# Appendix E
## Applicable Regulations

# APPENDIX E
# Applicable Regulations

## Air Resources

| Federal | |
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| 1990 Federal Clean Air Act Amendments | Pursuant to the 1990 Federal Clean Air Act Amendments, USEPA passed federal conformity rules to ensure that air pollutant emissions associated with federally approved or funded activities do not exceed emission budgets established in the applicable State Implementation Plans (SIP), and do not otherwise interfere with the State's ability to attain and maintain the NAAQS in such designated areas. When federal actions or funding of non-transportation related activities in non-attainment areas result in emissions that exceed de minimis threshold levels applicable to the specific non-attainment class, a formal, detailed General Conformity determination is required. The General Conformity rule applies to non-transportation related projects, such as the Proposed Action.<br><br>The MDAB is designated as a severe nonattainment area for ozone, and as a moderate nonattainment area for PM10. Although, the Riverside County portion of the MDAQMD (where the Project is located) is designated as an unclassifiable/attainment area for PM10, this analysis conservatively compares Project's PM10 emissions to the PM10 de minimis threshold. Ozone is not directly emitted from stationary or mobile sources, but is formed in the atmosphere as the result of chemical reactions between directly emitted nitrogen oxides (NOx) and volatile organic compounds (VOCs) in the presence of sunlight, therefore, NOx and VOC are the de minimis thresholds for ozone. |
| **State** | |
| California Air Quality Standards (CAAQS) | ARB has established CAAAQS for the criteria pollutants that are as stringent, or more stringent, than NAAQS. In addition to NAAQS, ARB provides CAAQS for sulfates, hydrogen sulfide, vinyl chloride, and visibility reducing particles. |
| California's Occupational Safety & Health Administration (Cal/OSHA)'s Respiratory Protection standard (8 CCR 5144) | When exposure to dust is unavoidable, employers must provide NIOSH-approved respiratory protection with particulate filters rated as N95, N99, N100, P100, or HEPA. Employers must develop and implement a respiratory protection program in accordance with Cal/OSHA's Respiratory Protection standard (8 CCR 5144). |
| **Local** | |
| Mojave Desert Air Quality Management District | MDAQMD regulates air pollutant emissions for all sources in the MDAB other than motor vehicles. MDAQMD enforces regulations and administers permits governing stationary sources. The MDAQMD Rules applicable to the Proposed Action and Alternatives include: Rule 401 – Visible Emissions, Rule 402 – Nuisance, Rule 403 – Fugitive Dust, Rule 404 – Particulate Matter Concentration, Rule 405 – Solid Particulate Matter Weight, Rule 406 – Specific Contaminants, Rule 407 – Liquid and Gaseous Air Contaminants, Rule 408 – Circumvention, Rule 409 – Combustion Contaminants, Rule 431 – Sulfur Content of Fuels, and Rule 442 – Usage of Solvents,<br><br>Jurisdictions of non-attainment areas are also required to prepare air quality attainment plans for achieving attainment. MDAQMD's 2004 state and federal Ozone Attainment Plan, and the 1996 PM10 Maintenance Plan are applicable to the Proposed Action and alternatives. |

## Biological Resources

| Federal | |
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| Federal Endangered Species Act (FESA) (16 USC Section 1531 et seq.) | This 1973 law, administered by the U.S. Fish and Wildlife Service, is designed to minimize impacts to imperiled plants and animals, as well as to facilitate recovery of such species. Declining plant and animal species are listed as "endangered" or "threatened" based on a variety of factors. Applicants for projects requiring federal agency action that could adversely affect listed species are required to consult with and mitigate impacts in consultation with USFWS. Adverse impacts are defined as "take" (defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in such conduct"), which is prohibited except as authorized through consultation with USFWS and issuance of an Incidental Take Statement under Section 7 or Section 10 of FESA, depending on whether there is a federal nexus (federal permit required or funding involved). |

# Biological Resources (continued)

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| **Federal (cont.)** | |
| Migratory Bird Treaty Act (MBTA) (16 USC §§703–712) | This law prohibits actions resulting in the pursuit, capture, killing, and/or possession of any protected migratory bird, nest, egg, or parts thereof. The USFWS issued a subsequent memorandum on April 11, 2018, clarifying that USFWS "interpret[s] the M-Opinion to mean that the MBTA's prohibitions on take apply when the purpose of an action is to take migratory birds, their eggs, or their nests." The guidance memorandum goes on to state that "the take of birds, eggs or nests occurring as the result of an activity, the purpose of which is not to take birds, eggs or nests, is not prohibited by the MBTA." |
| Bald and Golden Eagle Protection Act (16 United States Code [USC] §§668-668c) | This law, enacted in 1940, Prohibits the take, possession, sale, barter, offer to sell, purchase or barter, transport, export or import, of any bald or golden eagle, alive or dead, including any part, nest, or egg, unless allowed by permit. "Take" includes pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb. Disturb means to agitate or bother a bald or golden eagle to the point where it causes either injury to an eagle, a decrease in its productivity, or nest abandonment. |
| Clean Water Act (CWA) (33 USC §1251 et seq.) | Under Section 404 of the CWA, the U.S. Army Corps of Engineers (USACE) regulates the discharge of dredged or fill material into jurisdictional "waters of the U.S.," which include those waters listed in 33 Code of Federal Regulations (CFR) §328.3 (Definitions). |
| National Environmental Policy Act (NEPA) (42 USC §4321 et seq.) | NEPA requires federal agencies to analyze and publicly disclose of the environmental impacts of a proposed action. To do so, federal agencies are required to prepare either an environmental assessment or, where an action may significantly affect the quality of the human environment, an Environmental Impact Statement (EIS). These documents explore project alternatives and identify the likely environmental consequences of each action. |
| California Desert Conservation Area (CDCA) Plan | Per Title 43 C.F.R. §1610.5-3, the BLM must manage the land within its jurisdiction in compliance with a Resource Management Plan. The CDCA Plan of 1980, as amended, serves as a guide for the management of all BLM-administered lands in three desert areas: the Mojave, the Sonoran, and a small portion of the Great Basin. |
| Northern and Eastern Colorado Desert Coordinated Management Plan (NECO) | NECO is a landscape-scale, multiagency planning effort that protects and conserves natural resources while simultaneously balancing human uses of the California portion of the Sonoran Desert ecosystem. NECO provides reserve management for the desert tortoise, integrated ecosystem management for special-status species and natural communities for all federal lands, and regional standards and guidelines for public land health for the BLM lands. Within the NECO area, BLM has designated multiple DWMAs and ACECs. Several DWMAs and ACECs are located around the Project including the Chuckwalla DWMA, Chuckwalla Valley Dune Thicket ACEC, and Mule Mountains ACEC. |
| Desert Renewable Energy Conservation Plan (DRECP) | The DRECP is a landscape-level plan that was intended to streamline renewable energy permitting and development while conserving unique and valuable desert ecosystems and providing outdoor recreation opportunities. The DRECP is a collaborative effort between multiple agencies including the California Energy Commission (CEC), CDFW, BLM, and USFWS, known as the Renewable Energy Action Team (REAT). |
| Vegetation Treatments Using Herbicide Programmatic Environmental Impact Statement (2007) | This document may be applicable to herbicide use during the Project's operations phase. |
| **State** | |
| California Environmental Quality Act (Pub. Res. Code §21000) and its implementing regulations (Guidelines) (14 CCR. §15000 et seq.) | The California Environmental Quality Act (CEQA) and the CEQA Guidelines require identification of significant environmental effects of proposed projects (including impacts on biological resources) and avoidance (where feasible) or mitigation of the significant effects. CEQA applies to "projects" proposed to be undertaken or requiring approval by state and/or local governmental agencies. "Projects" are activities that have the potential to have a physical impact on the environment. |
| California Endangered Species Act (CESA) (California Fish and Game Code [CFGC] §§2050-2098) | This state law prohibits the "take" (defined as "to hunt, pursue, catch, capture, or kill" in CFGC Section 86) of state-listed species except as otherwise provided in state law. CESA, administered by CDFW, is similar to the federal ESA, although unlike the federal law, CESA applies incidental take prohibitions to species currently petitioned for state-listing status (i.e., candidate species). Also, CESA's take definition does not include harassment. Under Section 2081, CDFW authorizes "take" of state-listed endangered, threatened, or candidate species through incidental take permits or memoranda of understanding. |
| CFGC §3503 | This code section prohibits take, possession, or needless destruction of the nests or eggs of any bird, except as otherwise provided by the code or any regulation made pursuant thereto. |
| CFGC §3503.5 | This code section makes it unlawful to take, possess, or destroy birds of prey. It also prohibits the take, possession, or destruction of nests or eggs of any bird of prey. |
| CFGC §3511 | This code section describes bird species, primarily raptors, which are "fully protected." Fully protected birds may not be taken or possessed, except under specific permit requirements. |
| CFGC §3513 | This code section makes it unlawful to take or possess any migratory nongame bird as designated in the MBTA or any part of such migratory nongame bird except as provided by rules and regulations adopted by the Secretary of the Interior under provisions of the Migratory Bird Treaty Act. |

# Biological Resources (continued)

| State (cont.) | |
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| CFGC Section 4000 et seq. | This Code makes it unlawful to take fur-bearing mammals without a proper fur-bearing mammal take permit. Fur-bearing mammals are defined by this Code as fisher, marten, river otter, desert kit fox and red fox. As defined in CFGC Section 86, "take" is defined as "to hunt, pursue, catch, capture, or kill;" this take definition does not include harassment. |
| CFGC Sections 4700, 5050, and 5515 | These Codes list mammal, amphibian, and reptile species respectively that are classified as fully protected in California. Take of fully protected species is prohibited by these CFGCs. |
| Native Plant Protection Act (NPPA) (CFGC Section 1900 et seq.) | The NPPA includes measures to preserve, protect, and enhance rare and endangered native plant species. Definitions for "rare and endangered" are different from those contained in CESA, although CESA-listed rare and endangered species are included in the list of species protected under the NPPA. |
| Title 14, California Code of Regulations Sections 670.2 and 670.5 | These regulations list plant and animal species designated as threatened and endangered in California. California species of special concern (SSC) status is a designation applied by CDFW to those species that are indicators of regional habitat changes or are considered potential future protected species. SSCs do not have any special legal status but are intended by CDFW for use as a management tool to take these species into special consideration when decisions are made concerning the future of any land parcel. |
| CFGC Section 1600 et seq. | Notification is generally required for any activity that will take place in or in the vicinity of a river, stream, lake, or their tributaries, including rivers or streams that flow at least periodically or permanently through a bed or channel with banks and support fish or other aquatic life, and watercourses having a surface or subsurface flow that support or have supported riparian vegetation. |
| 1969 Porter Cologne Water Quality Control Act (Porter-Cologne) (California Water Code Section 13000 et seq.) | Through a programmatic agreement between the federal government and the states, the RWQCB has primary authority for permit and enforcement activities under Porter-Cologne) and the Clean Water Act. Under Porter-Cologne, the RWQCB regulates the "discharge of waste" to waters of the state. The term "discharge of waste" is also broadly defined in Porter-Cologne, such that discharges of waste include fill, any material resulting from human activity, or any other "discharge" that may directly or indirectly impact waters of the state relative to implementation of Section 401 of the CWA. |
| **Local** | |
| There are no local regulations, plans, or standards that are applicable to the Proposed Action. The project would be located entirely on BLM administered lands; therefore, Riverside County policies would not be applicable to the Project site. | |

# Greenhouse Gas Emissions

| Federal | |
|---|---|
| USEPA | The U.S. Supreme Court ruled that the GHG CO2 is an air pollutant, as defined under the CAA; therefore, USEPA has the authority to regulate emissions of GHGs. |
| **State** | |
| CARB | GHG legislation in California includes numerous executive orders, senate bills, assembly bills, and plans, as detailed in the technical report, Appendix B. |
| **Local** | |
| MDAQMD | MDAQMD developed an annual GHG emissions significance threshold of 100,000 metric tons (MT) of CO2e (MDAQMD, 2016). |
| Riverside County Climate Action Plan | Riverside County adopted a Climate Action Plan (CAP) (County of Riverside, 2015a) to create a GHG emissions baseline from which to benchmark GHG reductions; guide the development, enhancement, and implementation of actions that reduce GHG emissions; and provide a policy document with specific implementation measures to be considered as part of future development projects. The CAP provides a list of specific actions to reduce GHG emissions in the County and establishes a qualified reduction plan for which future development within the County can tier from (County of Riverside, 2015a). |
| Riverside County General Plan, Multipurpose Open Space Element and Air Quality Element | The County General Plan, Multipurpose Open Space Element of contains several policies which indirectly address global climate change, including development of solar energy use and development, while the Air Quality Element includes Alternative Energy Objectives including policy AQ 20.19, which calls for increasing the use of alternative energy sources to reduce the amount of GHG emissions, by facilitating development and siting of renewable energy facilities and transmission lines in appropriate locations (County of Riverside, 2015b). |

# Cultural, Tribal, and Historic Resources

| **Federal** | |
|---|---|
| National Historic Preservation Act | The principal federal law addressing historic properties is the National Historic Preservation Act (NHPA), as amended (54 USC 300101 et seq.), and its implementing regulations (36 CFR Part 800). Section 106 requires a federal agency with jurisdiction over a proposed federal action (referred to as an "undertaking" under the NHPA) to take into account the effects of the undertaking on historic properties, and to provide the Advisory Council on Historic Preservation (ACHP) an opportunity to comment on the undertaking.<br><br>The steps of the Section 106 process are accomplished through consultation with the State Historic Preservation Officer (SHPO), federally-recognized Indian tribes, local governments, and other interested parties. The goal of consultation is to identify potentially affected historic properties, assess effects to such properties, and seek ways to avoid, minimize, or mitigate any adverse effects on such properties. The agency also must provide an opportunity for public involvement (36 CFR 800.1(a)). Consultation with Indian tribes regarding issues related to Section 106 and other authorities (such as NEPA and Executive Order No. 13007) must recognize the government-to-government relationship between the Federal government and Indian tribes, as set forth in Executive Order 13175, 65 FR 87249 (Nov. 9, 2000), and Presidential Memorandum of Nov. 5, 2009. |
| National Register of Historic Places | The National Register was established by the NHPA of 1966, as "an authoritative guide to be used by federal, State, and local governments, private groups and citizens to identify the Nation's historic resources and to indicate what properties should be considered for protection from destruction or impairment" (36 CFR 60.2) (U.S. Department of the Interior, 2002). The National Register recognizes a broad range of cultural resources that are significant at the national, state, and local levels and can include districts, buildings, structures, objects, prehistoric archaeological sites, historic-period archaeological sites, traditional cultural properties, and cultural landscapes. A resource that is listed in or eligible for listing in the National Register is considered "historic property" under Section 106 of the NHPA.<br><br>To be eligible for listing in the National Register, a property must be significant in American history, architecture, archaeology, engineering, or culture. Properties of potential significance must meet one or more of the following four established criteria:<br><br>A. Are associated with events that have made a significant contribution to the broad patterns of our history;<br><br>B. Are associated with the lives of persons significant in our past;<br><br>C. Embody the distinctive characteristics of a type, period, or method of construction or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or<br><br>D. Have yielded, or may be likely to yield, information important in prehistory or history.<br><br>In addition to meeting one or more of the criteria of significance, a property must have integrity. Integrity is defined as "the ability of a property to convey its significance" (U.S. Department of the Interior, 2002). The National Register recognizes seven qualities that, in various combinations, define integrity. The seven factors that define integrity are location, design, setting, materials, workmanship, feeling, and association. To retain historic integrity a property must possess several, and usually most, of these seven aspects. Thus, the retention of the specific aspects of integrity is paramount for a property to convey its significance. |
| Definition of Adverse Effect under the NHPA | According to the Criteria of Adverse Effect set forth in 36 CFR 800, "an adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association [36 CFR 800.5(a)(1)]. |
| Native American Graves Protection and Repatriation Act | The Native American Graves Protection and Repatriation Act (NAGPRA) (25 USC 3001 et seq.) was enacted on November 16, 1990, to address the rights of lineal descendants, Indian tribes, and Native Hawaiian organizations to Native American cultural items, including human remains, funerary objects, sacred objects, and objects of cultural patrimony. NAGPRA provides a process for museums and Federal agencies to return certain Native American cultural items, including human remains, funerary objects, sacred objects, or objects of cultural patrimony, to lineal descendants, and culturally affiliated Indian tribes and Native Hawaiian organizations. NAGPRA includes provisions for unclaimed and culturally unidentifiable Native American cultural items, intentional and inadvertent discovery of Native American cultural items on Federal and tribal lands, and penalties for noncompliance and illegal trafficking. |
| Archaeological Resources Protection Act | ARPA establishes requirements to protect archaeological resources and sites on public lands and Indian lands and to foster increased cooperation and exchange of information between governmental authorities, the professional archaeological community, and private individuals. The Act (16 USC 470aa-470mm) established civil and criminal penalties for the destruction or alteration of cultural resources. |

# Cultural, Tribal, and Historic Resources (continued)

| **State** | |
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| California Environmental Quality Act | Under CEQA (Section 21084.1), a project that may cause a substantial adverse change in the significance of an historical resource is a project that may have a significant effect on the environment. The CEQA Guidelines (Title 14 California Code of Regulations [CCR] Section 15064.5) recognize that historical resources include: (1) a resource listed in, or determined to be eligible by the State Historical Resources Commission, for listing in the California Register of Historical Resources (California Register); (2) a resource included in a local register of historical resources, as defined in PRC Section 5020.1(k) or identified as significant in a historical resource survey meeting the requirements of PRC Section 5024.1(g); and (3) any object, building, structure, site, area, place, record, or manuscript which a lead agency determines to be historically significant or significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political, military, or cultural annals of California by the lead agency, provided the lead agency's determination is supported by substantial evidence in light of the whole record.<br><br>If an archaeological site does not meet the criteria for a historical resource contained in the CEQA Guidelines, then the site may be treated in accordance with the provisions of Section 21083, which is as a unique archaeological resource. As defined in Section 21083.2 of CEQA a "unique" archaeological resource is an archaeological artifact, object, or site, about which it can be clearly demonstrated that without merely adding to the current body of knowledge, there is a high probability that it meets any of the following criteria:<br><br>• Contains information needed to answer important scientific research questions and there is a demonstrable public interest in that information;<br>• Has a special and particular quality such as being the oldest of its type or the best available example of its type; or,<br>• Is directly associated with a scientifically recognized important prehistoric or historic event or person.<br><br>If an archaeological site meets the criteria for a unique archaeological resource as defined in Section 21083.2, then the site is to be treated in accordance with the provisions of Section 21083.2, which state that if the lead agency determines that a project would have a significant effect on unique archaeological resources, the lead agency may require reasonable efforts be made to permit any or all of these resources to be preserved in place (Section 21083.1(a)). If preservation in place is not feasible, mitigation measures shall be required. The CEQA Guidelines note that if an archaeological resource is neither a unique archaeological nor a historical resource, the effects of the project on those resources shall not be considered a significant effect on the environment (CEQA Guidelines Section 15064.5(c)(4)).<br><br>A significant effect under CEQA would occur if a project results in a substantial adverse change in the significance of a historical resource as defined in CEQA Guidelines Section 15064.5(a). Substantial adverse change is defined as "physical demolition, destruction, relocation, or alteration of the resource or its immediate surroundings such that the significance of a historical resource would be materially impaired" (CEQA Guidelines Section 15064.5(b)(1)). According to CEQA Guidelines Section 15064.5(b)(2), the significance of a historical resource is materially impaired when a project demolishes or materially alters in an adverse manner those physical characteristics that convey its significance or account for its inclusion in the California Register or a local register. |
| California Register of Historical Resources | The California Register is "an authoritative listing and guide to be used by State and local agencies, private groups, and citizens in identifying the existing historical resources of the State and to indicate which resources deserve to be protected, to the extent prudent and feasible, from substantial adverse change" (PRC Section 5024.1[a]). The criteria for eligibility for the California Register are based upon National Register criteria (PRC Section 5024.1[b]). Certain resources are determined by the statute to be automatically included in the California Register, including California properties formally determined eligible for, or listed in, the National Register.<br><br>To be eligible for the California Register, a prehistoric or historic-period property must be significant at the local, state, and/or federal level under one or more of the following four criteria:<br><br>1. Is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage;<br>2. Is associated with the lives of persons important in our past;<br>3. Embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possesses high artistic values; or<br>4. Has yielded, or may be likely to yield, information important in prehistory or history.<br><br>A resource eligible for the California Register must meet one of the criteria of significance described above, and retain enough of its historic character or appearance (integrity) to be recognizable as a historical resource and to convey the reason for its significance. It is possible that a historic resource may not retain sufficient integrity to meet the criteria for listing in the National Register, but it may still be eligible for listing in the California Register. |

# Cultural, Tribal, and Historic Resources (continued)

| State (cont.) | |
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| California Health and Safety Code Section 7050.5 | California Health and Safety Code Section 7050.5 requires that in the event human remains are discovered, the County Coroner be contacted to determine the nature of the remains. In the event the remains are determined to be Native American in origin, the Coroner is required to contact the NAHC within 24 hours to relinquish jurisdiction. |
| California Public Resources Code Section 5097.98 | California PRC Section 5097.98, as amended by Assembly Bill 2641, provides procedures in the event human remains of Native American origin are discovered during project implementation. PRC Section 5097.98 requires that no further disturbances occur in the immediate vicinity of the discovery, that the discovery is adequately protected according to generally accepted cultural and archaeological standards, and that further activities take into account the possibility of multiple burials. PRC Section 5097.98 further requires the NAHC, upon notification by a County Coroner, designate and notify a Most Likely Descendant (MLD) regarding the discovery of Native American human remains. Once the MLD has been granted access to the site by the landowner and inspected the discovery, the MLD then has 48 hours to provide recommendations to the landowner for the treatment of the human remains and any associated grave goods. |
| California Government Code Sections 6254(r) and 6254.10 | These sections of the California Public Records Act were enacted to protect archaeological sites from unauthorized excavation, looting, or vandalism. Section 6254(r) explicitly authorizes public agencies to withhold information from the public relating to "Native American graves, cemeteries, and sacred places maintained by the Native American Heritage Commission." Section 6254.10 specifically exempts from disclosure requests for "records that relate to archaeological site information and reports, maintained by, or in the possession of the Department of Parks and Recreation, the State Historical Resources Commission, the State Lands Commission, the Native American Heritage Commission, another state agency, or a local agency, including the records that the agency obtains through a consultation process between a Native American tribe and a state or local agency." |
| Assembly Bill 52 and Related Public Resources Code Sections | Assembly Bill (AB) 52, approved on September 25, 2014, amended California PRC Section 5097.94, and added PRC Sections 21073, 21074, 21080.3.1, 21080.3.2, 21082.3, 21083.09, 21084.2, and 21084.3. The primary intent of AB 52 is to include California Native American Tribes early in the environmental review process and to establish a new category of resources related to Native Americans that require consideration under CEQA, known as tribal cultural resources. PRC Section 21074(a)(1) and (2) defines tribal cultural resources as "sites, features, places, cultural landscapes, sacred places, and objects with cultural value to a California Native American Tribe" that are either included or determined to be eligible for inclusion in the California Register or included in a local register of historical resources, or a resource that is determined to be a tribal cultural resource by a lead agency, in its discretion and supported by substantial evidence. On July 30, 2016, the California Natural Resources Agency adopted the final text for tribal cultural resources update to Appendix G of the CEQA Guidelines, which was approved by the Office of Administrative Law on September 27, 2016.<br><br>PRC Section 21080.3.1 requires that within 14 days of a lead agency determining that an application for a project is complete, or a decision by a public agency to undertake a project, the lead agency provide formal notification to the designated contact, or a tribal representative, of California Native American Tribes that are traditionally and culturally affiliated with the geographic area of the project (as defined in PRC Section 21073) and who have requested in writing to be informed by the lead agency (PRC Section 21080.3.1(b)). Tribes interested in consultation must respond in writing within 30 days from receipt of the lead agency's formal notification and the lead agency must begin consultation within 30 days of receiving the tribe's request for consultation (PRC Sections 21080.3.1(d) and 21080.3.1(e)). |
| **Local** | |
| Riverside County General Plan- Multipurpose Open Space Element | The Multipurpose Open Space Element of the Riverside County General Plan (amended March 22, 2011) outlines policies intended to promote the preservation of cultural resources in the County of Riverside, as follows:<br><br>• OS 19.2 -The County of Riverside shall establish a cultural resources program in consultation with Tribes and the professional cultural resources consulting community. Such a program shall, at a minimum, address each of the following: application processing requirements; information database(s); confidentiality of site locations; content and review of technical studies; professional consultant qualifications and requirements; site monitoring; examples of preservation and mitigation techniques and methods; and the descendant community consultation requirements of local, state, and federal law. (AI-A)<br><br>• OS 19.3 - Review proposed development for the possibility of cultural resources and for compliance with the cultural resources program.<br><br>• OS 19.4 - To the extent feasible designate as open space and allocate resources and/or tax credits to prioritize the protection of cultural resources preserved in place or left in an undisturbed state, (AI-B)<br><br>• OS 19.5 - Exercise sensitivity and respect for human remains form both prehistoric and historic time periods and comply with all applicable laws concerning such remains. |

# Energy Conservation

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| **Federal** | |
| NEPA | NEPA Section 102(2)(c)(v) and 40 CFR 1502.16 requires that an EIS include a discussion of the irreversible and irretrievable commitments of resources which may occur should the project be implemented. Irreversible commitments of resources are those which cause either direct or indirect use of natural resources such that the resources cannot be restored or returned to their original condition. |
| National Energy Policy Act of 2005 | The Energy Policy Act of 2005 (42 USC §13201 et seq.) establishes equipment energy and efficiency requirements in order to reduce reliance on non-renewable energy resources and provide incentives to reduce current demand on these resources. For example, under this act, consumers and businesses can obtain federal tax credits for purchasing fuel-efficient appliances and products, including buying hybrid vehicles, building energy-efficient buildings, and improving the energy efficiency of commercial buildings. Additionally, tax credits are available for the installation of qualified fuel cells, stationary microturbine power plants, and solar power equipment. |
| **State** | |
| Warren-Alquist Act | The 1975 Warren-Alquist Act (Pub. Res. Code §25000 et seq.) established the California Energy Resources Conservation and Development Commission, now known as the California Energy Commission (CEC). The Act established a State policy to reduce wasteful, uneconomical and unnecessary uses of energy by employing a range of measures. The Act also was the driving force behind the creation of Appendix F to the CEQA Guidelines. |
| State of California Integrated Energy Policy | In 2002, the Legislature passed Senate Bill 1389, which required the CEC to develop an integrated energy plan every two years for electricity, natural gas, and transportation fuels, for the California Energy Policy Report. The plan calls for the state to assist in the transformation of the transportation system to improve air quality, reduce congestion, and increase the efficient use of fuel supplies with the least environmental and energy costs. An overarching goal of the resulting Integrated Energy Policy Report (IEPR) is to achieve the statewide GHG reduction targets, while improving overall energy efficiency. See, for example, the CEC's 2018 Integrated Energy Policy Report Update, which includes integrating renewable energy as a key component (CEC 2018d). |
| Title 24 Building Energy Efficiency Standards | The Energy Efficiency Standards for Residential and Nonresidential Buildings specified in Title 24, Part 6 of the California Code of Regulations include requirements for non-residential building lighting, insulation, ventilation, and mechanical systems (CEC 2015). Its provisions would be relevant to the Project's proposed structures, including O&M and Site Control Center buildings.<br><br>The California Green Building Standards Code (CALGreen, Title 24 Part 11) is a statewide regulatory code for all buildings. CALGreen is intended to encourage more sustainable and efficient building practices, require use of low-pollution emitting substances that cause less harm to the environment, conserve natural resources, and promote the use of energy-efficient materials and equipment (see, e.g., CBSC 2017). |
| Renewable Portfolio Standard | The California RPS program was established in 2002 by Senate Bill (SB) 1078 (Sher, 2002) with the initial requirement that 20% of electricity retail sales must be served by renewable resources by 2017. The program was accelerated in 2006 under SB 107 (Simitian, 2006), which required that the 20% mandate be met by 2010. In April 2011, SB 2 (1X) (Simitian) was signed into law, which codified a 33% RPS requirement to be achieved by 2020. In 2015, SB 350 (de León, 2015) was signed into law, which mandated a 50% RPS by December 31, 2030. SB 350 includes interim annual RPS targets with three-year compliance periods. In addition, SB 350 requires 65% of RPS procurement must be derived from long-term contracts of 10 or more years. In 2018, SB 100 (de León, 2018) was signed into law, which again increases the RPS to 60% by 2030 and requires all state's electricity to come from carbon-free resources by 2045. SB 100 will take effect on January 1, 2019. |
| Construction Equipment Idling | In order to reduce emissions from diesel-powered construction and mining vehicles, CARB adopted a regulation (13 Cal. Code Regs. Section 2449 et seq.) for in-use off-road diesel vehicles which imposes idling limitations on owners, operators, renters, or lessees of off-road diesel vehicles. The regulation requires an operator of applicable off-road vehicles (self-propelled diesel-fueled vehicles 25 horsepower and up that were not designed to be driven on-road) to limit idling to no more than 5 minutes. |
| SCAG 2008 Regional Comprehensive Plan | The SCAG Regional Comprehensive Plan (RCP) is a major advisory plan that addresses regional issues, serving as an advisory document for member agencies such as the City of Blythe and the County of Riverside. The plan includes an Energy Chapter which identifies energy goals such as reducing regional reliance on non-renewable energy and voluntary best practices for local governments to help reach those goals. |
| **Local** | |
| There are no local regulations, plans, or standards that are applicable to the Proposed Action. The project would be located entirely on BLM administered lands; therefore, Riverside County policies would not be applicable to the Project site. | |

# Geology and Soil Resources

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|---|---|
| **Federal** | |
| There are no federal regulations, plans, or standards that are applicable to the Proposed Action. | |
| **State** | |
| California Building Code | The California Building Code (CBC), which is codified in Title 24 of the California Code of Regulations, Part 2, establishes minimum standards related to structural strength, means of egress facilities, and general stability of buildings. Its purpose is to regulate and control the design, construction, quality of materials, use/occupancy, location, and maintenance of all buildings and structures within its jurisdiction. The provisions of the CBC apply to the construction, alteration, movement, replacement, location, and demolition of every building or structure or any appurtenances connected or attached to such buildings or structures throughout California.<br><br>The current (2016) CBC contains California amendments based on the American Society of Civil Engineers (ASCE) Minimum Design Standard ASCE/SEI 7-16, Minimum Design Loads for Buildings and Other Structures, provides requirements for general structural design and includes means for determining earthquake loads as well as other loads (such as wind loads) for inclusion into building codes. Seismic design provisions of the building code generally prescribe minimum lateral forces applied statically to the structure, combined with the gravity forces of the dead and live loads of the structure, which the structure then must be designed to withstand. The prescribed lateral forces are generally smaller than the actual peak forces that would be associated with a major earthquake. Consequently, structures should be able to resist: (1) minor earthquakes without damage, (2) moderate earthquakes without structural damage but with some nonstructural damage, and (3) major earthquakes without collapse, but with some structural as well as nonstructural damage. Conformance to the current building code recommendations does not constitute any kind of guarantee that substantial structural damage would not occur in the event of a maximum magnitude earthquake. However, it is reasonable to expect that a structure designed in-accordance with the seismic requirements of the CBC should not collapse in a major earthquake.<br><br>The earthquake design requirements take into account the occupancy category of the structure, site class, soil classifications, and various seismic coefficients. Chapter 18 of the CBC covers the requirements of geotechnical investigations (§1803), excavation, grading, and fills (§1804), load-bearing of soils (§1806), as well as foundations (§1808), shallow foundations (§1809), and deep foundations (§1810). Chapter 18 requires analysis of slope instability, liquefaction, and surface rupture attributable to faulting or lateral spreading, plus an evaluation of lateral pressures on basement and retaining walls, liquefaction and soil strength loss, and lateral movement or reduction in foundation soil-bearing capacity. It also addresses measures to be considered in structural design, which may include ground stabilization, selecting appropriate foundation type and depths, selecting appropriate structural systems to accommodate anticipated displacements, or any combination of these measures. The potential for liquefaction and soil strength loss must be evaluated for site-specific peak ground acceleration magnitudes and source characteristics consistent with the design earthquake ground motions. |
| **Local** | |
| There are no local regulations, plans, or standards that are applicable to the Proposed Action. The project would be located entirely on BLM administered lands; therefore, Riverside County zoning would not be applicable to the Project site. | |

# Hazards and Hazardous Materials

| | |
|---|---|
| **Federal** | |
| Hazardous Materials Management | The primary federal agencies with responsibility for hazardous materials management include the U.S. Environmental Protection Agency (USEPA), U.S. Department of Labor Occupational Safety and Health Administration (OSHA), and the U.S. Department of Transportation. State and local agencies often have either parallel or more stringent regulations than these federal agencies. In most cases, state law mirrors or overlaps federal law and enforcement of these laws is the responsibility of the state or of a local agency to which enforcement powers are delegated. |
| Hazardous Materials Transportation | The U.S. Department of Transportation regulates hazardous materials transportation on all interstate roads pursuant to its authority under the Hazardous Materials Transportation Uniform Safety Act (49 U.S.C. §5101 et seq.). The purpose of the Act is to “protect against the risks to life, property, and the environment that are inherent in the transportation of hazardous material in intrastate, interstate, and foreign commerce” (49 U.S.C.A. §5101). Within California, the state agencies with primary responsibility for enforcing federal and state regulations and for responding to transportation emergencies are the California Highway Patrol and California Department of Transportation. Together, federal and state agencies determine driver-training requirements, load labeling procedures, and container specifications. Although special requirements apply to transporting hazardous materials, requirements for transporting hazardous waste are more stringent, and hazardous waste haulers must be licensed to transport hazardous waste on public roads. |

# Hazards and Hazardous Materials (continued)

<table>
<tr><th colspan="2">Federal (cont.)</th></tr>
<tr><td>Toxic Substances Control Act, Resource Conservation and Recovery Act</td><td>The Federal Toxic Substances Control Act of 1976 and the Resource Conservation and Recovery Act of 1976 (RCRA) established a program administered by the USEPA for the regulation of the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA was amended in 1984 by the Hazardous and Solid Waste Amendments, which affirmed and extended the “cradle to grave” system of regulating hazardous materials and wastes.</td></tr>
<tr><td>Occupational Safety</td><td>OSHA is the agency responsible for assuring worker safety in the handling and use of chemicals in the workplace. The federal regulations pertaining to worker safety are contained in Title 29 of the Code of Federal Regulations (CFR), as authorized in the Occupational Safety and Health Act of 1970. They provide standards for safe workplaces and work practices, including standards relating to hazardous materials handling. At sites known or suspected to have soil or groundwater contamination, construction workers must receive training in hazardous materials operations and a site health and safety plan must be prepared. The health and safety plan establishes policies and procedures to protect workers and the public from exposure to potential hazards at the contaminated site.</td></tr>
<tr><th colspan="2">State</th></tr>
<tr><td>National Pollutant Discharge Elimination System (NPDES)</td><td>Section 402 of the Clean Water Act authorizes the SWRCB to issue a NPDES General Construction Storm Water Permit (Water Quality Order 2009-0009-DWQ), referred to as the “General Construction Permit.” Construction activities can comply with and be covered under the General Construction Permit provided that they:<ul><li>Develop and implement a Storm Water Pollution Prevention Plan (SWPPP) which specifies Best Management Practices (BMPs) that will prevent all construction pollutants from contacting stormwater and with the intent of keeping all products of erosion from moving off site into receiving waters.</li><li>Eliminate or reduce non-stormwater discharges to storm sewer systems and other waters of the nation.</li><li>Perform inspections of all BMPs.</li></ul>The Project site is located within the Colorado River Regional Water Control Board jurisdiction.</td></tr>
<tr><td>Occupational Safety</td><td>OSHA is the agency responsible for assuring worker safety in the handling and use of chemicals in the workplace. The federal regulations pertaining to worker safety are contained in Title 29 of the Code of Federal Regulations (CFR), as authorized in the Occupational Safety and Health Act of 1970. They provide standards for safe workplaces and work practices, including standards relating to hazardous materials handling. At sites known or suspected to have soil or groundwater contamination, construction workers must receive training in hazardous materials operations and a site health and safety plan must be prepared. The health and safety plan establishes policies and procedures to protect workers and the public from exposure to potential hazards at the contaminated site.</td></tr>
<tr><th colspan="2">Local</th></tr>
<tr><td>Riverside County Department of Environmental Health</td><td>The County of Riverside Department of Environmental Health (DEH) acts as the Certified Unified Program Agency (CUPA) for Riverside County and is responsible for reviewing Hazardous Materials Business Plans. A CUPA is a local agency that has been certified by Cal EPA to implement state environmental programs related to hazardous materials and waste. The DEH is responsible for protecting the health and safety of the public and the environment of Riverside County by assuring that hazardous materials are properly handled and stored. The DEH accomplishes this through inspection, emergency response, site remediation, and hazardous waste management services. The specific responsibilities of the DEH include the following:<ul><li>Inspecting hazardous material handlers and hazardous waste generators to ensure full compliance with laws and regulations.</li><li>Implementing CUPA programs for the development of accident prevention and emergency plans, proper installation, monitoring, and closure of underground storage tanks and the handling, storage and transportation and disposal of hazardous wastes.</li><li>Providing 24-hour response to emergency incidents involving hazardous materials or wastes in order to protect the public and the environment from accidental releases and illegal activities.</li><li>Overseeing the investigation and remediation of environmental contamination due to releases from underground storage tanks, hazardous waste containers, chemical processes or the transportation of hazardous materials.</li><li>Conducting investigations and taking enforcement action as necessary against anyone who disposes of hazardous waste illegally or otherwise manages hazardous materials or wastes in violation of federal, state, or local laws and regulations.</li></ul></td></tr>
</table>

# Land Use, Lands, and Realty

| Federal | |
|---|---|
| Federal Land Policy and Management Act (FLPMA) of 197 | The Federal Land Policy and Management Act (FLPMA) establishes public land policy; guidelines for administration; and provides for the management, protection, development, and enhancement of public lands. FLPMA Title V, Section 501, establishes BLM's authority to grant ROWs for generation, transmission, and distribution of electrical energy (FLPMA, as amended, 2001). BLM is responsible for responding to requests regarding the development of energy resources on BLM-administered lands in a manner that balances diverse resource uses and considers long-term needs for renewable and non-renewable resources for future generations. |
| California Desert Conservation Area Plan of 1980, as amended | The California Desert Conservation Area (CDCA) Plan provides overall regional guidance for BLM-administered lands in the CDCA and establishes long-term goals for protection and use of the California desert. The CDCA Plan establishes multiple use classes (MUCs); MUC guidelines; and plan elements for specific resources or activities. The proposed site is located in an area designated by the CDCA Plan as Multiple-use Class M. This class is intended to control the balance between higher intensity use and protection of public lands. This class provides for a wide variety or present and future uses such as mining, livestock grazing, recreation, energy, and utility development. Class M management is also designed to conserve desert resources and to mitigate damage to those resources which permitted uses may cause. |
| Western Energy Plan Solar Programmatic EIS | The Western Energy Plan Solar Programmatic EIS (Solar PEIS; BLM, 2012) provided a blueprint for utility-scale solar energy permitting in Arizona, California, Colorado, Nevada, New Mexico and Utah by establishing SEZs with access to existing or planned transmission, incentives for development within those zones, and a process through which to consider additional zones and solar projects. The Project is considered a "pending project" Solar PEIS Record of Decision (BLM, 2012). Pending applications are not subject to the Western Solar Plan (Western Solar Plan ROD Section B.1.2) or to the CDCA Plan amendments made in that decision. Therefore, if the BLM elects to approve the ROW grant application for the Crimson Solar Project, a Project-specific CDCA Plan Amendment (PA) to identify the development footprint as suitable for the proposed type of solar energy use would be required. |
| **State and Local** | |
| There are no applicable state regulations, plans, or standards that are applicable to the Proposed Action. The project would be located entirely on BLM administered lands; therefore, Riverside County zoning would not be applicable to the site of the Proposed Action and Alternatives. | |

# Noise

| Federal | |
|---|---|
| Although no federal noise regulations exist, USEPA has promulgated noise guidelines, and recommends 55 dBA Ldn to protect the public from the effect of environmental noise in residential areas and farms, and other outdoor areas (USEPA, 1974). | |
| **State** | |
| California Department of Transportation | The California Department of Transportation (Caltrans) Transportation and Construction Vibration Guidance Manual (Caltrans, 2013) provides vibration criteria based on source type for structural damage, when vibration levels exceed 0.25 to 2 in/sec PPV (based on structure type), and human annoyance, when vibration levels exceed 0.1 to 0.9 in/sec PPV. |
| **Local** | |
| There are no local regulations, plans, or standards that are applicable to the Proposed Action. The project would be located entirely on BLM administered lands; therefore, Riverside County zoning would not be applicable to the Project site. | |

# Paleontological Resources

| Federal | |
|---|---|
| A variety of federal, state, and local statutes specifically address paleontological resources. Federal statutes are applicable to all projects occurring on federal lands, such as those controlled by the BLM, and may be applicable to specific projects if the project involves a federal agency license, permit, approval, or funding. | |
| National Environmental Policy Act of 1969 | The National Environmental Policy Act (NEPA) (United States Code, section 4321 et seq.; 40 Code of Federal Regulations, section 1502.25), as amended, directs Federal agencies to "Preserve important historic, cultural, and natural aspects of our national heritage (Section 101(b) (4))." The current interpretation of this language has included scientifically important paleontological resources among those resources that may require preservation. |

# Paleontological Resources (continued)

| Federal (cont.) | |
|---|---|
| Paleontological Resources Preservation Act of 2009 | The Paleontological Resources Preservation Act (PRPA) is part of the Omnibus Public Land Management Act of 2009 (Public Law 111-011 Subtitle D). This act directs the Secretary of the Interior or the Secretary of Agriculture to manage and protect paleontological resources on federal land, and develop plans for inventorying, monitoring, and deriving the scientific and educational use of such resources. It prohibits the removal of paleontological resources from federal land without a permit issued under this Act, establishes penalties for violation of this act and establishes a program to increase public awareness about such resources. |
| **State** | |
| California Environmental Quality Act | Paleontological resources are afforded protection by environmental legislation set forth under CEQA. Appendix G (part V) of the State CEQA Guidelines provides guidance relative to significant impacts on paleontological resources, stating that “a project will normally result in a significant impact on the environment if it will …disrupt or adversely affect a paleontological resource or site or unique geologic feature.” |
| Public Resources Code Section 5097.5 | Requirements for paleontological resource management are included in the Public Resources Code (PRC) Division 5, Chapter 1.7, Section 5097.5, and Division 20, Chapter 3, Section 30244, which states:<br>No person shall knowingly and willfully excavate upon, or remove, destroy, injure or deface any historic or prehistoric ruins, burial grounds, archaeological or vertebrate paleontological site, including fossilized footprints, inscriptions made by human agency, or any other archaeological, paleontological or historical feature, situated on public lands, except with the express permission of the public agency having jurisdiction over such lands. Violation of this section is a misdemeanor. |
| **Local** | |
| There are no applicable state regulations, plans, or standards that are applicable to the Proposed Action. The project would be located entirely on BLM administered lands; therefore, Riverside County policies would not be applicable to the site of the Proposed Action and Alternatives. | |

# Recreation and Public Access (Off-Highway Vehicles)

| Federal | |
|---|---|
| Federal Land Policy and Management Act | Under FLPMA, the BLM is responsible for the development of energy resources on BLM-administered lands in a manner that balances diverse resource uses and that takes into account the long-term needs of future generations for renewable and non-renewable resources. Among those uses, FLPMA recognizes that the public lands should be managed in a manner that will provide for outdoor recreation. |
| California Desert Conservation Area Plan | The CDCA Plan is a comprehensive, long-range plan with goals and specific actions for the management, use, development, and protection of the resources and public lands within the CDCA, and it is based on the concepts of multiple use, sustained yield, and maintenance of environmental quality. The plan’s goals and actions for each resource are established in its 12 elements. Each of the plan elements provides both a desert-wide perspective of the planning decisions for one major resource or issue of public concern as well as more specific interpretation of multiple-use class guidelines for a given resource and its associated activities.<br>The CDCA Plan defines multiple-use classes for BLM-managed lands in the CDCA, which includes the land area encompassing the proposed Project location. |
| Northern and Eastern Colorado Area Plan Amendment | The NECO Plan amended the CDCA Plan to provide further protection of natural resources while balancing human uses of the California portion of the Sonoran Desert ecosystem. Lands within the planning area are popular for hiking, hunting, rockhounding, and driving for pleasure. The plan amendment’s inventory of officially designated existing routes within the planning area restricts motorized travel to these authorized routes, with the exception of washes open zones, in order to protect off-route resources. |
| **State and Local** | |
| There are no applicable state regulations, plans, or standards that are applicable to the Proposed Action. The project would be located entirely on BLM administered lands; therefore, Riverside County zoning would not be applicable to the site of the Proposed Action and Alternatives. | |

# Socioeconomics, Environmental Justice, Population and Housing

| **Federal** | |
|---|---|
| Executive Order 12898 (59 CFR 7629; February 16, 1994) | Executive Order 12898 (59 CFR 7629; February 16, 1994) focuses Federal attention on the environment and human health conditions of minority and low-income communities. The executive order directs federal agencies to develop strategies to address and achieve environmental justice. Federal agencies are required to identify and address any disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and/or low-income populations.<br><br>The Council on Environmental Quality (CEQ) provides oversight for the federal government's compliance with E.O. 12898 and NEPA. The CEQ, in consultation with USEPA, and other agencies, has developed guidance to assist federal agencies with their NEPA procedures to ensure that environmental justice concerns are effectively identified and addressed. The CEQ's 1997 guidance document "Environmental Justice Guidance Under the National Environmental Policy Act" established that agencies should consider the composition of the affected area to determine whether minority populations or low-income populations are present in the area affected by the proposed action, and if so whether there may be disproportionately high and adverse human health or environmental impacts (CEQ, 1997). |
| **State** | |
| CEQA Guidelines Section 15131 (a) through (c) | CEQA Guidelines Section 15131 (a) through (c) provides guidance for the analysis of economic and social effects. This section of the guidelines states that economic and social effects may be included in an EIR but "shall not be treated as significant effects on the environment." An EIR may trace a cause and effect chain from a decision on a project through expected economic and social changes resulting from the project to physical changes caused in turn by the economic and social changes. In addition, economic and social effects may be used to determine the significance of physical changes caused by the project. Further, public agencies are required to consider economic, social, and particularly housing factors, together with technological and environmental factors, in deciding whether changes in a project are feasible to reduce or avoid significant effects on the environment. |
| **Local** | |
| There are no applicable state regulations, plans, or standards that are applicable to the Proposed Action. The project would be located entirely on BLM administered lands; therefore, Riverside County zoning would not be applicable to the site of the Proposed Action and Alternatives. | |

# Special Designations

| **Federal** | |
|---|---|
| The Wilderness Act of 1964 (PL 88-577) | The Wilderness Act of 1964 gives Congress the sole power to designate Wilderness Areas. The Act defines wilderness as an area of land that "generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value." Except in emergencies or necessary administration of an area, vehicular travel is prohibited in Wilderness Areas. The BLM is responsible for managing 191 Wilderness Areas in the Western United States (BLM, 2015). |
| Bureau of Land Management Manual 6340—Management of Designated Wilderness | BLM Manual 6340 provides guidance to BLM personnel on managing BLM lands that have been designated by Congress as part of the National Wilderness Preservation System. These lands are also managed as part of the NLCS. The BLM's objectives for implementing this policy are to:<br>1. Manage and protect BLM wilderness areas in such a manner as to preserve wilderness characteristics.<br>2. Manage wilderness for the public purposes of recreational, scenic, scientific, educational, conservation, and historic use while preserving wilderness characteristics.<br>3. Effectively manage uses permitted under Sections 4(c) and 4(d) of the Wilderness Act, while preserving wilderness characteristics. |
| Bureau of Land Management Manual 6320—Consideration of Lands with Wilderness Characteristics in the Land Use Planning Process | BLM Manual 6320 provides policy and guidance for considering lands with wilderness characteristics in the land use planning process. Managing wilderness resources is part of BLM's multiple-use mission. The BLM will use the land use planning process to determine how to manage lands with wilderness characteristics, as part of BLM's multiple-use mandate. When such lands are present, BLM will examine options for managing these lands and determine the most appropriate land use allocations for them. Considering wilderness characteristics in the land use planning process may result in several outcomes and include, but not be limited to (1) emphasizing other multiple uses as a priority over protecting |

# Special Designations (continued)

| Federal (cont.) | |
|---|---|
| | wilderness characteristics, (2) emphasizing other multiple uses while applying management restrictions (e.g., conditions of use, mitigation measures) to reduce impacts to wilderness characteristics, and (3) protecting wilderness characteristics as a priority over other multiple uses. The BLM will continue to engage cooperating agencies, the public, and other interested parties in the land use planning process as it relates to the management of lands with wilderness characteristics.<br><br>Lands identified for protection of their wilderness characteristics in a land use plan are not managed as part of the National Wilderness Preservation System, the NLCS, or recommended as WSAs or for wilderness designation. |
| Wild Free-Roaming Horses and Burros Act of 1971 | Wild horses and burros are protected by the Wild Free-Roaming Horses and Burros Act of 1971 (16 United States Code 1331-1340), as amended by the Federal Land Policy and Management Act and the Public Rangelands Improvement Act of 1978. The Wild Free Roaming Horses and Burros Act protects wild, free-roaming horses and burros and their habitats. It directs BLM and the U.S. Forest Service (USFS) to manage, in their respective jurisdictions, these wild animals on public lands. The general management objectives for wild horses and burros are to: 1) Protect and manage viable, healthy herds while retaining their free-roaming natures; 2) Provide adequate habitat through the principles of multiple-use and environmental protection, while maintaining a thriving ecological balance; 3) Provide opportunities for the public to view wild horses and burros in their natural habitat; and 4) Protect wild horses and burros from unauthorized capture, branding, harassment, or death. |
| **State and Local** | |
| The BLM considers potential impacts of proposed actions to lands with special designations as part of its public land planning and management responsibilities consistent with the National System of Public Lands, including the laws and standards described above. These special federal designations do not govern state or local land use decision-making, and no state or local laws, regulations, plans, or standards apply to them. | |

# Transportation

| Federal | |
|---|---|
| There are no applicable federal regulations, plans, or standards that are applicable to the Proposed Action. | |
| **State** | |
| California Vehicle Code Section 35780 | California Vehicle Code, Section 35780, requires a Single-Trip Transportation Permit to transport oversized or excessive loads over state highways. The permit can be acquired through Caltrans. The Project will comply with this code by requiring that heavy haulers obtain a Single-Trip Transportation Permit for oversized loads for each vehicle, prior to delivery of any oversized load. |
| California Manual on Uniform Traffic Control Devices | California Manual on Uniform Traffic Control Devices, Part 6, requires a temporary traffic control plan be provided for “continuity of function (movement of traffic, pedestrians, bicyclists, transit operations), and access to property/utilities” during any time the normal function of a roadway is suspended. The administering agencies for this regulation are Caltrans and County of Riverside Public Works Department. If applicable, the Applicant will file a Traffic Control Plan prior to the start of construction. |
| **Local** | |
| Riverside County Congestion Management Program | Riverside County Transportation Commission (RCTC) is the transportation planning agency for Riverside County, and serves as the Congestion Management Agency (CMA) of Riverside County (RCTC, 2011). As the County’s CMA, RCTC is responsible for managing the County’s blueprint to reduce congestion and improve air quality. Roadways in proximity to the Project site that are designated in the CMP roadway system include I-10. The program sets a standard for all CMP roadway segments and intersections of LOS E. RCTC periodically monitors the CMP Roadway System and records levels of service along CMP facilities. Intersection and roadway level of service assessments of CMP facilities are conducted periodically and vary by year; the assessment of its facilities was completed in 2011, but an update is planned to be incorporated in the RCTC’s Long Range Transportation Plan, which is anticipated to be completed in early 2019 (RCTC, 2018). |

# Utilities and Public Services

| | |
|---|---|
| **Federal** | |
| There are no applicable federal policies. | |
| **State** | |
| California Education Code | Section 41376(a) establishes a goal of district-wide average class sizes of 30 students and maximum class size of 32 students throughout California public school districts. |
| 22 CCR Division 4.5 | Title 22 of the CCR discusses an array of requirements with respect to the disposal and recycling of hazardous and universal wastes. Specific standards and requirements are included for the identification, collection, transport, disposal, and recycling of hazardous wastes. Additional standards are included for the collection, transport, disposal and recycling of universal wastes (as identified in 22 CCR §66273.9). Requirements include recycling, recovery, returning spent items to the manufacturer, or disposal at an appropriately permitted facility. 22 CCR Division 4.5 also provides restrictions and standards relevant to waste destination facilities, and provides authorization requirements for various waste handlers. Title 22 includes California's Universal Waste Rule, as well as other additional waste handling and disposal requirements. |
| Water Supply Planning | SB 610 (2001) and SB 267(2011), require water supply and demand assessment planning for proposed photovoltaic (PV) energy generation facilities that would occupy more than 40 acres of land and demand more than 75 acre-feet per year (AFY) of water (PRC §21151.9; Water Code §10912(a)(5)). The required assessment is called a Water Supply Assessment (WSA). It considers any applicable Urban Water Management Plan (UWMP), whether the projected 20-year water supply would meet the projected demand with inclusion of the project. The WSA (AECOM, 2018b) conducted for the Project is included in Appendix [X] to this Draft EIR. |
| **Local** | |
| Countywide Integrated Waste Management Plan | Riverside County's Countywide Integrated Waste Management Plan (CIWMP) demonstrates the County's compliance with the California Integrated Waste Management Act's solid waste planning requirements. The Summary Plan element of the CIWMP presents goals and policies and measures divert 50 percent of solid waste from landfills, and is updated annually. The Countywide siting element is required to demonstrate that at least 15 years of disposal capacity is available to serve all jurisdictions within Riverside County. If the County's annual report to CalRecycle shows there is less than 15 years of remaining disposal capacity, the County must identify new or expanded solid waste disposal and transformation facilities necessary to provide the required permitted disposal capacity (14 CCR §18755). |
| Riverside County Board of Supervisors Resolution 91-474 | Resolution 91-474 establishes standards governing the use of portable toilets, and applies requirements for disposal of associated liquid wastes. The Resolution provides specifications regarding the number of portable toilets required at a given site and the duration of use of such facilities on site. At minimum, weekly maintenance of portable toilets is required. |

# Visual Resources

Most pertinent to this analysis are VRM classes, which BLM uses to classify scenery based on the scenic quality, visual sensitivity, and distance zones (the distance from which the landscape is most commonly viewed). Each VRM class is defined by a specific management objective that describes the acceptable level of change to visual resources. Change in the resource is measured though implementation of the contrast rating procedure and by assessing change in visual resource inventory values. Contrast is measured by evaluating basic design elements (form, line, color, and texture) in accordance with the BLM's Handbook H-8431-1 Visual Resource Contrast Rating (BLM, 1986). If the contrast rating reveals nonconformance of the Proposed Action or an alternative with assigned VRM class objectives, and mitigation measures are insufficient to bring it into compliance, then the design would need to be modified to the greatest extent possible to achieve conformance. If a project cannot be mitigated and/or redesigned to meet the VRM class objectives, the application may be denied or BLM may require the Project to be modified or relocated.

The Project would primarily occupy lands managed per VRM Class IV objectives; however, a small portion of the Project would be located on lands managed per VRM Class II objectives. VRM Class IV areas are considered to have low visual value, whereas VRM Class II areas are considered to have high visual value.

| VRM Class | Objective |
|---|---|
| Class II | The objective of this class is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape. |
| Class IV | The objective of this class is to provide for management activities which require major modifications of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements. |

# Water Resources

| Federal | |
|---|---|
| Clean Water Act | The Clean Water Act (CWA), enacted by Congress in 1972 and amended several times since its inception, is the primary federal law regulating water quality in the United States and forms the basis for several state and local laws throughout the country. Its objective is to reduce or eliminate water pollution in the nation's rivers, streams, lakes, and coastal waters. The CWA authorizes the U.S. Environmental Protection Agency (USEPA) to implement federal water pollution control programs such as setting water quality standards for contaminants in surface water, establishing wastewater and effluent discharge limits for various industry categories, and imposing requirements for controlling nonpoint-source pollution. At the federal level, the CWA is administered by the USEPA and U.S. Army Corps of Engineers (USACE). At the state and regional levels, the act is administered and enforced by the State Water Resources Control Board (SWRCB) and the nine Regional Water Quality Control Boards (RWQCBs). |
| Beneficial Use and Water Quality Objectives (CWA §303) | The RWQCB is responsible for the protection of the beneficial uses of waters within their jurisdiction. The RWQCB uses its planning, permitting, and enforcement authority to meet this responsibility and has adopted the Water Quality Control Plan for the Colorado River (the "Basin Plan") to implement plans, policies, and provisions for water quality management. The RWQCB published the second edition of the Basin Plan which was approved into law in November 1993 and has been subsequently updated, most recently in August 2017 (RWQCB 2017).<br><br>In accordance with state policy for water quality control, the RWQCB employs a range of beneficial use definitions for surface waters, groundwater basins, marshes, and mudflats that serve as the basis for establishing water quality objectives and discharge conditions and prohibitions. The Basin Plan identifies existing and potential beneficial uses supported by the key surface water drainages throughout its jurisdiction (RWQCB 2017). Table 3.19-1a identifies beneficial uses designated in the Basin Plan for the surface water and groundwater bodies relevant to the Project site. The Basin Plan also includes water quality objectives that are protective of the identified beneficial uses; the beneficial uses and water quality objectives collectively make-up the water quality standards for a given region and Basin Plan (RWQCB 2017). |

**TABLE 3.19-1A**
**DESIGNATED BENEFICIAL USES OF WATER BODIES IN THE PROJECT SITE AND SURROUNDING AREA**

| Water Body | Designated Beneficial Uses |
|---|---|
| Washes (Ephemeral Streams) | Groundwater Recharge (GWR), Noncontact Recreation (REC-2), Wildlife Habitat (WILD), and Warm Freshwater Habitat (WARM), |
| Chuckwalla Groundwater Basin | Municipal and Domestic Supply (MUN), AGR, and IND |

SOURCE: RWQCB 2017

| | |
|---|---|
| National Pollutant Discharge Elimination System Program (CWA §402) | The CWA provides that the discharge of pollutants to waters of the United States from any point source is unlawful unless the discharge is in compliance with a National Pollutant Discharge Elimination System (NPDES) permit. Amendments to the CWA added a framework for regulating municipal and industrial stormwater discharges, as well as stormwater discharges from construction sites that disturb one or more acres of soil. In California, the SWRCB has been delegated permitting authority for discharges regulated by NPDES permits. |
| NPDES Construction General Permit | The RWQCB administers the NPDES stormwater permitting program. Construction activities disturbing 1 acre or more of land, which includes the Project, are subject to the permitting requirements of the NPDES General Permit for Discharges of Storm Water Runoff Associated with Construction Activity (Construction General Permit) and must apply for Construction General Permit coverage. For all new projects, applicants must electronically file permit registration documents using the Stormwater Multiple Applications and Report Tracking Systems (SMARTS), and must include a Notice of Intent (NOI), risk assessment, site map, and Storm Water Pollution Prevention Plan (SWPPP) to be covered by the General Construction Permit prior to beginning construction. The risk assessment and SWPPP must be prepared by a state-qualified SWPPP Developer. |

# Water Resources (continued)

| Federal (cont.) | |
|---|---|
| | The Construction General Permit requires that the site be assigned a risk level of 1 (low), 2 (medium), or 3 (high) based on sediment and receiving waters risk. The sediment risk level is the relative amount of sediment that can be discharged given the project and location details. The receiving waters risk level reflects the risk sediment discharges pose to the receiving waters. A construction analysis provides a preliminary risk level assessment.<br><br>The Construction General Permit requires the preparation and implementation of a SWPPP, which must be prepared before construction begins. At a minimum, a SWPPP includes:<br><br>• Description of construction materials, practices, and equipment storage maintenance;<br>• List of pollutants likely to contact stormwater and site specific erosion and sedimentation control practices;<br>• List of provisions to eliminate or reduce discharge of materials to stormwater;<br>• Best management practices (BMPs) for fuel and equipment storage;<br>• Non-stormwater management measures such as installing specific discharge controls during activities such as paving operations and vehicle and equipment washing and fueling; and<br>• Commitment that equipment, materials, and workers will be available for rapid response to spills and/or emergencies. All corrective maintenance or BMPs will be performed as soon as possible, depending upon worker safety.<br><br>The SWPPP provides specific construction-related BMPs to prevent soil erosion and loss of topsoil. BMPs implemented could include, but would not be limited to: physical barriers to prevent erosion and sedimentation, construction of sedimentation basins, limitations on work periods during storm events, use of swales, protection of stockpiled materials, and a variety of other measures that would substantially reduce or prevent erosion from occurring during construction. Post-construction requirements require that construction sites match pre-project hydrology to ensure that the physical and biological integrity of aquatic ecosystems are sustained in their existing condition. |
| **State** | |
| Porter-Cologne Water Quality Control Act | The Porter-Cologne Water Quality Control Act (Porter-Cologne Act, Water Code §13000 et seq.) establishes the SWRCB and each RWQCB as the principal state agencies with primary responsibility to coordinate and control water quality in California. The SWRCB establishes statewide policy for water quality control and provides oversight of the RWQCBs' operations. The RWQCBs have jurisdiction over specific geographic areas that are defined by watersheds. In addition to other regulatory responsibilities, the RWQCBs have the authority to conduct, order, and oversee investigation and cleanup where discharges or threatened discharges of waste to waters of the State could cause pollution or nuisance, including impacts to public health and the environment. Fresno County is under the jurisdiction of the Central Valley RWQCB. |
| Waste Discharge Requirements | Actions that involve or are expected to involve discharge of waste may be subject to waste discharge requirements (WDRs) under the Porter-Cologne Act. Chapter 4, Article 4 of the Porter-Cologne Act (Water Code §§13260-13274) states that persons discharging or proposing to discharge waste that could affect the quality of waters of the state (other than into a community sewer system) shall file a Report of Waste Discharge with the applicable RWQCB. Industrial activities with the potential to impact stormwater discharges are required to obtain an NPDES permit for those discharges. In California, an Industrial Storm Water General Permit, Order 97-03-DWQ (General Industrial Permit CAS 000001) may be issued to regulate discharges associated with ten broad categories of industrial activities, including electrical power generating facilities. The General Industrial Permit requires the implementation of management measures that will protect water quality. In addition, the discharger must develop and implement a SWPPP and a monitoring plan. Through the SWPPP, sources of pollutants are to be identified and the means to manage the sources to reduce stormwater pollution described. The monitoring plan requires sampling of stormwater discharges during the wet season and visual inspections during the dry season. |
| **Local** | |
| Riverside County Ordinance Code, Title 8, Chapter 8.124 – Sewage Discharge | Section 8.124.030, General Requirements for an Approval and Construction Permit requires the capacity, location, and layout of each private system, such as a septic system, to comply with the rules and regulations of the health officer, and the WDRs of the RWQCB. A private system shall be constructed and maintained on the lot which is the site of the building it serves, unless the health officer in his discretion authorizes a different location.<br><br>Section 8.124.050 Operation Permits requires that each private system be managed, cleaned, regulated, repaired, modified and replaced from time to time by the owner or owner representatives, in accordance with the rules, regulations and other reasonable requirements of the health officer in conformity with the WDR issued by the regional board and in a manner which will safeguard against and prevent pollution, contamination or nuisance. |

# Wildland Fire Ecology

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| **Federal** | |
| Federal Wildland Fire Management Policy | On BLM-administered lands in the California Desert, the BLM implements Federal Wildland Fire Management policies and objectives in coordination with state and other federal agencies as part of the California Desert Interagency Fire Management Organization. The Federal Wildland Fire Management Policy was developed by a federal multi-agency group that establishes consistent and coordinated fire management policy across multiple federal jurisdictions. The policy acknowledges the essential role of fire in maintaining natural ecosystems, but also prioritizes firefighter and public safety first in every fire management activity, and focuses on risk management as a foundation for all fire management activities. The policy promotes basing responses to wildland fires on approved Fire Management Plans and land management plans, regardless of ignition source or the location of the ignition (NWCG, 2001). |
| **State** | |
| California Fire Code | Based on the International Fire Code, the California Fire Code (24 Cal. Code Regs. Chapter 9) is created by the California Buildings Standards Commission and regulates the use, handling, and storage requirements for hazardous materials at fixed facilities. Similar to the International Fire Code, the California Fire Code and the CBC use a hazards classification system to determine the appropriate measures to incorporate to protect life and property. |
| CPUC General Order No. 95 | CPUC General Order No. 95 formulates for the State of California, requirements for overhead line design, construction, and maintenance, the application of which will ensure adequate service and secure safety to persons engaged in the construction, maintenance, operation or use of overhead lines and to the public in general. |
| **Local** | |
| There are no local regulations, plans, or standards that are applicable to the Proposed Action. The project would be located entirely on BLM administered lands; therefore, Riverside County zoning would not be applicable to the site of the Proposed Action and Alternatives. | |

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# Appendix F
## Relationship to the DRECP

# APPENDIX F

# Relationship Between the Crimson Solar Project PA/EIS/EIR and the Desert Renewable Energy Conservation Plan and Conformance with Conservation and Management Actions

## 1. Introduction

The Bureau of Land Management (BLM) issued the Desert Renewable Energy Conservation Plan (DRECP) in October 2016. The DRECP amends the California Desert Conservation Area (CDCA) Plan, specifically with respect to natural resources conservation and renewable energy development. The DRECP provides a new framework under which lands in the CDCA are managed for resources conservation, and under which new applications for renewable energy projects are considered and evaluated.

Although the new framework is now in place as of October 2016, the new management prescriptions are not applicable to the Crimson Solar Project (Proposed Action, or Project) or to the analysis of the Project in this Plan Amendment (PA)/Environmental Impact Statement (EIS)/Environmental Impact Report (EIR) because, according to the DRECP, renewable energy applications in the Riverside East SEZ filed before June 30, 2009, including the application for the Project, are not, and will not be, subject to the terms of the DRECP. The DRECP recognizes that the Project would not be subject to the DRECP due to its status as a "pending" right-of-way (ROW) application under the Western Solar Plan and its location within a SEZ (DRECP Section II.3.2.4, p. 68-69).

Because of these factors, this PA/EIS/EIR has been based on the management framework that was available under the CDCA Plan, and on BLM's renewable energy siting, data collection, and impact analysis requirements that were in place prior to the adoption of the DRECP. However, BLM has also considered and evaluated the effects of the DRECP changes on the impact analysis. The purpose of this appendix is to summarize the changes that occurred under the DRECP, and to discuss how these changes would, or would not, have affected the impact analysis if the analysis had been performed under the new DRECP requirements.

## 2. BLM Land Use Allocations

One major effect of the DRECP was to modify BLM's land management use allocations that were operative under the CDCA Plan prior to October, 2016. These included:

- The Multiple-Use Classes (MUCs) that were previously in effect under the CDCA Plan, as well as previous land use allocations made for resource protection, including Areas of Critical Environmental Concern (ACECs) and Desert Wildlife Management Areas (DWMAs), have been replaced by a new classification system. Under the DRECP, land use allocations are now categorized as Development Focus Areas (DFAs), Variance
- Process Lands (VPLs), General Public Lands, and Resource Conservation Areas. Lands have also been designated for recreation purposes.
- Under the previous CDCA Plan, no Visual Resource Management (VRM) classes had been established in the CDCA, and the designation and adoption of Interim VRM classes in response to a specific project was a

BLM Field Office Manager decision. The DRECP has now established VRM classes for the entire CDCA, including the Project area.

While these changes do not affect the physical resources on and around the Project site, they do affect how those resources are managed. The affected environment in which the Project is proposed (discussed in Chapter 3 of the PA/EIS/EIR) includes physical resources such as wildlife and water resources. The analysis of Project impacts in Chapter 3 is, for some resources, based only on the direct impact of the Project on that physical resource. However, the impact analysis for other resources is based on how the Project conforms to BLM's requirements for management of that resource. In this way, the PA/EIS/EIR evaluates both the effect of the Project on a resource and the effect of the Project on the status or management goals of an area established for protection of that resource. It is the status and management goals of these areas that have changed under the DRECP.

The DRECP does not affect how the PA/EIS/EIR evaluates physical impacts to physical resources, but it does affect how the PA/EIS/EIR evaluates impacts to land use status or management goals. Because the Project is not subject to the DRECP, the analysis of the impact of the Project on land use status or management goals is based on the land use status and management goals that were in place prior to the adoption of the DRECP. The following subsections summarize the land use allocations that have changed, and how the changes do, or do not, affect the impact analysis in the PA/EIS/EIR.

## 2.1 On-Site and Adjacent Land Use Allocations

Under the CDCA Plan, the Project site was designated as Multiple Use Class – Moderate (MUC-M). Section 3.9 of the PA/EIS/EIR evaluates the conformance of the Project with this classification. In the DRECP, the Project site is designated as a DFA, which is an area where activities associated with solar, wind, and geothermal energy are allowed, streamlined, and incentivized. Because solar projects are allowed on DFA lands, the Project would be in conformance with this new land use allocation.

Section 3.18 of the PA/EIS/EIR evaluates the conformance of the Project with this classification. A majority of the Project site is located on lands managed as VRM Class IV. A small portion of the Project site is located on lands managed as VRM Class II. VRM Class IV allows for management activities and uses requiring major modifications to the natural landscape, while the objective of VRM Class II is to retain the existing character of the landscape, and the level of change to characteristic landscape should be moderate.

Under the CDCA Plan, there were no resource protection allocations, such as ACECs, DWMAs, Wilderness Areas, or Lands Managed for Wilderness Characteristics on the Project site. There were also no formal recreation designations for the site. Similarly, under the DRECP, no resource conservation or recreation designations have been made for the site, so no changes in impact analyses would have been needed in these areas.

## 2.2 Nearby Land Use Allocations

Under the CDCA Plan, land use allocations in the vicinity of the Project site were designated according to the MUC system. The directly adjacent lands were designated the same as the Project site, as MUC-M. Under DRECP, the distinction between MUC-M, MUC-I, and MUC-L on the lands in the vicinity of the Project site no longer exists. Instead, almost all lands have been designated for resource conservation, development, and/or recreation. Therefore, there is no correlative analysis under the DRECP. Although the analysis of the Project within the context of the MUC system is moot under the DRECP, there is no other analysis that would have been needed to be performed in its place.

Under both the CDCA Plan and DRECP, lands have been designated for resource conservation purposes. Section 3.14 of the PA/EIS/EIR identified the locations of nearby areas designated for resource conservation, including ACECs, DWMAs, Wilderness Areas, Lands with Wilderness Characteristics, and Back Country By-Ways. In that analysis, the closest lands under each category were as follows:

- The closest ACEC is the Mule Mountains ACEC, designated for protection of cultural resources, 1.5 miles southwest of the Project site.
- The closest DWMA was the Chuckwalla DWMA, designated for protection of the desert tortoise, 1.5 miles west of the Project site.
- The closest Wilderness Areas are the Little Chuckwalla Mountains Wilderness 6.8 miles to the southwest.
- The nearest land found to have wilderness characteristics is in the McCoy Mountains over 7 miles north of the Project site.
- The nearest Back Country By-Way is the Bradshaw Trail, located approximately 1.7 miles from the Project site.

Section 3.14 evaluates the impact of the Project on the designation status and management objectives of each of these areas. Section 3.3 evaluated the impact of the Project on wildlife in the ACECs and DWMAs, and Section 3.5 evaluated the direct and indirect impacts of the Project on cultural resources, including those in the Mule Mountains ACEC. Section 3.14 evaluated the impact of the Project on recreation in these specially designated areas.

Under the DRECP, the boundaries of some of these areas have changed. The largest change, and that closest to the Project site, is that several of the ACECs west of the project, including the Mule Mountains ACEC, have been expanded and combined into a single ACEC. However, the change in the boundary was to the west, away from the Project site. None of the newly

designated areas are located closer to the Project site than was the case under the CDCA Plan prior to October 2016. There are no newly designated areas (under the DRECP) that would be impacted but are left unevaluated.

Under both the CDCA Plan and the DRECP, lands have been designated for recreational purposes. Section 3.12 of the PA/EIS/EIR evaluates the impact of the proposed Project on general recreation on BLM land, including off-highway vehicle access to recreational areas, as well as on city of Blythe parks and recreational facilities. None of the general recreational opportunities or city of Blythe facilities have been changed as a result of the DRECP.

Section 3.12 identified the locations of nearby areas specially designated for recreation, including the Mule Mountains and Midland Long-Term Visitor Areas (LTVAs), campgrounds, and the Bradshaw Trail. Impacts to these areas were evaluated in Section 3.12. Under the DRECP, the new land use allocations included designation of both the Mule Mountains and Midland LTVAs as Special Recreation Management Areas (SRMAs). However, the boundaries or management objectives of these areas were not changed in a way that would make the current impact analysis inapplicable.

# 3. Conservation and Management Actions

The second major component of the DRECP is the implementation of Conservation and Management Actions (CMAs), which include a variety of project siting, impact mitigation, and BLM management requirements. CMAs were developed on a Land Use Plan Area (LUPA)-wide basis, as well as specifically for Conservation Lands, DFAs, VPLs, and lands used for power transmission.

Because the Project is exempted from the DRECP, the CMAs are not applicable to the Project. However, to ensure that the impact analysis is complete, and resources are protected to the maximum extent practicable, BLM has performed an applicability analysis of the Project with respect to the CMAs. Because the Project would be located wholly on DFA lands and includes transmission, the CMAs evaluated were those included in the LUPA-wide, DFA, DFA/VPL, and Transportation (TRANS) categories.

The analysis includes a determination of whether the CMA would have been applicable to the Project, if the Project had been subject to the DRECP. This includes an evaluation of whether the type of action covered by the CMA is within the scope of the Project, i.e., approval of a solar energy project. In addition, it includes a determination of whether the resource addressed by the CMA is present, or potentially impacted, on the Project site.

Following the applicability determination, the analysis included an evaluation of the design of the Project, the scope of the Applicant's field surveys and technical analyses, the Applicant's Proposed Measures, and the preliminary mitigation measures developed by the agencies with respect to each CMA. The evaluation was performed to verify that the resource conservation objectives of each CMA were met, determine whether changes could be made to Project design and technical analysis to improve conformance, and determine whether changes could be made to the preliminary mitigation measures, within the limitation that the Project is not legally subject to the CMAs.

In general, the analysis revealed that the Project design and/or mitigation measures satisfy applicable CMAs. In many cases, wording changes were made to mitigation measures to bring the language into line with the CMA language. In cases where no such changes are made, the analysis describes why the Applicant is not required to modify the Project or mitigate potential impacts, or why the CMA does not apply.

# 4. Datasets

Another effect of the approval of the DRECP is that it based its analysis on region-wide datasets for identification of potentially affected resources and required use of these datasets by future Applicants. This included mapping of habitat and migration corridors for various wildlife and plant species. Many of the CMAs were, in turn, based on the relationship of the Project to the resources as they were presented in the datasets.

In general, the datasets used by the DRECP have no effect on the analysis of the Project in the PA/EIS/EIR. For the DRECP, broad-scale mapping of vegetation alliances was done by the California Department of Fish and Wildlife. The vegetation classification for the DRECP follows Federal Geographic Data Committee and National Vegetation Classification Standards. In contrast, for the analysis in this PA/EIS/EIR, the vegetation was mapped as vegetation communities, on a site-specific basis, by the Applicant under direction from the BLM. Vegetation communities were characterized by the classification system used by Holland (1986) and the Northern and Eastern Colorado Desert Coordinated Management Plan Amendment to the CDCA Plan (Evens and Hartman 2007), and cross-referenced with *A Manual of California Vegetation* (Sawyer and Keeler-Wolf 2009), where appropriate.

| LUPA Wide | | | | | |
|---|---|---|---|---|---|
| **Category** | **CMA #** | **CMA Text** | **Project Applicability** | **Project Consistency.** | **Explanation** |
| **Biological Resources** | **LUPA-BIO-1** | Conduct a habitat assessment (see Glossary of Terms) of Focus and BLM Special Status Species' suitable habitat for all activities and identify and/or delineate the DRECP vegetation types, rare alliances, and special features (e.g., Aeolian sand transport resources, Joshua tree, microphyll woodlands, carbon sequestration characteristics, seeps, climate refugia) present using the most current information, data sources, and tools (e.g., DRECP land cover mapping, aerial photos, DRECP species models, and reconnaissance site visits) to identify suitable habitat (see Glossary of Terms) for Focus and BLM Special Status Species. If required by the relevant species specific CMAs, conduct any subsequent protocol or adequate presence/absence surveys to identify species occupancy status and a more detailed mapping of suitable habitat to inform siting and design considerations. If required by relevant species specific CMAs, conduct analysis of percentage of impacts to suitable habitat and modeled suitable habitat. | Applicable | Consistent | Based upon the BRTR (prepared by AECOM in December 2018) these habitats have been assessed on the project site and subsequent protocol surveys were conducted for special-status plants, desert tortoise, Mojave fringe-toed lizard, Couch's spadefoot, burrowing owls, elf owls, gila woodpecker, golden eagles, migratory birds, nocturnal avian species and bats. |
| | | • BLM will not require protocol surveys in sites determined by the designated biologist to be unviable for occupancy of the species, or if baseline studies inferred absence during the current or previous active season. | Not applicable | | Protocol surveys were conducted based on potential of special status species to occur onsite. (See above). |
| | | Utilize the most recent and applicable assessment protocols and guidance documents for vegetation types and jurisdictional waters and wetlands that have been approved by BLM, and the appropriate responsible regulatory agencies, as applicable. | Applicable | Consistent | Protocols listed in the BRTR are recent and applicable to the protocol surveys, some of which directly used BLM protocols (e.g. migratory bird transects). |
| | **LUPA-BIO-2** | Designated biologist(s) (see Glossary of Terms), will conduct, and oversee where appropriate, activity-specific required biological monitoring during pre-construction, construction, and decommissioning to ensure that avoidance and minimization measures are appropriately implemented and are effective. The appropriate required monitoring will be determined during the environmental analysis and BLM approval process. The designated biologist(s) will submit monitoring reports directly to BLM. | Applicable | Consistent | The requirement to have a designated biologist (DB) on the project is contained in BRTR Measure BIO-1. The following BRTR Measures specify a DB shall oversee/conduct monitoring and/or prepare reports: BIO-2, BIO-4, BIO-11, BIO-28, BIO-37, BIO-38, BIO-39, BIO-42, BIO-43, and BIO-50. |
| **Resource Setback Standards** | **LUPA-BIO-3** | Resource setbacks (see Glossary of Terms) have been identified to avoid and minimize the adverse effects to specific biological resources. Setbacks are not considered additive and are measured as specified in the applicable CMA. Allowable minor incursions (see Glossary of Terms), as per specific CMAs do not affect the following setback measurement descriptions. Generally, setbacks (which range in distances for different biological resources) for the appropriate resources are measured from: | Applicable | Consistent | 200-foot setbacks for microphyll woodlands have been incorporated into the project design except for the minor incursions from linear features which cross microphyll woodland at the least impacting location. No other setbacks are anticipated to be required. |
| | | • The edge of each of the DRECP desert vegetation types, including but not limited to those in the riparian or wetland vegetation groups (as defined by alliances within the vegetation type descriptions and mapped based on the vegetation type habitat assessments described in LUPA-BIO-1). | Applicable | Consistent | See above. No other setbacks are anticipated to be required given the vegetation communities onsite. |
| | | • The edge of the mapped riparian vegetation or the Federal Emergency Management Agency (FEMA) 100-year floodplain, whichever is greater, for the Mojave River. | Not applicable | | See above. The project does not occur in close proximity to the Mojave River. |
| | | • The edge of the vegetation extent for specified Focus and BLM sensitive plant species. | Applicable | Consistent | See above. |
| | | • The edge of suitable habitat or active nest substrates for the appropriate Focus and BLM Special Status Species. | Applicable | Consistent | Per BRTR Measures BIO-42 and BIO-43, setbacks would be calculated from burrowing owl burrows. |
| **Seasonal Restrictions** | **LUPA-BIO-4** | For activities that may impact Focus and BLM Special Status Species, implement all required species-specific seasonal restrictions on pre- construction, construction, operations, and decommissioning activities. | Applicable | Consistent | Seasonal restrictions have been included where applicable and are consistent with BRTR Measures BIO-28, BIO- 42, BIO-50, BIO-51, and BIO-65. |
| | | Species-specific seasonal restriction dates are described in the applicable CMAs. | - | - | - |
| | | Alternatively, to avoid a seasonal restriction associated with visual disturbance, installation of a visual barrier may be evaluated on a case-by-case basis that will result in the breeding, nesting, lambing, fawning, or roosting species not being affected by visual disturbance from construction activities subject to seasonal restriction. The proposed installation and use of a visual barrier to avoid a species seasonal restriction will be analyzed in the activity/project specific environmental analysis. | Not applicable | | Seasonal restrictions have been included where applicable; thus avoidance of season restrictions does not apply. |
| **Worker Education** | **LUPA-BIO-5** | All activities, as determined appropriate on an activity-by-activity basis, will implement a worker education program that meets the approval of the BLM. The program will be carried out during all phases of the project (site mobilization, ground disturbance, grading, construction, operation, closure/decommissioning or project abandonment, and restoration/reclamation activities). The worker education program will provide interpretation for non-English speaking workers, and provide the same instruction for new workers prior to their working on site. As appropriate based on the activity, the program will contain information about: | Applicable | Consistent | BRTR Measures BIO-2 and BIO-19 are consistent with worker education program requirements. |
| | | • Site-specific biological and nonbiological resources. | Applicable | Consistent | Consistent with BRTR Measure BIO-19. |
| | | • Information on the legal protection for protected resources and penalties for violation of federal and state laws and administrative sanctions for failure to comply with LUPA CMA requirements intended to protect site-specific biological and nonbiological resources. | Applicable | Consistent | Consistent with BRTR Measure BIO-19. |
| | | • The required LUPA and project-specific measures for avoiding and minimizing effects during all project phases, including but not limited to resource setbacks, trash, speed limits, etc. | Applicable | Inconsistent | Specific text related to setbacks, trash, speed limits being discussed in worker training is not included in the BRTR training measure (BIO-19). BRTR Measures Bio-9 and BIO-32 requires speed limits and trash removal for the project. |
| | | • Reporting requirements and measures to follow if protected resources are encountered, including potential work stoppage and requirements for notification of the designated biologist. | Applicable | Inconsistent | Specific text related to worker reporting requirements being discussed in training is not included in the BRTR training measure (BIO-19). |
| | | • Measures that personnel can take to promote the conservation of biological and nonbiological resources. | Applicable | Consistent | Consistent with BRTR Measure BIO-19. |

| LUPA Wide | | | | | |
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| **Category** | **CMA #** | **CMA Text** | **Project Applicability** | **Project Consistency.** | **Explanation** |
| **Subsidized Predators Standards** | **LUPA-BIO-6** | Subsidized predator standards, approved by BLM, in coordination with the USFWS and CDFW, will be implemented during all appropriate phases of activities, including but not limited to renewable energy activities, to manage predator food subsidies, water subsidies, and breeding sites including the following: | Applicable | Consistent | See consistency analysis below. |
| | | • Common Raven management actions will be implemented for all activities to address food and water subsidies and roosting and nesting sites specific to the Common Raven. These include identification of monitoring reporting procedures and requirements; strategies for refuse management; as well as design strategies and passive repellant methods to avoid providing perches, nesting sites, and roosting sites for Common Ravens. | Applicable | Consistent | BRTR Measure BIO-40 requires a Raven Monitoring, management and Control Plan and BRTR Measure BIO-58 lists strategies to prevent common raven occurrence onsite. |
| | | • The application of water and/or other palliatives for dust abatement in construction areas and during project operations and maintenance will be done with the minimum amount of water necessary to meet safety and air quality standards and in a manner that prevents the formation of puddles, which could attract wildlife and wildlife predators. | Applicable | Consistent | BRTR Measures BIO-12, BIO-37 and BIO-58 require elimination of standing water to avoid attracting ravens and other wildlife. |
| | | • Following the most recent national policy and guidance, BLM will take actions to not introduce, dispose of, or release any non- native species into areas of native habitat, suitable habitat, and natural or artificial waterways/water bodies containing native species. | Applicable | Consistent | BRTR Measure BIO-18 requires avoidance and control of nonnative plant species introduction and BIO-62 requires making sure the facility footprint is free from nonnative species during operation and maintenance. |
| | | All activity work areas will be kept free of trash and debris. Particular attention will be paid to "micro-trash" (including such small items as screws, nuts, washers, nails, coins, rags, small electrical components, small pieces of plastic, glass or wire, and any debris or trash that is colorful or shiny) and organic waste that may subsidize predators. All trash will be covered, kept in closed containers, or otherwise removed from the project site at the end of each day or at regular intervals prior to periods when workers are not present at the site. | Applicable | Consistent | BRTR Measure Bio-9 is consistent with trash and debris containment and removal. |
| | | • In addition to implementing the measures above on activity sites, each activity will provide compensatory mitigation that contributes to LUPA-wide raven management. | Applicable | Consistent | BRTR Measure BIO-40 requires contribution of funding to the USFWS Regional Raven Management program. |
| **Restoration of Areas Disturbed by Construction Activities But Not Converted by Long-Term Disturbance** | **LUPA-BIO-7** | Where DRECP vegetation types or Focus or BLM Special Status Species habitats may be affected by ground- disturbance and/or vegetation removal during pre-construction, construction, operations, and decommissioning related activities but are not converted by long-term (i.e., more than two years of disturbance, see Glossary of Terms) ground disturbance, restore these areas following the standards, approved by BLM authorized officer, following the most recent BLM policies and procedures for the vegetation community or species habitat disturbance/impacts as appropriate, summarized below: | Applicable | Inconsistent | According to the Proposed Action, restoration would be required following construction. BRTR Measures BIO-22, BIO-23, BIO-41 and BIO-48 say restoration of riparian habitat may be required and mitigation for impacts to desert tortoise and Mojave fringe-toed lizard will be required, but no specific restoration requirements, besides mitigation ratios, are detailed in the BRTR Measures. |
| | | • Implement site-specific habitat restoration actions for the areas affected including specifying and using: | Applicable | Inconsistent | See above |
| | | o The appropriate seed (e.g., certified weed- free, native, and locally and genetically appropriate seed) | Applicable | Inconsistent | See above |
| | | o Appropriate soils (e.g., topsoil of the same original type on site or that was previously stored by soil type after being salvaged during excavation and construction activities) | Applicable | Inconsistent | See above |
| | | o Equipment | Applicable | Inconsistent | See above |
| | | o Timing (e.g., appropriate season, sufficient rainfall) | Applicable | Inconsistent | See above |
| | | o Location | Applicable | Inconsistent | See above |
| | | o Success criteria | Applicable | Inconsistent | See above |
| | | o Monitoring measures | Applicable | Inconsistent | See above |
| | | o Contingency measures, relevant for restoration, which includes seeding that follows BLM policy when on BLM administered lands. | Applicable | Inconsistent | See above |
| | | • Salvage and relocate cactus, nolina, and yucca from the site prior to disturbance using BLM protocols. To the maximum extent practicable for short-term disturbed areas (see Glossary of Terms), the cactus and yucca will be re-planted back to the original site. | Applicable | Inconsistent | See above |
| | | • Restore and reclaim short-term (i.e. 2 years or less, see Glossary of Terms) disturbed areas, including pipelines, transmission projects, staging areas, and short-term construction-related roads immediately or during the most biologically appropriate season as determined in the activity/project specific environmental analysis and decision, following completion of construction activities to reduce the amount of habitat converted at any one time and promote recovery to natural habitats and vegetation as well as climate refugia and ecosystem services such carbon storage. | Applicable | Inconsistent | See above |
| **General Closure and Decommissioning Standards** | **LUPA-BIO-8** | All activities that are required to close and decommission the site (e.g., renewable energy activities) will specify and implement project-specific closure and decommissioning actions that meet the approval of BLM, and that at a minimum address the following: | Applicable | Inconsistent | Decommissioning impacts for biological resources are discussed in Section 5.3 of the BRTR, but there are no BRTR measures specific to decommissioning actions other than worker training (BIO-19) and a raven management (BIO-40). |
| | | • Specifying and implementing the methods, timing (e.g., criteria for triggering closure and decommissioning actions), and criteria for success (including quantifiable and measureable criteria). | Applicable | Inconsistent | See above |
| | | • Recontouring of areas that were substantially altered from their original contour or gradient and installing erosion control measures in disturbed areas where potential for erosion exists. | Applicable | Inconsistent | See above |
| | | • Restoring vegetation as well as soil profiles and functions that will support and maintain native plant communities, associated carbon sequestration and nutrient cycling processes, and native wildlife species. | Applicable | Inconsistent | See above |
| | | • Vegetation restoration actions will identify and use native vegetation composition, native seed composition, and the diversity to values commensurate with the natural ecological setting and climate projections. | Applicable | Inconsistent | See above |

| LUPA Wide | | | | | |
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| Category | CMA # | CMA Text | Project Applicability | Project Consistency. | Explanation |
| Water and Wetland Dependent Species Resources | LUPA-BIO-9 | Implement the following general LUPA CMA for water and wetland dependent resources<br>• Implement construction site standard practices to prevent toxic chemicals, hazardous materials, and other fluids from entering vegetation type streams, washes, and tributary networks through water runoff, erosion, and sediment transport by, at a minimum, implementing the following: | Applicable | Inconsistent | See comment on inconsistency below. |
| | | o On project sites, vehicles and other equipment will be maintained in proper working condition and only stored in designated containment areas where runoff is collected or controlled and that are located outside of streams, washes, and distributary networks to minimize accidental fluids and hazardous materials spills. | Applicable | Consistent | BRTR Measure BIO-16 says fueling would occur outside of drainages and equipment would be inspected and repaired. However, no BRTR measures say vehicles would be stored outside of drainages. |
| | | o Hazardous material leaks, spills, or releases will be immediately cleaned and equipment will be repaired upon identification. Removal and disposal of spill and related clean-up materials will occur at an approved off-site landfill. | Applicable | Consistent | Requirement is addressed in BRTR Measures BIO-13 and BIO-34. |
| | | o Maintenance and operations vehicles will carry the appropriate equipment and materials to isolate, clean up, and repair any hazardous material leaks, spills, or releases. | Applicable | Inconsistent | No specific text related to operations vehicles carrying appropriate materials to clean and repair issues onsite. BRTR Measure BIO-13 is consistent for service/maintenance vehicles. |
| | | • Activity-specific drainage, erosion, and sedimentation control actions, which meet the approval of BLM and the applicable regulatory agencies, will be carried out during all appropriate phases of the approved project. These actions, as needed, will address measures to ensure the proper protection of water quality, site-specific stormwater and sediment retention, and design of the project to minimize site disturbance, including the following: | Applicable | Inconsistent | See below comments pertaining to inconsistency. |
| | | o Identify site-specific surface water runoff patterns and implement measures to prevent excessive and unnatural soil deposition and erosion. | Applicable | Consistent | Consistent with BRTR Measure BIO-15 (remedying erosion within 2 days) and BIO-60 (SWPPP). |
| | | o Implement measures to maintain natural drainages and to maintain hydrologic function in the event drainages are disturbed. | Applicable | Consistent | Consistent with BRTR Measures BIO-20 through BIO-23. |
| | | o Reduce the amount of area covered by impervious surfaces through use of permeable pavement or other pervious surfaces. Direct runoff from impervious surfaces into retention basins. | Applicable | Consistent | The majority of the site, including new access roads, would remain pervious (covered in gravel) according to the Proposed Action. |
| | | o Stabilize disturbed areas following grading in the manner appropriate to the soil type so that wind or water erosion is minimized. | Applicable | Inconsistent | There is no specific text related to soil stabilization in the BRTR measures. |
| | | o Minimize irrigation runoff by using low or no irrigation native vegetation landscaping for landscaped retention basins. | Applicable | Inconsistent | There is no specific text related to minimization of irrigation in revegetated areas in the BRTR measures. |
| | | o Conduct regular inspections and maintenance of long-term erosion control measures to ensure long-term effectiveness. | Applicable | Inconsistent | There is no specific text in the BRTR measures related to monitoring erosion control measures long-term. |
| | | o Project applicants for sites that may affect intermittent and perennial streams, springs, swales, ephemeral washes, wetland vegetation, other DRECP water land covers, or sites occupied by aquatic or riparian Focus and BLM Special Status Species due to groundwater or surface water extraction will conduct hydrologic studies during project planning to determine the potential effect of groundwater and surface water extraction on the hydrologic unit. These studies will include both watershed effects as well as effects on perched, alluvial, and regional aquifers. Projects that are likely to affect ground-water resources in a manner that would result in substantial loss of riparian or wetland communities or habitat for riparian or aquatic Focus and BLM Special Status Species are prohibited. | Applicable | Inconsistent | The proposed project may obtain water from groundwater wells. Hydrologic studies are required, but no BRTR measures mention thus hydrologic studies. |
| | | o The use of evaporation ponds for water management will be avoided when the water could harm birds or other terrestrial wildlife due to constituents of concern present in the wastewater (e.g., selenium, hypersalinity, etc.). Evaporation ponds will be configured to minimize attractiveness to shorebirds (e.g., maintain water depths over two feet; maintain steep slopes along edge; enclose evaporation ponds in long-term structures; or obscure evaporation ponds from view using materials that blend in with the natural surroundings). | Not applicable | | No evaporation ponds are proposed by the project. |
| | | • Ramps that allow the egress of wildlife from ponds or other water management infrastructure will be installed. | Not applicable | | No ponds or other water management infrastructure would be installed on the project site. |
| Standard Practices for Weed Management | LUPA-BIO-10 | Consistent with BLM state and national policies and guidance, integrated weed management actions, will be carried out during all phases of activities, as appropriate, and at a minimum will include the following: | Applicable | Inconsistent | See comments on inconsistencies below. |
| | | • Thoroughly clean the tires and undercarriage of vehicles entering or reentering the project site to remove potential weeds. | Applicable | Consistent | BRTR Measure BIO-18 says vehicles would be cleaned by rumble strips or other methods. |
| | | • Store project vehicles on site in designated areas to minimize the need for multiple washings whenever vehicles re-enter the project site. | Applicable | Inconsistent | BRTR Measure BIO-33 says parking will occur within the desert tortoise-exclusion fence. No designated areas for vehicle storage after being washed have been identified in the BRTR measures. |
| | | • Properly maintain vehicle wash and inspection stations to minimize the introduction of invasive weeds or subsidy of invasive weeds. | Applicable | Inconsistent | BRTR Measure BIO-18 says vehicles would be cleaned by rumble strips or other methods, but no inspection stations are mentioned in BRTR measures. |

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| **Category** | **CMA #** | **CMA Text** | **Project Applicability** | **Project Consistency.** | **Explanation** |
| | | ● Closely monitor the types of materials brought onto the site to avoid the introduction of invasive weeds and non-native species. | Applicable | Inconsistent | Close monitoring of site materials for potential weed/nonnative introduction is not mentioned by any BRTR measures. |
| | | ● Reestablish native vegetation quickly on disturbed sites. | Applicable | Inconsistent | Quick native vegetation reestablishment on disturbed sites is not mentioned by any BRTR measures. |
| | | ● Monitor and quickly implement control measures to ensure early detection and eradication of weed invasions to avoid the spread of invasive weeds and non-native species on site and to adjacent off-site areas. | Applicable | Inconsistent | BRTR Measure BIO-18 says weed populations introduced into the site during construction shall be eliminated by chemical and/or mechanical means but does not specify monitoring and early detection/eradication. |
| | | ● Use certified weed-free mulch, straw, hay bales, or equivalent fabricated materials for installing sediment barriers. | Applicable | Consistent | BRTR Measure BIO-18 says weed-free materials would be used for erosion control. |
| **Nuisance Animals and Invasive Species** | **LUPA-BIO-11** | Implement the following CMAs for controlling nuisance animals and invasive species: | Applicable | Inconsistent | See comments regarding inconsistencies below. |
| | | ● No fumigant, treated bait, or other means of poisoning nuisance animals including rodenticides will be used in areas where Focus and BLM Special Status Species are known or suspected to occur. | Applicable | Inconsistent | There is no BRTR text specific to rodenticide use onsite. |
| | | ● Manage the use of widely spread herbicides and do not apply herbicides effective against dicotyledonous plants within 1,000 feet from the edge of a 100-year floodplain, stream and wash channels, and riparian vegetation or to soils less than 25 feet from the edge of drains. Exceptions will be made when targeting the base and roots of invasive riparian species such as tamarisk and Arundo donax (giant reed). Manage herbicides consistent with the most current national and California BLM policies | Applicable | Consistent | BRTR Measure BIO-18 says elimination of weed populations would be done so in a method approved by the resource agencies and Measure BIO-62 says only BLM-approved herbicides shall be applied during project operation. |
| | | ● Minimize herbicide, pesticide, and insecticide treatment in areas that have a high risk for groundwater contamination. | Applicable | Inconsistent | There is no BRTR measure text specific to pesticide use onsite. |
| | | ● Clean and dispose of pesticide containers and equipment following professional standards. Avoid use of pesticides and cleaning containers and equipment in or near surface or subsurface water. | Applicable | Inconsistent | There is no BRTR measure text specific to pesticide use onsite. |
| | | ● When near surface or subsurface water, restrict pesticide use to those products labeled safe for use in/near water and safe for aquatic species of animals and plants. | Applicable | Inconsistent | There is no BRTR measure text specific to pesticide use onsite. |
| **Noise** | **LUPA-BIO-12** | For activities that may impact Focus or BLM Special Status Species**,** implement the following LUPA CMA for noise: | Applicable | Inconsistent | See comments on inconsistencies below. |
| | | ● To the extent feasible, and determined necessary by BLM to protect Focus and BLM sensitive wildlife species, locate stationary noise sources that exceed background ambient noise levels away from known or likely locations of and BLM sensitive wildlife species and their suitable habitat. | Applicable | Inconsistent | There is no BRTR measure text stating the location of stationary noise sources. |
| | | ● Implement engineering controls on stationary equipment, buildings, and work areas including sound-insulation and noise enclosures to reduce the average noise level, if the activity will contribute to noise levels above existing background ambient levels. | Applicable | Inconsistent | There is no BRTR measure text describing the implementation of engineering controls to reduce noise levels. |
| | | ● Use noise controls on standard construction equipment including mufflers to reduce noise | Applicable | Inconsistent | There is no BRTR measure text stating mufflers would be used on construction equipment. |
| **General Siting and Design** | **LUPA-BIO-13** | Implement the following CMA for project siting and design | Applicable | Inconsistent | See comments on inconsistencies below. |
| | | ● To the maximum extent practicable site and design projects to avoid impacts to vegetation types, unique plant assemblages, climate refugia as well as occupied habitat and suitable habitat for Focus and BLM Special Status Species (see "avoid to the maximum extent practicable" in Glossary of Terms). | Applicable | Consistent | BRTR measures involving avoidance of sensitive habitats: BIO-5, BIO-20, BIO-24, BIO-25, BIO-26, and BIO-47. |
| | | ● The siting of projects along the edges (i.e. general linkage border) of the biological linkages identified in Appendix D (Figures D-1 and D-2) will be configured (1) to maximize the retention of microphyll woodlands and their constituent vegetation type and inclusion of other physical and biological features conducive to Focus and BLM Special Status Species' dispersal, and (2) informed by existing available information on modeled focus and BLM Special Status Species habitat and element occurrence data, mapped delineations of vegetation types, and based on available empirical data, including radio telemetry, wildlife tracking sign, and road-kill information. Additionally, projects will be sited and designed to maintain the function of F Special Status Species connectivity and their associated habitats in the following linkage and connectivity areas: | Applicable | Consistent | BRTR measures involving avoidance of sensitive habitats: BIO-5, BIO-20, BIO-24, BIO-25, BIO-26, and BIO-47. |
| | | o Within a 5-mile-wide linkage across Interstate 10 centered on Wiley's Well Road to connect the Mule and McCoy mountains (the majority of this linkage is within the Chuckwalla ACEC and Mule-McCoy Linkage ACEC) . | Applicable | Consistent | BRTR measures involving avoidance of sensitive habitats: BIO-5, BIO-20, BIO-24, BIO-25, BIO-26, and BIO-47. |
| | | o Within a 3-mile-wide linkage across Interstate 10 to connect the Chuckwalla and Palen mountains. | Applicable | Consistent | BRTR measures involving avoidance of sensitive habitats: BIO-5, BIO-20, BIO-24, BIO-25, BIO-26, and BIO-47. |
| | | o Within a 1.5-mile-wide linkage across Interstate 10 to connect the Chuckwalla Mountains to the Chuckwalla Valley east of Desert Center. | Applicable | Consistent | BRTR measures involving avoidance of sensitive habitats: BIO-5, BIO-20, BIO-24, BIO-25, BIO-26, and BIO-47. |
| | | o The confluence of Milpitas Wash and Colorado River floodplain within 2 miles of California State Route 78 (this linkage is entirely within the Chuckwalla ACEC) . | Applicable | Consistent | BRTR measures involving avoidance of sensitive habitats: BIO-5, BIO-20, BIO-24, BIO-25, BIO-26, and BIO-47. |
| | | ● Delineate the boundaries of areas to be disturbed using temporary construction fencing and flagging prior to construction and confine disturbances, project vehicles, and equipment to the delineated project areas to protect vegetation types and focus and BLM Special Status Species. | Applicable | Consistent | Consistent with BRTR Measure BIO-5 (no construction activities occurring outside of flagged disturbance areas) and BIO-7 (not disturbing areas outside of new and existing roads). |

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| **Category** | **CMA #** | **CMA Text** | **Project Applicability** | **Project Consistency.** | **Explanation** |
| | | ● Long-term nighttime lighting on project features will be limited to the minimum necessary for project security, safety, and compliance with Federal Aviation Administration requirements and will avoid the use of constant-burn lighting. | Applicable | Consistent | Consistent with BRTR Measure BIO-61 (limiting to the minimum illumination necessary). |
| | | ● All long-term nighttime lighting will be directed away from riparian and wetland vegetation, occupied habitat, and suitable habitat areas for Focus and BLM Special Status Species. Long- term nighttime lighting will be directed and shielded downward to avoid interference with the navigation of night-migrating birds and to minimize the attraction of insects as well as insectivorous birds and bats to project infrastructure. | Applicable | Inconsistent | BRTR Measure BIO-61 requires direction of long-term lighting away from sensitive habitat but does not state lighting will be shielded downward to interfere with birds or bats or minimize insect attraction. |
| | | ● To the maximum extent practicable (see Glossary of Terms), restrict construction activity to existing roads, routes, and utility corridors to minimize the number and length/size of new roads, routes, disturbance, laydown, and borrow areas. | Applicable | Consistent | Consistent with BRTR Measure BIO-7 (restricting activities to existing roads). |
| | | ● To the maximum extent practicable (see Glossary of Terms), confine vehicular traffic to designated open routes of travel to and from the project site, and prohibit, within project boundaries, cross- country vehicle and equipment use outside of approved designated work areas to prevent unnecessary ground and vegetation disturbance. | Applicable | Consistent | Consistent with BRTR Measure BIO-7 (restricting vehicular movement to existing roads). |
| | | ● To the maximum extent practicable(see Glossary of Terms) , construction of new roads and/or routes will be avoided within Focus and BLM Special Status Species suitable habitat within identified linkages for those Focus and BLM Special Status Species, unless the new road and/or route is beneficial to minimize net impacts to natural or ecological resources of concern. These areas will have a goal of "no net gain" of project roads and/or routes | Applicable | Consistent | See above |
| | | ● To the maximum extent practicable (see Glossary of Terms), any new road and/or route considered within Focus and BLM Special Status Species suitable habitat within identified linkages for those Focus and BLM Special Status Species will not be paved so as not to negatively affect the function of identified linkages. | Applicable | Consistent | See above |
| | | ● Use nontoxic road sealants and soil stabilizing agents. | Applicable | Inconsistent | Although road sealants would not be necessary, there is no BRTR measure text that discusses use of nontoxic soil stabilizing agents. |
| **Biology: General Standard Practices** | **LUPA-BIO-14** | Implement the following general standard practices to protect Focus and BLM Special Status Species: | Applicable | Inconsistent | See comments for inconsistent measures below. |
| | | ● Feeding of wildlife, leaving of food or trash as an attractive nuisance to wildlife, collection of native plants, or harassing of wildlife on a site is prohibited. | Applicable | Inconsistent | This text is not specifically included in a BRTR Measure with the exception of food or trash removal which is consistent with BIO-9. |
| | | ● Any wildlife encountered during the course of an activity, including construction, operation, and decommissioning will be allowed to leave the area unharmed. | Applicable | Consistent | Consistent with BRTR Measure BIO-11 (wildlife encountered during construction allowed to leave unharmed). |
| | | ● Domestic pets are prohibited on sites. This prohibition does not apply to the use of domestic animals (e.g., dogs) that may be used to aid in official and approved monitoring procedures/protocols, or service animals (dogs) under Title II and Title III of the American with Disabilities Act. | Applicable | Consistent | Consistent with BRTR Measure BIO-10. |
| | | ● All construction materials will be visually checked for the presence of wildlife prior to their movement or use. Any wildlife encountered during the course of these inspections will be allowed to leave the construction area unharmed. | Applicable | Inconsistent | BIO-33 says vehicles should be inspected for presence of desert tortoise before moving but does not mention inspection for other wildlife. Consistent with BRTR Measure BIO-11 (wildlife encountered during construction allowed to leave unharmed). |
| | | ● All steep-walled trenches or excavations used during the project will be covered, except when being actively used, to prevent entrapment of wildlife. If trenches cannot be covered, they will be constructed with escape ramps, following up-to-date design standards to facilitate and allow wildlife to exit, or wildlife exclusion fencing will be installed around the trench(s) or excavation(s). Open trenches or other excavations will be inspected by a designated biologist immediately before backfilling, excavation. or other earthwork. | Applicable | Consistent | Consistent with BRTR Measure BIO-11 (backfilling, sloping or covering trenches). |
| | | ● Minimize natural vegetation removal through implementation of crush and drive or cut or mow vegetation rather than removing entirely. | Applicable | Consistent | Consistent with BRTR Measure BIO-25 (drive and crush vegetation as an alternative to blading of roads to preserve the seed bank). |
| | **LUPA-BIO-15** | Use state-of-the-art, as approved by BLM, construction and installation techniques, appropriate for the specific activity/project and site, that minimize new site disturbance, soil erosion and deposition, soil compaction, disturbance to topography, and removal of vegetation. | Applicable | Inconsistent | The Proposed Action says Alternative B of the project will minimize grading to the extent feasible via Design Element DE-1 but Alternative A has no such minimization measures. Partially consistent with BRTR Measures BIO-15 (erosion reduction techniques). |
| **Activity-Specific Bird and Bat CMAs** | **LUPA-BIO-16** | For activities that may impact Focus and BLM sensitive birds, protected by the ESA and/or Migratory Bird Treaty Act of 1918, and bat species, implement appropriate measures as per the most up-to-date BLM state and national policy and guidance, and data on birds and bats, including but not limited to activity specific plans and actions. The goal of the activity -specific bird and bat actions is to avoid and minimize direct mortality of birds and bats from the construction, operation, maintenance, and decommissioning of the specific activities. | Applicable | Consistent | The project has been designed to avoid microphyll woodlands which have the highest potential to support bird and bat species. The project has proposed several measures that are consistent with this CMA including BRTR Measures BIO-42 through BIO-46, BIO-51 through BIO-55, BIO-61, and BIO-65. |

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| **Category** | **CMA #** | **CMA Text** | **Project Applicability** | **Project Consistency.** | **Explanation** |
| | | Activity-specific measures to avoid and minimize impacts may include, but are not | Applicable | Consistent | See above |
| | | limited to: | Applicable | Consistent | See above |
| | | • Siting and designing activities will avoid high bird and bat movement areas that separate birds and bats from their common nesting and roosting sites, feeding areas, or lakes and rivers. | Applicable | Consistent | See above |
| | | • For activities that impact bird and bat Focus and BLM Special Status Species, during project siting and design, conducting monitoring of bird and bat presence as well as bird and bat use of the project site using the most current survey methods and best procedures available at the time. | Applicable | Consistent | See above |
| | | • Reusing or co-locating new transmission facilities and other ancillary facilities with existing facilities and disturbed areas to reduce habitat destruction and avoid additional collision risks. | Applicable | Consistent | See above |
| | | • Reducing bird and bat collision hazards by utilizing techniques such as unguyed monopole towers or tubular towers. Where the use of guywires is unavoidable, demarcate guywires using the best available methods to minimize avian species strikes. | Applicable | Consistent | See above |
| | | • When fencing is necessary, use bird and bat compatible design standards. | Applicable | Consistent | See above |
| | | • Using lighting that does not attract birds and bats or their prey to project sites including using non-steady burning lights (red, dual red and white strobe, strobe- like flashing lights) to meet Federal Aviation Administration requirements, using motion or heat sensors and switches to reduce the time when lights are illuminated, using appropriate shielding to reduce horizontal or skyward illumination, and avoiding the use of high-intensity lights (e.g., sodium vapor, quartz, and halogen). | Applicable | Consistent | See above |
| | | • Implementing a robust monitoring program to regularly check for wildlife carcasses, document the cause of mortality, and promptly remove the carcasses. | Applicable | Consistent | See above |
| | | • Incorporating a bird and bat use and mortality monitoring program during operations using current protocols and best procedures available at time of monitoring | Applicable | Consistent | See above |
| **Activity-Specific Bird and Bat CMAs** | **LUPA-BIO-17** | For activities that may result in mortality to Focus and BLM Special–Status bird and bat species, a Bird and Bat Conservation Strategy (BBCS) will be prepared with the goal of assessing operational impacts to bird and bat species and incorporating methods to reduce documented mortality. The BBCS actions for impacts to birds and bats during these activities will be determined by the activity-specific bird and bat operational actions. The strategy shall be approved by BLM in coordination with USFWS, and CDFW as appropriate, and may include, but is not limited to: | Applicable | Consistent | Consistent with BRTR Measure BIO-55; see below |
| | | • Incorporating a bird and bat use and mortality monitoring program during operations using current protocols and best procedures available at time of monitoring. | Applicable | Consistent | Consistent with BRTR Measure BIO-55 (which identifies mortality management). |
| | | • Activity-specific operational avoidance and minimization actions that reduce the level of mortality on the populations of bird and bat species, such as: | Applicable | Consistent | Consistent with BRTR Measure BIO-55 (which identifies avoidance and minimization measures). |
| | | o Use techniques that minimize attraction of birds to hazardous situations that are mistaken to be or simulate natural habitats (e.g., bodies of water). | Applicable | Consistent | See above |
| | | o Implement operational management techniques that minimize impacts to migratory birds during diurnal and seasonal cycles (e.g., positioning of heliostats to decrease surface area exposed to avian species). | Applicable | Consistent | See above |
| | | o Evaluation and installation of the best available bird and bat detection and deterrent technologies available at the time of construction. | Applicable | Consistent | See above |
| | | Known important Focus and BLM Special Status bird areas are: | Not applicable | | None of these Focus and BLM Special Status Bird areas are in the Crimson Solar Project region. |
| | | • Dry lakes and playas of the north Mojave region, which include China Lake, Koehn Lake, Harper Lake, and Searles Lake (as shown in the Audubon Important Bird Areas in Appendix D) | Not applicable | | See above |
| | | • Antelope Valley (as shown in the Audubon Important Bird Areas in Appendix D) | Not applicable | | See above |
| | | • Lower Colorado River Valley (as shown in the Audubon Important Bird Areas in Appendix D) | Not applicable | | See above |
| | | • The Salton Sea and bordering areas including agricultural land of the Imperial Valley (as shown in the Audubon Important Bird Areas in Appendix D) | Not applicable | | See above |
| | | • Documented avian movement corridors along the north slope of the San Gabriel and San Bernardino mountain ranges | Not applicable | | See above |
| | | • Other regionally important seasonal use areas and migratory corridors identified in future studies or otherwise documented in the scientific literature over the term of the LUPA | Not applicable | | See above |
| | | The following provides the DRECP vegetation type, and Focus and BLM Special Status Species biological CMAs to be implemented throughout the LUPA Decision Area. | Not applicable | | See above |
| | | **Riparian and Wetland Vegetation Types and Associated Species (RIPWET)** | Applicable | Consistent | The Applicant has avoided all major drainages with microphyll woodlands and applied a 200-foot buffer around all microphyll woodlands regardless of vegetation classification, except for minor incursions from the linear features. Consistent with BRTR Measures BIO-20 and BIO-21. |
| | | Riparian Vegetation Types | Applicable | Consistent | See above |
| | | • Madrean Warm Semi-Desert Wash Woodland/Scrub | Applicable | Consistent | See above |
| | | • Mojavean Semi-Desert Wash Scrub | Applicable | Consistent | See above |

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| Category | CMA # | CMA Text | Project Applicability | Project Consistency. | Explanation |
| | | • Sonoran-Coloradan Semi-Desert Wash Woodland/Scrub | Applicable | Consistent | See above |
| | | • Southwestern North American Riparian Evergreen and Deciduous Woodland | Applicable | Consistent | See above |
| | | • Southwestern North American Riparian/Wash Scrub | Applicable | Consistent | See above |
| | | Wetland Vegetation Types | Not applicable | Consistent | None of these wetland species are present in the RE Crimson Solar Project Permitting Boundary. |
| | | • Arid west freshwater emergent marsh | Not applicable | | See above |
| | | • Californian Warm Temperate Marsh/Seep | Not applicable | | See above |
| | | • North American Warm Desert Alkaline Scrub and Herb Playa and Wet Flat | Not applicable | | See above |
| | | • Southwestern North American Salt Basin and High Marsh | Not applicable | | See above |
| | | Riparian and Wetland Bird Focus Species | Not applicable | | None of these bird species are present in the RE Crimson Solar Project Permitting Boundary. |
| | | • Willow Flycatcher | Not applicable | | See above |
| | | • Southwestern Willow Flycatcher | Not applicable | | See above |
| | | • Least Bell's Vireo | Not applicable | | See above |
| | | • Western Yellow-billed Cuckoo | Not applicable | | See above |
| | | • Yuma Clapper Rail | Not applicable | | See above |
| | | • California Black Rail | Not applicable | | See above |
| | | • Tricolored Blackbird | Not applicable | | See above |
| | | Fish Focus Species | Not applicable | | None of these fish species are present in the RE Crimson Solar Project Permitting Boundary. |
| | | • Desert pupfish | Not applicable | | See above |
| | | • Mohave Tui Chub | Not applicable | | See above |
| | | • Owens Tui Chub | Not applicable | | See above |
| | | • Owens Pupfish | Not applicable | | See above |
| **Other Riparian & Wetland Focus Species: Tehachapi Slender Salamander** | **LUPA-BIO-RIPWET-1** | The riparian and wetland DRECP vegetation types and other features listed in **Table 17** will be avoided to the maximum extent practicable, except for allowable minor incursions (see Glossary of Terms for "avoidance to the maximum extent practicable" and "minor incursion") with the specified setbacks. | Applicable | Consistent | The Applicant has avoided all major drainages with microphyll woodlands and applied a 200-foot buffer around all microphyll woodlands regardless of vegetation classification, except for minor incursions from the linear features. Consistent with BRTR Measures BIO-20 (avoiding mature trees and minimizing impacts to drainage) and BIO-21 (200-foot buffer). |
| | | For minor incursion (see "minor incursion" in the Glossary of Terms) to the DRECP riparian vegetation types, wetland vegetation types, or encroachments on the setbacks listed in **Table 17**, the hydrologic function of the avoided riparian or wetland communities will be maintained. | Applicable | Consistent | See above |
| | | • Minor incursions in the riparian and wetland vegetation types or other features including the setbacks listed in **Table 17** will occur outside of the avian nesting season, February 1 through August 31 or otherwise determined by BLM, USFWS and CDFW if the minor incursion(s) is likely to result in impacts to nesting birds. | Applicable | Consistent | See above |
| | **LUPA-BIO-RIPWET-2** | Hydrologic function of the following DRECP vegetation types will be maintained: North American Warm Desert Alkaline Scrub and Herb Playa and Wet Flat, Southwestern North American Salt Basin and High Marsh, and other undifferentiated wetland-related land covers (i.e., "Playa," "Wetland," and "Open Water"). | Not applicable | | These DRECP veg types are not present in the project site. |
| **BLM Special Status Riparian Bird Species** | **LUPA-BIO-RIPWET-3** | For activities that occur within 0.25 mile of a riparian or wetland DRECP vegetation type and may impact BLM Special Status riparian and wetland birds species, conduct a pre-construction/activity nesting bird survey for BLM Special Status riparian and wetland birds according to agency-approved protocols. | Applicable | Consistent | No BLM Special-Status riparian and wetland bird species are known to nest in the microphyll woodland between the RE Crimson Permitting Boundary. Therefore a 0.25 mile setback is not necessary. Consistent with BRTR Measures BIO-51 and BIO-65 that require nesting bird surveys to be conducted prior to vegetation clearing if conducted during the nesting bird season. |
| | | • Based on the results of the nesting bird survey above, setback activities that are likely to impact BLM Special Status riparian and wetland bird species, including but not limited to pre-construction, construction and decommissioning, 0.25 mile from active nests Special Status during the breeding season (February 1 through August 31 or otherwise determined by BLM, USFWS and CDFW). For activities in areas covered by this provision that occur during the breeding season and that last longer than one week, nesting bird surveys may need to be repeated, as determined by BLM, in coordination with USFWS and CDFW, as appropriate. No pre-activity nesting bird surveys are necessary for activities occurring outside of the breeding season. | Applicable | Consistent | See above |

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| **Category** | **CMA #** | **CMA Text** | **Project Applicability** | **Project Consistency.** | **Explanation** |
| **Federally Listed Fish Species** | **LUPA-BIO-RIPWET-4** | Setback pre-construction, construction, and decommissioning activities and other activities that may impact federally listed fish species, 0.25 mile from the edge of existing or newly discovered occurrences of federally listed fish species, except for minor incursions (see Glossary of Terms). | Not applicable | | According to Table 4-4 of the BRTR, no special-status fish are identified as having the potential to occur on the project site. |
| | | • Demonstrate neutral or beneficial long-term hydrologic effects on federally listed fish species and the adjoining riparian and wetland habitat prior to seeking authorization for and commencing a minor incursion. | Not applicable | | See above |
| | **LUPA-BIO-RIPWET-5** | Site and design activities to fully avoid operational impacts to existing and newly discovered occurrences of federally listed fish species. | Not applicable | | According to Table 4-4 of the BRTR, no special-status fish are identified as having the potential to occur on the project site. |
| **Tehachapi Slender Salamander** | **LUPA-BIO-RIPWET-6** | Avoid pre-construction, construction, and decommissioning activities or other activities that may impact the Tehachapi slender salamander within 0.25 mile of existing or newly discovered occurrences of or suitable habitat for Tehachapi slender salamander, except for minor incursions (see Glossary of Terms). | Not applicable | | According to Table 4-4 of the BRTR, the Tehachapi slender salamander does not have the potential to occur on the project site. |
| | **LUPA-BIO-RIPWET-7** | Construct culverts or other suitable below-grade crossings for new or improved roadways that bisect suitable habitat for the Tehachapi Slender Salamander. | Not applicable | | According to Table 4-4 of the BRTR, the Tehachapi slender salamander does not have the potential to occur on the project site. |
| | | • Construct barriers to reduce at-grade crossings along new or improved roadways that bisect suitable habitat. | Not applicable | | See above |
| **Dune DRECP Vegetation Types, Aeolian Processes and Associated Species (DUNE): Aeolian Processes** | **LUPA-BIO-DUNE-1** | Because DRECP sand dune vegetation types and Aeolian sand transport corridors are, by definition, shifting resources, activities that potentially occur within or bordering the sand dune DRECP vegetation types and/or Aeolian sand transport corridors must conduct studies to verify the location [refer to Appendix D, Figure D-7] and extent of the sand resource(s) for the activity-specific environmental analysis to determine: | Applicable | Consistent | A sand transport study (prepared in April 2018) concluded that mitigation may be necessary to avoid project impacts to Aeolian sands, especially in the Mule SMZ. |
| | | • Whether the proposed activity(s) occur within a sand dune or an Aeolian sand transport corridor | Applicable | Consistent | See above |
| | | • If the activity(s) is subject to dune/Aeolian sand transport corridor CMAs | Applicable | Consistent | See above |
| | | • If the activity(s) needs to be reconfigured to satisfy applicable avoidance requirements | Applicable | Consistent | See above |
| | **LUPA-BIO-DUNE-2** | Activities that potentially affect the amount of sand entering or transported within Aeolian sand transport corridors will be designed and operated to: | Applicable | Inconsistent | The project has been designed to avoid active sand dune areas. However, a sand transport study (prepared in April 2018) concluded that mitigation may be necessary to avoid project impacts to Aeolian sands, especially in the Mule SMZ. BRTR Measures BIO-47 and BIO-48 talk about compensation for impacts to Mojave fringe-toed lizard dune habitat. However, no mitigation directly for protecting Aeolian sand has been proposed. |
| | | • Maintain the quality and function of Aeolian transport corridors and sand deposition zones, unless related to maintenance of existing [at the time of the DRECP LUPA ROD] facilities/operations/activities | Applicable | Inconsistent | See above |
| | | • Avoid a reduction in sand-bearing sediments within the Aeolian system | Applicable | Inconsistent | See above |
| | | • Minimize mortality to DUNE associated Focus and BLM Special Status Species | Applicable | Inconsistent | See above |
| | **LUPA-BIO-DUNE-3** | Any facilities or activities that alter site hydrology (e.g., sediment barrier) will be designed to maintain continued sediment transport and deposition in the Aeolian corridor in a way that maintains the Aeolian sorting and transport to downwind deposition zones. Site designs for maintaining this transport function must be approved by BLM in coordination with USFWS and CDFW as appropriate. | Applicable | Inconsistent | The project has been designed to avoid active sand dune areas. However, a sand transport study (prepared in April 2018) concluded that mitigation may be necessary to avoid project impacts to Aeolian sands, especially in the Mule SMZ. BRTR Measures BIO-47 and BIO-48 talk about compensation for impacts to Mojave fringe-toed lizard dune habitat. However, no mitigation directly for protecting Aeolian sand has been proposed. |
| **Mohave Fringe-Toed Lizard** | **LUPA-BIO-DUNE-4** | Dune formations and other sand accumulations (i.e., sand ramps, sand sheets) with suitable habitat characteristics for the Mojave fringe-toed lizard (i.e., unconsolidated blow-sand) will be mapped according to mapping standards established by the BLM National Operations Center. | Applicable | Consistent | The project has been designed to pull away from and avoid active Aeolian sand dune areas and to pull away from areas with the highest density of Mojave fringe-toed lizards. |
| | | For minor incursions (see "minor incursion" in the Glossary of Terms) into sand dunes and sand transport areas the activity will be sited in the mapped zone with the least impacts to sand dunes and sand transport and Mojave fringe-toed lizards. | Applicable | Consistent | See above |
| | **LUPA-BIO-DUNE-5** | If suitable habitat characteristics are identified during the habitat assessment, clearance surveys (see Glossary of Terms) for Mojave fringe-toed lizard will be performed in suitable habitat areas. | Applicable | Consistent | Specific clearance surveys for Mojave fringe-toed lizards are not proposed; however, through biological monitoring, the species will be moved out of harm's way during site clearing, grubbing, and grading. Consistent with BRTR Measure BIO-4. |
| | | The following CMAs will be implemented for bat Focus and BLM Special Status Species, including but not limited to those listed below: | Applicable | Consistent | CA leaf-nosed bat and pallid bat both detected during surveys. Townsend's big-eared bat was not detected but has a high probability of being on the project site. Consistent with BRTR Measure BIO-55. |
| | | • California Leaf-nosed Bat | Applicable | Consistent | See above |

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| **Category** | **CMA #** | **CMA Text** | **Project Applicability** | **Project Consistency.** | **Explanation** |
| | | ● Pallid Bat | Applicable | Consistent | See above |
| | | ● Townsend's Big-eared Bat | Applicable | Consistent | See above |
| **Bat Species (BAT)** | **LUPA-BIO-BAT-1** | Activities, except wind projects, will not be sited within 500 feet of any occupied maternity roost or presumed occupied maternity roost as described below. Refer to CMA **DFA-VPL-BIO-BAT-1** for distances within DFAs and VPLs. | Applicable | Consistent | Although BRTR Measure BIO-55 discusses a Bird and Bat Conservation Strategy, bats are not expected to roost on the project site given the lack of suitable roosting areas. |
| | **LUPA-BIO-BAT-2** | Mines will be assumed to be occupied bat roosts, unless appropriate surveys for bat use have been conducted during all seasons (including maternity, lekking or swarming, and winter use). Mines not considered potential bat roosts are only those that have no structure/workings (adits or shafts or crevices out of view). | Not applicable | | There are no mines within the RE Crimson Permitting Boundary or within 500 feet. |
| | | The following CMAs will be implemented for all plant Focus and BLM Special Status Species, including but not limited to those listed below | Not applicable | | None of the plant species listed here were identified on the project site. |
| | | ● Alkali mariposa-lily | Not applicable | | See above |
| | | ● Bakersfield cactus | Not applicable | | See above |
| | | ● Barstow woolly sunflower | Not applicable | | See above |
| | | ● Desert cymopterus | Not applicable | | See above |
| | | ● Little San Bernardino Mountains linanthus | Not applicable | | See above |
| | | ● Mojave monkeyflower | Not applicable | | See above |
| | | ● Mojave tarplant | Not applicable | | See above |
| | | ● Owens Valley checkerbloom | Not applicable | | See above |
| | | ● Parish's daisy | Not applicable | | See above |
| | | ● Triple-ribbed milk-vetch | Not applicable | | See above |
| **Plant Species (PLANT): Plant Focus and BLM Special Status Species CMAs** | **LUPA-BIO-PLANT-1** | Conduct properly timed protocol surveys in accordance with the BLM's most current (at time of activity) survey protocols for plant Focus and BLM Special Status Species. | Applicable | Consistent | The most recent focused botanical surveys were completed in spring 2017 and results are included in the BRTR. |
| | **LUPA-BIO-PLANT-2** | Implement an avoidance setback of 0.25 mile for all Focus and BLM Special Status Species occurrences. Setbacks will be placed strategically adjacent to occurrences to protect ecological processes necessary to support the plant Species (see Appendix Q, Baseline Biology Report, in the Proposed LUPA and Final EIS [2015], or the most recent data and modeling). | Applicable | Inconsistent | There are multiple species that occur onsite that are identified as Focus or Special Status Species, but there is no mention of setbacks of 0.25 mile (over 1,000 feet) for these species. |
| | **LUPA-BIO-PLANT-3** | Impacts to suitable habitat for Focus and BLM Special Status plant species should be avoided to the extent feasible, and are limited [capped] to a maximum of 1% of their suitable habitat throughout the entire LUPA Decision Area. The baseline condition for measuring suitable habitat is the DRECP modeled suitable habitat for these species utilized in the EIS analysis (2014 and 2015), or the most recent suitable habitat modeling. | Not applicable | | None of the plant species listed in Table 23 occur within the RE Crimson Permitting Boundary. |
| | | ● For those plants with Species Specific DFA Suitable Habitat Impact Caps listed in Table 23, those caps apply in the DFAs only. Refer to CMA DFA-PLANT-1. | Not applicable | | See above |
| **Special Vegetation Features (SVF)** | **LUPA-BIO-SVF-1** | For activity-specific NEPA analysis, a map delineating potential sites and habitat assessment of the following special vegetation features is required: Yucca clones, creosote rings, Saguaro cactus, Joshua tree woodland, microphyll woodland, Crucifixion thorn stands. BLM guidelines for mapping/surveying cactus, yuccas, and succulents shall be followed. | Applicable | Consistent | Site surveys were completed in 2010-2017 and a figure of the mapped microphyll woodland is included in the BRTR. |
| | **LUPA-BIO-SVF-2** | Yucca clones larger than 3 meters in diameter (longest diameter if the clone forms an ellipse rather than a circular ring) shall be avoided. | Not applicable | | Protocol surveys were already performed and no yucca clones were found within the RE Crimson Permitting Boundary. |
| | **LUPA-BIO-SVF-3** | Creosote bush rings (see Glossary of Terms) larger than 5 meters in diameter (longest diameter if the "ring" forms an ellipse rather than a circle) shall be avoided. | Not applicable | | There are no creosote bush rings within the RE Crimson Permitting Boundary. |
| | **LUPA-BIO-SVF-4** | Saguaro cactus should be managed in such a way as to provide long-term habitat for the California populations not just individual plants, except in DFAs. | Not applicable | | Protocol surveys were already performed for the Crimson Solar Project and no saguaro cactus were found within the RE Crimson Permitting Boundary. |
| | **LUPA-BIO-SVF-5** | Joshua tree woodland (*Yucca brevifolia* Woodland Alliance): impacts to Joshua tree woodlands (see Glossary of Terms) will be avoided to the maximum extent practicable (see Glossary of Terms), except for minor incursions (see Glossary of Terms). | Not applicable | | Protocol surveys were already performed for the Crimson Solar Project and no Joshua tree woodlands were found within the RE Crimson Permitting Boundary. |
| | **LUPA-BIO-SVF-6** | Microphyll woodland: impacts to microphyll woodland (see Glossary of Terms) will be avoided, except for minor incursions (see Glossary of Terms). | Applicable | Consistent | The RE Crimson Solar Project has avoided all microphyll woodlands to the greatest extent feasible apart from minor incursions where the linear features cross microphyll woodlands.<br>Consistent with BRTR Measures BIO-20 and BIO-21. |
| | **LUPA-BIO-SVF-7** | Crucifixion thorn stands: (*Castela emoryi* Shrubland Special Stands) Crucifixion thorn stands with greater than 100 individuals will be avoided. | Not applicable | | Protocol surveys were already performed for the Crimson Solar Project and no crucifixion thorn stands were found within the RE Crimson Permitting Boundary |

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| **Category** | **CMA #** | **CMA Text** | **Project Applicability** | **Project Consistency.** | **Explanation** |
| **General Vegetation Management (VEG)** | **LUPA-BIO-VEG-1** | Management of cactus, yucca, and other succulents will adhere to current up-to-date BLM policy. | Applicable | Inconsistent | There is no BRTR measure text stating how cactus, yucca, and other succulents will be managed. |
| | **LUPA-BIO-VEG-2** | Promote appropriate levels of dead and downed wood on the ground, outside of campground areas, to provide wildlife habitat, seed beds for vegetation establishment, and reduce soil erosion, as determined appropriate on an activity-specific basis. | Applicable | Inconsistent | BRTR says this is not applicable. However, the RE Crimson Permitting Boundary contains 1.24 acres of CDFW riparian woodland; some microphyll woodland areas and riparian woodlands could be disturbed. There is no mitigation pertaining to keeping dead and downed wood on the ground. This could be applicable for restoration of riparian/microphyll woodlands should they be disturbed by construction. |
| | **LUPA-BIO-VEG-3** | Allow for the collection of plant material consistent with the maintenance of natural ecosystem processes. | Not Applicable | | Once construction is complete, plant material collection to maintain natural ecosystem processes would not be applicable on the site. |
| | **LUPA-BIO-VEG-4** | Within the Bishop Field Office area, provide yearlong protection of endangered, threatened, candidate, and sensitive plant and animal habitats. Yearlong protection means that no discretionary actions which would adversely affect target resources will be allowed. | Not applicable | | The project site is not near the Bishop Field Office. |
| | **LUPA-BIO-VEG-5** | All activities will follow applicable BLM state and national regulations and policies for salvage and transplant of cactus, yucca, other succulents, and BLM Sensitive plants. | Applicable | Inconsistent | There are no BLM sensitive plant species within the RE Crimson Permitting Boundary that would require salvage and transport. There is no BRTR measure text stating how cactus, yucca, and other succulents will be salvaged and transplanted. |
| | **LUPA-BIO-VEG-6** | BLM may consider disposal of succulents through public sale, as per current up-to-date state and national policy. | Applicable | Inconsistent | There is no BRTR measure text stating how BLM may consider disposal of succulents through public sale. |
| **Individual Focus Species (IFS): Desert Tortoise** | **LUPA-BIO-IFS-1** | Activities within desert tortoise linkages, identified in Appendix D, that may have a negative impact on the linkage will require an evaluation, in the environmental document(s), of the effects on the maintenance of long- term viable desert tortoise populations within the affected linkage. The analysis will consider the amount of suitable habitat, including climate refugia, required to ensure long-term viability within each linkage given the linkage's population density, long-term demographic and genetic needs, degree of existing habitat disturbance/impacts, mortality sources, and most up-to-date population viability modeling. Activities that would compromise the long-term viability of a linkage population or the function of the linkage, as determined by the BLM in coordination with USFWS and CDFW, are prohibited and will require reconfiguration or re-siting. | Not applicable | | The RE Crimson Solar Project is not within a desert tortoise linkage identified on Figure D-16 in Appendix D of the DRECP LUPA. |
| | **LUPA-BIO-IFS-2** | Construction of new roads and/or routes will be avoided to the maximum extent practicable (see Glossary of Terms) within desert tortoise habitat in tortoise conservation areas (TCAs) or tortoise linkages identified in Appendix D, unless the new road and/or route is beneficial to minimize net impacts to natural or ecological resources of concern for desert tortoise. TCAs and identified linkages should have the goal of "no net gain" of road density. | Not applicable | | The RE Crimson Solar Project is not within a desert tortoise linkage or TCA identified on Figure D-16 in Appendix D of the DRECP LUPA. |
| | | Any new road considered within a TCA or identified linkage will not be paved and will be designed and sited to minimize the effect to the function of identified linkages or local desert tortoise populations and shall have a maximum speed limit of 25 miles per hour. | Not applicable | | See above |
| | | Roads requiring the installation of long-term desert tortoise exclusion fencing for construction or operation will incorporate wildlife underpasses (e.g., culverts) to reduce population fragmentation. | Not applicable | | See above |
| | **LUPA-BIO-IFS-3** | All culverts for access roads or other barriers will be designed to allow unrestricted access by desert tortoises and will be large enough that desert tortoises are unlikely to use them as shelter sites (e.g., 36 inches in diameter or larger). Desert tortoise exclusion fencing may be utilized to direct tortoise use of culverts and other passages. | Applicable | Inconsistent | The BRTR says the RE Crimson Project would install Arizona crossings or culverts across main drainage channels. However, there are no mitigation measures requiring installation of these crossings/culverts. The Proposed Action chapter mentions Arizona crossings. A design feature should be added to the proposed action to make large enough for desert tortoise passage. |
| | **LUPA-BIO-IFS-4** | In areas where protocol and clearance surveys are required (see Appendix D), prior to construction or commencement of any long-term activity that is likely to adversely affect desert tortoises, desert tortoise exclusion fencing shall be installed around the perimeter of the activity footprint (see Glossary of Terms) in accordance with the Desert Tortoise Field Manual (USFWS 2009) or most up-to- date USFWS protocol. Additionally, short-term desert tortoise exclusion fencing will be installed around short-term construction and/or activity areas (e.g., staging areas, storage yards, excavations, and linear facilities), as appropriate, per the Desert Tortoise Field Manual (USFWS 2009) or most up-to-date USFWS protocol. | Applicable | Consistent | Consistent with BRTR Measures BIO-27 and BIO-28. If wildlife-friendly fencing is implemented during operations as described by BIO-65, the Applicant would use biological monitors, which is consistent with BIO-4. The Applicant will remain consistent with this CMA and follow the USFWS 2009 protocol (the most current regulations). |
| | | • Exemption from desert tortoise protocol survey requirements can be obtained from BLM, in coordination with USFWS, and CDFW as applicable, on a case-by-case basis if a designated biologist determines the activity site does not contain the elements of desert tortoise habitat, is unviable for occupancy, or if baseline studies inferred absence during the current or previous active season. | Not applicable | | No exemption |
| | | • Construction of desert tortoise exclusion fences will occur during the time of year when tortoise are less active in order to minimize impacts and to accommodate subsequent desert tortoise surveys. Any exemption or modification of desert tortoise exclusion fencing requirements will be based on the specifics of the activity and the site-specific population and habitat parameters. Sites with low population density and disturbed, fragmented, or poor habitat are likely to be candidates for fencing requirement exemptions or modifications. Substitute measures, such as on-site biological monitors in the place of the fencing requirement, may be required, as appropriate. | Applicable | Inconsistent | BRTR Measures BIO-27 makes no mention of fencing occurring when tortoises are less active or potential fencing exemptions due to low quality areas. |

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| Category | CMA # | CMA Text | Project Applicability | Project Consistency. | Explanation |
| | | • After an area is fenced, and until desert tortoises are removed, the designated biologist is responsible for ensuring that desert tortoises are not being exposed to extreme temperatures or predators as a result of their pacing the fence. Remedies may include the use of shelter sites placed along the fence, immediate translocation, removal to a secure holding area, or other means determined by the BLM, USFWS, and CDFW, as applicable. | Applicable | Inconsistent | No mention in the BRTR measures about ensuring tortoises are not at risk while pacing the fence after the fencing activities. |
| | | • Modification or elimination of the above requirement may also be approved if the activity design will allow retention of desert tortoise habitat within the footprint. If such a modification is approved, modified protective measures may be required to minimize impacts to desert tortoises that may reside within the activity area. | Not applicable | | No elimination possible since desert tortoise habitat would not be retained |
| | | • Immediately prior to desert tortoise exclusion fence construction, a designated biologist (see Glossary of Terms) will conduct a clearance survey of the fence alignment to clear desert tortoises from the proposed fence line's path. | Applicable | Inconsistent | BRTR Measure BIO-28 says clearance surveys for desert tortoise will be conducted following installation of the fence, not immediately prior |
| | | • All desert tortoise exclusion fencing will incorporate desert tortoise proof gates or other approved barriers to prevent access of desert tortoises to work sites through access road entry points. | Applicable | Consistent | Consistent per BRTR Measure BIO-27 (desert-tortoise exclusion gates with grates shall be established at all site entry points). |
| | | • Following installation, long-term desert tortoise exclusion fencing will be inspected for damage quarterly and within 48 hours of a surface flow of water due to a rain event that may damage the fencing. | Applicable | Consistent | Consistent per BRTR Measure BIO-27 (damage inspections would occur monthly and during all major rain events) |
| | | • All damage to long-term or short-term desert tortoise exclusion fencing will be immediately blocked to prevent desert tortoise access and repaired within 72 hours. | Applicable | Consistent | Consistent per BRTR Measure BIO-27 (damage to fencing would be repaired immediately) |
| | **LUPA-BIO-IFS-5** | Following the clearance surveys (see Glossary of Terms) within sites that are fenced with long-term desert tortoise exclusion fencing a designated biologist (see Glossary of Terms) will monitor initial clearing and grading activities to ensure that desert tortoises missed during the initial clearance survey are moved from harm's way. | Applicable | Consistent | The Applicant will retain a DB to support the project. And implement applicable BRTR measures: BIO-1, BIO-2, BIO-11, and BIO-27 to BIO-31. |
| | | A designated biologist will inspect construction pipes, culverts, or similar structures: (a) with a diameter greater than 3 inches, (b) stored for one or more nights, (c) less than 8 inches aboveground and (d) within desert tortoise habitat (such as, outside the long-term fenced area), before the materials are moved, buried, or capped. | Applicable | Inconsistent | BRTR Measure BIO-33 requires inspection of construction equipment parked in unfenced tortoise habitat. However, specific text regarding inspection of construction structures meeting requirements (a) through (c) is not included in the BRTR measures as they are currently written. |
| | | As an alternative, such materials shall be capped before storing outside the fenced area or placing on pipe racks. Pipes stored within the long-term fenced area after completing desert tortoise clearance surveys will not require inspection. | Applicable | Inconsistent | Specific text regarding capping as an alternative is not included in the BRTR measures as they are currently written. |
| | **LUPA-BIO-IFS-6** | When working in areas where protocol or clearance surveys are required (see Appendix D), biological monitoring will occur with any geotechnical boring or geotechnical boring vehicle movement to ensure no desert tortoises are killed or burrows are crushed. | Applicable | Inconsistent | Specific text regarding geotechnical boring (which may be required according to the conclusions of the geotechnical report which recommends a geotechnical investigation) is not included in the BRTR measures as they are currently written. |
| | **LUPA-BIO-IFS-7** | A designated biologist (see Glossary of Terms) will accompany any geotechnical testing equipment to ensure no tortoises are killed and no burrows are crushed. | Applicable | Inconsistent | Specific text regarding geotechnical testing (which may be required according to the conclusions of the geotechnical report which recommends a geotechnical investigation) is not included in the BRTR measures as they are currently written. |
| | **LUPA-BIO-IFS-8** | Inspect the ground under the vehicle for the presence of desert tortoise any time a vehicle or construction equipment is parked in desert tortoise habitat outside of areas fenced with desert tortoise exclusion fencing. If a desert tortoise is seen, it may move on its own. If it does not move within 15 minutes, a designated biologist may remove and relocate the animal to a safe location. | Applicable | Consistent | Consistent with BRTR Measure BIO-33. |
| | **LUPA-BIO-IFS-9** | Vehicular traffic will not exceed 15 miles per hour within the areas not cleared by protocol level surveys where desert tortoise may be impacted. | Applicable | Consistent | Consistent with BRTR Measure BIO-32. |
| **Flat-Tailed Horned Lizard** | **LUPA-BIO-IFS-10** | Comply with the conservation goals and objectives, criteria, and management planning actions identified in the most recent revision of the Flat-tailed Horned Lizard Rangewide Management Strategy (RMS). Activities will include appropriate design features using the most current information from the RMS and RMS Interagency Coordinating Committee to minimize adverse impacts during siting, design, pre-construction, construction, operation, and decommissioning; ensure that current or potential linkages and habitat quality are maintained; reduce mortality; minimize other adverse impacts during operation; and ensure that activities have a neutral or positive effect on the species. | Not applicable | | The species is not present within the RE Crimson Permitting Boundary and no impacts are anticipated to occur. |
| **Bendire's Thrasher** | **LUPA-BIO-IFS-11** | If Bendire's thrasher is present, conduct appropriate activity-specific biological monitoring (see Glossary of Terms) to ensure that Bendire's thrasher individuals are not directly affected by operations (i.e., mortality or injury, direct impacts on nest, eggs, or fledglings). | Not applicable | | The species is not present within the RE Crimson Permitting Boundary and no impacts are anticipated to occur. |
| **Burrowing Owl** | **LUPA-BIO-IFS-12** | If burrowing owls are present, a designated biologist (see Glossary of Terms) will conduct appropriate activity-specific biological monitoring (see Glossary of Terms) to ensure avoidance of occupied burrows and establishment of the 656 feet (200 meter) setback to sufficiently minimize disturbance during the nesting period on all activity sites, when practical. | Applicable | Not consistent | The species is not currently present within the RE Crimson Permitting Boundary. BRTR Measures BIO-42 through BIO-46 (pre-construction surveys addressing burrowing owl occurrences) would be followed in the event that western burrowing owls are discovered within the RE Crimson Permitting Boundary at a later date. However, only a 250-foot buffer is required by BRTR Measure BIO-43 during breeding season, where as this CMA requires a 656 foot buffer during nesting period. |

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| **Category** | **CMA #** | **CMA Text** | **Project Applicability** | **Project Consistency.** | **Explanation** |
| | **LUPA-BIO-IFS-13** | If burrows cannot be avoided on-site, passive burrow exclusion by a designated biologist (see Glossary of Terms) through the use of one-way doors will occur according to the specifications in Appendix D or the most up-to-date agency BLM or CDFW specifications. Before exclusion, there must be verification that burrows are empty as specified in Appendix D or the most up-to-date BLM or CDFW protocols. Confirmation that the burrow is not currently supporting nesting or fledgling activities is required prior to any burrow exclusions or excavations. | Applicable | Consistent | Consistent with BRTR Measure BIO-42. |
| | **LUPA-BIO-IFS-14** | Activity-specific active translocation of burrowing owls may be considered, in coordination with CDFW. | Applicable | Consistent | No active translocation of burrowing owls is proposed by BRTR Measures BIO-42 through BIO-46. |
| **California Condor** | **LUPA-BIO-IFS-15** | All activities will be designed and sited in a manner to avoid or minimize the likelihood of contact, injury, and mortality of California condors. If a condor is identified at a site, the BLM biological staff and USFWS will be immediately notified for guidance. | Not applicable | | The project area is not within the California condor range. |
| | **LUPA-BIO-IFS-16** | Flight activity (e.g., surveys, construction, as well as operation and maintenance activities) related to any activities will not be allowed in the airspace extending to 3,000 feet above condor nest sites. | Not applicable | | The project area is not within the California condor range. |
| | **LUPA-BIO-IFS-17** | In the range of the California condor, structures supported by guy wires will be marked with recommended bird deterrent devices at the appropriate spacing intervals. | Not applicable | | The project area is not within the California condor range. |
| | **LUPA-BIO-IFS-18** | In the range of the California condor, all equipment and work-related materials that are potentially hazardous to condors, including but not limited to items that can be ingested, picked up, or carried away (e.g., loose-wires, open containers with fluids, some construction materials, etc.) will be kept in closed containers either in the work area or placed inside vehicles when they are not being used and at the end of every work day. | Not applicable | | The project area is not within the California condor range. |
| | **LUPA-BIO-IFS-19** | In the range of the California condor, when feasible, ethylene glycol-based anti-freeze or other ethylene glycol-based liquid substances will be avoided, and propylene glycol-based antifreeze will be used. Vehicles and equipment using ethylene glycol based substances will be inspected before and after field use as well as during storage on sites for leaks and puddles. Standing fluid will be remediated without unnecessary delay. | Not applicable | | The project area is not within the California condor range. |
| | **LUPA-BIO-IFS-20** | Activities that are determined to have a potential risk of taking condors will implement the best detect, deter, and curtailment strategy available at the time of the activity to minimize adverse effects, and avoid or minimize the likelihood of condor injury and mortality. (An example of a 2015 curtailment strategy is shutting down wind generation operations when condor(s) are present, or wind generation facilities switching to night operations only). The strategy must be approved by the BLM and USFWS, in coordination with CDFW as appropriate. | Not applicable | | The project area is not within the California condor range. |
| | **LUPA-BIO-IFS-21** | If condors begin to regularly visit a site, BLM may require, in coordination with USFWS, and CDFW as appropriate, the implementation of additional measures to minimize potential impacts to condors. These measures will be based on best available data, activity and areas specifics, and may include, but are not limited to: | Not applicable | | The project area is not within the California condor range. |
| | | • Barriers, including welded wire fabric or hardware cloth, will be installed to prevent access around any facility element that poses a danger to condors. | Not applicable | | See above |
| | | • Stainless steel lines, rather than poly chemical lines will be used to preclude condors from obtaining and ingesting pieces of poly chemical lines. | Not applicable | | See above |
| | | • Landing deterrents attached to the walking perching substrates, such as porcupine wire or Daddi Long Legs ®. | Not applicable | | See above |
| | **LUPA-BIO-IFS-22** | Operations and/or activities that reach an activity-specified trigger for condor injury and/or mortality as determined by BLM and USFWS, and CDFW as appropriate, will curtail operations and/or activities using best available techniques, as determined by BLM and USFWS, and CDFW as appropriate. (An example of a 2015 curtailment strategy is shutting down wind generation operations when condor(s) are present, or wind generation facilities switching to night operations only.) If curtailment techniques are not viable or available, then operations and/or activities will be suspended until the injury and/or condor mortality issue is resolved to the satisfaction of BLM and USFWS, and CDFW, as appropriate. | Not applicable | | The project area is not within the California condor range. |
| | **LUPA-BIO-IFS-23** | In the range of the California condor, if an activity may have an impact on California condors, a Condor Operations Strategy (COS) will be developed and implemented on a activity-specific basis in order to avoid and/or reduce the likelihood of injury and mortality from activities. The COS shall be approved by BLM in coordination with USFWS, and CDFW as appropriate for third party activities, and may include, but is not limited, to detailing specifics on: the activity-specific detect, deter and curtailment strategy; monitoring approach to detect condor use of the site; adaptive management approach if condors are found to visit the site; and, activity-specific measures that assist in the recovery of condor. | Not applicable | | The project area is not within the California condor range. |
| **Golden Eagle** | **LUPA-BIO-IFS-24** | Provide protection from loss and harassment of active golden eagle nests through the following actions: | Not applicable | | No golden eagle nests are present onsite. The closest golden eagle nest is over 5 miles away. The project site is likely to only support foraging habitat given its topography, ecology and geography. |
| | | • Activities that may impact nesting golden eagles, will not be sited or constructed within 1-mile of any active or alternative golden eagle nest within an active golden eagle territory, as determined by BLM in coordination with USFWS as appropriate. | Not applicable | | See above |
| | **LUPA-BIO-IFS-25** | Cumulative loss of golden eagle foraging habitat within a 1 to 4 mile radius around active or alternative golden eagle nests (as identified or defined in the most recent USFWS guidance and/or policy) will be limited to less than 20%. See **CONS-BIO-IFS-5** for the requirement in Conservation Lands. | Not applicable | | No golden eagle nests are present onsite. The closest golden eagle nest is over 5 miles away. |
| | **LUPA-BIO-IFS-26** | For activities that impact golden eagles, applicants will conduct a risk assessment per the applicable USFWS guidance (e.g. the Eagle Conservation Plan Guidance) using best available information as well as the data collected in the pre-project golden eagle surveys. | Not applicable | | No golden eagle nests are present onsite. The closest golden eagle nest is over 5 miles away. |

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| **Category** | **CMA #** | **CMA Text** | **Project Applicability** | **Project Consistency.** | **Explanation** |
| | **LUPA-BIO-IFS-27** | If a permit for golden eagle take is determined to be necessary, an application will be submitted to the USFWS in order to pursue a take permit. | Not applicable | | According to the BRTR, take of golden eagle is not anticipated since the nearest nest is over 5 miles away and the project site only supports golden eagle foraging habitat. According to Appendix D, the site likely had a low number of golden eagles compared to other areas given its topography, geography, and ecology. |
| | **LUPA-BIO-IFS-28** | In order to evaluate the potential risk to golden eagles, the following activities are required to conduct 2 years of pre-project golden eagle surveys in accordance with USFWS Eagle Conservation Plan Guidance as follows: | Not applicable | | See below |
| | | ● Wind projects and solar projects involving a power tower | Not Applicable | | The proposed project would include a microwave tower (absent power tower). |
| | | ● Other activities for which the BLM, in coordination with USFWS, and CDFW as appropriate, determines take of golden eagle is reasonably foreseeable or there is a potential for take of golden eagle | Not applicable | | Golden eagle surveys were conducted in 2012 and 2018. In addition, migratory bird surveys were conducted in 2012 and 2016/2017. Although USFWS prefers two consecutive years of surveys, the absence of golden eagle observations on the Project site and completion of migratory bird surveys should be sufficient. |
| | **LUPA-BIO-IFS-29** | For active nests with recreational conflicts that risk the occurrence of take, provide public notification (e.g., signs) of the sensitive area and implement seasonal closures as appropriate. | Not Applicable | | According to the BRTR, take of golden eagle is not anticipated since the nearest nest is over 5 miles away and the project site only supports golden eagle foraging habitat. According to Appendix D, the site likely had a low number of foraging golden eagles compared to other areas given its topography, geography, and ecology. |
| | **LUPA-BIO-IFS-30** | For activities where ongoing take of golden eagles is anticipated, develop advanced conservation practices per USFWS Eagle Conservation Plan Guidance. | Not applicable | | According to the BRTR, take of golden eagle is not anticipated since the nearest nest is over 5 miles away and the project site only supports golden eagle foraging habitat. According to Appendix D, the site likely had a low number of foraging golden eagles compared to other areas given its topography, geography, and ecology. |
| | **LUPA-BIO-IFS-31** | As determined necessary by BLM in coordination with USFWS, and CDFW as appropriate, for activities/projects that are likely to impact golden eagles implement site-specific golden eagle mortality monitoring in support of the pre-construction, pre-activity risk assessment surveys. | Not applicable | | According to the BRTR, take of golden eagle is not anticipated since the nearest nest is over 5 miles away and the project site only supports golden eagle foraging habitat. |
| **Swainson's Hawk** | **LUPA-BIO-IFS-32** | Avoid use of rodenticides and insecticides within five miles of active Swainson's hawk nest. | Not applicable | | According to the BRTR, the nearest known nesting site for Swainson's hawk is located in the Antelope Valley (Los Angeles and Kern Counties) and more than 5 miles away. |
| **Desert Bighorn Sheep** | **LUPA-BIO-IFS-33** | Access to, and use of, designated water sources for desert bighorn sheep will not be impeded by activities in designated and new utility corridors. | Not applicable | | As shown in Figure D-6 of Appendix D of the DRECP, the proposed project is not within the range of bighorn sheep. |
| | **LUPA-BIO-IFS-34** | Transmission projects and new utility corridors will minimize effects on access to, and use of, designated water sources for desert bighorn sheep. | Not applicable | | As shown in Figure D-6 of Appendix D of the DRECP, the proposed project is not within the range of bighorn sheep. |
| **Mohave Ground Squirrel** | **LUPA-BIO-IFS-35** | Protocol surveys (see Glossary of Terms) are required for activities in Mohave ground squirrel key population centers and linkages as indicated in Appendix D. Results of protocol surveys will be provided to BLM and CDFW to consult on, as appropriate, for third party activities. | Not applicable | | As shown in Figure D-5 of Appendix D of the DRECP, the proposed project is not within the range of the Mohave ground squirrel. |
| | **LUPA-BIO-IFS-36** | Activities in Mohave ground squirrel key population centers, as identified in Appendix D, requiring an Environmental Impact Statement are required to assess the effect of the activity on the long term function of the affected key population center. | Not applicable | | As shown in Figure D-5 of Appendix D of the DRECP, the proposed project is not within the range of the Mohave ground squirrel. |
| | | ● Activities within a key population center, as identified in Appendix D, must be designed to avoid adversely impacting the long-term function of the affected key population center. | Not applicable | | See above |
| | **LUPA-BIO-IFS-37** | Activities in key population centers will be sited in previously disturbed areas, areas of low habitat quality and in areas with low habitat intactness, to the maximum extent practicable (see Glossary of Terms). | Not applicable | | As shown in Figure D-5 of Appendix D of the DRECP, the proposed project is not within the range of the Mohave ground squirrel. |
| | **LUPA-BIO-IFS-38** | Disturbance of suitable habitat from activities, requiring an EA or EIS, within the Mohave ground squirrel key population centers and linkages (as identified in Appendix D) will not occur during the typical dormant season (August 1 through February 28) unless absence is inferred and supported by protocol surveys or other available data during the previous active season. | Not applicable | | As shown in Figure D-5 of Appendix D of the DRECP, the proposed project is not within the range of the Mohave ground squirrel. |
| | **LUPA-BIO-IFS-39** | During the typical active Mohave ground squirrel season (February 1 through August 31), conduct clearance surveys throughout the site, immediately prior to initial ground disturbance in the areas depicted in Appendix D. In the cleared areas, perform monitoring to determine if squirrels have entered cleared areas. Contain ground disturbance to within areas cleared of squirrels | Not applicable | | As shown in Figure D-5 of Appendix D of the DRECP, the proposed project is not within the range of the Mohave ground squirrel. |
| | | ● Detected occurrences of Mohave ground squirrel will be flagged and avoided, with a minimum avoidance area of 50 feet, until the squirrels have moved out of harm's way. A designated biologist (see Glossary of Terms) may also actively move squirrels out of harm's way. | Not applicable | | See above |

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| **Category** | **CMA #** | **CMA Text** | **Project Applicability** | **Project Consistency.** | **Explanation** |
| | **LUPA-BIO-IFS-40** | Activities sited in a Mohave ground squirrel linkage (see | Not applicable | | As shown in Figure D-5 of Appendix D of the DRECP, the proposed project is not within the range of the Mohave ground squirrel. |
| | | Appendix D) that may impact the linkage are required to analyze the potential effects on connectivity through the linkage. The activity must be designed to maintain the function of the linkage after construction/implementation and during project/activity operations. Linkage function will be assessed by considering pre- and post-activity ability of the area to support resident Mohave ground squirrels and provide for dispersal of their offspring to key population centers outside the linkage, and dispersal through the linkage between key population centers. | Not applicable | | See above |
| | | Activities that occur in Mohave ground squirrel linkages shown in Appendix D must be configured and located in a manner that does not diminish Mohave ground squirrel populations in the linkage. | Not applicable | | See above |
| | **LUPA-BIO-IFS-41** | For any ground-disturbing (e.g., vegetation removal, earthwork, trenching) activities, occurrences of Mohave ground squirrel will be flagged and avoided, with a minimum avoidance area of 50 feet, until the squirrels have moved out of harm's way. A designated biologist (see Glossary of Terms) may also actively move squirrels out of harm's way. | Not applicable | | As shown in Figure D-5 of Appendix D of the DRECP, the proposed project is not within the range of the Mohave ground squirrel. |
| | **LUPA-BIO-IFS-42** | Rodenticides will not be used to manage rodents on activity within the range of the Mohave ground squirrel. Use of rodenticide inside of buildings is allowed. | Not applicable | | As shown in Figure D-5 of Appendix D of the DRECP, the proposed project is not within the range of the Mohave ground squirrel. |
| **Compensation** | **LUPA-BIO-COMP-1** | Impacts to biological resources, identified and analyzed in the activity specific environmental document, from activities in the LUPA Decision Area will be compensated using the standard biological resources compensation ratio, except for the biological resources and specific geographic locations listed as compensation ratio exceptions, specifics in CMAs **LUPA-BIO-COMP-2** through **-4**, and previously listed CMAs. Compensation acreage requirements may be fulfilled through non-acquisition (i.e., restoration and enhancement), land acquisition (i.e., preserve), or a combination of these options, depending on the activity specifics and BLM approval/authorization. | Applicable | Consistent | Of the species listed in Table 18, only desert tortoise would require habitat compensation. |
| | | Compensation for the impacts to designated desert tortoise critical habitat will be in the same critical habitat unit as the impact (see Table 18). Compensation for impacts to desert tortoise will be in the same recovery unit as the impact. | Applicable | Consistent | The Applicant anticipates that compensatory mitigation will be required for desert tortoise occupied habitat. BRTR Measure BIO-41 details desert tortoise compensation. |
| | | Refer to CMA **LUPA-COMP-1** and **2** for the timing requirements for initiation or completion of compensation. | - | - | - |
| | **LUPA-BIO-COMP-2** | Birds and Bats – The compensation for the mortality impacts to bird and bat Focus and BLM Special Status Species from activities will be determined based on monitoring of bird and bat mortality and a fee re-assessed every 5 years to fund compensatory mitigation. The initial compensation fee for bird and bat mortality impacts will be based on pre-project monitoring of bird use and estimated bird and bat species mortality from the activity. The approach to calculating the operational bird and bat compensation is based on the total replacement cost for a given resource, a Resource Equivalency Analysis. This involves measuring the relative loss to a population (debt) resulting from an activity and the productivity gain (credit) to a population from the implementation of compensatory mitigation actions. The measurement of these debts and gains (using the same "bird years" metric as described in Appendix D) is used to estimate the necessary compensation fee. | Applicable | Inconsistent | BRTR Measure BIO-55 requires a Bird and Bat Conservation Strategy that includes monitoring methods. However, compensation measures are never mentioned in the Measure (only conservation). We should add compensation information to this Measure. |
| | | Each activity, as determined appropriate by BLM in coordination with USFWS, and CDFW as applicable, will include a monitoring strategy to provide activity-specific information on mortality effects on birds and bats in order to determine the amount and type of compensation required to offset the effects of the activity, as described above and in detail in Appendix D. Compensation will be satisfied by restoring, protecting, or otherwise improving habitat such that the carrying capacity or productivity is increased to offset the impacts resulting from the activity. Compensation may also be satisfied by non-restoration actions that reduce mortality risks to birds and bats (e.g., increased predator control and protection of roosting sites from human disturbance). Compensation will be consistent with the most up to date DOI mitigation policy. | Applicable | Inconsistent | Same comment as above |
| | **LUPA-BIO-COMP-3** | Golden eagle – BLM and third-party initiated activities, will provide specific golden eagle compensation in accordance with the most up to date BLM or USFWS policies, including applicable USFWS Eagle Conservation Plan Guidance. | Not applicable | | The BRTR says "habitat compensation for resource impacts for other species would also provide permanent protection for golden eagle foraging habitat." No anticipated golden eagle impacts. The habitat conservation for other resources will also benefit GOEA but not as mitigation, more as a secondary benefit. |
| | **LUPA-BIO-COMP-4** | Golden eagle – Third-party applicant/activity proponents are required to contribute to a DRECP-wide golden eagle monitoring program, if the activity/project(s) has been determined, through the environmental analysis, to likely impact golden eagles. | Not applicable | | See above comment. |
| Air Resources | LUPA-AIR-1 | All activities must meet the following requirements: | | | |
| | | • Applicable National Ambient Air Quality Standards (Section 109) | Applicable | Inconsistent | Short-term construction emissions of the Proposed Action or alternative would each exceed maximum daily standards, which would potentially contribute to exceedances of NAAQS, even with implementation of Mitigation Measures AQ-A through AQ-D. However, operation of the Project would not exceed standards, and would be consistent. |
| | | • State Implementation Plans (Section 110) | Applicable | Consistent | Consistent because project annual emissions would not exceed any de minimis thresholds for non-attainment pollutants, for which SIPs are prepared . |

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| Category | CMA # | CMA Text | Project Applicability | Project Consistency. | Explanation |
| | | ● Control of Pollution from Federal Facilities (Section 118) including non-point source | Not applicable | | |
| | | ● Prevention of Significant Deterioration, including visibility impacts to mandatory Federal Class I Areas (Section 160 et seq.) | Not applicable | | |
| | | ● Conformity Analyses and Determinations (Section 176[c]) | Applicable | Consistent | The Proposed Action would conform to the SIP, therefore, BLM is exempt from performing a formal conformity determination. |
| | | ● Apply best management practices on a case by case basis | Applicable | Consistent | The Proposed Action would include construction BMPs to reduce construction emissions including fugitive dust. |
| | | ● Applicable local Air Quality Management Jurisdictions (e.g., 403 SCAQMD) | Applicable | Consistent | The Proposed Action would comply with all construction-related MDAQMD rules and regulations. |
| | LUPA-AIR-2 | Because project authorizations are a federal undertaking, air quality standards for fugitive dust may not exceed local standards and requirements. | Applicable | Consistent | The Proposed Action would comply with all construction-related MDAQMD rules and regulations. |
| | LUPA-AIR-3 | Where impacts to air quality may be significant under NEPA, requiring analysis through an Environmental Impact Statement, require documentation for activities to include a detailed discussion and analysis of Ambient Air Quality conditions (baseline or existing), National Ambient Air Quality Standards, criteria pollutant nonattainment areas, and potential air quality impacts of the proposed project (including cumulative and indirect impacts and greenhouse gas emissions). This content is necessary to disclose the potential impacts from temporary or cumulative degradation of air quality. The discussion will include a description and estimate of air emissions from potential construction and maintenance activities, and proposed mitigation measures to minimize net $PM_{10}$ and $PM_{2.5}$ emissions. The documentation will specify the emission sources by pollutant from mobile sources, stationary sources, and ground disturbance. A Construction Emissions Mitigation Plan will be developed. | Applicable | Consistent | All required documentation, discussion, and analysis is provided in this EIS/EIR. |
| | LUPA-AIR-4 | Because fugitive dust is the number one source of $PM_{10}$ and $PM_{2.5}$ emissions in the Mojave and Sonoran Deserts, fugitive dust impacts to air quality must be analyzed for all activities/projects requiring an Environmental Impact Statement and Environmental Assessment. | Applicable | Consistent | Fugitive Dust impacts are analyzed in this EIR/EIS. |
| | | ● The NEPA air quality analysis may include modelling of the sources of PM10 and PM2.5 that occur prior to construction and/or ground disturbance from the activity/project, and show the timing, duration and transport of emissions off site. When utilized, the modeling will also identify how the generation and movement of PM10 and PM2.5 will change during and after construction and/or ground disturbance of the activity/project under all activity/project specific NEPA alternatives. The BLM air resource specialist and Authorizing Officer will determine if modelling is required as part of the NEPA analysis based on estimated types and amounts of emissions. | Applicable | Consistent | Consistent through this EIS/EIR |
| | LUPA-AIR-5 | A fugitive Dust Control Plan will be developed for all projects where the NEPA analysis shows an impact on air quality from fugitive dust. | Applicable | Consistent | A fugitive Dust Control Plan is discussed in this EIS/EIR. |
| | | ***II.4.2.1.3 Comprehensive Trails and Travel Management*** | | | |
| | | **Components of a Designated Travel Network** | | | |
| | | In 2006, the BLM issued Instruction Memorandum No. 2006-173, which established policy for the use of terms and definitions associated with the management of transportation-related linear features. It also set a data standard and a method for storing electronic transportation asset data. According to the memorandum, all transportation assets are defined as follows: | Applicable | Consistent | The project site would include an existing paved Power Line road but would maintain the road area for project use. |
| | | ● Road: A linear route declared a road by the owner, managed for use by low-clearance vehicles having four or more wheels, and maintained for regular and continuous use. These may include ROW roads granted by the BLM to other entities. | Not applicable | | This is a definition and does not contain a policy or requirement. |
| | | ● Primitive Road: A linear route managed for use by four-wheel drive or high-clearance vehicles. These routes do not normally meet any BLM road design standards. | Not applicable | | This is a definition and does not contain a policy or requirement. |
| | | ● Trail: A linear route managed for human-powered, stock, or OHV forms of transportation or for historical or heritage values. Trails are not generally managed for use by four-wheel drive or high-clearance vehicles. | Not applicable | | This is a definition and does not contain a policy or requirement. |
| | | Designated Roads, Primitive Roads, and Trails are categorized as follows: | Not applicable | | This is a definition and does not contain a policy or requirement. |
| | | ● Tier 1: Roads and Primitive Roads with high values for commercial, recreational, casual uses, and/or to provide access to other recreation activities. | Not applicable | | This is a definition and does not contain a policy or requirement. |
| | | ● Tier 2: Roads and Primitive Roads with high values for recreation and other motorized access (i.e., important through routes). | Not applicable | | This is a definition and does not contain a policy or requirement. |
| | | ● Tier 3: Primitive Roads and Trails with high value for motorized and non-motorized recreational pursuits (i.e., spur routes). | Not applicable | | This is a definition and does not contain a policy or requirement. |
| | | **Off-Highway Vehicle Management** | | | |
| | | OHVs are synonymous with off-road vehicles. As defined in 43 CFR 8340.0-5 (a): Off-road vehicle means any motorized/battery-powered vehicle capable of, or designed for, travel on or immediately over land, water, or other natural terrain. | Not applicable | | This is a definition and does not contain a policy or requirement. |
| | | In accordance with 43 CFR 8342.1, the BLM's regulations for OHV management, "the authorized officer shall designate all public lands as open, limited, or closed to [OHVs]." As such, all public lands within the Planning Area have been designated in one of three OHV designation categories, as follows: | Applicable | Consistent | Consistent with Mitigation Measure REC-1 (requires notification of penalties for any off-route OHV activities to deter off-route travel). |

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| Category | CMA # | CMA Text | Project Applicability | Project Consistency. | Explanation |
| | | ● Open Area Designations are used for intensive OHV or other transportation use areas where there are no special restrictions or where there are no compelling resource protection needs, user conflicts, or public safety issues to warrant limiting cross-country travel. | Not applicable | | This is a definition and does not contain a policy or requirement. |
| | | ● Limited Area Designations are used where travel must be restricted to meet specific resource/resource use objectives. For areas classified as limited, the BLM must consider a range of possibilities, including travel that will be limited to the following: | Not applicable | | This is a definition and does not contain a policy or requirement. |
| | | o Types or modes of travel, such as foot, equestrian, bicycle, and motorized | Not applicable | | This is a definition and does not contain a policy or requirement. |
| | | o Existing roads and trails | Not applicable | | This is a definition and does not contain a policy or requirement. |
| | | o Time or season of use; limited to certain types of vehicles (OHVs, motorcycles, all-terrain vehicles, high clearance, etc.); limited to licensed or permitted vehicles or use | Not applicable | | This is a definition and does not contain a policy or requirement. |
| | | o BLM administrative use only | Not applicable | | This is a definition and does not contain a policy or requirement. |
| | | o Other types of limitations | Not applicable | | This is a definition and does not contain a policy or requirement. |
| | | ● Closed Area Designations prohibit vehicular travel, both motorized and mechanized, transportation cross-country and on routes, except for where valid rights continue to allow access, such as within a designated Wilderness Area. Areas are designated closed if closure to all vehicular use is necessary to protect resources, promote visitor safety, or reduce use conflicts. | Not applicable | | This is a definition and does not contain a policy or requirement. |
| | | **Back Country Byways Program** | | | |
| | | The BLM developed the Back County Byway Program to complement the National Scenic Byway Program established by the U.S. Secretary of Transportation. Back County Byways highlight the spectacular nature of the western landscapes. These routes vary from narrow graded roads that are passable only during a few months of the year to two-lane paved highways with year-round access. | Not applicable | | This provides background on the Back Country Byways Program and does not contain a policy or requirement. |
| | | BLM will comply with the policy and guidelines of the BLM Back Country Byway Program and intent to showcase routes with high scenic and outstanding natural, cultural, historic or other values consistent with the designation. Where appropriate and feasible, BLM will highlight the spectacular nature of the western landscapes through education and interpretation along linear travel routes which provide recreational driving opportunities that allow for the experiences of solitude and isolation by: | Applicable | Consistent | The Bradshaw Trail Backcountry is located 1.75 miles to the south of the permitting boundary. No other BLM Backcountry Byways or other significant linear features are located in the project area. The project site would include an existing paved Power Line road but would maintain the road area for project use. |
| | | ● Maintaining or improving access to BLM recreational destinations and activities | Not applicable | | There are no recreational resources in the project area. |
| | | ● Helping meet the increasing demand for pleasure driving in back country environments. | Not applicable | | No other BLM Backcountry Byways (besides the Bradshaw Trail) or other significant linear features are located in the project area. The project site would include an existing paved Power Line road but would maintain the road area for project use. |
| | | ● Facilitating effective partnerships at the local, state, and national levels | Not applicable | | There are no recreational resources in the project area and therefore partnerships with other local, state, or federal agencies are not required. |
| | | ● Contributing to local and regional economies through increased tourism | Not applicable | | There are no recreational resources in the project area. The project site would include an existing paved Power Line road but would maintain the road area for project use. However, this would not provide increase visitor numbers or access. |
| | | ● Increasing public awareness of the availability of outstanding recreation attractions on public lands | Not applicable | | There are no recreational resources in the project area. |
| | | ● Enhancing the visitors' recreation experience and communicate the multiple-use management message through an effective wayside interpretive program | Not applicable | | There are no recreational resources in the project area. |
| | | ● Increasing the visibility of BLM as a major supplier of outdoor recreation opportunities | Not applicable | | There are no recreational resources in the project area. |
| | | ● Managing the increased use created through the program to minimize impacts to the environment | Not applicable | | There are no recreational resources in the project area. |
| | | ● Contributing to the National Scenic Byways Program in a way that is uniquely suited to national public lands managed by BLM | Not applicable | | There are no recreational resources in the project area and therefore would not contribute to the National Scenic Byways Program. |
| | | Back country byways are designated by the type of road and the vehicle needed to safely travel the byway. Some back country byways vary from a single track bike trail to a low speed paved road that traverses back country areas. Segments of Back Country Byways are subdivided into four types based on the characteristic of the road. | Not applicable | | This provides background on the back country byways and does not contain a policy or requirement. |
| | | Due to their remoteness, byway travelers should always inquire locally as to byway access and road conditions. | Not applicable | | This is a definition and does not contain a policy or requirement. |
| | | ● Type I – Roads are paved or have an all-weather surface and have grades that are negotiable by 2-wheel drive vehicles and passenger cars. Most of these roads are narrow, slow speed, secondary routes though public lands. | Not applicable | | This is a definition and does not contain a policy or requirement. |

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| Category | CMA # | CMA Text | Project Applicability | Project Consistency. | Explanation |
| | | ● Type II – Roads that require high-clearance type vehicles such as trucks or 4-wheel drive vehicles. These roads are usually not paved, but may have some type of surfacing. Grades, curves, and road surface are such that they can be negotiated with a 2-wheel drive high clearance vehicle without undue difficulty. | Not applicable | | This is a definition and does not contain a policy or requirement. |
| | | ● Type III – Roads require 4-wheel drive vehicles or other specialized vehicles such as dirt bikes, all-terrain vehicles (ATVs), etc. These roads are usually not surfaced, but are managed to provide for safety and resource protection needs. These roads can often have steep grades, uneven tread surfaces, and other characteristics that will require specialized vehicles to negotiate usually at slow speeds. | Not applicable | | This is a definition and does not contain a policy or requirement. |
| | | ● Type IV – Trails are managed specifically to accommodate dirt bike, mountain bike, snowmobile or all-terrain vehicle use. Most of these routes are single track trails. | Not applicable | | This is a definition and does not contain a policy or requirement. |
| **LUPA-Wide Conservation and Management Actions for Comprehensive Trails and Travel Management** | **LUPA-CTTM-1** | Maintain and manage adequate Road, Primitive Road, and Trail Access to and within SRMAs, ERMAs, OHV Open Areas, and Level 1, 2, and 3 Recreation Facilities. | Applicable | Consistent | Consistent with Mitigation Measure REC-1 (requires notification of penalties for any off-route OHV activities to deter off-route travel). The project is not in a SRMA or ERMA or Level 1, 2, and 3 Recreation Facilities. |
| | **LUPA-CTTM-2** | Avoid activities that would have a significant adverse impact on use and enjoyment within 0.5 mile from centerline of tier 2 Roads/Primitive Roads, and 300 feet from centerline of tier 3 primitive roads/trails. If avoidance of Tier 2 and 3 roads, primitive roads and trails is not practicable, relocate access to the same or higher standard and maintain the setting characteristics and access to recreation activities, facilities, and destinations. | Not applicable | | The Bradshaw Trail Backcountry is located 1.75 miles to the south of the permitting boundary. No other BLM Backcountry Byways or other significant linear features are located in the project area. The project site would include an existing paved Power Line road but would maintain the road area for project use. |
| | **LUPA-CTTM-3** | Manage other significant linear features such as Mojave Road, Bradshaw Trail, or other recognized linear features to protect their important recreation activities, experiences and benefits. Prohibit activities that have a significant adverse impact on use and enjoyment within 0.5 mile (from centerline) of such linear features. | Not applicable | | The Bradshaw Trail Backcountry is located 1.75 miles to the south of the permitting boundary. No other BLM Backcountry Byways or other significant linear features are located in the project area. The project site would include an existing paved Power Line road but would maintain the road area for project use. |
| | **LUPA-CTTM-4** | If residual impacts to Tier 1 and Tier 2 roads/primitive roads, Back Country Byways, or significant linear features occur from adjacent DFAs or other activities, commensurate compensation in the form of enhanced recreation operations, access, recreation facilities or opportunities will be required. | Not applicable | | The Bradshaw Trail Backcountry is located 1.75 miles to the south of the permitting boundary. No other BLM Backcountry Byways or other significant linear features are located in the project area. The project site would include an existing paved Power Line road but would maintain the road area for project use. |
| | **LUPA-CTTM-5** | Manage OHV use per the appropriate Transportation and Travel Management Plan/RMP and/or the SRMA Objectives as outlined in Appendix C as Open, Limited or Closed. | Applicable | Consistent | Consistent with Mitigation Measure REC-1 (requires notification of penalties for any off-route OHV activities to deter off-route travel). |
| | **LUPA-CTTM-6** | Manage Back Country Byways as a component of BLM Recreation and Travel and Transportation Management program. | Not applicable | | The Bradshaw Trail Backcountry is located 1.75 miles to the south of the permitting boundary. No other BLM Backcountry Byways or other significant linear features are located in the project area. The project site would include an existing paved Power Line road but would maintain the road area for project use. |
| | **LUPA-CTTM-7** | Manage Recreation Facilities consistent with the objectives for the recreation management areas and facilities (see also Section II.4.2.1.10). | Not applicable | | None of these resources are in the vicinity or within the project area. |
| **Cultural Resources and Tribal Interests** | **LUPA-CUL-1** | Continue working with the California Office of Historic Preservation (OHP) to develop and implement a program for record keeping and tracking agency actions that meets the needs of BLM and OHP organizations pursuant to existing State and National agreements and regulation (BLM State Protocol Agreement; BLM National Programmatic Agreement). | Not applicable | | Agency responsibility |
| | **LUPA-CUL-2** | Using relevant archaeological and environmental data, identify priority geographic areas for new field inventory, based upon a probability for unrecorded significant resources and other considerations. | Not applicable | | Agency responsibility |
| | **LUPA-CUL-3** | Identify places of traditional cultural and religious importance to federally recognized Tribes and maintain access to these locations for traditional use. | Applicable | Inconsistent | Access to places of traditional cultural and religious importance may not be maintained |
| | **LUPA-CUL-4** | Design activities to minimize impacts on cultural resources including places of traditional cultural and religious importance to federally recognized Tribes. | Applicable | Consistent | Project's POD mentions cultural resources taken into consideration in project site selection process. Alternative B avoids cultural resources that are eligible for the National Register. |
| | **LUPA-CUL-5** | Develop interpretive material to correspond with recreational uses to educate the public about protecting cultural resources and avoiding disturbance of archaeological sites. | Not applicable | | Agency responsibility |
| | **LUPA-CUL-6** | Develop partnerships to assist in the training of groups and individuals to participate in site stewardship programs. | Not applicable | | Agency responsibility |

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| **Category** | **CMA #** | **CMA Text** | **Project Applicability** | **Project Consistency.** | **Explanation** |
| | **LUPA-CUL-7** | Coordinate with visual resources staff to ensure VRM Classes consider cultural resources and tribal consultation to include landmarks of cultural significance to Native Americans (TCPs, trails, etc.). | Not applicable | | Agency responsibility |
| | **LUPA-CUL-8** | Conduct regular contact and consultation with federally recognized Tribes and individuals, consistent with statute, regulation and policy. | Not applicable | | Agency responsibility |
| | **LUPA-CUL-9** | Promote DRECP desert vegetation types/communities by avoiding them where possible, then use required compensatory mitigation, off-site mitigation, and other means to ensure Native American vegetation collection areas and practices are maintained. | Not applicable | | Agency responsibility |
| | **LUPA-CUL-10** | Promote and protect desert fan palm oasis vegetation type/communities by avoiding where possible, then use required compensatory mitigation, off-site mitigation, and other means to ensure Native American cultural values are maintained. | Not applicable | | Desert fan palm oasis vegetation type/communities are not present with the APE |
| | **LUPA-CUL-11** | Promote and protect desert microphyll woodland vegetation type/communities to ensure Native American cultural values are maintained. | Applicable | Consistent | Mitigation Measures BIO-19 state that a 200-foot buffer around the microphyll woodlands will be established and avoided during project implementation. Mitigation Measures BIO-20, 21, and 22 would also promote and protect Special Status Species and desert microphyll woodland vegetation and communities. |
| **Lands and Realty** | **LUPA-LANDS-1** | Identify acquired lands as right-of-way exclusion areas when development is incompatible with the purpose of the acquisition. | Not applicable | | No deed requirements for donated and/or acquired lands. |
| | **LUPA-LANDS-2** | Prioritize acquisition of land within and adjacent to conservation designation allocations. Acquired land in any land use allocation in this Plan will be managed according to the applicable allocation requirements and/or for the purposes of the acquisition. Management boundaries for the allocation may be adjusted to include the acquired land if the acquisition lies outside the allocation area through a future land use plan amendment process. | Not applicable | | The Proposed Action does not include land acquisition. |
| | **LUPA-LANDS-3** | Within land use allocations where renewable energy and ancillary facilities are not allowed, an exception exists for geothermal development. Geothermal development will be an allowable use if a geothermal-only DFA overlays the allocation and the lease includes a no surface occupancy stipulation with exception of three specific parcels in the Ocotillo Wells SRMA (refer to the Ocotillo Wells SRMA Special Unit Management Plan in Appendix C). | Not applicable | | The Proposed Action would be within a DFA, where solar facilities are an allowable use. The Proposed Action does not include geothermal energy facilities. |
| | **LUPA-LANDS-4** | Nonfederal lands within the boundaries of BLM LUPA land use allocations are not affected by the LUPA. | Not applicable | | The Proposed Action would occur entirely on federal lands. |
| | **LUPA-LANDS-5** | The MUCs used to determine land tenure in the CDCA Plan will be replaced by areas listed in the CMAs below. | Not applicable | | The Proposed Action is located in an area that had a MUC of Moderate Use (M) in the CDCA Plan, but was designated a DFA under the DRECP. Therefore, the project site would be managed as DFA. The BLM planning action would not be relevant to the Proposed Action. |
| | **LUPA-LANDS-6** | Any activities on Catellus Agreement lands will be consistent with deed restrictions | Not applicable | | The project site does not include Catellus Agreement lands. |
| | **LUPA-LANDS-7** | Any activities on Catellus Agreement lands will be subject to the approval of the California State Director. | Not applicable | | The project site does not include Catellus Agreement lands. |
| | **LUPA-LANDS-8** | The CDCA Plan requirement that new transmission lines of 161kV or above, pipelines with diameters greater than 12 inches, coaxial cables for interstate communications, and major aqueducts or canals for interbasin transfers of water will be located in designated utility corridors, or considered through the plan amendment process outside of designated utility corridors, remains unchanged. The only exception is that transmission facilities may be located outside of designated corridors within DFAs without a plan amendment. This CMA does not apply the Bishop and Bakersfield RMPs. | Applicable | Consistent. | The 230kV gen-tie line would be located partially outside of the designated transmission corridor, but within the DFA. |
| **Exchanges with the State of California** | **LUPA-LANDS-8** | Continue land exchanges with the State of California, as per the LUPA goals and objectives in Section II.4.1.4. Refer to Appendix F. | Not applicable | | The project would not engage or interfere with a State land exchange. |
| | **LUPA-LANDS-9** | Enter into land exchanges with the California State Lands Commission (CSLC) which convey BLM lands suitable for, or developed as, large-scale renewable energy related projects in exchange for CSLC school lands located in and adjacent to designated conservation areas. These exchanges will follow the procedures outlined in Memorandum of Agreement Relating to Land Exchanges to Consolidate Land Parcels signed by the BLM and CSLC on May 21, 2012. | Not applicable | | The project would not engage or interfere with a State land exchange. |
| | **LUPA-LANDS-10** | Prioritize land exchange proposals from the CSLC on available lands if there are competing land tenure proposals (e.g., land sale or exchange), CSLC proposals that enhance revenues for schools will generally be given priority. | Not applicable | | The project would not engage or interfere with a State land exchange. |
| **Livestock Grazing** | **LUPA-LIVE-1** | Adopt the Standards of Rangeland Health and Guidelines for Grazing Management, as detailed below, for the CDCA. This CMA does not apply in the Bishop and Bakersfield RMPs.<br>**Standards of Rangeland Health and Guidelines for Grazing Management**<br>Regional Public Land Health Standards and Guidelines are required for all BLM administered lands in accordance with Part 43 of the CFR subsection 4180. These regulations require that State Directors, in consultation with Resource Advisory Councils, develop Standards for Rangeland Health and Guidelines for grazing management.<br>The BLM in coordination and consultation with the California Desert District Advisory Committee (see Section 601 of the FLPMA as amended) developed standards and guidelines for the CDCA and used the following land use plan amendments to analyze the specific standard and guideline and to provide the public and opportunity to comment.<br>• Northern and Eastern Colorado Desert Management Plan—NECO—ROD signed Dec. 2002 (BLM 2002a)<br>• Northern and Eastern Mojave Desert Management Plan—NEMO—ROD signed Dec. 2002 (BLM 2002b)<br>• West Mojave Plan—WEMO—ROD signed March 2006 (BLM 2006) | Not applicable | | There are no grazing allotments on the Project site, and no grazing is proposed. |

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| Category | CMA # | CMA Text | Project Applicability | Project Consistency. | Explanation |
| | | The regulations require approval by the Secretary of the Interior prior to full implementation of standards and guidelines. Until approval is received, the fallback standards and guidelines will be used. | | | |
| | | The regulations require approval by the Secretary of the Interior prior to full implementation of the California Desert District standards and guidelines. Until approval is received, the fallback standards and guidelines will be used in the 5 Desert District Offices. | | | |
| | | Bakersfield and Bishop Field Offices are covered under the Central California Standards and Guidelines and require no additional approval to continue to use that document. | | | |
| | | **Standards and Guidelines for the CDCA** | | | |
| | | **Standards** of land health are expressions of levels of physical and biological condition or degree of function required for healthy lands and sustainable uses, and define minimum resource conditions that must be achieved and sustained (BLM 2001). | | | |
| | | **Guideline.** A practice, method or technique determined to be appropriate to ensure that standards can be met or that significant progress can be made toward meeting the standard. Guidelines are tools such as grazing systems, vegetative treatments, or improvement projects that help managers and permittees achieve standards. Guidelines may be adapted or modified when monitoring or other information indicates the guideline is not effective, or a better means of achieving the applicable standard becomes appropriate (H-4180-1 Rangeland Health Standards). | | | |
| | | The following **Standards** for the CDCA are from the NECO, NEMO, WEMO, and Palm Springs South Coast Resource Management Plan (PSSCRMP) land use plan amendments. | | | |
| | | **Soils** | | | |
| | | Soils exhibit infiltration and permeability rates that are appropriate to soil type, climate, geology, land form, and past uses. Adequate infiltration and permeability of soils allow accumulation of soil moisture necessary for optimal plant growth and vigor, and provide a stable watershed, as indicated by: | | | |
| | | ● Canopy and ground cover are appropriate for the site. | | | |
| | | ● There is a diversity of plant species with a variety of root depths. | | | |
| | | ● Litter and soil organic matter are present at suitable sites. | | | |
| | | ● Microbiotic soil crusts are maintained and in place at appropriate locations. | | | |
| | | ● Evidence of wind or water erosion does not exceed natural rates for the site. | | | |
| | | ● Soil permeability, nutrient cycling, and water infiltration are appropriate for the soil type. | | | |
| | | **Native Species** | | | |
| | | Healthy, productive, and diverse habitats for native species, including Special Status Species (federal threatened and endangered, federally proposed, federal candidates, BLM sensitive, or California State threatened and endangered, and Unique Plant Assemblages), are maintained in places of natural occurrence, as indicated by: | | | |
| | | ● Photosynthetic and ecological processes are continuing at levels suitable for the site, season, and precipitation regimes. | | | |
| | | ● Plant vigor, nutrient cycle, and energy flow are maintaining desirable plants and ensuring reproduction and recruitment. | | | |
| | | ● Plant communities are producing litter within acceptable limits. | | | |
| | | ● Age class distribution of plants and animals are sufficient to overcome mortality fluctuations. | | | |
| | | ● Distribution and cover of plant species and their habitats allow for reproduction and recovery from localized catastrophic events. | | | |
| | | ● Alien and noxious plants and wildlife do not dominate a site or do not require action to prevent the spread and introduction of noxious/invasive weeds. | | | |
| | | ● Appropriate natural disturbances are evident. | | | |
| | | ● Populations and their habitats are sufficiently distributed and healthy to prevent the need for new listing as Special Status Species. | | | |
| | | **Riparian/Wetland and Stream Function** | | | |
| | | Wetland systems associated with subsurface, running, and standing water function properly and have the ability to recover from major disturbances. Hydrologic conditions are maintained, as indicated by: | | | |
| | | ● Vegetative cover adequately protects banks and dissipates energy during peak water flows. | | | |
| | | ● Dominant vegetation is an appropriate mixture of vigorous riparian species. | | | |
| | | ● Recruitment of preferred species is adequate to sustain the plant community. | | | |
| | | ● Stable soils store and release water slowly. | | | |
| | | ● Plant species present indicate soil moisture characteristics are being maintained. | | | |
| | | ● There is minimal cover of shallow-rooted invader species, and they are not displacing deep-rooted native species. | | | |
| | | ● Shading of stream courses and water courses is sufficient to support riparian vertebrates and invertebrates. | | | |
| | | ● Stream is in balance with water and sediment being supplied by the watershed. | | | |
| | | ● Stream channel size (depth and width) and meander is appropriate for soils, geology, and landscape. | | | |

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| Category | CMA # | CMA Text | Project Applicability | Project Consistency. | Explanation |
| | | ● Adequate organic matter (litter and standing dead plant material) is present to protect the site from excessive erosion and to replenish soil nutrients through decomposition.<br>**Water Quality**<br>Surface and groundwater complies with objectives of the Clean Water Act and other applicable water quality requirements, including meeting the California State standards, as indicated by:<br>● The following do not exceed the applicable requirements: chemical constituents, water temperature, nutrient loads, fecal coliform, turbidity, suspended sediment, and dissolved oxygen.<br>● Standards are achieved for riparian, wetlands, and water bodies.<br>● Aquatic organisms and plants (e.g., macro-invertebrates, fish, algae, and plants) indicate support for beneficial uses.<br>● Monitoring results or other data show water quality is meting the Standard.<br>The following **Guidelines** for grazing in the CDCA are from the NECO, NEMO, WEMO, and PSSCRMP land use plan amendments.<br>● Facilities will be located away from riparian-wetland areas whenever they conflict with achieving or maintaining riparian-wetland functions.<br>● The development of springs and seeps or other projects affecting water and associated resources will be designed to protect the ecological functions and processes of those sites.<br>● Grazing activities at an existing range improvement that conflict with achieving proper functioning conditions (PFC) and resource objectives for wetland systems (lentic, lotic, springs, adits, and seeps) would be modified so PFC and resource objectives can be met, and incompatible projects would be modified to bring them into compliance. The BLM would consult, cooperate, and coordinate with affected interests and livestock producers prior to authorizing modification of existing projects and initiation of new projects. New range improvement facilities would be located away from wetland systems if they conflict with achieving or maintaining PFC and resource objectives.<br>● Supplements (e.g., salt licks) will be located one-quarter mile or more away from wetland systems so they do not conflict with maintaining riparian-wetland functions.<br>● Management practices will maintain or promote perennial stream channel morphology (e.g., gradient, width/depth ratio, channel roughness, and sinuosity) and functions that are appropriate to climate and landform.<br>● Grazing management practices will meet state and federal water quality Standards. Impoundments (stock ponds) having a sustained discharge yield of less than 200 gallons per day to surface or groundwater, are excepted from meeting state drinking water standards per California State Water Resources Control Board Resolution Number 88-63.<br>● Refer to the most-up-to-date BLM Fire Policy for information related to suppression and use of wildland fire within the planning area.<br>● In years when weather results in extraordinary conditions, seed germination, seedling establishment, and native plant species growth should be allowed by modifying grazing use.<br>● Grazing on designated ephemeral rangeland could be allowed only if reliable estimates of production have been made, an identified level of annual growth or residue to remain on site at the end of the grazing season has been established, and adverse effects on perennial species are avoided.<br>● During prolonged drought, range stocking will be reduced to achieve resource objectives and/or prescribed perennial forage utilization. Livestock utilization of key perennial species on year-long allotments should be checked about March 1 when the Palmer Severity Drought Index/Standardized Precipitation Index indicates dry conditions are expected to continue.<br>● Through the assessment process or monitoring efforts, the extent of invasive and/or exotic plants and animals should be recorded and evaluated for future control measures. Methods and prescriptions should be implemented, and an evaluation would be completed to ascertain future control measures for undesirable species.<br>● Restore, maintain or enhance habitats to assist in the recovery of federally listed threatened and endangered species. Restore, maintain or enhance habitats of Special Status Species including federally proposed, federal candidates, BLM sensitive, or California State threatened and endangered to promote their conservation.<br>● Grazing activities should support biological diversity across the landscape, and native species and microbiotic crusts are to be maintained.<br>● Experimental research efforts should be encouraged to provide answers to grazing management and related resource concerns through cooperative and collaborative efforts with outside agencies, groups, and entities.<br>● Livestock utilization limits of key perennial species will be as shown in (see Table 19) for the various range types. | | | |

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| **Category** | **CMA #** | **CMA Text** | **Project Applicability** | **Project Consistency.** | **Explanation** |
| | | **Monitoring**<br>Monitoring of grazing allotment resource conditions would be routinely assessed to determine if Public Land Health Standards are being met. In those areas not meeting one or more Standards, monitoring processes would be established where none exist to monitor indicators of health until the Standard or resource objective has been attained. Livestock trail networks, grazed plants, livestock facilities, and animal waste are expected impacts in all grazing allotments and these ongoing impacts would be considered during analysis of the assessment and monitoring process. Activity plans for other uses or resources that overlap an allotment could have prescribed resource objectives that may further constrain grazing activities (e.g., ACEC). In an area where a Standard has not been met, the results from monitoring changes to grazing management required to meet Standards would be reviewed annually. During the final phase of the assessment process, the Range Determination includes the schedule for the next assessment of resource conditions. To attain Standards and resource objectives, the best science would be used to determine appropriate grazing management actions. Cooperative funding and assistance from other agencies, individuals, and groups would be sought to collect prescribed monitoring data for indicators of each Standard. | Not applicable | | There are no grazing allotments on the Project site, and no grazing is proposed. |
| **LUPA-Wide Conservation and Management Actions for Livestock Grazing** | **LUPA-LIVE-2** | In the CDCA only, accept grazing permit/lease donations in accordance with legislation in the Fiscal Year 2012 Appropriations Act (Public Law 112-74). | Not applicable | | There are no grazing allotments on the Project site, and no grazing is proposed. |
| | **LUPA-LIVE-3** | In the Bishop and Bakersfield RMPs, determine whether continued livestock grazing would be compatible with achieving land use plan management goals and objectives in the event that the permit/lease is relinquished. | Not applicable | | There are no grazing allotments on the Project site, and no grazing is proposed. |
| | **LUPA-LIVE-4** | If the BLM determines that the grazing allotment is to be put to a different public purpose than grazing, follow the notification requirements outline in the Grazing Regulations at 43 CFR 4110.4-2(b) and BLM Instruction Memorandum (IM) 2011-181 (BLM 2011), or future policy replacing IM 2011-181. | Not applicable | | There are no grazing allotments on the Project site, and no grazing is proposed. |
| | **LUPA-LIVE-5** | For grazing allotments within the CDCA that BLM has received a voluntary request for relinquishment prior to fiscal year 2012, continue the planning process for making these allotments unavailable for grazing. | Not applicable | | There are no grazing allotments on the Project site, and no grazing is proposed. |
| | **LUPA-LIVE-6** | Complete the process for approving rangeland health standards and guidelines for the CDCA Plan (NEMO, WEMO, NECO and PSSCRMP). | Not applicable | | There are no grazing allotments on the Project site, and no grazing is proposed. |
| | **LUPA-LIVE-7** | Make Pilot Knob, Valley View, Cady Mountain, Cronese Lake, and Harper Lake allotments, allocations unavailable for livestock grazing and change to management for wildlife conservation and ecosystem function. Reallocate the forage previously allocated to grazing use in these allotments to wildlife and ecosystem functions. Pilot Knob was closed in the WEMO plan amendment. The Cronese Lake, Harper Lake, and Cady Mountain allotments were closed as mitigation for the impacts to the Agassiz's desert tortoise resulting from the Fort Irwin expansion. All forage allocated to livestock grazing in these allotments will be reallocated to wildlife use and ecosystem function. | Not applicable | | There are no grazing allotments on the Project site, and no grazing is proposed. |
| | **LUPA-LIVE-8** | The following vacant grazing allotments within the CDCA will have all vegetation previously allocated to grazing use reallocated to wildlife use and ecosystem functions and will be closed and unavailable to future livestock grazing: Buckhorn Canyon, Crescent Peak, Double Mountain, Jean Lake, Johnson Valley, Kessler Springs, Oak Creek, Chemehuevi Valley, and Piute Valley. | Not applicable | | There are no grazing allotments on the Project site, and no grazing is proposed. |
| | **LUPA-LIVE-9** | Allocate the forage that was allocated to livestock use in the Lava Mountain and Walker Pass Desert allotments (which have already been relinquished under the 2012 Appropriations Act) to wildlife use and ecosystem function and permanently eliminate livestock grazing on the allotments. | Not applicable | | There are no grazing allotments on the Project site, and no grazing is proposed. |
| **Minerals** | **LUPA-MIN-1** | High Potential Mineral Areas (identified in CA GEM data)<br>● These areas have been identified as mineral lands having existing and/or historic mining activity and a reasonable probability of future mineral resource development. These identified areas will be designated as mineral land polygons on DRECP maps, recognized as probable future development areas for planning purposes and allowable use areas. | Not applicable | | The project is not in an area identified as a High Potential Mineral Area. |
| | | ● If an activity is proposed in a High Potential Mineral Area, analyze and consider the mineral resource value in the NEPA analysis. | Not applicable | | The project is not in an area identified as a High Potential Mineral Area. |
| | **LUPA-MIN-2** | Existing Mineral/Energy Operations<br>Existing authorized mineral/energy operations, including existing authorizations, modifications, extensions and amendments and their required terms and conditions, are designated as an allowable use within all BLM lands in the LUPA Decision Area, and unpatented mining claims subject to valid existing rights. Amendments and expansions authorized after the signing of the DRECP LUPA ROD are subject to applicable CMAs, including ground disturbance caps within Ecological and Cultural Conservation Areas, subject to valid existing rights, subject to governing laws and regulations. | Not applicable | | Mineral resources are not present on the project site or affected by the project. |
| | **LUPA-MIN-3** | Existing High Priority Mineral/Energy Operations Exclusion Areas<br>● Existing high-priority operation footprints and their identified expansion areas are excluded from DFA and conservation CMAs, but must comply with LUPA-wide CMAs subject to the governing laws and regulations. | Not applicable | | Mineral resources are not present on the project site or affected by the project. |
| | | ● High priority operation exclusions are referenced by name with their respective footprint (acreage) below. | Not applicable | | Mineral resources are not present on the project site or affected by the project. |
| | | o MolyCorp REE (General Legal Description: 35º 26'N; 115º 29'W)—10,490.9 surface acres | Not applicable | | Mineral resources are not present on the project site or affected by the project. |
| | | o Briggs Au, Etna (General Legal Description: 35º 56'N; 117º 11'W)—3,216.9 surface acres | Not applicable | | Mineral resources are not present on the project site or affected by the project. |

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| Category | CMA # | CMA Text | Project Applicability | Project Consistency. | Explanation |
| | | o Cadiz Evaporites (General Legal Description: 34º 17'N; 115º 23'W)—2,591.5 surface acres | Not applicable | | Mineral resources are not present on the project site or affected by the project. |
| | | o Searles Dry Lake (Evaporate) Operation (General Legal Description: 35º 43'N; 117º 19'W)—72,000 surface acres | Not applicable | | Mineral resources are not present on the project site or affected by the project. |
| | | o Bristol Dry Lake (Evaporate) Operation (General Legal Description: 34º 29'N; 115º 43'W)—3,500 surface acres | Not applicable | | Mineral resources are not present on the project site or affected by the project. |
| | | o Mesquite Gold Mine (General Legal Description: 33º 04'N; 114º 59'W)—4,500 surface acres | Not applicable | | Mineral resources are not present on the project site or affected by the project. |
| | | o Hector Mine (Hectorite Clay) (General Legal Description: 34º 45'N; 116º 25'W)—1,500 surface acres | Not applicable | | Mineral resources are not present on the project site or affected by the project. |
| | | o Castle Mountain/Viceroy Mine (Gold) (General Legal Description: 35º 17'N; 115º 3'W)—5,000 surface acres | Not applicable | | Mineral resources are not present on the project site or affected by the project. |
| | LUPA-MIN-4 | Access to Existing Operations | | | |
| | | • Established designated, approved, or authorized access routes to the aforementioned existing authorized operations and areas will be designated as allowable uses. | Not applicable | | Mineral resources are not present on the project site or affected by the project. |
| | | • Access routes to Plans of Operations and Notices approved under 43 CFR 3809 will be granted subject to valid existing rights listed in 43 CFR 3809.100. | Not applicable | | Mineral resources are not present on the project site or affected by the project. |
| | LUPA-MIN-5 | Areas Located Outside Identified Mineral Areas<br>• Areas which could not be characterized due to insufficient data and mineral potential may fluctuate dependent on market economy, extraction technology, and other geologic information- requiring periodic updating. Authorizations are subject to the governing laws and regulations and LUPA requirements. | Applicable | Consistent | The Project is in an area located outside an identified mineral area. However, authorization would be subject to the BLM and would adhere to all governing laws, regulations and LUPA requirements. |
| | LUPA-MIN-6 | New or expanded mineral operations will be evaluated on a case-by-case basis, and authorizations are subject to LUPA requirements, and the governing laws and regulations. | Not applicable | | Mineral resources are not present on the project site or affected by the project. |
| National Recreation Trails | LUPA-NRT-1 | The Nadeau Road NRT was designated by the Secretary of the Interior in June 2013. The California Desert District nominates the Sperry Wash Road, El Mirage Interpretive Trail East, and El Mirage Interpretive Trail West for NRT designation. | Not applicable | | The Proposed Action is not located near any trail designated with a NRT designation. |
| | LUPA-NRT-2 | The Nadeau NRT Management Corridor will be protected and activities impacting use and enjoyment of the trail will be avoided within 0.5 mile from centerline of the route. | Not applicable | | The Proposed Action is not located near the Nadeau Road NRT. |
| Paleontology | LUPA-PALEO-1 | If not previously available, prepare paleontological sensitivity maps consistent with the Potential Fossil Yield Classification for activities prior to NEPA analysis. | Not applicable | | Agency responsibility |
| | LUPA-PALEO-2 | Incorporate all guidance provided by the Paleontological Resources Protection Act. | Applicable | Consistent | Agency responsibility |
| | LUPA-PALEO-3 | Ensure proper data recovery of significant paleontological resources where adverse impacts cannot be avoided or otherwise mitigated. | Applicable | Consistent | No adverse effects to paleontological resources would occur with the implementation of Mitigation Measures PALEO-1 through -5. |
| | LUPA-PALEO-4 | Paleontological surveys and construction monitors are required for ground disturbing activities that require an EIS. | Applicable | Consistent | According to Mitigation Measure PALEO-4, all ground disturbing activities shall be monitored by a BLM-approved paleontologist. |
| Recreation and Visitor Services | LUPA-REC-1 | Maintain, and where possible enhance, the recreation setting characteristics – physical components of remoteness, naturalness and facilities; social components of contact, group size and evidence of use; and operational components of access, visitor services and management controls. | Not applicable | | Project site located in a DFA and is not located within a designated resource area. |
| | LUPA-REC-2 | Cooperate with the network of communities and recreation service providers active within the planning area to protect the principal recreation activities and opportunities, and the associated conditions for quality recreation, by enhancing appropriate visitor services, and by identifying and mitigating impacts from development, inconsistent land uses and unsustainable recreation practices such as minimizing impacts to known rockhounding gathering areas. | Applicable | Consistent | There are no recreational resources in the project area and implementation of mitigation measures REC-1 and REC-2 would minimize effects on surrounding recreational resources. |
| | LUPA-REC-3 | Manage lands not designated as SRMAs or ERMAs to meet recreation and visitor services and resource stewardship needs as described in Resource Management Plans (RMPs). | Applicable | Consistent | There are no recreational resources in the project area and implementation of mitigation measures REC-1 and REC-2 would minimize effects on surrounding recreational resources. |
| | LUPA-REC-4 | Prohibit activities that have a significant adverse impact and that do not enhance conservation or recreation values within one mile of Level 1 and Level 2 Recreation facility footprint. | Not applicable | | Within 0.5-miles of the Project Area, only Mule Mountains ACEC and Chuckwalla Valley Dune Thicket ACEC are designated recreational areas; however, these are not considered Level 1 or 2 Recreational Facilities. |
| | LUPA-REC-5 | Avoid activities that have a significant adverse impact and that do not enhance conservation or recreation values within one-half mile of Level 3 Recreation facility footprint including route access and staging areas. If avoidance is not practicable, the facility must be relocated to the same or higher recreation standard and maintain recreation objectives and setting characteristics. | Not applicable | | The project is not in a SRMA or ERMA or Level 1, 2, and 3 Recreation Facilities. Within 0.5-miles of the Project Area, only Mule Mountains ACEC and Chuckwalla Valley Dune Thicket ACEC are designated recreational areas; however, these are not considered Level 3 Recreational Facilities. |
| | LUPA-REC-6 | Limit signage to that necessary for recreation facility/area identification, interpretation, education and safety/regulatory enforcement. | Not applicable | | The Proposed Action area doesn't include any recreational facilities or resources and doesn't propose any signage for recreational facilities. |

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| **Category** | **CMA #** | **CMA Text** | **Project Applicability** | **Project Consistency.** | **Explanation** |
| | **LUPA-REC-7** | Refer to local RMPs, RMP amendments, and activity level planning for specially designated areas for Vehicular Stopping, Parking, and Camping limitations. | Not applicable | | The Proposed Action is not located in a RMP planning area. |
| | **LUPA-REC-8** | Provide on-going maintenance of recreation and conservation facilities, interpretive and regulatory signs, roads, and trails. | Applicable | Consistent | The project site would include an existing paved Powerline road but would maintain the road area for project use. |
| **Soil and Water General** | **LUPA-SW-1** | Stipulations or conditions of approval for any activity will be imposed that provide appropriate protective measures to protect the quantity and quality of all water resources (including ephemeral, intermittent, and perennial water bodies) and any associated riparian habitat (see biological CMAs for specific riparian habitat CMAs). The water resources to which this CMA applies will be identified through the activity-specific NEPA analysis. | Applicable | Consistent | The proposed improvements would be consistent with LUPA-BIO-9 and BRTR Measures BIO-4, BIO-16 through 19, and BIO 56 to ensure that drainage control features are incorporated into the project design to limit erosion and other adverse effects associated with storm water runoff. The SWPPP developed for the site would include post-construction measures to manage storm water such as detention basins, if deemed appropriate, and otherwise minimizing changes to existing drainage patterns to allow for natural storm water flow through the site to the extent feasible. |
| | **LUPA-SW-2** | Buffer zones, setbacks, and activity limitations specifically for soil and water (ground and surface) resources will be determined on an activity/site-specific basis through the environmental review process, and will be consistent with the soil and water resource goals and objectives to protect these resources. Specific requirements, such as buffer zones and setbacks, may be based, in part, on the results of the Water Supply Assessment defined below. In general, placement of long-term facilities within buffers or protected zones for soil and water resources is discouraged, but may be permitted if soil and water resource management objectives can be maintained. | Not applicable | | There are no identified soil and water resources on the site that require a buffer zone, setback or limitation on activities. |
| | **LUPA-SW-3** | Where a seeming conflict between CMAs within or between resources arises, the CMA(s) resulting in the most resource protection apply. | Not applicable | | No CMA conflicts with the project. |
| | **LUPA-SW-4** | Nothing in the "Exceptions" below applies to or takes precedence over any of the CMAs for biological resources. | Not applicable | | Project has a relatively low water supply demand. |
| **Groundwater Resources** | **LUPA-SW-5** | Exceptions to any of the specific soil and water stipulations contained in this section, as well as those listed below under the subheadings "Soil Resources," "Surface Water," and "Groundwater Resources," may be granted by the authorized officer if the applicant submits a plan, or, for BLM-initiated actions, the BLM provides documentation, that demonstrates:<br><br>● The impacts are minimal (e.g., no predicted aquifer drawdown beyond existing annual variability in basins where cumulative groundwater use is not above perennial yield and water tables are not currently trending downward) or can be adequately mitigated. | Not applicable | | Project has a relatively low water supply demand. |
| **Soil Resources** | **LUPA-SW-6** | In addition to the applicable required governmental safeguards, third party activities will implement up-to-date standard industry construction practices to prevent toxic substances from leaching into the soil. | Applicable | Consistent | Project will implement a SWPPP which would include post-construction BMPs that would include appropriate handling of the relatively minor toxic substances used on site. |
| | **LUPA-SW-7** | Prepare an emergency response plan, approved by the BLM contaminant remediation specialist, that ensures rapid response in the event of spills of toxic substances over soils. | Applicable | Consistent | Implementation of BRTR Measures BIO-4, BIO-16-19, and BIO-56 would ensure that hazardous materials are managed in a manner that minimizes releases and provides means to address any spills should they occur. |
| | **LUPA-SW-8** | As determined necessary on an activity specific basis, prepare a site plan specific to major soil types present (≥5% of footprint or laydown surfaces) in Wind Erodibility Groups 1 and 2 and in Hydrology Soil Class D as defined by the USDA Natural Resource Conservation Service to minimize water and air erosion from disturbed soils on activity sites. | Applicable | Consistent | Project will implement a SWPPP which would include erosion control BMPs that would minimize the potential for wind or water erosion on site. |
| | **LUPA-SW-9** | The extent of desert pavement within the proposed boundary of an activity shall be mapped if it is anticipated that the activity may create erosional or ecologic impacts. Mapping will use the best available data and standards, as determined by BLM. Disturbance of desert pavement within the boundary of an activity shall be limited to the extent possible. If disturbance from an activity is likely to exceed 10% of the desert pavement mapped within the activity boundary, the BLM will determine whether the erosional and ecologic impacts of exceeding the 10% cap by the proposed amount would be insignificant and/or whether the activity should be redesigned to minimize desert pavement disturbance. | Not applicable | | Desert pavement is only located on the eastern edge of the project site and would not exceed the disturbance threshold of the desert pavement. |
| | **LUPA-SW-10** | The extent of additional sensitive soil areas (cryptobiotic soil crusts, hydric soils, highly corrosive soils, expansive soils, and soils at severe risk of erosion) shall be mapped if it is anticipated that an activity will impact these resources. To the extent possible, avoid disturbance of desert biologically intact soil crusts, and soils highly susceptible to wind and water erosion. | Applicable | Consistent | Improvements would be designed to be consistent with the California Building Code which would include recommendations to address any geotechnical hazards including highly corrosive soils, expansive soils, and soils at severe risk of erosion. |
| | **LUPA-SW-11** | Where possible, side casting shall be avoided where road construction requires cut- and-fill procedures. | Not applicable | | Cut and fill for road construction not part of project. |
| **Surface Water** | **LUPA-SW-12** | Except in DFAs, exclude long-term structures in, playas (dry lake beds), and Wild and Scenic River corridors, except as allowed with minor incursions (see definition in the Glossary of Terms). | Not applicable | | Not located in playas or river corridors. |
| | **LUPA-SW-13** | BLM will manage all riparian areas to be maintained at, or brought to, proper functioning condition. | Not applicable | | No riparian areas in project site. |
| | **LUPA-SW-14** | All relevant requirements of Executive Orders 11988 (Floodplain Management) and 11990 (Protection of Wetlands) will be complied with. | Not applicable | | Project site is not within a flood zone. |
| | **LUPA-SW-15** | Surface water diversion for beneficial use will not occur absent a state water right. | Not applicable | | No surface water diversion on the site. |

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| **Category** | **CMA #** | **CMA Text** | **Project Applicability** | **Project Consistency.** | **Explanation** |
| | **LUPA-SW-16** | The 100-year floodplain boundaries for any surface water feature in the vicinity of the project will be identified. If maps are not available from the Federal Emergency Management Agency (FEMA), these boundaries will be determined via hydrologic modeling and analysis as part of the environmental review process. Construction within, or alteration of, 100-year floodplains will be avoided where possible, and permitted only when all required permits from other agencies are obtained. | Not applicable | | Not located within 100-year flood zone. |
| **Groundwater** | **LUPA-SW-17** | An activity's groundwater extraction shall not contribute to exceeding the estimated perennial yield for the basin in which the extraction is taking place. Perennial yield is that quantity of groundwater that can be withdrawn from the groundwater basin without exceeding the long-term recharge of the basin or unreasonably affecting the basin's physical, chemical, or biological integrity. It is further clarified arithmetically below. | Applicable | Consistent | According to the Water Demand Analysis for the project, the project demand is relatively small. |
| | **LUPA-SW-18** | Water extracted or consumptively used for the construction, operation, maintenance, or remediation of the project shall be solely for the beneficial use of the project or its associated mitigation and remediation measures, as specified in approved plans and permits. | Applicable | Consistent | Water would primarily be used for the beneficial purposes of dust suppression during construction and during operation only for occasional panel washing. |
| | **LUPA-SW-19** | Water flow meters shall be installed on all extraction wells permitted by BLM. | Not applicable | | The project may construct an on-site well or obtain water from other resources. If constructed on-site, it would adhere to BLM requirements. |
| | **LUPA-SW-20** | After application of applicable avoidance and minimization measures, all remaining unavoidable residual impacts to surface waters from the proposed activity shall be mitigated to ensure no net loss of function and value, as determined by the BLM. | Applicable | Consistent | Implementation of the SWPPP would include post construction BMPs to minimize potential residual impacts to surface waters. |
| | **LUPA-SW-21** | Consideration shall be given to design alternatives that maintain the existing hydrology of the site or redirect excess flows created by hardscapes and reduced permeability from surface waters to areas where they will dissipate by percolation into the landscape. | Applicable | Consistent | Project would be designed to maintain drainage patterns as close as possible to existing conditions. |
| | **LUPA-SW-22** | All hydrologic alterations shall be avoided that could reduce water quality or quantity for all applicable beneficial uses associated with the hydrologic unit in the project area, or specific mitigation measures shall be implemented that will minimize unavoidable water quality or quantity impacts, as determined by BLM in coordination with USFWS, CDFW, and other agencies, as appropriate. These beneficial uses may include municipal, domestic, or agricultural water supply; groundwater recharge; surface water replenishment; recreation; water quality enhancement; flood peak attenuation or flood water storage; and wildlife habitat. | Applicable | Consistent | Site will remain largely pervious and drainage will continue as overland flow relatively similar to existing conditions. The proposed improvements would be consistent with LUPA-BIO-9 and BRTR Measures BIO-4, BIO-16 through 19, and BIO 56 to ensure that drainage control features are incorporated into the project design to limit erosion and other adverse effects associated with storm water runoff. |
| | **LUPA-SW-23** | A Water (Groundwater) Supply Assessment shall be prepared in conjunction with the activity's NEPA analysis and prior to an approval or authorization. This assessment must be approved by the BLM in coordination with USFWS, CDFW, and other agencies, as appropriate, prior to the development, extraction, injection, or consumptive use of any water resource. The purpose of the Water Supply Assessment is to determine whether over-use or over-draft conditions exist within the project basin(s), and whether the project creates or exacerbates these conditions. The Assessment shall include an evaluation of existing extractions, water rights, and management plans for the water supply in the basin(s) (i.e., cumulative impacts), and whether these cumulative impacts (including the proposed project) can maintain existing land uses as well as existing aquatic, riparian, and other water-dependent resources within the basin(s). This assessment shall identify:<br>● All relevant groundwater basins or sub-basins and their relationships.<br>● All known aquifers in the basin(s), including their dimensions, whether confined or unconfined, estimated hydraulic conductivity and transmissivity, groundwater surface elevations, and direction and movement of groundwater.<br>● All surface water basin(s) related to water runoff, delivery, and supply, if different from the groundwater basin(s).<br>● All sites of surface outflow (springs or seeps) contained within the basin(s), including historic sites.<br>● All other surface water bodies in the basins(s), including rivers, streams, ephemeral washes/drainages, lakes, wetlands, playas, and floodplains.<br>● The water requirements of the proposed project and the source(s) of that water.<br>● An analysis demonstrating that water of sufficient quantity and quality is available from identified source(s) for the life of the project.<br>● An analysis of potential project-related impacts on water quality and quantity needed for beneficial uses, reserved water rights, existing groundwater users, or habitat management within or down gradient of the groundwater basin within which the project would be constructed.<br>● The above analyses shall be in the form of a numerical groundwater model. The model extent shall encompass the groundwater basin within which the project would be constructed, and any groundwater-dependent resources within or down gradient of that basin. | Applicable | Consistent | A Water Supply Assessment was completed for the project. |

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| **Category** | **CMA #** | **CMA Text** | **Project Applicability** | **Project Consistency.** | **Explanation** |
| | | The primary product of the Water Supply Assessment shall be a baseline water budget, which shall be established based on the best-available data and hydrologic methods for the identified basin(s). This water budget shall classify and describe all water inflow and outflow to the identified basin(s) or system using best-available science and the following basic hydrologic formula or a derivation: P – R – E – T – G = ΔS where P is precipitation and all other water inflow or return flow, R is surface runoff or outflow, E is evaporation, T is transpiration, G is groundwater outflow (including consumptive component of existing pumping), and ΔS is the change in storage. The volumes in this calculation shall be in units of either acre-feet per year or gallons per year. The water budget shall quantify the existing perennial yield of the basin(s). Perennial yield is defined arithmetically as that amount such that P – R – E – T – G is greater than or equal to 0<br>Water use by groundwater-dependent resources is implicitly included in the definition of perennial yield. For example, in many basins the transpiration component (T) includes water use by groundwater-dependent vegetation. Similarly, groundwater outflow (G) includes discharge to streams, springs, seeps, and wetlands. If one or more budget components is altered, then one or more of the remaining components must change for the hydrologic balance to be maintained. For example, an increase in the consumptive component of groundwater pumping can lower the water table and reduce transpiration by groundwater-dependent vegetation. The groundwater that had been utilized by the groundwater-dependent vegetation would then be considered "captured" by groundwater pumping. Similarly, increased groundwater consumption can capture groundwater that discharges to streams, springs, seeps, wetlands and playas. These changes can occur slowly over time, and may require years or decades before the budget components are fully adjusted. Accordingly, the water/groundwater supply assessment requires that the best-available data and hydrologic methods be employed to quantify these budgets, and that groundwater consumption effects on groundwater-dependent ecosystems be identified and addressed.<br>The Water Supply Assessment shall also address:<br>● Estimates of the total cone of depression considering cumulative drawdown from all potential pumping in the basin(s), including the project, for the life of the project through the decommissioning phase<br>● Potential to cause subsidence and loss of aquifer storage capacity due to groundwater pumping<br>● Potential to cause injury to other water rights, water uses, and land owners<br>● Changes in water quality and quantity that affect other beneficial uses<br>● Effects on groundwater dependent vegetation and groundwater discharge to surface water resources such as streams, springs, seeps, wetlands, and playas that could impact biological resources, habitat, or are culturally important to Native Americans<br>● Additional field work that may be required, such as an aquifer test, to evaluate site specific project pumping impacts and if necessary, establish trigger points that can be used for a Groundwater Water Monitoring and Mitigation Plan<br>● The mitigation measures required, if there are significant or potentially significant impacts on water resources include but are not limited to, the use of specific technologies, management practices, retirement of active water rights, development of a recycled water supply, or water imports | | | |
| | **LUPA-SW-24** | A Groundwater Monitoring and Reporting Plan, and Mitigation Action Plan shall be prepared to verify the Water Supply Assessment and adaptively manage water use as part of project operations. This plan shall be approved by BLM, in coordination with USFWS, CDFW, and other agencies as appropriate, prior to the development, extraction, injection, or consumptive use of any water resource. The quality and quantity of all surface water and groundwater used for the project shall be monitored and reported using this plan. Groundwater monitoring includes measuring the effects of a project's groundwater extraction on groundwater surface elevations, groundwater flow paths, changes to groundwater-dependent vegetation, and of aquifer recovery after project decommissioning. Surface water monitoring, if applicable, shall monitor for changes in the flows, water volumes, channel characteristics, and water quality as a result of a project's surface water use. Monitoring frequency and geographic scope and reporting frequency shall be decided on a project and site-specific basis and in coordination with the appropriate agencies that manage the water and land resources of the region. The geographic scope may include at the very least, all basins/sub-basins that potentially receive inflow from the basin where the proposed project may be sited, and all basins/sub-basins that may potentially contribute inflow to the basin where the proposed project is located. The plan shall also detail any mitigation measures that may be required as a result of the project. This plan and all monitoring results shall be made available to BLM. BLM will make the plan and results available to USFWS, CDFW, and other applicable agencies. | Not Applicable | | The project has a relatively small water supply demand that may come from a variety of different sources. The highest part of the demand is during the construction phase which is a short term demand. |
| | **LUPA-SW-25** | Where groundwater extraction, in conjunction with other cumulative impacts in the basin, has potential to exceed the basin's perennial yield or to impact water resources, one or more "trigger points," or specified groundwater elevations in specific wells or surface water bodies, shall be established by BLM. If the groundwater elevation at the designated monitoring wells falls below the trigger point(s)(or exceeds the trigger pumping rate), additional mitigation measures, potentially including cessation of pumping, will be imposed. | Not Applicable | | The project has a relatively small water supply demand that may come from a variety of different sources. The highest part of the demand is during the construction phase which is a short term demand. |

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| | **LUPA-SW-26** | Groundwater pumping mitigation shall be imposed if groundwater monitoring data indicate impacts on water-dependent resources that exceed those anticipated and otherwise mitigated for in the NEPA analysis and ROD, even if the basin's perennial yield is not exceeded. Water-dependent resources include riparian or phreatophytic vegetation, springs, seeps, streams, and other approved domestic or industrial uses of groundwater. Mitigation measures may include changes to pumping rates, volume, or timing of water withdrawals; coordinating and scheduling groundwater pumping activities in conjunction with other users in the basin; acquisition of project water from outside the basin; and/or replenishing the groundwater resource over a reasonably short timeframe. For permitted activities, permittees may also be required to contribute funds to basin-wide groundwater monitoring networks in basins such as those encompassed by the East Riverside DFA or in the Calvada Springs/South Pahrump Valley area, and to cooperate in the compilation and analysis of groundwater data. | Not Applicable | | The project has a relatively small water supply demand that may come from a variety of different sources. The highest part of the demand is during the construction phase which is a short term demand. |
| | **LUPA-SW-27** | Water-conservation measures shall be required in basins where current groundwater demand is high and has the future potential to rise above the estimated perennial yield (e.g., Pahrump Valley). These measures may include the use of specific technology, management practices, or both. A detailed discussion and analysis of the effectiveness of mitigation measures must be included. Application of these measures shall be detailed in the Groundwater Water Monitoring and Mitigation Plan. | Not Applicable | | The project has a relatively small water supply demand that may come from a variety of different sources. The highest part of the demand is during the construction phase which is a short term demand. |
| | **LUPA-SW-28** | Groundwater extractions from adjudicated basins, such as the Mojave River Basin, may be subject to additional restrictions imposed by the designated authority; examples include the Mojave Water Agency and San Bernardino County (see County Ordinance 3872). Where provisions of the adjudication allow for acquisition of water rights, project developers could be required to retire water rights at least equal in volume to those necessary for project operation or propose an alternative offset based on the conditions unique to the adjudicated basin. | Not Applicable | | The project has a relatively small water supply demand that may come from a variety of different sources. The highest part of the demand is during the construction phase which is a short term demand. The project site is not part of an adjudicated basin. |
| | **LUPA-SW-29** | Groundwater pumping mitigation may be imposed if monitoring data indicate impacts on groundwater or groundwater-dependent habitats outside the DRECP area, including those across the border in Nevada. See **LUPA-SW-26** for potential mitigation measures. | Not Applicable | | The project has a relatively small water supply demand that may come from a variety of different sources. The highest part of the demand is during the construction phase which is a short term demand. |
| | **LUPA-SW-30** | Activities shall comply with local requirements for any long term or short term domestic water use and wastewater treatment. | Applicable | Consistent | The proposed project does not include domestic facilities and would thus not include domestic water use. As detailed in Section 3.17, Utilities, the project would comply with local wastewater treatment requirements. |
| | **LUPA-SW-31** | The siting, construction, operation, maintenance, remediation, and abandonment of all wells shall conform to specifications contained in the California Department of Water Resources Bulletins #74-81 and #74-90 and their updates. | Applicable | Consistent | The Project is required to comply with California Department of Water Resources Bulletins #74-81 and #74-90 and their updates. |
| | **LUPA-SW-32** | Colorado River hydrologic basin - The concepts, principles and general methodology used in the Colorado River Accounting Surface Method, as defined in U.S. Geological Survey Scientific Investigations Report 2008-5113 (USGS 2009), and existing and future updates or a similar methodology, are considered the best available data for assessing activity/project related ground water impacts in the Colorado River hydrologic basin. The best available data and methodology shall be used to determine whether activity/project-related pumping would result in the extracted water being replaced by water drawn from the Colorado River. If activity/project-related groundwater pumping results in the static groundwater level at the well being near (within 1 foot), equal to, or below the Accounting Surface in a basin hydrologically connected to the Colorado River, that consumption shall be considered subject to the Law of the River (Colorado River Compact of 1922 and amendments). In such circumstances, BLM shall require the applicant to offset or otherwise mitigate the volume of water causing drawdown below the Accounting Surface. Details of such mitigation measures and the right to the use of water shall be described in the Groundwater Water Monitoring and Mitigation Plan. | Applicable | Consistent | The proposed water supply is expected to come from the Colorado River Hydrologic Region. Impacts to groundwater would be included in Section 3.19, Water Resources. |
| **Soil, Water, and Water-Dependent Resources Restricted to Specific Areas on BLM Lands** | **LUPA-SW-33** | **Stipulations for groundwater development in the proximity of Devils Hole**: Any development scenario for an activity within 25 miles of Devils Hole shall include a plan to achieve *zero-net* or *net-reduced* groundwater pumping to reduce the risk of adversely affecting senior federal reserved water rights, the designated critical habitat of the endangered Devils Hole pupfish, and the free-flowing requirements of the Wild and Scenic Armargosa River. This plan will require operators to acquire one or more minimization water rights (MWRs) in the over-appropriated, over-pumped, and hydraulically connected Amargosa Desert Hydrographic Basin in Nevada. The MWR(s) shall be: (1) an amount equal (at minimum) to that which is needed for construction and operations; (2) historically fully utilized, preferably for agricultural use; and (3) senior and closer to Devils Hole than the proposed point of diversion. | Not applicable | | The project site is not located within 25 miles of Devil's Hole. |
| | **LUPA-SW-34** | **Stipulations for groundwater development in the Calvada Springs/South Pahrump Valley area:** Activities in this area shall be required to acquire one or more MWRs in the Pahrump Valley Hydrographic Basin in Nevada. The acquired MWR(s) must: (1) be at least equal to the amount proposed to be required and actually used for project construction and operations; and (2) be fully utilized for at least the prior ten years. | Not applicable | | The project site is not located in the Calvada Springs/South Pahrump Valley area. |
| | **LUPA-SW-35** | Stipulations for activities in the vicinity of Death Valley National Park, Joshua Tree National Park, or Mojave National Preserve: The NEPA for activities involving groundwater extraction that are in the vicinity of Death Valley National Park, Joshua Tree National Park, or the Mojave National Preserve shall analyze and address any potential impacts of groundwater extraction on Death Valley National Park, Joshua Tree National Park, or Mojave National Preserve. BLM will consult with the National Park Service on this process. The analysis or analyses shall include: | Not applicable | | Project site is not located within the vicinity of Death Valley National Park or Mojave National Preserve. The project site is located 30 miles to the southeast of Joshua Tree National Park. |
| | | • Potential impacts on the water balances of groundwater basins within these parks and preserves | Not applicable | | See above |
| | | • A map identifying all potentially impacted surface water resources in the vicinity of the project, including a narrative discussion of the delineation methods used to discern those surface waters in the field | Not applicable | | See above |

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| Category | CMA # | CMA Text | Project Applicability | Project Consistency. | Explanation |
| | | ● Any project-related modifications to surface water resources, both temporary and permanent | Not applicable | | See above |
| | | | Not applicable | | See above |
| | | ● Analysis of any potential impacts on perennial streams, intermittent streams, and ephemeral drainages that could negatively impact natural riparian buffers | Not applicable | | See above |
| | | ● Impacts of any project proposed truncation, realignment, channelization, lining, or filling of surface water resources that could change drainage patterns, reduce available riparian habitat, decrease water storage capacity, or increase water flow velocity or sediment deposition, in particular where storm water diverted around or through the project site is returned to natural drainage systems downslope of the project | Not applicable | | See above |
| | | ● Any potential indirect project-related causes of hydrologic changes that could exacerbate flooding, erosion, scouring, or sedimentation in stream channels | Not applicable | | See above |
| | | ● Alternatives and mitigation measures proposed to reduce or eliminate such impacts | Not applicable | | See above |
| Visual Resources Management | LUPA-VRM-1 | Manage Visual Resources in accordance with the VRM classes shown on Figure 9. | Applicable | Consistent | Most of the Project site is within VRM Class IV, and development of the Project would be consistent with management objectives for Class IV. Mitigation measures require the use of BMPs to minimize contrast. |
| | LUPA-VRM-2 | Ensure that activities within each of the VRM Class polygons meets the VRM objectives described above, as measured through a visual contrast rating process. | | | The visual contrast rating process that was done for the Project measured the potential contrast and determined that the Project would meet the applicable VRM objectives. |
| | LUPA-VRM-3 | Ensure that transmission facilities are designed and located to meet the VRM Class objectives for the area in which they are located. New transmission lines routed through designated corridors where they do not meet VRM Class Objectives will require RMP amendments to establish a conforming VRM Objective. All reasonable effort must be made to reduce visual contrast of these facilities in order to meet the VRM Class before pursing RMP amendments. This includes changes in routing, using lattice towers (vs. monopole), color treating facilities using an approved color from the BLM Environmental Color Chart CC-001 (dated June 2008, as updated on April 2014, or the most recent version) (vs. galvanized) on towers and support facilities, and employing other BMPs to reduce contrast. Such efforts will be retained even if an RMP amendment is determined to be needed. Visual Resource BMPs that reduce adverse visual contrast will be applied in VRM Class conforming situations. For a reference of BMPs for reducing visual impacts see the "Best Management Practices for Reducing Visual Impacts of Renewable Energy Facilities on BLM-Administered Lands", available at http://www.blm.gov/style/medialib/blm/wo/MINERALS__REALTY__AND_RESOURCE_PROTECTION_/energy/renewable_references.Par.1568.File.dat/RenewableEnergyVisualImpacts_BMPs.pdf, or the most recent version of the document or BMPs for VRM, as determined by BLM. | | | The Project transmission facilities would be consistent with management objectives for Class IV. Mitigation measures require the use of BLM-identified BMPs to minimize contrast from transmission facilities. |
| Wilderness Characteristics | LUPA-WC-1 | Complete an inventory of areas for proposed activities that may impact wilderness characteristics if an updated wilderness characteristics inventory is not available. | Not applicable | | Wilderness characteristic inventory from DRECP LUPA used. |
| | LUPA-WC-2 | Employ avoidance measures as described under DFAs and approved transmission corridors. | Not applicable | | There are no identified wilderness protection areas within the RE Crimson Permitting Boundary. |
| | LUPA-WC-3 | For inventoried lands found to have wilderness characteristics but not managed for those characteristics compensatory mitigation is required if wilderness characteristics are directly impacted. The compensation will be: | Not applicable | | There are no identified wilderness protection areas within the RE Crimson Permitting Boundary. |
| | | ● 2:1 ratio for impacts from any activities that impact those wilderness characteristics, except in DFAs and transmission corridors | Not applicable | | See above |
| | | ● 1:1 ratio for impact from any activities that impact the wilderness characteristics in DFAs and transmission corridors | Not applicable | | See above |
| | | Wilderness compensatory mitigation may be accomplished through acquisition and donation, by willing landowners, to the federal government of (a) wilderness inholdings, (b) wilderness edge holdings that have inventoried wilderness characteristics, or (c) other areas within the LUPA Decision Area that are managed to protect wilderness characteristics. Restoration of impaired wilderness characteristics in Wilderness, Wilderness Study Area, and lands managed to protect wilderness characteristics could be substituted for acquisition. | Not applicable | | See above |
| | LUPA-WC-4 | For areas identified to be managed to protect wilderness characteristics, identified in Figure 7, the following CMAs are required: | Not applicable | | Based on review of Figure 7 in the LUPA of the DRECP, there are no identified wilderness characteristic areas within the RE Crimson Permitting Boundary. |
| | | ● Include a no surface occupancy stipulation for any leasable minerals with no exceptions, waivers, or modifications. | Not applicable | | See above |
| | | ● Exclude these areas from land use authorizations, including transmission. | Not applicable | | See above |
| | | ● Close areas to construction of new roads and routes. Vehicles will continue to be permitted on existing designated routes. | Not applicable | | See above |
| | | ● Close areas to mineral material sales. | Not applicable | | See above |
| | | ● Prohibit commercial or personal-use permits for extraction of materials (e. g. no wood-cutting permits). | Not applicable | | See above |
| | | ● Manage the area as VRM II. | Not applicable | | See above |

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| **Category** | **CMA #** | **CMA Text** | **Project Applicability** | **Project Consistency.** | **Explanation** |
| | | ● Require that new structures and facilities are related to the protection or enhancement of wilderness characteristics or are necessary for the management of uses allowed under the land use plan. | Not applicable | | See above |
| | | ● Make lands unavailable for disposal from federal ownership. | | | See above |
| | **LUPA-WC-5** | Manage the following Wilderness Inventory Units to protect wilderness characteristics: | Not applicable | | Based on review of Figure 7 in the LUPA of the DRECP, there are no identified wilderness characteristic areas within the RE Crimson Permitting Boundary. |
| | | ● 132A-2 / 132A-3 / 132B / 136 / 136-1 / 145-1-1 / 145-2-1 / 145-3-1 / 149-2 / 150-2-2 / 158-1 / 158-2 / 159 / 159-1 / 159A-1 / 160 / 160-1 / 160B-2A / 160B-2B / 160B-2F / 160B-3A / 160B-4A / 160B-3B / 160B-4B / 170-1 / 170-3 / 193-1 / 206-1-1 / 206-1-2 / 206-1-3 / 206-1-4 / 222-2-1 / 251-1 / 251-1-1 / 251-1-2 / 251-2-2 / 251-3 / 251A / 252 / 259-1 / 259-2 / 266-1 / 276-1 / 276-3 / 277 / 277A-1 / 278 / 280 / 294-1 / 294-2 / 295 / 295A / 304-2 / 305-1 / 305-2 / 307-1 / 307-2 / 307-1-1 / 307-1-2 / 307-1-3 / 312-1 / 312-2 / 312-3 / 322-1 / 325-1 / 325-2 / 325-3 / 325-4 / 325-5 / 325-7 / 325-8 / 315-14 / 325-17 / 329 / 352-2 / 352A / 352A-1 / 354 / 355-1 / 355-2 / 355-3 | Not applicable | | See above. |

| DFAs and VPLs | | | | | |
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| **Category** | **CMA #** | **CMA Text** | **Project Applicability** | **Project Consistency. (State either** | **Explanation** |
| **Biological Resources: North American Warm Desert Dune and Sand Flats** | **DFA-VPL-BIO-DUNE-1** | Activities in DFAs and VPLs, including transmission substations, will be sited to avoid dune vegetation (i.e., North American Warm Desert Dune and Sand Flats). Unavoidable impacts (see "unavoidable impacts to resources" in the Glossary of Terms) to dune vegetation will be limited to transmission projects, except transmission substations, and access roads that will be sited to minimize unavoidable impacts. | Applicable | Consistent | BRTR Says RE Crimson Permitting Boundary was designed to avoid active sand dunes to reduce Mojave fringe-toed lizard impacts but some dune habitat would be impacted. Consistent with BRTR Measures BIO-47 and BIO-48 (which says impacts to dune habitat associated with Mojave fringe-toed lizards will be minimized or compensated for via mitigation). |
| | | • For unavoidable impacts (see "unavoidable impacts to resources" in the Glossary of Terms) to dune vegetation, the following will be required: | Applicable | Consistent | See below comments. |
| | | o Access roads will be unpaved. | Applicable | Consistent | According to the Proposed Action, all new access roads within the RE Crimson Permitting Boundary will be unpaved. |
| | | o Access roads will be designed and constructed to be at grade with the ground surface to avoid inhibiting sand transportation. | Applicable | Consistent | Consistent with BRTR Measure BIO-47 (roads will be kept at grade to avoid blocking sand transport). |
| | **DFA-VPL-BIO-DUNE-2** | Within Aeolian corridors that transport sand to dune formations and vegetation types downwind inside and outside of the DFAs, all activities will be designed and operated to facilitate the flow of sand across activity sites, and avoid the trapping or diverting of sand from the Aeolian corridor. Buildings and structures within the site will take into account the direction of sand flow and, to the extent feasible, build and align structures to allow sand to flow through the site unimpeded. Fences will be designed to allow sand to flow through and not be trapped. | Applicable | Inconsistent | A draft sand transport study (published in April 2018) concluded the project could impact sand transport and mitigation could be necessary. No mitigation has been proposed thus far. |
| **Individual Focus Species (IFS): Desert Tortoise** | **DFA-VPL-BIO-IFS-1** | To the maximum extent practicable (see Glossary of Terms), activities will be sited in previously disturbed areas, areas of low quality habitat, and areas with low habitat intactness in desert tortoise linkages and the Ord-Rodman TCA, identified in Appendix D. | Applicable | Consistent | Since the project site is not mountainous, the RE Crimson Project is sited in an area that is low quality desert tortoise habitat. The RE Crimson Project is not located within the Ord-Rodman TCA. |
| **Mohave Ground Squirrel** | **DFA-VPL-BIO-IFS-2** | Within the Mohave ground squirrel range configure solar panel and wind turbine arrays to allow areas of native vegetation that will facilitate Mohave ground squirrel movement through the project site. This may include raised and/or rotating solar panels or open space between rows of panels or turbines. Fences surrounding sites should be permeable for Mohave ground squirrels. | Not Applicable | | The Mohave ground squirrel was not identified as a species occurring on the project site. |
| **Bats** | **DFA-VPL-BIO-BAT-1** | Wind projects will not be sited within 0.5 mile of any occupied or presumed occupied maternity roost. | Not applicable | | The proposed project is not a wind project. |
| **Fire Prevention/Protection** | **DFA-VPL-BIO-FIRE-1** | Implement the following standard practice for fire prevention/protection: | Not applicable | Inconsistent | See below comment |
| | | • Implement site-specific fire prevention/protection actions particular to the construction and operation of renewable energy and transmission project that include procedures for reducing fires while minimizing the necessary amount of vegetation clearing, fuel modification, and other construction-related activities. At a minimum these actions will include designating site fire coordinators, providing adequate fire suppression equipment (including in vehicles), and establishing emergency response information relevant to the construction site. | Applicable | Inconsistent | Partially consistent with BRTR Measures BIO-17 (fire suppression equipment) and BIO-36 (emergency response to fires). However, no existing mitigation includes specifically minimizing vegetation clearing or designating a site fire coordinator. |
| **Biological Compensation** | **DFA-VPL-BIO-COMP-1** | Impacts to biological resources from all activities in DFAs and VPLs will be compensated using the same ratios and strategies as LUPA-BIO-COMP-1 through 4, with the exception identified below in DFA-VPL-BIO-COMP-2. | Not applicable | | See below comment for DFA-VPL-BIO-COMP-2. |
| | **DFA-VPL-BIO-COMP-2** | Exception to the biological resources standard compensation ratio of 1:1 - desert tortoise intact linkage habitat compensation ratio of 2:1 applies to the identified modeled intact linkage habitat (Appendix D) in two linkages—Ord-Rodman critical habitat unit to Joshua Tree National Park, and Fremont-Kramer critical habitat unit to the Ord-Rodman critical habitat unit, as identified in Appendix D. Maintenance and enhancement of the function of these two linkages is essential to the function of the Ord-Rodman critical habitat unit. | Not applicable | | DFA-VPL-BIO-COMP-2 does not apply to the RE Crimson Solar Project since the Project is not located within the Ord-Rodman critical habitat unit to Joshua Tree National Park, and Fremont-Kramer critical habitat unit to the Ord-Rodman critical habitat unit linkages. |
| **Comprehensive Trails and Travel Management** | **DFA-VPL-CTTM-1** | Avoid Tier 1, Tier 2, Tier 3 roads/primitive roads/trails, Backcountry Byways, and other significant linear features (as defined in the LUPA-wide CMAs). If avoidance is not practicable, relocate access to the same or higher standard and maintain the recreation setting characteristics and access to recreation activities, facilities, and destination. | Not applicable | | The Bradshaw Trail Backcountry is located 1.75 miles to the south of the permitting boundary. No other BLM Backcountry Byways or other significant linear features are located in the project area. The project site would include an existing paved Power Line road but would maintain the road area for project use. |
| | **DFA-VPL-CTTM-2** | If residual impacts to Tier 1 and Tier 2 roads/primitive roads/trails, Backcountry Byways, or other significant linear features cannot be protected and maintained, commensurate compensation in the form of an enhanced recreation operations, recreation facilities or opportunities will be required. **Cultural Resources and Tribal Interests** | Not applicable | | See above comment DFA-VPL-CTTM-2 |

| DFAs and VPLs | | | | | |
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| **Category** | **CMA #** | **CMA Text** | **Project Applicability** | **Project Consistency. (State either** | **Explanation** |
| **Cultural Resources and Tribal Interests** | | BLM developed and maintains a geodatabase for Cultural Resources and Cultural Resources investigations in a GIS. The geodatabase is regularly updated with newly recorded and re-recorded resource and investigation data. However, while the geodatabase includes location information (feature classes or shapefiles), the associated information about each resource or investigation (attribute data) is limited or inconsistent. As it exists now, the geodatabase cannot be used for predictive analyses like those recommended in *A Strategy for Improving Mitigation Policies and Practices of the Department of the Interior* (DOI 2014). However, with some updates, the geodatabase will be a powerful tool for identifying potential conservation priorities as well as development opportunities. Many of the CMAs below are intended to facilitate the update of BLM's geodatabase, and require its use when the updates are complete.<br><br>The following CMAs are for renewable energy and transmission land use authorizations only, in DFAs and VPLs. All other activities in DFAs and VPs are subject to the NHPA Section 106 process. | | | |
| | **DFA-VPL-CUL-1** | For renewable energy activities and transmission, require the applicant to pay all appropriate costs associated with the following processes, through the appropriate BLM funding mechanism: | | | |
| | | • All appropriate costs associated with the BLM's analysis of the DRECP geodatabase and other sources for cultural resources sensitivity. | Applicable | Consistent | |
| | | • All appropriate costs associated with preliminary sensitivity analysis. | Applicable | Consistent | |
| | | • All appropriate costs associated with the Section 106 process including the identification and defining of cultural resources. These costs may also include logistical, travel, and other support costs incurred by tribes in the consultation process. | Applicable | Consistent | |
| | | • All appropriate costs associated with updating the DRECP cultural resources geodatabase with project specific results. | Applicable | consistent | |
| | **DFA-VPL-CUL-2** | Consistent and in compliance with the NHPA Programmatic Agreement, signed February 5, 2016, or the most up to date signed version -for renewable energy activities and transmission, a compensatory mitigation fee will be required within the LUPA Decision Area to address cumulative and some indirect adverse effects to historic properties. The mitigation fee will be calculated in a manner that is commensurate to the size and regional impacts of the project. Refer to the Programmatic Agreement for details regarding the mitigation fee. | Not applicable | | Agency responsibility |
| | **DFA-VPL-CUL-3** | For renewable energy activities and transmission, the management fee rate will be determined through the NHPA programmatic Section 106 consultation process that will be completed as part of the DRECP land use plan amendment. | Not applicable | | Agency responsibility |
| | **DFA-VPL-CUL-4** | For renewable energy activities and transmission, demonstrate that results of cultural resources sensitivity, based on the DRECP geodatabase, and other sources, are used as part of the initial planning pre-application process and to select of specific footprints for further consideration. | Applicable | Inconsistent | The Project's POD does not mention a review of the DRECP geodatabase as a consideration in initial planning |
| | **DFA-VPL-CUL-5** | For renewable energy activities and transmission, provide a statistically significant sample survey as part of the pre-application process, unless the BLM determines the DRECP geodatabase and other sources are adequate to assess cultural resources sensitivity of specific footprints. | Applicable | Consistent | A Class III inventory of the direct effects APE was conducted; the inventory consists of a systematic pedestrian survey of the direct effects APE |
| | **DFA-VPL-CUL-6** | For renewable energy activities and transmission, provide justification in the application why the project considerations merit moving forward if the specific footprint lies within an area identified or forecast as sensitive for cultural resources by the BLM. | Applicable | Inconsistent | The Project's POD provides no justification moving forward with the Project though the Project site is sensitive for cultural resource; however, the POD proposes design alternatives that would reduce impacts to potential subsurface archaeological resources. |
| | **DFA-VPL-CUL-7** | For renewable energy activities and transmission, complete the NHPA Section 106 Process as specified in 36 CFR Part 800, or via an alternate procedure, allowed for under 36 CFR Part 800.14 prior to issuing a ROD or ROW grant on any utility-scale renewable energy or transmission project. For utility-scale solar energy developments, the BLM may follow the Solar Programmatic Agreement. | Not applicable | | Agency responsibility |
| **Livestock Grazing** | **DFA-VPL-LIVE-1** | Avoid siting solar developments in active livestock grazing allotments. If a ROW is granted for solar development in an active livestock grazing allotment, prior to solar projects being constructed in active livestock allotments, an agreement must be reached with the grazing permittee/lessee on the 2-year notification requirements. If any rangeland improvements such as, but not limited to, fences, corrals, or water storage projects, are to be impacted by energy projects, reach agreement with the BLM and the grazing permittee/lessee on moving or replacing the range improvement. This may include the costs for NEPA, clearances, and materials. | Not applicable | | There are no grazing allotments on the Project site, and no grazing is proposed. |
| | **DFA-VPL-LIVE-2** | In California Condor use areas, wind energy ROWs will include a term and condition requiring the permittee and wind operator to eliminate grazing of livestock. | Not applicable | | There are no grazing allotments on the Project site, and no grazing is proposed. |
| | **DFA-VPL-LIVE-3** | Include no surface occupancy stipulation on geothermal leases in active grazing allotments. | Not applicable | | There are no grazing allotments on the Project site, and no grazing is proposed. |

| DFAs and VPLs | | | | | |
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| **Category** | **CMA #** | **CMA Text** | **Project Applicability** | **Project Consistency. (State either** | **Explanation** |
| **Vegetation** | **DFA-VPL-VEG-1** | Vegetative Use Authorizations: Commercial collection of seed in DFAs and VPLs is an allowable use. CMA's within these areas apply to this kind of activity. | Not applicable | | According to the Proposed Action, commercial collection of seed is not proposed. |
| **Visual Resources Management** | **DFA-VPL-VRM-1** | Encourage development in a planned fashion within DFAs (e.g., similar to the planned unit development concept used for urban design—i.e., in-fill vs. scattered development, use of common road networks, Generator Tie Lines etc., use of similar support facility designs materials and colors etc.) to avoid industrial sprawl. | Applicable | Consistent | The Project would be located within a DRECP LUPA-designated DFA, and in combination with neighboring projects (e.g., Desert Quartzite) would achieve an in-fill development pattern with the exception of areas avoided to preserve sensitive resources. These projects would use a common road network and gen tie corridor to the extent practicable based on the locations of existing infrastructure, and would use materials and colors approved by BLM landscape architects. |
| | **DFA-VPL-VRM-2** | Development in DFAs and VPLs are required to incorporate visual design standards and include the best available, most recent BMPs, as determined by BLM (e.g. Solar, Wind, West Wide Energy Corridor, and Geothermal PEISs, the "*Best Management Practices for Reducing Visual Impacts of Renewable Energy Facilities on BLM-Administered Lands*", and other programmatic BMP documents). | Applicable | Consistent | Project-specific mitigation measures require adherence to visual design standards outlined in "Best Management Practices for Reducing Visual Impacts of Renewable Energy Facilities on BLM-Administered Lands" with review and approval by BLM landscape architects. |
| | **DFA-VPL-VRM-3** | **Required Visual Resource BMPs.** All development within the DFAs and VPLs will abide by the BMPs addressed in the most recent version of the document "*Reducing Visual Impacts of Renewable Energy Facilities on BLM-Administered Lands*", or its replacement, including, but not limited to the following:<br>● Transmission:<br>o Color-treat monopoles Shadow Gray per the BLM Environmental Color Chart CC001 unless a more effective color choice is selected by the local Field Office VRM specialist.<br>o Lattice towers and conductors will have non-specular qualities.<br>o Lattice Towers will be located a minimum of 3/4 miles away from Key Observation Points such as roads, scenic overlooks, trails, campgrounds, navigable rivers and other areas people tend to congregate and located against a landscape backdrop when topography allows.<br>● Solar – Color treat all facilities Shadow Gray from the BLM Environmental Color Chart CC001 unless a more effective color is selected by the Field Office VRM specialist, including but not limited to:<br>o Concentrated solar thermal parabolic trough panel backs<br>o Solar power tower heliostats<br>o Solar power towers<br>o Cooling towers<br>o Power blocks<br>● Wind – Color treat all facilities Shadow Gray with the exception of the wind turbine and towers 200 vertical feet or more.<br>● Night Sky – BMPs to minimize impacts to night sky including light shielding will be employed | Applicable | Consistent | Project-specific mitigation measures require adherence to visual design standards outlined in "Best Management Practices for Reducing Visual Impacts of Renewable Energy Facilities on BLM-Administered Lands" with review and approval by BLM landscape architects. Color treatment of all project facilities would be approved by BLM VRM specialist, and BMPs to minimize night sky impacts are required. |

| Development Focus Areas | | | | | |
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| Category | CMA # | CMA Text | Project Applicability | Project Consistency. | Explanation |
| **Renewable Energy** | **DFA-RE-1** | In order to use the DRECP's BLM LUPA streamlined process for renewable energy in DFAs and transmission, project proponents must first consult with appropriate representatives of the Department of Defense to ensure the proposed renewable energy and/or transmission activity will not cause an unacceptable risk to national security. Refer to additional detail in LUPA Section IV.4 and Appendix E. Specifically, the following process will be implemented: | | | |
| | | • For renewable energy and transmission activities proposed in red areas (see Appendix E), the DRECP BLM LUPA streamlined process will not be available unless a letter is obtained from the Department of Defense Siting Clearinghouse stating that military impacts have been mitigated. | Not applicable | | The Proposed Action is not located in any red areas as shown in Appendix E of the LUPA Section IV.4. |
| | | • For renewable energy and transmission activities proposed in orange or yellow areas (see Appendix E), the DRECP BLM LUPA streamlined process will be not be available until Department of Defense representatives at the regional level have been consulted and have been provided a minimum of 30 days to assess potential mission impacts. If the regional representatives conclude within the 30 day period that there is a significant possibility that a proposed activity presents an unacceptable risk to national security, the BLM will not streamline the proposed activity process and will require additional environmental analysis regarding Department of Defense impacts, unless a letter is obtained from the Department of Defense Siting Clearinghouse stating that military impacts have been mitigated. | Not applicable | | The Proposed Action is not located in any orange or yellow areas as shown in Appendix E of the LUPA Section IV.4. |
| **Biological Resources** | **DFA-BIO-IFS-1** | Conduct the following surveys as applicable in the DFAs as shown in Table 21. | Applicable | Consistent | The RE Crimson Project has already completed biological surveys for the species listed in Table 21 that were determined to have a potential to occur. These surveys are detailed in the BRTR. |
| | **DFA-BIO-IFS-2** | Implement the following setbacks shown below in Table 22 as applicable in the DFAs. | Applicable | Consistent | There are no species in Table 22 within the RE Crimson Permitting Boundary where setbacks are necessary. |
| **Desert Tortoise** | **DFA-BIO-IFS-3** | Protocol surveys, as described in **DFA-BIO-IFS-1** and shown in Table 21, are required for development in the desert tortoise survey areas (see Appendix D). Based on the results of the protocol surveys the identified desert tortoises will be translocated, or the activity will be redesigned/relocated as described below: | Applicable | Inconsistent | Surveys were conducted in 2012 and 2016 and there are fewer than 35 desert tortoise within the RE Crimson Permitting Boundary. See below comment explaining inconsistency. |
| | | • If protocol surveys identify 35 or fewer desert tortoises in potential impact areas on an activity site, the USFWS and CDFW (for third party activities) will be contacted and provided with the protocol survey results and information necessary for the translocation of identified desert tortoises. Pre-construction and construction, and other activities will not begin until the clearance surveys for the site have been completed and the desert tortoises have been translocated. Translocation will be conducted in coordination with the USFWS and CDFW, as appropriate, per the protocols in the Desert Tortoise Field Manual (USFWS 2009) and the most up-to-date USFWS protocol. | Applicable | Inconsistent | BRTR Measure BIO-28 says clearance surveys would be conducted following installation of the desert tortoise exclusion fence, but this CMA requires clearance surveys to happen before all pre-construction and construction activities. |
| | | • If protocol surveys identify an adult desert tortoise density (i.e., individuals 160 millimeters or more) of more than 5 per square mile or more than 35 individuals total on a project site, the project will be required to be redesigned, re-sited, or relocated to avoid and minimize the impacts of the activity on desert tortoise. | Not applicable | | There are fewer than 35 desert tortoise within the RE Crimson Permitting Boundary. |
| **Mohave Ground Squirrel** | **DFA-BIO-IFS-4** | The DFA in the "North of Edwards" Mohave ground squirrel key population center is closed to renewable energy applications and any activity that is likely to result in the mortality (killing) of a Mohave ground squirrel until Kern and San Bernardino counties complete county General Plan amendments/updates that include renewable energy development and Mohave ground squirrel conservation on nonfederal land in the West Mojave ecoregion and the CDFW releases a final Mohave Ground Squirrel Conservation Strategy, or for a period of 5 years after the signing of the DRECP LUPA ROD, whichever comes first. If Kern and San Bernardino counties and CDFW do not complete their respective plans within the 5-year period, prior to opening the DFA to renewable energy applications and other impacting activities, BLM will assess new Mohave ground squirrel information, in coordination with the CDFW, to determine if modifications to the DFA or CMAs are warranted based on new Mohave ground squirrel information. | Not applicable | | No Mohave ground squirrels or potential Mohave ground squirrel habitat were detected in the RE Crimson Permitting Boundary. Proposed Action is located in Riverside County and outside of Kern or San Bernardino Counties. |
| | **DFA-BIO-IFS-5** | Once the planning criteria in CMA **DFA-BIO-IFS-4**, are met, the DFA in the "North of Edwards" Mohave ground squirrel key population center will be reevaluated. If Kern and San Bernardino counties receive Mohave ground squirrel take authorizations from the CDFW through completed Natural Community Conservation Plans or county-wide conservation strategies that address Mohave ground squirrel conservation at a landscape level and include renewable energy development areas on nonfederal land in the West Mojave ecoregion, the "North of Edwards" key population center DFA will be eliminated and the management changed to General Public Lands, as part of adaptive management. | Not applicable | | See above comment; DFA-BIO-IFS-4 is not applicable. |
| **Plants** | **DFA-BIO-PLANT-1** | Impact to suitable habitat (see Glossary of Terms) for the following plant Focus Species within the DRECP Plan Area will be capped (see "DFA Suitable Habitat Impacts Cap" in the Glossary of Terms) in the DFAs as described below and in Table 23. The suitable habitat impact cap for these plant species is to be measured in DFAs as a group, not individually. | Not applicable | | None of the plant species listed in Table 23 occur within the RE Crimson Permitting Boundary. |
| | | Triple-ribbed milk-vetch is an avoidance species in DFAs, therefore none of its suitable habitat is to be impacted. | Not applicable | | This plant species was not detected in the project area according to Appendix F of the BRTR. |
| **Recreation** | **DFA-REC-1** | Retain, to the extent possible, the identified recreation setting characteristics: physical components of remoteness, naturalness and facilities; social components of contact, group size and evidence of use; and operational components of access, visitor services and management controls (see recreation setting characteristics matrix). | Not applicable | | There are no recreational resources in the project area, where implementation of the Proposed Action would affect the existing recreation setting characteristics. |

| Development Focus Areas | | | | | |
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| **Category** | **CMA #** | **CMA Text** | **Project Applicability** | **Project Consistency.** | **Explanation** |
| | **DFA-REC-2** | Avoid large-scale ground disturbance within one-half mile of Level 3 | Not applicable | | The project is not in a SRMA or ERMA or Level 1, 2, and 3 Recreation Facilities. Within 0.5-miles of the Project Area, only Mule Mountains ACEC and Chuckwalla Valley Dune Thicket ACEC are designated recreational areas; however, these are not considered Level 3 Recreational Facilities. In addition, the Bradshaw Trail Backcountry is located 1.75 miles to the south of the permitting boundary. No other BLM Backcounty Byways or other significant linear features are located in the project area. The project site would include an existing paved Power Line road but would maintain the road area for project use. |
| | **DFA-REC-3** | SRMAs are exclusion areas for renewable energy development due to the incompatibility with the values of SRMAs. Two exceptions to this management action are: | | | |
| | | 1. geothermal development is an allowable use in the few instances in Imperial County where a geothermal-only DFA overlays the SRMA designation and the lease includes a "no surface occupancy" stipulation, with exception of three specific parcels in the Ocotillo Wells SRMA (the Special Unit Management Plan in Appendix C) | Not applicable | | The Proposed Action doesn't include geothermal development. |
| | | 2. the VPL at Antimony Flat in Kern County overlaying the SRMA, renewable energy may be allowed on a case-by-case basis if the proposed project is found to be compatible with the specific SRMA values. | Not applicable | | The Proposed Action isn't located in Kern County. |
| | **DFA-REC-4** | When considering large-scale development in DFAs, retain to the extent possible existing, approved recreation activities. | Applicable | Consistent | There are no recreational resources in the project area and implementation of mitigation measures Rec-1 and Rec-2 would minimize effects on surrounding recreational resources. |
| | **DFA-REC-5** | For displacement of dispersed recreation opportunities, commensurate compensation in the form of enhanced recreation operations, recreation facilities or opportunities will be required. If recreation displacement results in resource damage due to increased use in other areas, mitigate that damage through whatever measures are most appropriate as determined by the Authorized Officer. | Applicable | Consistent | Consistent with Mitigation Measure REC-1 (requires notification of penalties for any off-route OHV activities to deter off-route travel). |
| | **DFA-REC-6** | Where activities in DFAs displace authorized facilities, similar new recreation facilities/campgrounds (including but not limited to the installation of new structures including pit toilets, shade structures, picnic tables, installing interpretive panels, etc.), will be provided. | Not applicable | | The Proposed Action area doesn't include any recreational facilities and thus implementation of the Proposed Action would not displace any existing authorized recreational facilities. |
| | **DFA-REC-7** | If designated vehicle routes are directly impacted by activities (includes modification of existing route to accommodate industrial equipment, restricted access or full closure of designated route, pull outs, and staging area's to the public, etc.), mitigation will include the development of alternative routes to allow for continued vehicular access with proper signage, with a similar recreation experience. In addition, mitigation will also include the construction of an "OHV touring route" which circumvents the activity area and allows for interpretive signing materials to be placed at strategic locations along the new touring route, if determined to be appropriate by BLM. | Applicable | Consistent | Consistent with Mitigation Measure REC-1 (requires notification of penalties for any off-route OHV activities to deter off-route travel). The Bradshaw Trail Backcountry is located 1.75 miles to the south of the permitting boundary. No other BLM Backcounty Byways or other significant linear features are located in the project area. The project site would include an existing paved Power Line road but would maintain the road area for project use. |
| | **DFA-REC-8** | Impacts from activities in a DFA to Special Recreation Permit activities will be mitigated by providing necessary planning and NEPA compliance documentation for Special Recreation Permit replacement activities, as determined appropriate on a case-by case basis. | Not applicable | | Implementation of the Proposed Action would not impact any Special Recreation Permit activities. |
| | **DFA-REC-9** | If residual impacts to SRMAs occur from activity impacts in a DFA, commensurate mitigation through relocation or replacement of facilities or compensation (in the form of a recreation operations and enhancement fund) will be required. | Not applicable | | The project is not in a SRMA. |
| | **DFA-REC-10** | Within ERMAs, impacts from development projects that do not enhance conservation or recreation goals will require commensurate mitigation through relocation or replacement of facilities. | Not applicable | | The project is not in an ERMA. |
| **Lands and Realty** | **DFA-LANDS-1** | Lands within DFAs are available for disposal. | Not applicable | | The Proposed Action does not include disposal of lands. |
| | **DFA-LANDS-2** | Development of acquired lands within DFAs is allowed, at the discretion of the BLM California State Director, unless development is incompatible with the purposes of the acquisition and any applicable deed restrictions. | Not applicable | | No deed requirements for donated and/or acquired lands. |
| | **DFA-LANDS-3** | Lands proposed for exchange in DFAs will be segregated from the public land laws for 5 years, but wind, solar, geothermal and transmission applications and their associated facilities are allowed. | Not applicable | | The Proposed Action does not include lands proposed for exchange, and would be in an allowable use category (solar and transmission). |
| | **DFA-LANDS-4** | Review withdrawn lands in DFAs upon receipt of a ROW application and if appropriate modify to allow for issuance of ROW grants. | Applicable | Consistent | There are lands in the BLM WDL category for 20E sections 1,2,11, 12, and 24 including the access route and the northwest portion of the project. |
| | **DFA-LANDS-5** | Cost recovery funding used to process a ROW application may be used to adjudicate and remedy any conflicting land withdrawals, if necessary. | Applicable | Consistent | There are lands in the BLM WDL category for 20E sections 1,2,11, 12, and 24 including the access route and the northwest portion of the project. |

| Development Focus Areas | | | | | |
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| **Category** | **CMA #** | **CMA Text** | **Project Applicability** | **Project Consistency.** | **Explanation** |
| | **DFA-LANDS-6** | Make public lands in DFAs available for selection by the CSLC in lieu of base lands within DFAs. Base lands are School Lands the State of California was entitled to but did not receive title to due to prior existing encumbrances. | Not applicable | | Not applicable to current Proposed Action to develop a solar facility. |
| | **DFA-LANDS-7** | Transmission facilities are an allowable use and will not require a plan amendment within DFAs. | Applicable | Consistent | The gen-tie is an allowable use; however, the EIS explains why a Plan Amendment is applicable to the Proposed Action. |
| **Visual Resources Management** | **DFA-VRM-1** | Manage all DFAs as VRM Class IV to allow for industrial scale development. Employ best management practices to reduce visual contrast of facilities. | Applicable | Consistent | Most of the Project site is within VRM Class IV, and development of the Project would be consistent with management objectives for Class IV. Mitigation measures require the use of BMPs to minimize contrast. |
| | **DFA-VRM-2** | Regional mitigation for visual impacts is required in DFAs . Mitigation is be based on the VRI class and the underlying visual values (scenic quality, sensitivity, and distance zone) for the activity area as it stands at the time the ROD is signed for the DRECP LUPA. Compensatory mitigation may take the form of reclamation of other BLM lands to maintain (neutral) or enhance (beneficial) visual values on VRI Class II and III lands. Other considerations may include acquisition of conservation easements to protect and sustain visual quality within the viewshed of BLM lands. The following mitigation ratios will be applied in DFAs:<br>• VRI Class II 1:1 ratio<br>• VRI Class III ½ (0.5) : 1 ratio<br>• VRI Class IV, no mitigation required<br>Additional mitigation will be required where activities affect viewsheds of specially designated areas (e.g., National Scenic and Historic Trails). | Applicable | Inconsistent | The VRI class applicable to the Project site is Class II. No compensatory mitigation is proposed. |
| **Wild Horses and Burros** | **DFA-WHB-1** | Incorporate all guidance provided by the Wild Free-Roaming Horses and Burros Act of 1971, its amendments, associated regulations, and any pertinent court rulings into the project/activity proposal, as appropriate. | Applicable | Consistent | The Proposed Action would develop a solar project within the boundaries of a herd area, which the BLM allows under its multiple use objectives. The Proposed Action would incorporate DRECP |
| | **DFA-WHB-2** | Development that would reduce burros' access to forage, water, shelter, or space or impede their wild, free-roaming behavior in Herd Management Area is not allowed | Applicable | Consistent | The Proposed Action would develop a solar project within the boundaries of a herd area, which the BLM allows under its multiple use objectives. The Proposed Action would incorporate DRECP CMAs DFA-WHB-1 through DFA-WHB-3 in order to minimize possible effects on wild horses and burros. |
| | **DFA-WHB-3** | Mitigation can only occur on lands that the animals were found at the passage of the Wild Free-Roaming Horses and Burros Act of 1971. Expansion of the boundaries of a Herd Management Area back into the Herd Areas would require a land use plan amendment, the cost of which would be incurred by the applicant proposing to develop in the Herd Management Area, if part of the proposed mitigation package. | Applicable | Consistent | The Proposed Action would develop a solar project within the boundaries of a herd area, which the BLM allows under its multiple use objectives. The Proposed Action would incorporate DRECP CMAs DFA-WHB-1 through DFA-WHB-3 in order to minimize possible effects on wild horses and burros. |
| **Wilderness Characteristics** | **DFA-WC-1** | Renewable energy activities are allowed in DFAs that have been inventoried and identified as lands with wilderness characteristics. | Not applicable | | Based on review of Figure 7 in the LUPA of the DRECP, there are no identified wilderness characteristic areas within the RE Crimson Permitting Boundary. |
| | **DFA-WC-2** | For inventoried lands found to have wilderness characteristics in DFAs, compensatory mitigation is required at a 1:1 ratio if wilderness characteristics are directly impacted. This may be accomplished through acquisition and donation, from willing landowners, to the federal government of (a) wilderness inholdings, (b) wilderness edge holdings that have inventoried wilderness characteristics, or (c) other areas within the LUPA Decision Area that are managed to protect wilderness characteristics. Restoration of impaired wilderness characteristics in Wilderness, Wilderness Study Area, and lands managed to protect wilderness characteristics could be substituted for acquisition. | Not applicable | | Based on review of Figure 7 in the LUPA of the DRECP, there are no identified wilderness characteristic areas within the RE Crimson Permitting Boundary. |

# Appendix G
CDCA Plan Consistency

# APPENDIX G
# CDCA Plan Consistency

The Proposed Action site is within the Bureau of Land Management's (BLM's) California Desert District and within the planning boundaries of the California Desert Conservation Area (CDCA) Plan. The Project site is currently classified as Multiple-Use Class (MUC) Moderate (M) in the CDCA Plan. The BLM has determined that a CDCA Plan amendment would be required in order to process an application for a right-of-way (ROW) for the Project. The Desert Renewable Energy Conservation Plan (DRECP) recognizes the Project as a "pending" ROW application (BLM 2016, pages 68 and 69) not subject to the DRECP Land Use Plan Amendment (LUPA). Therefore, if the BLM elects to approve the ROW grant for the Project or an action alternative, a Project-specific CDCA Plan amendment would be required to identify the site as suitable for the proposed type of solar energy use.

The CDCA Plan would also need to be amended to allow the construction of the portion of gen-tie line that would be sited outside of the nearby BLM Utility Corridor K and Section 368 Federal Energy Corridor 30-52 (referred to as Corridor K/30-52 in this Draft Plan Amendment (PA) and Environmental Impact Statement (EIS)/Environmental Impact Report (EIR)) (AECOM 2018). If the BLM elects to approve the ROW grant for the Project or an action alternative, a Project-specific plan amendment would be required to authorize the gen-tie corridor.

The process for considering amendments to BLM land use plans is described in the agency's Land Use Planning Handbook (BLM 2005). The general process for amending a BLM Land Use Plan is as follows:

1. The plan amendment process would be completed in compliance with Federal Land Policy and Management Act of 1976 (FLPMA), National Environmental Policy Act (NEPA), and all other relevant federal law, executive orders, and BLM management policies.
2. The plan amendment process would include an EIS to comply with NEPA.
3. Where existing planning decisions remain valid, those decisions may remain unchanged and would be incorporated into the new plan amendment.
4. The plan amendment would recognize valid existing rights.
5. Native American tribal consultations would be conducted in accordance with policy, and tribal concerns would be given due consideration.
6. Consultation with other agencies with jurisdiction would be conducted throughout the plan amendment process.

The PA process is outlined in Chapter 7 of the CDCA Plan. The amendment would be a Category 3 amendment, because it addresses a specific use or activity that is not currently authorized by an existing plan element. In analyzing an Applicant's request for amending or changing the CDCA Plan, the BLM District Manager will:

1. Determine if the request has been properly submitted and if any law or regulation prohibits granting the requested amendment.
2. Determine if alternative locations within the CDCA are available which would meet the Applicant's needs without requiring a change in the Plan's classification, or an amendment to any Plan element.
3. Determine the environmental effects of granting and/or implementing the Applicant's request.
4. Consider the economic and social impacts of granting and/or implementing the Applicant's request.

5. Provide opportunities for and consideration of public comment on the proposed amendment, including input from the public and from federal, state, and local government agencies.
6. Evaluate the effect of the proposed amendment on BLM management's desert-wide obligation to achieve and maintain a balance between resource use and resource protection.

Details concerning the proposed PA for the Proposed Action or one of the other action alternatives are provided in Section 2.4. This Draft PA/EIS/EIR acts as the mechanism for satisfying NEPA requirements for the PA process, and provides the analysis required to support a PA to identify the proposed Project site and gen-tie line location as suitable or unsuitable for solar development within the Plan.

All of the BLM-administered lands proposed for use by the Project and alternatives are classified in the CDCA Plan as Class M. MUC designations govern the type and degree of land uses allowed within the classification area. All land use actions and resource management activities on BLM-administered lands within a MUC delineation must meet the guidelines for that class. These guidelines are provided in Table 1, Multiple-Use Class Guidelines, of the CDCA Plan.

The MUC-M designation allows electric generation plants for solar facilities to be developed in accordance with federal, state, and local regulations after NEPA requirements are met. The specific application of the MUC designations and resource management guidelines for a specific resource or activity are further discussed in the plan elements section of the CDCA Plan. MUC-M designations are based upon a controlled balance between higher-intensity use and protection of public lands. This class provides for a wide variety or present and future uses such as mining, livestock grazing, recreation, energy, and utility development. Class M management is also designed to conserve desert resources and to mitigate damage to those resources that permitted uses may cause.

For purposes of this discussion, the terminology "Proposed Action and alternatives" is used herein since the classification of the BLM-administered portion of the site of the Proposed Action and Alternatives 2 and 3 would be the same (MUC-M).

# Agriculture

Agricultural uses of MUC-M lands are not allowed, with the exception of livestock grazing. The BLM lands associated with the Project are not currently used for agriculture, and the Project would not involve use of the site for agriculture.

# Air Quality

MUC-M lands are to be managed to protect air quality and visibility in accordance with Class II objectives of Title I, Part C, of the Clean Air Act (CAA) as amended. The estimated maximum daily and annual construction emissions that would be associated with the Proposed Action and alternatives are provided in Tables 3.2-2 and 3.2-3 for the Proposed Action, and Tables 3.2-7 and 3.2-8 for Alternative B in Section 3.2, Air Resources. The analysis indicates that the annual emissions for all pollutants would be below the respective *de minimis* levels (below 100 tons/year), except for $NO_x$ and $PM_{10}$, which would exceed the *de minimis* level. The projected exceedance of the $NO_x$ and $PM_{10}$ Mojave Desert Air Quality Management District (MDAQMD) emissions threshold would also contribute to the non-attainment for both air pollutants in the area under California Ambient Air Quality Standards (CAAQS). The emission estimates in Table 3.2-5 show that emissions from operation and maintenance of the Project would all be below MDAQMD thresholds and *de minimis* levels. Impacts associated with operation and maintenance of the Project would not be expected to result in or contribute to an exceedance of a National Ambient Air Quality Standards (NAAQS) or CAAQS. The magnitude of the impacts of decommissioning emissions are expected to be significantly less than those estimated for Project construction, since decommissioning would occur after at least 30 years of operation, and it is expected that on-road and off-road equipment engine technology would be far more advanced and cleaner than is currently the case. Therefore, the Project would conform to the CAA Class II objectives referenced in the CDCA Plan MUC guidelines.

## Water Quality

The CDCA Plan states that MUC-M lands are to be managed "to minimize degradation of water resources." Best management practices (BMPs) would be used as part of the Project to keep impacts on water quality minimal and to comply with Executive Order 12088, both of which address federal compliance with pollution control standards (BLM 1980, p. 15). Implementation of surface and groundwater quality BMPs would reduce impacts to water resources and water quality such that no additional mitigation measures would be required and the Project would conform to the CDCA Plan guidelines for MUC-M lands.

## Cultural, Tribal, Historic, and Paleontological Resources

Cultural and paleontological resources are to be preserved and protected within MUC-M lands, and procedures described in 36 CFR 800 are to be observed where applicable. As described in detail in Sections 3.5, Cultural, Tribal, and Historic Resources and 3.11 Paleontological Resources, impacts on cultural and paleontological resources resulting from the construction, operation and maintenance, and decommissioning of the Project would be mitigated and would conform to the MUC Guidelines. Adverse effects on cultural resources listed in or determined eligible for the NRHP would be resolved in accordance with a Memorandum of Agreement (MOA) being prepared for the Project in consultation with the California State Historic Preservation Officer, Native American tribes, and other interested parties in accordance with the National Historic Preservation Act, Section 106.

## Native American Values

Under the MUC-M Guidelines, Native American cultural and religious values are to be protected and preserved, and the appropriate Native American tribes are to be consulted. Consultation with Indian tribes was initiated during the planning phase of the Project and will continue during the NEPA process (Section 3.5, Cultural, Tribal, and Historic Resources, and Chapter 4, Consultation, Coordination, and Public Involvement, describe the Native American consultation processes). Opportunities have been provided by the BLM to allow Native American tribes to identify places and resources of importance to them and to express concerns regarding cultural and religious values that could be affected by the Project.

Adverse effects on any places of traditional cultural or religious importance that are identified by tribes would be resolved in accordance with the MOA being developed for the Project with tribal participation. Potential impacts to and protection of cultural resources are discussed in more

detail in Section 3.5, Cultural, Tribal, and Historic Resources. Collectively, these measures ensure that preservation and protection of Native American cultural and religious values associated with cultural resources is accomplished in accordance with the CDCA Plan MUC-M Guidelines.

## Electrical Generation Facilities

Solar generation may be allowed on MUC-M lands after NEPA requirements are met. This Draft PA/EIS/EIR represents the mechanism for complying with NEPA requirements.

## Transmission Facilities

MUC-M guidelines allow electric transmission to occur in designated ROW corridors. The gen-tie line associated with the Proposed Action would be located directly south of the Southern California Edison Colorado River Substation and would be constructed within a designated ROW corridor. The CDCA Plan requires that all sites associated with power generation or transmission not identified in the Plan be considered through the PA process. Therefore, the BLM would undertake a Project-specific CDCA PA along with the ROW grant for the Proposed Action and applicable Alternatives. Upon BLM's amendment of the CDCA plan for the Proposed

Action and applicable Alternatives, the Project would be fully compliant with the CDCA Plan. This Draft PA/EIS/EIR acts as the mechanism for meeting NEPA requirements, and also provides the analysis required to support a PA identifying the facility within the Plan.

# Communication Sites

Communication sites may be allowed on MUC-M lands after NEPA requirements are met. The Project would not involve installation of communications sites, and therefore would not be affected by the MUC-M guidelines for this land use activity.

# Fire Management

The site is located entirely within a moderate Fire Hazard Severity Zone as recommended by the California Department of Forestry and Fire Protection. Following Project construction, the BLM would be the first responder for any wildland fires and the County for any structural fires that occurred on the Project site. As part of the Project, the Applicant would implement the fire prevention and suppression measures described in Section 3.20, Wildland Fire Ecology. Additionally, as described in Section 3.20, Wildland Fire Ecology, Mitigation Measure FIRE-1 requires the Applicant to prepare and implement a Fire Safety Plan to ensure the safety of workers and the public during Project construction, operation and maintenance, and decommissioning activities. This plan would complement or supplement provisions of the Applicant's proposed Hazardous Materials Management and Emergency Response Plan. The Fire Safety Plan would be provided to the BLM and Riverside County Fire Department (RCFD) for approval before the Applicant receives a Notice to Proceed. The implementation of Mitigation Measure FIRE-1 would prevent fires ignited by the Projects. Should a fire occur in the area that is not specific to the Project facility, it would be addressed by BLM or RCFD, not by the Applicant, and it would be addressed in conformance with the Fire Safety Plan and, therefore, would conform to the MUC guidelines for Fire Management for Class M lands.

# Vegetation

Table 1 of the CDCA Plan includes a variety of guidelines associated with vegetation as follows.

## Vegetation Harvesting

### Native Plants

Commercial or non-commercial removal of native plants in MUC-M areas may be allowed only by permit after NEPA requirements are met, and after development of necessary stipulation. Approval of a ROW grant for the Project would constitute the permit for such removal. The conditions of approval that would be required in a Record of Decision would constitute the stipulations to avoid or minimize impacts from removal of native plants.

### Harvesting by Mechanical Means

Harvesting by mechanical means may be allowed by permit only. However, the collection of seeds to assist with reclamation or the harvesting of areas where the vegetation would be destroyed by other actions as not proposed as part of the Project or as mitigation measures, as the temporary and permanent impacts to vegetation would be minimal. Therefore, the Project would be in conformance with this MUC guideline.

## Rare, Threatened, and Endangered Species, State and Federal

In all MUC areas, all Federal and state-listed species are to be fully protected. In addition, actions that may jeopardize the continued existence of Federally-listed species require consultation with the U.S. Fish and

Wildlife Service (USFWS). As evaluated in Section 3.3, Biological Resources, no federal- or state-listed plants would be affected by the Project.

### Sensitive Plant Species

Sensitive plant species, designated by the BLM, would be given protection in management decisions consistent with BLM's policy for sensitive species management discussed in BLM Manual 6840 (BLM 2008). The objective of this policy is to conserve and/or recover listed species, and to initiate conservation measures to reduce or eliminate threats to BLM sensitive species to minimize the likelihood of and need for listing. Six special-status plants were identified on the Project site, of which one, Harwood's eriastrum (*Eriastrum harwoodii*), is also considered a BLM-sensitive plant. Impacts and mitigation measures associated with this species and other special-status plant species are discussed in Section 3.3, Biological Resources. Mitigation measures included in this Draft PA/EIS/EIR would reduce the number of individuals of the species that would be affected. Because these measures are intended to reduce threats to these species to minimize the likelihood of listing, these measures are in conformance with the MUC guidance in the CDCA Plan.

### Unusual Plant Assemblages

No unusual plant assemblages are designated on the Project site.

## Vegetation Manipulation

### Mechanical Control

Mechanical control may be allowed on MUC-M lands after consideration of possible impacts. Vegetation manipulation is defined in the CDCA Plan as removing noxious or poisonous plants from rangelands, or eliminating introduced plant species.

During construction, operations, and decommissioning phases, the Applicant would abide by noxious weed control procedures as developed in cooperation with the BLM in order to limit the establishment of noxious/invasive vegetation through early detection and eradication measures. The Applicant would finalize the site-specific Weed Management Plan, described in Section 3.3, Biological Resources, prior to a ROW grant being issued. Such actions would be conducted as part of the Project. Vegetation management under the Weed Management Plan would conform to federal, state, and local regulations. Further discussion on the Weed Management Plan is described in Mitigation Measure BIO-16. The full text of the Weed Management Plan is provided in Appendix I in this Draft PA/EIS/EIR.

### Chemical Control

Aerial broadcasting application of chemical controls is not allowed on MUC-M lands. Noxious weed eradication may be allowed after site-specific planning. The Project would not include aerial broadcasting. As described in Section 3.3, Biological Resources, a Weed Management Plan would be used to control invasive and exotic weeds. The full text of the Weed Management Plan is provided in Appendix I in this Draft PA/EIS/EIR.

### Exclosures

Exclosures may be allowed on MUC-M lands. Exclosure is a manipulation technique where livestock and certain wildlife species can be excluded from fenced areas. This procedure provides comparison data and is valuable in the determination of grazing effects of vegetation. The Project would not include exclosures.

### Prescribed Burning

Prescribed burning may be allowed on MUC-M lands after development of a site-specific management plan. The Project would not include prescribed burning.

## Land Tenure Adjustment

MUC-M land may be sold in accordance with FLPMA and other applicable federal laws and regulations. The Project would not involve the sale of any BLM-administered lands.

## Livestock Grazing

Livestock grazing is allowed on MUC-M lands subject to the protection of sensitive resources. The Project would not involve livestock grazing.

## Minerals

The Project would not involve the development of minerals on MUC-M lands.

## Motorized Vehicle Access/Transportation

Pursuant to the CDCA MUC guidelines for MUC-M areas, new roads and routes may be developed under ROW grants or approved plans of operation, and periodic or seasonal closures or limitations of routes of travel may be required. One major designated open route, MM703 or Powerline Road, is an east-west open route along the northern boundary of the Project site. Open route MM703 does not traverse the proposed location of the Project's solar panels, and the proposed solar development would not require closure of open route MM703. Access to open route MM703 is obtained through open route MM1086 to the northwest of the Project site, and connects to Interstate-10. Open route MM703 connects users to open routes MM1094 and MM1094 just southeast of the Project site. Off-highway-vehicle routes are described in Section 3.12, Recreation and Public Access (Off-Highway Vehicles).

## Recreation

The Project would not involve use of the Project site for recreational uses.

## Waste Disposal

The Project would not involve the development of waste disposal sites.

## Wildlife Species and Habitat

Table 1 of the CDCA Plan includes a variety of guidelines associated with wildlife as follows:

### Rare, Threatened, and Endangered Species, State and Federal

In all MUC areas, all federal- and state-listed species and their critical habitat are to be fully protected. In addition, actions that may impact or jeopardize the continued existence of federally listed species require consultation with the USFWS in accordance with Section 7 of the federal Endangered Species Act (FESA). As evaluated in Section 3.3, Biological Resources, five wildlife species listed under both FESA and CESA occur or have the potential to occur or migrate through the Project site: desert tortoise, Yuma Ridgeway's rail, southwestern willow flycatcher, western yellow-billed cuckoo, and Least Bell's vireo. However, the desert tortoise is the only federally listed species currently detected within the Project site. There is currently no suitable breeding or foraging habitat for Yuma Ridgway's rail or western yellow-billed cuckoo within the Project site; however, the areas of microphyll woodland on the Project site provide suitable foraging habitat for migrating southwestern willow flycatcher. Additionally, four wildlife species listed under CESA occur or have a potential to occur or migrate through the Project site: Swainson's hawk, elf owl, Gila woodpecker, and bank swallow. Of these, the only state-listed species observed within the Project were the Swainson's hawk and the bank swallow. Mitigation measures developed as part of the Project would avoid, minimize, and/or compensate for potential effects to these species.

As specified in the guideline, BLM would initiate formal consultation with the USFWS in accordance with Section 7 of FESA. BLM has worked with USFWS, CDFW, and the Applicant to develop protection and compensation measures for the Mojave Desert tortoise. Therefore, the Project would comply with the guideline to provide full protection to the species.

### Sensitive Species

On MUC-M lands, identified species are to be given protection in management decisions consistent with BLM's policy for sensitive species management, BLM Manual 6840. The objective of this policy is to conserve and/or recover listed species, and to initiate conservation measures to reduce or eliminate threats to BLM sensitive species to minimize the likelihood of and need for listing. Several BLM-sensitive wildlife species present or likely to occur on habitat associated with the Project include, but are not limited to, Mojave fringe-toed lizard, banded gila monster, Couch's spadefoot toad, Golden Eagles, burrowing owl, desert kit fox, American badger, and migratory birds and bats. Those species that are likely to occur on the Project site would be protected under a number of mitigation measures meant to avoid, minimize, or compensate for impacts from the Project as discussed in detail in Section 3.3, Biological Resources.

### Predator and Pest Control

Control of depredation wildlife and pests is to be allowed on MUC-M lands in accordance with existing state and federal laws. As part of the Project, the Applicant would develop a litter control program that would be enforced during construction and operation and maintenance phases to reduce the likelihood that litter would attract predators (e.g., common raven) to the area and consequently increase the likelihood of predation on special status species (e.g., Mojave desert tortoise).

Therefore, this guideline is applicable to these actions but is allowed subject to conformance with state and federal laws.

### Habitat Manipulation

The Project would not include habitat manipulation.

### Reintroduction or Introduction of Established Exotic Species

The Project would not include the reintroduction or introduction of exotic species.

## Wetland/Riparian Areas

The Project site would be located at the eastern edge of the Chuckwalla Hydrologic Area with two riparian vegetation communities and a total of 91.8 acres of State jurisdictional wetlands and waters consisting of 1.2 acres of CDFW–associated riparian woodland and 90.6 acres of unvegetated streambed. A Streambed Alteration Agreement would be required with the CDFW, in accordance with California Fish and Game Code Section 1600 et seq. and any additional impacts associated with these areas would be reduced and minimized through the implementation of Mitigation Measure BIO-19 as discussed in Section 3.3, Biological Resources. The Project would not be located on any federal wetlands or waters as determined by the U.S. Army Corps of Engineers and would be in conformance with all other state laws and requirements.

## Wild Horses and Burros

The Project site would be located within the boundaries of a Wild Horse and Burro Herd Area; however, the Project would be an allowable use under the BLM's multiple-use objectives.

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# Appendix H
## Air Resources

1. Air Quality Technical Report, April 2019
2. Reduced Acreage Alternative Air Quality Analysis and Results Memo, April 2019
3. ESA Air Quality Calculations, June 2019

# H.1 Air Quality Technical Report, April 2019


# RE Crimson Solar Project

by Sonoran West Solar Holdings, LLC

## Air Quality Technical Report

Project Number: 60487757

April 2019

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## Revision History

| Revision | Revision date | Details | Authorized | Name | Position |
|---|---|---|---|---|---|
| A | April 18, 2018 | Response to CDFW & BLM Comments | Jennifer Guigliano | Paola Peña | Author |
| B | March 8, 2019 | Response to CDFW Comments and Construction Scope Changes | Jennifer Guigliano | Paola Peña | Author |
| C | April 1, 2019 | Response to Comments and Emission Estimate Edits | Amir Fanai | Paola Peña | Author |

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## Tables



## Figures



## Appendices

# 1. Project Overview

## 1.1 Introduction

Sonoran West Solar Holdings, LLC (Applicant), a wholly owned subsidiary of Recurrent Energy LLC (RE), proposes to construct and operate the RE Crimson Solar Project (Project). This Project is a utility-scale solar photovoltaic (PV) and energy storage project that would be located in the Riverside East Solar Energy Zone/Designated Leasing Area and within a Development Focus Area on federal lands managed by the Bureau of Land Management (BLM) within the California Desert Conservation Area planning area in unincorporated eastern Riverside County, approximately 13 miles west of Blythe, California (CA) (BLM CACA-051967). The Project would interconnect to the regional electrical grid at the Southern California Edison (SCE) 230-kilovolt (kV) Colorado River Substation (CRS), and would generate up to 350 megawatts (MW) of renewable energy using PV technology with up to 350 MW of integrated energy storage capacity.

The purpose of this study is to provide scientific and technical data regarding the existing air quality environment within the study area and the proposed Project's potential effects on the area's air quality environment. The Project information supporting this analysis is based primarily on the Applicant's RE Crimson Solar Project Plan of Development (POD) submitted to the BLM in January 2016 and updated in 2017 (RE 2017). If warranted, Applicant measures are proposed or recommended in this study to address adverse changes to the existing air quality environment as a result of the Project.

## 1.2 Project Description

The Project is located in unincorporated eastern Riverside County, approximately 13 miles west of Blythe, just north of Mule Mountain and just south of Interstate 10 (I-10), including portions of Sections 1, 2, 11, 12, 13, 24, 25 within Township 7 South, Range 20 East, and portions of Sections 6, 7, 8, 17, 18 within Township 7 South, Range 21 East (Figure 1-1). The Project site consists of approximately 2,489 acres of BLM- administered land within the Riverside East Solar Energy Zone and within the Desert Renewable Energy Conservation Plan (DRECP) Development Focus Area as presented in the Final Environmental Impact Statement (EIS) and approved in the Record of Decision and associated Land Use Plan Amendment in September 2016 (http://www.drecp.org/). The Project is not sited within the adjacent Section 368 Federal Energy Corridor pursuant to the Westwide Energy Corridor Final Programmatic EIS, except for a short gen-tie line that would interconnect the Project to the CRS.

The Project site is situated at the eastern edge of the Chuckwalla Hydrologic Area and supports a broad alluvial fan that includes many braided washes and channels that converge into a primary channel flowing into an intra-state playa lake northwest of the Project site. This playa lake is not a Traditional Navigable Water; therefore, the channels in the Project area do not qualify as federal jurisdictional waters.

The site is surrounded primarily by BLM-managed lands and some private parcels. The site is located at the northern foot of the Mule Mountain Area of Critical Environmental Concern, which is an important cultural resource for local Native American Tribes. The SCE high-voltage transmission line and CRS are located directly north of the Project site, and the I-10 freeway is north of and parallel to those facilities. East of the Project site is First Solar's proposed Desert Quartzite project. Further northeast of the Desert Quartzite project is the site of the recently approved Blythe Mesa Solar Project by RRG Renewables.

The Project applicant is proposing to construct the project using a traditional construction approach consisting of desert tortoise exclusion fencing, a mow and roll approach to site preparation, compacted roads, and trenching for electrical lines; however, the applicant is actively investigating alternative low-environmental impact design (LEID) elements and the potential for those to reduce Project impacts. LEID elements include several potential design changes including:

1. Minimizing grading during site preparation and maintaining more onsite vegetation to facilitate post-construction residual habitat value and post-operations/site reclamation success.
2. Avoiding or limiting trenching by placing electrical wiring aboveground.

3. Placing transformer/inverter groups on elevated support structures in lieu of cement foundations.

The LEID elements would further minimize grading, trenching, and vegetation removal beyond traditional design approaches for PV projects with the objective of reducing overall long-term impacts for the Project. Although the incorporation of LEID elements could result in slight modifications to the panel block locations due to topographic constraints, the permitting boundary or limits of development would be the same with LEID elements incorporated. The comparative impacts of the tradition design approach versus design with LEID elements incorporated is not known; therefore, to facilitate appropriate analysis of the Project and allow for the incorporation of LEID elements where practicable and environmentally beneficial, the environmental technical analysis is based on the elements that result in the worst-case scenario for construction and operations.

A vicinity map showing the Permitting (Development) Boundary is presented on Figure 1-2. The block layouts may vary slightly with the incorporation LEID elements, but would remain within the Permitting Boundary. The total area for the Project (i.e., Permitting Boundary) is 2,489 acres, including a 2,465 acre solar field development area with approximately 1,859 acre of solar panels (array blocks) and 24 acres for linear facilities including access/perimeter roads with a 30 to 60 foot corridor width and gen-tie and powerline corridors at 150 feet.

## 1.3 Design Option Scenarios

### 1.3.1 Traditional Design

An estimated 2 million panels would be arranged on the site in the form of solar arrays. Structures supporting the PV modules would consist of steel piles (e.g., cylindrical pipes, H-beams, or similar), which would be driven into the soil using pneumatic techniques, such as a hydraulic attachment on the boom of a backhoe tractor.

The proposed traditional design is laid out primarily in 2-MW increments, each 2-MW increment would include an inverter-transformer station constructed on a concrete pad or steel skid, and would be centrally located within the PV module arrays. Each inverter-transformer station would contain up to four inverters, a transformer, a battery enclosure, and a switchboard. Underground cables would be installed to convey the direct current (DC) electricity from the panels to the inverters to convert the DC to alternating current (AC). Between 300 and 500 wooden poles would be installed across the entire site to convey energy to a central substation location which would transform voltage from 34.5 kV to 230 kV.

Energy storage may be achieved by either a battery or flywheel storage system capable of storing up to 350 MW of electricity. The storage system would consist of banks of batteries or flywheels housed in electrical enclosures located indoors within the Project energy storage facilities.

Access to the Project site would be provided via the existing paved Wiley's Well Road and Powerline Road to the CRS from Interstate 10 (I-10) to the north. The Project's on-site roadway system would include a perimeter road, access roads, and internal roads. These roads would be surfaced with gravel, compacted dirt, or another commercially available surface and would accommodate the Project operations and maintenance (O&M) activities.

### 1.3.2 Low Environmental Impact Design Elements

As presented above, the applicant has proposed potential LEID elements for the Project for consideration with the objective of evaluating alternative design approaches that may reduce environmental impacts or negative effects from the project. These elements include changes to the grading approach, trenching and wiring, and elevation of inverter pads. To facilitate adequate analysis of potential design alternatives for the technical study, changes to the design were assessed for the potential LEID elements to determine the worst-case scenario. The design details with the incorporation of potential LEID elements are identical to those provided above for the traditional design, except for the following differences should LEID elements be incorporated:

- Solar blocks may be laid out in larger, 3- to 4-MW block sizes, requiring fewer inverter/transformer structures.
- Inverter/transformer equipment areas may be mounted on steel skids and installed on steel piers above the ground surface.

- Approximately 300 to 400 wooden AC transmission poles would be required in addition to the poles referenced under the traditional design to eliminate most trenching, which would result in the installation of up to 900 wooden poles in total.
- Access to the Project site would still be provided via the existing paved Wiley's Well Road and Powerline Road to the CRS via I-10; however, if the incorporation of elements results in fewer solar blocks, slightly fewer roads would be compacted and graded on-site.

## 1.4 Integrated Energy Storage System

The planned energy storage system (ESS) will be capable of storing up to 350 megawatts (MW), or 1,400 megawatt-hours (MWh) of energy. The two energy storage systems under consideration consist of a flywheel energy storage system (FESS), which stores kinetic energy using banks of rotors that are spun continuously in a low-friction environment, and a battery energy storage system (BESS), which relies on banks of high-capacity batteries stored in a temperature-controlled environment.

The ESS would either be dispersed throughout the project site or concentrated in one central location on the site. If selected, the singular "concentrated" energy storage system would be located at the northern end of the Project site near the site access gate and Project substation. The final system chosen for installation will depend on market conditions and the availability of commercial options at the time of construction.

## 1.5 Construction Details

Construction of the Project will occur in three planned phases and will require approximately 23 months to complete with construction expected to begin in late-2020. Both the traditional design and incorporation of LEID elements are expected to feature similar quantities of construction equipment and total workforce size; thus, construction assumptions in this air quality analysis consider only construction details associated with the traditional design, which were determined to be representative of both approaches and provide a worst-case scenario for the construction emissions and air quality assessment.

### 1.5.1 Preconstruction Activities

Prior to the start of construction, several activities would be undertaken to prepare the site for crews and construction including:

1. Geotechnical and Hazards investigations. The applicant would conduct a geotechnical investigation utilizing subsurface scientific testing and analysis, and would use ground penetrating radar to identify potential subsurface unexploded ordnance and Munitions and Explosives of Concern that may need to be stabilized or removed prior to construction
2. Surveying, Staking, Flagging, and Preconstruction Resource Surveys. Prior to construction the site boundary would be staked to demarcate the limits of disturbance, following which biologists would conduct preconstruction surveys to flag areas for avoidance as appropriate.
3. Fence Installation. The Project will be fenced with security fencing (chainlink topped with barbed wire) and desert tortoise exclusion fencing. The security fencing would be up to 8-feet tall. The exclusion fencing would be buried at least 12 inches below ground surface.
4. Resource Clearance Surveys. Following fence installation, likely in a phased approach, the project development area would be cleared for special status species.
5. Staging Area Establishment. One or more secure staging areas would be established in support of construction activities.

Site preparation activities may vary in order depending upon the incorporation of LEID components, the timeline for start of construction (e.g., survey windows), and other factors. In general, pre-construction activities have limited ground-disturbing impacts; but are necessary before full mobilization to support construction of the Project.

### 1.5.2 Phase 1 – Site Preparation and Grading

Phase 1 of construction will begin with the grubbing, grading, re-contouring, compacting, and graveling of access roads, followed by grading at the substation site. For Traditional Design, additional grading would be carried out at inverter and transformer pad locations where necessary. This construction phase will last approximately 19 months and will require an average daily workforce of approximately 251 workers on the Project site. Construction equipment operating on the site will include dozers, graders, skid steers, front-end loaders, vibratory rollers, scrapers, water pumps, and water trucks. The detailed construction air analysis spreadsheets are in Appendix A and include construction equipment assumptions.

### 1.5.3 Phase 2 – PV System Installation

Phase 2 of construction will begin with the pouring of foundations and the installation of the PV module support structure, which would consist of steel piles (e.g., cylindrical pipes, H-beams, or similar) being driven into the soil. To achieve ground preservation beneath the arrays, the incorporation of LEID elements will require individually sized piles to achieve a uniform elevation between module rows; thus, the duration of pile driving activities during this phase will last longer than those anticipated for Traditional Design. However, the incorporation of LEID elements that would reduce ground disturbance (e.g., no or reduced grading) is expected to require the use of track-mounted pile drivers, as opposed to the backhoe-mounted pneumatic pile drivers proposed in Traditional Design, to reduce tire passes over natural vegetation. Construction of the structural support systems will be followed by the installation of the PV modules. This construction phase will last approximately 19 months and require an average daily workforce of approximately 320 workers on the Project site. Construction equipment operating on the site will include post machines, skid steers, flatbed trucks, cranes, vibratory rollers, dump trucks, water trucks, forklifts, generators, air compressors, cable trenchers and mini-trenchers.

### 1.5.4 Phase 3 – Inverter, Transformer, Substation, and Electrical Collector System Commissioning

Phase 3 of construction will include the stringing of cable along module rows to a trunk cable system and the installation of AC and DC collector poles at inverter/transformer pad sites. If inverter/transformer pads will be elevated on piers as an LEID element, additional pile driving will be required during this phase for elevated pad installation. This construction phase will last approximately 18 months and require an average daily workforce of approximately 102 workers on the Project site. Construction equipment operating on the site will include graders, water trucks, cranes, backhoes, aerial lifts, forklifts, trenchers, generators, and flatbed trucks.

### 1.5.5 Site Deliveries During Construction Phases

Deliveries of materials and resources will occur throughout all construction phases. Water deliveries will occur a maximum of 14 times per day throughout all three construction phases, module and foundation deliveries will occur at a rate of approximately 10 times per day between construction Phases 1 and 2, tracker system delivery will occur at a rate of approximately 9 times per day during Phase 2, and inverter delivery will occur at a rate of approximately 2 times per day between Phases 2 and 3.

## 1.6 Operations and Maintenance

The solar modules and BESS are expected to be in operation during daylight and non-daylight hours, respectively, for 7 days per week, 365 days per year. Operational activities include solar module washing, maintenance of transformers, inverters, power conditioning systems, or other electrical equipment, road and fence repairs, vegetation/pest management, and site security. Solar modules would be washed as needed to maintain optimal electricity production (up to four times each year) using light utility vehicles with tow-behind water trailers. If LEID elements are incorporated into the design, the Project may also be visited regularly by a biological resource monitor, who will monitor applicable O&M activities and conduct periodic site assessments for the first 5 years of Project operation as part of a residual habitat study.

## 1.7 Decommissioning

The Applicant is expected to receive authorizations and permits with 30-year terms. At the end of the term, including any extensions, the Project would cease operation. At that time, the facilities would be decommissioned and dismantled and the site restored. Decommissioning activities would require approximately 9,883 truck trips, a workforce of approximately 320 workers, and would take approximately 17 months to complete. Upon decommissioning, the Project site could be converted to other uses in accordance with applicable land use regulations in effect at that time.

It is anticipated that during project decommissioning, project structures would be removed from the ground on the project sites. Aboveground and any underground equipment would be removed including module posts and support structures, gen-tie poles that are not shared with third parties and the overhead collection system within the project sites, inverters, transformers, electrical wiring, equipment on the inverter pads, and related equipment and concrete pads, and any O&M facilities and related equipment and infrastructure. The substation would be removed if it is owned by the project operator, however if a public or private utility assumes ownership of the substation, the substation may remain onsite to be used as part of the utility service to supply other applications.

Equipment would be de-energized prior to removal. Equipment would be shipped offsite by truck (after first being placed in secure transport enclosures as necessary) to be salvaged, recycled or disposed of at an appropriately licensed disposal facility. Removal of the solar modules would include disassembly and removal of the racks on which the solar modules are attached, and removal of the structures supporting the racks, and their placement in secure transport enclosures and a trailer for storage; the racks and structures supporting the racks would then be recycled or disposed of at an appropriately licensed disposal facility. Solar modules would be removed from the site and either transported to another solar electrical generating facility or a recycling facility, or disposed of at an appropriately licensed disposal facility. In conjunction with any solar modules which may be transported to another solar electrical generating facility, such solar modules may undergo a refurbishing process to extend their estimated 30-year lifespan. The demolition debris and removed equipment may be cut or dismantled into pieces to be safely lifted or carried with the equipment being used. The fence and gates would be removed and all materials would be recycled to the extent feasible. It is anticipated the project roads would be restored to their pre-construction condition unless the landowner elects to retain the improved roads for access throughout that landowner's property. The area would be thoroughly cleaned and all debris removed. As discussed above, most materials would be recycled to the extent feasible, with minimal disposal to occur in landfills in compliance with all applicable laws.

# 2. Air Pollutants – Regulatory Setting

## 2.1 Federal

### 2.1.1 Criteria Pollutants

Individual air pollutants at certain concentrations may adversely affect human or animal health, reduce visibility, damage property, and reduce the productivity or vigor of crops and natural vegetation. Six air pollutants have been identified by the United States Environmental Protection Agency (USEPA) and the California Air Resources Board (CARB) as being of concern both on a nationwide and statewide level: ozone; carbon monoxide (CO); nitrogen dioxide (NO2); sulfur dioxide (SO2); lead; and particulate matter (PM), which is subdivided into two classes based on particle size: PM equal to or less than 10 micrometers in diameter (PM10), and PM equal to or less than 2.5 micrometers in diameter (PM2.5). Because the air quality standards for these air pollutants are regulated using human health and environmentally based criteria, they are commonly referred to as “criteria air pollutants.”

**Ozone**

Ozone is the principal component of smog and is formed in the atmosphere through a series of reactions involving reactive organic gases (ROG) and nitrogen oxides (NOX) in the presence of sunlight. ROG and NOX are called precursors of ozone. NOX includes various combinations of nitrogen and oxygen, including nitric oxide (NO), NO2, and others. Ozone is a principal cause of lung and eye irritation in the urban environment. Significant ozone concentrations are usually produced only in the summer, when atmospheric inversions are greatest and temperatures are high. ROG and NOX emissions are both considered critical in ozone formation.

Individuals exercising outdoors, children, and people with preexisting lung disease, such as asthma and chronic pulmonary lung disease, are considered to be the most susceptible sub-groups for ozone effects. Short-term exposure (lasting for a few hours) to ozone can result in breathing pattern changes, reduction of breathing capacity, increased susceptibility to infections, inflammation of the lung tissue, and some immunological changes. In recent years, a correlation between elevated ambient ozone levels and increases in daily hospital admission rates, as well as mortality, has also been reported. An increased risk for asthma has been found in children who participate in multiple sports and live in communities with high ozone levels.

**Carbon Monoxide**

CO is a colorless and odorless gas that, in the urban environment, is associated primarily with the incomplete combustion of fossil fuels in motor vehicles. Relatively high concentrations are typically found near crowded intersections and along heavily used roadways carrying slow-moving traffic. Even under most severe meteorological and traffic conditions, high concentrations of CO are limited to locations within a relatively short distance (300 to 600 feet) of heavily traveled roadways. Vehicle traffic emissions can cause localized CO impacts, and severe vehicle congestion at major signalized intersections can generate elevated CO levels, called “hot spots,” which can be hazardous to human receptors adjacent to the intersections.

Individuals with a deficient blood supply to the heart are the most susceptible to the adverse effects of CO exposure. The effects observed include earlier onset of chest pain with exercise and electrocardiograph changes indicative of decreased oxygen supply to the heart. Inhaled CO has no direct toxic effect on the lungs but exerts its effect on tissues by interfering with oxygen transport. Hence, conditions with an increased demand for oxygen supply can be adversely affected by exposure to CO. Fetuses, patients with diseases involving heart and blood vessels, and patients with chronic hypoxemia (oxygen deficiency) as seen in high altitudes are most at risk from complications associated with exposure to CO.

**Nitrogen Dioxide**

NO2 is a product of combustion and is generated in vehicles and in stationary sources, such as power plants and boilers. It is also formed when ozone reacts with NO in the atmosphere. As noted above, NO2 is part of the NOX family and is a principal contributor to ozone and smog generation.

Population-based studies suggest that an increase in acute respiratory illness, including infections and respiratory symptoms in children, is associated with long-term exposure to NO2 at levels found in homes with gas stoves, which are higher than ambient levels found in southern California. Increase in resistance to air flow and airway contraction is observed after short-term exposure to NO2 in healthy subjects. Larger decreases in lung functions are observed in individuals with asthma or chronic obstructive pulmonary disease (e.g., chronic bronchitis, emphysema) than in healthy individuals, indicating a greater susceptibility of these sub-groups.

**Sulfur Dioxide**

SO2 is a combustion product, with the primary source being power plants and heavy industries that use coal or oil as fuel. SO2 is also a product of diesel engine combustion. SO2 in the atmosphere contributes to the formation of acid rain.

In asthmatics, increase in resistance to air flow as well as reduction in breathing capacity leading to severe breathing difficulties, are observed after acute exposure to SO2. In contrast, healthy individuals do not exhibit similar acute responses even after exposure to higher concentrations of SO2. Some population-based studies indicate that the mortality and morbidity effects associated with fine particles show a similar association with ambient SO2 levels. In these studies, efforts to separate the effects of SO2 from those of fine particles have not been successful. It is not clear whether the two pollutants act synergistically, or one pollutant alone is the predominant factor.

#### Lead

Lead is a highly toxic metal that may cause a range of human health effects. Previously, the lead used in gasoline anti-knock additives represented a major source of lead emissions to the atmosphere. USEPA began working to reduce lead emissions soon after its inception, issuing the first reduction standards in 1973. Lead emissions have significantly decreased due to the near elimination of leaded gasoline use.

Fetuses, infants, and children are more sensitive than others to the adverse effects of lead exposure. Exposure to low levels of lead can adversely affect the development and function of the central nervous system, leading to learning disorders, distractibility, inability to follow simple commands, and a lower intelligence quotient. In adults, increased lead levels are associated with increased blood pressure. Lead poisoning can cause anemia, lethargy, seizures, and death; although it appears that there are no direct effects of lead on the respiratory system.

#### Particulate Matter

PM is a complex mixture of extremely small particles and liquid droplets. PM is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles. Natural sources of PM include windblown dust and ocean spray. The size of PM is directly linked to the potential for causing health problems. USEPA is concerned about particles that are 10 micrometers in diameter or smaller because these particles generally pass through the throat and nose and enter the lungs. Once inhaled, these particles can affect the heart and lungs and cause serious health effects. Health studies have shown a significant association between exposure to PM and premature death. Other important effects include aggravation of respiratory and cardiovascular disease, lung disease, decreased lung function, asthma attacks, and certain cardiovascular problems, such as heart attacks and irregular heartbeat (USEPA 2007). Individuals particularly sensitive to fine particle exposure include older adults, people with heart and lung disease, and children. As previously discussed, USEPA groups particulate matter into two categories, which are described below.

#### PM2.5

Fine particles, such as those found in smoke and haze, are PM2.5. Sources of fine particles include all types of combustion activities (motor vehicles, power plants, wood burning, etc.) and certain industrial processes. PM2.5 is also formed through reactions of gases, such as SO2 and NOX, in the atmosphere. PM2.5 is the major cause of reduced visibility (haze) in California.

#### PM10

PM10 includes both fine and coarse dust particles; the fine particles are PM2.5. Coarse particles, such as those found near roadways and dusty industries, are larger than 2.5 micrometers and smaller than 10 micrometers in diameter. Sources of coarse particles include crushing or grinding operations and dust from paved or unpaved roads. Control of PM10 is primarily achieved through the control of dust at construction and industrial sites, the cleaning of paved roads, and the wetting or paving of frequently used unpaved roads.

### 2.1.2 Air Quality Standards

Health-based air quality standards have been established for the above described criteria pollutants by USEPA at the national level and by CARB at the state level. These standards were established to protect the public with a margin of safety from adverse health impacts due to exposure to air pollution. California has also established standards for sulfates, visibility-reducing particles, hydrogen sulfide, and vinyl chloride. The most current monitoring station data and attainment designations for the Project Site are provided below. Table 1 presents the National Ambient Air Quality Standards (NAAQS) and the California Ambient Air Quality Standards (CAAQS).

USEPA, under the provisions of the Clean Air Act (CAA), requires each state with regions that have not attained NAAQS to prepare a State Implementation Plan (SIP) detailing how these standards are to be met in each local area. The SIP is a legal agreement between each state and the federal government to commit resources to improving air quality. It serves as the template for conducting regional and project-level air quality analysis. The SIP is not a single document, but a compilation of new and previously submitted attainment plans, emissions reduction programs, district rules, state regulations, and federal controls.

**TABLE 1**
**NATIONAL AND CALIFORNIA AMBIENT AIR QUALITY STANDARDS**

| Pollutant | Averaging Time | California Standards [a] | National Standards [b] | |
|---|---|---|---|---|
| | | Concentration [c] | Primary [c,d] | Secondary [c,e] |
| Ozone | 1 hour | 0.09 ppm (180 μg/m$^3$) | – | Same as primary standard |
| | 8 hours | 0.070 ppm (137 μg/m$^3$) | 0.070 ppm (137 μg/m$^3$) | |
| Respirable particulate matter ($PM_{10}$)[f] | 24 hours | 50 μg/m$^3$ | 150 μg/m$^3$ | Same as primary standard |
| | Annual arithmetic mean | 20 μg/m$^3$ | – | |
| Fine particulate matter ($PM_{2.5}$) [f] | 24 hours | – | 35 μg/m$^3$ | Same as primary standard |
| | Annual arithmetic mean | 12 μg/m$^3$ | 12 μg/m$^3$ | 15 μg/m |
| Carbon monoxide (CO) | 1 hour | 20 ppm (23 mg/m$^3$) | 35 ppm (40 mg/m$^3$) | None |
| | 8 hour | 9.0 ppm (10 mg/m$^3$) | 9 ppm (10 mg/m$^3$) | |
| | 8 hours (Lake Tahoe) | 6 ppm (7 mg/m$^3$) | – | – |
| Nitrogen dioxide ($NO_2$) [g] | 1 hour | 0.18 ppm (339 μg/m$^3$) | 100 ppb (188 μg/m$^3$) | – |
| | Annual arithmetic mean | 0.030 ppm (57 μg/m$^3$) | 0.053 ppm (100 μg/m$^3$) | Same as primary standard |
| Sulfur dioxide ($SO_2$) [h] | 1 hour | 0.25 ppm (655 μg/m$^3$) | 75 ppb (196 μg/m$^3$) | – |
| | 3 hours | — | – | 0.5 ppm (1,300 μg/m$^3$) |
| | 24 hours | 0.04 ppm (105 μg/m$^3$) | 0.14 ppm (for certain areas) [h] | – |
| | Annual arithmetic mean | — | 0.030 ppm (for certain areas) [h] | – |
| Lead [i,j] | 30-day average | 1.5 μg/m$^3$ | – | – |
| | Calendar quarter | – | 1.5 μg/m$^3$ (for certain areas) [j] | Same as primary standard |
| | Rolling 3-month average | – | 0.15 μg/m$^3$ | |
| Visibility-reducing particles [k] | 8 hours | See Footnote j | No national standards | |
| Sulfates | 24 hours | 25 μg/m$^3$ | | |
| Hydrogen sulfide | 1 hour | 0.03 ppm (42 μg/m$^3$) | | |
| Vinyl chloride [i] | 24 hours | 0.01 ppm (26 μg/m$^3$) | | |

Notes: mg/m$^3$ = milligrams per cubic meter; ppb = parts per billion; ppm = parts per million; μg/m$^3$ = micrograms per cubic meter

[a] California standards for ozone, carbon monoxide (except 8-hour Lake Tahoe), sulfur dioxide (1- and 24-hour), nitrogen dioxide, and particulate matter ($PM_{10}$, $PM_{2.5}$, and visibility-reducing particles), are values that are not to be exceeded. All others are not to be equaled or exceeded. California ambient air quality standards are listed in the Table of Standards in Section 70200 of Title 17 of the California Code of Regulations.

[b] National standards (other than ozone, particulate matter, and those based on annual arithmetic mean) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest 8-hour concentration measured at each site in a year, averaged over 3 years, is equal to or less than the standard. For $PM_{10}$, the 24-hour is attained when the expected number of days per calendar year with a 24-hour average concentration above 150 μg/m$^3$ is equal to or less than 1. For $PM_{2.5}$, the 24-hour standard is attained when 98% of the daily concentrations, averaged over 3 years, are equal to or less than the standards.

[c] Concentration expressed first in the units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25 degrees Celsius and a reference pressure of 760 torr. Most measurements of air quality are to be corrected to a reference temperature of 25°C and reference pressure of 760 torr (ppm) in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

[d] National Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health.

[e] National Secondary Standards: The levels of air quality necessary to protect public welfare from any known or anticipated adverse

**TABLE 1**
**NATIONAL AND CALIFORNIA AMBIENT AIR QUALITY STANDARDS**

| Pollutant | Averaging Time | California Standards [a] | National Standards [b] | |
|---|---|---|---|---|
| | | Concentration [c] | Primary [c,d] | Secondary [c,e] |

effects of a pollutant.

[f] On December 14, 2012, the national annual PM2.5 primary standard was lowered from 15 µg/m3 to 12.0 µg/m3. The existing national 24-hour PM2.5 standards (primary and secondary) were retained at 35 µg/m3, as was the annual secondary standard of 15 µg/m3. The existing 24-hour PM10 standards (primary and secondary) of 150 µg/m3 also were retained. The form of the annual primary and secondary standards is the annual mean, averaged over 3 years.

[g] To attain the 1-hour national standard, the 3-year average of the annual 98th percentile of the 1-hour daily maximum concentrations at each site must not exceed 100 ppb. California standards are in units of ppm. To directly compare the national 1-hour standard to the California standards the units can be converted from 100 ppb to 0.100 ppm.

[h] On June 2, 2010, a new 1-hour $SO_2$ standard was established and the existing 24-hour and annual primary standards were revoked. To attain the 1-hour national standard, the 3-year average of the annual 99th percentile of the 1-hour daily maximum concentrations at each site must not exceed 75 ppb. The 1971 $SO_2$ national standards (24-hour and annual) remain in effect until 1 year after an area is designated for the 2010 standard, except that in areas designated nonattainment for the 1971 standards, the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standards are approved. To directly compare the 1-hour national standard to the California standard, the units can be converted to ppm. In this case, the national standard of 75 ppb is identical of 0.075 ppm.

[i] CARB has identified lead and vinyl chloride as toxic air contaminants with no threshold level of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.

[j] The national standard for lead was revised on October 15, 2008, to a rolling 3-month average. The 1978 lead standard (1.5 µg/m$^3$ as a quarterly average) remains in effect until 1 year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978 standard, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standards are approved.

[k] In 1989, ARB converted both the general statewide 10-mile visibility standard and the Lake Tahoe 30-mile visibility standard to instrumental equivalents, which are “extinction of 0.23 per kilometer” and the “extinction of 0.07 per kilometer” for the statewide and Lake Tahoe Air Basin standards, respectively.

Source: CARB 2016

### 2.1.3 General Conformity

General conformity requirements were adopted by Congress as part of the CAA Amendments and were implemented by USEPA regulations in the November 30, 1993 Federal Register (40 Code of Federal Regulations Sections 6, 51, and 93: “Determining Conformity of General Federal Actions to State or Federal Implementation Plans; Final Rule”).

General conformity requires that all federal actions conform to the SIP as approved or promulgated by USEPA. The Project is therefore required to evaluate its construction emissions against the applicable General Conformity Rule thresholds of significance, which are called de minimis thresholds. The de minimis levels are based on the attainment/maintenance and nonattainment designations and classifications for the project area. If the emissions would exceed the de minimis levels, a formal air quality conformity determination is required.

As shown in Figure 1-2, the Project is located in the Mojave Desert Air Basin (MDAB) under the jurisdiction of the Mojave Desert Air Quality Management District (MDAQMD).. The MDAB is designated as an unclassifiable/attainment area for CO and PM2.5; therefore, there are no de minimis thresholds for these pollutants. The MDAQMD is classified as a non-attainment area for ozone and PM10 for the southwest corner of the desert portion of San Bernardino County and San Bernardino County portion only, respectively (MDAQMD 2019). Thus, the Riverside County portion within the MDAQMD is designated as an unclassifiable/attainment area for ozone (NOx and VOC) and PM10. Although, the Project Site is located in the Riverside County portion of the MDAQMD which is designated as an unclassifiable/attainment area for ozone (NOx and VOC) and PM10, the analysis conservatively compares Project’s emissions to the de minimis threshold for NOx, VOC, and PM10. Thus, the only applicable de minimis thresholds to the project are for PM10, NOx, and VOC. Accordingly, the de minimis thresholds for the Project are presented below in Table 2.

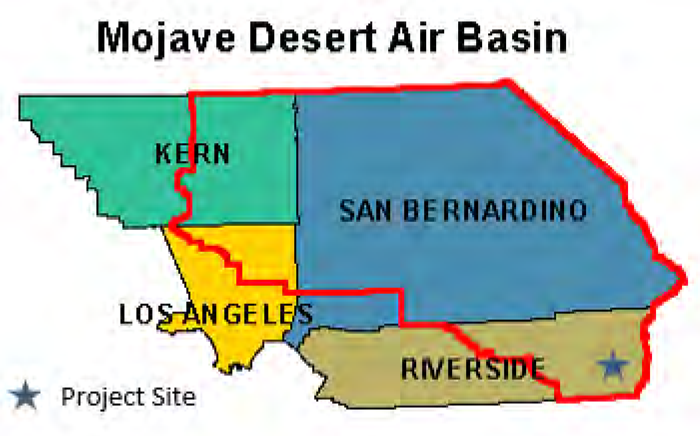



**Figure 1-2. Mojave Desert Air Basin**

**TABLE 2**
**GENERAL CONFORMITY *DE MINIMIS* THRESHOLDS FOR THE PROJECT STUDY AREA**

| Pollutant | Emission Threshold (tons per year) |
|---|---|
| CO | N/A[1] |
| $NO_X$ | 100[2] |
| VOC | 100[2] |
| $PM_{10}$ | 100[3] |
| $PM_{2.5}$ | N/A[1] |

Notes:
CO = carbon monoxide; $NO_X$ = oxides of nitrogen; $PM_{2.5}$ = fine particulate matter; $PM_{10}$ = respirable particulate matter; VOC = volatile organic compound
1 The Mojave Desert Air Basin is in attainment for CO and PM2.5. Therefore, there are no de minimis thresholds for these pollutants.
2 Although the Project is located in an unclassifiable/attainment portion of MDAB, the air basin is classified as a partial nonattainment area for ozone (NOx and VOC). The analysis conservatively compares the Project-related emissions to the CAA conformity thresholds for maintenance areas (i.e., areas that currently meet federal air quality standards, but have violated the standards in prior years), which in the project area are 100 tons per year per pollutant.
3 Although the Project is located in an unclassifiable/attainment portion of MDAB, the air basin is classified as a moderate nonattainment area for PM10.
Source: 40 Code of Federal Regulations 93 Section 153 (USEPA 2019)

### 2.1.4 Toxic Air Contaminants

In addition to criteria air pollutants, USEPA regulates hazardous air pollutants, also known as toxic air contaminants (TACs). TACs may be emitted by stationary, area, or mobile sources. Common stationary sources of TAC emissions include gasoline stations, dry cleaners, and diesel backup generators, which are subject to local air district permit requirements. The other, often more significant, sources of TAC emissions are motor vehicles on freeways, high-volume roadways, or other areas with high numbers of diesel vehicles, such as distribution centers. Off-road mobile sources are also major contributors of TAC emissions and include construction equipment, ships, and trains.

TACs can be separated into carcinogens and noncarcinogens based on the nature of the effects associated with exposure to the pollutant. For regulatory purposes, carcinogens are assumed to have no safe threshold below which health impacts would not occur. Any exposure to a carcinogen poses some risk of contracting cancer. Noncarcinogens differ in that there is generally assumed to be a safe level of exposure below which no negative health impact is believed to occur. These levels are determined on a pollutant by-pollutant basis.

## 2.2 State

CARB is the agency responsible for coordination and oversight of state and local air pollution control programs in California and for implementing the California CAA.

### 2.2.1 State Implementation Plan

CARB is the lead agency for developing the SIP in California. Local air districts and other agencies prepare Air Quality Attainment Plans (AQAPs) or Air Quality Management Plans (AQMPs) and submit them to CARB for review, approval, and incorporation into the applicable SIP. CARB also maintains air quality monitoring stations throughout the state in conjunction with local air districts. Data collected at these stations are used by CARB to classify air basins as being in attainment or nonattainment with respect to each pollutant, and to monitor progress in attaining air quality standards.

The California CAA requires that each area exceeding the CAAQS for ozone, CO, SO2, and NO2 must develop a plan aimed at achieving those standards. The California Health and Safety Code Section 40914 requires air districts to design a plan that achieves an annual reduction in district-wide emissions of five percent or more, averaged every consecutive three-year period. To satisfy this requirement, the local air districts have to develop and implement air pollution reduction measures, which are described in their AQMPs, and outline strategies for achieving the CAAQS for any criteria pollutant for which the region is classified as nonattainment.

CARB has established emission standards for vehicles sold in California and for various types of equipment. California gasoline specifications are governed by both state and federal agencies. During the past decade, federal and state agencies have imposed numerous requirements on the production and sale of gasoline in California. CARB has also adopted control measures for diesel PM and more stringent emissions standards for various on-road mobile sources of emissions, including transit buses and off-road diesel equipment (e.g., tractors, generators).

### 2.2.2 Toxic Air Contaminants

Particulate exhaust emissions from diesel-fueled engines (diesel PM) were identified as a TAC by CARB in 1998. Federal and state efforts to reduce diesel PM emissions have focused on the use of improved fuels, adding particulate filters to engines, and requiring the production of new-technology engines that emit fewer exhaust particulates.

Diesel engines tend to produce a much higher ratio of fine particulates than other types of internal combustion engines. The fine particles that make up diesel PM tend to penetrate deep into the lungs, and the rough surfaces of these particles makes it easy for them to bind with other toxins within the exhaust, thus increasing the hazards of particle inhalation. Long-term exposure to diesel PM is known to lead to chronic serious health problems including cardiovascular disease, cardiopulmonary disease, and lung cancer.

TACs in California are regulated primarily through the Tanner Air Toxics Act (Chapter 1047, Statutes of 1983) and the Air Toxics Hot Spots Information and Assessment Act (Chapter 1252, Statutes of 1987). Assembly Bill 1807 sets forth a formal procedure for CARB to designate substances as TACs. Research, public participation, and scientific peer review must occur before CARB can designate a substance as a TAC. The Air Toxics Hot Spots Information and Assessment Act requires that TAC emissions from stationary sources be quantified and compiled into an inventory according to criteria and guidelines developed by CARB, and if directed to do so by the local air district, a Health Risk Assessment (HRA) must be prepared to determine the potential health impacts of such emissions.

### 2.2.3 Mojave Desert Air Quality Management District

In eastern Riverside County, the MDAQMD is the agency responsible for protecting public health and welfare through the administration of federal and state air quality laws and policies. Included in the MDAQMD's tasks are monitoring of air pollution, preparation of the SIP for the MDAB, and promulgation of rules and regulations.

The MDAQMD prepared and adopted a SIP in 2004 Ozone Attainment Plan to attain the state and federal ozone standard. Subsequent SIP revisions were prepared in 2008 and 2016 for the Western Mojave Desert Ozone Nonattainment area. The Western Mojave Desert Ozone Nonattainment area includes a part of the San Bernardino County portion of the MDAQMD, as well as the Antelope Valley portion of Los Angeles County; thus, is not applicable to the Project. The MDAQMD prepared and adopted a PM10 Plan in 1995. As explained previously, the Riverside County portion of the MDAQMD is designated as unclassifiable/attainment area for PM10.

## 2.3 Regional and Local

### 2.3.1 Mojave Desert Air Quality Management District

As discussed above, the Project would be located in the jurisdiction of the MDAQMD. The MDAQMD is responsible for regulating stationary sources of air emissions in the Project area's air basin. Stationary sources that have the potential to emit air pollutants into the ambient air are subject to the Rules and Regulations adopted by the MDAQMD. The following MDAQMD rules are applicable to the Project (MDAQMD 2015).

Rule 401 – Visible Emissions. Rule 401 states that a person shall not discharge into the atmosphere, from any single source of emissions whatsoever, any air contaminant for a period or periods aggregating more than three minutes in any one hour which is:

- As dark or darker in shade as that designated as No. 1 on the Ringelmann Chart, as published by the U.S. Bureau of Mines, or
- Of such opacity as to obscure an observer's view to a degree equal to or greater than does smoke described in Subsection A [of the Rules].

Rule 402 - Nuisance. Rule 402 prohibits a person from discharging from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance or annoyance to any considerable number of persons or to the public, or which endanger the comfort, repose, health or safety of any such persons or the public, or which cause, or have a natural tendency to cause, injury or damage to business or property.

Rule 403 – Fugitive Dust. Rule 403 requires control of fugitive dust emissions during activities such as construction that have the potential to generate dust. The provisions of Rule 403 include the following:

1. A person shall not cause or allow the emissions of fugitive dust from any transport, handling, construction or storage activity so that the presence of such dust remains visible in the atmosphere beyond the property line of the emission source. (Does not apply to emissions emanating from unpaved roadways open to public travel or farm roads. This exclusion shall not apply to industrial or commercial facilities).
2. A person shall take every reasonable precaution to minimize fugitive dust emissions from wrecking, excavation, grading, clearing of land and solid waste disposal operations.
3. A person shall not cause or allow particulate matter to exceed 100 micrograms per cubic meter when determined as the difference between upwind and downwind samples collected on high volume samplers at the property line for a minimum of five hours.
4. A person shall take every reasonable precaution to prevent visible particulate matter from being deposited upon public roadways as a direct result of their operations. Reasonable precautions shall include, but are not limited to, the removal of particulate matter from equipment prior to movement on paved streets or the prompt removal of any material from paved streets onto which such material has been deposited.

5. Subsections (a) and (c) shall not be applicable when the wind speed instantaneously exceeds 40 kilometers (25 miles) per hour, or when the average wind speed is greater than 24 kilometers (15 miles) per hour. The average wind speed determination shall be on a 15 minute average at the nearest official air-monitoring station or by wind instrument located at the site being checked.

Rule 404 – Particulate Matter Concentration. Rule 404 restricts emissions of particulate matter from any source based on the concentrations specified in Table 404(a).

Rule 405 – Solid Particulate Matter Weight. Rule 405 restricts emissions of particulate matter from any source based on the concentrations specified in Table 405(a).

Rule 406 – Specific Contaminants. Rule 406 restricts emissions of sulfur compounds to 500 ppm or less, and restricts emissions of halogens, which are not generally emitted from construction projects.

Rule 407 – Liquid and Gaseous Air Contaminants. Rule 407 restricts emissions of carbon monoxide to 2,000 ppm or less.

Rule 408 – Circumvention. Rule 408 restricts the building, erection, installation or use of any equipment, the use of which, without resulting in a reduction in the total release of air contaminants to the atmosphere, reduces or conceals an emission which would otherwise constitute a violation of Chapter 3 (commencing with Section 41700) of Part 4, of Division 26 of the Health and Safety Code or of the MDAQMD Rules.

Rule 409 – Combustion Contaminants. Rule 409 restricts discharge into the atmosphere from the burning of fuel, combustion contaminants exceeding 0.23 gram per cubic meter (0.1 grain per cubic foot) of gas calculated to 12 percent of carbon dioxide ($CO_2$) at standard conditions averaged over a minimum of 25 consecutive minutes.

Rule 431 – Sulfur Content of Fuels. Rule 431 restricts the use of any gaseous fuel containing sulfur compounds in excess of 800 ppm calculated as hydrogen sulfide at standard conditions, or any liquid or solid fuel having a sulfur content in excess of 0.5 percent by weight.

Rule 442 – Usage of Solvents. Rule 442 restricts the emission of volatile organic compounds (VOCs) from any solvent material to 1,190 pounds per month, and requires proper storage and handling of VOC-containing solvents.

### 2.3.2 Riverside County General Plan

The Riverside County General Plan Air Quality Element (AQ) includes policies that limit emissions within the County boundaries. The goal is to support efforts to decrease region-wide pollution emissions, as surrounding jurisdictions significantly impact Riverside County's air quality. Policies were designed to establish a regional basis for improving air quality. The Riverside County General Plan's Air Quality Element (AQ) discusses the following applicable policies regarding air quality within Riverside County (Riverside County 2014b, 2018). Relevant countywide policies that address air quality within the County boundaries are also located in the Land Use Element (LU) of the County General Plan are also described below (Riverside County 2014c).

**Air Quality Element**

Policy AQ 1.1. Promote and participate with regional and local agencies, both public and private, to protect and improve air quality.

Policy AQ 1.4. Coordinate with the South Coast Air Quality Management District (SCAQMD) and MDAQMD to ensure that all elements of air quality plans regarding reduction of air pollution emissions are being enforced.

Policy AQ 1.5. Establish and implement air quality, land use and circulation measures that improve not only the County's environment but the entire region's.

Policy AQ 2.1. The County land use planning efforts shall assure that sensitive receptors are separated and protected from polluting point sources to the greatest extent possible.

Policy AQ 2.2. Require site plan designs to protect people and land uses sensitive to air pollution through the use of barriers and/or distance from emissions sources when possible.

Policy AQ 2.3. Encourage the use of pollution control measures such as landscaping, vegetation and other materials, which trap particulate matter or control pollution.

Policy AQ 4.1. Encourage the use of building materials/methods which reduce emissions.

Policy AQ 4.7. To the greatest extent possible, require every project to mitigate any of its anticipated emissions which exceed allowable emissions as established by the SCAQMD, MDAQMD, SOCAB [South Coast Air Basin], the Environmental Protection Agency and the California Air Resources Board.

Policy AQ 4.9. Require compliance with SCAQMD Rules 403 and 403.1, and support appropriate future measures to reduce fugitive dust emanating from construction sites.

Policy AQ 4.10. Coordinate with the SCAQMD and MDAQMD to create a communications plan to alert those conducting grading operations in the County of first, second, and third stage smog alerts, and when wind speeds exceed 25 miles per hour. During these instances all grading operations should be suspended.

Policy AQ 5.1. Utilize source reduction, recycling and other appropriate measures to reduce the amount of solid waste disposed of in landfills.

Policy AQ 16.1. Cooperate with local, regional, state and federal jurisdictions to better control particulate matter.

Policy AQ 16.2. Encourage stricter state and federal legislation on bias belted tires, smoking vehicles, and vehicles that spill debris on streets and highways, to better control particulate matter.

Policy AQ 16.3. Collaborate with the SCAQMD and MDAQMD to require and/or encourage the adoption of regulations or incentives to limit the amount of time trucks may idle.

Policy AQ 16.4. Collaborate with the EPA, SCAQMD, MDAQMD, and warehouse owners and operators to create regulations and programs to reduce the amount of diesel fumes released due to warehousing operations.

Policy AQ 17.3. Identify and create a control plan for areas within the County prone to wind erosion of soil.

Policy AQ 17.4. Adopt incentives, regulations and/or procedures to manage paved and unpaved roads and parking lots so they produce the minimum practicable level of particulates.

Policy AQ 17.8. Adopt regulations and programs necessary to meet state and federal guidelines for diesel emissions.

Policy AQ 20.18. Encourage the installation of solar panels and other energy-efficient improvements and facilitate residential and commercial renewable energy facilities (solar array installations, individual wind energy generators, etc.).

Policy AQ 20.19. Facilitate development and siting of renewable energy facilities and transmission lines in appropriate locations.

**Land Use Element**

Policy LU 6.4. Retain and enhance the integrity of existing residential, employment, agricultural, and open space areas by protecting them from encroachment of land uses that would result in impacts from noise, noxious fumes, glare, shadowing, and traffic.

Policy LU 10.2 Ensure adequate separation between pollution producing activities and sensitive emission receptors, such as hospitals, residences, child care centers and schools.

### 2.3.3 Odor

Odors are considered an air quality issue both at the local level (e.g., odor from wastewater treatment) and at the regional level (e.g., smoke from wildfires). Odors are generally regarded as an annoyance rather than a health hazard. However, manifestations of a person’s reaction to foul odors can range from psychological (e.g., irritation, anger, or anxiety) to physiological (e.g., circulatory and respiratory effects, nausea, vomiting, and headache).

The ability to detect odors varies considerably among the population and is subjective. Some individuals have the ability to smell minute quantities of specific substances while others may not have the same sensitivity, but may have sensitivities to odors of other substances. In addition, people may have different reactions to the same odor; an odor that is offensive to one person (e.g., from a fast-food restaurant or bakery) may be perfectly acceptable to another. Unfamiliar odors may be more easily detected and likely to cause complaints than familiar ones.

Several examples of common land use types that generate substantial odors include wastewater treatment plants, landfills, composting/green waste facilities, recycling facilities, petroleum refineries, chemical manufacturing plants, painting/coating operations, rendering plants, and food packaging plants.

Offensive odors can potentially affect human health in several ways. First, odorant compounds can irritate the eye, nose, and throat, which can reduce respiratory volume. Second, the organic gases that cause odors can stimulate sensory nerves to cause neurochemical changes that might influence health, for instance, by compromising the immune system. Finally, unpleasant odors can trigger memories or attitudes linked to unpleasant odors, causing cognitive and emotional effects such as stress.

# 3. Existing Conditions

## 3.1 Mojave Desert Air Basin

Ambient air pollutant concentrations in the MDAB are measured at air quality monitoring stations operated by CARB and the MDAQMD. The closest and most representative MDAB air quality monitoring station to the Project Site is the Blythe-445 West Murphy Street monitoring station, approximately 8 miles east of the Project Site. However, that monitoring station only has ozone concentration data available. Therefore, the Palm Springs Fire Station monitoring station was used to supplement ambient air quality monitoring data for PM10, PM2.5, and NO2 concentrations. Table 3 presents the most recent ozone, NO2, PM10, and PM2.5 concentrations recorded. These concentrations represent the existing, or baseline conditions, for the Project.

As shown in Table 3, ambient air concentrations of PM10 have exceeded NAAQS and CAAQS on one or more days each year for the past three years. Ambient air concentrations of PM2.5 have not exceeded NAAQS in the past three years. Ozone concentrations have not exceeded the NAAQS or CAAQS in the past three years. Monitoring data for other criteria air pollutants is not available from these or any other monitoring stations in the vicinity of the Project.

## 3.2 Attainment Status

Both USEPA and CARB use ambient air quality monitoring data to designate areas according to their attainment status for criteria air pollutants. The purpose of these designations is to identify the areas with air quality problems and initiate planning efforts for improvement. The three basic designation categories are nonattainment, attainment, and unclassified. An “attainment” designation for an area signifies that pollutant concentrations did not exceed the established standard. In most cases, areas designated or redesignated as attainment must develop and implement maintenance plans, which are designed to ensure continued compliance with the standard.

In contrast to attainment, a “nonattainment” designation indicates that a pollutant concentration has exceeded the established standard. Nonattainment may differ in severity. To identify the severity of the problem and the extent of planning and actions required to meet the standard, nonattainment areas are assigned a classification that is commensurate with the severity of their air quality problem (e.g., moderate, serious, severe, extreme).

Finally, an unclassified designation indicates that insufficient data exist to determine attainment or nonattainment. In addition, the California designations include a subcategory of nonattainment transitional, which is given to nonattainment areas that are progressing and nearing attainment.

**TABLE 3**
**AMBIENT AIR QUALITY SUMMARY**

| Pollutant Standards | 2015 | 2016 | 2017 |
|---|---|---|---|
| **Ozone** | | | |
| National 8-hour maximum concentration (ppm) | 0.066 | 0.061 | 0.054 |
| State 8-hour maximum concentration (ppm) | 0.067 | 0.061 | 0.055 |
| Measured Number of Days Standard Exceeded NAAQS 8-hour concentration (>0.070 ppm) | 0 | 0 | 0 |
| CAAQS 8-hour concentration (>0.070 ppm) | 0 | 0 | 0 |
| **Nitrogen dioxide ($NO_2$)** | | | |
| Annual average (ppb) | 6 | 6 | 7 |
| National maximum 1-hour concentration (ppb) | 41.5 | 42.6 | 42.5 |
| State maximum 1-hour concentration (ppb) | 41 | 42 | 42 |
| Measured Number of Days Standard Exceeded NAAQS 1-hour (>100 ppb) | 0 | 0 | 0 |
| CAAQS 1-hour (>180 ppb) | 0 | 0 | 0 |
| **Particulate Matter ($PM_{10}$)** | | | |
| National maximum 24-hour concentration ($\mu g/m^3$) | 199.0 | 447.2 | 105.6 |
| State maximum 24-hour concentration ($\mu g/m^3$) | 183.0 | 113.1 | 60.5 |
| National annual average concentration ($\mu g/m^3$) | 20.9 | 23.1 | 22.1 |
| State annual average concentration ($\mu g/m^3$) | * | * | * |
| Measured Number of Days Standard Exceeded NAAQS 24-hour (>150 $\mu g/m^3$) | 1 | 1 | 0 |
| CAAQS 24-hour (>50 $\mu g/m^3$) | 2 | 3 | 1 |
| **Particulate Matter ($PM_{2.5}$)** | | | |
| National maximum 24-hour concentration ($\mu g/m^3$) | 22.7 | 14.7 | 14.5 |
| State maximum 24-hour concentration ($\mu g/m^3$) | 22.7 | 14.7 | 14.5 |
| National annual average concentration ($\mu g/m^3$) | * | 5.4 | 6.0 |
| State annual average concentration ($\mu g/m^3$) | * | * | 6.0 |
| Measured Number of Days Standard Exceeded NAAQS 24-hour (>35 $\mu g/m^3$) | 0 | 0 | 0 |

Notes: *Insufficient data to determine the value.
$\mu g/m^3$ = micrograms per cubic meter; ppm = parts per million; ppb = parts per billion; NAAQS = National Ambient Air Quality Standards; CAAQS = California Ambient Air Quality Standards
Source: CARB 2019.

The Project is within the Riverside County portion of the MDAB. As shown in Table 4, the MDAB is designated as Unclassified/Attainment for all criteria air pollutants for the NAAQS except ozone and PM10, for which it is nonattainment. Unlike the rest of the air basin, the Riverside County portion of the MDAB is also designated as unclassified/attainment for PM10 and ozone. The MDAB meets the CAAQS for all criteria air pollutants except ozone and PM10. The MDAB is currently classified as a state nonattainment area for ozone and PM10.

**TABLE 4**
**MOJAVE DESERT AIR BASIN ATTAINMENT DESIGNATIONS**

| Pollutant | State | Federal |
|---|---|---|
| Ozone | Nonattainment | Nonattainment[1] |
| Carbon Monoxide | Attainment | Unclassified/Attainment |
| Nitrogen Dioxide | Attainment | Unclassified/Attainment |
| Sulfur Dioxide | Attainment | Unclassified/Attainment |
| PM10 | Nonattainment | Nonattainment[2] |
| PM2.5 | Attainment | Unclassified/Attainment |
| Sulfates | Attainment | N/A |
| Hydrogen Sulfide | Unclassified | N/A |
| Visibility Reducing Particles | Unclassified | N/A |
| Lead | Attainment | Unclassified/Attainment |

Notes: N/A = not applicable; no standard; PM = Particulate Matter
[1] Southwest corner of desert portion of San Bernardino County only; the Project is located in an unclassifiable/attainment portion of MDAQMD.
[2] San Bernardino County portion only; the Project is located in an unclassifiable/attainment portion of MDAQMD.
Source: CARB 2017a, CARB 2017b, MDAQMD 2019.

## 3.3 Sensitive Receptors

Some members of the population are especially sensitive to air pollutant emissions and should be given special consideration when evaluating air quality impacts from projects. These include children, the elderly, people with preexisting respiratory or cardiovascular illness, and athletes and others who engage in frequent exercise. Air quality regulators typically define sensitive receptors as schools, hospitals, resident care facilities, day-care centers, or other facilities that may house individuals with health conditions that would be adversely impacted by changes in air quality.

Residential areas are also considered sensitive to air pollution because residents (including children and the elderly) tend to be at home for extended periods of time, resulting in sustained exposure to pollutants present. Recreational land uses are considered moderately sensitive to air pollution. Exercise places a high demand on respiratory functions, which can be impaired by air pollution even though exposure periods during exercise are generally short. In addition, noticeable air pollution can detract from the enjoyment of recreation. Industrial and commercial areas are considered the least sensitive to air pollution. Exposure periods are relatively short and intermittent as the majority of the workers tend to stay indoors most of the time. There are no sensitive receptors located within 2 miles of the Project Site. The closest residence is located approximately 2.9 miles west of the Project Site.

# 4. Methodology

Construction-related exhaust emissions for the Project were estimated for construction worker commutes, haul trucks, and the use of off-road equipment. Construction-related emissions for the Project were estimated using emission factors from the CARB's OFFROAD and EMFAC 2014 inventory models (CARB 2013). Construction emissions from the operation of diesel-fueled off-road equipment were estimated by multiplying daily usage (i.e., hours per day) and total days of construction by OFFROAD equipment-specific emission factors. Emissions from on-road motor vehicles were estimated using vehicle trips, vehicle miles traveled, and EMFAC2014 mobile source emission factors. The emission factors represent the fleet-wide average emission factors within Riverside County. Grading, material loading, and travel on paved and unpaved roads would generate fugitive dust (PM10) emissions. Fugitive dust emissions were estimated using the USEPA's Compilation of Air Pollutant Factors (AP-42) and based on vehicle miles traveled on paved and unpaved roads, material loading, and hours of operation.

The primary emission sources during the construction of the Project would include exhaust from heavy construction equipment, on- and off-road vehicles, and fugitive dust generated in areas disturbed by grading, excavating, earth moving, and the movement of various construction vehicles around the site.

Fuel combustion emissions during construction would result from:

- Exhaust from the off-road construction equipment, including diesel construction equipment used for site grading, excavation, and installation of PV modules, and water trucks used to control construction dust emissions;
- Exhaust from on-road construction vehicles, including cement and water trucks used to transport materials and water between Blythe local area and the construction site, and from diesel trucks used to deliver, material, equipment, and construction supplies to the construction site;
- Exhaust from vehicles used by workers to commute to the construction site.

Fugitive dust emissions from the construction of the Project would result from:

- Site grading activities at the construction site
- Installation of PV panel system foundation and related equipment installation
- Installation of inverters, transformers, and substation electrical collector system
- On-site vehicle and equipment travel on unpaved surfaces
- Off-site travel of worker vehicles and trucks on unpaved and paved roads

As summarized in Section 1, Project construction is anticipated to start in 2020. Construction was assumed to last 23 months for the traditional design. Construction activities will include site preparation and grading, photovoltaic system installation, and installation of the inverters, transformers, substation and electrical collector system. The estimated construction workforce is expected to result in up to 854 vehicle trips per day during peak construction during PV system installation. The workforce is assumed to commute to the site from within 13 miles on average from the Project site. In addition to commute trips by construction workers, approximately 9,883 truck deliveries of equipment and materials, including water trucks, were estimated to be required over the course of the construction period. Construction phase-related truck deliveries are estimated to require one-way distances (within the boundaries of the MDAQMD) as follows: equipment and material deliveries at 150 miles and aggregate, water, and concrete deliveries at 13 miles. Concrete and water truck deliveries were assumed to be transporting material from the Blythe local area, which is approximately 13 miles away. Both the traditional design and incorporation of LEID elements are expected to feature similar quantities of construction equipment and total workforce size; thus, construction assumptions in this air quality analysis consider only construction details associated with the traditional design. It was determined to be representative of both approaches and provide a worst-case scenario for the construction emissions and air quality assessment.

Construction of the proposed solar facilities would occur primarily within the approximately 2,489-acre area and on-site cut-and-fill was assumed to be balanced. An approximate 2-mile travel distance for the Project's on-site roadway system was assumed and used for the on-site unpaved road traveling emission calculation. Additional details, equipment lists, and construction scheduling information are provided in Appendix A.

After construction, emissions would be generated from operation and maintenance of the Project. The Project would be designed with a comprehensive Supervisory Control and Data Acquisition (SCADA) system to allow remote monitoring of facility operation and/or remote control of critical components. For the Project as designed, with or without LEID elements incorporated, operational and maintenance activities would include solar module washing; vegetation, weed, and pest management; and security. Maintenance activities would also include panel repairs; maintenance of transformers, inverters, and other electrical equipment as needed; and road and fence repairs. Similar to construction-related emission estimates, operational emissions were estimated using CARB's EMFAC2014 and EPA AP-42 emission factors.

The maximum number of staff on-site at any time would be 50 (40 temporary staff and 10 permanent staff). The perimeter road and main access roads would be surfaced with gravel, compacted dirt, or another commercially available surface and would accommodate Project O&M activities such as cleaning of solar panels, and facilitate on-site circulation for emergency vehicles. The expected annual demand for water was assumed to be approximately 22 acre-feet per year (AFY) for process water, fire protection, dust control, vegetation management, water use at the O&M building, and the expected four solar module washings per year. Only limited deliveries would be necessary for replacement of PV modules and equipment during operation thus, heavy-duty off-road equipment is not expected to be used during operation of the Project. At the end of the operational term of the Project, the Project would cease operations and be decommissioned. Decommissioning activities and impacts are anticipated to be similar to those determined for the construction phase of the Project. The actual impacts would be dependent upon the proposed decommissioning action and final use of the site; thus, emissions associated with decommissioning are discussed qualitatively. Additional details and assumptions are provided in Appendix A.

## 4.1 CEQA Thresholds of Significance

According to CEQA Significance Determination Thresholds, a significant impact related to air quality would occur if implementation of the Project would:

- conflict with or obstruct implementation of the applicable air quality plan,
- violate any air quality standard or contribute substantially to an existing or projected air quality violation,
- result in cumulatively considerable net increase of any criteria pollutant for which the project region is nonattainment under an applicable federal or state ambient air quality standard (including releasing emission which exceed quantitative thresholds for ozone precursors),
- expose sensitive receptors to substantial pollutant concentrations, or
- create objectionable odors affecting a substantial number of people.

As stated in Appendix G of the CEQA Guidelines, the significance criteria established by the applicable air quality management board or air pollution control district may be relied on to make the impact determinations for specific program elements. MDAQMD has developed quantitative significance thresholds for CEQA projects in their CEQA and Federal Conformity Guidelines (MDAQMD 2016). The screening level thresholds are shown in Table 5.

**TABLE 5**
**REGIONAL POLLUTANT EMISSION SCREENING LEVEL THRESHOLDS OF SIGNIFICANCE**

| Mass Daily Thresholds | | |
|---|---|---|
| **Pollutant** | **AnnualThreshold (tons)** | **Daily Threshold (pounds)** |
| CO | 100 | 548 |
| NOx | 25 | 137 |
| PM10 | 15 | 82 |
| PM2.5 | 12 | 65 |
| VOC | 25 | 137 |
| Source: MDAQMD 2016 | | |

This analysis does not directly evaluate lead or SOX because little to no quantifiable and foreseeable emissions of these substances would be generated by the Project. Lead emissions have significantly decreased due to the near elimination of leaded fuel use. On- and off-road diesel fuel used in California must meet low sulfur standards established by CARB; thus, SOX emissions due to diesel exhaust are assumed to be minimal.

## 4.2 NEPA Thresholds

General conformity de minimis thresholds are appropriate thresholds to be used for determining NEPA significance. A NEPA air quality significance analysis differs from the General Conformity analysis in that all project criteria pollutant emissions are considered: emissions for pollutants where the area has attained the NAAQS as well as emissions for pollutants where the region is currently designated as a nonattainment or maintenance area. Therefore, in the Riverside County portion of the MDAB, project attainment emissions of VOC, NOX, CO, PM10, and PM2.5, would be considered for impact significance under NEPA for air quality in addition to VOC, NOX, and PM10 considered under General Conformity.

# 5. Impact Analysis

## 5.1 Project Impacts

**AQ-1:** *The Project would not conflict with or obstruct implementation of the applicable air quality plan. The impact would be less than significant.*

Air quality plans describe air pollution control strategies to be implemented by a city, county, or regional air district. The primary purpose of an air quality plan is to bring an area that does not attain federal and state air quality standards into compliance with those standards pursuant to the requirements of the federal CAA and California CAA. Projects that are consistent with the assumptions and control measures used in development of the applicable air quality plan are considered to not conflict with or obstruct the attainment of the air quality levels identified in the plan.

The applicable air quality plans for the project are prepared by MDAQMD as plans for improving air quality in the region. The MDAQMD has adopted a variety of AQAPs for the pollutants that are in nonattainment in the region, such as the 2004 state and federal Ozone Attainment Plan, and the 1996 Maintenance Plan for PM10.

Construction of the Project would involve the use of off-road equipment, haul trucks, and worker commute trips. The Project would not increase the assumptions for the hours of activity and equipment population reported to CARB for rule compliance. The design features of the Project also include fugitive dust control measures consistent with MDAQMD Rule 403. Therefore, while the Project would generate criteria pollutant emissions, the approach to exhaust and fugitive dust emission control measures would not conflict with or obstruct implementation any applicable air quality plan.

The Project is currently planned for an area within the SEZ and within the Desert Renewable Energy Conservation Plan (DRECP) DFA and the DRECP LUPA designated the site as suitable for solar development without an additional project-specific land use plan amendment. Additionally, the Project site is located on lands currently designated as Multiple-Use-Class (MUC) Moderate (M) under the California Desert Conservation Area (CDCA) Plan. Solar electric facilities are allowed under MUC M designation once NEPA requirements are met.

Based on the maximum of 50 staff on-site at any time, operational and maintenance activities associated with the Project would generate approximately 100 motor vehicle trips per day. The Project does not involve any uses that would increase population beyond that considered in the Riverside County General Plan. In addition, the Project would be consistent with the Riverside County General Plan Air Quality Element policies AQ 20.18 and 20.19, which encourage and facilitate the installation, development, and siting of commercial renewable energy facilities (Riverside County, 2018). The Project does not include the construction of new residential or commercial buildings; therefore, it would not directly increase population or regional employment.

Because the Project would be consistent with the assumptions regarding equipment activity and emissions in the SIP and existing planning documents, it is expected that the intensity of construction and operational emissions associated with the Project would have been accounted for in any applicable air quality plan. Similarly, equipment activity and emissions during decommissioning is anticipated to be similar to equipment use and impacts during the construction phase of the Project. Because the Project would comply with all construction-related MDAQMD rules and regulations and is consistent with the BLM land use classifications and planning documents, the Project would not conflict with or obstruct implementation of the applicable air quality plan. The impact would be less than significant.

**AQ-2:** *The Project would violate an air quality standard or contribute substantially to an existing or projected air quality violation. The impact would be significant, requiring mitigation.*

**Construction**

Construction emissions are described as "short-term" or temporary in duration; however, they have the potential to represent a significant impact with respect to air quality. Construction of the Project would result in the temporary generation of VOC, NOX, CO, PM10, and PM2.5 emissions. VOC, NOX, and CO emissions are primarily associated with mobile equipment exhaust, including off road construction equipment and on-road motor vehicles. Fugitive

PM dust emissions are primarily associated with site preparation, and vary as a function of parameters such as soil silt content, soil moisture, wind speed, acreage of disturbance area, and vehicle miles traveled by construction vehicles on- and off site. Earthmoving and material handling operations are the primary sources of fugitive PM dust emissions from the Project's construction activities.

As shown in Table 6, construction emissions for the Project would result in maximum daily emissions of approximately 53 pounds of VOC, 597 pounds of NOX, 368 pounds of CO, 598 pounds of PM10, and 99 pounds of PM2.5. Additional modeling assumptions and details are provided in Appendix A.

**TABLE 6**
**ESTIMATED MAXIMUM DAILY CONSTRUCTION EMISSIONS**

| | VOC | $NO_X$ | CO | PM10 [1,2] | PM2.5 [1] |
|---|---|---|---|---|---|
| **Daily Emissions (lbs/day)** | | | | | |
| 2020 | 13.88 | 183.10 | 97.84 | 218.65 | 43.53 |
| 2021 | 52.90 | 596.46 | 367.82 | 597.61 | 98.85 |
| 2022 | 52.90 | 596.46 | 367.82 | 597.61 | 98.85 |
| Maximum Daily Construction Emissions (lbs/day) | 52.90 | 596.46 | 367.82 | 597.61 | 98.85 |
| Threshold of Significance (lbs/day) | 137 | 137 | 548 | 82 | 65 |
| *Significant Impact?* | **NO** | **YES** | **NO** | **YES** | **YES** |
| **Annual Emissions (tons/year)** | | | | | |
| 2020 | 0.41 | 4.27 | 2.96 | 6.85 | 1.35 |
| 2021 | 5.84 | 55.78 | 41.80 | 71.90 | 11.76 |
| 2022 | 3.32 | 31.17 | 23.68 | 38.38 | 5.98 |
| Maximum Annual Emissions (tons/year) | 5.84 | 55.78 | 41.80 | 71.90 | 11.76 |
| Threshold of Significance (tons/year) | 25 | 25 | 100 | 15 | 12 |
| *Significant Impact?* | **NO** | **YES** | **NO** | **YES** | **NO** |

Notes: [1] PM10 emissions shown include the sum of particulate matter (PM) with aerodynamic diameter 0 to 2.5 microns and PM with aerodynamic diameter 2.5 to 10 microns.
[2]Does not include fugitive dust emissions reductions per MDAQMD Rule 403. .
[3] Additional details on the emissions for each calendar year are included in Appendix A.
VOC = volatile organic compounds; $NO_X$ = oxides of nitrogen; CO = carbon monoxide; PM10 = suspended PM; PM2.5 = fine PM; lbs/day = pounds per day
Source: Estimated by AECOM in 2019

As shown in Table 6, construction-related emissions of NOX, PM10, and PM2.5 would exceed the daily thresholds of significance. Construction-related emissions of NOX and PM10 would also exceed the annual thresholds of significance. Therefore, construction emissions could violate an ambient air quality standard or contribute substantially to an existing violation. The impact would be significant. To minimize this impact, the Applicant will phase construction to the maximum extent practicable to minimize the amount of equipment operating at the same time. In addition, implementation of mitigation measures (MMs) AQ-A through AQ-D would be required.

The General Conformity applicability and NEPA analyses are based on estimates of the total direct and indirect net emissions from construction of the Project. Table 7 summarizes the projected annual emissions associated with construction of the Project. The annual emissions estimates shown in Table 7 include emission reductions associated with MMs AQ-A through AQ-D discussed in Chapter 6 of this report. The federal agency can take measures to reduce emissions, and the changes must be state or federally enforceable to guarantee that emissions would be below de minimis levels. Based on CEQA provisions in 14 California Code of Regulations Section 15091(a)(1), MMs must be incorporated into the Project. For the purposes of the NEPA and General Conformity applicability analysis, MMs required by CEQA are considered design features of the Project. This is not considered "mitigation" under the General Conformity Rule. The Project assumes that MMs would be implemented to meet CEQA requirements.

**TABLE 7**
**GENERAL CONFORMITY - ESTIMATED ANNUAL CONSTRUCTION EMISSIONS**

| | VOC | $NO_X$ | CO | PM10 [1] | PM2.5[1] |
|---|---|---|---|---|---|
| 2020 | 0.10 | 1.18 | 3.53 | 1.39 | 0.33 |
| 2021 | 1.72 | 17.17 | 49.60 | 13.81 | 2.48 |
| 2022 | 1.01 | 9.81 | 28.08 | 7.28 | 1.21 |
| Maximum Annual Construction Emissions (tons/year) | 1.72 | 17.17 | 49.60 | 13.81 | 2.48 |
| Threshold of Significance [2] (tons/year) | 100 | 100 | N/A | 100 | N/A |
| *Significant Impact?* | No | No | No | No | No |

Notes: [1] PM10 emissions shown include the sum of particulate matter (PM) with aerodynamic diameter 0 to 2.5 microns and PM with aerodynamic diameter 2.5 to 10 microns.
[2] As explained in Section 2.1.3, the Riverside County portion of the MDAQMD is an unclassifiable/attainment area of the MDAB for all pollutants under the NAAQS and thus, general conformity de minimis thresholds do not apply. However, for the purposes of this analysis, this analysis conservatively compares project-related emissions for those pollutants for which the entire MDAB is in nonattainment.
VOC = volatile organic compounds; $NO_X$ = oxides of nitrogen; CO = carbon monoxide; $SO_2$ = sulfur dioxide; PM10 = suspended PM; PM2.5 = fine PM
Source: Estimated by AECOM in 2019

As shown in Table 7, the annual emissions would not exceed any de minimis levels. As explained previously, both the traditional design and incorporation of LEID elements are expected to feature similar quantities of construction equipment and total workforce size; thus, a formal conformity analysis would not be required and no direct or indirect effects would occur for either option.

**Operation**

The Project, both with or without LEID elements incorporated, would include an on-site O&M building. The Project is expected to generate approximately 100 daily trips associated with worker commute trips from the maximum number of staff expected to be on-site at one time for maintenance activities. On-site operations would also include solar module washing which was assumed to occur four times each year using light utility vehicles with tow-behind water trailers. Table 8 summarizes the projected annual emissions associated with operation of the Project. Operation of the Project would result in maximum daily emissions of approximately less than one pound of VOC and CO, 4 pounds of NOx, 43 pounds of PM10, and 7 pounds of PM2.5.

As shown in Table 8, the estimated operational emissions would not exceed the daily thresholds of significance. Therefore, operational emissions would not violate an ambient air quality standard or contribute substantially to an existing violation. The impact would be less than significant.

**TABLE 8**
**ESTIMATED OPERATIONAL EMISSIONS**

| | VOC | $NO_X$ | CO | PM10 [1,2] | PM2.5[1] |
|---|---|---|---|---|---|
| Daily Emissions (lbs/day) | | | | | |
| Operational Emissions | 0.11 | 3.70 | 2.40 | 77.25 | 11.73 |
| Threshold of Significance (lbs/day) | 137 | 137 | 548 | 82 | 65 |
| *Significant Impact?* | **NO** | **NO** | **NO** | **NO** | **NO** |
| Annual Emissions (tons/year) | | | | | |
| Operational Emissions | <0.01 | 0.14 | 0.09 | 6.33 | 1.00 |
| Threshold of Significance (tons/year) | 25 | 25 | 100 | 15 | 12 |
| *Significant Impact?* | **NO** | **NO** | **NO** | **NO** | **NO** |

Notes: [1] PM10 emissions shown include the sum of particulate matter (PM) with aerodynamic diameter 0 to 2.5 microns and PM with aerodynamic diameter 2.5 to 10 microns.
[2] Fugitive dust emissions include reductions based on watering two times per day per MDAQMD Rule 403.2.
[3] Additional details on the emissions for each calendar year are included in Appendix A.
VOC = volatile organic compounds; $NO_X$ = oxides of nitrogen; CO = carbon monoxide; $PM_{10}$ = suspended PM; PM2.5 = fine PM; lbs/day = pounds/day
Source: Estimated by AECOM in 2017

**Decommissioning**

Decommissioning impacts are anticipated to be similar to those determined for the construction phase of the Project as described above. The actual impacts would be dependent upon the proposed decommissioning action and final use of the site. Applicable construction phase applicant proposed measures (APMs) would be implemented during the decommissioning phase to minimize associated impacts.

**AQ-3:** *The Project would result in a cumulatively considerable net increase of any criteria pollutant for which the project region is nonattainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors). The impact would be significant, requiring mitigation.*

**Construction**

The cumulative analysis focuses on whether a specific project would result in cumulatively considerable contribution of emissions to the region. Per CEQA Guidelines Section 15064(h)(4), the existence of significant cumulative impacts caused by other projects alone shall not constitute substantial evidence that the Project's incremental effects are cumulatively considerable.

The MDAQMD as a whole is considered a nonattainment area for ozone (CAAQS and NAAQS) and PM (CAAQS and NAAQS). As discussed earlier, the Project would result in the generation of VOC, NOX, CO, PM10, and PM2.5 emissions. Emissions of NOX, PM10, and PM2.5 would exceed the recommended emissions thresholds for construction activities. These thresholds are designed to identify those projects that would result in significant levels of air pollution, and that would assist the region in attaining the applicable state and federal ambient air quality standards. When a project exceeds these significance thresholds, it is considered to impede attainment and maintenance of ambient air quality standards.

Because the Project would exceed the project-level air quality significance thresholds for criteria pollutant emissions, and incorporation of LEID elements would be similar to the traditional design, the Project's construction emissions would have a cumulatively considerable contribution to the region's air quality. Therefore, the cumulative impact would be significant. Implementation of MMs AQ-A through AQ-D would be required under both scenarios.

**Operation**

As shown in Table 8, operation of the Project would not result in emissions that exceed the project-level thresholds for criteria pollutant emissions. Therefore, operational emissions would not have a cumulatively considerable contribution to the region's air quality. The cumulative impact would be less than significant.

**Decommissioning**

Decommissioning impacts are anticipated to be similar to those determined for the construction phase of the Project as described above. The actual impacts would be dependent upon the proposed decommissioning action and final use of the site. Applicable construction phase APMs would be implemented during the decommissioning phase to minimize associated impacts.

**AQ-4**: *The Project would expose sensitive receptors to substantial pollutant concentrations. The impact would be significant, requiring mitigation.*

**Construction**

During construction, the greatest potential for toxic air contaminant (TAC) emissions would be related to diesel PM emissions associated with heavy-duty construction equipment activity. The Office of Environmental Health Hazard Assessment (OEHHA) developed a Guidance Manual for the Preparation of Health Risk Assessments (OEHHA 2015). According to OEHHA methodology, health effects from carcinogenic TACs are usually described in terms of individual cancer risk, which is based on a 30-year lifetime exposure to TACs. Construction activities are anticipated to last approximately 23 months and would cease following completion of the project. Therefore, the total exposure period for construction activities would be approximately six percent of the total exposure period used for typical residential health risk calculations (i.e. 30 years). Further, construction emissions would occur intermittently throughout the day, as construction equipment is required across the 2,489 project area, rather than as a constant plume of emissions from the project site.

In addition, concentrations of mobile source diesel PM emissions are typically reduced by 70 percent at a distance of approximately 500 feet from freeways, which are continuous emission sources, and an 80 percent decrease at 1,000 feet from distribution centers (ARB 2005). Studies also indicate that diesel PM emissions and the relative health risk can decrease substantially within 300 feet (ARB, 2005; Zhu et al., 2002). As explained previously, the Project Site is located in primarily open space, and not in the vicinity of any sensitive receptors. The nearest sensitive receptor is a residence located over 2 miles from the Project Site.

Therefore, considering the construction schedule, substantial buffer distance to the nearest sensitive receptor and the highly dispersive nature of diesel PM emissions, construction of the Project would not expose sensitive receptors to substantial pollutant concentrations. This impact would be less than significant.

**Operation**

As explained previously, operation of the Project would generate approximately 100 vehicle trips per day associated with worker trips. Operational activities would include solar module washing; vegetation, weed, and pest management; and security. Maintenance activities would also include panel repairs; maintenance of transformers, inverters, and other electrical equipment as needed; and road and fence repairs. As explained previously, the nearest sensitive receptor is located over 2 miles from Project Site, and mobile source diesel PM emissions are typically reduced by 70 percent at a distance of approximately 500 feet (ARB 2005). In addition, operation of the Project is not anticipated to involve heavy–duty off-road equipment. Therefore, the Project would not expose sensitive receptors to substantial pollutant concentrations that would result in a health risk. This impact would be less than significant.

**Decommissioning**

Decommissioning impacts are anticipated to be similar to those determined for the construction phase of the Project as described above. The actual impacts would be dependent upon the proposed decommissioning action and final use of the site. Applicable construction phase APMs would be implemented during the decommissioning phase to minimize associated impacts.

**AQ-5**: *The Project would not create objectionable odors affecting a substantial number of people. The impact would be less than significant.*

Sources that may emit odors during construction activities include exhaust from diesel construction equipment and heavy-duty trucks, which could be considered offensive to some individuals. Odors from these sources would be localized and generally confined to the immediate area surrounding the Project Site. The Project would use typical construction techniques, and the odors would be typical of most construction sites and temporary in nature. After construction of the Project, all construction-related odors would cease. PV solar projects are not typically large generators of odors; thus, operation of the Project would not be expected to add any new odor sources. Decommissioning activities are expected to be very similar to construction activities and may therefore also emit odors including exhaust from diesel equipment and heavy-duty trucks. After decommissioning, all associated odors would cease. As a result, the Project would not create objectionable odors affecting a substantial number of people during any phase of the Project. The impact would be less than significant.

## 5.2 Cumulative Impacts

By its very nature, air pollution is largely a cumulative impact. The nonattainment status of regional pollutants is a result of past and present development within the MDAB, and this regional impact is cumulative rather than being attributable to any one source. A project's emissions may be individually limited, but cumulatively considerable when taken in combination with past, present, and future development projects. The thresholds of significance are relevant to whether a project's individual emissions would result in a cumulatively considerable incremental contribution to the existing cumulative air quality conditions. As discussed in AQ-3 and AQ-4, the Project would exceed the project level air quality significance thresholds for criteria pollutant emissions. Therefore, the Project's construction emissions would have a cumulatively considerable contribution to the region's air quality.

# 6. Mitigation Measures

**AQ-A.** The Project Applicant shall develop and implement a Dust Control Plan that describes the fugitive dust control measures that would be implemented and monitored at all locations of proposed facility construction. The Dust Control Plan shall comply with the mitigation. The plan shall be submitted to MDAQMD no less than 60 days prior to the start of construction. The plan shall be incorporated into all contracts and contract specifications for construction work. The plan shall outline the steps to be taken to minimize fugitive dust generated by construction activities by:

- Describing each active operation that may result in the generation of fugitive dust;
- Identifying sources of fugitive dust, e.g., earth moving, storage piles, vehicular traffic;
- Describing the control measures to be applied to each of the sources identified. The descriptions shall be sufficiently detailed to demonstrate that the best available control measures required by the air quality districts for linear projects are used; and
- Providing the following control measures, in addition to or as listed in the applicable rules but not limited to:
  - Visible speed limit signs shall be posted at the site entrance(s);
  - No vehicle shall exceed 25 miles per hour (mph) on paved roads or 15 mph on unpaved roads. Speeds shall be reduced if visible dust emissions occur;
  - Use of street sweeping and trackout devices at the construction site. Sweep streets daily if visible soil material is carried into adjacent public streets or wash trucks and equipment before entering public streets;
  - Frequent watering or stabilization of excavation, spoils, access roads, storage piles, and other sources of fugitive dust (parking areas, staging areas, other) if construction activity cause persistent visible emissions of fugitive dust beyond the work area;
  - Apply chemical soil stabilizers or apply water to form and maintain a crust on inactive construction areas (disturbed lands that are unused for four consecutive days);
  - Cover stockpiles and suspend construction work when winds exceed 30 miles per hour;
  - Pre-watering of soils prior to clearing and trenching;
  - Pre-moisten, prior to transport, import and export dirt, sand, or loose materials;
  - Installing temporary coverings on storage piles when not in use. Cover loads in haul trucks or maintain at least six inches of free-board when traveling on public roads;
  - Dedicating water truck or high/capacity hose to any soil screening operations;
  - Minimizing drop height of material through screening equipment;
  - Reducing the amount of disturbed area where possible; and
  - Planting vegetative ground cover in disturbed areas as soon as possible following construction activities.

The Applicant or its designated representative shall obtain prior approval from the MDAQMD prior to any deviations from fugitive dust control measures specified in the Dust Control Plan. A justification statement used to explain the technical and safety reason(s) that preclude the use of required fugitive dust control measures shall be submitted to the appropriate agency for review. The provisions of the Dust Control Plan shall also apply to project decommissioning activities.

**AQ-B.** The construction contractor shall use off-road construction diesel engines that meet, at a minimum, the Tier 4 Final California Emissions Standards, unless such an engine is not available for a particular item of equipment. Tier 4 Interim or Tier 3 engines will be allowed on a case-by-case basis when the contractor has documented that no Tier 4 Final equipment, or emissions equivalent retrofit equipment is available for a particular equipment type that must be used to complete construction. Documentation shall consist of signed written statements from at least two construction equipment rental firms.

**AQ-C**. The construction contractor shall minimize idling time by shutting equipment off when not in use or reducing the time of idling to no more than five minutes (5-minute limit is required by the State Airborne Toxics Control Measure [Title 13, sections 2449 and 2485 of the California Code of Regulations]) and provide clear signage that posts this requirement for workers at the entrances to the Project Site.

**AQ-D.** The construction contractor shall maintain construction equipment in proper working condition according to manufacturer's specifications. The equipment must be checked by a certified mechanic and determined to be running in proper condition before it is operated.

# 7. Results and Findings

## 7.1 CEQA Significance Findings

### 7.1.1 Traditional Design

Implementation of MMs AQ-A through AQ-D would ensure construction activities associated with the construction of the Project would minimize criteria pollutant emissions. MM AQ-A would reduce fugitive dust emissions through implementation of a dust control plan. Although the specific control measures will be included in the plan, the emission estimates assumed frequent watering (at least three times per day) to achieve dust control efficiency of 60 percent, and limiting speeds to 15 miles per hour to achieve a combined dust control efficiency of 81 percent during construction activities. MM AQ-B requires engines in diesel-fueled construction equipment above 50 horsepower to meet Tier 4 emission standards. Emission standards for diesel off-road equipment are based on the engine model year. Implementation of these standards, referred to as Tier 1 emission standards, became effective in 1996. The more stringent Tier 2 and Tier 3 emission standards became effective between 2001 and 2008, with the effective date dependent on engine horsepower. Tier 4 interim standard became effective between 2008 and 2012, and Tier 4 final standards became effective in 2014 and 2015.

The OFFROAD model used in the analysis contains ranges of tier engines and uses average fleet data to develop emission factors for a given calendar year. Because the earliest year for construction of the Project would be 2020, and the requirements for production of Tier 3 and earlier engines have been in effect for over 10 years, it is reasonable to assume that most, if not all, off-road construction equipment would meet Tier 3 emission standards without the application of MM AQ-A. Based on the improvements in emissions standards required by CARB, off-road construction equipment with Tier 4 engines would result in an additional 20 percent reduction in VOC emissions, 91 percent reduction in NOX emissions, and 95 percent reduction in PM10 emissions from the use of Tier 3 equipment (SCAQMD 2014). Table 9 shows the mitigated emissions for construction activities for project proposed with a traditional design approach.

As shown in Table 9, implementation of MMs AQ-A through AQ-D would reduce emissions to the maximum extent feasible. Implementation of MMs AQ-A through AQ-D would reduce significant impacts of PM2.5 to a less than significant level; however, mitigated NOX and PM10 emissions would continue to exceed the recommended thresholds of significance. Emissions during the decommissioning phase of the Project are anticipated to be the same or less than the emissions estimated for construction activities. Therefore, the impact would be significant and unavoidable.

### 7.1.2 LEID Elements

Generally, the LEID elements would reduce overall ground disturbance activities, but would require similar equipment types, quantities, and workforce sizes as the traditional design. Thus, emissions for the LEID elements are anticipated to be similar to the traditional design. In addition, emissions during the decommissioning phase of the Project are anticipated to be the same or less than the emissions estimated for construction activities. Therefore, the impact would be significant and unavoidable.

**TABLE 9**
**MITIGATED MAXIMUM DAILY CONSTRUCTION EMISSIONS**

| | VOC | $NO_X$ | CO | PM10 [1,2] | PM2.5 [1] |
|---|---|---|---|---|---|
| **Daily Emissions (lbs/day)** | | | | | |
| 2020 | 4.03 | 84.89 | 115.85 | 45.33 | 11.12 |
| 2021 | 17.02 | 267.29 | 432.77 | 117.16 | 21.89 |
| 2022 | 17.02 | 267.29 | 432.77 | 117.16 | 21.89 |
| Maximum Daily Construction Emissions (lbs/day) | 17.02 | 267.29 | 432.77 | 117.16 | 21.89 |
| Threshold of Significance (lbs/day) | 137 | 137 | 548 | 82 | 65 |
| *Significant Impact?* | **NO** | **YES** | **NO** | **YES** | **NO** |
| **Annual Emissions (tons/year)** | | | | | |
| 2020 | 0.10 | 1.18 | 3.53 | 1.39 | 0.33 |
| 2021 | 1.72 | 17.17 | 49.60 | 13.81 | 2.48 |
| 2022 | 1.01 | 9.81 | 28.08 | 7.28 | 1.21 |
| Maximum Annual Emissions (tons/year) | 1.72 | 17.17 | 49.60 | 13.81 | 2.48 |
| Threshold of Significance (tons/year) | 25 | 25 | 100 | 15 | 12 |
| *Significant Impact?* | **NO** | **NO** | **NO** | **NO** | **NO** |

Notes: [1] PM10 emissions shown include the sum of particulate matter (PM) with aerodynamic diameter 0 to 2.5 microns and PM with aerodynamic diameter 2.5 to 10 microns.
[2] Fugitive dust emissions were reduced based on watering two times per day.
[3] Additional details on the emissions for each calendar year are included in Appendix A.
VOC = volatile organic compounds; $NO_X$ = oxides of nitrogen; CO = carbon monoxide; PM10 = suspended PM; PM2.5 = fine PM; lbs/day = pounds per day
Source: Estimated by AECOM in 2019

## 7.2 NEPA Impacts Summary

General conformity de minimis thresholds are appropriate thresholds to be used for determining NEPA significance. As shown in Tables 7 and Table 8, the Project would not result in a substantial adverse effect related to criteria pollutant emissions.

# 8. References


California Air Resources Board (CARB). 2013. Mobile Source Emission Inventory – Current Methods and Data. Available at http://www.arb.ca.gov/msei/modeling.htm. Accessed August 2017.

______. 2016. May. Ambient Air Quality Standards. Available at http://www.arb.ca.gov/research/aaqs/aaqs2.pdf. Accessed August 2017.

______. 2005. Air Quality and Land Use Handbook: A Community Health Perspective. Available at https://www.arb.ca.gov/ch/handbook.pdf. Accessed August 2017.

______. 2017a. Federal Standard Area Designations. Available at https://www.arb.ca.gov/desig/feddesig.htm. Accessed April 2018.

______. 2017b. Air Quality Standards and Area Designations. Available at https://www.arb.ca.gov/desig/desig.htm. Accessed April 2018.

______. 2019. Air Quality Data Statistics. Available at http://www.arb.ca.gov/adam/welcome.html. Accessed April 2019.

Mojave Desert Air Quality Management District (MDAQMD). 2016. CEQA and Federal Conformity Guidelines. Available at http://www.mdaqmd.ca.gov/home/showdocument?id=192. Accessed August 2017.

______. 2019. MDAQMD Attainment Status. Available at http://www.mdaqmd.ca.gov/home/showdocument?id=1267. Accessed April 2019.

Office of Environmental Health Hazard Assessment (OEHHA). 2015. Hot Spots Guidance Manual. Available at http://www.oehha.org/air/hot_spots/hotspots2015.html. Accessed August 2017.

Riverside County. 2015. General Plan. Available at http://planning.rctlma.org/ZoningInformation/GeneralPlan.aspx. Accessed August 2017.

______. 2018. General Plan – Air Quality Element. Available at https://planning.rctlma.org/Portals/14/genplan/general_plan_2018/elements/Ch09_AQE_071718.pdf. Accessed April 2019.

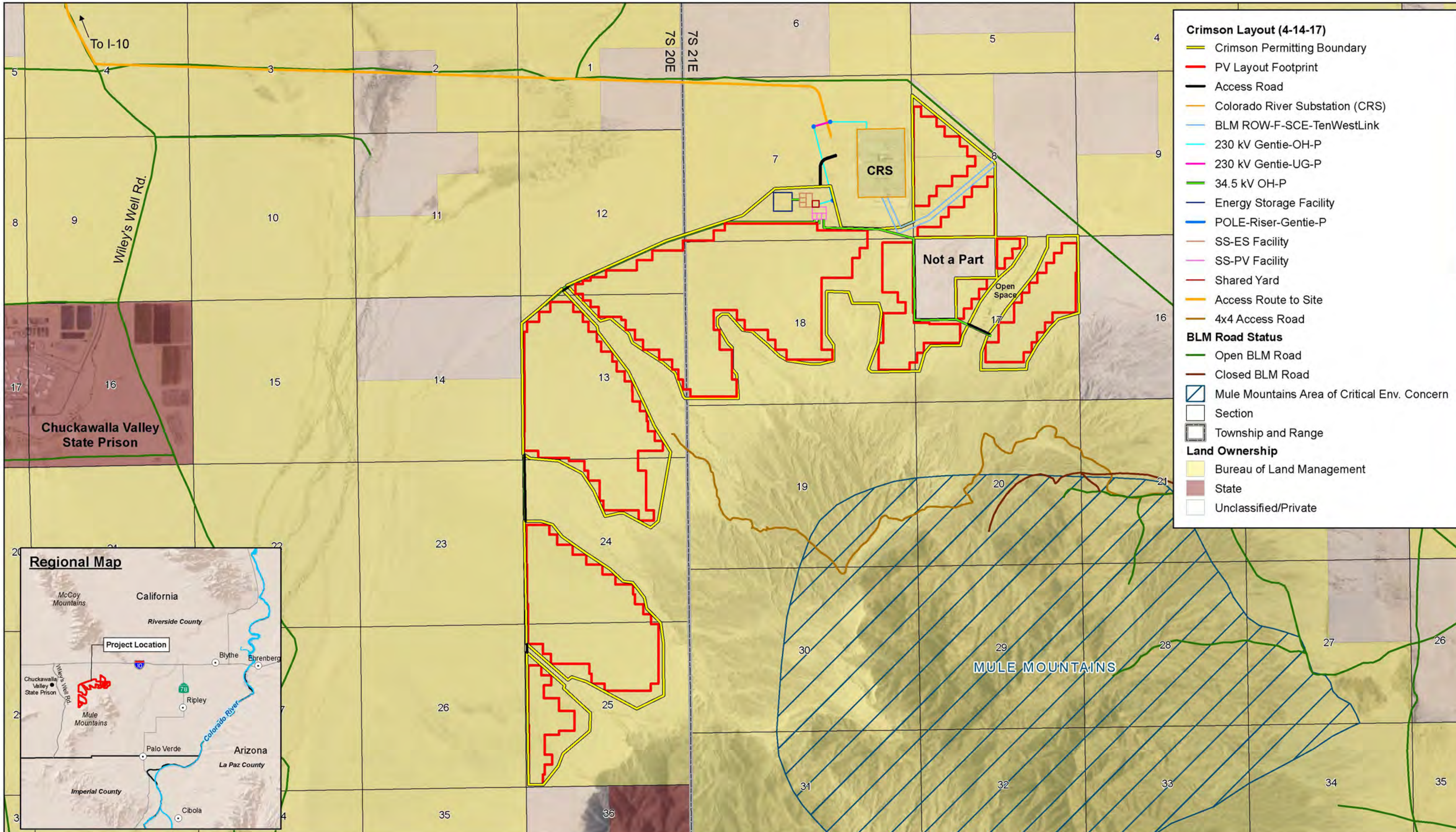
United States Environmental Protection Agency (USEPA). General Conformity: De Minimis Tables. Available at: https://www.epa.gov/general-conformity/de-minimis-tables. Accessed August 2017.

# 9. Acronyms

| | |
|---|---|
| μg/m3 | micrograms per cubic meter |
| AC | alternating current |
| APMs | applicant proposed measures |
| AQAP | Air Quality Attainment Plans |
| AQMP | Air Quality Management Plans |
| ARB | California Air Resources Board |
| BACM | Best Available Control Measures |
| BACT | Best Available Control Technology |
| BLM | Bureau of Land Management |
| CAA | Clean Air Act |
| CAAQS | California Ambient Air Quality Standards |
| CARB | California Air Resources Board |
| CEQA | California Environmental Quality Act |
| CO | carbon monoxide |
| County | County of Riverside |
| DC | direct current |
| EIS | Environmental Impact Statement |
| EMFAC | Emission Factor Model |
| ESS | Energy Storage System |
| kV | kilovolt |
| lbs | pounds |
| LEID | low-environmental impact design |
| MDAB | Mojave Desert Air Basin |
| MDAQMD | Mojave Desert Air Quality Management District |
| mg/m3 | milligrams per cubic meter |
| MM | mitigation measure |
| NAAQS | National Ambient Air Quality Standards |
| NEPA | National Environmental Policy Act |
| NO | nitric oxide |
| NO2 | nitrogen dioxide |
| NOX | oxides of nitrogen |
| PM | particulate matter |
| PM10 | particulate matter with size equal to or less than 10 micrometers in diameter |
| PM2.5 | particulate matter with size equal to or less than 2.5 micrometers in diameter |
| POD | Plan of Development |
| ppb | parts per billion |
| ppm | parts per million |
| Project Site | Location of the Project |
| PV | photovoltaic |
| SCADA | Supervisory Control and Data Acquisition |

| | |
|---|---|
| SIP | State Implementation Plan |
| SO2 | sulfur dioxide |
| TAC | toxic air contaminant |
| USEPA | United States Environmental Protection Agency |
| VOC | volatile organic compound |

# Figures




Source: Recurrent Energy, 2017. AECOM, 2017. esri, 2016.

3,000 0 3,000 Feet

Scale: 1:36,000 1 in = 3,000 feet

**FIGURE 1-1**
**SITE LAYOUT**

DATE: 8/29/2017

# Appendix A

## Emission Calculations

Option A -Traditional Design Construction
Construction Emissions Summary

| | Maximum Daily Emissions (lbs/day) | | | | |
|---|---|---|---|---|---|
| Construction Phase/Source | VOC | $NO_X$ | CO | $PM_{10}$ | $PM_{2.5}$ |
| 2020 | | | | | |
| Phase I | 13.88 | 183.10 | 97.84 | 218.65 | 43.53 |
| | | | | | |
| 2021 | | | | | |
| Phase I | 13.88 | 183.10 | 97.84 | 218.65 | 43.53 |
| Phase II | 27.91 | 298.91 | 189.03 | 255.88 | 38.97 |
| Phase III | 11.10 | 114.45 | 80.95 | 123.08 | 16.35 |
| Maximum Daily | 52.90 | 596.46 | 367.82 | 597.61 | 98.85 |
| | | | | | |
| 2022 | | | | | |
| Phase I | 13.88 | 183.10 | 97.84 | 218.65 | 43.53 |
| Phase II | 27.91 | 298.91 | 189.03 | 255.88 | 38.97 |
| Phase III | 11.10 | 114.45 | 80.95 | 123.08 | 16.35 |
| Maximum Daily | 52.90 | 596.46 | 367.82 | 597.61 | 98.85 |

| | Annual Emissions (tons/year) | | | | |
|---|---|---|---|---|---|
| | VOC | $NO_X$ | CO | $PM_{10}$ | $PM_{2.5}$ |
| 2020 | | | | | |
| Option A - Phase I | 0.41 | 4.27 | 2.96 | 6.85 | 1.35 |
| | | | | | |
| 2021 | | | | | |
| Option A - Phase I | 1.63 | 17.09 | 11.84 | 27.39 | 5.41 |
| Option A - Phase II | 3.18 | 27.98 | 21.98 | 30.41 | 4.56 |
| Option A - Phase III | 1.03 | 10.71 | 7.98 | 14.10 | 1.79 |
| Maximum Annual | 5.84 | 55.78 | 41.80 | 71.90 | 11.76 |
| | | | | | |
| 2022 | | | | | |
| Option A - Phase I | 0.54 | 5.70 | 3.95 | 9.13 | 1.80 |
| Option A - Phase II | 2.12 | 18.65 | 14.66 | 20.28 | 3.04 |
| Option A - Phase III | 0.66 | 6.82 | 5.08 | 8.97 | 1.14 |
| Maximum Annual | 3.32 | 31.17 | 23.68 | 38.38 | 5.98 |

Option A - Traditional Design Construction
Mitigated Construction Emissions Summary

| Construction Phase/Source | Maximum Daily Emissions (lbs/day) | | | | |
|---|---|---|---|---|---|
| | VOC | $NO_X$ | CO | $PM_{10}$ | $PM_{2.5}$ |
| 2020 | | | | | |
| Phase I | 4.03 | 84.89 | 115.85 | 45.33 | 11.12 |
| | | | | | |
| 2021 | | | | | |
| Phase I | 4.03 | 84.89 | 115.85 | 45.33 | 11.12 |
| Phase II | 10.35 | 152.04 | 222.61 | 48.75 | 7.95 |
| Phase III | 2.65 | 30.36 | 94.32 | 23.08 | 2.81 |
| Maximum Daily | 17.02 | 267.29 | 432.77 | 117.16 | 21.89 |
| | | | | | |
| 2022 | | | | | |
| Phase I | 4.03 | 84.89 | 115.85 | 45.33 | 11.12 |
| Phase II | 10.35 | 152.04 | 222.61 | 48.75 | 7.95 |
| Phase III | 2.65 | 30.36 | 94.32 | 23.08 | 2.81 |
| Maximum Daily | 17.02 | 267.29 | 432.77 | 117.16 | 21.89 |

| | Annual Emissions (tons/year) | | | | |
|---|---|---|---|---|---|
| | VOC | $NO_X$ | CO | $PM_{10}$ | $PM_{2.5}$ |
| 2020 | | | | | |
| Phase I | 0.10 | 1.18 | 3.53 | 1.39 | 0.33 |
| | | | | | |
| 2021 | | | | | |
| Phase I | 0.39 | 4.72 | 14.10 | 5.55 | 1.32 |
| Phase II | 1.08 | 10.40 | 26.00 | 5.62 | 0.85 |
| Phase III | 0.25 | 2.05 | 9.50 | 2.64 | 0.31 |
| Maximum Annual | 1.72 | 17.17 | 49.60 | 13.81 | 2.48 |
| | | | | | |
| 2022 | | | | | |
| Phase I | 0.13 | 1.57 | 4.70 | 1.85 | 0.44 |
| Phase II | 0.72 | 6.93 | 17.34 | 3.75 | 0.57 |
| Phase III | 0.16 | 1.31 | 6.04 | 1.68 | 0.20 |
| Maximum Annual | 1.01 | 9.81 | 28.08 | 7.28 | 1.21 |

**Option A - Phase 1 - Move On (Laydown, Construction Trailers, Parking Area), Grading, Site Preparation**

Phase Duration (days): 399 19 months 21 working days per month

| | | | | | | | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Equipment Category | Equipment Type | Number | Usage Factor (hrs/day or miles/day) | Power Rating (hp) | Load Factor | Total Days/VMT | VOC | NOX | CO | PM10 | PM2.5 | CO2 | CH4 | VOC | NOX | CO | PM10 | PM2.5 | $CO_2$ | CH4 | Total GHG Emissions (MT CO2e) |
| Off-Highway Trucks >176 and <250 | Water Truck | 2 | 8 | 230 | 0.38 | 399 | 0.85 | 7.73 | 4.29 | 0.30 | 0.28 | 1,449.50 | 0.47 | 0.17 | 1.54 | 0.86 | 0.06 | 0.06 | 289.18 | 0.09 | 265.53 |
| Off-Highway Trucks >176 and <250 | Water Pull | 2 | 8 | 185 | 0.41 | 399 | 0.74 | 6.71 | 3.72 | 0.26 | 0.24 | 1,257.95 | 0.41 | 0.15 | 1.34 | 0.74 | 0.05 | 0.05 | 250.96 | 0.08 | 230.44 |
| Graders >176 and <250 | Motor Grader | 3 | 6 | 185 | 0.41 | 399 | 1.06 | 14.08 | 4.04 | 0.45 | 0.41 | 1,430.65 | 0.46 | 0.21 | 2.81 | 0.81 | 0.09 | 0.08 | 285.42 | 0.09 | 262.08 |
| Rubber Tired Dozers > 121 and <175 | Dozer (D6) | 1 | 6 | 158 | 0.40 | 399 | 0.61 | 6.01 | 3.25 | 0.34 | 0.32 | 395.43 | 0.13 | 0.12 | 1.20 | 0.65 | 0.07 | 0.06 | 78.89 | 0.03 | 72.44 |
| Tractors/Loaders/Backhoes >176 and <250 | Loader | 2 | 6 | 190 | 0.36 | 399 | 0.41 | 4.95 | 2.16 | 0.16 | 0.15 | 851.40 | 0.28 | 0.08 | 0.99 | 0.43 | 0.03 | 0.03 | 169.85 | 0.05 | 155.97 |
| Skid Steer Loaders >51 and <120 | Skid Steer | 3 | 6 | 83 | 0.40 | 399 | 0.25 | 3.30 | 4.32 | 0.14 | 0.13 | 621.73 | 0.20 | 0.05 | 0.66 | 0.86 | 0.03 | 0.03 | 124.04 | 0.04 | 113.89 |
| Other Construction Equipment >51 and <120 | Tractor Buster | 2 | 6 | 120 | 0.42 | 399 | 0.69 | 6.36 | 4.98 | 0.47 | 0.43 | 629.63 | 0.20 | 0.14 | 1.27 | 0.99 | 0.09 | 0.09 | 125.61 | 0.04 | 115.34 |
| Other Construction Equipment >251 and <500 | Tractor Disk | 2 | 6 | 300 | 0.42 | 399 | 0.75 | 8.79 | 5.45 | 0.32 | 0.29 | 1,584.14 | 0.51 | 0.15 | 1.75 | 1.09 | 0.06 | 0.06 | 316.04 | 0.10 | 290.20 |
| Off-Highway Trucks >176 and <250 | Truck (onroad) | 10 | 4 | 238 | 0.38 | 399 | 2.19 | 20.00 | 11.09 | 0.78 | 0.72 | 3,749.80 | 1.21 | 0.44 | 3.99 | 2.21 | 0.16 | 0.14 | 748.08 | 0.24 | 686.92 |
| Generator Sets >51 and <120 | Generator (Office)(45 kW) | 1 | 24 | 60 | 0.74 | 399 | 0.86 | 7.45 | 7.94 | 0.42 | 0.42 | 1,335.08 | 0.08 | 0.17 | 1.49 | 1.58 | 0.08 | 0.08 | 266.35 | 0.01 | 242.76 |
| Generator Sets >26 and <50 | Generator (Security, IT)(30 kW) | 1 | 24 | 40 | 0.74 | 399 | 1.08 | 6.38 | 6.26 | 0.30 | 0.30 | 890.05 | 0.10 | 0.22 | 1.27 | 1.25 | 0.06 | 0.06 | 177.56 | 0.02 | 162.08 |
| Rollers >121 and <175 | Roller/Vibrator/Padder | 1 | 6 | 160 | 0.38 | 399 | 0.17 | 1.97 | 2.36 | 0.09 | 0.08 | 379.54 | 0.12 | 0.03 | 0.39 | 0.47 | 0.02 | 0.02 | 75.72 | 0.02 | 69.53 |
| Scrapers >251 and <500 | Scraper | 3 | 6 | 365 | 0.40 | 399 | 1.85 | 21.92 | 13.91 | 0.85 | 0.79 | 2,735.67 | 0.88 | 0.37 | 4.37 | 2.77 | 0.17 | 0.16 | 545.77 | 0.18 | 501.14 |
| Pumps >26 and <50 | Water Pump | 2 | 8 | 45 | 0.74 | 399 | 0.89 | 4.85 | 4.93 | 0.24 | 0.24 | 667.54 | 0.08 | 0.18 | 0.97 | 0.98 | 0.05 | 0.05 | 133.17 | 0.02 | 121.59 |
| **Total** | | **35** | **124** | | | | **12.38** | **120.50** | **78.70** | **5.14** | **4.81** | **17,978.10** | **5.13** | **2.47** | **24.04** | **15.70** | **1.03** | **0.96** | **3,586.63** | **1.02** | **3,289.92** |

**On Road Construction Emissions**

| | | | | | | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Daily Trips | Distance | Average Daily Mileage | Calculated Time - Rounded (days) | Total Mileage | VOC | $NO_x$ | CO | PM10 | PM2.5 | CO2 | $CH_4$ | VOC | $NO_x$ | CO | PM10 | PM2.5 | $CO_2$ | $CH_4$ | Total GHG Emissions (MT CO2e) |
| Worker Trips | 334 | 13 | 8,684 | 399 | 3,464,916 | 0.26 | 1.34 | 14.10 | 0.89 | 0.37 | 5,743 | 0.54 | 0.05 | 0.27 | 2.81 | 0.18 | 0.07 | 1,145.78 | 0.11 | 1,045.42 |
| Gravel Delivery | - | 13 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Module Delivery | 10 | 150 | 3,000 | 81 | 242,100 | 0.58 | 28.88 | 2.38 | 0.79 | 0.38 | 9,831 | 0.03 | 0.02 | 1.17 | 0.10 | 0.03 | 0.02 | 396.66 | 0.00 | 361.00 |
| Foundation Delivery | 10 | 150 | 3,000 | 98 | 293,550 | 0.58 | 28.88 | 2.38 | 0.79 | 0.38 | 9,831 | 0.03 | 0.03 | 1.41 | 0.12 | 0.04 | 0.02 | 480.96 | 0.00 | 437.71 |
| Water Delivery Trips | 14 | 13 | 364 | 102 | 37,267 | 0.07 | 3.50 | 0.29 | 0.10 | 0.05 | 1,193 | 0.00 | 0.00 | 0.18 | 0.01 | 0.00 | 0.00 | 61.06 | 0.00 | 55.57 |
| **Total** | | | | | | **1.50** | **62.60** | **19.15** | **2.57** | **1.17** | **26,597.05** | **0.62** | **0.11** | **3.02** | **3.04** | **0.25** | **0.11** | **2,084.45** | **0.11** | **1,899.70** |

Water trucks assumed to come from Blythe at a distance of approximately 13 miles (26 miles round trip).

| | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | VOC | $NO_x$ | CO | PM10 | PM2.5 | CO2 | $CH_4$ | VOC | $NO_x$ | CO | PM10 | PM2.5 | $CO_2$ | $CH_4$ | Total GHG Emissions (MT CO2e) |
| **Maximum Daily Emissions** | **13.88** | **183.10** | **97.84** | **7.71** | **5.98** | **44,575.14** | **5.75** | | | | | | | | |
| **Maximum Annual Emissions** | | | | | | | | **2.58** | **27.06** | **18.74** | **1.28** | **1.07** | **5,671.08** | **1.14** | **5,189.62** |

**Option A - Phase 2 - Construction - Solar Array Structural Components (Structural Components, Underground Work, Module Installation)**

Phase Duration (days): 399 19 months 21 working days per month

| | | | | | | | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Equipment Type** | **Equipment Category** | **Number** | **Usage Factor (hrs/day or miles/day)** | **Power Rating (hp)** | **Load Factor** | **Total Days/VMT** | **VOC** | **NOX** | **CO** | **PM10** | **PM2.5** | **CO2** | **CH4** | **VOC** | **NOX** | **CO** | **PM10** | **PM2.5** | **$CO_2$** | **CH4** | **Total GHG Emissions (MT CO2e)** |
| Off-Highway Trucks >176 and <250 | Water truck | 8 | 8 | 238 | 0.38 | 399 | 3.51 | 31.99 | 17.75 | 1.25 | 1.15 | 5,999.68 | 1.94 | 0.70 | 6.38 | 3.54 | 0.25 | 0.23 | 1,196.94 | 0.39 | 1,099.08 |
| Other Construction Equipment >16 and <25 | ATV | 40 | 4 | 24 | 0.40 | 399 | 3.63 | 17.05 | 18.30 | 1.37 | 1.26 | 1,787.85 | 0.58 | 0.72 | 3.40 | 3.65 | 0.27 | 0.25 | 356.68 | 0.12 | 327.52 |
| Air Compressors >26 and <50 | Air Compressor | 2 | 6 | 49 | 0.48 | 399 | 0.62 | 2.74 | 3.21 | 0.16 | 0.16 | 353.61 | 0.06 | 0.12 | 0.55 | 0.64 | 0.03 | 0.03 | 70.55 | 0.01 | 64.48 |
| Cranes >251 and <500 | Crane | 2 | 2 | 400 | 0.29 | 399 | 0.33 | 3.95 | 2.72 | 0.16 | 0.15 | 483.40 | 0.16 | 0.07 | 0.79 | 0.54 | 0.03 | 0.03 | 96.44 | 0.03 | 88.55 |
| Forklifts >51 and <120 | Forklift (5 K) | 10 | 4 | 67 | 0.20 | 399 | 0.54 | 4.88 | 4.44 | 0.36 | 0.33 | 557.20 | 0.18 | 0.11 | 0.97 | 0.89 | 0.07 | 0.07 | 111.16 | 0.04 | 102.07 |
| Aerial Lifts >51 and <120 | Forklift (10 K) (Aerial Lift) | 10 | 4 | 110 | 0.31 | 399 | 0.35 | 5.62 | 9.55 | 0.13 | 0.11 | 1,419.70 | 0.46 | 0.07 | 1.12 | 1.91 | 0.02 | 0.02 | 283.23 | 0.09 | 260.07 |
| Other Construction Equipment >26 and <50 | Post Machine | 14 | 6 | 49 | 0.40 | 399 | 3.89 | 18.28 | 19.62 | 1.47 | 1.35 | 1,916.35 | 0.62 | 0.78 | 3.65 | 3.91 | 0.29 | 0.27 | 382.31 | 0.12 | 351.06 |
| Skid Steer Loaders >51 and <120 | Skid Steer | 20 | 4 | 80 | 0.40 | 399 | 1.06 | 14.14 | 18.50 | 0.61 | 0.56 | 2,663.37 | 0.86 | 0.21 | 2.82 | 3.69 | 0.12 | 0.11 | 531.34 | 0.17 | 487.90 |
| Off-Highway Trucks >176 and <250 | Truck, flatbed (onroad) | 4 | 4 | 238 | 0.38 | 399 | 0.88 | 8.00 | 4.44 | 0.31 | 0.29 | 1,499.92 | 0.49 | 0.17 | 1.60 | 0.89 | 0.06 | 0.06 | 299.23 | 0.10 | 274.77 |
| Off-Highway Trucks >176 and <250 | Truck (onroad) | 30 | 4 | 238 | 0.38 | 399 | 6.57 | 59.99 | 33.28 | 2.34 | 2.15 | 11,249.39 | 3.64 | 1.31 | 11.97 | 6.64 | 0.47 | 0.43 | 2,244.25 | 0.73 | 2,060.77 |
| Generator Sets >51 and <120 | Generator (45 kW) | 1 | 24 | 60 | 0.74 | 399 | 0.86 | 7.45 | 7.94 | 0.42 | 0.42 | 1,335.08 | 0.08 | 0.17 | 1.49 | 1.58 | 0.08 | 0.08 | 266.35 | 0.01 | 242.76 |
| Excavators >51 and <120 | Backhoe/Excavator | 4 | 4 | 90 | 0.37 | 399 | 0.35 | 3.63 | 4.12 | 0.22 | 0.20 | 549.79 | 0.18 | 0.07 | 0.72 | 0.82 | 0.04 | 0.04 | 109.68 | 0.04 | 100.72 |
| Trenchers >51 and <120 | Cable Plow | 1 | 6 | 120 | 0.42 | 399 | 0.41 | 3.68 | 2.56 | 0.28 | 0.25 | 316.76 | 0.10 | 0.08 | 0.73 | 0.51 | 0.05 | 0.05 | 63.19 | 0.02 | 58.03 |
| Trenchers >26 and <50 | Cable Trencher | 1 | 6 | 42 | 0.50 | 399 | 0.25 | 1.30 | 1.34 | 0.10 | 0.09 | 146.42 | 0.05 | 0.05 | 0.26 | 0.27 | 0.02 | 0.02 | 29.21 | 0.01 | 26.82 |
| Paving Equipment >176 and <250 | Compactor | 1 | 4 | 180 | 0.43 | 399 | 0.17 | 2.20 | 0.85 | 0.08 | 0.07 | 322.27 | 0.10 | 0.03 | 0.44 | 0.17 | 0.02 | 0.01 | 64.29 | 0.02 | 59.04 |
| Rollers >176 and <250 | Roller/Vibrator/Padder | 2 | 6 | 180 | 0.38 | 399 | 0.38 | 4.98 | 2.27 | 0.16 | 0.15 | 856.58 | 0.28 | 0.08 | 0.99 | 0.45 | 0.03 | 0.03 | 170.89 | 0.06 | 156.92 |
| Trenchers >26 and <50 | Mini-Trencher | 4 | 6 | 40 | 0.50 | 399 | 0.96 | 4.95 | 5.11 | 0.38 | 0.35 | 557.78 | 0.18 | 0.19 | 0.99 | 1.02 | 0.08 | 0.07 | 111.28 | 0.04 | 102.18 |
| Rollers >51 and <120 | Sheepsfoot Roller | 3 | 6 | 95 | 0.38 | 399 | 0.56 | 5.56 | 5.06 | 0.35 | 0.33 | 678.83 | 0.22 | 0.11 | 1.11 | 1.01 | 0.07 | 0.07 | 135.43 | 0.04 | 124.36 |
| Off-Highway Trucks >251 and <500 | 5 CY Dump Truck | 1 | 4 | 480 | 0.38 | 399 | 0.40 | 3.77 | 2.27 | 0.14 | 0.13 | 763.36 | 0.25 | 0.08 | 0.75 | 0.45 | 0.03 | 0.03 | 152.29 | 0.05 | 139.84 |
| **Total** | | **158** | **112** | | | | **25.70** | **204.16** | **163.34** | **10.27** | **9.50** | **33,457.33** | **10.41** | **5.13** | **40.73** | **32.59** | **2.05** | **1.89** | **6,674.74** | **2.08** | **6,126.92** |

**On Road Construction Emissions**

| | | | | | | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Daily Trips** | **Distance** | **Average Daily Mileage** | **Calculated Time - Rounded (days)** | **Total Mileage** | **VOC** | **$NO_x$** | **CO** | **PM10** | **PM2.5** | **CO2** | **$CH_4$** | **VOC** | **$NO_x$** | **CO** | **PM10** | **PM2.5** | **$CO_2$** | **$CH_4$** | **Total GHG Emissions (MT CO2e)** |
| Worker Trips | 427 | 13 | 11,102 | 399 | 4,429,698 | 0.34 | 1.71 | 18.03 | 1.14 | 0.47 | 7,342 | 0.70 | 0.07 | 0.34 | 3.60 | 0.23 | 0.09 | 1,464.81 | 0.14 | 1,336.51 |
| Gravel Delivery | - | 13 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Module Delivery | 10 | 150 | 3,000 | 81 | 242,100 | 0.58 | 28.88 | 2.38 | 0.79 | 0.38 | 9,831 | 0.03 | 0.02 | 1.17 | 0.10 | 0.03 | 0.02 | 396.66 | 0.00 | 361.00 |
| Tracker Delivery | 9 | 150 | 2,700 | 207 | 560,100 | 0.52 | 25.99 | 2.14 | 0.71 | 0.34 | 8,847 | 0.03 | 0.05 | 2.70 | 0.22 | 0.07 | 0.04 | 917.68 | 0.00 | 835.17 |
| Foundation Delivery | 10 | 150 | 3,000 | 98 | 293,550 | 0.58 | 28.88 | 2.38 | 0.79 | 0.38 | 9,831 | 0.03 | 0.03 | 1.41 | 0.12 | 0.04 | 0.02 | 480.96 | 0.00 | 437.71 |
| Inverter Delivery | 2 | 150 | 600 | 36 | 21,750 | 0.12 | 5.78 | 0.48 | 0.16 | 0.08 | 1,966 | 0.01 | 0.00 | 0.10 | 0.01 | 0.00 | 0.00 | 35.64 | 0.00 | 32.43 |
| Water Delivery Trips | 14 | 13 | 364 | 102 | 37,267 | 0.07 | 3.50 | 0.29 | 0.10 | 0.05 | 1,193 | 0.00 | 0.00 | 0.18 | 0.01 | 0.00 | 0.00 | 61.06 | 0.00 | 55.57 |
| **Total** | | | | | | **2.21** | **94.74** | **25.69** | **3.69** | **1.68** | **39,009.78** | **0.80** | **0.18** | **5.90** | **4.05** | **0.38** | **0.17** | **3,356.80** | **0.15** | **3,058.39** |

Water trucks assumed to come from Blythe at a distance of approximately 13 miles (26 miles round trip).

| | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total** | **VOC** | **$NO_x$** | **CO** | **PM10** | **PM2.5** | **CO2** | **$CH_4$** | **VOC** | **$NO_x$** | **CO** | **PM10** | **PM2.5** | **$CO_2$** | **$CH_4$** | **Total GHG Emissions (MT CO2e)** |
| **Maximum Daily Emissions** | **27.91** | **298.91** | **189.03** | **13.96** | **11.18** | **72,467.12** | **11.21** | | | | | | | | |
| **Maximum Annual Emissions** | | | | | | | | **5.31** | **46.63** | **36.64** | **2.43** | **2.06** | **10,031.54** | **2.22** | **9,185.31** |

**Option A - Phase 3 - Construction - Electrical (Substation, Gen-Tie, Collection System, Energy Storage, O&M Building)**

Phase Duration (days): 378 | 18 months | 21 working days per month

| | | | | | | | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Equipment Type | Equipment Category | Number | Usage Factor (hrs/day or miles/day) | Power Rating (hp) | Load Factor | Total Days/VMT | VOC | NOX | CO | PM10 | PM2.5 | CO2 | CH4 | VOC | NOX | CO | PM10 | PM2.5 | $CO_2$ | CH4 | Total GHG Emissions (MT CO2e) |
| Off-Highway Trucks >176 and <250 | Water truck | 4 | 8 | 230 | 0.38 | 378 | 1.69 | 15.46 | 8.58 | 0.60 | 0.55 | 2,899.00 | 0.94 | 0.32 | 2.92 | 1.62 | 0.11 | 0.10 | 547.91 | 0.18 | 503.12 |
| Bore/Drill Rigs >176 and <250 | Auger | 5 | 4 | 238 | 0.50 | 378 | 0.75 | 9.48 | 5.60 | 0.27 | 0.25 | 2,449.48 | 0.79 | 0.14 | 1.79 | 1.06 | 0.05 | 0.05 | 462.95 | 0.15 | 425.10 |
| Excavators >51 and <120 | Backhoe/Excavator | 6 | 4 | 90 | 0.37 | 378 | 0.53 | 5.44 | 6.18 | 0.33 | 0.30 | 824.68 | 0.27 | 0.10 | 1.03 | 1.17 | 0.06 | 0.06 | 155.86 | 0.05 | 143.12 |
| Cranes >251 and <500 | Crane | 6 | 5 | 400 | 0.29 | 378 | 2.46 | 29.63 | 20.41 | 1.19 | 1.09 | 3,625.51 | 1.17 | 0.46 | 5.60 | 3.86 | 0.22 | 0.21 | 685.22 | 0.22 | 629.20 |
| Forklifts >51 and <120 | Forklift | 3 | 4 | 90 | 0.20 | 378 | 0.22 | 1.97 | 1.79 | 0.15 | 0.13 | 224.54 | 0.07 | 0.04 | 0.37 | 0.34 | 0.03 | 0.03 | 42.44 | 0.01 | 38.97 |
| Excavators >26 and <50 | Mini Excavator | 1 | 6 | 42 | 0.50 | 378 | 0.16 | 1.12 | 1.25 | 0.06 | 0.06 | 145.94 | 0.05 | 0.03 | 0.21 | 0.24 | 0.01 | 0.01 | 27.58 | 0.01 | 25.33 |
| Aerial Lifts >51 and <120 | Man/Aerial Lift | 2 | 4 | 60 | 0.31 | 378 | 0.04 | 0.61 | 1.04 | 0.01 | 0.01 | 154.88 | 0.05 | 0.01 | 0.12 | 0.20 | 0.00 | 0.00 | 29.27 | 0.01 | 26.88 |
| Tractors/Loaders/Backhoes >176 and <250 | Tractor | 1 | 6 | 190 | 0.36 | 378 | 0.20 | 2.48 | 1.08 | 0.08 | 0.07 | 425.70 | 0.14 | 0.04 | 0.47 | 0.20 | 0.02 | 0.01 | 80.46 | 0.03 | 73.88 |
| Off-Highway Trucks >176 and <250 | Truck, flatbed (onroad) | 2 | 2 | 200 | 0.38 | 378 | 0.18 | 1.68 | 0.93 | 0.07 | 0.06 | 315.11 | 0.10 | 0.03 | 0.32 | 0.18 | 0.01 | 0.01 | 59.56 | 0.02 | 54.69 |
| Off-Highway Trucks >176 and <250 | Truck (onroad) | 13 | 2 | 200 | 0.38 | 378 | 1.20 | 10.92 | 6.06 | 0.43 | 0.39 | 2,048.21 | 0.66 | 0.23 | 2.06 | 1.15 | 0.08 | 0.07 | 387.11 | 0.13 | 355.46 |
| Generator Sets >51 and <120 | Generator (45 kW) | 2 | 4 | 60 | 0.74 | 378 | 0.29 | 2.48 | 2.65 | 0.14 | 0.14 | 445.03 | 0.03 | 0.05 | 0.47 | 0.50 | 0.03 | 0.03 | 84.11 | 0.00 | 76.66 |
| Crawler Tractors >121 and <175 | Crawler Tractor | 1 | 4 | 147 | 0.29 | 126 | 0.18 | 1.83 | 1.26 | 0.10 | 0.09 | 177.07 | 0.06 | 0.01 | 0.12 | 0.08 | 0.01 | 0.01 | 11.16 | 0.00 | 10.24 |
| Tractors/Loaders/Backhoes >176 and <250 | Truck Mounted Digger | 1 | 4 | 190 | 0.42 | 126 | 0.16 | 1.93 | 0.84 | 0.06 | 0.06 | 331.10 | 0.11 | 0.01 | 0.12 | 0.05 | 0.00 | 0.00 | 20.86 | 0.01 | 19.15 |
| Other Construction Equipment >251 and <500 | Tensioner | 1 | 4 | 238 | 0.42 | 126 | 0.20 | 2.32 | 1.44 | 0.08 | 0.08 | 418.92 | 0.14 | 0.01 | 0.15 | 0.09 | 0.01 | 0.00 | 26.39 | 0.01 | 24.23 |
| Off-Highway Trucks >176 and <250 | Wire Truck | 1 | 4 | 238 | 0.38 | 126 | 0.22 | 2.00 | 1.11 | 0.08 | 0.07 | 374.98 | 0.12 | 0.01 | 0.13 | 0.07 | 0.00 | 0.00 | 23.62 | 0.01 | 21.69 |
| Graders >176 and <250 | Motor Grader | 1 | 1 | 185 | 0.41 | 126 | 0.06 | 0.78 | 0.22 | 0.02 | 0.02 | 79.48 | 0.03 | 0.00 | 0.05 | 0.01 | 0.00 | 0.00 | 5.01 | 0.00 | 4.60 |
| Scrapers >251 and <500 | Scraper | 1 | 1 | 365 | 0.40 | 126 | 0.10 | 1.22 | 0.77 | 0.05 | 0.04 | 151.98 | 0.05 | 0.01 | 0.08 | 0.05 | 0.00 | 0.00 | 9.57 | 0.00 | 8.79 |
| Trenchers >26 and <50 | Cable Trencher | 5 | 10 | 42 | 0.50 | 126 | 2.09 | 10.83 | 11.19 | 0.82 | 0.76 | 1,220.15 | 0.39 | 0.13 | 0.68 | 0.70 | 0.05 | 0.05 | 76.87 | 0.02 | 70.58 |
| **Total** | | **56** | | | | | **10.73** | **102.19** | **72.40** | **4.55** | **4.20** | **16,311.75** | **5.16** | **1.65** | **16.68** | **11.56** | **0.71** | **0.65** | **2,735.96** | **0.86** | **2,511.70** |

**On Road Construction Emissions**

| | | | | | | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Daily Trips | Distance | Average Daily Mileage | Calculated Time - Rounded (days) | Total Mileage | VOC | $NO_x$ | CO | PM10 | PM2.5 | CO2 | $CH_4$ | VOC | $NO_x$ | CO | PM10 | PM2.5 | $CO_2$ | $CH_4$ | Total GHG Emissions (MT CO2e) |
| Worker Trips | 180 | 13 | 4,680 | 378 | 1,769,040 | 0.14 | 0.72 | 7.60 | 0.48 | 0.20 | 3,095 | 0.29 | 0.03 | 0.14 | 1.44 | 0.09 | 0.04 | 584.98 | 0.06 | 533.75 |
| Inverter Delivery | 2 | 150 | 600 | 36 | 21,750 | 0.12 | 5.78 | 0.48 | 0.16 | 0.08 | 1,966 | 0.01 | 0.00 | 0.10 | 0.01 | 0.00 | 0.00 | 35.64 | 0.00 | 32.43 |
| Concrete Truck Trips (Unless Batched on site) | 9 | 13 | 234 | 378 | 88,452 | 0.05 | 2.25 | 0.19 | 0.06 | 0.03 | 767 | 0.00 | 0.01 | 0.43 | 0.04 | 0.01 | 0.01 | 144.92 | 0.00 | 131.88 |
| Water Delivery Trips | 14 | 13 | 364 | 102 | 37,267 | 0.07 | 3.50 | 0.29 | 0.10 | 0.05 | 1,193 | 0.00 | 0.00 | 0.18 | 0.01 | 0.00 | 0.00 | 61.06 | 0.00 | 55.57 |
| **Total** | | | | | | **0.37** | **12.25** | **8.55** | **0.80** | **0.35** | **7,020.81** | **0.31** | **0.04** | **0.85** | **1.49** | **0.11** | **0.05** | **826.60** | **0.06** | **753.62** |

Concrete and water trucks assumed to haul material from Blythe at a distance of approximately 13 miles (26 miles round trip).

| | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | VOC | $NO_x$ | CO | PM10 | PM2.5 | CO2 | $CH_4$ | VOC | $NO_x$ | CO | PM10 | PM2.5 | $CO_2$ | $CH_4$ | Total GHG Emissions (MT CO2e) |
| **Maximum Daily Emissions** | **11.10** | **114.45** | **80.95** | **5.34** | **4.54** | **23,332.56** | **5.46** | | | | | | | | |
| **Maximum Annual Emissions** | | | | | | | | **1.69** | **17.53** | **13.06** | **0.82** | **0.70** | **3,562.56** | **0.92** | **3,265.32** |

**Option A - Phase 1 - Move On (Laydown, Construction Trailers, Parking Area), Grading, Site Preparation**
**Mitigated Emissions**

Phase Duration (days): 399 | 19 months | 21 working days per month

| | | | | | | | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Equipment Category | Equipment Type | Number | Usage Factor (hrs/day or miles/day) | Power Rating (hp) | Load Factor | Total Days/VMT | VOC | NOX | CO | PM10 | PM2.5 | CO2 | CH4 | VOC | NOX | CO | PM10 | PM2.5 | $CO_2$ | CH4 | Total GHG Emissions (MT CO2e) |
| Off-Highway Trucks >176 and <250 | Water Truck | 2 | 8 | 230 | 0.38 | 399 | 0.18 | 0.80 | 6.78 | 0.02 | 0.02 | 1,449.50 | 0.47 | 0.04 | 0.16 | 1.35 | 0.00 | 0.00 | 289.18 | 0.09 | 265.53 |
| Off-Highway Trucks >176 and <250 | Water Pull | 2 | 8 | 185 | 0.41 | 399 | 0.16 | 0.70 | 5.89 | 0.02 | 0.02 | 1,257.95 | 0.41 | 0.03 | 0.14 | 1.17 | 0.00 | 0.00 | 250.96 | 0.08 | 230.44 |
| Graders >176 and <250 | Motor Grader | 3 | 6 | 185 | 0.41 | 399 | 0.18 | 0.78 | 6.62 | 0.02 | 0.02 | 1,430.65 | 0.46 | 0.04 | 0.16 | 1.32 | 0.00 | 0.00 | 285.42 | 0.09 | 262.08 |
| Rubber Tired Dozers > 121 and <175 | Dozer (D6) | 1 | 6 | 158 | 0.40 | 399 | 0.05 | 0.22 | 3.09 | 0.01 | 0.01 | 395.43 | 0.13 | 0.01 | 0.04 | 0.62 | 0.00 | 0.00 | 78.89 | 0.03 | 72.44 |
| Tractors/Loaders/Backhoes >176 and <250 | Loader | 2 | 6 | 190 | 0.36 | 399 | 0.11 | 0.47 | 3.98 | 0.01 | 0.01 | 851.40 | 0.28 | 0.02 | 0.09 | 0.79 | 0.00 | 0.00 | 169.85 | 0.05 | 155.97 |
| Skid Steer Loaders >51 and <120 | Skid Steer | 3 | 6 | 83 | 0.40 | 399 | 0.08 | 0.34 | 4.87 | 0.01 | 0.01 | 621.73 | 0.20 | 0.02 | 0.07 | 0.97 | 0.00 | 0.00 | 124.04 | 0.04 | 113.89 |
| Other Construction Equipment >51 and <120 | Tractor Buster | 2 | 6 | 120 | 0.42 | 399 | 0.08 | 0.35 | 4.93 | 0.01 | 0.01 | 629.63 | 0.20 | 0.02 | 0.07 | 0.98 | 0.00 | 0.00 | 125.61 | 0.04 | 115.34 |
| Other Construction Equipment >251 and <500 | Tractor Disk | 2 | 6 | 300 | 0.42 | 399 | 0.20 | 0.87 | 7.33 | 0.03 | 0.03 | 1,584.14 | 0.51 | 0.04 | 0.17 | 1.46 | 0.01 | 0.01 | 316.04 | 0.10 | 290.20 |
| Off-Highway Trucks >176 and <250 | Truck (onroad) | 10 | 4 | 238 | 0.38 | 399 | 0.48 | 2.07 | 17.55 | 0.06 | 0.06 | 3,749.80 | 1.21 | 0.10 | 0.41 | 3.50 | 0.01 | 0.01 | 748.08 | 0.24 | 686.92 |
| Generator Sets >51 and <120 | Generator (Office)(45 kW) | 1 | 24 | 60 | 0.74 | 399 | 0.28 | 6.44 | 8.69 | 0.02 | 0.02 | 1,335.08 | 0.08 | 0.06 | 1.28 | 1.73 | 0.00 | 0.00 | 266.35 | 0.01 | 242.76 |
| Generator Sets >26 and <50 | Generator (Security, IT)(30 kW) | 1 | 24 | 40 | 0.74 | 399 | 0.19 | 4.31 | 6.42 | 0.01 | 0.01 | 890.05 | 0.10 | 0.04 | 0.86 | 1.28 | 0.00 | 0.00 | 177.56 | 0.02 | 162.08 |
| Rollers >121 and <175 | Roller/Vibrator/Padder | 1 | 6 | 160 | 0.38 | 399 | 0.05 | 0.21 | 2.98 | 0.01 | 0.01 | 379.54 | 0.12 | 0.01 | 0.04 | 0.59 | 0.00 | 0.00 | 75.72 | 0.02 | 69.53 |
| Scrapers >251 and <500 | Scraper | 3 | 6 | 365 | 0.40 | 399 | 0.35 | 1.51 | 12.75 | 0.05 | 0.05 | 2,735.67 | 0.88 | 0.07 | 0.30 | 2.54 | 0.01 | 0.01 | 545.77 | 0.18 | 501.14 |
| Pumps >26 and <50 | Water Pump | 2 | 8 | 45 | 0.74 | 399 | 0.14 | 3.23 | 4.82 | 0.01 | 0.01 | 667.54 | 0.08 | 0.03 | 0.64 | 0.96 | 0.00 | 0.00 | 133.17 | 0.02 | 121.59 |
| **Total** | | | | | | | **2.53** | **22.29** | **96.70** | **0.30** | **0.30** | **17,978.10** | **5.13** | **0.50** | **4.45** | **19.29** | **0.06** | **0.06** | **3,586.63** | **1.02** | **3,289.92** |

**On Road Construction Emissions**

| | | | | | | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Daily Trips | Distance | Average Daily Mileage | Calculated Time - Rounded (days) | Total Mileage | VOC | $NO_x$ | CO | PM10 | PM2.5 | CO2 | $CH_4$ | VOC | $NO_x$ | CO | PM10 | PM2.5 | $CO_2$ | $CH_4$ | Total GHG Emissions (MT CO2e) |
| Worker Trips | 334 | 13 | 8,684 | 399 | 3,464,916 | 0.26 | 1.34 | 14.10 | 0.89 | 0.37 | 5,743 | 0.54 | 0.05 | 0.27 | 2.81 | 0.18 | 0.07 | 1,145.78 | 0.11 | 1,045.42 |
| Gravel Delivery | - | 13 | - | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Module Delivery | 10 | 150 | 3,000 | 81 | 242,100 | 0.58 | 28.88 | 2.38 | 0.79 | 0.38 | 9,831 | 0.03 | 0.02 | 1.17 | 0.10 | 0.03 | 0.02 | 396.66 | 0.00 | 361.00 |
| Foundation Delivery | 10 | 150 | 3,000 | 98 | 293,550 | 0.58 | 28.88 | 2.38 | 0.79 | 0.38 | 9,831 | 0.03 | 0.03 | 1.41 | 0.12 | 0.04 | 0.02 | 480.96 | 0.00 | 437.71 |
| Water Delivery Trips | 14 | 13 | 364 | 102 | 37,267 | 0.07 | 3.50 | 0.29 | 0.10 | 0.05 | 1,193 | 0.00 | 0.00 | 0.18 | 0.01 | 0.00 | 0.00 | 61.06 | 0.00 | 55.57 |
| **Total** | | | | | | **1.50** | **62.60** | **19.15** | **2.57** | **1.17** | **26,597.05** | **0.62** | **0.11** | **3.02** | **3.04** | **0.25** | **0.11** | **2,084.45** | **0.11** | **1,899.70** |

Notes:
Water trucks assumed to come from Blythe at a distance of approximately 13 miles (26 miles round trip).

| | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | VOC | $NO_x$ | CO | PM10 | PM2.5 | CO2 | $CH_4$ | VOC | $NO_x$ | CO | PM10 | PM2.5 | $CO_2$ | $CH_4$ | Total GHG Emissions (MT CO2e) |
| **Maximum Daily Emissions** | **4.03** | **84.89** | **115.85** | **2.87** | **1.46** | **44,575.14** | **5.75** | | | | | | | | |
| **Maximum Annual Emissions** | | | | | | | | **0.61** | **7.47** | **22.33** | **0.31** | **0.17** | **5,671.08** | **1.14** | **5,189.62** |

**Option A - Phase 2 - Construction - Solar Array Structural Components (Structural Components, Underground Work, Module Installation)**
**Mitigated Emissions**
Phase Duration (days): 399 19 months 21 working days per month

| | | | | | | | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Equipment Type | Equipment Category | Number | Usage Factor (hrs/day or miles/day) | Power Rating (hp) | Load Factor | Total Days/VMT | VOC | NOX | CO | PM10 | PM2.5 | CO2 | CH4 | VOC | NOX | CO | PM10 | PM2.5 | $CO_2$ | CH4 | Total GHG Emissions (MT CO2e) |
| Off-Highway Trucks >176 and <250 | Water truck | 8 | 8 | 238 | 0.38 | 399 | 0.77 | 3.32 | 28.07 | 0.10 | 0.10 | 5,999.68 | 1.94 | 0.15 | 0.66 | 5.60 | 0.02 | 0.02 | 1,196.94 | 0.39 | 1,099.08 |
| Other Construction Equipment >16 and <25 | ATV | 40 | 4 | 24 | 0.40 | 399 | 3.63 | 17.05 | 18.30 | 1.37 | 1.26 | 1,787.85 | 0.58 | 0.72 | 3.40 | 3.65 | 0.27 | 0.25 | 356.68 | 0.12 | 327.52 |
| Air Compressors >26 and <50 | Air Compressor | 2 | 6 | 49 | 0.48 | 399 | 0.07 | 1.71 | 2.55 | 0.00 | 0.00 | 353.61 | 0.06 | 0.01 | 0.34 | 0.51 | 0.00 | 0.00 | 70.55 | 0.01 | 64.48 |
| Cranes >251 and <500 | Crane | 2 | 2 | 400 | 0.29 | 399 | 0.06 | 0.27 | 2.25 | 0.01 | 0.01 | 483.40 | 0.16 | 0.01 | 0.05 | 0.45 | 0.00 | 0.00 | 96.44 | 0.03 | 88.55 |
| Forklifts >51 and <120 | Forklift (5 K) | 10 | 4 | 67 | 0.20 | 399 | 0.14 | 3.24 | 4.37 | 0.01 | 0.01 | 557.20 | 0.18 | 0.03 | 0.65 | 0.87 | 0.00 | 0.00 | 111.16 | 0.04 | 102.07 |
| Aerial Lifts >51 and <120 | Forklift (10 K) (Aerial Lift) | 10 | 4 | 110 | 0.31 | 399 | 0.18 | 0.78 | 11.13 | 0.02 | 0.02 | 1,419.70 | 0.46 | 0.04 | 0.16 | 2.22 | 0.00 | 0.00 | 283.23 | 0.09 | 260.07 |
| Other Construction Equipment >26 and <50 | Post Machine | 14 | 6 | 49 | 0.40 | 399 | 0.44 | 10.48 | 15.63 | 0.03 | 0.03 | 2,012.17 | 0.62 | 0.09 | 2.09 | 3.12 | 0.01 | 0.01 | 401.43 | 0.12 | 368.45 |
| Skid Steer Loaders >51 and <120 | Skid Steer | 20 | 4 | 80 | 0.40 | 399 | 0.34 | 1.36 | 19.32 | 0.04 | 0.04 | 2,463.62 | 0.86 | 0.07 | 0.27 | 3.85 | 0.01 | 0.01 | 491.49 | 0.17 | 451.64 |
| Off-Highway Trucks >176 and <250 | Truck, flatbed (onroad) | 4 | 4 | 238 | 0.38 | 399 | 0.19 | 0.83 | 7.02 | 0.03 | 0.03 | 1,499.92 | 0.49 | 0.04 | 0.17 | 1.40 | 0.01 | 0.01 | 299.23 | 0.10 | 274.77 |
| Off-Highway Trucks >176 and <250 | Truck (onroad) | 30 | 4 | 238 | 0.38 | 399 | 1.44 | 6.22 | 52.64 | 0.19 | 0.19 | 11,249.39 | 3.64 | 0.29 | 1.24 | 10.50 | 0.04 | 0.04 | 2,244.25 | 0.73 | 2,060.77 |
| Generator Sets >51 and <120 | Generator (45 kW) | 1 | 24 | 60 | 0.74 | 399 | 0.28 | 6.44 | 8.69 | 0.02 | 0.02 | 1,335.08 | 0.08 | 0.06 | 1.28 | 1.73 | 0.00 | 0.00 | 266.35 | 0.01 | 242.76 |
| Excavators >51 and <120 | Backhoe/Excavator | 4 | 4 | 90 | 0.37 | 399 | 0.07 | 0.31 | 4.46 | 0.01 | 0.01 | 564.65 | 0.18 | 0.01 | 0.06 | 0.89 | 0.00 | 0.00 | 112.65 | 0.04 | 103.44 |
| Trenchers >51 and <120 | Cable Plow | 1 | 6 | 120 | 0.42 | 399 | 0.04 | 0.21 | 2.94 | 0.01 | 0.01 | 377.09 | 0.12 | 0.01 | 0.04 | 0.59 | 0.00 | 0.00 | 75.23 | 0.02 | 69.08 |
| Trenchers >26 and <50 | Cable Trencher | 1 | 6 | 42 | 0.50 | 399 | 0.03 | 0.76 | 1.14 | 0.00 | 0.00 | 146.42 | 0.05 | 0.01 | 0.15 | 0.23 | 0.00 | 0.00 | 29.21 | 0.01 | 26.82 |
| Paving Equipment >176 and <250 | Compactor | 1 | 4 | 180 | 0.43 | 399 | 0.04 | 0.15 | 1.26 | 0.00 | 0.00 | 269.81 | 0.09 | 0.01 | 0.03 | 0.25 | 0.00 | 0.00 | 53.83 | 0.02 | 49.43 |
| Rollers >176 and <250 | Roller/Vibrator/Padder | 2 | 6 | 180 | 0.38 | 399 | 0.11 | 0.47 | 3.98 | 0.01 | 0.01 | 856.58 | 0.28 | 0.02 | 0.09 | 0.79 | 0.00 | 0.00 | 170.89 | 0.06 | 156.92 |
| Trenchers >26 and <50 | Mini-Trencher | 4 | 6 | 40 | 0.50 | 399 | 0.13 | 2.91 | 4.34 | 0.01 | 0.01 | 557.78 | 0.18 | 0.03 | 0.58 | 0.87 | 0.00 | 0.00 | 111.28 | 0.04 | 102.18 |
| Rollers >51 and <120 | Sheepsfoot Roller | 3 | 6 | 95 | 0.38 | 399 | 0.09 | 0.37 | 5.30 | 0.01 | 0.01 | 678.83 | 0.22 | 0.02 | 0.07 | 1.06 | 0.00 | 0.00 | 135.43 | 0.04 | 124.36 |
| Off-Highway Trucks >251 and <500 | 5 CY Dump Truck | 1 | 4 | 480 | 0.38 | 399 | 0.10 | 0.42 | 3.54 | 0.01 | 0.01 | 763.36 | 0.25 | 0.02 | 0.08 | 0.71 | 0.00 | 0.00 | 152.29 | 0.05 | 139.84 |
| **Total** | | | | | | | **8.14** | **57.30** | **196.920** | **1.90** | **1.79** | **33,376.13** | **10.42** | **1.62** | **11.43** | **39.29** | **0.38** | **0.36** | **6,658.54** | **2.08** | **6,112.21** |

**Notes:**
ATV not modeled with Tier 4 engine.

**On Road Construction Emissions**

| | | | | | | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Trips | Distance | Average Daily Mileage | Calculated Time - Rounded (days) | Total Mileage | VOC | $NO_x$ | CO | PM10 | PM2.5 | CO2 | $CH_4$ | VOC | $NO_x$ | CO | PM10 | PM2.5 | $CO_2$ | $CH_4$ | Total GHG Emissions (MT CO2e) |
| Worker Trips | 427 | 13 | 11,102 | 399 | 4,429,698 | 0.34 | 1.71 | 18.03 | 1.14 | 0.47 | 7,342 | 0.70 | 0.07 | 0.34 | 3.60 | 0.23 | 0.09 | 1,464.81 | 0.14 | 1,336.51 |
| Gravel Delivery | - | 13 | - | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Module Delivery | 10 | 150 | 3,000 | 81 | 242,100 | 0.58 | 28.88 | 2.38 | 0.79 | 0.38 | 9,831 | 0.03 | 0.02 | 1.17 | 0.10 | 0.03 | 0.02 | 396.66 | 0.00 | 361.00 |
| Tracker Delivery | 9 | 150 | 2,700 | 207 | 560,100 | 0.52 | 25.99 | 2.14 | 0.71 | 0.34 | 8,847 | 0.03 | 0.05 | 2.70 | 0.22 | 0.07 | 0.04 | 917.68 | 0.00 | 835.17 |
| Foundation Delivery | 10 | 150 | 3,000 | 98 | 293,550 | 0.58 | 28.88 | 2.38 | 0.79 | 0.38 | 9,831 | 0.03 | 0.03 | 1.41 | 0.12 | 0.04 | 0.02 | 480.96 | 0.00 | 437.71 |
| Inverter Delivery | 2 | 150 | 600 | 36 | 21,750 | 0.12 | 5.78 | 0.48 | 0.16 | 0.08 | 1,966 | 0.01 | 0.00 | 0.10 | 0.01 | 0.00 | 0.00 | 35.64 | 0.00 | 32.43 |
| Water Delivery Trips | 14 | 13 | 364 | 102 | 37,267 | 0.07 | 3.50 | 0.29 | 0.10 | 0.05 | 1,193 | 0.00 | 0.00 | 0.18 | 0.01 | 0.00 | 0.00 | 61.06 | 0.00 | 55.57 |
| **Total** | | | | | | **2.21** | **94.74** | **25.69** | **3.69** | **1.68** | **39,009.78** | **0.80** | **0.18** | **5.90** | **4.05** | **0.38** | **0.17** | **3,356.80** | **0.15** | **3,058.39** |

Water trucks assumed to come from Blythe at a distance of approximately 13 miles (26 miles round trip).

| | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | VOC | $NO_x$ | CO | PM10 | PM2.5 | CO2 | $CH_4$ | VOC | $NO_x$ | CO | PM10 | PM2.5 | $CO_2$ | $CH_4$ | Total GHG Emissions (MT CO2e) |
| **Maximum Daily Emissions** | **10.35** | **152.04** | **222.61** | **5.59** | **3.47** | **72,385.91** | **11.22** | | | | | | | | |
| **Maximum Annual Emissions** | | | | | | | | **1.80** | **17.33** | **43.34** | **0.76** | **0.52** | **10,015.34** | **2.22** | **9,170.60** |

**Option A - Phase 3 - Construction - Electrical (Substation, Gen-Tie, Collection System, Energy Storage, O&M Building)**
**Mitigated Emissions**
Phase Duration (days): 378 | 18 months | 21 working days per month

| | | | | | | | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Equipment Type | Equipment Category | Number | Usage Factor (hrs/day or miles/day) | Power Rating (hp) | Load Factor | Total Days/VMT | VOC | NOX | CO | PM10 | PM2.5 | CO2 | CH4 | VOC | NOX | CO | PM10 | PM2.5 | $CO_2$ | CH4 | Total GHG Emissions (MT CO2e) |
| Off-Highway Trucks >176 and <250 | Water truck | 4 | 8 | 230 | 0.38 | 378 | 0.37 | 1.60 | 13.56 | 0.05 | 0.05 | 2,899.00 | 0.94 | 0.07 | 0.30 | 2.56 | 0.01 | 0.01 | 547.91 | 0.18 | 503.12 |
| Bore/Drill Rigs >176 and <250 | Auger | 5 | 4 | 238 | 0.50 | 378 | 0.31 | 1.36 | 11.54 | 0.04 | 0.04 | 2,449.48 | 0.79 | 0.06 | 0.26 | 2.18 | 0.01 | 0.01 | 462.95 | 0.15 | 425.10 |
| Excavators >51 and <120 | Backhoe/Excavator | 6 | 4 | 90 | 0.37 | 378 | 0.11 | 0.46 | 6.52 | 0.01 | 0.01 | 824.68 | 0.27 | 0.02 | 0.09 | 1.23 | 0.00 | 0.00 | 155.86 | 0.05 | 143.12 |
| Cranes >251 and <500 | Crane | 6 | 5 | 400 | 0.29 | 378 | 0.46 | 1.99 | 16.88 | 0.06 | 0.06 | 3,625.51 | 1.17 | 0.09 | 0.38 | 3.19 | 0.01 | 0.01 | 685.22 | 0.22 | 629.20 |
| Forklifts >51 and <120 | Forklift | 3 | 4 | 90 | 0.20 | 378 | 0.03 | 0.12 | 1.76 | 0.00 | 0.00 | 224.54 | 0.07 | 0.01 | 0.02 | 0.33 | 0.00 | 0.00 | 42.44 | 0.01 | 38.97 |
| Excavators >26 and <50 | Mini Excavator | 1 | 6 | 42 | 0.50 | 378 | 0.03 | 0.76 | 1.14 | 0.00 | 0.00 | 145.94 | 0.05 | 0.01 | 0.14 | 0.22 | 0.00 | 0.00 | 27.58 | 0.01 | 25.33 |
| Aerial Lifts >51 and <120 | Man/Aerial Lift | 2 | 4 | 60 | 0.31 | 378 | 0.04 | 0.90 | 1.21 | 0.00 | 0.00 | 154.88 | 0.05 | 0.01 | 0.17 | 0.23 | 0.00 | 0.00 | 29.27 | 0.01 | 26.88 |
| Tractors/Loaders/Backhoes >176 and <250 | Tractor | 1 | 6 | 190 | 0.36 | 378 | 0.05 | 0.24 | 1.99 | 0.01 | 0.01 | 425.70 | 0.14 | 0.01 | 0.04 | 0.38 | 0.00 | 0.00 | 80.46 | 0.03 | 73.88 |
| Off-Highway Trucks >176 and <250 | Truck, flatbed (onroad) | 2 | 2 | 200 | 0.38 | 378 | 0.04 | 0.17 | 1.47 | 0.01 | 0.01 | 315.11 | 0.10 | 0.01 | 0.03 | 0.28 | 0.00 | 0.00 | 59.56 | 0.02 | 54.69 |
| Off-Highway Trucks >176 and <250 | Truck (onroad) | 13 | 2 | 200 | 0.38 | 378 | 0.26 | 1.13 | 9.58 | 0.03 | 0.03 | 2,048.21 | 0.66 | 0.05 | 0.21 | 1.81 | 0.01 | 0.01 | 387.11 | 0.13 | 355.46 |
| Generator Sets >51 and <120 | Generator (45 kW) | 2 | 4 | 60 | 0.74 | 378 | 0.09 | 2.15 | 2.90 | 0.01 | 0.01 | 445.03 | 0.03 | 0.02 | 0.41 | 0.55 | 0.00 | 0.00 | 84.11 | 0.00 | 76.66 |
| Crawler Tractors >121 and <175 | Crawler Tractor | 1 | 4 | 147 | 0.29 | 126 | 0.02 | 0.10 | 1.39 | 0.00 | 0.00 | 177.07 | 0.06 | 0.00 | 0.01 | 0.09 | 0.00 | 0.00 | 11.16 | 0.00 | 10.24 |
| Tractors/Loaders/Backhoes >176 and <250 | Truck Mounted Digger | 1 | 4 | 190 | 0.42 | 126 | 0.04 | 0.18 | 1.55 | 0.01 | 0.01 | 331.10 | 0.11 | 0.00 | 0.01 | 0.10 | 0.00 | 0.00 | 20.86 | 0.01 | 19.15 |
| Other Construction Equipment >251 and <500 | Tensioner | 1 | 4 | 238 | 0.42 | 126 | 0.05 | 0.23 | 1.94 | 0.01 | 0.01 | 418.92 | 0.14 | 0.00 | 0.01 | 0.12 | 0.00 | 0.00 | 26.39 | 0.01 | 24.23 |
| Off-Highway Trucks >176 and <250 | Wire Truck | 1 | 4 | 238 | 0.38 | 126 | 0.05 | 0.21 | 1.75 | 0.01 | 0.01 | 374.98 | 0.12 | 0.00 | 0.01 | 0.11 | 0.00 | 0.00 | 23.62 | 0.01 | 21.69 |
| Graders >176 and <250 | Motor Grader | 1 | 1 | 185 | 0.41 | 126 | 0.01 | 0.04 | 0.37 | 0.00 | 0.00 | 79.48 | 0.03 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 5.01 | 0.00 | 4.60 |
| Scrapers >251 and <500 | Scraper | 1 | 1 | 365 | 0.40 | 126 | 0.02 | 0.08 | 0.71 | 0.00 | 0.00 | 151.98 | 0.05 | 0.00 | 0.01 | 0.04 | 0.00 | 0.00 | 9.57 | 0.00 | 8.79 |
| Trenchers >26 and <50 | Cable Trencher | 5 | 10 | 42 | 0.50 | 126 | 0.28 | 6.37 | 9.49 | 0.02 | 0.02 | 1,220.15 | 0.39 | 0.02 | 0.40 | 0.60 | 0.00 | 0.00 | 76.87 | 0.02 | 70.58 |
| **Total** | | | | | | | **2.27** | **18.10** | **85.77** | **0.27** | **0.27** | **16,311.75** | **5.16** | **0.37** | **2.51** | **14.04** | **0.05** | **0.05** | **2,735.96** | **0.86** | **2,511.70** |

**On Road Construction Emissions**

| | | | | | | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Trips | Distance | Average Daily Mileage | Calculated Time - Rounded (days) | Total Mileage | VOC | $NO_x$ | CO | PM10 | PM2.5 | CO2 | $CH_4$ | VOC | $NO_x$ | CO | PM10 | PM2.5 | $CO_2$ | $CH_4$ | Total GHG Emissions (MT CO2e) |
| Worker Trips | 180 | 13 | 4,680 | 378 | 1,769,040 | 0.14 | 0.72 | 7.60 | 0.48 | 0.20 | 3,095 | 0.29 | 0.03 | 0.14 | 1.44 | 0.09 | 0.04 | 584.98 | 0.06 | 533.75 |
| Inverter Delivery | 2 | 150 | 600 | 36 | 21,750 | 0.12 | 5.78 | 0.48 | 0.16 | 0.08 | 1,966 | 0.01 | 0.00 | 0.10 | 0.01 | 0.00 | 0.00 | 35.64 | 0.00 | 32.43 |
| Concrete Truck Trips (Unless Batched on site) | 9 | 13 | 234 | 378 | 88,452 | 0.05 | 2.25 | 0.19 | 0.06 | 0.03 | 767 | 0.00 | 0.01 | 0.43 | 0.04 | 0.01 | 0.01 | 144.92 | 0.00 | 131.88 |
| Water Delivery Trips | 14 | 13 | 364 | 102 | 37,267 | 0.07 | 3.50 | 0.29 | 0.10 | 0.05 | 1,193 | 0.00 | 0.00 | 0.18 | 0.01 | 0.00 | 0.00 | 61.06 | 0.00 | 55.57 |
| **Total** | | | | | | **0.37** | **12.25** | **8.55** | **0.80** | **0.35** | **7,020.81** | **0.31** | **0.04** | **0.85** | **1.49** | **0.11** | **0.05** | **826.60** | **0.06** | **753.62** |

Concrete and water trucks assumed to haul material from Blythe at a distance of approximately 13 miles (26 miles round trip).

| | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | VOC | $NO_x$ | CO | PM10 | PM2.5 | CO2 | $CH_4$ | VOC | $NO_x$ | CO | PM10 | PM2.5 | $CO_2$ | $CH_4$ | Total GHG Emissions (MT CO2e) |
| **Maximum Daily Emissions** | **2.65** | **30.36** | **94.32** | **1.07** | **0.62** | **23,332.56** | **5.46** | | | | | | | | |
| **Maximum Annual Emissions** | | | | | | | | **0.41** | **3.36** | **15.54** | **0.16** | **0.09** | **3,562.56** | **0.92** | **3,265.32** |

**Fugitive Dust Summary**

**Option A**

| Construction Activity/Year | Construction Days | Daily Emissions $PM_{10}$ (lbs/day) | Daily Emissions $PM_{2.5}$ (lbs/day) | Total Emissions $PM_{10}$ (tons) | Total Emissions $PM_{2.5}$ (tons) |
|---|---|---|---|---|---|
| Phase I | 399 | 210.94 | 37.55 | 42.08 | 7.49 |
| Phase II | 399 | 241.92 | 27.79 | 48.26 | 5.54 |
| Phase III | 378 | 117.73 | 11.81 | 22.25 | 2.23 |

Note: Estimates do not include emission reductions associated with the fugitive dust control measures.

**Fugitive Dust Summary - Mitigated**

**Option A**

| Construction Activity/Year | Construction Days | Daily Emissions $PM_{10}$ (lbs/day) | Daily Emissions $PM_{2.5}$ (lbs/day) | Total Emissions $PM_{10}$ (tons) | Total Emissions $PM_{2.5}$ (tons) |
|---|---|---|---|---|---|
| Phase I | 399 | 42.46 | 9.66 | 8.47 | 1.93 |
| Phase II | 399 | 43.16 | 4.48 | 8.61 | 0.89 |
| Phase III | 378 | 22.01 | 2.19 | 4.16 | 0.41 |

Note: Estimates include emission reductions associated with the fugitive dust control measures.

Crimson Solar Fugitive Dust Emissions
Option A
Fugitive Dust - Truck Loading Emissions

| Construction Phase/Subphase | Work Days | Total Materials Moved (cy) | Total Materials Moved (tons) | Daily Materials Moved (tons/day) | Unmitigated Daily $PM_{10}$ (lbs/day) | Unmitigated Daily $PM_{2.5}$ (lbs/day) | Mitigated Daily $PM_{10}$ (lbs/day) | Mitigated Daily $PM_{2.5}$ (lbs/day) | Unmitigated $PM_{10}$ (tons) | Unmitigated $PM_{2.5}$ (tons) | Mitigated $PM_{10}$ (tons) | Mitigated $PM_{2.5}$ (tons) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Phase I | 399 | 191,000 | 286,500 | 718.05 | 0.21 | 0.03 | 0.09 | 0.01 | 0.04 | 0.01 | 0.02 | 0.00 |

**Earthwork Fugitive Particulate Matter Emissions - Bulldozing, Scraping and Grading**

| **Activity** | **Equipment** | **Daily Activity Level** | **Total Activity Level** | **PM10 Emission Factor (lb/activity)** | **PM2.5 Emission Factor (lb/activity)** | Unmitigated **PM10 (lb/day)** | Unmitigated **PM2.5 (lb/day)** | Mitigated Daily $PM_{10}$ (lbs/day) | Mitigated Daily $PM_{2.5}$ (lbs/day) | Unmitigated $PM_{10}$ (tons) | Unmitigated $PM_{2.5}$ (tons) | Mitigated $PM_{10}$ (tons) | Mitigated $PM_{2.5}$ (tons) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Phase I | 7 | 6.0 | 42.0 | 0.753 | 0.415 | 31.62 | 17.42 | 12.65 | 6.97 | 6.31 | 3.48 | 2.52 | 1.39 |
| Phase II | 0 | 0.0 | 0.0 | 0.753 | 0.415 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Phase III | 2 | 1.0 | 2.0 | 0.753 | 0.415 | 1.51 | 0.83 | 0.60 | 0.33 | 0.28 | 0.16 | 0.11 | 0.06 |

| | | |
|---|---|---|
| Rule 403 Control Measures | 0.6 | percent reduction |
| Work Days Per Week | 5 | |
| Work Days Per Month | 21 | |

Paved Roads Fugitive Dust Emissions

| | |
|---|---|
| Paved Roads | 100% |

| | Vehicle Type | Miles Per Day | Paved Road Dust Emissions (lbs/day) PM10 | Paved Road Dust Emissions (lbs/day) PM2.5 | Paved Road Dust Emissions (tons) PM10 | Paved Road Dust Emissions (tons) PM2.5 |
|---|---|---|---|---|---|---|
| Option A - Phase I | Truck | 6,364 | 26.26 | 6.45 | 1.02 | 0.25 |
| Option A - Phase II | Truck | 9,664 | 39.88 | 9.79 | 4.63 | 1.14 |
| Option A - Phase III | Truck | 1,198 | 4.94 | 1.21 | 0.29 | 0.07 |
| | | | | | | |
| | Vehicle Type | Miles Per Day | PM10 | PM2.5 | PM10 | PM2.5 |
| Option A - Phase I | Worker | 8,684 | 5.62 | 1.38 | 0.22 | 0.05 |
| Option A - Phase II | Worker | 11,102 | 7.19 | 1.76 | 0.83 | 0.20 |
| Option A - Phase III | Worker | 4,680 | 3.03 | 0.74 | 0.18 | 0.04 |

Paved Road Dust $EF_{DUST} = [(k(sL)^{0.91} \times (W)^{1.02}](1 - P/4N))$

Source: AP-42 Section 13.2.1 (Paved Roads) - http://www.epa.gov/ttnchie1/ap42/ch13/final/c13s0201.pdf

| Variable | Value | Description |
|---|---|---|
| k (PM10) | 0.0022 | particle size multiplier for particle size rangeand units of interest (lb/VMT) |
| k (PM2.5) | 0.00054 | particle size multiplier for particle size range and units of interest (lb/VMT) |
| sL | 0.1 | road surface silt loading (g/m$^2$) |
| W | 2.4 | average weight (tons) of vehicles (2.4 tons) |
| W | 14.75 | haul truck tons |
| P | 30 | number of "wet" days with at least 0.254 mm of precipitation during the averaging period |
| N | 365 | number of days in averaging period |

Pickup and Worker

| | | |
|---|---|---|
| EF (PM10) | 0.000647473 | lb/VMT |
| EF (PM2.5) | 0.000158925 | lb/VMT |

Haul Truck

| | | |
|---|---|---|
| EF (PM10) | 0.004126423 | lb/VMT |
| EF (PM2.5) | 0.001012849 | lb/VMT |

Fugitive Dust - Unpaved Roads

Daily On-Site Construction Motor Vehicle Fugitive Particulate Matter Emissions

| | Vehicle Type | Trips Per Day | Mi/Veh-Day | Surface Type | Silt Loading ($g/m^2$)/ Silt Content (%)[a] | Vehicle Weight (tons) | Uncontrolled Emission Factors (lb/mi)[b] | | Uncontrolled Emissions (lb/day)[c] | | Control Efficiency[d] | Controlled Emissions (lb/day)[e] | | Uncontrolled Emissions (tons) | | Controlled Emissions (tons) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | PM10 | PM2.5 | PM10 | PM2.5 | | PM10 | PM2.5 | PM10 | PM2.5 | PM10 | PM2.5 |
| Option A - Phase I | Truck | 34 | 2.00 | Unpaved | 5 | 25 | 2.17 | 0.18 | 147.2 | 12.3 | 81% | 28.5 | 2.4 | 29.4 | 2.4 | 5.7 | 0.5 |
| Option A - Phase II | Truck | 45 | 2.00 | Unpaved | 5 | 25 | 2.17 | 0.18 | 194.9 | 16.2 | 81% | 37.7 | 3.1 | 38.9 | 3.2 | 7.5 | 0.6 |
| Option A - Phase III | Truck | 25 | 2.00 | Unpaved | 5 | 25 | 2.17 | 0.18 | 108.3 | 9.0 | 81% | 20.9 | 1.7 | 20.5 | 1.7 | 4.0 | 0.3 |

Note: Totals may not match sum of individual values because of rounding.

[a] Unpaved surface silt content from SCAQMD CEQA Handbook, (1993) Table A9-9-D-1 for city and county roads

[b] Equations:

EF (unpaved) = $k_u (s/12)^a (W/3)^b$ Ref: AP-42, Section 13.2.2, "Unpaved Roads," November 2006

Constants:

| | | |
|---|---|---|
| $k_u$ = | 1.8 | (Particle size multiplier for PM) |
| | 0.15 | (Particle size multiplier for PM2.5) |
| a = | 1 | for PM10 |
| | 1 | for PM2.5 |
| b = | 0.5 | for PM10 |
| | 0.5 | for PM2.5 |

[c] Uncontrolled emissions [lb/day] = Emission factor [lb/mi] x Number x Daily miles traveled [mi/vehicle-day]

[d] Control efficiency from watering unpaved road twice a day (55%) and limiting maximum speed to 15 mph (57%), from Table XI-A, Mitigation Measure Examples, Fugitive Dust from Construction & Demolition, http://www.aqmd.gov/ceqa/handbook/mitigation/fugitive/MM_fugitive.html

[e] Controlled emissions [lb/day] = Uncontrolled emissions [lb/day] x (1 - Control efficiency [%])

**Fugitive Dust Emission Factors**

Truck Loading Fugitive Dust Emission Factors

$EF_D = k \times (0.0032) \times ((U/5)^{1.3})/((M/2)^{1.4})$

| Variable | Amount | Units | |
|---|---|---|---|
| EF ($PM_{10}$) | 0.0003 | lb/ton | |
| EF ($PM_{2.5}$) | 0.00004 | lb/ton | |
| k ($PM_{10}$) | 0.35 | factor | |
| k ($PM_{2.5}$) | 0.053 | factor | |
| U (mean wind speed) | 7.90 | miles/hr | WRCC average Annual Wind Speed Data for Blythe Airport |
| M (moisture content) | 7.90 | percent | USEPA, AP-42, July 1998, Table 11.9-3 Typical Values for Correction Factors Applicable to the Predictive Emission Factor Equations |
| Soil density (CalEEMod default) | 1.26 | tons/cy | |
| Rip rap density | 2.23 | tons/cy | |
| Gravel density | 1.50 | tons/cy | |

E (lbs) = EF (lb/ton) x TP (tons)

**Bulldozing, Scraping and Grading**

PM10 Emission Factor [lb/hr] = 0.75 x (silt content [%])$^{1.5}$ / (moisture)$^{1.4}$

PM2.5 Emission Factor [lb/hr] = 0.60 x (silt content [%])$^{1.2}$ / (moisture)$^{1.3}$

Reference: AP-42, Table 11.9-1, July 1998

| Parameter | Value | Basis |
|---|---|---|
| Silt Content | 6.9 | USEPA, AP-42, July 1998, Table 11.9-3 Typical Values for Correction Factors Applicable to the Predictive Emission Factor Equations |
| Moisture | 7.9 | USEPA, AP-42, July 1998, Table 11.9-3 Typical Values for Correction Factors Applicable to the Predictive Emission Factor Equations |

| | | |
|---|---|---|
| PM10 Emission Factor | 0.75 | lb/hr |
| PM2.5 Emission Factor | 0.41 | lb/hr |

Emissions [pounds per day] = Controlled emission factor [pounds per hour] x Bulldozing, scraping or grading time [hours/day]

Emission Factors - OFFROAD

| Equipment Type | Year | Low HP | High HP | TOG (g/bhp-hr) | ROG (g/bhp-hr) | CO (g/bhp-hr) | NOX (g/bhp-hr) | SO2 (g/bhp-hr) | PM10 (g/bhp-hr) | PM2.5 (g/bhp-hr) | CO2 (g/bhp-hr) | CH4 (g/bhp-hr) | Load Factor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aerial Lifts | 2020 | 6 | 15 | 0.199447 | 0.1676 | 3.09942 | 2.95486 | 0.0054 | 0.0309 | 0.0284 | 525.0743 | 0.1698 | 0.31 |
| Aerial Lifts | 2020 | 16 | 25 | 0.199447 | 0.1676 | 3.09942 | 2.95486 | 0.0054 | 0.0309 | 0.0284 | 525.0743 | 0.1698 | 0.31 |
| Aerial Lifts | 2020 | 26 | 50 | 0.199447 | 0.1676 | 3.09942 | 2.95486 | 0.0054 | 0.0309 | 0.0284 | 525.0743 | 0.1698 | 0.31 |
| Aerial Lifts >51 and <120 | 2020 | 51 | 120 | 0.136778 | 0.1149 | 3.1768 | 1.86859 | 0.0049 | 0.0416 | 0.0382 | 472.1142 | 0.1527 | 0.31 |
| Aerial Lifts | 2020 | 251 | 500 | 0.081859 | 0.0688 | 0.94623 | 0.63803 | 0.0049 | 0.009 | 0.0083 | 472.0545 | 0.1527 | 0.31 |
| Aerial Lifts | 2020 | 501 | 750 | 26.846 | 0.2 | 1.013 | 1.868 | 0.005 | 0.057 | 0.057 | 568.299 | 0.018 | 0.31 |
| Air Compressors | 2020 | 6 | 15 | 1.907 | 0.731 | 3.546 | 4.542 | 0.008 | 0.227 | 0.227 | 568.299 | 0.066 | 0.48 |
| Air Compressors | 2020 | 16 | 25 | 4.009 | 0.769 | 2.473 | 4.538 | 0.007 | 0.212 | 0.212 | 568.3 | 0.069 | 0.48 |
| Air Compressors >26 and <50 | 2020 | 26 | 50 | 8.048 | 1.001 | 5.164 | 4.397 | 0.007 | 0.25 | 0.25 | 568.299 | 0.09 | 0.48 |
| Air Compressors | 2020 | 51 | 120 | 8.287 | 0.489 | 3.698 | 3.4 | 0.006 | 0.224 | 0.224 | 568.299 | 0.044 | 0.48 |
| Air Compressors | 2020 | 121 | 175 | 11.957 | 0.374 | 3.203 | 2.558 | 0.006 | 0.133 | 0.133 | 568.299 | 0.033 | 0.48 |
| Air Compressors | 2020 | 176 | 250 | 13.668 | 0.288 | 1.121 | 2.172 | 0.006 | 0.069 | 0.069 | 568.299 | 0.026 | 0.48 |
| Air Compressors | 2020 | 251 | 500 | 23.406 | 0.279 | 1.076 | 1.935 | 0.005 | 0.067 | 0.067 | 568.299 | 0.025 | 0.48 |
| Air Compressors | 2020 | 501 | 750 | 36.303 | 0.28 | 1.076 | 1.982 | 0.005 | 0.067 | 0.067 | 568.299 | 0.025 | 0.48 |
| Air Compressors | 2020 | 751 | 1000 | 53.87 | 0.306 | 1.158 | 3.828 | 0.005 | 0.093 | 0.093 | 568.3 | 0.027 | 0.48 |
| Bore/Drill Rigs | 2020 | 6 | 15 | 0.851825 | 0.7158 | 4.51013 | 4.6451 | 0.0055 | 0.2941 | 0.2706 | 535.2948 | 0.1731 | 0.5 |
| Bore/Drill Rigs | 2020 | 16 | 25 | 0.851825 | 0.7158 | 4.51013 | 4.6451 | 0.0055 | 0.2941 | 0.2706 | 535.2948 | 0.1731 | 0.5 |
| Bore/Drill Rigs | 2020 | 26 | 50 | 0.851825 | 0.7158 | 4.51013 | 4.6451 | 0.0055 | 0.2941 | 0.2706 | 535.2948 | 0.1731 | 0.5 |
| Bore/Drill Rigs | 2020 | 51 | 120 | 0.292949 | 0.2462 | 3.32347 | 3.06601 | 0.0048 | 0.1586 | 0.1459 | 463.5827 | 0.1499 | 0.5 |
| Bore/Drill Rigs >121 and <175 | 2020 | 121 | 175 | 0.207426 | 0.1743 | 2.96948 | 1.87149 | 0.0049 | 0.0822 | 0.0757 | 477.722 | 0.1545 | 0.5 |
| Bore/Drill Rigs >176 and <250 | 2020 | 176 | 250 | 0.169462 | 0.1424 | 1.06766 | 1.80732 | 0.0048 | 0.0521 | 0.0479 | 466.8342 | 0.151 | 0.5 |
| Bore/Drill Rigs | 2020 | 251 | 500 | 0.148188 | 0.1245 | 1.01263 | 1.40938 | 0.0048 | 0.0446 | 0.041 | 466.8219 | 0.151 | 0.5 |
| Bore/Drill Rigs | 2020 | 501 | 750 | 0.129293 | 0.1086 | 0.97413 | 1.23085 | 0.0049 | 0.0409 | 0.0377 | 473.6679 | 0.1532 | 0.5 |
| Bore/Drill Rigs | 2020 | 751 | 1000 | 0.158163 | 0.1329 | 0.98839 | 3.05008 | 0.0049 | 0.0612 | 0.0563 | 471.8492 | 0.1526 | 0.5 |
| Cement and Mortar Mixers | 2020 | 6 | 15 | 1.075 | 0.661 | 3.47 | 4.142 | 0.008 | 0.161 | 0.161 | 568.299 | 0.059 | 0.56 |
| Cement and Mortar Mixers | 2020 | 16 | 25 | 3.265 | 0.723 | 2.397 | 4.442 | 0.007 | 0.187 | 0.187 | 568.299 | 0.065 | 0.56 |
| Concrete/Industrial Saws | 2020 | 16 | 25 | 1.532 | 0.685 | 2.339 | 4.332 | 0.007 | 0.161 | 0.161 | 568.299 | 0.061 | 0.73 |
| Concrete/Industrial Saws >26 and <50 | 2020 | 26 | 50 | 3.271 | 0.798 | 4.552 | 4.196 | 0.007 | 0.212 | 0.212 | 568.299 | 0.072 | 0.73 |
| Concrete/Industrial Saws | 2020 | 51 | 120 | 4.042 | 0.401 | 3.535 | 3.163 | 0.006 | 0.19 | 0.19 | 568.299 | 0.036 | 0.73 |
| Concrete/Industrial Saws | 2020 | 121 | 175 | 6.669 | 0.306 | 3.072 | 2.324 | 0.006 | 0.114 | 0.114 | 568.299 | 0.027 | 0.73 |
| Cranes | 2020 | 26 | 50 | 2.47956 | 2.0835 | 7.37625 | 5.98471 | 0.0053 | 0.6237 | 0.5738 | 517.9263 | 0.1675 | 0.29 |
| Cranes | 2020 | 51 | 120 | 0.871016 | 0.7319 | 4.17141 | 6.38117 | 0.0048 | 0.4529 | 0.4167 | 469.8821 | 0.152 | 0.29 |
| Cranes | 2020 | 121 | 175 | 0.638941 | 0.5369 | 3.56232 | 5.5697 | 0.0049 | 0.2978 | 0.274 | 474.5939 | 0.1535 | 0.29 |
| Cranes >176 and <250 | 2020 | 176 | 250 | 0.45669 | 0.3837 | 1.7904 | 4.56329 | 0.0049 | 0.1881 | 0.1731 | 472.9488 | 0.153 | 0.29 |
| Cranes >251 and <500 | 2020 | 251 | 500 | 0.381547 | 0.3206 | 2.66037 | 3.86243 | 0.0049 | 0.1548 | 0.1424 | 472.5579 | 0.1528 | 0.29 |
| Cranes | 2020 | 501 | 750 | 0.287724 | 0.2418 | 1.44353 | 3.10471 | 0.0049 | 0.116 | 0.1067 | 470.4254 | 0.1521 | 0.29 |
| Cranes | 2020 | 1001 | 9999 | 0.216797 | 0.1822 | 0.99943 | 2.3614 | 0.0049 | 0.0604 | 0.0556 | 472.0545 | 0.1527 | 0.29 |
| Crawler Tractors | 2020 | 26 | 50 | 2.443056 | 2.0528 | 7.3 | 5.64276 | 0.0053 | 0.5912 | 0.5439 | 515.679 | 0.1668 | 0.43 |
| Crawler Tractors | 2020 | 51 | 120 | 0.850709 | 0.7148 | 4.04412 | 6.00933 | 0.0049 | 0.5005 | 0.4604 | 476.3284 | 0.1541 | 0.43 |
| Crawler Tractors >121 and <175 | 2020 | 121 | 175 | 0.566576 | 0.4761 | 3.33989 | 4.87226 | 0.0049 | 0.2722 | 0.2504 | 471.015 | 0.1523 | 0.43 |
| Crawler Tractors | 2020 | 176 | 250 | 0.428471 | 0.36 | 1.55491 | 4.63225 | 0.0049 | 0.1746 | 0.1606 | 472.941 | 0.153 | 0.43 |
| Crawler Tractors | 2020 | 251 | 500 | 0.358593 | 0.3013 | 2.0875 | 3.62175 | 0.0049 | 0.1409 | 0.1296 | 475.2338 | 0.1537 | 0.43 |
| Crawler Tractors | 2020 | 501 | 750 | 0.304872 | 0.2562 | 1.31018 | 3.13716 | 0.0049 | 0.1151 | 0.1059 | 473.3119 | 0.1531 | 0.43 |
| Crawler Tractors | 2020 | 751 | 1000 | 0.551035 | 0.463 | 2.02764 | 7.23682 | 0.0049 | 0.212 | 0.195 | 475.6525 | 0.1538 | 0.43 |
| Crushing/Proc. Equipment | 2020 | 26 | 50 | 2.489 | 0.947 | 5.211 | 4.347 | 0.007 | 0.233 | 0.233 | 568.299 | 0.085 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 51 | 120 | 2.348 | 0.473 | 3.722 | 3.249 | 0.006 | 0.206 | 0.206 | 568.299 | 0.042 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 121 | 175 | 3.673 | 0.367 | 3.234 | 2.392 | 0.006 | 0.124 | 0.124 | 568.299 | 0.033 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 176 | 250 | 4.222 | 0.289 | 1.125 | 2.014 | 0.006 | 0.065 | 0.065 | 568.299 | 0.026 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 251 | 500 | 6.283 | 0.281 | 1.078 | 1.799 | 0.005 | 0.063 | 0.063 | 568.299 | 0.025 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 501 | 750 | 9.884 | 0.281 | 1.077 | 1.835 | 0.005 | 0.063 | 0.063 | 568.299 | 0.025 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 1001 | 9999 | 25.755 | 0.329 | 1.153 | 3.699 | 0.005 | 0.089 | 0.089 | 568.299 | 0.029 | 0.78 |
| Dumpers/Tenders | 2020 | 16 | 25 | 0.819 | 0.685 | 2.339 | 4.336 | 0.007 | 0.165 | 0.165 | 568.299 | 0.061 | 0.38 |
| Excavators | 2020 | 16 | 25 | 0.705964 | 0.5932 | 4.50032 | 4.03131 | 0.0054 | 0.2222 | 0.2044 | 525.3675 | 0.1699 | 0.38 |
| Excavators >26 and <50 | 2020 | 26 | 50 | 0.705964 | 0.5932 | 4.50032 | 4.03131 | 0.0054 | 0.2222 | 0.2044 | 525.3675 | 0.1699 | 0.38 |
| Excavators >51 and <120 | 2020 | 51 | 120 | 0.356064 | 0.2992 | 3.50495 | 3.08964 | 0.0048 | 0.1848 | 0.17 | 468.0546 | 0.1514 | 0.38 |
| Excavators | 2020 | 121 | 175 | 0.275327 | 0.2314 | 3.08597 | 2.27838 | 0.0049 | 0.1104 | 0.1015 | 472.2891 | 0.1527 | 0.38 |
| Excavators | 2020 | 176 | 250 | 0.211076 | 0.1774 | 1.11778 | 2.02738 | 0.0049 | 0.0614 | 0.0565 | 471.8828 | 0.1526 | 0.38 |
| Excavators >251 and <500 | 2020 | 251 | 500 | 0.182542 | 0.1534 | 1.1016 | 1.57199 | 0.0049 | 0.0518 | 0.0476 | 470.2956 | 0.1521 | 0.38 |
| Excavators | 2020 | 501 | 750 | 0.202011 | 0.1697 | 1.14543 | 1.79718 | 0.0048 | 0.0612 | 0.0563 | 468.8706 | 0.1516 | 0.38 |
| Forklifts | 2020 | 26 | 50 | 1.337399 | 1.1238 | 5.70563 | 4.68572 | 0.0054 | 0.3601 | 0.3313 | 525.4833 | 0.17 | 0.2 |
| Forklifts >51 and <120 | 2020 | 51 | 120 | 0.545921 | 0.4587 | 3.75954 | 4.13299 | 0.0049 | 0.3079 | 0.2833 | 471.5285 | 0.1525 | 0.2 |
| Forklifts | 2020 | 121 | 175 | 0.402357 | 0.3381 | 3.24885 | 3.3196 | 0.0049 | 0.1797 | 0.1653 | 472.1062 | 0.1527 | 0.2 |
| Forklifts | 2020 | 176 | 250 | 0.348476 | 0.2928 | 1.44178 | 3.24149 | 0.0049 | 0.1259 | 0.1158 | 473.3255 | 0.1531 | 0.2 |
| Forklifts | 2020 | 251 | 500 | 0.299035 | 0.2513 | 1.47807 | 2.43991 | 0.0049 | 0.0967 | 0.0889 | 473.6151 | 0.1532 | 0.2 |
| Generator Sets | 2020 | 6 | 15 | 1.715 | 0.646 | 3.546 | 4.516 | 0.008 | 0.212 | 0.212 | 568.299 | 0.058 | 0.74 |
| Generator Sets | 2020 | 16 | 25 | 3.307 | 0.721 | 2.473 | 4.538 | 0.007 | 0.205 | 0.205 | 568.299 | 0.065 | 0.74 |
| Generator Sets >26 and <50 | 2020 | 26 | 50 | 5.508 | 0.691 | 3.995 | 4.075 | 0.007 | 0.194 | 0.194 | 568.299 | 0.062 | 0.74 |
| Generator Sets >51 and <120 | 2020 | 51 | 120 | 7.383 | 0.364 | 3.38 | 3.173 | 0.006 | 0.179 | 0.179 | 568.299 | 0.032 | 0.74 |
| Generator Sets | 2020 | 121 | 175 | 9.884 | 0.267 | 2.93 | 2.38 | 0.006 | 0.105 | 0.105 | 568.299 | 0.024 | 0.74 |
| Generator Sets | 2020 | 176 | 250 | 10.963 | 0.198 | 1.026 | 2.016 | 0.006 | 0.057 | 0.057 | 568.299 | 0.017 | 0.74 |
| Generator Sets | 2020 | 251 | 500 | 16.528 | 0.188 | 1.005 | 1.816 | 0.005 | 0.055 | 0.055 | 568.299 | 0.017 | 0.74 |
| Generator Sets | 2020 | 501 | 750 | 27.045 | 0.191 | 1.005 | 1.858 | 0.005 | 0.056 | 0.056 | 568.299 | 0.017 | 0.74 |
| Generator Sets | 2020 | 1001 | 9999 | 66.08 | 0.242 | 1.082 | 3.608 | 0.005 | 0.079 | 0.079 | 568.3 | 0.021 | 0.74 |
| Graders | 2020 | 26 | 50 | 2.994737 | 2.5164 | 8.13394 | 5.82549 | 0.005 | 0.7086 | 0.6519 | 492.8615 | 0.1594 | 0.41 |
| Graders >51 and <120 | 2020 | 51 | 120 | 1.161574 | 0.976 | 4.56142 | 7.72513 | 0.0048 | 0.622 | 0.5722 | 469.3371 | 0.1518 | 0.41 |
| Graders >121 and <175 | 2020 | 121 | 175 | 0.674427 | 0.5667 | 3.62102 | 5.53045 | 0.0049 | 0.3085 | 0.2838 | 478.0403 | 0.1546 | 0.41 |
| Graders >176 and <250 | 2020 | 176 | 250 | 0.41877 | 0.3519 | 1.34183 | 4.67787 | 0.0049 | 0.1495 | 0.1376 | 475.3037 | 0.1537 | 0.41 |
| Graders | 2020 | 251 | 500 | 0.383198 | 0.322 | 1.5256 | 3.10731 | 0.0049 | 0.1206 | 0.111 | 471.9795 | 0.1526 | 0.41 |
| Graders | 2020 | 501 | 750 | 12.961 | 0.319 | 1.229 | 2.031 | 0.005 | 0.072 | 0.072 | 568.299 | 0.028 | 0.41 |
| Off-Highway Tractors | 2020 | 51 | 120 | 0.533073 | 0.4479 | 3.78798 | 4.18317 | 0.0049 | 0.307 | 0.2825 | 474.1481 | 0.1533 | 0.44 |
| Off-Highway Tractors | 2020 | 121 | 175 | 0.322507 | 0.271 | 3.21511 | 2.89032 | 0.0049 | 0.1402 | 0.129 | 472.9169 | 0.153 | 0.44 |
| Off-Highway Tractors | 2020 | 176 | 250 | 0.263453 | 0.2214 | 1.1813 | 2.57547 | 0.0049 | 0.0862 | 0.0793 | 470.943 | 0.1523 | 0.44 |
| Off-Highway Tractors >501 and <750 | 2020 | 501 | 750 | 0.239679 | 0.2014 | 1.13143 | 2.04663 | 0.0049 | 0.0762 | 0.0701 | 471.8151 | 0.1526 | 0.44 |
| Off-Highway Tractors | 2020 | 751 | 1000 | 0.178457 | 0.15 | 1.02156 | 2.39599 | 0.0049 | 0.063 | 0.058 | 472.0545 | 0.1527 | 0.44 |
| Off-Highway Trucks | 2020 | 121 | 175 | 0.36879 | 0.3099 | 3.3388 | 2.62769 | 0.0049 | 0.137 | 0.126 | 470.0967 | 0.152 | 0.38 |
| Off-Highway Trucks >176 and <250 | 2020 | 176 | 250 | 0.327003 | 0.2748 | 1.39106 | 2.50726 | 0.0049 | 0.0977 | 0.0899 | 470.1675 | 0.1521 | 0.38 |
| Off-Highway Trucks >251 and <500 | 2020 | 251 | 500 | 0.292906 | 0.2461 | 1.41417 | 2.34677 | 0.0049 | 0.0855 | 0.0787 | 474.5787 | 0.1535 | 0.38 |
| Off-Highway Trucks | 2020 | 501 | 750 | 0.371665 | 0.3123 | 2.02683 | 3.05816 | 0.0049 | 0.1196 | 0.11 | 472.7499 | 0.1529 | 0.38 |

| Equipment Type | Year | Low HP | High HP | TOG (g/bhp-hr) | ROG (g/bhp-hr) | CO (g/bhp-hr) | NOX (g/bhp-hr) | SO2 (g/bhp-hr) | PM10 (g/bhp-hr) | PM2.5 (g/bhp-hr) | CO2 (g/bhp-hr) | CH4 (g/bhp-hr) | Load Factor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Emission Factors - OFFROAD | | | | | | | | | | | | | |
| Off-Highway Trucks | 2020 | 751 | 1000 | 0.360605 | 0.303 | 1.37163 | 4.79365 | 0.0049 | 0.1252 | 0.1152 | 469.8892 | 0.152 | 0.38 |
| Other Construction Equipment | 2020 | 6 | 15 | 1.276029 | 1.0722 | 5.40446 | 5.03626 | 0.0054 | 0.4052 | 0.3728 | 527.9656 | 0.1708 | 0.42 |
| Other Construction Equipment >16 and <2 | 2020 | 16 | 25 | 1.276029 | 1.0722 | 5.40446 | 5.03626 | 0.0054 | 0.4052 | 0.3728 | 527.9656 | 0.1708 | 0.42 |
| Other Construction Equipment >26 and <5 | 2020 | 26 | 50 | 1.276029 | 1.0722 | 5.40446 | 5.03626 | 0.0054 | 0.4052 | 0.3728 | 527.9656 | 0.1708 | 0.42 |
| Other Construction Equipment >51 and <1 | 2020 | 51 | 120 | 0.617777 | 0.5191 | 3.73189 | 4.7712 | 0.0049 | 0.3537 | 0.3254 | 472.2162 | 0.1527 | 0.42 |
| Other Construction Equipment >121 and < | 2020 | 121 | 175 | 0.461441 | 0.3877 | 3.23528 | 4.11203 | 0.0049 | 0.217 | 0.1996 | 469.9837 | 0.152 | 0.42 |
| Other Construction Equipment >251 and < | 2020 | 251 | 500 | 0.266788 | 0.2242 | 1.6338 | 2.63672 | 0.0049 | 0.096 | 0.0883 | 475.2326 | 0.1537 | 0.42 |
| Other General Industrial Equipment | 2020 | 6 | 15 | 1.125869 | 0.946 | 5.50397 | 4.62219 | 0.0054 | 0.334 | 0.3073 | 526.1761 | 0.1702 | 0.34 |
| Other General Industrial Equipment | 2020 | 16 | 25 | 1.125869 | 0.946 | 5.50397 | 4.62219 | 0.0054 | 0.334 | 0.3073 | 526.1761 | 0.1702 | 0.34 |
| Other General Industrial Equipment | 2020 | 26 | 50 | 1.125869 | 0.946 | 5.50397 | 4.62219 | 0.0054 | 0.334 | 0.3073 | 526.1761 | 0.1702 | 0.34 |
| Other General Industrial Equipment | 2020 | 51 | 120 | 0.53075 | 0.446 | 3.77073 | 4.06079 | 0.0048 | 0.2959 | 0.2722 | 469.9998 | 0.152 | 0.34 |
| Other General Industrial Equipment | 2020 | 121 | 175 | 0.319281 | 0.2683 | 3.22922 | 2.57503 | 0.0049 | 0.135 | 0.1242 | 471.8502 | 0.1526 | 0.34 |
| Other General Industrial Equipment | 2020 | 176 | 250 | 0.281815 | 0.2368 | 1.23914 | 2.66782 | 0.0049 | 0.0902 | 0.083 | 473.2231 | 0.153 | 0.34 |
| Other General Industrial Equipment | 2020 | 251 | 500 | 0.247036 | 0.2076 | 1.34424 | 2.06187 | 0.0049 | 0.0724 | 0.0666 | 472.929 | 0.153 | 0.34 |
| Other General Industrial Equipment | 2020 | 501 | 750 | 0.207847 | 0.1746 | 1.46184 | 1.67591 | 0.0049 | 0.0622 | 0.0572 | 473.4638 | 0.1531 | 0.34 |
| Other General Industrial Equipment | 2020 | 751 | 1000 | 0.322174 | 0.2707 | 1.085 | 4.85721 | 0.0049 | 0.1186 | 0.1092 | 472.0545 | 0.1527 | 0.34 |
| Other Material Handling Equipment | 2020 | 26 | 50 | 1.481858 | 1.2452 | 6.1671 | 5.13925 | 0.0054 | 0.4392 | 0.4041 | 523.7088 | 0.1694 | 0.4 |
| Other Material Handling Equipment | 2020 | 51 | 120 | 0.36479 | 0.3065 | 3.58938 | 3.10396 | 0.0049 | 0.1823 | 0.1677 | 473.5884 | 0.1532 | 0.4 |
| Other Material Handling Equipment | 2020 | 121 | 175 | 0.299922 | 0.252 | 3.17089 | 2.36653 | 0.0049 | 0.1181 | 0.1086 | 472.2193 | 0.1527 | 0.4 |
| Other Material Handling Equipment | 2020 | 176 | 250 | 0.346024 | 0.2908 | 1.31882 | 3.59889 | 0.0049 | 0.1152 | 0.106 | 471.482 | 0.1525 | 0.4 |
| Other Material Handling Equipment | 2020 | 251 | 500 | 0.336187 | 0.2825 | 1.52346 | 3.20974 | 0.0049 | 0.1198 | 0.1102 | 470.2972 | 0.1521 | 0.4 |
| Other Material Handling Equipment | 2020 | 1001 | 9999 | 0.238473 | 0.2004 | 1.04898 | 3.61407 | 0.0049 | 0.0783 | 0.072 | 472.0545 | 0.1527 | 0.4 |
| Pavers | 2020 | 16 | 25 | 1.568718 | 1.3182 | 5.52345 | 4.76401 | 0.0054 | 0.4022 | 0.37 | 526.2098 | 0.1702 | 0.42 |
| Pavers | 2020 | 26 | 50 | 1.568718 | 1.3182 | 5.52345 | 4.76401 | 0.0054 | 0.4022 | 0.37 | 526.2098 | 0.1702 | 0.42 |
| Pavers | 2020 | 51 | 120 | 0.558949 | 0.4697 | 3.60405 | 4.42718 | 0.0048 | 0.3249 | 0.2989 | 469.8815 | 0.152 | 0.42 |
| Pavers | 2020 | 121 | 175 | 0.324615 | 0.2728 | 3.0097 | 2.91833 | 0.0049 | 0.1419 | 0.1305 | 472.7746 | 0.1529 | 0.42 |
| Pavers | 2020 | 176 | 250 | 0.209036 | 0.1756 | 1.02834 | 2.77699 | 0.0049 | 0.076 | 0.0699 | 472.8337 | 0.1529 | 0.42 |
| Pavers | 2020 | 251 | 500 | 0.195949 | 0.1647 | 0.98677 | 2.13394 | 0.0048 | 0.0772 | 0.071 | 466.2059 | 0.1508 | 0.42 |
| Paving Equipment | 2020 | 16 | 25 | 0.73951 | 0.6214 | 4.22322 | 3.9519 | 0.0054 | 0.2169 | 0.1996 | 520.1235 | 0.1682 | 0.36 |
| Paving Equipment | 2020 | 26 | 50 | 0.73951 | 0.6214 | 4.22322 | 3.9519 | 0.0054 | 0.2169 | 0.1996 | 520.1235 | 0.1682 | 0.36 |
| Paving Equipment | 2020 | 51 | 120 | 0.472907 | 0.3974 | 3.58172 | 3.78064 | 0.0049 | 0.2558 | 0.2353 | 473.3249 | 0.1531 | 0.36 |
| Paving Equipment >121 and <175 | 2020 | 121 | 175 | 0.294586 | 0.2475 | 3.02393 | 2.55498 | 0.0049 | 0.1278 | 0.1176 | 470.7359 | 0.1522 | 0.36 |
| Paving Equipment >176 and <250 | 2020 | 176 | 250 | 0.289784 | 0.2435 | 1.25215 | 3.2202 | 0.0049 | 0.1107 | 0.1018 | 472.1514 | 0.1527 | 0.36 |
| Plate Compactors | 2020 | 6 | 15 | 0.79 | 0.661 | 3.469 | 4.142 | 0.008 | 0.161 | 0.161 | 568.299 | 0.059 | 0.43 |
| Pressure Washers | 2020 | 6 | 15 | 1.78 | 0.646 | 3.546 | 4.516 | 0.008 | 0.212 | 0.212 | 568.299 | 0.058 | 0.3 |
| Pressure Washers | 2020 | 16 | 25 | 2.904 | 0.721 | 2.473 | 4.538 | 0.007 | 0.205 | 0.205 | 568.299 | 0.065 | 0.3 |
| Pressure Washers | 2020 | 26 | 50 | 4.025 | 0.499 | 3.393 | 3.917 | 0.007 | 0.161 | 0.161 | 568.299 | 0.045 | 0.3 |
| Pressure Washers | 2020 | 51 | 120 | 4.048 | 0.298 | 3.225 | 3.036 | 0.006 | 0.151 | 0.151 | 568.299 | 0.026 | 0.3 |
| Pressure Washers | 2020 | 121 | 175 | 16.638 | 0.258 | 2.907 | 2.383 | 0.006 | 0.104 | 0.104 | 568.299 | 0.023 | 0.3 |
| Pressure Washers | 2020 | 176 | 250 | 8.005 | 0.098 | 0.986 | 0.265 | 0.006 | 0.009 | 0.009 | 568.299 | 0.008 | 0.3 |
| Pumps | 2020 | 6 | 15 | 1.593 | 0.731 | 3.546 | 4.542 | 0.008 | 0.227 | 0.227 | 568.299 | 0.066 | 0.74 |
| Pumps | 2020 | 16 | 25 | 4.396 | 0.769 | 2.473 | 4.538 | 0.007 | 0.212 | 0.212 | 568.299 | 0.069 | 0.74 |
| Pumps >26 and <50 | 2020 | 26 | 50 | 7.613 | 0.755 | 4.197 | 4.128 | 0.007 | 0.206 | 0.206 | 568.299 | 0.068 | 0.74 |
| Pumps | 2020 | 51 | 120 | 8.832 | 0.386 | 3.432 | 3.219 | 0.006 | 0.189 | 0.189 | 568.299 | 0.034 | 0.74 |
| Pumps | 2020 | 121 | 175 | 11.744 | 0.285 | 2.974 | 2.418 | 0.006 | 0.111 | 0.111 | 568.299 | 0.025 | 0.74 |
| Pumps | 2020 | 176 | 250 | 12.575 | 0.212 | 1.042 | 2.05 | 0.006 | 0.06 | 0.06 | 568.299 | 0.019 | 0.74 |
| Pumps >251 and <500 | 2020 | 251 | 500 | 20.565 | 0.203 | 1.017 | 1.841 | 0.005 | 0.057 | 0.057 | 568.3 | 0.018 | 0.74 |
| Pumps | 2020 | 501 | 750 | 34.373 | 0.205 | 1.017 | 1.884 | 0.005 | 0.058 | 0.058 | 568.299 | 0.018 | 0.74 |
| Pumps | 2020 | 1001 | 9999 | 101.462 | 0.255 | 1.096 | 3.649 | 0.005 | 0.081 | 0.081 | 568.3 | 0.023 | 0.74 |
| Rollers | 2020 | 6 | 15 | 1.102095 | 0.9261 | 4.72504 | 4.53426 | 0.0054 | 0.3289 | 0.3026 | 525.8798 | 0.1701 | 0.38 |
| Rollers | 2020 | 16 | 25 | 1.102095 | 0.9261 | 4.72504 | 4.53426 | 0.0054 | 0.3289 | 0.3026 | 525.8798 | 0.1701 | 0.38 |
| Rollers | 2020 | 26 | 50 | 1.102095 | 0.9261 | 4.72504 | 4.53426 | 0.0054 | 0.3289 | 0.3026 | 525.8798 | 0.1701 | 0.38 |
| Rollers >51 and <120 | 2020 | 51 | 120 | 0.462004 | 0.3882 | 3.53135 | 3.88153 | 0.0049 | 0.2475 | 0.2277 | 473.8594 | 0.1533 | 0.38 |
| Rollers >121 and <175 | 2020 | 121 | 175 | 0.256128 | 0.2152 | 2.93333 | 2.45176 | 0.0049 | 0.1126 | 0.1036 | 471.9177 | 0.1526 | 0.38 |
| Rollers >176 and <250 | 2020 | 176 | 250 | 0.248138 | 0.2085 | 1.25343 | 2.75095 | 0.0049 | 0.0892 | 0.082 | 473.3669 | 0.1531 | 0.38 |
| Rollers | 2020 | 251 | 500 | 0.279691 | 0.235 | 2.11346 | 2.82823 | 0.005 | 0.1094 | 0.1007 | 479.3254 | 0.155 | 0.38 |
| Rough Terrain Forklifts | 2020 | 26 | 50 | 1.188595 | 0.9987 | 4.68594 | 4.4946 | 0.0054 | 0.3164 | 0.2911 | 525.6222 | 0.17 | 0.4 |
| Rough Terrain Forklifts >51 and <120 | 2020 | 51 | 120 | 0.225188 | 0.1892 | 3.25575 | 2.45218 | 0.0049 | 0.1026 | 0.0944 | 472.9842 | 0.153 | 0.4 |
| Rough Terrain Forklifts | 2020 | 121 | 175 | 0.170092 | 0.1429 | 2.84466 | 1.86888 | 0.0049 | 0.0684 | 0.0629 | 471.7152 | 0.1526 | 0.4 |
| Rough Terrain Forklifts | 2020 | 176 | 250 | 0.132727 | 0.1115 | 0.97848 | 1.60906 | 0.0049 | 0.0366 | 0.0337 | 472.5671 | 0.1528 | 0.4 |
| Rough Terrain Forklifts | 2020 | 251 | 500 | 0.105484 | 0.0886 | 0.94184 | 1.30199 | 0.0048 | 0.0281 | 0.0258 | 465.7709 | 0.1506 | 0.4 |
| Rubber Tired Dozers > 121 and <175 | 2020 | 121 | 175 | 0.864425 | 0.7264 | 3.89288 | 7.18525 | 0.0049 | 0.4107 | 0.3778 | 473.0116 | 0.153 | 0.4 |
| Rubber Tired Dozers > 176 and <250 | 2020 | 176 | 250 | 0.737248 | 0.6195 | 2.37104 | 6.50332 | 0.0049 | 0.3185 | 0.293 | 474.7928 | 0.1536 | 0.4 |
| Rubber Tired Dozers | 2020 | 251 | 500 | 0.636621 | 0.5349 | 4.41134 | 5.64089 | 0.0049 | 0.2591 | 0.2384 | 479.7569 | 0.1552 | 0.4 |
| Rubber Tired Dozers | 2020 | 501 | 750 | 0.543245 | 0.4565 | 2.60108 | 6.12255 | 0.0049 | 0.2181 | 0.2007 | 473.0562 | 0.153 | 0.4 |
| Rubber Tired Dozers | 2020 | 751 | 1000 | 7.811 | 0.522 | 2.164 | 5.306 | 0.005 | 0.16 | 0.16 | 568.299 | 0.047 | 0.4 |
| Rubber Tired Loaders | 2020 | 16 | 25 | 1.761913 | 1.4805 | 6.76793 | 5.25369 | 0.0054 | 0.4741 | 0.4362 | 524.6967 | 0.1697 | 0.36 |
| Rubber Tired Loaders | 2020 | 26 | 50 | 1.761913 | 1.4805 | 6.76793 | 5.25369 | 0.0054 | 0.4741 | 0.4362 | 524.6967 | 0.1697 | 0.36 |
| Rubber Tired Loaders | 2020 | 51 | 120 | 0.661113 | 0.5555 | 3.94839 | 4.68644 | 0.0048 | 0.367 | 0.3376 | 465.6735 | 0.1506 | 0.36 |
| Rubber Tired Loaders | 2020 | 121 | 175 | 0.450696 | 0.3787 | 3.36809 | 3.51735 | 0.0049 | 0.1936 | 0.1781 | 471.2135 | 0.1524 | 0.36 |
| Rubber Tired Loaders | 2020 | 176 | 250 | 0.345399 | 0.2902 | 1.26885 | 3.42116 | 0.0048 | 0.1136 | 0.1045 | 469.5127 | 0.1518 | 0.36 |
| Rubber Tired Loaders | 2020 | 251 | 500 | 0.343959 | 0.289 | 1.6304 | 3.01666 | 0.0048 | 0.1122 | 0.1032 | 466.7831 | 0.151 | 0.36 |
| Rubber Tired Loaders | 2020 | 501 | 750 | 0.329462 | 0.2768 | 1.39991 | 2.76722 | 0.0048 | 0.1075 | 0.0989 | 462.193 | 0.1495 | 0.36 |
| Rubber Tired Loaders | 2020 | 751 | 1000 | 0.370676 | 0.3115 | 1.20366 | 5.25309 | 0.0049 | 0.1385 | 0.1274 | 469.9352 | 0.152 | 0.36 |
| Scrapers | 2020 | 51 | 120 | 0.834143 | 0.7009 | 4.19756 | 6.6767 | 0.005 | 0.5101 | 0.4693 | 483.745 | 0.1565 | 0.48 |
| Scrapers | 2020 | 121 | 175 | 0.568453 | 0.4777 | 3.50114 | 4.86851 | 0.0049 | 0.262 | 0.241 | 478.6077 | 0.1548 | 0.48 |
| Scrapers | 2020 | 176 | 250 | 0.531032 | 0.4462 | 2.06469 | 5.089 | 0.0048 | 0.2232 | 0.2054 | 468.9883 | 0.1517 | 0.48 |
| Scrapers >251 and <500 | 2020 | 251 | 500 | 0.380326 | 0.3196 | 2.40063 | 3.78254 | 0.0049 | 0.1475 | 0.1357 | 472.1751 | 0.1527 | 0.48 |
| Scrapers | 2020 | 501 | 750 | 0.311991 | 0.2622 | 1.72502 | 3.12592 | 0.0049 | 0.1132 | 0.1042 | 471.7776 | 0.1526 | 0.48 |
| Signal Boards | 2020 | 6 | 15 | 1.04 | 0.661 | 3.469 | 4.142 | 0.008 | 0.161 | 0.161 | 568.299 | 0.059 | 0.82 |
| Signal Boards | 2020 | 26 | 50 | 7.28 | 0.788 | 4.448 | 4.132 | 0.007 | 0.206 | 0.206 | 568.299 | 0.071 | 0.82 |
| Signal Boards | 2020 | 51 | 120 | 8.081 | 0.395 | 3.504 | 3.134 | 0.006 | 0.187 | 0.187 | 568.299 | 0.035 | 0.82 |
| Signal Boards | 2020 | 121 | 175 | 11.756 | 0.298 | 3.043 | 2.309 | 0.006 | 0.11 | 0.11 | 568.299 | 0.026 | 0.82 |
| Signal Boards | 2020 | 176 | 250 | 14.813 | 0.274 | 1.281 | 2.35 | 0.007 | 0.071 | 0.071 | 686.695 | 0.024 | 0.82 |
| Skid Steer Loaders | 2020 | 16 | 25 | 0.522771 | 0.4393 | 3.76397 | 3.69113 | 0.0054 | 0.1447 | 0.1331 | 527.7577 | 0.1707 | 0.37 |
| Skid Steer Loaders | 2020 | 26 | 50 | 0.522771 | 0.4393 | 3.76397 | 3.69113 | 0.0054 | 0.1447 | 0.1331 | 527.7577 | 0.1707 | 0.37 |
| Skid Steer Loaders >51 and <120 | 2020 | 51 | 120 | 0.224183 | 0.1884 | 3.2771 | 2.5046 | 0.0049 | 0.1084 | 0.0997 | 471.9075 | 0.1526 | 0.37 |

| Equipment Type | Year | Low HP | High HP | TOG (g/bhp-hr) | ROG (g/bhp-hr) | CO (g/bhp-hr) | NOX (g/bhp-hr) | SO2 (g/bhp-hr) | PM10 (g/bhp-hr) | PM2.5 (g/bhp-hr) | CO2 (g/bhp-hr) | CH4 (g/bhp-hr) | Load Factor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Emission Factors - OFFROAD | | | | | | | | | | | | | |
| Surfacing Equipment | 2020 | 26 | 50 | 0.637406 | 0.5356 | 3.93357 | 4.23906 | 0.0055 | 0.2164 | 0.1991 | 535.5275 | 0.1732 | 0.3 |
| Surfacing Equipment | 2020 | 51 | 120 | 0.392345 | 0.3297 | 3.43932 | 3.61216 | 0.0049 | 0.2063 | 0.1898 | 473.8188 | 0.1532 | 0.3 |
| Surfacing Equipment | 2020 | 121 | 175 | 0.365927 | 0.3075 | 2.93068 | 3.67232 | 0.0048 | 0.1745 | 0.1606 | 469.2079 | 0.1518 | 0.3 |
| Surfacing Equipment | 2020 | 176 | 250 | 0.252128 | 0.2119 | 1.21774 | 3.22243 | 0.0049 | 0.0972 | 0.0894 | 476.4261 | 0.1541 | 0.3 |
| Surfacing Equipment | 2020 | 251 | 500 | 0.173203 | 0.1455 | 1.21902 | 1.83755 | 0.0049 | 0.0669 | 0.0615 | 471.6331 | 0.1525 | 0.3 |
| Surfacing Equipment | 2020 | 501 | 750 | 0.168871 | 0.1419 | 0.99569 | 2.09374 | 0.0049 | 0.0744 | 0.0684 | 469.6252 | 0.1519 | 0.3 |
| Sweepers/Scrubbers | 2020 | 6 | 15 | 1.599203 | 1.3438 | 6.1554 | 5.09515 | 0.0054 | 0.4629 | 0.4259 | 525.3284 | 0.1699 | 0.46 |
| Sweepers/Scrubbers | 2020 | 16 | 25 | 1.599203 | 1.3438 | 6.1554 | 5.09515 | 0.0054 | 0.4629 | 0.4259 | 525.3284 | 0.1699 | 0.46 |
| Sweepers/Scrubbers | 2020 | 26 | 50 | 1.599203 | 1.3438 | 6.1554 | 5.09515 | 0.0054 | 0.4629 | 0.4259 | 525.3284 | 0.1699 | 0.46 |
| Sweepers/Scrubbers | 2020 | 51 | 120 | 0.618762 | 0.5199 | 3.82752 | 4.4821 | 0.0049 | 0.3601 | 0.3313 | 474.1157 | 0.1533 | 0.46 |
| Sweepers/Scrubbers | 2020 | 121 | 175 | 0.549287 | 0.4616 | 3.35909 | 4.60809 | 0.0049 | 0.2371 | 0.2181 | 473.1221 | 0.153 | 0.46 |
| Sweepers/Scrubbers | 2020 | 176 | 250 | 0.246498 | 0.2071 | 1.13655 | 2.4856 | 0.0049 | 0.079 | 0.0727 | 470.1263 | 0.152 | 0.46 |
| Tractors/Loaders/Backhoes | 2020 | 16 | 25 | 0.987255 | 0.8296 | 5.03491 | 4.39784 | 0.0053 | 0.2878 | 0.2648 | 515.874 | 0.1668 | 0.37 |
| Tractors/Loaders/Backhoes | 2020 | 26 | 50 | 0.987255 | 0.8296 | 5.03491 | 4.39784 | 0.0053 | 0.2878 | 0.2648 | 515.874 | 0.1668 | 0.37 |
| Tractors/Loaders/Backhoes >51 and <120 | 2020 | 51 | 120 | 0.393883 | 0.331 | 3.60147 | 3.32571 | 0.0049 | 0.2103 | 0.1935 | 475.1543 | 0.1537 | 0.37 |
| Tractors/Loaders/Backhoes >121 and <175 | 2020 | 121 | 175 | 0.29217 | 0.2455 | 3.10518 | 2.41467 | 0.0048 | 0.1217 | 0.1119 | 467.5132 | 0.1512 | 0.37 |
| Tractors/Loaders/Backhoes >176 and <250 | 2020 | 176 | 250 | 0.268036 | 0.2252 | 1.19592 | 2.73794 | 0.0049 | 0.0898 | 0.0826 | 470.4998 | 0.1522 | 0.37 |
| Tractors/Loaders/Backhoes | 2020 | 251 | 500 | 0.230511 | 0.1937 | 1.35815 | 2.07976 | 0.0048 | 0.073 | 0.0672 | 468.2447 | 0.1514 | 0.37 |
| Tractors/Loaders/Backhoes | 2020 | 501 | 750 | 0.318709 | 0.2678 | 1.60984 | 3.11926 | 0.0048 | 0.1174 | 0.108 | 468.6602 | 0.1516 | 0.37 |
| Trenchers | 2020 | 6 | 15 | 1.076913 | 0.9049 | 4.8331 | 4.67651 | 0.0054 | 0.3561 | 0.3276 | 527.0962 | 0.1705 | 0.5 |
| Trenchers | 2020 | 16 | 25 | 1.076913 | 0.9049 | 4.8331 | 4.67651 | 0.0054 | 0.3561 | 0.3276 | 527.0962 | 0.1705 | 0.5 |
| Trenchers >26 and <50 | 2020 | 26 | 50 | 1.076913 | 0.9049 | 4.8331 | 4.67651 | 0.0054 | 0.3561 | 0.3276 | 527.0962 | 0.1705 | 0.5 |
| Trenchers >51 and <120 | 2020 | 51 | 120 | 0.726229 | 0.6102 | 3.83272 | 5.51952 | 0.0049 | 0.4132 | 0.3802 | 475.1265 | 0.1537 | 0.5 |
| Trenchers | 2020 | 121 | 175 | 0.500709 | 0.4207 | 3.32968 | 4.46042 | 0.0048 | 0.2281 | 0.2098 | 467.7348 | 0.1513 | 0.5 |
| Trenchers | 2020 | 176 | 250 | 0.466499 | 0.392 | 1.77405 | 4.8091 | 0.0049 | 0.1949 | 0.1793 | 473.5951 | 0.1532 | 0.5 |
| Trenchers | 2020 | 251 | 500 | 0.276702 | 0.2325 | 1.85932 | 2.775 | 0.0049 | 0.1052 | 0.0968 | 470.6367 | 0.1522 | 0.5 |
| Trenchers | 2020 | 501 | 750 | 0.083454 | 0.0701 | 0.95004 | 0.56006 | 0.0049 | 0.009 | 0.0083 | 472.6556 | 0.1529 | 0.5 |
| Welders | 2020 | 6 | 15 | 1.835 | 0.731 | 3.546 | 4.542 | 0.008 | 0.227 | 0.227 | 568.299 | 0.066 | 0.45 |
| Welders | 2020 | 16 | 25 | 3.507 | 0.769 | 2.473 | 4.538 | 0.007 | 0.212 | 0.212 | 568.299 | 0.069 | 0.45 |
| Welders >26 and <50 | 2020 | 26 | 50 | 9.83 | 0.937 | 4.84 | 4.304 | 0.007 | 0.238 | 0.238 | 568.299 | 0.084 | 0.45 |
| Welders | 2020 | 51 | 120 | 7.278 | 0.455 | 3.605 | 3.351 | 0.006 | 0.216 | 0.216 | 568.299 | 0.041 | 0.45 |
| Welders | 2020 | 121 | 175 | 13.663 | 0.344 | 3.122 | 2.523 | 0.006 | 0.127 | 0.127 | 568.299 | 0.031 | 0.45 |
| Welders | 2020 | 176 | 250 | 12.577 | 0.261 | 1.093 | 2.143 | 0.006 | 0.066 | 0.066 | 568.299 | 0.023 | 0.45 |
| Welders | 2020 | 251 | 500 | 17.094 | 0.252 | 1.055 | 1.91 | 0.005 | 0.064 | 0.064 | 568.299 | 0.022 | 0.45 |

Emission Factors - OFFROAD T4

| Equipment Type | Year | Low HP | High HP | TOG (g/bhp-hr) | ROG (g/bhp-hr) | CO (g/bhp-hr) | NOX (g/bhp-hr) | SO2 (g/bhp-hr) | PM10 (g/bhp-hr) | PM2.5 (g/bhp-hr) | CO2 (g/bhp-hr) | CH4 (g/bhp-hr) | Load Factor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aerial Lifts | 2020 | 6 | 15 | | | | | | | | | | |
| Aerial Lifts | 2020 | 16 | 25 | | | | | | | | | | |
| Aerial Lifts | 2020 | 26 | 50 | 0.199447 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 525.0743 | 0.1698 | 0.31 |
| Aerial Lifts >51 and <120 | 2020 | 51 | 120 | 0.136778 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 472.1142 | 0.1527 | 0.31 |
| Aerial Lifts | 2020 | 251 | 500 | 0.081859 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.0545 | 0.1527 | 0.31 |
| Aerial Lifts | 2020 | 501 | 750 | 26.846 | 0.06 | 2.2 | 0.26 | 0.005 | 0.008 | 0.008 | 568.299 | 0.018 | 0.31 |
| Air Compressors | 2020 | 6 | 15 | | | | | | | | | | |
| Air Compressors | 2020 | 16 | 25 | | | | | | | | | | |
| Air Compressors >26 and <50 | 2020 | 26 | 50 | 8.048 | 0.12 | 4.1 | 2.75 | 0.007 | 0.008 | 0.008 | 568.299 | 0.09 | 0.48 |
| Air Compressors | 2020 | 51 | 120 | 8.287 | 0.12 | 3.7 | 2.74 | 0.006 | 0.008 | 0.008 | 568.299 | 0.044 | 0.48 |
| Air Compressors | 2020 | 121 | 175 | 11.957 | 0.06 | 3.7 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.033 | 0.48 |
| Air Compressors | 2020 | 176 | 250 | 13.668 | 0.06 | 2.2 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.026 | 0.48 |
| Air Compressors | 2020 | 251 | 500 | 23.406 | 0.06 | 2.2 | 0.26 | 0.005 | 0.008 | 0.008 | 568.299 | 0.025 | 0.48 |
| Air Compressors | 2020 | 501 | 750 | 36.303 | 0.06 | 2.2 | 0.26 | 0.005 | 0.008 | 0.008 | 568.299 | 0.025 | 0.48 |
| Air Compressors | 2020 | 751 | 1000 | 53.87 | 0.06 | 2.6 | 2.24 | 0.005 | 0.016 | 0.016 | 568.3 | 0.027 | 0.48 |
| Bore/Drill Rigs | 2020 | 6 | 15 | | | | | | | | | | |
| Bore/Drill Rigs | 2020 | 16 | 25 | | | | | | | | | | |
| Bore/Drill Rigs | 2020 | 26 | 50 | 0.851825 | 0.12 | 4.1 | 2.75 | 0.0055 | 0.008 | 0.008 | 535.2948 | 0.1731 | 0.5 |
| Bore/Drill Rigs | 2020 | 51 | 120 | 0.292949 | 0.12 | 3.7 | 2.74 | 0.0048 | 0.008 | 0.008 | 463.5827 | 0.1499 | 0.5 |
| Bore/Drill Rigs >121 and <175 | 2020 | 121 | 175 | 0.207426 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 477.722 | 0.1545 | 0.5 |
| Bore/Drill Rigs >176 and <250 | 2020 | 176 | 250 | 0.169462 | 0.06 | 2.2 | 0.26 | 0.0048 | 0.008 | 0.008 | 466.8342 | 0.151 | 0.5 |
| Bore/Drill Rigs | 2020 | 251 | 500 | 0.148188 | 0.06 | 2.2 | 0.26 | 0.0048 | 0.008 | 0.008 | 466.8219 | 0.151 | 0.5 |
| Bore/Drill Rigs | 2020 | 501 | 750 | 0.129293 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 473.6679 | 0.1532 | 0.5 |
| Bore/Drill Rigs | 2020 | 751 | 1000 | 0.158163 | 0.06 | 2.6 | 2.24 | 0.0049 | 0.016 | 0.016 | 471.8492 | 0.1526 | 0.5 |
| Cement and Mortar Mixers | 2020 | 6 | 15 | | | | | | | | | | |
| Cement and Mortar Mixers | 2020 | 16 | 25 | | | | | | | | | | |
| Concrete/Industrial Saws | 2020 | 16 | 25 | | | | | | | | | | |
| Concrete/Industrial Saws >26 and <50 | 2020 | 26 | 50 | 3.271 | 0.12 | 4.1 | 2.75 | 0.007 | 0.008 | 0.008 | 568.299 | 0.072 | 0.73 |
| Concrete/Industrial Saws | 2020 | 51 | 120 | 4.042 | 0.12 | 3.7 | 2.74 | 0.006 | 0.008 | 0.008 | 568.299 | 0.036 | 0.73 |
| Concrete/Industrial Saws | 2020 | 121 | 175 | 6.669 | 0.06 | 3.7 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.027 | 0.73 |
| Cranes | 2020 | 26 | 50 | 2.47956 | 0.12 | 4.1 | 2.75 | 0.0053 | 0.008 | 0.008 | 517.9263 | 0.1675 | 0.29 |
| Cranes | 2020 | 51 | 120 | 0.871016 | 0.12 | 3.7 | 2.74 | 0.0048 | 0.008 | 0.008 | 469.8821 | 0.152 | 0.29 |
| Cranes | 2020 | 121 | 175 | 0.638941 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 474.5939 | 0.1535 | 0.29 |
| Cranes >176 and <250 | 2020 | 176 | 250 | 0.45669 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.9488 | 0.153 | 0.29 |
| Cranes >251 and <500 | 2020 | 251 | 500 | 0.381547 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.5579 | 0.1528 | 0.29 |
| Cranes | 2020 | 501 | 750 | 0.287724 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 470.4254 | 0.1521 | 0.29 |
| Cranes | 2020 | 1001 | 9999 | 0.216797 | 0.06 | 2.6 | 2.24 | 0.0049 | 0.016 | 0.016 | 472.0545 | 0.1527 | 0.29 |
| Crawler Tractors | 2020 | 26 | 50 | 2.443056 | 0.12 | 4.1 | 2.75 | 0.0053 | 0.008 | 0.008 | 515.679 | 0.1668 | 0.43 |
| Crawler Tractors | 2020 | 51 | 120 | 0.850709 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 476.3284 | 0.1541 | 0.43 |
| Crawler Tractors >121 and <175 | 2020 | 121 | 175 | 0.566576 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 471.015 | 0.1523 | 0.43 |
| Crawler Tractors | 2020 | 176 | 250 | 0.428471 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.941 | 0.153 | 0.43 |
| Crawler Tractors | 2020 | 251 | 500 | 0.358593 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 475.2338 | 0.1537 | 0.43 |
| Crawler Tractors | 2020 | 501 | 750 | 0.304872 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 473.3119 | 0.1531 | 0.43 |
| Crawler Tractors | 2020 | 751 | 1000 | 0.551035 | 0.06 | 2.6 | 2.24 | 0.0049 | 0.016 | 0.016 | 475.6525 | 0.1538 | 0.43 |
| Crushing/Proc. Equipment | 2020 | 26 | 50 | 2.489 | 0.12 | 4.1 | 2.75 | 0.007 | 0.008 | 0.008 | 568.299 | 0.085 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 51 | 120 | 2.348 | 0.12 | 3.7 | 2.74 | 0.006 | 0.008 | 0.008 | 568.299 | 0.042 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 121 | 175 | 3.673 | 0.06 | 3.7 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.033 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 176 | 250 | 4.222 | 0.06 | 2.2 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.026 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 251 | 500 | 6.283 | 0.06 | 2.2 | 0.26 | 0.005 | 0.008 | 0.008 | 568.299 | 0.025 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 501 | 750 | 9.884 | 0.06 | 2.2 | 0.26 | 0.005 | 0.008 | 0.008 | 568.299 | 0.025 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 1001 | 9999 | 25.755 | 0.06 | 2.6 | 2.24 | 0.005 | 0.016 | 0.016 | 568.299 | 0.029 | 0.78 |
| Dumpers/Tenders | 2020 | 16 | 25 | | | | | | | | | | |
| Excavators | 2020 | 16 | 25 | | | | | | | | | | |
| Excavators >26 and <50 | 2020 | 26 | 50 | 0.705964 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 525.3675 | 0.1699 | 0.38 |
| Excavators >51 and <120 | 2020 | 51 | 120 | 0.356064 | 0.12 | 3.7 | 2.74 | 0.0048 | 0.008 | 0.008 | 468.0546 | 0.1514 | 0.38 |
| Excavators | 2020 | 121 | 175 | 0.275327 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.2891 | 0.1527 | 0.38 |
| Excavators | 2020 | 176 | 250 | 0.211076 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 471.8828 | 0.1526 | 0.38 |
| Excavators >251 and <500 | 2020 | 251 | 500 | 0.182542 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 470.2956 | 0.1521 | 0.38 |
| Excavators | 2020 | 501 | 750 | 0.202011 | 0.06 | 2.2 | 0.26 | 0.0048 | 0.008 | 0.008 | 468.8706 | 0.1516 | 0.38 |

Emission Factors - OFFROAD T4

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Forklifts | 2020 | 26 | 50 | 1.337399 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 525.4833 | 0.17 | 0.2 |
| Forklifts >51 and <120 | 2020 | 51 | 120 | 0.545921 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 471.5285 | 0.1525 | 0.2 |
| Forklifts | 2020 | 121 | 175 | 0.402357 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.1062 | 0.1527 | 0.2 |
| Forklifts | 2020 | 176 | 250 | 0.348476 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 473.3255 | 0.1531 | 0.2 |
| Forklifts | 2020 | 251 | 500 | 0.299035 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 473.6151 | 0.1532 | 0.2 |
| Generator Sets | 2020 | 6 | 15 | | | | | | | | | | |
| Generator Sets | 2020 | 16 | 25 | | | | | | | | | | |
| Generator Sets >26 and <50 | 2020 | 26 | 50 | 5.508 | 0.12 | 4.1 | 2.75 | 0.007 | 0.008 | 0.008 | 568.299 | 0.062 | 0.74 |
| Generator Sets >51 and <120 | 2020 | 51 | 120 | 7.383 | 0.12 | 3.7 | 2.74 | 0.006 | 0.008 | 0.008 | 568.299 | 0.032 | 0.74 |
| Generator Sets | 2020 | 121 | 175 | 9.884 | 0.06 | 3.7 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.024 | 0.74 |
| Generator Sets | 2020 | 176 | 250 | 10.963 | 0.06 | 2.2 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.017 | 0.74 |
| Generator Sets | 2020 | 251 | 500 | 16.528 | 0.06 | 2.2 | 0.26 | 0.005 | 0.008 | 0.008 | 568.299 | 0.017 | 0.74 |
| Generator Sets | 2020 | 501 | 750 | 27.045 | 0.06 | 2.2 | 0.26 | 0.005 | 0.008 | 0.008 | 568.299 | 0.017 | 0.74 |
| Generator Sets | 2020 | 1001 | 9999 | 66.08 | 0.06 | 2.6 | 2.24 | 0.005 | 0.016 | 0.016 | 568.3 | 0.021 | 0.74 |
| Graders | 2020 | 26 | 50 | 2.994737 | 0.12 | 4.1 | 2.75 | 0.005 | 0.008 | 0.008 | 492.8615 | 0.1594 | 0.41 |
| Graders >51 and <120 | 2020 | 51 | 120 | 1.161574 | 0.12 | 3.7 | 2.74 | 0.0048 | 0.008 | 0.008 | 469.3371 | 0.1518 | 0.41 |
| Graders >121 and <175 | 2020 | 121 | 175 | 0.674427 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 478.0403 | 0.1546 | 0.41 |
| Graders >176 and <250 | 2020 | 176 | 250 | 0.41877 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 475.3037 | 0.1537 | 0.41 |
| Graders | 2020 | 251 | 500 | 0.383198 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 471.9795 | 0.1526 | 0.41 |
| Graders | 2020 | 501 | 750 | 12.961 | 0.06 | 2.2 | 0.26 | 0.005 | 0.008 | 0.008 | 568.299 | 0.028 | 0.41 |
| Off-Highway Tractors | 2020 | 51 | 120 | 0.533073 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 474.1481 | 0.1533 | 0.44 |
| Off-Highway Tractors | 2020 | 121 | 175 | 0.322507 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.9169 | 0.153 | 0.44 |
| Off-Highway Tractors | 2020 | 176 | 250 | 0.263453 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 470.943 | 0.1523 | 0.44 |
| Off-Highway Tractors >501 and <750 | 2020 | 501 | 750 | 0.239679 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 471.8151 | 0.1526 | 0.44 |
| Off-Highway Tractors | 2020 | 751 | 1000 | 0.178457 | 0.06 | 2.6 | 2.24 | 0.0049 | 0.016 | 0.016 | 472.0545 | 0.1527 | 0.44 |
| Off-Highway Trucks | 2020 | 121 | 175 | 0.36879 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 470.0967 | 0.152 | 0.38 |
| Off-Highway Trucks >176 and <250 | 2020 | 176 | 250 | 0.327003 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 470.1675 | 0.1521 | 0.38 |
| Off-Highway Trucks >251 and <500 | 2020 | 251 | 500 | 0.292906 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 474.5787 | 0.1535 | 0.38 |
| Off-Highway Trucks | 2020 | 501 | 750 | 0.371665 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.7499 | 0.1529 | 0.38 |
| Off-Highway Trucks | 2020 | 751 | 1000 | 0.360605 | 0.06 | 2.6 | 2.24 | 0.0049 | 0.016 | 0.016 | 469.8892 | 0.152 | 0.38 |
| Other Construction Equipment | 2020 | 6 | 15 | | | | | | | | | | |
| Other Construction Equipment >16 and <25 | 2020 | 16 | 25 | | | | | | | | | | |
| Other Construction Equipment >26 and <50 | 2020 | 26 | 50 | 1.276029 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 527.9656 | 0.1708 | 0.42 |
| Other Construction Equipment >51 and <12 | 2020 | 51 | 120 | 0.617777 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 472.2162 | 0.1527 | 0.42 |
| Other Construction Equipment >121 and <1 | 2020 | 121 | 175 | 0.461441 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 469.9837 | 0.152 | 0.42 |
| Other Construction Equipment >251 and <5 | 2020 | 251 | 500 | 0.266788 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 475.2326 | 0.1537 | 0.42 |
| Other General Industrial Equipment | 2020 | 6 | 15 | | | | | | | | | | |
| Other General Industrial Equipment | 2020 | 16 | 25 | | | | | | | | | | |
| Other General Industrial Equipment | 2020 | 26 | 50 | 1.125869 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 526.1761 | 0.1702 | 0.34 |
| Other General Industrial Equipment | 2020 | 51 | 120 | 0.53075 | 0.12 | 3.7 | 2.74 | 0.0048 | 0.008 | 0.008 | 469.9998 | 0.152 | 0.34 |
| Other General Industrial Equipment | 2020 | 121 | 175 | 0.319281 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 471.8502 | 0.1526 | 0.34 |
| Other General Industrial Equipment | 2020 | 176 | 250 | 0.281815 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 473.2231 | 0.153 | 0.34 |
| Other General Industrial Equipment | 2020 | 251 | 500 | 0.247036 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.929 | 0.153 | 0.34 |
| Other General Industrial Equipment | 2020 | 501 | 750 | 0.207847 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 473.4638 | 0.1531 | 0.34 |
| Other General Industrial Equipment | 2020 | 751 | 1000 | 0.322174 | 0.06 | 2.6 | 2.24 | 0.0049 | 0.016 | 0.016 | 472.0545 | 0.1527 | 0.34 |
| Other Material Handling Equipment | 2020 | 26 | 50 | 1.481858 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 523.7088 | 0.1694 | 0.4 |
| Other Material Handling Equipment | 2020 | 51 | 120 | 0.36479 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 473.5884 | 0.1532 | 0.4 |
| Other Material Handling Equipment | 2020 | 121 | 175 | 0.299922 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.2193 | 0.1527 | 0.4 |
| Other Material Handling Equipment | 2020 | 176 | 250 | 0.346024 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 471.482 | 0.1525 | 0.4 |
| Other Material Handling Equipment | 2020 | 251 | 500 | 0.336187 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 470.2972 | 0.1521 | 0.4 |
| Other Material Handling Equipment | 2020 | 1001 | 9999 | 0.238473 | 0.06 | 2.6 | 2.24 | 0.0049 | 0.016 | 0.016 | 472.0545 | 0.1527 | 0.4 |
| Pavers | 2020 | 16 | 25 | | | | | | | | | | |
| Pavers | 2020 | 26 | 50 | 1.568718 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 526.2098 | 0.1702 | 0.42 |
| Pavers | 2020 | 51 | 120 | 0.558949 | 0.12 | 3.7 | 2.74 | 0.0048 | 0.008 | 0.008 | 469.8815 | 0.152 | 0.42 |
| Pavers | 2020 | 121 | 175 | 0.324615 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.7746 | 0.1529 | 0.42 |
| Pavers | 2020 | 176 | 250 | 0.209036 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.8337 | 0.1529 | 0.42 |
| Pavers | 2020 | 251 | 500 | 0.195949 | 0.06 | 2.2 | 0.26 | 0.0048 | 0.008 | 0.008 | 466.2059 | 0.1508 | 0.42 |

Emission Factors - OFFROAD T4

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Paving Equipment | 2020 | 16 | 25 | | | | | | | | | | |
| Paving Equipment | 2020 | 26 | 50 | 0.73951 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 520.1235 | 0.1682 | 0.36 |
| Paving Equipment | 2020 | 51 | 120 | 0.472907 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 473.3249 | 0.1531 | 0.36 |
| Paving Equipment >121 and <175 | 2020 | 121 | 175 | 0.294586 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 470.7359 | 0.1522 | 0.36 |
| Paving Equipment >176 and <250 | 2020 | 176 | 250 | 0.289784 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.1514 | 0.1527 | 0.36 |
| Plate Compactors | 2020 | 6 | 15 | | | | | | | | | | |
| Pressure Washers | 2020 | 6 | 15 | | | | | | | | | | |
| Pressure Washers | 2020 | 16 | 25 | | | | | | | | | | |
| Pressure Washers | 2020 | 26 | 50 | 4.025 | 0.12 | 4.1 | 2.75 | 0.007 | 0.008 | 0.008 | 568.299 | 0.045 | 0.3 |
| Pressure Washers | 2020 | 51 | 120 | 4.048 | 0.12 | 3.7 | 2.74 | 0.006 | 0.008 | 0.008 | 568.299 | 0.026 | 0.3 |
| Pressure Washers | 2020 | 121 | 175 | 16.638 | 0.06 | 3.7 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.023 | 0.3 |
| Pressure Washers | 2020 | 176 | 250 | 8.005 | 0.06 | 2.2 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.008 | 0.3 |
| Pumps | 2020 | 6 | 15 | | | | | | | | | | |
| Pumps | 2020 | 16 | 25 | | | | | | | | | | |
| Pumps >26 and <50 | 2020 | 26 | 50 | 7.613 | 0.12 | 4.1 | 2.75 | 0.007 | 0.008 | 0.008 | 568.299 | 0.068 | 0.74 |
| Pumps | 2020 | 51 | 120 | 8.832 | 0.12 | 3.7 | 2.74 | 0.006 | 0.008 | 0.008 | 568.299 | 0.034 | 0.74 |
| Pumps | 2020 | 121 | 175 | 11.744 | 0.06 | 3.7 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.025 | 0.74 |
| Pumps | 2020 | 176 | 250 | 12.575 | 0.06 | 2.2 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.019 | 0.74 |
| Pumps >251 and <500 | 2020 | 251 | 500 | 20.565 | 0.06 | 2.2 | 0.26 | 0.005 | 0.008 | 0.008 | 568.3 | 0.018 | 0.74 |
| Pumps | 2020 | 501 | 750 | 34.373 | 0.06 | 2.2 | 0.26 | 0.005 | 0.008 | 0.008 | 568.299 | 0.018 | 0.74 |
| Pumps | 2020 | 1001 | 9999 | 101.462 | 0.06 | 2.6 | 2.24 | 0.005 | 0.016 | 0.016 | 568.3 | 0.023 | 0.74 |
| Rollers | 2020 | 6 | 15 | | | | | | | | | | |
| Rollers | 2020 | 16 | 25 | | | | | | | | | | |
| Rollers | 2020 | 26 | 50 | 1.102095 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 525.8798 | 0.1701 | 0.38 |
| Rollers >51 and <120 | 2020 | 51 | 120 | 0.462004 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 473.8594 | 0.1533 | 0.38 |
| Rollers >121 and <175 | 2020 | 121 | 175 | 0.256128 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 471.9177 | 0.1526 | 0.38 |
| Rollers >176 and <250 | 2020 | 176 | 250 | 0.248138 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 473.3669 | 0.1531 | 0.38 |
| Rollers | 2020 | 251 | 500 | 0.279691 | 0.06 | 2.2 | 0.26 | 0.005 | 0.008 | 0.008 | 479.3254 | 0.155 | 0.38 |
| Rough Terrain Forklifts | 2020 | 26 | 50 | 1.188595 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 525.6222 | 0.17 | 0.4 |
| Rough Terrain Forklifts >51 and <120 | 2020 | 51 | 120 | 0.225188 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 472.9842 | 0.153 | 0.4 |
| Rough Terrain Forklifts | 2020 | 121 | 175 | 0.170092 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 471.7152 | 0.1526 | 0.4 |
| Rough Terrain Forklifts | 2020 | 176 | 250 | 0.132727 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.5671 | 0.1528 | 0.4 |
| Rough Terrain Forklifts | 2020 | 251 | 500 | 0.105484 | 0.06 | 2.2 | 0.26 | 0.0048 | 0.008 | 0.008 | 465.7709 | 0.1506 | 0.4 |
| Rubber Tired Dozers > 121 and <175 | 2020 | 121 | 175 | 0.864425 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 473.0116 | 0.153 | 0.4 |
| Rubber Tired Dozers > 176 and <250 | 2020 | 176 | 250 | 0.737248 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 474.7928 | 0.1536 | 0.4 |
| Rubber Tired Dozers | 2020 | 251 | 500 | 0.636621 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 479.7569 | 0.1552 | 0.4 |
| Rubber Tired Dozers | 2020 | 501 | 750 | 0.543245 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 473.0562 | 0.153 | 0.4 |
| Rubber Tired Dozers | 2020 | 751 | 1000 | 7.811 | 0.06 | 2.6 | 2.24 | 0.005 | 0.016 | 0.016 | 568.299 | 0.047 | 0.4 |
| Rubber Tired Loaders | 2020 | 16 | 25 | | | | | | | | | | |
| Rubber Tired Loaders | 2020 | 26 | 50 | 1.761913 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 524.6967 | 0.1697 | 0.36 |
| Rubber Tired Loaders | 2020 | 51 | 120 | 0.661113 | 0.12 | 3.7 | 2.74 | 0.0048 | 0.008 | 0.008 | 465.6735 | 0.1506 | 0.36 |
| Rubber Tired Loaders | 2020 | 121 | 175 | 0.450696 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 471.2135 | 0.1524 | 0.36 |
| Rubber Tired Loaders | 2020 | 176 | 250 | 0.345399 | 0.06 | 2.2 | 0.26 | 0.0048 | 0.008 | 0.008 | 469.5127 | 0.1518 | 0.36 |
| Rubber Tired Loaders | 2020 | 251 | 500 | 0.343959 | 0.06 | 2.2 | 0.26 | 0.0048 | 0.008 | 0.008 | 466.7831 | 0.151 | 0.36 |
| Rubber Tired Loaders | 2020 | 501 | 750 | 0.329462 | 0.06 | 2.2 | 0.26 | 0.0048 | 0.008 | 0.008 | 462.193 | 0.1495 | 0.36 |
| Rubber Tired Loaders | 2020 | 751 | 1000 | 0.370676 | 0.06 | 2.6 | 2.24 | 0.0049 | 0.016 | 0.016 | 469.9352 | 0.152 | 0.36 |
| Scrapers | 2020 | 51 | 120 | 0.834143 | 0.12 | 3.7 | 2.74 | 0.005 | 0.008 | 0.008 | 483.745 | 0.1565 | 0.48 |
| Scrapers | 2020 | 121 | 175 | 0.568453 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 478.6077 | 0.1548 | 0.48 |
| Scrapers | 2020 | 176 | 250 | 0.531032 | 0.06 | 2.2 | 0.26 | 0.0048 | 0.008 | 0.008 | 468.9883 | 0.1517 | 0.48 |
| Scrapers >251 and <500 | 2020 | 251 | 500 | 0.380326 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.1751 | 0.1527 | 0.48 |
| Scrapers | 2020 | 501 | 750 | 0.311991 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 471.7776 | 0.1526 | 0.48 |
| Signal Boards | 2020 | 6 | 15 | | | | | | | | | | |
| Signal Boards | 2020 | 26 | 50 | 7.28 | 0.12 | 4.1 | 2.75 | 0.007 | 0.008 | 0.008 | 568.299 | 0.071 | 0.82 |
| Signal Boards | 2020 | 51 | 120 | 8.081 | 0.12 | 3.7 | 2.74 | 0.006 | 0.008 | 0.008 | 568.299 | 0.035 | 0.82 |
| Signal Boards | 2020 | 121 | 175 | 11.756 | 0.06 | 3.7 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.026 | 0.82 |
| Signal Boards | 2020 | 176 | 250 | 14.813 | 0.06 | 2.2 | 0.26 | 0.007 | 0.008 | 0.008 | 686.695 | 0.024 | 0.82 |
| Skid Steer Loaders | 2020 | 16 | 25 | | | | | | | | | | |
| Skid Steer Loaders | 2020 | 26 | 50 | 0.522771 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 527.7577 | 0.1707 | 0.37 |
| Skid Steer Loaders >51 and <120 | 2020 | 51 | 120 | 0.224183 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 471.9075 | 0.1526 | 0.37 |

Emission Factors - OFFROAD T4

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Surfacing Equipment | 2020 | 26 | 50 | 0.637406 | 0.12 | 4.1 | 2.75 | 0.0055 | 0.008 | 0.008 | 535.5275 | 0.1732 | 0.3 |
| Surfacing Equipment | 2020 | 51 | 120 | 0.392345 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 473.8188 | 0.1532 | 0.3 |
| Surfacing Equipment | 2020 | 121 | 175 | 0.365927 | 0.06 | 3.7 | 0.26 | 0.0048 | 0.008 | 0.008 | 469.2079 | 0.1518 | 0.3 |
| Surfacing Equipment | 2020 | 176 | 250 | 0.252128 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 476.4261 | 0.1541 | 0.3 |
| Surfacing Equipment | 2020 | 251 | 500 | 0.173203 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 471.6331 | 0.1525 | 0.3 |
| Surfacing Equipment | 2020 | 501 | 750 | 0.168871 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 469.6252 | 0.1519 | 0.3 |
| Sweepers/Scrubbers | 2020 | 6 | 15 | | | | | | | | | | |
| Sweepers/Scrubbers | 2020 | 16 | 25 | | | | | | | | | | |
| Sweepers/Scrubbers | 2020 | 26 | 50 | 1.599203 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 525.3284 | 0.1699 | 0.46 |
| Sweepers/Scrubbers | 2020 | 51 | 120 | 0.618762 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 474.1157 | 0.1533 | 0.46 |
| Sweepers/Scrubbers | 2020 | 121 | 175 | 0.549287 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 473.1221 | 0.153 | 0.46 |
| Sweepers/Scrubbers | 2020 | 176 | 250 | 0.246498 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 470.1263 | 0.152 | 0.46 |
| Tractors/Loaders/Backhoes | 2020 | 16 | 25 | | | | | | | | | | |
| Tractors/Loaders/Backhoes | 2020 | 26 | 50 | 0.987255 | 0.12 | 4.1 | 2.75 | 0.0053 | 0.008 | 0.008 | 515.874 | 0.1668 | 0.37 |
| Tractors/Loaders/Backhoes >51 and <120 | 2020 | 51 | 120 | 0.393883 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 475.1543 | 0.1537 | 0.37 |
| Tractors/Loaders/Backhoes >121 and <175 | 2020 | 121 | 175 | 0.29217 | 0.06 | 3.7 | 0.26 | 0.0048 | 0.008 | 0.008 | 467.5132 | 0.1512 | 0.37 |
| Tractors/Loaders/Backhoes >176 and <250 | 2020 | 176 | 250 | 0.268036 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 470.4998 | 0.1522 | 0.37 |
| Tractors/Loaders/Backhoes | 2020 | 251 | 500 | 0.230511 | 0.06 | 2.2 | 0.26 | 0.0048 | 0.008 | 0.008 | 468.2447 | 0.1514 | 0.37 |
| Tractors/Loaders/Backhoes | 2020 | 501 | 750 | 0.318709 | 0.06 | 2.2 | 0.26 | 0.0048 | 0.008 | 0.008 | 468.6602 | 0.1516 | 0.37 |
| Trenchers | 2020 | 6 | 15 | | | | | | | | | | |
| Trenchers | 2020 | 16 | 25 | | | | | | | | | | |
| Trenchers >26 and <50 | 2020 | 26 | 50 | 1.076913 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 527.0962 | 0.1705 | 0.5 |
| Trenchers >51 and <120 | 2020 | 51 | 120 | 0.726229 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 475.1265 | 0.1537 | 0.5 |
| Trenchers | 2020 | 121 | 175 | 0.500709 | 0.06 | 3.7 | 0.26 | 0.0048 | 0.008 | 0.008 | 467.7348 | 0.1513 | 0.5 |
| Trenchers | 2020 | 176 | 250 | 0.466499 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 473.5951 | 0.1532 | 0.5 |
| Trenchers | 2020 | 251 | 500 | 0.276702 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 470.6367 | 0.1522 | 0.5 |
| Trenchers | 2020 | 501 | 750 | 0.083454 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.6556 | 0.1529 | 0.5 |
| Welders | 2020 | 6 | 15 | | | | | | | | | | |
| Welders | 2020 | 16 | 25 | | | | | | | | | | |
| Welders >26 and <50 | 2020 | 26 | 50 | 9.83 | 0.12 | 4.1 | 2.75 | 0.007 | 0.008 | 0.008 | 568.299 | 0.084 | 0.45 |
| Welders | 2020 | 51 | 120 | 7.278 | 0.12 | 3.7 | 2.74 | 0.006 | 0.008 | 0.008 | 568.299 | 0.041 | 0.45 |
| Welders | 2020 | 121 | 175 | 13.663 | 0.06 | 3.7 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.031 | 0.45 |
| Welders | 2020 | 176 | 250 | 12.577 | 0.06 | 2.2 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.023 | 0.45 |
| Welders | 2020 | 251 | 500 | 17.094 | 0.06 | 2.2 | 0.26 | 0.005 | 0.008 | 0.008 | 568.299 | 0.022 | 0.45 |

Tier 4 Emission Factors

| | Low HP | High HP | ROG (g/bhp-hr) | CO (g/bhp-hr) | NOX (g/bhp-hr) | PM10 (g/bhp-hr) | PM2.5 (g/bhp-hr) |
|---|---|---|---|---|---|---|---|
| Tier 4 | 25 | 49 | 0.12 | 4.1 | 2.75 | 0.008 | 0.008 |
| Tier 4 | 50 | 74 | 0.12 | 3.7 | 2.74 | 0.008 | 0.008 |
| Tier 4 | 75 | 119 | 0.06 | 3.7 | 0.26 | 0.008 | 0.008 |
| Tier 4 | 120 | 174 | 0.06 | 3.7 | 0.26 | 0.008 | 0.008 |
| Tier 4 | 175 | 299 | 0.06 | 2.2 | 0.26 | 0.008 | 0.008 |
| Tier 4 | 300 | 599 | 0.06 | 2.2 | 0.26 | 0.008 | 0.008 |
| Tier 4 | 600 | 750 | 0.06 | 2.2 | 0.26 | 0.008 | 0.008 |
| Tier 4 | 751 | 2000 | 0.06 | 2.6 | 2.24 | 0.016 | 0.016 |

Equipment Load Factors

| Equipment Type | HP | Load Factor |
|---|---|---|
| Aerial Lifts | 63 | 0.31 |
| Air Compressors | 78 | 0.48 |
| Bore/Drill Rigs | 206 | 0.5 |
| Cement and Mortar Mixers | 9 | 0.56 |
| Concrete/Industrial Saws | 81 | 0.73 |
| Cranes | 226 | 0.29 |
| Crawler Tractors | 208 | 0.43 |
| Crushing/Proc. Equipment | 85 | 0.78 |
| Dumpers/Tenders | 16 | 0.38 |
| Excavators | 163 | 0.38 |
| Forklifts | 89 | 0.2 |
| Generator Sets | 84 | 0.74 |
| Graders | 175 | 0.41 |
| Off-Highway Tractors | 123 | 0.44 |
| Off-Highway Trucks | 400 | 0.38 |
| Other Construction Equipment | 172 | 0.42 |
| Other General Industrial Equipment | 88 | 0.34 |
| Other Material Handling Equipment | 167 | 0.4 |
| Pavers | 126 | 0.42 |
| Paving Equipment | 131 | 0.36 |
| Plate Compactors | 8 | 0.43 |
| Pressure Washers | 13 | 0.3 |
| Pumps | 84 | 0.74 |
| Rollers | 81 | 0.38 |
| Rough Terrain Forklifts | 100 | 0.4 |
| Rubber Tired Dozers | 255 | 0.4 |
| Rubber Tired Loaders | 200 | 0.36 |
| Scrapers | 362 | 0.48 |
| Signal Boards | 6 | 0.82 |
| Skid Steer Loaders | 65 | 0.37 |
| Surfacing Equipment | 254 | 0.3 |
| Sweepers/Scrubbers | 64 | 0.46 |
| Tractors/Loaders/Backhoes | 98 | 0.37 |
| Trenchers | 81 | 0.5 |
| Welders | 46 | 0.45 |

**Riverside County 2020 On-Road Emission Factors**

| VEH | FUEL | MDLYR | SPEED (Miles/hr) | POP (Vehicles) | VMT (Miles/day) | Percent VMT | TRIPS (Trips/day) | ROG_RUNEX (gms/mile) | CO_RUNEX (gms/mile) | NOX_RUNEX (gms/mile) | CO2_RUNEX (gms/mile) | PM10_Total (gms/mile) | PM2_5_Total (gms/mile) | CH4 (gms/mile) | N2O (gms/mile) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LDA | GAS | Aggregate | Aggregated | 6,241,441 | 216,000,000 | 67.95% | 39386956 | 0.011542713 | 0.641422526 | 0.055808459 | 274.0485814 | 0.04635407 | 0.019224949 | | |
| LDA | DSL | Aggregate | Aggregated | 58578.66528 | 2,170,199 | 0.68% | 364867 | 0.017077737 | 0.200965153 | 0.09501238 | 253.3966805 | 0.05480289 | 0.027367998 | | |
| LDT1 | GAS | Aggregate | Aggregated | 529468.9231 | 17,839,922 | 5.61% | 3216559 | 0.033208307 | 1.618669814 | 0.16094723 | 325.2843956 | 0.04735163 | 0.02014254 | | |
| LDT1 | DSL | Aggregate | Aggregated | 653.8523923 | 17,425 | 0.01% | 3379 | 0.144078437 | 0.907672212 | 0.859573101 | 342.1599989 | 0.15326639 | 0.121572011 | | |
| LDT2 | GAS | Aggregate | Aggregated | 2196840.435 | 81,691,951 | 25.70% | 13902518 | 0.015193731 | 0.816411177 | 0.086826897 | 366.6776059 | 0.04634722 | 0.019218653 | | |
| LDT2 | DSL | Aggregate | Aggregated | 3707.582469 | 150,823 | 0.05% | 23906 | 0.012822324 | 0.108536551 | 0.040662475 | 326.8633798 | 0.04952924 | 0.022322487 | | |
| Total | | | | 9,030,690 | 317,870,319 | | 56,898,185 | | | | | | | | |
| Average | | | | | | | | 0.014 | 0.738 | 0.070 | 300.617 | 0.046 | 0.019 | 0.028 | 0.037 |

Source: EMFAC 2014

| VEH | FUEL | MDLYR | SPEED (Miles/hr) | POP (Vehicles) | VMT (Miles/day) | TRIPS (Trips/day) | ROG_RUNEX (gms/mile) | CO_RUNEX (gms/mile) | NOX_RUNEX (gms/mile) | CO2_RUNEX (gms/mile) | PM10_Total (gms/mile) | PM2_5_Total (gms/mile) | CH4 (gms/mile) | N2O (gms/mile) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T7 tractor | DSL | Aggregate | Aggregated | 19484 | 2584405 | 0 | 0.088157696 | 0.360400388 | 4.375857349 | 1489.472848 | 0.12016896 | 0.056918679 | 0.0051 | 0.0048 |

Source: EMFAC 2014

Crimson Solar

Operational Emissions Summary

| | Total Daily Emissions (pounds/day) | | | | | Total Annual Emissions (tons/year) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ROG | NOX | CO | PM10 | PM2.5 | ROG | NOX | CO | PM10 | PM2.5 |
| Operations and Maintenance Vehicles | 0.1 | 3.7 | 2.4 | 77.2 | 11.7 | 0.0 | 0.1 | 0.1 | 6.3 | 1.0 |
| Electricity | | | | | | | | | | |
| Water | | | | | | | | | | |
| Wastewater | | | | | | | | | | |
| Gas Insulated Switchgear | | | | | | | | | | |
| Total | 0.1 | 3.7 | 2.4 | 77.2 | 11.7 | 0.0 | 0.1 | 0.1 | 6.3 | 1.0 |

| Renewable Energy Carbon Savings | | | | | |
|---|---|---|---|---|---|
| 350 | MW Renewable Energy | 1,533,000 | MWh | 355,836 | MT CO2e |
| SCE 2015 Average GHG per Unit of Electricity Provided (MT $CO_2$e/MWh) | 0.23 | | | | |

Notes: Assumes 12 hrs/day, 365 days/year

Source: SCE 2015 Corporate Responsibility Report

Operational Fugitive Dust Emissions

| Daily On-Site Construction Motor Vehicle Fugitive Particulate Matter Emissions | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Uncontrolled Emission Factors (lb/mi)[b] | | Uncontrolled Emissions (lb/day)[c] | | | Controlled Emissions (lb/day)[f] | | Uncontrolled Emissions (tons/year) | |
| Vehicle Type | No. | Mi/Veh-Day[f] | Surface Type | Silt Loading ($g/m^2$)/ Silt Content (%)[a] | Vehicle Weight (tons) | PM10 | PM2.5 | PM10 | PM2.5 | Control Efficiency[d] | PM10 | PM2.5 | PM10 | PM2.5 |
| Pickup Trucks | 4 | 40 | Unpaved | 6 | 2.4 | 4.81E-01 | 7.27E-02 | 77.0 | 11.6 | 55% | 34.7 | 5.2 | 6.3 | 1.0 |

Note: Totals may not match sum of individual values because of rounding.

[a] Unpaved surface silt content from SCAQMD CEQA Handbook, (1993) Table A9-9-D-1 for city and county roads

[b] Equations:

EF (unpaved) = $k_u (s/12)^a (W/3)^b$ Ref: AP-42, Section 13.2.2, "Unpaved Rods," November 2006

Constants:

| | | |
|---|---|---|
| $k_u$ = | 1.5 | (Particle size multiplier for PM) |
| | 0.15 | (Particle size multiplier for PM2.5) |
| a = | 0.9 | for PM10 |
| | 0.9 | for PM2.5 |
| b = | 0.45 | for PM10 |
| | 0.45 | for PM2.5 |

[c] Uncontrolled emissions [lb/day] = Emission factor [lb/mi] x Number x Daily miles traveled [mi/vehicle-day]

[d] Control efficiency from watering unpaved road twice a day (55%) and limiting maximum speed to 25 mph (44%), from Table XI-A, Mitigation Measure Examples, Fugitive Dust from Construction & Demolition, http://www.aqmd.gov/ceqa/handbook/mitigation/fugitive/MM_fugitive.html

[e] Controlled emissions [lb/day] = Uncontrolled emissions [lb/day] x (1 - Control efficiency [%])

[f] Based on 1 mile roundtrip from Rios Ave to staging area

Operational Emissions

**On-Road Vehicle Trips**

| | | | | | | Emissions Summary (lbs/day) | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Daily Trips | Distance | Average Daily Mileage | Calculated Time - Rounded (days) | Total Mileage | VOC | $NO_x$ | CO | PM10 | PM2.5 | VOC | $NO_x$ | CO | PM10 | PM2.5 | $CO_2$ | $CH_4$ | Total GHG Emissions (MT CO2e) |
| Worker Trips | 50 | 13 | 1,300 | 78 | 101,400 | 0.04 | 0.20 | 2.11 | 0.13 | 0.06 | 0.00 | 0.01 | 0.08 | 0.01 | 0.00 | 33.53 | 0.00 | 30.51 |
| Water Delivery Trips | 14 | 13 | 364 | 75 | 27,300 | 0.07 | 3.50 | 0.29 | 0.10 | 0.05 | 0.00 | 0.13 | 0.01 | 0.00 | 0.00 | 44.73 | 0.00 | 40.71 |
| **Total** | | | | | | **0.11** | **3.70** | **2.40** | **0.23** | **0.10** | **0.00** | **0.14** | **0.09** | **0.01** | **0.00** | **78.26** | **0.00** | **71.22** |

Note:

Construction equipment included with appropriate construction phase

Material deliveries are constant regardless of Option A or Option B design selection.

# H.2 Reduced Acreage Alternative Air Quality Analysis and Results Memo, April 2019

AECOM Imagine it. Delivered.

AECOM
401 West A Street, Suite 1200
San Diego, CA 92101
aecom.com

**Project name:**
RE Crimson Solar Project

**To:**
Sonoran West Solar Holdings, LLC
Recurrent Energy LLC

**From:**
Paola Peña

**Date:**
April 3, 2019

# Memorandum

**Subject:** Reduced Acreage Alternative Air Quality Analysis and Results

AECOM has prepared this air quality technical memorandum for the RE Crimson Solar Project (Project) for the Reduced Acreage Alternative. The Reduced Acreage Alternative would result in a slight decrease in grading compared to the Proposed Project.

## Methodology

The Proposed Project has a permitted boundary of 2,465 acres and would require earthwork and material movement of approximately 191,000 cubic yards (CY) of soil. The Reduced Acreage Alternative would have a permitted boundary of 2,160 acres. Based on the percent reduction in acreage, it was assumed the Reduced Acreage Alternative would require earthwork and material movement of 167,316 CY. Since on-site cut-and-fill was assumed to be balanced, and construction equipment usage and material delivery trips are anticipated to remain the same as the Proposed Project, the Reduced Acreage Alternative primarily results in slight changes to the fugitive dust (particulate matter) emissions during construction. Particulate matter (PM) is subdivided into two classes based on particle size: PM equal to or less than 10 micrometers in diameter (PM10), and PM equal to or less than 2.5 micrometers in diameter (PM2.5).

### *Construction Impacts*

Table 1 shows the estimated daily and annual construction emissions for the Reduced Acreage Alternative. As shown in Table 1, and similar to the Proposed Project, unmitigated construction emissions for the Reduced Acreage Alternative would exceed the daily thresholds of significance for nitrogen oxides (NOX), PM10, and PM2.5. Construction-related emissions of NOX and PM10 would also exceed the annual thresholds of significance.

**TABLE 1**
**ESTIMATED CONSTRUCTION EMISSIONS FOR REDUCED ACREAGE ALTERNATIVE**

| | VOC | $NO_X$ | CO | PM10 [1,2] | PM2.5 [1] |
|---|---|---|---|---|---|
| **Daily Emissions (lbs/day)** | | | | | |
| 2020 | 13.88 | 183.10 | 97.84 | 218.62 | 43.52 |
| 2021 | 52.90 | 596.46 | 367.82 | 597.58 | 98.84 |
| 2022 | 52.90 | 596.46 | 367.82 | 597.58 | 98.84 |
| Maximum Daily Construction Emissions (lbs/day) | 52.90 | 596.46 | 367.82 | 597.58 | 98.84 |
| Threshold of Significance (lbs/day) | 137 | 137 | 548 | 82 | 65 |
| *Significant Impact?* | **NO** | **YES** | **NO** | **YES** | **YES** |
| **Annual Emissions (tons/year)** | | | | | |
| 2020 | 0.41 | 4.27 | 2.96 | 6.85 | 1.35 |

| | | | | | |
|---|---|---|---|---|---|
| 2021 | 5.84 | 55.78 | 41.80 | 71.89 | 11.76 |
| 2022 | 3.32 | 31.17 | 23.68 | 38.37 | 5.98 |
| Maximum Annual Emissions (tons/year) | 5.84 | 55.78 | 41.80 | 71.89 | 11.76 |
| Threshold of Significance (tons/year) | 25 | 25 | 100 | 15 | 12 |
| *Significant Impact?* | **NO** | **YES** | **NO** | **YES** | **NO** |

Notes: [1] PM10 emissions shown include the sum of particulate matter (PM) with aerodynamic diameter 0 to 2.5 microns and PM with aerodynamic diameter 2.5 to 10 microns.
[2]Does not include fugitive dust emissions reductions per MDAQMD Rule 403. .
[3] Additional details on the emissions for each calendar year are included in Appendix A.
VOC = volatile organic compounds; $NO_X$ = oxides of nitrogen; CO = carbon monoxide; PM10 = suspended PM; PM2.5 = fine PM; lbs/day = pounds per day
Source: Estimated by AECOM in 2019

Table 2 shows the mitigated daily and annual construction emissions for the Reduced Acreage Alternative. Similar to the Proposed Project, implementation of MMs AQ-A through AQ-D would reduce significant impacts of PM2.5 to a less than significant level; however, mitigated NOX and PM10 emissions would continue to exceed the recommended daily thresholds of significance.

**TABLE 2**
**MITIGATED MAXIMUM DAILY CONSTRUCTION EMISSIONS FOR REDUCED ACREAGE ALTERNATIVE**

| | **VOC** | **$NO_X$** | **CO** | **PM10 [1,2]** | **PM2.5[1]** |
|---|---|---|---|---|---|
| **Daily Emissions (lbs/day)** | | | | | |
| 2020 | 4.03 | 84.89 | 115.85 | 45.32 | 11.12 |
| 2021 | 17.02 | 267.29 | 432.77 | 117.15 | 21.89 |
| 2022 | 17.02 | 267.29 | 432.77 | 117.15 | 21.89 |
| Maximum Daily Construction Emissions (lbs/day) | 17.02 | 267.29 | 432.77 | 117.15 | 21.89 |
| Threshold of Significance (lbs/day) | 137 | 137 | 548 | 82 | 65 |
| *Significant Impact?* | **NO** | **YES** | **NO** | **YES** | **NO** |
| **Annual Emissions (tons/year)** | | | | | |
| 2020 | 0.10 | 1.18 | 3.53 | 1.39 | 0.33 |
| 2021 | 1.72 | 17.17 | 49.60 | 13.81 | 2.48 |
| 2022 | 1.01 | 9.81 | 28.08 | 7.27 | 1.21 |
| Maximum Annual Emissions (tons/year) | 1.72 | 17.17 | 49.60 | 13.81 | 2.48 |
| Threshold of Significance (tons/year) | 25 | 25 | 100 | 15 | 12 |
| *Significant Impact?* | **NO** | **NO** | **NO** | **NO** | **NO** |

Notes: [1] PM10 emissions shown include the sum of particulate matter (PM) with aerodynamic diameter 0 to 2.5 microns and PM with aerodynamic diameter 2.5 to 10 microns.
[2] Fugitive dust emissions were reduced based on watering two times per day.
[3] Additional details on the emissions for each calendar year are included in Appendix A.
VOC = volatile organic compounds; $NO_X$ = oxides of nitrogen; CO = carbon monoxide; PM10 = suspended PM; PM2.5 = fine PM; lbs/day = pounds per day
Source: Estimated by AECOM in 2019

Table 3 presents the estimated annual construction emissions for the Reduced Acreage Alternative in comparison the thresholds used for the NEPA analysis. The Reduced Acreage Alternative would not result in a substantial adverse effect related to criteria pollutant emissions.

**TABLE 3**
**GENERAL CONFORMITY - ESTIMATED ANNUAL CONSTRUCTION EMISSIONS FOR REDUCED ACREAGE ALTERNATIVE**

| | VOC | $NO_X$ | CO | PM10 [1] | PM2.5[1] |
|---|---|---|---|---|---|
| 2020 | 0.10 | 1.18 | 3.53 | 1.39 | 0.33 |
| 2021 | 1.72 | 17.17 | 49.60 | 13.81 | 2.48 |
| 2022 | 1.01 | 9.81 | 28.08 | 7.27 | 1.21 |
| Maximum Annual Construction Emissions (tons/year) | 1.72 | 17.17 | 49.60 | 13.81 | 2.48 |
| Threshold of Significance (tons/year) | 100 | 100 | N/A | 100 | N/A |
| *Significant Impact?* | No | No | No | No | No |

Notes: [1] PM10 emissions shown include the sum of particulate matter (PM) with aerodynamic diameter 0 to 2.5 microns and PM with aerodynamic diameter 2.5 to 10 microns.
VOC = volatile organic compounds; $NO_X$ = oxides of nitrogen; CO = carbon monoxide; $SO_2$ = sulfur dioxide; PM10 = suspended PM; PM2.5 = fine PM
Source: Estimated by AECOM in 2019

## CEQA Significance Conclusions

Consistent with the findings of the Proposed Project in the Air Quality Technical Report (April 2019), emissions of NOX and PM10 associated with the Reduced Acreage Alternative would continue to exceed the recommended thresholds of significance. Operational emissions are anticipated to remain the same as the Proposed Project. Therefore, the air quality impact for the Reduced Acreage Alternative would be significant and unavoidable.

## NEPA Impacts Summary

Consistent with the findings of the Proposed Project in the Air Quality Technical Report (April 2019), emissions associated with the Reduced Acreage Alternative would not result in a substantial adverse effect related to criteria pollutant emissions.

Reduced Acreage Alternative
Construction Emissions Summary

| | Maximum Daily Emissions (lbs/day) | | | | |
|---|---|---|---|---|---|
| Construction Phase/Source | VOC | $NO_X$ | CO | $PM_{10}$ | $PM_{2.5}$ |
| 2020 | | | | | |
| Phase I | 13.88 | 183.10 | 97.84 | 218.62 | 43.52 |
| | | | | | |
| 2021 | | | | | |
| Phase I | 13.88 | 183.10 | 97.84 | 218.62 | 43.52 |
| Phase II | 27.91 | 298.91 | 189.03 | 255.88 | 38.97 |
| Phase III | 11.10 | 114.45 | 80.95 | 123.08 | 16.35 |
| Maximum Daily | 52.90 | 596.46 | 367.82 | 597.58 | 98.84 |
| | | | | | |
| 2022 | | | | | |
| Phase I | 13.88 | 183.10 | 97.84 | 218.62 | 43.52 |
| Phase II | 27.91 | 298.91 | 189.03 | 255.88 | 38.97 |
| Phase III | 11.10 | 114.45 | 80.95 | 123.08 | 16.35 |
| Maximum Daily | 52.90 | 596.46 | 367.82 | 597.58 | 98.84 |

| | Annual Emissions (tons/year) | | | | |
|---|---|---|---|---|---|
| | VOC | $NO_X$ | CO | $PM_{10}$ | $PM_{2.5}$ |
| 2020 | | | | | |
| Option A - Phase I | 0.41 | 4.27 | 2.96 | 6.85 | 1.35 |
| | | | | | |
| 2021 | | | | | |
| Option A - Phase I | 1.63 | 17.09 | 11.84 | 27.38 | 5.41 |
| Option A - Phase II | 3.18 | 27.98 | 21.98 | 30.41 | 4.56 |
| Option A - Phase III | 1.03 | 10.71 | 7.98 | 14.10 | 1.79 |
| Maximum Annual | 5.84 | 55.78 | 41.80 | 71.89 | 11.76 |
| | | | | | |
| 2022 | | | | | |
| Option A - Phase I | 0.54 | 5.70 | 3.95 | 9.13 | 1.80 |
| Option A - Phase II | 2.12 | 18.65 | 14.66 | 20.28 | 3.04 |
| Option A - Phase III | 0.66 | 6.82 | 5.08 | 8.97 | 1.14 |
| Maximum Annual | 3.32 | 31.17 | 23.68 | 38.37 | 5.98 |

Reduced Acreage Alternative
Mitigated Construction Emissions Summary

| | Maximum Daily Emissions (lbs/day) | | | | |
|---|---|---|---|---|---|
| Construction Phase/Source | VOC | $NO_X$ | CO | $PM_{10}$ | $PM_{2.5}$ |
| 2020 | | | | | |
| Phase I | 4.03 | 84.89 | 115.85 | 45.32 | 11.12 |
| | | | | | |
| 2021 | | | | | |
| Phase I | 4.03 | 84.89 | 115.85 | 45.32 | 11.12 |
| Phase II | 10.35 | 152.04 | 222.61 | 48.75 | 7.95 |
| Phase III | 2.65 | 30.36 | 94.32 | 23.08 | 2.81 |
| Maximum Daily | 17.02 | 267.29 | 432.77 | 117.15 | 21.89 |
| | | | | | |
| 2022 | | | | | |
| Phase I | 4.03 | 84.89 | 115.85 | 45.32 | 11.12 |
| Phase II | 10.35 | 152.04 | 222.61 | 48.75 | 7.95 |
| Phase III | 2.65 | 30.36 | 94.32 | 23.08 | 2.81 |
| Maximum Daily | 17.02 | 267.29 | 432.77 | 117.15 | 21.89 |

| | Annual Emissions (tons/year) | | | | |
|---|---|---|---|---|---|
| | VOC | $NO_X$ | CO | $PM_{10}$ | $PM_{2.5}$ |
| 2020 | | | | | |
| Phase I | 0.10 | 1.18 | 3.53 | 1.39 | 0.33 |
| | | | | | |
| 2021 | | | | | |
| Phase I | 0.39 | 4.72 | 14.10 | 5.55 | 1.32 |
| Phase II | 1.08 | 10.40 | 26.00 | 5.62 | 0.85 |
| Phase III | 0.25 | 2.05 | 9.50 | 2.64 | 0.31 |
| Maximum Annual | 1.72 | 17.17 | 49.60 | 13.81 | 2.48 |
| | | | | | |
| 2022 | | | | | |
| Phase I | 0.13 | 1.57 | 4.70 | 1.85 | 0.44 |
| Phase II | 0.72 | 6.93 | 17.34 | 3.75 | 0.57 |
| Phase III | 0.16 | 1.31 | 6.04 | 1.68 | 0.20 |
| Maximum Annual | 1.01 | 9.81 | 28.08 | 7.27 | 1.21 |

**Phase 1 - Move On (Laydown, Construction Trailers, Parking Area), Grading, Site Preparation**

Phase Duration (days): 399 19 months 21 working days per month

| | | | | | | | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Equipment Category | Equipment Type | Number | Usage Factor (hrs/day or miles/day) | Power Rating (hp) | Load Factor | Total Days/VMT | VOC | NOX | CO | PM10 | PM2.5 | CO2 | CH4 | VOC | NOX | CO | PM10 | PM2.5 | $CO_2$ | CH4 | Total GHG Emissions (MT CO2e) |
| Off-Highway Trucks >176 and <250 | Water Truck | 2 | 8 | 230 | 0.38 | 399 | 0.85 | 7.73 | 4.29 | 0.30 | 0.28 | 1,449.50 | 0.47 | 0.17 | 1.54 | 0.86 | 0.06 | 0.06 | 289.18 | 0.09 | 265.53 |
| Off-Highway Trucks >176 and <250 | Water Pull | 2 | 8 | 185 | 0.41 | 399 | 0.74 | 6.71 | 3.72 | 0.26 | 0.24 | 1,257.95 | 0.41 | 0.15 | 1.34 | 0.74 | 0.05 | 0.05 | 250.96 | 0.08 | 230.44 |
| Graders >176 and <250 | Motor Grader | 3 | 6 | 185 | 0.41 | 399 | 1.06 | 14.08 | 4.04 | 0.45 | 0.41 | 1,430.65 | 0.46 | 0.21 | 2.81 | 0.81 | 0.09 | 0.08 | 285.42 | 0.09 | 262.08 |
| Rubber Tired Dozers > 121 and <175 | Dozer (D6) | 1 | 6 | 158 | 0.40 | 399 | 0.61 | 6.01 | 3.25 | 0.34 | 0.32 | 395.43 | 0.13 | 0.12 | 1.20 | 0.65 | 0.07 | 0.06 | 78.89 | 0.03 | 72.44 |
| Tractors/Loaders/Backhoes >176 and <250 | Loader | 2 | 6 | 190 | 0.36 | 399 | 0.41 | 4.95 | 2.16 | 0.16 | 0.15 | 851.40 | 0.28 | 0.08 | 0.99 | 0.43 | 0.03 | 0.03 | 169.85 | 0.05 | 155.97 |
| Skid Steer Loaders >51 and <120 | Skid Steer | 3 | 6 | 83 | 0.40 | 399 | 0.25 | 3.30 | 4.32 | 0.14 | 0.13 | 621.73 | 0.20 | 0.05 | 0.66 | 0.86 | 0.03 | 0.03 | 124.04 | 0.04 | 113.89 |
| Other Construction Equipment >51 and <120 | Tractor Buster | 2 | 6 | 120 | 0.42 | 399 | 0.69 | 6.36 | 4.98 | 0.47 | 0.43 | 629.63 | 0.20 | 0.14 | 1.27 | 0.99 | 0.09 | 0.09 | 125.61 | 0.04 | 115.34 |
| Other Construction Equipment >251 and <500 | Tractor Disk | 2 | 6 | 300 | 0.42 | 399 | 0.75 | 8.79 | 5.45 | 0.32 | 0.29 | 1,584.14 | 0.51 | 0.15 | 1.75 | 1.09 | 0.06 | 0.06 | 316.04 | 0.10 | 290.20 |
| Off-Highway Trucks >176 and <250 | Truck (onroad) | 10 | 4 | 238 | 0.38 | 399 | 2.19 | 20.00 | 11.09 | 0.78 | 0.72 | 3,749.80 | 1.21 | 0.44 | 3.99 | 2.21 | 0.16 | 0.14 | 748.08 | 0.24 | 686.92 |
| Generator Sets >51 and <120 | Generator (Office)(45 kW) | 1 | 24 | 60 | 0.74 | 399 | 0.86 | 7.45 | 7.94 | 0.42 | 0.42 | 1,335.08 | 0.08 | 0.17 | 1.49 | 1.58 | 0.08 | 0.08 | 266.35 | 0.01 | 242.76 |
| Generator Sets >26 and <50 | Generator (Security, IT)(30 kW) | 1 | 24 | 40 | 0.74 | 399 | 1.08 | 6.38 | 6.26 | 0.30 | 0.30 | 890.05 | 0.10 | 0.22 | 1.27 | 1.25 | 0.06 | 0.06 | 177.56 | 0.02 | 162.08 |
| Rollers >121 and <175 | Roller/Vibrator/Padder | 1 | 6 | 160 | 0.38 | 399 | 0.17 | 1.97 | 2.36 | 0.09 | 0.08 | 379.54 | 0.12 | 0.03 | 0.39 | 0.47 | 0.02 | 0.02 | 75.72 | 0.02 | 69.53 |
| Scrapers >251 and <500 | Scraper | 3 | 6 | 365 | 0.40 | 399 | 1.85 | 21.92 | 13.91 | 0.85 | 0.79 | 2,735.67 | 0.88 | 0.37 | 4.37 | 2.77 | 0.17 | 0.16 | 545.77 | 0.18 | 501.14 |
| Pumps >26 and <50 | Water Pump | 2 | 8 | 45 | 0.74 | 399 | 0.89 | 4.85 | 4.93 | 0.24 | 0.24 | 667.54 | 0.08 | 0.18 | 0.97 | 0.98 | 0.05 | 0.05 | 133.17 | 0.02 | 121.59 |
| **Total** | | **35** | **124** | | | | **12.38** | **120.50** | **78.70** | **5.14** | **4.81** | **17,978.10** | **5.13** | **2.47** | **24.04** | **15.70** | **1.03** | **0.96** | **3,586.63** | **1.02** | **3,289.92** |

**On Road Construction Emissions**

| | | | | | | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Daily Trips | Distance | Average Daily Mileage | Calculated Time - Rounded (days) | Total Mileage | VOC | $NO_x$ | CO | PM10 | PM2.5 | CO2 | $CH_4$ | VOC | $NO_x$ | CO | PM10 | PM2.5 | $CO_2$ | $CH_4$ | Total GHG Emissions (MT CO2e) |
| Worker Trips | 334 | 13 | 8,684 | 399 | 3,464,916 | 0.26 | 1.34 | 14.10 | 0.89 | 0.37 | 5,743 | 0.54 | 0.05 | 0.27 | 2.81 | 0.18 | 0.07 | 1,145.78 | 0.11 | 1,045.42 |
| Gravel Delivery | - | 13 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Module Delivery | 10 | 150 | 3,000 | 81 | 242,100 | 0.58 | 28.88 | 2.38 | 0.79 | 0.38 | 9,831 | 0.03 | 0.02 | 1.17 | 0.10 | 0.03 | 0.02 | 396.66 | 0.00 | 361.00 |
| Foundation Delivery | 10 | 150 | 3,000 | 98 | 293,550 | 0.58 | 28.88 | 2.38 | 0.79 | 0.38 | 9,831 | 0.03 | 0.03 | 1.41 | 0.12 | 0.04 | 0.02 | 480.96 | 0.00 | 437.71 |
| Water Delivery Trips | 14 | 13 | 364 | 102 | 37,267 | 0.07 | 3.50 | 0.29 | 0.10 | 0.05 | 1,193 | 0.00 | 0.00 | 0.18 | 0.01 | 0.00 | 0.00 | 61.06 | 0.00 | 55.57 |
| **Total** | | | | | | **1.50** | **62.60** | **19.15** | **2.57** | **1.17** | **26,597.05** | **0.62** | **0.11** | **3.02** | **3.04** | **0.25** | **0.11** | **2,084.45** | **0.11** | **1,899.70** |

Water trucks assumed to come from Blythe at a distance of approximately 13 miles (26 miles round trip).

| | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total** | VOC | $NO_x$ | CO | PM10 | PM2.5 | CO2 | $CH_4$ | VOC | $NO_x$ | CO | PM10 | PM2.5 | $CO_2$ | $CH_4$ | Total GHG Emissions (MT CO2e) |
| **Maximum Daily Emissions** | **13.88** | **183.10** | **97.84** | **7.71** | **5.98** | **44,575.14** | **5.75** | | | | | | | | |
| **Maximum Annual Emissions** | | | | | | | | **2.58** | **27.06** | **18.74** | **1.28** | **1.07** | **5,671.08** | **1.14** | **5,189.62** |

**Phase 2 - Construction - Solar Array Structural Components (Structural Components, Underground Work, Module Installation)**

Phase Duration (days): 399 19 months 21 working days per month

| | | | | | | | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Equipment Type | Equipment Category | Number | Usage Factor (hrs/day or miles/day) | Power Rating (hp) | Load Factor | Total Days/VMT | VOC | NOX | CO | PM10 | PM2.5 | CO2 | CH4 | VOC | NOX | CO | PM10 | PM2.5 | $CO_2$ | CH4 | Total GHG Emissions (MT CO2e) |
| Off-Highway Trucks >176 and <250 | Water truck | 8 | 8 | 238 | 0.38 | 399 | 3.51 | 31.99 | 17.75 | 1.25 | 1.15 | 5,999.68 | 1.94 | 0.70 | 6.38 | 3.54 | 0.25 | 0.23 | 1,196.94 | 0.39 | 1,099.08 |
| Other Construction Equipment >16 and <25 | ATV | 40 | 4 | 24 | 0.40 | 399 | 3.63 | 17.05 | 18.30 | 1.37 | 1.26 | 1,787.85 | 0.58 | 0.72 | 3.40 | 3.65 | 0.27 | 0.25 | 356.68 | 0.12 | 327.52 |
| Air Compressors >26 and <50 | Air Compressor | 2 | 6 | 49 | 0.48 | 399 | 0.62 | 2.74 | 3.21 | 0.16 | 0.16 | 353.61 | 0.06 | 0.12 | 0.55 | 0.64 | 0.03 | 0.03 | 70.55 | 0.01 | 64.48 |
| Cranes >251 and <500 | Crane | 2 | 2 | 400 | 0.29 | 399 | 0.33 | 3.95 | 2.72 | 0.16 | 0.15 | 483.40 | 0.16 | 0.07 | 0.79 | 0.54 | 0.03 | 0.03 | 96.44 | 0.03 | 88.55 |
| Forklifts >51 and <120 | Forklift (5 K) | 10 | 4 | 67 | 0.20 | 399 | 0.54 | 4.88 | 4.44 | 0.36 | 0.33 | 557.20 | 0.18 | 0.11 | 0.97 | 0.89 | 0.07 | 0.07 | 111.16 | 0.04 | 102.07 |
| Aerial Lifts >51 and <120 | Forklift (10 K) (Aerial Lift) | 10 | 4 | 110 | 0.31 | 399 | 0.35 | 5.62 | 9.55 | 0.13 | 0.11 | 1,419.70 | 0.46 | 0.07 | 1.12 | 1.91 | 0.02 | 0.02 | 283.23 | 0.09 | 260.07 |
| Other Construction Equipment >26 and <50 | Post Machine | 14 | 6 | 49 | 0.40 | 399 | 3.89 | 18.28 | 19.62 | 1.47 | 1.35 | 1,916.35 | 0.62 | 0.78 | 3.65 | 3.91 | 0.29 | 0.27 | 382.31 | 0.12 | 351.06 |
| Skid Steer Loaders >51 and <120 | Skid Steer | 20 | 4 | 80 | 0.40 | 399 | 1.06 | 14.14 | 18.50 | 0.61 | 0.56 | 2,663.37 | 0.86 | 0.21 | 2.82 | 3.69 | 0.12 | 0.11 | 531.34 | 0.17 | 487.90 |
| Off-Highway Trucks >176 and <250 | Truck, flatbed (onroad) | 4 | 4 | 238 | 0.38 | 399 | 0.88 | 8.00 | 4.44 | 0.31 | 0.29 | 1,499.92 | 0.49 | 0.17 | 1.60 | 0.89 | 0.06 | 0.06 | 299.23 | 0.10 | 274.77 |
| Off-Highway Trucks >176 and <250 | Truck (onroad) | 30 | 4 | 238 | 0.38 | 399 | 6.57 | 59.99 | 33.28 | 2.34 | 2.15 | 11,249.39 | 3.64 | 1.31 | 11.97 | 6.64 | 0.47 | 0.43 | 2,244.25 | 0.73 | 2,060.77 |
| Generator Sets >51 and <120 | Generator (45 kW) | 1 | 24 | 60 | 0.74 | 399 | 0.86 | 7.45 | 7.94 | 0.42 | 0.42 | 1,335.08 | 0.08 | 0.17 | 1.49 | 1.58 | 0.08 | 0.08 | 266.35 | 0.01 | 242.76 |
| Excavators >51 and <120 | Backhoe/Excavator | 4 | 4 | 90 | 0.37 | 399 | 0.35 | 3.63 | 4.12 | 0.22 | 0.20 | 549.79 | 0.18 | 0.07 | 0.72 | 0.82 | 0.04 | 0.04 | 109.68 | 0.04 | 100.72 |
| Trenchers >51 and <120 | Cable Plow | 1 | 6 | 120 | 0.42 | 399 | 0.41 | 3.68 | 2.56 | 0.28 | 0.25 | 316.76 | 0.10 | 0.08 | 0.73 | 0.51 | 0.05 | 0.05 | 63.19 | 0.02 | 58.03 |
| Trenchers >26 and <50 | Cable Trencher | 1 | 6 | 42 | 0.50 | 399 | 0.25 | 1.30 | 1.34 | 0.10 | 0.09 | 146.42 | 0.05 | 0.05 | 0.26 | 0.27 | 0.02 | 0.02 | 29.21 | 0.01 | 26.82 |
| Paving Equipment >176 and <250 | Compactor | 1 | 4 | 180 | 0.43 | 399 | 0.17 | 2.20 | 0.85 | 0.08 | 0.07 | 322.27 | 0.10 | 0.03 | 0.44 | 0.17 | 0.02 | 0.01 | 64.29 | 0.02 | 59.04 |
| Rollers >176 and <250 | Roller/Vibrator/Padder | 2 | 6 | 180 | 0.38 | 399 | 0.38 | 4.98 | 2.27 | 0.16 | 0.15 | 856.58 | 0.28 | 0.08 | 0.99 | 0.45 | 0.03 | 0.03 | 170.89 | 0.06 | 156.92 |
| Trenchers >26 and <50 | Mini-Trencher | 4 | 6 | 40 | 0.50 | 399 | 0.96 | 4.95 | 5.11 | 0.38 | 0.35 | 557.78 | 0.18 | 0.19 | 0.99 | 1.02 | 0.08 | 0.07 | 111.28 | 0.04 | 102.18 |
| Rollers >51 and <120 | Sheepsfoot Roller | 3 | 6 | 95 | 0.38 | 399 | 0.56 | 5.56 | 5.06 | 0.35 | 0.33 | 678.83 | 0.22 | 0.11 | 1.11 | 1.01 | 0.07 | 0.07 | 135.43 | 0.04 | 124.36 |
| Off-Highway Trucks >251 and <500 | 5 CY Dump Truck | 1 | 4 | 480 | 0.38 | 399 | 0.40 | 3.77 | 2.27 | 0.14 | 0.13 | 763.36 | 0.25 | 0.08 | 0.75 | 0.45 | 0.03 | 0.03 | 152.29 | 0.05 | 139.84 |
| **Total** | | **158** | **112** | | | | **25.70** | **204.16** | **163.34** | **10.27** | **9.50** | **33,457.33** | **10.41** | **5.13** | **40.73** | **32.59** | **2.05** | **1.89** | **6,674.74** | **2.08** | **6,126.92** |

**On Road Construction Emissions**

| | | | | | | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Daily Trips | Distance | Average Daily Mileage | Calculated Time - Rounded (days) | Total Mileage | VOC | $NO_x$ | CO | PM10 | PM2.5 | CO2 | $CH_4$ | VOC | $NO_x$ | CO | PM10 | PM2.5 | $CO_2$ | $CH_4$ | Total GHG Emissions (MT CO2e) |
| Worker Trips | 427 | 13 | 11,102 | 399 | 4,429,698 | 0.34 | 1.71 | 18.03 | 1.14 | 0.47 | 7,342 | 0.70 | 0.07 | 0.34 | 3.60 | 0.23 | 0.09 | 1,464.81 | 0.14 | 1,336.51 |
| Gravel Delivery | - | 13 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Module Delivery | 10 | 150 | 3,000 | 81 | 242,100 | 0.58 | 28.88 | 2.38 | 0.79 | 0.38 | 9,831 | 0.03 | 0.02 | 1.17 | 0.10 | 0.03 | 0.02 | 396.66 | 0.00 | 361.00 |
| Tracker Delivery | 9 | 150 | 2,700 | 207 | 560,100 | 0.52 | 25.99 | 2.14 | 0.71 | 0.34 | 8,847 | 0.03 | 0.05 | 2.70 | 0.22 | 0.07 | 0.04 | 917.68 | 0.00 | 835.17 |
| Foundation Delivery | 10 | 150 | 3,000 | 98 | 293,550 | 0.58 | 28.88 | 2.38 | 0.79 | 0.38 | 9,831 | 0.03 | 0.03 | 1.41 | 0.12 | 0.04 | 0.02 | 480.96 | 0.00 | 437.71 |
| Inverter Delivery | 2 | 150 | 600 | 36 | 21,750 | 0.12 | 5.78 | 0.48 | 0.16 | 0.08 | 1,966 | 0.01 | 0.00 | 0.10 | 0.01 | 0.00 | 0.00 | 35.64 | 0.00 | 32.43 |
| Water Delivery Trips | 14 | 13 | 364 | 102 | 37,267 | 0.07 | 3.50 | 0.29 | 0.10 | 0.05 | 1,193 | 0.00 | 0.00 | 0.18 | 0.01 | 0.00 | 0.00 | 61.06 | 0.00 | 55.57 |
| **Total** | | | | | | **2.21** | **94.74** | **25.69** | **3.69** | **1.68** | **39,009.78** | **0.80** | **0.18** | **5.90** | **4.05** | **0.38** | **0.17** | **3,356.80** | **0.15** | **3,058.39** |

Water trucks assumed to come from Blythe at a distance of approximately 13 miles (26 miles round trip).

| | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total** | VOC | $NO_x$ | CO | PM10 | PM2.5 | CO2 | $CH_4$ | VOC | $NO_x$ | CO | PM10 | PM2.5 | $CO_2$ | $CH_4$ | Total GHG Emissions (MT CO2e) |
| **Maximum Daily Emissions** | **27.91** | **298.91** | **189.03** | **13.96** | **11.18** | **72,467.12** | **11.21** | | | | | | | | |
| **Maximum Annual Emissions** | | | | | | | | **5.31** | **46.63** | **36.64** | **2.43** | **2.06** | **10,031.54** | **2.22** | **9,185.31** |

**Phase 3 - Construction - Electrical (Substation, Gen-Tie, Collection System, Energy Storage, O&M Building)**

Phase Duration (days): 378 | 18 months | 21 working days per month

| Equipment Type | Equipment Category | Number | Usage Factor (hrs/day or miles/day) | Power Rating (hp) | Load Factor | Total Days/VMT | Emissions Summary (lbs/day) VOC | NOX | CO | PM10 | PM2.5 | CO2 | CH4 | Emissions Summary (tons per phase) VOC | NOX | CO | PM10 | PM2.5 | $CO_2$ | CH4 | Total GHG Emissions (MT CO2e) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Off-Highway Trucks >176 and <250 | Water truck | 4 | 8 | 230 | 0.38 | 378 | 1.69 | 15.46 | 8.58 | 0.60 | 0.55 | 2,899.00 | 0.94 | 0.32 | 2.92 | 1.62 | 0.11 | 0.10 | 547.91 | 0.18 | 503.12 |
| Bore/Drill Rigs >176 and <250 | Auger | 5 | 4 | 238 | 0.50 | 378 | 0.75 | 9.48 | 5.60 | 0.27 | 0.25 | 2,449.48 | 0.79 | 0.14 | 1.79 | 1.06 | 0.05 | 0.05 | 462.95 | 0.15 | 425.10 |
| Excavators >51 and <120 | Backhoe/Excavator | 6 | 4 | 90 | 0.37 | 378 | 0.53 | 5.44 | 6.18 | 0.33 | 0.30 | 824.68 | 0.27 | 0.10 | 1.03 | 1.17 | 0.06 | 0.06 | 155.86 | 0.05 | 143.12 |
| Cranes >251 and <500 | Crane | 6 | 5 | 400 | 0.29 | 378 | 2.46 | 29.63 | 20.41 | 1.19 | 1.09 | 3,625.51 | 1.17 | 0.46 | 5.60 | 3.86 | 0.22 | 0.21 | 685.22 | 0.22 | 629.20 |
| Forklifts >51 and <120 | Forklift | 3 | 4 | 90 | 0.20 | 378 | 0.22 | 1.97 | 1.79 | 0.15 | 0.13 | 224.54 | 0.07 | 0.04 | 0.37 | 0.34 | 0.03 | 0.03 | 42.44 | 0.01 | 38.97 |
| Excavators >26 and <50 | Mini Excavator | 1 | 6 | 42 | 0.50 | 378 | 0.16 | 1.12 | 1.25 | 0.06 | 0.06 | 145.94 | 0.05 | 0.03 | 0.21 | 0.24 | 0.01 | 0.01 | 27.58 | 0.01 | 25.33 |
| Aerial Lifts >51 and <120 | Man/Aerial Lift | 2 | 4 | 60 | 0.31 | 378 | 0.04 | 0.61 | 1.04 | 0.01 | 0.01 | 154.88 | 0.05 | 0.01 | 0.12 | 0.20 | 0.00 | 0.00 | 29.27 | 0.01 | 26.88 |
| Tractors/Loaders/Backhoes >176 and <250 | Tractor | 1 | 6 | 190 | 0.36 | 378 | 0.20 | 2.48 | 1.08 | 0.08 | 0.07 | 425.70 | 0.14 | 0.04 | 0.47 | 0.20 | 0.02 | 0.01 | 80.46 | 0.03 | 73.88 |
| Off-Highway Trucks >176 and <250 | Truck, flatbed (onroad) | 2 | 2 | 200 | 0.38 | 378 | 0.18 | 1.68 | 0.93 | 0.07 | 0.06 | 315.11 | 0.10 | 0.03 | 0.32 | 0.18 | 0.01 | 0.01 | 59.56 | 0.02 | 54.69 |
| Off-Highway Trucks >176 and <250 | Truck (onroad) | 13 | 2 | 200 | 0.38 | 378 | 1.20 | 10.92 | 6.06 | 0.43 | 0.39 | 2,048.21 | 0.66 | 0.23 | 2.06 | 1.15 | 0.08 | 0.07 | 387.11 | 0.13 | 355.46 |
| Generator Sets >51 and <120 | Generator (45 kW) | 2 | 4 | 60 | 0.74 | 378 | 0.29 | 2.48 | 2.65 | 0.14 | 0.14 | 445.03 | 0.03 | 0.05 | 0.47 | 0.50 | 0.03 | 0.03 | 84.11 | 0.00 | 76.66 |
| Crawler Tractors >121 and <175 | Crawler Tractor | 1 | 4 | 147 | 0.29 | 126 | 0.18 | 1.83 | 1.26 | 0.10 | 0.09 | 177.07 | 0.06 | 0.01 | 0.12 | 0.08 | 0.01 | 0.01 | 11.16 | 0.00 | 10.24 |
| Tractors/Loaders/Backhoes >176 and <250 | Truck Mounted Digger | 1 | 4 | 190 | 0.42 | 126 | 0.16 | 1.93 | 0.84 | 0.06 | 0.06 | 331.10 | 0.11 | 0.01 | 0.12 | 0.05 | 0.00 | 0.00 | 20.86 | 0.01 | 19.15 |
| Other Construction Equipment >251 and <500 | Tensioner | 1 | 4 | 238 | 0.42 | 126 | 0.20 | 2.32 | 1.44 | 0.08 | 0.08 | 418.92 | 0.14 | 0.01 | 0.15 | 0.09 | 0.01 | 0.00 | 26.39 | 0.01 | 24.23 |
| Off-Highway Trucks >176 and <250 | Wire Truck | 1 | 4 | 238 | 0.38 | 126 | 0.22 | 2.00 | 1.11 | 0.08 | 0.07 | 374.98 | 0.12 | 0.01 | 0.13 | 0.07 | 0.00 | 0.00 | 23.62 | 0.01 | 21.69 |
| Graders >176 and <250 | Motor Grader | 1 | 1 | 185 | 0.41 | 126 | 0.06 | 0.78 | 0.22 | 0.02 | 0.02 | 79.48 | 0.03 | 0.00 | 0.05 | 0.01 | 0.00 | 0.00 | 5.01 | 0.00 | 4.60 |
| Scrapers >251 and <500 | Scraper | 1 | 1 | 365 | 0.40 | 126 | 0.10 | 1.22 | 0.77 | 0.05 | 0.04 | 151.98 | 0.05 | 0.01 | 0.08 | 0.05 | 0.00 | 0.00 | 9.57 | 0.00 | 8.79 |
| Trenchers >26 and <50 | Cable Trencher | 5 | 10 | 42 | 0.50 | 126 | 2.09 | 10.83 | 11.19 | 0.82 | 0.76 | 1,220.15 | 0.39 | 0.13 | 0.68 | 0.70 | 0.05 | 0.05 | 76.87 | 0.02 | 70.58 |
| **Total** | | **56** | | | | | **10.73** | **102.19** | **72.40** | **4.55** | **4.20** | **16,311.75** | **5.16** | **1.65** | **16.68** | **11.56** | **0.71** | **0.65** | **2,735.96** | **0.86** | **2,511.70** |

**On Road Construction Emissions**

| | Daily Trips | Distance | Average Daily Mileage | Calculated Time - Rounded (days) | Total Mileage | Emissions Summary (lbs/day) VOC | $NO_x$ | CO | PM10 | PM2.5 | CO2 | $CH_4$ | Emissions Summary (tons per phase) VOC | $NO_x$ | CO | PM10 | PM2.5 | $CO_2$ | $CH_4$ | Total GHG Emissions (MT CO2e) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Worker Trips | 180 | 13 | 4,680 | 378 | 1,769,040 | 0.14 | 0.72 | 7.60 | 0.48 | 0.20 | 3 ,095 | 0.29 | 0.03 | 0.14 | 1.44 | 0.09 | 0.04 | 584.98 | 0.06 | 533.75 |
| Inverter Delivery | 2 | 150 | 600 | 36 | 21,750 | 0.12 | 5.78 | 0.48 | 0.16 | 0.08 | 1,966 | 0.01 | 0.00 | 0.10 | 0.01 | 0.00 | 0.00 | 35.64 | 0.00 | 32.43 |
| Concrete Truck Trips (Unless Batched on site) | 9 | 13 | 234 | 378 | 88,452 | 0.05 | 2.25 | 0.19 | 0.06 | 0.03 | 767 | 0.00 | 0.01 | 0.43 | 0.04 | 0.01 | 0.01 | 144.92 | 0.00 | 131.88 |
| Water Delivery Trips | 14 | 13 | 364 | 102 | 37,267 | 0.07 | 3.50 | 0.29 | 0.10 | 0.05 | 1 ,193 | 0.00 | 0.00 | 0.18 | 0.01 | 0.00 | 0.00 | 61.06 | 0.00 | 55.57 |
| **Total** | | | | | | **0.37** | **12.25** | **8.55** | **0.80** | **0.35** | **7,020.81** | **0.31** | **0.04** | **0.85** | **1.49** | **0.11** | **0.05** | **826.60** | **0.06** | **753.62** |

Concrete and water trucks assumed to haul material from Blythe at a distance of approximately 13 miles (26 miles round trip).

| Total | Emissions Summary (lbs/day) VOC | $NO_x$ | CO | PM10 | PM2.5 | CO2 | $CH_4$ | Emissions Summary (tons per phase) VOC | $NO_x$ | CO | PM10 | PM2.5 | $CO_2$ | $CH_4$ | Total GHG Emissions (MT CO2e) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Maximum Daily Emissions** | **11.10** | **114.45** | **80.95** | **5.34** | **4.54** | **23,332.56** | **5.46** | | | | | | | | |
| **Maximum Annual Emissions** | | | | | | | | **1.69** | **17.53** | **13.06** | **0.82** | **0.70** | **3,562.56** | **0.92** | **3,265.32** |

**Phase 1 - Move On (Laydown, Construction Trailers, Parking Area), Grading, Site Preparation**
**Mitigated Emissions**

Phase Duration (days): 399 | 19 months | 21 working days per month

| Equipment Category | Equipment Type | Number | Usage Factor (hrs/day or miles/day) | Power Rating (hp) | Load Factor | Total Days/VMT | Emissions Summary (lbs/day) VOC | NOX | CO | PM10 | PM2.5 | CO2 | CH4 | Emissions Summary (tons per phase) VOC | NOX | CO | PM10 | PM2.5 | $CO_2$ | CH4 | Total GHG Emissions (MT CO2e) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Off-Highway Trucks >176 and <250 | Water Truck | 2 | 8 | 230 | 0.38 | 399 | 0.18 | 0.80 | 6.78 | 0.02 | 0.02 | 1,449.50 | 0.47 | 0.04 | 0.16 | 1.35 | 0.00 | 0.00 | 289.18 | 0.09 | 265.53 |
| Off-Highway Trucks >176 and <250 | Water Pull | 2 | 8 | 185 | 0.41 | 399 | 0.16 | 0.70 | 5.89 | 0.02 | 0.02 | 1,257.95 | 0.41 | 0.03 | 0.14 | 1.17 | 0.00 | 0.00 | 250.96 | 0.08 | 230.44 |
| Graders >176 and <250 | Motor Grader | 3 | 6 | 185 | 0.41 | 399 | 0.18 | 0.78 | 6.62 | 0.02 | 0.02 | 1,430.65 | 0.46 | 0.04 | 0.16 | 1.32 | 0.00 | 0.00 | 285.42 | 0.09 | 262.08 |
| Rubber Tired Dozers > 121 and <175 | Dozer (D6) | 1 | 6 | 158 | 0.40 | 399 | 0.05 | 0.22 | 3.09 | 0.01 | 0.01 | 395.43 | 0.13 | 0.01 | 0.04 | 0.62 | 0.00 | 0.00 | 78.89 | 0.03 | 72.44 |
| Tractors/Loaders/Backhoes >176 and <250 | Loader | 2 | 6 | 190 | 0.36 | 399 | 0.11 | 0.47 | 3.98 | 0.01 | 0.01 | 851.40 | 0.28 | 0.02 | 0.09 | 0.79 | 0.00 | 0.00 | 169.85 | 0.05 | 155.97 |
| Skid Steer Loaders >51 and <120 | Skid Steer | 3 | 6 | 83 | 0.40 | 399 | 0.08 | 0.34 | 4.87 | 0.01 | 0.01 | 621.73 | 0.20 | 0.02 | 0.07 | 0.97 | 0.00 | 0.00 | 124.04 | 0.04 | 113.89 |
| Other Construction Equipment >51 and <120 | Tractor Buster | 2 | 6 | 120 | 0.42 | 399 | 0.08 | 0.35 | 4.93 | 0.01 | 0.01 | 629.63 | 0.20 | 0.02 | 0.07 | 0.98 | 0.00 | 0.00 | 125.61 | 0.04 | 115.34 |
| Other Construction Equipment >251 and <500 | Tractor Disk | 2 | 6 | 300 | 0.42 | 399 | 0.20 | 0.87 | 7.33 | 0.03 | 0.03 | 1,584.14 | 0.51 | 0.04 | 0.17 | 1.46 | 0.01 | 0.01 | 316.04 | 0.10 | 290.20 |
| Off-Highway Trucks >176 and <250 | Truck (onroad) | 10 | 4 | 238 | 0.38 | 399 | 0.48 | 2.07 | 17.55 | 0.06 | 0.06 | 3,749.80 | 1.21 | 0.10 | 0.41 | 3.50 | 0.01 | 0.01 | 748.08 | 0.24 | 686.92 |
| Generator Sets >51 and <120 | Generator (Office)(45 kW) | 1 | 24 | 60 | 0.74 | 399 | 0.28 | 6.44 | 8.69 | 0.02 | 0.02 | 1,335.08 | 0.08 | 0.06 | 1.28 | 1.73 | 0.00 | 0.00 | 266.35 | 0.01 | 242.76 |
| Generator Sets >26 and <50 | Generator (Security, IT)(30 kW) | 1 | 24 | 40 | 0.74 | 399 | 0.19 | 4.31 | 6.42 | 0.01 | 0.01 | 890.05 | 0.10 | 0.04 | 0.86 | 1.28 | 0.00 | 0.00 | 177.56 | 0.02 | 162.08 |
| Rollers >121 and <175 | Roller/Vibrator/Padder | 1 | 6 | 160 | 0.38 | 399 | 0.05 | 0.21 | 2.98 | 0.01 | 0.01 | 379.54 | 0.12 | 0.01 | 0.04 | 0.59 | 0.00 | 0.00 | 75.72 | 0.02 | 69.53 |
| Scrapers >251 and <500 | Scraper | 3 | 6 | 365 | 0.40 | 399 | 0.35 | 1.51 | 12.75 | 0.05 | 0.05 | 2,735.67 | 0.88 | 0.07 | 0.30 | 2.54 | 0.01 | 0.01 | 545.77 | 0.18 | 501.14 |
| Pumps >26 and <50 | Water Pump | 2 | 8 | 45 | 0.74 | 399 | 0.14 | 3.23 | 4.82 | 0.01 | 0.01 | 667.54 | 0.08 | 0.03 | 0.64 | 0.96 | 0.00 | 0.00 | 133.17 | 0.02 | 121.59 |
| **Total** | | | | | | | **2.53** | **22.29** | **96.70** | **0.30** | **0.30** | **17,978.10** | **5.13** | **0.50** | **4.45** | **19.29** | **0.06** | **0.06** | **3,586.63** | **1.02** | **3,289.92** |

**On Road Construction Emissions**

| | Daily Trips | Distance | Average Daily Mileage | Calculated Time - Rounded (days) | Total Mileage | Emissions Summary (lbs/day) VOC | $NO_x$ | CO | PM10 | PM2.5 | CO2 | $CH_4$ | Emissions Summary (tons per phase) VOC | $NO_x$ | CO | PM10 | PM2.5 | $CO_2$ | $CH_4$ | Total GHG Emissions (MT CO2e) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Worker Trips | 334 | 13 | 8,684 | 399 | 3,464,916 | 0.26 | 1.34 | 14.10 | 0.89 | 0.37 | 5 ,743 | 0.54 | 0.05 | 0.27 | 2.81 | 0.18 | 0.07 | 1,145.78 | 0.11 | 1,045.42 |
| Gravel Delivery | - | 13 | - | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Module Delivery | 10 | 150 | 3,000 | 81 | 242,100 | 0.58 | 28.88 | 2.38 | 0.79 | 0.38 | 9,831 | 0.03 | 0.02 | 1.17 | 0.10 | 0.03 | 0.02 | 396.66 | 0.00 | 361.00 |
| Foundation Delivery | 10 | 150 | 3,000 | 98 | 293,550 | 0.58 | 28.88 | 2.38 | 0.79 | 0.38 | 9,831 | 0.03 | 0.03 | 1.41 | 0.12 | 0.04 | 0.02 | 480.96 | 0.00 | 437.71 |
| Water Delivery Trips | 14 | 13 | 364 | 102 | 37,267 | 0.07 | 3.50 | 0.29 | 0.10 | 0.05 | 1 ,193 | 0.00 | 0.00 | 0.18 | 0.01 | 0.00 | 0.00 | 61.06 | 0.00 | 55.57 |
| **Total** | | | | | | **1.50** | **62.60** | **19.15** | **2.57** | **1.17** | **26,597.05** | **0.62** | **0.11** | **3.02** | **3.04** | **0.25** | **0.11** | **2,084.45** | **0.11** | **1,899.70** |

Notes:
Water trucks assumed to come from Blythe at a distance of approximately 13 miles (26 miles round trip).

| Total | Emissions Summary (lbs/day) VOC | $NO_x$ | CO | PM10 | PM2.5 | CO2 | $CH_4$ | Emissions Summary (tons per phase) VOC | $NO_x$ | CO | PM10 | PM2.5 | $CO_2$ | $CH_4$ | Total GHG Emissions (MT CO2e) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Maximum Daily Emissions** | **4.03** | **84.89** | **115.85** | **2.87** | **1.46** | **44,575.14** | **5.75** | | | | | | | | |
| **Maximum Annual Emissions** | | | | | | | | **0.61** | **7.47** | **22.33** | **0.31** | **0.17** | **5,671.08** | **1.14** | **5,189.62** |

**Phase 2 - Construction - Solar Array Structural Components (Structural Components, Underground Work, Module Installation)**
**Mitigated Emissions**
Phase Duration (days): 399 19 months 21 working days per month

| | | | | | | | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Equipment Type | Equipment Category | Number | Usage Factor (hrs/day or miles/day) | Power Rating (hp) | Load Factor | Total Days/VMT | VOC | NOX | CO | PM10 | PM2.5 | CO2 | CH4 | VOC | NOX | CO | PM10 | PM2.5 | $CO_2$ | CH4 | Total GHG Emissions (MT CO2e) |
| Off-Highway Trucks >176 and <250 | Water truck | 8 | 8 | 238 | 0.38 | 399 | 0.77 | 3.32 | 28.07 | 0.10 | 0.10 | 5,999.68 | 1.94 | 0.15 | 0.66 | 5.60 | 0.02 | 0.02 | 1,196.94 | 0.39 | 1,099.08 |
| Other Construction Equipment >16 and <25 | ATV | 40 | 4 | 24 | 0.40 | 399 | 3.63 | 17.05 | 18.30 | 1.37 | 1.26 | 1,787.85 | 0.58 | 0.72 | 3.40 | 3.65 | 0.27 | 0.25 | 356.68 | 0.12 | 327.52 |
| Air Compressors >26 and <50 | Air Compressor | 2 | 6 | 49 | 0.48 | 399 | 0.07 | 1.71 | 2.55 | 0.00 | 0.00 | 353.61 | 0.06 | 0.01 | 0.34 | 0.51 | 0.00 | 0.00 | 70.55 | 0.01 | 64.48 |
| Cranes >251 and <500 | Crane | 2 | 2 | 400 | 0.29 | 399 | 0.06 | 0.27 | 2.25 | 0.01 | 0.01 | 483.40 | 0.16 | 0.01 | 0.05 | 0.45 | 0.00 | 0.00 | 96.44 | 0.03 | 88.55 |
| Forklifts >51 and <120 | Forklift (5 K) | 10 | 4 | 67 | 0.20 | 399 | 0.14 | 3.24 | 4.37 | 0.01 | 0.01 | 557.20 | 0.18 | 0.03 | 0.65 | 0.87 | 0.00 | 0.00 | 111.16 | 0.04 | 102.07 |
| Aerial Lifts >51 and <120 | Forklift (10 K) (Aerial Lift) | 10 | 4 | 110 | 0.31 | 399 | 0.18 | 0.78 | 11.13 | 0.02 | 0.02 | 1,419.70 | 0.46 | 0.04 | 0.16 | 2.22 | 0.00 | 0.00 | 283.23 | 0.09 | 260.07 |
| Other Construction Equipment >26 and <50 | Post Machine | 14 | 6 | 49 | 0.40 | 399 | 0.44 | 10.48 | 15.63 | 0.03 | 0.03 | 2,012.17 | 0.62 | 0.09 | 2.09 | 3.12 | 0.01 | 0.01 | 401.43 | 0.12 | 368.45 |
| Skid Steer Loaders >51 and <120 | Skid Steer | 20 | 4 | 80 | 0.40 | 399 | 0.34 | 1.36 | 19.32 | 0.04 | 0.04 | 2,463.62 | 0.86 | 0.07 | 0.27 | 3.85 | 0.01 | 0.01 | 491.49 | 0.17 | 451.64 |
| Off-Highway Trucks >176 and <250 | Truck, flatbed (onroad) | 4 | 4 | 238 | 0.38 | 399 | 0.19 | 0.83 | 7.02 | 0.03 | 0.03 | 1,499.92 | 0.49 | 0.04 | 0.17 | 1.40 | 0.01 | 0.01 | 299.23 | 0.10 | 274.77 |
| Off-Highway Trucks >176 and <250 | Truck (onroad) | 30 | 4 | 238 | 0.38 | 399 | 1.44 | 6.22 | 52.64 | 0.19 | 0.19 | 11,249.39 | 3.64 | 0.29 | 1.24 | 10.50 | 0.04 | 0.04 | 2,244.25 | 0.73 | 2,060.77 |
| Generator Sets >51 and <120 | Generator (45 kW) | 1 | 24 | 60 | 0.74 | 399 | 0.28 | 6.44 | 8.69 | 0.02 | 0.02 | 1,335.08 | 0.08 | 0.06 | 1.28 | 1.73 | 0.00 | 0.00 | 266.35 | 0.01 | 242.76 |
| Excavators >51 and <120 | Backhoe/Excavator | 4 | 4 | 90 | 0.37 | 399 | 0.07 | 0.31 | 4.46 | 0.01 | 0.01 | 564.65 | 0.18 | 0.01 | 0.06 | 0.89 | 0.00 | 0.00 | 112.65 | 0.04 | 103.44 |
| Trenchers >51 and <120 | Cable Plow | 1 | 6 | 120 | 0.42 | 399 | 0.04 | 0.21 | 2.94 | 0.01 | 0.01 | 377.09 | 0.12 | 0.01 | 0.04 | 0.59 | 0.00 | 0.00 | 75.23 | 0.02 | 69.08 |
| Trenchers >26 and <50 | Cable Trencher | 1 | 6 | 42 | 0.50 | 399 | 0.03 | 0.76 | 1.14 | 0.00 | 0.00 | 146.42 | 0.05 | 0.01 | 0.15 | 0.23 | 0.00 | 0.00 | 29.21 | 0.01 | 26.82 |
| Paving Equipment >176 and <250 | Compactor | 1 | 4 | 180 | 0.43 | 399 | 0.04 | 0.15 | 1.26 | 0.00 | 0.00 | 269.81 | 0.09 | 0.01 | 0.03 | 0.25 | 0.00 | 0.00 | 53.83 | 0.02 | 49.43 |
| Rollers >176 and <250 | Roller/Vibrator/Padder | 2 | 6 | 180 | 0.38 | 399 | 0.11 | 0.47 | 3.98 | 0.01 | 0.01 | 856.58 | 0.28 | 0.02 | 0.09 | 0.79 | 0.00 | 0.00 | 170.89 | 0.06 | 156.92 |
| Trenchers >26 and <50 | Mini-Trencher | 4 | 6 | 40 | 0.50 | 399 | 0.13 | 2.91 | 4.34 | 0.01 | 0.01 | 557.78 | 0.18 | 0.03 | 0.58 | 0.87 | 0.00 | 0.00 | 111.28 | 0.04 | 102.18 |
| Rollers >51 and <120 | Sheepsfoot Roller | 3 | 6 | 95 | 0.38 | 399 | 0.09 | 0.37 | 5.30 | 0.01 | 0.01 | 678.83 | 0.22 | 0.02 | 0.07 | 1.06 | 0.00 | 0.00 | 135.43 | 0.04 | 124.36 |
| Off-Highway Trucks >251 and <500 | 5 CY Dump Truck | 1 | 4 | 480 | 0.38 | 399 | 0.10 | 0.42 | 3.54 | 0.01 | 0.01 | 763.36 | 0.25 | 0.02 | 0.08 | 0.71 | 0.00 | 0.00 | 152.29 | 0.05 | 139.84 |
| **Total** | | | | | | | **8.14** | **57.30** | **196.920** | **1.90** | **1.79** | **33,376.13** | **10.42** | **1.62** | **11.43** | **39.29** | **0.38** | **0.36** | **6,658.54** | **2.08** | **6,112.21** |

**Notes:**
ATV not modeled with Tier 4 engine.

**On Road Construction Emissions**

| | | | | | | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Trips | Distance | Average Daily Mileage | Calculated Time - Rounded (days) | Total Mileage | VOC | $NO_x$ | CO | PM10 | PM2.5 | CO2 | $CH_4$ | VOC | $NO_x$ | CO | PM10 | PM2.5 | $CO_2$ | $CH_4$ | Total GHG Emissions (MT CO2e) |
| Worker Trips | 427 | 13 | 11,102 | 399 | 4,429,698 | 0.34 | 1.71 | 18.03 | 1.14 | 0.47 | 7 ,342 | 0.70 | 0.07 | 0.34 | 3.60 | 0.23 | 0.09 | 1,464.81 | 0.14 | 1,336.51 |
| Gravel Delivery | - | 13 | - | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Module Delivery | 10 | 150 | 3,000 | 81 | 242,100 | 0.58 | 28.88 | 2.38 | 0.79 | 0.38 | 9,831 | 0.03 | 0.02 | 1.17 | 0.10 | 0.03 | 0.02 | 396.66 | 0.00 | 361.00 |
| Tracker Delivery | 9 | 150 | 2,700 | 207 | 560,100 | 0.52 | 25.99 | 2.14 | 0.71 | 0.34 | 8,847 | 0.03 | 0.05 | 2.70 | 0.22 | 0.07 | 0.04 | 917.68 | 0.00 | 835.17 |
| Foundation Delivery | 10 | 150 | 3,000 | 98 | 293,550 | 0.58 | 28.88 | 2.38 | 0.79 | 0.38 | 9,831 | 0.03 | 0.03 | 1.41 | 0.12 | 0.04 | 0.02 | 480.96 | 0.00 | 437.71 |
| Inverter Delivery | 2 | 150 | 600 | 36 | 21,750 | 0.12 | 5.78 | 0.48 | 0.16 | 0.08 | 1,966 | 0.01 | 0.00 | 0.10 | 0.01 | 0.00 | 0.00 | 35.64 | 0.00 | 32.43 |
| Water Delivery Trips | 14 | 13 | 364 | 102 | 37,267 | 0.07 | 3.50 | 0.29 | 0.10 | 0.05 | 1 ,193 | 0.00 | 0.00 | 0.18 | 0.01 | 0.00 | 0.00 | 61.06 | 0.00 | 55.57 |
| **Total** | | | | | | **2.21** | **94.74** | **25.69** | **3.69** | **1.68** | **39,009.78** | **0.80** | **0.18** | **5.90** | **4.05** | **0.38** | **0.17** | **3,356.80** | **0.15** | **3,058.39** |

Water trucks assumed to come from Blythe at a distance of approximately 13 miles (26 miles round trip).

| | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total** | VOC | $NO_x$ | CO | PM10 | PM2.5 | CO2 | $CH_4$ | VOC | $NO_x$ | CO | PM10 | PM2.5 | $CO_2$ | $CH_4$ | Total GHG Emissions (MT CO2e) |
| **Maximum Daily Emissions** | **10.35** | **152.04** | **222.61** | **5.59** | **3.47** | **72,385.91** | **11.22** | | | | | | | | |
| **Maximum Annual Emissions** | | | | | | | | **1.80** | **17.33** | **43.34** | **0.76** | **0.52** | **10,015.34** | **2.22** | **9,170.60** |

**Phase 3 - Construction - Electrical (Substation, Gen-Tie, Collection System, Energy Storage, O&M Building)**
**Mitigated Emissions**

Phase Duration (days): 378 | 18 months | 21 working days per month

| | | | | | | | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Equipment Type | Equipment Category | Number | Usage Factor (hrs/day or miles/day) | Power Rating (hp) | Load Factor | Total Days/VMT | VOC | NOX | CO | PM10 | PM2.5 | CO2 | CH4 | VOC | NOX | CO | PM10 | PM2.5 | $CO_2$ | CH4 | Total GHG Emissions (MT CO2e) |
| Off-Highway Trucks >176 and <250 | Water truck | 4 | 8 | 230 | 0.38 | 378 | 0.37 | 1.60 | 13.56 | 0.05 | 0.05 | 2,899.00 | 0.94 | 0.07 | 0.30 | 2.56 | 0.01 | 0.01 | 547.91 | 0.18 | 503.12 |
| Bore/Drill Rigs >176 and <250 | Auger | 5 | 4 | 238 | 0.50 | 378 | 0.31 | 1.36 | 11.54 | 0.04 | 0.04 | 2,449.48 | 0.79 | 0.06 | 0.26 | 2.18 | 0.01 | 0.01 | 462.95 | 0.15 | 425.10 |
| Excavators >51 and <120 | Backhoe/Excavator | 6 | 4 | 90 | 0.37 | 378 | 0.11 | 0.46 | 6.52 | 0.01 | 0.01 | 824.68 | 0.27 | 0.02 | 0.09 | 1.23 | 0.00 | 0.00 | 155.86 | 0.05 | 143.12 |
| Cranes >251 and <500 | Crane | 6 | 5 | 400 | 0.29 | 378 | 0.46 | 1.99 | 16.88 | 0.06 | 0.06 | 3,625.51 | 1.17 | 0.09 | 0.38 | 3.19 | 0.01 | 0.01 | 685.22 | 0.22 | 629.20 |
| Forklifts >51 and <120 | Forklift | 3 | 4 | 90 | 0.20 | 378 | 0.03 | 0.12 | 1.76 | 0.00 | 0.00 | 224.54 | 0.07 | 0.01 | 0.02 | 0.33 | 0.00 | 0.00 | 42.44 | 0.01 | 38.97 |
| Excavators >26 and <50 | Mini Excavator | 1 | 6 | 42 | 0.50 | 378 | 0.03 | 0.76 | 1.14 | 0.00 | 0.00 | 145.94 | 0.05 | 0.01 | 0.14 | 0.22 | 0.00 | 0.00 | 27.58 | 0.01 | 25.33 |
| Aerial Lifts >51 and <120 | Man/Aerial Lift | 2 | 4 | 60 | 0.31 | 378 | 0.04 | 0.90 | 1.21 | 0.00 | 0.00 | 154.88 | 0.05 | 0.01 | 0.17 | 0.23 | 0.00 | 0.00 | 29.27 | 0.01 | 26.88 |
| Tractors/Loaders/Backhoes >176 and <250 | Tractor | 1 | 6 | 190 | 0.36 | 378 | 0.05 | 0.24 | 1.99 | 0.01 | 0.01 | 425.70 | 0.14 | 0.01 | 0.04 | 0.38 | 0.00 | 0.00 | 80.46 | 0.03 | 73.88 |
| Off-Highway Trucks >176 and <250 | Truck, flatbed (onroad) | 2 | 2 | 200 | 0.38 | 378 | 0.04 | 0.17 | 1.47 | 0.01 | 0.01 | 315.11 | 0.10 | 0.01 | 0.03 | 0.28 | 0.00 | 0.00 | 59.56 | 0.02 | 54.69 |
| Off-Highway Trucks >176 and <250 | Truck (onroad) | 13 | 2 | 200 | 0.38 | 378 | 0.26 | 1.13 | 9.58 | 0.03 | 0.03 | 2,048.21 | 0.66 | 0.05 | 0.21 | 1.81 | 0.01 | 0.01 | 387.11 | 0.13 | 355.46 |
| Generator Sets >51 and <120 | Generator (45 kW) | 2 | 4 | 60 | 0.74 | 378 | 0.09 | 2.15 | 2.90 | 0.01 | 0.01 | 445.03 | 0.03 | 0.02 | 0.41 | 0.55 | 0.00 | 0.00 | 84.11 | 0.00 | 76.66 |
| Crawler Tractors >121 and <175 | Crawler Tractor | 1 | 4 | 147 | 0.29 | 126 | 0.02 | 0.10 | 1.39 | 0.00 | 0.00 | 177.07 | 0.06 | 0.00 | 0.01 | 0.09 | 0.00 | 0.00 | 11.16 | 0.00 | 10.24 |
| Tractors/Loaders/Backhoes >176 and <250 | Truck Mounted Digger | 1 | 4 | 190 | 0.42 | 126 | 0.04 | 0.18 | 1.55 | 0.01 | 0.01 | 331.10 | 0.11 | 0.00 | 0.01 | 0.10 | 0.00 | 0.00 | 20.86 | 0.01 | 19.15 |
| Other Construction Equipment >251 and <500 | Tensioner | 1 | 4 | 238 | 0.42 | 126 | 0.05 | 0.23 | 1.94 | 0.01 | 0.01 | 418.92 | 0.14 | 0.00 | 0.01 | 0.12 | 0.00 | 0.00 | 26.39 | 0.01 | 24.23 |
| Off-Highway Trucks >176 and <250 | Wire Truck | 1 | 4 | 238 | 0.38 | 126 | 0.05 | 0.21 | 1.75 | 0.01 | 0.01 | 374.98 | 0.12 | 0.00 | 0.01 | 0.11 | 0.00 | 0.00 | 23.62 | 0.01 | 21.69 |
| Graders >176 and <250 | Motor Grader | 1 | 1 | 185 | 0.41 | 126 | 0.01 | 0.04 | 0.37 | 0.00 | 0.00 | 79.48 | 0.03 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 5.01 | 0.00 | 4.60 |
| Scrapers >251 and <500 | Scraper | 1 | 1 | 365 | 0.40 | 126 | 0.02 | 0.08 | 0.71 | 0.00 | 0.00 | 151.98 | 0.05 | 0.00 | 0.01 | 0.04 | 0.00 | 0.00 | 9.57 | 0.00 | 8.79 |
| Trenchers >26 and <50 | Cable Trencher | 5 | 10 | 42 | 0.50 | 126 | 0.28 | 6.37 | 9.49 | 0.02 | 0.02 | 1,220.15 | 0.39 | 0.02 | 0.40 | 0.60 | 0.00 | 0.00 | 76.87 | 0.02 | 70.58 |
| **Total** | | | | | | | **2.27** | **18.10** | **85.77** | **0.27** | **0.27** | **16,311.75** | **5.16** | **0.37** | **2.51** | **14.04** | **0.05** | **0.05** | **2,735.96** | **0.86** | **2,511.70** |

**On Road Construction Emissions**

| | | | | | | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Trips | Distance | Average Daily Mileage | Calculated Time - Rounded (days) | Total Mileage | VOC | $NO_x$ | CO | PM10 | PM2.5 | CO2 | $CH_4$ | VOC | $NO_x$ | CO | PM10 | PM2.5 | $CO_2$ | $CH_4$ | Total GHG Emissions (MT CO2e) |
| Worker Trips | 180 | 13 | 4,680 | 378 | 1,769,040 | 0.14 | 0.72 | 7.60 | 0.48 | 0.20 | 3 ,095 | 0.29 | 0.03 | 0.14 | 1.44 | 0.09 | 0.04 | 584.98 | 0.06 | 533.75 |
| Inverter Delivery | 2 | 150 | 600 | 36 | 21,750 | 0.12 | 5.78 | 0.48 | 0.16 | 0.08 | 1,966 | 0.01 | 0.00 | 0.10 | 0.01 | 0.00 | 0.00 | 35.64 | 0.00 | 32.43 |
| Concrete Truck Trips (Unless Batched on site) | 9 | 13 | 234 | 378 | 88,452 | 0.05 | 2.25 | 0.19 | 0.06 | 0.03 | 767 | 0.00 | 0.01 | 0.43 | 0.04 | 0.01 | 0.01 | 144.92 | 0.00 | 131.88 |
| Water Delivery Trips | 14 | 13 | 364 | 102 | 37,267 | 0.07 | 3.50 | 0.29 | 0.10 | 0.05 | 1 ,193 | 0.00 | 0.00 | 0.18 | 0.01 | 0.00 | 0.00 | 61.06 | 0.00 | 55.57 |
| **Total** | | | | | | **0.37** | **12.25** | **8.55** | **0.80** | **0.35** | **7,020.81** | **0.31** | **0.04** | **0.85** | **1.49** | **0.11** | **0.05** | **826.60** | **0.06** | **753.62** |

Concrete and water trucks assumed to haul material from Blythe at a distance of approximately 13 miles (26 miles round trip).

| | Emissions Summary (lbs/day) | | | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | VOC | $NO_x$ | CO | PM10 | PM2.5 | CO2 | $CH_4$ | VOC | $NO_x$ | CO | PM10 | PM2.5 | $CO_2$ | $CH_4$ | Total GHG Emissions (MT CO2e) |
| **Maximum Daily Emissions** | **2.65** | **30.36** | **94.32** | **1.07** | **0.62** | **23,332.56** | **5.46** | | | | | | | | |
| **Maximum Annual Emissions** | | | | | | | | **0.41** | **3.36** | **15.54** | **0.16** | **0.09** | **3,562.56** | **0.92** | **3,265.32** |

**Fugitive Dust Summary**

**Option A**

| Construction Activity/Year | Construction Days | Daily Emissions $PM_{10}$ (lbs/day) | Daily Emissions $PM_{2.5}$ (lbs/day) | Total Emissions $PM_{10}$ (tons) | Total Emissions $PM_{2.5}$ (tons) |
|---|---|---|---|---|---|
| Phase I | 399 | 210.91 | 37.55 | 42.08 | 7.49 |
| Phase II | 399 | 241.92 | 27.79 | 48.26 | 5.54 |
| Phase III | 378 | 117.73 | 11.81 | 22.25 | 2.23 |

Note: Estimates do not include emission reductions associated with the fugitive dust control measures.

**Fugitive Dust Summary - Mitigated**

**Option A**

| Construction Activity/Year | Construction Days | Daily Emissions $PM_{10}$ (lbs/day) | Daily Emissions $PM_{2.5}$ (lbs/day) | Total Emissions $PM_{10}$ (tons) | Total Emissions $PM_{2.5}$ (tons) |
|---|---|---|---|---|---|
| Phase I | 399 | 42.45 | 9.66 | 8.47 | 1.93 |
| Phase II | 399 | 43.16 | 4.48 | 8.61 | 0.89 |
| Phase III | 378 | 22.01 | 2.19 | 4.16 | 0.41 |

Note: Estimates include emission reductions associated with the fugitive dust control measures.

**Crimson Solar Fugitive Dust Emissions**
**Reduced Acreage Alternative**
**Fugitive Dust - Truck Loading Emissions**

| | | | | | Unmitigated | | Mitigated | | Unmitigated | | Mitigated | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Construction Phase/Subphase** | **Work Days** | **Total Materials Moved (cy)** | **Total Materials Moved (tons)** | **Daily Materials Moved (tons/day)** | **Daily $PM_{10}$ (lbs/day)** | **Daily $PM_{2.5}$ (lbs/day)** | **Daily $PM_{10}$ (lbs/day)** | **Daily $PM_{2.5}$ (lbs/day)** | **$PM_{10}$ (tons)** | **$PM_{2.5}$ (tons)** | **$PM_{10}$ (tons)** | **$PM_{2.5}$ (tons)** |
| Phase I | 399 | 167,316 | 250,974 | 629.01 | 0.187 | 0.028 | 0.075 | 0.011 | 0.037 | 0.006 | 0.015 | 0.002 |

**Earthwork Fugitive Particulate Matter Emissions - Bulldozing, Scraping and Grading**

| | | | | | | Unmitigated | | Mitigated | | Unmitigated | | Mitigated | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Activity** | **Equipment** | **Daily Activity Level** | **Total Activity Level** | **PM10 Emission Factor (lb/activity)** | **PM2.5 Emission Factor (lb/activity)** | **PM10 (lb/day)** | **PM2.5 (lb/day)** | **Daily $PM_{10}$ (lbs/day)** | **Daily $PM_{2.5}$ (lbs/day)** | **$PM_{10}$ (tons)** | **$PM_{2.5}$ (tons)** | **$PM_{10}$ (tons)** | **$PM_{2.5}$ (tons)** |
| Phase I | 7 | 6.0 | 42.0 | 0.753 | 0.415 | 31.62 | 17.42 | 12.65 | 6.97 | 6.31 | 3.48 | 2.52 | 1.39 |
| Phase II | 0 | 0.0 | 0.0 | 0.753 | 0.415 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Phase III | 2 | 1.0 | 2.0 | 0.753 | 0.415 | 1.51 | 0.83 | 0.60 | 0.33 | 0.28 | 0.16 | 0.11 | 0.06 |

| | | |
|---|---|---|
| Rule 403 Control Measures | 0.6 | percent reduction |
| Work Days Per Week | 5 | |
| Work Days Per Month | 21 | |

**Paved Roads Fugitive Dust Emissions**

| | |
|---|---|
| Paved Roads | 100% |

| | | | Paved Road Dust Emissions (lbs/day) | | Paved Road Dust Emissions (tons) | |
|---|---|---|---|---|---|---|
| | **Vehicle Type** | **Miles Per Day** | **PM10** | **PM2.5** | **PM10** | **PM2.5** |
| Option A - Phase I | Truck | 6,364 | 26.26 | 6.45 | 1.02 | 0.25 |
| Option A - Phase II | Truck | 9,664 | 39.88 | 9.79 | 4.63 | 1.14 |
| Option A - Phase III | Truck | 1,198 | 4.94 | 1.21 | 0.29 | 0.07 |
| | **Vehicle Type** | **Miles Per Day** | **PM10** | **PM2.5** | **PM10** | **PM2.5** |
| Option A - Phase I | Worker | 8,684 | 5.62 | 1.38 | 0.22 | 0.05 |
| Option A - Phase II | Worker | 11,102 | 7.19 | 1.76 | 0.83 | 0.20 |
| Option A - Phase III | Worker | 4,680 | 3.03 | 0.74 | 0.18 | 0.04 |

**Paved Road Dust** $EF_{DUST} = [(k(sL)^{0.91} \times (W)^{1.02}](1 - P/4N))$

Source: AP-42 Section 13.2.1 (Paved Roads) - http://www.epa.gov/ttnchie1/ap42/ch13/final/c13s0201.pdf

| **Variable** | **Value** | **Description** |
|---|---|---|
| k (PM10) | 0.0022 | particle size multiplier for particle size rangeand units of interest (lb/VMT) |
| k (PM2.5) | 0.00054 | particle size multiplier for particle size range and units of interest (lb/VMT) |
| sL | 0.1 | road surface silt loading (g/m$^2$) |
| W | 2.4 | average weight (tons) of vehicles (2.4 tons) |
| W | 14.75 | haul truck tons |
| P | 30 | number of "wet" days with at least 0.254 mm of precipitation during the averaging period |
| N | 365 | number of days in averaging period |

**Pickup and Worker**

| | | |
|---|---|---|
| EF (PM10) | 0.000647473 | lb/VMT |
| EF (PM2.5) | 0.000158925 | lb/VMT |
| **Haul Truck** | | |
| EF (PM10) | 0.004126423 | lb/VMT |
| EF (PM2.5) | 0.001012849 | lb/VMT |

**Fugitive Dust - Unpaved Roads**

| | Daily On-Site Construction Motor Vehicle Fugitive Particulate Matter Emissions | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Silt Loading ($g/m^2$)/ Silt Content (%)[a] | | Uncontrolled Emission Factors (lb/mi)[b] | | Uncontrolled Emissions (lb/day)[c] | | | Controlled Emissions (lb/day)[e] | | Uncontrolled Emissions (tons) | | Controlled Emissions (tons) | |
| | Vehicle Type | Trips Per Day | Mi/Veh-Day | Surface Type | | Vehicle Weight (tons) | PM10 | PM2.5 | PM10 | PM2.5 | Control Efficiency[d] | PM10 | PM2.5 | PM10 | PM2.5 | PM10 | PM2.5 |
| Option A - Phase I | Truck | 34 | 2.00 | Unpaved | 5 | 25 | 2.17 | 0.18 | 147.2 | 12.3 | 81% | 28.5 | 2.4 | 29.4 | 2.4 | 5.7 | 0.5 |
| Option A - Phase II | Truck | 45 | 2.00 | Unpaved | 5 | 25 | 2.17 | 0.18 | 194.9 | 16.2 | 81% | 37.7 | 3.1 | 38.9 | 3.2 | 7.5 | 0.6 |
| Option A - Phase III | Truck | 25 | 2.00 | Unpaved | 5 | 25 | 2.17 | 0.18 | 108.3 | 9.0 | 81% | 20.9 | 1.7 | 20.5 | 1.7 | 4.0 | 0.3 |

Note: Totals may not match sum of individual values because of rounding.

[a] Unpaved surface silt content from SCAQMD CEQA Handbook, (1993) Table A9-9-D-1 for city and county roads

[b] Equations:

EF (unpaved) = $k_u (s/12)^a (W/3)^b$ Ref: AP-42, Section 13.2.2, "Unpaved Roads," November 2006

Constants:

| | | |
|---|---|---|
| $k_u$ = | 1.8 | (Particle size multiplier for PM) |
| | 0.15 | (Particle size multiplier for PM2.5) |
| a = | 1 | for PM10 |
| | 1 | for PM2.5 |
| b = | 0.5 | for PM10 |
| | 0.5 | for PM2.5 |

[c] Uncontrolled emissions [lb/day] = Emission factor [lb/mi] x Number x Daily miles traveled [mi/vehicle-day]

[d] Control efficiency from watering unpaved road twice a day (55%) and limiting maximum speed to 15 mph (57%), from Table XI-A, Mitigation Measure Examples, Fugitive Dust from Construction & Demolition, http://www.aqmd.gov/ceqa/handbook/mitigation/fugitive/MM_fugitive.html

[e] Controlled emissions [lb/day] = Uncontrolled emissions [lb/day] x (1 - Control efficiency [%])

**Fugitive Dust Emission Factors**

**Truck Loading Fugitive Dust Emission Factors**

$$EF_D = k \times (0.0032) \times ((U/5)^{1.3})/((M/2)^{1.4})$$

| Variable | Amount | Units | |
|---|---|---|---|
| EF ($PM_{10}$) | 0.0003 | lb/ton | |
| EF ($PM_{2.5}$) | 0.00004 | lb/ton | |
| k ($PM_{10}$) | 0.35 | factor | |
| k ($PM_{2.5}$) | 0.053 | factor | |
| U (mean wind speed) | 7.90 | miles/hr | WRCC average Annual Wind Speed Data for Blythe Airport |
| M (moisture content) | 7.90 | percent | USEPA, AP-42, July 1998, Table 11.9-3 Typical Values for Correction Factors Applicable to the Predictive Emission Factor Equations |
| Soil density (CalEEMod default) | 1.26 | tons/cy | |
| Rip rap density | 2.23 | tons/cy | |
| Gravel density | 1.50 | tons/cy | |

**E (lbs) = EF (lb/ton) x TP (tons)**

**Bulldozing, Scraping and Grading**

PM10 Emission Factor [lb/hr] = 0.75 x (silt content [%])$^{1.5}$ / (moisture)$^{1.4}$

PM2.5 Emission Factor [lb/hr] = 0.60 x (silt content [%])$^{1.2}$ / (moisture)$^{1.3}$

Reference: AP-42, Table 11.9-1, July 1998

| Parameter | Value | Basis |
|---|---|---|
| Silt Content | 6.9 | USEPA, AP-42, July 1998, Table 11.9-3 Typical Values for Correction Factors Applicable to the Predictive Emission Factor Equations |
| Moisture | 7.9 | USEPA, AP-42, July 1998, Table 11.9-3 Typical Values for Correction Factors Applicable to the Predictive Emission Factor Equations |

| | | |
|---|---|---|
| PM10 Emission Factor | 0.75 | lb/hr |
| PM2.5 Emission Factor | 0.41 | lb/hr |

Emissions [pounds per day] = Controlled emission factor [pounds per hour] x Bulldozing, scraping or grading time [hours/day]

**Emission Factors - OFFROAD**

| Equipment Type | Year | Low HP | High HP | TOG (g/bhp-hr) | ROG (g/bhp-hr) | CO (g/bhp-hr) | NOX (g/bhp-hr) | SO2 (g/bhp-hr) | PM10 (g/bhp-hr) | PM2.5 (g/bhp-hr) | CO2 (g/bhp-hr) | CH4 (g/bhp-hr) | Load Factor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aerial Lifts | 2020 | 6 | 15 | 0.199447 | 0.1676 | 3.09942 | 2.95486 | 0.0054 | 0.0309 | 0.0284 | 525.0743 | 0.1698 | 0.31 |
| Aerial Lifts | 2020 | 16 | 25 | 0.199447 | 0.1676 | 3.09942 | 2.95486 | 0.0054 | 0.0309 | 0.0284 | 525.0743 | 0.1698 | 0.31 |
| Aerial Lifts | 2020 | 26 | 50 | 0.199447 | 0.1676 | 3.09942 | 2.95486 | 0.0054 | 0.0309 | 0.0284 | 525.0743 | 0.1698 | 0.31 |
| Aerial Lifts >51 and <120 | 2020 | 51 | 120 | 0.136778 | 0.1149 | 3.1768 | 1.86859 | 0.0049 | 0.0416 | 0.0382 | 472.1142 | 0.1527 | 0.31 |
| Aerial Lifts | 2020 | 251 | 500 | 0.081859 | 0.0688 | 0.94623 | 0.63803 | 0.0049 | 0.009 | 0.0083 | 472.0545 | 0.1527 | 0.31 |
| Aerial Lifts | 2020 | 501 | 750 | 26.846 | 0.2 | 1.013 | 1.868 | 0.005 | 0.057 | 0.057 | 568.299 | 0.018 | 0.31 |
| Air Compressors | 2020 | 6 | 15 | 1.907 | 0.731 | 3.546 | 4.542 | 0.008 | 0.227 | 0.227 | 568.299 | 0.066 | 0.48 |
| Air Compressors | 2020 | 16 | 25 | 4.009 | 0.769 | 2.473 | 4.538 | 0.007 | 0.212 | 0.212 | 568.3 | 0.069 | 0.48 |
| Air Compressors >26 and <50 | 2020 | 26 | 50 | 8.048 | 1.001 | 5.164 | 4.397 | 0.007 | 0.25 | 0.25 | 568.299 | 0.09 | 0.48 |
| Air Compressors | 2020 | 51 | 120 | 8.287 | 0.489 | 3.698 | 3.4 | 0.006 | 0.224 | 0.224 | 568.299 | 0.044 | 0.48 |
| Air Compressors | 2020 | 121 | 175 | 11.957 | 0.374 | 3.203 | 2.558 | 0.006 | 0.133 | 0.133 | 568.299 | 0.033 | 0.48 |
| Air Compressors | 2020 | 176 | 250 | 13.668 | 0.288 | 1.121 | 2.172 | 0.006 | 0.069 | 0.069 | 568.299 | 0.026 | 0.48 |
| Air Compressors | 2020 | 251 | 500 | 23.406 | 0.279 | 1.076 | 1.935 | 0.005 | 0.067 | 0.067 | 568.299 | 0.025 | 0.48 |
| Air Compressors | 2020 | 501 | 750 | 36.303 | 0.28 | 1.076 | 1.982 | 0.005 | 0.067 | 0.067 | 568.299 | 0.025 | 0.48 |
| Air Compressors | 2020 | 751 | 1000 | 53.87 | 0.306 | 1.158 | 3.828 | 0.005 | 0.093 | 0.093 | 568.3 | 0.027 | 0.48 |
| Bore/Drill Rigs | 2020 | 6 | 15 | 0.851825 | 0.7158 | 4.51013 | 4.6451 | 0.0055 | 0.2941 | 0.2706 | 535.2948 | 0.1731 | 0.5 |
| Bore/Drill Rigs | 2020 | 16 | 25 | 0.851825 | 0.7158 | 4.51013 | 4.6451 | 0.0055 | 0.2941 | 0.2706 | 535.2948 | 0.1731 | 0.5 |
| Bore/Drill Rigs | 2020 | 26 | 50 | 0.851825 | 0.7158 | 4.51013 | 4.6451 | 0.0055 | 0.2941 | 0.2706 | 535.2948 | 0.1731 | 0.5 |
| Bore/Drill Rigs | 2020 | 51 | 120 | 0.292949 | 0.2462 | 3.32347 | 3.06601 | 0.0048 | 0.1586 | 0.1459 | 463.5827 | 0.1499 | 0.5 |
| Bore/Drill Rigs >121 and <175 | 2020 | 121 | 175 | 0.207426 | 0.1743 | 2.96948 | 1.87149 | 0.0049 | 0.0822 | 0.0757 | 477.722 | 0.1545 | 0.5 |
| Bore/Drill Rigs >176 and <250 | 2020 | 176 | 250 | 0.169462 | 0.1424 | 1.06766 | 1.80732 | 0.0048 | 0.0521 | 0.0479 | 466.8342 | 0.151 | 0.5 |
| Bore/Drill Rigs | 2020 | 251 | 500 | 0.148188 | 0.1245 | 1.01263 | 1.40938 | 0.0048 | 0.0446 | 0.041 | 466.8219 | 0.151 | 0.5 |
| Bore/Drill Rigs | 2020 | 501 | 750 | 0.129293 | 0.1086 | 0.97413 | 1.23085 | 0.0049 | 0.0409 | 0.0377 | 473.6679 | 0.1532 | 0.5 |
| Bore/Drill Rigs | 2020 | 751 | 1000 | 0.158163 | 0.1329 | 0.98839 | 3.05008 | 0.0049 | 0.0612 | 0.0563 | 471.8492 | 0.1526 | 0.5 |
| Cement and Mortar Mixers | 2020 | 6 | 15 | 1.075 | 0.661 | 3.47 | 4.142 | 0.008 | 0.161 | 0.161 | 568.299 | 0.059 | 0.56 |
| Cement and Mortar Mixers | 2020 | 16 | 25 | 3.265 | 0.723 | 2.397 | 4.442 | 0.007 | 0.187 | 0.187 | 568.299 | 0.065 | 0.56 |
| Concrete/Industrial Saws | 2020 | 16 | 25 | 1.532 | 0.685 | 2.339 | 4.332 | 0.007 | 0.161 | 0.161 | 568.299 | 0.061 | 0.73 |
| Concrete/Industrial Saws >26 and <50 | 2020 | 26 | 50 | 3.271 | 0.798 | 4.552 | 4.196 | 0.007 | 0.212 | 0.212 | 568.299 | 0.072 | 0.73 |
| Concrete/Industrial Saws | 2020 | 51 | 120 | 4.042 | 0.401 | 3.535 | 3.163 | 0.006 | 0.19 | 0.19 | 568.299 | 0.036 | 0.73 |
| Concrete/Industrial Saws | 2020 | 121 | 175 | 6.669 | 0.306 | 3.072 | 2.324 | 0.006 | 0.114 | 0.114 | 568.299 | 0.027 | 0.73 |
| Cranes | 2020 | 26 | 50 | 2.47956 | 2.0835 | 7.37625 | 5.98471 | 0.0053 | 0.6237 | 0.5738 | 517.9263 | 0.1675 | 0.29 |
| Cranes | 2020 | 51 | 120 | 0.871016 | 0.7319 | 4.17141 | 6.38117 | 0.0048 | 0.4529 | 0.4167 | 469.8821 | 0.152 | 0.29 |
| Cranes | 2020 | 121 | 175 | 0.638941 | 0.5369 | 3.56232 | 5.5697 | 0.0049 | 0.2978 | 0.274 | 474.5939 | 0.1535 | 0.29 |
| Cranes >176 and <250 | 2020 | 176 | 250 | 0.45669 | 0.3837 | 1.7904 | 4.56329 | 0.0049 | 0.1881 | 0.1731 | 472.9488 | 0.153 | 0.29 |
| Cranes >251 and <500 | 2020 | 251 | 500 | 0.381547 | 0.3206 | 2.66037 | 3.86243 | 0.0049 | 0.1548 | 0.1424 | 472.5579 | 0.1528 | 0.29 |
| Cranes | 2020 | 501 | 750 | 0.287724 | 0.2418 | 1.44353 | 3.10471 | 0.0049 | 0.116 | 0.1067 | 470.4254 | 0.1521 | 0.29 |
| Cranes | 2020 | 1001 | 9999 | 0.216797 | 0.1822 | 0.99943 | 2.3614 | 0.0049 | 0.0604 | 0.0556 | 472.0545 | 0.1527 | 0.29 |
| Crawler Tractors | 2020 | 26 | 50 | 2.443056 | 2.0528 | 7.3 | 5.64276 | 0.0053 | 0.5912 | 0.5439 | 515.679 | 0.1668 | 0.43 |
| Crawler Tractors | 2020 | 51 | 120 | 0.850709 | 0.7148 | 4.04412 | 6.00933 | 0.0049 | 0.5005 | 0.4604 | 476.3284 | 0.1541 | 0.43 |
| Crawler Tractors >121 and <175 | 2020 | 121 | 175 | 0.566576 | 0.4761 | 3.33989 | 4.87226 | 0.0049 | 0.2722 | 0.2504 | 471.015 | 0.1523 | 0.43 |
| Crawler Tractors | 2020 | 176 | 250 | 0.428471 | 0.36 | 1.55491 | 4.63225 | 0.0049 | 0.1746 | 0.1606 | 472.941 | 0.153 | 0.43 |
| Crawler Tractors | 2020 | 251 | 500 | 0.358593 | 0.3013 | 2.0875 | 3.62175 | 0.0049 | 0.1409 | 0.1296 | 475.2338 | 0.1537 | 0.43 |
| Crawler Tractors | 2020 | 501 | 750 | 0.304872 | 0.2562 | 1.31018 | 3.13716 | 0.0049 | 0.1151 | 0.1059 | 473.3119 | 0.1531 | 0.43 |
| Crawler Tractors | 2020 | 751 | 1000 | 0.551035 | 0.463 | 2.02764 | 7.23682 | 0.0049 | 0.212 | 0.195 | 475.6525 | 0.1538 | 0.43 |
| Crushing/Proc. Equipment | 2020 | 26 | 50 | 2.489 | 0.947 | 5.211 | 4.347 | 0.007 | 0.233 | 0.233 | 568.299 | 0.085 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 51 | 120 | 2.348 | 0.473 | 3.722 | 3.249 | 0.006 | 0.206 | 0.206 | 568.299 | 0.042 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 121 | 175 | 3.673 | 0.367 | 3.234 | 2.392 | 0.006 | 0.124 | 0.124 | 568.299 | 0.033 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 176 | 250 | 4.222 | 0.289 | 1.125 | 2.014 | 0.006 | 0.065 | 0.065 | 568.299 | 0.026 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 251 | 500 | 6.283 | 0.281 | 1.078 | 1.799 | 0.005 | 0.063 | 0.063 | 568.299 | 0.025 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 501 | 750 | 9.884 | 0.281 | 1.077 | 1.835 | 0.005 | 0.063 | 0.063 | 568.299 | 0.025 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 1001 | 9999 | 25.755 | 0.329 | 1.153 | 3.699 | 0.005 | 0.089 | 0.089 | 568.299 | 0.029 | 0.78 |
| Dumpers/Tenders | 2020 | 16 | 25 | 0.819 | 0.685 | 2.339 | 4.336 | 0.007 | 0.165 | 0.165 | 568.299 | 0.061 | 0.38 |
| Excavators | 2020 | 16 | 25 | 0.705964 | 0.5932 | 4.50032 | 4.03131 | 0.0054 | 0.2222 | 0.2044 | 525.3675 | 0.1699 | 0.38 |
| Excavators >26 and <50 | 2020 | 26 | 50 | 0.705964 | 0.5932 | 4.50032 | 4.03131 | 0.0054 | 0.2222 | 0.2044 | 525.3675 | 0.1699 | 0.38 |
| Excavators >51 and <120 | 2020 | 51 | 120 | 0.356064 | 0.2992 | 3.50495 | 3.08964 | 0.0048 | 0.1848 | 0.17 | 468.0546 | 0.1514 | 0.38 |
| Excavators | 2020 | 121 | 175 | 0.275327 | 0.2314 | 3.08597 | 2.27838 | 0.0049 | 0.1104 | 0.1015 | 472.2891 | 0.1527 | 0.38 |
| Excavators | 2020 | 176 | 250 | 0.211076 | 0.1774 | 1.11778 | 2.02738 | 0.0049 | 0.0614 | 0.0565 | 471.8828 | 0.1526 | 0.38 |
| Excavators >251 and <500 | 2020 | 251 | 500 | 0.182542 | 0.1534 | 1.1016 | 1.57199 | 0.0049 | 0.0518 | 0.0476 | 470.2956 | 0.1521 | 0.38 |
| Excavators | 2020 | 501 | 750 | 0.202011 | 0.1697 | 1.14543 | 1.79718 | 0.0048 | 0.0612 | 0.0563 | 468.8706 | 0.1516 | 0.38 |
| Forklifts | 2020 | 26 | 50 | 1.337399 | 1.1238 | 5.70563 | 4.68572 | 0.0054 | 0.3601 | 0.3313 | 525.4833 | 0.17 | 0.2 |
| Forklifts >51 and <120 | 2020 | 51 | 120 | 0.545921 | 0.4587 | 3.75954 | 4.13299 | 0.0049 | 0.3079 | 0.2833 | 471.5285 | 0.1525 | 0.2 |
| Forklifts | 2020 | 121 | 175 | 0.402357 | 0.3381 | 3.24885 | 3.3196 | 0.0049 | 0.1797 | 0.1653 | 472.1062 | 0.1527 | 0.2 |
| Forklifts | 2020 | 176 | 250 | 0.348476 | 0.2928 | 1.44178 | 3.24149 | 0.0049 | 0.1259 | 0.1158 | 473.3255 | 0.1531 | 0.2 |
| Forklifts | 2020 | 251 | 500 | 0.299035 | 0.2513 | 1.47807 | 2.43991 | 0.0049 | 0.0967 | 0.0889 | 473.6151 | 0.1532 | 0.2 |
| Generator Sets | 2020 | 6 | 15 | 1.715 | 0.646 | 3.546 | 4.516 | 0.008 | 0.212 | 0.212 | 568.299 | 0.058 | 0.74 |
| Generator Sets | 2020 | 16 | 25 | 3.307 | 0.721 | 2.473 | 4.538 | 0.007 | 0.205 | 0.205 | 568.299 | 0.065 | 0.74 |
| Generator Sets >26 and <50 | 2020 | 26 | 50 | 5.508 | 0.691 | 3.995 | 4.075 | 0.007 | 0.194 | 0.194 | 568.299 | 0.062 | 0.74 |
| Generator Sets >51 and <120 | 2020 | 51 | 120 | 7.383 | 0.364 | 3.38 | 3.173 | 0.006 | 0.179 | 0.179 | 568.299 | 0.032 | 0.74 |
| Generator Sets | 2020 | 121 | 175 | 9.884 | 0.267 | 2.93 | 2.38 | 0.006 | 0.105 | 0.105 | 568.299 | 0.024 | 0.74 |
| Generator Sets | 2020 | 176 | 250 | 10.963 | 0.198 | 1.026 | 2.016 | 0.006 | 0.057 | 0.057 | 568.299 | 0.017 | 0.74 |
| Generator Sets | 2020 | 251 | 500 | 16.528 | 0.188 | 1.005 | 1.816 | 0.005 | 0.055 | 0.055 | 568.299 | 0.017 | 0.74 |
| Generator Sets | 2020 | 501 | 750 | 27.045 | 0.191 | 1.005 | 1.858 | 0.005 | 0.056 | 0.056 | 568.299 | 0.017 | 0.74 |
| Generator Sets | 2020 | 1001 | 9999 | 66.08 | 0.242 | 1.082 | 3.608 | 0.005 | 0.079 | 0.079 | 568.3 | 0.021 | 0.74 |
| Graders | 2020 | 26 | 50 | 2.994737 | 2.5164 | 8.13394 | 5.82549 | 0.005 | 0.7086 | 0.6519 | 492.8615 | 0.1594 | 0.41 |
| Graders >51 and <120 | 2020 | 51 | 120 | 1.161574 | 0.976 | 4.56142 | 7.72513 | 0.0048 | 0.622 | 0.5722 | 469.3371 | 0.1518 | 0.41 |
| Graders >121 and <175 | 2020 | 121 | 175 | 0.674427 | 0.5667 | 3.62102 | 5.53045 | 0.0049 | 0.3085 | 0.2838 | 478.0403 | 0.1546 | 0.41 |
| Graders >176 and <250 | 2020 | 176 | 250 | 0.41877 | 0.3519 | 1.34183 | 4.67787 | 0.0049 | 0.1495 | 0.1376 | 475.3037 | 0.1537 | 0.41 |
| Graders | 2020 | 251 | 500 | 0.383198 | 0.322 | 1.5256 | 3.10731 | 0.0049 | 0.1206 | 0.111 | 471.9795 | 0.1526 | 0.41 |
| Graders | 2020 | 501 | 750 | 12.961 | 0.319 | 1.229 | 2.031 | 0.005 | 0.072 | 0.072 | 568.299 | 0.028 | 0.41 |
| Off-Highway Tractors | 2020 | 51 | 120 | 0.533073 | 0.4479 | 3.78798 | 4.18317 | 0.0049 | 0.307 | 0.2825 | 474.1481 | 0.1533 | 0.44 |
| Off-Highway Tractors | 2020 | 121 | 175 | 0.322507 | 0.271 | 3.21511 | 2.89032 | 0.0049 | 0.1402 | 0.129 | 472.9169 | 0.153 | 0.44 |
| Off-Highway Tractors | 2020 | 176 | 250 | 0.263453 | 0.2214 | 1.1813 | 2.57547 | 0.0049 | 0.0862 | 0.0793 | 470.943 | 0.1523 | 0.44 |
| Off-Highway Tractors >501 and <750 | 2020 | 501 | 750 | 0.239679 | 0.2014 | 1.13143 | 2.04663 | 0.0049 | 0.0762 | 0.0701 | 471.8151 | 0.1526 | 0.44 |
| Off-Highway Tractors | 2020 | 751 | 1000 | 0.178457 | 0.15 | 1.02156 | 2.39599 | 0.0049 | 0.063 | 0.058 | 472.0545 | 0.1527 | 0.44 |
| Off-Highway Trucks | 2020 | 121 | 175 | 0.36879 | 0.3099 | 3.3388 | 2.62769 | 0.0049 | 0.137 | 0.126 | 470.0967 | 0.152 | 0.38 |
| Off-Highway Trucks >176 and <250 | 2020 | 176 | 250 | 0.327003 | 0.2748 | 1.39106 | 2.50726 | 0.0049 | 0.0977 | 0.0899 | 470.1675 | 0.1521 | 0.38 |
| Off-Highway Trucks >251 and <500 | 2020 | 251 | 500 | 0.292906 | 0.2461 | 1.41417 | 2.34677 | 0.0049 | 0.0855 | 0.0787 | 474.5787 | 0.1535 | 0.38 |
| Off-Highway Trucks | 2020 | 501 | 750 | 0.371665 | 0.3123 | 2.02683 | 3.05816 | 0.0049 | 0.1196 | 0.11 | 472.7499 | 0.1529 | 0.38 |

| Equipment Type | Year | Low HP | High HP | TOG (g/bhp-hr) | ROG (g/bhp-hr) | CO (g/bhp-hr) | NOX (g/bhp-hr) | SO2 (g/bhp-hr) | PM10 (g/bhp-hr) | PM2.5 (g/bhp-hr) | CO2 (g/bhp-hr) | CH4 (g/bhp-hr) | Load Factor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Emission Factors - OFFROAD** | | | | | | | | | | | | | |
| Off-Highway Trucks | 2020 | 751 | 1000 | 0.360605 | 0.303 | 1.37163 | 4.79365 | 0.0049 | 0.1252 | 0.1152 | 469.8892 | 0.152 | 0.38 |
| Other Construction Equipment | 2020 | 6 | 15 | 1.276029 | 1.0722 | 5.40446 | 5.03626 | 0.0054 | 0.4052 | 0.3728 | 527.9656 | 0.1708 | 0.42 |
| Other Construction Equipment >16 and <2 | 2020 | 16 | 25 | 1.276029 | 1.0722 | 5.40446 | 5.03626 | 0.0054 | 0.4052 | 0.3728 | 527.9656 | 0.1708 | 0.42 |
| Other Construction Equipment >26 and <5 | 2020 | 26 | 50 | 1.276029 | 1.0722 | 5.40446 | 5.03626 | 0.0054 | 0.4052 | 0.3728 | 527.9656 | 0.1708 | 0.42 |
| Other Construction Equipment >51 and <1 | 2020 | 51 | 120 | 0.617777 | 0.5191 | 3.73189 | 4.7712 | 0.0049 | 0.3537 | 0.3254 | 472.2162 | 0.1527 | 0.42 |
| Other Construction Equipment >121 and < | 2020 | 121 | 175 | 0.461441 | 0.3877 | 3.23528 | 4.11203 | 0.0049 | 0.217 | 0.1996 | 469.9837 | 0.152 | 0.42 |
| Other Construction Equipment >251 and < | 2020 | 251 | 500 | 0.266788 | 0.2242 | 1.6338 | 2.63672 | 0.0049 | 0.096 | 0.0883 | 475.2326 | 0.1537 | 0.42 |
| Other General Industrial Equipment | 2020 | 6 | 15 | 1.125869 | 0.946 | 5.50397 | 4.62219 | 0.0054 | 0.334 | 0.3073 | 526.1761 | 0.1702 | 0.34 |
| Other General Industrial Equipment | 2020 | 16 | 25 | 1.125869 | 0.946 | 5.50397 | 4.62219 | 0.0054 | 0.334 | 0.3073 | 526.1761 | 0.1702 | 0.34 |
| Other General Industrial Equipment | 2020 | 26 | 50 | 1.125869 | 0.946 | 5.50397 | 4.62219 | 0.0054 | 0.334 | 0.3073 | 526.1761 | 0.1702 | 0.34 |
| Other General Industrial Equipment | 2020 | 51 | 120 | 0.53075 | 0.446 | 3.77073 | 4.06079 | 0.0048 | 0.2959 | 0.2722 | 469.9998 | 0.152 | 0.34 |
| Other General Industrial Equipment | 2020 | 121 | 175 | 0.319281 | 0.2683 | 3.22922 | 2.57503 | 0.0049 | 0.135 | 0.1242 | 471.8502 | 0.1526 | 0.34 |
| Other General Industrial Equipment | 2020 | 176 | 250 | 0.281815 | 0.2368 | 1.23914 | 2.66782 | 0.0049 | 0.0902 | 0.083 | 473.2231 | 0.153 | 0.34 |
| Other General Industrial Equipment | 2020 | 251 | 500 | 0.247036 | 0.2076 | 1.34424 | 2.06187 | 0.0049 | 0.0724 | 0.0666 | 472.929 | 0.153 | 0.34 |
| Other General Industrial Equipment | 2020 | 501 | 750 | 0.207847 | 0.1746 | 1.46184 | 1.67591 | 0.0049 | 0.0622 | 0.0572 | 473.4638 | 0.1531 | 0.34 |
| Other General Industrial Equipment | 2020 | 751 | 1000 | 0.322174 | 0.2707 | 1.085 | 4.85721 | 0.0049 | 0.1186 | 0.1092 | 472.0545 | 0.1527 | 0.34 |
| Other Material Handling Equipment | 2020 | 26 | 50 | 1.481858 | 1.2452 | 6.1671 | 5.13925 | 0.0054 | 0.4392 | 0.4041 | 523.7088 | 0.1694 | 0.4 |
| Other Material Handling Equipment | 2020 | 51 | 120 | 0.36479 | 0.3065 | 3.58938 | 3.10396 | 0.0049 | 0.1823 | 0.1677 | 473.5884 | 0.1532 | 0.4 |
| Other Material Handling Equipment | 2020 | 121 | 175 | 0.299922 | 0.252 | 3.17089 | 2.36653 | 0.0049 | 0.1181 | 0.1086 | 472.2193 | 0.1527 | 0.4 |
| Other Material Handling Equipment | 2020 | 176 | 250 | 0.346024 | 0.2908 | 1.31882 | 3.59889 | 0.0049 | 0.1152 | 0.106 | 471.482 | 0.1525 | 0.4 |
| Other Material Handling Equipment | 2020 | 251 | 500 | 0.336187 | 0.2825 | 1.52346 | 3.20974 | 0.0049 | 0.1198 | 0.1102 | 470.2972 | 0.1521 | 0.4 |
| Other Material Handling Equipment | 2020 | 1001 | 9999 | 0.238473 | 0.2004 | 1.04898 | 3.61407 | 0.0049 | 0.0783 | 0.072 | 472.0545 | 0.1527 | 0.4 |
| Pavers | 2020 | 16 | 25 | 1.568718 | 1.3182 | 5.52345 | 4.76401 | 0.0054 | 0.4022 | 0.37 | 526.2098 | 0.1702 | 0.42 |
| Pavers | 2020 | 26 | 50 | 1.568718 | 1.3182 | 5.52345 | 4.76401 | 0.0054 | 0.4022 | 0.37 | 526.2098 | 0.1702 | 0.42 |
| Pavers | 2020 | 51 | 120 | 0.558949 | 0.4697 | 3.60405 | 4.42718 | 0.0048 | 0.3249 | 0.2989 | 469.8815 | 0.152 | 0.42 |
| Pavers | 2020 | 121 | 175 | 0.324615 | 0.2728 | 3.0097 | 2.91833 | 0.0049 | 0.1419 | 0.1305 | 472.7746 | 0.1529 | 0.42 |
| Pavers | 2020 | 176 | 250 | 0.209036 | 0.1756 | 1.02834 | 2.77699 | 0.0049 | 0.076 | 0.0699 | 472.8337 | 0.1529 | 0.42 |
| Pavers | 2020 | 251 | 500 | 0.195949 | 0.1647 | 0.98677 | 2.13394 | 0.0048 | 0.0772 | 0.071 | 466.2059 | 0.1508 | 0.42 |
| Paving Equipment | 2020 | 16 | 25 | 0.73951 | 0.6214 | 4.22322 | 3.9519 | 0.0054 | 0.2169 | 0.1996 | 520.1235 | 0.1682 | 0.36 |
| Paving Equipment | 2020 | 26 | 50 | 0.73951 | 0.6214 | 4.22322 | 3.9519 | 0.0054 | 0.2169 | 0.1996 | 520.1235 | 0.1682 | 0.36 |
| Paving Equipment | 2020 | 51 | 120 | 0.472907 | 0.3974 | 3.58172 | 3.78064 | 0.0049 | 0.2558 | 0.2353 | 473.3249 | 0.1531 | 0.36 |
| Paving Equipment >121 and <175 | 2020 | 121 | 175 | 0.294586 | 0.2475 | 3.02393 | 2.55498 | 0.0049 | 0.1278 | 0.1176 | 470.7359 | 0.1522 | 0.36 |
| Paving Equipment >176 and <250 | 2020 | 176 | 250 | 0.289784 | 0.2435 | 1.25215 | 3.2202 | 0.0049 | 0.1107 | 0.1018 | 472.1514 | 0.1527 | 0.36 |
| Plate Compactors | 2020 | 6 | 15 | 0.79 | 0.661 | 3.469 | 4.142 | 0.008 | 0.161 | 0.161 | 568.299 | 0.059 | 0.43 |
| Pressure Washers | 2020 | 6 | 15 | 1.78 | 0.646 | 3.546 | 4.516 | 0.008 | 0.212 | 0.212 | 568.299 | 0.058 | 0.3 |
| Pressure Washers | 2020 | 16 | 25 | 2.904 | 0.721 | 2.473 | 4.538 | 0.007 | 0.205 | 0.205 | 568.299 | 0.065 | 0.3 |
| Pressure Washers | 2020 | 26 | 50 | 4.025 | 0.499 | 3.393 | 3.917 | 0.007 | 0.161 | 0.161 | 568.299 | 0.045 | 0.3 |
| Pressure Washers | 2020 | 51 | 120 | 4.048 | 0.298 | 3.225 | 3.036 | 0.006 | 0.151 | 0.151 | 568.299 | 0.026 | 0.3 |
| Pressure Washers | 2020 | 121 | 175 | 16.638 | 0.258 | 2.907 | 2.383 | 0.006 | 0.104 | 0.104 | 568.299 | 0.023 | 0.3 |
| Pressure Washers | 2020 | 176 | 250 | 8.005 | 0.098 | 0.986 | 0.265 | 0.006 | 0.009 | 0.009 | 568.299 | 0.008 | 0.3 |
| Pumps | 2020 | 6 | 15 | 1.593 | 0.731 | 3.546 | 4.542 | 0.008 | 0.227 | 0.227 | 568.299 | 0.066 | 0.74 |
| Pumps | 2020 | 16 | 25 | 4.396 | 0.769 | 2.473 | 4.538 | 0.007 | 0.212 | 0.212 | 568.299 | 0.069 | 0.74 |
| Pumps >26 and <50 | 2020 | 26 | 50 | 7.613 | 0.755 | 4.197 | 4.128 | 0.007 | 0.206 | 0.206 | 568.299 | 0.068 | 0.74 |
| Pumps | 2020 | 51 | 120 | 8.832 | 0.386 | 3.432 | 3.219 | 0.006 | 0.189 | 0.189 | 568.299 | 0.034 | 0.74 |
| Pumps | 2020 | 121 | 175 | 11.744 | 0.285 | 2.974 | 2.418 | 0.006 | 0.111 | 0.111 | 568.299 | 0.025 | 0.74 |
| Pumps | 2020 | 176 | 250 | 12.575 | 0.212 | 1.042 | 2.05 | 0.006 | 0.06 | 0.06 | 568.299 | 0.019 | 0.74 |
| Pumps >251 and <500 | 2020 | 251 | 500 | 20.565 | 0.203 | 1.017 | 1.841 | 0.005 | 0.057 | 0.057 | 568.3 | 0.018 | 0.74 |
| Pumps | 2020 | 501 | 750 | 34.373 | 0.205 | 1.017 | 1.884 | 0.005 | 0.058 | 0.058 | 568.299 | 0.018 | 0.74 |
| Pumps | 2020 | 1001 | 9999 | 101.462 | 0.255 | 1.096 | 3.649 | 0.005 | 0.081 | 0.081 | 568.3 | 0.023 | 0.74 |
| Rollers | 2020 | 6 | 15 | 1.102095 | 0.9261 | 4.72504 | 4.53426 | 0.0054 | 0.3289 | 0.3026 | 525.8798 | 0.1701 | 0.38 |
| Rollers | 2020 | 16 | 25 | 1.102095 | 0.9261 | 4.72504 | 4.53426 | 0.0054 | 0.3289 | 0.3026 | 525.8798 | 0.1701 | 0.38 |
| Rollers | 2020 | 26 | 50 | 1.102095 | 0.9261 | 4.72504 | 4.53426 | 0.0054 | 0.3289 | 0.3026 | 525.8798 | 0.1701 | 0.38 |
| Rollers >51 and <120 | 2020 | 51 | 120 | 0.462004 | 0.3882 | 3.53135 | 3.88153 | 0.0049 | 0.2475 | 0.2277 | 473.8594 | 0.1533 | 0.38 |
| Rollers >121 and <175 | 2020 | 121 | 175 | 0.256128 | 0.2152 | 2.93333 | 2.45176 | 0.0049 | 0.1126 | 0.1036 | 471.9177 | 0.1526 | 0.38 |
| Rollers >176 and <250 | 2020 | 176 | 250 | 0.248138 | 0.2085 | 1.25343 | 2.75095 | 0.0049 | 0.0892 | 0.082 | 473.3669 | 0.1531 | 0.38 |
| Rollers | 2020 | 251 | 500 | 0.279691 | 0.235 | 2.11346 | 2.82823 | 0.005 | 0.1094 | 0.1007 | 479.3254 | 0.155 | 0.38 |
| Rough Terrain Forklifts | 2020 | 26 | 50 | 1.188595 | 0.9987 | 4.68594 | 4.4946 | 0.0054 | 0.3164 | 0.2911 | 525.6222 | 0.17 | 0.4 |
| Rough Terrain Forklifts >51 and <120 | 2020 | 51 | 120 | 0.225188 | 0.1892 | 3.25575 | 2.45218 | 0.0049 | 0.1026 | 0.0944 | 472.9842 | 0.153 | 0.4 |
| Rough Terrain Forklifts | 2020 | 121 | 175 | 0.170092 | 0.1429 | 2.84466 | 1.86888 | 0.0049 | 0.0684 | 0.0629 | 471.7152 | 0.1526 | 0.4 |
| Rough Terrain Forklifts | 2020 | 176 | 250 | 0.132727 | 0.1115 | 0.97848 | 1.60906 | 0.0049 | 0.0366 | 0.0337 | 472.5671 | 0.1528 | 0.4 |
| Rough Terrain Forklifts | 2020 | 251 | 500 | 0.105484 | 0.0886 | 0.94184 | 1.30199 | 0.0048 | 0.0281 | 0.0258 | 465.7709 | 0.1506 | 0.4 |
| Rubber Tired Dozers > 121 and <175 | 2020 | 121 | 175 | 0.864425 | 0.7264 | 3.89288 | 7.18525 | 0.0049 | 0.4107 | 0.3778 | 473.0116 | 0.153 | 0.4 |
| Rubber Tired Dozers > 176 and <250 | 2020 | 176 | 250 | 0.737248 | 0.6195 | 2.37104 | 6.50332 | 0.0049 | 0.3185 | 0.293 | 474.7928 | 0.1536 | 0.4 |
| Rubber Tired Dozers | 2020 | 251 | 500 | 0.636621 | 0.5349 | 4.41134 | 5.64089 | 0.0049 | 0.2591 | 0.2384 | 479.7569 | 0.1552 | 0.4 |
| Rubber Tired Dozers | 2020 | 501 | 750 | 0.543245 | 0.4565 | 2.60108 | 6.12255 | 0.0049 | 0.2181 | 0.2007 | 473.0562 | 0.153 | 0.4 |
| Rubber Tired Dozers | 2020 | 751 | 1000 | 7.811 | 0.522 | 2.164 | 5.306 | 0.005 | 0.16 | 0.16 | 568.299 | 0.047 | 0.4 |
| Rubber Tired Loaders | 2020 | 16 | 25 | 1.761913 | 1.4805 | 6.76793 | 5.25369 | 0.0054 | 0.4741 | 0.4362 | 524.6967 | 0.1697 | 0.36 |
| Rubber Tired Loaders | 2020 | 26 | 50 | 1.761913 | 1.4805 | 6.76793 | 5.25369 | 0.0054 | 0.4741 | 0.4362 | 524.6967 | 0.1697 | 0.36 |
| Rubber Tired Loaders | 2020 | 51 | 120 | 0.661113 | 0.5555 | 3.94839 | 4.68644 | 0.0048 | 0.367 | 0.3376 | 465.6735 | 0.1506 | 0.36 |
| Rubber Tired Loaders | 2020 | 121 | 175 | 0.450696 | 0.3787 | 3.36809 | 3.51735 | 0.0049 | 0.1936 | 0.1781 | 471.2135 | 0.1524 | 0.36 |
| Rubber Tired Loaders | 2020 | 176 | 250 | 0.345399 | 0.2902 | 1.26885 | 3.42116 | 0.0048 | 0.1136 | 0.1045 | 469.5127 | 0.1518 | 0.36 |
| Rubber Tired Loaders | 2020 | 251 | 500 | 0.343959 | 0.289 | 1.6304 | 3.01666 | 0.0048 | 0.1122 | 0.1032 | 466.7831 | 0.151 | 0.36 |
| Rubber Tired Loaders | 2020 | 501 | 750 | 0.329462 | 0.2768 | 1.39991 | 2.76722 | 0.0048 | 0.1075 | 0.0989 | 462.193 | 0.1495 | 0.36 |
| Rubber Tired Loaders | 2020 | 751 | 1000 | 0.370676 | 0.3115 | 1.20366 | 5.25309 | 0.0049 | 0.1385 | 0.1274 | 469.9352 | 0.152 | 0.36 |
| Scrapers | 2020 | 51 | 120 | 0.834143 | 0.7009 | 4.19756 | 6.6767 | 0.005 | 0.5101 | 0.4693 | 483.745 | 0.1565 | 0.48 |
| Scrapers | 2020 | 121 | 175 | 0.568453 | 0.4777 | 3.50114 | 4.86851 | 0.0049 | 0.262 | 0.241 | 478.6077 | 0.1548 | 0.48 |
| Scrapers | 2020 | 176 | 250 | 0.531032 | 0.4462 | 2.06469 | 5.089 | 0.0048 | 0.2232 | 0.2054 | 468.9883 | 0.1517 | 0.48 |
| Scrapers >251 and <500 | 2020 | 251 | 500 | 0.380326 | 0.3196 | 2.40063 | 3.78254 | 0.0049 | 0.1475 | 0.1357 | 472.1751 | 0.1527 | 0.48 |
| Scrapers | 2020 | 501 | 750 | 0.311991 | 0.2622 | 1.72502 | 3.12592 | 0.0049 | 0.1132 | 0.1042 | 471.7776 | 0.1526 | 0.48 |
| Signal Boards | 2020 | 6 | 15 | 1.04 | 0.661 | 3.469 | 4.142 | 0.008 | 0.161 | 0.161 | 568.299 | 0.059 | 0.82 |
| Signal Boards | 2020 | 26 | 50 | 7.28 | 0.788 | 4.448 | 4.132 | 0.007 | 0.206 | 0.206 | 568.299 | 0.071 | 0.82 |
| Signal Boards | 2020 | 51 | 120 | 8.081 | 0.395 | 3.504 | 3.134 | 0.006 | 0.187 | 0.187 | 568.299 | 0.035 | 0.82 |
| Signal Boards | 2020 | 121 | 175 | 11.756 | 0.298 | 3.043 | 2.309 | 0.006 | 0.11 | 0.11 | 568.299 | 0.026 | 0.82 |
| Signal Boards | 2020 | 176 | 250 | 14.813 | 0.274 | 1.281 | 2.35 | 0.007 | 0.071 | 0.071 | 686.695 | 0.024 | 0.82 |
| Skid Steer Loaders | 2020 | 16 | 25 | 0.522771 | 0.4393 | 3.76397 | 3.69113 | 0.0054 | 0.1447 | 0.1331 | 527.7577 | 0.1707 | 0.37 |
| Skid Steer Loaders | 2020 | 26 | 50 | 0.522771 | 0.4393 | 3.76397 | 3.69113 | 0.0054 | 0.1447 | 0.1331 | 527.7577 | 0.1707 | 0.37 |
| Skid Steer Loaders >51 and <120 | 2020 | 51 | 120 | 0.224183 | 0.1884 | 3.2771 | 2.5046 | 0.0049 | 0.1084 | 0.0997 | 471.9075 | 0.1526 | 0.37 |

| Equipment Type | Year | Low HP | High HP | TOG (g/bhp-hr) | ROG (g/bhp-hr) | CO (g/bhp-hr) | NOX (g/bhp-hr) | SO2 (g/bhp-hr) | PM10 (g/bhp-hr) | PM2.5 (g/bhp-hr) | CO2 (g/bhp-hr) | CH4 (g/bhp-hr) | Load Factor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Emission Factors - OFFROAD** | | | | | | | | | | | | | |
| Surfacing Equipment | 2020 | 26 | 50 | 0.637406 | 0.5356 | 3.93357 | 4.23906 | 0.0055 | 0.2164 | 0.1991 | 535.5275 | 0.1732 | 0.3 |
| Surfacing Equipment | 2020 | 51 | 120 | 0.392345 | 0.3297 | 3.43932 | 3.61216 | 0.0049 | 0.2063 | 0.1898 | 473.8188 | 0.1532 | 0.3 |
| Surfacing Equipment | 2020 | 121 | 175 | 0.365927 | 0.3075 | 2.93068 | 3.67232 | 0.0048 | 0.1745 | 0.1606 | 469.2079 | 0.1518 | 0.3 |
| Surfacing Equipment | 2020 | 176 | 250 | 0.252128 | 0.2119 | 1.21774 | 3.22243 | 0.0049 | 0.0972 | 0.0894 | 476.4261 | 0.1541 | 0.3 |
| Surfacing Equipment | 2020 | 251 | 500 | 0.173203 | 0.1455 | 1.21902 | 1.83755 | 0.0049 | 0.0669 | 0.0615 | 471.6331 | 0.1525 | 0.3 |
| Surfacing Equipment | 2020 | 501 | 750 | 0.168871 | 0.1419 | 0.99569 | 2.09374 | 0.0049 | 0.0744 | 0.0684 | 469.6252 | 0.1519 | 0.3 |
| Sweepers/Scrubbers | 2020 | 6 | 15 | 1.599203 | 1.3438 | 6.1554 | 5.09515 | 0.0054 | 0.4629 | 0.4259 | 525.3284 | 0.1699 | 0.46 |
| Sweepers/Scrubbers | 2020 | 16 | 25 | 1.599203 | 1.3438 | 6.1554 | 5.09515 | 0.0054 | 0.4629 | 0.4259 | 525.3284 | 0.1699 | 0.46 |
| Sweepers/Scrubbers | 2020 | 26 | 50 | 1.599203 | 1.3438 | 6.1554 | 5.09515 | 0.0054 | 0.4629 | 0.4259 | 525.3284 | 0.1699 | 0.46 |
| Sweepers/Scrubbers | 2020 | 51 | 120 | 0.618762 | 0.5199 | 3.82752 | 4.4821 | 0.0049 | 0.3601 | 0.3313 | 474.1157 | 0.1533 | 0.46 |
| Sweepers/Scrubbers | 2020 | 121 | 175 | 0.549287 | 0.4616 | 3.35909 | 4.60809 | 0.0049 | 0.2371 | 0.2181 | 473.1221 | 0.153 | 0.46 |
| Sweepers/Scrubbers | 2020 | 176 | 250 | 0.246498 | 0.2071 | 1.13655 | 2.4856 | 0.0049 | 0.079 | 0.0727 | 470.1263 | 0.152 | 0.46 |
| Tractors/Loaders/Backhoes | 2020 | 16 | 25 | 0.987255 | 0.8296 | 5.03491 | 4.39784 | 0.0053 | 0.2878 | 0.2648 | 515.874 | 0.1668 | 0.37 |
| Tractors/Loaders/Backhoes | 2020 | 26 | 50 | 0.987255 | 0.8296 | 5.03491 | 4.39784 | 0.0053 | 0.2878 | 0.2648 | 515.874 | 0.1668 | 0.37 |
| Tractors/Loaders/Backhoes >51 and <120 | 2020 | 51 | 120 | 0.393883 | 0.331 | 3.60147 | 3.32571 | 0.0049 | 0.2103 | 0.1935 | 475.1543 | 0.1537 | 0.37 |
| Tractors/Loaders/Backhoes >121 and <175 | 2020 | 121 | 175 | 0.29217 | 0.2455 | 3.10518 | 2.41467 | 0.0048 | 0.1217 | 0.1119 | 467.5132 | 0.1512 | 0.37 |
| Tractors/Loaders/Backhoes >176 and <250 | 2020 | 176 | 250 | 0.268036 | 0.2252 | 1.19592 | 2.73794 | 0.0049 | 0.0898 | 0.0826 | 470.4998 | 0.1522 | 0.37 |
| Tractors/Loaders/Backhoes | 2020 | 251 | 500 | 0.230511 | 0.1937 | 1.35815 | 2.07976 | 0.0048 | 0.073 | 0.0672 | 468.2447 | 0.1514 | 0.37 |
| Tractors/Loaders/Backhoes | 2020 | 501 | 750 | 0.318709 | 0.2678 | 1.60984 | 3.11926 | 0.0048 | 0.1174 | 0.108 | 468.6602 | 0.1516 | 0.37 |
| Trenchers | 2020 | 6 | 15 | 1.076913 | 0.9049 | 4.8331 | 4.67651 | 0.0054 | 0.3561 | 0.3276 | 527.0962 | 0.1705 | 0.5 |
| Trenchers | 2020 | 16 | 25 | 1.076913 | 0.9049 | 4.8331 | 4.67651 | 0.0054 | 0.3561 | 0.3276 | 527.0962 | 0.1705 | 0.5 |
| Trenchers >26 and <50 | 2020 | 26 | 50 | 1.076913 | 0.9049 | 4.8331 | 4.67651 | 0.0054 | 0.3561 | 0.3276 | 527.0962 | 0.1705 | 0.5 |
| Trenchers >51 and <120 | 2020 | 51 | 120 | 0.726229 | 0.6102 | 3.83272 | 5.51952 | 0.0049 | 0.4132 | 0.3802 | 475.1265 | 0.1537 | 0.5 |
| Trenchers | 2020 | 121 | 175 | 0.500709 | 0.4207 | 3.32968 | 4.46042 | 0.0048 | 0.2281 | 0.2098 | 467.7348 | 0.1513 | 0.5 |
| Trenchers | 2020 | 176 | 250 | 0.466499 | 0.392 | 1.77405 | 4.8091 | 0.0049 | 0.1949 | 0.1793 | 473.5951 | 0.1532 | 0.5 |
| Trenchers | 2020 | 251 | 500 | 0.276702 | 0.2325 | 1.85932 | 2.775 | 0.0049 | 0.1052 | 0.0968 | 470.6367 | 0.1522 | 0.5 |
| Trenchers | 2020 | 501 | 750 | 0.083454 | 0.0701 | 0.95004 | 0.56006 | 0.0049 | 0.009 | 0.0083 | 472.6556 | 0.1529 | 0.5 |
| Welders | 2020 | 6 | 15 | 1.835 | 0.731 | 3.546 | 4.542 | 0.008 | 0.227 | 0.227 | 568.299 | 0.066 | 0.45 |
| Welders | 2020 | 16 | 25 | 3.507 | 0.769 | 2.473 | 4.538 | 0.007 | 0.212 | 0.212 | 568.299 | 0.069 | 0.45 |
| Welders >26 and <50 | 2020 | 26 | 50 | 9.83 | 0.937 | 4.84 | 4.304 | 0.007 | 0.238 | 0.238 | 568.299 | 0.084 | 0.45 |
| Welders | 2020 | 51 | 120 | 7.278 | 0.455 | 3.605 | 3.351 | 0.006 | 0.216 | 0.216 | 568.299 | 0.041 | 0.45 |
| Welders | 2020 | 121 | 175 | 13.663 | 0.344 | 3.122 | 2.523 | 0.006 | 0.127 | 0.127 | 568.299 | 0.031 | 0.45 |
| Welders | 2020 | 176 | 250 | 12.577 | 0.261 | 1.093 | 2.143 | 0.006 | 0.066 | 0.066 | 568.299 | 0.023 | 0.45 |
| Welders | 2020 | 251 | 500 | 17.094 | 0.252 | 1.055 | 1.91 | 0.005 | 0.064 | 0.064 | 568.299 | 0.022 | 0.45 |

**Emission Factors - OFFROAD T4**

| Equipment Type | Year | Low HP | High HP | TOG (g/bhp-hr) | ROG (g/bhp-hr) | CO (g/bhp-hr) | NOX (g/bhp-hr) | SO2 (g/bhp-hr) | PM10 (g/bhp-hr) | PM2.5 (g/bhp-hr) | CO2 (g/bhp-hr) | CH4 (g/bhp-hr) | Load Factor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aerial Lifts | 2020 | 6 | 15 | | | | | | | | | | |
| Aerial Lifts | 2020 | 16 | 25 | | | | | | | | | | |
| Aerial Lifts | 2020 | 26 | 50 | 0.199447 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 525.0743 | 0.1698 | 0.31 |
| Aerial Lifts >51 and <120 | 2020 | 51 | 120 | 0.136778 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 472.1142 | 0.1527 | 0.31 |
| Aerial Lifts | 2020 | 251 | 500 | 0.081859 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.0545 | 0.1527 | 0.31 |
| Aerial Lifts | 2020 | 501 | 750 | 26.846 | 0.06 | 2.2 | 0.26 | 0.005 | 0.008 | 0.008 | 568.299 | 0.018 | 0.31 |
| Air Compressors | 2020 | 6 | 15 | | | | | | | | | | |
| Air Compressors | 2020 | 16 | 25 | | | | | | | | | | |
| Air Compressors >26 and <50 | 2020 | 26 | 50 | 8.048 | 0.12 | 4.1 | 2.75 | 0.007 | 0.008 | 0.008 | 568.299 | 0.09 | 0.48 |
| Air Compressors | 2020 | 51 | 120 | 8.287 | 0.12 | 3.7 | 2.74 | 0.006 | 0.008 | 0.008 | 568.299 | 0.044 | 0.48 |
| Air Compressors | 2020 | 121 | 175 | 11.957 | 0.06 | 3.7 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.033 | 0.48 |
| Air Compressors | 2020 | 176 | 250 | 13.668 | 0.06 | 2.2 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.026 | 0.48 |
| Air Compressors | 2020 | 251 | 500 | 23.406 | 0.06 | 2.2 | 0.26 | 0.005 | 0.008 | 0.008 | 568.299 | 0.025 | 0.48 |
| Air Compressors | 2020 | 501 | 750 | 36.303 | 0.06 | 2.2 | 0.26 | 0.005 | 0.008 | 0.008 | 568.299 | 0.025 | 0.48 |
| Air Compressors | 2020 | 751 | 1000 | 53.87 | 0.06 | 2.6 | 2.24 | 0.005 | 0.016 | 0.016 | 568.3 | 0.027 | 0.48 |
| Bore/Drill Rigs | 2020 | 6 | 15 | | | | | | | | | | |
| Bore/Drill Rigs | 2020 | 16 | 25 | | | | | | | | | | |
| Bore/Drill Rigs | 2020 | 26 | 50 | 0.851825 | 0.12 | 4.1 | 2.75 | 0.0055 | 0.008 | 0.008 | 535.2948 | 0.1731 | 0.5 |
| Bore/Drill Rigs | 2020 | 51 | 120 | 0.292949 | 0.12 | 3.7 | 2.74 | 0.0048 | 0.008 | 0.008 | 463.5827 | 0.1499 | 0.5 |
| Bore/Drill Rigs >121 and <175 | 2020 | 121 | 175 | 0.207426 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 477.722 | 0.1545 | 0.5 |
| Bore/Drill Rigs >176 and <250 | 2020 | 176 | 250 | 0.169462 | 0.06 | 2.2 | 0.26 | 0.0048 | 0.008 | 0.008 | 466.8342 | 0.151 | 0.5 |
| Bore/Drill Rigs | 2020 | 251 | 500 | 0.148188 | 0.06 | 2.2 | 0.26 | 0.0048 | 0.008 | 0.008 | 466.8219 | 0.151 | 0.5 |
| Bore/Drill Rigs | 2020 | 501 | 750 | 0.129293 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 473.6679 | 0.1532 | 0.5 |
| Bore/Drill Rigs | 2020 | 751 | 1000 | 0.158163 | 0.06 | 2.6 | 2.24 | 0.0049 | 0.016 | 0.016 | 471.8492 | 0.1526 | 0.5 |
| Cement and Mortar Mixers | 2020 | 6 | 15 | | | | | | | | | | |
| Cement and Mortar Mixers | 2020 | 16 | 25 | | | | | | | | | | |
| Concrete/Industrial Saws | 2020 | 16 | 25 | | | | | | | | | | |
| Concrete/Industrial Saws >26 and <50 | 2020 | 26 | 50 | 3.271 | 0.12 | 4.1 | 2.75 | 0.007 | 0.008 | 0.008 | 568.299 | 0.072 | 0.73 |
| Concrete/Industrial Saws | 2020 | 51 | 120 | 4.042 | 0.12 | 3.7 | 2.74 | 0.006 | 0.008 | 0.008 | 568.299 | 0.036 | 0.73 |
| Concrete/Industrial Saws | 2020 | 121 | 175 | 6.669 | 0.06 | 3.7 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.027 | 0.73 |
| Cranes | 2020 | 26 | 50 | 2.47956 | 0.12 | 4.1 | 2.75 | 0.0053 | 0.008 | 0.008 | 517.9263 | 0.1675 | 0.29 |
| Cranes | 2020 | 51 | 120 | 0.871016 | 0.12 | 3.7 | 2.74 | 0.0048 | 0.008 | 0.008 | 469.8821 | 0.152 | 0.29 |
| Cranes | 2020 | 121 | 175 | 0.638941 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 474.5939 | 0.1535 | 0.29 |
| Cranes >176 and <250 | 2020 | 176 | 250 | 0.45669 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.9488 | 0.153 | 0.29 |
| Cranes >251 and <500 | 2020 | 251 | 500 | 0.381547 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.5579 | 0.1528 | 0.29 |
| Cranes | 2020 | 501 | 750 | 0.287724 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 470.4254 | 0.1521 | 0.29 |
| Cranes | 2020 | 1001 | 9999 | 0.216797 | 0.06 | 2.6 | 2.24 | 0.0049 | 0.016 | 0.016 | 472.0545 | 0.1527 | 0.29 |
| Crawler Tractors | 2020 | 26 | 50 | 2.443056 | 0.12 | 4.1 | 2.75 | 0.0053 | 0.008 | 0.008 | 515.679 | 0.1668 | 0.43 |
| Crawler Tractors | 2020 | 51 | 120 | 0.850709 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 476.3284 | 0.1541 | 0.43 |
| Crawler Tractors >121 and <175 | 2020 | 121 | 175 | 0.566576 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 471.015 | 0.1523 | 0.43 |
| Crawler Tractors | 2020 | 176 | 250 | 0.428471 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.941 | 0.153 | 0.43 |
| Crawler Tractors | 2020 | 251 | 500 | 0.358593 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 475.2338 | 0.1537 | 0.43 |
| Crawler Tractors | 2020 | 501 | 750 | 0.304872 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 473.3119 | 0.1531 | 0.43 |
| Crawler Tractors | 2020 | 751 | 1000 | 0.551035 | 0.06 | 2.6 | 2.24 | 0.0049 | 0.016 | 0.016 | 475.6525 | 0.1538 | 0.43 |
| Crushing/Proc. Equipment | 2020 | 26 | 50 | 2.489 | 0.12 | 4.1 | 2.75 | 0.007 | 0.008 | 0.008 | 568.299 | 0.085 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 51 | 120 | 2.348 | 0.12 | 3.7 | 2.74 | 0.006 | 0.008 | 0.008 | 568.299 | 0.042 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 121 | 175 | 3.673 | 0.06 | 3.7 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.033 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 176 | 250 | 4.222 | 0.06 | 2.2 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.026 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 251 | 500 | 6.283 | 0.06 | 2.2 | 0.26 | 0.005 | 0.008 | 0.008 | 568.299 | 0.025 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 501 | 750 | 9.884 | 0.06 | 2.2 | 0.26 | 0.005 | 0.008 | 0.008 | 568.299 | 0.025 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 1001 | 9999 | 25.755 | 0.06 | 2.6 | 2.24 | 0.005 | 0.016 | 0.016 | 568.299 | 0.029 | 0.78 |
| Dumpers/Tenders | 2020 | 16 | 25 | | | | | | | | | | |
| Excavators | 2020 | 16 | 25 | | | | | | | | | | |
| Excavators >26 and <50 | 2020 | 26 | 50 | 0.705964 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 525.3675 | 0.1699 | 0.38 |
| Excavators >51 and <120 | 2020 | 51 | 120 | 0.356064 | 0.12 | 3.7 | 2.74 | 0.0048 | 0.008 | 0.008 | 468.0546 | 0.1514 | 0.38 |
| Excavators | 2020 | 121 | 175 | 0.275327 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.2891 | 0.1527 | 0.38 |
| Excavators | 2020 | 176 | 250 | 0.211076 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 471.8828 | 0.1526 | 0.38 |
| Excavators >251 and <500 | 2020 | 251 | 500 | 0.182542 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 470.2956 | 0.1521 | 0.38 |
| Excavators | 2020 | 501 | 750 | 0.202011 | 0.06 | 2.2 | 0.26 | 0.0048 | 0.008 | 0.008 | 468.8706 | 0.1516 | 0.38 |

**Emission Factors - OFFROAD T4**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Forklifts | 2020 | 26 | 50 | 1.337399 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 525.4833 | 0.17 | 0.2 |
| Forklifts >51 and <120 | 2020 | 51 | 120 | 0.545921 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 471.5285 | 0.1525 | 0.2 |
| Forklifts | 2020 | 121 | 175 | 0.402357 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.1062 | 0.1527 | 0.2 |
| Forklifts | 2020 | 176 | 250 | 0.348476 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 473.3255 | 0.1531 | 0.2 |
| Forklifts | 2020 | 251 | 500 | 0.299035 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 473.6151 | 0.1532 | 0.2 |
| Generator Sets | 2020 | 6 | 15 | | | | | | | | | | |
| Generator Sets | 2020 | 16 | 25 | | | | | | | | | | |
| Generator Sets >26 and <50 | 2020 | 26 | 50 | 5.508 | 0.12 | 4.1 | 2.75 | 0.007 | 0.008 | 0.008 | 568.299 | 0.062 | 0.74 |
| Generator Sets >51 and <120 | 2020 | 51 | 120 | 7.383 | 0.12 | 3.7 | 2.74 | 0.006 | 0.008 | 0.008 | 568.299 | 0.032 | 0.74 |
| Generator Sets | 2020 | 121 | 175 | 9.884 | 0.06 | 3.7 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.024 | 0.74 |
| Generator Sets | 2020 | 176 | 250 | 10.963 | 0.06 | 2.2 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.017 | 0.74 |
| Generator Sets | 2020 | 251 | 500 | 16.528 | 0.06 | 2.2 | 0.26 | 0.005 | 0.008 | 0.008 | 568.299 | 0.017 | 0.74 |
| Generator Sets | 2020 | 501 | 750 | 27.045 | 0.06 | 2.2 | 0.26 | 0.005 | 0.008 | 0.008 | 568.299 | 0.017 | 0.74 |
| Generator Sets | 2020 | 1001 | 9999 | 66.08 | 0.06 | 2.6 | 2.24 | 0.005 | 0.016 | 0.016 | 568.3 | 0.021 | 0.74 |
| Graders | 2020 | 26 | 50 | 2.994737 | 0.12 | 4.1 | 2.75 | 0.005 | 0.008 | 0.008 | 492.8615 | 0.1594 | 0.41 |
| Graders >51 and <120 | 2020 | 51 | 120 | 1.161574 | 0.12 | 3.7 | 2.74 | 0.0048 | 0.008 | 0.008 | 469.3371 | 0.1518 | 0.41 |
| Graders >121 and <175 | 2020 | 121 | 175 | 0.674427 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 478.0403 | 0.1546 | 0.41 |
| Graders >176 and <250 | 2020 | 176 | 250 | 0.41877 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 475.3037 | 0.1537 | 0.41 |
| Graders | 2020 | 251 | 500 | 0.383198 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 471.9795 | 0.1526 | 0.41 |
| Graders | 2020 | 501 | 750 | 12.961 | 0.06 | 2.2 | 0.26 | 0.005 | 0.008 | 0.008 | 568.299 | 0.028 | 0.41 |
| Off-Highway Tractors | 2020 | 51 | 120 | 0.533073 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 474.1481 | 0.1533 | 0.44 |
| Off-Highway Tractors | 2020 | 121 | 175 | 0.322507 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.9169 | 0.153 | 0.44 |
| Off-Highway Tractors | 2020 | 176 | 250 | 0.263453 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 470.943 | 0.1523 | 0.44 |
| Off-Highway Tractors >501 and <750 | 2020 | 501 | 750 | 0.239679 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 471.8151 | 0.1526 | 0.44 |
| Off-Highway Tractors | 2020 | 751 | 1000 | 0.178457 | 0.06 | 2.6 | 2.24 | 0.0049 | 0.016 | 0.016 | 472.0545 | 0.1527 | 0.44 |
| Off-Highway Trucks | 2020 | 121 | 175 | 0.36879 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 470.0967 | 0.152 | 0.38 |
| Off-Highway Trucks >176 and <250 | 2020 | 176 | 250 | 0.327003 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 470.1675 | 0.1521 | 0.38 |
| Off-Highway Trucks >251 and <500 | 2020 | 251 | 500 | 0.292906 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 474.5787 | 0.1535 | 0.38 |
| Off-Highway Trucks | 2020 | 501 | 750 | 0.371665 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.7499 | 0.1529 | 0.38 |
| Off-Highway Trucks | 2020 | 751 | 1000 | 0.360605 | 0.06 | 2.6 | 2.24 | 0.0049 | 0.016 | 0.016 | 469.8892 | 0.152 | 0.38 |
| Other Construction Equipment | 2020 | 6 | 15 | | | | | | | | | | |
| Other Construction Equipment >16 and <25 | 2020 | 16 | 25 | | | | | | | | | | |
| Other Construction Equipment >26 and <50 | 2020 | 26 | 50 | 1.276029 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 527.9656 | 0.1708 | 0.42 |
| Other Construction Equipment >51 and <12 | 2020 | 51 | 120 | 0.617777 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 472.2162 | 0.1527 | 0.42 |
| Other Construction Equipment >121 and <1 | 2020 | 121 | 175 | 0.461441 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 469.9837 | 0.152 | 0.42 |
| Other Construction Equipment >251 and <5 | 2020 | 251 | 500 | 0.266788 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 475.2326 | 0.1537 | 0.42 |
| Other General Industrial Equipment | 2020 | 6 | 15 | | | | | | | | | | |
| Other General Industrial Equipment | 2020 | 16 | 25 | | | | | | | | | | |
| Other General Industrial Equipment | 2020 | 26 | 50 | 1.125869 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 526.1761 | 0.1702 | 0.34 |
| Other General Industrial Equipment | 2020 | 51 | 120 | 0.53075 | 0.12 | 3.7 | 2.74 | 0.0048 | 0.008 | 0.008 | 469.9998 | 0.152 | 0.34 |
| Other General Industrial Equipment | 2020 | 121 | 175 | 0.319281 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 471.8502 | 0.1526 | 0.34 |
| Other General Industrial Equipment | 2020 | 176 | 250 | 0.281815 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 473.2231 | 0.153 | 0.34 |
| Other General Industrial Equipment | 2020 | 251 | 500 | 0.247036 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.929 | 0.153 | 0.34 |
| Other General Industrial Equipment | 2020 | 501 | 750 | 0.207847 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 473.4638 | 0.1531 | 0.34 |
| Other General Industrial Equipment | 2020 | 751 | 1000 | 0.322174 | 0.06 | 2.6 | 2.24 | 0.0049 | 0.016 | 0.016 | 472.0545 | 0.1527 | 0.34 |
| Other Material Handling Equipment | 2020 | 26 | 50 | 1.481858 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 523.7088 | 0.1694 | 0.4 |
| Other Material Handling Equipment | 2020 | 51 | 120 | 0.36479 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 473.5884 | 0.1532 | 0.4 |
| Other Material Handling Equipment | 2020 | 121 | 175 | 0.299922 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.2193 | 0.1527 | 0.4 |
| Other Material Handling Equipment | 2020 | 176 | 250 | 0.346024 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 471.482 | 0.1525 | 0.4 |
| Other Material Handling Equipment | 2020 | 251 | 500 | 0.336187 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 470.2972 | 0.1521 | 0.4 |
| Other Material Handling Equipment | 2020 | 1001 | 9999 | 0.238473 | 0.06 | 2.6 | 2.24 | 0.0049 | 0.016 | 0.016 | 472.0545 | 0.1527 | 0.4 |
| Pavers | 2020 | 16 | 25 | | | | | | | | | | |
| Pavers | 2020 | 26 | 50 | 1.568718 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 526.2098 | 0.1702 | 0.42 |
| Pavers | 2020 | 51 | 120 | 0.558949 | 0.12 | 3.7 | 2.74 | 0.0048 | 0.008 | 0.008 | 469.8815 | 0.152 | 0.42 |
| Pavers | 2020 | 121 | 175 | 0.324615 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.7746 | 0.1529 | 0.42 |
| Pavers | 2020 | 176 | 250 | 0.209036 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.8337 | 0.1529 | 0.42 |
| Pavers | 2020 | 251 | 500 | 0.195949 | 0.06 | 2.2 | 0.26 | 0.0048 | 0.008 | 0.008 | 466.2059 | 0.1508 | 0.42 |

**Emission Factors - OFFROAD T4**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Paving Equipment | 2020 | 16 | 25 | | | | | | | | | | | |
| Paving Equipment | 2020 | 26 | 50 | 0.73951 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 520.1235 | 0.1682 | 0.36 |
| Paving Equipment | 2020 | 51 | 120 | 0.472907 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 473.3249 | 0.1531 | 0.36 |
| Paving Equipment >121 and <175 | 2020 | 121 | 175 | 0.294586 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 470.7359 | 0.1522 | 0.36 |
| Paving Equipment >176 and <250 | 2020 | 176 | 250 | 0.289784 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.1514 | 0.1527 | 0.36 |
| Plate Compactors | 2020 | 6 | 15 | | | | | | | | | | |
| Pressure Washers | 2020 | 6 | 15 | | | | | | | | | | |
| Pressure Washers | 2020 | 16 | 25 | | | | | | | | | | |
| Pressure Washers | 2020 | 26 | 50 | 4.025 | 0.12 | 4.1 | 2.75 | 0.007 | 0.008 | 0.008 | 568.299 | 0.045 | 0.3 |
| Pressure Washers | 2020 | 51 | 120 | 4.048 | 0.12 | 3.7 | 2.74 | 0.006 | 0.008 | 0.008 | 568.299 | 0.026 | 0.3 |
| Pressure Washers | 2020 | 121 | 175 | 16.638 | 0.06 | 3.7 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.023 | 0.3 |
| Pressure Washers | 2020 | 176 | 250 | 8.005 | 0.06 | 2.2 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.008 | 0.3 |
| Pumps | 2020 | 6 | 15 | | | | | | | | | | |
| Pumps | 2020 | 16 | 25 | | | | | | | | | | |
| Pumps >26 and <50 | 2020 | 26 | 50 | 7.613 | 0.12 | 4.1 | 2.75 | 0.007 | 0.008 | 0.008 | 568.299 | 0.068 | 0.74 |
| Pumps | 2020 | 51 | 120 | 8.832 | 0.12 | 3.7 | 2.74 | 0.006 | 0.008 | 0.008 | 568.299 | 0.034 | 0.74 |
| Pumps | 2020 | 121 | 175 | 11.744 | 0.06 | 3.7 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.025 | 0.74 |
| Pumps | 2020 | 176 | 250 | 12.575 | 0.06 | 2.2 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.019 | 0.74 |
| Pumps >251 and <500 | 2020 | 251 | 500 | 20.565 | 0.06 | 2.2 | 0.26 | 0.005 | 0.008 | 0.008 | 568.3 | 0.018 | 0.74 |
| Pumps | 2020 | 501 | 750 | 34.373 | 0.06 | 2.2 | 0.26 | 0.005 | 0.008 | 0.008 | 568.299 | 0.018 | 0.74 |
| Pumps | 2020 | 1001 | 9999 | 101.462 | 0.06 | 2.6 | 2.24 | 0.005 | 0.016 | 0.016 | 568.3 | 0.023 | 0.74 |
| Rollers | 2020 | 6 | 15 | | | | | | | | | | |
| Rollers | 2020 | 16 | 25 | | | | | | | | | | |
| Rollers | 2020 | 26 | 50 | 1.102095 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 525.8798 | 0.1701 | 0.38 |
| Rollers >51 and <120 | 2020 | 51 | 120 | 0.462004 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 473.8594 | 0.1533 | 0.38 |
| Rollers >121 and <175 | 2020 | 121 | 175 | 0.256128 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 471.9177 | 0.1526 | 0.38 |
| Rollers >176 and <250 | 2020 | 176 | 250 | 0.248138 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 473.3669 | 0.1531 | 0.38 |
| Rollers | 2020 | 251 | 500 | 0.279691 | 0.06 | 2.2 | 0.26 | 0.005 | 0.008 | 0.008 | 479.3254 | 0.155 | 0.38 |
| Rough Terrain Forklifts | 2020 | 26 | 50 | 1.188595 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 525.6222 | 0.17 | 0.4 |
| Rough Terrain Forklifts >51 and <120 | 2020 | 51 | 120 | 0.225188 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 472.9842 | 0.153 | 0.4 |
| Rough Terrain Forklifts | 2020 | 121 | 175 | 0.170092 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 471.7152 | 0.1526 | 0.4 |
| Rough Terrain Forklifts | 2020 | 176 | 250 | 0.132727 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.5671 | 0.1528 | 0.4 |
| Rough Terrain Forklifts | 2020 | 251 | 500 | 0.105484 | 0.06 | 2.2 | 0.26 | 0.0048 | 0.008 | 0.008 | 465.7709 | 0.1506 | 0.4 |
| Rubber Tired Dozers > 121 and <175 | 2020 | 121 | 175 | 0.864425 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 473.0116 | 0.153 | 0.4 |
| Rubber Tired Dozers > 176 and <250 | 2020 | 176 | 250 | 0.737248 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 474.7928 | 0.1536 | 0.4 |
| Rubber Tired Dozers | 2020 | 251 | 500 | 0.636621 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 479.7569 | 0.1552 | 0.4 |
| Rubber Tired Dozers | 2020 | 501 | 750 | 0.543245 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 473.0562 | 0.153 | 0.4 |
| Rubber Tired Dozers | 2020 | 751 | 1000 | 7.811 | 0.06 | 2.6 | 2.24 | 0.005 | 0.016 | 0.016 | 568.299 | 0.047 | 0.4 |
| Rubber Tired Loaders | 2020 | 16 | 25 | | | | | | | | | | |
| Rubber Tired Loaders | 2020 | 26 | 50 | 1.761913 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 524.6967 | 0.1697 | 0.36 |
| Rubber Tired Loaders | 2020 | 51 | 120 | 0.661113 | 0.12 | 3.7 | 2.74 | 0.0048 | 0.008 | 0.008 | 465.6735 | 0.1506 | 0.36 |
| Rubber Tired Loaders | 2020 | 121 | 175 | 0.450696 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 471.2135 | 0.1524 | 0.36 |
| Rubber Tired Loaders | 2020 | 176 | 250 | 0.345399 | 0.06 | 2.2 | 0.26 | 0.0048 | 0.008 | 0.008 | 469.5127 | 0.1518 | 0.36 |
| Rubber Tired Loaders | 2020 | 251 | 500 | 0.343959 | 0.06 | 2.2 | 0.26 | 0.0048 | 0.008 | 0.008 | 466.7831 | 0.151 | 0.36 |
| Rubber Tired Loaders | 2020 | 501 | 750 | 0.329462 | 0.06 | 2.2 | 0.26 | 0.0048 | 0.008 | 0.008 | 462.193 | 0.1495 | 0.36 |
| Rubber Tired Loaders | 2020 | 751 | 1000 | 0.370676 | 0.06 | 2.6 | 2.24 | 0.0049 | 0.016 | 0.016 | 469.9352 | 0.152 | 0.36 |
| Scrapers | 2020 | 51 | 120 | 0.834143 | 0.12 | 3.7 | 2.74 | 0.005 | 0.008 | 0.008 | 483.745 | 0.1565 | 0.48 |
| Scrapers | 2020 | 121 | 175 | 0.568453 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 478.6077 | 0.1548 | 0.48 |
| Scrapers | 2020 | 176 | 250 | 0.531032 | 0.06 | 2.2 | 0.26 | 0.0048 | 0.008 | 0.008 | 468.9883 | 0.1517 | 0.48 |
| Scrapers >251 and <500 | 2020 | 251 | 500 | 0.380326 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.1751 | 0.1527 | 0.48 |
| Scrapers | 2020 | 501 | 750 | 0.311991 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 471.7776 | 0.1526 | 0.48 |
| Signal Boards | 2020 | 6 | 15 | | | | | | | | | | |
| Signal Boards | 2020 | 26 | 50 | 7.28 | 0.12 | 4.1 | 2.75 | 0.007 | 0.008 | 0.008 | 568.299 | 0.071 | 0.82 |
| Signal Boards | 2020 | 51 | 120 | 8.081 | 0.12 | 3.7 | 2.74 | 0.006 | 0.008 | 0.008 | 568.299 | 0.035 | 0.82 |
| Signal Boards | 2020 | 121 | 175 | 11.756 | 0.06 | 3.7 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.026 | 0.82 |
| Signal Boards | 2020 | 176 | 250 | 14.813 | 0.06 | 2.2 | 0.26 | 0.007 | 0.008 | 0.008 | 686.695 | 0.024 | 0.82 |
| Skid Steer Loaders | 2020 | 16 | 25 | | | | | | | | | | |
| Skid Steer Loaders | 2020 | 26 | 50 | 0.522771 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 527.7577 | 0.1707 | 0.37 |
| Skid Steer Loaders >51 and <120 | 2020 | 51 | 120 | 0.224183 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 471.9075 | 0.1526 | 0.37 |

**Emission Factors - OFFROAD T4**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Surfacing Equipment | 2020 | 26 | 50 | 0.637406 | 0.12 | 4.1 | 2.75 | 0.0055 | 0.008 | 0.008 | 535.5275 | 0.1732 | 0.3 |
| Surfacing Equipment | 2020 | 51 | 120 | 0.392345 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 473.8188 | 0.1532 | 0.3 |
| Surfacing Equipment | 2020 | 121 | 175 | 0.365927 | 0.06 | 3.7 | 0.26 | 0.0048 | 0.008 | 0.008 | 469.2079 | 0.1518 | 0.3 |
| Surfacing Equipment | 2020 | 176 | 250 | 0.252128 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 476.4261 | 0.1541 | 0.3 |
| Surfacing Equipment | 2020 | 251 | 500 | 0.173203 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 471.6331 | 0.1525 | 0.3 |
| Surfacing Equipment | 2020 | 501 | 750 | 0.168871 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 469.6252 | 0.1519 | 0.3 |
| Sweepers/Scrubbers | 2020 | 6 | 15 | | | | | | | | | | |
| Sweepers/Scrubbers | 2020 | 16 | 25 | | | | | | | | | | |
| Sweepers/Scrubbers | 2020 | 26 | 50 | 1.599203 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 525.3284 | 0.1699 | 0.46 |
| Sweepers/Scrubbers | 2020 | 51 | 120 | 0.618762 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 474.1157 | 0.1533 | 0.46 |
| Sweepers/Scrubbers | 2020 | 121 | 175 | 0.549287 | 0.06 | 3.7 | 0.26 | 0.0049 | 0.008 | 0.008 | 473.1221 | 0.153 | 0.46 |
| Sweepers/Scrubbers | 2020 | 176 | 250 | 0.246498 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 470.1263 | 0.152 | 0.46 |
| Tractors/Loaders/Backhoes | 2020 | 16 | 25 | | | | | | | | | | |
| Tractors/Loaders/Backhoes | 2020 | 26 | 50 | 0.987255 | 0.12 | 4.1 | 2.75 | 0.0053 | 0.008 | 0.008 | 515.874 | 0.1668 | 0.37 |
| Tractors/Loaders/Backhoes >51 and <120 | 2020 | 51 | 120 | 0.393883 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 475.1543 | 0.1537 | 0.37 |
| Tractors/Loaders/Backhoes >121 and <175 | 2020 | 121 | 175 | 0.29217 | 0.06 | 3.7 | 0.26 | 0.0048 | 0.008 | 0.008 | 467.5132 | 0.1512 | 0.37 |
| Tractors/Loaders/Backhoes >176 and <250 | 2020 | 176 | 250 | 0.268036 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 470.4998 | 0.1522 | 0.37 |
| Tractors/Loaders/Backhoes | 2020 | 251 | 500 | 0.230511 | 0.06 | 2.2 | 0.26 | 0.0048 | 0.008 | 0.008 | 468.2447 | 0.1514 | 0.37 |
| Tractors/Loaders/Backhoes | 2020 | 501 | 750 | 0.318709 | 0.06 | 2.2 | 0.26 | 0.0048 | 0.008 | 0.008 | 468.6602 | 0.1516 | 0.37 |
| Trenchers | 2020 | 6 | 15 | | | | | | | | | | |
| Trenchers | 2020 | 16 | 25 | | | | | | | | | | |
| Trenchers >26 and <50 | 2020 | 26 | 50 | 1.076913 | 0.12 | 4.1 | 2.75 | 0.0054 | 0.008 | 0.008 | 527.0962 | 0.1705 | 0.5 |
| Trenchers >51 and <120 | 2020 | 51 | 120 | 0.726229 | 0.12 | 3.7 | 2.74 | 0.0049 | 0.008 | 0.008 | 475.1265 | 0.1537 | 0.5 |
| Trenchers | 2020 | 121 | 175 | 0.500709 | 0.06 | 3.7 | 0.26 | 0.0048 | 0.008 | 0.008 | 467.7348 | 0.1513 | 0.5 |
| Trenchers | 2020 | 176 | 250 | 0.466499 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 473.5951 | 0.1532 | 0.5 |
| Trenchers | 2020 | 251 | 500 | 0.276702 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 470.6367 | 0.1522 | 0.5 |
| Trenchers | 2020 | 501 | 750 | 0.083454 | 0.06 | 2.2 | 0.26 | 0.0049 | 0.008 | 0.008 | 472.6556 | 0.1529 | 0.5 |
| Welders | 2020 | 6 | 15 | | | | | | | | | | |
| Welders | 2020 | 16 | 25 | | | | | | | | | | |
| Welders >26 and <50 | 2020 | 26 | 50 | 9.83 | 0.12 | 4.1 | 2.75 | 0.007 | 0.008 | 0.008 | 568.299 | 0.084 | 0.45 |
| Welders | 2020 | 51 | 120 | 7.278 | 0.12 | 3.7 | 2.74 | 0.006 | 0.008 | 0.008 | 568.299 | 0.041 | 0.45 |
| Welders | 2020 | 121 | 175 | 13.663 | 0.06 | 3.7 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.031 | 0.45 |
| Welders | 2020 | 176 | 250 | 12.577 | 0.06 | 2.2 | 0.26 | 0.006 | 0.008 | 0.008 | 568.299 | 0.023 | 0.45 |
| Welders | 2020 | 251 | 500 | 17.094 | 0.06 | 2.2 | 0.26 | 0.005 | 0.008 | 0.008 | 568.299 | 0.022 | 0.45 |

**Tier 4 Emission Factors**

| | Low HP | High HP | ROG (g/bhp-hr) | CO (g/bhp-hr) | NOX (g/bhp-hr) | PM10 (g/bhp-hr) | PM2.5 (g/bhp-hr) |
|---|---|---|---|---|---|---|---|
| Tier 4 | 25 | 49 | 0.12 | 4.1 | 2.75 | 0.008 | 0.008 |
| Tier 4 | 50 | 74 | 0.12 | 3.7 | 2.74 | 0.008 | 0.008 |
| Tier 4 | 75 | 119 | 0.06 | 3.7 | 0.26 | 0.008 | 0.008 |
| Tier 4 | 120 | 174 | 0.06 | 3.7 | 0.26 | 0.008 | 0.008 |
| Tier 4 | 175 | 299 | 0.06 | 2.2 | 0.26 | 0.008 | 0.008 |
| Tier 4 | 300 | 599 | 0.06 | 2.2 | 0.26 | 0.008 | 0.008 |
| Tier 4 | 600 | 750 | 0.06 | 2.2 | 0.26 | 0.008 | 0.008 |
| Tier 4 | 751 | 2000 | 0.06 | 2.6 | 2.24 | 0.016 | 0.016 |

**Equipment Load Factors**

| Equipment Type | HP | Load Factor |
|---|---|---|
| Aerial Lifts | 63 | 0.31 |
| Air Compressors | 78 | 0.48 |
| Bore/Drill Rigs | 206 | 0.5 |
| Cement and Mortar Mixers | 9 | 0.56 |
| Concrete/Industrial Saws | 81 | 0.73 |
| Cranes | 226 | 0.29 |
| Crawler Tractors | 208 | 0.43 |
| Crushing/Proc. Equipment | 85 | 0.78 |
| Dumpers/Tenders | 16 | 0.38 |
| Excavators | 163 | 0.38 |
| Forklifts | 89 | 0.2 |
| Generator Sets | 84 | 0.74 |
| Graders | 175 | 0.41 |
| Off-Highway Tractors | 123 | 0.44 |
| Off-Highway Trucks | 400 | 0.38 |
| Other Construction Equipment | 172 | 0.42 |
| Other General Industrial Equipment | 88 | 0.34 |
| Other Material Handling Equipment | 167 | 0.4 |
| Pavers | 126 | 0.42 |
| Paving Equipment | 131 | 0.36 |
| Plate Compactors | 8 | 0.43 |
| Pressure Washers | 13 | 0.3 |
| Pumps | 84 | 0.74 |
| Rollers | 81 | 0.38 |
| Rough Terrain Forklifts | 100 | 0.4 |
| Rubber Tired Dozers | 255 | 0.4 |
| Rubber Tired Loaders | 200 | 0.36 |
| Scrapers | 362 | 0.48 |
| Signal Boards | 6 | 0.82 |
| Skid Steer Loaders | 65 | 0.37 |
| Surfacing Equipment | 254 | 0.3 |
| Sweepers/Scrubbers | 64 | 0.46 |
| Tractors/Loaders/Backhoes | 98 | 0.37 |
| Trenchers | 81 | 0.5 |
| Welders | 46 | 0.45 |

**Riverside County 2020 On-Road Emission Factors**

| VEH | FUEL | MDLYR | SPEED | POP | VMT | Percent VMT | TRIPS | ROG_RUNEX | CO_RUNEX | NOX_RUNEX | CO2_RUNEX | PM10_Total | PM2_5_Total | CH4 | N2O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (Miles/hr) | (Vehicles) | (Miles/day) | | (Trips/day) | (gms/mile) | (gms/mile) | (gms/mile) | (gms/mile) | (gms/mile) | (gms/mile) | (gms/mile) | (gms/mile) |
| LDA | GAS | Aggregate | Aggregated | 6,241,441 | 216,000,000 | 67.95% | 39386956 | 0.011542713 | 0.641422526 | 0.055808459 | 274.0485814 | 0.04635407 | 0.019224949 | | |
| LDA | DSL | Aggregate | Aggregated | 58578.66528 | 2,170,199 | 0.68% | 364867 | 0.017077737 | 0.200965153 | 0.09501238 | 253.3966805 | 0.05480289 | 0.027367998 | | |
| LDT1 | GAS | Aggregate | Aggregated | 529468.9231 | 17,839,922 | 5.61% | 3216559 | 0.033208307 | 1.618669814 | 0.16094723 | 325.2843956 | 0.04735163 | 0.02014254 | | |
| LDT1 | DSL | Aggregate | Aggregated | 653.8523923 | 17,425 | 0.01% | 3379 | 0.144078437 | 0.907672212 | 0.859573101 | 342.1599989 | 0.15326639 | 0.121572011 | | |
| LDT2 | GAS | Aggregate | Aggregated | 2196840.435 | 81,691,951 | 25.70% | 13902518 | 0.015193731 | 0.816411177 | 0.086826897 | 366.6776059 | 0.04634722 | 0.019218653 | | |
| LDT2 | DSL | Aggregate | Aggregated | 3707.582469 | 150,823 | 0.05% | 23906 | 0.012822324 | 0.108536551 | 0.040662475 | 326.8633798 | 0.04952924 | 0.022322487 | | |
| Total | | | | 9,030,690 | 317,870,319 | | 56,898,185 | | | | | | | | |
| Average | | | | | | | | 0.014 | 0.738 | 0.070 | 300.617 | 0.046 | 0.019 | 0.028 | 0.037 |

Source: EMFAC 2014

| VEH | FUEL | MDLYR | SPEED | POP | VMT | TRIPS | ROG_RUNEX | CO_RUNEX | NOX_RUNEX | CO2_RUNEX | PM10_Total | PM2_5_Total | CH4 | N2O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (Miles/hr) | (Vehicles) | (Miles/day) | (Trips/day) | (gms/mile) | (gms/mile) | (gms/mile) | (gms/mile) | (gms/mile) | (gms/mile) | (gms/mile) | (gms/mile) |
| T7 tractor | DSL | Aggregate | Aggregated | 19484 | 2584405 | 0 | 0.088157696 | 0.360400388 | 4.375857349 | 1489.472848 | 0.12016896 | 0.056918679 | 0.0051 | 0.0048 |

Source: EMFAC 2014

**Crimson Solar**

**Operational Emissions Summary**

| | Total Daily Emissions (pounds/day) | | | | | Total Annual Emissions (tons/year) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ROG | NOX | CO | PM10 | PM2.5 | ROG | NOX | CO | PM10 | PM2.5 |
| Operations and Maintenance Vehicles | 0.1 | 3.7 | 2.4 | 77.2 | 11.7 | 0.0 | 0.1 | 0.1 | 6.3 | 1.0 |
| Electricity | | | | | | | | | | |
| Water | | | | | | | | | | |
| Wastewater | | | | | | | | | | |
| Gas Insulated Switchgear | | | | | | | | | | |
| Total | 0.1 | 3.7 | 2.4 | 77.2 | 11.7 | 0.0 | 0.1 | 0.1 | 6.3 | 1.0 |

| Renewable Energy Carbon Savings | | | | | |
|---|---|---|---|---|---|
| 350 | MW Renewable Energy | 1,533,000 | MWh | 355,836 | MT CO2e |
| SCE 2015 Average GHG per Unit of Electricity Provided (MT $CO_2$e/MWh) | 0.23 | | | | |

Notes: Assumes 12 hrs/day, 365 days/year

**Source:** SCE 2015 Corporate Responsibility Report

**Operational Fugitive Dust Emissions**

| Daily On-Site Construction Motor Vehicle Fugitive Particulate Matter Emissions | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vehicle Type | No. | Mi/Veh-Day[f] | Surface Type | Silt Loading ($g/m^2$)/ Silt Content (%)[a] | Vehicle Weight (tons) | Uncontrolled Emission Factors (lb/mi)[b] | | Uncontrolled Emissions (lb/day)[c] | | Control Efficiency[d] | Controlled Emissions (lb/day)[f] | | Uncontrolled Emissions (tons/year) | |
| | | | | | | PM10 | PM2.5 | PM10 | PM2.5 | | PM10 | PM2.5 | PM10 | PM2.5 |
| Pickup Trucks | 4 | 40 | Unpaved | 6 | 2.4 | 4.81E-01 | 7.27E-02 | 77.0 | 11.6 | 55% | 34.7 | 5.2 | 6.3 | 1.0 |

Note: Totals may not match sum of individual values because of rounding.

[a] Unpaved surface silt content from SCAQMD CEQA Handbook, (1993) Table A9-9-D-1 for city and county roads

[b] Equations:

EF (unpaved) = $k_u$ $(s/12)^a$ $(W/3)^b$ — Ref: AP-42, Section 13.2.2, "Unpaved Rods," November 2006

Constants:

| | | |
|---|---|---|
| $k_u$ = | 1.5 | (Particle size multiplier for PM) |
| | 0.15 | (Particle size multiplier for PM2.5) |
| a = | 0.9 | for PM10 |
| | 0.9 | for PM2.5 |
| b = | 0.45 | for PM10 |
| | 0.45 | for PM2.5 |

[c] Uncontrolled emissions [lb/day] = Emission factor [lb/mi] x Number x Daily miles traveled [mi/vehicle-day]

[d] Control efficiency from watering unpaved road twice a day (55%) and limiting maximum speed to 25 mph (44%), from Table XI-A, Mitigation Measure Examples, Fugitive Dust from Construction & Demolition, http://www.aqmd.gov/ceqa/handbook/mitigation/fugitive/MM_fugitive.html

[e] Controlled emissions [lb/day] = Uncontrolled emissions [lb/day] x (1 - Control efficiency [%])

[f] Based on 1 mile roundtrip from Rios Ave to staging area

**Operational Emissions**
**On-Road Vehicle Trips**

| | | | | | | Emissions Summary (lbs/day) | | | | | Emissions Summary (tons per phase) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Daily Trips | Distance | Average Daily Mileage | Calculated Time - Rounded (days) | Total Mileage | VOC | $NO_x$ | CO | PM10 | PM2.5 | VOC | $NO_x$ | CO | PM10 | PM2.5 | $CO_2$ | $CH_4$ | Total GHG Emissions (MT CO2e) |
| Worker Trips | 50 | 13 | 1,300 | 78 | 101,400 | 0.04 | 0.20 | 2.11 | 0.13 | 0.06 | 0.00 | 0.01 | 0.08 | 0.01 | 0.00 | 33.53 | 0.00 | 30.51 |
| Water Delivery Trips | 14 | 13 | 364 | 75 | 27,300 | 0.07 | 3.50 | 0.29 | 0.10 | 0.05 | 0.00 | 0.13 | 0.01 | 0.00 | 0.00 | 44.73 | 0.00 | 40.71 |
| **Total** | | | | | | **0.11** | **3.70** | **2.40** | **0.23** | **0.10** | **0.00** | **0.14** | **0.09** | **0.01** | **0.00** | **78.26** | **0.00** | **71.22** |

Note:
Construction equipment included with appropriate construction phase
Material deliveries are constant regardless of Option A or Option B design selection.

# H.3 ESA Air Quality Calculations, June 2019

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **UNMITIGATED** | | pounds per day | | | | | tons per phse | | | | | MT |
| | | number | VOC | NOX | CO | PM10 | PM2.5 | VOC | NOX | CO | PM10 | PM2.5 | CO2e |
| PA | Phase 1 motor grader | 3 | 1.06 | 14.08 | 4.04 | 0.45 | 0.41 | 0.21 | 2.81 | 0.81 | 0.09 | 0.08 | 262.08 |
| Alt B | Phase 1 motor grader | 2 | 0.71 | 9.39 | 2.69 | 0.30 | 0.27 | 0.14 | 1.87 | 0.54 | 0.06 | 0.05 | 174.72 |
| | motor grader difference | | -0.35 | -4.69 | -1.35 | -0.15 | -0.14 | -0.07 | -0.94 | -0.27 | -0.03 | -0.03 | -87.36 |
| PA | Phase 1 scraper | 3 | 1.85 | 21.92 | 13.91 | 0.85 | 0.79 | 0.37 | 4.37 | 2.77 | 0.17 | 0.16 | 501.14 |
| Alt B | Phase 1 scraper | 2 | 1.23 | 14.61 | 9.27 | 0.57 | 0.53 | 0.25 | 2.91 | 1.85 | 0.11 | 0.11 | 334.09 |
| | scraper Difference | | -0.62 | -7.31 | -4.64 | -0.28 | -0.26 | -0.12 | -1.46 | -0.92 | -0.06 | -0.05 | -167.05 |
| PA | Phase 1 - Fugitive Dust | 7 | | | | 31.62 | 17.42 | | | | 6.31 | 3.48 | |
| Alt B | Phase 1 - Fugitive Dust | 5 | | | | 22.59 | 12.44 | | | | 4.51 | 2.49 | |
| | Fugitive Dust Difference | | | | | -9.03 | -4.98 | | | | -1.80 | -0.99 | |
| **Alt B** | **Phase 1 Net Difference** | | **-0.97** | **-12.00** | **-5.98** | **-9.47** | **-5.38** | -0.19 | -2.39 | -1.19 | -1.89 | -1.07 | **-254.41** |
| | ***Net Dif. Max. Annual** | | | | | | | **-0.12** | **-1.51** | **-0.75** | **-1.19** | **-0.68** | 0 |
| | 63.2 percent of Phase 1 emissions would occur in 2021, the peak year. | | | | | | | | | | | | |
| | | | pounds per day | | | | | tons per phse | | | | | MT |
| | | number | VOC | NOX | CO | PM10 | PM2.5 | VOC | NOX | CO | PM10 | PM2.5 | CO2 |
| PA | Phase 3 backhoe/excavator | 6 | 0.53 | 5.44 | 6.18 | 0.33 | 0.3 | 0.1 | 1.03 | 1.17 | 0.06 | 0.06 | 143.12 |
| Alt B | Phase 3 backhoe/excavator | 4 | 0.35 | 3.63 | 4.12 | 0.22 | 0.20 | 0.07 | 0.69 | 0.78 | 0.04 | 0.04 | 95.41 |
| | backhoe/excavater dif. | | -0.18 | -1.81 | -2.06 | -0.11 | -0.10 | -0.03 | -0.34 | -0.39 | -0.02 | -0.02 | -47.71 |
| PA | Phase 3 - 5 augers | 5 | 0.75 | 9.48 | 5.6 | 0.27 | 0.25 | 0.14 | 1.79 | 1.06 | 0.05 | 0.05 | 425.1 |
| Alt B | Phase 3 - 6 augers | 6 | 0.90 | 11.38 | 6.72 | 0.32 | 0.30 | 0.17 | 2.15 | 1.27 | 0.06 | 0.06 | 510.12 |
| | Auger difference | | 0.15 | 1.90 | 1.12 | 0.05 | 0.05 | 0.03 | 0.36 | 0.21 | 0.01 | 0.01 | 85.02 |
| PA | Phase 3 - 6 cranes | 6 | 2.46 | 29.63 | 20.41 | 1.19 | 1.09 | 0.46 | 5.6 | 3.86 | 0.22 | 0.21 | 629.2 |
| Alt B | Phase 3 - 7 cranes | 7 | 2.87 | 34.57 | 23.81 | 1.39 | 1.27 | 0.54 | 6.53 | 4.50 | 0.26 | 0.25 | 734.07 |
| | Crane difference | | 0.41 | 4.94 | 3.40 | 0.20 | 0.18 | 0.08 | 0.93 | 0.64 | 0.04 | 0.04 | 104.87 |
| PA | Phase 3 - Fugitive Dust | 2 | | | | 1.51 | 0.83 | | | | 0.28 | 0.16 | |
| Alt B | Phase 3 - Fugitive Dust | 0 | | | | 0.00 | 0.00 | | | | 0.00 | 0.00 | |
| | Fugitive Dust Difference | | | | | -1.51 | -0.83 | | | | -0.28 | -0.16 | |
| **Alt B** | **Phase 3 Net Difference** | | **0.38** | **5.02** | **2.46** | **-1.37** | **-0.70** | -0.01 | 0.01 | -0.18 | -0.25 | -0.14 | **37.31** |
| | ***Net Dif. Max. Annual** | | | | | | | **0.00** | **0.01** | **-0.07** | **-0.10** | **-0.05** | |
| | 38.9 percent of Phase 3 emissions would occur in 2021, the peak year. | | | | | | | | | | | | |
| | Total Fugitive Dust Net Difference for Phases 1 and 3 | | | | | -10.54 | -5.81 | | | | -2.08 | -1.15 | |
| | Total PA Emissions in MDAQMD | | 50.8 | 468.8 | 349.3 | 1311.9 | 147.7 | 5.8 | 53.1 | 41.6 | 106.8 | 13.2 | 21,827 |
| | **Total Net Difference** | | **-0.59** | **-6.98** | **-3.52** | **-10.84** | **-6.08** | -0.20 | -2.38 | -1.37 | -2.14 | -1.21 | **-217.09** |
| | **Maximum Annual Net Difference** | | | | | | | **-0.12** | **-1.51** | **-0.82** | **-1.29** | **-0.73** | **0.00** |
| | Alternative B Emissions(lbs/day) | | **50.21** | **461.82** | **345.78** | **1301.06** | **141.62** | | | | | | 21,609.91 |
| | Alternative B Emissions (tons/yr.) | | | | | | | **5.68** | **51.59** | **40.78** | **105.51** | **12.47** | |
| | Alternative B Emissions | | | | | | | | | | | | 21,609.91 |
| | Alternative B Emissions Amortized over life of the 30-year project. | | | | | | | | | | | | 720.33 |
| | Alternative C Emissions adjusted for 300 fewer acres (approximatley 88 percent (2,200 / 2,500) of Proposed Action). | | | | | | | | | | | | 19,207.76 |
| | AlternativeC Emissions Amortized over life of the 30-year project. | | | | | | | | | | | | 640.26 |
| | Alternative B Fugitive Dust | | | | | 1290.52 | 135.82 | | | | 103.43 | 11.31 | |
| | Alternative B PM Exhaust | | | | | 10.54 | 5.81 | | | | 2.08 | 1.15 | |

| | MITIGATED | | pounds per day | | | | | tons per phse | | | | | MT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | number | VOC | NOX | CO | PM10 | PM2.5 | VOC | NOX | CO | PM10 | PM2.5 | CO2e |
| PA | Phase 1 motor grader | 3 | 0.18 | 0.78 | 6.62 | 0.02 | 0.02 | 0.04 | 0.16 | 1.32 | 0 | 0 | 262.08 |
| Alt B | Phase 1 motor grader | 2 | 0.12 | 0.52 | 4.41 | 0.01 | 0.01 | 0.03 | 0.11 | 0.88 | 0.00 | 0.00 | 174.72 |
| | motor grader difference | | -0.06 | -0.26 | -2.21 | -0.01 | -0.01 | -0.01 | -0.05 | -0.44 | 0.00 | 0.00 | -87.36 |
| PA | Phase 1 scraper | 3 | 0.35 | 1.51 | 12.75 | 0.05 | 0.05 | 0.07 | 0.3 | 2.54 | 0.01 | 0.01 | 501.14 |
| Alt B | Phase 1 scraper | 2 | 0.23 | 1.01 | 8.50 | 0.03 | 0.03 | 0.05 | 0.20 | 1.69 | 0.01 | 0.01 | 334.09 |
| | scraper Difference | | -0.12 | -0.50 | -4.25 | -0.02 | -0.02 | -0.02 | -0.10 | -0.85 | 0.00 | 0.00 | -167.05 |
| PA | Phase 1 - Fugitive Dust | 7 | | | | 12.65 | 6.97 | | | | 2.52 | 1.39 | |
| Alt B | Phase 1 - Fugitive Dust | 5 | | | | 9.04 | 4.98 | | | | 1.80 | 0.99 | |
| | Fugitive Dust Difference | | | | | -3.61 | -1.99 | | | | -0.72 | -0.40 | |
| **Alt B** | **Phase 1 Net Difference** | | **-0.18** | **-0.76** | **-6.46** | **-3.64** | **-2.01** | **-0.04** | **-0.15** | **-1.29** | **-0.72** | **-0.40** | **-254.41** |
| | ***Net Dif. Max. Annual** | | | | | | | **-0.02** | **-0.10** | **-0.81** | **-0.46** | **-0.25** | |
| | 63.2 percent of Phase 1 emissions would occur in 2021, the peak year. | | | | | | | | | | | | |
| | | | pounds per day | | | | | tons per phse | | | | | MT |
| | | number | VOC | NOX | CO | PM10 | PM2.5 | VOC | NOX | CO | PM10 | PM2.5 | CO2 |
| PA | Phase 3 backhoe/excavator | 6 | 0.11 | 0.46 | 6.52 | 0.01 | 0.01 | 0.02 | 0.09 | 1.23 | 0 | 0 | 143.12 |
| Alt B | Phase 3 backhoe/excavator | 4 | 0.07 | 0.31 | 4.35 | 0.01 | 0.01 | 0.01 | 0.06 | 0.82 | 0.00 | 0.00 | 95.41 |
| | backhoe/excavater dif. | | -0.04 | -0.15 | -2.17 | 0.00 | 0.00 | -0.01 | -0.03 | -0.41 | 0.00 | 0.00 | -47.71 |
| PA | Phase 5 augers | 5 | 0.31 | 1.36 | 11.54 | 0.04 | 0.04 | 0.06 | 0.26 | 2.18 | 0.01 | 0.01 | 425.1 |
| Alt B | Phase 6 augers | 6 | 0.37 | 1.63 | 13.85 | 0.05 | 0.05 | 0.07 | 0.31 | 2.62 | 0.01 | 0.01 | 510.12 |
| | Auger difference | | 0.06 | 0.27 | 2.31 | 0.01 | 0.01 | 0.01 | 0.05 | 0.44 | 0.00 | 0.00 | 85.02 |
| PA | Phase 3 - 6 cranes | 6 | 0.46 | 1.99 | 16.88 | 0.06 | 0.06 | 0.09 | 0.38 | 3.19 | 0.01 | 0.01 | 629.2 |
| Alt B | Phase 3 - 7 cranes | 7 | 0.54 | 2.32 | 19.69 | 0.07 | 0.07 | 0.11 | 0.44 | 3.72 | 0.01 | 0.01 | 734.07 |
| | Crane difference | | 0.08 | 0.33 | 2.81 | 0.01 | 0.01 | 0.02 | 0.06 | 0.53 | 0.00 | 0.00 | 104.87 |
| PA | Phase 3 - Fugitive Dust | 2 | | | | 0.60 | 0.33 | | | | 0.11 | 0.06 | |
| Alt B | Phase 3 - Fugitive Dust | 0 | | | | 0.00 | 0.00 | | | | 0.00 | 0.00 | |
| | Fugitive Dust Difference | | | | | -0.60 | -0.33 | | | | -0.11 | -0.06 | |
| **Alt B** | **Phase 3 Net Difference** | | **0.10** | **0.45** | **2.95** | **-0.59** | **-0.32** | **0.02** | **0.09** | **0.56** | **-0.11** | **-0.06** | **37.31** |
| | ***Net Dif. Max. Annual** | | | | | | | **0.01** | **0.03** | **0.22** | **-0.04** | **-0.02** | |
| | 38.9 percent of Phase 3 emissions would occur in 2021, the peak year. | | | | | | | | | | | | |
| | Total Fugitive Dust Net Difference for Phases 1 and 3 | | | | | -4.21 | -2.32 | | | | -0.83 | -0.46 | |
| PA | Total PA Emissions | | 20.3 | 189 | 404.5 | 286.8 | 40.9 | 2.3 | 20.3 | 48.2 | 23.1 | 3.6 | |
| **Alt B** | **Total Net Difference** | | **-0.07** | **-0.31** | **-3.51** | **-4.22** | **-2.33** | -0.02 | -0.07 | -0.73 | -0.83 | -0.46 | -217.09 |
| | **Maximum Annual Net Difference** | | | | | | | **-0.02** | **-0.06** | **-0.60** | **-0.50** | **-0.27** | **0.00** |
| Alt B | Alternative B Emissions | | 20.23 | 188.69 | 400.99 | 282.58 | 38.57 | | | | | | |
| | Alternative B Emissions (tons/yr.) | | | | | | | **2.28** | **20.24** | **47.60** | **22.60** | **3.33** | |
| | Alternative B Fugitive Dust | | | | | 278.36 | 36.25 | | | | 21.77 | 2.87 | |
| | Alternative B PM10 Exhaust | | | | | 4.21 | 2.32 | | | | 0.83 | 0.46 | |

**Total Project Operation Emissions**

| Emissions Source | $CO_2$e metric tons |
|---|---|
| Total Operational Emissions | 171 |
| Amortized Construction over 30 Years | 728 |
| Amortized Decommissioning over 30 Years | 728 |
| Total | 1,627 |
| Carbon Savings | 355,836 |
| Total Net | 354,209 |

**Total Alternative B Operation Emissions**

| Emissions Source | $CO_2$e metric tons |
|---|---|
| Total Operational Emissions | 171 |
| Amortized Construction over 30 Years | 720 |
| Amortized Decommissioning over 30 Years | 720 |
| Total | 1,612 |
| Carbon Savings | 355,836 |
| Total Net | 354,224 |

**Total Alternative C Operation Emissions**

| Emissions Source | $CO_2$e metric tons |
|---|---|
| Total Operational Emissions | 171 |
| Amortized Construction over 30 Years | 640 |
| Amortized Decommissioning over 30 Years | 640 |
| Total | 1,452 |
| Carbon Savings | 355,836 |
| Total Net | 354,384 |

**Maximum Daily Construction Emissions Summary**

| | Maximum Daily Emissions (lbs/day) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | $PM_{10}$ | | | $PM_{2.5}$ | | | | |
| Construction Phase/Source | Exhaust | Dust | Total | Exhaust | Dust | Total | | |
| 2020 | | | | | | | | |
| Phase I | 7.71 | 210.94 | 218.65 | 5.98 | 37.55 | 43.53 | 218.65 | 43.53 |
| | | | | | | | | |
| 2021 | | | | | | | | |
| Phase I | 7.71 | 210.94 | 218.65 | 5.98 | 37.55 | 43.53 | 218.65 | 43.53 |
| Phase II | 13.98 | 241.92 | 255.9 | 11.18 | 27.79 | 38.97 | 255.88 | 38.97 |
| Phase III | 5.34 | 117.73 | 123.07 | 4.54 | 11.81 | 16.35 | 123.08 | 16.35 |
| Maximum Daily | 27.03 | 570.59 | 597.62 | 21.7 | 77.15 | 98.85 | 597.61 | 98.85 |
| | | | | | | | | |
| 2022 | | | | | | | | |
| Phase I | 7.71 | 210.94 | 218.65 | 5.98 | 37.55 | 43.53 | 218.65 | 43.53 |
| Phase II | 13.98 | 241.92 | 255.9 | 11.18 | 27.79 | 38.97 | 255.88 | 38.97 |
| Phase III | 5.34 | 117.73 | 123.07 | 4.54 | 11.81 | 16.35 | 123.08 | 16.35 |
| Maximum Daily | 27.03 | 570.59 | 597.62 | 21.7 | 77.15 | 98.85 | 597.61 | 98.85 |

**Percent of Phase by Year**

| Phase/Year | Total Days | Total Tons PM10 | Percent |
|---|---|---|---|
| Phase I | | | |
| 2020 | 63 | 6.85 | 15.79% |
| 2021 | 252 | 27.39 | 63.15% |
| 2022 | 84 | 9.13 | 21.05% |
| Total | 399 | 43.37 | |
| Phase 2 | | | |
| 2021 | 239 | 30.41 | 59.99% |
| 2022 | 160 | 20.28 | 40.01% |
| Total | 399 | 50.69 | |
| Phase 3 | | | |
| 2021 | 231 | 14.1 | 61.12% |
| 2022 | 147 | 8.97 | 38.88% |
| Total | 378 | 23.07 | |

**Total Particulate Matter Emissions Summary**

| | Total Emissions (tons/phase) | | | | | |
|---|---|---|---|---|---|---|
| | $PM_{10}$ | | | $PM_{2.5}$ | | |
| Construction Phase/Source | Exhaust | Dust | Total | Exhaust | Dust | Total |
| Phase I | 1.28 | 42.08 | 43.36 | 1.07 | 7.49 | 8.56 |
| Phase II | 2.43 | 48.26 | 50.69 | 2.06 | 5.54 | 7.6 |
| Phase III | 0.82 | 22.25 | 23.07 | 0.7 | 2.23 | 2.93 |

Source AECOM, 2019

**Maximum Annual Construction PM Emissions Summary for Fugitive Dust and Exhaust by Year**

| | | Maximum Annual Emissions (tons/year) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Percent per Phase per year | $PM_{10}$ | | | $PM_{2.5}$ | | | | |
| Construction Phase/Source | | Exhaust | Dust | Total | Exhaust | Dust | Total | | |
| 2020 | | | | | | | | | |
| Phase I | 16% | 0.20 | 6.65 | 6.85 | 0.17 | 1.18 | 1.35 | 6.85 | 1.35 |
| | | | | | | | | | |
| 2021 | | | | | | | | | |
| Phase I | 63% | 0.81 | 26.58 | 27.38 | 0.68 | 4.73 | 5.41 | 27.39 | 5.41 |
| Phase II | 60% | 1.46 | 28.95 | 30.41 | 1.24 | 3.32 | 4.56 | 30.41 | 4.56 |
| Phase III | 61% | 0.50 | 13.60 | 14.10 | 0.43 | 1.36 | 1.79 | 14.1 | 1.79 |
| Maximum Annual | | 2.77 | 69.13 | 71.89 | 2.34 | 9.42 | 11.76 | 71.9 | 11.76 |
| | | | | | | | | | |
| 2022 | | | | | | | | | |
| Phase I | 21% | 0.27 | 8.86 | 9.13 | 0.23 | 1.58 | 1.80 | 9.13 | 1.8 |
| Phase II | 40% | 0.97 | 19.31 | 20.28 | 0.82 | 2.22 | 3.04 | 20.28 | 3.04 |
| Phase III | 39% | 0.32 | 8.65 | 8.97 | 0.27 | 0.87 | 1.14 | 8.97 | 1.14 |
| Maximum Annual | | 1.56 | 36.82 | 38.38 | 1.32 | 4.66 | 5.98 | 38.38 | 5.98 |

**Mitigated Maximum Daily Construction PM Emissions Summary for Fugitive Dust and Exhaust by Year**

| Construction Phase/Source | Maximum Daily Emissions (lbs/day) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | $PM_{10}$ | | | $PM_{2.5}$ | | | | |
| | Exhaust | Dust | Total | Exhaust | Dust | Total | | |
| 2020 | | | | | | | | |
| Phase I | 2.87 | 42.46 | 45.33 | 1.46 | 9.66 | 11.12 | 45.33 | 11.12 |
| | | | | | | | | |
| 2021 | | | | | | | | |
| Phase I | 2.87 | 42.46 | 45.33 | 1.46 | 9.66 | 11.12 | 45.33 | 11.12 |
| Phase II | 5.59 | 43.16 | 48.75 | 3.47 | 4.48 | 7.95 | 48.75 | 7.95 |
| Phase III | 1.07 | 22.01 | 23.08 | 0.62 | 2.19 | 2.81 | 23.08 | 2.81 |
| Maximum Daily | 9.53 | 107.63 | 117.16 | 5.55 | 16.33 | 21.88 | 117.16 | 21.89 |
| | | | | | | | | |
| 2022 | | | | | | | | |
| Phase I | 2.87 | 42.46 | 45.33 | 1.46 | 9.66 | 11.12 | 45.33 | 11.12 |
| Phase II | 5.59 | 43.16 | 48.75 | 3.47 | 4.48 | 7.95 | 48.75 | 7.95 |
| Phase III | 1.07 | 22.01 | 23.08 | 0.62 | 2.19 | 2.81 | 23.08 | 2.81 |
| Maximum Daily | 9.53 | 107.63 | 117.16 | 5.55 | 16.33 | 21.88 | 117.16 | 21.89 |

**Total Mitigated Particulate Matter Emissions Summary**

| Construction Phase/Source | Total Emissions (tons/phase) | | | | | |
|---|---|---|---|---|---|---|
| | $PM_{10}$ | | | $PM_{2.5}$ | | |
| | Exhaust | Dust | Total | Exhaust | Dust | Total |
| Phase I | 0.31 | 8.47 | 8.78 | 0.17 | 1.93 | 2.10 |
| Phase II | 0.76 | 8.61 | 9.37 | 0.52 | 0.89 | 1.41 |
| Phase III | 0.16 | 4.16 | 4.32 | 0.09 | 0.41 | 0.50 |

Source AECOM, 2019

**Mitigated Maximum Annual Construction PM Emissions Summary for Fugitive Dust and Exhaust by Year**

| Construction Phase/Source | Percent per Phase per year | Maximum Annual Emissions (tons/year) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | $PM_{10}$ | | | $PM_{2.5}$ | | | | |
| | | Exhaust | Dust | Total | Exhaust | Dust | Total | | |
| 2020 | | | | | | | | | |
| Phase I | 16% | 0.05 | 1.34 | 1.39 | 0.03 | 0.30 | 0.33 | 1.39 | 0.33 |
| | | | | | | | | | |
| 2021 | | | | | | | | | |
| Phase I | 63% | 0.20 | 5.35 | 5.54 | 0.11 | 1.22 | 1.33 | 5.55 | 1.32 |
| Phase II | 60% | 0.46 | 5.17 | 5.62 | 0.31 | 0.53 | 0.85 | 5.62 | 0.85 |
| Phase III | 61% | 0.10 | 2.54 | 2.64 | 0.06 | 0.25 | 0.31 | 2.64 | 0.31 |
| Maximum Annual | | 0.75 | 13.06 | 13.81 | 0.47 | 2.00 | 2.48 | 13.81 | 2.48 |
| | | | | | | | | | |
| 2022 | | | | | | | | | |
| Phase I | 21% | 0.07 | 1.78 | 1.85 | 0.04 | 0.41 | 0.44 | 1.85 | 0.44 |
| Phase II | 40% | 0.30 | 3.44 | 3.75 | 0.21 | 0.36 | 0.56 | 3.75 | 0.57 |
| Phase III | 39% | 0.06 | 1.62 | 1.68 | 0.03 | 0.16 | 0.19 | 1.68 | 0.2 |
| Maximum Annual | | 0.43 | 6.85 | 7.28 | 0.28 | 0.92 | 1.20 | 7.28 | 1.21 |

## Option A - Traditional Design Construction

## Criteria Air Pollutant Emissions

### On-road Trip Emissions - Within Mojave Desert AQMD jurisdiction

| | workdays /phase | roundtrips/day | mi/one-way trip[1] | round trips/ phase | Ave daily mileage | Ave daily mileage (paved) | Onsite mi/one-way trip (unpaved) | Ave daily onsite mileage (unpaved) | No. of days/ phase | mileage/ phase | mileage/ phase (paved) | onsite mileage/ phase (unpaved) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Phase 1* | *19 months* | | | | | | | | | | | |
| Module delivery | 399 | 10 | 15 | 810 | 300 | 260 | 2 | 40 | 81 | 24,300 | 21,060 | 3,240 |
| Foundation delivery | 399 | 10 | 15 | 980 | 300 | 260 | 2 | 40 | 98 | 29,400 | 25,480 | 3,920 |
| Water Delivery Trips | 399 | 25 | 13 | 9,776 | 637 | 539 | 2 | 98 | 399 | 254,176 | 215,072 | 39,104 |
| Other on-road trips (worker) | --- | | | | | | | | | | | |
| Total on-road for Phase 1 | --- | | | | | | | | | | | |
| *Phase 2* | *19 months* | | | | | | | | | | | |
| Module delivery | 399 | 10 | 15 | 810 | 300 | 260 | 2 | 40 | 81 | 24,300 | 21,060 | 3,240 |
| Tracker delivery | 399 | 9 | 15 | 1,863 | 270 | 234 | 2 | 36 | 207 | 55,890 | 48,438 | 7,452 |
| Foundation delivery | 399 | 10 | 15 | 980 | 300 | 260 | 2 | 40 | 98 | 29,400 | 25,480 | 3,920 |
| Inverter delivery | 399 | 2 | 15 | 72 | 60 | 52 | 2 | 8 | 36 | 2,160 | 1,872 | 288 |
| Water Delivery Trips | 399 | 49 | 13 | 19,551 | 1,274 | 1,078 | 2 | 196 | 399 | 508,326 | 430,122 | 78,204 |
| Other on-road trips (worker) | --- | | | | | | | | | | | |
| Total on-road for Phase 2 | --- | | | | | | | | | | | |
| *Phase 3* | *18 months* | | | | | | | | | | | |
| Inverter delivery | 378 | 2 | 15 | 72 | 60 | 52 | 2 | 8 | 36 | 2,160 | 1,872 | 288 |
| Water Delivery Trips | 378 | 9 | 13 | 3,259 | 224 | 190 | 2 | 34 | 378 | 84,734 | 71,698 | 13,036 |
| Other on-road trips(worker & concrete) | --- | | | | | | | | | | | |
| Total on-road for Phase 3 | --- | | | | | | | | | | | |
| Other (cement) Trips | | 9 | | 3,402 | | | | | 378 | | | |
| Total Trips | | 144 | | 41,575 | | | | | | | | |

**Emissions Factors (gms/mile)[2]**

| | VOC | NOx | CO | PM10 Exh. | paved road PM10 Dust[3] | unpaved road PM10 Dust[3] | PM2.5 Exhaust | paved road PM2.5 Dust[3] | unpaved road PM2.5 Dust[3] |
|---|---|---|---|---|---|---|---|---|---|
| *Phase 1* | | | | | | | | | |
| Module delivery | 0.09 | 4.38 | 0.36 | 0.12 | 1.87 | 984.30 | 0.06 | 0.46 | 81.65 |
| Foundation delivery | 0.09 | 4.38 | 0.36 | 0.12 | 1.87 | 984.30 | 0.06 | 0.46 | 81.65 |
| Water Delivery Trips | 0.09 | 4.38 | 0.36 | 0.12 | 1.87 | 984.30 | 0.06 | 0.46 | 81.65 |
| Other on-road trips (worker) | --- | | | | | | | | |
| Total on-road for Phase 1 | --- | | | | | | | | |
| *Phase 2* | | | | | | | | | |
| Module delivery | 0.09 | 4.38 | 0.36 | 0.12 | 1.87 | 984.30 | 0.06 | 0.46 | 81.65 |
| Tracker delivery | 0.09 | 4.38 | 0.36 | 0.12 | 1.87 | 984.30 | 0.06 | 0.46 | 81.65 |
| Foundation delivery | 0.09 | 4.38 | 0.36 | 0.12 | 1.87 | 984.30 | 0.06 | 0.46 | 81.65 |
| Inverter delivery | 0.09 | 4.38 | 0.36 | 0.12 | 1.87 | 984.30 | 0.06 | 0.46 | 81.65 |
| Water Delivery Trips | 0.09 | 4.38 | 0.36 | 0.12 | 1.87 | 984.30 | 0.06 | 0.46 | 81.65 |
| Other on-road trips (worker) | --- | | | | | | | | |
| Total on-road for Phase 2 | --- | | | | | | | | |
| *Phase 3* | | | | | | | | | |
| Inverter delivery | 0.09 | 4.38 | 0.36 | 0.12 | 1.87 | 984.30 | 0.06 | 0.46 | 81.65 |
| Water Delivery Trips | 0.09 | 4.38 | 0.36 | 0.12 | 1.87 | 984.30 | 0.06 | 0.46 | 81.65 |
| Other on-road trips(worker & concrete) | --- | | | | | | | | |
| Total on-road for Phase 3 | --- | | | | | | | | |
| Other (cement) Trips | | 3.5002 | | | | | | | |
| Total Trips | | | | | | | | | |

**Emissions (lbs/day)**

| | VOC | NOx | CO | PM10 Exh. | Paved road PM10 Dust | Unpaved road PM10 Dust | PM10 Dust Total | PM10 Total | PM2.5 Exh. | Paved Road PM2.5 Dust | Unpaved Road PM2.5 Dust | PM2.5 Dust Total | PM2.5 Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Phase 1* | | | | | | | | | | | | | |
| Module delivery | 0.06 | 2.89 | 0.24 | 0.08 | 1.07 | 86.80 | 87.87 | 87.95 | 0.04 | 0.26 | 7.20 | 7.46 | 7.50 |
| Foundation delivery | 0.06 | 2.89 | 0.24 | 0.08 | 1.07 | 86.80 | 87.87 | 87.95 | 0.04 | 0.26 | 7.20 | 7.46 | 7.50 |
| Water Delivery Trips | 0.12 | 6.15 | 0.51 | 0.17 | 2.22 | 212.67 | 214.90 | 215.06 | 0.08 | 0.55 | 17.64 | 18.19 | 18.27 |
| Other on-road trips (worker) | 0.26 | 1.34 | 14.10 | 0.89 | 5.62 | 0.00 | 5.62 | 6.51 | 0.37 | 1.38 | 0.00 | 1.38 | 1.75 |
| Total on-road for Phase 1 | 0.50 | 13.27 | 15.08 | 1.22 | 9.99 | 386.27 | 396.26 | 397.48 | 0.53 | 2.45 | 32.04 | 34.49 | 35.02 |
| *Phase 2* | | | | | | | | | | | | | |
| Module delivery | 0.06 | 2.89 | 0.24 | 0.08 | 1.07 | 86.80 | 87.87 | 87.95 | 0.04 | 0.26 | 7.20 | 7.46 | 7.50 |
| Tracker delivery | 0.05 | 2.60 | 0.21 | 0.07 | 0.97 | 78.12 | 79.09 | 79.16 | 0.03 | 0.24 | 6.48 | 6.72 | 6.75 |
| Foundation delivery | 0.06 | 2.89 | 0.24 | 0.08 | 1.07 | 86.80 | 87.87 | 87.95 | 0.04 | 0.26 | 7.20 | 7.46 | 7.50 |
| Inverter delivery | 0.01 | 0.58 | 0.05 | 0.02 | 0.21 | 17.36 | 17.57 | 17.59 | 0.01 | 0.05 | 1.44 | 1.49 | 1.50 |
| Water Delivery Trips | 0.25 | 12.29 | 1.01 | 0.34 | 4.45 | 425.32 | 429.77 | 430.11 | 0.16 | 1.09 | 35.28 | 36.37 | 36.53 |
| Other on-road trips (worker) | 0.34 | 1.71 | 10.03 | 1.14 | 7.19 | 0.00 | 7.19 | 8.33 | 0.47 | 1.76 | 0.00 | 1.76 | 2.23 |
| Total on-road for Phase 2 | 0.77 | 22.97 | 11.78 | 1.72 | 14.96 | 694.40 | 709.36 | 711.09 | 0.75 | 3.67 | 57.60 | 61.27 | 62.01 |
| *Phase 3* | | | | | | | | | | | | | |
| Inverter delivery | 0.01 | 0.58 | 0.05 | 0.02 | 0.21 | 17.36 | 17.57 | 17.59 | 0.01 | 0.05 | 1.44 | 1.49 | 1.50 |
| Water Delivery Trips | 0.04 | 2.16 | 0.18 | 0.06 | 0.78 | 74.84 | 75.62 | 75.68 | 0.03 | 0.19 | 6.21 | 6.40 | 6.43 |
| Other on-road trips(worker & concrete) | 0.64 | 2.97 | 7.79 | 0.54 | 6.59 | 49.67 | 56.26 | 56.80 | 0.23 | 1.61 | 4.13 | 5.74 | 5.97 |
| Total on-road for Phase 3 | 0.70 | 5.71 | 8.02 | 0.62 | 7.58 | 141.87 | 149.45 | 150.07 | 0.27 | 1.86 | 11.78 | 13.63 | 13.90 |
| Total Trips | | | 365.00 | | | | | | | | | | |

**Emissions (tons/phase)**

| | VOC | NOx | CO | PM10 Exh. | Paved Road PM10 Dust | Unpaved road PM10 Dust | PM10 Dust Total | PM10 Total | PM2.5 Exh. | Paved Road PM2.5 Dust | Unpaved Road PM2.5 Dust | PM2.5 Dust Total | PM2.5 Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Phase 1* | | | | | | | | | | | | | |
| Module delivery | 0.00 | 0.09 | 0.01 | 0.00 | 0.04 | 3.19 | 3.23 | 3.23 | 0.00 | 0.01 | 0.26 | 0.27 | 0.28 |
| Foundation delivery | 0.00 | 0.11 | 0.01 | 0.00 | 0.05 | 3.86 | 3.91 | 3.91 | 0.00 | 0.01 | 0.32 | 0.33 | 0.33 |
| Water Delivery Trips | 0.02 | 0.94 | 0.08 | 0.03 | 0.40 | 38.49 | 38.89 | 38.92 | 0.01 | 0.10 | 3.19 | 3.29 | 3.31 |
| Other on-road trips (worker) | 0.05 | 0.27 | 2.81 | 0.18 | 0.22 | 0.00 | 0.22 | 0.40 | 0.07 | 0.05 | 0.00 | 0.05 | 0.12 |
| Total on-road for Phase 1 | 0.07 | 1.41 | 2.90 | 0.21 | 0.71 | 45.54 | 46.25 | 46.46 | 0.09 | 0.17 | 3.78 | 3.95 | 4.04 |
| *Phase 2* | | | | | | | | | | | | | |
| Module delivery | 0.00 | 0.11 | 0.01 | 0.00 | 0.04 | 3.19 | 3.23 | 3.23 | 0.00 | 0.01 | 0.26 | 0.27 | 0.28 |
| Tracker delivery | 0.00 | 0.24 | 0.02 | 0.01 | 0.09 | 7.33 | 7.43 | 7.43 | 0.00 | 0.02 | 0.61 | 0.63 | 0.63 |
| Foundation delivery | 0.00 | 0.13 | 0.01 | 0.00 | 0.05 | 3.86 | 3.91 | 3.91 | 0.00 | 0.01 | 0.32 | 0.33 | 0.33 |
| Inverter delivery | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.28 | 0.29 | 0.29 | 0.00 | 0.00 | 0.02 | 0.02 | 0.02 |
| Water Delivery Trips | 0.04 | 2.22 | 0.18 | 0.06 | 0.81 | 76.98 | 77.78 | 77.84 | 0.03 | 0.20 | 6.39 | 6.58 | 6.61 |
| Other on-road trips (worker) | 0.07 | 0.34 | 3.60 | 0.23 | 0.83 | 0.00 | 0.83 | 1.06 | 0.09 | 0.20 | 0.00 | 0.20 | 0.29 |
| Total on-road for Phase 2 | 0.12 | 3.05 | 3.82 | 0.30 | 1.82 | 91.64 | 93.46 | 93.76 | 0.13 | 0.44 | 7.60 | 8.04 | 8.17 |
| *Phase 3* | | | | | | | | | | | | | |
| Inverter delivery | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.28 | 0.29 | 0.29 | 0.00 | 0.00 | 0.02 | 0.02 | 0.02 |
| Water Delivery Trips | 0.01 | 0.37 | 0.03 | 0.01 | 0.13 | 12.83 | 12.97 | 12.98 | 0.00 | 0.03 | 1.06 | 1.10 | 1.10 |
| Other on-road trips(worker & concrete) | 0.04 | 0.57 | 1.48 | 0.10 | 0.34 | 10.36 | 10.70 | 10.80 | 0.05 | 0.11 | 0.86 | 0.97 | 1.02 |
| Total on-road for Phase 3 | 0.05 | 0.95 | 1.51 | 0.11 | 0.48 | 23.47 | 23.95 | 24.06 | 0.05 | 0.14 | 1.95 | 2.09 | 2.15 |

1. Estimated one-way travel distance for trucks from Port of Los Angeles to the MDAQMD jurisdiction western border for module, tracker, foundation, and inverter deliveries. Water deliveries are assumed to be from Blythe, assuming the following round trip amounts: Phase 1 – 9,776 trips; Phase 2 – 19,551 trips; and Phase 3 – 3,259 trips.
2. Exhaust emission factors for obtained from Riverside County 2020 Onroad emission factors for diesel T7 tractor (aggregated model years and speeds) from AECOM appendix.
3. PM10 dust and PM2.5 dust emission factors based on AP-42 emission calculations for paved road and unpaved road dust from haul trucks (also from AECOM appendix)

*Shaded numbers were obtained from, or based on, the AECOM Air Quality Report.

426.7 320

## Off-road Construction Equipment Exhaust Emissions

| | Emissions (lbs/day) | | | | | Emissions (tons/phase) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | VOC | NOx | CO | PM10 | PM2.5 | VOC | NOx | CO | PM10 | PM2.5 |
| Phase 1 - unmitigated | 12.38 | 120.50 | 78.70 | 5.14 | 4.81 | 2.47 | 24.04 | 15.7 | 1.03 | 0.96 |
| Phase 1 - All Tier 4 Final | 2.53 | 22.29 | 96.70 | 0.30 | 0.30 | 0.5 | 4.45 | 19.29 | 0.06 | 0.06 |
| Reduction from mitigation | 9.85 | 98.21 | -18.00 | 4.84 | 4.51 | 1.97 | 19.59 | -3.59 | 0.97 | 0.9 |
| Phase 1 - 85% Tier 4 Final | 4.01 | 37.02 | 94.00 | 1.03 | 0.98 | 0.7955 | 7.3885 | 18.7515 | 0.2055 | 0.195 |
| | | | | | | | | | | |
| Phase 2 - unmitigated | 25.70 | 204.16 | 163.34 | 10.27 | 9.50 | 5.13 | 40.73 | 32.59 | 2.05 | 1.89 |
| Phase 2 - All Tier 4 Final | 8.14 | 57.30 | 196.92 | 1.90 | 1.79 | 1.62 | 11.43 | 39.29 | 0.38 | 0.36 |
| Reduction from mitigation | 17.56 | 146.86 | -33.58 | 8.37 | 7.71 | 3.51 | 29.3 | -6.7 | 1.67 | 1.53 |
| Phase 2 - 85% Tier 4 Final | 10.77 | 79.33 | 191.88 | 3.16 | 2.95 | 2.1465 | 15.825 | 38.285 | 0.6305 | 0.5895 |
| | | | | | | | | | | |
| Phase 3 - unmitigated | 10.73 | 102.19 | 72.40 | 4.55 | 4.20 | 1.65 | 16.68 | 11.56 | 0.71 | 0.65 |
| Phase 3 - All Tier 4 Final | 2.27 | 18.10 | 85.77 | 0.27 | 0.27 | 0.37 | 2.51 | 14.04 | 0.05 | 0.05 |
| Reduction from mitigation | 8.46 | 84.09 | -13.37 | 4.28 | 3.93 | 1.28 | 14.17 | -2.48 | 0.66 | 0.6 |
| Phase 3 - 85% Tier 4 Final | 3.54 | 30.71 | 83.76 | 0.91 | 0.86 | 0.562 | 4.6355 | 13.668 | 0.149 | 0.14 |

## TOTAL CONSTRUCTION EMISSIONS (UNMITIGATED)

| | Emissions (lbs/day) | | | | | | | | | Emissions (tons/phase) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | VOC | NOx | CO | PM10 Exh. | PM10 Dust | PM10 Total | PM2.5 Exh. | PM2.5 Dust | PM2.5 Total | VOC | NOx | CO | PM10 Exh. | PM10 Dust | PM10 Total | PM2.5 Exh. | PM2.5 Dust | PM2.5 Total |
| Phase 1 - onroad emissions with water trip haul length adjustments | 0.50 | 13.27 | 15.08 | 1.22 | 396.26 | 397.48 | 0.53 | 34.49 | 35.02 | 0.07 | 1.41 | 2.90 | 0.21 | 46.25 | 46.46 | 0.09 | 3.95 | 4.04 |
| Phase 1 - offroad equipment and dust emissions[4] | 12.38 | 120.50 | 78.70 | 5.14 | 31.83 | 36.97 | 4.81 | 17.45 | 22.26 | 2.47 | 24.04 | 15.70 | 1.03 | 6.35 | 7.38 | 0.96 | 3.49 | 4.45 |
| Total revised Phase 1 emissions | 12.88 | 133.77 | 93.78 | 6.36 | 428.09 | 434.45 | 5.34 | 51.94 | 57.28 | 2.54 | 25.45 | 18.60 | 1.24 | 52.60 | 53.84 | 1.05 | 7.44 | 8.49 |
| | | | | | | | | | | | | | | | | | | |
| Phase 2 -onroad emissions with water trip haul length adjustments | 0.77 | 22.97 | 11.78 | 1.72 | 709.36 | 711.09 | 0.75 | 61.27 | 62.01 | 0.12 | 3.05 | 3.82 | 0.30 | 93.46 | 93.76 | 0.13 | 8.04 | 8.17 |
| Phase 2 - offroad equipment and dust emissions[5] | 25.70 | 204.16 | 163.34 | 10.27 | 0.00 | 10.27 | 9.50 | 0.00 | 9.50 | 5.13 | 40.73 | 32.59 | 2.05 | 0.00 | 2.05 | 1.89 | 0.00 | 1.89 |
| Total revised Phase 2 emissions | 26.47 | 227.13 | 175.12 | 11.99 | 709.36 | 721.36 | 10.25 | 61.27 | 71.51 | 5.25 | 43.78 | 36.41 | 2.35 | 93.46 | 95.81 | 2.02 | 8.04 | 10.06 |
| | | | | | | | | | | | | | | | | | | |
| Phase 3 - onroad emissions with water trip haul length adjustments | 0.70 | 5.71 | 8.02 | 0.62 | 149.45 | 150.07 | 0.27 | 13.63 | 13.90 | 0.05 | 0.95 | 1.51 | 0.11 | 23.95 | 24.06 | 0.05 | 2.09 | 2.15 |
| Phase 3 - offroad equipment and dust emissions[6] | 10.73 | 102.19 | 72.40 | 4.55 | 1.51 | 6.06 | 4.20 | 0.83 | 5.03 | 1.65 | 16.68 | 11.56 | 0.71 | 0.28 | 0.99 | 0.65 | 0.16 | 0.81 |
| Total revised Phase 3 emissions | 11.43 | 107.90 | 80.42 | 5.17 | 150.96 | 156.13 | 4.47 | 14.46 | 18.93 | 1.70 | 17.63 | 13.07 | 0.82 | 24.23 | 25.05 | 0.70 | 2.25 | 2.96 |

4. Phase 1 PM10 dust and PM2.5 dust emissions include fugitive dust emissions from truck loading and earthwork.
5. There would be no Phase 2 PM10 dust or PM2.5 dust emissions associated with truck loading or earthwork.
6. Phase 3 PM10 dust and PM2.5 dust emissions include fugitive dust emissions from earthwork.

## TOTAL CONSTRUCTION EMISSIONS BY YEAR (UNMITIGATED)

| Construction Year | Maximum Daily Emissions (lbs/day) | | | | | | | | | Emissions (tons/year) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | VOC | NOx | CO | PM10 Exh. | PM10 Dust | PM10 Total | PM2.5 Exh. | PM2.5 Dust | PM2.5 Total | VOC | NOx | CO | PM10 Exh. | PM10 Dust | PM10 Total | PM2.5 Exh. | PM2.5 Dust | PM2.5 Total |
| 2020 | | | | | | | | | | | | | | | | | | |
| Phase 1 | 12.9 | 133.8 | 93.8 | 6.4 | 428.1 | 434.4 | 5.3 | 51.9 | 57.3 | 0.4 | 4.0 | 3.0 | 0.2 | 8.4 | 8.6 | 0.2 | 1.2 | 1.3 |
| 2020 Emisions | 12.9 | 133.8 | 93.8 | 6.4 | 428.1 | 434.4 | 5.3 | 51.9 | 57.3 | 0.4 | 4.0 | 3.0 | 0.2 | 8.4 | 8.6 | 0.2 | 1.2 | 1.3 |
| | | | | | | | | | | | | | | | | | | |
| 2021 | | | | | | | | | | | | | | | | | | |
| Phase 1 | 12.9 | 133.8 | 93.8 | 6.4 | 428.1 | 434.4 | 5.3 | 51.9 | 57.3 | 1.6 | 16.1 | 11.8 | 0.8 | 33.2 | 34.0 | 0.7 | 4.7 | 5.4 |
| Phase 2 | 26.5 | 227.1 | 175.1 | 12.0 | 709.4 | 721.4 | 10.2 | 61.3 | 71.5 | 3.2 | 26.3 | 21.8 | 1.4 | 56.1 | 57.5 | 1.2 | 4.8 | 6.0 |
| Phase 3 | 11.4 | 107.9 | 80.4 | 5.2 | 151.0 | 156.1 | 4.5 | 14.5 | 18.9 | 1.0 | 10.7 | 8.0 | 0.5 | 14.8 | 15.3 | 0.4 | 1.4 | 1.8 |
| 2021 Emissions | 50.8 | 468.8 | 349.3 | 23.5 | 1288.4 | 1311.9 | 20.0 | 127.7 | 147.7 | 5.8 | 53.1 | 41.6 | 2.7 | 104.1 | 106.8 | 2.3 | 10.9 | 13.2 |
| | | | | | | | | | | | | | | | | | | |
| 2022 | | | | | | | | | | | | | | | | | | |
| Phase 1 | 12.9 | 133.8 | 93.8 | 6.4 | 428.1 | 434.4 | 5.3 | 51.9 | 57.3 | 0.5 | 5.3 | 3.9 | 0.3 | 11.0 | 11.3 | 0.2 | 1.6 | 1.8 |
| Phase 2 | 26.5 | 227.1 | 175.1 | 12.0 | 709.4 | 721.4 | 10.2 | 61.3 | 71.5 | 2.1 | 17.5 | 14.6 | 0.9 | 37.4 | 38.3 | 0.8 | 3.2 | 4.0 |
| Phase 3 | 11.4 | 107.9 | 80.4 | 5.2 | 151.0 | 156.1 | 4.5 | 14.5 | 18.9 | 0.7 | 6.9 | 5.1 | 0.3 | 9.5 | 9.8 | 0.3 | 0.9 | 1.2 |
| 2022 Emissions | 50.8 | 468.8 | 349.3 | 23.5 | 1288.4 | 1311.9 | 20.0 | 127.7 | 147.7 | 3.3 | 29.7 | 23.6 | 1.5 | 57.9 | 59.4 | 1.3 | 5.7 | 7.0 |
| MDAQMD Thresholds | 137 | 137 | 548 | | | 82 | | | 65 | 25 | 25 | 100 | | | 15 | | | 12 |
| Significant? | No | Yes | No | | | Yes | | | Yes | No | Yes | No | | | Yes | | | Yes |
| Federal de minimus threshold | -- | -- | -- | -- | | | -- | | | 100 | 100 | 100 | | | 100 | | | 100 |
| | -- | -- | -- | -- | | | -- | | | No | No | No | | | No | | | No |

## TOTAL MITIGATED CONSTRUCTION EMISSIONS

0.34

| | Emissions (lbs/day) | | | | | | | | | Emissions (tons/phase) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | VOC | NOx | CO | PM10 Exh. | PM10 Dust | PM10 Total | PM2.5 Exh. | PM2.5 Dust | PM2.5 Total | VOC | NOx | CO | PM10 Exh. | PM10 Dust | PM10 Total | PM2.5 Exh. | PM2.5 Dust | PM2.5 Total |
| Phase 1 - onroad emissions with reductions for unpaved road dust | 0.50 | 13.27 | 15.08 | 1.22 | 83.38 | 84.60 | 0.53 | 8.54 | 9.07 | 0.1 | 1.4 | 2.9 | 0.2 | 9.4 | 9.57 | 0.1 | 0.9 | 0.98 |
| Phase 1 - offroad emissions with 85% Tier 4 Final equipment and reductions for dust[7] | 4.01 | 37.02 | 94.00 | 1.03 | 12.74 | 13.77 | 0.98 | 6.98 | 7.96 | 0.8 | 7.4 | 18.8 | 0.2 | 2.5 | 2.75 | 0.2 | 1.4 | 1.59 |
| Total revised Phase 1 emissions | 4.51 | 50.30 | 109.08 | 2.24 | 96.12 | 98.37 | 1.50 | 15.52 | 17.02 | 0.9 | 8.8 | 21.7 | 0.4 | 11.9 | 12.3 | 0.3 | 2.3 | 2.6 |
| | | | | | | | | | | | | | | | | | | |
| Phase 2 - onroad emissions with trip length adjustment | 0.77 | 22.97 | 11.78 | 1.72 | 146.90 | 148.62 | 0.75 | 14.61 | 15.36 | 0.1 | 3.1 | 3.8 | 0.3 | 19.2 | 19.53 | 0.1 | 1.9 | 2.01 |
| Phase 2 - offroad emissions with 85% Tier 4 Final equipment and reductions for dust[8] | 10.77 | 79.33 | 191.88 | 3.16 | 0.00 | 3.16 | 2.95 | 0.00 | 2.95 | 2.1 | 15.8 | 38.3 | 0.6 | 0.0 | 0.63 | 0.6 | 0.0 | 0.59 |
| Total revised Phase 2 emissions | 11.54 | 102.30 | 203.66 | 4.88 | 146.90 | 151.78 | 3.69 | 14.61 | 18.31 | 2.3 | 18.9 | 42.1 | 0.9 | 19.2 | 20.2 | 0.7 | 1.9 | 2.6 |
| | | | | | | | | | | | | | | | | | | |
| Phase 3 - onroad emissions with trip length adjustment | 0.70 | 5.71 | 8.02 | 0.62 | 34.54 | 35.15 | 0.27 | 4.09 | 4.36 | 0.0 | 1.0 | 1.5 | 0.1 | 4.9 | 5.05 | 0.1 | 0.5 | 0.57 |
| Phase 3 - offroad emissions with 85% Tier 4 Final equipment and reductions for dust[9] | 3.54 | 30.71 | 83.76 | 0.91 | 0.60 | 1.51 | 0.86 | 0.33 | 1.19 | 0.6 | 4.6 | 13.7 | 0.1 | 0.1 | 0.26 | 0.1 | 0.1 | 0.20 |
| Total revised Phase 3 emissions | 4.23 | 36.42 | 91.78 | 1.53 | 35.14 | 36.67 | 1.13 | 4.42 | 5.55 | 0.6 | 5.6 | 15.2 | 0.3 | 5.0 | 5.3 | 0.2 | 0.6 | 0.8 |

7. Phase 1 PM10 dust and PM2.5 dust emissions include mitigated fugitive dust emissions from truck loading and earthwork.

8. There would be no fugitive dust emissions during Phase 2 associatedw ith truck loading or earthwork.

9. Phase 3 PM10 dust and PM2.5 dust emissions include mitigated fugitive dust emissions from earthwork.

## TOTAL MITIGATED CONSTRUCTION EMISSIONS BY YEAR

| Construction Year | Maximum Daily Emissions (lbs/day) | | | | | | | | | Emissions (tons/year) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | VOC | NOx | CO | PM10 Exh. | PM10 Dust | PM10 Total | PM2.5 Exh. | PM2.5 Dust | PM2.5 Total | VOC | NOx | CO | PM10 Exh. | PM10 Dust | PM10 Total | PM2.5 Exh. | PM2.5 Dust | PM2.5 Total |
| 2020 | | | | | | | | | | | | | | | | | | |
| Phase 1 | 4.5 | 50.3 | 109.1 | 2.2 | 96.1 | 98.4 | 1.5 | 15.5 | 17.0 | 0.1 | 1.4 | 3.4 | 0.1 | 1.9 | 2.0 | 0.0 | 0.4 | 0.4 |
| 2020 Emisions | 4.5 | 50.3 | 109.1 | 2.2 | 96.1 | 98.4 | 1.5 | 15.5 | 17.0 | 0.1 | 1.4 | 3.4 | 0.1 | 1.9 | 2.0 | 0.0 | 0.4 | 0.4 |
| | | | | | | | | | | | | | | | | | | |
| 2021 | | | | | | | | | | | | | | | | | | |
| Phase 1 | 4.5 | 50.3 | 109.1 | 2.2 | 96.1 | 98.4 | 1.5 | 15.5 | 17.0 | 0.5 | 5.6 | 13.7 | 0.3 | 7.5 | 7.8 | 0.2 | 1.4 | 1.6 |
| Phase 2 | 11.5 | 102.3 | 203.7 | 4.9 | 146.9 | 151.8 | 3.7 | 14.6 | 18.3 | 1.4 | 11.3 | 25.3 | 0.6 | 11.5 | 12.1 | 0.4 | 1.1 | 1.6 |
| Phase 3 | 4.2 | 36.4 | 91.8 | 1.5 | 35.1 | 36.7 | 1.1 | 4.4 | 5.5 | 0.4 | 3.4 | 9.3 | 0.2 | 3.1 | 3.2 | 0.1 | 0.3 | 0.5 |
| 2021 Emissions | 20.3 | 189.0 | 404.5 | 8.7 | 278.2 | 286.8 | 6.3 | 34.6 | 40.9 | 2.3 | 20.3 | 48.2 | 1.0 | 22.1 | 23.1 | 0.7 | 2.9 | 3.6 |
| | | | | | | | | | | | | | | | | | | |
| 2022 | | | | | | | | | | | | | | | | | | |
| Phase 1 | 4.5 | 50.3 | 109.1 | 2.2 | 96.1 | 98.4 | 1.5 | 15.5 | 17.0 | 0.2 | 1.8 | 4.5 | 0.1 | 2.5 | 2.6 | 0.1 | 0.5 | 0.5 |
| Phase 2 | 11.5 | 102.3 | 203.7 | 4.9 | 146.9 | 151.8 | 3.7 | 14.6 | 18.3 | 0.9 | 7.6 | 16.8 | 0.4 | 7.7 | 8.1 | 0.3 | 0.8 | 1.0 |
| Phase 3 | 4.2 | 36.4 | 91.8 | 1.5 | 35.1 | 36.7 | 1.1 | 4.4 | 5.5 | 0.2 | 2.2 | 5.9 | 0.1 | 2.0 | 2.1 | 0.1 | 0.2 | 0.3 |
| 2022 Emissions | 20.3 | 189.0 | 404.5 | 8.7 | 278.2 | 286.8 | 6.3 | 34.6 | 40.9 | 1.3 | 11.6 | 27.3 | 0.6 | 12.2 | 12.7 | 0.4 | 1.5 | 1.9 |
| MDAQMD Thresholds | 137 | 137 | 548 | | | 82 | | | 65 | 25 | 25 | 100 | | | 15 | | | 12 |
| Significant? | No | **Yes** | No | | | **Yes** | | | **Yes** | No | No | No | | | **Yes** | | | No |
| Federal de minimus threshold | -- | -- | -- | -- | | | -- | | | 100 | 100 | 100 | | | 100 | | | 100 |
| | -- | -- | -- | -- | | | -- | | | No | No | No | | | No | | | No |

## Option A - Traditional Design Construction
## Criteria Air Pollutant Emissions

### On-road Truck Trip Emissions - Within South Coast AQMD jurisdiction

| | workdays/phase | trips/day | miles/one-way trip[1] | Average daily mileage | No. of days/phase | mileage/phase | Emissions Factors (gms/mile) VOC | NOx | CO | PM-10 Exhaust | PM10 Dust | PM-2.5 Exhaust | PM2.5 Dust |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Phase 1* | *19 months* | | | | | | | | | | | | |
| Module delivery | 399 | 10 | 213 | 4260 | 81 | 345060 | 0.088158 | 4.375857 | 0.3604 | 0.120169 | 1.871716 | 0.056919 | 0.459421 |
| Foundation delivery | 399 | 10 | 213 | 4260 | 98 | 417480 | 0.088158 | 4.375857 | 0.3604 | 0.120169 | 1.871716 | 0.056919 | 0.459421 |
| Total on-road for Phase 1 | --- | | | | | | --- | | | | | | |
| *Phase 2* | *19 months* | | | | | | | | | | | | |
| Module delivery | 399 | 10 | 213 | 4260 | 81 | 345060 | 0.088158 | 4.375857 | 0.3604 | 0.120169 | 1.871716 | 0.056919 | 0.459421 |
| Tracker delivery | 399 | 9 | 213 | 3834 | 207 | 793638 | 0.088158 | 4.375857 | 0.3604 | 0.120169 | 1.871716 | 0.056919 | 0.459421 |
| Foundation delivery | 399 | 10 | 213 | 4260 | 98 | 417480 | 0.088158 | 4.375857 | 0.3604 | 0.120169 | 1.871716 | 0.056919 | 0.459421 |
| Inverter delivery | 399 | 2 | 213 | 852 | 36 | 30672 | 0.088158 | 4.375857 | 0.3604 | 0.120169 | 1.871716 | 0.056919 | 0.459421 |
| Total on-road for Phase 2 | --- | | | | | | --- | | | | | | |
| *Phase 3* | *18 months* | | | | | | | | | | | | |
| Inverter delivery | 378 | 2 | 213 | 852 | 36 | 30672 | 0.088158 | 4.375857 | 0.3604 | 0.120169 | 1.871716 | 0.056919 | 0.459421 |
| Total on-road for Phase 3 | --- | | | | | | --- | | | | | | |

| | Emissions (lbs/day) VOC | NOx | CO | PM-10 Exhaust | PM10 Dust | PM10 Total | PM-2.5 Exhaust | PM2.5 Dust | PM2.5 Total |
|---|---|---|---|---|---|---|---|---|---|
| *Phase 1* | | | | | | | | | |
| Module delivery | 0.83 | 41.10 | 3.38 | 1.13 | 17.58 | 18.71 | 0.53 | 4.31 | 4.85 |
| Foundation delivery | 0.83 | 41.10 | 3.38 | 1.13 | 17.58 | 18.71 | 0.53 | 4.31 | 4.85 |
| Total on-road for Phase 1 | 1.66 | 82.19 | 6.77 | 2.26 | 35.16 | 37.41 | 1.07 | 8.63 | 9.70 |
| *Phase 2* | | | | | | | | | |
| Module delivery | 0.83 | 41.10 | 3.38 | 1.13 | 17.58 | 18.71 | 0.53 | 4.31 | 4.85 |
| Tracker delivery | 0.75 | 36.99 | 3.05 | 1.02 | 15.82 | 16.84 | 0.48 | 3.88 | 4.36 |
| Foundation delivery | 0.83 | 41.10 | 3.38 | 1.13 | 17.58 | 18.71 | 0.53 | 4.31 | 4.85 |
| Inverter delivery | 0.17 | 8.22 | 0.68 | 0.23 | 3.52 | 3.74 | 0.11 | 0.86 | 0.97 |
| Total on-road for Phase 2 | 2.57 | 127.40 | 10.49 | 3.50 | 54.49 | 57.99 | 1.66 | 13.38 | 15.03 |
| *Phase 3* | | | | | | | | | |
| Inverter delivery | 0.17 | 8.22 | 0.68 | 0.23 | 3.52 | 3.74 | 0.11 | 0.86 | 0.97 |
| Total on-road for Phase 3 | 0.17 | 8.22 | 0.68 | 0.23 | 3.52 | 3.74 | 0.11 | 0.86 | 0.97 |

| | Emissions (tons/phase) VOC | NOx | CO | PM-10 Exhaust | PM10 Dust | PM10 Total | PM-2.5 Exhaust | PM2.5 Dust | PM2.5 Total |
|---|---|---|---|---|---|---|---|---|---|
| *Phase 1* | | | | | | | | | |
| Module delivery | 0.03 | 1.51 | 0.12 | 0.04 | 0.65 | 0.69 | 0.02 | 0.16 | 0.18 |
| Foundation delivery | 0.04 | 1.83 | 0.15 | 0.05 | 0.78 | 0.83 | 0.02 | 0.19 | 0.22 |
| Total on-road for Phase 1 | 0.07 | 3.34 | 0.27 | 0.09 | 1.43 | 1.52 | 0.04 | 0.35 | 0.39 |
| *Phase 2* | | | | | | | | | |
| Module delivery | 0.03 | 1.51 | 0.12 | 0.04 | 0.65 | 0.69 | 0.02 | 0.16 | 0.18 |
| Tracker delivery | 0.07 | 3.47 | 0.29 | 0.10 | 1.49 | 1.58 | 0.05 | 0.36 | 0.41 |
| Foundation delivery | 0.04 | 1.83 | 0.15 | 0.05 | 0.78 | 0.83 | 0.02 | 0.19 | 0.22 |
| Inverter delivery | 0.00 | 0.13 | 0.01 | 0.00 | 0.06 | 0.06 | 0.00 | 0.01 | 0.02 |
| Total on-road for Phase 2 | 0.14 | 6.94 | 0.57 | 0.19 | 2.97 | 3.16 | 0.09 | 0.73 | 0.82 |
| *Phase 3* | | | | | | | | | |
| Inverter delivery | 0.00 | 0.13 | 0.01 | 0.00 | 0.06 | 0.06 | 0.00 | 0.01 | 0.02 |
| Total on-road for Phase 3 | 0.00 | 0.13 | 0.01 | 0.00 | 0.06 | 0.06 | 0.00 | 0.01 | 0.02 |

1. Estimated one-way travel distance for trucks from Port of Los Angeles to the MDAQMD jurisdiction western border.

### TOTAL CONSTRUCTION EMISSIONS BY YEAR (UNMITIGATED)

| Construction Year | Maximum Daily Emissions (lbs/day) VOC | NOx | CO | PM10 Exhaust | PM10 Dust | PM10 Total | PM2.5 Exhaust | PM2.5 Dust | PM2.5 Total | Emissions (tons/year) VOC | NOx | CO | PM10 Exhaust | PM10 Dust | PM10 Total | PM2.5 Exhaust | PM2.5 Dust | PM2.5 Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2020 | | | | | | | | | | | | | | | | | | |
| Phase 1 | 1.7 | 82.2 | 6.8 | 2.3 | 35.2 | 37.4 | 1.1 | 8.6 | 9.7 | 0.0 | 0.5 | 0.0 | 0.0 | 0.2 | 0.2 | 0.0 | 0.1 | 0.1 |
| 2020 Emisions | 1.7 | 82.2 | 6.8 | 2.3 | 35.2 | 37.4 | 1.1 | 8.6 | 9.7 | 0.0 | 0.5 | 0.0 | 0.0 | 0.2 | 0.2 | 0.0 | 0.1 | 0.1 |
| | | | | | | | | | | | | | | | | | | |
| 2021 | | | | | | | | | | | | | | | | | | |
| Phase 1 | 1.7 | 82.2 | 6.8 | 2.3 | 35.2 | 37.4 | 1.1 | 8.6 | 9.7 | 0.0 | 2.1 | 0.2 | 0.1 | 0.9 | 1.0 | 0.0 | 0.2 | 0.2 |
| Phase 2 | 2.6 | 127.4 | 10.5 | 3.5 | 54.5 | 58.0 | 1.7 | 13.4 | 15.0 | 0.1 | 4.2 | 0.3 | 0.1 | 1.8 | 1.9 | 0.1 | 0.4 | 0.5 |
| Phase 3 | 0.2 | 8.2 | 0.7 | 0.2 | 3.5 | 3.7 | 0.1 | 0.9 | 1.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2021 Emissions | 4.4 | 217.8 | 17.9 | 6.0 | 93.2 | 99.1 | 2.8 | 22.9 | 25.7 | 0.1 | 6.4 | 0.5 | 0.2 | 2.7 | 2.9 | 0.1 | 0.7 | 0.8 |
| | | | | | | | | | | | | | | | | | | |
| 2022 | | | | | | | | | | | | | | | | | | |
| Phase 1 | 1.7 | 82.2 | 6.8 | 2.3 | 35.2 | 37.4 | 1.1 | 8.6 | 9.7 | 0.0 | 0.7 | 0.1 | 0.0 | 0.3 | 0.3 | 0.0 | 0.1 | 0.1 |
| Phase 2 | 2.6 | 127.4 | 10.5 | 3.5 | 54.5 | 58.0 | 1.7 | 13.4 | 15.0 | 0.1 | 2.8 | 0.2 | 0.1 | 1.2 | 1.3 | 0.0 | 0.3 | 0.3 |
| Phase 3 | 0.2 | 8.2 | 0.7 | 0.2 | 3.5 | 3.7 | 0.1 | 0.9 | 1.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2022 Emissions | 4.4 | 217.8 | 17.9 | 6.0 | 93.2 | 99.1 | 2.8 | 22.9 | 25.7 | 0.1 | 3.5 | 0.3 | 0.1 | 1.5 | 1.6 | 0.0 | 0.4 | 0.4 |
| MDAQMD Thresholds | 137 | 137 | 548 | | | 82 | | | 65 | 25 | 25 | 100 | | | 15 | | | 12 |
| Significant? | No | Yes | No | | | Yes | | | Yes | No | Yes | No | | | Yes | | | No |
| Federal de minimus threshold | -- | -- | -- | -- | | | -- | | | 100 | 100 | 100 | | | 100 | | | 100 |
| | -- | -- | -- | -- | | | -- | | | No | No | No | | | No | | | No |

Back calculation of Construction Schedule

Based on Table showing annual unmitigated emissions in AECOM Tech Report

| | VOC (tons/year) emissions | | | |
|---|---|---|---|---|
| | **Total** | **2020** | **2021** | **2022** |
| Phase 1 | 2.58 | 0.41 | 1.63 | 0.54 |
| Phase 2 | 5.3 | 0 | 3.18 | 2.12 |
| Phase 3 | 1.69 | 0 | 1.03 | 0.66 |

Months of construction in each calendar year

| | Total | 2020 | 2021 | 2022 |
|---|---|---|---|---|
| Phase 1 | 19 | 3.0 | 12.0 | 4.0 |
| Phase 2 | 19 | 0.0 | 11.4 | 7.6 |
| Phase 3 | 18 | 0.0 | 11.0 | 7.0 |

Fraction of total phase emissions in each calendar year

| | 2020 | 2021 | 2022 |
|---|---|---|---|
| Phase 1 | 0.158914729 | 0.631782946 | 0.209302326 |
| Phase 2 | 0 | 0.6 | 0.4 |
| Phase 3 | 0 | 0.609467456 | 0.390532544 |

# Appendix I
## Biological Resources

1. Biological Resources Technical Report, March 2019
2. Jurisdictional Delineation Letter Report, November 2017
3. Geomorphic, Stratigraphic & Geologic Eolian Evaluation Report, October 12, 2018
4. Decommissioning & Reclamation Plan, November 2018
5. Bird and Bat Conservation Strategy, February 2019
6. Burrowing Owl Management Plan, February 2019
7. Nesting Bird Monitoring and Management Plan, December 2018
8. American Badger and Desert Kit Fox Monitoring and Management Plan, December 2018
9. Couch's Spadefoot Protection Plan, April 2019
10. Weed Management Plan, March 2019
11. Common Raven Monitoring, Management, and Control Plan, December 2018
12. Desert Tortoise Translocation Plan, May 2019

# I.1 Biological Resources Technical Report, March 2019

AECOM

**RE Crimson Solar Project**
by Sonoran West Solar Holdings, LLC

# Biological Resources Technical Report

Project Number: 60487757

March 2019

Sonoran West Solar Holdings, LLC

Recurrent Energy LLC
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## Quality information

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## Revision History

| Revision | Revision date | Details | Authorized | Name | Position |
|---|---|---|---|---|---|
| 01 | 05/18/2018 | Revision to Agency Comments | | Jennifer Guigliano | Project Director |
| 02 | 10/18/2018 | Revision to Agency Comments | | Jennifer Guigliano | Project Director |
| 03 | 11/19/2018 | Revision to Agency Comments | | Jennifer Guigliano | Project Director |
| 04 | 12/19/2018 | Revision for Project Description Change | | Jennifer Guigliano | Project Director |
| 05 | 01/28/2019 | Revision to USFWS comments on birds | | Jennifer Guigliano | Project Director |
| 06 | 03/21/2019 | Editorial changes and clarification on acreages | | Jennifer Guigliano | Project Director |

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## Tables



## Figures

# Appendices

# ACRONYMS

| | |
|---|---|
| ABPP | Avian Bat Protection Plan |
| AC | Alternating current |
| ACEC | Area of Critical Environmental Concern |
| AICc | Akaike's Information Criteria |
| AMSL | above mean sea level |
| AO | Authorized Officer |
| APLIC | Avian Power Line Interaction Committee |
| BBCS | Bird and Bat Conservation Strategy |
| BLM | Bureau of Land Management |
| BLM Sensitive | Bureau of Land Management designated Sensitive species |
| BMP | Best Management Practice |
| BrightSource | BrightSource Energy, Inc. |
| BRMIMP | Biological Resources Mitigation Implementation Monitoring Plan |
| BRTR | biological resources technical report |
| BSA | botanical survey area |
| CBOC | California Burrowing Owl Consortium |
| CCR | California Code of Regulations |
| CDCA | California Desert Conservation Area |
| CDFG | California Department of Fish and Game |
| CDFW | California Department of Fish and Wildlife |
| CDNPA | California Desert Native Plants Act |
| CEC | California Energy Commission |
| CEQA | California Environmental Quality Act |
| CFGC | California Fish and Game Code |
| CFR | Code of Federal Regulations |
| CI | Confidence Interval |
| CMA | Conservation and Management Action |
| CMAGR | Chocolate Mountain Aerial Gunnery Range |
| CNDDB | California Natural Diversity Database |
| CNPS | California Native Plant Society |
| CRPR | California Rare Plant Rank |
| CRS | Colorado River Substation |
| CVSP | Chuckwalla Valley State Prison |
| CWA | Clean Water Act |
| DB | Designated Biologist |
| dBA | decibels A-weighted |
| DC | direct current |
| DFA | Development Focus Area |
| DRECP | Desert Renewable Energy Conservation Plan |
| DWMA | Designated Wildlife Management Area |
| ECM | Environmental Compliance Manager |

| | |
|---|---|
| EIS | Environmental Impact Statement |
| ESA | Federal Endangered Species Act |
| ESAs | Environmentally Sensitive Areas |
| Fc | Frequency |
| FLPMA | Federal Land Policy and Management Act |
| FP | Fully Protected Species |
| FS | Focus species |
| gen-tie | generation interconnection |
| GIS | Geographic Information System |
| GPS | Global Positioning System |
| HMA | Herd Management Area |
| HMANA | Hawk Migration Association of North America |
| I-10 | Interstate 10 |
| kHz | kilohertz |
| km | kilometer |
| km/h | kilometers per hour |
| kV | kilovolt |
| LEID | low environmental impact design |
| LUPA | Land Use Plan Amendment |
| MBTA | Migratory Bird Treaty Act |
| MCL | mean carapace length |
| mph | miles per hour |
| MW | megawatt |
| NCCP | Natural Community Conservation Plan |
| NECO | Northern and Eastern Colorado Desert Coordinated Management Plan |
| NEPA | National Environmental Protection Act |
| NPPA | Native Plant Protection Act |
| NRCS | Natural Resource Conservation Service |
| O&M | Operation and maintenance |
| PEIS | Programmatic Environmental Impact Statement |
| POD | Plan of Development |
| Project | RE Crimson Solar Project |
| PS | planning species |
| PV | Photovoltaic |
| RE | Recurrent Energy LLC |
| REAT | Renewable Energy Action Team |
| ROD | Record of Decision |
| ROE | Right-of-Entry |
| ROW | right-of-way |
| ROWD | Report of Waste Discharge |
| RWQCB | Regional Water Quality Control Board |
| SAA | Streambed Alteration Agreement |
| SCE | Southern California Edison |
| SSC | Species of Special Concern |
| SWP Site | Sonoran West Project Site |

| | |
|---|---|
| U.S. | United States |
| USACE | United States Army Corps of Engineers |
| USC | United States Code |
| USFWS | United States Fish and Wildlife Service |
| WDR | waste discharge requirement |
| WEAP | Worker Environmental Awareness Program |
| ZOI | Zone of Influence |
| ° | Degrees |
| ± | Plus or minus |

# Executive Summary

The Recurrent Energy LLC (RE) RE Crimson Solar Project (Project) is located in Riverside County, approximately 13 miles west of Blythe, California. The Project is located in the Riverside East Solar Energy Zone/Development Focus Area and within a Development Focus Area on public land administered by United States (U.S.) Bureau of Land Management (BLM). The Project's Plan of Development (POD) includes a traditional photovoltaic (PV) design referred to as Option A, as well as consideration of several potential low environmental impact design (LEID) elements. The traditional PV design approach consists of desert tortoise (*Gopherus agassizii*) exclusion fencing, a mow-and-roll approach to site preparation, compacted roads, and trenching for electrical lines; however, the applicant has also been actively investigating alternative LEID elements and the potential for those to reduce Project impacts. LEID elements include several potential design changes which may be implemented in their entirety, in part, or not at all. These include:

1. Minimizing grading during site preparation and maintaining more onsite vegetation to facilitate post-construction residual habitat value and post-operations/site reclamation success.

2. Avoiding or limiting trenching by placing electrical wiring aboveground.

3. Placing transformer/inverter groups on elevated support structures in lieu of cement foundations.

The LEID elements would minimize grading, trenching, and vegetation removal beyond traditional design approaches for PV projects with the objective of reducing overall long-term impacts for the Project. Although the incorporation of LEID elements could result in slight modifications to the module locations due to topographic constraints, the Permitting Boundary or limits of development would be the same with LEID elements incorporated. The comparative impacts of the traditional design approach versus design with LEID elements incorporated is not known; therefore, to facilitate appropriate analysis of the Project and allow for the incorporation of LEID elements where practicable and environmentally beneficial, the environmental technical analysis are based on the elements that result in the worst-case scenario for construction and operations.

The total area for the Project (i.e., RE Crimson Permitting Boundary) is 2,489 acres, including a 2,465-acre solar field development area with approximately 1,859 acres of solar modules (array blocks) and 24 acres for linear facilities including access/perimeter roads with a 30-to 60-foot corridor width and generation interconnection (gen-tie) and power line corridors with a 150-foot width. The block layouts may vary slightly with the incorporation of LEID elements, but would remain within the RE Crimson Permitting Boundary.

The construction and operation of the Project would be similar with or without the incorporation of all or some of the LEID design elements. The Project would interconnect to the regional electrical grid at the Southern California Edison (SCE) 230-kilovolt (kV) Colorado River Substation (CRS). It would generate up to 350 megawatts (MW) of renewable energy using PV technology and would include up to 350 MW of integrated energy storage capacity.

The biological resources assessment included a review of the California Natural Diversity Database (CNDDB) and United States Fish and Wildlife Service (USFWS) regional database to identify previous biological resource locations in the project vicinity. Based on the results of the database review, AECOM biologists conducted vegetation mapping, rare plant surveys, and protocol surveys for the special-status species identified on or near the Project site.

The Project site is not located within a Desert Wildlife Management Area (DWMA), Area of Critical Environmental Concern (ACEC), a designated Wilderness Area, or Herd Management Area (HMA); however, it is located north and west of the Mule Mountains ACEC, and east of the Chuckwalla Valley Dune thicket and Chuckwalla Desert Wildlife

Management Area. Additionally, federally designated critical habitat for desert tortoise is outside of, but adjacent to, the western boundary of the Project site within the Chuckwalla Critical Habitat Unit.

A larger area consisting of the RE Crimson Project area and surrounding lands was originally proposed for development by BrightSource Energy, Inc. (BrightSource), as the Sonoran West Solar Energy Generating Facility (Sonoran West Project [SWP] Site). Surveys for the SWP Site were conducted in 2011 and 2012. These surveys included a general vegetation survey, invasive plant species survey, special-status plant species surveys, various wildlife species surveys, and a jurisdictional waters delineation. Wildlife species surveys included desert tortoise, Mojave fringe-toed lizard (*Uma scoparia*), Couch's spadefoot (*Scaphiopus couchii*), burrowing owl (*Athene cunicularia*), elf owl (*Micrathene whitneyi*), gila woodpecker (*Melanerpes uropygialis*), golden eagle (*Aquila chrysaetos*), migratory bird surveys, nocturnal avian radar, desert kit fox and American badger (*Taxidea taxus*), and bat surveys. Some of these surveys were repeated again in 2016 and 2017 for certain species, while others were determined to be sufficient and therefore not repeated. In 2016 and 2017, surveys were conducted for special-status plant species, an updated (modified) jurisdictional waters delineation, (modified) desert tortoise, burrowing owl, elf owl, migratory bird surveys, desert kit fox and American badger, bat surveys, and wildlife camera surveys.

The Project area supports ten native desert vegetation communities, of which creosote bush—white bursage scrub is the most widespread. Sensitive vegetation communities onsite consist of desert dunes (only within linear features), creosote bush—white bursage/big galleta grass association and blue palo verde—ironwood woodland. No federal or state-listed plants were found onsite, but the following special-status plant species were detected within the RE Crimson Permitting Boundary most recently during the spring 2017 surveys:  Harwood's eriastrum (*Eriastrum harwoodii*), ribbed cryptantha (*Johnstonella costata*), Utah vine milkweed (*Funastrum utahense*), and desert unicorn plant (*Proboscidea althaeifolia*). The only federally listed wildlife species observed onsite was the desert tortoise. Twenty individuals were observed during focused surveys in October 2016 with desert tortoises located primarily outside the southern and eastern portions of the Project area near the base of the Mule Mountains. Only two desert tortoise (both adults) were actually detected within the RE Crimson Permitting Boundary. Two state listed threatened wildlife species were detected including Swainson's hawk (*Buteo swainsoni*) and bank swallow (*Riparia riparia*). Additional special-status species were detected within the RE Crimson Permitting Boundary including Mojave fringe-toed lizard and a variety of avian, bat, and mammalian species. In total, during biological surveys for the Project area, 163 wildlife species were detected including 12 invertebrate, 17 reptile, 108 bird, and 26 mammal species.

This report addresses permanent, temporary, direct, and indirect impacts to biological resources within, and adjacent to the 2,489-acre RE Crimson Permitting Boundary. The impacts would vary depending upon the type of construction and operation approach followed, whether the traditional construction approach is used or any combination of the LEID elements are incorporated into the final Project. Regardless of the approach, the Project is expected to result in impacts to three sensitive vegetation communities, desert dunes, creosote bush—white bursage/big galleta grass association, and blue palo verde—ironwood woodland. Direct and/or indirect impacts to special-status plant species within the RE Crimson Permitting Boundary include:  Harwood's eriastrum, desert unicorn plant, ribbed cryptantha, and Utah vine milkweed. Impacts to special-status wildlife species would include potential direct impacts to desert tortoises, Mojave fringe-toed lizards, and other special-status bird and wildlife species. Additionally, wildlife movement may be impacted; however, the Project avoids the microphyll woodlands, and therefore wildlife will still be allowed to travel through the Project area at several locations without hindrance. Project impacts will be reduced by implementation of impact avoidance, minimization, and mitigation measures.

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# 1.0 Introduction

## 1.1 Project Location

The proposed Project is located in unincorporated eastern Riverside County, approximately 13 miles west of Blythe, just north and west of the Mule Mountains and just south of Interstate 10 (I-10), including portions of Sections 1, 2, 11, 12, 13, 24, 25 within Township 7 South, Range 20 East, and portions of Sections 6, 7, 8, 17, 18 within Township 7 South, Range 21 East (Figure 1). The Project site consists of approximately 2,489 acres of Bureau of Land Management (BLM)-administered land within the Riverside East Solar Energy Zone/Development Leasing Area and within the Desert Renewable Energy Conservation Plan (DRECP) Development Focus Area as presented in the Final Environmental Impact Statement (EIS) and approved in the Record of Decision and associated Land Use Plan Amendment in September 2016 (BLM 2015). The Project is not sited within the adjacent Section 368 Federal Energy Corridor pursuant to the Westwide Energy Corridor Final Programmatic EIS, except for a short generation intertie (gen-tie) line that would interconnect the Project to the Southern California Edison's (SCE's) Colorado River Substation (CRS).

## 1.2 Site Description

The Project site is nearly completely vacant and undeveloped land that is owned by the Federal government and administered by the BLM. There is a 120.5-acre private parcel in the center of the Project site that currently is not planned for use by the Project. Surveys were not conducted within the private parcel. There are no existing structures within the Project that would need to be demolished, and there are no existing roads within the proposed Project solar development area. An existing transmission line and paved access road oriented east-west are located along the northern boundary of the Project site that lead to the Colorado River Substation (CRS). I-10 is just over 1 mile north of the northern project boundary, and the western edge of the Colorado River Valley is approximately 4.5 miles to the east.

The site is surrounded primarily by BLM-managed lands and some private parcels. The site is located at the northern foot of the Mule Mountain Area of Critical Environmental Concern (ACEC). The SCE high-voltage transmission line and CRS are located directly north of the Project site, and I-10 is north of and parallel to those facilities. East of the Project site is First Solar's proposed Desert Quartzite Solar Project (Desert Quartzite). Farther northeast of Desert Quartzite is the site of the recently approved Blythe Mesa Solar Project owned by Renewable Resources Group. Federally designated critical habitat for desert tortoise (*Gopherus agassizii*) within the Chuckwalla Critical Habitat Unit and the vast Chuckwalla Desert Wildlife Management Area (DWMA) are west of the Project site (Figure 2).

The Project site has a gentle slope north and west, away from the base of the Mule Mountains, with elevation ranging from a high of about 710 feet above mean sea level (AMSL) around the base of the Mule Mountains to a low of about 430 feet AMSL near the northwestern corner of the site closest to I-10. Terrain onsite generally slopes down from higher land at the base of the Mule Mountains to the south. Onsite slopes range from approximately 5.6 percent (%) in the steeper southeastern corner that abuts the Mule Mountains, 1 to 3% on bajadas and alluvial fans along the base of the mountains, to relatively flat terrain in the central and northern sections of the site. The Project site is situated at the eastern edge of the Chuckwalla Hydrologic Area and supports a broad alluvial fan that includes many braided washes and channels that converge into a primary channel flowing into an intra-state playa lake northwest of the Project site. This playa lake is not a Traditional Navigable Water; therefore, the channels in the Project area do not qualify as federal jurisdictional waters.

Regionally, the Project site is situated within the Colorado Desert on gently rolling open terrain dominated by desert scrub vegetation. The Colorado Desert is a portion of the larger Sonoran Desert located in California. The Sonoran Desert extends across the southwest United States and into Mexico. The climate in this region is very hot and dry in the summer months, and cool and moist in the winter. Perennial and intermittent rivers and streams are rare, and most water flow occurs as flood flows within defined washes and less defined flood-flow paths during major winter rains and summer monsoons. Habitats in this region of the Colorado Desert vary with topography, elevation, and precipitation levels. Desert scrub vegetation covers most of the site, except for sparsely vegetated desert dunes and more heavily vegetated desert washes.

The Project site has experienced some historical disturbance from military training during World War II, including tank and off-road vehicle use. During World War II, the site was part of the General George S. Patton Desert Training Center, officially the California-Arizona Maneuver Area, a simulated theater of operations. More recent disturbance from recreational off-road vehicle users is evident within the Project site, even though there are no BLM-designated routes within the Project site. Most off-road vehicle use was evident within the washes with vehicle tracks leading toward the Mule Mountains.

### 1.3 Project Description

Sonoran West Solar Holdings, LLC (applicant), a wholly owned subsidiary of RE, proposes to construct and operate the RE Crimson Solar Project (Project). This Project is a utility-scale solar PV and energy storage project that would be located on federal lands managed by the BLM within the California Desert Conservation Area (CDCA) planning area. The Project would interconnect to the regional electrical grid at the SCE 230-kV CRS. The project would be located on up to 2,500 acres of public lands. It would generate up to 350 MW of renewable energy using PV technology and would include up to 350 MW of integrated energy storage capacity.

The total area for the Project (i.e., RE Crimson Permitting Boundary; 2,489 acres) includes a 2,465-acre solar field development area with approximately 1,859 acres of solar modules (array blocks) and 24 acres for linear facilities, including access/perimeter roads assuming a 30-to 60-foot corridor width and gen-tie and power line corridor 150 feet wide (Figure 3). The Project applicant is proposing to construct the Project using traditional construction methods consisting of desert tortoise exclusion fencing, mow-and-roll of vegetation for site preparation, compacted roads, and trenching for electrical lines. The applicant is also actively investigating alternative LEID elements and the potential for those to reduce Project impacts.

The Project site was formerly proposed for development as the Sonoran West Solar Energy Generating Facility proposed by BrightSource with submittal of an SF-299 application for CACA-051967 in 2009. The former Sonoran West project would have been a 540-MW, dual-turbine power tower project on approximately 7,000 acres of a combination of BLM-managed and privately owned land. The current revised proposal represents a substantial reduction in land use requirements and associated impacts.

### 1.4 Design Option Scenarios

The Project applicant is proposing to construct the Project using a traditional construction approach consisting of desert tortoise exclusion fencing, a mow-and-roll approach to site preparation, grubbing and grading for areas of excessive topography or slope, site structures such as the onsite substation, inverter pads, roads, and Operations and Maintenance (O&M) facilities, compacted roads, and trenching for electrical lines; however, the applicant is actively investigating alternative LEID elements and the potential for those to reduce Project impacts. LEID elements include several potential design changes including:

1. Minimizing grading during site preparation and maintaining more onsite vegetation to facilitate post-construction residual habitat value and post-operations/site reclamation success;

2. Avoiding or limiting trenching by placing electrical wiring aboveground; and

3. Placing transformer/inverter groups on elevated support structures in lieu of cement foundations.

The LEID elements would minimize grading, trenching, and vegetation removal beyond traditional design approaches for PV projects with the objective of reducing overall long-term impacts for the Project. Although the incorporation of LEID elements could result in slight modifications to the module locations due to topographic constraints, the Permitting Boundary or limits of development would be the same with LEID elements incorporated. The comparative impacts of the traditional design approach versus design with LEID elements incorporated is not known; therefore, to facilitate appropriate analysis of the Project and allow for the incorporation of LEID elements where practicable and environmentally beneficial, the environmental technical analyses are based on the elements that result in the worst-case development/impact scenario for construction and operations.

A summary of the proposed traditional design approach is presented below followed by more information on the potential LEID elements that are being actively considered by RE. A more detailed description of the Project is included in Appendix A and is based upon the information provided by RE in the revised November POD (RE 2017).

### 1.4.1 Traditional Design

An estimated 2 million solar modules would be arranged on the site in the form of solar arrays (fixed-tilt or tracking systems). Structures supporting the PV modules would consist of steel piles (e.g., cylindrical pipes, H-beams, or similar), which would be driven into the soil using pneumatic techniques, such as a hydraulic attachment on the boom of a backhoe tractor.

The proposed traditional design is laid out primarily in 2-MW increments, each 2-MW increment would include an inverter-transformer station (approximately 40 feet by 25 feet) constructed on a concrete pad or steel skid, and would be centrally located within the PV module arrays. Each inverter-transformer station would contain up to four inverters, a transformer, a battery enclosure, and a switchboard 8 to 11 feet high. Underground cables would be installed to convey the direct current (DC) electricity from the solar modules to the inverters to convert the DC to alternating current (AC). Between 300 and 500 wooden poles (approximately 30 to 50 feet tall) would be installed across the entire site at approximately 250-foot intervals to convey energy to a central substation location, which would transform voltage from 34.5 kV to 230 kV.

Up to four substations would transform voltage from 34.5 kV to 230 kV. The area of each substation and associated equipment would be approximately 30,000 square feet (150 feet by 200 feet) in close proximity to the CRS. Each substation would collect consolidated intermediate voltage cables from the PV collector system. Electrical transformers, switchgear, and related substation facilities would be designed and constructed to transform medium-voltage power from the Project's delivery system to the 230-kV CRS.

An O&M building would be located near the Project substations. The O&M building would be approximately 2,000 square feet in size (approximately 40 feet by 50 feet by 15 feet at its tallest point), which would accommodate O&M staff. Two equipment storage containers measuring 40 feet by 8 feet by 9 feet each also would be located at the substation area. The O&M building would be constructed on a concrete foundation.

Energy storage may be achieved by either a battery or flywheel storage system capable of storing up to 350 MW of electricity. The storage system would consist of banks of batteries or flywheels housed in electrical enclosures located indoors within the Project energy storage facilities.

Access to the Project site would be provided via the existing paved Wiley's Well Road and Powerline Road to the CRS from I-10 to the north. The Project's onsite roadway system would include a perimeter road, access roads, and internal roads. These roads would be graded and surfaced with gravel, compacted dirt, or another commercially available surface and would accommodate the Project O&M activities.

### 1.4.2 Low Environmental Impact Design Elements

As presented above, the applicant has proposed potential LEID elements for the Project for consideration with the objective of evaluating alternative design approaches that may reduce environmental impacts or negative effects from the project. These elements include changes to the grading approach, trenching and wiring, and elevation of inverter pads. To facilitate adequate analysis of potential design alternatives for the technical study, changes to the design were assessed for the potential LEID elements to determine the worst-case scenario. The design details with the incorporation of potential LEID elements are identical to those provided above for the traditional design, except for the following differences should LEID elements be incorporated:

- Solar blocks may be laid out in larger, 3-to 4-MW block sizes, requiring fewer inverter/transformer structures.
- Inverter/transformer equipment areas may be mounted on steel skids and installed on steel piers above the ground surface.
- Approximately 300 to 400 wooden AC transmission poles would be required in addition to the poles referenced under the traditional design to eliminate most trenching, which would result in the installation of up to 900 wooden poles in total.
- Access to the Project site would still be provided via the existing paved Wiley's Well Road and Powerline Road to the CRS via I-10; however, if the incorporation of elements results in fewer solar blocks, slightly fewer roads would be constructed (compacted and graded) onsite.

### 1.4.3 Construction Details

Construction of the Project will occur in three planned phases and will require approximately 17 months to complete with construction expected to begin in late-2020. The construction timeline may vary depending upon incorporation of LEID elements and associated changes required to the construction approach. Project phasing is summarized below with key activities. More details are provided in the Project Description included in Appendix A. In general, a reduction in ground-disturbing activities reduces the potential for impacting biological resources. LEID elements reduce ground-disturbance and would therefore have the potential to reduce adverse effects to biological resources. The following discussions include information on the relative differences in ground disturbance associated with traditional design versus LEID construction practices.

***Pre-Construction Activities***

Prior to the start of construction, several activities would be undertaken to prepare the site for crews and construction including:

1. Geotechnical and Hazards investigations. The applicant would conduct a geotechnical investigation utilizing subsurface scientific testing and analysis, and would use ground-penetrating radar to identify potential subsurface unexploded ordnance and Munitions and Explosives of Concern that may need to be stabilized or removed prior to construction.
2. Surveying, Staking, Flagging, and Preconstruction Resource Surveys. Prior to construction, the site boundary would be staked to demarcate the limits of disturbance, following which biologists would conduct preconstruction surveys to flag areas for avoidance, as appropriate.

3. Fence Installation. The Project will be fenced with security fencing (chain link topped with barbed wire) and desert tortoise exclusion fencing. The security fencing would be up to 8 feet tall. The exclusion fencing would be buried at least 12 inches below ground surface.

4. Resource Clearance Surveys. Following fence installation, likely in a phased approach, the Project development area would be cleared for special-status wildlife species (e.g., desert tortoise, desert kit-fox).

5. Staging Area Establishment. One or more secure staging areas would be established in support of construction activities.

Site preparation activities may vary in order, depending upon the incorporation of LEID components, the timeline for start of construction (e.g., biological resource survey windows), and other factors. In general, pre-construction activities have limited ground-disturbing impacts; but are necessary before full mobilization to support construction of the Project.

***Phase 1 – Site Preparation and Grubbing***

Phase 1 of construction will begin with the grubbing, grading, re-contouring, and compacting of the site, and graveling of access roads, followed by grading at the substation site. For traditional design, additional grading would be carried out at inverter and transformer pad locations where necessary. This construction phase will last approximately 16 weeks. The incorporation of LEID elements could result in reduced ground disturbance, if feasible, with reduced grading of solar field areas and/or the reduction or elimination of trenching.

Across flatter areas of the site, a mow-and-roll technique would be used to remove surface vegetation and keep root balls in place; vegetation would be mowed to within 6 inches of the ground surface, with any stubs worked over with a roller. Across portions of the site, grubbing and grading would be required to level rough or undulating areas of the site for solar modules installation and to prepare the soil for concrete foundations for substation equipment and inverters. Grubbing and grading generally involves the complete removal of all vegetation (including root balls) through scraping the soil with a dozer or other equipment and then blading the soil to maintain an even surface. Access road beds would also be grubbed, graded, and compacted. The site cut and fill would be approximately balanced; minimal import/export would be necessary.

If the Project implemented design measures to minimize grading, natural watercourses would be maintained across the site except along main access roadways, which would be graded, grubbed, recontoured, compacted, and graveled under either design option. Grading would occur at only road locations and the substation location. Otherwise, only minimal vegetation trimming would be conducted using hand techniques, and only particularly tall vegetation would require trimming. Vegetation below 18 inches would not be trimmed or modified.

***Phase 2 – PV System Installation***

Phase 2 of construction will begin with the pouring of foundations and the installation of the PV module support structure, which would consist of steel piles (e.g., cylindrical pipes, H-beams, or similar) being driven into the soil. To achieve ground preservation beneath the arrays, the incorporation of LEID elements would require individually sized piles to achieve a uniform elevation between module rows; thus, the duration of pile driving activities during this phase would last longer than those anticipated for traditional design. Additionally, the incorporation of LEID elements that would reduce ground disturbance (e.g., no or reduced grading) is expected to require the use of track-mounted pile drivers, as opposed to the backhoe-mounted pneumatic pile drivers used in traditional design, to reduce tire passes over natural vegetation. Construction of the structural support systems will be followed by the installation of the PV modules. This construction phase will last approximately 46 weeks. Construction equipment operating on the site will include track-mounted pile drivers, skid steers with auger/hoe attachments, flatbed trucks, water trucks, forklifts, trenchers, and welding units.

***Phase 3 – Inverter, Transformer, Substation, and Electrical Collector System Commissioning***

Phase 3 of construction will include the stringing of cable along module rows to a trunk cable system and the installation of AC and DC collector poles at inverter/transformer pad sites. Underground cables to connect module strings would be installed using ordinary trenching techniques, which typically include a rubber-tired backhoe excavator or trencher. Wire depths would be in accordance with local, State, and Federal requirements, and would likely be buried at a minimum of 18 inches below grade, by excavating a trench approximately 3 to 6 feet wide to accommodate the conduits or direct buried cables. After excavation, cable rated for direct burial or cables installed inside a polyvinyl chloride conduit would be installed in the trench, and, the excavated soil would likely be used to fill the trench and lightly compressed. All cabling excavations would be to a maximum depth of 10 feet.

All electrical inverters and the transformer would be placed on concrete foundation structures or steel skids. If inverter/transformer pads will be elevated on piers as an LEID element, additional pile driving will be required during this phase for elevated pad installation. If trenching were to be reduced or eliminated and associated wires were racked above ground this would result in reduced ground disturbance.

The substation areas would be excavated for the transformer equipment and control building foundation and oil containment area. The site area for the substations would be graded and compacted to an approximately level grade. Concrete pads would be constructed as foundations for substation equipment, and the remaining area would be graveled. Concrete for foundations would be brought onsite from a batching plant in the City of Blythe or would be batched on site as necessary.

This construction phase will last approximately 32 weeks. Construction equipment operating on the site will include a track-mounted pile driver, a dozer, a grader, a front-end loader, a vibratory roller, a flatbed truck, a water truck, skid steers with auger/hoe attachments, cranes, backhoes, aerial lifts, trenchers, and concrete trucks.

### 1.4.4 Operations and Maintenance

The solar modules are expected to be in operation during daylight hours for 7 days per week, 365 days per year. Operational activities include solar module washing, maintenance of transformers, inverters, or other electrical equipment, road and fence repairs, vegetation/pest management, and site security. Solar modules would be washed as needed to maintain optimal electricity production (up to four times per year) using light utility vehicles with tow-behind water trailers. If LEID elements are incorporated into the design, the Project may also be visited regularly by a biological resource monitor, who will monitor applicable O&M activities and conduct periodic site assessments.

***Weed Control***

RE anticipates the need to control weeds during both Project construction and operations. Herbicide control would involve the use of BLM-approved herbicides to control weed populations when manual control methods are not successful in managing the spread of invasive plants.

### 1.4.5 Decommissioning

The Applicant is expected to receive authorizations and permits with 30-year terms. At the end of the term, including any extensions, the Project would cease operation. At that time, the facilities would be decommissioned and dismantled and the site would be restored to conditions similar to pre-construction conditions. Decommissioning activities would require approximately 9,883 truck trips and a workforce of approximately 320 workers, and would take approximately 17 months to complete. Upon decommissioning, the Project site could be converted to other uses in accordance with applicable land use regulations in effect at that time.

It is anticipated that during project decommissioning, project structures would be removed from the ground on the project sites. Aboveground and any underground equipment would be removed including module posts and support structures, gen-tie poles that are not shared with third parties, and the overhead collection system within the Project sites, inverters, transformers, electrical wiring, equipment on the inverter pads, and related equipment and concrete pads, and any O&M facilities and related equipment and infrastructure. The substation would be removed if it is owned by the Project operator; however, if a public or private utility assumes ownership of the substation, the substation may remain onsite to be used as part of the utility service to supply other land uses.

Equipment would be de-energized prior to removal. Equipment would be shipped offsite by truck (after first being placed in secure transport enclosures as necessary) to be salvaged, recycled, or disposed of at an appropriately licensed disposal facility. Removal of the solar modules would include disassembly and removal of the racks on which the solar modules are attached, removal of the structures supporting the racks, and their placement in secure transport enclosures and a trailer for storage; the racks and structures supporting the racks would then be recycled or disposed of at an appropriately licensed disposal facility. Solar modules would be removed from the site and either transported to another solar electrical generating facility or a recycling facility, or disposed of at an appropriately licensed disposal facility. In conjunction with any solar modules, which may be transported to another solar electrical generating facility, such solar modules may undergo a refurbishing process to extend their estimated 30-year lifespan. The demolition debris and removed equipment may be cut or dismantled into pieces to be safely lifted or carried with the equipment being used. The fence and gates would be removed and all materials would be recycled to the extent feasible. It is anticipated the Project roads would be restored to their pre-construction condition unless the BLM elects to retain the improved roads for access throughout the property. All debris would be removed from the site. As discussed above, most materials would be recycled to the extent feasible, with minimal disposal to occur in landfills in compliance with all applicable laws.

## 1.5 Project Background and History

The Project site was originally surveyed in 2011 and 2012 as part of the larger Sonoran West Solar Energy Generating Facility (hereafter referred to as the SWP Site) as proposed by BrightSource. A series of biological surveys were conducted for the SWP site from 2011 through 2012 and a biological resources technical report (BRTR) was drafted, but never submitted to the Resource Agencies. BrightSource submitted an application to the BLM for their proposed power tower technology on the site and initiated permitting with the BLM but withdrew the project in 2012. RE purchased the Project and submitted a new POD for the proposed RE Crimson PV project. As part of their planning and siting effort, RE conducted a siting constraints analysis and refined the proposed development boundary down to a smaller footprint as part of an effort to avoid sensitive resources. Updated resource surveys were conducted in 2016 and 2017 for the current Project. This BRTR details the historical surveys that were conducted in 2011 and 2012 (hereafter 2011/2012) for the SWP Site, and provides updated information for surveys conducted in 2016 and 2017 (hereafter 2016/2017) for the proposed Project.

## 1.6 Purpose

The purpose of this BRTR is to present the existing conditions associated with the Project site as it relates to biological resources and to assess the potential Project impacts on these resources with project implementation. The Project information supporting this analysis is based primarily on the applicant's RE Crimson Solar Project POD submitted to the BLM in January 2016 and most recently updated in November 2017 (RE 2017). If warranted, applicant measures are proposed or recommended in this study to address potential adverse effects on biological resources that would result from Project implementation. This study is submitted to the BLM (the federal lead agency) and the California Department of Fish and Wildlife (CDFW), the state lead agency, to support their independent review and evaluation of the potential environmental impacts of the Project pursuant to applicable federal, state, and local laws. The POD is part of the BLM right-of-way (ROW) grant application process, which, for this Project, includes preparation of an EIS in accordance with the National Environmental Policy Act (NEPA). The proposed Project will require a Streambed Alteration Agreement (SAA) and an Incidental Take Permit from the State through CDFW, which would require compliance with the California

Environmental Quality Act (CEQA) (e.g., Environmental Impact Report). Therefore, it is currently assumed that a joint EIS/EIR will be prepared by the BLM and CDFW.

# 2.0 Regulatory Setting

## 2.1 Regulatory Framework

This section details the federal, state, and local regulations that govern the Project. The Project will be implemented to be consistent with the applicable regulations. Potentially applicable regulations are summarized in Table 2-1 and discussed below.

**Table 2-1. Regulations Applicable to the Proposed Project**

| Regulation | Applicability |
|---|---|
| **Federal** | |
| Bald and Golden Eagle Protection Act (16 United States Code [USC] 668-668c) enacted in 1940 | Prohibits the take, possession, sale, barter, offer to sell, purchase or barter, transport, export or import, of any bald or golden eagle, alive or dead, including any part, nest, or egg, unless allowed by permit. "Take" includes pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb. |
| Endangered Species Act of 1973 (ESA), 16 USC Section 1531 et seq., and implementing regulations, Title 50 Code of Federal Regulations [CFR] Section 17.1 et seq. | Designates and protects federal threatened and endangered plants and animals and their critical habitat. Requires federal agency consultation with United States Fish and Wildlife Service (USFWS) and issuance of Biological Opinion and incidental take authorization for listed species if it is determined that a project may affect a listed species. |
| Migratory Bird Treaty Act (MBTA), 16 USC Sections 703–712 | Prohibits take of protected migratory birds. |
| Clean Water Act (CWA), 33 USC Section 1251 et seq. | Restore and maintain the chemical, physical, and biological integrity of the nation's waters and regulate the discharge of pollutants and dredged or fill material to the navigable waters of the United States. |
| NEPA, 42 USC Section 4321 et seq., and implementing regulations 40 CFR 1500-1508 | Requires federal agencies to analyze environmental impacts of proposed actions with a Federal nexus and to disclose impacts to the public. |
| CDCA Plan | Under the Federal Land Policy and Management Act, the BLM is required to develop Resource Management Plans. All activities proposed for public land must be consistent with the approved Resource Management Plan(s). |
| NECO | Protects and conserves natural resources while simultaneously balancing human uses of the California portion of the Sonoran Desert ecosystem. |
| DRECP | The DRECP is a landscape-level collaborative agency effort to streamline renewable energy development in multiple counties while conserving desert ecosystems and the plants and wildlife that depend on them, while providing multiple use opportunities. The Land Use Plan Amendment (LUPA) for the DRECP was finalized in September 2016. The LUPA and the DRECP do not apply to projects that had submitted applications prior to the LUPA. These projects are considered exempt |

| Regulation | Applicability |
|---|---|
| | from the DRECP requirements. The RE Crimson Project is within the Development Focus Areas (DFA) identified in the DRECP. The project is grandfathered from the DRECP requirements because the Project application was submitted prior to June 30, 2009 and is considered a "pending project" pursuant to BLM guidance. |
| BLM's Solar Energy Program (Western Solar Plan) | The Office of Energy Efficiency and Renewable Energy, Department of Energy; and the BLM, Department of the Interior, prepared a Programmatic Environmental Impact Statement (PEIS) to evaluate utility-scale solar energy development, to develop and implement agency-specific programs or guidance that would establish environmental policies and mitigation strategies for solar energy projects, and to amend relevant BLM land use plans with the consideration of establishing a new BLM Solar Energy Program |
| **State** | |
| CEQA (Public Resources Code Section 15000 et seq.) | CEQA requires identification of significant environmental effects of proposed projects (including impacts on biological resources) and avoidance (where feasible) or mitigation of the significant effects. CEQA applies to "projects" proposed to be undertaken or requiring approval by state and/or local governmental agencies. "Projects" are activities that have the potential to have a physical impact on the environment. The CEC licensing process, under the Warren-Alquis Act, is a CEQA-equivalent process. |
| California Endangered Species Act (CESA) of 1984, California Fish and Game Code (CFGC) Sections 2050–2098 | Protects California's endangered and threatened species, including species designated as candidates for listing. |
| CFGC: Bird Protections<br>Section 3503, 3503.5, 3513: Protection of bird's nests and taking MBTA birds. | Provides protection of bird's nests and outlines regulations regarding taking of birds protected under the MBTA. |
| CFGC: Fur-bearing Mammals<br>Section 4000 et seq. | Prohibits take of fur-bearing mammals without a proper fur-bearing mammal take permit. |
| CFGC Fully Protected Species:<br>Section 3511: Fully protected birds<br>Section 4700: Fully protected mammals<br>Section 5050: Fully protected reptiles and amphibians<br>Section 5515: Fully protected fishes | Prohibits the taking of animals classified as "Fully Protected" in California. |
| Native Plant Protection Act (NPPA) of 1977, CFGC Section 1900 et seq. | Provides specific protection measures for identified populations of State rare and endangered plants. |
| Title 14 California Code of Regulations (CCR) Sections 670.2 and 670.5 | Listings of plants and animals of California declared to be threatened or endangered. |
| CFGC Section 1600 et seq., SAA | Requires the CDFW to review project impacts to waters of the State (bed, banks, channel, or associated riparian areas of a river, stream, or lake), including impacts to wildlife and vegetation from sediments, diversions, and other disturbances. |
| The 1969 Porter-Cologne Water Quality Control Act (Porter-Cologne) California Water Code Section 13000 et seq. | Regulates discharges of waste and fill material to waters of the State, including "isolated" waters and wetlands. |
| **Local** | |

| Regulation | Applicability |
|---|---|
| Riverside County General Plan (2003) | Provides land use designations, goals, and policies for the development and conservation of land within the unincorporated areas of Riverside County. |

### 2.1.1 Federal Jurisdiction

***Bald and Golden Eagle Protection Act (16 United States Code [USC] Section 668-668c)***

This law, enacted in 1940, Prohibits the take, possession, sale, barter, offer to sell, purchase or barter, transport, export or import, of any bald or golden eagle, alive or dead, including any part, nest, or egg, unless allowed by permit. “Take” includes pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb. Disturb means to agitate or bother a bald or golden eagle to the point where it causes either injury to an eagle, a decrease in its productivity, or nest abandonment. This definition can include disturbance that interferes with the normal breeding, feeding, or sheltering behavior. Additionally, the Bald and Golden Eagle Protection Act covers impacts that result from human-induced alterations initiated around a previously used nest site during a time when eagles are not present, that cause disturbance to eagles upon their return (United States Fish and Wildlife Service [USFWS] 2016).

***Endangered Species Act (ESA) (16 USC Section 1531 et seq.)***

This 1973 law, administered by the USFWS, is designed to minimize impacts to imperiled plants and animals, as well as to facilitate recovery of such species. Declining plant and animal species are listed as “endangered” or “threatened” based on a variety of factors. Applicants for projects requiring federal agency action that could adversely affect listed species are required to consult with and mitigate impacts in consultation with USFWS. Adverse impacts are defined as “take” (defined as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in such conduct”), which is prohibited except as authorized through consultation with USFWS and issuance of an Incidental Take Statement under Section 7 or Section 10 of the ESA, depending on whether there is a federal nexus (federal permit required or funding involved).

***Migratory Bird Treaty Act (MBTA) (16 USC Sections 703–712)***

This law prohibits actions resulting in the pursuit, capture, killing, and/or possession of any protected migratory bird, nest, egg, or parts thereof. USFWS maintains a list of designated migratory birds occurring in various regions of the United States. This regulation can constrain construction. US Department of the Interior Solicitor Opinion M-37041 (December 22, 2017) provided context on the history of the MBTA and direction on the interpretation of the MBTA to include intentional take only. The USFWS issued a subsequent memorandum on April 11, 2018, providing guidance on this M-Opinion and clarifying that USFWS “interpret[s] the M-Opinion to mean that the MBTA’s prohibitions on take apply when the *purpose* of an action is to take migratory birds, their eggs, or their nests.” The guidance memorandum goes on to state that “the take of birds, eggs or nests occurring as the result of an activity, the purpose of which is not to take birds, eggs or nests, is not prohibited by the MBTA.”

***Clean Water Act (CWA) (33 USC Section 1251 et seq.)***

Under Section 404 of the CWA, the U.S. Army Corps of Engineers (USACE) regulates the discharge of dredged or fill material into jurisdictional “waters of the U.S.,” which include those waters listed in 33 Code of Federal Regulations (CFR) 328.3 (Definitions). Additionally, Section 401 of the CWA requires states to certify that any activity that may result in discharge into waters of the U.S. will comply with state water quality standards. All permits issued by USACE under Section 404 of the CWA require certification pursuant to Section 401. The Regional Water Quality Control Board (RWQCB), as delegated by the U.S. Environmental Protection Agency and State Water Resources Control Board, is the state agency responsible for issuing a CWA Section 401 Water Quality Certification or waiver.

***National Environmental Policy Act (NEPA) (42 USC Section 4321 et seq.)***

NEPA established a national policy for promoting environmental protection that includes a multidisciplinary approach to considering environmental effects in decision making intended to “encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man…”

NEPA requires federal agencies to analyze and publicly disclose of the environmental impacts of a proposed project. To do so, federal agencies are required to prepare either an environmental assessment or, where an action may significantly affect the quality of the human environment, an EIS. These documents explore project alternatives and identify the likely environmental consequences of each action. These documents contain statements of the environmental impacts and include mitigation measures to lessen the effects of a proposed project to the extent practicable. The significance of an impact is determined by both its context and its intensity. “Context” includes society as a whole, the affected region, the affected interests, and the locality. “Intensity” refers to the severity of impact, including “the degree to which the action may adversely affect an endangered or threatened species or habitat that has been determined to be critical under [ESA].”

***California Desert Conservation Area (CDCA) Plan***

Per Title 43 CFR Section 1610.5-3, the BLM must manage the land within its jurisdiction in compliance with a Resource Management Plan. The CDCA Plan (1980) serves as a guide for the management of all BLM-administered lands in three desert areas: the Mojave, the Sonoran, and a small portion of the Great Basin. The CDCA Plan covers approximately 25 million acres, of which 12 million is public lands. The primary goal of the CDCA Plan is to provide overall maintenance of the land while planning for multiple uses and balancing the needs of people with the protection of the natural environment.

***Northern and Eastern Colorado Desert Coordinated Management Plan (NECO)***

The Federal Land Policy and Management Act (FLPMA) requires the BLM to develop land use plans also known as Resource Management Plans to guide BLM’s management of public land. BLM is required to determine conformity of the project developments with the CDCA including the Northern and Eastern Colorado Desert Coordinated Management Plan (NECO; BLM 2002). NECO is a landscape-scale, multiagency planning effort that protects and conserves natural resources while simultaneously balancing human uses of the California portion of the Sonoran Desert ecosystem. This plan was prepared under the regulations implementing the FLPMA of 1976. NECO provides reserve management for the desert tortoise, integrated ecosystem management for special-status species and natural communities for all federal lands, and regional standards and guidelines for public land health for the BLM lands. The planning area encompasses over 5 million acres and includes 60 sensitive plant and animal species. NECO amends the 1980 CDCA Plan (BLM 2002).

Within the NECO area, BLM has designated multiple DWMAs and ACECs. Several DWMAs and ACECs are located around the Project including the Chuckwalla DWMA, Chuckwalla Valley Dune Thicket ACEC, and Mule Mountains ACEC (Figure 2).

***Desert Renewable Energy Conservation Plan (DRECP)***

The DRECP is a landscape-level plan that was intended to streamline renewable energy permitting and development while conserving unique and valuable desert ecosystems and providing outdoor recreation opportunities. It encompasses 22.5 million acres in the desert regions and adjacent lands of seven California counties – Imperial, Inyo, Kern, Los Angeles, Riverside, San Bernardino, and San Diego. The DRECP is a collaborative effort between multiple agencies including the California Energy Commission (CEC), CDFW, BLM, and USFWS, known as the Renewable Energy Action Team (REAT).

The goals of the DRECP are:

1. preserve, restore, and enhance natural communities and ecosystems and conserve sensitive species;

2. protect and enhance other resources and values on BLM-administered lands, including cultural resources, recreation opportunities, visual landscapes, etc.;

3. identify appropriate areas for the siting of utility-scale renewable energy projects; and

4. provide efficient and predictable environmental review and permitting for projects sited in these areas (BLM 2015).

The plan consists of three components that support the DRECP's overall goals and include:

- A Natural Community Conservation Plan (NCCP) under the California NCCP Act and the CESA;
- A General Conservation Plan under the Federal Endangered Species Act; and
- BLM Land Use Plan Amendments (LUPA) under the Federal Land Policy and Management Act.

Although the DRECP was intended to be a collaborative effort by the REAT with the final action consisting of the three components above, only the BLM proceeded forward with the LUPA as part of the DRECP action. On September 14, 2016, the BLM signed the Record of Decision (ROD) approving its LUPA (which amended the CDCA), completing Phase I of the DRECP. The BLM LUPA covers the 10 million acres of BLM-managed lands in the DRECP plan area and supports the overall renewable energy and conservation goals of the DRECP.

Phase II of the DRECP focuses on better aligning local, state, and federal renewable energy development and conservation plans, policies, and goals. It includes building off of the Renewable Energy Conservation Planning Grants that were awarded by the CEC to counties in the plan area. The DRECP is currently in Phase II.

The RE Crimson Project is within a Development Focus Area (DFA) as identified in the DRECP; however, the Project application was submitted prior to June 30, 2009 and is considered a "pending project" pursuant to BLM guidance. Therefore, pursuant to the DRECP's terms, the Project is grandfathered from DRECP requirements. Although the Project is grandfathered from the DRECP requirements, the Applicant will implement measures consistent with the DRECP Conservation Management Actions (CMAs) to the extent feasible and practicable.

***Western Solar Plan***

BLM's Solar Energy Program (also known as the Western Solar Plan) was established in October 2012 through the ROD for the Final Programmatic Environmental Impact Statement (PEIS) for Solar Energy Development in Six Southwestern States (Solar PEIS). The BLM created a Solar Energy Program for utility-scale solar energy development on BLM-administered lands in six southwestern states: Arizona, California, Colorado, Nevada, New Mexico, and Utah. As applicable to the Solar Energy Program, utility-scale projects are those with capacities of 20 MW or greater that generate electricity that is delivered into the transmission grid.

A number of Executive Orders, Congressional mandates, and Federal agency orders and policies promote expedited and concentrated Federal action to support the development of domestic renewable energy resources. The BLM is taking actions in support of U.S. renewable energy goals and objectives for solar energy development in the aforementioned six southwestern states as described in the Final PEIS and the Approved ROD and associated plan amendments.

Through the Solar PEIS ROD, the BLM has established a comprehensive Solar Energy Program that allows the permitting of future solar energy development projects on public lands to proceed in a more efficient, standardized, and environmentally responsible manner (BLM 2014).

### 2.1.2 State Jurisdiction

***California Environmental Quality Act (CEQA) (Public Resources Code Section 15000 et seq.)***

CEQA requires identification of significant environmental effects of proposed projects (including impacts on biological resources) and avoidance (where feasible) or mitigation of the significant effects. CEQA applies to “projects” proposed to be undertaken or requiring approval by state and/or local governmental agencies. “Projects” are activities that have the potential to have a physical impact on the environment.

***California Endangered Species Act (CESA) (California Fish and Game Code [CFGC] Section 2050-2098)***

This state law prohibits the “take” (defined as “to hunt, pursue, catch, capture, or kill” in CFGC Section 86) of state-listed species except as otherwise provided in state law. CESA, administered by CDFW, is similar to the federal ESA, although unlike the federal law, CESA applies incidental take prohibitions to species currently petitioned for state-listing status (i.e., candidate species). Also, CESA’s take definition does not include harassment. State lead agencies are required to consult with CDFW to ensure that their authorized actions are not likely to jeopardize the continued existence of any state-listed species or result in the degradation of occupied habitat.

Under Section 2081, CDFW authorizes “take” of state-listed endangered, threatened, or candidate species through incidental take permits or memoranda of understanding if (1) the take is incidental to otherwise lawful activities, (2) impacts of the take are minimized and fully mitigated, (3) the permit is consistent with regulations adopted in accordance with any recovery plan for the species in question, and (4) the applicant ensures suitable funding to implement the measures required by CDFW.

***CFGC Section 3503***

This Code prohibits take, possession, or needless destruction of the nests or eggs of any bird, except as otherwise provided by the code or any regulation made pursuant thereto.

***CFGC Section 3503.5***

This Code makes it unlawful to take, possess, or destroy birds of prey. It also prohibits the take, possession, or destruction of nests or eggs of any bird of prey.

***CFGC Section 3511***

This Code describes bird species, primarily raptors, which are “fully protected.” Fully protected birds may not be taken or possessed, except under specific permit requirements.

***CFGC Section 3513***

This Code makes it unlawful to take or possess any migratory nongame bird as designated in the MBTA or any part of such migratory nongame bird except as provided by rules and regulations adopted by the Secretary of the Interior under provisions of the Migratory Treaty Act.

***CFGC Section 4000 et seq.***

This Code makes it unlawful to take fur-bearing mammals without a proper fur-bearing mammal take permit. Fur-bearing mammals are defined by this Code as fisher, marten, river otter, desert kit fox and red fox. As defined in CFGC Section 86, “take” is defined as “to hunt, pursue, catch, capture, or kill;” this take definition does not include harassment.

***CFGC Sections 4700, 5050, and 5515***

These Codes list mammal, amphibian, and reptile species respectively that are classified as fully protected in California. Take of fully protected species is prohibited by these CFGCs.

***Native Plant Protection Act (NPPA) (CFGC Section 1900 et seq.)***

The NPPA includes measures to preserve, protect, and enhance rare and endangered native plant species. Definitions for “rare and endangered” are different from those contained in CESA, although CESA-listed rare and endangered species are included in the list of species protected under the NPPA.

***Title 14, California Code of Regulations Sections 670.2 and 670.5***

These regulations list plant and animal species designated as threatened and endangered in California. California species of special concern (SSC) status is a designation applied by CDFW to those species that are indicators of regional habitat changes or are considered potential future protected species. SSCs do not have any special legal status but are intended by CDFW for use as a management tool to take these species into special consideration when decisions are made concerning the future of any land parcel.

***CFGC Section 1600 et seq.***

CDFW regulates all changes to the natural flow, bed or bank, of any river, stream, or lake that supports fish or wildlife resources. A stream is defined broadly as a body of water that flows at least periodically, or intermittently, through a channel that has banks and that supports fish or other aquatic biota. Such areas are formally referred to as waters of the state. Impacts to vegetation and wildlife from sediment, diversions, and other disturbances are included in the review.

Project proponents must provide CDFW with written notification before activities begin that will:

- Substantially divert or obstruct the natural flow of any river, stream, or lake;
- Substantially change or use any material from the bed, channel, or bank of, any river, stream, or lake; or
- Deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it can pass into any river, stream, or lake.

Notification is generally required for any activity that will take place in or in the vicinity of a river, stream, lake, or their tributaries, including rivers or streams that flow at least periodically or permanently through a bed or channel with banks and support fish or other aquatic life, and watercourses having a surface or subsurface flow that support or have supported riparian vegetation. Generally, CDFW is concerned with activities that have the potential to impact state-regulated resources at the activity site, as well as the effects of those actions on the ecosystem at and surrounding the activity (i.e., upstream, downstream, and neighboring).

***1969 Porter-Cologne Water Quality Control Act (Porter-Cologne) (California Water Code Section 13000 et seq.)***

Through a programmatic agreement between the federal government and the states, the RWQCB has primary authority for permit and enforcement activities under Porter-Cologne) and the CWA. Under Porter-Cologne, the RWQCB regulates the "discharge of waste" to waters of the state. The term "discharge of waste" is also broadly defined in Porter-Cologne, such that discharges of waste include fill, any material resulting from human activity, or any other "discharge" that may directly or indirectly impact waters of the state relative to implementation of Section 401 of the CWA.

Porter-Cologne authorizes the RWQCB to regulate discharges of waste and fill material to waters of the state, including "isolated" waters and wetlands, through the issuance of waste discharge requirements (WDRs). Under Porter-Cologne, all parties proposing to discharge waste that could affect the quality of waters of the state, other than into a community sewer system, will file with the appropriate RWQCB a Report of Waste Discharge (ROWD) containing such information and data as may be required by the RWQCB. The RWQCB will then respond to the ROWD by issuing a WDR in a public hearing, or by waiving WDRs (with or without conditions) for that proposed discharge. The RWQCB has a statutory obligation to prescribe WDRs except where the RWQCB finds that a waiver of WDRs for a specific type of discharge is in the public interest. Therefore, all parties proposing to discharge waste that could affect waters of the state, but do not affect federal waters (which requires a CWA Section 404 permit and CWA Section 401 Certification) must file an ROWD with the appropriate RWQCB.

### 2.1.3 Local Jurisdiction

***Riverside General Plan, Land Use, and Multi-Purpose Open Space Elements (2003)***

Riverside County requires actions to ensure that proposed development projects demonstrate a high degree of compatibility with any threatened or endangered species habitat they may affect. The administering agency is the Riverside County Planning Department.

# 3.0 Methodology

This chapter outlines the methods used to identify and define the vegetation communities, jurisdictional waters, special-status plant species, and special-status wildlife species that are historically known to occur, or potentially occur, within and around the Project. This chapter begins with how special-status species were defined, and then describes the methodologies used for the various surveys conducted for the Project within 2011/2012 and 2016/2017.

It is necessary to first define the various survey areas and boundaries where biological studies were conducted. These terms are used throughout this BRTR and include the following definitions.

> *Project area* – RE Crimson Permitting Boundary plus the adjacent surrounding areas that will be avoided and no permanent direct impacts will occur, including microphyll woodlands and desert dune areas. The vast majority of biological surveys took place within the Project area. The Project area does not have a defined boundary and is therefore not shown on any of the figures, but is more of a descriptive term used to include the area of direct and indirect impacts from the Project.
>
> *RE Crimson Permitting Boundary* – A 2,489-acre area including 2,465 acres for solar field development and 24 acres for linear facility corridors, the area of direct impacts shown on the majority of figures.

*Linear Facility Corridors* – Approximately 24 acres for the gen-tie line (150-foot wide corridor), perimeter road and transmission lines (150-foot wide corridor), and the main access road (60-foot wide corridor).

*SWP Site* – Sonoran West Project Site includes the 7,653-acre proposed area for the former BrightSource Sonoran West Solar Energy Generating Facility, including the 2012 1,602-acre expansion area. This area boundary is no longer applicable to the current Project; however, it is included for historical context purposes (and included on many of the figures) as many biological surveys were conducted in 2011 and 2012 across the Sonoran West Project Site.

In addition to these terms, various survey areas or study areas for specific resources have been defined under the specific resource where surveys were conducted. These survey areas or study areas generally included the RE Crimson Permitting Boundary or the Project area plus a surrounding buffer distance.

## 3.1 Special-Status Species Definitions

For the purposes of this BRTR, vegetation communities and plant and wildlife species were considered to be sensitive, or have special-status if they met at least one of the following criteria:

- Covered under ESA or CESA, including candidate species (CDFW 2017a);
- CDFW species of special concern (CDFW 2017a);
- CDFW fully protected species (CDFW 2017a);
- BLM sensitive species (BLM 2017);
- Covered as a state protected furbearing mammal (14 California Code of Regulations [CCR] Section 460);
- Listed by the California Native Plant Society (CNPS) (2017) as List 1A (presumed extinct in California), 1B (rare, threatened, and endangered in California and elsewhere), or 2 (rare, threatened, or endangered in California, but more common elsewhere). CNPS List 1A, 1B, and 2 species are considered special-status plant species as defined in the NPPA, CFGC Section 1901 or the CESA, CFGC Sections 2050 through 2098;
- CNPS List 3: (plants for which more information is needed [a review list]), or List 4 (plants of limited distribution [watch list]) (CNPS 2017);
- Special-status species listed under the NECO Plan (BLM 2002); listed as a DRECP Focus or Planning Species (BLM 2015); and/or
- Sensitive vegetation communities as defined based on the Hierarchical list of Natural Communities with Holland Types (California Department of Fish and Game [CDFG] 2010) and ranked based on the NatureServe Conservation Status Assessments: Methodology for Assigning Ranks (Faber-Langendoen et al. 2012).

Species that are protected by only the MBTA and/or do not meet any of the above criteria, were not considered special-status. The following section outlines the data sources used to determine the sensitive vegetation communities and special-status plant and wildlife species potential to occur within the Project vicinity.

## 3.2 Literature and Geographic Information System Database Review

A detailed analysis of existing data from historical surveys (from the SWP Site) was reviewed to determine the potential for sensitive resources to occur within the Project. Applicable historical geographic information system (GIS) data were included in the analysis. For the purpose of environmental review, resource databases were searched for a 10-mile radius buffer around the Project boundary to determine the potential special-status plant and wildlife species that have historically been detected in the vicinity of the Project. The following resources were checked for sensitive vegetation communities and special-status plant and wildlife species that have historically been documented within 10 miles of the Project:

Agency Lists and NCCP Documents

- CDFW Special Animals List (CDFW 2017a)
- NECO list of special-status species (BLM 2002)
- DRECP list of Focus Species and Planning Species (BLM 2015)
- CNPS Inventory of Rare and Endangered Plants (CNPS 2017)
- BLM California Special Status Animal Species and Sensitive Species Lists

Electronic Databases

- 7.5-minute U.S. Geological Survey topographic quadrangle maps
- CNDDB (CDFW 2017b)
- eBird (eBird 2017)
- USFWS Online Database (USFWS 2017a)
- National Wetlands Inventory Wetlands and Riparian Google Earth file (USFWS 2017b)
- National Hydrography Dataset and CalWater 2.2.1 viewed in ArcMap
- web-based Natural Resource Conservation Service (NRCS) Web Soil Survey (NRCS 2017)
- National List of Hydric Soils (NRCS 2015)

Other Biological Resources

- California Amphibian and Reptile Species of Special Concern (Thomson *et al.* 2016)
- California Bird Species of Special Concern (Shuford and Gardali 2008)

These resources, along with range maps, were consulted to determine occurrence of sensitive vegetation communities, and special-status plant and wildlife species within 10 miles of the Project. Special-status species were then categorized into one of five categories of potential to occur within the Project. Generally the following criteria were used to determine the potential for each species to occur within the Project:

*Present:* The species (or its tracks, scat, or other sign) has been observed within the RE Crimson Permitting Boundary.

*High:* There is both a historical record for the species within the RE Crimson Permitting Boundary or the immediate vicinity (within 10 miles) and the environmental conditions associated with the species are present within the RE Crimson Permitting Boundary.

*Moderate:* Either a historical record exists for the species within the immediate vicinity (within 10 miles), or the environmental conditions (including soil type) associated with the species are present within the RE Crimson Permitting Boundary.

*Low:* No historical records exist for the species occurring within the RE Crimson Permitting Boundary or immediate vicinity (within 10 miles) and/or the environmental conditions (including elevation ranges and vegetation communities) associated with the species presence are marginal within the RE Crimson Permitting Boundary.

Species that had no potential to occur because they were not observed during historical surveys within the RE Crimson Permitting Boundary and the species is restricted to environmental conditions (including elevation ranges, vegetation communities, or habitat types) that do not occur within the RE Crimson Permitting Boundary were not included in analysis in this BRTR. The list of sensitive vegetation communities and special-status plant and wildlife species with a potential to occur within the Project site is included in Chapter 4.

### 3.3 Biological Survey Methods

This section identifies the specific locations in which biological resource surveys were completed, and describes the survey methodologies (i.e., protocols) for biological surveys conducted in 2011/2012 for the SWP Site. This section includes an updated survey methodology for surveys conducted in 2016/2017 within the Project area. The survey results from 2011/2012 surveys are summarized in this chapter.

For the SWP Site, the buffer size evaluated for each biological resource was dependent on the type of survey being conducted, but ranged from 250 feet (for plants along linear features) up to 10 miles (for golden eagle surveys). Surveys were performed on all portions of the SWP Site where Right-of-Entry was granted, and in some cases an additional area referred to as the “expansion area” was included. The SWP Site overlapped with, and encompassed a much larger area than the RE Crimson Permitting Boundary; however, there were a few small areas added to the 2016/2017 surveys for the RE Crimson Permitting Boundary that were not within the SWP Site, primarily east of the Colorado River Substation (Figure 4).

Table 3-1 details the surveys that were conducted in 2011/2012 compared to those conducted in 2016/2017 along with the survey area and any applicable buffers. For the majority of surveys conducted in 2016/2017, no survey buffer around the RE Crimson Permitting Boundary was included. For surveys in 2016/2017, all survey methods were defined in survey work plans, which were submitted to the Resource Agencies, including the BLM, CDFW, and USFWS, for review and approval prior to initiation of field work. Therefore, all survey methods, as well as the lack of specific surveys, were approved by the agencies for each resource area.

**Table 3-1. Comparison of 2011/2012 and 2016/2017 Biological Surveys**

| Survey Type | Survey Area | |
|---|---|---|
| | **Sonoran West Project Site 2011/2012** | **RE Crimson Project area 2016/2017** |
| **Vegetation mapping** | SWP Site plus a 500-foot buffer around the site and a 250-foot buffer around linear features | Updated vegetation mapping within the RE Crimson Permitting Boundary plus adjacent washes/microphyll woodlands. |
| **Special-status plant species** | SWP Site plus a 250-foot buffer | RE Crimson Permitting Boundary, plus adjacent washes/microphyll woodlands, and no buffer |
| **Jurisdictional waters delineation** | SWP Site | RE Crimson Permitting Boundary, plus adjacent washes/microphyll woodlands, and no buffer |
| **Desert tortoise surveys** | SWP Site plus a 500-foot buffer, plus Zone of Influence transects at 200, 400, and 600-meters from the SWP boundary | RE Crimson Permitting Boundary, plus adjacent washes/microphyll woodlands, and a 500-foot buffer on the south and east side adjacent to the Mule Mountains |
| **Mojave fringe-toed lizard** | SWP Site minus the expansion area, plus a 500-foot buffer around the site and a 250-foot buffer around linear features | Recorded incidentally during other biological surveys within the RE Crimson Permitting Boundary and adjacent microphyll woodlands. |
| **Couch's spadefoot** | SWP Site in areas of potentially suitable habitat | Recorded incidentally during other biological surveys within the RE Crimson Permitting Boundary and adjacent microphyll woodlands. |
| **Bighorn sheep** | Incidental data only | Recorded incidentally during other biological surveys within the RE Crimson Permitting Boundary and adjacent microphyll woodlands. |
| **Burro deer** | Incidental data only | Recorded incidentally during other biological surveys within the RE Crimson Permitting Boundary and adjacent microphyll woodlands. In addition, wildlife cameras were |

| Survey Type | Survey Area | |
|---|---|---|
| | **Sonoran West Project Site 2011/2012** | **RE Crimson Project area 2016/2017** |
| | | installed within several microphyll woodlands to record wildlife usage. |
| **Burrowing owl** | SWP Site plus a 500-foot buffer around the site and a 250-foot buffer around linear features | Conducted one survey during the breeding season across the RE Crimson Permitting Boundary and no buffer. |
| **Elf owl** | SWP Site plus a 0. 5-mile buffer within microphyll woodlands | Conducted surveys within microphyll woodlands between the RE Crimson Permitting Boundary and no buffer. |
| **Gila woodpecker** | SWP Site plus a 0.25-mile buffer within microphyll woodlands | Recorded incidentally if detected within the RE Crimson Permitting Boundary and microphyll woodlands. |
| **Golden eagle surveys** | SWP Site plus a 10-mile buffer | Updated surveys were conducted in winter/spring 2018, which include a 10-mile survey radius of within the RE Crimson site Permitting Boundary and a 10-mile buffer. |
| **Migratory bird observation points** | SWP Site with no buffer | RE Crimson Permitting Boundary, plus adjacent washes/microphyll woodlands. |
| **Migratory bird transects** | SWP Site with no buffer | RE Crimson Permitting Boundary, plus adjacent washes/microphyll woodlands. |
| **Avian nocturnal radar monitoring** | SWP Site with no buffer | No surveys were conducted. |
| **Baseline common raven population surveys** | SWP Site with no buffer | Recorded during avian (migratory bird) surveys within the RE Crimson Permitting Boundary plus adjacent washes/microphyll woodlands. |
| **Desert kit fox and American badger surveys** | SWP Site plus a 500-foot buffer around the site and a 250-foot buffer around linear features | Recorded incidentally within the RE Crimson Permitting Boundary, plus adjacent washes/microphyll woodlands |

| Survey Type | Survey Area | |
|---|---|---|
| | **Sonoran West Project Site 2011/2012** | **RE Crimson Project area 2016/2017** |
| | | during desert tortoise and burrowing owl surveys. |
| **Bat acoustic monitoring** | SWP Site with a 0.25-mile buffer | Washes/microphyll woodlands between the RE Crimson Permitting Boundary. |

The surveys listed above are detailed in the following sections and separated by 2011/2012 surveys and 2016/2017 surveys where appropriate. In some cases surveys were only conducted in one year and therefore only one year is stated, at other times, surveys spanned multiple years (2011/2012 or 2016/2017) and that is indicated where applicable.

The BRTR for the SWP Site was not finalized and was never submitted to the Resource Agencies; therefore, the methods and results have been included in this BRTR to the extent feasible and where applicable. The appendices within this BRTR include data from surveys conducted in 2011/2012, if no repeat surveys were conducted in 2016/2017 due to adequate previous coverage of the SWP Site, which encompassed the RE Crimson Permitting Boundary and approved by the BLM, CDFW, and the USFWS. The appendices within this BRTR reflect the most updated biological survey data and the more current biological survey dates, personnel, and other pertinent information. Therefore, Appendix B is a table of all biological surveys conducted for the Project from 2016 through 2017, and does not include historical survey dates and times from 2011/2012.

### 3.3.1 Vegetation Mapping

***2011/2012 Surveys***

Vegetation mapping was conducted on the entire SWP Site during the fall of 2011 and spring of 2012. Vegetation communities were mapped within the SWP Site plus a surrounding 500-foot buffer, and a 250-foot buffer was placed around linear features such as the access roads and a natural gas line (Figure 4). Biologists first documented vegetation communities onsite and in the buffer during the fall 2011 botanical survey. Vegetation communities were classified according to *A Manual of California Vegetation, Second Edition* (Sawyer *et al.* 2009). The dominant plants in the uppermost layer, or, in some cases, indicator species that are considered representative, diagnostic, or characteristic even if they have relatively low cover, define the communities, or alliances and associations. Details on percentages of relative cover used to define individual alliances vary between alliances, are discussed in the *Manual* (Sawyer *et al.* 2009). Percent cover of plant species was visually estimated in the field.

***2016 Surveys***

Vegetation mapping was completed for the portion of the Project area outside of the SWP Site in 2016. In addition, previous vegetation mapping results for the SWP Site and associated with washes and microphyll woodlands was confirmed and refined as-needed during the spring 2016 botany surveys (Figure 4). Similar vegetation community mapping methods and nomenclature were used in 2016 to provide congruence with the 2012 approach. During the vegetation mapping/verification process, the characteristics of each vegetation community were verified by surveyors on the ground, and recent aerial photography were used in the field to assist in updating the delineation of vegetation communities. Additional information, such as topographic mapping, was used to define the limits of each vegetation type. Handheld global positioning system (GPS) units were used to mark survey waypoints to help interpret vegetation boundaries, which were drawn on the maps while in the field. Thus, a final vegetation map of the entire Crimson Permitting Boundary was created and digitized into GIS (Figure 4).

### 3.3.2 Special-Status Plant Species Surveys

***2011/2012 Surveys***

In fall 2011, spring 2012, and fall 2012, botanical surveys were conducted within the SWP Site and buffer (hereafter referred to as the SWP Site botanical survey area [BSA]) to document special-status plant species that were both evident and identifiable by flowers and/or fruits (Figure 5). These surveys involved multiple visits to the same location (i.e., during fall, early spring, and late spring for flowering plants) to determine if special-status plants were present, as well as to capture the floristic diversity of the SWP Site BSA. Geographic location, the vegetation communities present, and weather patterns determined the timing and number of visits in the year in which the surveys were conducted. A fall botanical survey of the SWP Site BSA was conducted in late September 2011. An early spring 2012 botanical survey of the expanded area was conducted in late March 2012. The late spring 2012 survey was cancelled due to low rainfall. The final survey of 2012 also covered the expanded area surveyed in spring 2012, and was conducted in late September 2012.

Protocol-level botanical surveys for special-status plants were floristic in nature and followed the botanical survey guidelines of the Resource Agencies and CNPS (USFWS 2000a; CDFG 2009a; BLM 2009a; and CNPS 2001). One-hundred-percent coverage (aerial extent of the survey area) protocol-level special-status plant surveys were conducted to census, map, photograph, and record data for all special-status plants encountered.

For the surveys, the SWP Site BSA was divided into survey units, or cells, that encompassed approximately 100 acres in each cell, and four to five surveyors with handheld GPS units walked transects spaced 30 meters apart within each cell. This narrow spacing permitted detection of small, cryptically colored special-status plants, which were expected to be scarce and unevenly distributed. Survey team leaders carried paper maps detailing the survey grid. The survey cells shown on the maps corresponded to images on the GPS units used to navigate and collect data in the field. GPS units used during the survey included Garmin 60CSx, Garmin Rino 520, and similar models having a 3-to 5-meter accuracy, as well as Trimble Juno and Flint/BAP handheld units with 1 to 3-meter accuracy.

Surveyors searched for special-status plants by scanning the ground (including under shrubs) in front of them, on either side of the transect line up to 15 meters away, and behind them, as they walked transects. Survey team members stayed together while walking each transect. Each time special-status plants were encountered, the number of individuals was counted, the occurrence was mapped by GPS, photographed, and recorded on a GPS point form and a field checklist. Data collected included the phenology (vegetative, in bud, in flower, old flowers, in fruit), substrate, vegetation type, associated species, and disturbance condition. For species protected only by the California Desert Native Plants Act (CDNPA) (California Food and Agriculture Code 1981), plants were either counted and mapped, or for the following common species, only recorded as occurring in the survey cell: silver or golden cholla (*Cylindropuntia echinocarpa*), ironwood (*Olneya tesota*), blue palo verde (*Parkinsonia florida*), honey mesquite (*Prosopis glandulosa* var. *torreyana*), smoke tree (*Psorothamnus spinosus*), catclaw acacia (*Senegalia greggii*), and ocotillo (*Fouquieria splendens*).

Voucher specimens of special-status species were collected to provide verifiable documentation of species' presence and identification, as well as to provide a public record of conditions, in accordance with applicable state and federal permit requirements (e.g., scientific collection permit). Voucher collections of special-status species were only made when such actions would not jeopardize the continued existence of the population or species.

***2016 Surveys***

In the spring of 2016, AECOM conducted one floristic survey of the BSA (2016 BSA), which included the RE Crimson Permitting Boundary plus all adjacent washes and microphyll woodlands (early spring) to capture the blooming period of the greatest number of special-status species possible to update the existing special-status plant data from 2011/2012 surveys (Figure 5). No buffer area was surveyed as part of the 2016 BSA. Two spring surveys were planned (early and late season); however, due to the lack of rain and germination of plants, only one survey was conducted, with late spring surveys being cancelled. Spring rare plant surveys were conducted the week of March 21, 2016, based on current rainfall records and reports of field conditions. Dates were adjusted based on reference population checks. The spring surveys occurred over a 5-day period. Fall surveys were not conducted due to a complete lack of summer monsoonal rains. The protocol-level surveys for special-status plants adhered to the following guidelines to the greatest extent feasible:

- USFWS Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed Plants (USFWS 1996);
- CDFG Protocols for Surveying and Evaluating Impacts to Special-Status Native Plant Populations and Natural Communities (CDFG 2009a);
- CNPS Botanical Survey Guidelines (CNPS 2001); and
- BLM Survey Protocols Required for NEPA and ESA Compliance for BLM Special-Status Plant Species (BLM 2009a).

To conduct special-status plant surveys in 2016 for the proposed RE Crimson project area, botanists used the same methods from the 2011/2012 surveys (described above) within the 2016 BSA. The 2016 BSA was broken down into cells of approximately 100 acres. Botanists walked transects spaced 30 meters apart to provide 100% visual coverage of the 2016 BSA.

All plant species encountered were recorded for each cell surveyed and a census per unit area was recorded for each special-status species that was detected. The special-status plant or population was mapped with a GPS unit, photographed, and recorded electronically or on a field form, and/or in the field notes of the survey team leader. For special-status plant species listed exclusively by the CDNPA (e.g., mesquite, ocotillo, catclaw acacia, cactus species, and others) only an approximate census and mapping of the extent of occurrence was conducted (versus individual GPS points that were recorded for the other special-status species).

In 2016, an invasive plant (weed) inventory was also conducted during the botanical surveys for the purposes of creating a weed distribution map of the 2016 BSA to aid in future onsite weed management. Invasive species encountered were noted during the 2016 inventory; however, because invasive plants were generally scattered, locations were not recorded via GPS.

***2017 Surveys***

The BLM requested botanical focused surveys once again in 2017 due to the 2016/2017 rainy season being above average. Because full site botanical surveys were conducted in 2011/2012 for SWP and again in the spring of 2016 for the Project, the BLM requested focused surveys for Harwood’s eriastrum because that species would require mitigation and therefore needs to be adequately surveyed and documented in the Project impact area (Marsden pers. comm. 2017). This resulted in a more focused survey area selected to encompass five areas (hereafter Survey Areas 1 through 5) where Harwood’s eriastrum was observed during the 2011/2012 survey (Figure 5). Following this communication, additional communication from the BLM provided direction for the survey protocol and instructed the survey team to use the Intuitively Controlled Method (Liberatore pers. comm. 2017). Per the provided method, surveys consisted of traversing the project site to obtain a reasonable cross-section of the major plant habitats and topographic features with focused 100%-coverage surveys in areas of “high potential” habitat (Survey Areas 1 through 5). This cross-section was achieved by the survey team while traversing the site to access the various focus areas.

Given that the proposed surveys included only one target species, Harwood’s eriastrum, only one spring survey was conducted during the blooming period. Focus areas for surveying were based on observations of the species during prior surveys and the habitat associations that were observed during those prior surveys. Figure 5 shows the target areas which were defined as “high potential” habitat based on data to date and for which 100%-coverage surveys were conducted. Full coverage surveys within the “high potential” habitat areas, including site cross-section surveys, followed the protocols presented below and were consistent with previous botanical surveys conducted for the Project area.

Botanical surveys were conducted by qualified biologists familiar with the special-status plant species potentially occurring at the project site. The protocol-level surveys for special-status plants were floristic in nature and followed these guidelines to the degree feasible:

- USFWS Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed Plants (USFWS 2000a);
- CDFW Protocols for Surveying and Evaluating Impacts to Special-Status Native Plant Populations and Natural Communities (CDFG 2009a);
- CNPS Botanical Survey Guidelines (CNPS 2001); and
- Bureau of Land Management Survey Protocols Required for NEPA and ESA Compliance for BLM Special-Status Plant Species (BLM 2009a).

The goal of the 100% protocol-level special-status plant surveys was to census, map, photograph, and record habitat data for every special-status plant encountered, focusing on Harwood's eriastrum. For those special-status plant species listed exclusively by the California Desert Native Plants Act (e.g., mesquite or catclaw acacia) only mapping occurred. Transects spaced at 30 meters were expected to provide 100% visual coverage of the 2017 BSA Survey Areas 1 through 5. This spacing was selected to permit detection of small, cryptically colored special-status plants, which may be scarce and unevenly distributed.

Surveyors searched for special-status plants by scanning the ground 15 meters to either side of their transect line while also frequently turning to look behind them to search for special-status plants located at the base of shrubs. If a special-status plant was encountered (live or in a senesced state if positively identifiable), a census per unit area was taken of the individual or the population. The special-status plant or population was then mapped with a GPS unit, photographed, and recorded electronically. Habitat data included scientific name, number of individuals, phenology (vegetative, in bud, in flower, old flowers, in fruit), substrate, vegetation type, associated species, and disturbance condition.

### 3.3.3 Jurisdictional Waters Delineation

This section describes the approach to delineate wetlands and waters of the State of California. The majority of the mapping effort was conducted in 2011/2012 for the SWP Site, with a field verification and updated mapping in 2016 for the Project.

***2011/2012 Surveys***

A desktop level jurisdictional delineation was conducted as part of the Environmental Constraints Analysis for the SWP Site on a broad scale using National Wetlands Inventory maps to highlight potentially jurisdictional waters. The SWP Site supports a broad alluvial fan that includes many braided washes and channels that converge into a primary channel that flows to an intra-state playa lake northwest of the SWP Site. This playa lake is not a Traditional Navigable Water; therefore, the channels in the SWP Site do not qualify as federal jurisdictional waters. Any channels having well-defined bed and banks were mapped as jurisdictional waters of the State, subject to CFGC Section 1602 SAA and the Porter-Cologne Water Quality Act. Blue palo verde—ironwood woodlands that were adjacent to State jurisdictional channels were also considered CDFW jurisdictional waters.

Use of higher resolution color aerial photography allowed for development of a more detailed topographic map (2-foot contours) and a refined delineation of CDFW jurisdictional waters. Field sampling along transects across the SWP Site were conducted to provide confirmatory information for the desktop delineation. Handheld GPS units were used to mark survey waypoints to help interpret state jurisdictional boundaries. Final maps were prepared in GIS format (Figure 6).

***Delineations for Potential Jurisdictional Waters of the State (SWP Site)***

Areas considered and assessed as potential waters of the State were evaluated based on delineation practices that were in compliance with requirements of Section 1600 of the CFGC, SAA.

Waters delineators followed CDFW's usual practice to interpret the jurisdictional limits of State jurisdictional waters to include any one of the criteria identified below.

1. At minimum, intermittent and seasonal flow through a well-defined bed or channel with banks and also supports fish or other aquatic life.

2. A watercourse having a surface or subsurface flow regime that supports or has previously supported riparian vegetation.

3. Hydrogeomorphically distinct top-of-embankment to top-of-embankment limits (i.e., well-defined bed and bank).

4. Outer ground cover and canopy extent of typical riparian associated vegetation beyond the top-of bank that would be sustained by surface and/or subsurface waters of the watercourse.

GIS field data were collected for subsequent analysis and mapping. Ten drainages were pre-chosen using high-resolution aerial photographs, as representative of typical ephemeral washes found throughout the site. These 10 drainages were chosen based on size, flow direction, connectivity, flow patterns, vegetation composition, topography, and United States Geological Survey "blue lines". Waters delineation surveys were conducted along transects crossing the 10 drainages and included points representing locations of the middle of the drainage channel, ordinary high water marks, locations of low and high banks, and the outer extent of vegetation typically associated with each drainage. Data were recorded using a Flint® BAP GPS.

Data points collected along transect lines were plotted on high-resolution aerial photographs having 1 to 2-foot resolution, and drainage features within the SWP Site were manually digitized into a GIS database using the nearest reference location data to aid in the mapping. When determining drainage acreages using desktop mapping, categories, such as 1-3 feet wide, 3-6 feet wide, 6-9 feet wide, 9-12 feet wide, 12-15 feet wide, and greater than 15 feet wide, were used to quantify the acreage.

Features for each drainage system included single, large channels with well-defined bed and banks, as well as broad, but sometimes weakly expressed, assemblages of shallow braided ephemeral channels. In addition to these channels, all mapped desert wash and associated microphyll woodland, considered a wash-dependent vegetation, were mapped as waters of the State (Figure 6).

***2016 Surveys***

<u>CDFW Jurisdictional Verification Methods (RE Crimson)</u>

Previous mapping of CDFW waters and microphyll (blue palo verde—ironwood) woodlands was used to focus the survey effort to previously mapped areas. The mapping conducted for the SWP Site encompassed the RE Crimson Permitting Boundary and was the basis for further verification in 2016. AECOM verified the boundaries of the prior delineated waters per discussion with CDFW. AECOM also surveyed blue palo verde—ironwood woodlands that remained within the proposed development area to further refine the extent of that vegetation community as it currently stands.

AECOM verified the conditions (extents and widths) of previously delineated waters by comparing the mapped extent of each mapped feature to actual conditions in the field. AECOM surveyed drainages in a loop, such that one direction hit the drainage ends, while the other direction hit the drainage midpoints. This simulated walking transects across the tips and midpoints of a representative sample of drainages onsite. AECOM walked across the ends of drainages to determine if they extended in length or width and noted changes in the field. To determine if any drainages increased in width further upstream, AECOM walked across the project site to intersect drainages near their midpoints and checked to verify if any new braids developed and/or if there were changes in width. Observed changes were used to update the mapping/acreage accordingly.

At the time of the survey, in August 2016, almost all of the blue palo verde—ironwood woodland areas were avoided by the proposed design at that time; however, those blue palo verde—ironwood woodland areas that still remained within the proposed development area were called out for 100% surveys and were subsequently surveyed and remapped to determine the exact acreage within those areas during this effort. Proposed access routes connecting the various project areas were also 100% surveyed for waters and blue palo verde—ironwood woodlands, with the goal being to locate these crossings in areas that avoid waters and woodlands to the maximum extent feasible. A GPS point was taken for individual trees with a diameter greater than 4 inches at breast height (roughly 4 feet from the ground) in the access corridors to facilitate avoidance of mature trees during placement of the drainage crossings (either Arizona crossings or box culverts).

GPS track logs were collected to document the survey routes. A GPS point and bank width measurement were also taken at each drainage crossed by the survey route. These data were compared to existing mapping to facilitate refinements, as necessary. Updates to the existing waters map were made based on the data collected (Figure 6).

### 3.3.4 Desert Tortoise Surveys

***2012 Surveys***

Focused surveys for the desert tortoise (*Gopherus agassizii*; federally and state threatened) were conducted according to the 2010 USFWS Desert Tortoise Pre-Project Survey Protocol (USFWS 2010a). Survey guidelines require 100% coverage of all suitable habitat using 10-meter (30-foot)-wide belt transects. Zone of Influence (ZOI) surveys, which consisted of a transect at 200, 400, and 600 meters parallel to and around the SWP Site, were also completed. Surveys were conducted throughout the SWP Site plus a 500-foot buffer for a total desert tortoise survey area of 9,115 acres. ZOI surveys were not mandated due to desert tortoise presence on the SWP Site. However, the ZOI surveys were completed to help further understand the distribution of the species within the SWP Site (Figures 7 and 8).

Desert tortoises are generally most active from April through May and September through October (USFWS 2010a). The bulk of desert tortoise surveys in 2012 took place during the first half of April. Parcels for which access was not originally granted were surveyed from late April to mid-May 2012. ZOI surveys occurred from mid to late May. To facilitate the planning and execution of the surveys, the site was broken down into 80 meter-wide survey cells of 25 acres (including some smaller cells along the northern edge of the Project), such that a team of four qualified biologists was able to survey the cell in two passes. Each team was able to complete approximately three to seven cells each day depending on terrain and frequency of data collection. Dividing the site into smaller cells also facilitated avoidance of potential temporal or human variances by allowing for random sampling of the site, and provided an easy way to reference specific survey areas in the database if needed. Locations of desert tortoises and desert tortoise sign (including desert tortoise burrows, scat, carcasses, tracks, and eggshell fragments) observed during the focused survey were recorded using Garmin GPS units, and additional information was recorded on datasheets. Photographs were also collected to document each GPS point taken for live desert tortoise or desert tortoise sign. When a live tortoise was found, other descriptive information such as the tortoise's health, its location in the landscape, and current weather conditions at the time of discovery was recorded. The numbers of live desert tortoises observed during the surveys were used to estimate the number of desert tortoises potentially occurring within the SWP Site. The 2010 USFWS Desert Tortoise Pre-Project Survey Protocol provides the spreadsheet used for this estimate. Although biologists documented incidental observations of other special-status species, desert tortoise surveys were not conducted concurrently with other survey efforts.

***2016 Surveys***

To define the desert tortoise survey area for the 2016 desert tortoise surveys, the results of the 2012 surveys were used to assess desert tortoise abundance and density across the SWP Site and then use that to determine what survey area and buffer to use for the Project. In 2012, the majority of the desert tortoises and recent sign were found along the southern and eastern sides of the SWP Site adjacent to the base of the Mule Mountains. The desert tortoise sign was much lower in the northern and western part of the SWP Site and contained no live desert tortoise or active burrows. Therefore, CDFW agreed to allow a modified DT survey design for 2016 that focused on the area of the Project with the highest desert tortoise density (Rodriguez pers. comm. 2016). The desert tortoise survey area in the fall of 2016 included the RE Crimson Permitting Boundary, all the microphyll woodlands and washes within the Project, plus a 500-foot buffer on the southern and eastern sides where the boundary abutted the base of the Mule Mountains. There is a private inholding (120.5 acres) just south of the Colorado River Substation, and this area was not included in the 2016 desert tortoise surveys, as it would not be developed for the Project and access rights were not obtained. Therefore, the 2016 desert tortoise survey area comprised 3,636 acres, which included a 500-foot buffer on the southern and eastern sides of the RE Crimson Permitting Boundary around the Mule Mountains (Figure 9).

Surveys in 2016 generally followed the 2010 USFWS desert tortoise protocol with one modification to the spacing of transects. Surveys were conducted using 20-meter spaced transects over 46% (1,679 acres) of the total survey area (3,636 acres) and 10-meter spaced transects were used over the remaining 54% of the survey area (1,957 acres) (Figure 9). This method deviated from the standard 10-meter spaced transects because this survey used information gathered from the previous desert tortoise surveys from 2012. The 2012 desert tortoise surveys documented the majority of desert tortoise in the southern and eastern part of the SWP Site around the base of the Mule Mountains. Because the 2016 desert tortoise surveys were aimed at updating the existing 2012 desert tortoise surveys, CDFW authorized 20-meter-wide transects in areas where there was a low historical desert tortoise density and low sign from the 2012 survey (Rodriguez pers. comm. 2016). 10-meter-wide transects were used in areas that had a higher desert tortoise density based on 2012 surveys (Figures 9 and 10). The desert tortoise survey area was broken down into a grid system with approximately 25 acres per grid, which corresponds to one biologist walking approximately one 10-kilometer transect per grid. All surveyors were experienced tortoise surveyors and were approved by BLM (Marsden pers. comm. 2016a, 2016b) and USFWS prior to the start of surveys. The list of biologists and their resumes are included in Appendix C.

Surveys were conducted in October 2016 by biologists walking 10-to 20-meter spaced transects (depending upon the region of the desert tortoise survey area that was being surveyed) scanning the ground around and in front of them for any desert tortoise sign (live desert tortoise, scat, tracks, carcasses and shell fragments, pallets, burrows, eggshell fragments, etc.). Generally, surveys started around dawn and ended around 4 pm. Biologists were split into two teams of four biologists with one leader per team that recorded the data for their team. When desert tortoise sign (tracks, scat, carcasses, eggshell fragments, burrows, etc.) was detected, the surveyors stopped, recorded data such as date, time, surveyor, GPS location, class of scat (class 1 through 5), class of carcass (class 1 through 5), and detailed burrow/pallet information (class, height, width, orientation, presence of desert tortoise sign, etc.); a photograph was usually taken. When a live desert tortoise was located, either in a burrow, or above ground, surveyors stopped, observed the desert tortoise from a safe distance for a few minutes while recording detailed information on the observation. The desert tortoise was not moved, touched, or harassed. An electronic version of the USFWS desert tortoise form was filled out by the team leader. Information such as what the desert tortoise was doing (feeding on big galleta grass, etc.), its sex (as best determined by the length of the gular, size of tail [if visible], and other characteristics), approximate length, any potential signs of upper respiratory tract disease or other diseases (swollen/puffy eyes, nasal blockage/discharge, other facial abnormalities), or other health traits and shell characteristics (shell cracks, holes, peeling scutes, any abnormalities, presence of ticks, etc.). A photograph was taken using a digital camera with a zoom lens, and then the photograph was carefully examined to look for potential signs of compromised health. This process allowed biologists to document any potential health issues with each desert tortoise that could be photographed as well as build a library of photographs for the different desert tortoise documented during surveys.

Because desert tortoise surveys were spaced 10 to 20 meters apart and all burrows encountered were checked for occupation (no scoping or probing of burrows was conducted), any potential desert kit fox, American badger, and burrowing owl burrows and sign found while surveying for desert tortoise were also recorded. Any other special-status wildlife species detected during desert tortoise surveys was recorded.

To understand the total number of desert tortoise that may occur within the desert tortoise survey area, the USFWS formula in Table 3 (USFWS Desert Tortoise Pre-Project Survey Guidance; USFWS 2010a) was used. Detailed information regarding the assumptions made are included in the results section of Chapter 4.

### 3.3.5 Mojave Fringe-toed Lizard Surveys

#### *2012 Surveys*

Focused surveys for Mojave fringe-toed lizard were conducted during June 2012 across the SWP Site, which encompassed 7,509 acres, including a 500-foot buffer around the SWP Site and a 250-foot buffer around the access roads and gas line (Figure 11). Due to access constraints, several areas were not surveyed:

- The expansion parcel and its associated buffer that was covered during previous focused surveys, such as desert tortoise;
- Habitat within 500 feet of the active construction road that leads to the Colorado River Substation; and
- The steep, rocky area in the southeastern corner of the SWP Site.

Although a formal survey protocol does not exist for Mojave fringe-toed lizard, a general habitat assessment was first conducted to map areas of potential habitat. Potentially suitable habitat areas containing suitable windblown sand habitat, as well as a 50-meter buffer around all suitable habitat, were surveyed for Mojave fringe-toed lizards using 10-meter-wide transects. After the potentially suitable habitat had been surveyed, biologists walked transects spaced 100-meters apart where the initial habitat assessment noted an absence of suitable habitat (windblown sand habitat) to ensure small patches of suitable habitat were not overlooked. Suitable habitat discovered during 100-meter transect surveys was delineated on field maps and surveyed with 10-meter-wide transects the following day. Each transect was completed by walking slowly and continuously scanning back and forth for sign (tracks) and individuals. Locations of live Mojave fringe-toed lizard and sign (live individuals, tracks, etc.) observed during the focused survey were recorded on datasheets and GPS units.

Using previous vegetation mapping and detailed aerial photos as guides, a group of four biologists performed a habitat assessment of the survey area June 12 through June 14, 2012 in order to determine areas requiring 10-meter survey coverage. The habitat within the survey area was delineated into two different habitats regarding Mojave fringe-toed lizard potential use, shown in Figure 11:

- Suitable habitat (2,458 acres)
- Unsuitable habitat (5,051 acres)

Suitable Mojave fringe-toed lizard habitat is defined as an area of fine, windblown sand large enough to support the territory of a male Mojave fringe-toed lizard, which is approximately 0.25 acres (Kaufmann 1982). Unsuitable habitat consisted of the following: a complete absence of windblown sand; coarse sand of fluvial origin present in some washes; and small patches of windblown sand smaller than 0.25 acres that are surrounded by hard-packed soil, cobble, or other rough substrates.

Upon further review of survey results, biologists noted that no distinction was made between superior and marginal Mojave fringe-toed lizard habitat during the survey, and so additional clarification was supplied:

- Superior suitable habitat consists of windblown sand dunes, which have a high frequency of lizard detections and provide optimum foraging and cover habitat.
- Marginal Mojave fringe-toed lizard habitat comprises patchy distributions of fine sand amidst coarser soils, which have few lizard detections and are unlikely to support large numbers of Mojave fringe-toed lizards due to resource constraints.

Because live Mojave fringe-toed lizard and sign were not observed in some areas of mapped suitable habitat, biologists also calculated occupied Mojave fringe-toed lizard habitat as a way of more precisely establishing population density and location within the survey area. To determine acres of occupied Mojave fringe-toed lizard habitat, Calico Commission Decision (CEC 2010) guidelines were followed: a 45-meter buffer was created around lone sightings of live Mojave fringe-toed lizard and their sign, and around clusters of sightings to define occupied suitable foraging and cover habitat.

***2016/2017 Surveys***

Surveys for Mojave fringe-toed lizards were not repeated in 2016/2017, as the surveys in 2012 covered the majority of the RE Crimson Permitting Boundary. Mojave fringe-toed lizards were recorded incidentally during other biological surveys (Figure 11).

### 3.3.6 Couch's Spadefoot Surveys

***2012 Surveys***

In 2012, focused surveys for Couch's spadefoot were conducted after summer monsoonal rain events (generally June through August) in all areas determined to have the potential to be breeding pools identified during other field surveys. After rain events, areas previously identified as having the potential to pond water were visited again to determine if they actually ponded water. Sites observed to have ponded water were surveyed on foot at night for at least 20 minutes in order to aurally determine if Couch's spadefoot were breeding and calling in the area. The same pools were checked the following day for eggs, tadpoles, toadlets, and toads.

A second round of Couch's spadefoot surveys was conducted approximately 8 days after the initial storm event to determine if the pools remained inundated for the amount of time necessary for Couch's spadefoot to complete their aquatic life cycle (transition from eggs to tadpoles to toadlets). Pools still inundated were monitored again for calling/breeding toads and checked for signs of eggs, tadpoles and toadlets.

### *2016/2017 Surveys*

No focused surveys for Couch's spadefoot were conducted in 2016/2017; however, any areas that had the potential to pond and retain water long enough for breeding were mapped during other resource surveys, including desert tortoise surveys in October 2016 and during burrowing owl surveys in 2017.

## 3.3.7 Burrowing Owl Surveys

### *2012 Surveys*

In 2012, focused breeding season surveys for the burrowing owl were conducted at the SWP Site and a 500-foot buffer. Protocol surveys were conducted per the 1993 California Burrowing Owl Consortium's (CBOC) *Burrowing Owl Survey Protocol and Mitigation Guidelines*. Three survey phases, outlined in the CBOC Burrowing Owl Survey Protocol, were followed (CBOC 1993 and CDFG 2012b). The first phase (Phase I), was an initial habitat assessment. Phase I was completed in 2011, and it was determined that suitable habitat for burrowing owl occurred within the SWP Site and 500-foot buffer which was later confirmed by two incidental sightings of burrowing owls during the fall 2011 botanical survey (late September to early October); therefore, the entire SWP Site and 500-foot buffer was surveyed for the presence of burrowing owls during the breeding season (Figure 12). Nonbreeding season burrowing owl surveys were not conducted.

Phase II consisted of surveying the entire SWP Site, including a surrounding 500-foot buffer. According to Phase II of the 1993 protocol (CBOC 1993) and in the "Survey Method" subsection of the Breeding Season Surveys section of Appendix D of the 2012 CDFG *Staff Report on Burrowing Owl Mitigation* (CDFG 2012), focused surveys were conducted during the breeding season from March 27 to April 8 of 2012. Biologists conducted surveys by walking parallel transects that were spaced 20 meters apart to provide 100% visual coverage. All burrows potentially used by burrowing owls were recorded during the survey. Burrowing owl burrows were identified by the presence of one or more burrowing owls, pellets, prey remains, whitewash, nesting materials or decoration. When identified, burrowing owl burrows and/or sign were noted, described on datasheets, and marked with a GPS unit; photographs were taken.

Phase III surveys, consisted of four separate site visits to each potentially active owl burrow, to detect burrowing owl activity. The four site visits were conducted on four separate days (between May 15 and July 10 of 2012). The surveys were conducted during weather that was conducive to observing owls outside of their burrows; thus, surveys were not conducted during heavy rain, high winds (greater than 20 miles per hour [mph]), or dense fog. If temperatures were over 100 degrees (°) Fahrenheit (°F) during the evening 3-hour survey window, surveys were conducted only during the morning 3-hour survey window.

Burrows were observed using binoculars or a spotting scope to provide visual coverage of the burrows. Surveyors maintained a minimum distance of 50 meters (approximately 160 feet) from burrows on first approach. If no burrowing owls or owl sign were observed from 50 meters after 30 minutes of observation, the biologist moved in carefully for closer observation. If burrowing owls were observed, the burrow would be documented as occupied, the biologist would leave quickly, and the burrow was not revisited. If recent owl sign was observed before arriving at the burrow, the biologist would continue observing from a safe distance for another 30 minutes. If, after the 30 minutes, no owls were observed, the biologist moved carefully into the burrow area and examined the sign closely. Burrows that were identified as inactive (historically used by burrowing owls but contained no recent sign) were observed for 30 minutes during each subsequent visit to determine if they were eventually used by burrowing owls during the breeding season.

***2017 Surveys***

Per communication from CDFW and the USFWS, Western burrowing owl surveys were required on the Project site in 2017, but did not require full protocol level surveys. One spring survey conducted at the height of the breeding season (April 15 through June 15) was considered acceptable to provide additional information on the current status of burrowing owl on the Project site (Rodriguez pers. comm. 2017a).

To implement this requirement, qualified biologists followed Appendix D of the 2012 *Staff Report on Burrowing Owl Mitigation* survey protocol (CDFG 2012) for breeding season, but modified it to include only one survey visit, not four as stated. Biologists conducted the single visit during the peak part of the breeding season between April 15 and June 15. The survey area included the current RE Crimson Permitting Boundary only and did not include any buffer areas or the microphyll woodlands (Figure 12).

The survey area was walked on foot at a spacing of 20 meters. Surveys were conducted between morning civil twilight and 10am, and/or 2 hours before sunset to evening civil twilight. No surveys were conducted if weather conditions included rain, fog, sustained wind over 12.4 mph (20 kilometers per hour [km/h]), or temperature below 68°F (20° Celsius). Aside from modifying the survey to one visit instead of four, the protocol in Appendix D of the 2012 staff report was followed consistent with previous burrowing owl surveys.

### 3.3.8 Elf Owl Surveys

***2012 Surveys***

Elf owl surveys were conducted in the spring and summer of 2012 within the SWP Site and a one-half mile buffer (elf owl survey area) within areas of microphyll woodland habitat (potentially suitable elf owl habitat). Three surveys were conducted within the elf owl survey area from April 10 to June 6 of 2012. The protocol for the cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*), developed by the Arizona Game and Fish Department and USFWS was followed (USFWS 2000b), with modification by Dr. John Boone of the Great Basin Bird Observatory who recently developed a survey protocol for elf owl (Boone and Carroll 2012). Modifications allowed for increased spacing between call/broadcast stations (400-meters between stations); decreased playback and listening duration at each station; reduction of buffer size from one mile to one-half mile; and altered survey timing. Surveys were conducted within potentially suitable microphyll woodland habitat (Figure 13).

Surveys were conducted from twilight until 5 hours after twilight and were conducted throughout the night while the moon was visible on full-moon nights and the two nights on either side of a full moon. Surveys were not conducted under adverse weather conditions such as rain or wind over 12 mph. Surveys were conducted using a recorded elf owl vocalization that was played at a series of call stations located within the microphyll woodlands. Call stations consisted of a biologist arriving at a fix point and an initial 1-minute listening period, a series of three 30-second playback recordings and 90-second listening and observation periods, and a final 1-minute listening period (Boone 2012). Therefore, a biologist was present at each call station for approximately 5 minutes before leaving the station to walk to the next call station. Intermediate listening stations were located approximately halfway between two call stations and were implemented as an additional measure to increase the likelihood of detection (by simply listening for calling owls, instead of hiking straight to the next call station). Two-minute listening periods were conducted at each intermediate listening station. Where practical, call stations were staggered between survey rounds so that a previous round's call stations would effectively function as intermediate listening stations during subsequent rounds (Figure 13). This method was adopted to ensure that the elf owl calls were not broadcast from the same locations during all three survey rounds and to increase the likelihood of species detection.

Biologists altered the spacing, timing, and duration of call stations located near I-10 to reduce road noise interference. Call station spacing was reduced from 400 meters to 150 meters in the microphyll woodland located adjacent to I-10, the duration of each call station was increased, and the timing of surveys in this area was altered. Surveys were conducted later in the evening in these areas, when there were lower traffic volumes and thus less noise interference. These precautions were taken to ensure that responding elf owls would be detected despite elevated noise levels.

***2017 Surveys***

Nocturnal surveys were conducted in 2017 to determine the presence/absence of elf owl. A similar protocol from 2012 was followed, with several modifications. A modified survey protocol was approved by BLM on April 20, 2017 in which two surveys would be conducted between April and June with the surveys occurring on separate months (Rodriguez pers. comm. 2017b). Instead of four surveys across four survey months as done in 2012, only two surveys would be necessary across the same survey period (April through June). Surveys were conducted in washes with trees large enough to support woodpecker cavities. Surveys were recommended in 2017, because elf owls had been detected as far west as Joshua Tree National Park and 2017 was an above average rainfall year in the desert (Rodriguez pers. comm. 2017b). Surveys occurred on May 30 and 31, 2017, and June 20 and 21, 2017. Surveys focused on surveying the microphyll woodlands between the RE Crimson Permitting Boundary with the largest trees. Given the large size, distance between microphyll woodlands, and limited evening hours, it took two biologists two days to cover all four of the major washes with potential elf owl habitat. No buffer around the microphyll woodlands between the RE Crimson Permitting Boundary was surveyed. Surveys consisted of walking a meandering transect through dense stands of microphyll woodland and playing calls of the elf owl approximately every 150 to 200 meters (Figure 13). After a series of calls were broadcast, observers listened for two to three minutes before moving on to the next call location. Biologists listened for calls of elf owls while walking away from a call station, in case an owl decided to call after biologists had left. Only elf owl vocalizations were broadcast, but all avian species detected were recorded. Any known tree cavities were checked carefully, and the elf owl call was played a short distance away from each cavity and biologists watched the entrance to each cavity while the call was played to see if any owls emerged. Surveys were generally conducted during nights with light winds and when the moon was between one-quarter and three-quarters full to maximize detectability and probability of response. Surveys took take place between one-half hour after sunset and midnight.

### 3.3.9 Gila Woodpecker Surveys

***2012 Surveys***

While there is no established survey protocol for gila woodpecker, surveys were conducted to determine the distribution and abundance of gila woodpecker in the microphyll woodland within the SWP Site following the methodology described below (Blair and White 2012).

During the breeding season, six full-coverage surveys of the microphyll woodland of the SWP Site, the expansion area, and an associated one-quarter mile buffer were conducted for gila woodpecker.

Surveys occurred from April 12 to June 1 of 2012. Surveys were conducted during all hours of daylight starting at sunrise and lasting until mid-afternoon or starting mid-afternoon and lasting until sunset. During the start and end of each survey day, the time, temperature, and wind speed were recorded on data sheets.

The survey protocol consisted of biologists slowly walking meandering transects through microphyll woodland habitat and playing recorded gila woodpecker calls every 100 meters to elicit a response from any gila woodpeckers that might have been in the vicinity. During call broadcast periods, the biologists would stop walking for roughly 1 minute and scan the surrounding area for bird movement and listen for gila woodpeckers. Trees and dead snags with potential to support a gila woodpecker nesting cavity were visually searched for signs of nesting. If a gila woodpecker was detected, the following data were recorded on the data sheets: GPS identification; coordinates; grid number; detection method; and other pertinent information.

***2016/2017 Surveys***

No focused surveys for gila woodpecker were conducted in 2016 or 2017; however, they were recorded if detected at migratory bird observation points, on bird survey transects, or if incidentally detected during any other biological surveys.

### 3.3.10 Golden Eagle Surveys

***2012 Surveys***

Bloom Biological, Inc. conducted golden eagle surveys from March 24 to May 26 of 2012. The survey approach followed the USFWS Interim Golden Eagle Inventory and Monitoring Protocols (Pagel et al. 2010), which recommend at least two surveys for eagle nests by helicopter:

- The first survey flights to be conducted in March with a goal of detecting and reporting territory occupancy; and

- The second survey flights to be conducted in late April/early May with a primary goal of observing and reporting on the productivity of nests identified during the first helicopter surveys in March.

The SWP golden eagle survey area included the SWP Site (minus the expansion area) plus a surrounding 10-mile radius (Figure 14). Particular emphasis was placed on topographic features where golden eagles might nest (such as the Mule Mountains, McCoy Mountains, and Little Chuckwalla Mountains) and large power lines where golden eagles may perch and nest. The first helicopter survey flights were conducted on March 24, 25, and 26, 2012, with the helicopter portion of the second survey conducted on April 8 and 9, 2012. Follow-up ground surveys were conducted on May 5 and 26, 2012, to look for potential post-breeding dispersants from adjacent areas.

Helicopter surveys followed the helicopter survey methodology described in Section VII.b Aerial Surveys of Pagel et al. (2010). Two GPS units, one primary and one backup, were used to document geographic locations of importance and the routes taken. The survey duration was adequate to cover the entire area and reexamine large stick nests for the presence of inactive and active golden eagle nests. Any potential nests, birds, or other special-status species were recorded during the helicopter and ground surveys. The complete details of the 2012 golden eagle surveys are located in the confidential survey report in Appendix D.

***2016/2017 Surveys***

No project-specific focused golden eagle survey was conducted in 2016/2017. Historical golden eagle nest location data within a 10-mile buffer radius around the RE Crimson Permitting Boundary was received on July 17, 2017, and August 10, 2017, from surveys conducted for other projects in the region (Sanzenbacher pers. comm. 2017a, 2017b). Those golden eagle nest location data are included on Figure 14.

***2018 Surveys***

Golden eagle surveys via helicopter were conducted during winter and spring 2018; these surveys encompassed a 10-mile radius surrounding the RE Crimson Permitting Boundary. Surveys followed Pagel et al. 2010 in similar fashion as the aerial surveys described from 2012 above with the exception that timing of surveys occurred earlier in the breeding season per request by the USFWS and documented in the golden eagle survey work plan approved by the resource agency. The complete details of the 2018 golden eagle surveys are located in the confidential survey report in Appendix E.

### 3.3.11 Migratory Bird Observation Points

***2012 Surveys***

Qualified biologists conducted surveys for all species of birds from seven fixed observation points (four focused on non-raptors and three focused on raptors) within the SWP Site with no surrounding buffer (Figure 15). The observation point surveys were used to complement the transect surveys (detailed in Section 3.3.12, below) with information concerning migratory bird activity and flyover events.

Non-Raptor Observation Points

Four observation points focused on non-raptors and were located in areas that provided a wide expanse of observation area while being in areas with high potential for bird activity (e.g., adjacent to microphyll woodlands and areas with higher vegetation density) (Figure 15). Non-raptor observation points were surveyed for 8 hours per day on 3 consecutive days per week between April 10, 2012, and May 31, 2012. Surveys were conducted under good weather conditions (no sustained precipitation or fog, winds below 20 mph, and temperature below 105°F) and stopped when the temperature exceeded 105°F. To reduce sampling bias, the 8-hour observation period initially alternated between the morning (8 hours after sunrise) and evening (8 hours before sunset). Observation periods during the final 2 weeks (May 21 through 31) of surveys were conducted in the morning because mid-day and late afternoon temperature forecasts were in excess of the 105°F cut-off.

One qualified biologist per day surveyed each non-raptor observation point. The time, temperature, cloud cover, and wind speed were recorded on data sheets at the start and end of each survey. Biologists scanned the sky and surrounding area recording every raptor and non-raptor seen or heard at an unlimited distance from the observation point. Information collected included: hour period, species, observation method (audio/visual), distance and direction from point, number of individuals, flight direction, flight height, and information on the behavior of the bird.

Raptor Observation Points

Raptor observation points focused on gathering local raptor migration data. Three points were located at least 2 miles apart in areas with wide, unobstructed fields of view to provide maximum visual coverage across the SWP Site (Figure 15). Qualified raptor biologists monitored raptor migration from the three established raptor points for 8 hours per day, 4 days per week, between April 17 and April 27, 2012, following methodology based on the Hawk Migration Association of North America (HMANA) Field Survey Technique (HMANA 2010). Surveys started at 0900 and ended at 1700. During the survey, raptor biologists scanned the sky and surrounding area to an unlimited distance. For every raptor or non-raptor observed, the raptor biologists documented the hour period, species, observation method (audio/visual), distance and direction from the observation point, number of individuals, flight direction, flight height, and information on the behavior of the bird(s). Monitoring was performed under good weather conditions (no sustained precipitation or fog, winds below 20 mph, and temperature below 105°F).

***2016/2017 Surveys***

For 2016/2017 surveys, there was no distinction between non-raptor and raptor observation points. Surveys were conducted in accordance with the agency-approved RE Crimson Avian Work Plan (AECOM 2016). The survey area included the RE Crimson Permitting Boundary plus the microphyll woodlands, and no adjacent buffer. Four weekly bird observation point surveys for migratory birds were conducted in the spring (February 1 through May 31; approximately 16 weeks) and fall (July 18 through November 18; approximately 18 weeks). Surveys began in July 2016 and ended in May 2017 so that an entire year of data was collected within the RE Crimson Permitting Boundary.

For each week of surveys, qualified biologists were stationed at four observation points for 4 hours per day on 2 separate days (Figure 15). Thus, each point was surveyed for a total of 8 hours per week. During the summer, once high temperatures were projected (over 95°F or higher), biologists no longer surveyed the two southern bird observation points (bird point 1 and 2) in the afternoon due to health and safety concerns. Because the two southern bird points required a walk over 1 mile each way in the intense heat to reach the bird point, it was determined unsafe for biologists. Additionally, if there were high winds projected for the afternoon (such as sustained winds over 20 mph), biologists did not conduct surveys at bird points 1 and 2 as the wind-blown sand made viewing birds difficult.

The observation points provided a wide field-of-view from a single point and were spaced out roughly evenly across the RE Crimson Permitting Boundary in locations where migratory birds could be seen if flying past. All avian species observed during these surveys were counted with an unlimited observation radius. Locations and flights of raptors/waterfowl/water birds/special-status species were mapped and digitized. Each of the four observation points were surveyed for a total of two surveys per point per week during spring and fall migration with the ideal mix being once in the morning (5am to 11am window) and once in the afternoon (1pm to 8pm window) each week. In addition to rotating the survey windows in the morning and afternoon, the survey days were also rotated each week. To the extent feasible, surveys were staggered to ensure at least one point was being surveyed on different days for the work week. This approach considered a broad suite of possible migratory birds including raptors, passerines, and waterfowl. Any unusual (such as flocks of raptors or water birds) or special-status species incidental observations made outside of survey time while in the RE Crimson Permitting Boundary (i.e., while traversing the site to access survey transects and observation points) were recorded separately. Survey results were analyzed to estimate detections based on number of birds detected per hour of observation then multiplied by 100 to avoid detection estimates less than 1. Thus, the unit of measure for detection estimates was detections per 100 hours of observation. Distance sampling methods require the assumption of a closed population (no immigration or emigration) in order to estimate density – in that no birds enter or leave the survey area during the survey window. The point count data do not meet this assumption of a closed population (Buckland *et al.* 2001) due to the length of the observation periods. Therefore, distance sampling methods were not used to analyze migratory bird observation point data.

***2017 Coachella Valley State Prison Pond Surveys***

Waterbirds are often attracted to solar arrays, presumably due to their resemblance to ponded water. The RE Crimson Project is just east of two prisons that have surface water impoundments associated with water treatment facilities. In order to properly understand existing baseline conditions and the potential water bird species that may be attracted to the Project, avian surveys were conducted at the wastewater treatment ponds at the Chuckwalla Valley State Prison (CVSP) which currently provide a year-round water source. Three wastewater treatment ponds are located at the northeastern corner of the CVSP, approximately 2.6 miles to the west of the Project. Avian surveys were conducted for 1 hour during the morning on a weekly basis from March 22, 2017, through May 26, 2017, and then biweekly from June 6, 2017, through July 18, 2017, for a total of 15 surveys. A biologist stood at the northeastern corner of the ponds and counted the number and species of birds using the ponds during each survey.

### 3.3.12 Migratory Bird Transects

***2012 Surveys***

Twelve transects containing eight observation points per transect were established in the SWP Site following the methodology of Ralph *et al.* 1995 and the 2009 BLM Solar Facility Point Count Protocol (BLM 2009b) which recommends one transect per square mile and eight point count locations per transect with points spaced 250 meters apart (Figure 15). No buffer around the SWP Site was included.

Transect locations were chosen to sample multiple habitats across the SWP Site, with a preference for microphyll woodlands where higher bird densities were expected. Transects were surveyed on a weekly basis by qualified biologists from April 19, 2012, to June 1, 2012. Surveys started at sunrise and ended no later than 11am, or if the temperature exceeded 90°F at the start of a transect. All points along each transect were surveyed on the same day. Transects were surveyed by one qualified biologist per transect. Time, temperature, cloud cover, and wind speed were recorded on data sheets at the start and end of each transect survey. Biologists began the survey at one end of a transect on the first point and surveyed systematically through the eight points in numerical order (recording any incidental sightings observed during transit between survey points). At each point, passive surveying for birds occurred for 10 minutes. All birds seen or heard at unlimited distance from the point were recorded. Information collected included: hour period, species, observation method (audio/visual), distance and direction from point, distance from point, number of individuals, flight direction, flight height, and information on the behavior of the bird.

***2016/2017 Surveys***

Transect surveys were conducted within the Project area (including the microphyll woodlands) along four walking transects throughout the year with surveys conducted weekly in the spring (February 1 through May 31; approximately 16 weeks) and fall (July 18 through November 18; approximately 18 weeks) and every other week during the remaining portion of the year (18 weeks, or 9 weeks of surveys). Surveys were conducted in accordance with the agency-approved RE Crimson Avian Work Plan (AECOM 2016). Surveys began in July 2016 and continued as noted above. Surveys for February through June were conducted in 2017 so that an entire year of data was collected for the Project. Transects included areas with high potential for bird activity (e.g., washes and microphyll woodlands), and were distributed across the Project area to get a representative sample of avian activity (Figure 15).

Transect length, start times, and durations was standardized to allow for future analysis using the distance sampling approach (Bibby et al. 2000; Thomas et al. 2010). Each walking transect was approximately 1750 meters in length with no limit on observation distance. To conduct the distance sampling analysis, the following assumptions were accounted for when surveying (Bibby et al. 2000):

1. It was presumed that all avian species were not detected during the survey effort; however, for the utilization of this method, it was assumed every avian species on the actual transect line was detected (that is, every species right on the transect line, within 20 to 30 feet of the surveyor);

2. It was important to note the location and distance of the individual bird when it was first detected/disturbed by the surveyor; and

3. Distances were estimated accurately.

Transect surveys were conducted in the morning to coincide with the period when birds were most active. Surveys rotated days each week to account for any temporal variability. Each survey consisted of approximately 2 hours of walking and observing. All avian species observed during these surveys were recorded. Specific information collected included species identification, number of birds seen, general habitat type (for birds perched or seen landed), behavior (perched, local flight, flyover, etc.), flight height, horizontal distance (perpendicular to transect line), and mapping of raptors/waterfowl/water birds/special-status species. Any unusual (such as flocks of raptors or water birds) or special-status species incidental observations made outside of survey time while in the RE Crimson Permitting Boundary (i.e., while traversing the site to access survey transects and observation points) were recorded separately.

Analyses were conducted using distance sampling methods and distance software (Thomas *et al.* 2010) to estimate avian density during different seasonal periods. Spring and fall (defined above) are representative of important migratory windows; surveys conducted between those seasons were defined as winter (November 19 to January 31) and summer (June 1 to July 17). Only observations of birds recorded at distances estimated at less than 100 meters perpendicular line distance from transects were included for these analyses. Akaike's Information Criteria (AICc) with a small sample size correction was used for model selection as well as for selecting the number of series expansion terms associated with each model (Burnham and Anderson 2002). AICc is a measure of the relative support of a statistical model (the lower the AICc value, the better the fit or model) given the data. Birds were occasionally detected in flocks (defined for statistical purposes as two or more birds) so any potential bias in detection of flocks of different sizes at different distances was corrected for using a size-biased regression (ln [flock size] against the estimated detection function g[x]) if the regression was significant at an alpha level of 0.15; the mean of observed flock sizes was used if the regression was not significant. Due to difficulties in estimating distance in a desert landscape, observations were often estimated at 5-meter or 10-meter increments (e.g., 10, 15, 20, 25, etc.) and as a result, preliminary analyses of these data revealed heaping (i.e., many observations at 5-to 10-meter intervals) (Buckland *et al.* 2015). To correct for heaping, data were binned at 9-meter intervals: 0-9 meters, 10-19 meters, 20-29 meters, 30-39 meters, 40-49 meters, 50-59 meters, 60-69 meters, 70-79 meters, 80-89 meters, and 90-99 meters. Avian species recorded during transect surveys were recorded and grouped based on taxonomic order, with the exception of the passerine family *Corvidae* (or corvids). Corvids were grouped by family to allow for estimation of density for common ravens (*Corvus corax*); common ravens were the only representative species for the corvids. Densities of birds were estimated for each avian group (order or family) during each seasonal period of survey: fall 2016, winter 2016/2017, spring 2017, summer 2017, and fall 2017. Density estimates were calculated as individual birds per hectare then multiplied by 100 to avoid density estimates less than 1. Thus, the unit of measure for density estimates was number of individuals per 100 hectares.

### 3.3.13 Nocturnal Avian Radar Monitoring

Nocturnal avian radar monitoring was conducted in 2012 for the SWP Site but was not conducted in 2016/2017. The nocturnal avian radar monitoring survey report which includes the methods and results is provided in Appendix F. The nocturnal avian migration monitoring followed the protocol and methodology guidance contained in the National Wind Siting Committee Nocturnal Monitoring Methods which recommend that a radar unit be deployed for 30 to 45 days within a given migration season (i.e., spring or fall) (Kunz et al. 2007). As a result, one mobile radar laboratory composed of two radar units was deployed within the SWP Site during part of the spring migration season, over a 52-day period from April 9 through June 1 of 2012. However, due to the large size of the SWP Site, sampling time was split between two survey stations (one on the west and one on the eastern side of the SWP Site) to cover a larger proportion of the SWP Site (Figure 15). The mobile radar laboratory consisted of two marine radar units mounted on a 4-wheel-drive pickup. The radars used were Furuno 1510 (X-band) transmitting at 9,410 megahertz, and with a power output of 12 kW. Each radar was connected to an automated system (XIR3000c from Russell Technologies) and equipped with hard drives in which the migration data were logged every night.

One radar unit was horizontally positioned to obtain information on flight direction, flight behavior, overall flight path, movement rates (birds per hour/7.1 square kilometers [$km^2$]), and ground speed of birds (km/hr). The horizontal radar unit was positioned to reduce the amount of clutter from the surrounding landscape. The radar unit was hinged so that the radar could be tilted upward to reduce the amount of ground clutter on the display and scan more of the surrounding sky. The radar antennas were tilted in increments of 5° with a maximum of 25°. The amount of ground clutter at each station was minor (less than 15%) and likely did not cause any birds to be missed.

A second radar was tilted 90° to survey in vertical mode to collect information on bird altitudes across the landscape. The vertical radar was oriented along an east-west axis that was perpendicular to the expected flight paths of migrating birds (thought to be north-south based on topography). The orientation of the vertical radar maximized the probability of detecting migrating birds and measuring their heights as they passed over the SWP Site. For every target, bearing and radial distance from the vertical radar were recorded. The vertical radar data were used to calculate the proportion of birds passing through at different heights. Both the horizontal radar and vertical radar were operated simultaneously and each collected data throughout each night.

The study period for the 2012 spring migration season was 52 nights from April 9 to June 1 of 2012 during. Nocturnal radar sampling occurred from approximately sunset (around 7pm) until sunrise (around 6am) each night. Because X-band radar systems are effective at detecting small targets (such as insects), several steps were taken both during data collection and prior to data analysis to clean up the data, including:

- Targets with poor reflectivity (i.e., targets that appeared small, dim, and low-density) were omitted from the analysis (Mabee and Cooper 2004);
- Targets with ground speeds less than 9 meters per second were also omitted from analysis (Mabee and Cooper 2004); and
- Targets with limited range (i.e., targets only observed 200 to 300 meters away from the horizontal radar) were omitted from analysis (Mabee and Cooper 2004).

When used in conjunction, this combination of methods effectively removes most insect targets from the analysis. However, because there was some overlap in flight speed and size between insects and birds, some insect targets may still have been present in the data, and some birds may have been removed.

To analyze the data, two-sample comparisons of speeds, passage rates, and heights were made using two-sample t-tests with Welch's correction for unequal variance where appropriate. Multi-sample comparisons were made with an analysis of variance. Circular data (i.e., flight directions) were compared using a circular analysis of variance (Mardia and Jupp 1999). The nocturnal avian radar monitoring survey report is included in Appendix F.

### 3.3.14 Baseline Common Raven Population Survey

#### *2012 Surveys*

Common ravens (*Corvus corax*) are known to prey upon juvenile desert tortoise and are also known to be subsidized in remote desert environments by human development. In 2012, surveys were conducted to document the common raven population in the SWP Site to provide a baseline estimate for comparison once the Project had been constructed. The common raven population was assessed based on visual observation counts during migratory bird point count transect and observation point surveys. Counts of common ravens were quantified to determine the baseline population level. No statistical analysis was conducted with the data; only raw counts of the total numbers of common ravens were tabulated.

#### *2016/2017 Surveys*

Similar to the methods described above, in 2016/2017, biologists tallied the number of common ravens detected during the migratory bird observation points and transects. This number was then standardized based on the level of effort to provide a realistic estimate of the number of common ravens present within the Project across a year of surveys. Common raven detections were estimated for each season (fall and spring) from data collected from migratory bird observation points based on number of ravens detected per hour (of observation) then multiplied by 100 to avoid detection estimates less than 1. Thus, the unit of measure for detection estimates was detections per 100 hours of observation. Distance sampling methods require the assumption of a closed population (closure) in order to estimate density – in that no birds enter or leave the survey area during the survey window. The point count data from migratory bird observation points do not meet this assumption of a closed population (Buckland et al. 2001) due to the length of the observation periods. Therefore, distance sampling methods were not used to analyze common raven observation point data. Migratory bird transect data do meet the assumption of closure and, therefore, were analyzed using distance sampling methods and Distance software (Thomas et al. 2010) as described in section 3.3.12.

### 3.3.15 Desert Kit Fox and American Badger Survey

***2012 Surveys***

In 2012, biologists recorded potential desert kit fox and American badger burrows while conducting desert tortoise, burrowing owl, and/or other biological surveys. This recording was done while biologists were walking 10-meter-wide transects during desert tortoise surveys. Desert kit fox burrows were identified based on burrow shape, size, and presence of sign (generally scat and tracks) while the presence of claw marks on burrow walls were used to identify a burrow that had been excavated by an American badger. Desert kit fox and American badger tracks, scat, and remains were also recorded if identifiable to provide evidence of their presence (Figure 18).

***2016/2017 Surveys***

During the October 2016 desert tortoise surveys biologists walked 10-and 20-meter-wide transects across the entire desert tortoise survey area and recorded any potential desert kit fox and American badger burrows, or other sign such as tracks and carcasses. In spring 2017, biologists conducting burrowing owl surveys walked 20-meter-wide transects across the entire RE Crimson Permitting Boundary and recorded any desert kit fox or American badger burrows or other sign. Therefore, the entire RE Crimson Permitting Boundary was walked twice, and all detected desert kit fox and American badger burrows and other sign were recorded (Figure 18).

### 3.3.16 Wildlife Camera Survey

During the course of avian surveys in 2017, four wildlife cameras were installed within the main microphyll woodlands to try and capture photographs of the wildlife species moving through the microphyll woodlands. The goal was to gather incidental data on Project area usage by wildlife. Two cameras were placed at opposite ends of the southern-most wash where avian transect T1 was located. One camera was placed in the wash immediately north of T1, where avian transect T2 was located. The fourth wildlife camera was placed in the eastern-most wash where avian transect T4 was located (Figure 16). The four wildlife cameras were set-up on April 28, 2017, and left in place through July 18, 2017. The cameras were not checked during that time and allowed to run without disturbance. The cameras were set-up and removed after approximately three months while biologists were onsite conducting avian transect surveys. The cameras were strapped to a large tree within microphyll woodlands within sections of wash that were narrower, or would act as natural topographic funnels for wildlife (Figure 16). No scent lures were used; therefore, there was no bias in attracting wildlife to the cameras.

### 3.3.17 Bat Acoustic Monitoring Survey

***2012 Surveys***

Acoustic bat monitoring surveys were conducted from April 17 through July 30 of 2012 using passive monitoring with three Anabat SD2 acoustic bat detectors. These data were used to identify the species of bats that utilized the SWP Site. Anabat location 1 was placed within Wiley's Well Wash and was surrounded by a broad, meandering microphyll woodland. Anabat location 2 was placed in the eastern-most microphyll woodland (a large, broad wash with mature ironwood and palo verde trees), and Anabat location 3 was placed in a smaller microphyll woodland near the southern part of the SWP Site.

<u>Equipment</u>

Three Anabat SD2 acoustic bat detectors were set up within the SWP Site in microphyll woodland habitat (Figure 16). Bat detectors were mounted to ironwood trees within woodland habitat with adequate spacing between the detectors to provide maximum coverage of the SWP Site (REAT 2011). The detector microphones were placed approximately

4 to 6 feet above ground and were housed within Bat-Hats using 45° reflectors. The detectors were set to record from 1 hour before the earliest sunset of the year (3:30pm) to 1 hour after the latest sunrise of the year (7:43am).

Call Analysis

Anabat units recorded bat calls as files of one or more bat passes, up to a maximum of 15 seconds with a maximum of 5 seconds between pulses within each file. A bat pulse or call with a single echolocation is referred to as a “chirp”. Bat passes contained a sequence of call pulses separated by at least 1 second (Hayes 1997).

Call analysis involved review of the duration, slope, sweep, and frequency of calls. Due to the large number of files recorded, filters were used for analysis. All call files were initially passed through a noise filter which required files to contain calls that met the following parameters: smoothness up to 50, frequency between 5 and 60 kilohertz (kHz), duration of 1 to 100 milliseconds, and a minimum of three pulses over 3 seconds. This filter was used to reduce the number of noise files and poor quality (indistinguishable) bat calls. Multiple additional filters were used for calls in order to group together similar call types. These filters were used in combination with visual analysis of call files and adjusted to achieve the highest accuracy of identifying bat species by call.

Bat species were placed in groups with similar call characteristics and some species produce calls in two or more groups. Anabat call files that contained calls from multiple bat call groups were counted for each group. For example, a single file that contained calls from multiple bats in both the 50-kHz call group and the 30-kHz call group was counted as a call file for 50 kHz and a call file for 30 kHz.

***2016/2017 Surveys***

From September 1, 2016, through August 31, 2017, three Anabat SD1 bat detectors (Titley Scientific) were installed at three locations within microphyll woodland within the Project (Figure 16). To maximize coverage, the three locations were spaced evenly within the largest microphyll woodlands between the RE Crimson Permitting Boundary. Each unit was coupled with an electronically monitored ecosystems Bat-Hat (microphone extension and protective shroud) and enclosure system (protective box, solar panel, 12-volt battery, and a charger circuit). Each Anabat SD1 was programmed using the delayed start mode, which allowed it to switch from sleep to standby prior to sunset, and switch back to sleep shortly after sunrise. While in sleep mode, the detector was essentially shut off to preserve battery, and the solar panel charged the 12-volt battery. While in standby mode, the detector continuously monitored for bat calls. Once a bat call was detected, the Anabat SD1 recorded and saved the call to a SanDisk CompactFlash memory card. Data were collected monthly by a biologist who exchanged the memory cards. Data were downloaded from each detector, call files were organized into folders, and data were analyzed.

On March 24, 2017, Garcia and Associates biologists had a conference call with the USFWS and BLM to discuss the configuration of the three Anabat SD1 units (Garcia and Associates 2017). It was determined that each unit should be reconfigured with the Bat-Hat positioned at the top of the t-post and above the solar panel. Placement of the Bat-Hat at the top of the t-post is intended to increase efficiency of recording by relocating the microphone further from the ground, as well as reducing the potential for interference from the solar panel. Reconfiguring of each unit occurred on April 18, 2017.

Analysis of the acoustic data collected was performed with Analook W software (version 4.2d). The software allowed users to view and analyze real-time or prerecorded Anabat call files. Files were displayed as a sonogram, with time on the X-axis and frequency on the Y-axis. This display allowed identification of call characteristics, such as maximum and minimum frequency, characteristic frequency, and call duration. Other call characteristics displayed included shape and the presence of harmonics. To aid in species identification, calls recorded for the Project were compared against a call library comprised of bat species known to, or with the potential to, occur in the Project vicinity.

# 4.0 Affected Environment

The affected environment presented in this chapter represent findings within the RE Crimson Permitting Boundary for vegetation communities, jurisdictional areas, and special-status plant and wildlife species. The data include the results of surveys in 2011/2012 and 2016/2017. The data from the two survey periods are presented separately where applicable, but generally the 2016/2017 surveys were focused on updating the existing data from the 2011/2012 surveys. Additionally, the 2011/2012 surveys were conducted across a larger survey area compared to the 2016/2017 surveys. There were a few small areas around the CRS where the survey area for 2016/2017 surveys extended outside of the previous 2011/2012 survey area.

## 4.1 Vegetation Communities

Vegetation communities in the RE Crimson Permitting Boundary were classified according to *A Manual of California Vegetation, Second Edition* (Sawyer *et al.* 2009). Ten vegetation communities and other cover types were identified within the Project area during the 2011/2012 and 2016 field surveys, including riparian, upland, and other cover types. Of these ten vegetation communities, nine vegetation communities are found specifically within the RE Crimson Permitting Boundary; the most widespread was creosote bush—white bursage scrub, followed by creosote bush—white bursage/big Galleta grass association scrub and creosote bush scrub. The tenth vegetation community, white bursage-desert-holly association, was mapped during surveys in 2011/2012 and would be completely avoided by the RE Crimson Permitting Boundary. Therefore, white bursage-desert-holly association, is not discussed below, as there would be no impacts to this vegetation community.

A map of vegetation communities is provided in Figure 4. Table 4-1 shows the approximate acreages of vegetation communities in the RE Crimson Permitting Boundary, which includes the linear features (gen-tie line, access road, etc.). During surveys and during subsequent drone aerial imagery collection, it was evident that the actual plant density of vegetation habitats onsite is low. Microphyll woodlands outside of the RE Crimson Permitting Boundary provide cover and shade; however, outside of the woodland drainages, perennial vegetation becomes more sparse. This sparseness is best reflected in an aerial image collected by drone in May 2017 following a wet spring season (see Appendix G, Photograph 3).

**Table 4-1. Vegetation Communities in the RE Crimson Permitting Boundary**

| Vegetation Communities | RE Crimson Solar Development Areas (acres) | RE Crimson Linear Features (acres) | RE Crimson Permitting Boundary Total (acres) |
|---|---|---|---|
| *Riparian* | | | |
| Creosote Bush—White Bursage/Big Galleta Grass Association[1] | 289.4 | - | 289.4 |
| Blue Palo Verde—Ironwood Woodland[1] | - | 1.2 | 1.2 |
| *Upland* | | | |
| Creosote Bush—White Bursage Scrub | 1,935.0 | 8.0 | 1,943.0 |
| Creosote Bush Scrub | 51.3 | 0.4 | 51.8 |
| White Bursage Scrub | 121.2 | 0.4 | 121.6 |
| Brittlebush Scrub | 0.7 | - | 0.7 |

| Vegetation Communities | RE Crimson Solar Development Areas (acres) | RE Crimson Linear Features (acres) | RE Crimson Permitting Boundary Total (acres) |
|---|---|---|---|
| Creosote Bush—White Bursage—Ocotillo Association | 67.5 | - | 67.5 |
| Desert Dunes | - | 13.8 | 13.8 |
| *Other Cover Type* | | | |
| Developed | - | 0.1 | 0.1 |
| **Total** | 2,465.1 | 24.0 | 2,489.1 |

[1] Sensitive vegetation community (CDFW 2017c).

Of the vegetation communities mapped within the RE Crimson Permitting Boundary (inclusive of the linear features), two are considered sensitive by CDFW: creosote bush-white bursage/big galleta association and blue palo verde—ironwood woodland. These are considered special community types (e.g., high priority for inventory in the CNDDB) per CDFW's Vegetation and Mapping Program (CDFW 2017c).

Vegetation community descriptions are provided below and grouped together as riparian, upland, and other cover types and are shown on Figure 4.

### 4.1.1 Riparian Vegetation Communities

Two riparian vegetation communities are present within the RE Crimson Permitting Boundary. These communities are associated with the braided washes and blue palo verde—ironwood woodland that traverse the Project area from the Mule Mountains and extend to the north toward I-10. These riparian vegetation communities are mostly avoided by the RE Crimson Permitting Boundary.

***Creosote Bush—White Bursage/Big Galleta Grass Association***

The creosote bush—white bursage/big galleta grass association is similar to the creosote bush—white bursage alliance described below, with the distinctive presence of the large, perennial bunchgrass known as big galleta grass (*Hilaria rigida*). This association also occurs between 75 and 1,200 meters AMSL, but is usually located in sandy areas and/or basins. (Sawyer *et al.* 2009) Other plants observed in this habitat onsite included rush milkweed (*Asclepias subulata*), desert palafox (*Palafoxia arida*), and California croton (*Croton californicus*).

Although creosote bush—white bursage scrub is not a special-status community, the creosote bush— white bursage/big galleta grass association is much less common and has a state rarity ranking of S1 (Sawyer *et al*. 2009). This S1 rank indicates that there are fewer than 2,000 acres statewide, but its level of threatened status has not yet been designated. Vegetation communities with state ranks of S1, S2, or S3 are treated as special-status communities because they are of special concern at the state level (CDFW 2017c) and are considered rare and threatened throughout their California range (Sawyer *et al.* 2009).

Within the Project area, this vegetation community occurs at the base of the Mule Mountains on the northern side, and a portion is avoided by the RE Crimson Permitting Boundary (Figure 4).

***Blue Palo Verde—Ironwood Woodland***

Blue palo verde—ironwood woodland is dominated by blue palo verde and/or ironwood in an open to continuous tall shrub or tree canopy. The shrub layer is intermittent or open, and herbs are sparse, with seasonal annuals. This woodland occurs between 10 and 500 meters AMSL on desert arroyo margins, seasonal watercourses and washes, bottomlands, middle and upper bajadas and alluvial fans, and lower slopes, where soils are sandy and well drained. (Sawyer *et al*. 2009). In the Project area, this woodland is dominated by blue palo verde with occasional ironwoods, shrubs such as catclaw acacia, common burrobrush (*Ambrosia salsola*), sandpaper plant (*Petalonyx thurberi*), and herbs such as wide-toothed pectocarya and arched-nut pectocarya (*Pectocarya platycarpa, P. recurvata*) and fan-leaved tiquilia (*Tiquilia plicata*).

Blue palo verde—ironwood woodland, one type of microphyll woodland within the Project area, has a state rarity ranking of S3.2 (CDFG 2010, Sawyer *et al.* 2009); the S3 rank indicates that there are 10,000 to 50,000 acres statewide, and the threat rank of .2 indicates that this community is threatened. BLM (2002) estimated 675,000 acres of microphyll woodlands occur within the NECO planning area which includes the Project area. Vegetation communities with state ranks of S1, S2, or S3 are treated as special-status communities because they are of special concern at the state level (CDFW 2017c) and are considered rare and threatened throughout their California range (Sawyer *et al.* 2009).

Blue palo verde—ironwood woodland that was mapped within the Project area is located within the desert washes and is avoided by the RE Crimson Permitting Boundary. The only areas where impacts may occur within the RE Crimson Permitting Boundary consist of road crossing corridors between development areas (Figure 4). Road crossings will be microsited to avoid all mature trees.

### 4.1.2 Upland Vegetation Communities

Six upland vegetation communities are present within the RE Crimson Permitting Boundary.

***Creosote Bush—White Bursage Scrub***

Creosote bush—white bursage scrub is a community in which creosote bush (*Larrea tridentata*) and white bursage (*Ambrosia dumosa*) are co-dominant in an open to intermittent canopy. The herbaceous layer is also open or intermittent with seasonal annuals or perennial grasses. This vegetation typically occurs between 75 and 1,200 meters AMSL on upland slopes, bajadas, alluvial fans, and minor washes and rills. The well-drained sandy soils are sometimes underlain by a hardpan or covered with desert pavement (Sawyer *et al.* 2009). Annual herbs may flower in late March and April with sufficient winter rain, and in early fall after summer (monsoon) rain. Other native plants observed in creosote bush—white bursage scrub onsite included shrubs such as button brittlebush (*Encelia frutescens*), Pima rhatany (*Krameria erecta*), occasional cacti such as silver cholla, and herbaceous species such as white tack-stem (*Calycoseris wrightii*), hairy and soft prairie clovers (*Dalea mollis* and *D. mollissima*), and desert trumpet (*Eriogonum inflatum*). On desert pavement, the sparse herb layer included desert star (*Monoptilon bellidiforme*, *M. bellioides*), Schott's calico (*Loeseliastrum schottii*), and California fagonbush (*Fagonia laevis*).

This community is the most extensive vegetation community within the RE Crimson Permitting Boundary and occurs throughout the Project area (Figure 4).

***Creosote Bush Scrub***

Creosote bush scrub is a common desert community characterized by an open to intermittent shrub canopy strongly dominated by creosote bush. The herbaceous layer is open or intermittent with seasonal annuals or perennial grasses. This plant community typically occurs at elevations of 75 to 1,000 meters AMSL on alluvial fans, bajadas, and major or minor washes with well-drained soils, and, sometimes, desert pavement (Sawyer *et al.* 2009). Annual herbs may flower in late March and April with sufficient winter rain, and early fall after summer (monsoon) rain. Other native plants observed in creosote bush scrub onsite included, in sandier areas, herbs such as small wire lettuce (*Stephanomeria exigua*), smallseed sandmat (*Chamaesyce polycarpa*), Booth's evening-primrose

(*Eremothera boothii*), and annual buckwheats (*Eriogonum* spp.). On desert pavement, the sparse herb layer included desert chicory (*Rafinesquia neomexicana*), cleftleaf wild heliotrope (*Phacelia crenulata*), and devil's spineflower (*Chorizanthe rigida*). This vegetation community is located near the base of the Mule Mountains on the northern side and only slightly extends into the RE Crimson Permitting Boundary (Figure 4).

***Creosote Bush—White Bursage—Ocotillo Association***

The creosote bush—white bursage—ocotillo association is similar to the creosote bush—white bursage scrub described above, with the distinctive presence of the ocotillo. This association also occurs between 75 and 1,200 meters AMSL, but is usually located in rocky upland areas (Sawyer *et al*. 2009). In the RE Crimson Permitting Boundary, this community occurs on gently sloping terrain that includes many fingers of desert pavement and other deposits of small rocks (Figure 4). Other species observed in this community onsite included Pima rhatany, desert lily (*Hesperocallis undulata*), pebble and desert pincushions (*Chaenactis carphoclinia, C. stevioides*), desert dandelion (*Malacothrix glabrata*), and devil's spineflower. This vegetation community is located in the southern-most development area of the RE Crimson Permitting Boundary (Figure 4).

***White Bursage Scrub***

In this vegetation community, white bursage is dominant, or co-dominant with other shrubs and cacti; the shrub canopy is generally less than 1 meter tall and is open to intermittent. The herbaceous layer is typically open to intermittent with seasonal annuals. White bursage scrub is usually found between zero and 1,700 meters AMSL, on older washes and river terraces, alluvial fans, bajadas, rocky hills, partially stabilized and stabilized sand fields, and upland slopes. Soils are sandy, clay-rich, or calcareous and may have pavement surfaces (Sawyer *et al*. 2009). In the RE Crimson Permitting Boundary, this community occurs on gently sloping desert pavement dissected by sandy-bottomed washes (Figure 4). On the desert pavement, vegetation was limited to sparse herbs such as California fagonbush, bristly langloisia (*Langloisia setosissima* ssp. *setosissima*), and desert trumpet. The washes support white bursage with button brittlebush and herbs such as big galleta grass, Sonoran sandmat (*Chamaesyce micromera*), and brittle spineflower (*Chorizanthe brevicornu* var. *brevicornu*); common fishhook cactus (*Mammillaria tetrancistra*) was observed on slopes and banks above the washes. This vegetation community is located in the eastern-most development area of the RE Crimson Permitting Boundary (Figure 4).

***Brittlebush Scrub***

Brittlebush scrub is a shrub community in which brittlebush (*Encelia farinosa*) is dominant and accompanied by a variety of other shrubs or cacti. The shrub canopy is typically less than two meters tall, and is open to intermittent. The herbaceous layer is open with seasonal annuals. This community occurs between 75 and 1,400 meters AMSL on alluvial fans, bajadas, colluvium, rocky hillsides, slopes of small washes and rills. Soil is usually well-drained and rocky, and may be covered by desert pavement (Sawyer *et al.* 2009). In the RE Crimson Permitting Boundary, this community occurs on rocky hillsides and is co-dominated by white bursage, with California barrel cactus (*Ferocactus cylindraceus*) and a very sparse herbaceous layer (Figure 4). Herbs observed in this community onsite included rock daisy (*Perityle emoryi*), Mojave popcornflower (*Plagiobothrys jonesii*), and California fagonbush. This vegetation community is location at the base of the Mule Mountains and is primarily avoided by the RE Crimson Permitting Boundary (Figure 4).

***Desert Dunes***

Desert dunes, also known as the *Dicoria canescens—Abronia villosa* sparsely vegetated alliance, are characterized by the presence of desert twinbugs (*Dicoria canescens*) and desert sand verbena (*Abronia villosa*), although these species are not necessarily dominant. Shrubs such as white bursage and creosote bush may be present within an open to intermittent herb canopy of seasonal annuals generally less than a meter tall. This community occurs between 10 and 1,200 meters AMSL on active dunes, partially stabilized dunes, stabilized dunes, and sand fields with fine to moderately coarse sand. The presence of stabilized sand sheets or sand dunes defines this alliance more than characteristic vegetation (Sawyer *et al*. 2009). Other native dune plants observed in this habitat onsite included desert-sunflower (*Geraea canescens*), ribbed cryptantha, annual desert milkvetch (*Astragalus aridus*), Harwood's milkvetch, and basket evening primrose (*Oenothera deltoides*). In some areas of the dunes, the most common plants were the invasive Russian thistles (*Salsola tragus, S. paulsenii*) and Asian mustard (*Brassica tournefortii)*.

The desert dunes community has a state rarity ranking of S2.2 (CDFG 2010, Sawyer *et al.* 2009); the S2 rank indicates that there are 2,000-10,000 acres statewide, and the threat rank of .2 indicates that this community is threatened. Vegetation communities with state ranks of S1, S2, or S3 are treated as special-status communities because they are of special concern at the state level (CDFG 2017c) and are considered rare and threatened throughout their California range (Sawyer *et al.* 2009). Desert dunes are only present within the linear features of the RE Crimson Permitting Boundary (Figure 4).

### 4.1.3 Other Cover Types

One other cover type is present within the linear features of the RE Crimson Permitting Boundary.

***Developed***

Although the Project area is primarily undeveloped, linear features of the RE Crimson Permitting Boundary would cross a paved access road from Wiley's Well Road to the Colorado River Substation (Figure 4).

### 4.1.4 Invasive Nonnative Plant Species

Invasive nonnative plant species observed onsite during the 2011/2012 and 2016/2017 botanical surveys are combined and presented in Table 4-2. The full plant list of all species detected within both the SWP Site and RE Crimson Permitting Boundary is provided in Appendix H and representative site photographs taken during 2016/2017 are included in Appendix G.  Due to the overall sparse presence of invasive plant species within the RE Crimson Permitting Boundary, GPS locations were not recorded and percent cover determinations were not calculated.

**Table 4-2. Invasive Nonnative Plant Species Detected**

| Family Name/Species Name | Common Name |
|---|---|
| **Asteraceae** | |
| *Lactuca serriola* | prickly lettuce |
| *Ambrosia artemisiifolia* | common ragweed |
| *Sonchus oleraceus* | common sowthistle |
| **Brassicaceae** | |
| *Brassica tournefortii* | Asian mustard |
| **Chenopodiaceae** | |
| *Salsola* spp. (*S. paulsenii, S. tragus,* and unidentified species) | Russian thistles |
| **Poaceae** | |
| *Schismus arabicus* | Arabian schismus |
| *Schismus barbatus* | common Mediterranean grass |
| **Zygophyllaceae** | |
| *Tribulus terrestris* | puncturevine |

The most common invasive plants were Asian mustard (*Brassica tournefortii*), Mediterranean grasses (*Schismus arabicus* and *S. barbatus*), and Russian thistles (*Salsola* spp.). Asian mustard and the Russian thistles were especially common in dunes in the northern part of the BSA, where they have colonized dune habitat. Common Mediterranean grass and Arabian schismus are somewhat widespread throughout shrub habitats onsite. Prickly lettuce (*Lactuca serriola*), common ragweed (*Ambrosia artemisiifolia*), common sowthistle (*Sonchus oleraceus*), and puncture vine (*Tribulus terrestris*) were much less common.

## 4.2 Waters of the State

Waters considered under the jurisdiction of the State (CDFW and RWQCB) include unvegetated streambed and associated riparian vegetation.

### 4.2.1 CDFW Waters of the State

A total of approximately 90.6 acres of CDFW waters in the form of unvegetated streambed is present within the RE Crimson Permitting Boundary (Figure 6).

### 4.2.2 CDFW Riparian Vegetation

Although most of the CDFW riparian vegetation, consisting of blue palo verde—ironwood woodland vegetation, has been avoided, 1.2 acres occurs within two road crossing corridors between development areas within the RE Crimson Permitting Boundary (Figures 4 and 6). These areas are mapped larger than necessary to allow the road to be moved within this corridor as necessary to avoid impacts to existing riparian trees. All mature trees will be avoided during micrositing of the access roads. Therefore, the actual impact to this resource will likely be less than 1.2 acres.

### 4.2.3 Porter Cologne Water Quality Control Act

In addition to CDFW regulatory authority, the RWQCB also regulates impacts to waters of the State under the Porter Cologne Water Quality Control Act. Although water quality issues related to impacts to waterways are normally addressed during a CWA Section 401 Water Quality Certification, because waters are not federally jurisdictional by the USACE, Porter Cologne Water Quality Control Act compliance would be addressed under the National Pollutant Discharge Elimination System Storm Water Construction General Permit, State General Waste Discharge Order, or waste discharge requirements, depending upon the level of impact and the properties of the drainage.

## 4.3 FLORA

This section discusses special-status plant species detected or with the potential to occur within the comprehensive BSA. The comprehensive BSA consists of the combined survey limits from the SWP Site BSA (2011/2012), the spring 2016 BSA, and the spring 2017 BSA. A total of 179 plant species was detected during the 2011/2012 botanical surveys and 82 were detected during the 2016/2017 surveys. Ten plant species detected during the 2016/2017 surveys were new species observed for a total of 189 unique species observed within the comprehensive BSA. A complete list of the plant species detected during the 2011/2012 and 2016/2017 botanical surveys is located in Appendix H, with representative photographs of special-status floral species in Appendix G.

Thirteen additional species regulated by the CDNPA, but not considered special-status per the definitions in this BRTR were also observed within the comprehensive BSA: buckhorn cholla (*Cylindropuntia acanthocarpa var. coloradensis*), silver or golden cholla, diamond cholla (*Cylindropuntia ramosissima*), cottontop cactus (*Echinocactus polycephalus* var. *polycephalus*) (in SWP expansion parcel only), California barrel cactus (*Ferocactus viridescens*), common fishhook cactus, desert-holly (*Atriplex hymenelytra*), ironwood, blue palo verde, honey mesquite, smoke tree, catclaw acacia, and ocotillo. Locations of cottontop cactus, California barrel cactus, common fishhook cactus, desert-holly, and ocotillo are shown in Figure 5. The remaining species were too common to map during this survey but their locations were documented through vegetation mapping (Figure 4; e.g., blue palo verde and ironwood occur almost exclusively within the vegetation type "Blue Palo Verde—Ironwood Woodland").

Of the plant species detected over the course of the 2011/2012 and 2016/2017 surveys, six species (Harwood's milkvetch (*Astragalus insularis* var. *harwoodii*), ribbed cryptantha (*Johnstonella costata*), Harwood's eriastrum (*Eriastrum harwoodii*), Abrams' spurge (*Euphorbia abramsiana*), Utah vine milkweed (*Funastrum utahense*), and desert unicorn plant (*Proboscidea althaeifolia*)) are considered special-status (CNPS Listed), but none of the species are listed in the Focus Species Occurring within the Cadiz Valley and Chocolate Mountains Ecoregion Subarea of the DRECP (BLM 2015). These six special-status species are discussed in detail in the following section, although only four of these species are found within the RE Crimson Permitting Boundary (Harwood's eriastrum, desert unicorn plant, ribbed cryptantha, and Utah vine milkweed) (Figure 5). Other special-status species with potential to occur are noted in Table 4-3.

### 4.3.1 Federally and State-Listed Plant Species

Based on regional databases, no federally or state-listed plant species were determined to have potential to occur within the RE Crimson Permitting Boundary. Based on site-specific habitat evaluations conducted by AECOM and a CNDDB records search of a 10-mile radius around the Project, it was determined that no federally or state-listed plant species were recorded or have potential to occur in the BSA (CDFW 2017b). No federally or state-listed plant species were detected during the surveys in 2011/2012 or 2016/2017; therefore, federally or state-listed plant species will not be discussed further in this BRTR.

### 4.3.2 Special-Status Plant Species

***2011/2012 Survey Results***

In 2011/2012, six special-status plant species were observed within the SWP Site BSA (Figure 5), including Harwood's milkvetch, ribbed cryptantha, Harwood's eriastrum, Abrams' spurge, Utah vine milkweed, and desert unicorn plant.

***2016 Survey Results***

In 2016, four of the six special-status plant species previously detected in the SWP Site BSA were detected during surveys in the RE Crimson Project Boundary BSA (desert unicorn plant, Utah vine milkweed, ribbed cryptantha, and Harwood's eriastrum). The 2016 BSA was much smaller and excluded some of the 2011/2012 survey area where many of the special-status plant species were located (Figure 5). Additionally, only one survey was conducted in 2016 from March 21 through 25, and botanists mapped any special-status plant species detected, regardless if they were flowering or not.

***2017 Survey Results***

In 2017, surveys were conducted around populations of Harwood's eriastrum previously identified during 2011/2012 and 2016 surveys. The goal being to survey predetermined areas for Harwood's eriastrum and other special-status species. During the 2017 effort, two special-status species (Harwood's eriastrum and Harwood's milkvetch) were observed in the focused survey areas (2017 BSA Survey Areas 1 through 5). CDNPA-regulated species were also noted when observed (Figure 5).

***Harwood's Milkvetch***

Harwood's milkvetch (CRPR [California Rare Plant Rank] 2B.2) is a native annual that grows in the Mojave and Colorado deserts of California. This species is more commonly found in the Sonoran desert of Arizona and Sonora, Mexico. It is considered fairly endangered in California, where it is threatened by off-road vehicle use and habitat loss resulting from development. Harwood's milkvetch is associated with sandy soils in desert scrub and desert dunes, at elevations of 0 to 710 meters AMSL. This species blooms between January and May (CNPS 2017).

<u>2011/2012 Survey Results</u>

Approximately 162 individuals of Harwood's milkvetch were found within the SWP Site BSA during the spring 2012 survey in varying stages of blooming and fruiting, within dune and loose sand areas mainly in the southern portion of the SWP Site (Figure 5). None of these locations are within the RE Crimson Permitting Boundary.

<u>2016 Survey Results</u>

Harwood's milkvetch was not observed during the spring 2016 surveys.

<u>2017 Survey Results</u>

Only two individuals of Harwood's milkvetch were observed during the focused 2017 surveys (Figure 5). These two individuals were located just outside the RE Crimson Permitting Boundary in the southeastern portion of the site, near 2017 BSA Survey Area 1 on Figure 5.

***Ribbed Cryptantha***

Ribbed cryptantha (CRPR 4.3) is an uncommon native annual of Mojave and Sonoran Desert creosote bush scrub and desert dunes in eastern California, southwestern Arizona, and Baja California, Mexico. As a CRPR 4, or watch list species, ribbed cryptantha has limited distribution in California and warrants monitoring. It is considered possibly threatened by development, vehicles, and competition from non-native plants. Ribbed cryptantha is often found in sandy soils at elevations of 60 to 500 meters AMSL. The species blooms between February and May (CNPS 2017).

<u>2011/2012 Survey Results</u>

Approximately 15,265 ribbed cryptantha plants were mapped in dunes and other sandy areas within the SWP Site BSA during the early spring 2012 protocol survey (Figure 5). Approximately 2,153 of these observations were located within the RE Crimson Permitting Boundary. This number is conservative and is meant to represent an estimate of the number of plants, not necessarily an absolute count.

<u>2016 Survey Results</u>

Approximately 20 ribbed cryptantha plants were observed adjacent to the eastern edge of the Colorado River Substation. These individuals were located outside the RE Crimson Permitting Boundary (Figure 5).

<u>2017 Survey Results</u>

Ribbed cryptantha was not observed during the spring 2017 focused surveys.

***Harwood's Eriastrum***

Harwood's eriastrum (BLM Sensitive; CRPR 1B.2) is an annual wildflower endemic to Southern California. With only 29 current known occurrences in the CNDDB, this species is endemic to California and is considered by CNPS as fairly endangered throughout its range. Mining, competition from non-native plants, off-road vehicle use, and habitat loss due to development are potential threats to the survival of this species. Current Harwood's eriastrum populations occur in San Bernardino County and Riverside County, in areas of loose sand in stabilized or partially stabilized desert dune habitat, at elevations ranging from 200 to 915 meters AMSL. This species blooms between March and June (CNPS 2017).

<u>2011/2012 Survey Results</u>

During the early spring 2012 survey, 3,510 individuals in varying stages of bloom were detected in dunes and loose sand areas, in greatest numbers in the northern portion of the SWP Site BSA but also in other sandy areas (Figure 5). Three detections of this species fall within the RE Crimson Permitting Boundary.

<u>2016 Survey Results</u>

Approximately 172 Harwood's eriastrum individuals were observed during the spring 2016 survey. Most of these were in the later stages of bloom, observed in loose sand areas adjacent to the large washes present in the spring 2016 BSA (Figure 5). One individual of this species falls within the RE Crimson Permitting Boundary.

<u>2017 Survey Results</u>

Approximately 3,815 Harwood's eriastrum individuals were observed during the focused 2017 survey for this species. Both individuals and polygons were mapped, with the main concentration of individuals being located in the dune areas north of the site, and also along the washes within the survey area. Approximately 420 Harwood's eriastrum individuals were observed within the RE Crimson Permitting Boundary; the remainder of individuals observed in 2017 are located in dune and wash habitat outside the RE Crimson Permitting Boundary. These are primarily located along the northern edge of the site near the sand dunes, and adjacent to the avoided washes in the central part of the site, namely near 2017 BSA Survey Area 2 (Figure 5).

***Abrams' Spurge***

Abrams' spurge (CRPR 2B.2) is an annual herb found in sandy Mojavean and Sonoran desert scrub at elevations of-5 to 915 meters AMSL. This herb is fairly endangered in California but is more common in other parts of its range, including Nevada, Arizona, and Baja California and Sonora in Mexico. Abrams' spurge usually blooms between September and November (CNPS 2017).

<u>2011/2012 Survey Results</u>

A total of 2,415 individuals was observed within dune and sandy habitat within the SWP Site BSA during the 2011/2012 surveys (44 in the fall 2011 survey and 2,371 in the fall 2012 survey) (Figure 5). None of these detections fall within the RE Crimson Permitting Boundary.

<u>2016 Survey Results</u>

Abrams' spurge was not observed during the spring 2016 surveys.

2017 Survey Results

Abrams' spurge was not observed during the spring 2017 surveys.

### *Utah Vine Milkweed*

Utah vine milkweed (CRPR 4.2) is a perennial vine-like herb native to California, Arizona, Utah, and Nevada. Found at elevations of 150 to 1,435 meters AMSL, this species prefers dry, sandy or gravelly soils in Mojave and Sonoran desert scrub habitats. As a CRPR 4, or watchlist species, Utah vine milkweed is of limited distribution in California and warrants monitoring. It is considered threatened by habitat loss resulting from development, and potentially threatened by off-road vehicle use. The bloom period for this species is from April through June (CNPS 2017).

2011/2012 Survey Results

During the fall 2011 botanical surveys, 598 individuals were found, and during the early spring 2012 survey, 76 individuals were found, for a total of 674 within the SWP Site BSA (Figure 5). Approximately 105 individuals were detected within the current RE Crimson Permitting Boundary.

2016 Survey Results

Utah vine milkweed was not observed during the spring 2016 surveys.

2017 Survey Results

Utah vine milkweed was not observed during the spring 2017 surveys.

### *Desert Unicorn Plant*

Desert unicorn plant (CRPR 4.3) is a deciduous perennial herb typically found in Sonoran creosote bush shrub at elevations of 90 to 1000 meters AMSL. As a CPRR 4, or watchlist species, desert unicorn plant is of limited distribution in California and warrants monitoring, but also occurs in Arizona, New Mexico, and Baja California and Sonora, Mexico. This species blooms between May and October (CNPS 2017).

2011/2012 Survey Results

A total of approximately 285 desert unicorn plants was observed within the SWP Site BSA during the fall 2011 (36 individuals) and fall 2012 (249 individuals) surveys (Figure 5). Approximately 11 individuals were located within the current RE Crimson Permitting Boundary.

2016 Survey Results

Desert unicorn plant was not observed during the spring 2016 surveys.

2017 Survey Results

Desert unicorn plant was not observed during the spring 2017 surveys.

**Table 4-3. Special-Status Plant Species with Potential to Occur in the Vicinity of the Project**

| ***Scientific Name*** **Common Name** | **Status** | **Flowering Period** | **Habitat** | **Potential to Occur[1]** | |
|---|---|---|---|---|---|
| | | | | **SWP Site** | **RE Crimson Permitting Boundary** |
| **MONOCOTS** | | | | | |
| AGAVACEAE (Century Plant Family) | | | | | |
| Shrub-like species such as Century plant, yucca, nolina, agave, etc. | CDNPA: Covered | Varies by species | Sonoran desert scrub; creosote bush scrub; rocky and gravelly slopes; Elevation varies according to species | **High**; suitable habitat is present; however, no species from this family have been recorded during site surveys over the course of several years. Species from this family are also fairly common. | |
| POACEAE (Grass Family) | | | | | |
| *Panicum hirticaule* ssp. *hirticaule*<br>Roughstalk witch grass | CRPR: 2B.1 | Aug–Dec | Inhabits sandy, silty, depressions in desert dunes, Joshua tree woodland, Mojavean desert scrub, and Sonoran desert scrub. Elevation of 148 to 4,314 feet. | **High**; this species was not documented, but suitable habitat is present within the microphyll woodlands, which are being avoided. | |
| THEMIDACEAE (Brodiaea Family) | | | | | |
| *Androstephium breviflorum*<br>Small–flowered androstephium | CRPR: 2B.2 | Mar-Apr | Desert dunes; Mojavean desert scrub (bajadas); Elevation of 720 to 2,624 feet. | **Low**; suitable habitat is present, but there are no known nearby locations (within 10 miles). | |
| **DICOTS** | | | | | |
| APOCYNACEAE (Dogbane Family) | | | | | |
| *Funastrum utahense*<br><br>Utah vine milkweed | CRPR: 4.2<br><br>NECO: SS | April–June | Mojave or Sonoran desert, dry sandy or gravely areas less than 3,280 feet in elevation. | **Present**; 674 plants found during fall 2011 and spring 2012 surveys. | **Present**; the species was not detected during surveys in 2016 or 2017; however, 105 individuals were documented within the RE Crimson Permitting Boundary from 2011/2012 surveys. |
| ASTERACEAE (Sunflower Family) | | | | | |
| *Hymenoxys odorata*<br>Bitter rubberweed | CRPR: 2B.1 | Feb-Nov | Sonoran desert scrub, sandy riparian scrub. Elevation range from 195 to 4,920 feet. | **Moderate**; suitable habitat is present; the closest records are to the east around Blythe, and around the town of Palo Verde in the 1940's (CDFW 2017b). | |

| *Scientific Name* Common Name | Status | Flowering Period | Habitat | Potential to Occur[1] SWP Site | RE Crimson Permitting Boundary |
|---|---|---|---|---|---|
| BORAGINACEAE (Borage or Waterleaf Family) | | | | | |
| *Johnstonella costata* ribbed cryptantha | CRPR: 4.3 | Feb–May | Desert dunes, quite specific to loose drifting sand less than 1,625 feet in elevation. | **Present**; 15,265 individual plants found during spring 2012 surveys. | **Present**; 2,153 individuals[2] observed within the RE Crimson Permitting Boundary in 2011/2012, but none observed in 2016/2017. |
| *Johnstonella holoptera* winged cryptantha | CRPR: 4.3<br>NECO: SS | Mar–April | Sonoran desert scrub, primarily on rocky slopes less than 5,500 feet of elevation. | **Moderate**; this species was not documented during surveys, but suitable habitat is present within the RE Crimson Permitting Boundary and although there are no known nearby occurrences (within 10 miles). | |
| BRASSICACEAE (Mustard Family) | | | | | |
| *Ditaxis serrata* var. *californica* California ditaxis | CRPR: 3.2<br>NECO: SS | Mar–Dec | Sonoran desert scrub, on sandy washes and alluvial fans of the foothills and lower desert slopes. Elevation of 98 to 3,281 feet. | **Moderate**; suitable habitat is present, but no documented locations within 10 miles. | |
| BURSERACEAE (Torchwood Family) | | | | | |
| *Bursera microphylla* Little-leaf elephant tree | CRPR: 2B.3<br>CDNPA: Covered | Jun-Jul | Sonoran desert scrub (rocky); Elevation of 655 to 2,300 feet. | **Low**; this species is not widespread and is currently known from areas much greater than 10 miles away. | |
| CACTACEAE (Cactus Family) | | | | | |
| All species not listed in table | CDNPA: Covered | varies | Sonoran desert scrub; creosote bush scrub; Elevation varies according to species. | **Present**; several species of cactus were observed within the SWP Site and RE Crimson Permitting Boundary. These include *Cylindropuntia acanthocarpa* var. *coloradensis, Cylindropuntia echinocarpa, Cylindropuntia ramosissima, Echinocactus polycephalus* var. *polycephalus, Ferocactus cylindraceus,* and, *Mammillaria tetrancistra.* | |
| *Coryphantha alversonii* Foxtail cactus | CRPR: 4.3<br>NECO: SS | Apr–June | Mojavean desert scrub, Sonoran desert scrub (sandy or rocky, usually granitic). Elevation of 246 to 5,003 feet. | **Moderate**; suitable habitat is present although there are no known occurrences nearby (within 10 miles). | |
| *Cylindropuntia munzii* Munz's cholla | CRPR: 1B.3<br>BLM: S<br>NECO: SS | May | Sonoran desert scrub (sandy or gravelly); Elevation of 490 to 1,970 feet. | **Moderate**; suitable habitat is present and the species is historically located nearby. | |

| *Scientific Name* Common Name | Status | Flowering Period | Habitat | Potential to Occur[1] SWP Site | Potential to Occur[1] RE Crimson Permitting Boundary |
|---|---|---|---|---|---|
| *Ferocactus cylindraceus* Barrel cactus | CDNPA: Covered | Apr-May | Sonoran desert scrub; creosote bush scrub; Elevation of 195 to 4,920 feet. | **Present**; individuals of this species were observed within the SWP Site BSA. | **High**; this species was not observed during focused surveys; however, this species is highly likely to occur due to nearby occurrences from the 2011/2012 SWP Site surveys. |
| CHENOPODIACEAE (Goosefoot Family) | | | | | |
| *Atriplex hymenelytra* Desert holly | CDNPA: Covered | Jan-Apr | Sonoran desert scrub; creosote bush scrub; Elevation less than 4,920 feet. | **Present**; individuals of this species were observed within the SWP Site. | **High**; this species was not observed during focused surveys; however, this species is highly likely to occur due to nearby occurrences from the 2011/2012 SWP Site surveys. |
| CLEOMACEAE (Spiderflower Family) | | | | | |
| *Wislizenia refracta* ssp. *palmeri* Palmer's jackass clover | CRPR: 2B.2 NECO: SS | Jan-Dec | Chenopod scrub; desert dunes; Sonoran desert scrub; Sonoran thorn woodland; Elevation up to 985feet. | **Low**; suitable habitat present, known from occurrences ~40 miles west of RE Crimson Permitting Boundary. | |
| *Wislizenia refracta* ssp. *refracta* Jackass clover | CRPR: 2B.2 | Apr-Nov | Desert dunes; Mojavean desert scrub; Playas; Sonoran desert scrub; Elevation of 1,970 to 2,625 feet. | **Low**; suitable habitat present, known from occurrences ~30 miles west of RE Crimson Permitting Boundary. | |
| EUPHORBIACEAE (Spurge Family) | | | | | |
| *Euphorbia abramsiana* Abrams' spurge | CRPR: 2B.2 | Sep–Nov | Mojavean desert scrub, Sonoran desert scrub, sandy sites. Elevation of 16 to 3,002 feet. | **Present**; 44 plants found during fall 2011 surveys; 2,371 plants found during fall 2012 surveys. | **High**; This species is highly likely to occur within the RE Crimson Permitting Boundary based on known occurrences from 2011/2012 surveys. |
| FABACEAE (Legume Family) | | | | | |

| *Scientific Name* Common Name | Status | Flowering Period | Habitat | Potential to Occur[1] | |
|---|---|---|---|---|---|
| | | | | SWP Site | RE Crimson Permitting Boundary |
| *Astragalus insularis* var. *harwoodii* Harwood's milkvetch | CRPR: 2B.2 NECO: SS | Jan–May | Desert dunes and Mojavean desert scrub (sandy or gravelly—mostly in creosote bush scrub). Found at elevations up to 2,329 feet. | **Present**; 162 found during the spring 2012 survey and another two individuals found during the spring 2017 survey. | **High**; this species was not observed during focused surveys; however, this species is highly likely to occur based on known occurrences from the SWP Site. |
| *Astragalus lentiginosus* var. *borreganus* Borrego milkvetch | CRPR: 4.3 NECO: SS | Feb-May | Sandy; Mojavean desert scrub; Sonoran desert scrub; Elevation of 100 to 2,940 feet. | **Low**; suitable habitat present, but is not known to occur within 10 miles. | |
| *Olneya tesota* Ironwood | CDNPA: Covered | Apr-May | Sonoran desert scrub, washes; Elevation less than 4,265 feet. | **Present**; although the washes which contain ironwood trees are being avoided, a handful of individuals of this species were observed along an avoided wash within the western portion of RE Crimson Permitting Boundary. | |
| *Parkinsonia florida, P. microphylla* Palo verde | CRPR:4.3 (*P.m.*) CDNPA: Covered | Apr-May | Sonoran desert scrub, washes; Elevation less than 3,600 feet. | **Present**; although the washes which contain *Parkinsonia florida* are being avoided, a handful of individuals of this species were observed along an avoided wash within the western portion of RE Crimson Permitting Boundary. | |
| *Prosopis* sp. Mesquite (all species) | CDNPA: Covered | Apr-Sep | Sonoran desert scrub; creosote bush scrub; desert washes; Elevation varies | **Present**; individuals of this species were observed during 2011/2012 surveys. | High; this species was not observed during focused surveys; however, this species is highly likely to occur based on known occurrences from the SWP Site. |
| *Psorothamnus spinosus* Smoke tree | CDNPA: Covered | Jun-Jul (uncommon in Oct-Nov) | Sonoran desert scrub, washes; Elevation up to 1,310 feet. | **Present**; individuals of this species were observed during 2011/2012 surveys. | High; this species was not observed during focused surveys; however, this species is highly likely to occur based on known occurrences from the SWP Site. |
| *Senegalia greggii* Catclaw acacia | CDNPA: Covered | Apr-Jun | Sonoran desert scrub; creosote bush scrub; desert washes; Elevation of 330 to 4,590 feet. | **Present**; individuals of this species were observed during 2011/2012 surveys. | High; this species was not observed during focused surveys; however, this species is highly likely to occur based on known occurrences from the SWP Site. |
| FOUQUIERIACEAE (Ocotillo Family) | | | | | |

| *Scientific Name* Common Name | Status | Flowering Period | Habitat | Potential to Occur[1] | |
|---|---|---|---|---|---|
| | | | | SWP Site | RE Crimson Permitting Boundary |
| *Fouquieria splendens subsp. Splendens* Ocotillo | CDNPA: Covered | Mar-Jun | Sonoran desert scrub; creosote bush scrub; Elevation less than 2,300 feet. | **Present**; individuals of this species were observed within the RE Crimson Permitting Boundary. | |
| LAMIACEAE (Mint Family) | | | | | |
| *Teucrium cubense* ssp. *depressum* Dwarf germander | CRPR: 2B.2 | Mar–May | Found in sandy soils in washes, fields, and alkali flats. Elevation of 148 to 1,312 feet. | **Moderate**; suitable habitat is present, and the species has historically been detected around the Wiley's Well Exit and I-10 (CDFW 2017b). | |
| LOASACEAE (Loassa Family) | | | | | |
| *Mentzelia puberula* Darlington's blazing star | CRPR: 2B.2 | Mar-May | Mojavean desert scrub; Sonoran desert scrub; sandy or rocky; Elevation of 295 to 4,200 feet. | **Moderate**; suitable habitat present, and known to occur within 10 miles of RE Crimson Permitting Boundary. | |
| *Mentzelia tricuspis* Spiny-hair blazing star | CRPR: 2B.1 | Mar-May | Sandy, gravelly, slopes and washes; Mojavean desert scrub; Elevation of 490 to 4,200 feet. | **Low**; suitable habitat present, but is not known to occur within 10 miles of RE Crimson Permitting Boundary. | |
| MARTYNIACEAE (Unicorn Plant Family) | | | | | |
| *Proboscidea althaeifolia* Desert unicorn plant | CRPR: 4.3 NECO: SS | June–July | Occurs in sandy portions of the Sonoran desert less than 3,250 feet of elevation. | **Present**; 36 plants detected during fall 2011 surveys, with another 249 individuals detected during fall 2012 surveys. | Present; Eleven individuals observed within the RE Crimson Permitting Boundary in 2011/2012, but not observed in 2016/2017. |
| NYCTAGINACEAE (Four O'clock Family) | | | | | |
| *Abronia villosa* var. *aurita* Chaparral sand-verbena | CRPR: 1B.1 BLM: S | Jan–Sept | Chaparral, sandy desert dunes, coastal scrub, sandy areas. Elevation of 263 to 5,250 feet. | **Low**; suitable habitat is present, but there are no known nearby locations (within 10 miles). | |
| *Acleisanthes longiflora* Angel trumpets | CRPR: 2B.3 NECO: SS | May | Sonoran desert scrub; generally on limestone. Elevation of 295 to 312 feet. | **Moderate**; Sonoran desert scrub is present and the species is known to occur to the north in the Maria Mountains (beyond 10 miles). | |
| ONAGRACEAE (Evening-primrose Family) | | | | | |

| *Scientific Name* Common Name | Status | Flowering Period | Habitat | Potential to Occur[1] | |
|---|---|---|---|---|---|
| | | | | SWP Site | RE Crimson Permitting Boundary |
| *Chylismia arenaria* Sand evening-primrose | CRPR: 2B.2 | Mar–Apr | Sonoran desert scrub (sandy or rocky) growing at elevations of -200 feet to 3,000 feet. | **Moderate;** suitable habitat is present within the BSA, but there are no nearby known occurrences (CDFW 2017b). | |
| PLANTAGINACEAE (Plantain Family) | | | | | |
| *Penstemon pseudospectabilis* ssp. *pseudospectabilis* Desert beardtongue | CRPR: 2B.2 | Jan-May | Occurs in creosote bush scrub at elevations of 855 to 1,640 feet. | **Low**: found within the Palo Verde Mountains in 1985 (CDFW 2017b). | |
| POLEMONIACEA (Phlox Family) | | | | | |
| *Eriastrum harwoodii* Harwood's eriastrum | CRPR: 1B.2 BLM: S | Mar–June | Desert dunes and loose sand on valley bottoms. Elevation less than 3,280 feet. | **Present**; 3,510 found during spring 2012 surveys; 172 observed during the spring 2016 survey; and, 3,815 observed during the spring 2017 focused survey. | **Present**; Three individuals found during the spring 2012 survey, one individual during spring 2016 survey, and approximately 420 individuals found during the spring 2017 surveys. |
| RHAMNACEAE (Buckthorn Family) | | | | | |
| *Colubrina californica* Las Animas colubrina | CRPR: 2B.3 NECO: SS | Apr–June | Mojavean desert scrub and Sonoran desert scrub. Elevation of 11 to 1,095 feet. | **Moderate**; suitable habitat present, and the species is known to occur on the north side of I-10 on the east side of the McCoy Mountains (CDFW 2017b). | |
| *Condalia globosa* var. *pubescens* Spiny abrojo | CRPR: 4.2 NECO: SS | Mar-May (Nov, uncommon) | Sonoran desert scrub; Elevation of 280 to 3,280 feet. | **Moderate**; suitable habitat present, and known to occur within 10 miles of the RE Crimson Permitting Boundary. | |
| SIMAROUBACEAE (Quassia or Simarouba Family) | | | | | |
| *Castela emoryi* Crucifixion thorn | CRPR: 2B.2 NECO: SS CDNPA: Covered | June-July | Mojavean desert scrub, playas, and Sonoran desert scrub (gravelly). Elevations of up to 4,921 feet. | **Low**; suitable habitat is present, but closest record is from 1989 about 2.5 miles west of Wiley's Well Road (CFDW 2017b). | |
| SOLANACEAE (Nightshade Family) | | | | | |

| *Scientific Name* Common Name | Status | Flowering Period | Habitat | Potential to Occur[1] | |
|---|---|---|---|---|---|
| | | | | SWP Site | RE Crimson Permitting Boundary |
| *Lycium parishii* Parish's desert-thorn | CRPR: 2B.3 | Mar-Apr | Sonoran desert scrub/creosote bush scrub at elevations between 525 and 3,380 feet. | **Moderate**; detected about 5 miles south along Wiley's Well road in 1985 (CDFW 2017b). | |

Notes:

**Sensitivity Status Key**
BLM = Bureau of Land Management
CRPR = California Native Plant Society California Rare Plant Rank
CNDDB = California Natural Diversity Database
CDNPA = California Desert Native Plants Act
NECO = Northern and Eastern Colorado Desert Coordinated Management Plan

**Federal:**
FE = Listed as endangered under the Federal Endangered Species Act
FT = Listed as threatened under the Federal Endangered Species Act
FC = Candidate for listing under the Federal Endangered Species Act
SC = Species of concern

**Other Designations:**
BLM: S = sensitive species
CDNPA: Covered = CDNPA regulated native plant
NECO: SS = NECO Plan special-status species

**State:**
SE = Listed as endangered under the California Endangered Species Act
ST = Listed as threatened under the California Endangered Species Act
SP = Proposed for listing under the California Endangered Species Act
RARE = California listed as rare

**California Rare Plant Rank (CNPS):**
1A = Plants presumed extinct in California
1B = Plants rare and endangered in California and throughout their range
2 = Plants rare, threatened, or endangered in California but more common elsewhere in their range
3 = Plants about which more information is needed; a review list
4 = Plants of limited distribution; a watch list
0.1 = Seriously endangered in California
0.2 = Fairly endangered in California
0.3 = Not very endangered in California

[1] Potential to occur based on CNDDB database search of a 10-mile buffer around the Project and presence of suitable habitat.
[2] This number is conservative and is meant to represent an estimate of the number of plants, not necessarily an absolute count.

## 4.4 FAUNA

A total of 163 wildlife species has been detected during biological surveys within the SWP Site and the Project area. This total includes 12 invertebrate species, 17 reptile species, 108 bird species, and 26 mammal species. While not all of these faunal species have been detected directly within the RE Crimson Permitting Boundary, they have been detected in the Project area and, therefore, have a potential to occur both directly within and adjacent to the RE Crimson Permitting Boundary. A complete list of all wildlife species detected during the 2011/2012 and 2016/2017 surveys is in Appendix I. Representative Project area photographs are presented in Appendix G.

Tortoise and lizard species detected include desert tortoise, desert horned lizard (*Phrynosoma platyrhinos*), desert spiny lizard (*Sceloporus magister*), Mojave fringe-toed lizard, long-tailed brush lizard (*Urosaurus graciosus*), side-blotched lizard (*Uta stansburiana*), zebra-tailed lizard (*Callisaurus draconoides*), Great Basin whiptail (*Aspidoscelis tigris tigris*), desert iguana (*Dipsosaurus dorsalis*), long-nosed leopard lizard (*Gambelia wislizenii*), and western banded gecko (*Coleonyx variegatus*). Snake species detected include desert threadsnake (*Rena humilis cahuilae*), western shovel-nosed snake (*Chionactis occipitalis*), western diamond-backed rattlesnake (*Crotalus atrox*), sidewinder (*Crotalus cerastes*), Mojave rattlesnake (*Crotalus scutulatus*), and coachwhip (*Coluber flagellum*).

Some of the most commonly detected bird species in the Project area include horned lark (*Eremophila alpestris*), loggerhead shrike (*Lanius ludovicianus*), LeConte's thrasher (*Toxostoma lecontei*), verdin (*Auriparus flaviceps*), barn swallow (*Hirundo rustica*), mourning dove (*Zenaida macroura*), ash-throated flycatcher (*Myiarchus cinerascens*), and red-tailed hawk (*Buteo jamaicenis*).

Mammal species observed or detected from sign within the Project area (tracks, scat, burrows, carcasses, etc.) include four rodent species, desert cottontail (*Sylvilagus auduboni*), black-tailed jackrabbit (*Lepus californicus*), fourteen species of bats, American badger, desert kit fox, spotted skunk (*Spilogale gracilis*), coyote (*Canis latrans*), wild burro (*Equus asinus*), and burro deer (*Odocoileus hemionus eremicus*).

### 4.4.1 Special-Status Wildlife Species

This section details the federally and state listed wildlife species and the CDFW SSC, BLM Sensitive species, and DRECP focus species (FS); planning species (PS) that are known to occur or have a potential to occur. Overall, 26 special-status wildlife species were definitively detected within the Project area in 2016/2017. Including special-status wildlife species only detected during surveys for the SWP Site, there are 31 special-status wildlife species known to occur in the area. There is the potential for two other species, Couch's spadefoot and golden eagle, to occur within the Project area; however, these species could not be definitively determined due to lack of photographic evidence and visual observations and have been left as potentially present. Table 4-4 provides a summary of the special-status species known or with a potential to occur within the Project area. Species that were determined to have no potential to occur due to the Project being outside of the species range or lack of specific habitat requirements are not included in Table 4-4. Detailed discussions of each special-status species detected within the Project area are provided following Table 4-4.

**Table 4-4. Special-Status Wildlife Species with Potential to Occur in the Vicinity of the Project**

| *Scientific Name* Common Name | Status | Habitat and Known Locations | Potential to Occur[1] | |
|---|---|---|---|---|
| | | | SWP Site | RE Crimson Permitting Boundary |
| **REPTILES** | | | | |
| TESTUDINIDAE (land tortoises) | | | | |
| *Gopherus agassizii* desert tortoise | Fed: T<br>State: T<br>NECO: SS<br>DRECP: FS | Inhabits suitable desert habitats with friable soils for burrowing. May be found in desert washes up to about 5,000 feet, but suitable burrow locations often limit where they occur. May occur in a variety of desert vegetation communities, but often found around creosote bush scrub, big galleta grass, dry washes, and desert dry wash woodland habitats. | **Present**; 24 individuals detected during protocol desert tortoise surveys in spring 2012. | **Present**; 20 individuals found within the desert tortoise survey area, although only two of the desert tortoises were located within the RE Crimson Permitting Boundary during protocol surveys in fall 2016. |
| PHRYNOSOMATIDAE (fringe-toed lizards, horned lizards, and relatives) | | | | |
| *Uma scoparia* Mojave Desert fringe-toed lizard | State: SSC<br>BLM: SS<br>NECO: SS<br>DRECP: FS | Inhabits sand dunes in the Mojave Desert at elevations below sea level to 591 feet. The species range does not overlap with other species of fringe-toed lizards. | **Present**; many individuals detected throughout the study area in 2011/2012. | **Present**; several individuals detected incidentally within the RE Crimson Permitting Boundary in 2016/2017. |
| HELODERMATIDAE (venomous lizards) | | | | |
| *Heloderma suspectum cinctum* banded gila monster | State: SSC<br>BLM: S | Very few records of this species in California, primarily outside of Riverside County in San Bernardino County. The species inhabits rocky slopes, bajadas, arroyos, and washes, in association with burrows. | **Low**; species last documented around Blythe in 1948 (Lovich and Beaman 2007). | |

| *Scientific Name* Common Name | Status | Habitat and Known Locations | Potential to Occur[1] | |
|---|---|---|---|---|
| | | | SWP Site | RE Crimson Permitting Boundary |
| **AMPHIBIANS** | | | | |
| SCAPHIOPODIDAE (spadefoot toads) | | | | |
| *Scaphiopus couchii* Couch's spadefoot | State: SSC<br>BLM: S<br>NECO: SS | Found in temporary desert rain pools with subterranean refuge sites in appropriate soil types nearby. The species comes above ground to breed in ephemeral pools during intense monsoonal summer rain events (Thomson et al. 2016). The low frequency sound of the rain on the desert ground draws Couch's spadefoot out of their deep burrows (Dimmitt and Ruibal 1980). Per CNDDB, one toad was incidentally detected on August 27, 2012 within the western part of the SWP Site walking in a large wash (CDFW 2017b). | **Potentially Present**; per CNDDB, a Couch's spadefoot was incidentally found on the west side of the SWP Site during bird point count surveys on August 27, 2012, however this could not be verified (there are no photographs or descriptive text that would support a definitive conclusion), and therefore the species is considered potentially present. Western spadefoot (*Spea hammondii*) also could occur and could have been mistaken as a Couch's spadefoot due to their similar identifying characteristics. | **Moderate**; the species was not documented within the RE Crimson Permitting Boundary during biological surveys in 2016/2017, but there is a high potential to occur within the microphyll woodlands, which are being avoided. Potentially ponded areas were observed within a wash on the eastern side of the RE Crimson Permitting Boundary, but this wash would be avoided. Per the CNDDB point from 2012, Couch's spadefoot is present in a wash in the western part of the Project area, but outside of the RE Crimson Permitting Boundary. |
| **BIRDS** | | | | |
| PELECANIIDAE (pelicans) | | | | |
| *Pelecanus erythrorhynchos* American white pelican | State: SSC (nesting colony) | Generally found on freshwater lakes, bays, estuaries, and other slow-moving waters. Found along the Colorado River. The species may migrate through/over the Project area enroute to breeding and wintering areas. | **Low**; the species has not been detected during surveys. The species would only occur flying over the Project area during migration as no suitable nesting or foraging habitat is present within the RE Crimson Permitting Boundary. | |
| ACCIPITRIDAE (hawks, kites, harriers and eagles) | | | | |
| *Buteo regalis* ferruginous hawk | NECO: SS | Only winters within California and preys on rodents, often in open, agricultural or grassland areas, and occasionally the desert. | **High**; while the species was not detected during avian surveys, there is a high potential for it to fly through the SWP Site. | **Present**; detected on several occasions between October 2016 and March 2017 as a winter resident and migrant within the RE Crimson Permitting Boundary. |

| *Scientific Name* Common Name | Status | Habitat and Known Locations | Potential to Occur[1] | |
|---|---|---|---|---|
| | | | SWP Site | RE Crimson Permitting Boundary |
| *Buteo swainsonii* Swainson's hawk | State: T (nesting) BLM: S DRECP: FS | Found in grassland, savannah, and desert habitats; nests in large mesquite shrubs in the Mojave Desert and Arizona, riparian trees near the Colorado River. Only occurs as a migratory species within the Project area. This species often feeds on sphinx moth caterpillars within the desert that emerge following winter/spring rains. | **Present**; detected during avian surveys in 2012 within the SWP Site. | **Present**; several groups, including one flock of at least 80 individuals on March 23, 2017 were detected migrating through the RE Crimson Permitting Boundary. The species may feed on sphynx moth larvae if available during migration within the RE Crimson Permitting Boundary. |
| *Aquila chrysaetos* golden eagle | State: FP (nesting and wintering) BLM: S NECO: SS DRECP: FS | Prefers to nest in secluded, elevated sites, including cliff faces, and tall trees. Forages across arid deserts, shrublands, grasslands, and open woodlands. Known to nest in the Little Chuckwalla and McCoy Mountains. | **High**; The species has not been observed within the SWP Site, but is known to nest in the general vicinity. | **Present (foraging only)**; the carcass of a desert kit fox that was potentially killed and eaten by a golden eagle was found on March 3, 2017 just west of, but outside the RE Crimson Permitting Boundary. The way the carcass had been eaten and nearby eagle tracks in the sand indicate a golden eagle had recently fed on the carcasses. Since no eagle was actually observed, but all evidence points to the presence of a golden eagle, the species is considered possibly present. |
| *Circus hudsonius* northern harrier | State: SSC (nesting) | Found in grasslands, shrub lands, marshes, and other dense vegetation near water sources during breeding. Winters throughout Southern California in open habitats with rodents. | **Present**; found within the SWP Site as a winter migrant in 2012. | **Present**; detected in fall 2016 and early spring 2017 as a migrant through the RE Crimson Permitting Boundary. |
| FALCONIDAE (falcons) | | | | |
| *Falco peregrinus anatum* American peregrine falcon | Fed: DL State: DL, FP | Found in open habitats ranging from desert communities to forest habitats. Requires cliff ledges or ledge-type structure for nesting. | **Present**; detected flying through the SWP Site while foraging in 2012, but does not breed within the SWP Site. | **Moderate**; Not detected during surveys in 2016/2017, but has a potential to fly through the RE Crimson Permitting Boundary. |

| *Scientific Name* Common Name | Status | Habitat and Known Locations | Potential to Occur[1] | |
|---|---|---|---|---|
| | | | SWP Site | RE Crimson Permitting Boundary |
| *Falco mexicanus* prairie falcon | NECO: SS | Found nesting in rocky mountainous areas in the desert. The species requires a ledge or hole in a cliff for nesting. | **Present**; detected flying through the SWP Site while foraging in 2012, but does not breed within the SWP Site. | **Present**; detected flying through the RE Crimson Permitting Boundary while foraging in 2016/2017. Known to breed in the surrounding nearby mountains. |
| CHARADRIIDAE (plovers and relatives) | | | | |
| *Charadrius montanus* mountain plover | State: SSC (wintering) BLM: S NECO: SS | Found in desert environments with very short grassland, cropland habitats, recently burned fields, bare dirt fields, etc. The species only occurs in California as a winter resident. | **Low**; the species uses burned, fallow, dirt, and short grass fields for wintering in the Palo Verde Valley (CDFW 2017b). These habitat types are absent from the RE Crimson Permitting Boundary. | |
| RALLIDAE (rails) | | | | |
| *Rallus obsoletus yumanensis* Yuma Ridgway's rail | Fed: E State: T, FP DRECP: FS | Nests in freshwater marshes along the Colorado River and along the southern and eastern ends of the Salton Sea. | **Low**; the species is known to occur along the Colorado River and may occasionally fly over the RE Crimson Permitting Boundary between the Salton Sea and the Colorado River. | |
| STRIGIDAE (owls) | | | | |
| *Asio otus* long-eared owl | State: SSC (nesting) | Nests in riparian bottomlands and live oaks adjacent to streams. It will nest in Tamarisk trees or windrows within the desert. | Not detected during surveys in 2011/2012. | **Present**; detected within the Project area, but outside of the RE Crimson Permitting Boundary in microphyll woodlands in fall 2016. Likely a migrant, with suitable breeding habitat within microphyll woodlands outside of the RE Crimson Permitting Boundary, but foraging habitat within the RE Crimson Permitting Boundary. |

| *Scientific Name* Common Name | Status | Habitat and Known Locations | Potential to Occur[1] | |
|---|---|---|---|---|
| | | | SWP Site | RE Crimson Permitting Boundary |
| *Asio flammeus* Short-eared owl | State: SSC (nesting) | Nests in short grass, and wetland areas especially in open country. In migration, may be found in a variety of locations, but primarily around water or short grassy areas. Occurs only as a winter resident to the desert regions of Southern California. | **Present**; one individual was incidentally detected migrating through the SWP Site in 2012. | **High**; Not detected during surveys in 2016/2017, no suitable habitat occurs within the RE Crimson Permitting Boundary, however the species is known to migrate through the area. |
| *Athene cunicularia* burrowing owl | State: SSC (burrow sites and some wintering sites) BLM: S NECO: SS DRECP: FS | Occurs in open scrub, grassland, and agricultural habitat. Species known to nest in desert environments, but more common during the winter months when more owls are present. Often found along canals, drainages, or other areas with an abundant insect and rodent populations. Will readily use desert tortoise and desert kit fox burrows. | **Present**; detected within the SWP Site in 2012 during the winter and in migration. No breeding burrowing owls detected. | **High**; detected just outside of the RE Crimson Permitting Boundary in fall 2016 during desert tortoise surveys. The species likely migrates through the RE Crimson Permitting Boundary, and may occasionally winter within the RE Crimson Permitting Boundary. No breeding burrowing owls were detected during recent spring 2017 surveys. |
| *Micrathene whitneyi* elf owl | State: E NECO: SS BLM: S | Nests in California along the Colorado River in cottonwood-willow and mesquite riparian zones. Nests in tree and cactus cavities made by other bird species. Also known to sporadically occur at Desert Center and Corn Springs palm oasis in the 1970s (eBird 2017). Most recently detected in 2017 at Joshua Tree National Park (Rodriguez pers. comm. 2017b). | **Low**; species not detected during surveys in 2012. | **Low**; species not detected during surveys in 2017 and suitable habitat is not present. |
| APODIDAE (swifts) | | | | |
| *Chaetura vauxi* Vaux's swift | State: SSC (nesting) | Nests in forests and woodlands in Central California north into Alaska The species only occurs in migration within the Project area. | **Present**; detected flying through in migration during surveys in 2012. The species only occurs as a migrant within the SWP Site. | **Present**; detected flying through in migration during surveys in 2016/2017. The species only occurs as a migrant within the RE Crimson Permitting Boundary. |

| ***Scientific Name*** **Common Name** | **Status** | **Habitat and Known Locations** | **Potential to Occur[1]** | |
|---|---|---|---|---|
| | | | **SWP Site** | **RE Crimson Permitting Boundary** |
| PICIDAE (woodpeckers) | | | | |
| *Melanerpes uropygialis* Gila woodpecker | State: E BLM: S NECO: SS DRECP: FS | Found in cottonwood trees and other desert riparian trees. Nests in riparian trees, palm trees, or saguaro cactus. May occur in urban areas of the desert where palm trees have been planted. Known to breed along the Colorado River. | **Low**; potentially suitable habitat is present in microphyll woodland, but the species has not been detected thus far within the RE Crimson Permitting Boundary. | |
| TYRANNIDAE (tyrant flycatchers) | | | | |
| *Pyrocephalus rubinus* vermillion flycatcher | State: SSC (nesting) NECO: SS | Nests in desert riparian habitats near irrigated fields, pastures, short grasslands, community parks, cemeteries, etc. Known to breed along the Colorado River. | **Low**; the species may fly through the RE Crimson Permitting Boundary during migration. No suitable breeding habitat is present within the RE Crimson Permitting Boundary. | |
| *Contopus cooperi* Olive-sided flycatcher | State: SSC (nesting) | Nests in boreal and coniferous forests as well as deciduous forests with nearby meadows, marshes, or locations for hawking insects. Does not breed in Southern California. | Not detected during surveys in 2011/2012. | **Present**; detected during migration in fall 2016 within microphyll woodlands outside of the RE Crimson Permitting Boundary, and the species could fly through the RE Crimson Permitting Boundary during migration. |
| *Empidonax traillii extimus* southwestern willow flycatcher | Fed: E State: E NECO: SS DRECP: FS | Occurs in multi-layered riparian woodlands within a few river drainages in Southern California. Breeds within the Palo Verde Ecological Reserve in Blythe. | **Low**; the species may fly through the RE Crimson Permitting Boundary during migration. No suitable breeding habitat is present within the RE Crimson Permitting Boundary. | |
| LANIIDAE (shrikes) | | | | |
| *Lanius ludovicianus* loggerhead shrike | State: SSC (nesting) | Inhabits large, open areas conducive to hunting. Nests in dense brush and shrubs. Often found along desert dry wash woodlands where dense palo verde, ironwood, and other trees provide suitable nesting habitat with adjacent open desert for foraging. | **Present**; commonly found throughout the SWP Site in 2011/2012. The species is a year-round resident within the SWP Site. | **Present**; commonly found throughout the RE Crimson Permitting Boundary in 2016/2017. The species is a year-round resident with confirmed breeding within microphyll woodlands outside the RE Crimson Permitting Boundary. |

| *Scientific Name* Common Name | Status | Habitat and Known Locations | Potential to Occur[1] | |
|---|---|---|---|---|
| | | | SWP Site | RE Crimson Permitting Boundary |
| HIRUNDINIDAE (swallows) | | | | |
| *Riparia riparia* Bank swallow | State: T BLM: S | Nests in central and northern California in banks along rivers, streams, lakes, and ocean coasts. The species may migrate through the Project area. | **Present**; detected flying through the SWP Site in migration during 2012 avian surveys. The species only occurs as a migrant within the SWP site. | **Present**; detected flying through the RE Crimson Permitting Boundary in migration during 2012 avian surveys. The species only occurs as a migrant. |
| *Progne subis* Purple martin | State: SSC (nesting) | Inhabits woodlands, low elevation coniferous forest of Douglas-fir, ponderosa pine, and Monterey pine habitats. | **Low**; the species may fly through the RE Crimson Permitting Boundary during migration. No suitable breeding habitat is present within the RE Crimson Permitting Boundary. | |
| MIMIDAE (mockingbirds and thrashers) | | | | |
| *Toxostoma bendirei* Bendire's thrasher | State: SSC BLM: S NECO: SS DRECP: FS | Requires dense, shrubs for nesting. Found in a variety of desert habitats, particularly along desert washes, but readily forages within creosote bush scrub. Nests in desert washes particularly in mistletoe and other areas of dense leaf foliage or clumps of dense branches. | **Low**; the species has not been detected during any biological surveys as the habitat is marginal. Within the region, the species is known to occur in Joshua Tree National Park, but there are no nearby known locations for this species to the RE Crimson Permitting Boundary. | |
| *Toxostoma crissale* Crissal thrasher | State: SSC NECO: SS | Inhabits desert riparian and desert wash habitats. The species prefers mesquite thickets and pockets of very dense desert vegetation. Suitable habitat is present within Wiley's Well Wash. | **Present**; one individual found during avian surveys in 2012. The species is unlikely to breed within the SWP Site due to a lack of dense desert vegetation. | **Low**; Not detected during surveys in 2016/2017 and no dense habitat occurs within the RE Crimson Permitting Boundary. |
| *Toxostoma lecontei* LeConte's thrasher | NECO: SS | Requires dense, shrubs for nesting. Found in a variety of desert habitats, particularly along desert washes, but readily forages within creosote bush scrub. Nests in desert washes particularly in mistletoe and other areas of dense leaf foliage or clumps of dense branches. | **Present**; commonly found throughout the SWP Site particularly in association with wash or riparian vegetation in 2011/2012. The species is a year-round resident and is known to breed within the SWP Site. | **Present**; commonly found throughout the RE Crimson Permitting Boundary particularly in association with wash or riparian vegetation in 2016/2017. The species is a year-round resident and is known to breed within the microphyll woodlands between the RE Crimson Permitting Boundary. |

| *Scientific Name* Common Name | Status | Habitat and Known Locations | Potential to Occur[1] | |
|---|---|---|---|---|
| | | | SWP Site | RE Crimson Permitting Boundary |
| PARULIDAE (wood-warblers) | | | | |
| *Dendroica petechia* Yellow warbler | State: SSC (nesting) NECO: SS | Nests in wetlands and mature riparian woodlands dominated by cottonwoods, alders, and willows. Species migrates through the desert but does not breed around the Project. May breed at the Palo Verde Ecological Reserve in Blythe. | **Present**; found during avian surveys in 2012. Unlikely to breed within the SWP Site, but may breed nearby along the Colorado River and occur as a migrant through the SWP Site. | **Present;** Species was detected in 2016/2017 migrating through the RE Crimson Permitting Boundary. No suitable nesting habitat is present within the RE Crimson Permitting Boundary. |
| *Oreothlypis luciae* Lucy's warbler | State: SSC (nesting) BLM: S | Nests in wetlands and mature riparian woodlands. Nests in tree cavities within mesquite scrub and other riparian vegetation and in desert washes. Breeds at the Palo Verde Ecological Reserve in Blythe. | **Present**; found during avian surveys in 2012. Unlikely to breed within the SWP Site, breeds nearby along the Colorado River and likely occurs as a migrant through the SWP Site. | **Low**; Not detected during surveys in 2016/2017 and no suitable habitat occurs within the RE Crimson Permitting Boundary. |
| *Coccyzus americanus occidentalis* Western yellow-billed cuckoo | Fed: T State: E BLM: S DRECP: FS | Nests in riparian forest habitat, along the broad lower flood-bottoms of larger river systems. Breeds at the Palo Verde Ecological Reserve in Blythe. | **Low**; the species may fly through the RE Crimson Permitting Boundary during migration. No suitable breeding habitat is present within the RE Crimson Permitting Boundary. | |
| *Icteria virens* Yellow-breasted chat | State: SSC (nesting) | Inhabits riparian thickets of willow and other brushy tangles near watercourses. Breeds at the Palo Verde Ecological Reserve in Blythe. | **Low**; the species may fly through the RE Crimson Permitting Boundary during migration. No suitable breeding habitat is present within the RE Crimson Permitting Boundary. | |
| ICTERIDAE (blackbirds) | | | | |
| *Xanthocephalus xanthocephalus* Yellow-headed blackbird | State: SSC (nesting) | Found around flooded fields, canals, and marshes with tules, cattails, and freshwater vegetation. Feeds around agricultural areas and known to nest around Blythe. | **Present**; found during avian surveys in 2012. Suitable breeding habitat is not present within the SWP Site the species was likely flying through the area. | **Low**; Not detected during surveys in 2016/2017 and no suitable habitat occurs within the RE Crimson Permitting Boundary. |

| *Scientific Name* Common Name | Status | Habitat and Known Locations | Potential to Occur[1] SWP Site | Potential to Occur[1] RE Crimson Permitting Boundary |
|---|---|---|---|---|
| **MAMMALS** | | | | |
| PHYLLOSTOMIDAE (leaf-nosed bats) | | | | |
| *Macrotus californicus* California leaf-nosed bat | State: SSC<br>BLM: S<br>NECO: SS<br>DRECP: FS | Roosts in mines, caves, or rugged terrain in desert riparian, desert wash, and desert scrub habitats. Species observed in 2002 within surrounding habitat within the Roosevelt and Hodge mines less than 3 miles from the Project area in the Mule Mountains (CDFW 2017b). | **High**; potential calls were identified during bat acoustic monitoring in 2012, but could not be conclusively identified to this species. | **Present**; Detected during surveys in 2016/2017, and the species may fly through and forage within the RE Crimson Permitting Boundary. |
| VESPERTILIONIDAE (evening bats) | | | | |
| *Antrozous pallidus* pallid bat | State: SSC<br>BLM: S<br>NECO: SS<br>DRECP: FS | Roosts in dry, open habitats. Occurs in desert, grasslands, shrub lands, woodlands, and forests. | **Present**; species detected during bat acoustic surveys in 2012. | **Present**; species detected during bat acoustic surveys in 2016/2017. |
| *Corynorhinus townsendii* Townsend's big-eared bat | State: SSC<br>BLM: S<br>NECO: SS<br>DRECP: FS | Occurs in a variety of habitats throughout California. Roosts in open areas. Historically detected around Palo Verde in 1919 (CDFW 2017b). | **High**; potential calls were identified during bat acoustic monitoring in 2012, but could not be conclusively identified to this species. | **High**; Not detected during surveys in 2016/2017, but the species may fly through and forage within the RE Crimson Permitting Boundary. |
| *Lasiurus blossevillii* Western red bat | State: SSC | Roosts in trees, primarily in riparian vegetation. | **Present**; species detected during bat acoustic surveys in 2011/2012. | **Present**; species detected during bat acoustic surveys in 2016/2017. |
| *Lasiurus xanthinus* Western yellow bat | State: SSC | Roosts in trees, primarily in dead fronds of palm trees. May occur in fan palm oasis areas. | **High**; potential calls were identified during bat acoustic monitoring in 2012, but could not be conclusively identified to this species. | **Present**; species detected during bat acoustic surveys in 2016/2017. |
| *Myotis ciliolabrum* Western small-footed myotis | BLM: S | Roosts in cliffs, crevices, caves, and mines. | **High**; potential calls were identified during bat acoustic monitoring in 2012, but could not be conclusively identified to this species. | **High**; Not detected during surveys in 2016/2017, but the species may fly through and forage within the RE Crimson Permitting Boundary. |

| *Scientific Name* Common Name | Status | Habitat and Known Locations | Potential to Occur[1] | |
|---|---|---|---|---|
| | | | SWP Site | RE Crimson Permitting Boundary |
| *Myotis occultus* Arizona myotis | State: SSC | Occurs in the lowlands of the Colorado River and desert mountain ranges nearby. Historically detected around Ripley (CDFW 2017b). | **High**; potential calls were identified during bat acoustic monitoring in 2012, but could not be conclusively identified to this species. | **Present**; Detected during surveys in 2016/2017, and the species may fly through and forage within the RE Crimson Permitting Boundary. |
| *Myotis thysanodes* fringed myotis | BLM: S<br>NECO: SS | Roosts in caves and attics of buildings and houses. | **High**; potential calls were identified during bat acoustic monitoring in 2012. | **High**; Not detected during surveys in 2016/2017, but the species may fly through and forage within the RE Crimson Permitting Boundary. |
| *Myotis velifer* cave myotis | State: SSC<br>BLM: S<br>NECO: SS | Found in the lowlands of the Colorado River and adjacent mountain ranges with access to caves or mines for roosting. Species observed in 2002 within surrounding habitat within the Roosevelt and Hodge mines less than 3 miles from the Project area in the Mule Mountains (CDFW 2017b). | **High**; potential calls were identified during bat acoustic monitoring in 2012, but could not be conclusively identified to this species. | **Present**; Detected during surveys in 2016/2017, and the species may fly through and forage within the RE Crimson Permitting Boundary. |
| *Myotis yumanensis* Yuma myotis | BLM:S | Found in open forests and woodland in proximity to permanent water sources for foraging and drinking. | **High**; potential calls were identified during bat acoustic monitoring in 2012, but could not be conclusively identified to this species. | **Present**; Detected during surveys in 2016/2017, and the species may fly through and forage within the RE Crimson Permitting Boundary. |
| MOLOSSIDAE (free-tailed bats) | | | | |
| *Eumops perotis californicus* western mastiff bat | State: SSC<br>BLM: S<br>NECO: SS | Roosts in crevices of high cliffs and trees in open, arid and semi-arid habitats. | **High**; potential calls were identified during bat acoustic monitoring in 2012, but could not be conclusively identified to this species. | **Present**; species detected during bat acoustic surveys in 2016/2017. |
| *Nyctinomops femorosaccus* pocketed free-tailed bat | State: SSC<br>NECO: SS | Found in pine-juniper woodlands, desert scrub, and palm oasis habitats in Southern California. | **Present**; species detected during bat acoustic surveys in 2012. | **Present**; species detected during bat acoustic surveys in 2016/2017. |

| *Scientific Name* Common Name | Status | Habitat and Known Locations | Potential to Occur[1] | |
|---|---|---|---|---|
| | | | SWP Site | RE Crimson Permitting Boundary |
| *Nyctinomops macrotis* big free-tailed bat | State: SSC | Occurs in low-lying arid areas in Southern California. Needs high cliffs or rocky outcrops for roosting sites (CDFG 2003). | **High**; potential calls were identified during bat acoustic monitoring in 2012, but could not be conclusively identified to this species. | **High**; the species was not detected in 2016/2017, but it still has a potential to fly through the RE Crimson Permitting Boundary. |
| HETEROMYIDAE (kangaroo rats, pocket mice, and kangaroo mice) | | | | |
| *Chaetodipus fallax pallidus* pallid San Diego pocket mouse | State: SSC | Found in sandy, herbaceous areas occurring in desert wash, desert scrub, and desert succulent shrub habitats. The species has been historically detected within the Mule Mountains (CDFW 2017b). | **High**; suitable habitat is present within the RE Crimson Permitting Boundary, however no species-specific surveys have been conducted. | |
| CANIDAE (foxes, wolves, and coyotes) | | | | |
| *Vulpes macrotis arsipus* desert kit fox | State: CCR, protected furbearing mammal DRECP: PS | Suitable habitat for this fossorial mammal consists of arid open areas, shrub grassland, and desert ecosystems. | **Present**; found within the SWP Site in 2011/2012. | **Present**; tracks, scat, and burrows were found throughout the RE Crimson Permitting Boundary in 2016/2017. |
| MUSTELIDAE (weasels and relatives) | | | | |
| *Taxidea taxus* American badger | State: SSC | Associated with dry scrub, forest, desert scrub, and herbaceous habitats. This species has a large home range and occurs in a variety of desert environments, often related to prey abundance. This species may use desert kit fox burrows or other burrows for shelter and rearing young. | **Present**; found within the SWP Site in 2011/2012. | **Present**; tracks and a skull were found within the RE Crimson Permitting Boundary in 2016/2017. One individual was captured on wildlife cameras as it walked through microphyll woodlands. |
| FELIDAE (cats and relatives) | | | | |
| *Puma concolor browni* Yuma mountain lion | State: SSC NECO: SS | Primarily a nocturnal species found in rugged mountains and forests. Known to follow its primary prey, burro deer, which travel through the microphyll woodlands within the Project area. | **Moderate**; historically known from the Colorado River Valley and surrounding mountains. | |

| *Scientific Name* Common Name | Status | Habitat and Known Locations | Potential to Occur[1] | |
|---|---|---|---|---|
| | | | SWP Site | RE Crimson Permitting Boundary |
| CERVIDAE (deer and relatives) | | | | |
| *Odocoileus hemionus eremicus* burro deer | NECO: SS<br>DRECP: PS | A subspecies of mule deer found along the lower Colorado River Valley, adjacent drainages and nearby desert mountains. The species migrates between the Colorado River and desert mountains depending upon the rainfall and time of year. | **Present**; scat found within the SWP Site in 2011/2012. | **Present**; scat, tracks, and a skull were found within microphyll woodlands and adjacent habitat within the RE Crimson Permitting Boundary during desert tortoise surveys in 2016. Several does and bucks were captured on wildlife cameras as they walked through the microphyll woodlands between the RE Crimson Permitting Boundary. |
| BOVIDAE (sheep and relatives) | | | | |
| *Ovis canadensis nelsoni* desert bighorn sheep | State: FP<br>BLM: S<br>NECO: SS<br>DRECP: FS | Inhabits open, rocky, steep areas with access to water and herbaceous vegetation such as palm oases. Limited by water resources. | **Moderate**; the species may occasionally use the Mule Mountains and move through the microphyll woodlands between RE Crimson Permitting Boundary moving through to other mountain ranges. | |

**Notes:**

**Federal Designations (Federal Endangered Species Act, USFWS):**
E: federally listed, endangered
T: federally listed, threatened
FC: federal candidate species
**DL: federal delisted**

**Other Designations:**
**BLM: Bureau of Land Management sensitive species (S)**
**NECO:** Northern and Eastern Colorado Desert Coordinated Management **Plan special-status species** (SS)
DRECP: Desert Renewable Energy Conservation Plan: focus species (FS); planning species (PS)

**State Designations (California Endangered Species Act, CDFW):**
E: endangered
T: threatened
CT: candidate threatened
SSC: California species of special concern
FP: fully protected species
CCR: California Code of Regulations

[1] Potential to occur was determined based on CNDDB records within a 10-mile buffer around the Project.

### ***Federally Listed Wildlife Species***

Four wildlife species listed under the ESA occur or have a potential to occur or migrate through the RE Crimson Permitting Boundary: desert tortoise, Yuma Ridgway's rail, southwestern willow flycatcher, and western yellow-billed cuckoo. Of these federally listed species, only desert tortoise has been detected during surveys and has suitable habitat within the RE Crimson Permitting Boundary. There is no suitable breeding or foraging habitat for Yuma Ridgway's rail or western yellow-billed cuckoo within the Project area; however, the areas of microphyll woodlands between the RE Crimson Permitting Boundary provide suitable foraging habitat for migrating southwestern willow flycatcher. All four species are discussed in detail below, including their occurrence in the region, surveys that were conducted, and species presence or potential to occur within the RE Crimson Permitting Boundary.

Desert Tortoise

Desert tortoise is federally listed as threatened under the ESA, with critical habitat designated by the USFWS (USFWS 1994). The listing was initially made on August 4, 1989, by emergency rule (USFWS 1989) and by final rule on April 2, 1990 (USFWS 1990). This listing status applies to the entire population of desert tortoise, except in Arizona south and east of the Colorado River, and in Mexico. An approved recovery plan has been published by USFWS (1994). The desert tortoise was listed as threatened under CESA on June 22, 1989 (CFGC 1989). No federally designated critical habitat for the desert tortoise occurs within the RE Crimson Permitting Boundary, but it is adjacent to the RE Crimson Permitting Boundary on the western side in the Chuckwalla Critical Habitat Unit within the Colorado Desert Recovery Unit.

The desert tortoise is widely distributed in the deserts of California, southern Nevada, extreme southwestern Utah, and western and southern Arizona, and throughout most of Sonora, Mexico. Desert tortoise primarily occurs in four subpopulations in the California Mojave Desert (Ord-Rodman, Superior-Cronese, Fremont-Kramer, and Joshua Tree DWMAs). Outside of these DWMAs, desert tortoises tend to occur at much lower densities. Populations of desert tortoise over about 50% of its U.S. range (30% of its overall range) began declining in the late 1960s and early 1970s (USFWS 1990; 1994). These declines have been attributed to several factors, including an upper respiratory tract disease, habitat loss and fragmentation due to urbanization and off-road vehicular use, illegal collecting and vandalism by humans, and predation on young desert tortoise, especially by common ravens. Common raven populations, for example, have exploded with the increasing use of the deserts by humans and their discarded garbage, a prime food source for ravens. Scientists believe that disease-related mortality may be a result of multiple factors including drought, poor nutrition, environmental toxicants, or habitat degradation such as exotic plant invasion and fire (USFWS 2011).

Suitable landscapes for desert tortoise are generally defined as alluvial fans and plains and rocky slopes at elevations of 1,969 to 3,937 feet above sea level (USFWS 2008). There have been studies regarding slope and aspect preference for desert tortoise (Weinstein 1989; Andersen et al. 2000). Desert tortoises choose sites based on surface conditions, which are influenced by a complex interaction between climate and topography (Nussear et al. 2009). Desert tortoises require soils that can support burrows but also allow for excavation (Andersen et al. 2000). In some cases, desert tortoises take advantage of existing natural shelters such as rock formations or exposed calcic soils horizons (Nussear et al. 2009). Within the Project area, desert tortoise burrows were also found at the base of big galleta grass clumps where the roots provided the structure necessary to hold the sandy soil intact to allow for burrowing.

The presence of ephemeral plant species is an indicator of habitat suitability for the desert tortoise because ephemeral plants are the primary components of the desert tortoise diet (Esque 1994; Jennings 1997; Avery 1998). Generally desert tortoises prefer creosote bush scrub habitat with a high diversity and cover of perennial plant species and high productivity of ephemeral plants.

The diet of desert tortoises consists of herbaceous perennial and annual wildflowers, as well as perennial grasses and the fresh pads and buds of some cactus species (Berry and Duck 2010). When available, tortoises also consume certain non-native plant species such as red-stem filaree (*Erodium cicutarium*) and red brome (*Bromus rubens*) (USFWS 2011). Tortoises typically have overlapping home ranges averaging between 5 to 131 acres, which can fluctuate in size on a year-to-year basis due to the sex of the tortoise, rainfall, availability of resources, or other factors (Berry 1986; Duda 1999; CDFG 2000). Lifetime home ranges of desert tortoise can cover 964 acres or more (Berry 1986). Individuals commonly traverse 1,500 to 2,600 feet/day within their home range and males have been recorded traveling up to 3,200 feet/day within their home range. Mojave desert tortoises are also known to disperse over more extended distances (10,032 feet [1.9 miles] in 16 days and 23,760 feet [4.5 miles] in 15 months) (Berry 1986).

Variations in habitat quality within the Project area are primarily a result of greater water availability associated with mountainous areas and large drainages around the base of the Mule Mountains. The drainages that flow north from the base of the Mule Mountains provide areas of relatively higher productivity of forage and suitable burrowing habitat for desert tortoise, compared to the sandy areas on the north and west sides of the Project site. Generally the habitat diversity was greater near the base of the Mule Mountains particularly within the washes (microphyll woodlands) and as the woodlands fanned out to the north, toward I-10 and the vegetation because sparse, the desert tortoise sign decreased with increasing distance from the Mule Mountains.

Desert tortoises are known to use low-quality intermountain habitat as dispersal routes over time, providing passage between high-quality habitat areas in the surrounding mountains (Averill-Murray and Averill-Murray 2005). Historically, tortoise populations in the Sonoran Desert have exchanged individuals at a rate of one migrant per generation (Averill-Murray and Averill-Murray 2005). Maintaining connectivity between the Mule Mountains and the surrounding McCoy and Little Chuckwalla Mountains is critical to ensure genetic heterogeneity within desert tortoise populations.

The climate and vegetation within the Project site are consistent with the Sonoran Desert rather than the Mojave Desert. This consistency may be key in explaining the distribution of desert tortoise in this area. Precipitation and temperature correlate to elevation, aspect, and geographical location in the desert. Precipitation events such as the monsoon, which are important for desert tortoises in the Sonoran Desert, are highly dependent on local orographic effects from topographic features such as mountains, and vary significantly from one area to another (Nussear et al. 2009). Within the Mojave Desert, the rainfall is a Mediterranean winter rainfall as opposed to a bimodal rainfall pattern with important summer monsoon rains in the Sonoran Desert. This rainfall may help explain why desert tortoises are more abundant in the Mule Mountains and alluvial fans and drainages associated with the Mule Mountains rather than in the desert valley areas stretching toward I-10 and the CRS.

*2012 Survey Results*

Observations made during focused desert tortoise surveys and incidental observations made during all biological surveys conducted in fall 2011 and spring 2012 were noted. Focused survey observations in the SWP Site consisted of 20 live adult desert tortoise and one live juvenile desert tortoise (plus an additional adult in the expansion area and two additional adults in the ZOI for a total of 24 desert tortoise observed during focused surveys), 77 carcasses (plus an additional 35 in the expansion area and three in the ZOI; these include carcass/bone fragments and do not necessarily indicate a complete desert tortoise carcass was detected), 111 instances of scat (plus an additional nine in the expansion area and seven in the ZOI) and 189 burrows (plus an additional 26 in the expansion area and 15 in the ZOI). The highest abundance of desert tortoises and desert tortoise sign were located along the southeastern edge of the SWP Site in the area at the base of the Mule Mountains. Incidental observations are excluded from the focused desert tortoise survey results and population estimates because they may include repeat counts of individuals, burrows, and/or signs, which were not part of a sampling design for estimation of populations. A summary of observations made during both focused desert tortoise surveys and incidental observations from all other surveys is provided in Table 4-5. Observations of desert tortoise sign in the SWP Site plus expansion area, 500-foot buffer and ZOI are shown in Figure 7 while live tortoise observed are shown in Figure 8.

The CDFW Desert Tortoise Species Account (CDFG 2000) states that typical desert tortoise densities are approximately nine tortoises per square mile in the eastern Mojave Desert. Additionally, a 10-year research project conducted in the

California Mojave Desert by the BLM estimated desert tortoise densities from 21 to 467 desert tortoises per square mile (eight to 184 desert tortoises per kilometer$^2$)(Berry 1986). The estimated density of desert tortoise within the SWP Site (USWFS protocol estimated 1.8 tortoises per square mile) is substantially lower than the densities reported by CDFW and BLM.

**Table 4-5. Desert Tortoise and Sign Detected During Biological Surveys in 2011/2012**

| Observation Type | Focus Survey Detections in SWP Site | Focus Survey Detections in Expansion Area | Incidental Detections[1] |
|---|---|---|---|
| Live Desert Tortoise | 21[2] | 1[2] | 27 |
| Active Tortoise Burrow (class 1) | 35 | 1 | Not recorded |
| Inactive Tortoise Burrow (classes 2 and 3) | 99 | 14 | Not recorded |
| Possible Tortoise Burrow (classes 4 and 5) | 55 | 11 | Not recorded |
| Total Burrows | 189[3] | 26[3] | 122[3] |
| Tortoise Carcass[4] | 77 | 35 | 93 |
| Tortoise Scat | 111 | 9 | 35 |
| **Total** | **398** | **70** | **275** |

Notes:

[1] Numbers listed may include repeat counts of the same tortoise or sign

[2] Excludes two tortoises observed in ZOI, includes one juvenile and 20 adult tortoises

[3] Class 1, 2, 3, 4, and 5 burrows

[4] Includes all carcass classes and carcass and bone fragments

The distribution of desert tortoise and sign throughout the SWP Site was concentrated along the southeastern edge and corner of the SWP Site bordering the Mule Mountains (Figures 7 and 8). The soils in this area of the SWP Site are more compact and less sandy compared to the soils on the rest of the site. These soils are better suited for tortoise burrowing activities. Additionally there are multiple small ridges, washes, and topographic undulations where desert tortoise burrows were located.

The results of the protocol tortoise survey (20 adult desert tortoises) were entered into the USFWS formula for estimating the adult tortoise population and, according to the formula, the SWP Site is estimated to support approximately 50 adult desert tortoises (with 95% confidence range of 19 to 135 individuals). Assuming an equal sex ratio, 150 eggs and 387 juveniles are estimated to also occur within the SWP Site (Croft 2010).

*2016 Survey Results*

To review, the desert tortoise survey area in the fall of 2016 included the Project area (RE Crimson Permitting Boundary plus the adjacent microphyll woodlands) and a 500-foot buffer on the southern and eastern side of the RE Crimson Permitting Boundary. A team of eight biologists covered the entire desert tortoise survey area in 2 ½ weeks from October 3 to 19, 2016. Biologists surveyed 1,680 acres with 20-meter-wide transects and 1,957 acres with 10-meter-wide transects. A 500-buffer on the southern and eastern sides around the Mule Mountains was surveyed with 10-meter-wide transects, and ZOI transects were not walked (Figure 9). A total of 20 desert tortoises was found, which included 17 adults (greater than 160 millimeter [mm]) and three juveniles (less than 160 mm)(Figure 10). Of the 17 adult tortoises found, two of them were just outside of the 500-foot buffer toward the Mule Mountains, and they were not included in any

USFWS desert tortoise density calculations. Of the adults, only two were found directly within the RE Crimson Permitting Boundary. All others were within the microphyll woodlands, or buffer area. No desert tortoises were found in the area that was surveyed by 20-meter-wide transects, and there was very little recent desert tortoise sign in that area. Most of the habitat covered by the 20-meter-wide transects was sandy with sparse vegetation and included active windblown sand habitat that was relatively flat. The area covered by 10-meter-wide transects was generally more topographically diverse, had greater soil stability, and the majority of the washes were located in these areas. The 10-meter-wide transects covered the area around the base of the Mule Mountains and had a much higher percentage of desert tortoise sign.

The majority of desert tortoises were located within an elevational band around the base of the Mule Mountains between 550 to 700 feet AMSL. This area was characterized by relatively low vegetative cover at the time of surveys, but contained multiple small hills, ravines, washes, and topographic undulations that were dotted with desert tortoise burrows. A total of 158 desert tortoise burrows was detected across the Project area during surveys in 2016. A large concentration of the burrows was located within a region around base of the Mule Mountains. At times there were multiple burrows adjacent to each other, and some appeared to represent desert tortoise burrow complexes. The numbers of scat, burrows, and carcasses in Table 4-6 is a representation of what was found during the fall 2016 surveys and is not meant to be construed as an absolute number. Additionally, within the burrows there were often pieces of scat, tracks, and sometimes eggshell fragments at the apron of burrows.

Desert tortoises were generally found resting and sunning at the apron to their burrows, or relatively close to their burrows in the morning hours and were occasionally observed walking around and foraging on big galletta grass and desiccated annuals. At the time of surveys in October, there had been no monsoonal rainfall within the desert tortoise survey area; therefore, the vegetation was dry and showed little sign of vegetative growth.

**Table 4-6. Desert Tortoise and Sign Detected During Focused Desert Tortoise Surveys in 2016**

| Desert Tortoise Sign | Type[1] | RE Crimson Permitting Boundary | Desert Tortoise Survey Area (outside of the RE Crimson Permitting Boundary) | 500-foot buffer | Total |
|---|---|---|---|---|---|
| **Live desert tortoise** | Adult | 2 | 5 | 8 | 15[2] |
| | Subadult/Juvenile (less than 160 mm) | 0 | 0 | 3 | 3 |
| | *Total* | 2 | 5 | 11 | 18[2] |
| **Burrows** | Class 1 | 0 | 8 | 16 including 4 with a desert tortoise in them | 24 |
| | Class 2 | 2 | 24 | 45 | 71 |
| | Class 3 | 1 | 9 | 8 | 18 |
| | Class 4 | 2 | 19 | 9 | 30 |
| | Class 5 | 3 | 7 | 5 | 15 |
| | *Total* | 8 | 67 | 83 | 158 |
| **Scat** | Class 1 | 0 | 0 | 0 | 0 |
| | Class 2 | 0 | 3 | 5 | 8 |
| | Class 3 | 1 | 10 | 17 | 28 |
| | Class 4 | 4 | 14 | 23 | 41 |

| Desert Tortoise Sign | Type[1] | RE Crimson Permitting Boundary | Desert Tortoise Survey Area (outside of the RE Crimson Permitting Boundary) | 500-foot buffer | Total |
|---|---|---|---|---|---|
| | Class 5 | 2 | 18 | 16 | 36 |
| | *Total* | 7 | 45 | 61 | 113 |
| **Carcasses (Shell Remains)** | Class 1 | 0 | 0 | 0 | 0 |
| | Class 2 | 0 | 0 | 0 | 0 |
| | Class 3 | 0 | 0 | 0 | 0 |
| | Class 4 | 0 | 0 | 0 | 0 |
| | Class 5 (intact carcass) | 1 | 0 | 1 | 2 |
| | Class 5 (scattered bone/shell fragments) | 89 | 72 | 26 | 187 |
| | *Total* | 90 | 72 | 27 | 189 |
| **Tortoise Fossilized Bones** | | 3 | 0 | 0 | 3 |
| **Tortoise Tracks** | | 4 | 3 | 3 | 10 |
| **Tortoise Egg Shell Fragments** | | 0 | 2 | 1 | 3 |

Notes:

[1] Classified using the Information Index for Desert Tortoise Sign: Burrows and Dens, Scats and Shell Remains as in the USFWS Protocol (USFWS 1992).

[2] Two adult desert tortoises were found just outside of the 500-foot buffer and, therefore, are not included here.

The following burrow, scat, and shell remain class definitions were followed from the USFWS *Field Survey Protocol for any Non-Federal Action That May Occur within the Range of the Desert Tortoise* (protocol) (USFWS 1992).

(1) Burrows/Dens:

1. currently active, with tortoise or recent tortoise sign
2. good condition, definitely tortoise; no evidence of recent use
3. deteriorated condition (please describe); definitely tortoise
4. deteriorated condition; possibly tortoise (please describe)
5. good condition; possibly tortoise (please describe)

(2) Scats:

6. wet (not from rain or dew) or freshly dried; obvious odor
7. dried with glaze; some odor; dark brown
8. dried; no glaze or odor; signs of bleaching (light brown), tightly packed material

9. dried; light brown to pale yellow, loose material; scaly appearance
10. bleached, or consisting only of plant fiber

(3) Shell Remains:

1. fresh or putrid
2. normal color; scutes adhere to bone
3. scutes peeling off bone
4. shell bone is falling apart; growth rings on scutes are peeling
5. disarticulated and scattered

The 17 adult desert tortoises (including the two adults just outside of the 500-foot buffer) were comprised of eight adult males and nine adult females (some were not conclusively sexed due to their location in a burrow or underbrush) with a roughly equal sex ratio. Most of the adult desert tortoises were located within or near to a burrow, but at least four of them were observed walking within or near a wash. None of the adult desert tortoise showed any indicative signs of clinically advanced upper respiratory tract disease, and only one female was observed with two ticks on the outside of her shell.

The three juvenile desert tortoises were located very close to each other in adjacent washes, and two of them were several hundred feet apart and appeared to be the same size. The third juvenile was slightly larger and located slightly further away. All three appeared healthy and did not show signs of attempted depredation. No common ravens were observed when the juvenile desert tortoises were detected and none of the desert tortoise carcasses found were from young desert tortoise that had recently died (no signs of common raven predation were evident).

All the desert tortoise carcasses were old, primarily disarticulated, and highly bleached. Many of them were a few bones, pieces of shell, and scattered around. Occasionally pieces were found upstream in a wash, and then more pieces were found further downstream and could have originated from the same carcass. To simplify the mapping, bone fragments that were greater than 10 meters apart were mapped separately, even though they could be from the same carcass. There were no desert tortoise carcasses that were fresh, putrid, or were from desert tortoise that had died in the past several years. Several of the desert tortoise bones found in the sandy flats around the CRS appeared fossilized.

Data from the Project were inputted into the USFWS formula in Table 3 with several different metrics to determine the range of potential desert tortoise within the Project area. The area covered by 20-meter-wide transects (the northern area) was approximately 46% (1,680 acres) of the desert tortoise survey area, and the area covered by 10-meter spaced transects (the southern area) comprised 54% (1,957 acres) of the desert tortoise survey area. While 20 individual desert tortoises were detected during surveys in fall 2016, three of them were juveniles (less than 160 mm mean carapace length [MCL]; therefore, they were excluded from the calculations), and two of the adults were just outside of the 500-foot buffer (they were excluded from the calculations). The rainfall for the previous winter (October 2015 through March 2016) was calculated at 1.45 inches or 37 mm, based on rainfall measured at the Blythe airport (The Weather Company 2017) and therefore the probability that a desert tortoise is above ground was 0.64.

The southern area, covered by 10-meter-wide transects plus a 500-foot buffer on the southern and eastern sides of the Project, equaled 1,957 acres. A total of 792 km of transects was walked, spaced 10 meters apart but had unequal transect lengths that varied from 1 km to 10 km long. Therefore, 108 transects were walked, and 15 adult desert tortoise were found. With this method, N = 37.2, the lower 95% Confidence Interval (CI) was 13.81, and the upper 95% CI was

100.21. Therefore, the southern area is estimated to contain 37 adult desert tortoises with CIs of 14 to 100 adult desert tortoises.

The northern part of the desert tortoise survey area that contained 20-meter spaced transects could not be directly inserted into the USFWS Table 3 because the transect spacing was larger than 10 meters. The USFWS requested the desert tortoise data from fall 2016 surveys to run the calculations and define the best approach to determine the potential number of desert tortoise within the northern area. Per dialogue with the USFWS on January 27, 2017 (Sanzenbacher pers. comm. 2017c), they concluded the following:

1. The northern portion of the RE Crimson Project has a low habitat potential value equal to 0.3 (as defined by Nussear et al. 2009).

2. 100%-coverage surveys with 10-meter transects conducted in 2012 did not locate any live tortoise in this portion of the Project.

3. Surveys of this portion of the Project found only bone fragments in the area and no scat, burrows, or other sign.

4. Observations from a January 24, 2017, site visit by the USFWS suggest that this portion of the Project is largely unsuitable for desert tortoise habitation (i.e., deep, and active sandy substrate, sparse and deteriorating perennial vegetation, and lack of topographic diversity).

5. Therefore, the USFWS recommended that the northern area be assigned a desert tortoise count estimate of 0 tortoises with an undefined 95% CI.

When the desert tortoise density estimate for the northern part of the study area is combined with the southern part, there are an estimated 37 adult desert tortoises within the desert tortoise survey area, with a lower 95% CI of 14 tortoises and an upper 95% CI of 100 tortoises.

Several different techniques have been historically employed to estimate the number of small desert tortoises (juveniles subadults that measure less than 160 mm MCL) and the number of eggs. Estimating the numbers of small desert tortoises and eggs can be difficult because they are not easily detected during surveys due to their small size and cryptic nature, and because demographic variables (e.g., sex ratio, survival rate, fecundity, and age distribution) are not static from site to site. Of recent, estimation techniques have been based on the life-table presented in Turner et al. (1987), which was derived from a 4-year study of tortoise population ecology and is accepted as the most reliable, published life-table for the species. The exact method of applying Turner et al. (1987) has varied; however, in all cases, the estimated number of small tortoise tier from estimates of large tortoises (greater than 160 mm MCL).

As previously noted, estimates for the SWP study area were based on the 2012 dataset (point estimate of 50 large tortoises) and estimates of small tortoises and eggs were derived using a life-table worksheet (Croft 2010), which was adapted from Turner et al. (1987) and assumes that small tortoises account for approximately 89% of the total population.

Using the 2016 dataset for the RE Crimson study area (point estimate of 37 large tortoises) and applying the life-table distribution in Table 32 of Turner et al. (1987), which indicates that small tortoises account for approximately 85% of the total population, results in a potential for 203 small tortoises/eggs. Specifically within the RE Crimson Permitting Boundary, only two large desert tortoises were found, resulting in the estimated number of large tortoises to be approximately 5 individuals. Applying the life-table distribution in Table 32 of Turner et al. (1987) would result in the potential for 27 small tortoises/eggs. It should be noted that the number for small tortoises estimated above were based on the point estimates of large tortoises. A greater range of estimated individuals would result if the 95% confidence intervals are used.

Yuma Ridgway's Rail

The Yuma Ridgway's rail is a federally endangered and California threatened and fully protected species that in California breeds along the Lower Colorado River and around the Salton Sea. The species prefers freshwater marshes with cattails and bulrushes that are greater than 6 feet tall, with emergent vegetation and shallow (less than 12 inches) open water (USFWS 2010). The species is non-migratory; however, Yuma Ridgway's rails disperse throughout wide areas of the southwest. Yuma Ridgway's rails are capable of long-distance movements for several reasons: dispersal by juveniles, dispersal of unpaired males, movements of post-breeding adults, movements during winter, and home-range shifts associated with high water (Eddleman 1989). The Yuma Ridgway's rail has shown recent range expansions northward from the Colorado River Delta and the southern end of the Colorado River into Lake Mead and the Virgin River (USFWS 2006, 2010b). The closest known breeding locations for Yuma Ridgway's rails are along the Colorado River approximately 16 miles northeast at the Palo Verde Ecological Reserve and approximately 25 miles to the southeast at the Cibola National Wildlife Refuge. There have been two Yuma Ridgway's rails found dead at solar projects in recent years. One Yuma Ridgway's rail mortality was noted at Desert Sunlight Solar Project in July 2013 (approximately 45 miles northwest of the RE Crimson Permitting Boundary) with a second Yuma Ridgway's rail mortality at Solar Gen 2 in Imperial County (approximately 41 miles southwest of the RE Crimson Permitting Boundary) (Roth 2014; Ironwood Consulting 2014). In addition, a live Yuma Ridgway's rail was detected on September 8, 2015 at the Blythe Solar Power Project during construction, approximately 8 miles to the northeast of the RE Crimson Solar Permitting Boundary. While there is no suitable breeding or foraging habitat for Yuma Ridgway's rail within the Project area, there is a potential for the species to fly through the site during dispersal or other long-distance movements.

***Western Yellow-Billed Cuckoo***

The western yellow-billed cuckoo is federally threatened and state endangered and currently breeds in the southwestern U.S. including California, Arizona, and New Mexico. Within Southern California, the species primarily breeds along the Colorado River, and the closest breeding location to Crimson is the Palo Verde Ecological Reserve in Blythe. Yellow-billed cuckoos typically arrive in Southern California around mid-to late May, with the majority arriving in mid-June and into early July (Corman 2005; Laymon 1998). Nesting typically occurs between late June and late July with nests placed in well-concealed dense vegetation (Halterman *et al.* 2015). Breeding habitat for western yellow-billed cuckoos includes low to moderate elevation riparian woodlands with native broadleaf trees and shrubs that are 50 acres or more in extent within arid to semiarid landscapes (Hughes 1999). Usually cottonwood-willow-dominated vegetation cover is the preferred nesting habitat in California and large blocks of continuous habitat are necessary. Western yellow-billed cuckoos tend to prefer younger stands of riparian vegetation that provide suitably dense breeding habitat and an abundance of prey insects (primarily large arthropods such as cicadas, katydids, grasshoppers, and caterpillars). The species usually has one brood per year, but more broods are possible in years of high prey abundance. The species typically leaves the breeding grounds between September and October to head to its winter range.

Western yellow-billed cuckoo winter range and migration routes are poorly known. The species is a Neotropical migrant that winters in South American east of the Andes in the Amazon basin and then migrates north to breed (Halterman *et al.* 2015). In 2014, one western yellow-billed cuckoo mortality was discovered at Ivanpah Solar Electric Generating System located in the Mojave Desert (Walston *et al.* 2015; Kagan *et al.* 2014; Ironwood Consulting 2014). A second yellow-billed cuckoo was found dead in a power block unit at the Genesis Solar Power Project approximately 10 miles to the northwest of June 24, 2015. The species migrates through the Mojave Desert and surrounding areas to reach breeding grounds. The lower Colorado River and its tributaries are migratory corridors (Halterman 2009). The RE Crimson Permitting Boundary is approximately 15 miles west of the Colorado River (and 18 miles southwest of the Palo Verde Ecological Reserve), so there is a low potential for the species to fly through during migration, as no suitable breeding habitat is present.

<u>Southwestern Willow Flycatcher</u>

The southwestern willow flycatcher is a federally  and state endangered species that breeds in New Mexico, Arizona, Southern California, Nevada, Utah, and possibly west Texas (Rourke et al. 1999). All subspecies to the southwestern willow flycatcher are state listed as threatened in California. The primary factor responsible for the decline of the southwestern willow flycatcher is habitat loss, exacerbated by nest predation and brood parasitism by brown-headed cowbird (*Molothrus ater*) (Rourke et al. 1999). The southwestern willow flycatcher is a Neotropical migrant that breeds in riparian forests with a distinct vegetation structure: a dense understory where nests are built, a moderately closed canopy, and an open foraging area at mid-story. Southwestern willow flycatcher breeding habitat is also characterized by actively changing hydrology, frequently including standing water, but also dry areas that have flooded within the past few years and retain the appropriate vegetation structure. In California, less than 5% of appropriate riparian habitat remains from when California achieved statehood in 1850 (Kus 2003). The closest known breeding location to the RE Crimson Permitting Boundary is the Palo Verde Ecological Reserve, located approximately 18 miles northeast along the Colorado River in Blythe.

While the southwestern willow flycatcher is the only subspecies of the willow flycatcher (Empidonax traillii) to breed in Southern California, willow flycatchers that breed in more northerly latitudes migrate north through the California deserts. It is not uncommon to find willow flycatchers in spring and fall migrating through desert oasis and desert riparian areas. Data from eBird show many records of willow flycatchers scattered throughout the desert, with the closest location at Wiley's Well (eBird 2017). However, the southwestern willow flycatcher subspecies population is very small compared to other willow flycatcher subspecies. The most recent rangewide synthesis of survey data for the southwestern willow flycatcher, completed in 2007, documented 1299 territories across the subspecies range (Durst et al 2008). In contrast, the number of willow flycatchers (all subspecies) that migrate through western North America (and potentially southern California) is estimated at greater than 3 million birds (Partners in Flight Science Committee 2013). Therefore, there is a moderate potential for willow flycatchers to migrate through the microphyll woodlands between the RE Crimson Permitting Boundary, but a low potential that they would be of the southwestern subspecies. For example, one dead willow flycatcher identified to the non-listed subspecies brewsterii was detected at the Desert Sunlight Solar Project along the gen-tie line during the second quarter 2014 mortality surveys, approximately 45 miles northwest of RE Crimson Permitting Boundary (Ironwood Consulting 2014; Sanzenbacher 2019]).

***State Listed Wildlife Species***

Four wildlife species listed only under the CESA occur or have a potential to occur or migrate through the RE Crimson Permitting Boundary: Swainson's hawk, elf owl, gila woodpecker, and bank swallow. Of these, only Swainson's hawk and bank swallow were observed within the RE Crimson Permitting Boundary. All four species are discussed in detail below, including their occurrence in the region, surveys that were conducted, and species presence or potential to occur within the RE Crimson Permitting Boundary. The locations of State-listed avian species that were detected during surveys in 2016/2017 are included in Figure 17.

<u>Swainson's Hawk</u>

Swainson's hawk is a state threatened species that breeds throughout much of the Rocky Mountains and western Great Plains, from southern Alberta and Saskatchewan in Canada to northern Mexico. Its breeding range in California is limited to the central and northern portion of the state, particularly the central valley; however a few pairs breed within the Antelope Valley. It is most often found in grasslands, shrubs, and agricultural areas, where both open land for foraging and trees for roosting and nesting are available. Ground squirrels, gophers, voles, mice, small birds, lizards, insects, and snakes comprise the majority of the hawk's prey. A decline in Swainson's hawk populations has been reported across much of the species' range over the past 50 years. Loss or degradation of nesting, foraging, wintering, and migration stop-over habitat contribute the primary reasons for population decline; however, illegal shooting and electrocutions on power lines have contributed to fatalities.

Within the deserts of Southern California, Swainson's hawks feed on spring eruptions of sphinx moth caterpillars within sandy habitats. The species is a regular spring migrant through the California deserts, with large flocks often reported around the agricultural fields in Blythe. Foraging habitat is present for Swainson's hawk, and the species was documented migrating and foraging in the Project area. However, the Swainson's hawk is not expected to breed in the Project area because of the lack of suitable nesting trees and the absence of breeding records in the Colorado Desert, even historically when the species was more common (Grinnell and Miller 1944; Garrett and Dunn 1981).

There were nine observations of Swainson's hawk during the spring 2012 migratory bird surveys. This species does not breed within or around the SWP Site or Project area, as it is outside of the species' breeding range, and observed individuals were migrants. Within 2016/2017 there were several observations of migratory Swainson's hawks flying over the Project area. Most migrating Swainson's hawks were recorded in late September and early October of 2016 and in late March and early April of 2017. There were several single birds observed flying over the Project area and one group of five birds on September 22, 2016, 15 birds on October 6, 2016, and a large group of 80 birds on March 23, 2017 (Figure 17).

Elf Owl

The elf owl is a state endangered species whose current range extends northward of the U.S.-Mexico border into portions of Southern California, southern Arizona, New Mexico, and southern and western Texas (Halterman, Laymon, & Whitfield 1987). In California, elf owls are distributed primarily along the Lower Colorado River Valley, where they are usually associated with riparian woodlands and immediately adjoining habitats, such as mesquite thickets. However, historical sightings have also been reported in desert oases to the west of the Project in the Corn Springs and Desert Center areas (eBird 2017). Most recently, the species was detected in 2017 in Joshua Tree National Park (Rodriguez pers. comm. 2017b).

The elf owl's main diet consists of arthropods captured while in flight, although they have been occasionally observed hunting small lizards (Ligon 1968). They typically hunt from an elevated perch located most commonly in tall cottonwood, sycamore, willow, mesquite, or saguaro overlooking open habitat (Ligon 1968). Elf owls arrive in California by March, and their breeding period extends from April to mid-July (Gould 1987). Unless depredated early in the breeding season, elf owls typically have only one brood. This estimation is based largely on the length of the incubation and young rearing stages, approximately 24 days and 28 to 33 days, respectively (Ligon 1968).

Habitat conditions in the Project area consist of sparsely scattered palo verde and ironwood trees. Elf owls throughout their range are not typically associated with microphyll woodland habitat, and are more commonly found in habitat supporting saguaro cactus or cottonwood and willow thickets (Gould 1987). The microphyll woodland present in the Project area supports low quality habitat for nesting elf owls due to a lack of trees large enough for nest cavities and areas of riparian woodland. Riparian areas contain mature trees that provide suitable nesting cavities due to an increased prevalence of primary cavity nesting birds (woodpecker species), but also a more stable and prevalent prey base. Presently, elf owls are more widely distributed and abundant outside of California and historically are not exceptionally abundant in California as California represents the extreme western limit of their range (Henry and Gehlbach 1999).

*2012 Survey Results*

There were no observations of elf owls during the three rounds of spring 2012 elf owl surveys (Figure 13). If present on more than a transient basis, elf owls would likely have been detected during the three survey rounds. The microphyll woodland habitat in the elf owl survey area does not support the saguaro-dominated or riparian areas that comprise the species' preferred habitats. The microphyll woodlands also sustain a low number of nesting cavities and a generally smaller prey base compared with saguaro-dominated or riparian areas. Finally, elf owl use of the non-saguaro and non-riparian areas that characterize the SWP Site for nesting would be atypical, particularly since the species' preferred habitat is located and accessible in other locations in the vicinity (e.g., Colorado River east of the site).

*2017 Survey Results*

One survey was conducted on May 30 and 31, 2017, with a second survey conducted on June 20 and 21, 2017 within the four major areas of microphyll woodland within the Project area (Figure 13). Similar to the 2012 survey results, no elf owls were detected within the Project area. There were three potential tree cavities within microphyll woodlands that were checked on each survey and no elf owls were detected. One of the tree cavities was occupied by a ladder-backed woodpecker (*Dryobates scalaris*). Generally, the microphyll woodlands do not contain trees with enough cavities, or cavities of the correct size to support breeding elf owls. One known population of elf owls at the Bill William National Wildlife Refuge (65 miles northeast of the Project area) was checked prior to the start of surveys to compare an area of occupied habitat to the Project area and determine the stage of nesting for elf owls in the region. The microphyll woodlands within the Project area lack the density of trees, and other vegetation that supports nesting cavities and a prey base for elf owls. An elf owl may occasionally migrate through the Project area; however, the species is unlikely to breed due to a lack of suitable breeding cavities. The microphyll woodlands are relatively open and contain trees and shrubs without large trunks or snags that are dead and hollow. There are very few woodpecker species within the Project area and, therefore, few species to create tree cavities. There is much higher quality suitable habitat to the west of the site within Wiley's Well Wash, and to the east along the Colorado River.

<u>Gila Woodpecker</u>

Gila woodpeckers, a state endangered species, are conspicuous, permanent residents across their range in southeastern California, southern Nevada, central Arizona, and southwestern New Mexico (Alcorn 1988, Edwards and Schnell 2000, Hubbard 1978). Small populations are also found through Baja California and western Mexico from the U.S.–Mexico border south to Central Mexico (Wilbur 1987, Howell and Webb 1995; American Ornithologists' Union 1998).

Morphologically, gila woodpeckers are better adapted for soft-wood excavation; therefore, nesting habitat is restricted to desert mesas supporting large saguaro cacti or riparian woodlands, xeric-riparian woodlands, and human-altered environments with large softwood tree species, hardwoods with pre-existing cavities or decaying hardwood snags (Hunter 1984). Dominant tree species used for nesting include riparian woodlands-Fremont cottonwood (*Populus fremontii*) and Goodding's willow (*Salix gooddingii*); xeric-riparian woodlands-blue palo verde and ironwood; saguaro scrub communities -giant saguaro (*Carnegia gigantea*); in human-altered environments -various palms, eucalyptus (*Eucalyptus* spp.), and Athel tamarisk (*Tamarix aphylla*) (Edwards and Schnell 2000).

In California, gila woodpeckers tend to be restricted to dense riparian woodlands along the Lower Colorado River Valley and eastern Imperial Valley where ample nesting habitat exists. Many of the few remaining patches of dense riparian woodlands in California that support gila woodpecker are found in public parks and private residential settings with a high amount of human disturbance (Hunter 1984).

There are no known gila woodpecker locations within 10 miles of the Project area; however, the species is known to occur to the west at Lake Tamarisk in Desert Center, Corn Springs, and to the east in and around Blythe and along the Colorado River (eBird 2017). Within these areas, the species appears to use large palm trees for nesting in addition to other tree species.

*2012 Survey Results*

During the breeding season, six full-coverage surveys were conducted for gila woodpecker from April 12, 2012, to June 1, 2012 within microphyll woodlands. No gila woodpeckers were detected during the 2012 gila woodpecker focus surveys.

*2016/2017 Survey Results*

No focused surveys for gila woodpeckers were conducted, and none were recorded during any of the avian surveys or other biological surveys conducted within the Project area. There are known locations on both the western and eastern sides of the Project area that the species may occasionally fly through; however, the Project area lacks trees that are large enough to support nesting cavities for the species. No tree cavities large enough to support gila woodpeckers were detected.

Bank Swallow

Bank swallow, a state threatened species, breeds over most of central North America from Arkansas northward to Alaska, then eastward to the Atlantic Provinces and south into Virginia. They winter throughout most of South America. In California, the bank swallow is a locally common to uncommon breeding season resident restricted to northern and central California. Bank swallows nest exclusively in the fresh banks or earthen walls cut by moving water, usually at lower elevations. They prefer meandering streams and rivers. Artificial banks created incidentally by mining are also used. Foraging and migrating occur over fields, streams, wetlands, farmlands, and still water. No specific focused surveys were conducted for bank swallows during 2011/2012 or 2016/2017. There were two observations of migrant bank swallows during the spring 2012 migratory bird surveys. One bank swallow was detected on August 25, 2016, migrating through the Project area during avian surveys in 2016/2017 (Figure 17). Like many of the swallow species seen migrating through the Project, the bank swallow observed in 2016 it was flying at a low altitude of approximately 10 feet above the ground.

***Non-listed Special-Status Wildlife Species***

This section describes the non-listed special-status wildlife species that were detected during the biological surveys (or are potentially present) for the SWP Site or within the Project area (per Table 4-6), including species that are State SSC, BLM Sensitive, NECO SS, and DRECP FS and PS. Reptile species are described first, then avian species, and finally mammal species. Special-status wildlife species that are included in Table 4-6 above, but were not detected during surveys within the SWP Site or the Project area, are not included below.

Mojave Fringe-toed Lizard

Mojave fringe-toed lizard, a State SSC, BLM Sensitive, NECO SS, and DRECP FS, inhabit areas of fine windblown Aeolian sand in the Mojave Desert from the southern portion of Death Valley, south of the Colorado River near Blythe, California, and into western Arizona. Suitable habitat includes sparsely vegetated arid areas with fine wind-blown sand including dunes, isolated pockets along hillsides, and flats with sandy hummocks formed around the bases of vegetation. The elevation range for this species is approximately 300 to 3,000 feet (Stebbins 2003; Espinoza 2009). Mojave fringe-toed lizards can be found in both large and small dunes, margins of dry lakebeds and washes, and isolated dune pockets against hillsides (Stebbins 1944, 1985; Smith 1946; Norris 1958), generally within creosote scrub desert habitat (Norris 1958; Stebbins 1985). Shade from plants may be necessary for thermoregulatory burrowing (Muth 1991). Because Mojave fringe-toed lizards are dependent on loose, windblown sand habitat, disruption of the dune ecosystem, including source sand, wind transport, or sand transport corridors, poses a threat to the habitat needed for Mojave fringe-toed lizards. Preservation of sand dune ecosystems, including their source sand and sand corridors, is necessary for the long-term survivorship of Aeolian sand specialists such as Mojave fringe-toed lizards (Barrows 1996). Mojave fringe-toed lizards require fine, loose sand for burrowing, and will bury themselves in the sand or dart into a rodent burrow to avoid predators (Stebbins 2003). Adults burrow into the sand and hibernate from November to February. The Mojave fringe-toed lizard's diet includes small invertebrates such as ants, beetles, grasshoppers, spiders, and antlion larvae. Plant buds, stems, leaves and seeds are also consumed (Miller and Stebbins 1964, Kaufmann 1982). Clutches of one to five eggs are laid during the breeding period from April to July, and daily activity is temperature dependent (Mayhew 1964, Miller and Stebbins 1964). Common predators of Mojave fringe-toed lizard include snakes, long-nosed leopard lizard

(*Gambelia wislizenii*), American badger, burrowing owl, greater roadrunner, loggerhead shrike, hawks, coyotes, and other species (Espinoza 2009).

*2012 Survey Results*

Most Mojave fringe-toed lizard observations in the SWP Site were associated with windblown sand areas, including small wash areas containing fine sands. During the spring 2012 focused survey, there were 414 observations of Mojave fringe-toed lizards, and 138 observations of Mojave fringe-toed lizard sign (tracks). Biologists recorded 147 observations of Mojave fringe-toed lizards and their sign as incidentals observations during desert tortoise, fall and spring botany, and focused burrowing owl surveys (Figure 11).

*2016/2017 Survey Results*

No Mojave-fringe toed lizard surveys were conducted in 2016 or 2017. The species was incidentally detected during other biological surveys. The species was generally detected in the same places as 2012 surveys. The species was detected within sandy areas within the RE Crimson Permitting Boundary, but was generally absent from the microphyll woodlands and area of rocky substrate (Figure 11).

<u>Couch's Spadefoot</u>

Couch's spadefoot, a State SSC, BLM Sensitive, and NECO SS, is generally active at night during spring and early summer rains and can be found in temporary desert rain pools. Breeding generally occurs from May through September during rainfall periods. Couch's spadefoot is hard to detect except when it comes above ground to breed in ephemeral pools during intense monsoonal summer rain events (Thompson *et al.* 2016). The low frequency sound of the rain on the desert ground draws Couch's spadefoot out of their deep burrows (Dimmitt and Ruibal 1980). Otherwise, the species remains below ground in burrows. The aquatic lifecycle of this species (i.e., the time it takes the eggs to hatch into tadpoles and then metamorphose into toadlets) is approximately 8 to 10 days. They require friable soil for burrowing where they typically spend up to 11 months underground until sufficient rainfall has accumulated. Couch's spadefoot occupies a variety of habitat types, including desert dry wash woodland, creosote bush scrub, desert riparian, palm oasis, desert succulent scrub, shortgrass plains, mesquite savannah, and alkali sink scrub. In California, the Couch's spadefoot habitat lies within Imperial, Riverside, and San Bernardino Counties between 500 to 3,000 feet. The distances traveled between upland retreats and breeding sites is unknown, likewise, the precise terrestrial habitat requirements of adults or juveniles are also unknown (Thompson *et al.* 2016).

*2012 Survey Results*

Potential Couch's spadefoot habitat was mapped during biological surveys within the SWP Site in areas with dense creosote bush scrub and evidence of previously ponded water (such as dried, cracked, silty areas). Potentially suitable habitat was located along the north section of the gen-tie line corridor and along the access road from Wiley's Well to the CRS. After summer monsoonal rains in early July 2012, biologists visited all potential pool habitat to document ponding and survey for Couch's spadefoots. These pools were revisited approximately eight days after they formed to see if they remained inundated for the time required to fulfill the aquatic portion of the toad's lifecycle. Due to the large amount of permeable sand in the area, no pools were documented to hold water for more than a few days and no Couch's spadefoot were detected during focused surveys.

One Couch's spadefoot was incidentally detected on August 27, 2012, by a biologist walking to an avian point count (CDFW 2017b). This point is located at the western end of a broad wash on the western side of the Project. The biologist saw the toad walking out in the large wash, and no more information is provided in the CDNNB database, from which this point was found. There is no documentation provided within any of the SWP Site data. Therefore, it is assumed that Couch's spadefoot are present within the wash areas on the SWP Site.

*2016/2017 Survey Results*

While Couch's spadefoot surveys were not conducted during 2016/2017, potentially suitable habitat was mapped in a large, broad, wash along the eastern-most side of the Project (Figure 11). This area showed cracked soils and small depressions that indicate the presence of surface water for some period of time. Based on the surrounding dry, sparse, and spindly creosote bush scrub vegetation in the immediate vicinity and the sandy soils nearby, it is unlikely that the area would support surface water long enough to support breeding Couch's spadefoot (surface water must be present for 8 to 10 days). This wash is outside of the RE Crimson Permitting Boundary and therefore would be avoided. The potential Couch's spadefoot habitat that was documented within the SWP Site in 2012, is located north of, and outside of the Project. The Couch's spadefoot found in August 2012 is located in a wash that would also be avoided by the Project and is outside of the RE Crimson Permitting Boundary. Therefore, the species is considered to be potentially present within the Project area, but likely absent from the RE Crimson Permitting Boundary.

<u>Ferruginous Hawk</u>

Ferruginous hawk, a NECO SS, is known to spend the winter in Southern California, but does not breed in the area. Ferruginous hawks nest in the central U.S. and Canada, and winter in the southwestern part of North America. The species is found in prairies, deserts, grasslands, and other wide open areas where it eats small mammals and rodents. The species arrives in California to spend the winter as early as late September and may stay until April, before returning to the breeding grounds. Near the Project area, they generally overwinter in small numbers in the lower Colorado River Valley. Ferruginous hawk was not detected during surveys in 2012; however, several individuals were detected from October 2016 through March 2017 (Figure 17). Therefore the species is considered present as a wintering resident within the RE Crimson Permitting Boundary.

<u>Golden Eagle</u>

Golden eagle, a State FP, BLM Sensitive, NECO SS, and DRECP FS, is distributed throughout North America, although the species is an uncommon resident within California (Zeiner *et al.* 1990; Unitt 1984). Golden eagles forage in grassy and open shrubby habitats and nest primarily on cliffs, but are known to nest in large trees (e.g., oaks, sycamores). Breeding pairs may occupy territories of several square miles, within which they may often use several nest sites, shifting nest sites from year to year. This species' population has declined because of loss of foraging and nesting habitat to urban and agricultural development, illegal shooting, incidental poisoning of prey species (e.g., ground squirrels, prairie dogs), egg collecting, power line electrocution, and human disturbance at nest sites (Snow 1973; Johnsgard 1990; Scott 1985). While northern populations of golden eagles are migratory, often making trips of thousands of miles to the wintering grounds; golden eagle populations within Southern California tend to be resident year-round. Therefore, there is often an increase in golden eagles during the winter months.

While golden eagles are capable of killing large prey such as cranes, wild ungulates, and domestic livestock, they primarily subsist on rabbits, hares, ground squirrels, and prairie dogs (Bloom and Hawks 1982, Olendorff 1976). They will also prey on other bird species, such as red-tailed hawks, common ravens, turkey vultures, and feed on carrion. Golden eagles typically reach sexual maturity, form territories, and begin nesting at 4 years of age. Pairs generally stay within the limits of their territory, which can measure 20 to 30 $km^2$, and within that territory there can be as many as 14 nests (Bloom Biological 2012.) which a pair maintains and repairs as part of their courtship. Alternative nest sites within a territory are important, as eagles may use them on certain years for nesting and other years only add nesting material to their alternative nest sites. Kochert *et al.* (2002) also noted that the nesting season is prolonged, extending more than 6 months from the time the 1 to 3 eggs are laid until the young reach independence. A typical golden eagle raises an average of only one young per year and up to 15 young over its lifetime. Golden eagle pairs commonly refrain from laying eggs in some years, particularly when prey is scarce; therefore, the number of young that golden eagles produce each year depends on a combination of weather and prey conditions. During high prey years, more young can be raised, and during periods of prolonged drought golden eagles may not breed. Black-tailed jackrabbits (*Lepus californicus*) are a key prey species throughout much of their range, and eagle reproductive rates fluctuate with jackrabbit population cycles.

*2012 Survey Results*

No golden eagle individuals were observed during the protocol golden eagle surveys in spring of 2012 (Appendix D). No active or occupied golden eagle nests were identified within the 10-mile spatial buffer of the SWP Site for the 2012 breeding season (January through June). Three inactive nests were identified within the survey area, two in the northern portion of the survey area in the McCoy Mountains and one in the western portion of the survey area in the Little Chuckwalla Mountains (Figure 14). One cliff nest in the McCoy Mountains was documented on March 24, 2012, and was located 4.81 miles from the SWP Site. Another cliff nest in the McCoy Mountains was documented on March 24, 2012, located approximately 8.21 miles from the SWP Site. A third nest was located on March 25, 2012, on a cliff in the Little Chuckwalla Mountains, 7.07 miles from the SWP Site.

In addition to the inactive golden eagle nests, the locations of 41 other raptor or corvid nests of the following species: red-tailed hawk (27), turkey vulture (3, [*Cathartes aura*]) and common raven (11) were also documented. Based on the lack of active golden eagle nesting activity, it is likely that the ecology, geography, and topography of this local region do not lend themselves to successfully nesting eagles because of limited prey abundance (due to prolonged drought, scant vegetation, and limited water resources), and few cliffs or rock outcrops of the size that attract nesting eagles. Several of the cliffs that are structurally capable of supporting eagle nests do not have them perhaps in part because they have nesting red-tailed hawks and/or prairie falcons on them. Those cliffs that have no nests likely do not because the cliff is relatively short or is structurally incapable of supporting large eagle nest structures.

In addition to the focused golden eagle surveys, biologists conducted surveys for all species of birds from seven fixed observation points (four focused on non-raptors and three focused on raptors) from April 10, 2012, through May 31, 2012. Observation points for non-raptors were staffed for 8 hours per day on 3 consecutive days per week between April 10, 2012, and May 31, 2012. Qualified raptor biologists monitored raptor migration from the three established raptor points for 8 hours per day, 4 days per week, between April 17 and April 27, 2012, following methodology based on the HMANA Field Survey Technique (HMANA 2010). Additionally, 12 migratory bird transects were surveyed on a weekly basis from April 19, 2012, through June 1, 2012. Cumulatively, surveys were conducted during a time period when resident golden eagles would have been present and foraging at increased intensity, if any active nests with young were nearby. No golden eagles were observed by biologists during any of the surveys in 2012; therefore, golden eagle abundance and density are likely low within the SWP Site.

*2016/2017 Survey Results*

No focused golden eagle surveys were conducted; however, migratory bird observation points and transects were conducted, and no golden eagles were detected during any of these surveys which were conducted during a time of year to document both resident, migratory, and wintering golden eagles, if present.

One potential golden eagle-killed desert kit fox was detected the morning of March 3, 2017, by a biologist walking back from an avian transect (T1) outside of the southwestern corner of the Project (Figure 16). The biologist noted that the left hind leg muscle, parts of the back, and intestines were eaten; clumps of fur had been plucked from the carcass; and the meat was pulled off the carcass with no bones crushed (Conohan pers. comm. 2017). There were no coyote tracks near the carcass, and a set of large eagle tracks was observed nearby. The tracks measured over 5 inches from the middle talon to the hind talon and were consistent with the foot sizes of golden eagles. There were possible talon drag marks toward the carcass. While a golden eagle was never observed, and the carcass was revisited later in the afternoon with no golden eagles observed, this observation is highly suggestive that golden eagles are foraging around and likely within the RE Crimson Permitting Boundary.

*2018 Survey Results*

Golden eagle surveys via helicopter occurred during winter and spring 2018 with surveys on January 8 and 9 and March 14 and 15; these surveys encompassed a 10-mile radius surrounding the RE Crimson Permitting Boundary. The results of these surveys are contained in a separate report (Bloom Biological May 2018) provided to the Resource Agencies under separate cover to maintain confidential data (Appendix E).

Northern Harrier

Northern harrier, a CDFW SSC, breeds in North America from northern Alaska and Canada to the mid-and lower latitudes of the U.S., and south to northern Baja California. Within Southern California, the species occurs both as year-round resident birds, and during the winter the population is augmented by birds from more northerly latitudes. The species prefers open habitats with lookout perches such as shrubs or fence posts. These habitats include weedy borders of rivers, lakes, and streams, freshwater marshes, grasslands, weed fields, pastures, and some croplands (including alfalfa and melons). This species is often polygamous, with a single male mating with two or more females. It nests on the ground on mounds of dead reeds and grass in marshes or shrubby meadows. The northern harrier flies slowly and close to the ground while hunting and takes small animals, birds, reptiles, and insects by surprise. There was a single northern harrier observation (fly-over) during the spring 2012 bird surveys. No signs of breeding or nesting were observed during spring 2012 bird surveys. The species may migrate through the desert and occasionally forage within the SWP Site, however, due to the lack of moist habitats that are preferred foraging and breeding areas, the species occurrence is likely transitory.

In 2016/2017, there were two observations of migratory northern harriers flying over the Project area, one on November 3, 2016, and one on March 10, 2017 (Figure 17). This species may forage on small mammals and birds during migration, but there is no suitable breeding habitat within the Project area.

American Peregrine Falcon

The American peregrine falcon is federally and state delisted, but is still classified as a state fully protected species. In North America, the American peregrine falcon nests in Canada, U.S., and northern Mexico. The California breeding range, which has been expanding, includes the central and Southern California coast, inland northern coastal mountains, Klamath Mountains, Cascade Ranges, Sierra Nevada, and desert regions in Southern California. Peregrine falcons nest almost exclusively on protected ledges of high cliffs, primarily in woodland, forest, coastal habitat, and desert environments. Nest sites usually provide a panoramic view of open country, are near water, and are associated with a local abundance of passerine, waterfowl, or shorebird prey. Historically, peregrine falcons nested on cliff sides along the Lower Colorado River before the drastic population declines in the 1940s, 50s, and 60s due to eggshell thinning and nesting failure associated with dichlorodiphenyltrichloroethane (DDT) application. However, once again, the species has been documented nesting in more desert environments. In 2013, two peregrine falcon eyries were detected along the Lower Colorado River (one in Imperial County, California and one in Yuma County, Arizona) within a north-facing recessed ledge near water (Zuan *et al.* 2014). Additionally, a pair of peregrine falcons has been detected possibly breeding near the Ranger Station within Whitewater Canyon (eBird 2017). No cliff-sides or rocky outcrops suitable for nesting peregrine falcons are present on the Project area. There was a single incidental peregrine falcon observation during the fall 2011 botany surveys (Figure 17). No signs of breeding or nesting were documented during 2012 aerial golden eagle surveys. No peregrine falcons were detected during avian surveys in 2016/2017.

Prairie Falcon

The prairie falcon is a NECO SS species that is a permanent year-round resident within the deserts of the southwestern U.S. Within the deserts of Southern California, the species breeds in rock cliffs, crevices, and holes in rocks. They prefer to forage over open areas with sparse vegetation where they take birds, small mammals, and reptiles. They are known to perch on transmission towers and power poles while searching for prey. Prairie falcons were found throughout the SWP Site in 2012, and the RE Crimson Permitting Boundary in 2016/2017 (Figure 17). While no prairie falcon nests were found within 10-miles of the SWP Site in 2012, there is a high potential for the species to nest in the Mule Mountains and other nearby mountain ranges (BBI 2012). There is no suitable nesting habitat within or immediately adjacent to the RE Crimson Permitting Boundary; however, the entire RE Crimson Permitting Boundary is assumed to be suitable and occupied foraging habitat for prairie falcon. The area of the Mule Mountains to the east of the southern portions of the RE Crimson Permitting Boundary could provide suitable nesting habitat; however, there is a buffer area between the Project and the base of the mountains and no nesting habitat would be impacted by the Project.

Long-eared Owl

The long-eared owl, a State SSC, is broadly distributed throughout California except for the Central Valley, some developed coastal areas, and the Imperial Valley basin (Shuford and Gardali 2008). The species is a year-round resident, with seasonal variation and wanderings of individuals and groups, along with influxes from outside of the state during winter. Within the Colorado River basin, long-eared owl nests have been found in large trees over 10 km from the Colorado River in desert woodland habitat (Shuford and Gardali 2008). The species preys on a variety of rodents but require dense cover for nesting and roosting, suitable nest platforms (which may include the nests of other raptor or corvid species, mistletoe brooms, forks in trees, or piles of brush that are lodged in tree branches that provide a platform), and open foraging areas. In the desert regions of Southern California, the species will nest in tamarisk trees, blue palo verde, and ironwood. Long-eared owl was not detected in 2011/2012; however, one individual owl was detected on October 20, 2016, in the large eastern-most microphyll woodland wash between the RE Crimson Permitting Boundary (Figure 17). This bird was detected once during transect surveys during migration, and no nesting owls were found the following spring. Therefore this individual was likely transitory through the Project area. While there is marginally suitable nesting habitat for the species within the microphyll woodlands between the RE Crimson Permitting Boundary, there is higher quality habitat to the west in Wiley's Well Wash, and to the east along the Colorado River.

Short-eared Owl

The short-eared owl, a State SSC, has a patchy breeding distribution within California, and is much more common during the winter, when there is an influx of northerly breeding birds into the state. In the deserts of Southern California, the species breeds at scattered wetlands, such as Harper Dry Lake (Shuford and Gardali 2008). There are no known breeding records for the species along the lower Colorado River, likely due to the lack of the species preferred habitat- salt and freshwater marshes, irrigated alfalfa or grain fields, and ungrazed grasslands and pastures with vegetative cover between 12-20 inches (Holt and Leasure 1993). Open country with microtine rodents and sufficient herbaceous cover to conceal their ground nests is essential breeding habitat for short-eared owls. This habitat type does not exist within the RE Crimson Permitting Boundary; however, during the winter and migration, short-eared owls may be found in a variety of locations. One short-eared owl was incidentally detected during the surveys in 2011/2012 just south of the paved access road to the CRS in large creosote bush scrub habitat (outside of the RE Crimson Permitting Boundary). The species was likely a migrant moving through and is not expected to breed or winter in the area due to a lack of sufficient ground cover that the species prefers. No short-eared owls were detected in 2016/2017.

Burrowing Owl

The burrowing owl is a State SSC, BLM Sensitive, NECO SS, and DRECP FS. Suitable burrowing owl habitat consists of annual and perennial grasslands, deserts, and scrublands characterized by low-growing vegetation (Zarn 1974; CBOC 1993; Haug et al. 1993). Suitable burrowing owl habitat may also include trees and shrubs if the canopy covers less than 30% of the ground surface (DeSante *et al.* 1996). Burrows are the essential component of burrowing owl habitat, and both natural and artificial burrows provide protection, shelter, and nests for burrowing owl. Burrowing owls typically use burrows made by mammals such as desert kit foxes, ground squirrels, or American badgers, but also may use human-made structures, such as cement culverts; cement, asphalt, or wood debris piles; or openings beneath cement or asphalt pavement (Collins and Landry 1977; Trulio 1994). Where the ranges of burrowing owl and desert tortoise overlap, burrowing owl also use desert tortoise burrows.

In Southern California, two types of burrowing owl populations are present: migratory and permanent year-round residents. In the Colorado desert of Southern California, the most commonly used rodent burrows are that of the round-tailed ground squirrel (*Xerospermophilus tereticaudus*) and the white-tailed antelope ground squirrel (*Ammospermophilus* *leucurus*). It is not uncommon for burrowing owls to use old, abandoned desert kit fox burrows. Burrowing owls in California are most abundant in the Central and Imperial Valleys, primarily in agricultural areas (Center for Biological Diversity *et al.* 2003). Small, scattered populations occur in the Mojave Desert. Although the burrowing owl population in the southern desert region is primarily resident (i.e., present year-round), some migration from northern populations to this area occurs during winter (Center for Biological Diversity *et al.* 2003 citing Garrett and Dunn 1981). Seasonal non-migratory movements and shifts in burrow use by juveniles and adults within a region also occur. Population density seems to be correlated with prey availability, particularly small mammals (Klute *et al.* 2003).

*2012 Survey Results*

During the Phase II focused burrowing owl surveys, 27 burrows that exhibited burrowing owl activity during the last three years were identified and mapped (Figure 12). These 27 burrows were subsequently observed on four separate site visits as part of the Phase III focused surveys. There were no observations of burrowing owls or burrowing owl sign during either the Phase II or Phase III focused burrowing owl surveys, suggesting no recent breeding season activity in the SWP Site; however, two burrowing owls were incidentally observed during the fall 2011 botanical survey, both in the northwestern portion of the SWP Site (Figure 12).

*2016/2017 Survey Results*

Several individual burrowing owls were detected during October 2016 desert tortoise surveys (Figure 12). These burrowing owls appeared to be using desert tortoise burrows and there was no indication that they had been nesting in the area. Rather, based on the limited amount of sign (pellets, white wash, prey remains, burrow decorations) outside of the burrows where they were detected, the burrowing owls appeared to be migrating through the area and using burrows as temporary shelter, or wintering in the area. None of the burrows showed characteristic burrow decorations (small sticks, coyote and other mammalian scat, prey remains, etc.) that are often visible at burrow entrances where burrowing owls are breeding. The burrow owls detected during desert tortoise surveys were generally located around the foothills of the Mule Mountains in a similar area to the highest desert tortoise density. In several cases the burrowing owls appeared to be using active or recently active desert tortoise burrows. Based on the evidence around the burrows where burrowing owls were detected, it appears that the Project currently does not support breeding burrow owls, but provides suitable wintering and migration habitat. In one case while biologists were walking to the Project area to conduct desert tortoise surveys in October 2016, a burrowing owl located outside of the RE Crimson Permitting Boundary was detected eating a western shovel-nosed snake (*Chionactis occipitalis*).

No owls or active burrows were observed during the 2017 modified-protocol burrowing owl survey that occurred only within the RE Crimson Permitting Boundary.

<u>Vaux's Swift</u>

Vaux's swift, a State SSC, breeds from southeastern Alaska, southern British Columbia, northern Idaho, and western Montana south to central California. Generally, in California, it is primarily a migratory and summer resident from mid-April to mid-October. In Southern California, it is a spring and fall migrant, and it is also occasionally present in winter, but does not breed within Southern California (Shuford and Gardali 2008). Vaux's swifts usually roost and nest in large cavities in a variety of tree species and less frequently in artificial structures. This species forages over a variety of habitats during the breeding season, including over water at various heights where it searches for small flying insects.

There were eight Vaux's swifts observed as migrants flying over the SWP Site during the spring 2012 bird surveys. The species was detected three times (September 22, 2016, and April 19 and 20, 2017) during avian surveys in 2016/2017 migrating through the open desert within the Project area (Figure 17).

Olive-sided Flycatcher

Olive-sided flycatcher, a State SSC, in California breeds in coniferous forests with nearby adjacent meadows, moist grasslands, or other clearings in the forest. The species is a common migrant flycatcher through the desert and along the Colorado River, but does not breed anywhere in the nearby vicinity. The species generally prefers to breed in forests with edges, openings, and clearings with tall trees that provide perching opportunities for catching insects on the wing (Shuford and Gardali 2008). The species winters in South America in the Amazon basin.

Olive-sided flycatcher was not detected during 2011/2012 surveys, but there were two detections during 2016/2017 surveys, one on September 21 and one on September 29, 2016 during fall migration within the Project area (Figure 17). The species occurs only as a migrant and prefers microphyll woodlands during migration through the desert.

Loggerhead Shrike

Loggerhead shrike, a State SSC, is an uncommon year-round resident of grassland and desert scrub habitats. It prefers open habitat with scattered shrubs, trees, posts and other perches (Zeiner *et al.* 1990). This species occurs throughout central, northeastern, and Southern California (Shuford and Gardali 2008). The species occurs year-round in desert environments. Territories and home ranges are similar in size and vary from 11 to 40 acres, averaging approximately 19 acres (Zeiner *et al.* 1990). Nests are well concealed and usually found in densely foliaged shrubs or trees, typically below 15 feet in height, although found much higher as well. They prey on a variety of species from invertebrates, snakes, lizards, small birds, and small mammals. The species searches for prey from perches at least two feet above ground, swooping directly upon prey once located. Shrikes also hover in search of prey and occasionally hawk insects. It is known as the “butcher bird” for its habit of skewering prey on small twigs or barbed wire before consuming them (Unitt 2004).

There were 178 observations of loggerhead shrike during the spring 2012 bird surveys. The habitat within the SWP Site provides suitable foraging and nesting habitat for this species. Four active loggerhead shrike nests were found during the spring 2012 nesting bird surveys. Within the SWP Site, loggerhead shrikes nest in microphyll woodlands, and then hunt in the surrounding open desert scrub.

The species was also commonly detected during the avian surveys in 2016/2017. The species was present in all microphyll woodlands around the RE Crimson Permitting Boundary and several pairs successfully fledged young. There were so many detections for loggerhead shrike that they were not plotted on a figure. Rather, the species is considered present across the entire RE Crimson Permitting Boundary with particular preference for microphyll woodlands, which are being avoided by the Project.

Crissal Thrasher

Crissal thrasher, a State SSC, is a non-migratory resident whose territory ranges from southeastern California and southern Nevada through western Texas and central Mexico, and is a common species along the Colorado River in areas of dense mesquite and atriplex scrub. This species prefers habitats characterized by dense, low scrubby vegetation, such as desert and foothill scrub and riparian brush.

There was one observation of a single individual crissal thrasher during the spring 2012 migratory bird surveys. No crissal thrashers were detected during the 2016/2017 avian surveys. The habitat within the Project area may provide limited foraging habitat for crissal thrasher; however, the species generally nests in very dense stands of scrub, which are not present within the Project area. There is suitable nesting and foraging habitat outside of the Project area within Wiley’s Well Wash to the west and, therefore, the single bird detected in 2012 was likely a dispersing bird.

LeConte's Thrasher

LeConte's thrasher, a NECO SS, is a year-round resident in the Mojave Desert of Southern California. The species inhabits desert wash woodland, microphyll woodland, saltbush scrub, and other generally flat-terrain or gently sloping desert habitat types. The species prefers areas with pockets of dense brush where its nests are protected, often times in a wash. The feed on a variety of insects and arthropods along with occasional seeds and small vertebrates, which they find primarily while digging and probing into the soil and sand. They begin breeding in late January, and during wet years, multiple clutches can be raised. This species was commonly detected during the surveys in both 2012 and 2016/2017 throughout the SWP Site and the RE Crimson Permitting Boundary; therefore, there are too many locations to include on a figure. The species was detected nesting within the microphyll woodlands between the RE Crimson Permitting Boundary, and foraging throughout the RE Crimson Permitting Boundary.

Yellow Warbler

Yellow warbler, a State SSC and NECO SS, has a wider breeding range than any other North American warbler. There are currently 43 subspecies recognized, and are treated geographically as three groups (*aestiva* group, *petechia* group and *erithachorides* group). Of the three groups only subspecies of the *aestiva* group are found in California. Three yellow warbler subspecies nest in California: *D. p. brewsteri* along the Pacific coast and a few desert interior locations, *D .p. morcomi* from the east slope of the Sierra Nevada to the Great Basin, and *D .p. sonorana* along the Colorado River. The subspecies of yellow warbler that nests along the Lower Colorado River, the Sonoran yellow warbler, is known to nest within cottonwood, willows, and tamarisk trees. The species was once commonly along the Colorado River, but the population crashed with the installation of the Hoover Dam and subsequent habitat loss. However, the species has started nesting within nonnative tamarisk. Currently, the species nests from Lake Mead to the Mexican border in at least 60 locations, with more than half on the California side of the river (McKernan and Braden 2002). During migration, yellow warblers are commonly observed in California on both the Pacific slope and in the deserts and interior valleys.

There were 12 yellow warbler observations during the spring 2012 migratory bird surveys. No signs of yellow warbler nesting were observed during the spring 2012 bird surveys. One yellow warbler was detected migrating through the microphyll woodland between the RE Crimson Permitting Boundary on April 25, 2017 (Figure 17). There is no suitable breeding habitat for the species within the RE Crimson Permitting Boundary, and therefore it only occurs as a migrant.

Lucy's Warbler

Lucy's warbler, a State SSC and BLM Sensitive, breeds only in the southwestern U.S. (Arizona, southern New Mexico, southwestern Texas, extreme southern Nevada and Utah, and southeastern California) and adjacent northern Mexico (Dunn and Garrett 1997 *in* Shuford and Gardali 2008). Within the U.S., it is most abundant in south-central Arizona (Price *et al.* 1995). Lucy's warblers migrate north from Mexico in the first half of March, coinciding with the leafing out of honey mesquite (Rosenberg *et al.* 1991). Breeding occurs mainly from mid-April to early July (Rosenberg *et al.* 1991, Johnson *et al.* 1997, Unitt 2004). Most depart the California breeding grounds by mid-July, but some do not migrate south until September (Rosenberg *et al.* 1991). Lowland riparian breeding habitat includes mesquite and willow "thickets", cottonwood-mesquite, cottonwood-willow gallery forests, cottonwoods, willows, and mid-elevation ash-walnut-sycamore-live oak associations and tamarisk thickets, while more arid habitats include (usually locally) larger stands of xero-riparian vegetation along dry desert washes or occasional upland mesquites, and rarely palo verde and ironwood (Johnson *et al.* 1997). The species nests within a cup placed in a tree, or within a tree cavity.

Three Lucy's warbler observations were made during the spring 2012 migratory bird surveys, but no signs of nesting were observed during spring 2012 bird surveys. The species was not detected during the 2016/2017 surveys and is not expected to nest within the RE Crimson Permitting Boundary due to a lack of dense vegetation, but may occasionally fly through the Project area.

Yellow-headed Blackbird

Yellow-headed blackbird, a State SSC, is a short-to medium-distance migrant that breeds throughout much of the interior western U.S. and winter primarily in Arizona, New Mexico, Texas, and Mexico, as well as at a few locations in California. Breeding habitat is restricted to freshwater marshes with stands of tule, cattail, and bulrush. The closest breeding location to the SWP Site is within freshwater wetland habitat along the Colorado River. Wintering grounds in Southern California include the Lower Colorado River Valley and the Imperial Valley.

There was one yellow-headed blackbird observation during the spring 2012 migratory bird surveys. The species was not detected during avian surveys in 2016/2017 and there is no suitable foraging, wintering, or breeding habitat within the RE Crimson Permitting Boundary for yellow-headed blackbird. Therefore, the detection likely represents an individual bird that was migrating through the Project area.

Desert Kit Fox

The desert subspecies of kit fox is protected from “take” under CFGC Section 4000 et seq. as a fur-bearing mammal, and is also considered a DRECP Protected Species. As defined in CFGC Section 86, “take” is defined as “to hunt, pursue, catch, capture, or kill” and does not include harassment.

Suitable habitat for this fossorial mammal consists of arid open areas, shrub grassland, and desert ecosystems. The desert kit fox diet consists mostly of small rodents, especially kangaroo rats. Desert kit foxes will also eat rabbits, lizards, insects, and berries. Dens have multiple entrances that are up to 8 inches wide and often keyhole-shaped. Litters of three to five young are born in February or March (Egoscue 1962; McGrew 1979).

*2011/2012 Survey Results*

Live desert kit fox, burrows, burrow complexes, and sign (tracks, scat, and carcasses) were observed within the SWP Site (Figure 18). While desert kit fox den complexes were prevalent in the SWP Site (26 active and 27 inactive complexes observed), many den complexes occur within the home ranges of each single female and can be used for birthing or as refuges from coyotes. In addition to the 53 observed complexes, an additional 271 single potential desert kit fox burrows were also recorded throughout the SWP Site (32 active and 239 inactive). The species is solitary except during the breeding season and does not maintain territories. Females usually use one complex for birthing that is three to four kilometers from the nearest neighbor to ensure a good hunting territory. Pups are born in February or March and are weaned by June. Den changes are frequent during the summer when pups are fed. In October, the pups leave their parents’ home range and may travel long distances (30 or more km) before establishing their own territories. With desert kit fox ranges varying from 1 to 2 square miles (Morrell 1972), the 53 den complexes observed may represent five to 10 home ranges within the SWP Site. One of the active complexes was positively identified as a natal den within the expansion area southwest of the SWP Site (Figure 18). Biologists observed single juvenile and adult desert kit fox at the natal den over the course of several visits during bird transects.

*2016/2017 Survey Results*

Potential burrows, burrow complexes, and other desert kit fox sign was recorded incidentally during desert tortoise surveys. One potential golden eagle-killed desert kit fox was detected the morning of March 3, 2017, by a biologist walking back from an avian transect (T1) outside of the southwestern corner of the Project. Although the left hind leg, parts of back, and intestines were eaten, the individual was still identifiable and confirmed as a desert kit fox (Figure 16). Desert kit fox burrows and other sign are depicted on Figure 18 and occur throughout the RE Crimson Permitting Boundary.

American Badger

The American badger, a State SSC, is a resident of level, open areas in grasslands, agricultural areas, and open shrub habitats. It digs large burrows in dry, friable soils and feeds mainly on fossorial mammals: ground squirrels, gophers, rats, mice, etc. American badgers are primarily active during the day but may become more nocturnal in proximity to humans. The home range of badgers has been measured to be 1,327 to 1,549 acres for males and 338 to 751 acres for females in Utah (Lindzey 1978) and 400 to 600 acres in Idaho (Messick and Hornocker 1981). Mating occurs in late summer or early fall, and two to three young are born 183 to 265 days later in March or April (Long 1973). American badgers are known to live up to 11 to 15 years (Messick and Hornocker 1981).

*2011/2012 Survey Results*

No live American badgers were observed within the SWP Site; however, surveyors recorded six potential burrows and the remains of one badger (Figure 18). Burrows were identified based on size, shape, and presence of scat or claw marks. Four of the burrows had been recently used at the time of the spring 2012 survey, based on the presence of fresh dirt in the burrow apron and/or fresh scat. White-tailed antelope ground squirrels and other small mammals are known to occur on the SWP Site and provide a prey base for American badgers. American badgers have home ranges from 338 to 1,549 acres, with males having larger home ranges than females (CDFG 2009b).

*2016/2017 Survey Results*

Potential burrows, burrow complexes, and other American badger sign was recorded incidentally during desert tortoise surveys. Two American badger skulls were detected within the Project and day-old tracks were located within the northern part of the Project. American badger burrows and other sign are depicted on Figure 18 and were found throughout the RE Crimson Permitting Boundary.

Bat Species

Bat monitoring was conducted in accordance with methodologies approved by the Resource Agencies in 2012 and in 2016/2017. The echolocation calls of potential special-status bat species were detected and recorded via three Anabat detectors. Results of the surveys and a discussion on the special-status bat species detected are presented below and again in Appendix J.

*2012 Survey Results*

The acoustic bat monitoring surveys included in this report were conducted from April 17 and 18, 2012, through July 29 and 30, 2012 using passive monitoring with three Anabat SD2 acoustic bat detectors. 9,324 bat calls were recorded over 104 nights of data collection (Figure 16). Multiple species were detected across a wide range of bat call frequencies, including six special-status species (discussed below). Bat activity at the SWP Site peaked in spring (April), reached its lowest point in June, and increased again in July. Anabat location 1 had the highest number of bat calls recorded, followed by location 2, and location 3 had the lowest number of calls recorded. The number of bat calls was directly correlated with increased microphyll woodland size.

*2016/2017 Survey Results*

One year of acoustic bat monitoring was conducted from September 1, 2016, through August 31, 2017, at three locations (Anabat 1, Anabat 2, and Anabat 3) within microphyll woodlands between the RE Crimson Permitting Boundary (Figure 16). These three locations were located in mature microphyll woodlands within the Project area where bats were likely to fly through and forage. During the year-long study, 13 bat species were detected, including nine special-status species. The full details of the bat survey results and a list of all species detected during the surveys in 2016/2017 are provided in Appendix J.

The following section details the nine special-status bat species that were detected within the SWP Site and Project area. Because the Anabat units were placed within microphyll woodlands, which are being avoided by the Project, the bat species that occur within the Project area are also likely to forage or fly through the RE Crimson Permitting Boundary.

California Leaf-nosed Bat

California leaf-nosed bat is a State SSC, BLM Sensitive, NECO SS, and DRECP FS. The California leaf-nosed bat roosts in caves and does not hibernate or migrate. All major maternity, mating, and overwintering sites also occur in mines or caves (Brown 1995). In the Colorado River Basin, all known winter roosts are in geothermal-heated mines and may be up to 1 km away from the entrance (Brown 1995). Summer and winter roosts are typically located no more than a few km apart. Hodge Mine, located approximately 18 miles southeast of the RE Crimson Permitting Boundary, contains a large winter colony of over 4,000 California leaf-nosed bats that use the Roosevelt mine as a maternity colony (Figure 16).

This species feeds primarily on moths and immobile diurnal insects such as butterflies and katydids, which it locates by vision, even at low ambient light levels (Brown 1995), an aspect of behavior that could potentially make this species more difficult to detect by acoustic monitoring. Radio-telemetry studies of this species in the California desert show that the bats forage almost exclusively among desert wash vegetation within 10 km of their roost (Brown 1995). Roosts tend to be within 1 to 3 miles from foraging habitat. The adjacency of roosting and foraging is more important in winter when the bats tend to forage closer to their roost (Brown *et al.* 1993). The bats emerge from their roosts 30 or more minutes after sunset, and fly near the ground or vegetation in slow, maneuverable flight. Primary threats are human entry into mine or cave roosts, closure of mines for hazard abatement, and renewed mining. Loss of desert riparian habitat is also responsible for population declines (Brown 1995).

*2012 Survey Results*

While no distinctive California leaf-nosed bat calls were identified during acoustic monitoring, potential calls from this species were identified during the spring 2012 acoustic bat monitoring.

*2016/2017 Survey Results*

During the yearlong survey, the California leaf-nosed bat was recorded at only Anabat 1 (the southern-most location closest to the Roosevelt Mine; Figure 16) in June 2017. Therefore, the California leaf-nosed bat is considered present within the Project area, but at a very low density.

Pallid Bat

The pallid bat is a State SSC, BLM Sensitive, NECO SS, and DRECP FS. The pallid bat's range includes the Mojave and Sonoran Deserts where it is most abundant in xeric ecosystems. Pallid bats roost in crevices in rocky outcrops, cliffs, caves, mines, and trees. Roost reuse is common, although pallid bats may switch roosts on a daily or seasonal basis. Pallid bats are not known to migrate long distances between summer and winter sites; however, the winter habits of this species are poorly understood. Pallid bat's tendency to roost gregariously and their relative sensitivity to disturbance make them vulnerable to mass displacement (Sherwin 2005).

*2012 Survey Results*

During the spring 2012 acoustic bat monitoring, a likely pallid bat social call was identified. There is no suitable roosting habitat for this species within the RE Crimson Permitting Boundary or within the Project area itself; therefore, the species was likely foraging or flying through. There is suitable roosting habitat within the Mule Mountains, and the species may commute through the Project area during foraging.

*2016/2017 Survey Results*

During the yearlong survey, the pallid bat was recorded at all three monitoring locations during the following months:

- Anabat 1 – September and October of 2016 and March, April, and June of 2017;
- Anabat 2 – September 2016 and April, May, July, and August of 2017; and
- Anabat 3 – September through October of 2016 and April through August of 2017.

Given the range of dates that pallid bats were detected, the species likely spends the summers around the Project area, but then leaves the area after October and does not winter in the area. The RE Crimson Permitting Boundary does not contain suitable roosting habitat for pallid bats, but is considered suitable and occupied foraging habitat for the species.

<u>Western Red Bat</u>

The western red bat is a State SSC, and the species occurs over a broad range reaching from southern British Columbia in Canada, through much of the western U.S., through Mexico and Central America, to Argentina and Chile in South America. This species may be associated with intact riparian habitat (particularly willows, cottonwoods, and sycamores). Western red bats roost in trees, often in edge habitats adjacent to streams or open fields, in orchards, and sometimes in urban areas. This species may also occasionally roost in caves (Bolster 2005). Red bats are highly migratory. Although generally solitary, red bats appear to migrate in groups and forage in close association with one another in summer. Winter behavior of this species is poorly understood (Bolster 2005).

*2012 Survey Results*

During the spring 2012 acoustic bat monitoring, 211 western red bat calls were identified among the recordings.

*2016/2017 Survey Results*

During the yearlong survey, the western red bat was recorded at only Anabat 1 in October 2016. Because western red bat calls were identified in spring 2012 and fall 2016, the species is likely a migrant that moves through the Project area, but is not a resident. Therefore, the RE Crimson Permitting Boundary and surrounding areas are considered suitable and occupied migratory habitat for the western red bat, but the species is not likely to roost, winter, or use the habitat for any extended period of time.

<u>Western Yellow Bat</u>

The western yellow bat is a State SSC and is a medium sized (10 to 15 grams) bat with yellow fur (Harvey *et al.* 1999). This species is known to occur in the Mexican Plateau of the desert southwest (Western Bat Working Group [WBWG] 2005a). Within California, the western yellow bat occurs year-round in valley foothill riparian, desert riparian, desert wash, and palm oasis habitats associated with the Mojave Desert and Sonoran Desert (CDFW 2014).

The western yellow bat forages over water and among trees on flying insects (CDFW 2014). Although limited, information regarding roosting behavior suggests that the western yellow bat is non-colonial with individuals roosting in trees, hanging from the underside of leaves (WBWG 2005a). Palm tree fronds appear to be a common roosting structure in the southwestern U.S. (WBWG 2005a).

*2012 Survey Results*

The species was not detected during the surveys in spring 2012.

*2016/2017 Survey Results*

During the yearlong survey, the western yellow bat was recorded at all three monitoring locations during the following months:

- Anabat 1 – September 2016 and February, March, April, June of 2017;
- Anabat 2 – October 2016; and
- Anabat 3 – September 2016 and April, May, August of 2017.

Because the western yellow bat was detected primarily in the fall and spring, and sporadically during the summer, the species is likely a fall and spring migrant that occasionally moves through the site in the summer. There is no suitable breeding habitat nearby; therefore, the species is likely to only occur as a migrant through the RE Crimson Permitting Boundary.

<u>40-Kilohertz Bats (Arizona myotis and cave myotis)</u>

The 40-kHz acoustic group consists of small-to medium-sized (7 to 15 grams) bats (Harvey *et al.* 1999). Those with the potential to occur in the Project area consist of the Arizona and cave myotis. The Arizona myotis is a State SSC, and the cave myotis is a State SSC, BLM Sensitive, and NECO SS. Both of these species are small bats that are located in the lowlands of the Colorado River and adjacent mountain ranges of California (CDFW 2014). Occupied habitat includes desert scrub, desert succulent shrub, desert wash, and desert riparian (CDFW 2014).

Both of the 40-kHz myotis species are aerial hunters feeding on small flying insects. Although both species roost colonially, cave myotis colonies can be as large as 10,000 individuals and Arizona myotis colonies may be comprised of as many as 800 individuals (WBWG 2005b; CDFW 2014).

Specific to the cave myotis, its distribution is limited to the Colorado River basin, primarily the Whipple, Mule, and Riverside mountains. The species is present in California primarily during the maternity season, from early April through September. Maternity colonies form in early May in California and disband in late summer. The cave myotis roosts primarily in caves and mines, but has also been found in buildings, under bridges, and, particularly during the non-reproductive season, in swallow nests. Where the majority of the California population goes in the winter is unknown (Pierson and Rainey 1998). Roosts tend to be within 1 to 3 miles from foraging habitat. The adjacency of roosting and foraging is more important in winter when the bats tend to forage closer to their roost (Brown *et al*. 1993). Foraging habitat for the California population is predominantly the floodplain of the Colorado River. This species is reported to forage low (2 to 4 meters above the ground) over dense vegetation in this area (Pierson and Rainey 1998). Cave myotis bats have been reported foraging over dense riparian vegetation and in drier desert washes (Peckham 2005).

*2012 Survey Results*

The Project area is within 3 miles of the Roosevelt and Hodge Mines. The Hodge Mine contains the second largest known cave myotis colony along the Lower Colorado River. While no distinctive cave myotis calls were identified during the acoustic monitoring in 2011/2012, potential calls from this species are included in the 40-kHz group.

*2016/2017 Survey Results*

During the yearlong survey, 40-kHz bats were recorded at all three monitoring sites during the following months:

- Anabat 1 – September 2016 and March and June of 2017;

- Anabat 2 – September 2016 and April and June of 2017; and
- Anabat 3 – September 2016 and April through August of 2017.

50-Kilohertz Bats (*California myotis* and *Yuma myotis*)

The 50-kHz group of bats with the potential to occur in the Project area is comprised of the California and Yuma myotis. Both of these species are small (3 to 6 grams) bats that are common throughout California (Harvey *et al.* 1999; CDFW 2014). They occupy a wide range of habitats including desert, chaparral, woodland, and forested (CDFW 2014). The Yuma myotis is a State SSC, and the California myotis is not considered a special-status species, but is included herein, as the call structure is very similar to the Yuma myotis and the two species were not separated during the analysis.

Both of these 50-kHz species are aerial hunters feeding on small flying insects. Both species may be found roosting in crevices, but the Yuma myotis will also utilize larger cavities (CDFW 2014). Maternity colonies of California myotis are small with only a few individuals, while Yuma myotis will have maternity colonies of several thousand individuals (CDFW 2014).

*2012 Survey Results*

These species were not detected during the 2012 surveys.

*2016/2017 Survey Results*

During the yearlong survey, 50-kHz bats were recorded at all three monitoring locations during the following months:

- Anabat 1 – September 2016 through April 2017 and June 2017;
- Anabat 2 – September through November of 2016 and February through August of 2017; and
- Anabat 3 – September 2016 through August 2017.

These species are considered year-round residents, as they were detected throughout the yearlong survey period. There is no suitable roosting habitat within the Project area; however, the Mule Mountains and other nearby mountains likely provide suitable roosting locations. Therefore, the RE Crimson Permitting Boundary is considered occupied foraging habitat for the California and Yuma myotis.

Western Mastiff Bat

The western mastiff bat is a State SSC, BLM Sensitive, and NECO SS. The western mastiff bat subspecies that occurs in North America, *Eumops perotis californicus*, ranges from central Mexico across the southwestern U.S. (parts of California, southern Nevada, Arizona, southern New Mexico, and western Texas). Western mastiff bats can be found in a variety of habitats, from desert scrub to chaparral to oak woodland and into the ponderosa pine belt and high elevation meadows of mixed conifer forests. In California, these bats are most frequently encountered in broad, open areas. Distribution is locally determined by availability of suitable roosting habitat provided by significant rock features. Foraging habitat includes dry desert washes, flood plains, chaparral, oak woodland, open ponderosa pine forest, grassland, and agricultural areas. The western mastiff bat is primarily a cliff-dwelling species, where maternity colonies of 30 to several hundred (typically fewer than 100) roost generally under exfoliating rock slabs (e.g., granite, sandstone or columnar basalt). It has also been found in similar crevices in large boulders and buildings. Western mastiff bats have been estimated to forage considerable distances from roosting sites. The western mastiff bat appears to move relatively short distances seasonally and does not undergo prolonged hibernation (Bolster 2005).

*2012 Survey Results*

A potential western mastiff bat call was recorded during the spring 2012 acoustic bat monitoring.

*2016/2017 Survey Results*

During the yearlong survey, the western mastiff bat was recorded at all three monitoring locations during the following months:

- Anabat 1 – September 2016 and February 2017;
- Anabat 2 - June 2017; and
- Anabat 3 - September and December of 2016 and May and August of 2017.

Given the range of months when the western mastiff bat was detected, the species is likely an uncommon resident within the area that forages or flies through the RE Crimson Permitting Boundary, but does not roost onsite.

Pocketed Free-tailed Bat

The pocketed free-tailed bat is a State SSC and NECO SS, and is uncommon in California but more common in Mexico. Its habitats include pinyon-juniper woodlands, desert scrub, desert succulent shrub, desert riparian, desert wash, alkali desert scrub, Joshua tree, and palm oasis. Pocketed free-tailed bats prefer to roost in rock crevices in cliffs. This species is probably a non-migratory, year-round resident (Harris 2000).

*2012 Survey Results*

Calls that were likely produced by pocketed free-tailed bats were recorded during the spring 2012 acoustic bat monitoring.

*2016/2017 Survey Results*

During the yearlong survey, the pocketed free-tailed bat was recorded at all three monitoring sites during the following months:

- Anabat 1 – September through November of 2016 and January through June of 2017;
- Anabat 2 – October through November of 2016 and March, May, and July of 2017; and
- Anabat 3 – September through December of 2016, February through May of 2017, and August 2017.

Given the wide range of months that the pocketed free-tailed bat was detected, it is likely a year-round resident bat that forages within the RE Crimson Permitting Boundary and roosts outside of the Project area.

Burro Deer

Burro deer are the desert subspecies of mule deer that occur in the desert southwest and are considered a DRECP PS. They are associated with river corridors and dry desert washes, especially along the Colorado River and nearby areas. In the hottest months of the year, burro deer remain close to permanent water sources with suitable forage such as along the Colorado River. During the onset of summer monsoons in late July and September, burro deer may disperse into the desert mountains (Celentano and Garcia 1984). In the late summer, burro deer move away from the Colorado River following major desert wash systems and head towards the desert mountains, and in the late spring, they return to the Colorado River (Celentano and Garcia 1984). Seasonal movements of burro deer occur in the major drainages that flow towards the Colorado River to the east and are generally sandy dry washes dominated by ironwood and palo verde tree, which provide a major food source and cover during migration. Burro deer are located in two main herds to the north and south of I-10, with an important linkage between the Mule and McCoy Mountains (BLM 2015).

*2011/2012 Survey Results*

While no specific surveys were conducted for burro deer, their sign was noted during the surveys in 2011 and 2012.

*2016/2017 Survey Results*

Most of the washes within the Project contained tracks and scat of burro deer moving through the washes. During desert tortoise surveys in October 2016, fresh deer tracks were noted in several of the larger washes, and an old deer skull was found in one of the washes at the base of the Mule Mountains. Additional wildlife camera surveys (discussed below) photographed several burro deer moving through the microphyll woodland between the RE Crimson Permitting Boundary. While sign of burro deer was highest within the microphyll woodlands, there were tracks noted within the RE Crimson Permitting Boundary; therefore it is considered occupied by burro deer.

### 4.4.2 Wildlife Camera Surveys

Wildlife camera surveys were conducted in spring and summer 2017 to document potential wildlife movement through the microphyll woodlands between the RE Crimson Permitting Boundary (Figure 16). The four cameras were run from April through July of 2017 and were allowed to run the entire time with no quite periods, or periods when the cameras were turned off. No scent lures were used; therefore, there was no bias in attracting wildlife to the cameras. The goals of the wildlife camera surveys were to try and document species that are rare, not easily detected, or occur at low abundance, and to determine the use of the microphyll woodlands as wildlife movement corridors.

The two southern-most wildlife cameras (Wildlife Cameras 1 and 2) documented multiple burro deer (including males and females), coyote, American badger, spotted skunk, desert kit fox, black-tailed jackrabbit, round-tailed ground squirrel, desert iguana, and several species of birds (LeConte's thrashers, mourning dove, ash-throated flycatcher).

The middle wildlife camera (Wildlife Camera 3) documented burro deer, black-tailed jackrabbit, desert cottontail, and Gamble's quail.

The eastern-most wildlife camera (Wildlife Camera 4) did not document any wildlife species moving through the microphyll woodland. The camera was correctly positioned and functional (it recorded photographs during high wind events), however, no wildlife species were captured on camera.

Therefore, the wildlife camera surveys documented and confirmed the presence of several wildlife species. The microphyll woodland with the greatest level of wildlife activity appeared to be the southern-most wash where Wildlife Cameras 1 and 2 were located. This wash was closest to the base of the Mule Mountains, and the wash was narrow and funneled wildlife species past the wildlife cameras, while Wildlife Cameras 3 and 4 were located in broader washes where wildlife could spread out and more easily move around the cameras without being detected. Overall, the wildlife camera surveys reiterate the importance of microphyll woodland for wildlife movement.

### 4.4.3 Migratory Bird Observation Points and Transects

The following sections detail the results of the migratory bird observation points and transects that were conducted in 2011/2012 and 2016/2017. The data from 2011/2012 from the SWP Site encompass a much larger area than the RE Crimson Permitting Boundary; therefore, the data from 2016/2017 depict a more refined view of the level of avian abundance and diversity within the RE Crimson Permitting Boundary.

***2011/2012 Survey Results***

The results of both migratory bird observation points and migratory bird transects are presented together in this section. Seven fixed migratory bird observation points were surveyed from April 10, 2012, through May 31, 2012. Twelve transects with eight observation points per transect were surveyed on a weekly bases from April 19, 2012, through June 1, 2012. A total of 2,638 bird observations consisting of 84 species was made during the spring 2012 bird surveys. The most common bird species observed were cliff swallow (*Petrochelidon pyrrhonota*; 255 observations), horned lark (231 observations), loggerhead shrike (178 observations), ash-throated flycatcher (164 observations), mourning dove (153 observations), barn swallow (143 observations), cactus wren (*Campylorhynchus brunneicapillus*; 116 observations) and turkey vulture (*Cathartes aura*; 113 observations). The raw data is provided in Appendix K.

No large flocks (over 50 birds) were encountered during surveys. Occasionally small flocks of over 10 individuals were seen during non-raptor observation surveys (less than 1% of all observations). Species observed in these flocks included cliff swallow (maximum of 45 individuals), double-crested cormorant (*Phalacrocorax auritus*; maximum of 27 individuals), red-winged blackbird (*Agelaius phoeniceus*; maximum of 19 individuals), barn swallow (maximum of 14 individuals) and horned lark (maximum of 10 individuals). All of these species are migratory, apart from horned lark, which may breed within the SWP Site.

Aside from 81 observations of double-crested cormorant and two observations of long-billed curlew (*Numenius americanus*) flying east toward the Lower Colorado River on April 11, 2012, no other water birds were seen. Double-crested cormorants are common along the Colorado River, and Salton Sea; therefore, they may move between these areas (the SWP Site is directly between the Colorado River and Salton Sea). During periods of high rainfall, when Ford Dry Lake is full, it attracts large populations of migratory birds (especially waders, species of ducks, shorebirds, and some passerines in the surrounding vegetation).

Songbirds were the most commonly observed species group accounting for 76.3% of all observations followed by non-passerines other than raptors and water birds (12.3% of all observations), raptors (8.2% of all observations), and water birds (3.1% of all observations).

To compare habitat use between the desert uplands, microphyll woodlands, and transitional areas 100 meters from microphyll woodlands, data was analyzed on all non-flyover observations within 0 to 100 meters of each transect point using a Kruskal-Wallis One Way Analysis of Variance on Ranks, Multiple Comparison Procedure (Dunn's Method) at the 95% CI. For the analysis, non-flyover observations included birds seen hunting/foraging, perching, or breeding. Flyovers and observations over 100 meters from the point were excluded because they did not reflect actual use of the habitat around the point. Prior to field work, all points were classified as desert upland, microphyll woodland, or desert upland directly adjacent to microphyll woodland (less than 100 meters from microphyll woodland) using GIS/GPS software and confirmed in the field during surveys. As anticipated in a desert environment, a significantly higher use of microphyll woodlands compared to desert upland habitats was found for both the number of observations and species between each habitat. Of the 12 migratory bird transects, the locations closest to the base of the Mule Mountains and the transect placed in the eastern-most wash had the highest number of avian observations. Generally, the washes were the densest near the base of the Mule Mountains; they gradually spread out and ended in open desert scrub with increasing distance from the Mule Mountains. Therefore, it is not surprising that the highest numbers of birds were recorded in the areas where the microphyll woodlands were the densest. The eastern-most wash had the highest number of observations, at over 40 bird observations. A table of this data is provided in Appendix K.

There were ten special-status bird species observed during the spring 2012 observation points and transect surveys. No federally listed endangered or threatened species were observed. No state endangered species were observed. Two state threatened species were observed within the surveyed area, bank swallow and Swainson's hawk. These special-status bird species were previously discussed in Section 4.4.2, including their life history and presence within the SWP Site.

***2016/2017 Survey Results***

Surveys were conducted again in 2016/2017 in accordance with the survey work plan approved by the BLM, USFWS, and CDFW. The results of both migratory bird observation points and migratory bird transects are presented together in this section for the 2016/2017 year-long avian surveys. For reference, the spring survey period was defined as February 1 through May 31, summer was defined as June 1 through July 17, fall was defined as July 18 through November 18, and winter was defined as November 19 through January 31.

***Migratory Bird Observation Point Surveys***

Migratory bird observation point survey efforts were conducted for two migratory seasonal periods – fall 2016 (18 weeks) and spring 2017 (16 weeks) – for a total of 34 weeks of surveys. Each survey consisted of observations from four stations over an 8-hour window, so there were 576 hours of observation during fall 2016 and 512 hours of observation during spring 2017. A total of 3,396 birds was recorded during both migratory seasonal periods consisting definitively of 60 species during the migratory bird observation point survey efforts during fall 2016 and spring 2017 (Appendix L). Avian groups observed during observation point surveys included: corvids, doves and pigeons, gamebirds, nighthawks, passerine (non-corvids), raptors and vultures, swifts and hummingbirds, and water birds. The most common bird species observed were turkey vulture (*Cathartes aura*; 863 observations), horned lark (*Eremophila alpestris*; 783 observations), barn swallow (*Hirundo rustica*; 259 observations), common raven (*Corvus corax*; 194 observations), tree swallow (*Tachycineta bicolor*; 193 observations), and Swainson's hawk (*Buteo swainsoni*; 183 observations).

Five large flocks (over 50 birds) were encountered during observation point surveys and consisted of two flocks of turkey vultures (approximately 400 and approximately 75) observed during fall 2016, two flocks of Swainson's hawks (approximately 80 each) during spring 2017, and a single flock of tree swallow (approximately 75) observed during spring 2017. Small flocks of over 10 individuals (but less than 50) were seen during observation point surveys (less than 3% of all observations). Species observed in these flocks included barn swallow (maximum of 15 individuals), horned lark (maximum of 19 individuals), red-winged blackbird (*Agelaius phoeniceus*; maximum of 20 individuals), Swainson's hawk (one flock of 15 individuals), tree swallow (maximum of 30 individuals), turkey vulture (maximum of 40 individuals), and a flock of water birds of unknown species (a single flock of 16 individuals). All of these species are migratory, apart from horned lark, which may breed within the RE Crimson Permitting Boundary.

Detection estimates were calculated for observations within 100 meters to reduce any detection bias beyond this distance. Raw counts of birds for each avian group (order or family) are presented for fall 2016 (Table 4-7) and spring 2017 (Table 4-8). Additionally, a standardized detection rate for each bird group (order/family) was quantified for each season, fall 2016 (Table 4-7) and spring 2017 (Table 4-8) based on the number of birds detected (raw counts within 100 meters) and the number of hours of observation for that season. The standardized detection rate represents the number of individuals of each group detected per 100 hours of survey to avoid detection rates less than one bird. Thus, the unit of measure for detection estimates was number of individuals per 100 hours of observation (Tables 4-7 and 4-8). Passerine (non-corvid) birds demonstrated the highest detection rate for fall 2016 and spring 2017, with nearly equal estimated rates of detection: 127.95 birds per 100 hour of observation and 127.73 birds per 100 hours of observation (fall 2016 and spring 2017, respectively). Excluding observations greater than 100-meter distance from the observer removed many raptor and vulture records. As these larger birds are more easily detected and identified at greater distances, the rates of detections for species in this group were calculated separately.

Detection estimates for raptors and vultures were calculated for those detections within 800 meters to account for the increased detectability of these birds at distances greater than 100 meters. Raw counts of raptors and vulture species are presented for fall 2016 (Table 4-9) and spring 2017 (Table 4-10). The standardized detection rate for each species was quantified for each season, (Tables 4-9 and 4-10) and is based on the number of birds detected (raw counts within 800 meters) and the number of hours of observation for that season. The standardized detection rate represents the number of individuals of each bird detected per 100 hours of survey to avoid detection rates less than one bird (where possible). Thus, the unit of measure for detection estimates was number of individuals per 100 hours of observation

**Table 4-7. Results of Fall 2016 Avian Surveys**

| | Jul-16 | | Aug-16 | | Sep-16 | | Oct-16 | | Nov-16 | | Total Per Group | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Group | Raw Count | Detection per 100 hours | Raw Count | Detection per 100 hours | Raw Count | Detection per 100 hours | Raw Count | Detection per 100 hours | Raw Count | Detection per 100 hours | Raw Count | Detection per 100 hours |
| Corvids | 0 | 0.00 | 0.00 | 0.00 | 2.00 | 1.56 | 2.00 | 1.56 | 1.00 | 1.04 | **5.00** | **0.87** |
| Doves and Pigeons | 4 | 6.25 | 7.00 | 4.38 | 2.00 | 1.56 | 1.00 | 0.78 | 0.00 | 0.00 | **14.00** | **2.43** |
| Nighthawks | 4 | 6.25 | 1.00 | 0.63 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **5.00** | **0.87** |
| Passerines (non-corvids) | 10 | 15.63 | 50.00 | 31.25 | 304.00 | 237.50 | 254.00 | 198.44 | 119.00 | 123.96 | **737.00** | **127.95** |
| Raptors and Vultures | 0 | 0.00 | 2.00 | 1.25 | 27.00 | 21.09 | 0.00 | 0.00 | 3.00 | 3.13 | **32.00** | **5.56** |
| Swifts and Humming-birds | 0 | 0.00 | 0.00 | 0.00 | 1.00 | 0.78 | 0.00 | 0.00 | 0.00 | 0.00 | **1.00** | **0.17** |
| Waterbirds | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 16.00 | 12.50 | 0.00 | 0.00 | **16.00** | **2.78** |
| **Total Per Month** | **18** | **28.13** | **60.00** | **37.50** | **336.00** | **262.50** | **273.00** | **213.28** | **123.00** | **128.13** | **810.00** | **140.63** |

**Table 4-8. Results of Spring 2017 Avian Surveys**

| | Feb-17 | | Mar-17 | | Apr-17 | | May-17 | | Total Per Season | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Group** | **Raw Count** | **Detection per 100 hours** | **Raw Count** | **Detection per 100 hours** | **Raw Count** | **Detection per 100 hours** | **Raw Count** | **Detection per 100 hours** | **Raw Count** | **Detection per 100 hours** |
| Corvids | 1.00 | 1.04 | 14.00 | 8.75 | 7.00 | 5.47 | 1.00 | 0.78 | **23.00** | **4.49** |
| Doves and Pigeons | 0.00 | 0.00 | 2.00 | 1.25 | 2.00 | 1.56 | 17.00 | 13.28 | **21.00** | **4.10** |
| Nighthawks | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.78 | 5.00 | 3.91 | **6.00** | **1.17** |
| Passerines (non-corvids) | 121.00 | 126.04 | 186.00 | 116.25 | 140.00 | 109.38 | 207.00 | 161.72 | **654.00** | **127.73** |
| Raptors and Vultures | 0.00 | 0.00 | 184.00 | 115.00 | 5.00 | 3.91 | 8.00 | 6.25 | **197.00** | **38.48** |
| Swifts and Hummingbirds | 0.00 | 0.00 | 0.00 | 0.00 | 9.00 | 7.03 | 0.00 | 0.00 | **9.00** | **1.76** |
| Water birds | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.00** | **0.00** |
| **Total Per Month** | **122.00** | **127.08** | **386.00** | **241.25** | **164.00** | **128.13** | **238.00** | **185.94** | **910.00** | **177.73** |

**Table 4-9. Results of Fall 2016 Avian Surveys for Raptors**

| | Jul-16 | | Aug-16 | | Sep-16 | | Oct-16 | | Nov-16 | | Grand Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Species** | **Raw Count** | **Detection per 100 hours** | **Raw Count** | **Detection per 100 hours** | **Raw Count** | **Detection per 100 hours** | **Raw Count** | **Detection per 100 hours** | **Raw Count** | **Detection per 100 hours** | **Raw Count** | **Detection per 100 hours** |
| American Kestrel | 0.00 | 0.00 | 1.00 | 0.17 | 0.00 | 0.00 | 1.00 | 0.17 | 0.00 | 0.00 | 2.00 | 0.35 |
| Cooper's Hawk | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.17 | 3.00 | 0.52 | 0.00 | 0.00 | 4.00 | 0.69 |
| Northern Harrier | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.17 | 1.00 | 0.17 |
| Prairie Falcon | 0.00 | 0.00 | 1.00 | 0.17 | 0.00 | 0.00 | 1.00 | 0.17 | 5.00 | 0.87 | 7.00 | 1.22 |
| Red-tailed Hawk | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.17 | 6.00 | 1.04 | 5.00 | 0.87 | 12.00 | 2.08 |
| Swainson's Hawk | 0.00 | 0.00 | 0.00 | 0.00 | 6.00 | 1.04 | 0.00 | 0.00 | 0.00 | 0.00 | 6.00 | 1.04 |
| Turkey Vulture | 1.00 | 0.17 | 2.00 | 0.35 | 26.00 | 4.51 | 4.00 | 0.69 | 0.00 | 0.00 | 33.00 | 5.73 |
| **TOTAL** | **1.00** | **0.17** | **4.00** | **0.69** | **34.00** | **5.90** | **15.00** | **2.60** | **11.00** | **1.91** | **65.00** | **11.28** |

**Table 4-10. Results of Spring 2017 Avian Surveys for Raptors**

| | Feb-17 | | Mar-17 | | Apr-17 | | May-17 | | Grand Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Species** | **Raw Count** | **Detection per 100 hours** | **Raw Count** | **Detection per 100 hours** | **Raw Count** | **Detection per 100 hours** | **Raw Count** | **Detection per 100 hours** | **Raw Count** | **Detection per 100 hours** |
| American Kestrel | 0.00 | 0.00 | 3.00 | 1.88 | 0.00 | 0.00 | 0.00 | 0.00 | 3.00 | 0.59 |
| Ferruginous Hawk | 0.00 | 0.00 | 2.00 | 1.25 | 0.00 | 0.00 | 0.00 | 0.00 | 2.00 | 0.39 |
| Merlin | 0.00 | 0.00 | 1.00 | 0.63 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.20 |
| Northern Harrier | 0.00 | 0.00 | 1.00 | 0.63 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.20 |
| Osprey | 0.00 | 0.00 | 1.00 | 0.63 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.20 |
| Prairie Falcon | 1.00 | 1.04 | 2.00 | 1.25 | 0.00 | 0.00 | 4.00 | 3.13 | 7.00 | 1.37 |
| Red-tailed Hawk | 5.00 | 5.21 | 6.00 | 3.75 | 4.00 | 3.13 | 5.00 | 3.91 | 20.00 | 3.91 |
| Swainson's Hawk | 0.00 | 0.00 | 161.00 | 100.63 | 0.00 | 0.00 | 0.00 | 0.00 | 161.00 | 31.45 |
| Turkey Vulture | 58.00 | 60.42 | 29.00 | 18.13 | 11.00 | 8.59 | 10.00 | 7.81 | 108.00 | 21.09 |
| **TOTAL** | **64.00** | **66.67** | **206.00** | **128.75** | **15.00** | **11.72** | **19.00** | **14.84** | **304.00** | **59.38** |

(Tables 4-9 and 4-10). Overall, detections of raptors and vultures was much lower in fall 2016, with a detection rate of 11.28 birds per 100 hours of observation (Table 4-9), compared to spring 2017, with a detection rate of 59.38 birds per 100 hours of observation (Table 4-10). For fall 2016, turkey vultures had the highest detection rate with 5.73 birds per 100 hours of (Table 4-9), and Swainson's hawk had the highest detection rate with 31.45 birds per 100 hours of observation in spring 2017 (Table 4-10).

Coachella Valley State Prison Pond Surveys

Birds were identified to species and counted at the CVSP ponds during weekly surveys from March 22, 2017, through May 26, 2017, and then biweekly from June 6, 2017, through July 18, 2017, for a total of 15 surveys. The full list of the species detected during the pond surveys including the total number of birds seen per species is included in Appendix M. A large portion of the water birds detected was duck species, grebes, herons, egrets, shorebird species, flycatchers, doves, and a variety of songbird species. Additionally, many swallow species, and one state-threatened bank swallow was detected foraging and flying around the ponds. Many of the species were coming to drink, and others were actively foraging on insects in the area. Overall, a large portion of the bird species detected at the CVSP prison ponds was not detected during the avian surveys within the Project area.

***Migratory Bird Transect Surveys***

Migratory birds transect survey efforts were conducted for just over 1 year beginning in July 2016 and ending in July 2017. Surveys consisted of walking four 1,750-meter transects on a weekly basis during spring (February 1 through May 31) and fall (July 18 through November 18), and on a bi-weekly basis during summer (June 1 through July 17) and winter (November 19 through January 31). A total of 2,603 bird observations, consisting of 76 species, was made during the migratory bird transect survey efforts from July 2016 through July 2017 (Appendix L). Avian groups observed during transect surveys included: corvids, doves and pigeons, gamebirds, nighthawks, owls, passerine (non-corvids), raptors and vultures, swifts and hummingbirds, water birds, and woodpeckers. The most common bird species observed include horned lark (*Eremophila alpestris*; 347 observations), turkey vulture (*Cathartes aura*; 207 observations), LeConte's thrasher (*Toxostoma lecontei*; 197 observations), mourning dove (*Zenaida macroura*; 191 observations), Brewer's sparrow (*Spizella breweri*; 187 observations), black-throated sparrow (*Amphispiza bilineata*; 133 observations), loggerhead shrike (*Lanius ludovicianus*; 125 observations) and barn swallow (*Hirundo rustica;* 113 observations).

A single large flock (over 50 birds) was encountered during surveys and consisted of an estimated 200 turkey vultures during spring 2017. Occasionally small flocks of over 10 individuals were seen during transect surveys (less than 3% of all observations). Species observed in these flocks included horned lark (maximum of 25 individuals), Brewer's sparrow (maximum of 20 individuals), white-crowned sparrow (*Zonotrichia leucophrys*; maximum of 20 individuals), Gambel's quail (*Callipepla gambelii*; one flock of 15 individuals) and white-throated swift (*Aeronautes saxatalis*; one flock of 20 individuals).

Density estimates for each group (order or family) of observed birds recorded and density estimates for all groups of observed birds were calculated for observations within 100 meters (less than or equal to 99 meters) using distance sampling methods for each seasonal period for which transect surveys were conducted: fall 2016, winter 2016/2017, spring 2017, summer 2017, and fall 2017. Density estimates were calculated as individual birds per acre then multiplied by 100 to avoid density estimates less than 1. Thus the unit of measure for density estimates was number of individuals per 100 acres. For all seasonal periods, passerine (non-corvid) birds represented the highest density (Table 4-11) with fall 2016 and spring 2017 demonstrating the highest density estimates for this group. Fall 2016 had a passerine (non-corvid) density estimate of 22.77 birds per 100 acres and spring 2017 had a passerine (non-corvid) density estimate of 59.95 birds per 100 acres. The migratory seasonal periods of fall and spring also demonstrated the highest overall (all avian groups) density estimates with 32.10 birds per 100 acres (fall 2016) and 69.95 birds per 100 acres (spring 2017). Fall 2017 consisted of only 1 week of transect surveys, as one survey was conducted after the last summer 2017 survey in mid-July 2017 and, hence, was considered part of the fall 2017 survey period. Since fall 2017 was only 1 week long due to when surveys ended, it is not comparable to fall 2016; therefore, fall 2016 represents the most accurate estimate

**Table 4-11. Density Estimates from Transect Surveys Calculated using Distance Sampling Methods**

| Season | Group | Number of Observations | Density | Density per 100 Acre | Coefficient of Variation | Degrees of Freedom | 95% LCL[1] | 95% UCL[1] |
|---|---|---|---|---|---|---|---|---|
| **Fall 2016** | Doves and Pigeons | 51 | 0.036873 | 3.69 | 28.12 | 4.74 | 0.04 | 0.19 |
| | Gamebird | 3 | 0.002169 | 0.22 | 65.08 | 3.24 | 0.00 | 0.03 |
| | Nighthawks | 59 | 0.042658 | 4.27 | 65.35 | 3.24 | 0.02 | 0.65 |
| | Owl | 1 | 0.000723 | 0.07 | 100.81 | 3.10 | 0.00 | 0.02 |
| | Passerine (non-corvids) | 315 | 0.227749 | 22.77 | 17.87 | 12.26 | 0.38 | 0.83 |
| | Corvids | 3 | 0.002169 | 0.22 | 65.08 | 3.24 | 0.00 | 0.03 |
| | Raptors and Vultures | 10 | 0.00723 | 0.72 | 0.01 | 28.78 | 0.01 | 0.04 |
| | Waterfowl | 1 | 0.000723 | 0.07 | 0.00 | 100.81 | 0.00 | 0.02 |
| | Woodpeckers | 1 | 0.000723 | 0.07 | 0.00 | 100.81 | 0.00 | 0.02 |
| | All Groups | | 0.321017 | 32.10 | 17.94 | 26.70 | 0.55 | 1.14 |
| **Winter 2016/2017** | Doves and Pigeons | 4 | 0.006025 | 0.60 | 55.39 | 7.75 | 0.00 | 0.05 |
| | Gamebird | 1 | 0.001506 | 0.15 | 103.84 | 7.20 | 0.00 | 0.03 |
| | Passerine (non-corvids) | 57 | 0.085862 | 8.59 | 15.23 | 50.12 | 0.16 | 0.29 |
| | Corvids | 1 | 0.001506 | 0.15 | 98.18 | 7.23 | 0.00 | 0.03 |
| | Raptors and Vultures | 2 | 0.003013 | 0.30 | 98.18 | 7.23 | 0.00 | 0.05 |
| | Swifts and Hummingbirds | 1 | 0.001506 | 0.15 | 103.84 | 7.20 | 0.00 | 0.03 |
| | All Groups | | 0.099419 | 9.94 | 15.67 | 68.64 | 0.18 | 0.34 |
| **Spring 2017** | Doves and Pigeons | 60 | 0.065996 | 6.60 | 34.88 | 3.28 | 0.06 | 0.46 |
| | Gamebird | 4 | 0.0044 | 0.44 | 71.09 | 3.06 | 0.00 | 0.08 |
| | Nighthawks | 7 | 0.0077 | 0.77 | 36.69 | 3.25 | 0.01 | 0.06 |
| | Passerine (non-corvids) | 545 | 0.599462 | 59.95 | 15.94 | 4.81 | 0.98 | 2.24 |
| | Corvids | 7 | 0.0077 | 0.77 | 43.48 | 3.18 | 0.01 | 0.07 |
| | Raptors and Vultures | 4 | 0.0044 | 0.44 | 100.27 | 3.03 | 0.00 | 0.15 |
| **Season** | **Group** | **Number of** | **Density** | **Density per** | **Coefficient of** | **Degrees of** | **95% LCL** | **95% UCL** |

| | | Observations | | 100 Acre | Variation | Freedom | | |
|---|---|---|---|---|---|---|---|---|
| | Swifts and Hummingbirds | 9 | 0.009899 | 0.99 | 42.70 | 3.18 | 0.01 | 0.09 |
| | All Groups | | 0.699541 | 69.95 | 14.45 | 6.28 | 1.22 | 2.45 |
| **Summer 2017** | Doves and Pigeons | 4 | 0.036468 | 3.65 | 19.21 | 8.56 | 0.06 | 0.14 |
| | Nighthawks | 3 | 0.008416 | 0.84 | 65.01 | 3.23 | 0.00 | 0.13 |
| | Passerine (non-corvids) | 43 | 0.120625 | 12.06 | 21.79 | 6.45 | 0.18 | 0.50 |
| | All Groups | | 0.165509 | 16.55 | 18.56 | 11.77 | 0.27 | 0.61 |
| **Fall 2017** | Doves and Pigeons | 4 | 0.038586 | 3.86 | 30.48 | 4.30 | 0.04 | 0.21 |
| | Nighthawks | 5 | 0.048235 | 4.82 | 55.72 | 2.45 | 0.02 | 0.78 |
| | Passerine (non-corvids) | 9 | 0.086817 | 8.68 | 25.97 | 6.15 | 0.12 | 0.40 |
| | All Groups | | 0.173639 | 17.36 | 25.37 | 12.35 | 0.25 | 0.74 |

[1] LCL: Lower Confidence Limit; UCL: Upper Confidence Limit

of avian density during the fall period. Winter 2016/2017 had the lowest density estimates for both passerine (non-corvid), 8.59 birds per 100 acres, and overall (all groups), 9.94 birds per 100 acres. Summer 2017 had similar density estimates to fall 2017 for passerine (non-corvids), 12.06 birds per 100 acres, and overall (all groups), 16.55 birds per 100 acres.

Density estimates for raptors and vultures were highest during fall 2016 with 0.72 bird per 100, followed by 0.44 bird per 100 acres for spring 2017, and 0.30 bird per 100 acres in winter 2016/2017. Density estimates for raptors and vultures during summer 2017 and fall 2017 were not available as no raptors or vultures were detected within 100 meters of transects (Table 4-10).

***Avian Nocturnal Radar Monitoring***

Radar sampling was conducted over a 40-night period from April 9, 2012, through June 1, 2012. Approximately 360 hours of radar sampling was split between two radar survey stations (Station 1 was located near Wiley's Well Wash at the western side of the SWP Site, and Station 2 was located in more open desert scrub on the eastern side of the SWP Site) and each radar sampling period (equivalent to one night) lasted approximately 9 to 11 hours, depending on the timing of sunset (Figure 15). The passage rate was defined as the average number of detected events per $sqkm^2$ of radar sampled area per hour. The results of the nocturnal radar monitoring found an average hourly passage rate of 3.5 targets/7.1 $km^2$/hour, a mean flight speed of 21.0 mph, mean flight direction of 6°, mean nocturnal flight altitude 320 plus or minus (±) 0.6 meters (1,050± 2 feet) above ground level, and that 33.6% of targets detected on the vertical radar were recorded below 229 meters. The results show a bell-shaped curve skewed to earlier in the season of targets detected per hour across the 40-night sampling period. There were several pulses of migratory birds detected, with the highest pulse at over 45 targets per hour on April 23, 2012. There was another peak of targets per hour on May 1, 2012 and then a slightly smaller one on May 8, 2012. Per night, the hourly passage rate also exhibited a bell-shaped curve with the peak at midnight. The mean flight direct for Station 1 was at 115°, and 264° at Station 2. The peak of activity (highest number of targets per hour) was recorded early in the season (April 23), and then generally flattened out toward the end of the sampling period, indicating that the majority of migratory activity during the 2012 spring season was likely captured by the study. Overall, the SWP Site had low passage rates compared to those reported elsewhere in the literature in California (Western Ecosystems Technology, Inc. and Natural Resource Consultants 2011; Hamer Environmental, L.P. 2010). This difference may be due to the lack of water, sparse cover, general lack of food and other resources that birds rely on during migration. It is expected that birds are more likely to follow the Colorado River during migration where there is increased vegetation for cover, food, water, and other resources. The full details of the results of the 2012 nocturnal avian radar monitoring are located in Appendix F.

No nocturnal radar monitoring was conducted in 2016/2017, as the 2012 data were considered sufficient.

***Baseline Common Raven Population Estimates***

<u>2011/2012 Survey Results</u>

Common ravens were recorded during gila woodpecker surveys, non-raptor observation point surveys, and migratory bird point count transect surveys. A total of 43 common raven observations occurred during the various surveys from April through May of 2012. Some of these observations may be of the same individuals. Red-tailed hawks were observed 83 times, which is approximately twice as often as common ravens. During the golden eagle aerial surveys, nests of all corvid and raptor species were recorded. No common raven nests were documented directly within the SWP Site; however, several nests were located along transmission towers that run parallel to I-10 and connect to the CRS. Several additional nests were located on cliff substrate with one nest in the Mule Mountains, and several within the Palo Verde Mountains. The density and abundance of common ravens in and around the SWP Site is likely limited by the lack of permanent standing water. One of the closest permanent water sources is located at the

Ironwood and Chuckwalla Valley State Prisons, approximately 2.6 miles to the west of the RE Crimson Permitting Boundary. Additionally, there is a small game guzzler noted in the NECO plan that is located west of the RE Crimson Permitting Boundary near Wiley's Well Wash, which may provide water for common ravens whenever it contains water.

2016/2017 Survey Results

No common ravens were document nesting within or immediately adjacent to the RE Crimson Permitting Boundary; however, multiple common raven nests are known from transmission towers along Powerline Road, and the species may breed within the Mule Mountains. Most common raven detections were of birds flying overhead. Common raven density estimates were calculated using distance sampling methods from transect survey data. Common ravens were recorded during observation point surveys and migratory bird point count transect surveys. Overall, the rates of detection (within 100 meters of the observation point or 100 meters perpendicular distance from the transect) were relatively low. During observation point surveys, the rate of detection for common ravens was less than 1 bird per 100 hours of observation during fall 2016 (Table 4-9) and 4.49 birds per 100 hours of observation for spring 2017 (Table 4-10). Density estimates for common ravens were calculated using distance sampling methods from transect survey data (Table 4-11). Estimated density for common ravens during fall 2016 was 0.22 bird per 100 acres, during winter 2016/2017 was 0.15 bird per 100 acres, and during spring 2017 was 0.77 bird per 100 acres. No common ravens were detected within 100 meters of the transects during summer 2017 or fall 2017 surveys and, therefore, have an estimated density of 0 birds per 100 acres (Table 4-11).

The RE Crimson Permitting Boundary is 2,489 acres and, therefore, density estimates across the entire Permitting Boundary range from 3.7 (or 4 birds) during winter when observed densities were lowest, to 19.2 (or 19 birds) during spring when densities were the highest due to birds breeding. These numbers are estimates, and the actual density of common ravens would vary across the RE Crimson Permitting Boundary; however, they provide a baseline of common raven density prior to Project construction.

## 4.5 Critical Habitat

The RE Crimson Permitting Boundary does not contain any designated critical habitat for special-status plant or wildlife species. There is desert tortoise critical habitat immediately adjacent to the RE Crimson Permitting Boundary to the west within the Chuckwalla Critical Habitat Unit. There will be no loss of desert tortoise critical habitat from the Project, and therefore, critical habitat will not be discussed further in this BRTR.

## 4.6 Wildlife Movement

The Project area is used by a variety of wildlife species for movement purposes as determined through the wildlife camera surveys, and other biological surveys. Wildlife movement activities typically fall into one of three movement categories: 1) dispersal (e.g., juvenile animals from natal areas, or individuals extending range distributions); 2) seasonal migration; and 3) movements related to home range activities (foraging for food or water, defending territories, searching for mates, breeding areas, or cover).

Regionally, the Project is located to the north and west of the Mule Mountains and west of the Colorado River within the NECO planning area of the CDCA. The purpose of NECO and the other concurrent management plans is to provide a regional approach to managing desert ecosystems. The NECO planning area consists of a series of DWMAs for the desert tortoise and WHMAs. The intention of these areas is to protect habitats assumed to be suitable for many species and therefore preserve biodiversity. The Mule Mountains are also part of the Palen McCoy Mountains-Little Picacho linkage planning area for multiple species such as American badger and bighorn sheep (Penrod et al 2012). This linkage connects the Palen and McCoy Mountains to the north of I-10 with the Little Picacho

Mountains along the Colorado River via Wiley's Well Wash, the Mule Mountains, Palo Verde Mountains, and the Chocolate Mountains.

There are several washes that meander north, northwest, and northeast from the base of the Mule Mountains into the Project. These washes contain a variety and density of vegetative cover, such as ironwood and palo verde trees, that provide food, shade, and tend to concentrate resources into one linear area. This vegetation tends to make washes a favored location for wildlife movement, as opposed to the surrounding open desert scrub. Washes also funnel nutrients, may pond water for a longer period of time, and provide a variety of structural complexity that multiple species use. Wildlife that use washes for local movement include small mammal and reptile species (including desert tortoise), black-tailed jackrabbit, desert kit fox, coyote (*Canis latrans*), burro deer, and potentially wild burros and Yuma mountain lion. These washes likely support local movement of wildlife species between the valley floor and nearby surrounding mountains including the McCoy Mountains to the north, the Mule Mountains to the south, and the Little Chuckwalla Mountains to the west. The upland areas between the washes have little vegetation compared to the washes where wildlife is more exposed during the day.

The Project area could support local dispersal opportunities for desert tortoise. The Project may affect desert tortoise in the context of local population dispersal because it is a resident species that generally only moves within its home range;, with the exception of juvenile dispersal. Desert tortoise home range varies with locality, year, resource availability, and social interactions (Berry 1986; O'Connor *et al.* 1994). The male desert tortoise home range (0.04 to 0.31 square mile) is estimated to be twice the size of the female (Burge 1977; Berry 1986). Desert tortoises use multiple dens throughout individual home ranges and appear to migrate to steeper, rockier slopes in the winter (Barrett 1990). Desert tortoise dispersal distances have been documented up to 4.1 miles. Areas suitable for desert tortoise, but that are low density or occasionally not occupied, can be important for local desert tortoise movement, as this species is likely distributed in metapopulations (Tracy *et al.* 2004). Metapopulations are groups within a population that are typically confined to specific regions as a result of resource availability. If a metapopulation becomes fragmented, it may no longer be sustainable because individuals are not exchanged between metapopulations. Desert tortoises are likely present more frequently in the montane areas within this region due to the Sonoran climatic influence. The development of intervening valleys could preclude the natural dispersal of desert tortoises between these montane populations. Local wildlife movement may be reduced or restricted because the Project would contribute to fragmentation of the surrounding large and contiguous desert landscape. Desert tortoises are known to use low-quality intermountain habitat as dispersal routes over time, providing passage between high-quality habitat areas in the surrounding mountains (Averill-Murray and Averill-Murray 2005). Historically, tortoise populations in the Sonoran Desert have exchanged individuals at a rate of one migrant per generation (Averill-Murray and Averill-Murray 2005).

Burro deer are associated with river corridors and dry desert washes, especially along the Colorado River and nearby areas. Most of the washes within the Project area contained tracks and scat of burro deer moving through the washes. During the onset of summer monsoons in late July and September, burro deer may disperse into the desert mountains, and in the late spring, they return to the Colorado River (Celentano and Garcia 1984). Burro deer have been documented to have large dispersal distances (60.3 to 134.8 miles) with males exhibiting variable but typically greater distances than females (Robinette 1966).

Burro deer are located in two main herds to the north and south of I-10, with an important linkage between the Mule and McCoy Mountains (BLM 2015). The RE Crimson Permitting Boundary is located directly north and west of the Mule Mountains within this desert linkage network. Although evidence of burro deer was observed within the microphyll woodlands, these woodlands will be avoided by the Project and will remain open to potentially allow movement across the Project site between development areas, assuming disturbance from Project activities does not reduce or limit this movement.

No desert bighorn sheep sign was found within the Project area during the surveys in 2011/2012 and 2016/2017. While desert bighorn sheep may occur occasionally within the Mule Mountains, the lack of permanent water within or adjacent to the Project is likely to prevent desert bighorn sheep from using the area on a regular basis. Desert bighorn sheep have been historically documented in the Chuckwalla Mountains to the west of the Project, and while the Project occurs in part along the western side of the Mule Mountains, if desert bighorn sheep cross between the Chuckwalla and Mule Mountains they will be able to do so south of the Project by crossing Wiley's Well wash. Populations of bighorn sheep within individual mountain ranges are often small, and there is typically considerable movement between mountain ranges (Bleich *et al.* 1990). These intermountain movements are particularly important to long-term population viability. The intermountain areas of desert (valley floor) where the Project is located could potentially serve as a seasonal and dispersal movement area for desert bighorn sheep. If bighorn sheep were to use the Project, the main resource for bighorn sheep would be forage during the spring months. Due to a lack of permanent nearby water, bighorn sheep would only be able to use the Project area on a seasonal basis. Bighorn sheep must have a source of permanent water within their home range.

The desert bighorn sheep that may use the Project area are part of the Sonoran Bighorn Sheep Metapopulation WHMA, which includes the Chuckwalla Mountains and the Little Mule Mountains (BLM 2002). Per NECO, the BLM and CDFW may augment the desert bighorn sheep deme in this WHMA at a later date when sufficient numbers of sheep are available for augmentation. Additionally, one of the objectives in the NECO plan is to re-establish desert bighorn sheep demes within the Mule Mountains, and the adjacent Palo Verde Mountains, which would involve translocation of sheep to these ranges along with the establishment of new water developments (BLM 2002). According to NECO, there are no known regular demes of desert bighorn sheep in the Mule Mountains, and none have been detected during any biological surveys for the Project. Although there is the potential for desert bighorn sheep to become re-established within the Mule Mountains in the future, there is currently very low potential for desert bighorn sheep to use the Project area given the lack of nearby known occurrences.

While Yuma mountain lions have not been detected within the Project area, they have a moderate potential to occur as their main prey source, burro deer, have been detected using the desert washes within the Project area. Burro deer are important prey for Yuma mountain lions, and desert bighorn sheep will be taken as well (Kucera 1998). They are known to range vast distances from 389 $km^2$ to 1,621 $km^2$ and tend to prefer habitats similar to their prey sources ranging from the Colorado River to the desert mountains (Peirce and Cashman 1993).

# 5.0 Impacts

This section addresses Project-related impacts on vegetation communities, jurisdictional waters, and special-status plant and wildlife species during both Project construction and operation. Direct and indirect impacts may be either permanent or temporary. These impact categories are defined below.

- Direct: Direct impacts are caused by the Project and occur at the same time and place. Any alteration, disturbance, or destruction of biological resources that would result from Project-related activities is considered a direct impact. Direct impacts would include direct losses to native habitats, potential jurisdictional waters, wetlands, and sensitive species, and diverting natural surface water flows. Specifically, direct impacts may include injury, death, and/or harassment of listed and/or sensitive species. Direct impacts may also include the destruction of habitats necessary for species breeding, feeding, or sheltering. Direct impacts to plants can include crushing of adult plants, bulbs, or seeds.

- Indirect: As a result of Project-related activities, biological resources may also be impacted in a manner that is not direct. Indirect impacts may occur later in time or at a place that is farther removed in distance than direct impacts, but are still reasonably foreseeable and attributable to Project-related activities. Examples include habitat fragmentation; elevated noise, dust, and lighting levels; soil compaction; increased human activity; decreased water quality; changes in hydrology, runoff, and sedimentation; and the introduction of invasive wildlife and plants.

- Permanent: All impacts that result in the long-term or irreversible removal of biological resources are considered permanent. Examples include constructing a building or permanent road on an area containing biological resources. All direct impacts in the Project footprint are considered permanent.

- Temporary: Any impacts considered to have reversible effects on biological resources can be viewed as temporary. Examples include the generation of fugitive dust during construction, or removing vegetation for underground pipeline trenching activities and either allowing the natural vegetation to recolonize or actively revegetating the impact area. Surface disturbance that removes vegetation and disturbs the soil typically would be considered a long-term temporary impact if vegetation is allowed to reestablish overtime.

For the purpose of this analysis, the following applicable thresholds of significance have been used to determine whether implementing the Project would result in a significant impact under CEQA or a substantial adverse effect under NEPA. The thresholds of significance are based on Appendix G of the State CEQA Guidelines and also support the NEPA determination. A biological resources impact is considered significant if implementation of the Project would do any of the following:

- Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by CDFW or USFWS;

- Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, or regulations or by CDFW or USFWS;

- Have a substantial adverse effect on Federal protected wetlands as defined by Section 404 of the CWA (including, but not limited to, marshes, vernal pools, and coastal areas) or any State-protected jurisdictional areas not subject to regulation under Section 404 of the CWA through direct removal, filling, hydrological interruption, or other means;

- Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites;

- Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy, or ordinance;

- Conflict with the provisions of an adopted habitat conservation plan; natural community conservation plan; or other approved local, regional, or State habitat conservation plan; or

- Substantially reduce the habitat of a fish or wildlife species; cause a fish or wildlife population to drop below self-sustaining levels; threaten to eliminate a plant or animal community; or substantially reduce the number or restrict the range of an endangered, rare, or threatened species.

The following sections summarize impacts for the traditional design for construction, O&M, and decommissioning. Where applicable, analysis of the LEID elements are incorporated into the impacts discussion, as they may either increase or decrease impacts to specific biological resources. Potential construction-related impacts are discussed first followed by O&M impacts. Potential impacts from decommissioning are discussed last.

## 5.1 Construction Impacts

This section identifies impacts to the biological resources within the RE Crimson Permitting Boundary that would result from construction-related activities. Sensitive vegetation communities and sensitive species were defined in Section 3.1. All jurisdictional waters, including unvegetated channels, are considered sensitive.

### 5.1.1 Sensitive Vegetation Communities

Sensitive vegetation communities and other land cover types were defined in Section 4.1. Ten vegetation communities and other cover types were identified within the Project area during the 2011/2012 and 2016/2017 field surveys. Of these ten vegetation communities, nine were found within the RE Crimson Permitting Boundary and only creosote bush-white bursage/big galleta association, blue palo verde—ironwood woodland, and desert dunes are considered special community types (e.g., high priority for inventory in the CNDDB) per the CDFW Vegetation and Mapping Program (CDFG 2003). However, all potential jurisdictional waters, including blue palo verde—ironwood woodland and unvegetated ephemeral dry wash, are considered sensitive vegetation communities. Table 5-1 details the acreage of permanent direct impacts to sensitive vegetation communities from construction of the Project within the RE Crimson Permitting Boundary, and the linear features.

**Table 5-1. Sensitive Vegetation Communities in the RE Crimson Permitting Boundary**

| Vegetation Communities | RE Crimson Solar Development Area (acres) | RE Crimson Linear Features (acres) | RE Crimson Permitting Boundary Total (acres) |
|---|---|---|---|
| *Riparian* | | | |
| Creosote Bush—White Bursage/Big Galleta Grass Association[1] | 289.4 | - | 289.4 |
| Blue Palo Verde—Ironwood Woodland[1] | - | 1.2[2] | 1.2 |
| *Upland* | | | |
| Desert Dunes | - | 13.8 | 13.8 |
| **Total** | 289.4 | 15 | 304.3 |

Notes:

1 Sensitive vegetation community (CDFW 2017c).

2 This is the total acreage of the corridor for linear features. Actual impacts would be substantially less; however, a corridor has been identified to allow micrositing and avoidance of mature trees.

***Direct Impacts***

<u>Traditional Construction Approach</u>

Permanent direct impacts to both non-sensitive and sensitive vegetation communities within the RE Crimson Permitting Boundary would occur as a result of construction-related activities. The permanent direct impacts would be a result of grading and installation of the solar facility, which would result in the permanent removal of vegetation within the RE Crimson Permitting Boundary.

Table 5-1 identifies the three sensitive vegetation communities that would be directly and permanently impacted by the Project. Approximately 289.4 acres of creosote bush-white bursage/big galleta grass association would be removed during construction of the Project. Additionally, up to 1.2 acres of blue palo verde—ironwood woodland associated with linear corridors between the solar development areas would be directly impacted by access roads and other linear features connecting the development areas. Approximately 13.8 acres of desert dunes located within the linear features would be impacted, particularly around the CRS. The access roads between the solar development areas would be graded and surfaced with gravel, compacted dirt, or another commercially available surface and would not be paved or made of impervious material. Although impacts will occur to woodland and dunes as a result of the construction and operation of linear features (roads and transmission), the estimated acreages were calculated for a corridor to allow for micrositing; therefore, the actual impacts to these communities associated would likely be less than the total acreage calculated for the development corridors.

<u>LEID Approach</u>

Impacts to sensitive-vegetation communities within the solar development area would be lower with incorporation of the LEID elements that reduce grading and trenching for solar field construction. Estimates are provided in the POD for ground disturbance (see POD Table 1-1). This reduction cannot be quantified by acreage at this time since the extent of grading would vary across the Project as the modules are installed; however, vegetation structure would be retained over larger areas depending upon the elements selected and would be allowed to grow under panels, being maintained to no greater than 18-inches in height. LEID elements that result in less grading or ground-disturbance would reduce the loss of vegetation during construction and provide potential onsite residual habitat value following construction. The LEID elements would not result in changes to impacts associated with the linear features.

***Indirect Impacts***

<u>Traditional Construction Approach</u>

Potential temporary and permanent, indirect impacts to the vegetation communities surrounding the RE Crimson Permitting Boundary would occur as a result of construction-related activities. Grading activities that have potential to create airborne dust, sedimentation, and erosion, can lead to the eventual death of buried vegetation. The potential spread of exotic species into the surrounding vegetation communities would be considered a permanent, indirect impact. Exotic species are opportunistic and could occupy disturbed soils within the disturbance area and spread into adjacent vegetation communities. Once introduced, these exotic species often out-compete natives for resources resulting in a reduction in growth, future dispersal, and recruitment of native species and the eventual degradation of the vegetation community.

The Project construction approach would minimize potential impacts to existing seedbanks in the RE Crimson Permitting Boundary. The mow and roll technique will retain existing seedbanks. Cut and fill for areas that need to be grubbed, graded and leveled and compacted would be balanced onsite, therefore keeping native material and seedbank sources within the RE Crimson Permitting Boundary. Micro-topography and general flow patterns would also be retained and would therefore preserve the potential transport patterns for seedbanks onsite.

Blue palo verde—ironwood woodlands are primarily being avoided by the RE Crimson Permitting Boundary. Water flowing down the woodlands would be allowed to continue unimpeded with the exception of two road crossings between development areas. Single Arizona-style crossings (or culverts if needed) would cross the woodlands generally at the ends of the woodlands to allow access between development areas. Improperly installed Arizona-style crossings or culverts have the potential to alter the natural flow of water through a drainage and may increase or decrease the volumes and rates of water when compared to current conditions. This in turn may lead to the desiccation of some vegetation communities and edema (excess water) in other vegetation communities. In addition, higher flow rates may result in erosion and root exposure leading to the eventual death of vegetation. A hydrology study was conducted to analyze this potential impact and the results are included in the *Phase C Hydrology Study for the RE Crimson Solar Project* (Westwood 2017). The hydrology analysis showed that during a 100-year event (an event with a 1% chance of occurring in any given year) there was little to no flow across the Project area. Both the flow rates and depths are very low. Given the Project's avoidance of woodlands and the associated larger washes as well as the lack of flow across the site, the Project is not likely to cause significant alteration of natural flow. Therefore, impacts to sensitive vegetation communities from altering the flow are likely to be less than significant.

LEID Approach

LEID elements involving reduced grading and trenching would reduce the direct loss of vegetation and therefore also reduce potential indirect impacts by reducing the potential for establishment and spread of nonnative species. There would be less dust and erosion since plant roots would remain intact and allow for better soil stabilization across the Project. The reduction in ground-disturbance and vegetation removal would also have the potential to support faster habitat recovery during decommissioning and reclamation of the site by retaining not only the existing seedbank, but also existing vegetation root mass and above ground growth. Existing topography and general flow patterns would also be retained.

***Significance after Mitigation***

Potential construction-related direct and indirect impacts to sensitive vegetation communities would be reduced to less than significant through implementation of the avoidance, minimization, and mitigation measures as noted in Chapter 6.

### 5.1.2 Jurisdictional Waters

Jurisdictional waters within the RE Crimson Permitting Boundary were defined in Section 4.2 and consist of CDFW waters of the State and CDFW-associated riparian vegetation. There will be no impacts to federal waters. The Project is currently in the process of applying for a Section 1600 SAA with CDFW for impacts to State jurisdictional waters. Impacts to jurisdictional waters of the State will be addressed through the SAA permitting process, including appropriate compensatory mitigation.

***Direct Impacts***

Traditional Construction Approach

Permanent direct impacts would occur to approximately 90.6 acres of unvegetated jurisdictional waters of the State and approximately 1.2 acres of CDFW riparian woodland (blue palo verde—ironwood woodland). This acreage (1.2 acres) includes the entire linear features corridor through the washes; however, the actual impact will only be the width of the road approximately 30-feet wide and other linear features such as the transmission and/or distribution lines adjacent to or within the access road. Therefore, the impacts will be substantially less than 1.2 acres. The road and other linear features will be microsited to avoid mature trees within the washes between the development areas. Figure 6 depicts the mature trees within the linear features that would be avoided during micrositing. The only linear feature that comes close to mature trees is on the west side of the RE Crimson Permitting Boundary and would be routed between the trees as shown on Figure 6. Although the Project would allow water to continue to flow across the site without major changes to the topography, permanent direct and indirect impacts to jurisdictional waters would be considered a significant impact if left unmitigated.

LEID Approach

LEID elements that reduce grading and trenching within the solar development areas, have the potential to reduce the acreage of impacts to unvegetated waters of the state (impacts to woodlands would not change). However, driving across the features may cause inadvertent changes to the unvegetated waters; therefore, a reduced acreage of impacts is unable to be quantified.

***Indirect Impacts***

Traditional Construction Approach

Alteration of drainage patterns is expected to be minimal as a result of PV facility construction. Waters will not be rerouted and larger drainages will be avoided. Grading would occur to smooth surfaces and facilitate access for module installation; however, overall topography would be retained with changes only occurring at a micro-topographic level. Therefore, there are no indirect impacts to off-site waters expected as a result of changes to drainage patterns. Off-site erosion and sedimentation resulting from grading activities associated with construction have the potential to result in temporary indirect impacts to jurisdictional waters. Airborne dust may result from construction vehicle travel on dirt access roads, grading, and other ground-disturbing activities and has the potential to result in temporary indirect impacts to jurisdictional waters. These impacts have the potential to degrade the quality of adjacent jurisdictional waters.

*LEID Approach*

Indirect impacts would be less through incorporation of LEID elements due to reduced ground disturbance. Due to a reduced level of site grading, and by allowing existing vegetation to remain intact (to the extent feasible), impacts from dust and erosion would be lower. In addition, the incorporation of the LEID Element resulting in elevated inverter pads could reduce both direct and indirect impacts to jurisdictional waters by allowing washes to remain in place and for flows, even if local, to follow existing paths.

***Significance after Mitigation***

Impacts to jurisdictional waters of the State would be addressed through the issuance of a Section 1600 SAA. Potential construction-related direct and indirect impacts to jurisdictional waters would be reduced to less than significant through implementation of the avoidance, minimization, and mitigation measures described in Chapter 6.

### 5.1.3 Flora

***Federally and State-Listed Plant Species***

Based on regional databases and botanical surveys conducted for the Project, no federally or state-listed plant species were determined to have a potential to occur within the RE Crimson Permitting Boundary. No federally or state-listed plant species were detected during surveys in 2011/2012 or 2016/2017. Therefore, the Project is anticipated to have no impacts on federally or state-listed plant species and they will not be discussed further.

***Other Special-Status Plant Species***

Six special-status plant species were detected over the course of the 2011/2012 and 2016/2017 surveys; however, only four were detected within the RE Crimson Permitting Boundary and include Harwood’s eriastrum, desert unicorn plant, ribbed cryptantha, and Utah vine milkweed. Direct and indirect impacts to the four non-listed special-status plant species detected during botanical surveys are discussed as a group because impacts would be similar among plant species.

***Direct Impacts***

Traditional Construction Approach

The permanent removal of Harwood's eriastrum, desert unicorn plant, ribbed cryptantha, and Utah vine milkweed would result from Project-related construction activities such as grading, and would be considered a direct impact. Impacts to these species in the form of permanent removal would be considered a significant impact if left unmitigated.

<u>LEID Approach</u>

Through incorporating LEID elements that reduce ground disturbance, the Project would have a substantially lower impact on special-status plant species, because they would not be removed by grading and/or would be permitted to grow underneath and around the modules. The plants would be permitted to flower and set-seed, thus contributing to the seedbank. As necessary, hand removal of vegetation would occur, but this would be conducted after special-status plant species had flowered, and hence would not negatively impact the seedbank. There would be substantially less grading and trenching, thereby avoiding areas where perennial special-status plant species such as Utah vine milkweed occur.

***Indirect Impacts***

<u>Traditional Construction Approach</u>

Potential temporary, indirect impacts to non-listed special-status plant species would arise from unmitigated runoff and sedimentation, erosion, fugitive dust, and unauthorized access outside of the disturbance area by construction workers. Runoff, sedimentation, and erosion can adversely impact plant populations by damaging individuals or by altering site conditions sufficiently to favor other species (native and exotic nonnatives) that would competitively displace the special-status species. Construction-generated fugitive dust can adversely affect plants by reducing the rates of metabolic processes such as photosynthesis and respiration. Potential permanent, indirect impacts to non-listed special-status plant species are also likely to arise from population fragmentation and introduction of nonnative exotic species. Due to low densities in rare plant populations, they are susceptible to and are likely to become easily fragmented by the placement of Project facilities, which can impact pollinator activity and, as a result, gene flow. In addition, the introduction and establishment of exotic species within, or adjacent to, special-status plant populations can adversely affect native species by reducing growth in addition to dispersal and recruitment. Special-status plant seedbanks could be disturbed by surface disturbance. Exotic species are opportunistic and often occupy disturbed soils such as those created in transmission line corridors and areas of exposed bare ground resulting from ground disturbing activities. Wildfires caused by construction or downed transmission lines are rare but may occur. Exotics often frequent areas adjacent to and within burn areas following a wildfire. These potential permanent indirect impacts would be considered a significant impact if left unmitigated.

<u>LEID Approach</u>

With the incorporation of LEID elements, there would be substantially fewer indirect impacts to special-status plant species since the existing ground topography, soils, and vegetation would remain in a more natural extent. By reducing the amount of ground disturbance, indirect impacts from nonnative species (which often flourish on disturbed soils), runoff, sedimentation, and erosion (or altered surface hydrology) would be substantially lower.

***Significance after Mitigation***

Potential Project-related construction direct and indirect impacts to non-listed special-status plant species would be considered significant. Potential construction-related direct and indirect impacts to non-listed special-status plant species would be reduced to less than significant through implementation of the avoidance, minimization, and mitigation measures described in Chapter 6.

### 5.1.4 Federally Listed Wildlife Species

Four federally listed wildlife species have the potential to occur or migrate through the RE Crimson Permitting Boundary and include desert tortoise, Yuma Ridgway's rail, southwestern willow flycatcher, and western yellow-billed cuckoo. Of these federally listed species, only desert tortoise was detected during the 2011/2012 and 2016/2017 surveys.

Desert tortoise is the only species which has occupied habitat within the RE Crimson Permitting Boundary (2,489 acres) and will, therefore, be the only species discussed in detail below. Impacts to Yuma Ridgway's rail, southwestern willow flycatcher, and western yellow-billed cuckoo are not anticipated since none of these three species were detected during any of the survey efforts (migratory bird observation points and migratory bird transects) conducted in 2011/2012 and 2016/2017, or incidentally during other surveys. There is no suitable breeding habitat for these species within or adjacent to the RE Crimson Permitting Boundary; therefore, no impacts to Yuma Ridgway's rail, southwestern willow flycatcher, and western yellow-billed cuckoo are anticipated. However, all three of these species still have a low potential to fly through the RE Crimson Permitting Boundary during migration and dispersal, and have been detected at other solar facilities found within the Mojave Desert and Sonoran Desert. While impacts to Yuma Ridgway's rail, southwestern willow flycatcher, and western yellow-billed cuckoo are not individually addressed further in this BRTR, general impacts to all avian species, regardless of their status, are discussed in the impacts to migratory birds, Section 5.1.6.

***Desert Tortoise***

Desert tortoise surveys in 2012 and 2016 documented desert tortoise both within the RE Crimson Permitting Boundary, and within the adjacent microphyll woodlands (collectively the Project area). Desert tortoise surveys conducted in 2012 found 21 live tortoises within the SWP Site (Figure 8) and desert tortoise surveys in 2016 found 20 desert tortoises within the survey area (Figure 10). No desert tortoise or recent sign were found in the northern part of the RE Crimson Permitting Boundary (the area covered by 20-meter spaced transects as shown on Figure 10). In addition, very little old sign of desert tortoise was detected and what was observed consisted of Class 5 burrows and bone fragments. It is likely that the species moves through the area during foraging and dispersal; however, given the lack of active burrows, live desert tortoise, or any recent sign over multiple years of surveys, this northern area of the RE Crimson Permitting Boundary is considered desert tortoise dispersal habitat.

Two adult desert tortoise were found in fall 2016 within the southern part of the RE Crimson Permitting Boundary with additional adult and juvenile tortoise found within the microphyll woodlands and surrounding areas outside of the RE Crimson Permitting Boundary (Figure 10). Additionally, four adult desert tortoises were detected incidentally during spring 2017 during other biological surveys. These four desert tortoises were found within the RE Crimson Permitting Boundary in the southern solar development area. All of the desert tortoises found within the RE Crimson Permitting Boundary were located near the southern portion of the Project area and were in similar areas to where desert tortoises were detected during the fall 2016 protocol surveys. Because desert tortoises tend to forage more widely during the spring, and there was above average rainfall during the winter of 2016/2017, there was an explosion of annual plant growth throughout the Project area during spring 2017 (Appendix G). Therefore, it is not surprising to find desert tortoise over a greater area in the spring and less restricted to their burrows as compared to fall 2016. Based on the fall 2016 protocol surveys, the southern part of the Project area is estimated to contain 37 adult desert tortoises with CIs of 14 to 100 adult desert tortoises. While many of these desert tortoises are likely concentrated in the microphyll woodlands and foothills around the base of the Mule Mountains, they are likely to forage within the RE Crimson Permitting Boundary during the spring, especially when rainfall is sufficient.

Common ravens, known predators on desert tortoise juveniles and hatchlings, were not documented actively nesting within or immediately adjacent to the RE Crimson Permitting Boundary and most common raven detections were of birds flying overhead. Several old nests from previous years, likely from common ravens, were detected in various tower structures along Powerline Road leading to the CRS, however none of which were confirmed active. Common raven density estimates across the entire Permitting Boundary range from four birds during winter when observed densities were lowest, to 19 birds during spring when densities were the highest due to birds breeding. These numbers are estimates and the actual density of common ravens would vary across the RE Crimson Permitting Boundary, but they provide a baseline of common raven density prior to Project construction.

***Direct Impacts***

Traditional Construction Approach

Permanent direct impacts to desert tortoise would occur from vehicle collision strikes, destruction of burrows, and loss of up to 967.4 acres (960.6 acres within the solar development areas and 6.8 acres within linear corridors) of occupied habitat used for foraging and breeding due to project construction. An additional 1,521.7 acres (1,504.5 acres within the solar development areas and 17.2 acres of linear features) are located within the RE Crimson Permitting Boundary that could support dispersal or foraging, but sign of recent use was not observed. Permanent direct impacts to desert tortoise would result from the construction of facilities and development of the disturbance area regardless of the selected alternative.[1] Due to site grading and trenching, traditional construction would likely result in a complete loss of 967.4 acres of suitable and occupied desert tortoise habitat and 1,521.7 acres of adjacent potential dispersal and foraging habitat. While it is not possible to quantify the precise number of desert tortoise that may occur within the RE Crimson Permitting Boundary, it is likely that multiple individual desert tortoises would need to be removed and relocated or translocated during the clearance surveys prior to construction.

Temporary direct impacts to desert tortoise would result from an increase in vehicle traffic during development of the disturbance area prior to the establishment of the desert tortoise exclusionary fencing. There would be a substantial increase in vehicle traffic during Project construction along the Powerline Road from Wiley's Well Road to the CRS. An analysis of vehicle traffic from construction of the Project was conducted and is included in the Traffic Impact Analysis (AECOM 2017). This analysis was based on an assumed approximately 17-month construction timeframe. The construction workforce was estimated to account for an average of 167 (roundtrip) vehicle trips per day (assumed 22 work days per month), with a maximum of 320 (roundtrip) vehicle trips per day during peak construction (PV system installation). In addition to trips made by construction workers, approximately 9,883 truck deliveries of equipment, materials, and water are estimated to be required over the course of the construction period. This increase in vehicle traffic could increase the potential that desert tortoise are killed while crossing Powerline Road; however, very little and no recent sign of tortoises has been detected in this area. It is likely that desert tortoise dispersal moves north/south further west near the larger wash within the adjacent critical habitat unit.

LEID Approach

The incorporation of LEID elements during Project construction have varying potential effects on desert tortoises. The elements that would minimize the amount of grading and trenching (no trenching for wires, reduced grading with hand-trimming of vegetation) would result in the preservation of more onsite vegetation and associated residual habitat value and would be expected to further reduce erosion and sediment transport.

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1 These acreages were obtained by dividing the acreage within the RE Crimson Permitting Boundary based on the separation between 10-meter and 20-meterTransect Areas (shown on Figure 9) and as initially coordinated with the Resource Agencies for the survey effort. Acreage above/north of the line was considered unoccupied since no recent sign of desert tortoise was found during surveys in 2012 and 2016. Acreage below/south of the line was considered occupied based on survey results. The acreages were broken down between the solar development areas and linear corridors that fell north or south of the dividing line.

Temporary direct impacts to desert tortoise would result from an increase in vehicle traffic during development of the RE Crimson Permitting Boundary prior to the establishment of the desert tortoise exclusionary fencing. There would be a similar substantial increase in vehicle traffic during Project construction along Powerline Road from Wiley's Well Road to the CRS compared to the traditional construction approach detailed above.

***Indirect Impacts***

Traditional Construction Approach

Permanent indirect impacts to desert tortoise would occur from increased common raven presence associated with the construction of new elevated perching sites (e.g., new transmission line towers, perimeter fencing) as well as from food and water subsidies resulting from human development and could result in increased predation on desert tortoise in the vicinity of each disturbance area.

Permanent indirect impacts would also result from invasive plants that outcompete native plants and reduce foraging habitat for desert tortoise. Additionally the potential deposition of sediment loads during heavy rain events and flooding downstream of the site could impact existing desert tortoise burrows outside of the survey area.

Temporary indirect impacts would result from noise and light disturbance on desert tortoise behavior and movement in adjacent habitat during the construction phase.

LEID Approach

Permanent and temporary indirect impacts to desert tortoise would be the same as those described under the traditional construction approach. As stated above, permanent indirect impacts would occur from increased common raven presence associated with the construction of new elevated perching sites (e.g., new transmission line towers, perimeter fencing). The incorporation of LEID elements associated with reduced or no trenching would result in the construction of an additional 300 to 400 wooden AC transmission poles (for up to 900 poles across the RE Crimson Permitting Boundary), which could in turn increase raven numbers to an even greater extent than the traditional construction approach. While the LEID approach may increase in the number of poles that potentially serve as perches for desert tortoise predators, reduced grading and trenching would increase the amount of annual and perennial vegetative cover, which would decrease the potential for erosion, run-off, fugitive dust, and reduce the potential for spread of invasive nonnative species.

***Significance after Mitigation***

Potential impacts would be reduced to less than significant through implementation of the avoidance, minimization, and mitigation measures described in Chapter 6. These measures will include a relocation/translocation program as part of site clearance efforts (to be outlined in a Relocation/Translocation Plan). If traditional translocation is required, additional impacts may occur associated with control and recipient sites that would need to be evaluated and addressed as part of the project measures.

### 5.1.5 State-Listed Wildlife Species

Four wildlife species listed under the CESA have the potential to occur or migrate through the RE Crimson Permitting Boundary and include Swainson's hawk, elf owl, gila woodpecker, and bank swallow. Per the surveys in 2011/2012 and 2016/2017, elf owl and gila woodpecker were not detected, and there was no suitable breeding habitat identified for these species within the RE Crimson Permitting Boundary. No impacts to elf owl or gila woodpecker are anticipated and, therefore, these species are not individually discussed further in this BRTR. Both of these species still have a low potential to fly through the RE Crimson Permitting Boundary during migration and dispersal, and are, therefore, discussed in the impacts to migratory birds, Section 5.1.6.

Of these four state-listed wildlife species mentioned above, only Swainson's hawk and bank swallow were detected during the 2011/2012 and 2016/2017 survey efforts (Figure 17). Direct and indirect impacts specific to both of the state-listed wildlife species are discussed together because impacts would be similar between species. General impacts to all avian species, regardless of their status or presence onsite, are also discussed in the impacts to migratory birds section, Section 5.1.6

***Swainson's Hawk and Bank Swallow***

***Direct Impacts***

<u>Traditional Construction Approach</u>

Site preparation, including grading and trenching, would result in permanent direct impacts to 2,489 acres of habitat that may potentially be used by Swainson's hawk and bank swallow for foraging. Neither species breed around the Project area; both are known to migrate through the site. Although neither species was detected foraging within the RE Crimson Permitting Boundary, Swainson's hawks are known to feed on caterpillars in desert environments during migration. Bank swallows may also forage on insect species while migrating through the Project, but due to a lack of permanent or seasonal water, the insect abundance is likely lower than other nearby areas (such as along the Colorado River and surrounding valley). Permanent direct impacts are most likely to result in the form of potential in-flight collisions with erected vertical structures including transmission poles and associated lines. Contact with elevated electrical equipment may result in potential electrocution that could ultimately lead to death. Under the traditional construction approach, between 300 and 500 wooden poles (approximately 30 to 50 feet tall) would be installed across the entire site to convey energy to a central substation location. These poles and associated power lines would increase the risk of collision for Swainson's hawk and bank swallow. Swainson's hawks are diurnal migrants and several swallow species were documented migrating early in the morning through the Project. These species have a higher chance of seeing the power lines and poles prior to collision (as opposed to nocturnal migrants that are less likely to see the power lines and poles). During avian surveys in 2016/2017, many swallow species were observed migrating through the site at very low altitudes, some as low as 10 feet or less above the surface of the ground. Therefore, bank swallows are more likely to migrate at a flight height that would put them at risk of collision with the modules and other nearby structures such as the power lines and poles (although they may be able to see them and avoid them). Swainson's hawks typically roost on the ground or in trees during the night, and then as the sun rises and warms the air, they take off and begin migrating by spiraling up into the sky on rising air thermals. This migration patterns allows them to avoid many obstacles since they generally migrate at altitudes above proposed Project structures.

<u>LEID Approach</u>

Incorporating the no-trenching LEID element could reduce loss of foraging habitat by maintaining some of the existing vegetation; however, additional permanent direct impacts through collision could result from an increase in power lines and poles (up to 900 total spread across the Project). Because the electrical wiring will be aboveground on poles, the matrix of power lines and poles will be substantially greater with the no-trenching LEID, which may lead to an increase in the potential that Swainson's hawks and bank swallows collide with power lines and poles during migration, or while foraging around the Project.

***Indirect Impacts***

<u>Traditional Construction Approach</u>

Temporary indirect impacts from noise, light, and human presence created during the 17 months of construction may cause Swainson's hawks and bank swallows to avoid the area. The 2,489 acres will be developed in phases, and birds are likely to avoid the areas with the greatest human presence during construction, which may shift as the various phases of construction are completed. There are large portions of undeveloped desert habitat adjacent to the RE Crimson Permitting Boundary, and Swainson's hawk and bank swallow will be able to fly around or over the Project during migration without hindrance.

LEID Approach

Temporary indirect impacts would be the same for the LEID approach; however, the severity of impacts may be lessened slightly as a result of reduced grading and ground disturbance. A slightly longer construction period may result in a longer duration for exposure to indirect impacts.

***Significance After Mitigation***

The potential loss of foraging habitat is considered significant, as is the potential death caused by collision; however, these impacts would be reduced to less than significant through implementation of the avoidance, minimization, and mitigation measures as noted in Chapter 6. There is the potential that the matrix of lines associated with the no-trenching LEID element would be an un-mitigatable impact.

### 5.1.6 Other Special-Status Wildlife Species

Non-listed special-status wildlife species that were detected during the 2011/2012 and/or 2016/2017 biological surveys for the SWP Site or within the Project area include Mojave fringe-toed lizard, Couch's spadefoot, Vaux's swift, northern harrier, ferruginous hawk, short-eared owl, long-eared owl, burrowing owl, American peregrine falcon, prairie falcon, olive-sided flycatcher, loggerhead shrike, crissal thrasher, LeConte's thrasher, yellow-headed blackbird, Lucy's warbler, yellow warbler, pallid bat, western red bat, western yellow bat, western mastiff bat, pocketed free-tailed bat, California leaf-nosed bat, Arizona myotis, cave myotis, Yuma myotis, American badger, desert kit fox, and burro deer. Species for which focused wildlife surveys were specifically conducted are discussed including: Mojave fringe-toed lizard, Couch's spadefoot, golden eagle, burrowing owl, migratory bird species, desert kit fox and American badger, and bat species. Potential impacts to these species are discussed below for the traditional construction approach and for the incorporation of LEID elements as appropriate. Impacts are discussed collectively for some species where applicable.

***Mojave Fringe-toed Lizard***

Focused Mojave fringe-toed lizard surveys were conducted in 2012 across the entire SWP Site, which included the RE Crimson Permitting Boundary; therefore, only incidentally detected Mojave fringe-toed lizards were recorded in 2016/2017 (Figure 11). Most observations were associated with windblown sand areas and areas of active dunes, but some observations were outside of dune areas and within non-dune habitat. In part due to the presence of active dunes with a high density of Mojave fringe-toed lizards, the RE Crimson Permitting Boundary was designed to avoid areas of active sand dunes to reduce potential impacts to Mojave fringe-toed lizards (Figure 11). There is still suitable and occupied habitat (that was mapped in 2011/2012) within the RE Crimson Permitting Boundary for Mojave fringe-toed lizards as detailed in Table 5-2.

**Table 5-2. Acreage Impacts to Mojave Fringe-toed Lizard Habitat**

| Habitat Type | Solar Development Areas (Acres) | Linear Features (Acres) | RE Crimson Permitting Boundary (Acres) |
|---|---|---|---|
| Occupied Dune Habitat | 0 | 5.8 | 5.8 |
| Occupied Non-dune Habitat[1] | 142 | 0.1 | 142.1 |
| Potential Suitable Dune Habitat | 0 | 3.7 | 3.7 |
| Potential Suitable Non-dune Habitat | 374.4 | 0.1 | 374.5 |
| **Acreage Totals** | 516.4 | 9.7 | 526.1 |

[1] Non-dune habitat consists of portions of the following vegetation community types: Creosote Bush—White Bursage—Ocotillo Association; Creosote Bush—White Bursage Scrub; Creosote Bush—White Bursage/Big Galleta Grass Association; Creosote Bush Scrub; and White Bursage Scrub.

***Direct Impacts***

Traditional Construction Approach

Permanent direct impacts to Mojave fringe-toed lizard habitat would result from Project construction and would include loss of 147.9 acres of occupied breeding and foraging habitat and 378.2 acres of potentially suitable breeding and foraging habitat (Table 5-2).

Temporary direct impacts to Mojave fringe-toed lizard would result from an increase in vehicle traffic while the Project is under construction and, consequently, an increase in vehicular strikes of this species. Powerline Road passes through multiple active sand dune areas that are occupied by Mojave fringe-toed lizards. Biologists routinely observed Mojave fringe-toed lizards on Powerline Road; therefore, there is the potential for increased mortality during construction. As previously detailed under the desert tortoise impacts section 5.1.4, the construction workforce is estimated to account for an average of 167 (roundtrip) vehicle trips per day (assumed 22 work days per month), with a maximum of 320 (roundtrip) vehicle trips per day during peak construction (PV system installation). In addition to trips made by construction workers, approximately 9,883 truck deliveries of equipment, materials, and water are estimated to be required over the course of the construction period. This amount is a large, though temporary, increase in the traffic along Powerline Road and, hence, an increased potential for Mojave fringe-toed lizards to be killed.

LEID Approach

Permanent direct impacts to Mojave fringe-toed lizard would be the same as those listed above; however, the severity of impacts would be lessened by the reduction of grading activities. Because less grading and trenching would occur and vegetation would be permitted to grow (although maintained at a certain level), there would be fewer impacts to the invertebrate community that Mojave fringe-toed lizards feed on. A lower level of ground disturbance would decrease the potential for invasive nonnative plants to spread and is more likely to maintain the soil characteristics (including less soil compaction) that support Mojave fringe-toed lizards.

***Indirect Impacts***

Traditional Construction Approach

Temporary indirect impacts are likely to arise from construction-generated fugitive dust accumulation on surrounding vegetation resulting in destruction and/or avoidance of habitat by Mojave fringe-toed lizard. Nighttime lighting during the construction phase would also disrupt species movement and may cause increased predation rates. Indirect impacts from potential deposition of sediment loads during heavy rain events and flooding downstream of the site would impact existing habitat for Mojave fringe-toed lizard outside of the survey area; however, impacts would be minimal given the lack of flow across this site (Westwood 2017). Permanent desert tortoise-proof fencing may reduce the amount and distribution of windblown sand across the Project, thereby decreasing the habitat quality for Mojave fringe-toed lizards. Because Mojave fringe-toed lizards are still able to move through the spaces in the desert tortoise-proof fencing, the fencing does not preclude them from the Project; however, the lack of vegetation and compacted soils are likely to discourage use by Mojave fringe-toed lizards, as they are more likely to experience predation.

Permanent indirect impacts to Mojave fringe-toed lizard may occur from increased common raven (and other avian predators on Mojave fringe-toed lizards, such as loggerhead shrikes) presence associated with the construction of new elevated perching sites (e.g., new transmission line towers, perimeter fencing).

LEID Approach

Permanent and temporary indirect impacts to Mojave fringe-toed lizard would be similar to those described under the traditional construction approach, however with the no-trenching element, there would be a greater number of poles (up to 900) spread across the RE Crimson Permitting Boundary. This may supply supplemental perch locations for predators. Alternately, the reduced ground-disturbance associated with the no-trenching and reduced grading LEID element would reduce potential indirect impacts by better retaining existing surface soil and vegetation conditions.

***Significance After Mitigation***

Potential construction-related direct and indirect impacts to Mojave fringe-toed lizard would be reduced to less than significant through implementation of the avoidance, minimization, and mitigation measures as noted in Chapter 6.

***Couch's Spadefoot***

Focused surveys for Couch's spadefoot were conducted in 2012 and no Couch's spadefoot were detected. However, per CNDDB, one adult Couch's spadefoot was incidentally detected while a biologist was conducting an avian survey in the western part of the Project area (Figure 11). The location where this Couch's spadefoot was found is being avoided by the RE Crimson Permitting Boundary, as it occurs within a microphyll woodland. Focused Couch's spadefoot surveys were not conducted during 2016/2017; however, potentially suitable breeding habitat was mapped if it was detected during desert tortoise and burrowing owl surveys in fall 2016 and spring 2017, respectively. There were two mapped locations of potential habitat in the northeastern corner of the Project area adjacent to the eastern-most wash (Figure 11). These two areas were mapped, as it appeared that water had ponded in those areas due to the cracked soil. However, both areas did not have large basins or appear to have areas where water would pond long enough for Couch's spadefoot to complete their life cycle (8 days of ponding is necessary). There are very limited areas of detected ponding areas that appear sufficient to support Couch's spadefoot toad and the RE Crimson Permitting Boundary has avoided the major washes and microphyll woodlands where Couch's spadefoot are most likely to occur; therefore, there are no anticipated permanent direct impacts to Couch's spadefoot.

***Direct Impacts***

<u>Traditional Construction Approach</u>

No permanent direct impacts are anticipated as a result of the traditional construction approach because all potential microphyll wash habitat is outside of the RE Crimson Permitting Boundary and has been be avoided by the Project.

Temporary direct impacts may occur to Couch's spadefoot, if present, as construction vibration may cause toads to come above ground during suboptimal periods and perish due to desiccation or predation. The low frequency sound of rain on the desert ground draws Couch's spadefoot out of their deep burrows (Dimmitt and Ruibal 1980), which may be emulated by noise from construction equipment. Noise generated by off-highway vehicles has been implicated in eliciting emergence in Couch's spadefoot, as it mimics the sound of falling rain (Brattstrom and Bondello 1979). Therefore, the potential to impact aestivating Couch's spadefoot by false emergence may be detrimental. A plan will need to be in place in the event that heavy equipment results in false emergence and should be reported to BLM.

<u>LEID Approach</u>

No permanent direct impacts are anticipated as a result of the incorporation of LEID elements, as all potential microphyll wash habitat is outside of the RE Crimson Permitting Boundary with the exception of minor linear crossings that would be designed to avoid mature trees.  Detected ponded areas can be avoided by Project activities. Because the LEID approach involves less grading and vegetation removal, Couch's spadefoot, if aestivating outside of the washes in surrounding habitat, are less likely to be impacted by a slightly lower level of ground disturbance.

***Indirect Impacts***

<u>Traditional Construction Approach</u>

Permanent indirect impacts from potential deposition of sediment loads during heavy rain events and flooding downstream of the site could impact existing habitat for Couch's spadefoot outside of the Project site. Similarly, there is the potential for permanent indirect impacts to habitat by changes in drainage patterns potentially altering offsite vegetation communities. Although changed to drainage across the site could affect Couch's spadefoot, hydrologic models for the Project show that there is no substantial flow through the Project site. Therefore, impacts associated with changes to drainage patterns are unlikely. Indirect impacts may also result from an increase in predation rate within the washes, due to new power poles that provide perches for avian predators.

<u>LEID Approach</u>

Permanent indirect impacts would be the same for the LEID approach; however, the severity of some impacts may be less as a result of less grading and ground disturbance. Permanent indirect impacts may also occur from increased common raven (and other avian predators) presence associated with the construction of new elevated perching sites (e.g., new transmission line towers, perimeter fencing). The LEID approach would result in the construction of an additional 300 to 400 wooden transmission poles and associated lines.

***Significance After Mitigation***

Potential construction-related direct and indirect impacts to Couch's spadefoot would be reduced to less than significant through implementation of the avoidance, minimization, and mitigation measures as noted in Chapter 6.

***Western Burrowing Owl***

Focused surveys were conducted for western burrowing owl in spring 2012 and again in spring 2017. Western burrowing owl sign was found within the RE Crimson Permitting Boundary only during 2012; however, no active western burrowing owl burrows or owls were ever detected (Figure 12). No western burrowing owl sign was found within the RE Crimson Permitting Boundary during 2017; however, multiple western burrowing owl burrows were detected near the base of the Mule Mountains during the fall 2016 desert tortoise surveys; therefore, western burrowing owls are more likely migrant or wintering owls as opposed to resident breeding owls within the Project area. Based on the data collected, it is assumed that the Project does not support breeding western burrowing owls, but does provide suitable wintering and migration habitat that would be impacted by Project activities.

***Direct Impacts***

Traditional Construction Approach

The traditional construction approach would result in permanent direct impacts to 2,489 acres of wintering, foraging, and migration habitat for western burrowing owl. The traditional construction approach would result in more grading activities during site preparation, resulting in greater habitat loss. Should the traditional construction approach be chosen, the site will be smoothed (mow-and-roll type approach) and electrical wiring will be buried beneath the ground resulting in permanent direct impacts in the form of ground disturbance and habitat loss.

LEID Approach

Incorporating LEID elements could reduce loss of suitable wintering and foraging habitat due to reduced grading and the preservation of vegetation may permit limited foraging within the RE Crimson Permitting Boundary.

***Indirect Impacts***

Traditional Construction Approach

Indirect impacts could result from increased raptor predation on western burrowing owl associated with the addition of new elevated perching sites, including the transmission structures, perimeter fencing, and transmission lines. Additionally, the presence of 500 wooden transmission poles and associated power lines may present a collision hazard to migrating and foraging western burrowing owls. Contact with elevated electrical equipment may result in potential electrocution that could ultimately lead to death.

LEID Approach

Indirect impacts would be the same for the LEID approach; however, with the incorporation of the no-trenching LEID element, the severity of impacts may increase as a result of the additional 300 to 400 wooden transmission poles and associated power lines that would be erected. These poles and associated lines would serve as new elevated perching sites for raptors and could result in a greater number of overhead collisions during migratory events poles and power lines.

***Significance after Mitigation***

Potential construction-related direct and indirect impacts to western burrowing owl would be reduced to less than significant through implementation of the avoidance, minimization, and mitigation measures as noted in Chapter 6. There is the potential that the matrix of lines associated with the no-trenching LEID element would be an un-mitigatable impact.

***Golden Eagle***

No golden eagle individuals were detected during the protocol surveys in 2012 (Appendix D) and no active nests were observed in the survey area (Figure 14). The closest nests are located on the north side of I-10 near McCoy Peak in the McCoy Mountains over five miles north of the Project area. Focused golden eagle nest surveys were not conducted in 2016/2017; however, migratory bird observation points and transects were surveyed and no golden eagles were detected over the survey period. A potential golden eagle kill (a desert kit fox with evidence that a golden eagle had been feeding on it) was detected incidentally in 2017 just outside of the Project area, indicating that it is highly likely golden eagles are foraging around and likely within the RE Crimson Permitting Boundary. Golden eagle surveys via helicopter occurred during winter and spring 2018 and encompassed a 10-mile radius surrounding the RE Crimson Permitting Boundary. The results of these surveys are contained in a separate report (Bloom Biological May 2018) provided to the Resource Agencies under separate cover to maintain confidential data (Appendix E).

***Direct Impacts***

Traditional Construction Approach

The traditional construction approach would result in permanent direct impacts to 2,489 acres of foraging habitat for golden eagle. The Project would remove golden eagle foraging habitat and reduce the potential that eagles would use the area, or forage within the washes due to the presence of the solar facility.

LEID Approach

Incorporating LEID elements are not likely to change the habitat quality for golden eagles, as they are not likely to forage within the solar fields, even with reduced ground disturbance. Therefore, the direct impacts to foraging habitat are likely the same between both construction approaches.

***Indirect Impacts***

Traditional Construction Approach

Indirect impacts may result from electrocution or in-flight collisions with the 500 wooden poles and associated above-ground electrical wiring. Additionally, the loss of foraging habitat, and hence loss of prey species, may negatively impact nesting golden eagles in the vicinity.

LEID Approach

With incorporation of LEID elements, there is a greater potential for electrocution or collisions with electrical wiring attached to the additional 300 to 400 wooden transmission poles and associated power lines that would be erected as part of the approach. Contact with elevated electrical equipment may result in potential electrocution that could ultimately lead to death. The matrix of electrical wires across the Project would be a negative impact for golden eagles, however the presence of the solar fields are likely to deter golden eagles from foraging within the RE Crimson Permitting Boundary.

***Significance After Mitigation***

While no golden eagles were directly observed, either foraging, flying, or migrating through the RE Crimson Permitting Boundary, the presence of a potential golden eagle kill outside of, but adjacent to the RE Crimson Permitting Boundary indicates the potential for golden eagles to forage in the area. Golden eagles are generally wary of people and are not likely to forage within the RE Crimson Permitting Boundary once the modules have been

Lands purchased as mitigation for impacts to other species (such as desert tortoise), could also provide foraging habitat for golden eagles. Potential construction-related direct and indirect impacts to golden eagle would be reduced to less than significant through implementation of the avoidance, minimization, and mitigation measures as noted in Chapter 6.

***Migratory Birds***

Migratory bird surveys were conducted at observation points and transects in both 2011/2012 and 2016/2017 (Figures 15 and 17). These surveys documented a variety of different passerine and raptor species migrating over or through the RE Crimson Permitting Boundary, as well as resident birds nesting within the Project area during the breeding season. A large portion of migratory birds, and in particular special-status avian species, was detected within the microphyll woodlands, which are being avoided by the Project. Impacts to migratory birds are discussed as a group because impacts are expected to be similar across all species.

***Direct Impacts***

<u>Traditional Construction Approach</u>

The traditional construction approach would result in direct construction-related impacts to bird population's onsite in the form of 2,489 acres of habitat loss, and potentially death, injury, or harassment of nesting birds, their eggs and their young. Although, "Take" under the MBTA has generally been interpreted to include the direct death or injury of birds from collisions with structures, vehicles and other machinery, per recent Department of the Interior Solicitor's Opinion and USFWS guidance, MBTA prohibitions on "take" only apply when the purpose of an action is to take migratory birds, their eggs, or their nests. Injury or death to birds that is incidental to construction most frequently occurs during the vegetation clearing stage and involves eggs, nestlings, and recently fledged young that cannot safely avoid equipment. Resident species such as loggerhead shrikes and LeConte's thrashers would primarily experience a loss of foraging habitat, as they primarily nest in clumps of dense vegetation within a tree or bush, usually within microphyll woodlands. Avian surveys documented multiple nests of LeConte's thrashers, all of which were within woodlands, which are not being directly impacted; however, the adjacency of nearby modules may cause some birds to abandon traditional nesting areas, if the construction disturbance is too close to historical nesting locations.

<u>LEID Approach</u>

Incorporating LEID elements could reduce habitat loss and some species, such as horned larks, may even nest in the residual vegetation underneath and around the modules. With incorporation of LEID elements, impacts on nesting and foraging habitat on avian species are likely to less than the traditional approach, due to reduced ground disturbance and by allowing the native vegetation to remain relatively intact.

***Indirect Impacts***

<u>Traditional Construction Approach</u>

Indirect impacts on migratory birds may include increased avian predation associated with the addition of new subsidies including elevated perching sites, perimeter fencing and support structures and food sources (e.g., waste). Temporary indirect impacts are likely to arise from construction-generated fugitive dust accumulation on surrounding vegetation and construction-related erosion, runoff, and sedimentation into plant communities resulting in reduced habitat quality. Additionally, construction-related noise has the potential to cause migratory bird nest abandonment in areas adjacent to construction in each disturbance area. Indirect impacts from these construction-related activities would be temporary, as these impacts would end with cessation of Project construction.

There is also the potential for an increase in avian mortality through collisions with the 500 wooden poles and associated electrical lines spread across the Project. Currently, there are no power lines within the majority of the RE Crimson Permitting Boundary, apart from power lines around the CRS. Therefore, resident birds and migratory birds are likely to encounter this new hazard. Contact with new elevated electrical equipment may also result in potential electrocution that could ultimately lead to death. Because the Project avoids the microphyll woodlands, there will be no electrical lines crossing the microphyll woodlands, except for at two locations where the linear features (i.e., roads and utilities) cross through microphyll woodland areas between each solar development area (see Figure 6). The fencing and modules within the development areas may focus birds towards the microphyll woodlands and cause a bottleneck effect where birds are more concentrated within the microphyll woodlands. The linear features that cross each microphyll woodland between the development areas are generally located perpendicular to the wash where the woodlands are located. Therefore, as birds fly through the microphyll woodlands, they are likely to encounter a new hazard in the form of electrical wires.

Data from a limited number of solar projects in southern California suggest that birds may also potentially be susceptible to collisions with solar panels (Genesis Solar, LLC 2013a, 2013b, and 2013c; Desert Sunlight, Ironwood Consulting, Inc. 2014). Solar panels are both reflective and, with respect to PV solar panels, have a strong polarization signature; thus, it is possible that solar panels may potentially attract species that mistake the panels for bodies of water. This theory is generally referred to as the “lake effect” and, while no scientific conclusions have been reached, it posits that certain birds could be susceptible to increased risk of impacts such as potential collision with project infrastructure, the possibility of being stranded within site fencing once they land, or other forms of distress. The causes of avian injuries and fatalities at commercial-scale solar projects are being evaluated; uncertainty remains because: 1) the mortality data has been collected over a relatively short period of time and still is being evaluated; 2) in most cases, the cause of death is not clear; and 3) mortality information from one project location is not necessarily indicative of the mortality that might be found at another project location.

<u>LEID Approach</u>

Temporary indirect impacts would be the same for the LEID approach however the severity of some impacts may be lessened as a result of less grading and ground disturbance. However, there is the potential for a substantial increase in the collision hazard for avian species through the additional 300 to 400 wooden transmission poles and associated electrical lines that would be erected. The need for additional poles may result in up to 900 wooden poles and electrical lines spread across the RE Crimson Permitting Boundary.

***Significance after Mitigation***

Potential construction-related direct and indirect impacts to migratory birds would be reduced to the extent feasible through implementation of the avoidance, minimization, and mitigation measures as noted in Chapter 6. The loss of 2,489 acres of foraging, breeding, and migrating habitat would likely be offset through mitigation for impacts to other species (such as desert tortoise). The potential for impacts from overhead electrical lines and 500 to 900 wooden transmission poles (depending upon the Project design approach taken), would be a significant impact to birds, particularly migrating birds. The electrical lines located within linear features that cross each microphyll woodland would have flight diverters installed on them per APLIC guidelines to make the electrical lines more obvious to migrating birds and reduce the potential for collisions. There is the potential that the matrix of lines associated with the no-trenching LEID element would be an un-mitigatable impact.

***Desert Kit Fox and American Badger***

Desert kit fox and American badger sign was found throughout the RE Crimson Permitting Boundary during both the 2011/2012 survey season and 2016/2017 survey season (Figure 18). Sign included tracks, scat, burrows, and live individuals, and indicates that both species frequent habitat within the RE Crimson Permitting Boundary. Impacts for both species are discussed together because impacts are assumed to be similar between species.

***Direct Impacts***

Traditional Construction Approach

There would be permanent direct impacts to 2,489 acres of occupied desert kit fox and American badger habitat through construction of the Project, including the loss of burrows used for breeding (natal burrows), and satellite burrows. Additionally, most prey species for desert kit fox and American badger would be removed during construction and, therefore, result in a loss of prey. This loss may cause desert kit fox and American badgers to seek other areas for foraging, increasing interspecific competition. Temporary direct impacts would also result from an increase in vehicle traffic while the Project is under construction and, consequently, an increased potential for vehicular strikes of both species, especially along Powerline Road.

*LEID Approach*

Permanent and temporary direct impacts resulting from the LEID approach would be similar to those resulting from the traditional approach; however, the severity of impacts may be lessened over the longer term with the incorporation of LEID elements that reduce grading and ground disturbance. Both species would still be excluded during construction (to the extent feasible), and any burrows within areas of direct impacts would be collapsed.

***Indirect Impacts***

Traditional Construction Approach

Indirect impacts may result from noise, light, and human disturbance during construction on both species' behavior and movement in adjacent habitat during the construction phase. During construction, these species may be less likely to move through the microphyll woodlands due to the close proximity of construction and activities. In addition, without preventative measures, the presence of humans and potential passive relocation of desert kit foxes from the site could also result in the introduction and spread of diseases such as canine distemper, which could affect kit fox.

LEID Approach

Indirect impacts would be the same for the LEID approach; however, the severity of impacts may be lessened as a result of less grading and ground disturbance. The presence of native vegetation would permit the habitat to remain in a more natural state, and it would be more likely to support prey species for desert kit fox and American badgers should they reenter the site.

***Significance after Mitigation***

Potential construction-related direct and indirect impacts to desert kit fox and American badger would be reduced to less than significant through implementation of the avoidance, minimization, and mitigation measures as noted in Chapter 6.

***Special-Status Bat Species***

Bat surveys were conducted in spring 2012, and for an entire year from 2016 through 2017. During this time frame, no bat roosts, maternity colonies, hibernacula, or other sensitive bat areas were detected. However, several special-status bat species were detected flying through and likely foraging within the Project area as evidenced by recordings of their calls at three Anabat locations. These Anabat units were placed within microphyll woodland habitat, which would be avoided by the Project; however, many of the special-status bat species would be likely to fly through or forage within the RE Crimson Permitting Boundary. Because there are no permanent sources of above-ground water within or adjacent to the RE Crimson Permitting Boundary, there are no drinking resources for bats within the Project area, and most bat species are likely foraging, migrating, or commuting through the Project area. The Roosevelt and Hodge Mines are located less than three miles south of the RE Crimson Permitting Boundary within the Mule Mountains. While there would be no impacts to these mines from the Project, they are known, established bat roosts for several species. There may be a loss of bat foraging habitat from construction of the Project.

***Direct Impacts***

Traditional Construction Approach

There would be a loss of 2,489 acres of potential foraging habitat for several special-status bat species. While most of the bat species are located within the microphyll woodlands, there are several species that forage within open desert habitats, such as those found within the RE Crimson Permitting Boundary.

LEID Approach

Impacts would be similar to the traditional construction approach in terms of loss of foraging habitat. Reduced grading and an increase in vegetative cover may provide more insects and feeding resources for bats; however, the similar coverage with modules would limit foraging potential. Therefore, impacts from the LEID approach are considered similar to the traditional approach for bat species.

***Indirect Impacts***

Traditional Construction Approach

The installation of 500 wooden poles and electrical lines throughout the RE Crimson Permitting Boundary may pose a collision hazard for bats that are foraging, migrating, or commuting through the area, although bat collisions with these features has not been evidenced at other sites to date.

LEID Approach

The installation of up to 900 wooden poles and electrical lines throughout the RE Crimson Permitting Boundary may pose a collision hazard that is greater than the traditional approach for bats that are foraging, migrating, or commuting through the area.

***Significance after Mitigation***

Potential construction-related direct and indirect impacts to special-status bat species would be reduced to less than significant through implementation of the avoidance, minimization, and mitigation measures as noted in Chapter 6. There is the potential that the matrix of lines associated with the no-trenching LEID element would be an un-mitigatable impact.

### 5.1.7 Wildlife Movement

The RE Crimson Permitting Boundary has been designed to avoid impacts to microphyll woodlands and allow for the safe passage of wildlife between the development areas during Project construction. Preservation of the microphyll woodlands allows for a variety of wildlife species to move freely within the woodlands and travel between the RE Crimson solar development areas, thus reducing potential impacts to wildlife corridors. While wildlife will be allowed to travel through the woodlands without hindrance, there may be impacts to certain wildlife species movement at a variety of scales. Generally, smaller wildlife, such as lizard and small mammal species, may experience a loss of connectivity between adjacent habitats after the perimeter fence is installed if they are too large to get through; however, many smaller animals are unlikely to be excluded by fencing. Other species, such as birds, will be able to fly over the Project or travel through the washes, and there is likely to be a minimal impact on birds. Larger species, such as burro deer, kit fox, coyotes, and American badgers, although excluded from the solar development areas, will be able to travel through the woodlands, but may experience some caution and hesitation, due to the nearby solar facility fencing, lighting, mirrors, and other structures.

***Direct Impacts***

<u>Traditional Construction Approach</u>

The Project may result in direct impacts to local wildlife movement. These impacts would result from construction of the perimeter fence that would surround the solar development areas. During construction, wildlife species that cannot fit between the desert tortoise exclusion fencing would be excluded from the RE Crimson Permitting Boundary, however, these species would still be permitted to travel through the adjacent washes and microphyll woodlands. The visibility of man-made structures and presence of construction equipment, people, and lighting adjacent to the microphyll woodlands, may cause behavioral avoidance of the washes.

The Project may adversely affect the local movement and dispersal for desert tortoise. Although desert tortoise is not a migratory species, opportunities for local movements within their home ranges and juvenile dispersal are important for maintaining viable populations. These effects would result from construction of perimeter security and desert tortoise exclusion fencing that would surround the Project facilities. The fence would create a permanent barrier and generally prevent local movement across the site by desert tortoise. However, the desert tortoise would be able to travel through the washes and microphyll woodland without hindrance as there would be no fencing across the main washes. These passages allow multiple locations for moving across the Project area and through the Permitting Boundary.

Other wildlife species such as desert kit fox, American badger, coyotes, burro deer, etc. would be excluded from the RE Crimson Permitting Boundary, but would be able to move through the washes or around the Project, as the area surrounding the Project would be left as native vegetation.

Additionally, as previously discussed under the impacts to migratory birds and bats, the construction of 500 wooden poles and electrical lines across the RE Crimson Permitting Boundary would introduce a new hazard to migrating species and may cause mortality from collisions.

<u>LEID Approach</u>

Direct impacts to wildlife movement from the LEID approach would be similar during construction because the entire RE Crimson Permitting Boundary would be fenced with desert tortoise exclusion fencing.

***Indirect Impacts***

Traditional Construction Approach

Potential indirect impacts of the Project and associated edge effects include but are not limited to altered behavior due to environmental stressors, changes in daily activity patterns, reductions in population reproductive capacity, and local population extinctions due to compromised population genetics over time or an inability to re-colonize isolated patches of habitat. These impacts vary depending on the population structure, size of the home range, migrations, and dispersal movements of the species being considered, as well as the species' behavioral response to artificial light, noise, degraded surrounding habitat, and other anthropogenic influences.

Construction of the Project would have permanent indirect effects on wildlife movement. Wildlife movement would be altered due to edge effects associated with development. Individually, species respond behaviorally to the edge itself (the "ecotonal effect") or to the indirect habitat changes associated with edges (the "matrix effect") (Lidicker and Peterson 1999; Kristan *et al.* 2003). Behavioral avoidance of human-made structures and associated edges can decrease wildlife movement and deter passage. In addition, the Project would indirectly affect wildlife movement through species avoidance in response to human presence.

LEID Approach

Impacts to wildlife movement would be similar to the Traditional Construction Approach detailed above, because of the presence of desert tortoise exclusion fencing.

***Significance after Mitigation***

Although impacts on local wildlife movement are anticipated, these impacts would generally be less than significant for common species (such as lizards, snakes, and small mammals). Local movement and habitat continuity may be impeded by construction of the Project, however, much of the land surrounding the Project is expected to remain in its natural state, which would allow movement by common terrestrial wildlife species to continue outside of the perimeter of the RE Crimson Permitting Boundary without significant impediment. For these reasons, impacts on common terrestrial wildlife species would be less than significant.

Since the Project is designed to avoid all microphyll woodlands, which are the main wildlife corridors, the Project is anticipated to have minimal impacts on wildlife movement corridors. Finally, potential construction-related direct and indirect impacts to wildlife corridors will be further reduced through implementation of the avoidance, minimization, and mitigation measures as noted in Chapter 6.

## 5.2 Operation and Maintenance

This section identifies impacts to the biological resources within the Project area that would result from O&M-related activities. O&M activities would include solar module washing, maintenance of transformers, inverters, or other electrical equipment, maintenance of electrical poles and lines, road and fence repairs including Arizona crossings, vegetation/pest management, and site security. O&M of the Project with or without LEID elements would be very similar. The incorporation of LEID elements could result in changes to the level of effort for vegetation management depending upon the elements selected associated with ground disturbing activities.

### 5.2.1 Sensitive Vegetation Communities

***Direct Impacts***

Traditional O&M Approach

Current vegetation densities within the RE Crimson Permitting Boundary are low and vegetation is generally sparse. A mow-and-roll technique is proposed for construction of the solar development areas. Limited vegetation will occur within the solar development areas following construction and recovery and or reestablishment of vegetation is not anticipated to be substantial. Therefore, O&M of the Project would not result in temporary or permanent direct impacts to sensitive vegetation communities beyond initial construction impacts. Since the linear features are designed to avoid impacts to blue palo verde—ironwood woodland there are no anticipated O&M impacts to sensitive vegetation communities apart from maintaining roads between the development areas. Following a major storm event, grading, blading, or soil stabilization may be necessary for the access roads connecting the development areas (that pass through the washes between the development areas).

LEID Approach

Incorporation of the reduced grading and/or no-trenching LEID elements would result in reduced vegetation removal within the solar development areas and would allow for the continued growth of vegetation (especially annuals) within the RE Crimson Permitting Boundary. Therefore, it will be necessary to trim the vegetation to a suitable height (approximately 18 inches) to prevent impacts to the modules. It is anticipated that throughout the life of the Project, vegetation trimming may be necessary in certain areas to prevent vegetation from growing up into the modules or other areas. Since the linear features are designed to avoid impacts to blue palo verde—ironwood woodland there are no anticipated O&M impacts to sensitive vegetation communities apart from maintaining roads between the development areas. Following a major storm event, grading, blading, or soil stabilization may be necessary for the access roads connecting the development areas (that pass through the washes between the development areas).

***Indirect Impacts***

Traditional O&M Approach

O&M of the Project may result in permanent indirect impacts to sensitive vegetation communities surrounding the RE Crimson Permitting Boundary. Permanent, indirect impacts to sensitive vegetation communities may include edge effects and increased exposure to nonnative plants. Erosion and stormwater contaminant runoff may degrade adjacent sensitive vegetation communities, although the apparent lack of flows through the site would indicate this is unlikely to be a substantial impact. Nonnative plant species are opportunistic and often occupy disturbed soils such as those within transmission line corridors and areas of exposed bare ground that may occur within the disturbance area. Wildfires caused by downed transmission lines are rare but may occur. Nonnative plants often frequent areas adjacent to and within burn areas following a wildfire. Once introduced, these nonnative plant species often outcompete natives for resources resulting in a reduction in growth, future dispersal, and recruitment of native species and the eventual degradation of the vegetation community.

LEID Approach

Potential indirect impacts to sensitive vegetation communities would be the same as the traditional O&M approach, which are detailed above. In addition, shading from the solar arrays may affect the residual habitat value onsite and would need to be considered as part of the residual habitat study should LEID elements be incorporated.

***Significance after Mitigation***

Indirect impacts to sensitive vegetation communities would be considered significant impacts. Potential O&M-related indirect impacts to sensitive communities would be reduced to less than significant through implementation of the avoidance, minimization, and mitigation measures described in Chapter 6.

### 5.2.2 Jurisdictional Waters

***Direct Impacts***

O&M of the Project would be the same under the traditional and LEID approach and would not result in temporary or permanent, direct impacts to jurisdictional waters, as they will not occur within the disturbance area following construction or have otherwise been mitigated for as part of the construction impacts. There may need to be minor repairs to access roads between the development areas (that cross the washes) following a major storm event. All impacts to waters will be addressed in the Section 1600 SAA.

***Indirect Impacts***

O&M of the Project would be the same under the traditional approach and with the incorporation of LEID elements and may result in permanent indirect impacts to jurisdictional waters of the State. Erosion and stormwater contaminant runoff may degrade adjacent jurisdictional waters of the State. These impacts would be considered significant where waters of the State occur adjacent to the disturbance area, if left unmitigated.

***Significance after Mitigation***

Potential O&M-related indirect impacts to jurisdictional waters of the state would be reduced to less than significant through implementation of the avoidance, minimization, and mitigation measures described in Chapter 6.

### 5.2.3 Flora

***Direct Impacts***

<u>Traditional O&M Approach</u>

Operation of the Project would not result in temporary or permanent, direct impacts to non-listed, special-status plant species, as they will not occur within the disturbance area following construction or would have been mitigated for following construction impacts. If non-listed special-status plant species remain onsite or repopulate the site during O&M activities, they will be permitted to grow and would be maintained as necessary to avoid impacts to the modules (height maintenance).

<u>LEID Approach</u>

With the incorporation of the reduced grading and/or no-trenching LEID elements, residual vegetation will be permitted to grow within the RE Crimson Permitting Boundary. Non-listed special-status plant species will be permitted to grow each year, flower and set-seed, and then they may be mowed or trimmed depending upon the vegetation height and their location or proximity to Project features. Vegetation will be trimmed to 18 inches and the frequency of trimming may vary depending upon the extent of winter and monsoonal rains. This cycle of permitting plant growth and then trimming it down after it has set-seed is not anticipated to impact the plant species, as they will be permitted to regrow each year. Therefore, O&M of the Project with applicable reduced ground-disturbing LEID elements incorporated is anticipated to be beneficial to non-listed special-status plant species as it will preserve the seed source, and maintain the seed bank in the soil.

***Indirect Impacts***

Traditional O&M Approach

O&M of the Project may result in permanent indirect impacts to non-listed special-status plant species. Erosion and stormwater contaminant runoff may degrade adjacent habitat for non-listed special-status plant species. The periodic washing of the modules may permit some nonnative species to grow around the modules, which, if left to set-seed, may spread to adjacent native habitats where non-listed special-status species are located. If left alone, these nonnative species may outcompete and choke out the non-listed special-status plant species.

LEID Approach

Indirect impacts from O&M with the incorporation of LEID elements are anticipated to be similar to but less than for the traditional approach since there will be less initial grading, then the potential for run-off during panel washing, or spread of nonnative species is reduced due to the preservation of native vegetation communities under and around the modules. Since there will be less grading, the potential for erosion, scouring, and spread of nonnative plant seeds during storm events will likely be less as the water will be able to follow natural flow patterns and absorb into the soil (due to less soil compaction).

***Significance after Mitigation***

Potential O&M-related indirect impacts to special-status plant species would be reduced to less than significant through implementation of the avoidance, minimization, and mitigation measures described in Chapter 6.

### 5.2.4 Wildlife Species

***Direct Impacts***

Traditional Construction Approach

Permanent direct impacts to wildlife species may occur from mortality of individuals (by crushing or vehicle collisions), that pass through the desert tortoise exclusion fencing (primarily small vertebrates) or go over the desert tortoise gates and enter the RE Crimson Permitting Boundary. Additionally, there is the potential for species to be killed or crushed while crossing the Powerline Road, and the roads connecting the development areas, which would not be fenced.

LEID Approach

Permanent direct impacts to wildlife with the incorporation of LEID elements would be similar to those for the traditional Project.

***Indirect Impacts***

Traditional Construction Approach

Operation of the Project could result in permanent indirect impacts to special-status wildlife species, which includes edge effects, where facilities would lead to increased lighting and nonnative plant proliferation. O&M of the Project would not lead to increased noise greater than 60 decibels A-weighted outside of the disturbance area (therefore, there are no anticipated noise impacts to nearby nesting birds). Nighttime lighting could disrupt species movement and/or cause increased predation rates, although any nighttime lighting would include motion sensors and be shielded away from native habitat outside of the RE Crimson Permitting Boundary. Wildfires caused by downed transmission lines are rare (especially given the sparse vegetation within the area) but may occur and damage adjacent habitat. The potential for an increased common raven population resulting from regular human presence and an increase in perching locations would increase the potential for predation of juvenile desert tortoises as well as other smaller special-status species that are easily preyed upon. The addition of 500 wooden transmission poles and associated electrical lines across the RE Crimson Permitting Boundary would provide additional perch locations for avian predators, and serve as potential collision hazards for avian species.

<u>LEID Approach</u>

Permanent indirect impacts to wildlife as described above would also occur via the LEID approach; however the addition of 300 to 400 more wooden transmission poles (up to 900) would increase perch locations for predators, and increase the potential for avian collisions (particularly for migratory species).

***Significance after Mitigation***

Potential O&M-related indirect impacts to special-status wildlife species would be reduced to less than significant through implementation of the avoidance, minimization, and mitigation measures described in Chapter 6. There is the potential that the matrix of lines associated with the no-trenching LEID element would be an un-mitigatable impact.

### 5.2.5 Wildlife Movement

***Direct Impacts***

<u>Traditional O&M Approach</u>

O&M of the Project under the traditional approach is not anticipated to result in additional direct impacts to wildlife movement beyond those described in section 5.1.7.

<u>LEID Approach</u>

With the incorporation of reduced ground-disturbing LEID elements, existing vegetation would be greatly preserved and permitted to grow; therefore, forage and cover resources would be available for wildlife species and would reduce the recovery time for the site following facility decommissioning. Without the incorporation of one or all of the reduced ground-disturbing LEID elements, there is unlikely to be much residual habitat value. However, there is currently very little vegetation within the proposed solar development areas regardless.

***Indirect Impacts***

O&M of the Project under the traditional or LEID approach is not anticipated to result in additional indirect impacts to wildlife corridors beyond those described in Section 5.1.7. The primary indirect impact that would continue during O&M would be the potential for avian collision (primarily from migratory birds) from the 500 to 900 wooden poles and electrical wires spread across the RE Crimson Permitting Boundary. This hazard, along with the potential for avian collision with the modules, would continue for the life of the Project during O&M.

***Significance after Mitigation***

Operation of the Project would not result in any additional significant impacts to wildlife movement; thus, no avoidance, minimization, and mitigation measures are necessary.

## 5.3 Decommissioning

Decommissioning impacts are anticipated to be similar to those determined for the construction phase of the Project. The actual impacts would be dependent upon the proposed decommissioning action and final use of the site. Applicable construction phase APMs would be implemented during the decommissioning phase to minimize associated impacts.

The Applicant will retain a project biologist for the decommissioning phase of the Project to verify that all environmental protection measures are implemented. The Applicant will submit the names and qualifications of all proposed biologists to the USFWS and BLM for review and approval at least 30 days prior to decommissioning activities. Decommissioning activities will not begin until the proposed biologists are approved by the aforementioned agencies.

The incorporation of LEID elements, including reduced ground-disturbing activities has the potential to result in the preservation of more vegetation and habitat function during and following construction. The more residual habitat value that exists during O&M and into decommissioning, the faster the recovery of the site would be should it be reclaimed to native habitat.

## 5.4 Cumulative Impacts

This section addresses the potential additive impacts of implementing the Project in combination with other past, present, and reasonably foreseeable projects in proximity to the Project. A search of past, present, and reasonably foreseeable projects was conducted in an approximately 40-mile radius around the Project and included projects in Arizona, because impacts to desert species may also occur there on BLM lands (Appendix N).

The multiple projects proposed on BLM land including solar power, wind power, or transmission projects are identified in Appendix N. The BLM ROW for multiple solar projects on BLM land would use up to thousands of acres of desert lands along the I-10 corridor, based on currently available data. The actual disturbance area of these projects will likely be considerably smaller. Refer to Appendix N, for detailed information on projects considered for this cumulative analysis. The development of these projects would unavoidably impact biological resources currently found on the various project sites and would cumulatively reduce the available habitat for special-status species.

The large acreage assumed to be developed in each of the various projects would impact wildlife movement and fragment species populations despite mitigation (i.e., the permanent protection of offsite habitat for these species). Since most of the projects are in the valleys and along the I-10 corridor, this could potentially reduce movement and impair gene flow among species populations. Through the project-specific environmental review process, these various projects would individually be required to mitigate their own impacts through measures such as providing suitable habitat at an agency agreed-upon ratio for the affected species to compensate for the habitat loss. Acquired mitigation lands should be planned with consideration of providing local movement between areas of open space and between NECO-designated WHMAs and DWMAs. The Project will fully mitigate impacts to biological resources. Because Project impacts will be fully mitigated, the cumulative contribution of the Project would be less than significant.

# 6.0 Avoidance, Minimization, and Conservation Measures

This chapter details the Applicant Proposed avoidance, minimization, and conservation measures (APMs) to reduce Project impacts to less than significant for all sensitive vegetation communities, jurisdictional waters, and special-status plant and wildlife species. Following the general measures, there are species-specific avoidance, minimization, and conservation measures that will further reduce potential impacts from the Project. Generally, measures have been grouped together to reduce redundancy. These APMs will be implemented within the RE Crimson Permitting Boundary during Project implementation and throughout the life of the Project to the greatest extent feasible. These measures apply to both the traditional and LEID construction and O&M approaches and decommissioning, where applicable, and are differentiated where necessary.

Although the Project is grandfathered from the DRECP, the Project proponent has committed to implementing measures that are consistent with the CMAs identified in the DRECP whenever possible. The CMAs related to biological resources, as applicable to the RE Crimson Project, are summarized in Appendix O. The table included in this appendix provides a review of the Project's consistency with the relevant CMAs.

## 6.1 General Avoidance and Minimization Measures during Construction

The following is a list of general impact avoidance and minimization measures that would apply to Project construction activities. These measures are standard practices designed to prevent environmental degradation, and the Project applicant will be responsible for implementation of these measures to avoid and minimize impacts to the greatest extent feasible. A Biological Resources Mitigation Implementation and Monitoring Plan (BRMIMP) will be developed for review by the BLM and part of the issuance of the ROW Grant. The BRMIMP comprehensively describes avoidance, minimization, and mitigation measures, and provides a matrix to document their implementation and monitor their effectiveness. Those measures include:

BIO-1 The Project proponent will designate at least one BLM-, USFWS-, and CDFW-approved Designated Biologist (DB) to the Project. Hereafter the BLM, USFWS, and CDFW are referred to as the Resource Agencies. The Project proponent shall submit the resume of the proposed DB(s) with at least three references and contact information to the BLM Authorized Officer (AO) for approval in consultation with the USFWS and CDFW. If the DB is not also a USFWS Authorized Biologist (AB), a separate AB shall be approved by the Resource Agencies and be present onsite for measures associated with the federal- and state- listed desert tortoise.

BIO-2 The Project proponent shall ensure that the DB(s) performs the activities described below during any pre-construction site mobilization activities, construction-related ground-disturbance, grading, boring, trenching, commissioning, or other activities that may impact biological resources. The DB may be assisted by the approved Biological Monitor(s) but remains the contact for the Project proponent and the BLM AO. The DB shall be responsible for overseeing monitoring and compliance with protective measures for the biological resources. Approval from the CDFW and a Biological Opinion in accordance with Section 7 would be necessary for the monitoring or handling of federally listed wildlife species. The DB shall maintain communications with the appropriate personnel (project manager, resident engineer) to ensure that issues relating to biological resources are appropriately and lawfully managed. The DB shall also be present to verify compliance with all conservation measures. The DB would submit reports that document compliance with these measures to the Resource Agencies upon request or, at a minimum, included in the end-of-the-year report. In addition, DB would perform the following duties.

a. The DB shall be onsite during all vegetation clearing and grubbing during Project construction in upland and riparian habitat to be impacted.

b. Each employee shall participate in a training/awareness program that shall be presented by the DB, prior to working on the Project.

c. Proper implementation of protective measures developed in coordination with USFWS and CDFW to avoid all impacts to all encountered sensitive species as well as other nesting birds shall be verified.

d. The resident engineer shall be immediately notified to halt work, if necessary, and coordinate with the Resource Agencies to ensure the proper implementation of species and habitat protection measures. The DB shall report any breech of the conservation measures within 24 hours of its occurrence.

BIO-3 The Project proponent shall employ Biological Monitors to support Project compliance activities as needed. The Project proponent or DB shall submit the resume, at least three references, and contact information of the proposed Biological Monitors to the BLM AO and CDFW. The resume shall demonstrate, to the satisfaction of the BLM AO, the appropriate education and experience to accomplish the assigned biological resource tasks.

BIO-4 Biological Monitors shall assist the DB in conducting surveys and in monitoring of site mobilization activities and all vegetation and ground-disturbing activities, including pre-construction phase activities.

BIO-5 The anticipated impact zones, including staging areas, equipment access, and disposal or temporary placement of spoils, shall be delineated with stakes and flagging prior to construction to avoid natural resources where possible. No construction-related activities will occur outside of the designated impact area (i.e., RE Crimson Permitting Boundary).

BIO-6 The Project proponent shall ensure that all construction materials, staging, storage, dispensing, fueling, and maintenance activities are located in upland areas outside of sensitive habitat, and that adequate measures are taken to prevent any potential runoff from entering waters of the State. Staging areas shall be located within permanent impact areas or previously disturbed sites within the Project footprint.

BIO-7 Cross-country vehicle and equipment use outside designated work areas shall be prohibited. New and existing roads that are planned for either construction or widening shall not extend beyond the disturbance area. All vehicles passing or turning around shall do so within the disturbance area. Where new access is required outside of existing roads or the construction zone, the route shall be clearly marked (i.e., flagged and/or staked) prior to the onset of construction.

BIO-8 Spoils shall be stockpiled in disturbed areas presently lacking native vegetation. Stockpile areas shall be marked to define the limits where stockpiling can occur.

BIO-9 Spoils, trash, or any debris shall be removed offsite to an approved disposal facility. A trash abatement program shall be established. Trash and food items shall be contained in closed containers and removed daily to reduce the attractiveness to opportunistic predators such as common ravens, coyotes, desert kit foxes, and other predators that may prey on sensitive species.

BIO-10 Workers shall be prohibited from bringing pets and firearms to the site.

BIO-11 Wildlife pitfalls shall be avoided:

a. Backfill Trenches. At the end of each workday, the DB or Biological Monitor shall ensure that all potential wildlife pitfalls (trenches, bores, and other excavations), both outside and within the area fenced with desert tortoise exclusion fencing, have been backfilled. If backfilling is not feasible, all trenches, bores, and other excavations shall be sloped at a 3:1 ratio at the ends to provide wildlife escape ramps, or covered completely to prevent wildlife access, or fully enclosed with desert tortoise-exclusion fencing. All trenches, bores, and other excavations outside the areas permanently fenced with desert tortoise exclusion fencing shall be inspected periodically throughout the day, at the end of each workday and at the beginning of each day by the DB or a Biological Monitor. Should a tortoise or other wildlife become trapped, an AB or Biological Monitor shall remove and relocate the individual as described in the Desert Tortoise Relocation/Translocation Plan. Any wildlife encountered during the course of construction shall be allowed to leave the construction area unharmed.

b. Avoid Entrapment of Desert Tortoise and/or Burrowing Owl. Any construction pipe, culvert, or similar structure with a diameter greater than 3 inches, stored less than 8 inches aboveground and within desert tortoise and/or burrowing owl habitat (i.e., outside the permanently fenced area) for one or more nights, shall be inspected for tortoises and owls before the material is moved, buried or capped. As an alternative, all such structures may be capped before being stored outside the fenced area, or placed on pipe racks.

BIO-12 Minimize Standing Water. Water applied to dirt roads and construction areas (trenches or spoil piles) for dust abatement shall use the minimal amount needed to meet safety and air quality standards in an effort to prevent the formation of puddles, which could attract desert tortoises and common ravens to construction sites. A Biological Monitor shall patrol these areas to ensure water does not puddle and shall take appropriate action (e.g., coordinating with the contractor to reduce watering frequency) to reduce water application where necessary.

BIO-13 Minimize Spills of Hazardous Materials. All vehicles and equipment shall be maintained in proper working condition to minimize the potential for fugitive emissions of motor oil, antifreeze, hydraulic fluid, grease, or other hazardous materials. The DB shall be informed of any hazardous spills immediately. Hazardous spills shall be immediately cleaned up and the contaminated soil properly disposed of at a licensed facility. Servicing of construction equipment shall take place only at a designated area. Service/maintenance vehicles shall carry a bucket and pads to absorb leaks or spills.

BIO-14 If construction activities occur at night, all Project lighting (e.g., staging areas, equipment storage sites, roadway) shall be directed onto the roadway or construction site and away from sensitive habitat. Light glare shields shall also be used to reduce the extent of illumination into adjoining areas.

BIO-15 Best Management Practices (BMPs) shall be employed to prevent loss of habitat due to erosion caused by Project-related impacts (i.e., grading or clearing for new roads) as specified in the DESCP. The Project inspector shall periodically monitor the work area to ensure that construction-related activities do not generate erosion or excessive amounts of fugitive dust. All detected erosion shall be remedied within 2 days of discovery.

BIO-16 Fueling of equipment shall take place within existing paved roads and not within 300 feet or adjacent to drainages or native desert habitats. Contractor equipment shall be checked for leaks prior to operation and repaired as necessary.

BIO-17 Wildfires shall be prevented by exercising care when driving and by not parking vehicles where catalytic converters could ignite dry vegetation. In times of high fire hazard (e.g. high wind), trucks may need to carry water and shovels or fire extinguishers in the field or high fire risk installations (e.g. electric lines) may need to be delayed. The use of shields, protective mats, or other fire prevention equipment shall be used during grinding and welding to prevent or minimize the potential for fire. No smoking or disposal of cigarette butts shall take place within vegetated areas.

BIO-18 The introduction of nonnative plant species shall be avoided and controlled wherever possible, and may be achieved through physical or chemical (pending BLM approval) removal and prevention. Preventing nonnative plants from entering the site via vehicular sources shall include measures such as the use of rumble strips (e.g., Trackclean) or other method(s) of vehicle cleaning for vehicles coming and going from the site. Earth-moving equipment will be cleaned prior to transport to the project site. Weed-free rice straw or other certified weed-free straw shall be used for erosion control. Weed populations introduced into the site during construction shall be eliminated by chemical and/or mechanical means approved by the Resource Agencies and in accordance with applicable federal, state, and local regulations. These measures collectively form the Weed Management Plan for the Project.

BIO-19 The Project proponent shall develop a Worker Environmental Awareness Training (WEAP) to be approved by the BLM AO and CDFW. The WEAP shall contain information on all special-status species, vegetation communities, nonnative invasive weed species (and how to reduce/limit their spread), and protection measures for special-status species. The WEAP shall be administered to all Project personnel and shall include documentation of training with training acknowledgements signed by each worker. The WEAP shall be implemented during site preconstruction, construction, operation, and decommissioning. The WEAP shall:

1. Be developed by or in consultation with the DB and consist of an onsite or training center presentation in which supporting written material and electronic media, including photographs of protected species, is made available to all participants;

2. Discuss the locations and types of sensitive biological resources on the Project site and adjacent areas, and explain the reasons for protecting these resources; provide information to participants that no snakes, reptiles, or other wildlife shall be harmed;

3. Place special emphasis on desert tortoise and desert kit fox, including information on physical characteristics, distribution, behavior, ecology, sensitivity to human activities, legal protection, penalties for violations, reporting requirements, and protection measures;

4. Include a discussion of fire prevention measures to be implemented by workers during Project activities; request workers dispose of cigarettes and cigars appropriately and not leave them on the ground or buried;

5. Describe the temporary and permanent habitat protection measures to be implemented at the Project site;

6. Identify whom to contact if there are further comments and questions about the material discussed in the program; and

7. Include a training acknowledgment form to be signed by each worker indicating that they received training and shall abide by the guidelines.

The WEAP can be administered by a competent individual(s) or by media acceptable to the DB and BLM AO.

In addition to the avoidance and minimization measures outlined in this chapter, the Project proponent shall implement any measures required by the Resource Agencies as a condition of Project approval and issuance of the ROW Grant.

## 6.2 Resource-Specific Avoidance, Minimization, and Mitigation Measures

Resource-specific impact avoidance, minimization, and mitigation measures for Project impacts that were determined to be potentially significant are discussed below. Incorporation of these measures shall reduce potentially significant measures to below a level of significance.

### 6.2.1 Waters of the State

There are no federal waters present within or immediately adjacent to the RE Crimson Permitting Boundary and, therefore, there will be no impacts to federal waters. However, there are 91 acres of potential jurisdictional waters of the State and approximately 1.2 acres of CDFW riparian woodland (blue palo verde—ironwood woodland) within the RE Crimson Permitting Boundary. The following are recommendations regarding possible compensatory mitigation of impacts:

BIO-20 Impacts to microphyll woodlands shall be avoided with the exception of two crossings within the RE Crimson Permitting Boundary. Crossing widths shall be sited to avoid mature trees and constructed with the minimum width necessary to minimize direct impacts to the drainage.

BIO-21 Buffers of approximately 200 feet will be established around microphyll woodlands, with the exception of crossing locations, within the Project area to reduce indirect impacts associated with the Project.

BIO-22 Impacts to waters of the State shall require the following permit: (1) CDFW, CFGC, Section 1602 agreement for alteration of a streambed (application currently in progress). Mitigation for unavoidable permanent impacts to jurisdictional waters within the disturbance area could be mitigated via a combination of methods. The mitigation could occur in the form of approved mitigation bank credits, an approved In-Lieu fee program, conservation easement(s), and/or jurisdictional habitat creation-restoration (that results in a net increase in jurisdictional habitat acreage), enhancement, or creation-restoration combined with enhancement. Project-specific mitigation ratios shall be developed in consultation with CDFW and in consideration of the NECO mitigation requirements for desert dry wash woodland.

BIO-23 The development of a conceptual mitigation, maintenance, and monitoring plan shall be required for all mitigation for all species where mitigation is necessary, including mitigation for CFGC Section 1600 et seq. if jurisdictional waters (including aquatic habitat) of the State are impacted as a result of the proposed Project. This plan shall include details regarding site preparation (e.g., grading), planting specifications, and irrigation design, as well as maintenance and monitoring procedures. The plan shall outline yearly success criteria and remedial measures shall the mitigation effort fall short of the success criteria. Any riparian mitigation that cannot be achieved through onsite creation-restoration and enhancement shall be performed off site through the purchase and management (into perpetuity) of conservation lands, typically per agency guidance within the same hydrologic unit (watershed) where impacts occur. Alternatively, the mitigation obligations may also be satisfied by participating in a fee-based mitigation program through a mitigation bank. This plan shall be developed in consultation with BLM and CDFW and subject to their approval.

### 6.2.2 Special-Status Plants

Four special-status plant species are known to occur within or adjacent to the RE Crimson Permitting Boundary; Harwood's eriastrum, desert unicorn plant, ribbed cryptantha, and Utah vine milkweed. The Project proponent will implement avoidance, minimization, and compensation measures to protect special-status plants to reduce impacts to the maximum extent practicable including implementation of the following measures:

BIO-24 Prior to the start of vegetation or ground-disturbing activities a qualified botanist will establish Environmentally Sensitive Areas (ESAs) outside of the RE Crimson Permitting Boundary within 100 feet of the limits of disturbance. This includes areas identified to have special-status plant species during prior surveys. The locations of ESAs will be clearly marked on construction drawings and will be flagged in the field.

BIO-25 Incorporate site design modifications to minimize impacts to special-status plant along Project linear features including:

1. Limit the extent of work areas;
2. Microsite roads and linear features to avoid known occurrences; and,
3. Drive and crush vegetation as an alternative to blading of roads to preserve the seed bank.

BIO-26 Special-status plant species within the RE Crimson Permitting Boundary are allowed to regrow each year and will not be mowed or trimmed lower than 18 inches, until the plants have flowered and set-seed in order to preserve the seed bank for these special-status plant species.

### 6.2.3 Special-Status Wildlife

Anticipated mitigation requirements for the Project's permanent impacts to habitats occupied, or presumed occupied, by special-status listed wildlife species (i.e., desert tortoise) are outlined in Table 6-1 below. Mitigation for permanent impacts to these species' habitat is generally provided by acquiring and conserving in-kind habitat of equal or greater value than the habitat impacted.

Avoidance and minimization measures for temporary indirect impacts to habitat of special-status wildlife species will be achieved through onsite monitoring of construction activities in areas with the potential to support these species.

**Table 6-1. Acreage Impacts to Listed Species Habitats within the RE Crimson Permitting Boundary**

| Habitat Type | RE Crimson Permitting Boundary Total (Acres) | Mitigation Ratio | Total Mitigation Acreage |
|---|---|---|---|
| Mojave Desert Tortoise – Occupied Habitat | 967.4 | 1:1 | 967.4 |
| Unoccupied Habitat | 1,521.7 | 1:1 | 1,521.7 |
| Total | 2,489.1 | -- | 2,489.1 |

Compensatory mitigation totals for permanent loss of habitat for special-status listed species would be in accordance with Table 6-1. Because there are no western burrowing owls currently breeding or wintering within the RE Crimson Permitting Boundary, this species does not require mitigation. However, lands purchased as mitigation for desert tortoise will likely provide protection for western burrowing owls as well. If western burrowing owls are detected breeding or wintering within the RE Crimson Permitting Boundary, then mitigation may be necessary. Additional discussion of the management and/or mitigation measures required for desert tortoise and for burrowing owl, should they be detected onsite, is presented below as are other special-status species that do not require compensatory mitigation (Mojave fringe-toed lizard, desert kit fox, American badger, and migratory birds).

***Desert Tortoise***

BIO-27 Prior to the onset of construction, the entire disturbance area shall be enclosed with a permanent desert tortoise-exclusion fence to keep desert tortoise in habitat adjacent to the site from entering the site during construction and operations phases. The fencing type shall be 1-inch by 2-inch vertical mesh galvanized fence material, extending at least 2 feet above the ground and buried at least 1 foot. Where burial is impossible, the mesh shall be bent at a right angle toward the outside of the fence and covered with dirt, rocks, or gravel to prevent the desert tortoise from digging under the fence. Desert tortoise-exclusion gates (with grates) shall be established at all site entry points. Any utility corridors and tower locations shall be temporarily fenced to prevent desert tortoise entry during construction. Temporary fencing shall follow guidelines for permanent fencing and supporting stakes shall be sufficiently spaced to maintain fence integrity.

The access roads between development areas will have temporary desert tortoise-exclusion fence installed along their length through the washes in areas with the highest desert tortoise density (between the two southern-most development areas). Following completion of construction, the desert tortoise-exclusion fencing along these access roads between development areas will be removed and desert tortoise-exclusion gates with grates will be installed at each end of the access road between development areas.

All fence construction shall be monitored by an AB or appointed monitors to verify that no desert tortoise is harmed. Following installation, the fencing shall be inspected monthly and within 24 hours after all major rainfall events. Damage to the fencing shall be repaired immediately.

BIO-28 Pre-construction surveys shall be conducted to locate and remove desert tortoises prior to grading or actions which might result in harm to a desert tortoise or which remove tortoise habitat. Clearance surveys for desert tortoise will be conducted across the entire RE Crimson Permitting Boundary following installation of the desert tortoise-exclusion fence. A minimum of two clearance perpendicular passes will be completed after desert tortoise-exclusion fencing is installed, and these passes will coincide with heightened desert tortoise activity, from late March through May and during September through October, to the greatest extent feasible. This measure shall maximize the probability of finding all desert tortoise. Clearance surveys will be conducted and desert tortoise found shall be moved by a DB/AB in accordance with an approved Desert Tortoise Relocation/Translocation Plan. Once the site is deemed free of desert tortoise after two consecutive clearance passes with no desert tortoise found, then heavy equipment shall be allowed to enter the site to perform construction activities. For areas not enclosed by exclusion fencing, preconstruction clearance surveys shall be conducted within 24 hours prior to the onset of surface disturbance and a Biological Monitor shall be present in the vicinity of construction activities.

Following site clearance, a report shall be prepared by the DB to document the clearance surveys, the capture and release locations of all desert tortoise found, individual desert tortoise data, and other relevant data. This report shall be submitted to the Resource Agencies.

BIO-29 An AB shall be appointed to oversee compliance with the protection measures for the desert tortoise and other species. The AB shall be on site during fencing activities. The AB shall have the right to halt all activities that are in violation of the desert tortoise protection measures. Work shall proceed only after hazards to the desert tortoise are removed and the species is no longer at risk, or the individual has been moved from harm's way by the AB. The AB shall have in their possession a copy of all the compliance measures while work is being conducted onsite.

BIO-30 Project activities shall not begin until an AB is approved by the Resource Agencies. ABs shall be allowed to handle and relocate desert tortoise when necessary. Biological Monitors shall ensure compliance with the protection measures but shall not be allowed to handle desert tortoise without direct oversight of an AB. Workers shall notify the AB of all desert tortoise observations.

BIO-31 The AB shall be responsible for awareness trainings, surveys, compliance monitoring, and reporting related to desert tortoise.

BIO-32 Personnel shall only access the site via Powerline Road and shall maintain the posted speed limit of 25 mph. Speed limits on roads within the Project Area shall not exceed 15 mph. The project shall impose penalties if Project personnel (including contractors, subcontractors, and delivery personnel) are detected exceeding site speed limits (through regular speed limit checks). To minimize the likelihood for vehicle strikes of desert tortoise and other wildlife, a maximum speed limit of 15 mph shall be established for travel within the desert tortoise habitat outside of fenced areas.

BIO-33 Parking and storage will occur within the desert tortoise-exclusion fencing. Anytime a vehicle or construction equipment is parked in unfenced desert tortoise habitat, the ground under the vehicle shall be inspected for the presence of desert tortoise before the vehicle is moved. This inspection will involve both the front and rear tires, in front of each tire, and behind each tire. If a desert tortoise is observed, it shall be left to move on its own. If it does not move within 15 minutes, the AB, or BM under the direct supervision of an AB, shall remove and relocate the desert tortoise to a safe location.

BIO-34 All vehicles and equipment shall be in proper working condition to ensure that there is no potential for fugitive emissions of motor oil, antifreeze, hydraulic fluid, grease, or other hazardous materials. The DB shall be informed of any hazardous spills within 24 hours. Hazardous spills shall be immediately cleaned up and the contaminated soil shall be properly disposed of at a licensed facility.

BIO-35 Intentional killing or collection of the desert tortoise in the survey area and surrounding areas shall be prohibited. The AB and/or DB shall be notified of any such occurrences immediately and the Resource Agencies shall be notified of any such occurrences within 24 hours and any corrective/legal actions will be taken.

BIO-36 For emergency response situations, the AB and/or DB shall notify the agency representatives immediately. As a part of this response, the agency representatives may require additional measures to protect the desert tortoise. During any responses related to human health, fire, hazardous waste, or repairs requiring off-road vehicle and equipment use, the Resource Agencies may also require measures to recover damaged habitat.

BIO-37 Water shall be applied to the construction ROW, dirt roads, trenches, spoil piles, and other areas where ground disturbance has taken place to minimize dust emissions and topsoil erosion. During the desert tortoise active season, a DB, AB, or Biological Monitor shall patrol these areas to ensure water does not puddle for extended periods of time (generally several hours) and attract desert tortoise, common ravens, and other wildlife to the site.

BIO-38 Upon locating a dead or injured desert tortoise, the AB and/or DB shall make initial notification to the Resource Agencies within 24 hours of its finding. The notification must be made by telephone and writing to the nearest USFWS Field Office, located in Palm Springs, California, and CDFW contact listed in ITP. The report shall include the date and time of the finding or incident (if known), location of the carcass, a photograph, cause of death (if known), and other pertinent information. Desert tortoise fatally injured as a result of Project-related activities shall be submitted for necropsy as outlined in Salvaging Injured, Recently Dead, Ill, and Dying Wild, Free-Roaming Desert Tortoises (Berry 2003). Desert tortoise with fewer major injuries shall be transported to a nearby qualified veterinarian for treatment at the expense of the proponent. If an injured desert tortoise does not recover, the Resource Agencies shall be contacted for final disposition of the desert tortoise.

BIO-39 During construction activities, quarterly and final compliance reports shall be provided by the DB to BLM, CDFW, and other applicable Resource Agencies documenting the effectiveness and practicality of the protection measures that are in place and making recommendations for modifying the measures to enhance species protection, as needed. The report shall also provide information on the overall biological resources-related activities conducted, including the worker awareness training, clearance/pre-activity surveys, monitoring activities, and any observed desert tortoise including injuries and fatalities.

BIO-40 The Project proponent shall prepare a Raven Monitoring, Management, and Control plan that is consistent with the most current USFWS-approved raven management guidelines. The management plan shall include but not be limited to a program to monitor raven presence in the Project vicinity, determine if raven numbers are increasing, and to implement raven control measures as needed based on monitoring results. The purpose of the plan is to avoid any Project-related increases in raven numbers during construction, operation, and decommissioning. The Applicant shall also provide funding for implementation of the USFWS Regional Raven Management Program.

BIO-41 In addition to the measures discussed above, the Project proponent shall compensate for impacts to desert tortoise habitat in the disturbance area during construction activities. This compensation shall be accomplished either by land acquisition acceptable to the BLM and the Resource Agencies, or an assessed financial contribution calculated based on the final construction footprint. Direct permanent impacts to desert tortoise habitat shall be mitigated at a 1:1 ratio of mitigation to impacts. Funding for the long-term management of mitigation land shall also be required. The offsite location of the mitigation land and a management program shall be negotiated between the Resource Agencies and the Project Applicant.

***Western Burrowing Owl***

Avoidance, minimization, and mitigation of impacts to western burrowing owl shall consist of the following if western burrowing owls are discovered during desert tortoise clearance surveys (as described above), or within the RE Crimson Permitting Boundary:

BIO-42 If during preconstruction surveys western burrowing owl activity is detected at a burrow during the nonbreeding season (September 1 through January 31), a 160-foot buffer shall be flagged surrounding the occupied burrow and all Project-related activity shall remain outside of the flagged area (CBOC 1993). This buffer can be adjusted by the DB or qualified biologist with concurrence by the Resource Agencies. Western burrowing owl shall be excluded from active burrows during the nonbreeding season (September 1 through January 31) and encouraged to passively relocate to suitable, unoccupied habitat at least 160 feet outside of the exclusion area. Western burrowing owl shall be excluded by installing one-way doors in burrow entrances. One-way doors shall be left in place 48 hours to ensure owls have left the burrow before excavation. One alternate natural or artificial burrow shall be provided for each burrow that shall be excavated in the disturbance area. The excluded burrows shall be monitored daily for 1 week to confirm owl use of alternate burrows before excavating burrows. After burrows are confirmed to no longer be in use (1 week), the burrow shall be excavated using hand tools and refilled to prevent reoccupation. Sections of flexible plastic pipe measuring 4 inches in diameter or greater shall be inserted into the tunnels during excavation to maintain an escape route for any western burrowing owl inside the burrow.

BIO-43 If during preconstruction surveys western burrowing owl activity is detected at a burrow during the breeding season (February 1 through August 31), a 250-foot buffer shall be flagged surrounding the occupied burrow and all Project-related activity shall remain outside of the flagged area. This buffer can be adjusted by the DB or a qualified biologist with concurrence by the Resource Agencies. Western burrowing owl shall not be moved or excluded from burrows during the breeding season. Construction may only occur within the buffer if a DB or qualified biologist verifies through noninvasive methods that the birds have either not initiated egg laying or juveniles from the occupied burrow are foraging independently and are capable of independent survival.

BIO-44 The western burrowing owl shall be included as part of the WEAP.

BIO-45 During construction activities, quarterly and final compliance reports shall be provided to the Resource Agencies documenting the effectiveness of mitigation measures and the level of take associated with the Project. Biological issues also shall be covered in the ongoing compliance reporting required by the BLM.

BIO-46 At this time, no mitigation is required for impacts to western burrowing owl, as none have been detected within the RE Crimson Permitting Boundary. If western burrowing owls are detected at a later date, then mitigation may be necessary and will follow the latest CDFW Staff Report on Burrowing Owl Mitigation (State of California 2012). Habitat mitigation acreage may be allowed to nest with desert tortoise mitigation acreage if all conditions for both species are met at the site.

***Mojave Fringe-toed Lizard***

Avoidance, minimization, and mitigation of impacts to Mojave fringe-toed lizard shall consist of the following:

BIO-47 The Project proponent shall minimize impacts to dune habitat associated with linear features that support Mojave fringe-toes lizards. Roads shall be kept at-grade to avoid blocking local sand transport.

BIO-48 The Project proponent shall compensate for impacts to Mojave fringe-toed lizard dune habitat in the disturbance area during construction activities. This shall be accomplished either by land acquisition acceptable to the Resource Agencies, or an assessed financial contribution calculated based on the final construction footprint. Direct permanent impacts to dunes that are both occupied and unoccupied Mojave fringe-toed lizard habitat shall be mitigated at a ratio of 3:1 mitigation to impact. Habitat conservation generally consists of the offsite purchase of in-kind habitat of equal value than that impacted. Funding for the long-term management of the land preserved shall also be required. The location of the preserved land and the management program shall be negotiated between the CEC and Resource Agencies and the Project applicant.

***Desert Kit Fox and American Badger***

BIO-49 The Project proponent will prepare a Desert Kit Fox and American Badger Management Plan prior to the start of construction that defines the strategy for management of kit fox and badgers, subject to the

BLM and CDFW approval. The plan will clearly identify the approach for the clearance of the solar development areas within the RE Crimson Permitting Boundary and passive relocation methods.

BIO-50 Any potential desert kit fox and/or American badger burrows within the RE Crimson Permitting Boundary found between January 15 and July 31, or until pups are independent, will be monitored (through wildlife cameras) to determine if they are active. Passive relocation cannot occur while young are in the burrow and still dependent upon their parents, and must be avoided from March 1 through August 31. Therefore, the burrows must be avoided during that timeframe with a 500-foot non-disturbance buffer. This buffer can be adjusted by the DB or a qualified biologist with concurrence by the Resource Agencies. Once wildlife cameras confirm that desert kit fox and/or American badgers are no longer using a burrow or burrow complex (as determined by 3 consecutive nights with no desert kit fox or American badgers using the burrow[s]), it can be collapsed and filled in before site grading in that area is permitted. It may be necessary to conduct additional wildlife camera surveys to ensure that burrows are not re-excavated by desert kit fox or American badgers following the collapse of a previously occupied burrow(s).

***Migratory Birds***

BIO-51 To the extent possible, vegetation clearing will occur outside of the breeding season for avian species protected under the MBTA (e.g., February 15 through September 15). If vegetation clearing must occur during the general avian breeding season, a pre-construction nest survey will be conducted within the construction footprint and surrounding 500-foot buffer by a qualified biologist(s) 10 days prior to the start of construction in any given area of the project footprint. If no active nests are discovered, construction may proceed. If active nests are observed that could be disturbed by construction activities, these nests and an appropriately sized buffer will be avoided until the young have fledged and/or the monitor determines that no impacts are anticipated to the nesting birds or their young. If construction ceases for seven or more consecutive days during the nesting season, repeat nesting bird surveys will be required to ensure that new nesting locations have not been established within the construction footprint and a 500-foot buffer.

BIO-52 When above-ground lines are necessary, power line/wire marking devices, including aerial marker spheres, swinging plates, bird diverters, paint, and other bird avoidance devices, will be used if determined necessary to prevent avian collisions as outlined in the Avian Power Line Interaction Committee's (APLIC's) Reducing Avian Collisions with Power Lines: State of the Art (2012).

BIO-53 When aboveground lines, transformers, or conductors are necessary, all will be spaced and designed to comply with the APLIC's suggested practices to prevent avian electrocutions (APLIC 2006; 2012).

BIO-54 Lattice structures, if used, will be designed and/or fitted to prevent raptors and other birds from nesting in accordance with 2012 APLIC guidelines to the extent practicable.

BIO-55 The Project proponent shall prepare a Bird and Bat Conservation Strategy (BBCS) in consultation with the Resource Agencies. The BBCS will define avoidance and minimization measures for impacts to avian and bat species, monitoring methods, conservation actions, and the approach to management of injuries and mortalities.

### 6.2.4 Wildlife Movement

The RE Crimson Project has avoided all microphyll woodland drainages and has created separately fenced solar development areas to maintain connectivity across the RE Crimson Permitting Boundary. The avoidance of these drainages minimizes impacts to movement corridors and maintains multiple corridors for access across the site. The following recommendation may enhance compensation for potential impacts to wildlife corridors from the Project:

BIO-56 Prioritize compensatory land acquisition (for all species where required) within the vicinity of the Project that maintains connectivity to adjacent open spaces and provides corridors between open spaces for wildlife species that are impacted.

## 6.3 General Avoidance and Minimization Measures during Operation

General impact avoidance and minimization measures applicable during the O&M phase only are presented below.

BIO-57 All vehicles and site access shall remain on designated project roads. No off-road travel shall occur.

BIO-58 BMPs shall be employed to prevent common raven occurrence onsite. BMPs shall include, but are not limited to, the following:

a. potential use of perch-deterrent devices (especially on the 500 to 900 wooden transmission poles [depending up the construction approach] spread across the RE Crimson Permitting Boundary);

b. measures that help to reduce raven presence and nesting activities (e.g., removing food items, garbage, potential roadkill along Powerline Road and other roads, and eliminating standing water); and

c. remedial actions that shall be employed (e.g., nest removal) if raven predation of desert tortoise is detected.

BIO-59 Fueling of equipment shall take place within existing paved roads and not within 300 feet or adjacent to drainages or native desert habitats. Maintenance equipment shall be checked for leaks prior to operation and repaired as necessary.

BIO-60 A Storm Water Pollution Prevention Plan and a Drainage, Erosion, and Sediment Control Plan shall be prepared to comply with BLM, CDFW, and RWQCB requirements. The Project shall employ a comprehensive system of management controls, including site-specific BMPs, to minimize erosion and stormwater contact with contaminants and thereby reduce exposure of wildlife and plants to pollutants in the stormwater. These management controls include erosion and sediment control BMPs; an employee training program; good housekeeping and preventive maintenance programs; structural BMPs, including temporary containment during maintenance activities and permanent secondary containment structures at chemical storage and process areas; materials, equipment and vehicle management practices; spill prevention and response programs; and inspection programs.

BIO-61 The Project's lighting system shall provide the minimum illumination required to meet safety and security objectives and shall be oriented to minimize additional illumination in areas not pertinent to the facility. If lighting is adjacent to sensitive habitat it shall be directed or shielded away from the habitat. Motion-sensitive lighting may also be utilized so that there is not a constant source of light illuminating the surrounding habitat. No permanent lights are proposed to be installed within sensitive habitat. Light glare shields shall also be used to reduce the extent of illumination into adjoining areas.

BIO-62 During Project O&M, the facility footprint shall be maintained free from nonnative invasive species. This can be accomplished through physical or chemical removal and prevention. Application of all BLM-approved herbicides (not toxic to wildlife) shall be applied or directly supervised by a state licensed applicator following the label instructions including application rates and protective equipment. Herbicide shall be applied only when wind speeds are less than 5 miles per hour.

BIO-63 To minimize the likelihood for vehicle strikes of wildlife species, a speed limit of 25 miles per hour shall be established for travel along Powerline Road, and a speed limit of 15 miles per hour shall be adhered to for travel within the RE Crimson Permitting Boundary. Speed limits shall be clearly marked by the proponent, and workers shall be made aware of these limits. Desert tortoise-proof gates and grates that exclude desert tortoise shall be installed and maintained at the entrance of the perimeter fencing around solar development areas.

### 6.4 Resource-Specific Avoidance and Minimization Measures during Operation

The following resource-specific avoidance and minimization measures will be implemented throughout the life of the Project during all O&M activities where applicable.

#### 6.4.1 Special-Status Plants

BIO-64 Where vegetation is maintained onsite, all vegetation trimming and mowing in areas known to support special-status plant species will be conducted after the plants have flowered and set-seed, allowing them to replenish the seed bank in the area.

#### 6.4.2 Special-Status Wildlife

***Migratory Birds***

BIO-65 Vegetation trimming and mowing will occur outside of the breeding season for avian species protected under the MBTA (e.g., February 15 through September 15). If vegetation clearing must occur during the general avian breeding season, a pre-vegetation trimming/mowing nest survey will be conducted within the area to be trimmed or mowed by qualified biologist(s) 48 hours prior to the start of O&M activities. If no active nests are discovered, O&M activities may proceed. If active nests are observed that could be disturbed by O&M activities, these nests and an appropriately sized buffer (typically a 500-foot buffer, but this depends on the species and proposed Project activity) will be avoided until the young have fledged and/or the monitor determines that no impacts are anticipated to the nesting birds or their young.

## 7.0 References

AECOM. 2016. Avian Survey Work Plan, RE Crimson Solar Project, Riverside County, California. May.

2017. RE Crimson Solar Project Traffic Impact Analysis. August.

Alcorn, J.R. 1988. The Birds of Nevada. Fallon, Nevada: Fairview West Publishing.

Andersen, M.C., J.M. Watts, J.E. Freilich, S.R. Yool, G.I. Wakefield, J.F. McCauley, and P.B. Fahnestock. 2000. Regression-Tree Modeling of Desert Tortoise Habitat in the Central Mojave Desert. Ecological Applications, 10, 890–200.

American Ornithologists' Union. 1998. Check-list of North American Birds. 7th ed. Washington, D.C.: American Ornithologists' Union.

Averill-Murray, R.C., and A. Averill-Murray. 2005. Regional-scale estimation of density and habitat use of the desert tortoise (*Gopherus agassizii*) in Arizona. Journal of Herpetology 39(1):65–72.

Avery, H.W. 1998. Nutritional ecology of the desert tortoise (*Gopherus agassizii*) in relation to cattle grazing in the Mojave Desert. Ph.D. Dissertation. University of California, Los Angeles.

Avian Power Line Interaction Committee (APLIC). 2012. Reducing Avian Collisions with Power Lines: The State of the Art in 2012. Edison Electrical Institute and APLIC. Washington D. C.

Barrett, S.L. 1990. Home range and habitat of the desert tortoise (*Xerobates agassizi*) in the Picacho Mountains of Arizona. Herpetologica 46(2):202–206.

Barrows, C. 1996. An Ecological Model for the Protection of a Dune Ecosystem.

Berry, K.H. 1986. Desert tortoise (*Gopherus agassizii*) research in California, 1976-1985. Herpetologica 42:62-67.

2003. Salvaging Injured, Recently Dead, Ill, and Dying Wild, Free-roaming Desert Tortoises (*Gopherus agassizii*). Revised June.

Berry, Kristin and Timothy Duck. 2010. Answering Questions About Desert Tortoises, A Guide for People Who Work with the Public. http://www.deserttortoise.org/answeringquestions/index.html

Bibby, C.J., N.D. Burgess, D.A. Hill, S.H. Mustoe. 2000. Bird Census Techniques 2$^{nd}$ Edition. Academic Press. London.

Blair, H. and S. White. 2012. Rio Mesa SEGF Data Request (pages 19-47 of Rio Mesa Data Requests, Set 1A (No. 1-84). http://www.energy.ca.gov/sitingcases/riomesa/documents/2012-02 07_Staff_Data_Requests_Set-1A_1-84_TN-63573.pdf Docketed: February 7, 2012. Accessed: July 2012.

Bleich, V.C., J.D. Wehausen, and S.A. Holl. 1990. Desert-dwelling mountain sheep: conservation implications of a naturally fragmented distribution. Conservation Biology 4:383–390.

Bloom Biological. 2012. Results of protocol surveys to determine occupancy by nesting Golden Eagle (*Aquila chrysaetos*) within ten miles of the proposed Sonoran West Solar Project located in the vicinity of Blythe, Riverside County, California. Summary report of survey findings to URS Corporation. August 27.

Bloom, P. H. and S. J. Hawks. 1982. Food habits of nesting Golden Eagles in northeast California and northwest Nevada. Raptor Res. 16:110-115.

Bolster, B.C. 2005. Western Bat Working Group Species Accounts: for Lasiurus blossevillii, Western Red Bat and Eumops perotis, Western Mastiff Bat. http://www.wbwg.org/speciesinfo/ species_accounts/vespertilonidae/anpa.pdf.

Boone, J.D., Ph.D. 2012. Conference Call Notes: Elf Owl Survey Protocols: Email Regarding Elf Owl Survey Protocol/Data Request 49. April 19, 2012. Docketed April 24, 2012. (PDF file, 2 pages, 98 kb). http://www.energy.ca.gov/sitingcases/riomesa/documents/2012-04-19_Report_of_Conversation_Regarding_Elf_Owl_Survey_Protocols_TN-64908.pdf. Accessed June 2012.

Boone, J.D., Ph.D., and Carroll, S. 2012. Letters from Dr. John Boone and Steve Carroll regarding Elf Owl Surveys for Rio Mesa Solar Electric Generating Facility (11-AFC-4). Docketed April 18, 2012.

Brattstrom, B. H. and Bondello, M. C. 1979. The effect of ORV sounds on the emergence of Couch's spadefoot toad, *Scaphiopus couchii*. Bureau of Land Management, Riverside, CA.

Brown, P.E. 1995.California leaf-nosed bat (*Macrotus californicus*). Species Accounts. Western Bat Working Group. Developed For the 1998 Reno Biennial Meeting. Updated at the 2005 Portland Biennial Meeting http://www.wbwg.org/speciesinfo/species_accounts/phyllostomidae/maca.pdf.

Brown, P.E.; Berry, R.D.; Brown, C. 1993. Foraging behavior of the California leaf-nosed bat, Macrotus californicus. In: Ecology, conservation, and management of western bat species: Bat species accounts. Unpublished document distributed at the Western Bat Working Group Workshop, February 9-13, 1998, Reno, NV.

Buckland, S.T., Anderson, D.R., Burnham, K.P., Laake, J.L., Borchers, D.L. and Thomas, L. 2001. Introduction to Distance Sampling: Estimating Abundance of Biological Populations. Oxford University Press, Oxford, UK.

Buckland, S. T., Rexstad, E. A., Marques, T. A., & Oedekoven, C. S. 2015. Distance sampling: methods and applications. New York, NY, USA: Springer.

Bureau of Land Management (BLM). 2002. Proposed Northern & Eastern Colorado Desert Coordinated Management Plan; an amendment to the California Desert Conservation Area Plan 1980 and Sikes Act Plan with the CDFG and Final EIS. July. Available at: http://www.blm.gov/ca/news/pdfs/neco2002/.

2009a. Survey Protocols Required for NEPA and ESA Compliance for BLM Special-status Plant Species." http://www.blm.gov/ca/dir/pdfs/2009/im/CAIM2009-026.pdf.

2009b. Solar Facility Point Count Protocol. Unpublished.

2014. Solar Energy Program. Accessed in October 2017. Available at: http://blmsolar.anl.gov/program/.

2015. DRECP Proposed LUPA and Final EIS. October.

2017. BLM Special Status Animal Species by Field Office. Available at: https://www.blm.gov/sites/blm.gov/files/documents/files/Programs_FishandWildlife_BLMCA%20Special%20Status%20Species.pdf.

Burge, B.L. 1977. Movements and behavior of the desert tortoise, *Gopherus agassizi*. University of Nevada, Las Vegas.

Burnham, K. P. and D. R. Anderson. 2002. Model selection and multimodel inference -a practical information-theoretic approach. New York, Springer.

California Burrowing Owl Consortium (CBOC). 1993. Burrowing Owl Survey Protocol and Mitigation Guidelines. Technical Report. Burrowing Owl Consortium, Alviso, California. Accessed online: http://www.dfg.ca.gov/wildlife/nongame/docs/boconsortium.pdf

California Department of Fish and Game (CDFG). 2000. Life History Accounts and Range Maps, Desert Tortoise. http://www.dfg.ca.gov/biogeodata/cwhr/cawildlife.aspx.

2003. California Department of Fish and Game Wildlife Habitat Data Analysis Branch. The Vegetation Classification and Mapping Program -List of California Terrestrial Natural Communities Recognized by the California Natural Diversity Database. September. Available at: http://www.dfg.ca.gov/whdab/pdfs/natcomlist.pdf.

2009a. "Protocol for Surveying and Evaluating Impacts to Special-status Native Plant Populations and Natural Communities." http://www.dfg.ca.gov/biogeodata/cnddb/pdfs/Protocols_for_Surveying_and_Evaluating_Impacts.pdf

2009b. Life History Accounts and Range Maps, American badger. http://www.dfg.ca.gov/biogeodata/cwhr/cawildlife.aspx

2010. Sensitive Vegetation Communities. http://www.dfg.ca.gov/biogeodata/vegcamp/pdfs/natcomlist.pdf. Accessed online July, 2011.

2012. Staff Report on Burrowing Owl Mitigation. Unpublished report. Sacramento, CA, USA. Accessed online: http://www.dfg.ca.gov/wildlife/nongame/docs/BUOWStaffReport.pdf.

California Department of Fish and Wildlife (CDFW). California Interagency Wildlife Task Group. 2014. CWHR version 9.0 personal computer program. Sacramento, CA.

2017a. Natural Diversity Database. Special Animals List. Periodic publication. 51. Pp.

2017b. Biogeographic Data Branch. California Natural Diversity Database Maps and Data. RareFind 5. Available at: https://www.wildlife.ca.gov/Data/CNDDB/Maps-and-Data October. Accessed November 10, 2016.

2017c. Sensitive Vegetation Communities. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=107303&inline. Accessed online August 10, 2017.

California Energy Commission (CEC). 2010. Calico Solar Power Project Presiding Member's Proposed Decision. Docket 08-AFC-13. CEC-800-2010-012-PMPD. September.

California Fish and Game Commission (CFGC). 1989. Animals of California Declared to Be Endangered or Threatened. 14 CCR § 670.5, Barclays Official California Code of Regulations Title 14. Natural Resources, Division 1, Fish and Game Commission-Department of Fish and Game, Subdivision 3. General Regulations, Chapter 3, Miscellaneous.

California Food and Agriculture Code. 1981. California Desert Native Plants Act [80001. – 80201.]. California Code, Division 72 and 73.

California Native Plant Society (CNPS) 2001. CNPS Botanical Survey Guidelines. Sacramento, CA. 3 pp.

2017. Rare Plant Program. Inventory of Rare and Endangered Plants of California (online edition, v8-03 0.39). Website http://www.rareplants.cnps.org [accessed 20 October 2017].

Celentano, R.R., and J.R. Garcia. 1984. The Burro Deer Herd Management Plan.

Center for Biological Diversity, Santa Clara Valley Audubon Society, Defenders of Wildlife, San Bernardino Valley Audubon Society, California State Park Rangers Association and Tri-County Conservation League. 2003. Petition to the State of California Fish and Game Commission and Supporting Information for Listing the California Population of the Western Burrowing Owl (*Athene cunicularia hypugaea*) as an Endangered or Threatened Species Under the California Endangered Species Act. Submitted on April 7.

Collins, C.T., and R.E. Landry. 1977. Artificial nest burrows for burrowing owls. North American BirdBander 2:151–154.

Conohan, R. 2017. Personal email correspondence with Andrew Fisher regarding Potential Kit Fox kill by Golden Eagle at the RE Crimson Project. March 3.

The Cornell Lab of Ornithology. 2017. All About Birds. Willow Flycatcher Life History. Accessed October 12, 2018 at https://www.allaboutbirds.org/guide/Willow_Flycatcher/lifehistory#

Corman, T.E. 2005. Yellow-billed Cuckoo (Coccyzus americanus) in Arizona Breeding Bird Atlas. T.E. Corman and C. Wise-Gervais (editors). Univ. of New Mexico Press, Albuquerque, NM, pp. 202-203.

Croft, B. 2010. Life Table Spreadsheet Estimating Juvenile Tortoise Numbers based on Estimate of Adult Tortoises.

DeSante, D.F., E.D. Ruhlen and D.K. Rosenberg. 1996. The distribution and relative abundance of burrowing owls in California: evidence for a declining population. Institute for Bird Populations. Point Reyes Station, California.

Dimmitt, M. A. and R. Ruibal. 1980. Environmental correlates of emergence in spadefoot toads (*Scaphiopus*). Journal of Herpetology 14:21-29.

Duda, J.J., Krzysik, A.J., and Freilich, J.E. 1999. Effects of drought on desert tortoise movement and activity. Journal of Wildlife Management 63:1181-1192.

Durst, S.L., Sogge, M.K., Stump, S.D., Walker, H.A., Kus, B.E., and Sferra, S.J., 2008, Southwestern willow flycatcher breeding sites and territory summary--2007: U.S. Geological Survey Open-File Report 2008-1303, 31 p. https://pubs.usgs.gov/of/2008/1303/

eBird. 2017. eBird: An online database of bird distribution and abundance [web application]. eBird, Cornell Lab of Ornithology, Ithaca, New York. Available: http://www.ebird.org. Accessed: August 9, 2017.

Eddleman, W.R. 1989. Biology of the Yuma Clapper Rail in the Southwestern United States and Northwestern Mexico. Report prepared for the U.S. Bureau of Reclamation. Yuma, Arizona.

Edwards, H. H. and Schnell, G.D. 2000. Gila Woodpecker (Melanerpes uropygialis), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/532.

Egoscue, H.J. 1962. Ecology and life history of the kit fox in Tooele County, Utah. Ecology 43(3):481–497.

Espinoza, Robert E. 2009. "Mohave Fringe-Toed Lizard." Lizards of the American Southwest: A Photographic Field Guide. Ed. Robert E. Lovich and Lawrence L. C. Jones. Tuscon: Rio Nuevo, 2009. 278-81.

Esque, T.C. 1994. Diet and diet selection of the desert tortoise (*Gopherus agassizii*) in the northeastern Mojave Desert. Master's Thesis. Colorado State University. Fort Collins.

Faber-Langendoen, D., J. Nichols, L. Master, K. Snow, A. Tomaino, R. Bittman, G. Hammerson, B. Heidel, L. Ramsay, A. Teucher, and B. Young. 2012. *NatureServe Conservation Status Assessments: Methodology for Assigning Ranks*. NatureServe, Arlington, VA.

Garcia and Associates. 2017. Crimson Solar Acoustic Bat Monitoring Update. September 20.

Garrett, K., and J. Dunn. 1981. Birds of Southern California. Status and distribution. Los Angeles Audubon Society.

Grinnell, J., and A. Miller. 1944. The distribution of the birds of California. Pacific Coast Avifauna Number 27, Cooper Ornithological Club, Berkeley, California.

Gould, G.I., Jr. 1987. Five Year Status Report, Elf Owl. California Department of Fish and Game, Nongame Wildlife Investigations rep., Proj. W-54-R-4, Job II-3. 7pp.

Halterman, M., M.J. Johnson, J.A. Holmes and S.A. Laymon. 2015. A Natural History Summary and Survey Protocol for the Western Distinct Population Segment of the Yellow-billed Cuckoo: U.S. Fish and Wildlife Techniques and Methods, 45 p.

Halterman, M. D. 2009. Sexual dimorphism, detection probability, home range, and parental care in the yellow-billed cuckoo. Ph.D. Dissertation, University of Nevada, Reno, NV.

Halterman, M.D., S.A. Laymon, and M.J. Whitfield. 1987. Population Assessment of the Elf Owl in California. Final Report to Nongame Bird and Mammal Section, Wildlife Management Division, Department of Fish and Game. Contract C-1981 (FY 1985–86). 16 pp.

Hamer Environmental, L.P. 2010. Spring Nocturnal Bird Migration at the Proposed Antelope Valley Renewable Energy Project, Lancaster, California. Prepared for Western EcoSystems Technology, Inc.

Harris, J. 2000. Pocketed Free-tailed Bat. California Department of Fish and Game, Wildlife Habitat Relationships System. Updated May 2000.

Harvey, M. J., J. S. Altenbach, and T. L. Best. 1999. Bats of the United States. Arkansas Game and Fish Commission. 64 pp.

Haug, E. A., B. A. Millsap, and M. S. Martell. 1993. Burrowing Owl (*Athene cunicularia*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna. birds.cornell.edu/bna/species/061Hawthorne, Vernon M. 1971. Coyote movements in Sagehen Creek Basin, northeastern California. California Fish and Game. 57(3):154–161.

Hawk Migration Association of North America (HMANA). 2010. Data collection protocol. http://hmana.org/data_entry_paper.php.

Hayes, J.P. 1997. Temporal Variation in Archiving of Bats and the Design of Echolocation Studies. Journal of Mammalogy. 78: 514-524.

Henry, Susanna G. and Frederick R. Gehlbach. 1999. Elf Owl (Micrathene whitneyi), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/413.

Holt, D. W. and Leasure, S. M. 1993. Short-eared Owl (*Asio flammeus*), in The Birds of North America (A. Poole and F. Gill, eds.), no. 62. Acad. Nat. Sci., Philadelphia.

Howell, S.N.G., and S. Webb. 1995. A Guide to the Birds of Mexico and Northern Central America. New York, New York: Oxford University Press.

Hubbard, J.P. 1978. Revised Check-list of the Birds of New Mexico. New Mexico Ornithological Society, Publication No. 6.

Hughes, J.M. 1999. Yellow-billed Cuckoo (Coccyzus americanus). In The Birds of North America, No. 148 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA. 28 pp.

Hunter, W.C. 1984. Petition to the State of California Fish and Game Commission. http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentVersionID=3356.

Ironwood Consulting. 2014. 2014 Fourth Quarter and Final Report for Biological Resources Monitoring. First Solar Desert Sunlight Solar Project, Riverside County. BLM Case File Number CACA-48469, Biological Opinion# FWS-EIV-08B0789-11F0041. Prepared for Bureau of Land Management, Palm Springs – South Coast Field Office.

Jennings, W.B. 1997. Habitat use and food preferences of the desert tortoise, *Gopherus agassizii*, in the western Mojave and impacts of off-road vehicles. Pages 42–45 in J. Van Abbema (ed.), Proceedings of the International Conference on Conservation, Restoration, and management of Tortoises and Turtles. New York Turtle and Tortoise Society, New York.

Johnsgard, P.A. 1990. Hawks, eagles, and falcons of North America. Washington, DC: Smithsonian Institution Press.

Johnson, R. R., H. K. Yard and B. T. Brown. 1997. Lucy's Warbler (Vermivora luciae). In: The birds of North America, No. 318 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Kagan, R. A., T. C. Viner, P. W. Trail, and E. O. Espinoza. 2014. Avian Mortality at Solar Energy Facilities in Southern California: A Preliminary Analysis. National Fish and Wildlife Forensics Laboratory. April.

Kaufmann, J.S. 1982. Patterns of habitat resource utilization in a population of *Uma scoparia*, the Mojave fringe-toed lizard. M.S. Thesis, Univ. of Illinois, Chicago, Illinois.

Klute, D.S., L.W. Ayers, M.T. Green, W.H. Howe, S.L. Jones, J.A. Shaffer, S.R. Sheffield, and T.S. Zimmerman. 2003. Status Assessment and Conservation Plan for the Western Burrowing Owl in the United States. U.S. Department of Interior, Fish and Wildlife Service, Biological Technical Publication FWS/BTP-R6001-2003, Washington, D.C.

Kochert, M. N., K. Steenhof, C. L. Mcintyre and E. H. Craig. 2002. Golden Eagle (Aquila chrysaetos), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/684.

Kristan, W.B. III, A.J. Lynam, M.V. Price, and J.T. Rottenberry. 2003. Alternative causes of edge-abundance relationships in birds and small mammals in California coastal sage scrub. Ecography 26:29–44.

Kucera, T. 1998. Terrestrial Mammal Species of Special Concern in California, Bolster, B.C., Ed., Yuma mountain lion, *Felis concolor browni*. Pg 135.

Kunz, T.H., E.B. Arnett, B.M. Cooper, W.P. Erickson, R.P. Larkin, T. Mabee, M.L. Morrison, M.D. Strickland, and J.M. Szewczak. 2007. Assessing Impacts of Wind-Energy Development on Nocturnally Active Birds and Bats: A Guidance Document. Journal Wildlife Management 71(8): 2249-2486.

Kus, B. E. 2003. Population Structure and Demography of the Least Bell's Vireo and Southwestern Willow Flycatcher. Available at http://www.werc.usgs.gov/sandiego/flycat.html. March.

Laymon, S.A. 1998. Partners in Flight Bird Conservation Plan: Yellow-billed Cuckoo (Coccyzus americanus). (http://www.prbo.org/calpif/htmldocs/species/riparian/yellowbilled_cuckoo.htm).

Liberatore, M. 2017. Email Communication from Bureau of Land Management Planning and Environmental Coordinator regarding Botany Survey Protocol. March 23.

Lidicker, W.Z. Jr., and J.A. Peterson. 1999. Response of small mammals to habitat edges. Pages 221-227 in Barrett, G.W. and J.D. Peles, (eds.). Landscape ecology of small mammals. Springer, New York, New York.

Ligon, J. D. 1968. The Biology of the Elf Owl, *Micrathene whitneyi*. Univ. Mich. Mus. Zool., Misc. Publ. No. 136. 70pp.

Lindzey, F.G. 1978. Movement patterns of badgers in northwestern Utah. J. Wildlife Management 42:418–422.

Long, C. A. 1973. Taxidea taxus. Mammal. Species. No. 26. 4pp.

Lovich, J. E., and K. R. Beaman. 2007. Volume 106. Issue 2 (August 2007) Bulletin, Southern California Academy of Sciences Article: pp. 39–58 I Abstract I PDF (3.15M) A History of Gila Monster (*Heloderma suspectum cinctum*). Records from California with Comments on Factors Affecting their Distribution.

Mabee, T.J. and B.A. Cooper. 2004. Bird migration in northeastern Oregon and Southeastern Washington. Northwestern Naturalist 85(2):39-47

Mardia, K. and P. Jupp. 1999. Directional Statistics, Section 7.4, John Wiley and Sons, England.

Marsden, K. 2016a. Email Communication from Bureau of Land Management Natural Resource Specialist Regarding Desert Tortoise Surveyor Approval for Crimson. July 26.

2016b. Email Communication from Bureau of Land Management Natural Resource Specialist Approving Crimson Desert Tortoise Fall Survey Crew. August 26.

2017. Email Communication from Bureau of Land Management Natural Resource Specialist requesting Spring 2017 botanical surveys for the Crimson Project. March 17.

Mayhew, W.W. 1964. Taxonomic status of California populations of the lizard genus *Uma*. Herpetologica 20(3):170-183.

McGrew, J. C. 1979. *Vulpes macrotis*. Mammalian Species 123:1–6.

McKernan, R. L., and Braden, G. 2002. Status, distribution, and habitat affinities of the Southwestern Willow Flycatcher along the lower Colorado River—Year 6, 2001. Biol. Sci. Div., San Bernardino County Mus., Redlands, CA.

Messick, J. P., and M. G. Hornocker. 1981. Ecology of the badger in southwestern Idaho. Wildlife. Monographs. No.76. 53pp.

Miller, A.H. and R.C. Stebbins. 1964. The lives of desert animals in Joshua Tree National Monument. Univ. California Press, Berkeley, California.

Morrell, S. 1972. Life history of the San Joaquin kit fox. Calif. Fish and Game. 58:162-174.

Muth, A. 1991. Population Biology of the Coachella Valley Fringe-toed Lizard. Final Report, Contract 86/87 C2056 and 87/88 C2056, Am.1. California Department of Fish and Game, Inland Fisheries Division, Sacramento, California.

Natural Resource Conservation Service (NRCS). 2015. *National List of Hydric Soils*. December. Available at: http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/use/hydric/. Accessed November 4, 2016.

2017. *Web Soil Survey*. Available at: http://websoilsurvey.nrcs.usda.gov/.

Norris, K.S. 1958. The Evolution and Systematics of the Iguanid Genus Uma and Its Relation to the Evolution of Other North American Desert Reptiles. Bull. Amer. Mus. Nat. Hist. 114(3):251–317.

Nussear, K.E., Esque, T.C., Inman, R.D., Gass, Leila, Thomas, K.A., Wallace, C.S.A., Blainey, J.B., Miller, D.M., and Webb, R.H., 2009, Modeling habitat of the desert tortoise (Gopherus agassizii) in the Mojave and parts of the Sonoran Deserts of California, Nevada, Utah, and Arizona: U.S. Geological Survey Open-File Report 2009-1102, 18 p.

O'Connor, M.P., L.C. Zimmerman, D.E. Ruby, S.J. Bulova, and J.R. Spotila. 1994. Home Range Size and Movements by Desert Tortoises, *Gopherus agassizii*, in the Eastern Mojave Desert. Herpetological Monographs, 8:60–71.

Olendorff, R.R. 1976. The Food Habits of North American Golden Eagles. American Midland Naturalist 95 (1): 231-236.

Pagel, J.E., D.M. Whittington and G.T. Allen. 2010. Interim Golden Eagle inventory and monitoring protocols; and other recommendations. Division of Migratory Birds, U.S. Fish and Wildlife Service.

Partners in Flight Science Committee. 2013. Population Estimates Database, version 2013. Available at http://pif.birdconservancy.org/PopEstimates. Accessed on January 28, 2019.

Peckham, K. 2005. Western Bat Working Group Species Accounts: *Myotis velifer* Cave Myotis. http://www.wbwg.org/speciesinfo/species_accounts/vespertilonidae/myve.pdf.

Peirce, M., and J. Cashman. 1993. Region IV mountain lion project. Arizona Game and Fish Department, Tucson.

Penrod, K., P. Beier, E. Garding, and C. Cabanero. 2012. A Linkage Network for the California Deserts. Produced for the Bureau of Land Management and The Wildlands Conservancy. Produced by Science and Collaboration for Connected Wildlands, Fair Oaks, CA and Northern Arizona University. February.

Pierson, E.D. and W.E. Rainey. 1998. Cave myotis, Myotis velifer Terrestrial Mammal Species of Special Concern in California, Bolster, B.C., Ed. http://www.dfg.ca.gov/wildlife/nongame/ssc/docs/mammal/species/15.pdf.

Price, J., Droege, S., and Price, A. 1995. The Summer Atlas of North American Birds. Academic Press, London.

Ralph, C.J., S. Droege and J.R. Sauer. 1995. Managing and Monitoring Birds Using Point Counts: Standards and Applications. Pages 161-168 in C. J. Ralph, J. R. Sauer, and S. Droege, Eds. Monitoring Bird Populations by Point Counts, USDA Forest Service, Pacific Southwest Research Station, General Technical Report PSW-GTR-149.

Recurrent Energy LLC (RE). 2017. Plan of Development RE Crimson Solar Project by Sonoran West Solar Holdings, LLC, Riverside County, California. BLM Case File Number CACA-051967. November.

Renewable Energy Action Team (REAT). 2011. Interagency Recommendations: Migratory and Breeding Season Bird and Bat Baseline Data, Rio Mesa Solar Project, Riverside County, California. December 16.

Robinette, W.L. 1966. Mule deer home range and dispersal in Utah. Journal of Wildlife Management. 30:335–349.

Rodriguez, Magdalena. 2016. Email Communication Regarding the RE Crimson Desert Tortoise Survey Area. September 29.

2017a. Email Communication Regarding RE Crimson Burrowing Owl Surveys. Email approval of modified burrowing owl survey approach for 1 visit during the height of the breeding season. February 14.

2017b. Email Communication Regarding Modified Elf Owl Survey Protocol. April 20.

Rosenberg, K. V., R. D. Ohmart, W. C. Hunter, and B. W. Anderson. 1991. Birds of the lower Colorado River Valley. Univ. of Arizona Press, Tucson.

Roth, S. 2014. Lawsuit over desert solar plants' bird deaths. The Desert Sun. http://www.desertsun.com/story/news/environment/2014/08/22/solar-plant-agencies-lawsuit/14426871/. August 21.

Rourke, J. W., T. D. McCarthey, R. F. Davidson, and A. M. Santaniello. 1999. Southwestern Willow Flycatcher Nest Monitoring Protocol. Nongame and Endangered Wildlife Program Technical Report 144. Arizona Game and Fish Department, Phoenix, Arizona.

Sanzenbacher, Peter. 2017a. Email communication regarding golden eagle nest locations within a 10-mile radius buffer around the RE Crimson Project Site. Data from the Carlsbad Fish and Wildlife Office database. July, 17.

2017b. Email communication regarding golden eagle nest information from the Desert Quartzite Project. August, 10.

Sanzenbacher, P. 2017c. Email communication regarding Crimson Desert Tortoise Surveys-Density Calculations. January 27.

Sanzenbacher, P. 2019. Personal communication regarding willow flycatcher subspecies identification. January 28.

Sawyer, J.O., T. Keeler-Wolf, and J.M. Evens. 2009. A Manual of California Vegetation. 2nd ed. California Native Plant Society Press. Sacramento, CA. 1300 pp.

Scott, T. A. 1985. Human impacts on the Golden Eagle population of San Diego County. Master's Thesis, San Diego State Univ., San Diego, CA.

Sherwin, R. 2005. Western Bat Working Group Species Accounts: Antrozous pallidus, Pallid Bat. http://www.wbwg.org/speciesinfo/species_accounts/vespertilonidae/anpa.pdf.

Shuford, W. D., and T. Gardali, editors. 2008. California Bird Species of Special Concern: A ranked assessment of species, subspecies, and distinct populations of birds of immediate conservation concern in California. Studies of

Western Birds 1. Western Field Ornithologists, Camarillo, California, and California Department of Fish and Game, Sacramento.

Smith, H.M. 1946. Handbook of Lizards: Lizards of the United State and Canada. Comstock Publishing Co., Ithaca, New York.

Snow, C. 1973. Habitat management series for unique or endangered species, Report No. 7, Golden Eagle, Aquila chrysaetos. U.S. Department of Interior, Bureau of Land Management Technical Note, December 1973, Denver, Colorado, USA.

State of California. 2012. Staff Report on Burrowing Owl Mitigation. Natural Resources Agency. Department of Fish and Game. March 7.

Stebbins, R.C. 1944. Some Aspects of the Ecology of the Iguanid Genus Uma. Ecol. Monographs 14(3):311–332.

1985. A Field Guide to Western Reptiles and Amphibians. Second edition. Houghton Mifflin Co., Boston. 336 pp.

2003. A Field Guide to Western Reptiles and Amphibians. Third Edition. Houghton Mifflin Company, Boston. 533 pp.

The Weather Company. 2017. Monthly summary of rainfall data at the Blythe Airport from October 2015 through March 2016. https://www.wunderground.com/history/airport/KBLH/2015/12/1/MonthlyHistory.html?req_city=&req_state=&req_statename=&reqdb.zip=&reqdb.magic=&reqdb.wmo=.

Thomas, L., Buckland, S.T., Rexstad, E.A., Laake, J.L., Strindberg, S., Hedley, S.L., Bishop, J.R., Marques, T.A. & Burnham, K.P. 2010. Distance software: design and analysis of distance sampling surveys for estimating population size. Journal of Applied Ecology, 47, 5–14.

Thomson, R.C., A. N. Wright, and H. B. Shaffer. 2016. California Amphibian and Reptile Species of Special Concern. California Department of Fish and Wildlife. University of California Press: Oakland, California.

Tracy, C.R., R. Averill-Murray, W.I. Boarman, D. Delehanty, J. Heaton, E. McCoy, D. Morafka, K. Nussear, B. Hagerty, and P. Medica. 2004. Desert Tortoise Recovery Plan Assessment. Report to the U.S. Fish and Wildlife Service, Reno, Nevada.

Trulio, L.A. 1994. The ecology of a population of burrowing owls at a naval air station in northern California. Dept. of the Navy. San Bruno, California.

Turner, F.B., K.H. Berry, D.C. Randall, and G.C. White. 1987. Population Ecology of the Desert Tortoise at Goffs, California, 1983-1986.

United States Fish and Wildlife Service (USFWS). 1989. Endangered and Threatened Wildlife and Plants; Emergency Determination of Endangered Status for the Mojave Population of the Desert Tortoise. Federal Register 54(149):32326–32331.

1990. Endangered and Threatened Wildlife and Plants; Emergency Determination of Endangered Status for the Mojave Population of the Desert Tortoise. Federal Register 54(149):12178–12191.

1992. Field Survey Protocol for Any Non-Federal Action That May Occur within the Range of the Desert Tortoise. January.

1994. Endangered and Threatened Wildlife and Plants; Determination of Critical Habitat for the Mojave Population of the Desert Tortoise. Federal Register 59(26):5820–5866.

1996. Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed and Candidate Plants. September 23.

2000a. "Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed, and Candidate Plants." http://www.fws.gov/ventura/species_information/protocols_guidelines/docs/botanicalinventories. pdf.

2000b. Cactus Ferruginous Pygmy-Owl Survey Protocol. Arizona Ecological Services Tucson Sub-Office, Tucson, Arizona, 10 pp.

2006. "5-Year Review [for the Yuma Clapper Rail, 2000– 2005]." May 30, 2006. Albuquerque, New Mexico: U.S. Fish and Wildlife Service, Region 2, Southwest Regional Office.

2008. Draft Revised Recovery Plan for the Mojave Population of the Desert Tortoise. Available at: http://www.fws.gov/nevada/desert%5 Ftortoise/documents/recovery_plan/DraftRevRP_Mojave_Desert_Tortoise.pdf.

2010a. 2010 Pre-project Field Survey Protocol for Potential Desert Tortoise Habitats.

2010b. Yuma Clapper Rail Recovery Plan (Rallus longirostris yumanensis). Draft First Revision. February 10, 2010. Albuquerque, New Mexico: U.S. Fish and Wildlife Service, Southwest Region.

2011. Revised recovery plan for the Mojave population of the desert tortoise (Gopherus agassizii). U.S. Fish and Wildlife Service, Pacific Southwest Region, Sacramento, California. 222 pp.

2016. Eagle Permits. The Bald and Golden Eagle Protection Act. Online data last updated February 1. https://www.fws.gov/midwest/midwestbird/eaglepermits/bagepa.html. Accessed September 11, 2017.

2017a. Carlsbad Fish and Wildlife Office GIS Coordinator. Species Occurrence Data. Available at: https://www.fws.gov/carlsbad/GIS/ CFWOGIS.html. Updated April 29. Accessed September 8, 2017.

2017b. National Wetland Inventory. Available at: https://www.fws.gov/wetlands/. Accessed September 8, 2017.

Unitt, P. 1984. The Birds of San Diego County. *San Diego Society of Natural History Memoir* 13: i-xxiv, 1-276.

2004. San Diego County Bird Atlas. San Diego Society of Natural History. Proceeding No. 39.

Walston Jr., L. J., K. E. Rollins, K. P. Smith, K. E. LaGory, K. Sinclair, C. Turchi, and H. Souder. 2015. A Review of Avian Monitoring and Mitigation Information at Existing Utility-Scale Solar Facilities. Environmental Science Division, Argonne National Laboratory, National Renewable Energy Laboratory. Prepared for U.S. Department of Energy, SunShot Initiative and Office of Energy Efficiency & Renewable Energy. April.

Weinstein, M.N. 1989. Modeling desert tortoise habitat: Can a useful management tool be developed from existing transect data? Los Angeles, University of California, unpublished PhD dissertation, 121 p.

Western Bat Working Group (WBWG). 2005a. Species accounts canyon bat (*Lasiurus blossevillii*). Prepared by Patricia E. Brown. Available online: http://wbwg.org/western-bat-species. Accessed September 2017.

2005b. Species accounts cave myotis (*Myotis velifer*). Prepared by Patricia E. Brown. Available online: http://wbwg.org/western-bat-species. Accessed September 2017.

Western Ecosystems Technology, Inc. and Natural Resource Consultants. 2011. A biological constraints analysis of the approximately 4,352 acre Wildflower Green Energy Site, Los Angeles County, California.

Westwood. 2017. Phase C Hydrology Study for the RE Crimson Solar Project. March.

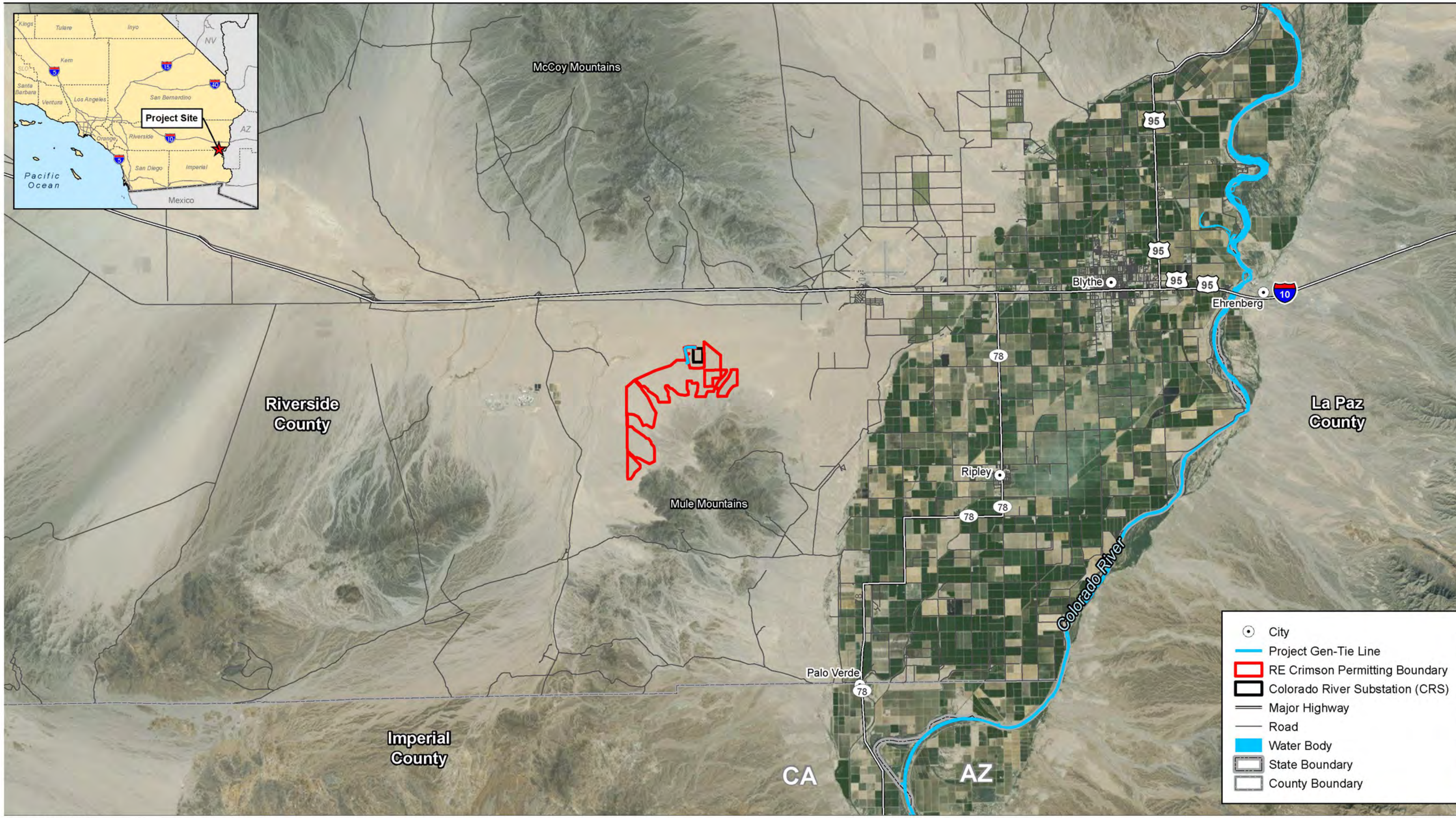
Wilbur, S.R. 1987. Birds of Baja California. Berkeley, California: University of California Press.

Zarn, M. 1974. Burrowing Owl. U.S. Department of the Interior, Bureau of Land Management. Technical Note T-N-250, Denver, Colorado, USA.

Zeiner, D. C., W. F. Laudenslayer, Jr., K. E. Mayer, and M. White. 1990. California's Wildlife, Volume I-III: Amphibians and Reptiles, Birds, Mammals. California Statewide Wildlife Habitat Relationships System, California Department of Fish and Game, Sacramento.

Zuan, B. J., J. R. Barnett, C. D. Weise, and L. A. Piest. 2014. Notes, Nesting of the Peregrine Falcon in the Desert Southwest. Western Birds 45:151-153.

# Figures




Source: ESRI; AECOM.

3 1.5 0 3 Miles

1:190,080 1 inch = 3 miles

**Figure 1**
**Regional Map**

RE Crimson Solar - Riverside County, CA

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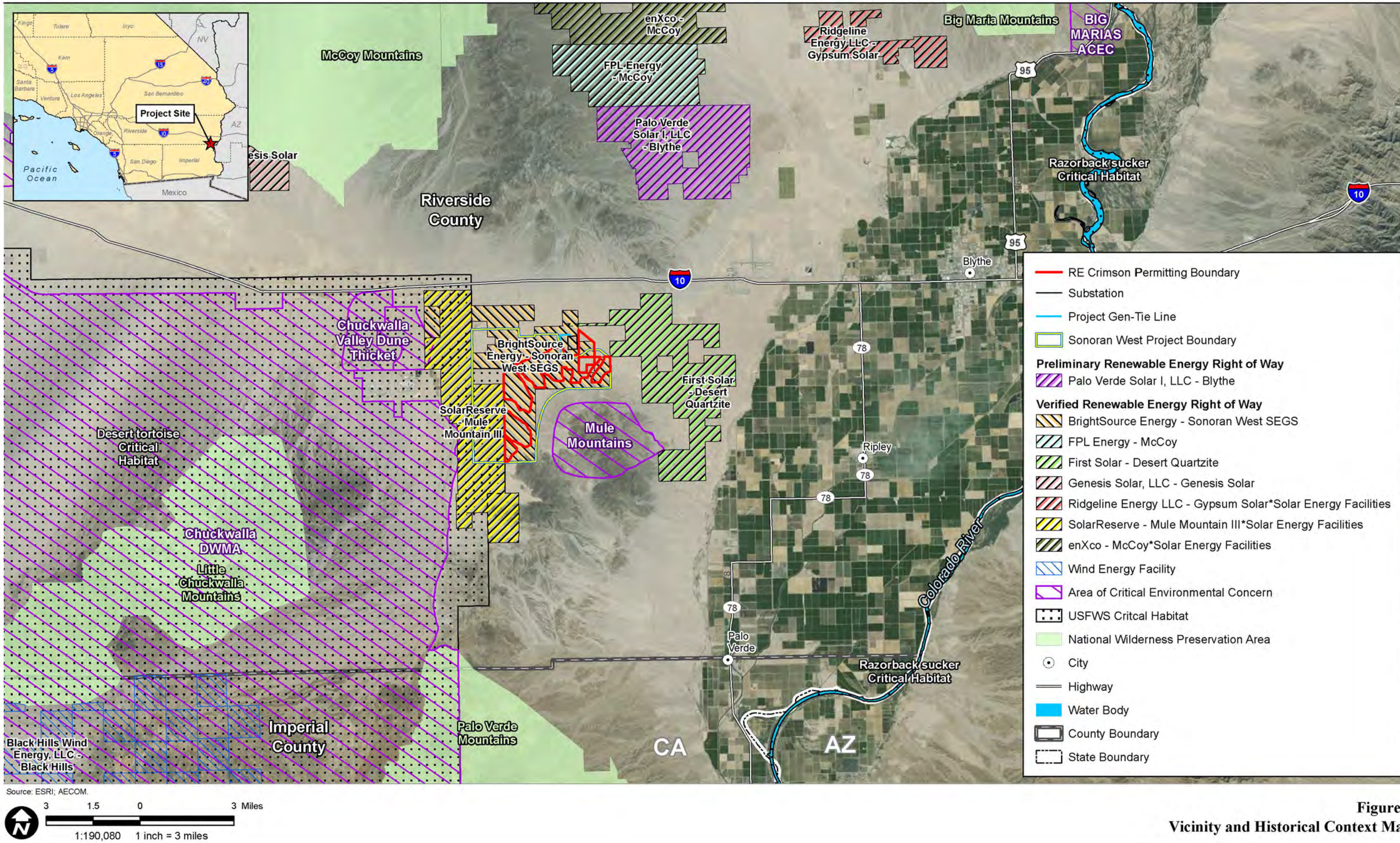


**Figure 2**
**Vicinity and Historical Context Map**

RE Crimson Solar - Riverside County, CA

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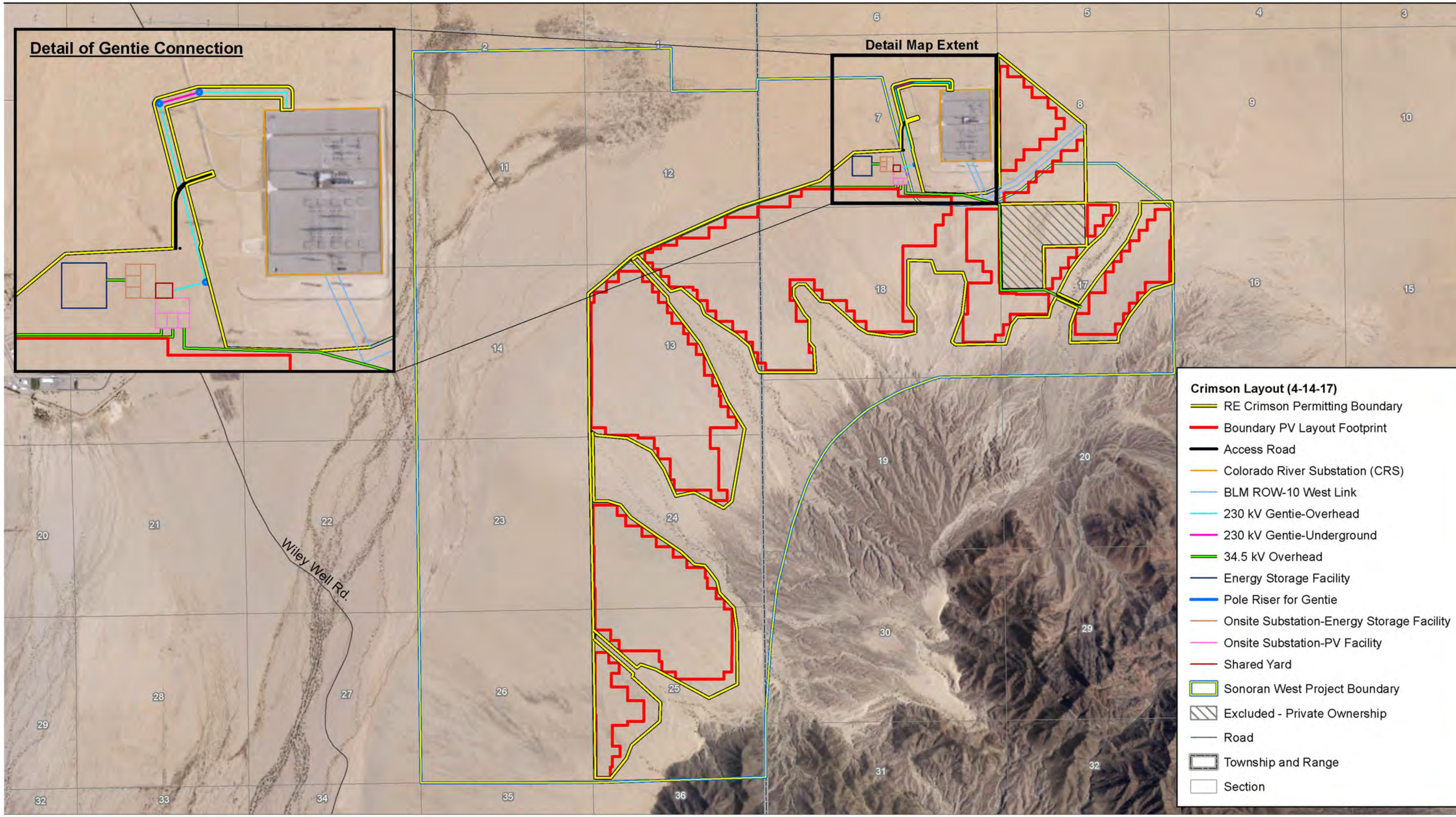


Source: ESRI; AECOM.

3,000 1,500 0 3,000 Feet

1:36,000 1 inch = 3,000 feet

**Figure 3**
**Project Detail Map**

RE Crimson Solar - Riverside County, CA

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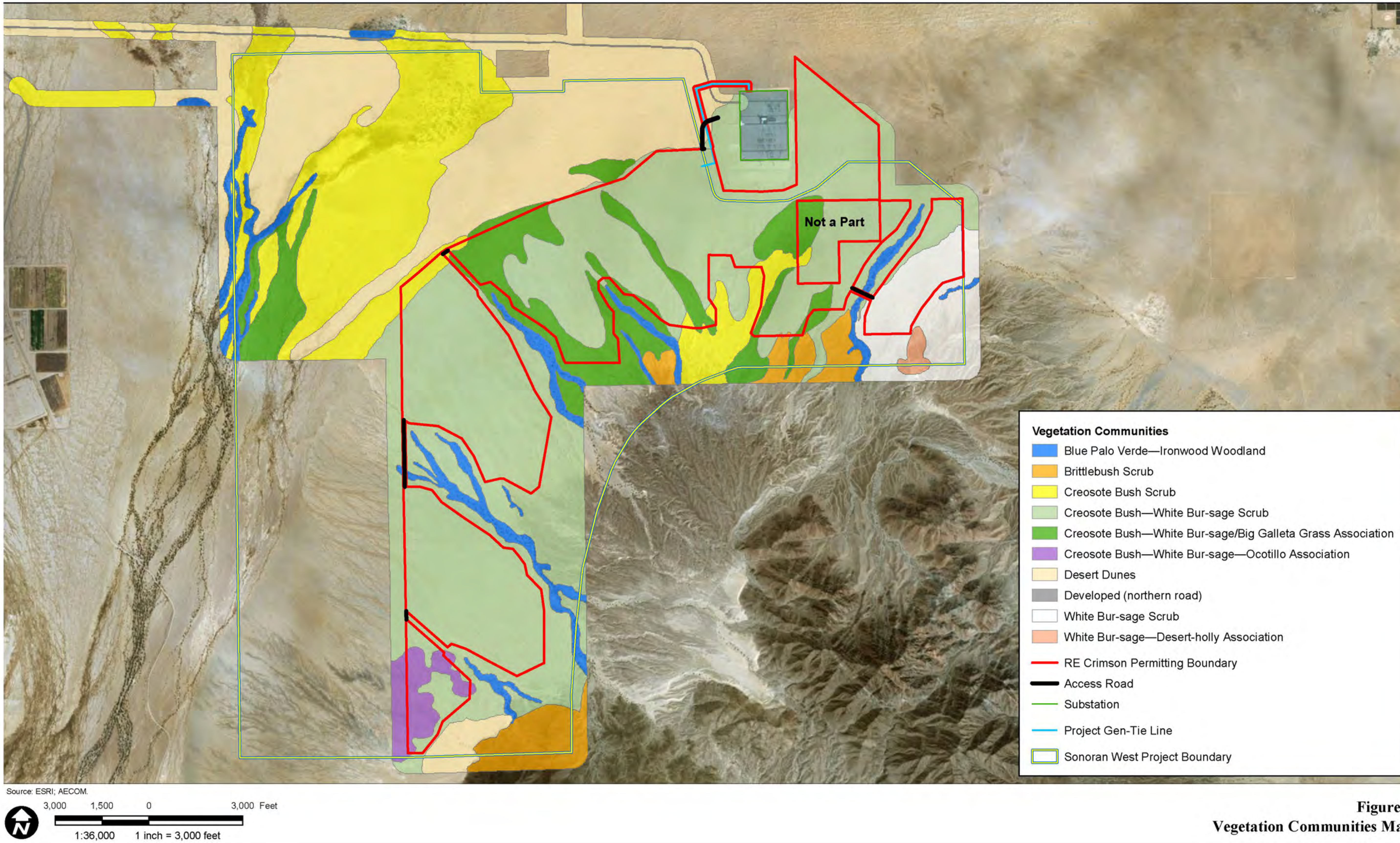
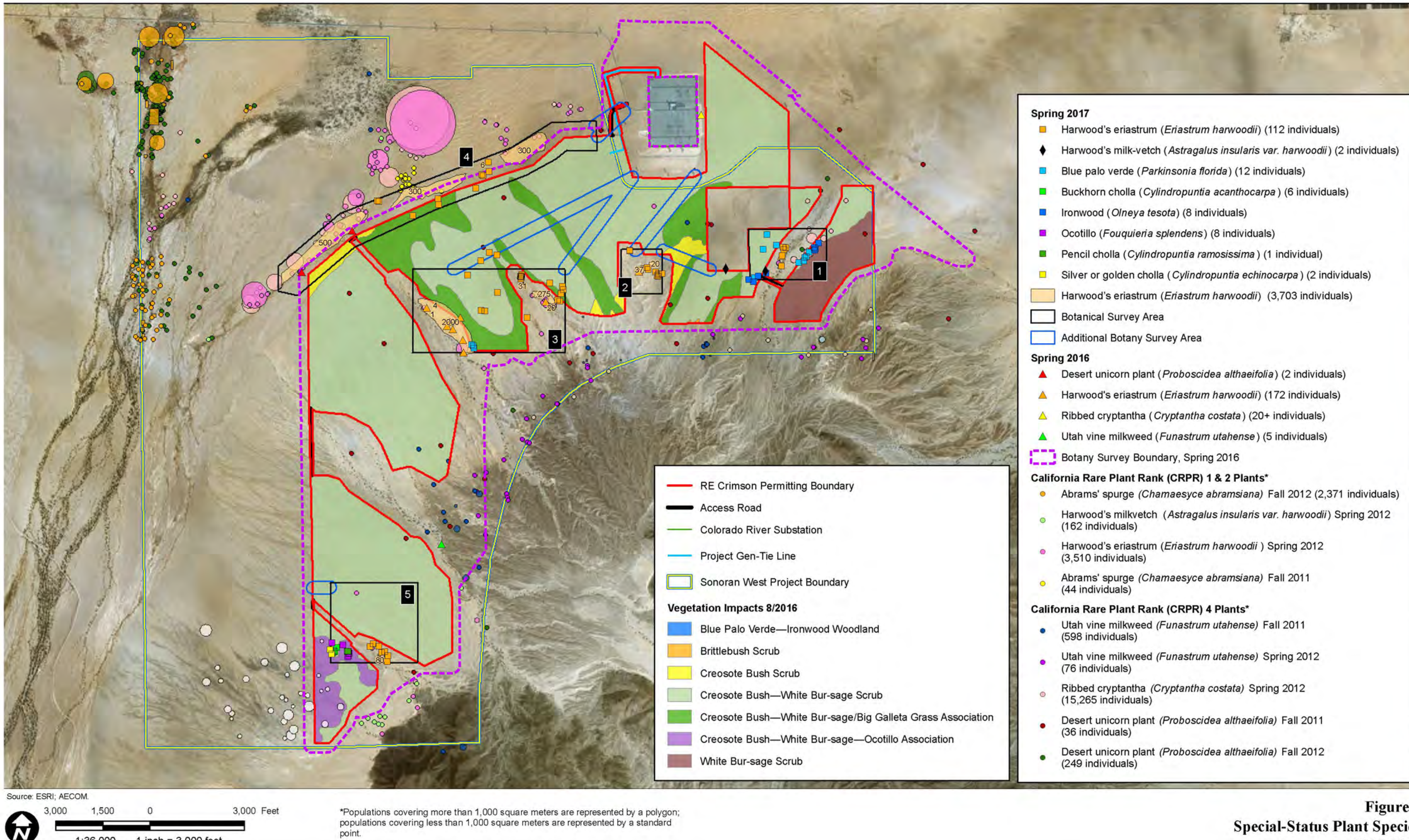



**Figure 4**
**Vegetation Communities Map**




*Populations covering more than 1,000 square meters are represented by a polygon; populations covering less than 1,000 square meters are represented by a standard point.

**Figure 5**
**Special-Status Plant Species**
**2011-2017**

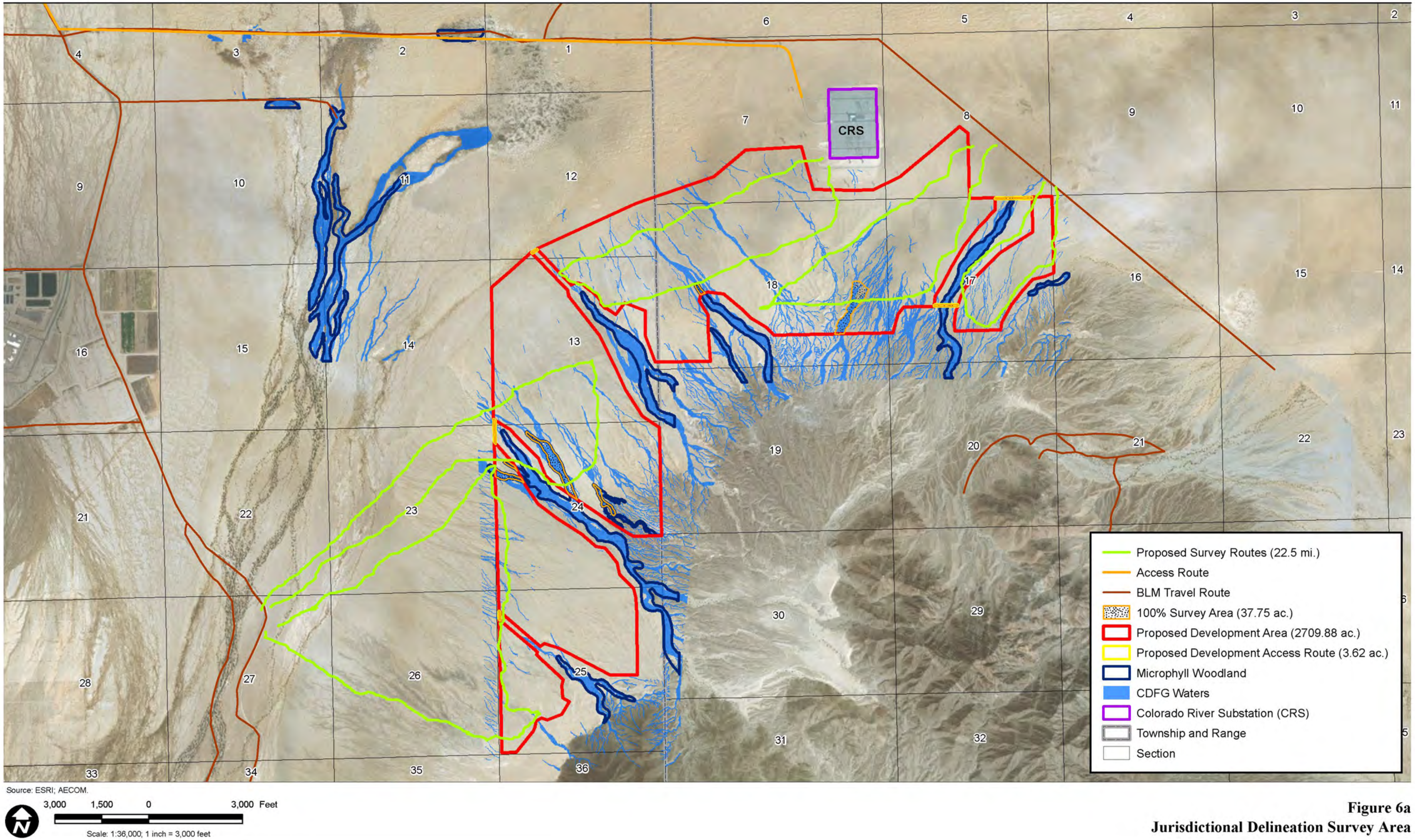



**Figure 6a**
**Jurisdictional Delineation Survey Area**

RE Crimson Solar - Riverside County, CA

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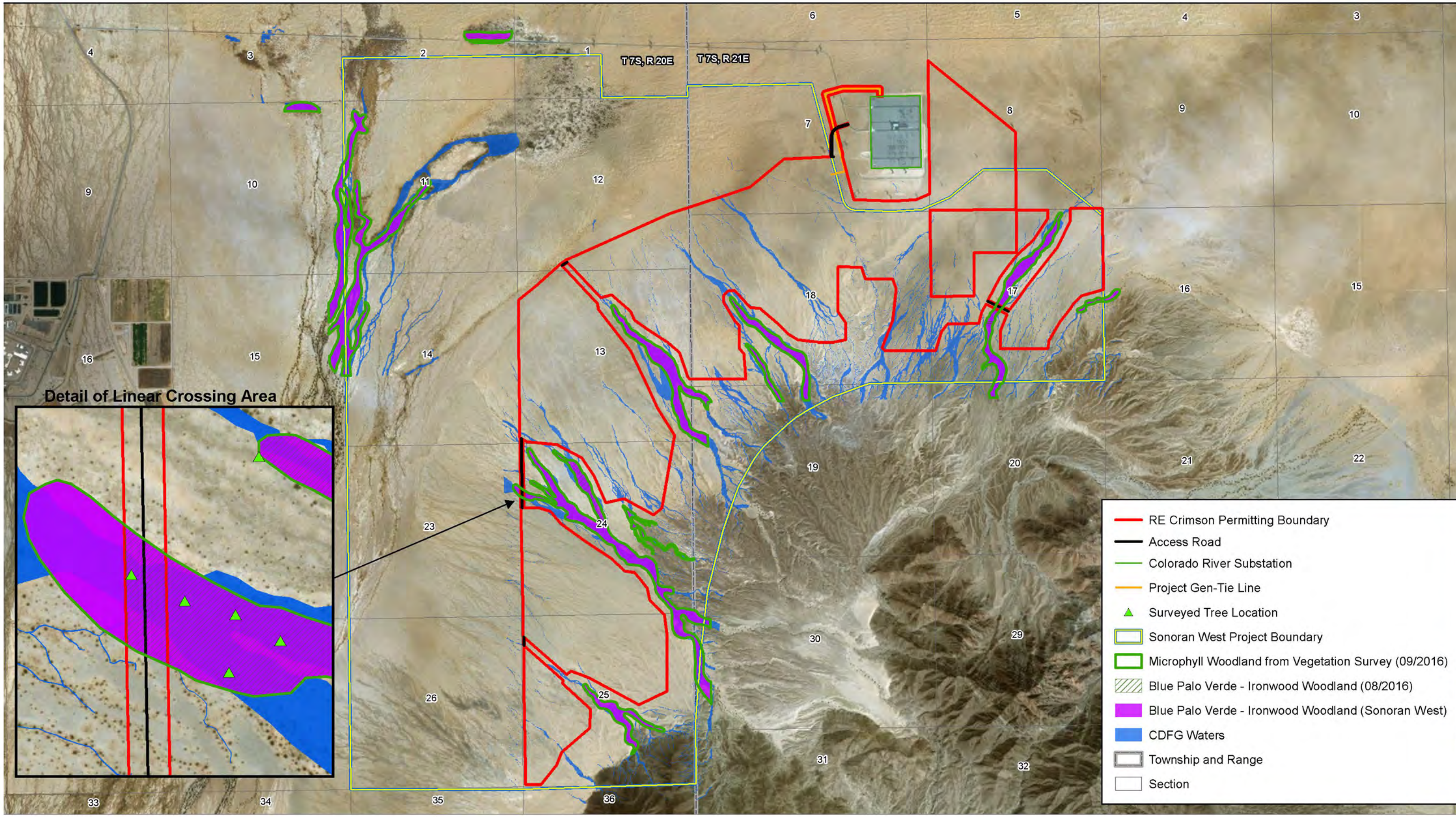


Source: ESRI; AECOM.

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1:36,000 1 inch = 3,000 feet

**Figure 6b**
**Jurisdictional Waters**

RE Crimson Solar - Riverside County, CA

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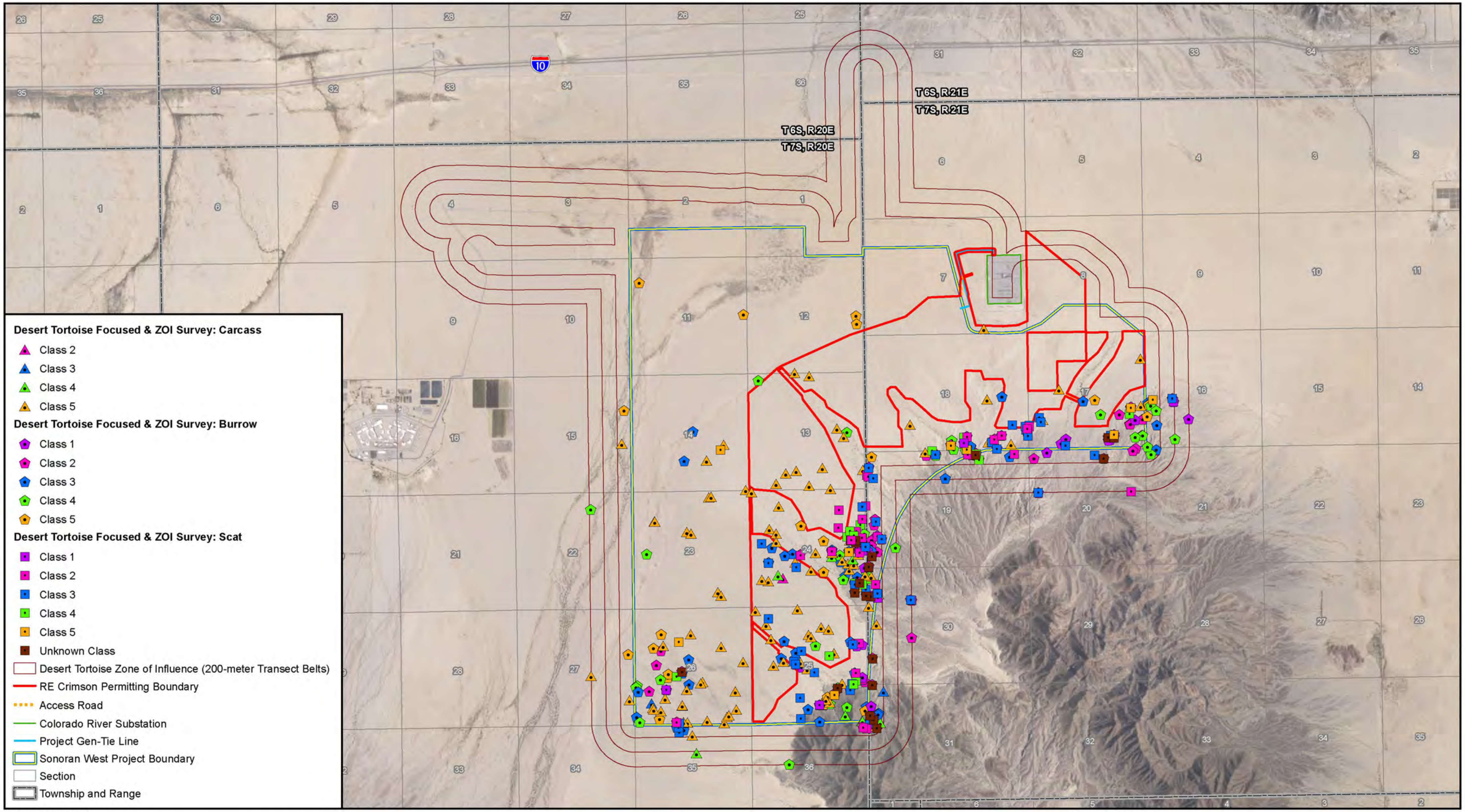



Source: ESRI; AECOM.

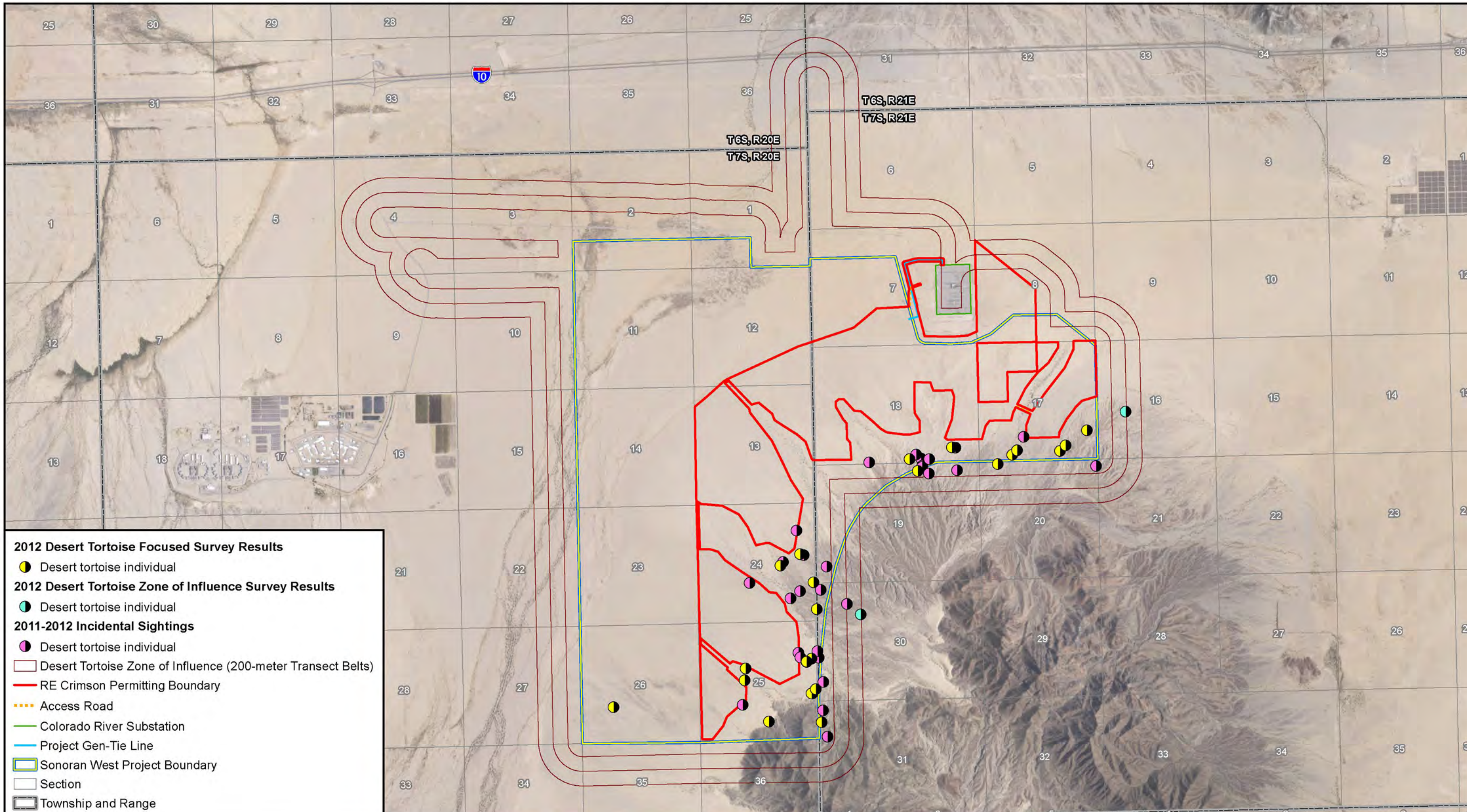
4,400 2,200 0 4,400 Feet

1:52,800 1 inch = 4,400 feet

**Figure 7**
**Desert Tortoise Sign Detected During Focused Desert Tortoise Surveys**
**2012**

RE Crimson Solar - Riverside County, CA

*Path: U:\Projects\Recurrent Energy\60487757_Crimson\900-Work\920-GIS\map_docs\mxd\Bio\BTR\deto_2011-2012_sign.mxd, 9/26/2017, jason.sokol*

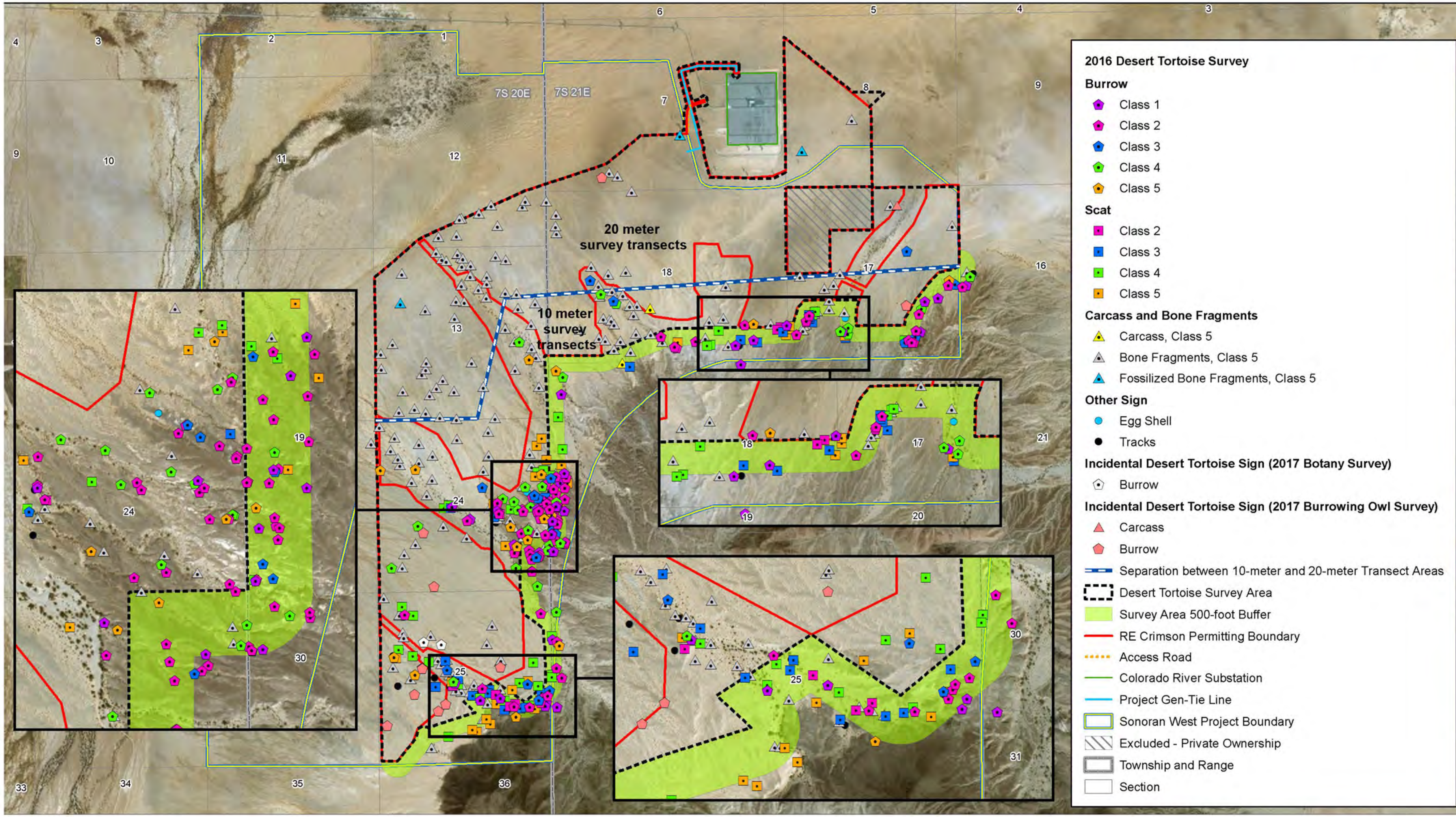



Source: ESRI; AECOM.

4,400 2,200 0 4,400 Feet

1:52,800 1 inch = 4,400 feet

**Figure 8**
**Desert Tortoise Individuals Observed**
**2011-2012**




Source: AECOM, ESRI.

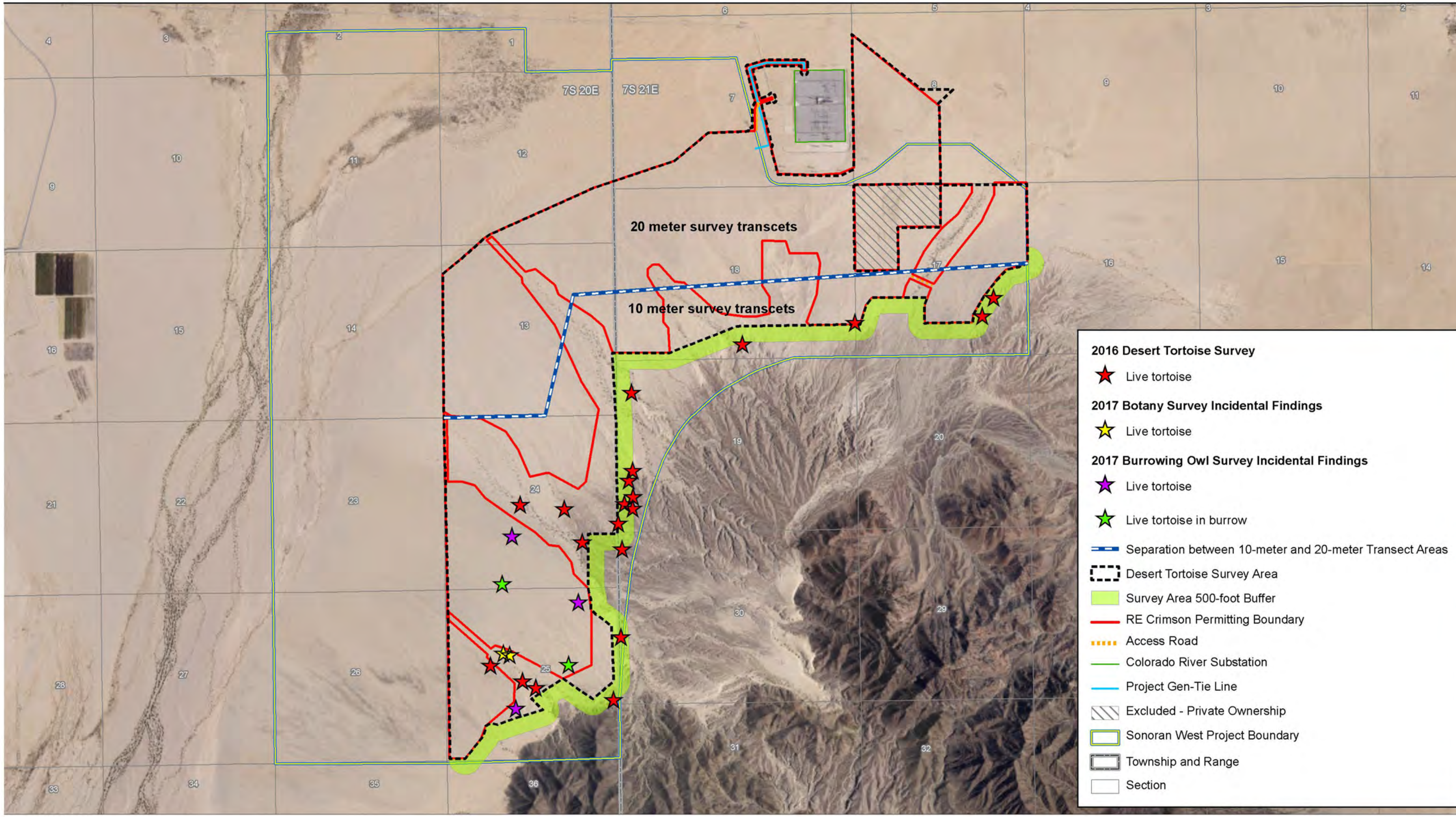
3,000 1,500 0 3,000 Feet

1:36,000 1 inch = 3,000 feet

**Figure 9**
**Desert Tortoise Sign Detected During Focused Surveys 2016-2017**

RE Crimson Solar - Riverside County, CA

*Path: U:\Projects\Recurrent Energy\60487757_Crimson\900-Work\920-GIS\map_docs\mxd\Bio\BTR\deto_2016_2017_sign.mxd, 5/24/2018, daniel.arellano*




Source: AECOM, ESRI.

3,000 1,500 0 3,000 Feet

1:36,000 1 inch = 3,000 feet

**Figure 10**
**Desert Tortoise Individuals Observed**
**2016-2017**

RE Crimson Solar - Riverside County, CA

*Path: U:\Projects\Recurrent Energy\60487757_Crimson\900-Work\920-GIS\map_docs\mxd\Bio\BTR\deto_2016_2017_live_individuals.mxd, 9/25/2017, jason.sokol*

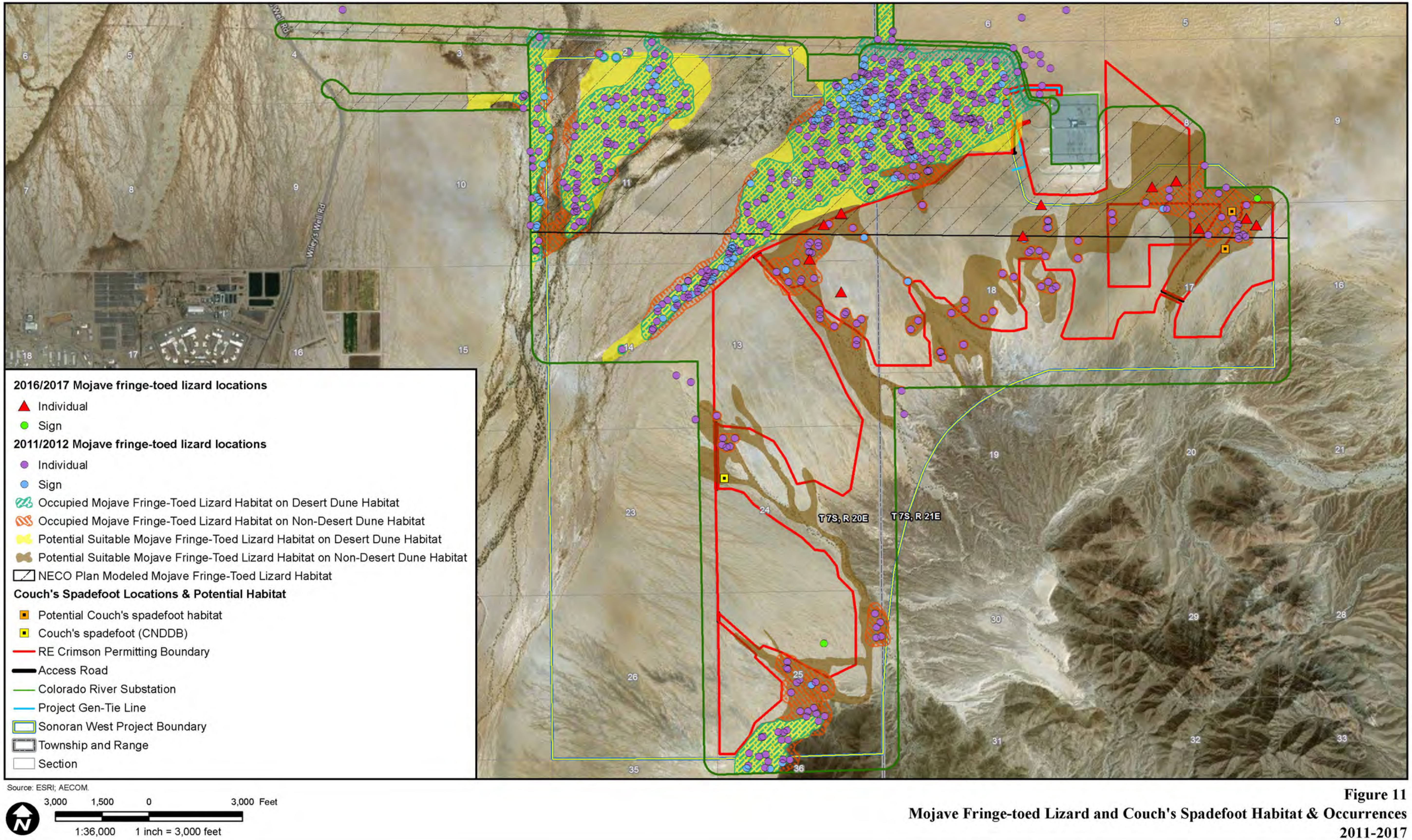



**Figure 11**
**Mojave Fringe-toed Lizard and Couch's Spadefoot Habitat & Occurrences**
**2011-2017**

RE Crimson Solar - Riverside County, CA

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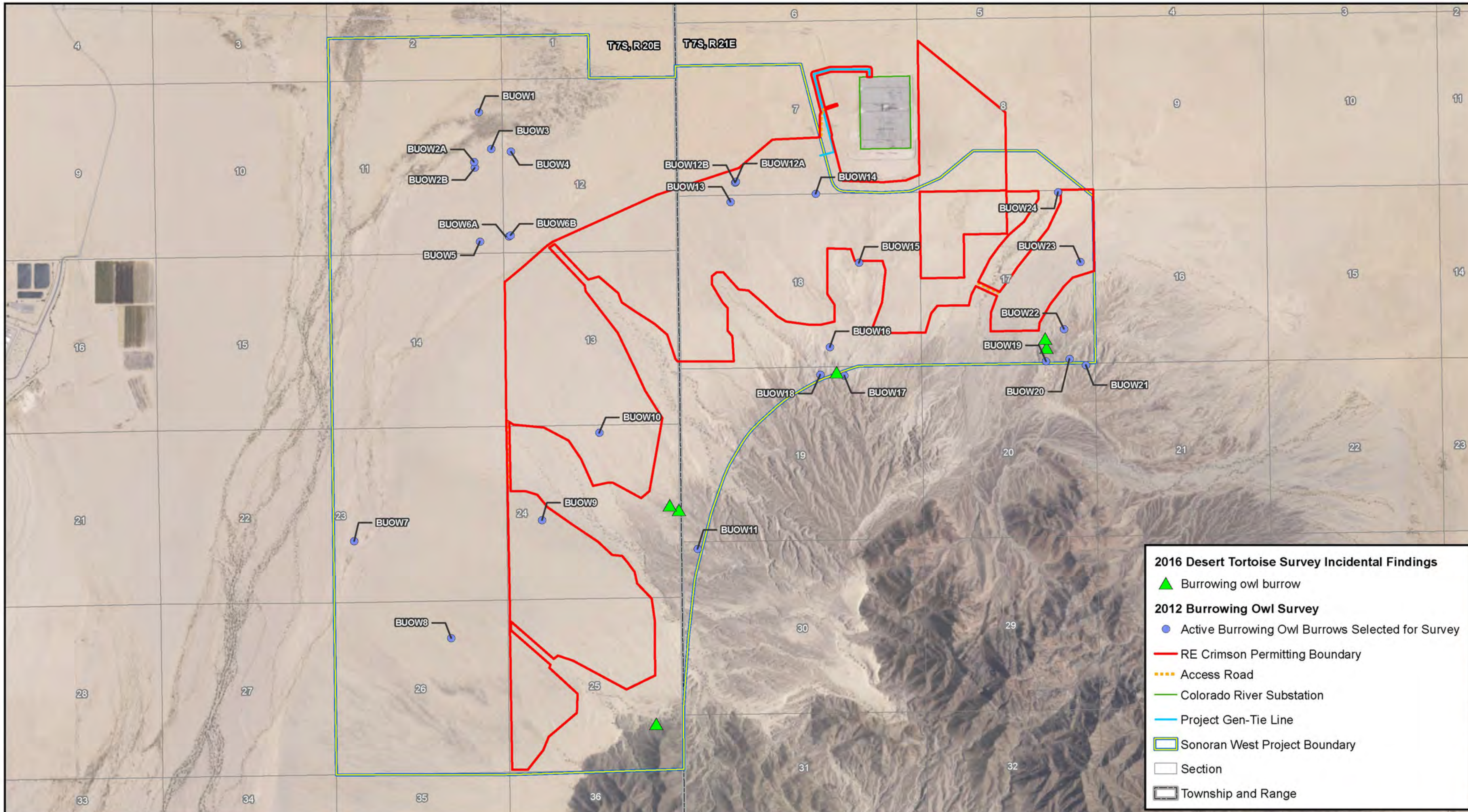


Source: ESRI; AECOM.

3,000 1,500 0 3,000 Feet

1:36,000 1 inch = 3,000 feet

**Figure 12**
**Burrowing Owl Occurrences**
**2011-2017**

RE Crimson Solar - Riverside County, CA

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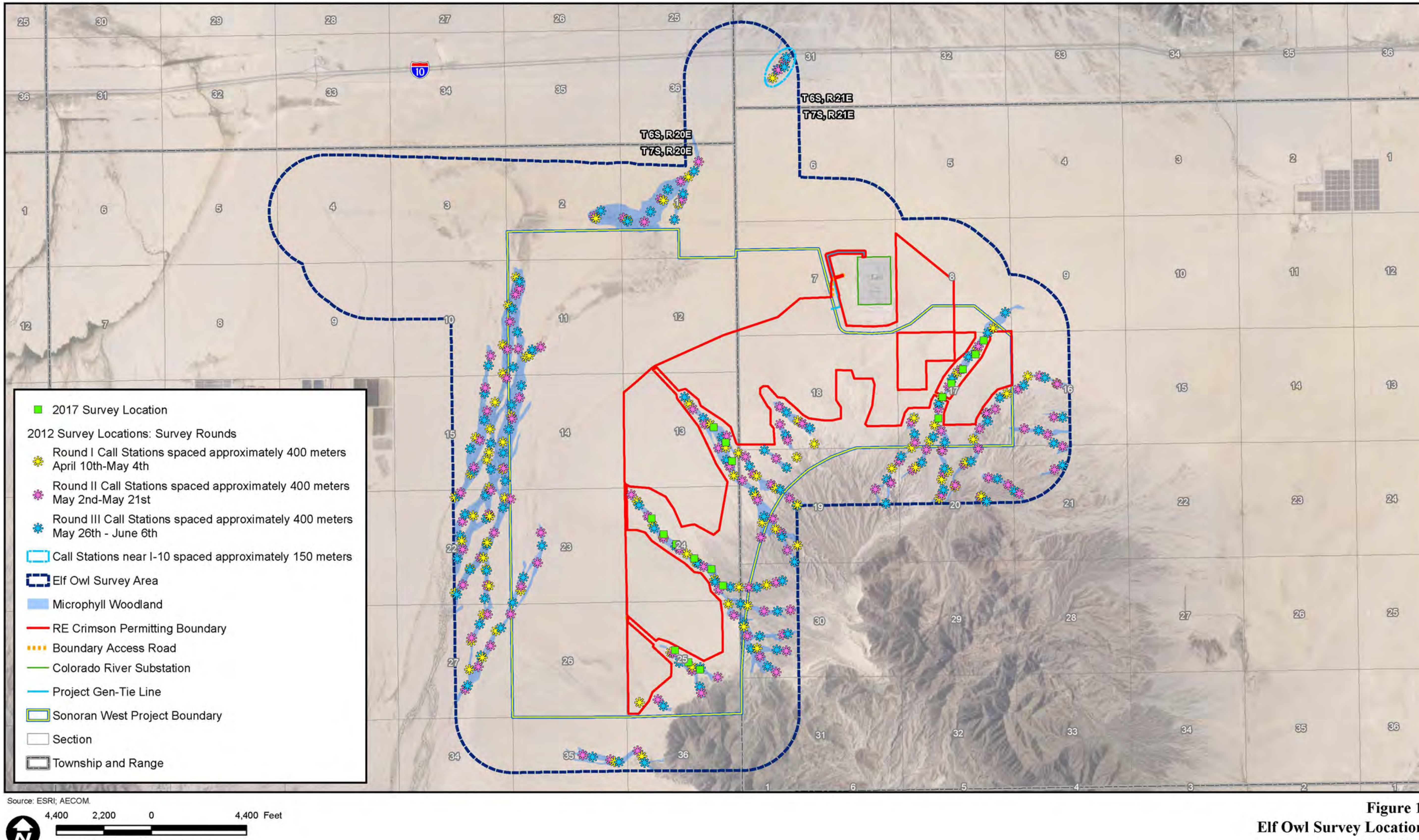



**Figure 13**
**Elf Owl Survey Locations**
**2012-2017**

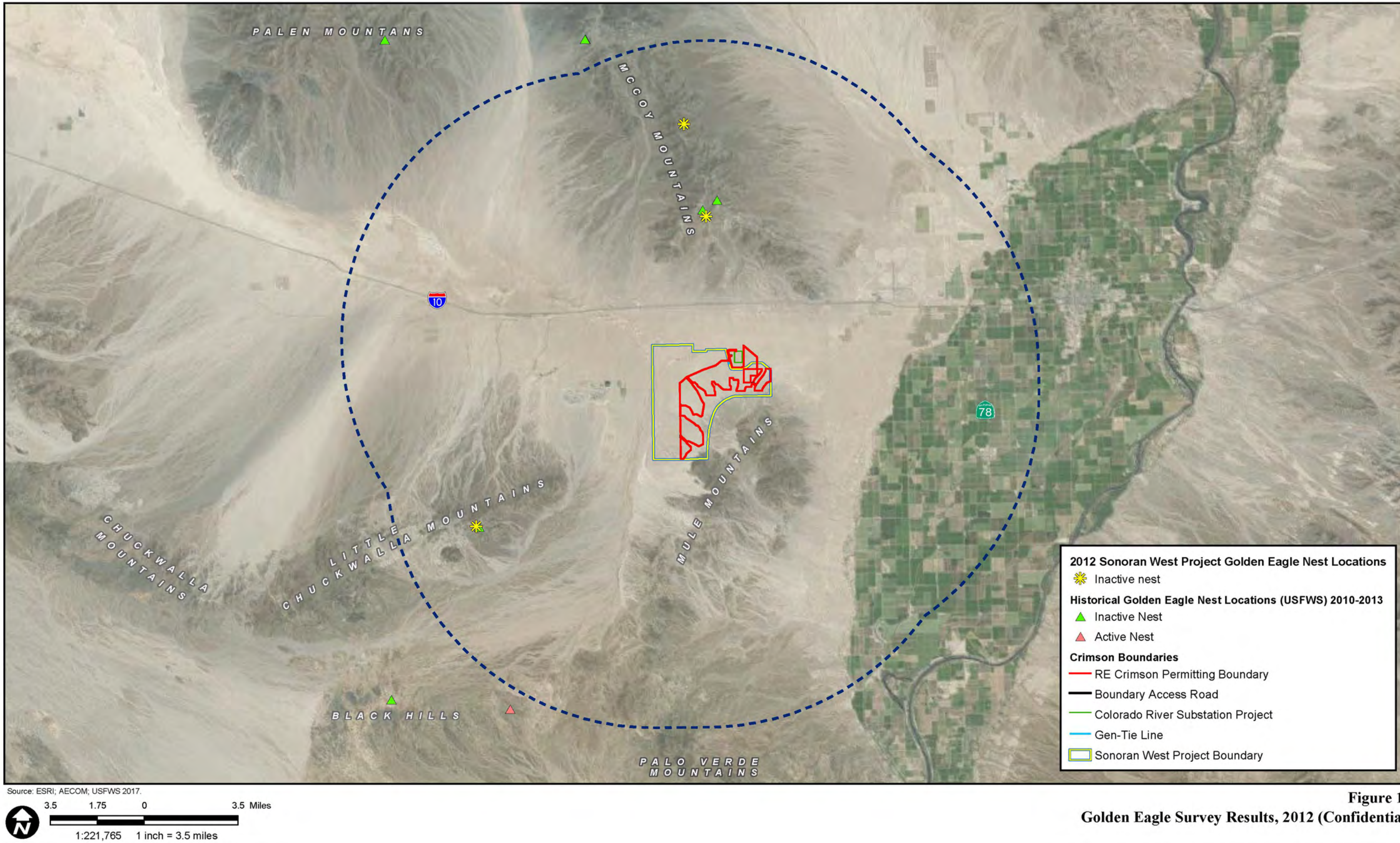



**Figure 14**
**Golden Eagle Survey Results, 2012 (Confidential)**

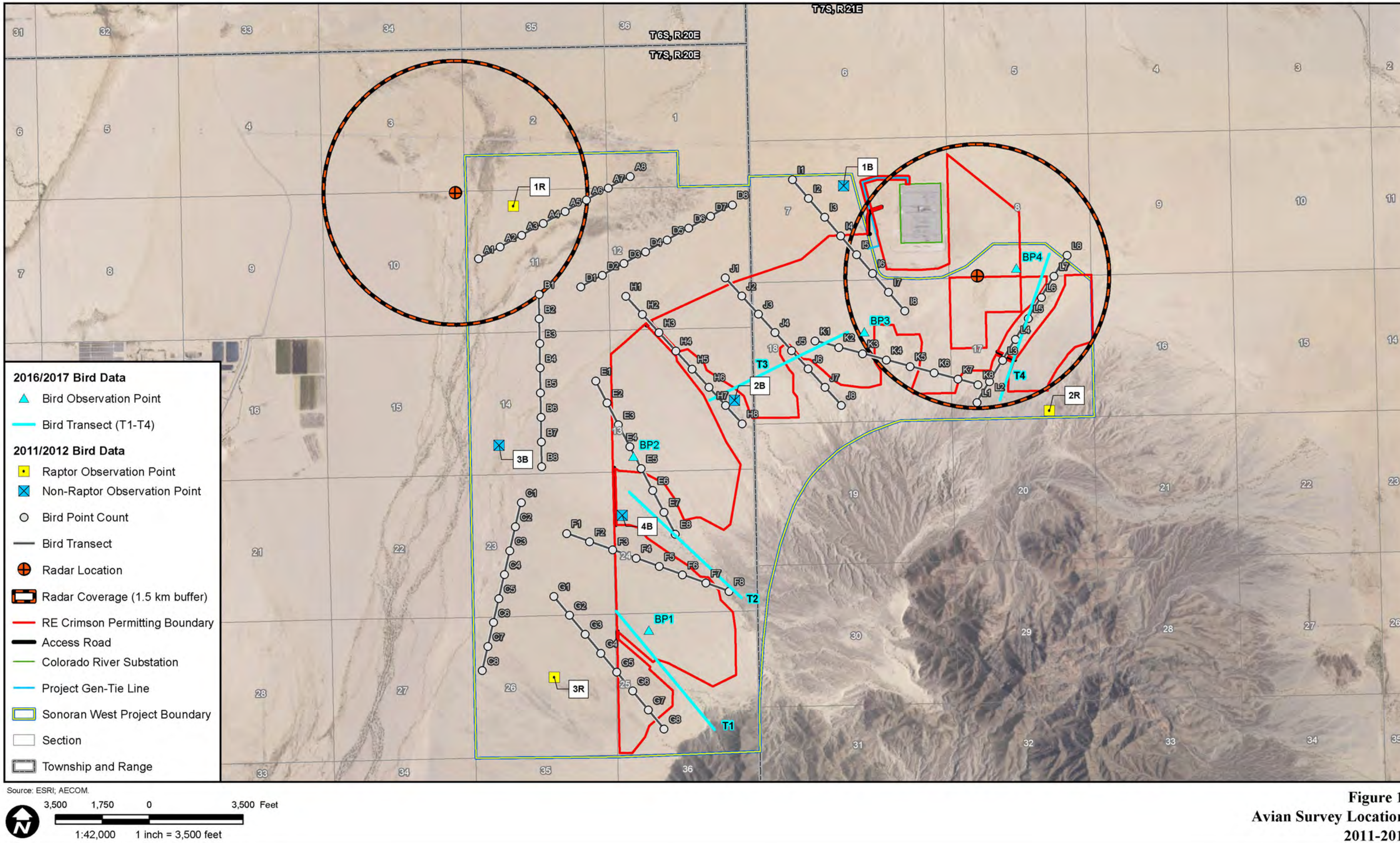
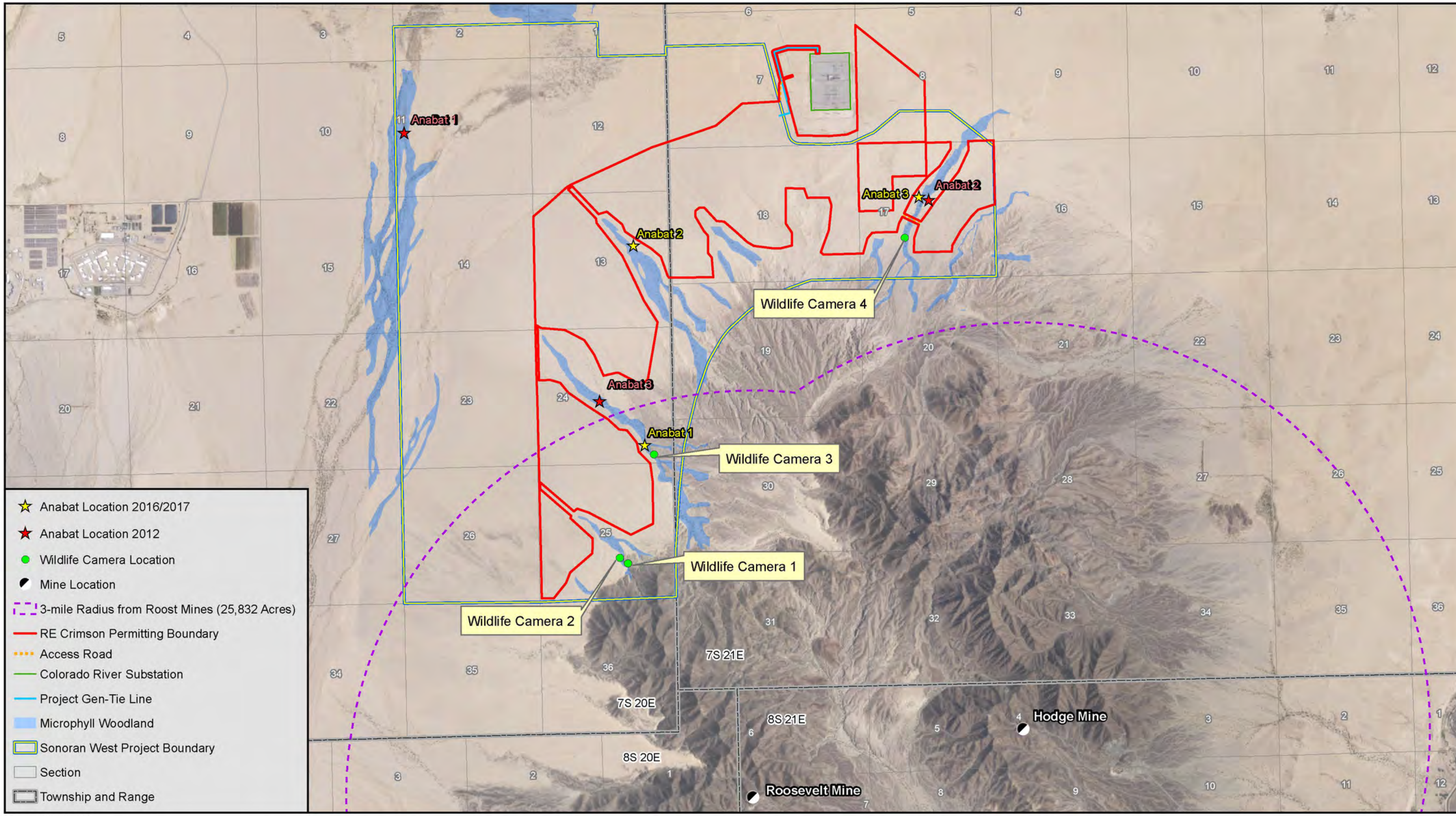



**Figure 15**
**Avian Survey Locations**
**2011-2017**




Source: ESRI; AECOM.

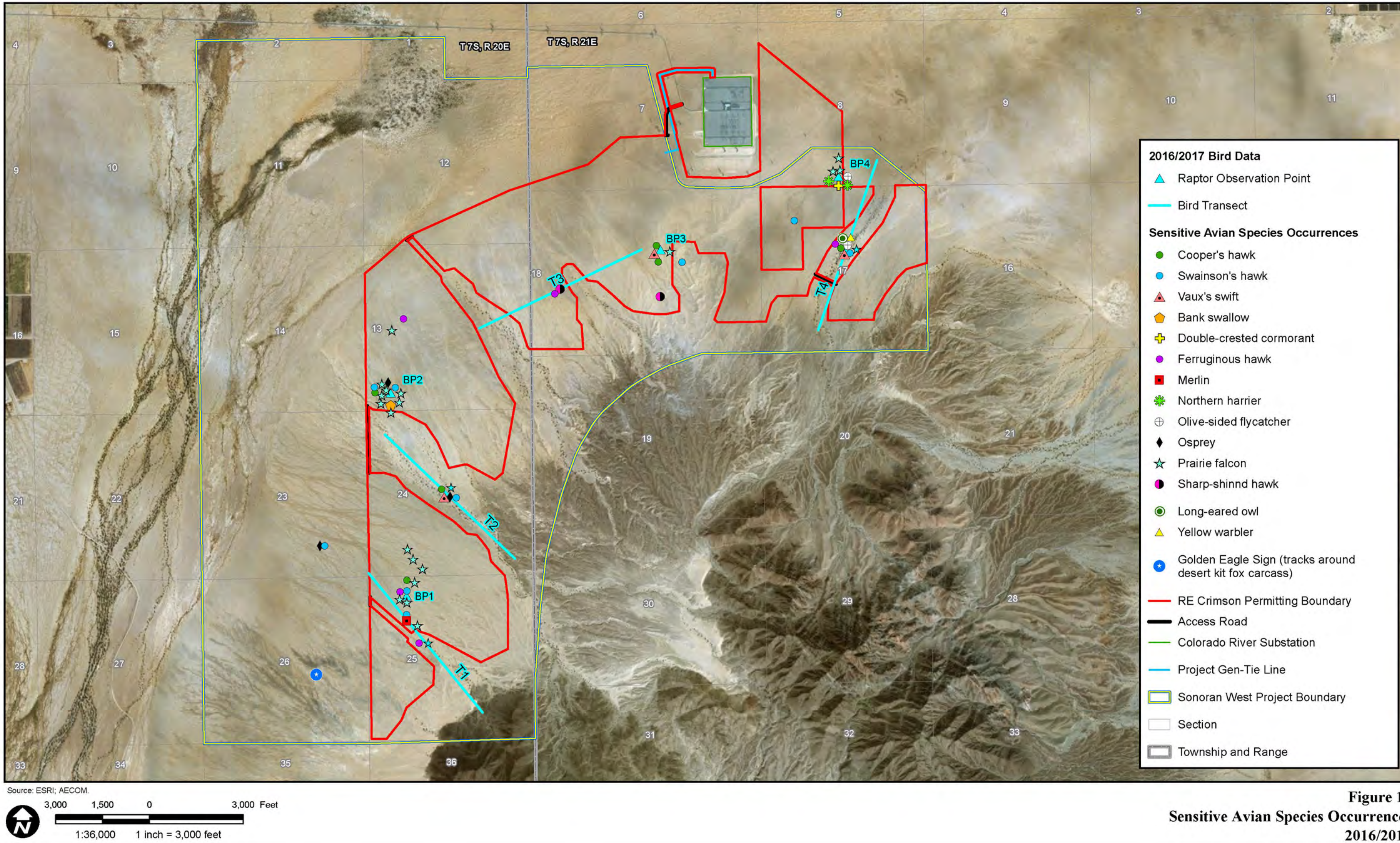
3,800 1,900 0 3,800 Feet

1:45,600 1 inch = 3,800 feet

**Figure 16**
**Bat Acoustic Monitoring and Wildlife Camera Locations**
**2011-2017**

RE Crimson Solar - Riverside County, CA

Document Path: U:\Projects\Recurrent Energy\60487757_Crimson\900-Work\920-GIS\map_docs\mxd\Bio\BTR\bat_locations_2011-2017.mxd

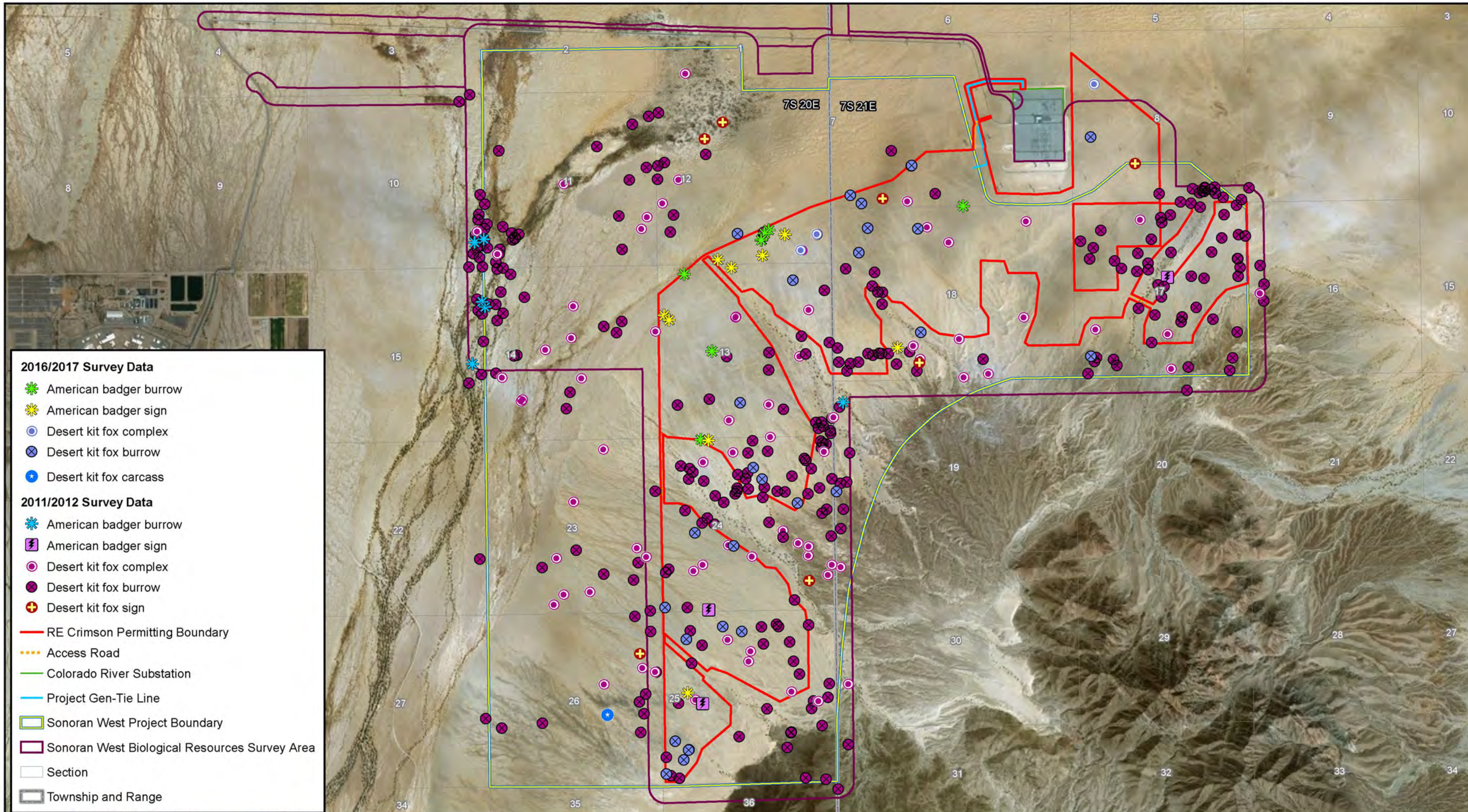



Source: ESRI; AECOM.

**Figure 17**
**Sensitive Avian Species Occurrences**
**2016/2017**

RE Crimson Solar - Riverside County, CA

Document Path: U:\Projects\Recurrent Energy\60487757_Crimson\900-Work\920-GIS\map_docs\mxd\Bio\BTR\sensitive_avian_species_2016-2017.mxd




Source: ESRI; AECOM.

3,000 1,500 0 3,000 Feet

1:36,000 1 inch = 3,000 feet

**Figure 18**
**Desert Kit Fox and American Badger Data**
**2011-2017**

RE Crimson Solar - Riverside County, CA
Document Path: U:\Projects\Recurrent Energy\60487757_Crimson\900-Work\920-GIS\map_docs\mxd\Bio\BTR\Badger_KitFox_2011-2017.mxd

# Appendix A

# Project Description

# Appendix A - Project Description

## 1.0 Technical Project Description

Sonoran West Solar Holdings, LLC (Applicant), a wholly owned subsidiary of Recurrent Energy LLC, proposes to construct and operate the RE Crimson Solar Project (Project), a utility-scale solar photovoltaic (PV) and energy storage project that would be located on federal lands managed by the Bureau of Land Management (BLM) within the California Desert Conservation Area planning area. The Project would interconnect to the regional electrical grid at the Southern California Edison (SCE) 230-kilovolt (kV) Colorado River Substation (CRS). It would generate up to 350 megawatts (MW) of renewable energy using PV technology and would include up to 350 MW of integrated energy storage capacity.

The proposed Project is located in unincorporated eastern Riverside County, approximately 13 miles west of Blythe, just north of Mule Mountain and just south of Interstate 10 (I-10), including portions of Sections 1, 2, 11, 12, 13, 24, 25 within Township 7 South, Range 20 East, and portions of Sections 6, 7, 8, 16, 17, 18 within Township 7 South, Range 21 East. The Project site consists of approximately 2,489 acres of BLM-administered land within the Riverside East Solar Energy Zone and within the Desert Renewable Energy Conservation Plan (DRECP) Development Focus Area as presented in the Final Environmental Impact Statement (EIS) and approved in the Record of Decision and associated Land Use Plan Amendment in September 2016 (http://www.drecp.org/). The Project is not sited within the adjacent Section 368 Federal Energy Corridor pursuant to the Westwide Energy Corridor Final Programmatic EIS, except for a short gen-tie line that would interconnect the Project to the CRS.

The Project site is situated at the eastern edge of the Chuckwalla Hydrologic Area and supports a broad alluvial fan that includes many braided washes and channels that converge into a primary channel flowing into an intra-state playa lake northwest of the Project site. This playa lake is not a Traditional Navigable Water; therefore, the channels in the Project area do not qualify as federal jurisdictional waters.

The site is surrounded primarily by BLM-managed lands and some private parcels. The site is located at the northern foot of the Mule Mountain Area of Critical Environmental Concern, which is an important cultural resource for local Native American Tribes. The SCE high-voltage transmission line and CRS are located directly north of the Project site, and I-10 is north of and parallel to those facilities. East of the Project site is First Solar's proposed Desert Quartzite project. Further northeast of the Desert Quartzite project is the site of the recently approved Blythe Mesa Solar Project by RRG Renewables. Designated critical habitat for desert tortoise (*Gopherus agassizii*) and the vast Chuckwalla Desert Wildlife Management Area and Critical Habitat Unit are located west of the Project site.

### 1.1 PROJECT SITE LAYOUT DETAILS

The Project applicant is proposing to construct the Project using traditional construction methods consisting of desert tortoise exclusion fencing, mow and roll of vegetation for site preparation, compacted roads, and trenching for electrical lines. The applicant is also actively investigating alternative low-environmental impact design (LEID) elements and the potential for those to reduce Project impacts.

### 1.1.1 Photovoltaic Modules and Support Structures

The Project would include an estimated 2 million solar modules, although the precise module count would depend on the technology ultimately selected at the time of procurement. The ultimate decision for the module types and racking systems described here would depend on market conditions and environmental factors, including the recycling potential of the modules at the end of their useful lives and which design option is selected for construction. Types of modules that may be installed include thin-film modules (including cadmium telluride and copper indium gallium diselenide technologies), crystalline silicon modules, or any other commercially available PV technology. Solar thermal technology is not being considered. Module mounting systems that may be installed include either fixed-tilt or tracking technology. Multiple types of modules and racking systems may be installed across the site, depending on the terms and conditions of the Right of Way (ROW) Grant or Lease.

The PV modules would be manufactured at an off-site location and transported to the Project site. Modules would be arranged in strings, called rows, with a maximum height of 12 feet. Module faces would be minimally reflective, dark in color, and highly absorptive.

Modules would be arranged on the site in solar arrays. For single-axis tracking systems, the length of each row of modules would be approximately 350 feet along the north/south axis. For fixed-tilt systems, a row consists of multiple tables four modules high by ten modules wide, depending on design. Each table would be approximately 65 feet along the east/west axis, with 1-foot spacing between each table. Spacing between each row would be a minimum of 4 feet. The solar module array would generate electricity directly from sunlight, collect it to a single point at one of the Project substations, and interconnect it to the CRS.

Structures supporting the PV modules would consist of steel piles (e.g., cylindrical pipes, H-beams, or similar), which would be driven into the soil using pneumatic techniques, such as a hydraulic rock hammer attachment on the boom of a rubber-tired backhoe excavator. The piles typically would be spaced 10 feet apart. For a single-axis tracking system, piles typically would be installed to a reveal height of approximately 4 feet above grade, while for a fixed-tilt system the reveal height would vary based on the racking configuration specified in the final design. For single-axis tracking systems, following pile installation the associated motors, torque tubes, and drivelines (if applicable) would be placed and secured. Some designs allow for PV modules to be secured directly to the torque tubes using appropriate module clamps. For some single-axis tracking systems, and for all fixed-tilt systems, a galvanized metal racking system, which secures the PV modules to the installed foundations, would then be field-assembled and attached according to the manufacturer’s guidelines.

Fixed-tilt arrays would be oriented along an east-west axis with modules facing generally south. Tracking arrays would be oriented along a north-south axis with modules tracking east to west to follow the movement of the sun. The total height of the module system measured from ground surface would be up to 12 feet. For fixed-tilt systems, the modules would be fixed at an approximate 20- to 60-degree angle or as otherwise determined necessary during final Project design.

Where excavations are required, the majority of proposed construction activities would be limited to less than 6 feet in depth; however, some excavations, such as those undertaken for the installation of collector poles and dead-end structures, may reach depths of 20 feet or more.

### 1.1.2 Inverters, Transformers, and Electrical Collection System

The Project would be designed and laid out primarily in 2-MW increments, which would include an inverter equipment area measuring 40 feet by 25 feet. Non-conforming module blocks would be designed and sized as appropriate to accommodate the irregular shape of the Project footprint. The final module block increment sizes ultimately would depend on available technology and market conditions. Each 2-MW increment would include an inverter-transformer station constructed on a concrete pad or steel skid, and would be centrally located within the PV arrays. Each inverter-transformer station would contain up to four inverters, a transformer, a battery enclosure, and a switchboard 8 to 11 feet high. The pads would contain a security camera at the top of an approximately 20-foot pole. If required based on site meteorological conditions, an inverter shade structure would be installed at each pad. The shade structure would consist of wood or metal supports and a durable outdoor material shade structure (metal, vinyl, or similar). The shade structure would extend up to 10 feet above the top of the inverter pad.

Modules would be electrically connected into module strings using wiring secured to the module racking system. Underground cables would be installed to convey the direct current (DC) electricity from the modules via combiner boxes located throughout the PV arrays to inverters to convert the DC to alternating current (AC). The output voltage of the inverters would be stepped up to the collection system voltage via transformers located in close proximity to the inverters. The 34.5-kV level collection cables would either be buried underground or installed overhead on wood poles. Some of the wood poles could be located at the outside edge of the property line, but a majority of these poles are expected to be located on-site. Between 300 and 500 wood poles located at 250-foot intervals could be installed across the entire site. The typical height of the poles would be approximately 30 to 50 feet, with diameters varying from 12 to 14 inches.

Up to four substations would transform voltage from 34.5 kV to 223 kV. The area of each substation and associated equipment would be approximately 30,000 square feet (150 feet by 200 feet) in close proximity to the CRS. Each substation would collect consolidated intermediate voltage cables from the PV collector system. Electrical transformers, switchgear, and related substation facilities would be designed and constructed to transform medium-voltage power from the Project's delivery system to the 230-kV CRS.

Structural components in each substation area would include:

- Power transformers (approximately 25 feet by 40 feet, and 25 feet high);
- Footings for power transformers;

- Pre-fabricated control buildings (each approximately 23 feet by 15 feet, and 12 feet high) to enclose the protection and control equipment, including relays and low voltage switchgear;
- Footings (up to 12 feet deep) for the control enclosure structure;
- Metering stand;
- Capacitor bank(s);
- Circuit breakers and air disconnect switches;
- One microwave tower adjacent to the control building comprising a monopole structure up to 100 feet in height mounted with an antenna up to 5 feet in diameter; and
- Dead-end structure(s) up to 80 feet in height to connect the Project substation(s) to the CRS.

The substation area would be graded and compacted to an approximately level grade. Concrete pads would be constructed on-site as foundations for substation equipment, and the remaining area would be graveled to a maximum depth of approximately 6 inches. Because each of the substation transformers would contain mineral oil, the substations would be designed to accommodate an accidental spill of transformer fluid by the use of containment-style mounting. Each substation would be surrounded by an up-to 8-foot high chain link fence topped with 1 foot of barbed wire. Each of the dead-end structures would require foundations excavated to a depth of 20 feet or more. Fences will be marked to minimize avian collisions as required.

The project gen-tie would be up to 3,000 feet in length, and would be constructed with either monopoles, lattice steel structures, or wooden H-frame poles. A portion of the gen-tie line (up to approximately 600 feet) may be constructed underground to cross under existing SCE transmission lines[1]. For the overhead gen-tie line, structure foundations would be excavated to a depth of 20 feet or more and include concrete supports depending on final engineering. Gen-tie structures would be up to 150 feet tall. There would be up to 10 gen-tie support structures. A three-phase 230-kV conductor would be strung along the gen-tie line, and the line would be equipped with a ground wire and a telecommunications fiber-optic cable.

An operation and maintenance (O&M) building would be located near the Project substations. The O&M building would be approximately 2,000 square feet in size (approximately 40 feet by 50 feet by 15 feet at its tallest point), which would accommodate O&M staff. Two equipment storage containers measuring 40 feet by 8 feet by 9 feet each also would be located at the substation area. The O&M building would be constructed on a concrete foundation.

The facility would be designed with a comprehensive Supervisory Control and Data Acquisition (SCADA) system to allow remote monitoring of facility operation and/or remote control of critical components. The fiber optic or other cabling required for the monitoring system typically would be installed in buried conduit, leading to a SCADA system cabinet centrally located within the Project site or a series of appropriately located SCADA system cabinets constructed within the O&M building. The dimensions of each cabinet would be approximately 20 feet by 8 feet by 9 feet high. External telecommunications connections to the SCADA system cabinets could be

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[1] If constructed, the underground line would be located in an area of previous disturbance and would not affect the Project's total temporary or permanent disturbance calculations.

provided through wireless or hard-wired connections to locally available commercial service providers.

### 1.1.3 Energy Storage

Storage systems can assist grid operators in more effectively integrating intermittent renewable resources into the statewide grid and can assist utilities in their efforts to meet energy storage goals mandated by the California Public Utilities Commission. The Project could include, at the Applicants' option, a battery or flywheel storage system capable of storing up to 350 MW of electricity. If provided, the storage system would consist of battery or flywheel banks housed in electrical enclosures and buried electrical conduit. The battery system would either be concentrated near the Project substations or dispersed throughout the Project site. Up to 3,000 electrical enclosures measuring 40 feet by 8 feet by 8.5 feet high would be installed on concrete foundations designed for secondary containment. The Project could use any commercially available battery technology. Battery systems are operationally silent, and flywheel systems have a noise rating of 45 dBA.

### 1.1.4 Meteorological Data Collection System

The Project would include a meteorological (met) data collection system. Each met station would have multiple weather sensors: a pyranometer for measuring solar irradiance, a thermometer to measure air temperature, a barometric pressure sensor, and wind sensors to measure speed and direction. The 4-foot horizontal cross-arm of each met system would include the pyranometer mounted on the left hand side and the two wind sensors installed on a vertical mast to the right. The temperature sensor would be mounted inside the solar shield behind the main mast. Each sensor would be connected by cable to a data logger inside the enclosure.

### 1.1.5 Telecommunications Facilities

The Project's SCADA system would interconnect to the fiber optic network at the CRS, and no additional disturbance associated with telecommunications is anticipated.

### 1.1.6 Access Roads

Access to the Project site would be provided from the existing paved Powerline Road to the CRS. The Project's on-site roadway system would include a perimeter road, access roads, and internal roads. The perimeter road and main access roads would be approximately 20 to 30 feet wide and constructed to be consistent with facility maintenance requirements and BLM fire standards. These roads would be surfaced with gravel, compacted dirt, or another commercially available surface. Selection of the surface to be used will consider surfaces that minimize attracting animals to bask on the roadway. The road would provide a fire buffer, accommodate Project O&M activities such as cleaning of solar modules, and facilitate on-site circulation for emergency vehicles.

Internal roads would have permeable surfaces and be approximately 12 to 20 feet in width or as otherwise required by BLM FIRE standards. They would be treated to create a durable, dustless surface for use during construction and operation. This would not involve lime treatment but would likely involve surfacing with gravel, compacted native soil, or a dust palliative. Any dust palliatives would be approved by BLM prior to application.

There is also a public land access road alternative. In the unlikely event that the Applicant cannot reach an agreement with the private landowner, two new access road segments along Powerline Road would be constructed in order to avoid two privately-owned parcels through which the existing Powerline Road crosses. These two new roadway segments, approximately 4,500 feet and 7,500 feet in length, would be routed to the north and to the south of the roadway, respectively, to travel around each privately-owned parcel and remain entirely on BLM-administered public land.

The alternative access road segments would be similar to the existing Powerline Road and would be 24 feet wide with a 2-foot-wide shoulder on each side, for a total width of approximately 30 feet, including allowances for side slopes and surface runoff control. Construction of the alternative access road segments would include compacting subsurface soils and placing a 4-inch-thick layer of asphalt concrete over a 6-inch-thick layer of compacted aggregate base. However, final selection of the surface to be used will consider surfaces that minimize attracting animals to bask on the roadway.

#### 1.1.7 Solar Facility Site Safety and Security

Multiple points of ingress/egress would be accessed via locked gates. Each Project unit would have at least one point of access. The boundary of the Project site would be secured by an up-to 8-foot-high, chain-link, perimeter fence, topped with three-strand barbed wire. If required, the security fence would be collocated with a planned desert tortoise fence. Motion sensitive, directional security lights would be installed to provide adequate illumination around the substation areas, each inverter cluster, at gates, and along perimeter fencing. All lighting would be shielded and directed downward to minimize the potential for glare or spillover onto adjacent properties.

Off-site security personnel could be dispatched during nighttime hours or could be on-site, depending on security risks and operating needs. Infrared security cameras, motion detectors, and/or other similar technology would be installed to allow for monitoring of the site through review of live footage 24 hours per day, 7 days per week. Such cameras or other equipment would be placed along the perimeter of the Project and/or at the inverters. Security cameras located at the inverters would be posted on poles approximately 20 feet high.

#### 1.1.8 Water Requirements

Water for construction-related dust control and operations would be obtained from several potential sources, including an on-site or off-site groundwater wells, or trucked from an off-site water purveyor.

During the construction phase, it is anticipated that up to 1,400 acre-feet of water would be used for dust suppression and other purposes. During construction, restroom facilities would be provided by portable units to be serviced by licensed providers.

During the operation and maintenance phase water would be required for module washing and maintenance, and for substation restroom facilities. During operation, the Project would require the use of approximately 7,300,000 gallons of water (approximately 22 acre-feet) annually for module washing and other uses, equivalent to 16,250 gallons per MW annually. Of this, approximately 563,000 gallons of non-potable water would be used by employees on-site for washing or rinsing equipment and other non-toilet uses. Approximately 5,400,000 gallons would be used for washing the modules up to four times a year (up to 1,350,000 gallons of water per washing period).

During O&M, one or two small aboveground, portable, sanitary waste facilities may be installed to retain wastewater for employee use. If installed, these facilities would remain on-site for the duration of the Project. It is expected that each facility would have a capacity of approximately 2,000 gallons. These facilities would be installed in accordance with state requirements and emptied as needed by a contracted wastewater service vehicle. No wastewater would be generated during module washing as water would be absorbed into the surrounding soil or would evaporate.

### 1.1.9 Waste Generation

Construction of the Project would involve the use of hazardous materials, such as fuels and greases to fuel and service construction equipment. Such substances may be stored in temporary aboveground storage tanks or sheds located on the Project site. The fuels stored on-site would be in a locked container within a fenced and secure temporary staging area. As there would be regulated hazardous materials on-site, storage procedures would be dictated by a Hazardous Materials Business Plan that would be developed prior to construction. Because the quantities stored may be in excess of 1,320 gallons, storage would be undertaken in compliance with the Spill Prevention, Control, and Countermeasure Rule. These spill prevention measures would be implemented as part of the Project; however, strict compliance under Title 40 of the Code of Federal Regulations (CFR) Section 112 or Clean Water Act Section 311 would not be required, because there would be no discharges to waters of the U.S. (i.e., navigable waterways or shorelines).

Trucks and construction vehicles would be serviced from off-site facilities. The use, storage, transport, and disposal of hazardous materials used in construction of the Project would be carried out in accordance with federal, state, and county regulations. No extremely hazardous substances (i.e., those governed pursuant to Title 40, CFR Part 335) are anticipated to be produced, used, stored, transported, or disposed of as a result of Project construction.

Construction materials would be sorted on-site throughout construction and transported to appropriate waste management facilities. Recyclable materials would be separated from non-recyclable items and stored until they could be transported to a designated recycling facility. It is anticipated that at least 20 percent of construction waste would be recyclable, and 50 percent of those materials would be recycled. Wooden construction waste (such as wood from wood pallets) would be sold, recycled, or chipped and composted. Other compostable materials, such as vegetation, might also be composted off site. Non-hazardous construction materials that cannot be reused or recycled would likely be disposed of at municipal county landfills.

Hazardous waste and electrical waste would not be placed in a landfill, but rather would be transported to a hazardous waste handling facility (e.g., electronic-waste recycling). All contractors and workers would be educated about waste sorting, appropriate recycling storage areas, and how to reduce landfill waste.

## 1.2 Alternative Design Considerations

RE Crimson continues to optimize the design of the project. As this process has progressed the project layout has been refined to reduce the Project footprint. In addition to lay-out considerations several design elements are being evaluated that have the potential to reduce environmental impacts. These elements include:

1. Minimizing grading during site preparation and maintaining more onsite vegetation to facilitate post-construction residual habitat value and post-operations/site reclamation success.
2. Avoiding or limiting trenching by placing electrical wiring aboveground.
3. Placing transformer/inverter groups on elevated support structures in lieu of cement foundations.

The LEID elements would further minimize grading, trenching, and vegetation removal beyond traditional design approaches for PV projects with the objective of reducing overall long-term impacts for the Project. Although the incorporation of LEID elements could result in slight modifications to the module block locations due to topographic constraints, the permitting boundary or limits of development would be the same with LEID elements incorporated.

The alternative design elements would modify components of the proposed design as discussed and could slightly modify the site layout due to topographic constraints. The key design changes resulting from the above alternative design elements are discussed below.

### 1.2.1 Inverters, Transformers, and Electrical Collection System

Should the project design include elevated inverter skids the site would be laid out in larger, 3- to 4-MW block sizes, requiring fewer inverter/transformer structures than for the proposed design. Non-conforming module blocks would be designed and sized as appropriate to accommodate the irregular shape of the Project footprint. Each inverter/transformer equipment area would measure roughly 40 feet by 225 feet, and would be mounted on steel skids and installed on steel piers above the ground surface in order to minimize surface disturbance and allow for natural stormwater flow through the site. Each inverter-transformer station would contain up to four inverters, a transformer, and a switchboard 8 to 11 feet high.

Another alternative design element would involve minimizing trenching by elevating electrical wiring. Modules would be electrically connected into module strings using wiring secured to the module racking system. Overhead cables would be installed to convey the DC electricity from the modules via trunk cables from each row of modules to the inverters to convert the DC to AC. Approximately 400 to 500 DC wooden transmission poles would be required. The output voltage of the inverters would be stepping up to the collection system voltage via transformers located in close proximity to the inverters. The 34.5-kV level collection cables would be installed overhead on wood poles and the conductors routed to the substation. Some of the wood poles could be located at the outside edge of the property line, but a majority of these poles are expected to be located on-site. Therefore, in addition between 300 and 400 wooden AC poles located at 300-foot intervals would be installed across the site. Although the AC and DC cables would be collocated where feasible, in sum up to 900 wood poles may be required. The typical height of the AC and DC collection poles would be approximately 30 to 50 feet, with diameters varying from 12 to 14 inches.

Areas within the Project footprint exhibiting steeper topography that would otherwise require cut, fill, grading, and grubbing would be avoided to the greatest extent practicable.

# 2.0 Construction Details

## 2.1 Pre-Construction Activities

Prior to construction activities at the Project site and along the gen-tie alignment, a number of activities would be undertaken to prepare the site and crews for construction. These pre-construction activities are listed below.

### 2.1.1 Geotechnical and Hazards Investigations

In order to gather information required to support the design of the PV electric generation and energy storage facility, the applicant would conduct a geotechnical investigation utilizing subsurface scientific testing and analysis, and would use ground penetrating radar to identify potential subsurface unexploded ordnance and Munitions and Explosives of Concern (UXO/MEC) that may need to be stabilized or removed prior to construction. The geotechnical field work would include survey work, field exploration borings and soil sampling, and prototype pile testing. Hazards investigation would involve driving several transects with a truck-mounted ground-penetrating radar to identify potential subsurface UXO hazards over 10 miles of transects and covering 10 acres followed by shovel or mini-excavator excavation of up to 2,000 anomalies. Each component is described in more detail below.

*Geotechnical Investigation*

A single crew consisting of two staff would access the geotechnical field work areas in a single four-wheel drive vehicle. Off-road driving speeds would be limited to 10 miles per hour (mph), and the vehicle would be accompanied by environmental monitors to facilitate avoidance of impacts to special-status species and currently unknown cultural and paleontological resources, as well as to avoid UXO/MEC that may be present onsite. Survey equipment used would be hand-held. Wooden stakes would be driven into the ground using hand tools, and colored flags would be used to denote work areas. Currently, 55 borings are proposed to explore the site; however, the locations and number may change following reconnaissance of the site and based on environmental resource constraints identified during field surveys and monitoring. The geotechnical field work is anticipated to occur between 7 a.m. and 5 p.m., six days per week, over a total of four weeks.

*Hazards Investigation*

Two steel equipment storage containers and a temporary office trailer would be set up just south of the CRS in an area that has been previously disturbed by vehicle and equipment traffic and lacks native vegetation. An explosive storage magazine (4-foot square metal lock box) would be within one of the equipment storage containers. An instrument verification strip would be set up near the office trailer; this would consist of a 0.5-acre area approved by the environmental monitors where buried UXO detection equipment would be installed up to 18 inches below the ground surface using hand shovels. The instrument verification strip would be used to calibrate equipment on a daily basis, and equipment would drive across the test strip for daily calibration.

A continuous 10-mile transect would be evaluated with a truck-mounted ground-penetrating radar, which is a passive, non-invasive method of evaluating subsurface conditions. Off-road driving speeds would be limited to 10 mph and vehicles and equipment would be accompanied by environmental monitors to facilitate the avoidance of impacts to special status species and currently unknown cultural and paleontological resources.

Investigations of identified anomalies would be performed by field technicians by excavating with a hand shovel or a mini-excavator (only as required and in locations approved by the environmental monitors) to depths up to approximately 4 feet below ground surface. Up to 2,000 anomalies could be investigated. If anomalies prove to be UXO/MEC, they would be inspected by the UXO technician and evaluated by the on-site cultural monitor and recorded as necessary. If anomalies prove to be live or hazardous, they would be detonated by qualified UXO/MEC technicians and placed in the explosive storage magazine.

### 2.1.2 Pre-Construction Resource Surveys

Qualified biologists would conduct pre-construction surveys for sensitive species. Sensitive resource areas would be flagged so they are avoided or appropriately managed during construction.

### 2.1.3 Construction Crew Training

Prior to construction, all contractors, subcontractors, and Project personnel would receive Worker Environmental Awareness Program training regarding the appropriate work practices necessary to effectively understand and implement the biological commitments in the Project description; implement the mitigation measures; comply with applicable environmental laws and regulations; avoid and minimize impacts; and understand the importance of these resources and the purpose and necessity of protecting them. The following species and their habitat would be specifically covered in the WEAP: desert tortoise, Mojave fringe-toed lizard, burrowing owl, other raptors and migratory birds, American badger, and desert kit fox. Applicable sensitive plant species would also be covered in the WEAP.

### 2.1.4 Surveying, Staking, and Flagging

Pre-construction field survey work would include identifying precise locations of the site boundary, desert tortoise and security fence, and gen-tie ROW boundary. These features would be subsequently staked in the field. No paint or permanent discoloring agents would be applied to rocks or vegetation to indicate survey or construction limits. All off-road vehicle travel would be monitored by qualified biologists, archaeologists, and tribal monitors, as appropriate.

#### 2.1.5 Desert Tortoise Fence Installation

A permanent desert tortoise exclusion fence would be installed per the U.S. Fish and Wildlife Service (USFWS) protocol. The tortoise fence would be integrated with the site security fence for maximum durability. Fence installation would be monitored by qualified biologists, archaeologists, and tribal monitors, as appropriate. Following installation, clearance surveys would be conducted.

#### 2.1.6 Biological Clearance Surveys

Desert tortoise, mammal, and burrowing owl (*Athene cunicularia*) clearance surveys would be conducted following fence installation. Mammals and owls would be passively relocated using one-way doors or other approved techniques. Desert tortoise individuals would be actively relocated or translocated to an approved site pursuant to an approved Relocation/Translocation Plan to be developed in consultation with USFWS and CDFW.

#### 2.1.7 Establishment of Construction Staging Area

A staging area would be established for storing materials, construction equipment, and vehicles. The staging area would be surveyed and monitored by qualified biologists, archaeologists, and tribal monitors, as appropriate.

### 2.2 Construction Phase 1: Site Preparation

#### 2.2.1 Construction-related Grading and Vegetation Management

Across flatter areas of the site, a mow and roll technique would be used to remove surface vegetation and keep root balls in place; vegetation would be mowed to within 6 inches of the ground surface with any stubs worked over with a roller. Across a majority of the site, grubbing and grading would be required to level rough or undulating areas of the site and to prepare soils for concrete foundations for substation equipment and inverters. Access road beds would also be grubbed, graded, and compacted. The site cut and fill would be approximately balanced; minimal import/export would be necessary.

#### 2.2.2 Erosion and Sediment Control and Pollution Prevention

A Stormwater Pollution Prevention Plan (SWPPP) or SWPPP-equivalent document would be prepared by a qualified engineer or erosion control specialist, and would be implemented before construction. The SWPPP would be designed to reduce potential impacts related to erosion and surface water quality during construction activities and throughout the life of the Project. It would include Project information and best management practices (BMPs). The BMPs would include dewatering procedures, stormwater runoff quality control measures, concrete waste management, stormwater detention, watering for dust control, and construction of perimeter silt fences, as needed.

If the Project implemented design measures to minimize grading, natural watercourses would be maintained across the site except along main access roadways, which would be graded, grubbed, recontoured, compacted, and graveled. Grading would only occur at road locations and at the substation location. Otherwise, only minimal vegetation trimming would be conducted using hand techniques, and only particularly tall vegetation would require trimming. Vegetation below 18 inches would not be trimmed or modified.

## 2.3 Construction Phase 2: Photovoltaic Module System

The structure supporting the PV module arrays would consist of steel piles (e.g., cylindrical pipes, H- beams, or similar), which would be driven into the soil using pneumatic techniques, similar to a hydraulic rock hammer attachment on the boom of a rubber-tired backhoe excavator. The piles typically are spaced 10 feet apart. For a single-axis tracking system, piles typically would be installed to a reveal height of approximately 4 feet above grade, while for a fixed-tilt system the reveal height would vary based on the racking configuration specified in the final design. For single-axis tracking systems, following pile installation the associated motors, torque tubes, and drivelines (if applicable) would be placed and secured. Some designs allow for PV modules to be secured directly to the torque tubes using appropriate module clamps. For some single-axis tracking systems and for all fixed-tilt systems, a galvanized metal racking system, which secures the PV modules to the installed foundations, would then be field-assembled and attached according to the manufacturer's guidelines.

The PV module system would be constructed roughly identically under both the proposed design and if alternative design elements are incorporated. The layout of 2 MW blocks under the proposed design as compared with 3 or 4 MW blocks under alternative design elements would not alter module installation methods. If the alternative resulting in larger block sizes is used, steel piles would be individually sized to allow for a uniform elevation of module rows; therefore, the duration of the pile installation step in the construction process may be slightly extended. Piles would be installed with a track-mounted pile driver. Typical pile drivers are configured with two 12- to 18-inch-wide tracks with a 4-foot space between the tracks.

## 2.4 Construction Phase 3: Inverters, Transformers, Substation and Electrical Collector

Underground cables to connect module strings would be installed using ordinary trenching techniques, which typically include a rubber-tired backhoe excavator or trencher. Wire depths would be in accordance with local, state, and federal requirements, and would likely be buried at a minimum of 18 inches below grade, by excavating a trench approximately 3 to 6 feet wide to accommodate the conduits or direct buried cables. After excavation, cable rated for direct burial or cables installed inside a polyvinyl chloride (PVC) conduit would be installed in the trench, and, the excavated soil would likely be used to fill the trench and lightly compressed. All cabling excavations would be to a maximum depth of 10 feet.

All electrical inverters and the transformer would be placed on concrete foundation structures or steel skids. In lieu of steel skids or pre-cast concrete foundations, foundations for the transformer and inverter locations would be formed with plywood, and reinforced with structural rebar. Commissioning of equipment would include testing, calibration of equipment, and troubleshooting. The substation equipment, inverters, collector system, and PV array systems would be tested prior to commencement of commercial operations. Upon completion of successful testing, the equipment would be energized.

The substation areas would be excavated for the transformer equipment and control building foundation and oil containment area. The site area for the substations would be graded and compacted to an approximately level grade. Concrete pads would be constructed as foundations for substation equipment, and the remaining area would be graveled. Concrete for foundations would be brought on-site from a batching plant in Blythe or would be batched on-site as necessary.

If the design alternative to reduce trenching was used, trenching would not occur for cabling, and grading/compaction would not occur for inverter/transformer stations. The module strings will be connected from the exterior portion of each row and meet at the midpoint where the module strings will be connected to trunk cables. The trunk cables are DC cables that will connect with the module strings for each row as it leads towards the inverter. The trunk cables will be supported via a CAB system which typically has a hanger every 18 inches. The DC wiring will be transmitted via overhead wiring to the inverter.

AC and DC collector poles would be installed using an auger truck to drill the holes, forklifts to transport the poles, and a small skid steer to move the spoils. For each collector pole, a hole would be augered, the pole would be moved into position, and then the excavation would be backfilled with the spoils. Guy wires would be installed, as needed, to support the pole. There would be a single pass of wheeled (not tracked) vehicles overland using drive and crush to transport the equipment between pole locations.

All electrical inverters and the transformer will be placed on a skid that will be delivered to the site. The foundation of the inverter and transformer pad are to be driven piles, the quantity will be determined by the structural engineer based on the design of the skid. The piles allow for the least amount of disturbed soil. All DC, medium voltage, communication wiring can then be routed from the overhead poles through the void between the bottom of the skid and the ground. All medium voltage cables exiting the inverters will be carried via wooden utility poles.

### 2.5 Construction Site Stabilization and Restoration

Following the completion of major construction, the Project site would be revegetated for the operations phase pursuant to an approved Restoration Plan for site stabilization as well as to restore temporarily impacted areas outside of the final development footprint. Where necessary, native re-seeding or vertical mulching techniques would be used.

Should alternative design elements be used to minimize surface disturbance, site stabilization/restoration would be limited to cleaning up trash, performing weed control and management, and allowing native vegetation to continue to occupy the site.

### 2.6 Construction Schedule and Workforce

Construction equipment would operate between the hours of 7:00 a.m. and 7:00 p.m., Monday through Friday, for up to a maximum of 8 hours per piece of equipment, daily. Weekend construction work is not expected to be required, but may occur on occasion, depending on schedule considerations.

Pre-construction activities would commence in the third quarter of 2020, with desert tortoise clearance surveys being conducted in September of 2020. Construction activities would commence in the fourth quarter of 2020, and would be expected to be complete by December of 2022.

Preliminary construction phasing would be as follows:

- Pre-construction Activities, including desert tortoise fence installation, geotechnical work, and UXO investigation: approximately 16 weeks
- Phase 1, Site Preparation: approximately 16 weeks
- Phase 2, PV Module System Installation: approximately 48 weeks, overlapping with Phase 1 by approximately 12 weeks
- Phase 3, Installation of Inverters, Substations, and Connection: approximately 38 weeks, overlapping with Phase 2 by approximately 25 weeks.

| | **Construction Phase** | | |
|---|---|---|---|
| **Construction Element** | **Site Preparation** | **Photovoltaic Module System Installation** | **Installation of Inverters, Substation, and Connection** |
| SOLAR FACILITY | | | |
| Average Number of Workers | 251 | 320 | 62 |
| Maximum Number of Workers | 334 | 427 | 82 |
| Length of Phase (work days) | 78 | 232 | 116 |
| ENERGY STORAGE SYSTEM | | | |
| Average Number of Workers | 74 | 63 | 54 |
| Maximum Number of Workers | 98 | 84 | 71 |
| Length of Phase (work days) | 22 | 174 | 146 |

Incorporation of alternative design elements is not expected to materially alter the construction schedule or workforce.

## 2.7 Construction Access, Equipment, and Traffic

All materials for the Project's construction would be delivered by truck. The majority of truck traffic would occur on designated truck routes and major streets. Flatbed trailers and trucks would be used to transport construction equipment and construction materials to the site. Project components would be assembled on-site. Traffic resulting from construction activities would be temporary and could occur along area roadways as workers and materials are transported to and from the Project site. Materials deliveries during construction would travel up to 150 miles one way from source to the Project site.

The anticipated preliminary number of pieces of equipment for each construction phase of the solar facility is as follows:

| Phase I: Site Prep | | | | |
|---|---|---|---|---|
| **Equipment Description** | **No. of Units** | **Total Work Days Per Unit** | **Fuel Type** | **Daily Operation Per Unit (Hours)** |
| Pickup | 9 | 75 | Gasoline | 4 |
| Tractor/dozer | 66 | 78 | Diesel | 7 |
| Water Truck | 38 | 77 | Diesel | 4 |
| Grader | 5 | 16 | Diesel | 7 |
| Flatbed Truck | 16 | 76 | Diesel | 4 |
| Skid steer w auger/hoe | 10 | 75 | Diesel | 7 |
| FE Loader | 2 | 39 | Diesel | 7 |
| Roller, vibratory | 4 | 61 | Diesel | 7 |
| Backhoe | 1 | 0 | Diesel | 7 |
| Instrument Man | 9 | 75 | Diesel | 7 |
| Gravel Truck - 20 CY | 103 | 60 | Diesel | 4 |
| **Phase 2: PV System Installation** | | | | |
| **Equipment Description** | **No. of Units** | **Total Work Days Per Unit** | **Fuel Type** | **Daily Operation Per Unit (Hours)** |
| Water Truck | 7 | 179 | Diesel | 4 |
| Flatbed Truck | 60 | 232 | Diesel | 4 |
| Skid steer w auger/hoe | 7 | 179 | Diesel | 7 |
| Pile Driver | 7 | 179 | Diesel | 7 |
| Forklift | 20 | 234 | Diesel | 4 |
| Welder | 40 | 234 | Diesel | 4 |
| Trencher | 6 | 192 | Diesel | 4 |
| **Phase 3: Inverters Substation & Connection** | | | | |
| **Equipment Description** | **No. of Units** | **Total Work Days Per Unit** | **Fuel Type** | **Daily Operation Per Unit (Hours)** |
| Water Truck | 1 | 29 | Diesel | 4 |
| Skid steer w auger/hoe | 4 | 90 | Diesel | 7 |
| Pile Driver | 1 | 85 | Diesel | 7 |
| Trencher | 4 | 116 | Diesel | 4 |
| Backhoe | 2 | 82 | Diesel | 7 |
| Crane | 6 | 101 | Diesel | 4 |
| Aerial Lift | 8 | 93 | Diesel | 4 |
| Concrete Truck - 10 CY | 9 | 1 | Diesel | 4 |

| Phases 1-3 | | | |
|---|---|---|---|
| **Freight Trucks** | **No. of Trucks** | **Delivery Phase** | **Distribution** |

| | | | |
|---|---|---|---|
| Module Delivery | 1,614 | Between Site Prep & PV | 10 Trucks Per Day |
| Tracker Delivery | 1,867 | PV System Installation | 9 Trucks Per Day |
| Foundation Delivery | 1,957 | Between Site Prep & PV | 10 Trucks Per Day |
| Inverter Delivery | 145 | Between PV & Inverters | 2 Trucks Per Day |
| Water Deliveries - 10,000-gallon | 4,300 | All | 14 Trucks Per Day (max) |

**Energy Storage System On-Site Equipment and Vehicle Use**

**The exact timing of installation of the energy storage component is unknown, but is expected to overlap with construction of the final phase of the solar facility. Incorporation of alternative design elements would not affect the energy storage component of the Project. The anticipated preliminary number of pieces of equipment for the energy storage system should there be overlap with each construction phase is shown below.**

| Equipment | Estimated Usage | | |
|---|---|---|---|
| | **Units** | **Hours/Day** | **Total Days Per Unit** |
| **Phase 1: Site Preparation** | | | |
| Pickup | 8 | 4 | 22 |
| Bulldozers | 16 | 7 | 22 |
| Water Trucks | 14 | 4 | 22 |
| Graders | 6 | 7 | 21 |
| Flatbeds | 3 | 4 | 18 |
| Skid Steers | 1 | 7 | 12 |
| Front End Loaders | 5 | 7 | 20 |
| Roller Compactor | 5 | 7 | 20 |
| Instrument | 8 | 7 | 22 |
| Gravel Trucks | 161 | 4 | 22 |
| **Phase 2: Photovoltaic Module System Installation** | | | |
| Pickup | 3 | 4 | 102 |
| Water Trucks | 3 | 4 | 102 |
| Skid Steers | 3 | 7 | 102 |
| Trenchers | 2 | 4 | 74 |
| Crane | 3 | 4 | 170 |
| **Phase 3: Installation of Inverters, Substation & Connection** | | | |
| Skid Steer | 2 | 7 | 64 |
| Pile Drivers | 2 | 7 | 64 |
| Trenchers | 7 | 4 | 146 |
| Backhoes | 3 | 7 | 47 |

| Equipment | Estimated Usage | | |
|---|---|---|---|
| | Units | Hours/Day | Total Days Per Unit |
| Cranes | 3 | 4 | 121 |
| Aerial Lifts | 2 | 4 | 70 |
| Concrete Trucks | 3 | 4 | 1 |

### 2.8 Post-Construction Cleanup

Construction sites would be kept in an orderly condition throughout the construction period by using approved enclosed refuse containers. All refuse and trash would be removed from the site and disposed of in accordance with BLM and other applicable regulations. No open burning of construction trash would occur.

All vegetation that may interfere with equipment would be trimmed and removed using manual non- mechanical means or sprayed with a BLM-approved herbicide, as necessary.

Based on the aridity of the Project area and the overall low densities of vegetation present, it is not likely that vegetation would encroach upon structures so that access would become impaired. However, noxious weeds and other nonnative invasive plant species could create a fire hazard if allowed to become established, and invasive weeds could also become problematic from an ecological perspective. Therefore, weed control activities would be implemented within the Project limits.

Weed control activities would include both non-mechanical and herbicide control methods. Manual non-mechanical means of vegetation management would be limited to the use of hand-operated power tools and hand tools to cut, clear, or prune herbaceous and woody species. Hand-operated tools such as hoes, shovels, and hand saws could be used under the program, as well as hand-pulling of plants. Mechanical control activities, such as chaining, disking, grubbing, and mowing using tractors or other heavy equipment may also be used as necessary.

Herbicide control would involve the use of BLM-approved herbicides to control weed populations when manual control methods are not successful in managing the spread of invasive plants. All weed control using herbicides and adjuvants would be conducted in compliance with California BLM-approved chemicals (including manufacturer application rates and use) as identified in the BLM's 2007 Programmatic EIS for Vegetation Management Using Herbicides and updated in Information Bulletin No. 2012-022 (December 2011). The process for treatments would be characterized in a Weed Management Plan followed by a Pesticide Use Proposal (PUP) for specific chemical treatments, both approved by the BLM. Additional information on the proposed weed treatment approach can be found in Attachment 1.

The processes for post-construction cleanup and weed control for Design Alternative would be similar to the processes described above.

## 3.0 Operations and Maintenance Activities

The solar modules at the site would operate during daylight 7 days a week, 365 days a year. Operational activities would include solar module washing; vegetation, weed, and pest management; and security. Security staff will respond to automated electronic alerts based on monitored data, including actual versus expected tolerances for system output and other key performance metrics; and communicate with customers, transmission system operators, and other entities involved in facility operations.

### 3.1 Operations and Maintenance Workforce

Up to 10 permanent staff could be on the site at any one time for ongoing facility maintenance and repairs if the entire site is operated as a single unit. Alternatively, approximately two permanent staff and eight Project operators would be located off-site and would be on call to respond to alerts generated by the monitoring equipment at the Project site. Intermittently, up to 25 workers could be required on-site if repairs or replacement of equipment were needed in addition to module washing. A record of inspections would be kept on-site. The duration of scheduled maintenance activities would vary in accordance with the required task, but could involve up to 40 workers full-time for up to two weeks up to four times a year for module washing, and a similar number and duration for workers regularly visiting the site for routine maintenance activities. In addition, a biological resources monitor would accompany any ground disturbing activities required during operations and maintenance. The maximum number of staff on-site at any time would be 50 (40 temporary staff and 10 permanent staff). The personnel and time required for emergency maintenance would vary in accordance with the necessary response.

### 3.2 Site Maintenance

The Project site maintenance program would be largely conducted on-site during daytime hours. Equipment repairs could take place in the early morning or evening when the Project would be producing the least amount of energy. Key program elements would include maintenance activities originating from the on-site O&M facility.

Maintenance typically would include module repairs; module washing; maintenance of transformers, inverters, and other electrical equipment as needed; and road and fence repairs. Weed management also would be performed in accordance with an approved Weed Management Plan and PUP.

On-site vegetation would be managed to ensure access to all areas of the site and to screen Project elements as needed. Solar modules would be washed as needed (up to four times each year) using light utility vehicles with tow-behind water trailers, as needed, to maintain optimal electricity production. No chemical cleaners would be used for module washing.

## 4.0 Decommissioning

The Applicant is expected to receive authorizations and permits with more than 30-year terms. At the end of the term, including any extensions, the Project would cease operation. At that time, the facilities would be decommissioned and dismantled and the site restored. Decommissioning activities would require approximately 9,883 truck trips, a workforce of approximately 320 workers, and would take approximately 17 months to complete. Upon decommissioning, the Project site could be converted to other uses in accordance with applicable land use regulations in effect at that time.

It is anticipated that during Project decommissioning, Project structures would be removed from the ground on the Project sites. Aboveground and any underground equipment would be removed including module posts and support structures, gen-tie poles that are not shared with third parties and the overhead collection system within the Project sites, inverters, transformers, electrical wiring, equipment on the inverter pads, and related equipment and concrete pads, and any O&M facilities and related equipment and infrastructure. The substation would be removed if it is owned by the Project operator, however if a public or private utility assumes ownership of the substation, the substation may remain onsite to be used as part of the utility service to supply other applications.

Equipment would be de-energized prior to removal. Equipment would be shipped offsite by truck (after first being placed in secure transport enclosures as necessary) to be salvaged, recycled or disposed of at an appropriately licensed disposal facility. Removal of the solar modules would include disassembly and removal of the racks on which the solar modules are attached, and removal of the structures supporting the racks, and their placement in secure transport enclosures and a trailer for storage; the racks and structures supporting the racks would then be recycled or disposed of at an appropriately licensed disposal facility. Solar modules would be removed from the site and either transported to another solar electrical generating facility or a recycling facility, or disposed of at an appropriately licensed disposal facility. In conjunction with any solar modules which may be transported to another solar electrical generating facility, such solar modules may undergo a refurbishing process to extend their estimated 30-year lifespan. The demolition debris and removed equipment may be cut or dismantled into pieces to be safely lifted or carried with the equipment being used. The fence and gates would be removed and all materials would be recycled to the extent feasible. It is anticipated the Project roads would be restored to their pre-construction condition unless the landowner elects to retain the improved roads for access throughout that landowner's property. The area would be thoroughly cleaned and all debris removed. As discussed above, most materials would be recycled to the extent feasible, with minimal disposal to occur in landfills in compliance with all applicable laws.

## ATTACHMENT 1

Herbicide control would involve the use of BLM-approved herbicides to control weed populations when manual control methods are not successful in managing the spread of invasive plants. All weed control using herbicides and adjuvants would be conducted in compliance with California BLM-approved chemicals (including manufacturer application rates and use) as identified in the BLM's 2007 PEIS for vegetation management using herbicides (BLM 2007) and updated in Information Bulletin No. 2012-022 (December 2011). The process for treatments would be characterized in a Weed Management Plan and supporting Pesticide Use Proposal approved by the BLM. Herbicides would likely be necessary to control the spread of invasive weeds following construction disturbance as part of an integrated pest management strategy. All components of the weed management approach would comply with the requirements of the Record of Decision for the 2007 Vegetation Treatments PEIS. Herbicide control would include the following:

- Use of Monsanto Corporation glyphosate products, including Roundup PRO® or AquaMaster® herbicides, with Roundup PRO applied in the upland portions of the ROW and AquaMaster (or similar formulations) applied in the potentially jurisdictional waters of the State or drainages.
- Triclopyr (Garlon®) from Dow Agrosciences may be used as an alternative treatment chemical if needed, and would be applied at the manufacturer's recommended typical application rate.
- Herbicide would be applied by hand from a backpack sprayer or a truck-mounted spray rig. The truck mounted spray rig would use individual lines that are applied by hand directly to individual plants and would not use a truck-mounted boom sprayer, or any broadcast type sprayer. Non-toxic dye would be added to the mixture to mark areas that have already been treated, thereby avoiding over-application.
- The maximum rate of application for Roundup would be 10.6 quarts per acre per year, and for AquaMaster would be 8 quarts per acre per year.
- The intended rate of application is 2% solution for Roundup and 1.5% solution for AquaMaster.
- The maximum rate of application for Garlon 4 would be 2 gallons per acre per year.
- The pound of active ingredient or acid equivalent would be 8 pounds per acre per year.
- Application dates would be intended to cover the entire period of the ROW grant, beginning during the construction phase, if needed.
- Treatments would be as needed, upon emergence of the target weed species during the growing season. Growing seasons are typically during the winter months (November to April), but may include the summer months (July to September) if summer rainfall is sufficient to germinate target weed species during those months.
- The total number of applications would depend on the extent of weed infestation within the disturbance area, but it is expected that three or more treatment efforts may be required per year. Treatment efforts may be defined as one round of complete coverage for the entire gen-tie ROW within BLM lands. Rainfall amounts would determine the number of treatment efforts that would be needed, but it is assumed that there would be weed control visits conducted no more than once a month during the winter/spring season. Based on these basic assumptions (three visits per year), there is the potential for approximately 105 annual treatments for the gen-tie ROW during a 35-year period.

- The primary nonnative species to be targeted are Saharan mustard (*Brassica tournefortii*), Russian thistle (*Salsola tragus*), Mediterranean grass (*Schismus barbatus*), and filaree (*Erodium* spp.). If additional nonnative plant species are identified during monitoring, these would also be targeted for control efforts.
- Crew members who conduct weed treatment in the Project area would have extensive experience working around sensitive habitats and species. In addition, crews would be monitored by a restoration ecologist and a desert tortoise monitor. Weed control would be specifically applied to individual plants and not sprayed broadly across the Project area.
- Crews would work under the direct supervision of a licensed Certified Pesticide Applicator.
- Crews would adhere to strict application guidelines when applying herbicide during wind to minimize drift and chemical contact with non-target vegetation or wildlife. Herbicide application would be suspended if winds are in excess of 6 miles per hour, or if precipitation is occurring or imminent (predicted within the next 24 hours).

  The chemical active ingredients chosen (glyphosate and triclopyr) have been identified for use due to low likelihood of toxicity to wildlife species, in particular Agassiz's desert tortoise, as analyzed in BLM's 2007 Vegetation Treatments PEIS. There is a potential for ingestion of recently treated plants, but an on-site restoration ecologist and tortoise monitors would minimize this risk. After treatment, the herbicide would dry rapidly in the desert environment and the risk would be further minimized.

Herbicide availability and formulations may change over time; therefore, the approach may be refined or modified to allow for use of the best available technologies and herbicide formulations. The PUP would be updated as appropriate to obtain necessary authorizations. Changes to chemicals are not expected to substantially change the analysis of herbicide use by the Project.

# Appendix B

## 2016/2017 Survey Dates and Personnel for the RE Crimson Project

## 2016/2017 SURVEY DATES AND PERSONNEL FOR THE RE CRIMSON PROJECT

| Date | Survey Personnel[1] |
|---|---|
| **2016 Botany Surveys** | |
| March 20, 2016 | SAM, JLO, JGO, MBI, RME, KWE, CCD |
| March 21, 2016 | SAM, JLO, JGO, MBI, RME, KWE, CCD, SHI |
| Marsh 22, 2016 | SAM, JLO, JGO, MBI, RME, KWE, SHI |
| March 23, 2016 | SAM, JLO, JGO, MBI, RME, KWE, SHI |
| March 24, 2016 | SAM, JLO, JGO, MBI, RME, KWE, SHI |
| **2017 Botany Surveys** | |
| April 24, 2017 | SAM, CHA, SHI, HCK |
| April 25, 2017 | SAM, CHA, SHI, HCK |
| April 26, 2017 | SAM, CHA, SHI, HCK |
| April 27, 2017 | SAM, CHA, SHI, HCK |
| **Jurisdictional Waters** | |
| August 15, 2016 | SAM, JBE, BFE, AFO |
| August 16, 2016 | SAM, JBE, BFE, AFO |
| August 17, 2016 | SAM, JBE, BFE, AFO |
| August 18, 2916 | SAM, JBE, BFE, AFO |
| **Desert Tortoise Surveys** | |
| October 3, 2016 | AFI, EFR, SAM, JPA, TSU, MZE, JBE, BHE |
| October 4, 2016 | AFI, EFR, SAM, JPA, TSU, MZE, JBE, BHE |
| October 5, 2016 | AFI, EFR, SAM, JPA, TSU, MZE, JBE, BHE |
| October 6, 2016 | AFI, EFR, SAM, JPA, TSU, MZE, JBE, BHE |
| October 7, 2016 | AFI, EFR, SAM, JPA, TSU, MZE, JBE, BHE |
| October 10, 2016 | AFI, EFR, SAM, JPA, TSU, MZE, JBE, BHE |
| October 11, 2016 | AFI, EFR, SAM, JPA, TSU, MZE, JBE, BHE |
| October 12, 2016 | AFI, EFR, SAM, JPA, TSU, MZE, JBE, BHE |
| October 13, 2016 | AFI, EFR, SAM, JPA, TSU, MZE, JBE, BHE |
| October 14, 2016 | AFI, EFR, SAM, JPA, TSU, MZE, JBE, BHE |
| October 17, 2016 | AFI, EFR, SAM, JPA, TSU, MZE, BHE |
| October 18, 2016 | AFI, EFR, SAM, JPA, TSU, MZE, BHE |
| October 19, 2016 | AFI, EFR SAM, MZE, BHE |
| **Avian Surveys** | |
| July 20-21, 2016 | EFR, RBA, JMC, RCO |
| July 26-27, 2016 | EFR, RBA, JMC, RCO |
| August 4-5, 2016 | BMU, RCO, JMC, RBA |
| August 9-10, 2016 | EFR, JMC, RCO, RBA |
| August 17-18, 2016 | BMU, JMC, RCO, RBA |
| August 24-25, 2016 | BMU, RCO, EFR, JMC |
| August 30-31, 2016 | JMC, RCO, RBA, SAM |
| September 7, 2016 | EFR, RCO, TSU, SAM |
| September 8, 2016 | EFR, RCO, TSU |
| September 14-15, 2016 | EFR, JMC, RCO, SAM |
| September 21-22, 2016 | BMU, EFR, RCO, SAM |

## 2016/2017 SURVEY DATES AND PERSONNEL FOR THE RE CRIMSON PROJECT

| Date | Survey Personnel[1] |
|---|---|
| September 28-29, 2016 | BMU, EFR, RBA, RCO |
| October 5, 2016 | BMU, JMC |
| October 6-7, 2016 | BMU, JMC, RCO |
| October 12-13, 2016 | BMU, JMC, RCO |
| October 14, 2016 | RCO, EFR |
| October 17, 2016 | BMU |
| October 18, 2016 | RBA, RCO |
| October 19, 2016 | BMU, RCO, RBA |
| October 20, 2016 | RBA, RCO |
| October 26-27, 2016 | BMU, JMC, EFR, RBA |
| November 2-3, 2016 | BMU, JMC, EFR, RCO |
| November 9-11, 2016 | RCO, RBA, SAM, TSU |
| November 15-16, 2016 | BMU, JMC, RCO, RBA |
| November 30, 2016 | BMU, JMC |
| December 1, 2016 | BMU, JMC |
| December 15-16, 2016 | BMU, JMC |
| December 28-29, 2016 | BMU, RBA |
| January 10-11, 2017 | BMU, JMC |
| January 24-25, 2017 | JMC, EFR |
| February 7-10, 2017 | BMU, EFR |
| February 14-17, 2017 | BMU, JMC |
| February 20-23, 2017 | EFR, RBA |
| February 28, 2017 | RBA, RCO |
| March 1-3, 2017 | RBA, RCO |
| March 4, 2017 | JMC |
| March 7-10, 2017 | BMU, JMC |
| March 14-17, 2017 | SAM, RCO |
| March 21-24, 2017 | EFR, RBA |
| March 28-31, 2017 | EFR, RCO |
| April 4-8, 2017 | RBA, SAM |
| April 11-14, 2017 | JMC, SAM |
| April 18-20, 2017 | AFI, SAM |
| April 21, 2017 | AFI |
| April 25-28, 2017 | EFR, TSU |
| April 30-May 1, 2017 | AFI |
| May 2-3, 2017 | AFI, SAM |
| May 4-5, 2017 | SAM |
| May 9-12, 2017 | RBA, RCO |
| May 16-19, 2017 | RBA, RCO |
| May 23-26, 2017 | RCO, SAM |
| May 30-31, 2017 | AFI, RCO |
| June 7-8, 2017 | RBA, SAM |
| June 20-21, 2017 | BMU, JMC |
| June 21-22, 2017 | RBA, TSU |

## 2016/2017 SURVEY DATES AND PERSONNEL FOR THE RE CRIMSON PROJECT

| Date | Survey Personnel[1] |
|---|---|
| July 6-7, 2017 | BMU, JMC |
| July 18-19, 2017 | EFR, RBA |
| **Burrowing Owl Surveys** | |
| May 15-19, 2017 | BHE, SAM, SHI, MPR |
| May 22-26, 2017 | BHE, MAN, MZE, MDA |
| May 31-June 2, 2017 | BHE, SAM, RBA, MZE, RMA |
| **Bat Surveys** | |
| September 1, 2016 | JTO, SHI |
| September 20, 2016 | JTO |
| September 28, 2016 | SHI |
| November 1, 2016 | MZE |
| December 16, 2016 | SHI |
| January 10, 2017 | SHI |
| February 9, 2017 | SHI |
| March 10, 2017 | SHI |
| April 18, 2017 | SHI |
| May 31, 2017 | SHI |
| June 22, 2017 | SHI |
| July 28, 2017 | SHI |
| September 1, 2017 | SHI |

[1] AFI: Andrew Fisher; AFO: Alix Fowler; BFE: Brian Felten; BHE: Bonnie Hendricks; CCD: Carolyn Chainey-Davis; CHA: Chris Hargreaves; EFR: Emma Fraser; HCK: Huang-Chi Kuo; JBE: Joseph Betzler; JGE: Jennifer George; JLO: Julie Love; JPA: John Parent; JTO: Justin Tortosa; KWE: Karen Weber; MBI: Mark Bibbo; MDA: Minh Dao; MPR: Mandy Proudman; MZE: Mike Zerwekh; RBA: Rick Bailey; RCO: Rob Conahan; RMA: Rachel MacNutt; RME: Ryan Meszaros; SAM: Sundeep Amin; SHI: Stephanie Hines; and TSU: Tom Sullivan

# Appendix C

## 2016 Desert Tortoise Biologists' Resumes

# Sundeep Amin

**Senior Biologist**

## Education

BS, Ecology, Behavior, and Evolution, University of California, San Diego, 1998

## Licenses/Registrations

California Department of Fish and Game (CDFG) Scientific Collectors Permit #SC-009178
CDFG Rare, Threatened, and Endangered Plant Voucher Collecting Permit #09012.
Level 2 Blunt-nosed Leopard Lizard (Gambelia sila) surveyor.
Authorized Flat-tail Horned Lizard (Phrynosoma mcallii) surveyor.
Authorized Desert Tortoise (Gopherus agassizii) Monitor

## Years of Experience

| | |
|---|---|
| With AECOM | 6 |
| With Other Firms | 5 |

## Professional Associations

California Native Plant Society, Member
Society for Ecological Restoration, California, Member
Southern California Botanists, Member
Wildlife Society, Member

## Training and Certifications

Flat-tailed horned lizard Identification Training by the BLM (2008)
Desert Tortoise Handling Workshop by Desert Tortoise Council (2007)

Sundeep Amin is a senior biologist with over ten years of professional experience working as a biologist, restoration ecologist, environmental compliance specialist, project manager, and/or project crew supervisor on a variety of projects throughout Southern and Central California, including projects in Nevada and Arizona. His main areas of expertise include habitat restoration, biological constraints analyses, and leading and conducting sensitive species surveys (floral and faunal). Mr. Amin is also experienced in mitigation monitoring, botanical surveys, jurisdictional delineations, technical report writing, client/agency interaction, and project management. He has worked on projects for a variety of clients including all branches of the military, private developers, private energy clients, utility companies, and local, State, and Federal agencies. He is experienced with State and Federal regulations such as the California Environmental Quality Act (CEQA), National Environmental Policy Act (NEPA), Federal and California Endangered Species Acts (FESA and CESA), Migratory Bird Treaty Act (MBTA), Natural Community Conservation Plans (NCCP), and various state energy commission requirements.

## Experience

**Sonoran West Solar – Blythe, CA.:** Biologist tasked with preparing the Biological Technical Report for the project which included survey results for desert tortoise, Mojave fringe-toed lizard, burrowing owl, migratory birds, bat surveys, general wildlife surveys, vegetation mapping, and rare plants. Other tasks include conducting avian point count surveys and a jurisdictional delineation.

**Rio Mesa Solar AFC – Blythe, CA.:** Biologist responsible for organizing and leading a team of up to 16 biologists conducting protocol desert tortoise surveys, burrowing owl surveys, Mojave fringe-toe lizard surveys, and avian point counts over an approximately 11,000 acre site. Other tasks conducted included Couch's spadefoot toad surveys, vegetation mapping, jurisdictional delineation, construction monitoring, and report preparation.

**Calico Solar Project AFC – Barstow, CA.:** Biologist responsible for managing a team of 20 to 28 biologists conducting protocol desert tortoise surveys over approximately 20,000 acres of land of which the project site itself was 8,000 acres. A total of approximately 370 hours were spent conducting protocol desert tortoise surveys. Other tasks include data analysis and biological resources report preparation in support of an Application for Certification for a solar power plant project in San Bernardino County. Reports prepared include the biological technical report, a baseline biological report, a biological assessment, a raven management plan, and weed management plan. Other tasks included conducting a jurisdictional waters survey along a proposed transmission line, surveys for Mohave ground squirrel, burrowing owls, and rare plants on an 8,000-acre project site and 100-mile transmission line in the Mojave Desert.

**Imperial Valley Solar-Thermal Plant AFC – Imperial County, CA.:** Field biologist conducting rare plant and flat-tailed horned lizard surveys in support of an Application for Certification for an 800MW thermal generating facility covering 7,000 acres in Imperial County. Other tasks include data analysis and preparation of assorted documents including a raven management plan and weed management plan if support of the Application for Certification.

**Southern California Edison Devers to Palo Verde No. 2 Transmission Line Construction Project – Riverside County, CA.:** Biologist working as Field Contact Representative for the Devers to Valley portions of the transmission line. Duties included scheduling of biologists to monitor construction work, scheduling and writing of preconstruction biology surveys and survey reports, review and editing of daily monitoring forms in the FRED database program, client and agency coordination, presence in the field to guide and direct monitors, safety coordination, monitoring of Coachella Valley fringe-toe exclusion fence in modeled habitat, desert tortoise surveys, Mojave fringe-toe lizard surveys, and writing of notice to proceed requests for various components of the project, including the transmission line and construction yard.

**Kinder Morgan California-to-Nevada (Cal-Nev) Pipeline – Mojave Desert of California and Nevada:** Field biologist conducting desert tortoise presence/absence and rare plant surveys over portions of a 233-mile fuel pipeline project from Colton, CA to Las Vegas, NV. A total of approximately 156 hours were spent conducting focused desert tortoise surveys. Other duties included leading desert tortoise survey crews, assisting with least Bell's vireo surveys, assisting with jurisdictional delineations, investigating potential other potentially jurisdictional waters along the entire pipeline length, and assisting with preparation of associated technical documents.

**Nextlight Fort Mojave Solar – Laughlin, NV.:** Biologist conducting preliminary special status species habitat assessments of a potential solar site and associated transmission line in the Eastern Mojave Desert. Potential habitat for desert tortoise, burrowing owl, southwestern willow flycatcher, Bell's vireo, other riparian bird species, and rare plants was identified during the reconnaissance surveys.

**Ausra Solar Thermal Energy Project AFC – San Luis Obispo County, CA.:** Field biologist/crew leader conducting focused presence/absence surveys for adult and juvenile blunt-nosed leopard lizards over roughly two (2) square miles of fallow agricultural land near the Carrizo Plains. Surveys are in support of an Application for Certification for an 180MW thermal generating facility located within San Luis Obispo County.

**Carrizo Valley Solar Reserve AFC – San Luis Obispo County, CA.:** Field biologist/blunt-nosed leopard lizard (BNLL) Level 2 crew leader conducting focused presence/absence surveys for adult BNLL over multiple sections of agricultural land in support of an Application for Certification for an alternative energy project near the Carrizo Plains in San Luis Obispo County.

**Soda Mountain Solar– Mojave Desert, California:** Field biologist conducting desert tortoise and rare plant surveys in support of solar energy project in the Mojave Desert, east of Barstow, California. A total of approximately 20 hours were spent conducting focused desert tortoise surveys.

**California City – California City, CA.:** Biologist performing desert tortoise presence/absence and zones of influence surveys on three sections of land in the California City area. A total of approximately 74 hours were spent conducting focused desert tortoise surveys. Other work included habitat assessments for rare plants that may potentially occur on-site and blooming season rare plant surveys.

**San Joaquin Solar Hybrid AFC – Coalinga CA.:** Field biologist/Level 2 crew leader conducting focused presence/absence surveys for adult and juvenile blunt-nosed leopard lizards and small mammal trapping through two proposed transmission line routes in support of an Application for Certification for a solar thermal and bio-fuels hybrid power plant project in Fresno County.

**Dominion Energy Apollo Solar – Kings and Fresno Counties, CA.:** Environmental compliance manager responsible for overseeing the permit compliance of three 200 acre, 20 megawatt photovoltaic solar sites in Kings and Fresno Counties. Primary duties included oversight of the EPC subcontractor in relation to compliance of mitigation measures as set forth in project specific conditional use permits (CUPs). Specific issues addressed include environmental reporting, governmental/agency coordination, dust control and SWPPP compliance, spill reporting/documentation, nesting bird issues, and burrow monitoring/excavation as San Joaquin kit fox mitigation.

**San Manuel General Plan – San Manuel, AZ.:** Biologist working as part of a team to map the vegetation of over 25,000 acres of various Sonoran Desert habitat, including the identification of potentially jurisdictional water features for later assessment. Other duties included writing sections of a long-term river management plan to address issues with the x mile portion of the San Manuel River that crosses the site. The work was commissioned by BHP Billiton in anticipation of the closing of the local copper mine, and subsequent sale of land to expand the town of San Manuel, Arizona.

**California High Speed Train Botanical Surveys – Bakersfield to Palmdale route, CA.:** Biologist serving as a technical expert for a large team of biologists conducting botanical surveys of the proposed high speed train route from Bakersfield to Palmdale.

**California High Speed Train Wetland Delineation – Fresno to Bakersfield route, CA.:** Biologist serving as a technical expert for a large team of biologists conducting a preliminary wetland/jurisdictional delineation of the proposed high speed train route from Fresno to Bakersfield.

# Andrew Fisher
## Wildlife Biologist

4929 Vance Drive
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(619) 937-1086
mzeesamaki@gmail.com

**Current Employer and Supervisor**
AECOM Technology Inc.
700 G Street, Suite 500
Anchorage, AK 99501
Erin Riley (619) 610-7643 Erin.Riley@aecom.com (permission to contact)

**Education**
BS, Wildlife, Fish, and Conservation Biology, University of California, Davis, 2006

**Training**
Wildlife Trailing Workshop, San Diego Tracking Team, 2007
California Fairy Shrimp Identification Course and Practical Exam for all Species of Fairy Shrimp in California, University of California, Davis, 2007
Flat-tailed Horned Lizard Worksop, BLM, 2008
Southwestern Willow Flycatcher Workshop, Southern Sierra Research Station, 2008
Bat Ecology and Field Techniques Workshop, The Wildlife Society, Western Section, 2008
**Desert Tortoise Council Workshop on Surveying, Monitoring, and Handling Techniques for Desert Tortoise, Ridgecrest, CA 2009**
Quino Checkerspot Butterfly Identification Test, USFWS, 2011
Remote Wildlife Camera Techniques Workshop, The Wildlife Society, 2011
Western Yellow-billed Cuckoo Survey Protocol Workshop, Blythe, CA 2014

**Certification**
10(a)(1)(A) Endangered Species Permit TE 820658 for:
- Coastal California gnatcatcher
- Listed vernal pool branchiopods
- Quino checkerspot butterfly
- Southwestern willow flycatcher

California Department of Fish and Wildlife (CDFW) Authorization for Flat-tailed Horned Lizard Surveys
CDFW Scientific Collecting Permit 9746
CPR Certification

**Professional Affiliations**
Member, East African Wildlife Society
Member, The Wildlife Society-Western Section
Member, Wildlife Research Institute

**Presentations**
Distribution of Least Bell's Vireo in Border Field State Park, ESRI International User Conference, 2009

**Volunteer Organizations**
Wildlife Research Institute, golden eagle banding in San Diego County 2008–2011
Wildlife Research Institute, raptor migration surveys, golden eagle trapping and banding, Rodgers Pass, Montana, Oct 2010 and 2011
Cabrillo National Monument, Monitoring Avian Productivity and Survival, songbird banding 2008–2010
National Park Service, Santa Rosa and Santa Cruz Islands, spring loggerhead shrike surveys 2009–2010
Institute for Wildlife Studies, San Clemente Island, spring loggerhead shrike surveys, 2009, 2010, 2011

Andrew Fisher has 10 years of experience as a professional wildlife biologist in California and Alaska. Skills include biological surveys for California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) documentation, avian identification, herp and small mammal surveys, fish surveys, mist netting and bird banding, wildlife movement surveys (roadkill and remote camera surveys), wildlife habitat assessments, biological monitoring, global positioning system data gathering and processing, photo documentation, wildlife tracking and trailing, large mammal radiotelemetry, and raptor rehabilitation. He conducts and assists with federally listed wildlife species surveys for the following species: listed vernal pool branchiopods, Quino checkerspot butterfly (*Euphydryas editha quino*), arroyo toad (*Anaxyrus californicus*), desert tortoise (*Gopherus agassizii*), least Bell's vireo (*Vireo bellii pusillus*), southwestern willow flycatcher (*Empidonax traillii extimus*), coastal California gnatcatcher (*Polioptila californica californica*), Pacific pocket mouse (*Perognathus longimembris pacificus*), and Stephens' kangaroo rat (*Dipodomys stephensi*). He also conducts surveys for state species of special concern. He has also worked implementing human/wildlife conflict resolution measures in Kenya.

### Desert Tortoise Experience

**InterConnect Towers LLC, Multiple Communication Cell Towers, San Bernardino County, CA**
As a project biologist he conducted pre-construction surveys for **desert tortoise** along the access road and proposed cell tower site. A total of 4 desert tortoise were found (none were handled) with multiple burrows and scat. Around 18 hours of surveys and 12 miles were covered. [04/2014]

**Beacon Solar, LLC, Beacon Solar Project, Kern County, CA**
As a project biologist he conducted pre-construction **desert tortoise** and nesting bird clearance surveys ahead of construction crews. Around 16 hours of surveys and 20 miles were covered. [03/2014]

**NextEra Energy, LLC, Genesis Solar Power Project, San Bernardino County, CA**
As an approved project biologist he conducted pre-construction nesting bird, burrowing owl, **desert tortoise** , Couch's spadefoot toad (*Scaphiopus couchii*), and other biological surveys for construction of a large-scale solar

thermal power project in the Colorado Desert. He conducted desert tortoise fence inspections, conducted pre-clearance surveys ahead of crews, and monitored construction crews when outside of tortoise fencing. Many miles were walked around the outside of the desert tortoise fence and while conducting pre-construction surveys. [04/2012-05/2014]

**Abengoa Solar, LLC, Mojave Solar Power Project, Mojave Desert, San Bernardino County, CA**
As an approved project biologist, he conducted per-clearance **desert tortoise** and nesting bird surveys ahead of ground-moving activities during project construction. Multiple desert tortoises were observed along with multiple burrows and scat in offsite habitat that was being considered as a mitigation site. He walked many miles looking for tortoises ahead of construction crews and while assessing offsite mitigation areas.

Additionally he conducted winter raptor and common raven (*Corvus corax*) surveys for pre-construction baseline survey data for a large solar power project. He organized and conducted winter golden eagle (*Aquila chrysaetos*) surveys using carcasses and wildlife cameras to estimate the abundance of wintering golden eagles on the project site and an 10-mile buffer. [12/2007-05/2012]

**Blythe Solar Power Project, Mojave Desert, CA**
As one of the project biologists he conducted focused **desert tortoise** surveys for multiple components of a large-scale desert solar project. This included surveys of the proposed desert tortoise relocation site, and clearance surveys for specific project components. He walked over 30 miles of transects looking for desert tortoise as part of assessing a relocation site, and conducting pre-construction clearance surveys. [2008-2010]

## Other Project Experience

**Alaska Liquefied Natural Gas (LNG) Pipeline Project, State of Alaska, AK**
Current duties include overseeing field crews, conducting safety meetings, serving as the liaison between management and field crew, and facilitating data collection and transmission. In 2015, he served as the geographic information specialist on the fish crew conducting fish surveys along the entire project corridor from Nikiski to Point Thompson to document the presence/absence of anadromous fish species in streams that cross the project right-of-way. He guided the fish crew to remote areas, coordinated with helicopter pilots to locate survey locations, and ensured data quality. [06/2015-Present]

**Escondido Creek and Sycamore Canyon Preserves, California Department of Parks and Recreation, San Diego County, CA**
As one of the lead wildlife biologists he is currently conducting a wildlife inventory survey on two preserves. This includes surveys via drift fences and funnel traps for herpetofauna species as well as small mammal trapping. [03/2016-Present]

**Pine Tree Wind Farm, Los Angeles Department of Water and Power, Kern County, CA**
As one of the field biologists he conducted raptor surveys as part of an independent third party assessment of a BirdsVision WindSafeFlight System to detect and deter avian targets from collisions with wind turbines. He is currently writing up the findings in a scientific paper. [10/2014-Present]

**Naval Facilities Engineering Command (NAVFAC), Natural Resources Inventory for Remote Training Site Warner Spring and Camp Michael Monsoor, San Diego County, CA**
As one of the lead wildlife biologists he conducted wildlife surveys using small mammal traps, herpetofauna funnel traps, fish traps and seines, remote sensing wildlife cameras, and visual encounter surveys to catalogue the wildlife species on two Naval bases in eastern San Diego County. He also conducted surveys for the Quino Checkerspot Butterfly and assisted with writing the natural resource inventory report. [01/2014-06/2015]

**NAVFAC, 41 Area Landing Zone Relocation Project, MCB Camp Pendleton, San Diego County, CA**
As the lead wildlife biologist he is conducting listed vernal pool branchiopod and coastal California gnatcatcher surveys for the relocation of a landing zone in the 41 Area of MCB Camp Pendleton. [11/2013-Present]

**San Diego Gas and Electric (SDG&E), Transmission Line 695 Wildlife Studies, Marine Corps Base (MCB) Camp Pendleton, San Diego County, CA**
As lead project biologist he conducted a habitat assessment, and then protocol breeding season surveys for the coastal California gnatcatcher along the 9-mile long corridor. Winter burrowing owl surveys are currently being conducted. [08/2014-06/2015]

**California Department of Transportation (Caltrans), State Route 76 Middle Expansion Project Biological Surveys, San Diego County, CA**
As lead field wildlife biologist he installed wildlife camera stations at wildlife undercrossings to understand the use of newly installed wildlife undercrossings by various wildlife species. This was coupled with roadkill surveys to determine the efficiency of wildlife directional fencing along a newly aligned section of State Route 76. [06/2013-06/2015]

**NAVFAC, Wildlife Studies and NEPA Documentation for the Naval Base Coronado Coastal Campus Environmental Impact Statement, Naval Base Coronado, San Diego, CA**
As lead wildlife biologist, conducted biological surveys in support of environmental documentation. Conducted 1 year

of avian surveys (using bird point counts and transects) and protocol Pacific pocket mouse surveys, and assisted with bat surveys. Was the primary author for the biological resources sections for the environmental impact statement and biological assessment. Met with US Fish and Wildlife Service and Navy representatives to discuss biological surveys. [11/2011-12/2014]

**U.S. Army Corps of Engineers, Santa Ana Nonnative Vegetation Removal Project, Orange County, CA**
As biologist he conducted focused protocol-level surveys for least Bell's vireo and southwestern willow flycatcher as part of a 5-year study to measure the effects of invasive nonnative vegetation removal within a 250-acre section of the Santa Ana River Valley on federally listed and resident bird species. Also conducted monthly bird use counts to determine avian use of the restored habitat throughout the year by resident and migrant species. [04/2010-7/2014]

**City of Escondido, Lake Wohlford Dam Replacement Project Wildlife Studies, Escondido, CA**
As lead wildlife biologist he conducted a detailed habitat assessment for various federally listed species that may be impacted by the creation of a new dam at Lake Wohlford. Upon completion of the habitat assessment, conducted protocol surveys for coastal California gnatcatcher, least Bell's vireo, and southwestern willow flycatcher. Documented findings in reports to the US Fish and Wildlife Service. [02/2013-8/2013]

**NAVFAC, Wildlife Studies for Naval Outlying Landing Field Imperial Beach Perimeter Fence Replacement Project, Naval Base Coronado, San Diego, CA**
As lead wildlife biologist he conducted protocol wet and dry season listed vernal pool branchiopod surveys and assisted with light-footed Ridgway's rail surveys (*Rallus obsoletus*). He wrote various biological reports and NEPA documents. [12/2012-8/2013]

**NAVFAC, Wildlife Studies for Marine Corps Special Operations Command Expansion Project, MCB Camp Pendleton, CA**
As lead wildlife biologist he conducted protocol wet- and dry-season listed vernal pool branchiopod surveys and coastal California gnatcatcher surveys, and assisted with surveys for Pacific pocket mouse. Wrote various biological reports and interacted between the US Fish and Wildlife Service and the Navy. [11/2012-8/2013]

**NAVFAC, Wildlife Surveys for Continuing Environmental Review Studies for Basewide Utility Infrastructure Improvements, MCB Camp Pendleton, CA**
As biologist he conducted habitat assessments and presence/absence surveys for coastal California gnatcatcher and listed vernal pool branchiopods throughout MCB Camp Pendleton as part of continuing environmental review studies. Drafted habitat assessment documents and biological assessments, and been involved in meetings with NAVFAC and MCB Camp Pendleton staff to ensure project success. [11/2011-07/2012]

**NAVFAC, Listed Vernal Pool Branchiopod Surveys for the San Onofre Lease Area Vernal Pool Mesa Conservation Plan, MCB Camp Pendleton, CA**
As biologist he conducted biological surveys for listed vernal pool branchiopods in support of environmental documentation for a conservation plan. Lead biologist for vernal pool surveys and involved in the reporting to help determine mitigation locations for impacts from various other projects on MCB Camp Pendleton. [11/2011-7/2012]

**IID, Burrowing Owl Surveys, Imperial County, CA**
As biologist he was responsible for field crew coordination, data management, and surveys across the Imperial Valley within IID's right-of-way. Led the field effort for 16 biologists to survey randomly selected 3- by 3-kilometer grids in a double independent observer methodology. [04/2011-06/2012]

**NAVFAC, Wildlife Surveys for Basewide Water Improvements and Stuart Mesa Bridge Replacement Project, MCB Camp Pendleton, CA**
As biologist he conducted habitat assessments and presence/absence surveys for coastal California gnatcatcher and listed vernal pool branchiopods (San Diego fairy shrimp and Riverside fairy shrimp) throughout the MCB Camp Pendleton. Also conducted habitat assessments and surveys for other threatened and endangered species, including surveys for Pacific pocket mouse and Stephens' kangaroo rat. Wrote several sections in NEPA compliance documents. [03/2010-08/2012]

**California Department of Corrections and Rehabilitation, Lethal Electrified Fence Monitoring Project, San Diego, Imperial, San Bernardino, Kern, and Los Angeles Counties, CA**
As biologist he worked at various state correctional institutions to monitor lethal electrified fences for "take" of all vertebrate wildlife species. This included identifying carcasses of avian and mammalian species that contacted the lethal electrified fence and were killed. Identified carcasses to species as part of a take permit for the Department of Corrections and Rehabilitation. Conducted annual training for custody staff on how to collect, tag, and store carcasses that were found in and adjacent to the lethal electrified fence. [01/2009-11/2011]

**Invenergy, Shu'luuk Wind Project, San Diego County, CA**
As a project biologist he conducted bird use counts, bird area searches, and all-day raptor point counts with a focus on golden eagle to determine the seasonal use, abundance, and distribution of resident and migratory bird species as an indicator of potential impacts from a wind development project in eastern San Diego County. In addition, conducted

focused protocol-level surveys for arroyo toad, least Bell's vireo, and southwestern willow flycatcher, and assisted with nest surveys for raptors and other large avian species. Completed surveys with other biologists for the federally endangered Quino Checkerspot butterfly. [03/2009-10/2012]

**County of San Diego Department of Public Works, Wildcat Canyon Road Enhancement Project Before-After-Control-Impact Study – Pre-Construction, San Diego County, CA**
As biologist he assisted with a post-construction wildlife movement study for the Wildcat Canyon Road Enhancement Project Before-After-Control-Impact Study. The project involved defining current movement trends through the use of control vs. construction sample sites. The project was designed to identify movement patterns and focal species, and to establish baseline conditions for wildlife use of the project area to compare against post-construction data. Methods included conducting tracking station, camera station, tracking transect, and roadkill surveys. Roadkill surveys consisted of conducting meandering transects on either side of a section of Wildcat Canyon Road in search of wildlife that had been hit by vehicles and left in the road or thrown into adjacent vegetation. Surveys were conducted twice a month for three consecutive days for one year. Surveys were designed to capture spatial clusters of mortality and reduce scavenging bias. [07/2008-11/2009]

**California Department of Parks and Recreation, Border Field State Park Sediment Basin Restoration Project, San Diego County, CA**
As biologist he monitored least Bell's vireo populations via protocol surveys enhanced with spot-mapping techniques to delineate territories. Used ArcPad GIS software to complete spot-mapping surveys and spatially compare territories over 3 years. Conducted focused protocol surveys, and then analyzed results compared with vegetation success criteria. Presented results at a paper session at the 2009 ESRI International User Conference in San Diego. [04/2008-07/2008]

**NAVFAC, Wildlife Surveys for Basewide Utility Infrastructure Improvements Project, MCB Camp Pendleton, CA**
As biologist he conducted protocol surveys for federally listed wildlife species on MCB Camp Pendleton. Surveys for species included coastal California gnatcatcher, listed vernal pool branchiopods, Stephens' kangaroo rat, and Pacific pocket mouse. Was an integral part of drafting NEPA documentation (Environmental Impact Statements and Biological Assessments) for large projects. Involved in meetings with key project management staff and natural resource specialists on MCB Camp Pendleton to ensure project success. [02/2008 – 11/2012]

**NAVFAC, Wildlife Surveys for Grow-the Force and Basewide Utility Infrastructure Improvements Project, MCB Camp Pendleton, CA**
He conducted presence/absence surveys for coastal California gnatcatcher throughout MCB Camp Pendleton. Also conducted habitat assessments and surveys for other threatened and endangered species, including Pacific pocket mouse and Stephens' kangaroo rat. [02/2008-06/2010]

**NAVFAC, Basewide Vernal Pool Floral and Faunal Surveys, MCB Camp Pendleton, CA**
As biologist he conducted field collection of listed vernal pool branchiopod species in various training areas on MCB Camp Pendleton. Assisted with lab identification of Lindahl's fairy shrimp (*Branchinecta lindahli*), San Diego and Riverside fairy shrimp. Also assisted with entering and maintaining data collected during these surveys. [01/2008-07/2008]

**Los Angeles Department of Water and Power, Pine Canyon Wind Development Project, Kern County, CA**
As biologist he assisted in biological surveys in support of environmental documentation for a wind energy project in the foothills of the Sierra Nevada, south of Kings Canyon National Park and north of the city of Tehachapi. Conducted avian point count surveys and bat acoustic monitoring for a spring session and fall session. [04/2008-11/2008]

**Los Angeles County Sanitation Districts, Common Raven and Avian Point Count Surveys for Mesquite Regional Landfill Habitat Monitoring Plan, Imperial County, CA**
As biologist he conducted pre-construction baseline common raven surveys in the Sonoran Desert for a new regional landfill. Surveys included all-day bi-monthly surveys for a year at various points where common ravens may congregate (water and garbage locations) and at control points. This data was used to estimate pre-landfill common raven populations and daily trends. Also assisted in setting up and conducting avian point count surveys around the proposed landfill as part of a baseline wildlife study to compare avian population changes in the desert around the landfill. [10/2007-05/2008]

**Los Angeles County Sanitation Districts, Small Mammal Trapping, Mesquete Regional Landfill Habitat Monitoring Plan, Imperial County, CA**
As biologist he assisted in trapping, handling, processing, sexing, weighing, and toe-clipping various small mammal species in the Colorado Desert. Species included *Dipodomys merriami, Chaetodipus pencillatus, Chaetodipus baileyi, Chaetodipus spinatus,* and *Neotoma lepida intermedia.* Grids totaling 150 traps were trapped for three consecutive nights during a spring and fall trapping session. Handled over 100 small mammals during trapping. [10/2007-05/2008]

**Caltrans, State Route 76 East Expansion Project Biological Surveys, San Diego County, CA**
As project biologist he assisted with a pre-construction wildlife movement study for the expansion of State Route (SR) 76 using tracking stations, tracking transects, and

roadkill surveys. Roadkill surveys consisted of conducting meandering transects on either side of a section of SR-76 in search of wildlife that had been hit by vehicles and left in the road, or thrown into adjacent vegetation. Surveys were conducted twice a month for three consecutive days for one year. Surveys were designed to capture spatial clusters of mortality and reduce scavenging bias. [09/2007-09/2008]

**Project Experience Prior to AECOM**

**Biological Science Technician (GS05 at 40 hrs/wk), United States Fish and Wildlife Service, Carlsbad, CA**
Supervisor: Clark Winchell (760) 431-9440 (permission to contact)
As biological science technician he conducted point count surveys for coastal California gnatcatcher throughout San Diego County. Recoded weather measurements and used GPS to locate points and track routes. Hiked in rugged terrain and in remote areas to access survey points. Collected and analysed soil samples for texturing and bulk density. Familiar with plants of San Diego and conducted vegetation surveys throughout the county. Kept detailed field notes, entered scientific data into Access databases, performed quality assurance/quality control on data, and assisted in data presentation. [03/2007-08/2007]

**Raptor Rehabilitator, Davis, CA**
As a raptor rehabilitator, fed, treated, and rehabilitated sick and injured birds of prey. Practiced veterinary techniques and proper handling methods. Assisted in cage cleaning; improved holding facilities; and practiced methods for prevention of imprinting, proper rehabilitation, and release techniques. Conducted health exams and weight checks, and learned to diagnose illness and injury. Initiated and conducted an independent study and analysis of red-tailed hawk weight fluctuations during rehabilitation. Practiced methods for release and physical therapy. [UC Davis-Spring and Winter 2006; 10 hrs/wk]

**Tsavo East National Park Research Volunteer, Voi, Kenya**
As a research volunteer, monitored a population of African elephants (*Loxodonta africana*) in the Tsavo Conservation Area using radio telemetry from collared elephants. Studied the social structure, habitat preference, behavior, and general ecology of translocated and local elephant populations inside the Tsavo East National Park. Assisted with and conducted vegetation surveys, GPS road mapping, animal road counts, rainfall data collection, and statistical analyses. Learned how to age and sex animals based on osteological evidence. Drafted methodologies to conduct vegetation surveys in and around animal exclosure plots. Used monthly road count data in conjunction with rainfall data to interpret animal abundance and distributions. Used poaching data and talked with stakeholders to discuss ways to alleviate poaching pressure in and around the national park. Created fish sampling tools and data sheets, and compiled graphs and charts from analyzed data for presentations by park staff. [08/2006-11/2006; 40 hrs/wk]

Joseph Betzler
Senior Botanist & Biologist

**Education**
Diploma, Plant Conservation Techniques, Royal Botanic Gardens at Kew, United Kingdom, 2003

MS, Biology-Botany, San Diego State University, San Diego, California, 1984

BS, Botany, San Diego State University, San Diego, California 1981

**Certification**
HAZWOPER training (40 hr.) - 29 CFR 1910.120(e)

**Experience Summary**
Mr. Betzler is recognized as a Biological Monitor and Project Leader for cooperative work with the U.S. Fish and Wildlife Service as well as a recognized botanist with the Bureau of Land Management on its "List of Prospective Botanists or Environmental Firms for Conducting Rare Plants Inventories". He also has experience working with Nevada Dept. of Wildlife, U.S. Forest Service, California Dept. of Fish and Wildlife, the U.S. Navy, and other organizations.

Mr. Betzler is knowledgeable in the plant communities of the Mojave, Sonoran, Vizcaíno, and Colorado Desert ecological associations as well as the California floristic region. He has designed and conducted botanical surveys and reports for: sensitive species, plant community assessments, cactus and yucca inventories, desert tortoise surveys, and other natural resource surveys. He is experienced with modern data capture techniques used for the rapid assessment and standardized methods developed by federal agencies. He is recognized as a succulent plant expert with over 25 years of experience with cactus and other succulent plants. He has experience conducting field work observing these plants in remote locations of: Arizona, California, Nevada, Baja California, Mexico, and Namaqualand, South Africa.

He has over 20 years of experience writing and gathering data for biological assessments, evaluations, inventories, surveys, adaptive management plans, and other technical reports. He has experience with horticulture and revegetation projects in California and Nevada. He has managed teams of biologists and botanists, coordinating work schedules and training large groups of people.

While living in Nevada he has been a biological consultant and worked with governmental agencies in the Las Vegas region. Working with the Army Corps of Engineers, Mr. Betzler has completed wetland delineations in southern Nevada.

Mr. Betzler has managed biological compliance monitors during construction to help clients meet their permit requirements. He worked closely with the project management team to keep project schedules and goals on time. These projects included transmission and power infrastructure projects in Arizona, California, and Nevada to meet alternative energy goals. Additionally he has worked on solar energy projects, water infrastructure expansion planning, to document natural resource components in Arizona, California, and Nevada. Mr. Betzler has received HAZWOPER training and is assisting with ground water sampling for volatile organic compounds in Nevada.

**Project Experience**

**Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) for the Performance Based Remediation (PBR) at Nellis AFB (Southwest Group).**
Mr. Betzler has been assisting with the collection of groundwater samples. This UFP-QAPP is the facility-wide plan for 32 sites at Nellis AFB. The Nevada Division of Environmental Protection (NDEP) is the lead regulatory agency for the remediation.

**NVEnergy Master Services Agreement Projects: Nellis AFB Solar PV Project in Area II – Environmental Compliance Support, Desert Tortoise Mitigation Services to support the Canyon Substation Replacement Capacitive Trip Project, Harry Allen Substation Expansion Project – Desert Tortoise Monitoring Services**
Biological Field Coordinator for monitoring biologists responsible for daily reporting and health and safety documentation and acting as a liaison between NVEnergy biologists and the biological field teams.

**Southern California Edison, Eldorado to Ivanpah Transmission Project (EITP), Restoration and Revegetation Plan, Boulder City, NV to Ivanpah Dry Lake, CA**
Lead Biologist assisting with the field restoration phase. Mr. Betzler is a desert tortoise monitor and has received authorization from the BLM to collect rare plant seed associated with the project. He has also participated with the early restoration phase and continues to participate with the restoration effort.

**Arizona Public Service Company, Palo Verde to Sun Valley (TS5) Proposed 500kv Transmission Line Project**
Senior Biologist and Botanist leading invasive plant surveys and documenting desert tortoise and burrowing owl sign along the transmission corridor and proposed substation locations. Mr. Betzler met in the field with BLM subcontractors so they could become familiar with the habitat, local species, and ROW access routes.

**Los Angeles Department of Water and Power, Beacon Solar Energy Project, Kern County**
Senior Biologist assisting with surveys for biological resources. The major survey work included desert tortoise and kit fox. After surveys were completed and preliminary observations of the kit fox burrows were recorded; abandoned kit fox burrows were excavated according to protocols to prepare for construction.

**Southern California Edison, EITP, Biological and Mitigation Monitoring for Construction of a Transmission Project and Associated Components, Boulder City, NV to Ivanpah Dry Lake, CA**
Lead Biologist and Botanist coordinating teams of biological specialists for preconstruction surveys and construction compliance monitoring. There were more than 10 components to the transmission project constructed to deliver power from a large solar power generating facility (ISEGS). During the early stages Mr. Betzler was responsible for a team of up to 80 biologists (another lead biologist was added in Nov 2012). He was also responsible for training more than 700 project personnel as prescribed in the project Biological Opinion for the WEAP. Mr. Betzler reviewed and approved daily reports that were entered in the clients Field Reporting Environmental Database. He was responsible for assisting with scheduling and periodic team meetings. He was the first point of contact for project biologists, and disciplinary actions for biologists on his team.

**Southern California Edison, Eldorado to Ivanpah Transmission Project, Biological and Mitigation Monitoring for Geophysical Investigations, Boulder City, NV to Ivanpah Dry Lake, CA**
Field Contact Representative (FCR) coordinating two Authorized Biologists that are monitoring drill crews conducting geophysical surveys for a transmission project. The FCR conducts training as needed for Worker Environmental Awareness Program mitigation requirements as well as basic desert tortoise training. The Authorized Desert Tortoise Biologists reported to Mr. Betzler and coordinateed with him for their daily tasks and directions.

**Southern California Edison, Eldorado to Ivanpah Transmission Project, Boulder City NV to Ivanpah Dry CA**
Senior biologist and botanist tasked to assist client in meeting the requirements for the biological surveys along a power line ROW on BLM lands to deliver solar generated electricity from Ivanpah Dry Lake in California to a substation in Boulder City, Nevada. Mr. Betzler is responsible for the botanical technical report and overseeing the other biological reports from the clients contracted environmental firms. Mr. Betzler is also assisting the client with other alternative energy projects in the Mojave Desert region.

**Solar Millennium, Solar Power Project in Three Desert Locations in California: Blythe, Palen Dry Lake, and Ridgecrest, CA**
Senior biologist conducting and leading botanical reconnaissance in three locations for potential construction of solar thermal electrical generation facilities. Mr. Betzler is also managing botanical field personnel to gather data to for preparation of plant community characterizations, botanical inventories, and rare plant surveys for each project area.

**NextLight Renewable Power, Desert Tortoise Survey, Boulder City, NV**
Senior biologist tasked to conduct a desert tortoise survey using the latest FWS protocols (April 2009) with a team of biologists and produce a plant inventory. The proposed 1,200 acre photovoltaic generation project is in Boulder City's energy zone located in the Eldorado Valley. [Prior to AECOM]

**Las Vegas Ski and Snowboard Resort, Snowmaking Water Storage Pond Botany Survey Report, Las Vegas, NV**
Lead botanist tasked to complete a botany survey report for the ski resort and the US Forest Service. The rare plant survey was for a potential construction area planned for 2010. Mr. Betzler worked in the field surveying for rare plants and completed a plant inventory. [Prior to AECOM]

**Southern Nevada Water Authority, Pipeline Restoration along the Coyote Springs to Moapa Pipeline, NV**
Wildlife biologist/senior scientist monitored a restoration contractor working on a revegetation project along a 16-mile pipeline disturbance corridor. Ensured contractor performed in a safe manner and monitor the project for desert tortoises. Trained staff as needed for desert tortoise safety procedures and invasive plant education, as well proper off-road driving rules. Monitored vehicle operators for proper tortoise checks, especially water trucks and tractors. Cleared project work sites each morning for desert tortoise, other reptiles, and wildlife. [Prior to AECOM]

**Southern Nevada Water Authority, South Valley Facilities Expansion Project, Las Vegas, NV**
Wildlife biologist/senior scientist provided biological expertise for planning aspects of alternative routing for pipelines and infrastructural elements along approximately 42 linear miles of water delivery elements in the Las Vegas Valley. Acted as a biological liaison between the federal, state, and local agency staff and the water authority engineering team. Wrote an SOQ and an RFP for choosing a biological survey subcontractor. Worked with subcontractors to assign, manage, and review biological surveys and evaluations preformed for use in technical documents. [Prior to AECOM]

**Emma Fraser**
**Wildlife Biologist**

**Professional History**

06/2015 –Present: AECOM; Wildlife Biologist

04/2015 - 06/2015: Rincon Consultants, Inc.; Field Biologist

03/2015 - 05/2015: Tetra Tech, Inc.; Field Biologist

07/2014 - 06/2015: Blackhawk Environmental; Field Biologist

10/2013 - 05/2014: Biological and Environmental Consulting; Field Biologist

03/2013 - 09/2013: San Diego Zoo Institute for Conservation Research; Research Assistant

10/2012 - 03/2013: Power Engineers, Inc.; Biological Monitor

01/2012 - 05/2012: Cornell University; Research Assistant

03/2011 - 09/2011: Partnership For Interdisciplinary Studies of Coastal Oceans; Seasonal Research Assistant

10/2010 - 02/2011: US Geological Survey; Desert Ecology and Herpetology Intern

05/2010 - 09/2010: U.S. Fisheries and Wildlife Service; Biological Intern

06/2008 - 09/2009: US National Park Service; Field Technician

**Education**

BS, Zoology, Oregon State University, 2009

**Years of Experience**

With AECOM: 10 months

Ms. Fraser has seven years of experience as a field biologist and has worked under both California Environmental Quality Act and National Environmental Policy Act policies and guidelines. She serves as a wildlife biologist for the San Diego office and supports staff on a variety of natural resource projects. She has conducted habitat assessments, focused surveys for sensitive and listed species, nesting bird surveys, and biological monitoring. Ms. Fraser has conducted protocol-level surveys for rare wildlife species including desert tortoise, California gnatcatcher, least Bell’s vireo, burrowing owl, California least tern, western snowy plover, hawksbill sea turtle, horseshoe crab, little hermit hummingbird, piping plover, roseate tern, and tiger beetle. Ms. Fraser has been approved by the US Fish and Wildlife Services as an authorized desert tortoise biologist on previous projects and is currently pending approval for federal Endangered Species Act 10(a)(1)(A) independent permits for western snowy plover and California least tern. In addition, she has experience conducting focused rare plant surveys, vegetation mapping, mist netting, bird banding, and water sampling.

**Related Experience**

**Eldorado Waterline Project Phase 1, Southern California Edison, Boulder City, Nevada.**
Performed preconstruction surveys for desert tortoise and burrowing owl prior to ground disturbing activities for the Eldorado Waterline Project. Surveys involved searching for all tortoise sign including scat, burrows, carcasses, and taking note of any predators observed within the project vicinity.

**Eldorado Waterline Project Phase 2, Southern California Edison, Boulder City, Nevada**.
Acted as the authorized desert tortoise biologist and field contact representative during the active construction portion of phase 2 of the Eldorado Waterline Project. Monitored all ground disturbing activities and acted as an agent of BLM and the Service to ensure that all instances of non-compliance or incidental take were reported. Responsible for ensuring compliance with all conservation measures for the project.

**US National Park Service, Hawaii Volcanoes National Park - Hawksbill Turtle Recovery, Volcanoe, Hawaii.** Monitored nesting sites for the endangered hawksbill sea turtle and performed nightly beach checks for nesting activity. Performed nest excavations, tagged females, and recorded data on all nesting turtles. Conducted predator control euthanasia on mongoose, rats, and feral cats. Educated the public on conservation issues and interacted with private landowners to create positive relationships. In addition, assisted in training and orienting new volunteers; crew lead for groups working in the field; and provided aid and instruction to all

With Other Firms: 7

**Professional Affiliations**

-National Audubon Society
-Desert Tortoise Council

**Training**

-2015 Introduction to Desert Tortoises and Field Techniques Workshop
-Basic Hunter Education
-OSHA 10-Hour Construction Training Course
-2016 Western Burrowing Owl Workshop (The Wildlife Society)

**Certifications**

-Authorized Desert Tortoise Biologist
-CA Special Purpose-Relocate Permit, (MB65027B-0): house finch, mourning dove, western gull, barn owl, great-horned owl
-Basic First Aid, CPR, and AED Certified

volunteers. Led overnight trips into back-country and introduced new employees/volunteers to research methods, project protocols, and safety plans. Also organized and managed data collection in and out of the field. [Prior to AECOM]

**US Geological Survey, Desert Tortoise Vegetation Preference, Henderson, Nevada.**
Cared for a population of captive desert tortoise hatchlings used by USGS to determine vegetation preference and diet restrictions. Monthly measurements were recorded on all individuals to determine growth rates/changes and how they correlated with selected diets. Assisted with artificial burrow construction and pen maintenance. Weekly pen checks were conducted to accurately record change in plant dominance and ground cover. [Prior to AECOM]

**US Geological Survey, Nevada Burn, Henderson, Nevada.**
Responsible for tracking and monitoring select populations of desert tortoise using radio telemetry; data was collected to monitor behavior, microsite selection, and movement patterns of tortoises living in or adjacent to habitat burned by wildlife; data was collected on all identified corvid nests - surrounding areas were surveyed for carcasses and predation sign. Collected data with Trimble GPS units and transferred/uploaded all data using Pendragon software. Research included extensive plant identification necessary for annual and perennial vegetation analysis. [Prior to AECOM]

**Nevada Department of Transportation, Kyle and Lee Canyon Road Expansion, Las Vegas, Nevada.**
Biological and desert tortoise monitor during the addition of approximately 17 miles of road shoulder/bike lanes to both Kyle and Lee Canyon Roads. Ensured that no sensitive species were disturbed during construction and assisted in cactus salvage, nesting bird surveys, and desert tortoise relocations. Swept construction areas on a daily basis and surveyed for any new or developing tortoise sign. Made note of any corvid nests identified within the project boundaries and monitored for tortoise depredation. [Prior to AECOM]

**Nevada Department of Transportation, I-15 Resurfacing, Moapa, Nevada.**
Conducted baseline surveys for NEPA documentation including over 140 hours of desert tortoise clearance surveys prior to resurfacing 26 miles of both the northboundand southbound lanes. This included identifying active corvid nests and searching for the presence of desert tortoise remains within the surrounding area. Carried out construction site compliance monitoring as well as desert tortoise monitoring according to the mitigation measures required. Performed weekly fence checks and trained all new personnel on project protocols and desert tortoise awareness. [Prior to AECOM]

**Nevada Department of Transportation, Cactus Interchange, Las Vegas, Nevada.**
Oversaw construction of a high-profile interstate interchange and was an environmental and biological desert tortoise monitor. Documented contractor compliance with environmental specifications and coordinated with the environmental team and contractors on a daily basis to review

biological concerns. Ensured that perimeter tortoise fencing was maintained. [Prior to AECOM]

**US Army, Desert Tortoise Translocation, Fort Irwin, California.**
Actively surveyed for desert tortoise signs in preparation for active military training on ranges with suitable tortoise habitat. Assisted with attachment of transmitters to all new individuals observed and tracked previous tagged populations to ensure their health and success rates before and after translocation efforts. [Prior to AECOM]

**US Navy, California Least Tern and Western Snowy Plover Conservation Program, NB Coronado, California.**
Assisted with ongoing monitoring efforts concerning California least tern and western snowy plover populations. Surveyed breeding grounds and assessed the productivity and success of nesting pairs and colonies. Much of the work involved collecting and recording data regarding nest and chick status, population numbers, human disturbances, and predator threats/interactions. If reoccurring depredations were identified as corvid, collaboration was made with the predator control team to eradicate problem individuals. Re-sighted bands and assisted with chick processing (weight and wing measurements; banding). [Prior to AECOM]

**US Marine Corps, California Least Tern and Western Snowy Plover Conservation Program, MCB Camp Pendleton, California.**
Assisted with ongoing monitoring efforts concerning California least tern and western snowy plover populations. Surveyed breeding grounds and assessed the productivity and success of nesting pairs and colonies. Much of the work involved collecting and recording data regarding nest and chick status, population numbers, human disturbances, and predator threats/interactions. If reoccurring depredations were identified as corvid, collaboration was made with the predator control team to eradicate problem individuals. Re-sighted bands, assisted with chick processing (weight and wing measurements; banding), and conducted vegetation surveys on common California flora in order to establish a nesting preference. [Prior to AECOM]

**Valley Electric Association, Vista-Pahrump Transmission Line, Pahrump, Nevada.**
Surveyed and monitored a 13-mile active construction site for desert tortoise presence. Identified all tortoise sign including scat, burrows, carcasses, and evidence of predation. Made note of any active corvid nests within the project boundaries and monitored for signs of predation. Recorded all necessary data on desert tortoises observed and ensured the project was in compliance with the biological opinion. In addition, escorted personnel on and off site and monitored construction activities to document and ensure environmental compliance; ensured proper protocols were followed on site to minimize disturbance to desert tortoises and surrounding critical habitat. Acted as crew lead and managed a team of five other biologists. [Prior to AECOM]

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# Bonnie Hendricks
## Senior Ecologist

### Education

MS, Biology, Ecology Emphasis, San Diego State University, 1990
BS, Biology, Magna Cum Laude, Western Washington University, 1983

### Years of Experience

With AECOM: 20
With Other Firms: 8

### Community Volunteer Projects

Riparian Enhancement and Arundo Removal, Project Director, Mussey Grade Watershed and Wildlife Coalition, 2011 to present

### Certifications and Training

California Rapid Assessment Method (CRAM) for Riparian, Depressional, and Estuarine Wetlands, 40 hr Training Certification, 2016
Jepson Herbarium Workshop on Desert Plant Families, March 2017
Jepson Herbarium Workshop on the Monkeyflowers, June 2016
Authorization to Collect Voucher Specimens of State-Listed Endangered and Threatened Plants, 2016
California Gnatcatcher Independently Permitted, U.S. Fish and Wildlife, 1993 to present
Quino Checkerspot Butterfly Independently Permitted, U.S. Fish and Wildlife, 1999 to present
Wildlife Track and Sign Interpretation, Certified Level II Tracker, North American Evaluation, 2006
California Native Plant Society Conference (CNPS) San Diego, California 2012

Bonnie Hendricks has 28 years of experience in biological research, ecology, and environmental consulting. She has extensive experience in southern California ecosystems (28 years) and has also worked in northern California, Nevada, Utah, Colorado, Arizona, Oregon, Washington, Pennsylvania, and Mexico. Ms. Hendricks has conducted and managed ecological and botanical field studies for numerous projects in southern California. Her expertise includes rare plant and floristic surveys, vegetation classification and mapping, wetland delineation and permitting, She has specialized in the rare plants of coastal and desert southern California ecosystems and has had two to three years of experience with Coachella Valley milkvetch *(Astragalus lentiginosus* var *coachellae*).

Ms. Hendricks also conducts Quino checkerspot butterfly surveys, California gnatcatcher surveys, wildlife tracking, restoration and monitoring of vernal pool habitat, and regional conservation planning. She also has experience with herpetological surveys, avian surveys, desert tortoise, and general wildlife surveys.

Ms. Hendricks has extensive experience working with a variety of clients, including County of San Diego, City of San Diego, Caltrans, County Water Authority, Marine Corps Base (MCB) Camp Pendleton, Marine Corps Air Station (MCAS) Miramar, San Diego Gas & Electric (SDG&E), and confidential solar and wind clients. She also has experience with the National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA), and in writing sections of Environmental Impact Reports (EIR), Environmental Assessments (EA), Biological Technical Reports (BTR), Natural Environment Studies (NES), and Biological Assessments (BA). Ms. Hendricks writes 10a reports, restoration plans, and restoration and monitoring reports. She also collects and manages large databases and performs quality assurance and quality control.

### Project Experience

**Southern California Edison, DPV2 Transmission Project, Botanical and Mitigation Monitoring along the corridor from Valley Substation to Colorado River Substation, Riverside County, CA.** Botanical monitor responsible for evaluating plant density and identification in restoration areas. Identification of weeds and measuring density in restoration locations. Surveying for sensitive species including **Coachella Valley milkvetch** *(Astragalus lentiginosus* var *coachellae*). Also acted as a biological monitor for restoration teams seedling and planting restoration areas and controlling weeds. [2016-2018]

**Golden State Ventures, Agua Caliente Indian Reservation, City of Rancho Mirage, Riverside County, CA.** Conducted detailed population mapping, counts and recorded phenological data for a large population of

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From Sea to Summit: Botany of San Diego County March 31–April 3, 2011 (Jepson Herbarium Class)
Arid West Regional Supplement to the Wetland Delineation Manual, 8 hr Course, Wetland Training Institute, 2007
Advanced Hydric Soils 24 hr Course, Wetland Training Institute, 2006
Basic Wetland Delineation 40 hr Course, Wetland Training Institute, 1993
Desert Tortoise Survey and Handling Techniques Workshop, Desert Tortoise Council, 1991

**Professional Affiliations**

Member, California Native Plant Society
Member, Southern California Botanists
Member, San Diego Tracking Team

the federally endangered **Coachella Valley milkvetch** within an undeveloped area of sand dunes near Palm Desert proposed for development by Golden State Ventures. [2002]

**California Intelligent Communities Joshua Hills, Riverside County, CA.** As botany task manager, conducted botanical surveys and vegetation mapping of a 9,000-acre proposed development near Palm Desert, California. Developed comprehensive mapping techniques and managed botany team for a large-scale investigation involving complex vegetation transitional communities in a desert alluvial system. Potential target rare plant species included **Coachella Valley milkvetch** (*Astragalus lentiginosus* var *coachellae*) and triple ribbed milkvetch (*Astragalus tricarinatus),* among others. [2000]

**Southern California Edison, CWA 38 Western Riverside County, Rare Plant Surveys.** Conducted surveys and population mapping for approximately 12 rare and endangered plants in Western Riverside County. Methods included field checks at known reference populations of all 12 species and study of herbarium specimens at UCR to determine appropriate survey timing and become familiarized with difficult taxa prior to project site surveys. [2017]

**RE Crimson Solar Energy Project, Mojave Desert, CA.** As project biologist conducted rare plant, tortoise, desert kit fox, and burrowing owl surveys over approximately 3,000 acres in the Mojave Desert for a solar array project. [2016]

**Digital 395 Project, San Bernardino, Kern, Inyo, Mono Counties, CA to Mindon, NV.** As project botanist, conducted preconstruction investigations and clearance surveys on an over 300 mile long fiber-optic cable alignment from Barstow, CA to Mindon, NV. Conducted botanical and rare plant surveys along all segments of the project across multiple counties and two states including a wide transect of habitat types and elevation ranges. [2012]

**Invenergy Wind, Campo Band of Mission Indians, Shu'luuk Wind Energy Project, San Diego County, CA.** As a biologist, participated in focused rare plant surveys, vegetation mapping, and protocol Quino checkerspot butterfly surveys for a proposed wind energy project across a 4,400-acre study area in the inner-montane region of eastern San Diego County. Rare plants were documented with global positioning system (GPS) locations and population data were collected. [2010]

**San Diego Gas & Electric, Sunrise Powerlink Restoration Services, San Diego County, CA.** Participated in the botanical field effort to survey all SDG&E tower sites before construction. This pre-vegetation survey served as documentation for the restoration efforts following tower construction in temporary impact areas. Individual species and vegetation communities were recorded in each temporary impact area. Also performed post-impact surveys to determine the area of impact to each temporary site. Participated in the field effort to collect seed from over 100 plant species from the desert and mountains west to the coastal areas. [2011 – 2016]

**Sempra Energy, Energia Sierra Juarez U.S. Generator Tie-Line Project, Jacumba.** As project biologist conducted focused rare plant surveys and prepared rare plant survey report for the proposed project. Conducted Quino checkerspot butterfly surveys and prepared 45-day summary report for USFWS.

**Confidential Client, Solar Energy Project, Boulevard, CA.** As project biologist, organized botanical field surveys for AECOM and independent botanists. Performed field surveys for vegetation communities and rare plants and assisted in data management of the botanical data collection. Studied rare plant specimens from eastern San Diego County at the San Diego Natural History Museum. Additionally, performed protocol Quino checkerspot butterfly surveys. Co-led the preparation of the 10a report for Quino and the Biological Resources Report (BRR). [2011]

**San Diego Gas & Electric, Salt Creek Substation and Powerline Project, San Diego County, CA.** As lead biologist, conducted rare plant surveys, vegetation mapping, protocol California gnatcatcher surveys, and protocol Quino checkerspot butterfly surveys for a proposed substation. Led and oversaw biological sensitive species surveys and reporting,[2011]

**Solar Millennium Power Projects, Mojave Desert, CA.** As a biologist, participated in the botany field effort conducting focused rare plant surveys for special status plants that had the potential to occur within the impact area of planned solar energy projects located in the western Mojave desert. Over 2,000 acres of land was surveyed for the target rare plant species, in addition to a 1-mile buffer zone. Vegetation mapping and an inventory of any special status wildlife was also conducted.

**Los Angeles Department of Water and Power, Pine Tree Wind Development Project, Kern County, CA.** As project biologist, assisted in the environmental documentation for an approximately 8,000-acre wind development site. The project was located in a Wind Energy Resource Area in the foothills of the Sierra Nevada south of Kings Canyon National Park and north of the city of Tehachapi. Performed botanical surveys and vegetation mapping and contributed to the biological technical report and permitting procedures for compliance with regulatory agencies.

**San Diego Gas & Electric Valley-Rainbow 500kV Interconnect Electrical Transmission Line Project, Riverside and San Diego Counties, CA.** Lead biologist for botanical surveys, Quino checkerspot butterfly protocol surveys, and wetland delineations associated with a 500kV transmission line connecting an existing substation in Riverside County with a proposed new substation in San Diego County. The biological resources within nearly 14,000 acres of study corridors were summarized and updated via focused field surveys. Extensive use of GIS-based mapping layers derived from the USFWS and the Western Riverside County MSHCP were utilized.

**The LandWell Company Provenance, Henderson, NV.** As senior biologist, conducted wildlife movement studies within a proposed green community on a 2,600-acre desert site in Henderson, Nevada. Performed a wildlife corridor study and constraints analysis to analyze the most suitable areas for ecological preservation and enhancement, including the creation of open space corridors and wildlife preserve areas to maintain connectivity and long-term viability of wildlife populations.

**Northern Power Distribution System, Camp Pendleton, San Diego County, CA.** Field biologist for investigations and impact assessments for the placement of electrical distribution poles and associated aboveground electrical line along 15 miles on the base. Conducted biological investigations, including detailed vegetation community mapping, general wildlife surveys, focused surveys for rare plant species, protocol surveys for California gnatcatcher, and reconnaissance surveys for Pacific pocket mouse and Stephens' kangaroo rat.

**Imperial Irrigation District, Transmission Line Pole Replacement Projects, Imperial, San Diego, and Riverside Counties, CA.** Assistant project manager for biological resource investigations along two existing transmissions lines (R and L-Lines) through desert ecosystems across three counties. This project spanned a total of 184 miles requiring replacement of 300 existing poles. Conducted biological surveys including an assessment of the vegetation communities along the lines, and pole-specific accounts of the biological resources (including rare plants, flat-tailed horned lizard, burrowing owls, and sensitive desert vegetation communities) within the proposed construction areas.

**Imperial Irrigation District, Chiriaco Summit Transmission Line, Riverside County.** As botanical resource task manager prepared BTR and EA and carried out construction monitoring for the Chiriaco Summit transmission line. Conducted rare plant surveys and vegetation mapping along the proposed transmission line corridor. Carried out desert tortoise transect monitoring during the construction phase.

### Water Conveyance Projects

**Mid-America Pipeline Company Rocky Mountain Loop Project, Uintah County, UT, and Rio Blanco County, CO.** Project biologist for focused investigations of wetland communities and jurisdictional waters along 200 miles of pipeline as part of a larger scale study. Conducted detailed wetland delineations per the ACOE 1987 manual at all locations where jurisdictional wetlands or waters coincided with the 200-foot-wide project study corridor. Flagged wetlands and waters in the field, recorded locations and pertinent data with GPS equipment, prepared field sketches, and completed wetland delineation data sheets.

**Otay Water District, Otay Mesa Conveyance and Disinfection System Project, San Diego County, CA.** As project biologist, led biological surveys for conveyance and treatment infrastructure to treat and convey excess water supplied from a new desalination plant planned to be located in Rosarito, Mexico. Led rare plant surveys, vegetation mapping, and Quino checkerspot butterfly protocol surveys and contributed to data collection for western burrowing owl, least Bell's vireo, and California gnatcatcher. Participated in preparation of 10a reports and biological technical report. [2013]

**City of San Luis Obispo Nacimiento-to-San Luis Obispo Pipeline, San Luis Obispo County, CA.** As botanical resource task manager, conducted studies to determine the potential impacts of constructing a 70-mile aqueduct connecting Lake Nacimiento to the City of San Luis Obispo. Conducted focused rare plant surveys, vegetation mapping, and focused surveys for red-legged frog and San Joaquin kit fox. Prepared vegetation and sensitive plants species sections of the Environmental Impact Report (EIR).

**U.S. Generating Company Otay Mesa Generating Project, San Diego County, CA.** As project biologist, served as lead biologist for a biological resources study submitted to the California Energy Commission. Conducted field studies to determine the potential impacts of a power-generating project including 60 kV and 230 kV power lines, a sewer line, and associated facilities in the Otay Mesa area of San Diego County. Surveys included rare plants and animals, and vegetation mapping. Assisted the client in avoiding impacts to biological habitat, and threatened and endangered species, through project design. Used GIS to map project components, quantify existing conditions and impacts, and to generate report graphics.

**San Diego County Water Authority Emergency Water Storage Project, San Diego County, CA.** As field biologist, conducted and managed biological field investigations for alternative pipeline alignments, including wetland delineations, vegetation mapping, and sensitive plant surveys. Analyzed large data sets for the fine screening of project alternatives. Developed methodology and prepared a report for assessing wetlands functions and values. Involved in ongoing monitoring of and permitting for rare plants and California gnatcatcher.

### Transportation Projects

**Otay Truck Trail Road Expansion, Vegetation Mapping Otay, CA.** As project biologist, led field surveys for vernal pools, burrowing owls, Quino checkerspot butterfly and vegetation mapping. Prepared the 10a report and a Natural Environment Study (NES) for the project. [2012-2013]

**California Department of Transportation (Caltrans), Dennery Canyon Vernal Pool Restoration Project, Otay Mesa, CA.** Project consists of enhancement and construction of more than 30 vernal pools and adjacent upland habitat for Quino checkerspot butterfly habitat. As a biologist, led the Quino checkerspot butterfly and California gnatcatcher protocol surveys and prepared 10a reports. Participated in the monitoring of vernal pool and upland vegetation monitoring. [2009 – 2013]

**Caltrans State Route 76 Road Improvement Project, San Diego County, CA.** As task manager of botanical studies, Ms. Hendricks conducted and oversaw rare plant surveys and vegetation mapping along three alternative routes proposed for improving SR 76 in the eastern segment between I-15 and South Mission Road in Bonsall. Conducted comprehensive wetland delineations for the eastern and middle segments, Bonsall and Oceanside west to Melrose Drive, along the San Luis Rey River. Also participated in protocol surveys for least Bell's vireo, California gnatcatcher, and southwestern arroyo toad. Managed the preparation of an NES for the project and contributed to the wetland delineation report, wildlife tracking study, and BA.

**Caltrans State Route 52 Inside Widening, San Diego County, CA.** Field biologist for studies supporting a Natural Environment Study and Jurisdictional Delineation Report for proposed widening into the median of SR-52. Tasks included rare plants surveys; vegetation mapping; surveys for Quino checkerspot butterfly, coastal California gnatcatcher, and wetland delineations. The NES identifies potential impacts and avoidance, minimization, and mitigation measures. The JDR summarized findings at over 100 waters coincident with the right-of-way.

**Caltrans, West Mission Bay Drive Bridge Replacement, San Diego, CA.** As senior biologist/task manager, conducted biological surveys and analyses of direct and indirect impacts of a bridge replacement project at the mouth of the San Diego River involving wetlands, brackish water, and endangered species habitats.

**City of Oceanside Pacific Street Bridge Project, San Diego County, CA.** Project biologist for the evaluation of alternative alignments to replace a road with a bridge crossing near the mouth of the San Luis Rey River. Conducted biological investigations including wetland delineations, rare plant surveys, and focused surveys for California gnatcatcher. Project analyses included a review of aerial photographs showing changes in the river over the prior 20 years. Spatial changes in habitat were modeled using ArcView's Spatial Analyst Extension; this analysis supported findings made in the technical report and EIR/EA regarding expected benefits of the project and locations for mitigation.

**Temecula River (Pala Road) Bridge Project, Riverside County, CA.** Field biologist for permitting and flood plain risk assessments associated with bridge widening and realignment. Conducted wetlands delineations, a bridge evaluation, a local hydraulic study, and habitat functional assessments; prepared a 404(b)(1) Alternatives Analysis, a conceptual wetland mitigation plan, and acquired a Section 404 Individual Permit, 401 Water Quality Certification, and 1601 Streambed Alteration Agreement.

**Oceanside-Escondido Rail Project, San Diego County, CA.** Field biologist for evaluation of impacts of proposed improvements to 22 miles of existing railroad right-of-way. Responsibilities included CEQA and NEPA analyses; delineation of sensitive habitats, including problem wetlands requiring field verification with the ACOE; preparation of a BA for formal endangered species consultation; and interagency coordination for application of federal permitting regulations for linear projects.

**Caltrans SR-54 and SR-94 Widening, Natural Environment Study Report and Mitigation Recommendations, San Diego County, CA.** As biologist, prepared natural environment study report and mitigation report. Delineated wetlands using the federal method, and conducted an oak tree impact analysis based on oak tree canopy measurements.

### Military Projects

**NAVFAC Southwest MCAS Miramar Upland Endangered Plant Species Census and Monitoring for Del Mar Manzanita and Willowy Monardella, San Diego County, CA.** As project manager and field team leader conducted the Del Mar Manzanita basewide census for 2015 and monitoring within established plots to evaluate long-term population trends. Monitoring was also conducted within established plots for Willowy Monardella.

**Naval Air Station North Island IR Site 9, San Diego County, CA.** As project botanist, conducted focused surveys for rare plants in coastal dune habitat on NAS North Island for impact avoidance during soils testing for remediation of contaminated soils. Nuttall's lotus and Brand's phacelia were detected and mapped within and outside the project area [2016].

**NAVFAC Southwest, MCB Camp Pendleton, 41 Area Project, San Diego County, CA.** As project botanist, conducted protocol *Brodiaea filifolia* and associated rare plant surveys and vernal pool classification surveys within the project area. [2014]

**Marine Corps Special Operations Command Expansion (MARSOC) Project, U.S. Marine Corps Base (MCB) Camp Pendleton, San Diego County, CA.** As a lead biologist, coordinated and conducted focused rare plant surveys and contributed to survey reporting. Conducted vernal pool classification surveys, vegetation mapping, and protocol surveys for *Eryngium pendletonense* and *Brodiaea filifolia* within the project area. [2013]

**U.S. Marine Corps Base (MCB) Camp Pendleton Survey/Inventory of Pendleton Button-Celery.** As botanist and project manager, designed and conducted an inventory and basewide survey for *Eryngium pendletonense*. The first year study and report was submitted in November 2007. A study and protocol survey to further quantify the extent of the population was conducted for this species in new areas and the reports submitted in 2010 and 2011.

**MCB Camp Pendleton Grow the Force (GTF) Vegetation Mapping and Sensitive Plant Survey, San Diego, CA.** As a biologist, produced vegetation maps and conducted protocol rare plant surveys for *Brodiaea filifolia* on multiple sites base-wide for the GTF project. Conducted protocol California gnatcatcher surveys on multiple sites. Participated in preparation of an EA.

**NAVFAC Southwest, MCB Camp Pendleton, Military Family Housing Project, San Diego County, CA.** As task manager, conducted and oversaw vegetation, rare plant, and wildlife surveys on three alternative military family housing sites. Developed methodology and documentation for an extensive newly discovered population of *Brodiaea filifolia.* Conducted protocol California gnatcatcher surveys on the approximately 84-acre Rodeo Grounds site. Prepared biological sections of the EA for the project.

**NAVFAC Southwest, East Miramar Housing, San Diego County, CA.** As senior biologist/task manager, conducted and managed Quino checkerspot butterfly surveys per the USFWS year 2000 survey protocol for three alternative sites on MCAS Miramar totaling approximately 1,200 acres. Surveyed for rare plants and vernal pools.

**NAVFAC Southwest MCAS Miramar Vernal Pool Restoration and Enhancement Plan, San Diego County, CA.** As project manager, prepared and implemented a detailed restoration and enhancement plan for 90 vernal pool basins on four sites at MCAS Miramar. Primary goal was to restore or enhance habitat for the endangered San Diego mesa mint and fairy shrimp in areas that had been degraded by past disturbance. The 5-year maintenance and monitoring program has been successfully completed. The program included monitoring of hydrology, flora, and fauna for the restored pools and adjacent control pools, and measures to maintain and protect the restoration site.

**U.S. Marine Corps Helicopter Outlying Field, MCB Camp Pendleton, San Diego County, CA.** As biologist, mapped vegetation habitats and conducted focused surveys for rare plants (including *Brodiaea filifolia*) on four sites at MCB Camp Pendleton for a proposed helicopter landing field. Prepared vegetation and sensitive plant species sections for the biological technical report.

**MCB Camp Pendleton P-527 and P-529 Wastewater Compliance Programs, San Diego County, CA.** As biologist, conducted vegetation and rare plant surveys (including *Brodiaea filifolia*) addressing the potential impacts of wastewater treatment facilities and pipelines across multiple upland habitats and wetlands associated with Santa Margarita River, San Mateo Creek, San Onofre Creek, Las Flores Creek, and Pilgrim Creek.

**OHM Remediation Services Corp. North Island Remediation DO36 Sites 9 and 11, San Diego County, CA.** As biologist, conducted vegetation and rare plant surveys for two coastal sites proposed for remediation. Prepared rare plant mitigation plan for two coastal plant species.

**NAVFAC Southwest P-634 Range 409 Armor/Anti-Armor Tracking Range Upgrade, MCB Camp Pendleton, CA.** As project biologist, conducted coastal California gnatcatcher (*Polioptila Californica*) surveys, botanical surveys, vegetation mapping, wetland delineation, and Quino checkerspot butterfly (*Euphydryas editha quino*) habitat assessment, and assisted in fairy shrimp wet season sampling for the proposed reorientation and technological upgrade of the Marine Corps weapons and training Range 409. This project involved production of a BA and EA.

### Botanical Field Surveys and Reports

**Caltrans and California Transportation Ventures, Inc. Lake Jennings Open Space Preserve/Restoration Area Land Management and Post-fire Recovery Monitoring, San Diego County, CA.** As senior biologist, collected quantitative and qualitative vegetation data for assessing the success of habitat restoration for the coastal cactus wren on this burned and partially disturbed area as part of the post-fire monitoring and long-term management of the preserve. Contributed to the Post-Fire Monitoring Report. Detected cactus wren and California gnatcatcher on site after wildfires and made recommendations for continued preserve management.

**City of Escondido Hale Avenue Resource Recovery Facility Expansion Tanks, San Diego County, CA.** As a task manager, conducted and oversaw general biological surveys, wetland delineation, rare plant surveys, and a tree impact survey for the installation of two expansion tanks for the Hale Avenue Resource Recovery Facility, using GPS methodology and GIS mapping. Prepared a Biological Technical Report and wetland permit packages for this project.

**City of Carlsbad Cannon Road Reach 4, Carlsbad, CA.** As project biologist, performed rare plant surveys and vegetation mapping for the preparation of the Cannon Road Reach 4 Preliminary Environmental Assessment Report (PEAR). The City of Carlsbad proposed to construct the final segment of Cannon Road, which is classified as a major arterial in the Carlsbad Circulation Element. These studies established a baseline for future environmental documentation and review within the context of the Local Assistance process.

**City of San Diego, Metropolitan Wastewater District Coastal Sewer Alignment, San Diego County, CA.** As biologist, conducted botanical investigations in various salt marsh, freshwater marsh, and coastal dune habitats for a proposed sewer alignment extending from the Mission Bay area south to Borderfield National Monument.

**Kennecott Minerals Company Cahuilla Project, Imperial County, CA.** As botanical resource task manager, designed and managed a quantitative vegetation sampling program to describe desert plant communities to be impacted by mining exploration in Imperial County. Initial vegetation mapping involved aerial photo interpretation; quantitative field investigations involved vegetation transect and quadrat sampling.

**U.S. Immigration and Naturalization Service Brown Field Border Patrol Station EA, San Diego County, CA.** As biologist, conducted botanical surveys and prepared biology sections of an EA and biological technical report to address development of the Brown Field border patrol master plan on 30 acres of U.S. Navy-owned land. The site was adjacent to the Brown Field Air Station, 4 miles north of the United States and Mexico international border. Issues of concern included mitigation of two vernal pools, federally endangered plant and animal species (San Diego button-celery and San Diego fairy shrimp), and a California species of special concern (burrowing owl).

**City of San Diego New City Landfills, San Diego County, CA.** Project biologist for evaluation of three San Diego County landfill sites during feasibility analysis, technical studies, and EIR preparation. Prepared detailed floral and faunal inventories, habitat mapping, surveys for listed species and vernal pool habitat, and wetland delineations.

**County of San Diego North County Landfills, San Diego County, CA.** As biologist, conducted rare plant surveys, vegetation mapping, and wetland delineations using the federal method on four proposed North San Diego County landfill sites.

**City of San Diego and County of San Diego Southwest County Landfills, San Diego County, CA.** As biologist, conducted and managed field surveys for sensitive plant species, vegetation mapping, and wetland delineations on five proposed San Diego landfill sites. Also conducted focused California gnatcatcher surveys. Prepared site feasibility assessment for biological resources.

**City of San Diego, Department of Waste Management Miramar Landfill General Development Plan, San Diego County, CA.** As biologist, conducted vegetation and sensitive species surveys general development plan. Assisted in the preparation of the BTR and EIR.

**Baldwin Company Thread-Leaved Brodiaea Mitigation Site, San Diego County, CA.** As biologist, collected field data on a series of experimental plots in San Marcos for a study that monitored survivorship and growth of *Brodiaea filifolia* under a number of test conditions.

**City of Chula Vista Otay Ranch EIR, San Diego County, CA.** As biologist, prepared botanical sections of the EIR, including response to comments from the public, and assisted in the preparation of the findings of fact, and mitigation and monitoring report. The Otay Ranch Project was a large-scale, multijurisdictional development that involved over 40 sensitive plant species and numerous sensitive habitats on an approximately 23,000-acre property in Chula Vista.

**McMillin Communities Biological Resources Analysis and Spring Survey for Sensitive Plants of Scripps Ranch, San Diego County, CA.** As biologist, conducted rare plant surveys, and classified and mapped vegetation. Prepared report on assessment of potential vernal pool habitat and rare plants.

**Shea Homes Biological Constraints Analysis of Daley Ranch, San Diego County, CA.** As biologist, conducted focused surveys for rare plants and California gnatcatchers, and assisted in wetland delineation, in Escondido.

**Baldwin Corporation Otay Ranch BTRs, San Diego County, CA.** As biologist, conducted detailed study on the vernal pools within this 23,000-acre property. Prepared technical reports on the hydrology and flora of Otay Ranch vernal pools. Conducted rare plant surveys on one of the three major parcels of Otay Ranch (the Jamul Mountains).

**Baldwin Corporation Rare Plant Mapping of Otay Ranch, San Diego County, CA.** As biologist, conducted focused surveys for 52 sensitive plants on the Jamul Mountains area of the 23,000-acre Otay Ranch.

**City of San Marcos Discovery Hills EIR, San Diego County, CA.** As biologist, conducted and supervised floral and faunal surveys, including mapping of vegetation communities, rare plants, and California gnatcatchers, in San Marcos. Prepared BTR for the EIR.

**City of San Diego BTR for Extension of Jackson Drive, San Diego County, CA.** As biologist, assisted in vegetation and floristic surveys, and in the preparation of BTR for the EIR. Worked with city planners, engineers, and the resource agencies for development of viable mitigation alternatives.

**Dillon Development Biological Resources Analysis of Roberts Ranch, San Diego County, CA.** As biologist, conducted biological surveys to map and describe the vegetation and sensitive resources. Conducted an oak tree survey and inventory. Prepared biological technical report.

### Wildlife Biology

**Culvert Repair Project CalTrans (CPEN) Gnatcatcher Surveys, San Diego, CA.** Conducted California gnatcatcher (CAGN) surveys on coastal bluff scrub and coastal sage scrub habitat prior to and during monitoring of crews working on culvert repairs. [2013]

**NAVFAC Southwest U.S. Marine Corps Base Camp Pendleton Military Family Housing Project, San Diego County, CA.** As task manager, conducted and oversaw vegetation, rare plant, and wildlife surveys on three alternative military family housing sites. Conducted protocol California gnatcatcher surveys on the approximately 84-acre Rodeo Grounds site. More than 10 pairs of gnatcatchers were detected. Prepared 45-day report for California gnatcatcher survey to USFWS and the biological sections of the EA for the project.

**Caltrans and California Transportation Ventures, Inc. State Route 125 South Johnson Canyon Open Space Preserve Land Management Mitigation, San Diego County, CA.** As senior biologist, conducted focused protocol surveys for California gnatcatcher as part of the long-term management of the preserve (mitigation site for State Route 125). Prepared 45-Day Report for California gnatcatcher survey to USFWS. Recommended management actions and coordinated with restoration biologists to minimize impacts to listed species.

**NAVFAC Southwest P-634 Range 409 Armor/Anti-Armor Tracking Range Upgrade, MCB Camp Pendleton, CA.** As project biologist, conducted coastal California gnatcatcher (*Polioptila Californica*) surveys, botanical surveys, vegetation mapping, wetland delineation, and Quino checkerspot butterfly (*Euphydryas editha quino*) habitat assessment, and assisted in fairy shrimp wet season sampling for the proposed reorientation and technological upgrade of the Marine Corps weapons and training Range 409. This project involved production of a BA and EA.

**Power Engineers and SDG&E Valley-Rainbow 500kV Interconnect Electrical Transmission Line Project, Riverside and San Diego Counties, CA.** Senior biologist and task manager for the endangered Quino checkerspot butterfly investigations on behalf of SDG&E for a 500kV transmission line connecting southern California Edison's Valley substation in Riverside County with a proposed new SDG&E substation in Rainbow, San Diego County. Work included management of protocol surveys for the Quino checkerspot butterfly within the preferred corridor, and consultations with the resource agencies regarding project impacts, mitigation, and permits.

**San Diego County Department of Public Works Wildcat Canyon Road Enhancement Project, San Diego County, CA.** As senior biologist, studied wildlife movement and determined corridor use surrounding Wildcat Canyon Road using transects and stations for track and sign identification of target mammal species. The purpose of this study was to identify potential impacts that road widening might pose on local and regional wildlife corridors. Areas that would benefit from the construction of a specifically designed wildlife crossing were also identified. Provided initial wildlife tracking training to junior staff biologists prior to project initiation.

**East Otay Mesa Specific Plan, County of San Diego, CA.** As senior biologist/task manager, conducted and managed surveys for Quino checkerspot butterfly over approximately 1,300 acres of occupied habitat in East Otay Mesa. Documented approximately 105 occurrences of Quino checkerspot butterflies. Managed subconsultants and coauthored with independent consultant, Ken Osborne, the Site Assessment and Focused Adult Survey for Quino Checkerspot Butterfly in the East Otay Mesa Specific Plan Area.

**NAVFAC Southwest East Miramar Housing, San Diego County, CA.** As senior biologist/task manager, conducted and managed Quino checkerspot butterfly surveys per the USFWS year 2000 survey protocol for three alternative sites on MCAS Miramar totaling 1,200 acres. Conducted rare plant and vernal pool surveys.

**OHM Remediation DO93 San Pedro Project, Los Angeles County, CA.** As biologist, conducted vegetation and host plant mapping for the Palos Verdes blue butterfly at the U.S. Navy Defense Fuel Support Point in San Pedro. Prepared an environmental protection plan to ensure avoidance of impacts to the butterfly from testing and remediation of a tar seep.

**NAVFAC Southwest Northern Power Distribution System, MCB Camp Pendleton, San Diego County, CA.** As field biologist, conducted biological field investigations and impact assessments of the placement of electrical distribution poles and associated aboveground electrical line along 15 miles in Oceanside. Conducted biological investigations including detailed vegetation community mapping and general wildlife surveys, focused surveys for rare plant species, protocol surveys for California gnatcatcher, and reconnaissance surveys for Pacific pocket mouse and Stephens' kangaroo rat. Mapped biological data using GIS ArcInfo database.

**NAVFAC Southwest MCB Camp Pendleton Passerine Study, San Diego County, CA.** As biologist, conducted an intensive behavioral study of potential adverse effects of helicopter activity on the endangered least Bell's vireo. Participated in field investigations to document detailed behavioral observations of birds and noise conditions for the large vireo population adjacent to MCB Camp Pendleton and for a comparable off-site control population.

**4-S Ranch Biological Resources Analysis, San Diego County, CA.** As biologist, conducted focused surveys for California gnatcatchers, sensitive reptiles, and sensitive plants on 3,000 acres of primarily coastal sage scrub within the 4-S Ranch in San Diego.

**Caltrans Avian Studies, San Diego County, CA.** As biologist, trapped and banded brown-headed cowbirds to investigate their daily and seasonal movement patterns as they relate to parasitism of the federally listed endangered least Bell's vireo. Investigated vegetative parameters of the nesting habitat for the least Bell's vireo on three San Diego County rivers.

### Resource Management Projects

**California Department of Fish and Game Hollenbeck Canyon Wildlife Area Land Management Plan, San Diego County, CA.** Field biologist for development of a Land Management Plan for a 5,247-acre designated Wildlife Area. Tasks included vegetation mapping, rare plant surveys, and general wildlife assessments. The LMP evaluates current Department-approved uses, e.g., hiking, bicycling, horseback riding, hunting, and dog training. Sensitive biological resources addressed in LMP include coastal sage scrub, oak woodland, wetlands, native grasslands, San Diego thornmint, coastal California gnatcatcher, Quino checkerspot butterfly, and wildlife corridors.

**U.S. Army Space and Missile Defense Command Critical Habitat Evaluation: Program Review of Integrated Natural Resource Management Plans.** Project biologist under contract with the U.S. Army for the Program Review of Integrated Natural Resource Management Plans (INRMPs). The objective of the review was to identify potential shortfalls that may lead to the designation of critical habitat on military lands and recommend corrective actions. The INRMPs were reviewed using criteria listed by the U.S. Fish and Wildlife Service and included multiple measures regarding the conservation benefit provided to listed species and assurances regarding plan implementation and effectiveness. Reviews were conducted for INRMPs written for installations in California.

**MCAS Miramar Fire Management Plan and EA, San Diego County, CA.** Biologist assisting in the preparation of a Fire Management Plan for the 23,015-acre Marine Corps Air Station Miramar. The FMP addressed wildland fire and fuels management strategies; guidelines and trainings; fire regimes; and fire effects on natural resources. The program addressed vegetation and fire management measures intended to protect high value areas on and adjacent to MCAS Miramar; measures included specific fuel treatment zones, prescribed fire areas, and access concerns.

**Caltrans and California Transportation Ventures, Inc. Johnson Canyon Open Space Preserve Habitat Management Plan for State Route 125 South, San Diego County, CA.** As senior biologist, conducted vegetation, rare plant, California gnatcatcher, and Quino checkerspot butterfly surveys for the development of a habitat management plan for this 210-acre Johnson Canyon area in Otay Mesa, located in southern San Diego County. The management area consists of an array of parcels acquired for the mitigation of sensitive species and habitats affected by the construction of State Route 125 South.

**SDCWA and City of Poway Habitat Management Plan for the Sanrex Property, City of Poway, CA.** The San Diego County Water Authority entered into an agreement with the City of Poway to mitigate for impacts of the Authority's Emergency Storage Project through the acquisition and management of a 46-acre site containing upland habitat. As Senior Biologist, conducted biological surveys of this coastal sage scrub/chaparral ecotone and prepared a management plan for the continued preservation and management of this open space in perpetuity.

The plan included a description of current biological conditions and habitat management procedures such as an annual inventory and associated methods, provisions against trespassing, exotic species removal and trash cleanup, restoration and fire management, and an annual cost analysis for habitat management.

**City of San Diego, Multiple Species Conservation Plan, San Diego County, CA.** As project biologist, conducted and coordinated field surveys for habitat and sensitive plant species mapping within 20 target study areas in San Diego. The study areas were chosen to fill identified gaps in the regional database for sensitive biological resources. The survey data were used in a habitat evaluation model for regional preserve planning.

**County of San Diego, Department of Public Works Assessment of Potential Biological Resource Mitigation Banks, San Diego County, CA.** As biologist, conducted research and assessment of six County-owned properties (1,305 acres total) to be considered for establishment as mitigation banks. Performed detailed vegetation mapping and focused surveys for sensitive plant and other animal species. Evaluated current and planned land uses within the properties and throughout adjacent properties, and assimilated all data to determine the relative value of designating a site as a mitigation bank. Presented findings to the County's Mitigation Task Force to determine which bank(s) would be established.

**City of Escondido Master Plan of Parks, Trails, and Open Space, San Diego County, CA.** As biologist, prepared biological impact analysis for the City of Escondido Master Plan. Conducted biological surveys on numerous proposed park sites. Conducted aerial photointerpretation for vegetation types and wildlife corridors in the master plan area.

### Wetland Delineations and Restoration

**City of Santa Clarita Cross Valley Connector East Project, Los Angeles County, CA.** As senior biologist, conducted formal U.S. Army Corps of Engineers wetland delineation of riparian habitats on the Santa Clara River for the proposed Cross Valley Connector. Assisted with preparation of the Natural Environmental Survey Report.

**Power Engineers and SDG&E Valley-Rainbow 500kV Interconnect Electrical Transmission Line Project, Riverside and San Diego Counties, CA.** Senior biologist for wetland delineations on behalf of SDG&E for a 500kV transmission line and substation in Rainbow, San Diego County. Work included wetland delineations of intermittent streams and wet meadow habitat at the proposed Rainbow substation including consultations with the resource agencies regarding project impacts, mitigation, and permits.

**Santa Fe Pacific Pipeline Partners, Inc. Pipeline Upgrade and Management Plan, MCB Camp Pendleton, San Diego County, CA.** As biologist, conducted field studies, including wetland delineations, wetland functions assessment, surveys for sensitive plants and animals, and habitat mapping. The project involved the replacement of over 24 miles of petroleum pipeline through MCB Camp Pendleton. Products included a BTR and wetland delineation report.

**State of Pennsylvania Characterization of Wetlands Plant Community and Metals Concentrations in Vegetation, Jefferson County, PA.** As project biologist, designed and conducted field investigations to determine the effects of contaminated sludge from an abandoned ceramics factory on the structure and functioning of a 200-acre wetland ecosystem in Falls Creek. Prepared the Phase I plant community report and assisted in preparation of a risk assessment report for the Jackson Ceramix site.

**Metropolitan Water District of Southern California Sylvan Meadows, Santa Rosa Plateau, Riverside County, CA.** As biologist, conducted an extensive wetland delineation on the 740-acre property, including field evaluation of soils, hydrology, and vegetation. The analysis was aided by aerial photointerpretation for vegetation types. The Sylvan Meadows property was proposed to be added to the Santa Rosa Plateau Preserve and managed jointly by the Nature Conservancy and Metropolitan Water District.

**NAVFAC Southwest Base Realignment and Closure, MCB Camp Pendleton, San Diego County, CA.** As biologist, conducted a comprehensive wetland delineation and wetland functions assessment on the Santa Margarita River for construction and operation of new facilities associated with base realignment. Aerial photointerpretation was used to aid in the mapping of vegetation communities.

**ASIC U.S. Air Force Enhanced Training, Owhyee County, ID.** As biologist, prepared a wetland habitat analysis in support of an EIS for the proposed expansion of U.S. Air Force base activities.

**Riverside County Transportation Department Temecula River (Pala Road) Bridge Project, Riverside County, CA.** As biologist, conducted comprehensive wetland delineation and wetland functions assessment of bridge widening for a categorical exemption/exclusion under CEQA and NEPA, and conducted an alternatives analysis under 404(b)(1) guidelines. Prepared permit applications for acquisition of a 401 Water Quality Certification and a 1601 Streambed Alteration Agreement in accordance with Caltrans, and applicable state and federal standards.

**North County Transit District Oceanside-to-Escondido Rail Project and Bike Path, San Diego County, CA.** As biologist, prepared a wetland functions assessment for riparian habitats to be impacted by the proposed light rail project.

**Chet Upham Biological Technical Report (BTR), San Diego County, CA.** As biologist, conducted vernal pool surveys, rare plant surveys, and wetland delineations for site in San Marcos. Prepared the BTR and vernal pool mitigation plan. Prepared and obtained federal and state permits for impacting wetlands and endangered species.

**City of San Diego, Department of Parks and Recreation First San Diego River Improvement Plan, San Diego County, CA.** Served as assistant project manager of quantitative monitoring, data synthesis, and report preparation for the riparian vegetation of the rechannelized San Diego

River. Monitored multiple phases of growth, and assessed project success against agency-established criteria. Botanical monitoring consisted of vegetation transects, herbaceous and freshwater marsh quadrats, tree measurements, and foliage height diversity.

**Caltrans Biological Studies for Road Improvements, Riparian Mitigation Plans, San Diego County, CA.** Served as independent biological consultant for Caltrans. Conducted botanical surveys and habitat mapping for impact analysis and mitigation design for road and highway improvements in San Diego, working under CEQA and NEPA regulations. Managed three monitoring programs for riparian revegetation on the San Diego and Sweetwater rivers. Supervised planting of riparian revegetation site on the San Diego River.

**Bureau of Land Management Burro Creek Riparian Habitat Restoration for Recovery of the Mexican Black Hawk, Kingman, AZ.** As volunteer biologist, conducted vegetation and stream dynamics surveys for suitability of riparian habitat restoration along an approximately 20-mile reach of Burro Creek in Central Arizona. Responsibilities also included implementation of cottonwood riparian forest restoration, periodic avian surveys, and preparation of a habitat restoration report for Burro Creek.

### Vernal Pool Ecology and Restoration

**County of San Diego, Department of Planning and Land Use, Ramona Vernal Pool Conservation Study, San Diego County, CA.** As senior biologist, conducted a comprehensive study of vernal pools in Ramona to document biological functions, quality, diversity, and distribution of vernal pools and pool complexes to determine conservation priorities. Designed sample parameters and methods for vernal pool assessments, conducted rare plant surveys, and created a database for GIS modeling, mapping, and analysis. The Ramona Vernal Pool Conservation Study has been integrated into the larger North County MSCP to identify conservation priorities consistent with regional planning efforts.

**San Diego County Department of Public Works Ramona Air Center Vernal Pool and Sensitive Plant Survey.** As a biologist, conducted vernal pool survey on a future expansion of the aviation services for the Ramona Airport. A 50-acre area was evaluated for sensitive plant species and vernal pools by different criteria to justify their being classified as such; US Army Corps of Engineers (1997), Bauder and McMillan (1998) and Draft North County Multiple Species Conservation Plan.

**NAVFAC Southwest MCAS Miramar Vernal Pool Restoration and Enhancement Plan, San Diego County, CA.** As project manager, prepared and implemented a detailed restoration and enhancement plan for 90 vernal pool basins on four sites at MCAS Miramar. Primary goal was to restore or enhance habitat for the endangered San Diego mesa mint and fairy shrimp in areas that had been degraded by past disturbance. The 5-year maintenance and monitoring program has been successfully completed. The program included monitoring of hydrology, flora, and fauna for the restored pools and adjacent control pools, and measures to maintain and protect the restoration site.

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**County of San Diego Department of Public Works Ramona Airport IHMP, San Diego County, CA.** As senior biologist, contributed to an integrated habitat management plan for the Ramona Airport property. This work included conducting detailed vernal pool surveys using GPS equipment, identifying basins by indicator plant species, directing fairy shrimp surveys (dry and wet season), and performing jurisdictional wetlands delineations. Land management to integrate these resources and protect them in perpetuity was the focus of the plan. Conducted intensive mitigation site search for vernal pool properties and developed mitigation plans for vernal pool and wet meadow restoration.

**City of San Diego McAuliffe Park, San Diego County, CA.** As senior biologist, conducted detailed vernal pool delineations, vegetation mapping, and surveys for rare, threatened, and endangered plant species for a proposed City of San Diego Recreational Park. Prepared a biological technical report and biology sections for the Draft EIR.

**MCI Telecommunications Vernal Pool Restoration along Kearny Villa Road, San Diego County, CA.** Managed the monitoring phase of a restoration plan and implementation program for vernal pools of the F-series in the community of Mira Mesa in San Diego. The project involved inoculum collection and reapplication from adjacent vernal pool systems; and seed collection and seeding of two federally endangered vernal pool plant species, San Diego mesa mint and San Diego button celery, according to USFWS protocol. Conducted long-term hydrological and vegetation monitoring, including preparation of the annual report to the ACOE, USFWS, and CDFG. The project was successfully completed in the year 2000, with pools maintaining an increasing population of San Diego fairy shrimp and San Diego mesa mint.

**The Environmental Trust West Otay Mesa Vernal Pool Delineation, San Diego County, CA.** As biologist, conducted and managed field investigations to characterize and map vernal pools, and to identify the potential and techniques for restoration. Coordinated with resource agencies to establish a vernal pool mitigation bank. Used GPS for detailed mapping and input into GIS.

**Metropolitan Water District of Southern California Metropolitan Mitigation Site, Riverside County, CA.** As biologist, conducted field investigations to establish existing conditions and annual monitoring of a preserve containing various unique wetland habitats and endangered plant species. Investigations included floral surveys, habitat mapping of vernal pools and alkali playa, soils profiling, and identification of restoration potential for alkali playa and associated endangered plant species.

**NAVFAC Southwest Chollas Heights and Murphy Canyon Vernal Pool Restoration Plan, San Diego County, CA.** As biologist, designed and managed field investigations to delineate vernal pools and identify restoration approaches on two San Diego vernal pool preserve sites used to mitigate impacts from a planned Navy family housing project. Prepared a comprehensive vernal pool restoration and management plan.

**NAVFAC Southwest MCAS Miramar BAs, San Diego County, CA.** As biologist, delineated vernal pools, and associated rare plant and animal species, which might have been impacted when NAS Miramar was realigned as a Marine Corps air station. Prepared a vernal pool restoration and management plan for NAS Miramar in support of the BA.

**BTR and Vernal Pool Mitigation Plan, San Diego County, CA.** As biologist, prepared BTR and vernal pool mitigation plan for San Marcos site. Conducted vernal pool survey and delineated wetlands using the federal method.

**City of Chula Vista Rancho del Rey Specific Plan Area III Vernal Pool Mitigation Plan, San Diego County, CA.** As biologist, developed detailed mitigation plan for restoration and enhancement of vernal pool habitat in Chula Vista.

**Baldwin Corporation Vernal Pool Study of Otay Ranch, San Diego County, CA.** Served as assistant project manager for detailed study of the hydrology and flora of more than 900 vernal pools in Chula Vista.

**NAVFAC Southwest Vernal Pool Management Plan, MCAS Miramar, San Diego County, CA.** As biologist, conducted botanical surveys of all vernal pool groups on MCAS Miramar, and assisted in development of management plan to protect vernal pool resources in a multiple-use system.

## International Projects

**San Diego State University Tropical Coastal Ecosystem Study, Master's Thesis, El Estacion de Biologia Chamela, México.** Conducted a study on the interactions between tropical trees and their insect herbivores during dry- and wet-season periods. Worked closely with local residents of Jalisco and students from Mexico City.

## Publications

Hendricks, B.J. 1987. *Abundance and damage of a Mexican harlequin bug, Murgantia varicolor, on plants of different age and sex in the dioecious tree, Forchhammeria pallida*. Abstracts from the American Association for the Advancement of Science Conference, San Diego. (Best Student Presentation Award).

Hendricks, B.J. and J.P. Rieger. 1988. *Description of nesting habitat for least Bell's vireo in San Diego County*. Proceedings of the California Riparian Systems Conference, Davis, California.

Hendricks, B.J. 1988. *Effects of sex and age of a tropical tree Forchhammeria pallida on herbivory by the pentatomid bug Murgantia varicolor*. Ecological Society of America Program and Abstracts 69 (2): 166, Davis, California.

Hendricks, B.J. 1990. *Interactions between a tropical dioecious tree Forchhammeria pallida (Capparaceae) and its herbivore Murgantia varicolor (Hemiptera: Pentatomidae)*, M.S. Thesis. San Diego State University.

AECOM

Hendricks, B.J. and B.D. Collier. 2003. *Effects of sex and age of a dioecious tree, Forchhammeria pallida (Capparaceae) on the performance of its primary herbivore, Murgantia varicolor (Hemiptera: Pentatomidae)*. Ecological Research 18 (3), 247-255.

# John Parent
## Wildlife Biologist

**Education**
B.S., Biology, California State University Fullerton, Fullerton, CA, 2012
A.S., Biological Sciences, Santiago Canyon College, Orange, CA,2008

**Additional Training/Accreditation**
Southwestern Willow Flycatcher Training, 2015
Advanced Bird Banding Workshop, 2013
Desert Tortoise Surveying, Monitoring, and Handling Techniques Workshop, 2012
Cactus Wren Habitat Assessment and Surveying Workshop, 2012

**Permits/Professional Licenses**
California Department of Fish and Wildlife Scientific Collecting Permit (SCP-12695), EXP 08/2016

**Professional History**
AECOM
2014 – Present
Great Basin Institute
2014
ICF
2013-2014
Chamber's Group
2012-2013
Leatherman BioConsulting
2012-2013

John Parent has 4 plus years of experience as a wildlife biologist and construction monitor. He has experience in conducting habitat assessments, focused surveys for Burrowing owl, Least Bell's vireo, Giant garter snake, and Arroyo toad, and invasive species mitigation. He has assisted permitted biologists during protocol surveys for California gnatcatcher and California desert tortoise. Mr. Parent has also conducted construction monitoring which included monitoring for sensitive species, such as Western pond turtle and Unarmored three-spined stickleback.. He has assisted clients in understanding and complying with regulations that govern impacts to sensitive plant and wildlife species and natural communities. Mr. Parent has also managed and maintained an invasive species trapping program throughout Central Orange County.

### Project Experience

**Silver Lake Reservoir Complex Storage Replacement Project, Los Angeles Department of Water and Power, Los Angeles, Ca**
As biologist, conducted nesting bird surveys and monitoring of great blue heron (*Ardea herodias*) rookery at the Silver Lake Reservoir Complex, during project construction occurring at the reservoir complex. Assisted in the preparation of a Red-eared slider relocation plan, and performed live trapping in support of the plan. Prepared daily and monthly monitoring reports and provided regular field updates to client project manager. [03/15-present]

**Wildscape Restoration, Biological Monitoring of Arundo Removal, Arroyo Simi, Ventura County, CA**
As biologist, monitored the removal of arundo (*Arundo donax*) and other invasive tree species in riparian habitat along Arroyo Simi. Species of concern in the area included least Bell's vireo, southwestern willow flycatcher (*Empidonax traillii extimus*), arroyo toad (*Anaxyrus californicus*), unarmored three-spined stickleback (*Gasterosteus aculeatus williamsoni*), two-striped garter snake (*T. hammondii*), and Western pond turtle (*Emys marmorata*). Project activities included the removal of debris associated with homeless camps located throughout the project area. Identified sensitive biological resources to be avoided and monitored for compliance with conditions identified in agency permits. Monitored the application of herbicides to avoid inadvertent loss of native vegetation. [Prior to AECOM; 01/2013 – 03/2013]

**Resource Conservation Partners, Santa Clarita Arundo Removal Project, Santa Clara River, Santa Clarita, Los Angeles County, CA**
As biologist, monitored the daily operation of arundo and tamarisk removal. Species of concern in the area included least Bell's vireo, southwestern willow flycatcher, arroyo toad, unarmored three-spined stickleback, and Western pond turtle. Identified acceptable access routes to ensure avoidance of sensitive biological resources. Monitored herbicide application to avoid inadvertent loss of native vegetation. Documented compliance with all measures identified by the resource agencies. [Prior to AECOM; 09/2012 – 11/2012]

**San Bernardino County Department of Public Works, Twenty-Nine Palms Storm Channel Repair Project, San Bernardino County, CA**
As biologist, conducted biological monitoring during the repair and construction of 9 miles of storm channel near Twenty-Nine Palms. Daily pre-construction sweeps were conducted to ensure that no impacts to desert tortoise (*Gopherus agassizii*) or other wildlife occurred. [Prior to AECOM; 04/2013 – 06/2013]

**San Bernardino County Department of Public Works, Twenty-Nine Palms Storm Channel Repair Project, San Bernardino County, CA**
As biologist, conducted biological monitoring during the repair and construction of 9 miles of storm channel near Twenty-Nine Palms. Daily pre-construction sweeps were conducted to ensure that no impacts to desert tortoise or other wildlife occurred. [Prior to AECOM; 04/2013 – 06/2013]

**Southern California Edison, West of Devers Interim Project, San Bernardino County, CA**
As biologist, conducted construction monitoring and prepared daily monitoring reports during construction of a temporary substation at the West of Devers facility. Provided daily desert tortoise awareness and permit compliance training for all construction personnel on-site. [Prior to AECOM; 02/2013]

**San Bernardino County Department of Public Works, Harper Lake Road Resurfacing Project, San Bernardino County, CA**
As biologist, conducted construction monitoring for desert tortoise along Harper Lake Road during the demolition and resurfacing of a 7-mile stretch of the road north of State Route 58. Monitoring was conducted along sections of the road that did not have tortoise fencing and in areas where gaps in the tortoise fencing occurred at road intersections to ensure that no impacts to desert tortoise occurred. [Prior to AECOM; 11/2012 – 12/2012]

**San Joaquin River Restoration Program, Bureau of Reclamation, Fresno County, Ca**
As biologist, conducted protocol-level surveys for least Bell's vireo (*Vireo bellii pusillus*), pre-construction nesting bird surveys, and project construction monitoring for least Bell's vireo and giant garter snake (*Thamnophis gigas*) in support of river reclamation project. Prepared daily monitoring reports and coordinated with US Fish & Wildlife regarding potential impacts to nesting birds and special-status species. Coordinated with land owners regarding access for survey and monitoring efforts. [04/2015-present]

**McKittrick Landfill Expansion Project, Waste Management, Kern County, Ca**
As biologist, provided a Worker Environmental Awareness Program (WEAP) training, performed habitat assessment, pre-construction nesting bird surveys, and construction monitoring. Monitored for, collected, and relocated silvery legless lizard (*Anniella pulchra pulchra*) that were disturbed as a result of construction activities. Prepared biological assessments and daily monitoring reports. [01/2015 – 02/2015]

**Mill Creek Hydroelectric Decommissioning Project, Southern California Edison, Mountain Home, Ca**
As biologist, conducted daily pre-construction sweeps for sensitive species, specifically the Mountain yellow-legged frog, and monitored construction activities during the demolition of hydroelectric facilities within Mill Creek and adjacent habitat. [12/2014 – 01/2015]

**Southern California Edison, Arrowhead–Strawberry Peak Fiber Optic Cable Project, San Bernardino, CA**
As biologist, conducted daily pre-construction sweeps for nesting birds and for the southern rubber boa (*Charina umbratica*). Monitored construction activities during the installation of a fiber-optic cable in the San Bernardino Mountains, through both public and private lands. [Prior to AECOM; 07/2013 – 08/2013]

**CarbonLite, Springbrook Wash Hazardous Waste Clean-Up, Riverside, CA**
As bioloigst, conducted vegetation surveys, nesting bird surveys, and arroyo toad surveys, as well as construction monitoring during hazardous waste clean-up activities. Assisted in preparing daily monitoring reports and assisted with project coordination with the California Department of Fish and Wildlife and the Environmental Protection Agency. [Prior to AECOM; 03/2012]

**Atkinson-Walsh Joint Venture, SR-91 Improvements Project, Orange and Riverside Counties, CA**
As biologist, conducted biological monitoring for compliance with California Department of Fish and Wildlife Streambed Alteration Agreement protection/mitigation measures. Provided protocol level Least Bell's vireo surveys and nest monitoring. Provided nesting bird surveys for compliance with the Nesting Bird Management and Monitoring Plan. Provided compliance monitoring support on both day and night shifts to prevent potential delays in the construction schedule, surveyed scheduled work areas prior to active construction, and monitored throughout construction to determine if nesting birds or other sensitive species were present. Monitored active vegetation removal during the nesting bird season within the project right-of-way to prevent wildlife endangerment. Prepared daily monitoring reports that

summarized field monitoring and survey methodologies and results, reported any nesting behavior, and coordinated with U.S. Fish and Wildlife and California Department of Fish and Wildlife. Reports were submitted to the Agencies on a weekly basis. [06/2015 – Present]

**Kiewit, I-405 Sepulveda Pass Widening, Los Angeles, CA**
As biologist, conducted biological monitoring for compliance with California Department of Fish and Wildlife Streambed Alteration Agreement protection/mitigation measures. Provided protocol level Least Bell’s vireo surveys. Provided nesting bird surveys for compliance with the Nesting Bird Mitigation/Monitoring Plan. Also provided compliance monitoring support on both day and night shifts to prevent potential delays in the construction schedule. Surveyed scheduled work areas prior to active construction, and monitored throughout construction to determine if nesting birds or other sensitive species were present. Monitored active vegetation removal within the project right-of-way to prevent wildlife endangerment. Prepared monitoring reports that summarized field monitoring and survey methodologies and results, and reported any nesting behavior. Reports were submitted to the California Department of Fish and Wildlife on a monthly basis. [Prior to AECOM; 03/2012 – 06/2013]

Thomas Sullivan
Environment
April 2016

Ontario, CA

# Thomas Sullivan
# Biologist

**Education**

B.S., Biology, University of California, Riverside
Relevant Courses Include: Animal Behavior, Ecology and Conservation Biology, Plant Anatomy, Restoration Ecology, Spring Wildflower Identification, Taxonomy of Flowering Plants, and Vertebrae Anatomy

**Years of Experience**

With AECOM 3

**Technical Specialties**

Global Positioning System equipment including Trimble, Garmin, and more

Extensive 4X4 manual/automatic transmission truck/SUV/trailer and ATV/UTV operation experience

Microsoft Windows 98, 2003, 2007, Vista, iOS and Mobile OSs

Analog compass

Two way communication radios

**Training and Certifications**

Desert Tortoise Council Handling and Field Techniques Workshop
Qualified Stormwater Practitioner (QSP) Trained
CPR/AED Certified/Trained (American Red Cross)

40-Hour HAZWOPER Trained

HAZWOPER Medical Exam

Behavior Based Safety Training Module 1&2

Driver & Vehicle Safety Awareness Trained

Natural Biological Hazards

Mr. Sullivan has approximately 3 years of experience in biological resources support and environmental impact analysis. He has provided biological monitoring in support of vegetation relocation efforts and construction activities. Mr. Sullivan has conducted habitat assessments and biological resource surveys; including, sensitive plant surveys and electro-shocking and fish trapping, he has prepared biological technical reports and environmental assessments, as well as contributed to environmental costing exercises. He has conducted field work in southern California and Nevada and he has a working knowledge and an understanding of naturalized southern California plant communities and native wildlife.

**AECOM Experience**

**Beacon Solar Energy Project, Los Angeles Department of Water and Power, Kern County CA.** Provided biological services in support of developing a 250 MW solar thermal power plant in the Mojave Desert, Kern County, California. The proposed project would use photovoltaic panels to produce electrical power. Due to the large acreage required for the project, potential impacts and mitigation for biological resources were major issues. Biological services provided include protocol-level presence absence and clearance surveys for desert tortoise; protocol-level clearance surveys for western burrowing owl and desert kit fox, including the installation of passive relocation equipment, monitoring of passive relocation, and scoping and excavation of cleared burrows; pre-construction nesting bird surveys; and monitoring sensitive biological resources during construction activities.

**Southern California Edison, Mill Creek Amphibian Presence/Absence Survey and Biological monitoring for Mill Creek 2 Decommissioning, Mill Creek, San Bernardino County, CA.** Provided Amphibian presence/absence surveys. Survey was for a portion of Mill Creek that will be impacted by foot travel. Monitored deconstruction of concrete structures and pipeline in aquatic and riparian habitat.

**United States Navy, Unexploded Ordinance Survey Biological Monitor, Former Salton Sea Test Base, Imperial County, CA.** Provided Biological monitoring for unexploded ordinance survey along 4.5 mile stretch of shoreline on the former Salton Sea Test Base. Monitored for biological resources during the installation of 10 signs throughout the former Salton Sea Test Base.

**Southern California Edison, Alberhill System Project Focused Sensitive Plant Surveys, Riverside County, CA.** Conducted sensitive plant surveys for the proposed Substation, 500kV transmission and 115kV subtransmission alignments. This included surveying for and mapping criteria area and narrow

Awareness Trained
Fire Extinguisher Safety Awareness Trained

endemic sensitive plant species identified in the Riverside County Multiple Species Habitat Conservation Plan using a Trimble Juno GPS. Assisted with development and writing of the Biological Resources Technical Report for the project.

**Southern California Edison, Lytle Creek Fish Relocation, Lytle Creek, San Bernardino County, CA.** Provided assistance with electro-shocking and fish trapping to capture fish and release back into Lytle Creek upstream of the SCE facility along Lytle Creek. Fish species relocated include rainbow trout and speckled dace.

**Chevron Environmental Management Company, Habitat Assessment for Well Abandonment, Temecula, Riverside County, CA.** Performed a habitat assessment for riparian/riverine vegetation, vernal pools and vernal pool vegetation, sensitive fairy shrimp, sensitive riparian bird species, and burrowing owl.

**Southern California Edison, On-Call Biological Services Agreement, Various Locations, CA.** Provided on-call biological support to various SCE projects, including habitat assessments for sensitive plant species and fairy shrimp species, burrowing owl, coastal California gnatcatcher, Quino checkerspot butterfly, western spadefoot, and Stephen's kangaroo rat. Co-authored several habitat assessment reports.

**Southern California Edison, Eldorado-Ivanpah Transmission Project, southern Nevada and eastern California.** Conducted Nevada state-protected succulent plant surveys to identify quantity and distribution of plant species. Monitored succulent transplantations to ensure plants were not overlooked or destroyed during relocation; responsibilities included tagging and mapping the relocated plant locations, recording plant tag numbers, species identification and health status along a 70-mile stretch of transmission alignment. Data collection was conducted using a Trimble Juno GPS.

# Michael S. Zerwekh
## *Wildlife Biologist*

**EDUCATION**

- B.A., Biology – University of Kansas, 2006

**PROFESSIONAL HISTORY**

- **Wildlife Biologist,** Garcia and Associates, Oceanside, CA, June 2014 - Present
- **Staff Biologist,** Pangea Biological, Encinitas, CA, February 2014 – June 2014
- **Wildlife Biologist,** Garcia and Associates, Oceanside, CA, October 2011 – March 2013
- **Environmental Biologist,** PAR Electrical Contractors/Greenstone Environmental, November 2010 – September 2011
- **Biological Field Technician**, Garcia and Associates, May 2010 – November 2010
- **Volunteer Field Biologist,** University of Kansas, Kansas Biological Survey, May 2009 – May 2010
- **Herpetologist,** Western Riverside County Biological Monitoring Program (MSHCP), Riverside, CA, May 2008 – May 2009

**PROFESSIONAL PROFILE**

Mr. Zerwekh is a wildlife biologist and environmental compliance specialist with six years of professional experience conducting wildlife surveys and environmental compliance monitoring throughout southern California. He specializes in herpetology, and has surveyed for sensitive species such as the California red-legged frog, arroyo toad, western pond turtle, desert tortoise, Coachella Valley fringe-toed lizard, and flat-tailed horned lizard, as well as nesting birds, burrowing owl, and desert kit fox. Mr. Zerwekh has also worked as an on-site environmental compliance monitor on several high-profile construction projects, including the Tehachapi Renewable Transmission Project (TRTP), Devers to Palo Verde No. 2 Transmission Line (DPV2), Pipeline Safety Enhancement Plan (PSEP), and Sunrise Powerlink. During his time as a professional wildlife biologist, Mr. Zerwekh has become well-acquainted with field collection techniques, USGS and MSHCP protocols, the Migratory Bird Treaty Act, FESA/CESA, and NEPA/CEQA guidelines.

**SELECTED PROJECT EXPERIENCE**

**Pipeline Safety Enhancement Plan (April 2015 - Present) Los Angeles, Riverside, and Imperial Counties, CA.**
Mr. Zerwekh is currently a wildlife biologist and on-site environmental compliance monitor during natural gas pipeline inspection and replacement activities. Responsibilities include pre-construction surveys and monitoring for sensitive biological resources, including the Coachella Valley fringe-toed lizard, flat-tailed horned lizard, desert tortoise, desert kit fox, burrowing owl, and other nesting birds, insuring that appropriate BMPs are used, and submitting reports.

**SDG&E On-call Monitoring (March 2015 - Present) MCB Camp Pendleton, San Diego County, CA**
Mr. Zerwekh is currently an on-call wildlife biologist and on-site environmental compliance monitor during SDG&E operations and maintenance activities at MCB Camp Pendleton. Responsibilities include pre-construction surveys and monitoring for nesting birds and other wildlife, insuring that appropriate BMPs are used, and submitting reports.

**Pardee-Vincent #2 Re-conductor Project (December 2014 - October 2015) Los Angeles County, CA**
Mr. Zerwekh conducted protocol-level pre-construction habitat assessments and surveys for the California red-legged frog as part of Southern California Edison's Pardee-Vincent #2 Re-conductor Project. Responsibilities included leading protocol CRLF habitat assessments and surveys, and writing reports. Mr. Zerwekh was also an on-site environmental compliance monitor during construction activities. Responsibilities included conducting daily clearance sweeps and monitoring for California red-legged frog, arroyo toad, and nesting birds.

**Tehachapi Renewable Transmission Project (June 2014 - Present) Los Angeles and San Bernardino Counties, CA**
Mr. Zerwekh is currently a wildlife biologist and on-site environmental compliance monitor during construction of a 500 kV transmission line in Angeles National Forest, and a 3.5-mile underground 500 kV transmission line in Chino Hills, California. Responsibilities include monitoring for sensitive biological resources, including the arroyo toad, California red-legged frog, nesting birds, and special-status trees and plants, monitoring habitat restoration activities, and submitting daily reports. Mr. Zerwekh has been approved for monitoring within California red-legged frog and arroyo toad-occupied habitat for this project.

**Pangea Biological (February 2014 - Present) San Diego County, CA**
Mr. Zerwekh was a staff biologist and biological compliance monitor for several SDG&E operations and maintenance projects. Responsibilities included conducting pre-activity surveys for NCCP-covered wildlife and plants, writing pre-activity survey reports, and serving as an on-site environmental compliance monitor during construction activities. Mr. Zerwekh also attended the 2014 Arroyo Toad Workshop, and volunteered on protocol-level arroyo toad surveys with the United States Geological Survey.

**DPV2 Transmission Project (October 2011 – November 2012) Riverside County, CA**
Mr. Zerwekh was a wildlife biologist and on-site biological compliance monitor during construction of the Devers to Palo Verde No. 2 transmission line. Responsibilities included performing protocol-level pre-construction surveys and habitat assessments for sensitive biological resources, including the Coachella Valley fringe-toed lizard, flat-tailed horned lizard, desert tortoise, desert kit fox, nesting birds, and rare plants, and monitoring for biological compliance during construction activities.

**SDG&E Helicopter Pad Installation (April 2012 – June 2012) San Diego County, CA**
Mr. Zerwekh was a wildlife biologist and on-site biological compliance monitor during

helicopter pad installations near Fallbrook, CA. Responsibilities included monitoring for nesting birds and other wildlife, and documenting compliance-related issues. Mr. Zerwekh also received Range Safety Officer (RSO) training at Camp Pendleton Marine Corps Base.

**Sunrise Powerlink (November 2010 – September 2011) San Diego and Imperial Counties, CA**
Mr. Zerwekh was an environmental biologist and on-site compliance monitor during construction of the Sunrise Powerlink transmission line. Responsibilities included BMP and SWPPP inspections, spill clean-ups, and coordinating with other environmental compliance monitors to resolve compliance-related issues. Mr. Zerwekh also received training in identification and handling of flat-tailed horned lizards from the California Department of Fish and Wildlife.

**Alta-Oak Creek Wind Development Project (May 2010 – November 2010) Kern County, CA**
Mr. Zerwekh was a biological field technician and on-site environmental compliance monitor during construction of a wind farm. He performed protocol-level pre-construction surveys for desert tortoises and rare plants at proposed sites for wind turbines, and was also an on-site biological and environmental compliance monitor for desert tortoises during construction activities.

**CH2MHill/PG&E Yolo Pipeline Line 406 Project (May 2010 – July 2010) Yolo County, CA**
Mr. Zerwekh was a biological field technician and on-site environmental compliance monitor during construction of a natural gas pipeline. He performed protocol-level pre-construction surveys for raptors and burrowing owls, and was also an on-site environmental compliance monitor during construction activities for sensitive biological resources, including wetlands, vernal pools, burrowing owls, Swainson's hawk, California tiger salamander, and giant garter snake.

**Western Riverside County Biomonitoring Program (May 2008 – May 2009) Riverside County, CA**
Mr. Zerwekh performed USGS and MSHCP protocol-level surveys for sensitive biological resources within the Western Riverside County MSHCP, including the arroyo toad, western pond turtle, California red-legged frog, and other native and introduced herpetofauna. He also assisted with trapping surveys for Stephen's kangaroo rat, and carnivore tracking surveys.

## TRAINING AND WORKSHOPS

- 2014 Arroyo Toad Workshop
- Range Safety Officer (RSO) Training – Camp Pendleton Marine Corps Base
- 2011 Desert Tortoise Council Workshop – Introduction to Surveying, Monitoring, and Handling Techniques

## PROFESSIONAL MEMBERSHIPS

- Society for the Study of Amphibians and Reptiles

**PUBLICATIONS**

*Observations of cavity roosting behavior in Costa Rican Lophostoma brasiliense (Chiroptera: Phyllostomidae).* Published in Mammalian Biology, vol. 73/3, pp. 230-232.

*A Field Study of the Timber Rattlesnake in Leavenworth County, Kansas*, Published in September 2004 edition of the Journal of Kansas Herpetology, pp. 18-24.

*Large Northern Water Snake (Nerodia sipedon) from Kansas,* Published in September 2003 edition of the Journal of Kansas Herpetology, p. 12.

# Appendix D (CONFIDENTIAL)

# 2012 Golden Eagle Survey Report

# Appendix E (CONFIDENTIAL)

# 2018 Golden Eagle Survey Report

# Appendix F

## 2012 Nocturnal Avian Radar Monitoring Report

# Spring Avian Nocturnal Migration Surveys for the Sonoran West Solar Energy Project, Riverside County, California

HAMER ENVIRONMENTAL
Innovative Solutions to Natural Resource Issues

**Prepared by:** Joshua Stumpf, Nathalie Denis and Tom Hamer

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Mount Vernon, WA 98273
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**August 17, 2012**

**EXECUTIVE SUMMARY**


- This report presents the results of a radar study of nocturnal bird migration conducted for URS at the Sonoran West Solar Energy Project, located in Riverside County, California.
- Radar observations were conducted from sunset until sunrise each night.
- The focus of the survey was to collect baseline information on nocturnal migrating passerines and waterfowl.
- We found that the average hourly passage rate for both sites combined during spring 2012 surveys was 3.5 targets/7.1 $km^2$/hr.
- The mean flight speed of targets during the survey period for both survey sites combined was 9.4 m/s (21.0 miles per hour).
- The mean flight direction for all fall migratory targets was 6 degrees (northerly); 115degrees at Site 1 and 264 degrees at Site 2.
- Mean nocturnal flight altitude during the spring of 2012 across all survey hours and both survey locations was 320± 0.6m (1,050± 2 ft) above ground level.
- 33.6% of targets detected on the vertical radar were recorded below 229 meters.
- The mean passage rates in this area are orders of magnitude less than those reported at other wind energy developments during pre-construction surveys. When coupled with the low number of proposed towers (2-3) and the lack of moving parts (turbine blades) in comparison to a wind energy development, it is unlikely that this development poses a high risk to migrating birds.

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## INTRODUCTION

The purpose of this nocturnal avian radar survey was to characterize spring avian migration over the solar resource area and provide data that can be used to determine the relative magnitude of nocturnal migration over the area when compared to other sites. This included collecting baseline information on flight direction, passage rates, and flight altitude of nocturnal migrants at representative sampling locations within the proposed development boundaries. The specific radar sampling locations were chosen to: 1) maximize the detectability of birds in a 360º circle around the radar; 2) minimize ground clutter; 3) maximize coverage of the project area and; 4) efficiently sample the diversity of habitats and topography within the area.

## STUDY AREA

The proposed Sonoran West Solar Energy Project is located near the town of Blythe, in Riverside County, California (Figure 1). The proposed project is east of Blythe, north of the Mule Mountains and south of Interstate 10. The surrounding habitat is primarily composed of dry Sonoran Desert habitat, ranging in elevation from approximately 125 m (410 ft) to 283 m (928 ft) above sea level. The area receives an average of 8 cm (3 in) of rain per year.

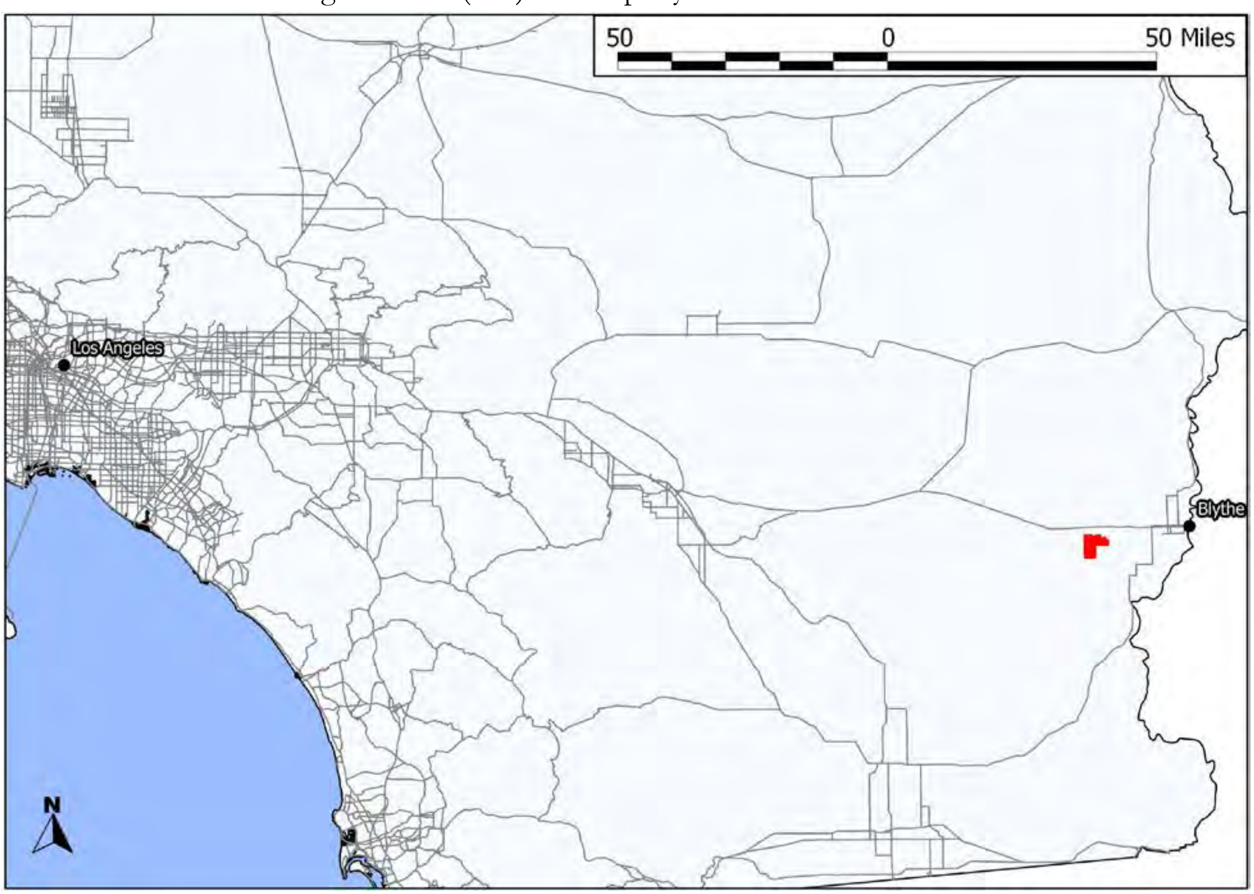



**Figure 1. Map of the surrounding area including the Sonoran West Energy Project (in red), Riverside County, CA**

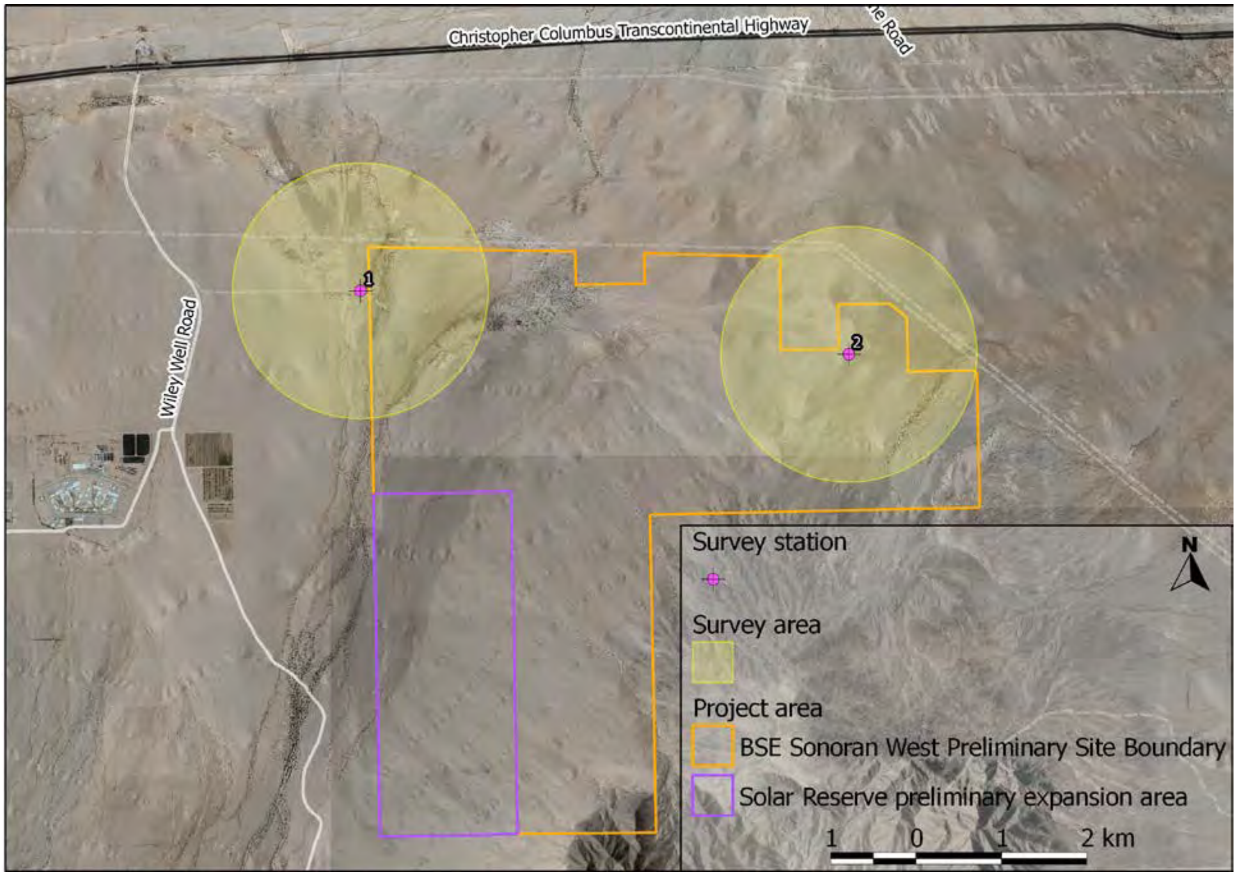



**Figure 2. Radar survey locations (including 1.5 km radius survey coverage) used to measure nocturnal bird migration at the Sonoran West Solar Energy Project, Riverside County, CA**

## METHODS

The nocturnal avian migration monitoring followed the protocol and methodology guidance contained in the "National Wind Siting Committee Nocturnal Monitoring Methods" document (Kunz et al. 2007) which recommends that a radar unit be deployed for 30-45 days within a given migration season (i.e. Spring or Fall). As a result, we deployed two radar units within the proposed solar project area during part of the spring migration season, defined as 9 April – 1 June 2012. However, due to the large size of the project area, sampling time was split between two survey stations to cover a larger proportion of the solar project area (Figure 2; Table 1). The mobile radar lab consisted of two marine radar units mounted on a 4wd pickup/mobile radar lab (Figure 3). The radars used were Furuno 1510 (X-band) transmitting at 9,410 MHz, and with a power output of 12 kW. Each radar was connected to an automated system (XIR3000c from Russell Technologies) and equipped with hard drives in which the migration data were logged every night. The hard drives were backed-up every day and stored securely while outside the project area.

Similar radar labs have been successfully used to monitor nocturnal avian migration and are described in Cooper et al. (1991) and Harmata et al. (1999) and many other recent studies.

**Table 1.** Station locations, elevations, and radar tilt angle from horizontal for each station surveyed 9 April – 1 June 2012.

| Stations | UTM | Elevation (m) | Tilt (degrees) |
|---|---|---|---|
| **Station 1** | 11T 697295/3718034 | 128 | 25 |
| **Station 2** | 11T 703022/3717285 | 141 | 25 |

**Figure 3. Furuno Model FR-1510 Mark 3 modified marine radar units utilized for nocturnal radar sampling, as mounted on a pickup truck camper.**

In surveillance position (horizontal), one radar unit obtained information on flight direction, flight behavior, overall flight path, movement rates (birds/hour [hr]/7.1 $km^2$), and ground speed of birds (km/hr). One limitation of radar is that when radar energy is reflected off of solid objects, such as surrounding landforms and/or trees/shrubs, it creates solid echoes on the radar screen (i.e., ground clutter) making it impossible to detect birds in these areas. Because ground clutter can obscure birds of interest, we carefully selected each of our sampling locations to minimize the amount of ground clutter on our radar screen.

The horizontal scanning array was hinged so that the radar could be tilted upward to reduce the amount of ground clutter on the display and scan more of the surrounding sky. We tilted the radar antennas in increments of 5° with a maximum of 25°. In addition, we added a ground clutter screen to clip the lower radar beam and reflect radar energy from reaching the ground. Because of these modifications and the selection of optimal survey locations, the amount of ground clutter at each station was minor (less than 15%) and likely did not cause us to miss any birds.

Bird targets are not equally detectable throughout the area sampled by the surveillance radar. At further distances (e.g. greater than 1,000 m from the radar) smaller targets may be more difficult to detect than their larger counterparts. In addition, the shape and size of the effective radar sampling beam is not perfectly hemispherical, and can be attenuated by topographic features such as hills. Because of these confounding factors, distance sampling methods cannot be used to correct for any possible decline in detectability with distance.

A second scanning radar was tilted 90 degrees to survey in vertical mode to collect information on bird altitudes across the landscape. The vertical radar was oriented along an east-west axis that was perpendicular to the expected flight paths of migrating birds. The orientation of the vertical radar maximized the probability of detecting migrating birds and measuring their heights as they passed over the project area. For every target, bearing and radial distance from the vertical radar were recorded. The vertical radar data were used to calculate the proportion of birds passing through the area that were flying at or below the height of the proposed solar towers. Both the surveillance radar and vertical radar were operated simultaneously and each collected data throughout each night.

**Data Collection**

The study period for the 2012 spring migration season was 52 nights from 9 April to 1 June 2012 during. Nocturnal radar sampling occurred from (approximately) sunset (~1900) until sunrise (~0600) each night.

As X-band radar systems are effective at detecting small targets, removing insect targets from the data is of primary importance. In order reduce the probability of insect contamination several steps were taken both during data collection and prior to data analysis:

- Targets with poor reflectivity (i.e. targets that appear small, dim, and low-density) were omitted from the analysis (Mabee and Cooper 2004);
- Targets with ground speeds less that 9 m/s were also omitted from analysis (Mabee and Cooper 2004);
- Targets with limited range (i.e. targets only observed 200-300 m from the surveillance (horizontal) radar) were omitted from sampling (Mabee and Cooper 2004).

When used in conjunction, this combination of methods effectively removes most insect targets from the analysis. However, as there is some overlap in flight speed and size between insects and birds, some insect targets may still be present in the data, and some birds may be removed.

Two-sample comparisons of speeds, passage rates, and heights were made using two-sample t-tests with Welch's correction for unequal variance where appropriate. Multi-sample comparisons were made with an Analysis of Variance (ANOVA). Circular data (i.e. flight directions) were compared using a circular analysis of variance (Mardia and Jupp 1999).

# RESULTS

## Survey Effort

Radar sampling took place over 40 nights from 9 April to 1 June 2012. Approximately 360 hours of nocturnal radar sampling was split between the two survey stations. Starting approximately at sunset, the radar survey sessions lasted 9-11 hours (e.g. between ~1900 h and ~0600 h depending on the date) each night to focus on collecting baseline information on nocturnal migrating passerines and waterfowl.

## Passage Rates

Passage rate at the Sonoran West Project was defined as the average number of detected events per square kilometer of radar sampled area per hour (

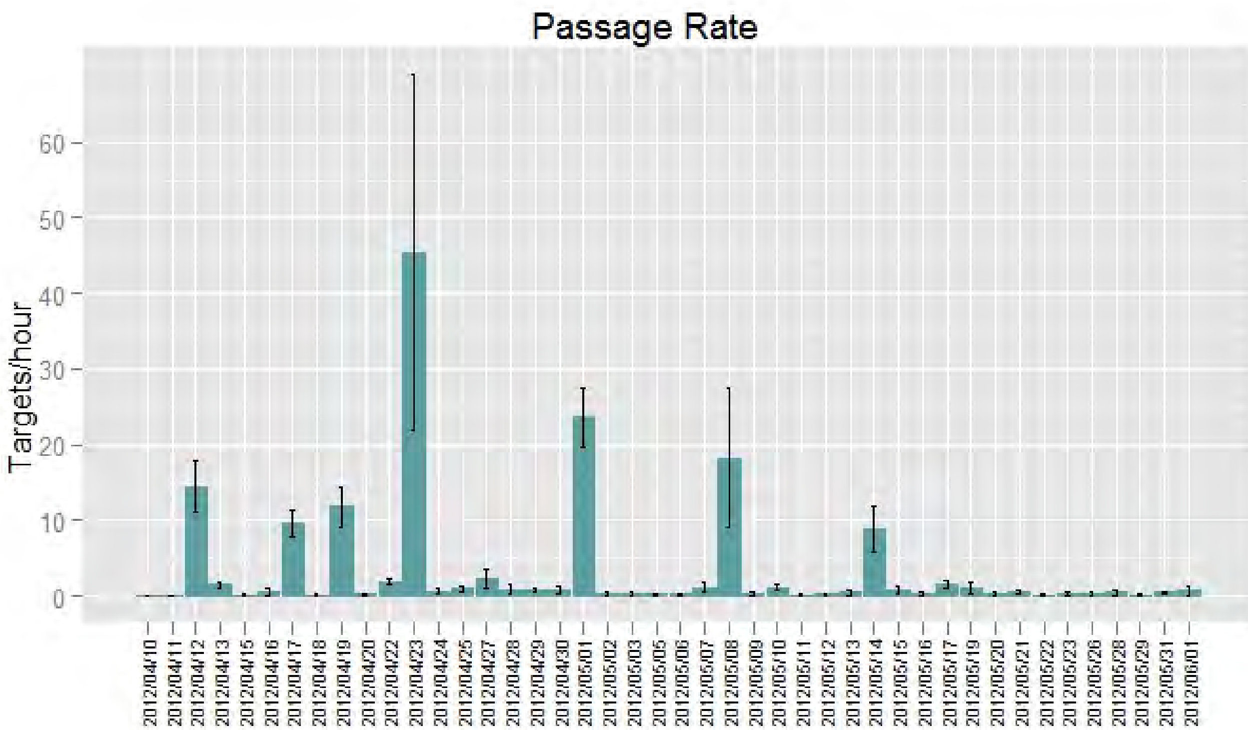



**Figure 4. Mean passage rate (±1SE) of avian targets detected on horizontal radar by survey day during nocturnal survey sessions at both survey stations combined.**

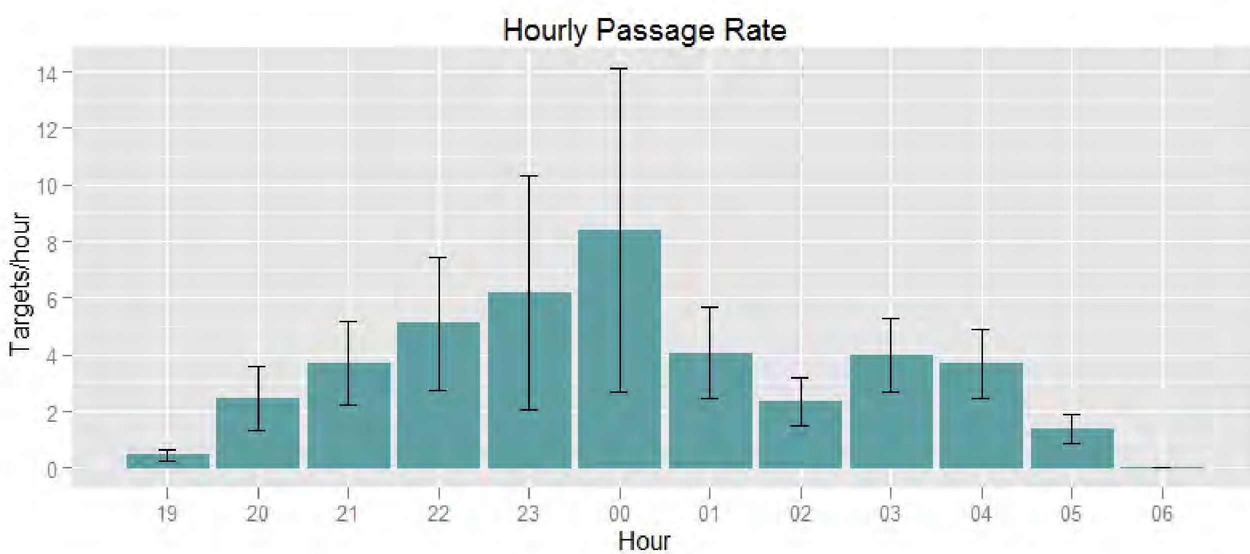



**Figure 5. Mean hourly passage rate (±1SE) of avian targets detected on horizontal radar at both survey locations combined.**

## Flight Direction

Mean flight direction for both sites combined was 6 degrees (northerly): 115 degrees at site 1 and 264 degrees at Station 2. Flight directions were significantly statistically different between the two sites ($p<0.01$; Figure 7)

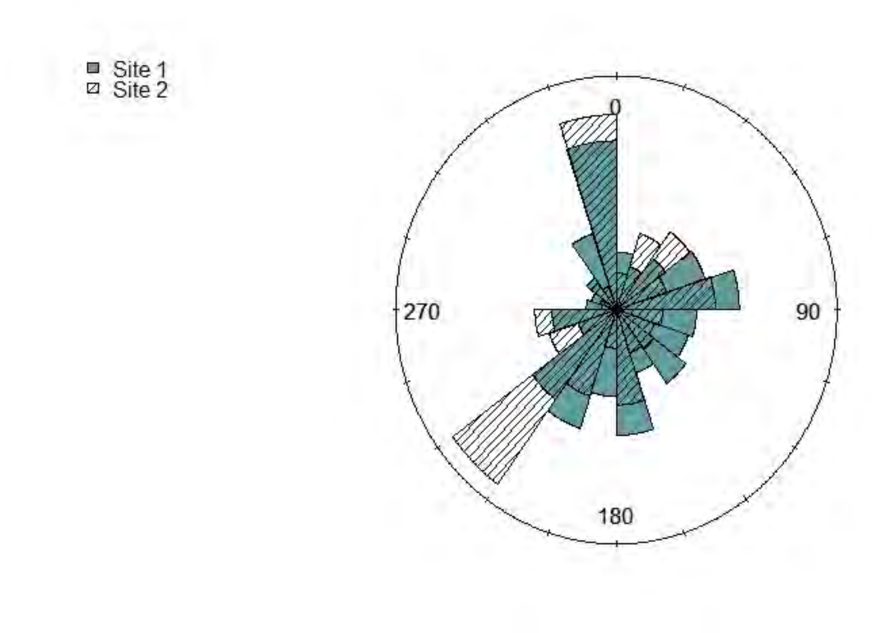



**Figure 6. Rose diagram of flight directions (in degrees) of avian nocturnal migrants on surveillance radar at both radar survey locations.**

## Heights

Target altitudes peaked slightly at 22:00, and the lowest mean heights were recoreded in the early morning hours (Figure 7). Mean target altitude for both sites combined was 320

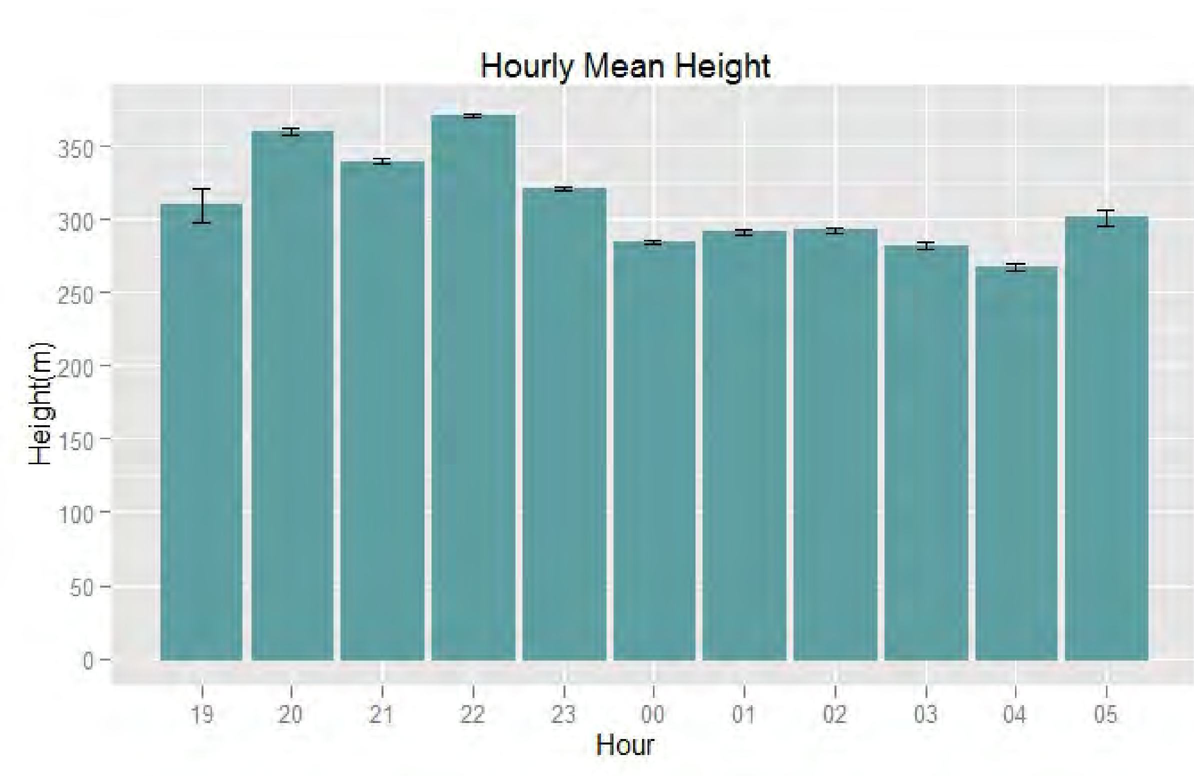



Figure 7. Mean height of targets presented by hour.

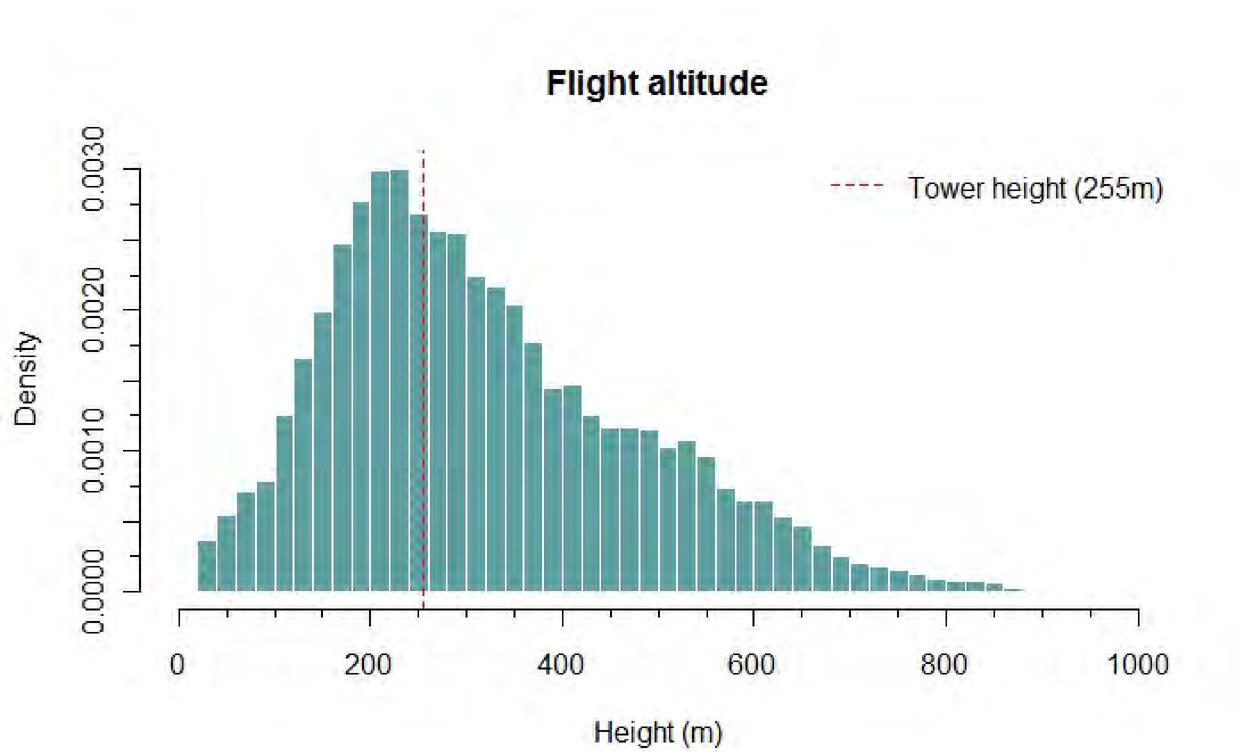



Figure 8. Probability density histogram of targets detected by flight height category in 20 m increments for both survey sites combined. Each bar represents the proportion of the total targets within that height class.

**Flight Speeds**

Mean ground speed of targets from both sites combined was 9.4 m/s. Speeds were slightly higher at Station 1 (13.3 m/s) than at Station 2 (8.8 m/s; $t = 2.1$, $p = 0.03$).

## DISCUSSION

Few nocturnal migration studies have been published from the Sonoran desert ecosystems; so direct comparisons with studies are problematic. Both the study presented here and those performed by Mabee and Copper (2004) in a high desert ecosystem in eastern Washington state recorded similar timing of activity, with passage rates rising early in the evening. In addition, the speeds and height profiles are consistent with those reported in other radar-based studies of nocturnal migration, and the dispersion of flight directions at both stations had a strong northerly component (Mabee et al 2006, Mabee and Cooper 2004, Cooper and Ritchie 1995). Taken together, these indicate that the targets recorded were avian and/or bat targets observed during migration. The peaks of activity early in the survey season, coupled with the lack of activity for the last two weeks of the study indicates that the majority of the migratory activity over the proposed project area was captured by this study.

The difference between the flight altitudes recorded at station 1 and those recorded at station 2 may be attributable to the influence of the nearby Mule Mountains on the behavior of birds as they transit the area. As they transit from south to north, birds may be following the mountain range, while using the agricultural land to the east for stopover sites, food, and refuge. The lack of resources and cover in the desert areas to the west may preclude birds from using the area, resulting in the lower passage rates observed at station 1.

Passage rates reported in this study were much lower than those reported elsewhere in the literature. Studies completed in the Mojave near the Tehachapi Mountains reported targets/km$^2$/hr (NRC and WEST 2011; Hamer Environmental, LP 2010). Throughout North America, estimates of spring passage rate from radar data range from 100 to 509 targets/km$^2$/hr (Mabee et al 2006). It is likely that the low avian nocturnal passage rate reported here (3.4 targets/km$^2$/hr ) is due to the lack of cover, water, and forage needed by migrating birds during daily stop-over's during migration. At radar survey stations 1 and 2, there was a complete lack of water, sparse cover, and a general lack of food for migrating birds due to the dry desert environment. It is expected that most migrating birds through this region would be following the Colorado River northward where there is water, abundant vegetation for cover, more insect activity, and large acreages of agricultural fields for forage.

The 255m height of the proposed solar collection towers at the Sonoran West project area, coupled with the lower mean altitude of migrating birds in the area results in a higher proportion targets below tower height when compared with most other wind energy developments (the most common type of development where these data are often collected). However, the mean passage rates in this area are orders of magnitude less than those reported at other wind energy developments during pre-construction surveys. When coupled with the low number of proposed towers (2-3) and the lack of moving parts (turbine blades) in comparison to a wind energy development, it is unlikely that this development poses a high risk to migrating birds.

## LITERATURE CITED

Alerstam T. 1990. Bird migration. Cambridge, UK: Cambridge University Press. 420 p.

Baddeley. A. and R. Turner. 2005. Spatstat: an R package for analyzing spatial point patterns. Journal of Statistical Software 12 (6), 1-42. ISSN: 1548-7660. URL: www.jstatsoft.org

Bellrose F.C. 1971. The distribution of nocturnal migration in the air space. Auk 88:397-424.

Cooper, B. A., R. H. Day, R. J. Ritchie, and C. L. Cranor. 1991. An improved marine radar system for studies of bird migration. Journal of Field Ornithology 62:367–377.

Cooper B.A., Ritchie R.J. 1995. The altitude of bird migration in east-central Alaska: a radar and visual study. Journal of Field Ornithology 66:590-608.

Gauthreaux, S.A. Jr. 1991. The flight behavior of migrating birds in changing wind fields: radar and visual analyses. American Zoologist 31:187-204.

Hamer Environmental, L.P. 2010. Spring Nocturnal Bird Migration at the Proposed Antelope Valley Renewable Energy Project, Lancaster, California. Prepared for Western EcoSystems Technology, Inc.

Harmata, A. R., K. M. Podruzny, J. R. Zelenak, and M. L. Morrison. 1999. Using marine surveillance radar to study bird movements and impact assessment. Wildlife Society Bulletin 27:44–52.

Hilgerloh, G. 1989. Autumn migration of Trans-Saharan migrating passerines in the Straits of Gibraltar. Auk 106:233-239.

Kunz et al. 2007. Assessing Impacts of Wind-Energy Development on Nocturnally Active Birds and Bats: A Guidance Document. Journal Wildlife Management 71(8): 2249-2486.

Mardia, K. and P. Jupp. 1999. Directional Statistics, Section 7.4, John Wiley and Sons, England

Mabee, T.J. and B.A. Cooper. 2004. Bird migration in northeastern Oregon and Southeastern Washington. Northwestern Naturalist 85(2):39-47

Mabee, T.J. and P.M. Sanzenbacher, 2008, A radar study of bird and bat migration at the proposed Hatchet Ridge wind project, California, Fall 2007. Final report prepared for Hatchet Ridge, LLC. 700 Taylor St. Ste. 210 Portland, OR, 97205

Mabee , T.J., B.A.Cooper, J.H. PLissner, and D.P. Young. 2006. Nocturnal Bird Migration or an Appalachain ridge at a proposed wind power project. Wildlife Society Bulletin 34(3):682-690

Richardson, J.W. 1978. Timing and amount of bird migration in relation to weather: a review. Oikos 30:224-272

Silverman, B.W. 1986. Density Estimation for Statistics and Data Analysis. New York: Chapman and Hall.

WEST, inc. and Natural Resources Constultants. 2011. A biological constraints analysis of the approximately 4,352 acre Wildflower Green Energy Site located in Lon Angeles County, California

# Appendix G

## 2016/2017 Representative Photographs

## 2016/2017 REPRESENTATIVE PHOTOGRAPHS

**General Landscape Photographs**

Photograph 1. Early morning view of desert lily (*Hesperocallis undulata*) plants in spring 2017 within the RE Crimson Permitting Boundary.

Photograph 2. Early morning view of annuals growing in spring 2017 within the RE Crimson Permitting Boundary.

Photograph 3. View southeast of the RE Crimson Permitting Boundary showing sparse desert vegetation. Photograph taken end of May 2017.

Photograph 4. View north of microphyll woodland in a wash outside of the RE Crimson Permitting Boundary between development areas. Photograph from October 2016.

**Plant Surveys**

Photograph 5. Harwood's milkvetch (*Astragalus insularis* var. *harwoodii*) taken during spring 2017 botanical surveys.

Photograph 6. Harwood's eriastrum (*Eriastrum harwoodii*) taken during spring 2017 botanical surveys.

**Desert Tortoise Surveys**

Photograph 7. Biologists conducting desert tortoise (*Gopherus agassizii*) surveys in fall 2016.

Photograph 8. View of desert tortoise burrow with egg shell fragments at entrance to the burrow.

Photograph 9. Side view of juvenile desert tortoise located outside of RE Crimson Permitting Boundary near base of the Mule Mountains.

Photograph 10. Frontal view of adult female desert tortoise eating big galletta grass (*Hilaria rigida*) outside of the RE Crimson Permitting Boundary, but within large microphyll woodland wash area between development areas.

Photograph 11. Close-up view of large adult male desert tortoise located just inside of the RE Crimson Permitting Boundary near the base of the Mule Mountains on the northern side.

Photograph 12. View of large adult male desert tortoise in wash on the far eastern portion of the desert tortoise survey area outside of the RE Crimson Permitting Boundary.

**Avian Surveys**

Photograph 13. View northwest of migratory bird observation point 2.

Photograph 14. Adult LeConte's thrasher (*Toxostoma lecontei*).

Photograph 15. Fleeting view of skiddish long-eared owl (*Asio otus*) in microphyll woodland in the eastern-most wash between the RE Crimson Permitting Boundary.

**Wildlife Camera Surveys**

Photograph 16. Reconyx wildlife camera (Wildlife Camera 3) attached to a tree on the edge of a large wash.


Photograph 17. American badger (*Taxidea taxus*) photographed on Wildlife Camera 1, walking in the southern-most wash.


Photograph 18. Female burro deer (*Odocoileus hemionus eremicus*) photographed on Wildlife Camera 3, walking down wash.

## 2016/2017 REPRESENTATIVE PHOTOGRAPHS

**Bat Surveys**

Photograph 19. View of original bat acoustic monitoring set-up (on left).

Photograph 20. View of modified bat acoustic monitoring set-up (on right).

**Special-Status Species Incidentally Detected**

Photograph 21. Mojave fringe-toed lizard (*Uma scoparia*) buried in fine windblown sand.

Photograph 22. Mojave fringe-toed lizard waiting to warm up on a cool morning.

Photograph 23. Burrowing owl (*Athene cunicularia*) found during desert tortoise surveys (fall 2016) at the entrance to a desert tortoise burrow outside of the RE Crimson Permitting Boundary.

# Appendix H

# Plant Species Detected in the Project Area

## Plant Species Detected in the Project Area

| Common Name | Scientific Name | Sensitivity Status[1] | SWP Site (2011/2012) | RE Crimson Project Area (2016/2017) |
|---|---|---|---|---|
| **ANGIOSPERMS (Flowering plants)** | | | | |
| **MONOCOTS** | | | | |
| **Century Plant Family** | **Agavaceae** | | | |
| Desert lily | *Hesperocallis undulata* | | x | x |
| **Grass Family** | **Poaceae** | | | |
| Sixweeks three-awn | *Aristida adscensionis* | | x | x |
| California three-awn, Mojave three-awn | *Aristida californica* | | x | |
| Purple threeawn | *Aristida purpurea* | | x | |
| Three-awn | *Aristida* sp. | | x | |
| Needle grama | *Bouteloua aristidoides* var. *aristidoides* | | x | |
| Sixweeks grama | *Bouteloua barbata* var. *barbata* | | x | |
| Low woollygrass | *Dasyochloa pulchella (Erioneuron pulchellum)* | | x | |
| Big galleta | *Hilaria rigida (Pleuraphis r.)* | | x | x |
| Arabian schismus | *Schismus arabicus** | | x | |
| Common Mediterranean grass | *Schismus barbatus** | | x | x |
| Sand rice grass | *Stipa hymenoides (Achnatherum h.)* | | x | |
| **DICOTS** | | | | |
| **Amaranth Family** | **Amaranthaceae** | | | |
| Honeysweet | *Tidestromia suffruticosa* var. *oblongifolia (T. o.)* | | x | |
| **Dogbane Family (including former Milkweed Family)** | **Apocynaceae (formerly Asclepiadaceae)** | | | |
| Desert milkweed | *Asclepias erosa* | | x | |
| Rush milkweed | *Asclepias subulata* | | x | |
| Climbing milkweed | *Funastrum cynanchoides* var. *hartwegii (Sarcostemma c. var. h.)* | | x | |
| Trailing townula | *Funastrum hirtellum (Sarcostemma h.)* | | x | |
| Utah vine milkweed | *Funastrum utahense (Cynanchum u.)* | CNPS: 4.2<br>NECO: SS | x | |
| **Sunflower Family** | **Asteraceae** | | | |

## Plant Species Detected in the Project Area

| Common Name | Scientific Name | Sensitivity Status[1] | SWP Site (2011/2012) | RE Crimson Project Area (2016/2017) |
|---|---|---|---|---|
| Common ragweed | *Ambrosia artemisiifolia** | | x | |
| White bur-sage | *Ambrosia dumosa* | | x | x |
| Common burrobrush, cheesebush | *Ambrosia salsola (Hymenoclea s.)* | | x | x |
| Desert marigold | *Baileya multiradiata* | | | x |
| Laxflower | *Baileya pauciradiata* | | x | x |
| Wool desert marigold | *Baileya pleniradiata* | | | x |
| Sweetbush | *Bebbia juncea* var. *aspera* | | x | |
| White tack-stem | *Calycoseris wrightii* | | x | x |
| Pebble pincushion | *Chaenactis carphoclinia* var. carphoclinia | | x | x |
| Fremont pincushion | *Chaenactis fremontii* | | x | |
| Desert pincushion | *Chaenactis stevioides* | | x | x |
| Desert twinbugs | *Dicoria canescens* | | x | x |
| Brittlebush | *Encelia farinosa* | | x | x |
| Button brittlebush | *Encelia frutescens* | | x | x |
| Desert-sunflower | *Geraea canescens* | | x | x |
| Prickly lettuce | *Lactuca serriola ** | | x | x |
| Dwarf cottonrose | *Logfia depressa* | | x | |
| Desert dandelion | *Malacothrix glabrata* | | x | |
| Daisy desertstar | *Monoptilon bellidiforme* | | x | |
| Mojave desertstar | *Monoptilon bellioides* | | x | x |
| Desert palafox | *Palafoxia arida* var. *arida* | | x | x |
| Chinch-weed | *Pectis papposa* var. *papposa* | | x | x |
| Emory's rock daisy | *Perityle emoryi* | | x | x |
| Bush arrowleaf | *Pleurocoronis pluriseta* | | x | |
| Turtleback | *Psathyrotes ramosissima* | | x | x |
| Desert chicory | *Rafinesquia neomexicana* | | x | x |
| Common sowthistle | *Sonchus oleraceus** | | | x |
| Small wire lettuce | *Stephanomeria exigua* | | x | x |
| Small wire lettuce | *Stephanomeria exigua* subsp. *exigua* | | x | |
| White plume wire lettuce | *Stephanomeria exigua subsp. coronaria* | | | x |
| Wire lettuce | *Stephanomeria pauciflora* | | x | |
| Wire lettuce | *Stephanomeria* sp. | | x | |
| Yellowdome | *Trichoptilium incisum* | | x | |
| **Borage or Waterleaf Family** | **Boraginaceae** | | | |

## Plant Species Detected in the Project Area

| Common Name | Scientific Name | Sensitivity Status[1] | SWP Site (2011/2012) | RE Crimson Project Area (2016/2017) |
|---|---|---|---|---|
| Fiddleneck | *Amsinckia sp.* | | x | |
| Narrow-leaved cryptantha | *Cryptantha angustifolia* | | x | x |
| bearded cryptantha | *Cryptantha barbigera* | | x | |
| Panamint cryptantha | *Cryptantha inaequata* | | x | |
| Guadalupe cryptantha | *Cryptantha maritima* | | x | x |
| Redroot crypthantha | *Cryptantha micrantha* | | x | x |
| Nevada cryptantha | *Cryptantha nevadensis* | | x | |
| Wingnut cryptantha | *Cryptantha pterocarya* | | x | |
| Cryptantha | *Cryptantha* sp. | | x | |
| Bindweed heliotrope | *Heliotropium convolvulaceum* | | | x |
| ribbed cryptantha | *Johnstonella costata (Cryptantha costata)* | CNPS: 4.3 | x | |
| Sand bells | *Nama hispida* var. *spathulata* | | | x |
| Purple mat | *Nama* sp. | | x | |
| Mixed-nut pectocarya | *Pectocarya heterocarpa* | | x | |
| Wide-toothed pectocarya | *Pectocarya platycarpa* | | x | |
| Arched-nut pectocarya | *Pectocarya recurvata* | | x | x |
| Round-nut pectocarya | *Pectocarya setosa* | | x | |
| Pectocarya | *Pectocarya* sp. | | x | |
| Cleftleaf wild heliotrope | *Phacelia crenulata* | | x | x |
| Purplestem phacelia | *Phacelia crenulata* var. *ambigua* | | x | |
| Cleftleaf wild heliotrope | *Phacelia crenulata* var. *crenulata* | | x | x |
| Cleftleaf wild heliotrope | *Phacelia crenulata* var. *minutiflora* | | x | x |
| Ives' phacelia | *Phacelia ivesiana* | | x | x |
| Phacelia | *Phacelia* sp. | | x | |
| Mojave popcornflower | *Plagiobothrys jonesii* | | x | |
| Popcornflower | *Plagiobothrys* sp. | | x | |
| Palmer's tiquilia | *Tiquilia palmeri* | | x | x |
| Fan-leaved tiquilia | *Tiquilia plicata* | | x | x |
| **Mustard Family** | **Brassicaceae** | | | |
| Asian mustard | *Brassica tournefortii** | | x | x |
| California mustard | *Caulanthus lasiophyllus (Guillenia lasiophylla)* | | x | |
| Western tansymustard | *Descurainia pinnata* | | x | |
| California shieldpod, spectaclepod | *Dithyrea californica* | | x | x |

## Plant Species Detected in the Project Area

| Common Name | Scientific Name | Sensitivity Status[1] | SWP Site (2011/2012) | RE Crimson Project Area (2016/2017) |
|---|---|---|---|---|
| Desert pepperweed | *Lepidium fremontii* | | x | |
| Shaggyfruit pepperweed | *Lepidium lasiocarpum* subsp. *lasiocarpum* | | x | x |
| Pepperweed | *Lepidium* sp. | | x | |
| Longbeak streptanthella | *Streptanthella longirostris* | | x | |
| **Cactus Family** | **Cactaceae** | | | |
| Buckhorn cholla | *Cylindropuntia acanthocarpa* var. *coloradensis* | CDNPA: Covered | x | x |
| Silver or golden cholla | *Cylindropuntia echinocarpa* | CDNPA: Covered | x | x |
| Diamond cholla, pencil cactus | *Cylindropuntia ramosissima* | CDNPA: Covered | x | x |
| Cottontop cactus | *Echinocactus polycephalus* var. *polycephalus* | CDNPA: Covered | x | |
| California barrel cactus | *Ferocactus cylindraceus* | CDNPA: Covered | x | |
| Common fishhook cactus | *Mammillaria tetrancistra* | CDNPA: Covered | x | |
| **Pink Family** | **Caryophyllaceae** | | | |
| Onyx flower, frost-mat | *Achyronychia cooperi* | | x | x |
| **Goosefoot Family** | **Chenopodiaceae** | | | |
| Desert-holly | *Atriplex hymenelytra* | CDNPA: Covered | x | |
| Allscale saltbush | *Atriplex polycarpa* | | x | |
| Meadow goosefoot | *Chenopodium pratericola* | | | x |
| Pigweed, goosefoot | *Chenopodium* sp. | | x | |
| Barbwire Russian thistle | *Salsola paulsenii** | | x | |
| Russian thistle | *Salsola* sp.* | | x | |
| Russian thistle, tumbleweed | *Salsola tragus** | | x | x |
| **Spurge Family** | **Euphorbiaceae** | | | |
| Abrams' spurge | *Euphorbia abramsiana (Chamaesyce abramsiana)* | CNPS: 2B.2 | x | |
| Sonoran sandmat | *Euphorbia micromera (Chamaesyce micromera)* | | x | x |
| Smallseed sandmat | *Euphorbia polycarpa (Chamaesyce polycarpa)* | | x | x |
| Yuma sandmat | *Euphorbia setiloba (Chamaesyce setiloba)* | | x | |
| California croton | *Croton californicus* | | x | |
| Narrowleaf silverbush | *Ditaxis lanceolata (Argythamnia lanceolata)* | | x | |

## Plant Species Detected in the Project Area

| Common Name | Scientific Name | Sensitivity Status[1] | SWP Site (2011/2012) | RE Crimson Project Area (2016/2017) |
|---|---|---|---|---|
| New Mexico silverbush | *Ditaxis neomexicana (Argythamnia neomexicana)* | | x | x |
| Yuma silverbush | *Ditaxis serrata* var. *serrata* | | x | |
| Annual toothleaf | *Stillingia spinulosa* | | x | x |
| **Legume Family** | **Fabaceae** | | | |
| Strigose bird's-foot trefoil | *Acmispon strigosus (Lotus s.)* | | x | x |
| Deervetch, deerweed | *Acmispon* sp. | | x | |
| Annual desert milkvetch | *Astragalus aridus* | | x | x |
| Harwood's milkvetch | *Astragalus insularis* var. *harwoodii* | CNPS: 2B.2<br>NECO: SS | x | x |
| Hairy prairie clover | *Dalea mollis* | | x | x |
| Soft prairie clover | *Dalea mollissima* | | x | |
| Arizona lupine | *Lupinus arizonicus* | | x | |
| Parry's false prairie-clover | *Marina parryi* | | x | |
| Ironwood | *Olneya tesota* | CDNPA: Covered | x | x |
| Blue palo verde | *Parkinsonia florida* | CDNPA: Covered | x | x |
| Honey mesquite | *Prosopis glandulosa* var. *torreyana* | CDNPA: Covered | x | |
| Dyebush | *Psorothamnus emoryi* | | x | x |
| Indigo-bush | *Psorothamnus schottii* | | x | x |
| Smoke tree | *Psorothamnus spinosus* | CDNPA: Covered | x | |
| Catclaw, devil's claw | *Senegalia greggii (Acacia greggii)* | CDNPA: Covered | x | |
| **Ocotillo Family** | **Fouquieriaceae** | | | |
| Ocotillo | *Fouquieria splendens* subsp. *Splendens* | CDNPA: Covered | x | x |
| **Geranium Family** | **Geraniaceae** | | | |
| Texas filaree | *Erodium texanum* | | x | |
| **Rhatany Family** | **Krameriaceae** | | | |
| White rhatany | *Krameria bicolor (K. grayi)* | | x | |
| Pima rhatany, purple heather, little-leaved rhatany | *Krameria erecta* | | x | x |
| **Mint Family** | **Lamiaceae** | | | |
| Hesert lavender | *Condea emoryi (Hyptis emoryi)* | | x | |
| **Loasa Family** | **Loasaceae** | | | |

## Plant Species Detected in the Project Area

| Common Name | Scientific Name | Sensitivity Status[1] | SWP Site (2011/2012) | RE Crimson Project Area (2016/2017) |
|---|---|---|---|---|
| Whitestem blazingstar | *Mentzelia albicaulis* | | x | x |
| Whitestem blazingstar | *Mentzelia involucrata* | | x | x |
| Adonis blazingstar | *Mentzelia longiloba (M. multiflora* var. *l.)* | | x | x |
| Blazing star | *Mentzelia* sp. (confirmed not sensitive species) | | x | |
| Thurber's sandpaper plant | *Petalonyx thurberi* | | x | x |
| **Mallow Family** | **Malvaceae** | | | |
| White mallow | *Eremalche exilis* | | x | x |
| Desert fivespot | *Eremalche rotundifolia* | | x | x |
| Pale face | *Hibiscus denudatus* | | x | |
| Apricot mallow | *Sphaeralcea ambigua* var. *ambigua* | | x | |
| Roughleaf apricot mallow | *Sphaeralcea ambigua* var. *rugosa* | | x | |
| **Unicorn-plant Family** | **Martyniaceae** | | | |
| Desert unicorn-plant | *Proboscidea althaeifolia* | CNPS: 4.3<br>NECO: SS | x | |
| **Miner's Lettuce Family** | **Montiaceae** | | | |
| Desert calandrinia | *Cistanthe ambigua* | | | x |
| **Four O'Clock Family** | **Nyctaginaceae** | | | |
| Desert sand-verbena | *Abronia villosa* var. *villosa* | | x | x |
| Trailing windmills | *Allionia incarnata* | | x | |
| Coulter's spiderling | *Boerhavia coulteri* var. *palmeri* | | x | |
| Spiderling | *Boerhavia* sp. | | x | |
| Slender spiderling | *Boerhavia triquetra* var. *intermedia (B. intermedia)* | | x | |
| Largebract spiderling | *Boerhavia wrightii* | | x | |
| Wishbone-bush | *Mirabilis laevis* var. *villosa* | | x | |
| **Evening-primrose Family** | **Onagraceae** | | | |
| Yellow cups | *Chylismia brevipes (Camissonia b.)* | | x | |
| Heartleaf suncup | *Chylismia cardiophylla (Camissonia c.)* | | x | |
| Browneyes | *Chylismia claviformis (Camissonia c.)* | | x | |
| Booth's evening-primrose | *Eremothera boothii (Camissonia b.)* | | x | |
| Shredding suncup | *Eremothera boothii* subsp. | | x | |

## Plant Species Detected in the Project Area

| Common Name | Scientific Name | Sensitivity Status[1] | SWP Site (2011/2012) | RE Crimson Project Area (2016/2017) |
|---|---|---|---|---|
| | *condensata (Camissonia b.* subsp. *c.)* | | | |
| Longcapsule suncup | *Eremothera chamaenerioides (Camissonia c.)* | | x | |
| California suncup | *Eulobus californicus (Camissonia californica)* | | x | |
| Devil's lantern, lion-in-a-cage, basket evening-primrose | *Oenothera deltoides* | | x | |
| Devil's lantern, lion-in-a-cage, basket evening-primrose | *Oenothera deltoides* subsp. *deltoides* | | | x |
| **Broomrape Family** | **Orobanchaceae** | | | |
| Desert broomrape | *Orobanche cooperi* | | x | |
| **Poppy Family** | **Papaveraceae** | | | |
| Pygmy poppy | *Eschscholtzia minutiflora* | | x | x |
| **Plantain Family** | **Plantaginaceae** | | | |
| Desert Indianwheat | *Plantago ovata* | | x | x |
| **Phlox Family** | **Polemoniaceae** | | | |
| Broad-leaved aliciella | *Aliciella latifolia* subsp. *latifolia (Gilia l.)* | | x | |
| Harwood's eriastrum | *Eriastrum harwoodii (E. sparsiflorum* subsp. *harwoodii)* | CNPS: 1B.2<br>BLM: S | x | x |
| Rock gilia | *Gilia scopulorum* | | x | |
| Bristly langloisia | *Langloisia setosissima* subsp. *setosissima* | | x | x |
| Jones' linanthus | *Linanthus jonesii* | | x | |
| Desert calico | *Loeseliastrum matthewsii* | | x | |
| Schott's calico | *Loeseliastrum schottii* | | x | x |
| **Buckwheat Family** | **Polygonaceae** | | | |
| Brittle spineflower | *Chorizanthe brevicornu* var. *brevicornu* | | x | x |
| Wrinkled spineflower | *Chorizanthe corrugata* | | x | x |
| Devil's spineflower | *Chorizanthe rigida* | | x | x |
| Skeleton week | *Eriogonum deflexum* | | x | |
| Desert trumpet | *Eriogonum inflatum* | | x | |
| Kidneyleaf buckwheat | *Eriogonum reniforme* | | | x |
| Wild buckwheat | *Eriogonum* sp. | | x | |
| Thomas' wild buckwheat | *Eriogonum thomasii* | | x | x |
| Little desert trumpet | *Eriogonum trichopes* | | x | |

## Plant Species Detected in the Project Area

| Common Name | Scientific Name | Sensitivity Status[1] | SWP Site (2011/2012) | RE Crimson Project Area (2016/2017) |
|---|---|---|---|---|
| **Mignonette Family** | **Resedaceae** | | | |
| lineleaf whitepuff | *Oligomeris linifolia* | | x | x |
| **Nightshade Family** | **Solanaceae** | | | |
| Water jacket | *Lycium andersonii* | | x | |
| Rabbit thorn | *Lycium pallidum* var. *oligospermum* | | x | |
| Boxthorn, wolf-berry | *Lycium* sp. | | x | |
| Desert tobacco | *Nicotiana obtusifolia* | | x | |
| Tobacco | *Nicotiana* sp. | | x | |
| **Mistletoe Family** | **Viscaceae** | | | |
| Desert mistletoe | *Phoradendron californicum* | | x | |
| **Caltrop Family** | **Zygophyllaceae** | | | |
| California fagonbush | *Fagonia laevis* | | x | |
| California caltrop | *Kallstroemia californica* | | x | |
| Arizona poppy | *Kallstroemia grandiflora* | | x | |
| Creosote bush | *Larrea tridentata* | | x | x |
| Puncturevine | *Tribulus terrestris** | | x | |

[*] Nonnative species
[1] Notes:
Sensitivity Status Key
BLM = Bureau of Land Management
CNPS = California Native Plant Society Rare Plant Rank
CDNPA = California Desert Native Plants Act
NECO = Northern and Eastern Colorado Desert Coordinated Management Plan

Sensitivity Designations:
BLM: S = sensitive species
CDNPA: Covered = CDNPA regulated native plant
NECO: SS = NECO Plan special-status species

California Rare Plant Rank (CNPS):
1A = Plants presumed extinct in California
1B = Plants rare and endangered in California and throughout their range
2 = Plants rare, threatened, or endangered in California but more common elsewhere in their range
3 = Plants about which more information is needed; a review list
4 = Plants of limited distribution; a watch list
0.1 = Seriously endangered in California
0.2 = Fairly endangered in California
0.3 = Not very endangered in California

# Appendix I

## Wildlife Species Detected in the Project Area

## Wildlife Species Detected in the Project Area

| Common Name | Scientific Name | Sensitivity Status[1] | SWP Site (2011/2012) | RE Crimson Project Area (2016/2017) |
|---|---|---|---|---|
| **Invertebrates** | | | | |
| Painted lady butterfly | *Vanessa cardui* | | X | X |
| Monarch | *Danaus plexippus* | | | X |
| Orange sulfur | *Colias eurytheme* | | | X |
| Funereal duskywing | *Erynnis funeralis* | | X | X |
| Sphinx moth | *Hiles lineata* | | X | X |
| Dragonfly | Suborder *Anisoptera* | | X | |
| Pinacate beetle/stink beetle | *Eleodes obscuras* | | X | X |
| Giant desert hairy scorpion | *Hadrurus arizonensis* | | X | X |
| Tarantula hawk | *Pepsis sp.* | | X | X |
| Tarantula | *Aphonopelma* | | | X |
| Sun spider | Order *Solifugae* | | | X |
| Red harvester ant | *Pogonomyrmex barbatus* | | X | X |
| **Reptiles** | | | | |
| **Testudines** | | | | |
| Desert tortoise | *Gopherus agassizii* | Fed: THR<br>State: THR<br>NECO: SS<br>DRECP: FS | X | X |
| **Squamata** | | | | |
| Desert horned lizard | *Phrynosoma platyrhinos* | | X | X |
| Desert spiny lizard | *Sceloporus magister* | | X | |
| Mojave fringe-toed lizard | *Uma scoparia* | State: SSC<br>BLM: SS<br>NECO: SS<br>DRECP: FS | X | X |
| Long-tailed brush lizard | *Urosaurus graciosus* | | X | X |
| Side-blotched lizard | *Uta stansburiana* | | X | X |
| Zebra-tailed lizard | *Callisaurus draconoides* | | X | X |
| Great basin whiptail | *Aspidoscelis tigris tigris* | | X | X |
| Desert iguana | *Dipsosaurus dorsalis* | | X | X |
| Long-nosed leopard lizard | *Gambelia wislizenii* | | X | X |
| Western banded gecko | *Coleonyx variegatus* | | X | X |
| **Serpentes** | | | | |
| Desert threadsnake (blind snake) | *Rena humilis cahuilae* | | | X |

**Wildlife Species Detected in the Project Area**

| Common Name | Scientific Name | Sensitivity Status[1] | SWP Site (2011/2012) | RE Crimson Project Area (2016/2017) |
|---|---|---|---|---|
| Western shovel-nosed snake | *Chionactis occipitalis* | | X | X |
| Western diamond-backed rattlesnake | *Crotalus atrox* | | X | X |
| Sidewinder | *Crotalus cerastes* | | X | X |
| Mojave rattlesnake | *Crotalus scutulatus* | | X | |
| Coachwhip | *Coluber flagellum* | | X | X |
| **Birds** | | | | |
| **Galliformes** | | | | |
| Gambel's Quail | *Callipepla gambelii* | | X | X |
| **Columbiformes** | | | | |
| Eurasian Collared-Dove | *Streptopelia decaocto* | | X | X |
| Mourning Dove | *Zenaida macroura* | | X | X |
| White-winged Dove | *Zenaida asiatica* | | X | X |
| **Cuculiformes** | | | | |
| Greater Roadrunner | *Geococcyx californianus* | | X | X |
| **Caprimulgiformes** | | | | |
| Common Poorwill | *Phalaenoptilus nuttallii* | | X | X |
| Lesser Nighthawk | *Chordeiles acutipennis* | | X | X |
| **Apodiformes** | | | | |
| Vaux's Swift | *Chaetura vauxi* | State: SSC (nesting) | X | X |
| White-Throated Swift | *Aeronautes saxatalis* | | X | X |
| Anna's Hummingbird | *Calypte anna* | | | X |
| Black-chinned Hummingbird | *Archilochus alexandri* | | X | |
| Costa's Hummingbird | *Calypte costae* | | X | X |
| **Charadriiformes** | | | | |
| Long-billed Curlew | *Numenius americanus* | | X | |
| **Suliformes** | | | | |
| Double-crested Cormorant | *Phalacrocorax auritus* | | X | X |
| **Pelecaniformes** | | | | |
| Great Blue Heron | *Ardea herodias* | | | X |
| White-faced Ibis | *Plegadis chihi* | | | X |
| Cattle Egret | *Bubulcus ibis* | | | X |
| **Cathartiformes** | | | | |
| Turkey Vulture | *Cathartes aura* | | X | X |
| **Accipitriformes** | | | | |
| Osprey | *Pandio haliaetus* | | | X |

## Wildlife Species Detected in the Project Area

| Common Name | Scientific Name | Sensitivity Status[1] | SWP Site (2011/2012) | RE Crimson Project Area (2016/2017) |
|---|---|---|---|---|
| Northern Harrier | *Circus hudsonius* | State: SSC (nesting) | X | X |
| Cooper's Hawk | *Accipiter cooperii* | | X | X |
| Sharp-shinned Hawk | *Accipiter striatus* | | | X |
| Red-tailed Hawk | *Buteo jamaicensis* | | X | X |
| Swainson's Hawk | *Buteo swainsoni* | State: THR (nesting)<br>BLM: SS<br>DRECP: FS | X | X |
| Ferruginous Hawk | *Buteo regalis* | NECO: SS | | X |
| **Strigiformes** | | | | |
| Great Horned Owl[2] | *Bubo virginianus* | | X | X |
| Short-eared Owl | *Asio flammeus* | State: SSC (nesting) | X | |
| Long-eared Owl | *Asio otus* | State: SSC (nesting) | | X |
| Burrowing Owl[2] | *Athene cunicularia* | State: SSC (burrow sites and some wintering sites)<br>BLM: SS<br>NECO: SS<br>DRECP: FS | X | X |
| **Piciformes** | | | | |
| Ladder-backed Woodpecker | *Picoides scalaris* | | X | X |
| Northern Flicker | *Colaptes auratus* | | | X |
| **Falconiformes** | | | | |
| American Kestrel | *Falco sparverius* | | X | X |
| Merlin | *Falco columbarius* | | | X |
| American Peregrine Falcon | *Falco peregrinus anatum* | Fed: DL<br>State: DL, FP | X | |
| Prairie Falcon | *Falco mexicanus* | NECO: SS | X | X |
| **Passeriformes** | | | | |
| ***Tyrannidae*** | | | | |
| Ash-throated Flycatcher | *Myiarchus cinerascens* | | X | X |
| Black Phoebe | *Sayornis nigricans* | | X | X |
| Cassin's Kingbird | *Tyrannus vociferans* | | X | |
| Gray Flycatcher | *Empidonax wrightii* | | X | |

**Wildlife Species Detected in the Project Area**

| Common Name | Scientific Name | Sensitivity Status[1] | SWP Site (2011/2012) | RE Crimson Project Area (2016/2017) |
|---|---|---|---|---|
| Pacific Slope Flycatcher | *Empidonax difficilis* | | X | X |
| Say's Phoebe | *Sayornis saya* | | X | X |
| Western Kingbird | *Tyrannus verticalis* | | X | X |
| Western Wood-Pewee | *Contopus sordidulus* | | X | |
| Olive-sided flycatcher | *Contopus cooperi* | State: SSC (nesting) | | X |
| ***Laniidae*** | | | | |
| Loggerhead Shrike | *Lanius ludovicianus* | State: SSC (nesting) | X | X |
| ***Vireonidae*** | | | | |
| Warbling Vireo | *Vireo gilvus* | | X | X |
| ***Corvidae*** | | | | |
| American Crow | *Corvus brachyrhynchos* | | X | |
| Common Raven | *Corvus corax* | | X | X |
| ***Alaudidae*** | | | | |
| Horned Lark | *Eremophila alpestris* | | X | X |
| ***Hirundinidae*** | | | | |
| Bank Swallow | *Riparia riparia* | State: THR BLM: SS | X | X |
| Barn Swallow | *Hirundo rustica* | | X | X |
| Cliff Swallow | *Petrochelidon pyrrhonota* | | X | X |
| Northern Rough-winged Swallow | *Stelgidopteryx serripennis* | | X | X |
| Tree Swallow | *Tachycineta bicolor* | | X | X |
| Violet-green Swallow | *Tachycineta thalassina* | | X | X |
| ***Remizidae*** | | | | |
| Verdin | *Auriparus flaviceps* | | X | X |
| ***Troglodytidae*** | | | | |
| House Wren | *Troglodytes aedon* | | | X |
| Bewick's Wren | *Thryomanes bewickii* | | X | |
| Cactus Wren | *Campylorhynchus brunneicapillus* | | X | X |
| Canyon Wren | *Catherpes mexicanus* | | X | |
| Rock Wren | *Salpinctes obsoletus* | | | X |
| ***Polioptilidae*** | | | | |
| Black-tailed Gnatcatcher | *Polioptila melanura* | | X | X |
| Blue-gray Gnatcatcher | *Polioptila caerulea* | | X | X |
| ***Regulidae*** | | | | |

**Wildlife Species Detected in the Project Area**

| Common Name | Scientific Name | Sensitivity Status[1] | SWP Site (2011/2012) | RE Crimson Project Area (2016/2017) |
|---|---|---|---|---|
| Ruby-crowned Kinglet | *Regulus calendula* | | X | |
| ***Turdidae*** | | | | |
| Mountain Bluebird | *Sialia currucoides* | | | X |
| ***Mimidae*** | | | | |
| Crissal Thrasher | *Toxostoma crissale* | State: SSC<br>NECO: SS | X | |
| LeConte's Thrasher | *Toxostoma lecontei* | NECO: SS | X | X |
| Northern Mockingbird | *Mimus polyglottos* | | X | X |
| Sage Thrasher | *Oreoscoptes montanus* | | X | X |
| ***Bombycillidae*** | | | | |
| Phainopepla | *Phainopepla nitens* | | X | X |
| ***Motacillidae*** | | | | |
| American Pipit | *Anthus rubescens* | | | X |
| ***Passerellidae*** | | | | |
| Abert's Towhee | *Pipilo aberti* | | X | |
| Bell’s Sparrow | *Artemisiospiza belli* | | X | X |
| Bell’s/Sagebrush Sparrow | *Artemisiospiza* sp. | | | X |
| Black-Headed Grosbeak | *Pheucticus melanocephalus* | | X | X |
| Black-throated Sparrow | *Amphispiza bilineata* | | X | X |
| Blue Grosbeak | *Passerina caerulea* | | X | X |
| Brewer's Sparrow | *Spizella breweri* | | X | X |
| Chipping Sparrow | *Spizella passerina* | | X | X |
| House Finch | *Carpodacus mexicanus* | | X | X |
| Lark Sparrow | *Chondestes grammacus* | | X | X |
| Lazuli Bunting | *Passerina amoena* | | X | X |
| Lesser Goldfinch | *Spinus psaltria* | | X | |
| Lincoln’s Sparrow | *Melospiza lincolnii* | | | X |
| Sagebrush sparrow | *Artemisiospiza nevadensis* | | | X |
| Savannah Sparrow | *Passerculus sandwichensis* | | X | X |
| White-crowned Sparrow | *Zonotrichia leucophrys* | | X | X |
| ***Icteridae*** | | | | |
| Brewer's Blackbird | *Euphagus cyanocephalus* | | X | X |
| Brown-headed Cowbird | *Molothrus ater* | | X | X |
| Bullock's Oriole | *Icterus bullockii* | | X | X |
| Hooded Oriole | *Icterus cucullatus* | | X | X |

## Wildlife Species Detected in the Project Area

| Common Name | Scientific Name | Sensitivity Status[1] | SWP Site (2011/2012) | RE Crimson Project Area (2016/2017) |
|---|---|---|---|---|
| Scott's Oriole | *Icterus parisorum* | | X | X |
| Red-winged Blackbird | *Agelaius phoeniceus* | | X | X |
| Yellow-headed Blackbird | *Xanthocephalus xanthocephalus* | State: SSC (nesting) | X | |
| Great-tailed Grackle | *Quiscalus mexicanus* | | | X |
| Western Meadowlark | *Sturnella neglecta* | | | X |
| ***Parulidae*** | | | | |
| Black-throated Gray Warbler | *Setophaga nigrescens* | | X | X |
| Common Yellowthroat | *Geothlypis trichas* | | X | |
| Hermit Warbler | *Setophaga occidentalis* | | X | |
| Lucy's Warbler | *Oreothlypis luciae* | State: SSC BLM: SS | X | |
| MacGillivray's Warbler | *Geothlypis tolmiei* | | X | X |
| Nashville Warbler | *Oreothlypis ruficapilla* | | X | |
| Orange-crowned Warbler | *Oreothlypis celata* | | X | X |
| Townsend's Warbler | *Setophaga townsendi* | | X | X |
| Wilson's Warbler | *Cardellina pusilla* | | X | X |
| Yellow Warbler | *Setophaga petechia* | State: SSC (nesting) NECO: SS | X | X |
| Yellow-rumped Warbler | *Setophaga coronata* | | X | X |
| ***Cardinalidae*** | | | | |
| Western Tanager | *Piranga ludoviciana* | | X | X |
| **Mammals** | | | | |
| **Rodentia** | | | | |
| Little Pocket Mouse | *Perognathus longimembris* | | | X |
| Desert Kangaroo Rat | *Dipodomys deserti* | | X | X |
| White-tailed Antelope Ground Squirrel | *Ammospermophilus leucurus* | | X | X |
| Round-tailed Ground Squirrel | *Xerospermophilus tereticaudus* | | X | X |
| **Lagomorpha** | | | | |
| Desert Cottontail | *Sylvilagus audubonі* | | X | X |
| Black-tailed Jackrabbit | *Lepus californicus* | | X | X |
| **Chiroptera** | | | | |
| Hoary Bat | *Lasiurus cinereus* | | X | |
| Pallid Bat | *Antrozous pallidus* | State: SSC | X | X |

## Wildlife Species Detected in the Project Area

| Common Name | Scientific Name | Sensitivity Status[1] | SWP Site (2011/2012) | RE Crimson Project Area (2016/2017) |
|---|---|---|---|---|
| | | BLM: SS<br>NECO: SS<br>DRECP: FS | | |
| Western Red Bat | *Lasiurus blossevillii* | State: SSC | X | X |
| Western Yellow Bat | *Lasiurus xanthinus* | State: SSC | | X |
| Western Mastiff Bat | *Eumops perotis* | State: SSC<br>BLM: SS<br>NECO: SS | | X |
| Mexican (Brazilian) Free-tailed Bat | *Tadarida brasiliensis* | | X | X |
| Pocketed Free-tailed Bat | *Nyctinomops femorosaccus* | State: SSC<br>NECO: SS | X | X |
| Canyon Bat (Western Pipistrelle) | *Parastrellus hesperus* | | X | X |
| Big Brown Bat | *Eptesicus fuscus* | | | X |
| California Leaf-nosed Bat | *Macrotus californicus* | State: SSC<br>BLM: SS<br>NECO: SS<br>DRECP: FS | | X |
| Arizona Myotis[3] | *Myotis occultus* | State: SSC | | X |
| Cave Myotis[3] | *Myotis velifer* | State: SSC<br>BLM: SS<br>NECO: SS | | X |
| California Myotis[4] | *Myotis californicus* | | | X |
| Yuma Myotis[4] | *Myotis yumanensis* | BLM: SS | | X |
| **Carnivora** | | | | |
| American Badger | *Taxidea taxus* | State: SSC | X | X |
| Desert Kit Fox | *Vulpes macrotis arsipus* | State: CCR, protected furbearing mammal<br>DRECP: PS | X | X |
| Spotted skunk | *Spilogale gracilis* | | | X |
| Coyote | *Canis latrans* | | X | X |
| **Perissodactyla** | | | | |
| Wild Burro | *Equus asinus* | | X | X |
| **Artiodactyla** | | | | |
| Burro Deer | *Odocoileus hemionus eremicus* | NECO: SS<br>DRECP: PS | X | X |

## Wildlife Species Detected in the Project Area

[1] **Federal Designations (Federal Endangered Species Act, USFWS):**
END: federally listed, endangered
THR: federally listed, threatened
FC: federal candidate species
FSC: federal species of concern
FPD: federal proposed for delisting
DL: federal delisted

**Other Designations:**
BLM: Bureau of Land Management sensitive species (SS)
NECO: Northern and Eastern Colorado Desert Coordinated Management Plan: special-status species (SS)
DRECP: Desert Renewable Energy Conservation Plan: focus species (FS); planning species (PS)

**State Designations (California Endangered Species Act, CDFW):**
END: endangered
THR: threatened
CT: candidate threatened
SSC: California species of special concern
FP: fully protected species
CCR: California Code of Regulations

Sensitivity status taken from:

California Department of Fish and Wildlife. 2017. Natural Diversity Database. Special Animals List. Periodic publication. 51 pp. July.

[2] Detected adjacent to, but outside the Project Area. Species could still forage within the Project Area and RE Crimson Permitting Boundary.
[3] These bat species are within a 40 kilohertz acoustic group and due to call similarities they were not differentiated to species. Therefore, it is assumed that both species are present.
[4] These bat species are within a 50 kilohertz acoustic group and due to call similarities they were not differentiated to species. Therefore, it is assumed that both species are present.

# Appendix J

## 2016/2017 Bat Acoustic Survey Report

**Garcia and Associates**
**435 Lincoln Way**
**Auburn, CA 95603**
**Phone: (530) 823-3151**
**Fax: (530) 823-3138**

| | |
|---|---|
| **To:** | Sundeep Amin, AECOM |
| **From:** | Justin Tortosa |
| **Date:** | September 20, 2017 |
| **RE:** | Crimson Solar Acoustic Bat Monitoring Letter Report |

# Introduction

On September 1, 2016, Garcia and Associates biologists, Justin Tortosa and Stephanie Hines, installed three AnaBat SD1™ bat detectors (Titley Scientific™, Brendale, Australia) at three predetermined locations (AB1, AB2, and AB3) in microphyll woodland habitat for the Crimson Solar Project (Project) near Blythe in Riverside County, California (AECOM 2016). These three bat detectors performed nightly monitoring for echolocating bats at each location until their removal from service on September 1, 2017.

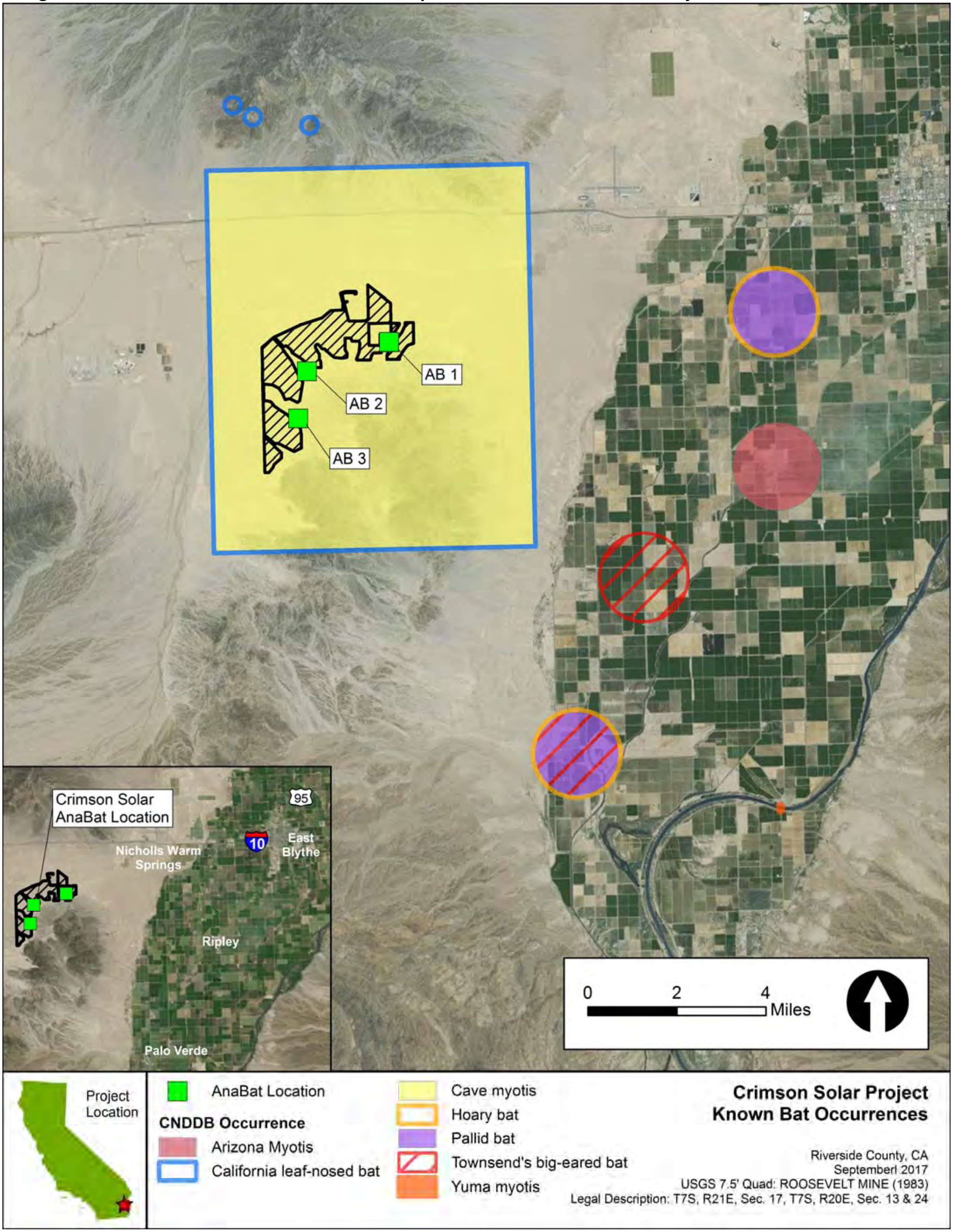
## Methods

### *Equipment*

Each unit was coupled with an EME System Bat-Hat (microphone extension and protective shroud), enclosure system (NEMA box), and stand-alone power source (solar panel, 12-volt battery, and a charger circuit). Each AnaBat SD1™ was programmed using the delayed start mode, which allows them to switch from a daytime sleep setting to a standby setting prior to sunset and switch back to sleep shortly after sunrise. While in sleep mode, the detector was essentially shut off to preserve battery power, and the solar panel charged the 12-volt battery. While in standby, the detector continuously monitored for bat calls. Once a bat call was detected, the AnaBat SD1™ recorded and saved the call to a CompactFlash (CF) Memory Card (SanDisk®, Milpitas, California).

Since deployment, the three sites were visited 12 times. The first visit occurred on September 20, 2016, to ensure that the units were working properly. The remaining 11 visits occurred monthly on September 28, November 1, and December 16, 2016, January 9, February 9, March 10, April 18, May 31, June 21, July 27, and September 1, 2017. Although the primary focus of the 11 monthly visits was for data retrieval, these visits ensured that each unit received any necessary maintenance. Upon download, data from each detector was saved to folders that correspond to the site location and period (i.e., month) in which monitoring occurred. Call files were further organized into folders that corresponded to the date they were recorded (i.e., day). The latter was performed by the software during data transfer from the CF card to a laptop computer.

**Figure 1. Known bat occurrences within a nine-quad search area around the Project.**



On March 24, 2017, Garcia and Associated biologists Justin Tortosa and Jon Goin attended a conference call with Peter Sanzenbacher of the U.S. Fish Wildlife Service and Danielle Ortiz of the Bureau of Land Management to discuss the configuration of the three AnaBat SD1 units. It was determined that each unit would be reconfigured so that the Bat-Hat is positioned at the top of the t-post and above the solar panel. Placement of the Bat-Hat at the top of the t-post was intended to increase efficiency of recording by relocating the microphone further from the ground, as well as reducing the potential for interference from the solar panel. Each unit was reconfigured on April 18, 2017. Photographs of each unit were taken before and after the modifications were made and are provided below.

**Photo 1. Station 1, Original Configuration**

**Photo 2. Station 1, Updated Configuration**

**Photo 3. Station 2, Original Configuration**

**Photo 4. Station 2, Updated Configuration**

**Photo 5. Station 3, Original Configuration**

**Photo 6. Station 3, Updated Configuration**

***Call Analysis***

Analysis of the acoustic data has been performed with Analook W™ software, developed by Chris Corbin (version 4.2d, April, 25, 2016). The software allows users to view and analyze real-time or pre-recorded Anabat™ call files. Files are displayed as a sonogram, with time on the X-axis and frequency on the Y-axis. This display allows identification of call characteristics, such as maximum and minimum frequency, characteristic frequency, slope, and call duration. Other call characteristics displayed include shape and the presence of harmonics. To aid in species identification, calls recorded for the Project were compared against a call library comprised of bat species with the potential to or known to occur in the Project area. [1,2] These species include California leaf-nosed bat (*Macrotus californicus*) (California Department of Fish and Wildlife [CDFW] Species of Special Concern [SSC]), Bureau of Land Management [BLM] Sensitive [S]; pallid bat (*Antrozous pallidus*) (CDFW:SSC, BLM:S, United States Forest Service [USFS] Sensitive [S]); big brown bat (*Eptesicus fuscus*); spotted bat (*Euderma maculatum*) (CDFW:SSC, BLM:S); western red bat (*Lasiurus blossevillii*) (CDFW:SSC); hoary bat (*Lasiurus cinereus*); western yellow bat (*Lasiurus xanthinus*) (CDFW:SSC); California myotis (*Myotis californicus*)[3]; Arizona myotis (*M. occultus*)[4] (CDFW:SSC); cave myotis (*M. velifer*)[2] (CDFW:SSC, BLM:S); Yuma myotis (*M. yumanensis*)[1] (BLM:S); canyon bat (*Parastrellus hesperus*); Townsend's big-eared bat (*Corynorhinus townsendii*) (CDFW:SSC, BLM:S, USFS:S); western mastiff bat (*Eumops perotis*) (CDFW:SSC, BLM:S); pocketed free-tailed bat (*Nyctinomops femorosaccus*) (CDFW:SSC); and Brazilian free-tailed bat (*Tadarida brasiliensis*) (CDFW 2017). Figure 1 shows known occurrences of bat species within and around the Project that was derived from a query of the California Natural Diversity Database (CNDDB) (2017). The query area included the United States Geological Survey (USGS), 7.5' topographic quadrangles (Quad) of Roosevelt Mine, which encompasses the Project, and the eight surrounding Quads of McCoy Peak, Ripley, Palo Verde, McCoy Spring, McCoy Wash, Hopkins Well, Thumb Peak, and Wiley Well.

## Results and Discussion

Nine species and two acoustic groups are represented by the acoustic data collected at the three monitoring locations within the Project area. Table 1 summarizes acoustic recordings of bats at each of the three sites by month.[5]

---

[1] Call library was obtained from Chris Corbin.
[2] Species known to occur or with the potential to occur in the Project area were derived from a query of the California Natural Diversity Data Base and review of species range maps.
[3] Due to similarities in call characteristics, Yuma myotis and California myotis are grouped into a single acoustic group known as 50 kilohertz *Myotis*.
[4] Due to similarities in call characteristics, Arizona myotis and cave myotis are grouped into a single acoustic group known as 40 kilohertz *Myotis*.
[5] A call resembling big free-tailed bat (*Nyctinomops macrotis*) was recorded at site AB3 in May, 2017, which was subsequently reviewed by Dr. Pat Brown and Drew Stokes (Wildlife Biologist, Department of Birds and Mammals, San Diego Natural History Museum) for species confirmation. It was determined that the call file was from a western mastiff bat (*Eumops perotis*).

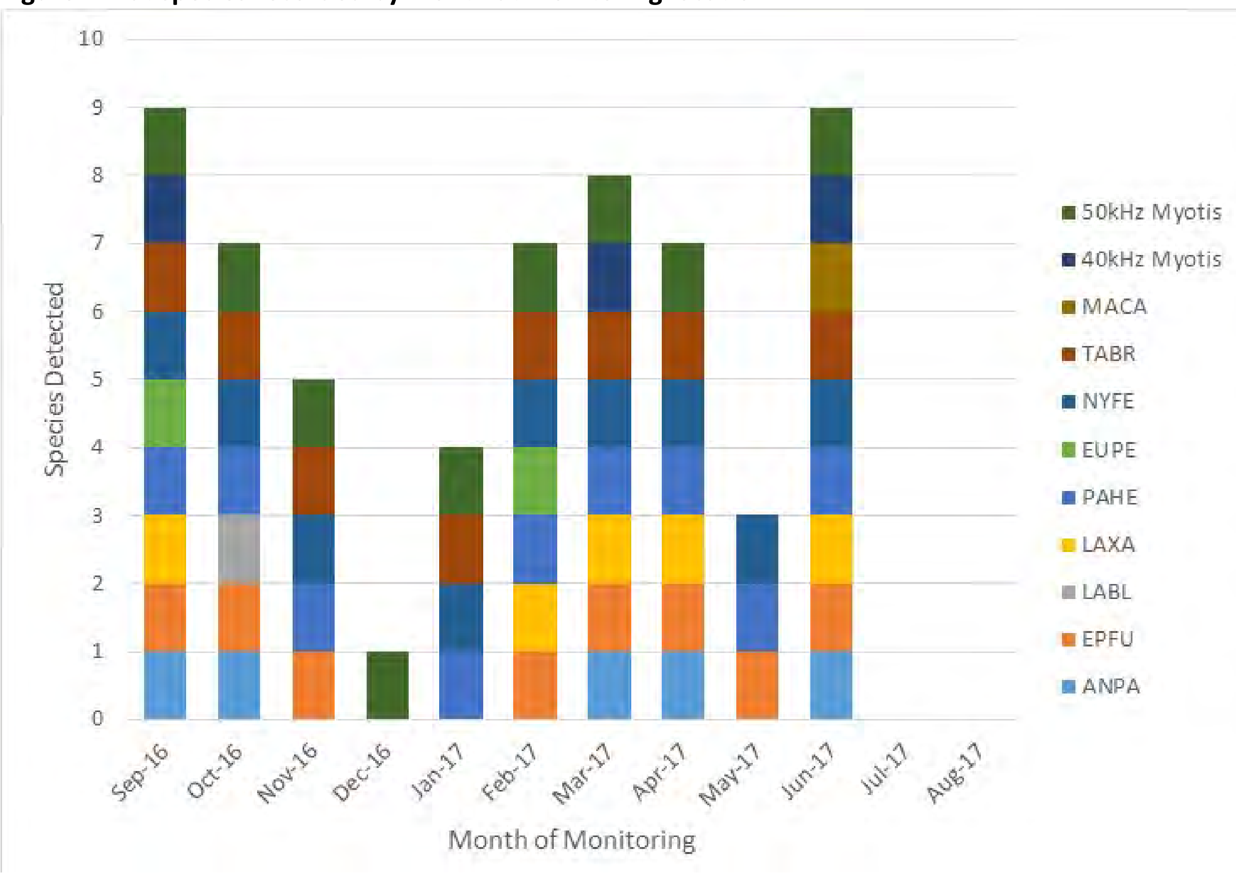
**Table 1. Summary of bat species present at each monitoring location based on acoustic recordings.**

| Survey Location | Month | Species | | | | | | | | | | | # of Call Files |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ANPA | EPFU | LABL | LAXA | PAHE | EUPE | NYFE | TABR | MACA | 40kHz *Myotis* | 50kHz *Myotis* | |
| **AB1** | September | X | X | | X | X | X | X | X | | X | X | 1,456 |
| | October | X | X | X | | X | | X | X | | | X | 1,874 |
| | November | | X | | | X | | X | X | | | X | 679 |
| | December | | | | | | | | | | | X | 7,409 |
| | January | | | | | X | | X | X | | | X | 2,141 |
| | February | | X | | X | X | | X | X | | | X | 1,242 |
| | March | X | X | | X | X | | X | X | | X | X | 12,473 |
| | April | X | X | | X | X | | X | X | | | X | 5,521 |
| | May | | X | | | X | | X | | | | | 3,411 |
| | June | X | X | | X | X | | X | X | X | X | X | 2,562 |
| | July | | | | | | | | | | | | 0 |
| | August | | | | | | | | | | | | 2 |
| **AB2** | September | X | X | | | X | | | X | | X | X | 527 |
| | October | X | X | | X | X | | X | X | | | X | 921 |
| | November | | X | | | X | | X | X | | | X | 46 |
| | December | | | | | X | | | | | | | 11 |
| | January | | | | | X | | | | | | | 7 |
| | February | | | | | X | | | X | | | X | 167 |
| | March | | X | | | X | | X | X | | | X | 667 |
| | April | X | X | | | X | | | X | | X | X | 2,106 |
| | May | X | X | | | X | | X | | | | X | 1,740 |
| | June | | | | | X | X | | | | X | X | 527 |
| | July | X | | | | X | | X | | | | X | 206 |
| | August | X | X | | | X | | | X | | | X | 558 |
| **AB3** | September | X | X | | X | X | X | X | X | | X | X | 2,358 |
| | October | X | X | | | X | | X | X | | | X | 1,847 |
| | November | | X | | | X | | X | X | | | X | 225 |
| | December | | | | | X | X | | | | | X | 366 |
| | January | | | | | X | | | | | | X | 101 |
| | February | | | | | X | | X | x | | | X | 5,984 |
| | March | | X | | | X | | X | X | | | X | 1,149 |
| | April | X | X | | X | X | | X | X | | X | X | 3,082 |
| | May | X | X | | X | X | X | X | X | | X | X | 11,338 |
| | June | X | X | | | X | | | | | X | X | 347 |
| | July | X | X | | | X | | | | | X | X | 2,775 |
| | August | X | X | | X | X | X | X | X | | X | X | 2,662 |

Key:
"X" indicates that the species was recorded.
ANPA – pallid bat (*Antrozous pallidus*)
EPFU – big brown bat (*Eptesicus fuscus*)
LABL – western red bat (*Lasiurus blossevillii*)
LAXA – western yellow bat (*Lasiurus xanthinus*)
PAHE – canyon bat (*Parastrellus hesperus*)
EUPE – western mastiff bat (*Eumops perotis*)
NYFE – pocketed free-tailed bat (*Nyctinomops femorosaccus*)
TABR – Brazilian free-tailed bat (*Tadarida brasiliensis*)
MACA – California leaf-nosed bat (*Macrotus caqlifornicus*)
40kHz Myotis are a group of bats that echolocate in the 40kHz range that are difficult to differentiate due to similarities in call structure. This group includes Arizona myotis (*Myotis occultus*) and cave myotis (*M. velfer*).
50kHz Myotis are a group of bats that echolocate in the 50kHz range that are difficult to differentiate due to similarities in call structure. This group includes California myotis (*M. californicus*) and Yuma myotis (*M. yumanensis*).
# of Call Files – This number represents the number of times the Anabat unit was triggered to record, which includes bat calls as well as recordings that were triggered by noise (e.g., wind or insects).

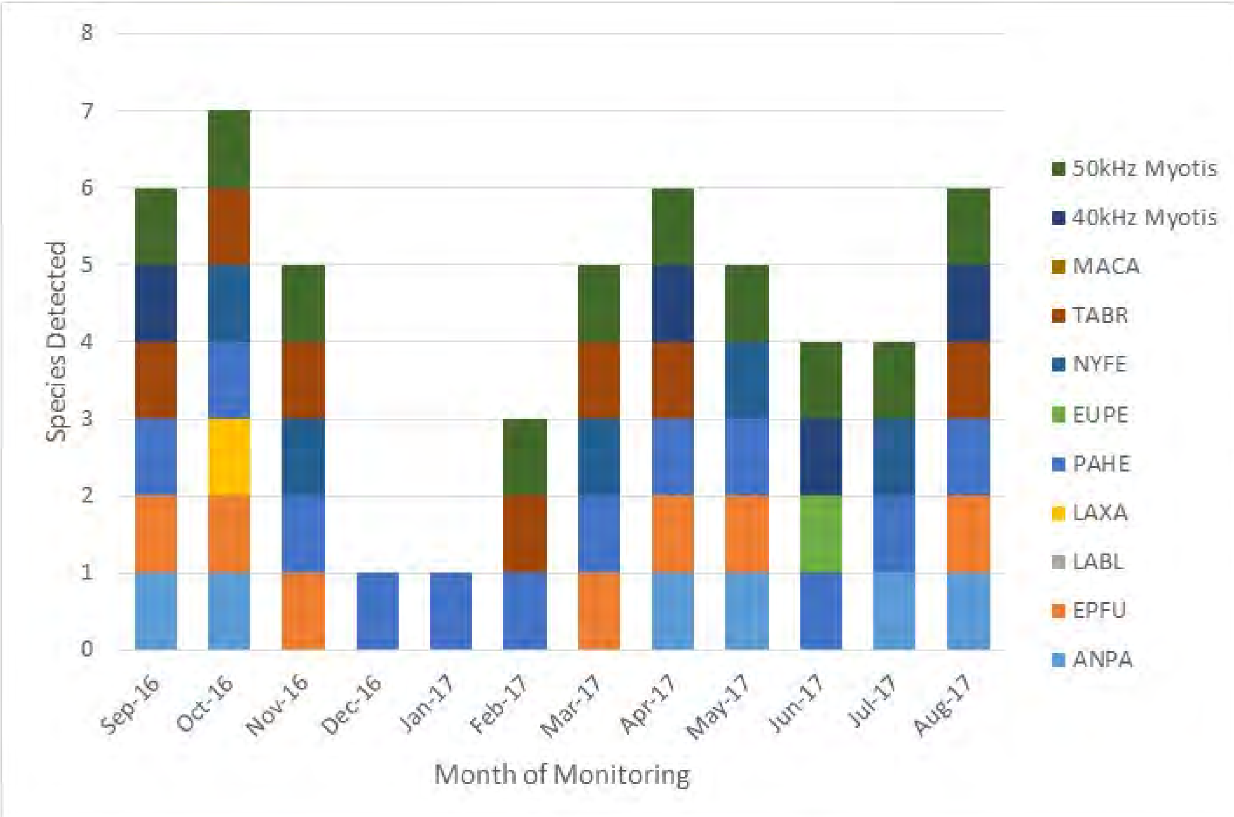
Figures 2, 3, and 4 show the species recorded by month for each of the three monitoring locations. From the start of monitoring in September 2016, through December 2016, and January 2017, all three monitoring locations saw a decline in the number of species recorded. This was followed by an increase in the number of species recorded through spring (March, April, and May) 2017. With regards to the number of species recorded from spring, through summer (June, July, and August) and the end of monitoring, AB1 experienced a drop in May, which was followed by a spike in June, and then no species were recorded in July or August 2017. A review of the AnaBat log indicates that the unit was working properly (e.g., switching between sleep and monitor modes), and some noise files were recorded during this time, so it is believed that the unit did not malfunction. The number of species recorded at AB2 and AB3 followed similar trends from spring to the end of monitoring. This trend included a dip in the number of species recorded between April and May, and July, which was followed by an increase through the end of the monitoring period on August 31, 2017.

**Figure 2. Bat species recorded by month at monitoring location AB1.**



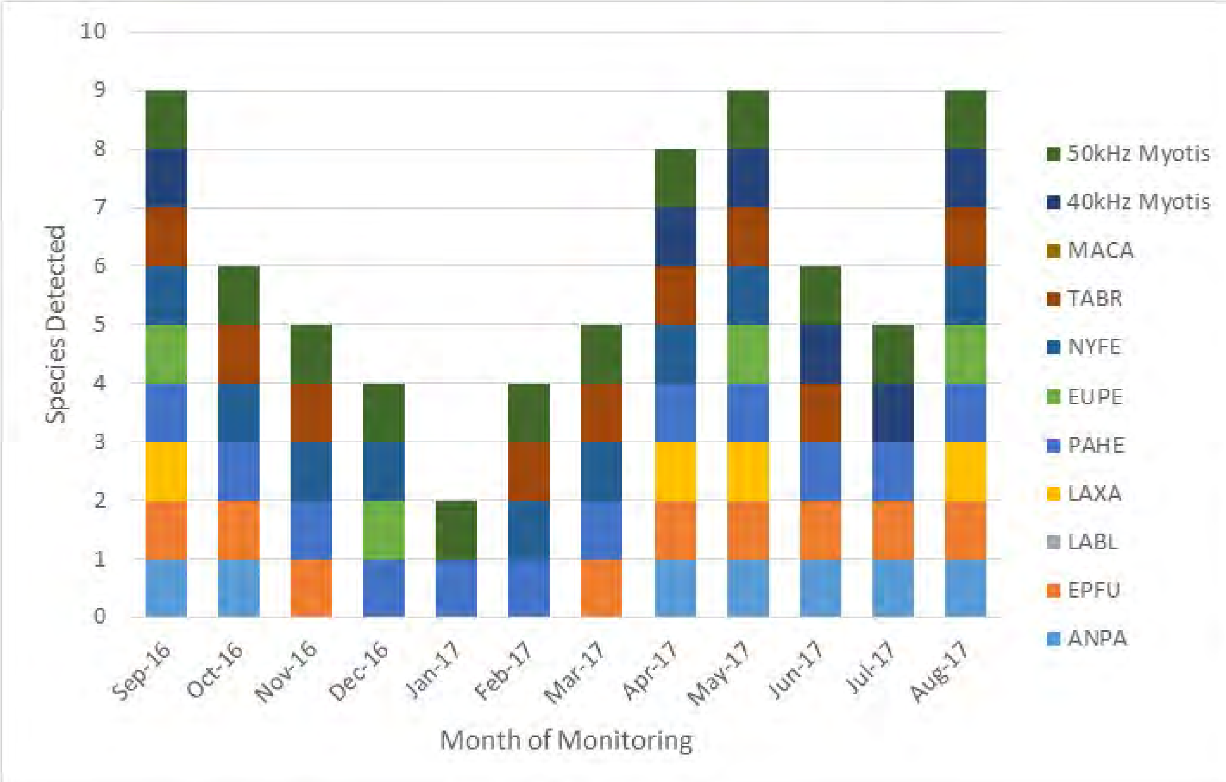

50kHz Myotis are a group of bats that echolocate in the 50kHz range that are difficult to differentiate due to similarities in call structure. This group includes California myotis (*M. californicus*) and Yuma myotis (*M. yumanensis*).
MACA – California leaf-nosed bat (*Macrotus caqlifornicus*)
TABR – Brazilian free-tailed bat (*Tadarida brasiliensis*)
NYFE – pocketed free-tailed bat (*Nyctinomops femorosaccus*)
EUPE – western mastiff bat (*Eumops perotis*)
PAHE – canyon bat (*Parastrellus hesperus*)
LAXA – western yellow bat (*Lasiurus xanthinus*)
LABL – western red bat (*Lasiurus blossevillii*)
EPFU – big brown bat (*Eptesicus fuscus*)
ANPA – pallid bat (*Antrozous pallidus*)

**Figure 3. Bat species recorded by month at monitoring location AB2.**




50kHz Myotis are a group of bats that echolocate in the 50kHz range that are difficult to differentiate due to similarities in call structure. This group includes California myotis (*M. californicus*) and Yuma myotis (*M. yumanensis*).
MACA – California leaf-nosed bat (*Macrotus caqlifornicus*)
TABR – Brazilian free-tailed bat (*Tadarida brasiliensis*)
NYFE – pocketed free-tailed bat (*Nyctinomops femorosaccus*)
EUPE – western mastiff bat (*Eumops perotis*)
PAHE – canyon bat (*Parastrellus hesperus*)
LAXA – western yellow bat (*Lasiurus xanthinus*)
LABL – western red bat (*Lasiurus blossevillii*)
EPFU – big brown bat (*Eptesicus fuscus*)
ANPA – pallid bat (*Antrozous pallidus*)

**Figure 4. Bat species recorded by month at monitoring location AB3.**




50kHz Myotis are a group of bats that echolocate in the 50kHz range that are difficult to differentiate due to similarities in call structure. This group includes California myotis (*M. californicus*) and Yuma myotis (*M. yumanensis*).
MACA – California leaf-nosed bat (*Macrotus caqlifornicus*)
TABR – Brazilian free-tailed bat (*Tadarida brasiliensis*)
NYFE – pocketed free-tailed bat (*Nyctinomops femorosaccus*)
EUPE – western mastiff bat (*Eumops perotis*)
PAHE – canyon bat (*Parastrellus hesperus*)
LAXA – western yellow bat (*Lasiurus xanthinus*)
LABL – western red bat (*Lasiurus blossevillii*)
EPFU – big brown bat (*Eptesicus fuscus*)
ANPA – pallid bat (*Antrozous pallidus*)

Below is a brief species description and summary of presence across the three monitoring locations for each of the detected species.

***Pallid Bat***

The pallid bat is a large (20-35 grams), light-colored bat with long prominent ears that ranges throughout western North America (Harvey et al. 1999, WBWG 2005a). This species inhabits low elevation (i.e., < 6,000 feet) rocky arid deserts and canyonlands, shrub-steppe grasslands, karst formations, and higher elevation coniferous forests above 7,000 feet (WBWG 2005a). Within California it occurs statewide except for the high Sierra Nevada and is a yearlong resident throughout most of its range (CDFW 2014). This species forages over open ground, usually between 1.6 and 8 feet above ground level (CDFW 2014). Although aerial take of prey does occur, gleaning is the most frequent method for prey capture. Prey items include a wide variety of insects and arachnids (CDFW 2014).

Caves, crevices, mines, and occasionally hollow trees and buildings are used as day roosts for the pallid bat (CDFW 2014). Night roosts are more open in nature and include the exterior or interior of man-made structures (CDFW 2014. A roost may consist of a single individual, small groups of 20, or hundreds of individuals (CDFW 2014, WBWG 2005a). Maternity colonies disperse between August and October (WBWG 2005a). Although their winter habits are poorly known, pallid bats are not known to migrate long distances between winter and summer sites (WBWG 2005a).

A query of the CNDDB (2017) identified occurrences of pallid bat east of the Project area in the Chuckwalla Valley, Palo Verde, and Neighbors areas (Figure 1).

During the yearlong survey, the pallid bat was recorded at all three monitoring locations during the following months:

- AB1 – September-October 2016, March, April, and June, 2017
- AB2 – September 2016, April, May, July, and August 2017
- AB3 – September-October 2016, April-August 2017

***Big Brown Bat***

The big brown bat is a medium to large (14-21 grams) bat with dark fur that is known to occur in a wide variety of habitats throughout western North America (Harvey et al. 1999). Within California, the big brown bat is widespread and abundant, but is considered to be uncommon in hot desert habitats and is absent from the highest alpine meadows and talus slopes (CDFW 2014). The big brown bat forages at approximately 20 - 30 feet above open habitats, among scattered trees and in residential areas (CDFW 2014). Primary prey includes large, hard-shelled flying insects, which are taken in flight (CDFW 2014). This species is well known for its use of man-made structures for roosting, including buildings, mines, and bridges (WBWG 2005b). However, natural roosts are also used, which include caves, crevices in cliff faces, and trees. Colonies, specifically maternity colonies, vary in size from a few individuals to several hundred. Big brown bats are not known to migrate large distances between summer and winter habitats (WBWG 2005b). The sexes roost separately in the spring and summer and co-roost while hibernating in the winter (WBWG 2005b). The big brown bat is known to be active on warm winter nights in the southwestern portion of its range (WBWG 2005b).

A query of the CNDDB (2017) for big brown bat identified no known occurrences within a nine-quad area surrounding the Project.

During the yearlong survey, the big brown bat was recorded at all three monitoring locations during the following months:

- AB1 – September-November 2016, February-June 2017
- AB2 – September-November 2016, March-May, and August 2017
- AB3 – September-November 2016, March-August 2017

***Western Red Bat***

The western red bat is a medium sized (10-15 grams) bat with red frosted fur that is white at the tips (Harvey et al. 1999). This species is known to occur from western Canada and south to Central America

WBWG 2005c). In California, the western red bat occurs west of the Sierra Nevada and Cascade crest and deserts (CDFW 2014).

The western red bat forages on a variety of insects while in flight between ground level and above the tree canopy (CDFW 2014). This species roosts in trees of edge habitats adjacent to streams, fields, or urban areas (WBWG 2005c). Preferred roost sites are protected from above and are open below between 2 and 40 feet above ground level (CDFW 20014). Although nursery colonies that include many females and their young are occasionally observed, this species typically roosts singularly (WBWG 2005c). The western red bat seasonally migrates between summer and winter ranges, and in cold climates it spends the winter in hibernation (WBWG 2005c).

A query of the CNDDB (2017) for western red bat identified no known occurrences within a nine-quad area surrounding the Project.

During the yearlong survey, the western red bat was only recorded at AB1 in October of 2016.

***Western Yellow Bat***

The western yellow bat is a medium sized (10-15 grams) bat with yellow fur (Harvey et al. 1999). This species is known to occur in the Mexican Plateau of the desert southwest (WBWG 2005d). Within California, the western yellow bat occurs year-round in valley foothill riparian, desert riparian, desert wash, and palm oasis habitats associated with the Mojave Desert (CDFW 2014).

The western yellow bat forages over water and among trees on flying insects (CDFW 2014). Although limited, information regarding roosting behavior suggests that the western yellow bat is non-colonial with individuals roosting in trees, hanging from the underside of leaves (WBWG 2005d). Palm tree fronds appear to be a common roosting structure in the southwestern U.S (WBWG 2005d).

A query of the CNDDB (2017) for western yellow bat identified no known occurrences within a nine-quad area surrounding the Project.

During the yearlong survey, the western yellow bat was recorded at all three monitoring locations during the following months:

- AB1 – September 2016; February, March, April, June 2017
- AB2 – October of 2016
- AB3 – September 2016; April, May, August 2017

***Canyon Bat***

The canyon bat (formerly known as the western pipistrelle) is the smallest (3-6 grams) of all North American bats (Harvey et al. 1999). This species has light tan fur and ranges from southern Washington, south to Mexico, and east into west Texas (WBWG 2005e). In California, this species is a common to abundant yearlong resident of deserts, arid grasslands, and woodland habitats (CDFW 2014).

The canyon bat is often found foraging over water in rocky canyons and along cliff faces (CDFW 2014). Primary prey items include a variety of flying insects with soft-bodied prey being the majority of food items (CDFW 2014). This species roosts primarily in rock crevices, and is occasionally found in mines and caves (CDFW 2014). The canyon bat is rarely observed roosting in buildings (CDFW 2014). The canyon bat tends to roost singly or in small groups of just a few individuals. This species does hibernate, but it is known to emerge to forage during warm days (WBWG 2005d).

A query of the CNDDB (2017) for canyon bat identified no known occurrences within a nine-quad area surrounding the Project.

During the yearlong survey, the canyon bat was recorded at all three monitoring locations during the following months:

- AB1 – September-November 2016; January-June 2017
- AB2 – September 2016-August 2017
- AB3 – September 2016-August 2017

***Western Mastiff Bat***

The western mastiff bat is the largest (60-70 grams) of all North American bats (Harvey et al. 1999). This species is primarily found from central California, east across Arizona, southern New Mexico, west Texas, and south to Central Mexico (WBWG 2005e). However, recent surveys have documented this species in northern Arizona and southern Utah (WBWG 2005e). In California, this species occurs in open, semi-arid to arid habitats, including conifer and deciduous woodlands, costal scrub, annual and perennial grasslands, palm oases, chaparral, desert scrub, and urban (CDFW 2014).

The western mastiff bat forages in open areas at heights of 100 to 200 feet above the ground (WBWG 2005e). Moths (*Lepidoptera* spp.) are primary prey items, while beetles, crickets, and katydids are also consumed (WBWG 2005e). This species is known to travel long distances from its roost to foraging areas over agricultural fields in the Imperial Valley and along the Lower Colorado River (WBWG 2005e). The western mastiff bat is primarily a cliff-dwelling species with colonies typically containing fewer than 100 individuals (WBWG 2005e). Roosts are generally high above the ground, usually allowing a clear vertical drop of at least 3 meters (9.8 feet) to take flight (WBWG 2005e). The western mastiff bat is not known to undergo prolonged hibernation and is active throughout the year (WBWG 2005e).

A query of the CNDDB (2017) for western mastiff bat identified no known occurrences within a nine-quad area surrounding the Project.

During the yearlong survey, the western mastiff bat was recorded at all three monitoring locations during the following months:

- AB1 – September 2017
- AB2 - June 2016
- AB3 - September and December 2016; May and August 2017

***Pocketed Free-tailed Bat***

The pocketed free-tailed bat is a medium sized (10-15 grams) bat that occurs in the southwestern U.S, from southern California, east to western Texas, and south into Mexico (Harvey et al. 1999, WBWG 2005f). In California, this species inhabits pinyon-juniper woodlands, desert scrub, desert succulent shrub, desert riparian, desert wash, alkali desert scrub, Joshua tree, and palm oasis habitats (CDFW 2014).

The pocketed free-tailed bat forages on flying insects, mainly large moths, and high over ponds, streams, or arid desert habitats (CDFW 2014). This species is colonial and roosts in crevices of rugged cliffs, high rocky outcrops, and slopes (WBWG 2005f).

A query of the CNDDB (2017) for pocketed free-tailed bat identified no known occurrences within a nine-quad area surrounding the Project.

During the yearlong survey, the pocketed free-tailed bat was recorded at all three monitoring sites during the following months:

- AB1 – September-November 2016, January-June 2017
- AB2 – October and September 2016, March, May, and July 2017
- AB3 – September-November 2016, February-May, and August 2017

***Brazilian Free-tailed Bat***

The Brazilian free-tailed bat is a medium sized (11-5 grams) bat (Harvey et al. 1999). It is one of the most widely distributed mammalian species in the Western Hemisphere (WBWG 2005g). In California, this species is found statewide. However, it is uncommon in the high Sierra Nevada and north coastal region (CDFW 2014).

The Brazilian free-tailed bat is an aerial hunter and primarily forages on small moths. Foraging can occur as high as 100 feet above the ground (CDFW 2014). This species roosts in large colonies in caves, mines, tunnels, crevices, bridges, and buildings (CDFW 2014).

A query of the CNDDB (2017) for Brazilian free-tailed bat identified no known occurrences within a nine-quad area surrounding the Project.

During the yearlong survey, the Brazilian free-tailed bat was recorded at all three monitoring sites during the following months:

- AB1 – September-November 2016, January-April, and June 2017
- AB2 – September-November 2016, February-April, and August 2017
- AB3 – September-November 2016, February-May, and August 2017

***California Leaf-nosed Bat***

The California leaf-nosed bat is a small to medium sized (8-17 grams) bat with gray fur and a distinct leaf like projection at the tip of its nose (Harvey et al. 1999, WBWG 2005h). This species occurs in the deserts of California, southern Nevada, Arizona, and south into Baja California and Sonora, Mexico (WBWG 2005h). In California it occupies desert riparian, desert wash, desert scrub, desert succulent shrub, alkali desert scrub, and palm oasis habitats (CDFW 2014).

This species forages close to the ground, often less than 3 feet above ground level (CDFW 2014). The California leaf-nosed bat gleans insects from foliage and captures prey on the ground and in the air (CDFW 2014). They forage up to 1 mile from their roost (CDFW 2014). The California leaf-nosed bat roosts in deep mine tunnels or caves, which must provide shelter from heat and aridity (CDFW 2014). Roosts may contain several hundred individuals (WBWG 2005h). This species does not migrate or hibernate and is active year-round (WBWG 2005h).

A query of the CNDDB (2017) revealed four occurrences of California leaf-nosed bat. Of those, three are located north of the Project in the vicinity of McCoy Peak (Figure 1). The location of the fourth occurrence is only provided as a polygon that encompasses the entire 7.5’ Roosevelt Mine USGS Quadrangle, which also encompasses the Project (Figure 1).

During the yearlong survey, the California leaf-nosed bat was only recorded at AB1 in June of 2017.

***40 Kilohertz Bats (Arizona myotis and cave myotis)***

The 40 kilohertz (kHz) acoustic group of small to medium sized (7-15 grams) bats (Harvey et al. 1999). Those with the potential to occur in the Project area consist of the Arizona and cave myotis. Both of these species are small bats that are located in the lowlands of the Colorado River and adjacent mountain ranges of California (CDFW 2014). Occupied habitat includes desert scrub, desert succulent shrub, desert wash, and desert riparian (CDFW 2014).

Both of the 40 kHz myotis species are aerial hunters feeding on small flying insects. Although both species roost colonially, cave myotis colonies can be as large as 10,000 individuals, and Arizona myotis colonies may be comprised of 800 individuals (WBWG 2005i, CDFW 2014).

A query of the CNDDB (2017) for 40 kHz bats revealed occurrences for both species within a nine-quad area surrounding the Project. However, only the location of the cave myotis is provided, which is described as “about 6.8 miles south southwest of Blythe, California” (Figure 1).

During the yearlong survey, 40 kHz bats were recorded at all three monitoring sites during the following months:

- AB1 – September 2016, March and June 2017
- AB2 – September 2016, April, and June 2017
- AB3 – September 2016, April-August 2017

***50 Kilohertz Bats (California myotis and Yuma myotis)***

The 50 kHz group of bats with the potential to occur in the Project area is comprised of the California and Yuma myotis. Both of these species are small (3-6 grams) bats that are common throughout California (Harvey et al. 1999, CDFW 2014). They occupy a wide range of habitats including desert, chaparral, woodland, and forested (CDFW 2014).

Both of these 50 kHz species are aerial hunters feeding on small flying insects. Both species may be found roosting in crevices, but the Yuma myotis will also utilize larger cavities (CDFW 2014). Maternity colonies of California myotis are small with only a few individuals, while Yuma myotis will have maternity colonies of several thousand individuals (CDFW 2014).

A query of the CNDDB (2017) for 50 kHz bats revealed a single Yuma myotis occurrence at the Cibola Bridge over the Colorado River (Figure 1).

During the yearlong survey 50 kHz bats were recorded at all three monitoring locations during the following months:

- AB1 – September 2016-April 2017 and June 2017
- AB2 – September-November 2016, February-August 2017
- AB3 – September 2016-August 2017

## References


AECOM. 2017. Avian survey work plan re Crimson Solar Project Riverside County, California. Prepared for Sonoran West Solar Holdings, LLC. Prepared by AECOM. May 2016.

California Department of Fish and Wildlife. California Interagency Wildlife Task Group. 2014. CWHR version 9.0 personal computer program. Sacramento, CA.

California Department of Fish and Wildlife, Natural Diversity Database. July 2017. Special Animals List. Periodic publication. 51 pp.

California Natural Diversity Database (CNDDB). 2017. RareFind 5 [Internet]. California Department of Fish and Wildlife. September 1, 2017.

Harvey, M. J., J. S. Altenbach, and T. L. Best. 1999. Bats of the United States. Arkansas Game and Fish Commission. 64 pp.

Western bat Working Group. 2005a. Species accounts pallid bat (*Antrozous pallidus*). Prepared by Rick Sherwin, updated by Daniela A. Rambaldini. Available online: http://wbwg.org/western-bat-species. Accessed September 2017.

Western bat Working Group. 2005b. Species accounts big brown bat (*Eptesicus fuscus*). Prepared by Mark Perkins. Available online: http://wbwg.org/western-bat-species. Accessed September 2017.

Western bat Working Group. 2005c. Species accounts western red bat (*Lasiurus blossevillii*). Prepared by Betsy C. Bolster. Available online: http://wbwg.org/western-bat-species. Accessed September 2017.

Western bat Working Group. 2005d. Species accounts canyon bat (*Parastrellus hesperus*). Prepared by Patricia E. Brown. Available online: http://wbwg.org/western-bat-species. Accessed September 2017.

Western bat Working Group. 2005e. Species accounts western mastiff bat (*Eumops perotis*). Prepared by Elizabeth D. Pierson, updated by Melissa S. Siders. Available online: http://wbwg.org/western-bat-species. Accessed September 2017.

Western bat Working Group. 2005f. Species accounts pocketed free-tailed bat (*Nyctinomops femorosaccus*). Prepared by Kirk Navo. Available online: http://wbwg.org/western-bat-species. Accessed September 2017.

Western bat Working Group. 2005g. Species accounts Brazilian free-tailed bat (*Tadarida brasiliensis*). Prepared by Bat Conservation International. Available online: http://wbwg.org/western-bat-species. Accessed September 2017.

Western bat Working Group. 2005h. Species accounts California leaf-nosed bat (*Macrotis californicus*). Prepared by Patricia E. Brown. Available online: http://wbwg.org/western-bat-species. Accessed September 2017.

Western bat Working Group. 2005i. Species accounts cave myotis (*Myotis velfer*). Prepared by Patricia E. Brown. Available online: http://wbwg.org/western-bat-species. Accessed September 2017.

# Appendix K

# Sonoran West Avian Summary Data

| Table 1: 2012 Bird Survey Results for the Sonoran West Solar Electric Generating Facility Project | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Common Name | Scientific Name | Special Status | | Elf Owl | Gila Woodpecker | Non-raptor Observation Points | Raptor Observation Points | Migratory Bird Transects | Grand Total |
| | | Federal | State | | | | | | |
| **Waterbirds** | | | | | | | | | |
| **Shorebirds & Relatives** | **Order Charadriiformes** | | | | | | | | |
| Long-billed Curlew | *Numenius americanus* | BCC | WL | | | 2 | | | 2 |
| **Cormorants** | **Order Suliformes** | | | | | | | | |
| Double-Crested Cormorant | *Phalacrocorax auritus* | | WL | | | 81 | | | 81 |
| **Raptors** | | | | | | | | | |
| **Vultures & Hawks** | **Order Accipitriformes** | | | | | | | | |
| Cooper's Hawk | *Accipiter cooperii* | | WL | | | 1 | 1 | | 2 |
| Northern Harrier | *Circus cyaneus* | | SSC | | | | 1 | | 1 |
| Red-Tailed Hawk | *Buteo jamaicensis* | | | | present | 43 | 32 | 8 | 83 |
| Swainson's Hawk | *Buteo swainsoni* | BCC | ST | | | 3 | 5 | 1 | 9 |
| Turkey Vulture | *Cathartes aura* | | | present | present | 36 | 65 | 12 | 113 |
| **Falcons & Eagles** | **Order Falconiformes** | | | | | | | | |
| American Kestrel | *Falco sparverius* | | | | | | 2 | 1 | 3 |
| Prairie Falcon | *Falco mexicanus* | BCC | WL | | present | 4 | 1 | | 5 |
| **Owls** | **Order Strigiformes** | | | | | | | | |
| Great Horned Owl | *Bubo virginianus* | | | present | present | | 1 | | 1 |
| **Other Non-Passerines** | | | | | | | | | |
| **Game Birds** | **Order Galliformes** | | | | | | | | |
| Gambel's Quail | *Callipepla gambelii* | | | present | present | 40 | | 37 | 77 |
| **Doves and Pigeons** | **Order Columbiformes** | | | | | | | | |
| Eurasian Collared-Dove | *Streptopelia decaocto* | | | | present | 3 | | 4 | 7 |
| Mourning Dove | *Zenaida macroura* | | | present | present | 100 | | 53 | 153 |
| White-Winged Dove | *Zenaida asiatica* | | | present | present | 38 | | 9 | 47 |
| **Cuckoos and Relatives** | **Order Cuculiformes** | | | | | | | | |
| Greater Roadrunner | *Geococcyx californianus* | | | present | present | 5 | | | 5 |
| **Nightjars and Relatives** | **Order Caprimulgiformes** | | | | | | | | |
| Common Poor-Will | *Phalaenoptilus nuttallii* | | | | | 2 | | | 2 |
| Lesser Nighthawk | *Chordeiles acutipennis* | | | present | present | 2 | | 6 | 8 |
| **Swifts** | **Order Apodiformes** | | | | | | | | |
| Vaux's Swift | *Chaetura vauxi* | | SSC | | | 7 | | 1 | 8 |
| White-Throated Swift | *Aeronautes saxatalis* | | | | | | | 1 | 1 |

| Table 1: 2012 Bird Survey Results for the Sonoran West Solar Electric Generating Facility Project | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Common Name | Scientific Name | Special Status | | Elf Owl | Gila Woodpecker | Non-raptor Observation Points | Raptor Observation Points | Migratory Bird Transects | Grand Total |
| | | Federal | State | | | | | | |
| **Hummingbirds** | **Order Trochiliformes** | | | | | | | | |
| Black-Chinned Hummingbird | *Archilochus alexandri* | | | | | 10 | | | 10 |
| Costa's Hummingbird | *Calypte costae* | | | | present | 3 | | 2 | 5 |
| **Woodpeckers and Relatives** | **Order Piciformes** | | | | | | | | |
| Ladder-Backed Woodpecker | *Picoides scalaris* | | | | | 2 | | | 2 |
| **Passerines** | | | | | | | | | |
| **Perchingbirds** | **Order Passeriformes** | | | | | | | | |
| **Flycatchers** | | | | | | | | | |
| Ash-Throated Flycatcher | *Myiarchus cinerascens* | | | present | present | 87 | | 77 | 164 |
| Black Phoebe | *Sayornis nigricans* | | | | | 1 | | | 1 |
| Cassin's Kingbird | *Tyrannus vociferans* | | | | present | 1 | | 1 | 2 |
| Gray Flycatcher | *Empidonax wrightii* | | | | | 7 | | 1 | 8 |
| Pacific Slope Flycatcher | *Empidonax difficilis* | | | | | | | 1 | 1 |
| Say's Phoebe | *Sayornis saya* | | | | present | 6 | | 3 | 9 |
| Western Kingbird | *Tyrannus verticalis* | | | | | 22 | | 18 | 40 |
| Western Wood-Pewee | *Contopus sordidulus* | | | | present | 6 | | 3 | 9 |
| **Verdins** | | | | | | | | | |
| Verdin | *Auriparus flaviceps* | | | | present | 17 | | 21 | 38 |
| **Larks** | | | | | | | | | |
| Horned Lark | *Eremophila alpestris* | | WL | present | present | 124 | | 107 | 231 |
| **Swallows** | | | | | | | | | |
| Bank Swallow | *Riparia riparia* | | ST | | | | | 2 | 2 |
| Barn Swallow | *Hirundo rustica* | | | | present | 114 | | 29 | 143 |
| Cliff Swallow | *Petrochelidon pyrrhonota* | | | | | 236 | | 19 | 255 |
| Northern Rough-Winged Swallow | *Stelgidopteryx serripennis* | | | | | 23 | | 5 | 28 |
| Tree Swallow | *Tachycineta bicolor* | | | | | 57 | | 16 | 73 |
| Violet-Green Swallow | *Tachycineta thalassina* | | | | | 2 | | 1 | 3 |
| **Jays and Crows** | | | | | | | | | |
| American Crow | *Corvus brachyrhynchos* | | | | | | | 4 | 4 |
| Common Raven | *Corvus corax* | | | | present | 32 | | 11 | 43 |
| **Wrens** | | | | | | | | | |
| Bewick's Wren | *Thryomanes bewickii* | | | | | 1 | | | 1 |

| Table 1: 2012 Bird Survey Results for the Sonoran West Solar Electric Generating Facility Project | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Common Name | Scientific Name | Special Status | | Elf Owl | Gila Woodpecker | Non-raptor Observation Points | Raptor Observation Points | Migratory Bird Transects | Grand Total |
| | | Federal | State | | | | | | |
| Cactus Wren | *Campylorhynchus brunneicapillus* | | | present | present | 51 | | 65 | 116 |
| Canyon Wren | *Catherpes mexicanus* | | | | | 1 | | 1 | 2 |
| **Mockingbirds and Thrashers** | | | | | | | | | |
| Crissal Thrasher | *Toxostoma crissale* | | SSC | | | 1 | | | 1 |
| Le Conte's Thrasher | *Toxostoma lecontei* | BCC | SSC | | present | 44 | | 19 | 63 |
| Northern Mockingbird | *Mimus polyglottos* | | | | | 6 | | 3 | 9 |
| Sage Thrasher | *Oreoscoptes montanus* | | | | present | | | | 1 |
| **Gnatcatchers and Kinglets** | | | | | | | | | |
| Black-Tailed Gnatcatcher | *Polioptila melanura* | | | | present | 55 | | 19 | 74 |
| Blue-Gray Gnatcatcher | *Polioptila caerulea* | | | | | 3 | | 3 | 6 |
| Ruby-Crowned Kinglet | *Regulus calendula* | | | | | 1 | | 1 | 2 |
| **Phainopeplas** | | | | | | | | | |
| Phainopepla | *Phainopepla nitens* | | | present | present | 6 | | 3 | 9 |
| **Shrikes** | | | | | | | | | |
| Loggerhead Shrike | *Lanius ludovicianus* | BCC | SSC | present | present | 114 | 1 | 63 | 178 |
| **Warblers** | | | | | | | | | |
| Black-Throated Gray Warbler | *Setophaga nigrescens* | | | | present | 6 | | 1 | 7 |
| Common Yellowthroat | *Geothlypis trichas* | | | | | 2 | | 1 | 3 |
| Hermit Warbler | *Setophaga occidentalis* | | | | | 1 | | | 1 |
| Lucy's Warbler | *Oreothlypis luciae* | BCC | SSC | | | 2 | | 1 | 3 |
| MacGillivray's Warbler | *Geothlypis tolmiei* | | | | | 3 | | 7 | 10 |
| Nashville Warbler | *Oreothlypis ruficapilla* | | | | | 20 | | 6 | 26 |
| Orange-Crowned Warbler | *Oreothlypis celata* | | | | present | 28 | | 9 | 37 |
| Townsend's Warbler | *Setophaga townsendi* | | | | | 6 | | 3 | 9 |
| Wilson's Warbler | *Cardellina pusilla* | | | | | 52 | | 31 | 83 |
| Yellow Warbler | *Setophaga petechia* | BCC | SSC | | present | 9 | | 3 | 12 |
| Yellow-Rumped Warbler | *Setophaga coronata* | | | | | 26 | | 1 | 27 |
| **Vireos** | | | | | | | | | |
| Warbling Vireo | *Vireo gilvus* | | | | present | 6 | | 1 | 7 |
| **Blackbirds and Orioles** | | | | | | | | | |
| Brewer's Blackbird | *Euphagus cyanocephalus* | | | | | | | 5 | 5 |
| Brown-Headed Cowbird | *Molothrus ater* | | | | | 5 | | 3 | 8 |

| Table 1: 2012 Bird Survey Results for the Sonoran West Solar Electric Generating Facility Project | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Common Name** | **Scientific Name** | **Special Status** | | **Elf Owl** | **Gila Woodpecker** | **Non-raptor Observation Points** | **Raptor Observation Points** | **Migratory Bird Transects** | **Grand Total** |
| | | **Federal** | **State** | | | | | | |
| Bullock's Oriole | *Icterus bullockii* | | | | present | 27 | | 8 | 35 |
| Hooded Oriole | *Icterus cucullatus* | | | | | 1 | | 1 | 2 |
| Red-Winged Blackbird | *Agelaius phoeniceus* | | | | | 49 | | 2 | 51 |
| Yellow-Headed Blackbird | *Xanthocephalus xanthocephalus* | | SSC | | | 1 | | | 1 |
| **Tanagers** | | | | | | | | | |
| Western Tanager | *Piranga ludoviciana* | | | | present | 30 | | | 30 |
| **Cardinals, Sparrows and Finches** | | | | | | | | | |
| Abert's Towhee | *Pipilo aberti* | | | | | 1 | | | 1 |
| Black-Headed Grosbeak | *Pheucticus melanocephalus* | | | | present | 7 | | 3 | 10 |
| Black-Throated Sparrow | *Amphispiza bilineata* | | | | | 2 | | | 2 |
| Blue Grosbeak | *Passerina caerulea* | | | | | | | 1 | 1 |
| Brewer's Sparrow | *Spizella breweri* | BCC | | | | 35 | | 24 | 59 |
| Chipping Sparrow | *Spizella passerina* | | | | | 2 | | 6 | 8 |
| House Finch | *Carpodacus mexicanus* | | | | | 20 | | 9 | 29 |
| Lark Sparrow | *Chondestes grammacus* | | | | | 2 | | 1 | 3 |
| Lazuli Bunting | *Passerina amoena* | | | | present | 4 | | | 4 |
| Lesser Goldfinch | *Spinus psaltria* | | | | present | 8 | | | 8 |
| Sage Sparrow | *Amphispiza belli* | | | | | 5 | | | 5 |
| Savannah Sparrow | *Passerculus sandwichensis* | | | | | 1 | | | 1 |
| White-Crowned Sparrow | *Zonotrichia leucophrys* | | | | | 5 | | 5 | 10 |
| **Totals Number of Observations** | | | | **-** | **-** | **1,766** | **109** | **763** | **2,638** |
| **Total Number of Species** | | | | **12** | **34** | **74** | **9** | **61** | **84** |
| SE - State Endangered (California Endangered Species Act) | | | | | | | | | |
| ST - State Threatened (California Endangered Species Act) | | | | | | | | | |
| BCC - Birds of Conservation Concern (United States Fish and Wildlife Service) | | | | | | | | | |
| FP - Fully Protected (California Department of Fish and Game) | | | | | | | | | |
| SSC - Species of Special Concern (California Department of Fish and Game) | | | | | | | | | |
| WL - Watch List (California Department of Fish and Game) | | | | | | | | | |

= Over 100 individuals observed

**Table 2: Comparison of Microphyll Woodland Use to Desert Upland During Spring 2012 Bird Transect Surveys at the Sonoran West Solar Electric Generating Facility**

| Group | N | Median | Significance * | Mean | Std Dev | SEM |
|---|---|---|---|---|---|---|
| **Number of Observations** | | | | | | |
| Woodlands | 13 | 14 | A | 16.69 | 13.64 | 3.783 |
| Desert Upland | 71 | 0 | B | 1.11 | 1.76 | 0.209 |
| Adjacent | 12 | 5 | A | 6.83 | 7.81 | 2.256 |
| **Number of Species** | | | | | | |
| Group | N | Median | Significance * | Mean | Std Dev | SEM |
| Woodland | 13 | 12 | A | 13.39 | 10.71 | 2.969 |
| Desert Upland | 71 | 0 | B | 0.90 | 1.27 | 0.15 |
| Adjacent | 12 | 3.5 | A | 5.58 | 6.68 | 1.928 |

*Kruskal-Wallis One Way Analysis of Variance on Ranks, Multiple Comparison Procedure (Dunn's Method). $P < 0.05$ for groups with different letters

| Table 3: Special Status Birds Species Observed During Spring 2012 Bird Survey at Sonoran West Solar Electric Generating Facility Project | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Common Name** | **Scientific Name** | **Special Status** | | **Non-raptor Observation Points** | **Raptor Observation Points** | **Migratory Bird Transects** | **Grand Total** |
| | | **Federal** | **State** | | | | |
| **Raptors** | | | | | | | |
| **Vultures & Hawks** | **Order Accipitriformes** | | | | | | |
| Northern Harrier | *Circus cyaneus* | | SSC | | 1 | | 1 |
| Swainson's Hawk | *Buteo swainsoni* | BCC | ST | 3 | 5 | 1 | 9 |
| **Other Non-Passerines** | | | | | | | |
| **Swifts** | **Order Apodiformes** | | | | | | |
| Vaux's Swift | *Chaetura vauxi* | | SSC | 7 | | 1 | 8 |
| **Passerines** | | | | | | | |
| **Swallows** | | | | | | | |
| Bank Swallow | *Riparia riparia* | | ST | | | 2 | 2 |
| **Mockingbirds and Thrashers** | | | | | | | |
| Crissal Thrasher | *Toxostoma crissale* | | SSC | 1 | | | 1 |
| Le Conte's Thrasher | *Toxostoma lecontei* | BCC | SSC | 44 | | 19 | 63 |
| **Shrikes** | | | | | | | |
| Loggerhead Shrike | *Lanius ludovicianus* | BCC | SSC | 114 | 1 | 63 | 178 |
| **Warblers** | | | | | | | |
| Lucy's Warbler | *Oreothlypis luciae* | BCC | SSC | 2 | | 1 | 3 |
| Yellow Warbler | *Setophaga petechia* | BCC | SSC | 9 | | 3 | 12 |
| **Blackbirds and Orioles** | | | | | | | |
| Yellow-Headed Blackbird | *Xanthocephalus xanthocephalus* | | SSC | 1 | | | 1 |
| **Totals Number of Observations** | | | | **181** | **7** | **90** | **278** |
| **Total Number of Species** | | | | **8** | **3** | **7** | **10** |

SE - State Endangered (California Endangered Species Act)

ST - State Threatened (California Endangered Species Act)

BCC - Birds of Conservation Concern (United States Fish and Wildlife Service)

FP - Fully Protected (California Department of Fish and Game)

SSC - Species of Special Concern (California Department of Fish and Game)

WL - Watch List (California Department of Fish and Game)

[shaded] = Over 100 individuals observed

# Appendix L

# RE Crimson Avian Summary Data

## RE Crimson Avian Summary Data

### Table 1. Numbers of Individuals and Flocks of Avian Species Detected at 2016/2017 Migratory Bird Observation Points per Season

| Common Name | Scientific Name | Individuals | | | Flocks (# of individuals per flock)[1] | | |
|---|---|---|---|---|---|---|---|
| | | Spring | Fall | *Total* | Spring | Fall | *Total* |
| American Kestrel | *Falco sparverius* | 3 | 3 | *6* | 0 | 0 | *0* |
| American Pipit | *Anthus rubrescens* | 8 | 11 | *19* | 0 | 0 | *0* |
| Ash-throated Flycatcher | *Myiarchus cinerascens* | 7 | 0 | *7* | 0 | 0 | *0* |
| Bank Swallow | *Riparia riparia* | 0 | 1 | *1* | 0 | 0 | *0* |
| Barn Swallow | *Hirundo rustica* | 41 | 218 | *259* | 0 | 5 (10, 15, 10, 10, 15) | *5* |
| Brown-headed Cowbird | *Molothrus ater* | 0 | 3 | *3* | 0 | 0 | *0* |
| Brewer's Blackbird | *Euphagus cyanocephalus* | 6 | 0 | *6* | 0 | 0 | *0* |
| Brewer's Sparrow | *Spizella breweri* | 5 | 1 | *6* | 0 | 0 | *0* |
| Black-tailed Gnatcatcher | *Polioptila melanura* | 1 | 2 | *3* | 0 | 0 | *0* |
| Black-throated Sparrow | *Amphispiza bilineata* | 72 | 0 | *72* | 0 | 0 | *0* |
| Cactus Wren | *Campylorhynchus brunneicapillus* | 18 | 1 | *19* | 0 | 0 | *0* |
| Cliff Swallow | *Petrochelidon pyrrhonota* | 27 | 22 | *49* | 0 | 0 | *0* |
| Cooper's Hawk | *Accipiter cooperii* | 0 | 4 | *4* | 0 | 0 | *0* |
| Costa's Hummingbird | *Calypte costae* | 1 | 0 | *1* | 0 | 0 | *0* |
| Common Raven | *Corvus corax* | 115 | 79 | *194* | 0 | 0 | *0* |
| Double-crested Cormorant | *Phalacrocorax auritus* | 0 | 16 | *16* | 0 | 1 (16) | *1* |
| Eurasian Collared-Dove | *Streptopelia decaocto* | 1 | 0 | *1* | 0 | 0 | *0* |

## RE Crimson Avian Summary Data

| Common Name | Scientific Name | Individuals | | | Flocks (# of individuals per flock)[1] | | |
|---|---|---|---|---|---|---|---|
| | | Spring | Fall | *Total* | Spring | Fall | *Total* |
| Ferruginous Hawk | *Buteo regalis* | 3 | 0 | *3* | 0 | 0 | *0* |
| Gambel's Quail | *Callipepla gambelii* | 4 | 0 | *4* | 0 | 0 | *0* |
| Great Blue Heron | *Ardea herodias* | 0 | 1 | *1* | 0 | 0 | *0* |
| Greater Roadrunner | *Geococcyx californianus* | 1 | 0 | *1* | 0 | 0 | *0* |
| Great-tailed Grackle | *Quiscalus mexicanus* | 0 | 5 | *5* | 0 | 0 | *0* |
| House Finch | *Haemorhous mexicanus* | 13 | 19 | *32* | 0 | 0 | *0* |
| Horned Lark | *Eremophila alpestris* | 352 | 431 | *783* | 2 (10, 15) | 6 (13, 12, 12, 17, 10, 19) | *8* |
| Lark Sparrow | *Chondestes grammacus* | 0 | 1 | *1* | 0 | 0 | *0* |
| LeConte's Thrasher | *Toxostoma lecontei* | 53 | 45 | *98* | 0 | 0 | *0* |
| Lesser Nighthawk | *Chordeiles acutipennis* | 7 | 11 | *18* | 0 | 0 | *0* |
| Loggerhead Shrike | *Lanius ludovicianus* | 32 | 49 | *81* | 0 | 0 | *0* |
| Merlin | *Falco columbarius* | 1 | 0 | *1* | 0 | 0 | *0* |
| Mourning Dove | *Zenaida macroura* | 31 | 22 | *53* | 0 | 0 | *0* |
| Northern Harrier | *Circus cyaneus* | 1 | 1 | *2* | 0 | 0 | *0* |
| Northern Mockingbird | *Mimus polyglottos* | 22 | 0 | *22* | 0 | 0 | *0* |
| Northern Rough-winged Swallow | *Stelgidopteryx serripennis* | 0 | 7 | *7* | 0 | 0 | *0* |
| Olive-sided Flycatcher | *Contopus cooperi* | 0 | 1 | *1* | 0 | 0 | *0* |
| Osprey | *Pandion haliaetus* | 1 | 1 | *2* | 0 | 0 | *0* |
| Phainopepla | *Phainopepla nitens* | 1 | 1 | *2* | 0 | 0 | *0* |

## RE Crimson Avian Summary Data

| Common Name | Scientific Name | Individuals | | | Flocks (# of individuals per flock)[1] | | |
|---|---|---|---|---|---|---|---|
| | | Spring | Fall | *Total* | Spring | Fall | *Total* |
| Prairie Falcon | *Falco mexicanus* | 8 | 11 | *19* | 0 | 0 | *0* |
| Rock Wren | *Salpinctes obsoletus* | 1 | 0 | *1* | 0 | 0 | *0* |
| Red-tailed Hawk | *Buteo jamaicensis* | 28 | 23 | *51* | 0 | 0 | *0* |
| Red-winged Blackbird | *Agelaius phoeniceus* | 59 | 0 | *59* | 2 (16, 20) | 0 | *2* |
| Say's Phoebe | *Sayornis saya* | 12 | 22 | *34* | 0 | 0 | *0* |
| Sage Thrasher | *Oreoscoptes montanus* | 10 | 0 | *10* | 0 | 0 | *0* |
| Sage sparrow species | *Artemisiospiza* species | 2 | 8 | *10* | 0 | 0 | *0* |
| Sharp-shinned Hawk | *Accipiter striatus* | 0 | 1 | *1* | 0 | 0 | *0* |
| Swainson's Hawk | *Buteo swainsoni* | 162 | 21 | *183* | 2 (80) | 1 (15) | *3* |
| Tree Swallow | *Tachycineta bicolor* | 160 | 33 | *193* | 3 (30, 80, 15) | 1 (10) | *4* |
| Turkey Vulture | *Cathartes aura* | 276 | 587 | *863* | 7 (14, 20, 22, 12, 40, 20, 30) | 6 (15, 23, 400, 75, 17, 20) | *13* |
| Vaux's Swift | *Chaetura vauxi* | 0 | 1 | *1* | 0 | 0 | *0* |
| Violet-green Swallow | *Tachycineta thalassina* | 29 | 0 | *29* | 1 (10) | 0 | *1* |
| White-crowned Sparrow | *Zonotrichia leucophrys* | 1 | 1 | *2* | 0 | 0 | *0* |
| Western Kingbird | *Tyrannus verticalis* | 0 | 1 | *1* | 0 | 0 | *0* |
| Western Meadowlark | *Sturnella neglecta* | 0 | 16 | *16* | 0 | 0 | *0* |
| Western Tanager | *Piranga ludoviciana* | 0 | 1 | *1* | 0 | 0 | *0* |
| White-faced Ibis | *Plegadis chihi* | 0 | 16 | *16* | 0 | 1 (16) | *1* |
| White-throated Swift | *Aeronautes saxatalis* | 8 | 0 | *8* | 0 | 0 | *0* |

| Common Name | Scientific Name | Individuals | | | Flocks (# of individuals per flock)[1] | | |
|---|---|---|---|---|---|---|---|
| | | Spring | Fall | *Total* | Spring | Fall | *Total* |
| Yellow-rumped Warbler | *Setophaga coronata* | 3 | 21 | *24* | 0 | 0 | *0* |
| Unidentified Dove Species | | 2 | 0 | *2* | 0 | 0 | *0* |
| Unidentified Flycatcher Species | | 0 | 2 | *2* | 0 | 0 | *0* |
| Unidentified Gnatcatcher Species | | 0 | 1 | *1* | 0 | 0 | *0* |
| Unidentified Passerine Species | | 0 | 3 | *3* | 0 | 0 | *0* |
| Unidentified Raptor Species | | 0 | 3 | *3* | 0 | 0 | *0* |
| Unidentified Swallow Species | | 46 | 23 | *69* | 1 (20) | 0 | *1* |
| Unidentified Warbler Species | | 0 | 1 | *1* | 0 | 0 | *0* |

[1] Flocks are defined as consisting of 10 individuals or more of the same species. The number of individuals reported for each flock is included in the sum of individuals in columns to the left.

## Table 2. Numbers of Individuals and Flocks of Avian Species Detected at 2016/2017 Migratory Bird Transects per Season

| Common Name | Scientific Name | Individuals | | | | | Flocks (# of individuals per flock)[1] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Winter | Spring | Summer | Fall | *Total* | Winter | Spring | Summer | Fall | *Total* |
| American Kestrel | *Falco sparverius* | 0 | 1 | 0 | 1 | *2* | 0 | 0 | 0 | 0 | *0* |
| American Pipit | *Anthus rubrescens* | 0 | 0 | 0 | 6 | *6* | 0 | 0 | 0 | 0 | *0* |
| Anna's Hummingbird | *Calypte anna* | 0 | 1 | 0 | 0 | *1* | 0 | 0 | 0 | 0 | *0* |
| Ash-throated Flycatcher | *Myiarchus cinerascens* | 2 | 28 | 2 | 10 | *42* | 0 | 0 | 0 | 0 | *0* |
| Barn Swallow | *Hirundo rustica* | 0 | 37 | 0 | 76 | *113* | 0 | 0 | 0 | 0 | *0* |
| Blue-gray Gnatcatcher | *Polioptila caerulea* | 0 | 0 | 0 | 2 | *2* | 0 | 0 | 0 | 0 | *0* |
| Brown-headed Cowbird | *Molothrus ater* | 0 | 1 | 1 | 0 | *2* | 0 | 0 | 0 | 0 | *0* |
| Black-headed Grosbeak | *Pheucticus melanocephalus* | 0 | 4 | 0 | 0 | *4* | 0 | 0 | 0 | 0 | *0* |

## RE Crimson Avian Summary Data

| Common Name | Scientific Name | Individuals | | | | | Flocks (# of individuals per flock)[1] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Winter | Spring | Summer | Fall | *Total* | Winter | Spring | Summer | Fall | *Total* |
| Blue Grosbeak | *Passerina caerulea* | 0 | 1 | 0 | 0 | *1* | 0 | 0 | 0 | 0 | *0* |
| Black Phoebe | *Sayornis nigricans* | 0 | 1 | 0 | 1 | *2* | 0 | 0 | 0 | 0 | *0* |
| Brewer's Sparrow | *Spizella breweri* | 0 | 161 | 0 | 26 | *187* | | 7 (13, 15, 10, 10, 20, 13, 10) | | 1 (10) | *8* |
| Black-tailed Gnatcatcher | *Polioptila melanura* | 10 | 46 | 6 | 48 | *110* | 0 | 0 | 0 | 0 | *0* |
| Black-throated Sparrow | *Amphispiza bilineata* | 0 | 126 | 3 | 4 | *133* | 0 | 0 | 0 | 0 | *0* |
| Black-throated Gray Warbler | *Setophaga nigrescens* | 0 | 3 | 0 | 0 | *3* | 0 | 0 | 0 | 0 | *0* |
| Bullock's Oriole | *Icterus bullockii* | 0 | 2 | 1 | 1 | *4* | 0 | 0 | 0 | 0 | *0* |
| Cactus Wren | *Campylorhynchus brunneicapillus* | 3 | 16 | 2 | 3 | *24* | 0 | 0 | 0 | 0 | *0* |
| Cattle Egret | *Bubulcus ibis* | 0 | 0 | 0 | 1 | *1* | 0 | 0 | 0 | 0 | *0* |
| Chipping Sparrow | *Spizella passerina* | 0 | 0 | 0 | 1 | *1* | 0 | 0 | 0 | 0 | *0* |
| Cliff Swallow | *Petrochelidon pyrrhonota* | 0 | 8 | 0 | 1 | *9* | 0 | 0 | 0 | 0 | *0* |
| Cooper's Hawk | *Accipiter cooperii* | 0 | 1 | 0 | 1 | *2* | 0 | 0 | 0 | 0 | *0* |
| Costa's Hummingbird | *Calypte costae* | 1 | 3 | 0 | 0 | *4* | 0 | 0 | 0 | 0 | *0* |
| Common Poorwill | *Phalaenoptilus nuttallii* | 0 | 0 | 0 | 2 | *2* | 0 | 0 | 0 | 0 | *0* |
| Common Raven | *Corvus corax* | 2 | 45 | 2 | 19 | *68* | 0 | 0 | 0 | 0 | *0* |
| Eurasian Collared-Dove | *Streptopelia decaocto* | 0 | 2 | 0 | 0 | *2* | 0 | 0 | 0 | 0 | *0* |
| Ferruginous | *Buteo regalis* | 0 | 1 | 0 | 2 | *3* | 0 | 0 | 0 | 0 | *0* |

## RE Crimson Avian Summary Data

| Common Name | Scientific Name | Individuals | | | | | Flocks (# of individuals per flock)[1] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Winter | Spring | Summer | Fall | *Total* | Winter | Spring | Summer | Fall | *Total* |
| Hawk | | | | | | | | | | | |
| Gambel's Quail | *Callipepla gambelii* | 4 | 26 | 0 | 5 | *35* | 0 | 1 (15) | 0 | 0 | *0* |
| Greater Roadrunner | *Geococcyx californianus* | 0 | 1 | 0 | 0 | *1* | 0 | 0 | 0 | 0 | *0* |
| House Finch | *Haemorhous mexicanus* | 0 | 26 | 0 | 24 | *50* | 0 | 0 | 0 | 0 | *0* |
| Horned Lark | *Eremophila alpestris* | 10 | 97 | 3 | 237 | *347* | 0 | 1 (10) | 0 | 4 (25, 18, 13, 15) | *5* |
| Hooded Oriole | *Icterus cucullatus* | 0 | 1 | 0 | 0 | *1* | 0 | 0 | 0 | 0 | *0* |
| House Wren | *Troglodytes aedon* | 0 | 2 | 0 | 0 | *2* | 0 | 0 | 0 | 0 | *0* |
| Lazuli Bunting | *Passerina amoena* | 0 | 2 | 0 | 0 | *2* | 0 | 0 | 0 | 0 | *0* |
| LeConte's Thrasher | *Toxostoma lecontei* | 20 | 115 | 18 | 44 | *197* | 0 | 0 | 0 | 0 | *0* |
| Lesser Nighthawk | *Chordeiles acutipennis* | 0 | 9 | 7 | 75 | *91* | 0 | 0 | 0 | 0 | *0* |
| Long-eared Owl | *Asio otus* | 0 | 0 | 0 | 1 | *1* | 0 | 0 | 0 | 0 | *0* |
| Lincoln's Sparrow | *Melospiza lincolnii* | 0 | 1 | 0 | 1 | *2* | 0 | 0 | 0 | 0 | *0* |
| Loggerhead Shrike | *Lanius ludovicianus* | 5 | 80 | 21 | 19 | *125* | 0 | 0 | 0 | 0 | *0* |
| MacGillivray's Warbler | *Geothlypis tolmiei* | 0 | 0 | 0 | 2 | *2* | 0 | 0 | 0 | 0 | *0* |
| Mountain Bluebird | *Sialia currucoides* | 0 | 0 | 0 | 1 | *1* | 0 | 0 | 0 | 0 | *0* |
| Mourning Dove | *Zenaida macroura* | 5 | 86 | 22 | 78 | *191* | 0 | 0 | 0 | 0 | *0* |

## RE Crimson Avian Summary Data

| Common Name | Scientific Name | Individuals | | | | | Flocks (# of individuals per flock)[1] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Winter | Spring | Summer | Fall | *Total* | Winter | Spring | Summer | Fall | *Total* |
| Northern Flicker | *Colaptes auratus* | 0 | 0 | 0 | 1 | *1* | 0 | 0 | 0 | 0 | *0* |
| Northern Mockingbird | *Mimus polyglottos* | 0 | 85 | 1 | 1 | *87* | 0 | 0 | 0 | 0 | *0* |
| Northern Rough-winged Swallow | *Stelgidopteryx serripennis* | 0 | 0 | 0 | 2 | *2* | 0 | 0 | 0 | 0 | *0* |
| Orange-crowned Warbler | *Oreothlypis celata* | 0 | 7 | 0 | 0 | *7* | 0 | 0 | 0 | 0 | *0* |
| Olive-sided Flycatcher | *Contopus cooperi* | 0 | 0 | 0 | 1 | *1* | 0 | 0 | 0 | 0 | *0* |
| Osprey | *Pandion haliaetus* | 0 | 0 | 0 | 1 | *1* | 0 | 0 | 0 | 0 | *0* |
| Phainopepla | *Phainopepla nitens* | 0 | 5 | 0 | 4 | *9* | 0 | 0 | 0 | 0 | *0* |
| Prairie Falcon | *Falco mexicanus* | 0 | 0 | 0 | 3 | *3* | 0 | 0 | 0 | 0 | *0* |
| Pacific-slope Flycatcher | *Empidonax difficilis* | 0 | 2 | 0 | 0 | *2* | 0 | 0 | 0 | 0 | *0* |
| Rock Wren | *Salpinctes obsoletus* | 5 | 9 | 0 | 5 | *19* | 0 | 0 | 0 | 0 | *0* |
| Red-tailed Hawk | *Buteo jamaicensis* | 2 | 7 | 2 | 7 | *18* | 0 | 0 | 0 | 0 | *0* |
| Red-winged Blackbird | *Agelaius phoeniceus* | 0 | 2 | 0 | 0 | *2* | 0 | 0 | 0 | 0 | *0* |
| Sage Sparrow species | *Artemisiospiza* species | 8 | 15 | 0 | 15 | *38* | 0 | 0 | 0 | 0 | *0* |
| Say's Phoebe | *Sayornis saya* | 7 | 19 | 1 | 29 | *56* | 0 | 0 | 0 | 0 | *0* |
| Sage Thrasher | *Oreoscoptes montanus* | 0 | 9 | 0 | 1 | *10* | 0 | 0 | 0 | 0 | *0* |
| Scott's Oriole | *Icterus parisorum* | 0 | 3 | 0 | 0 | *3* | 0 | 0 | 0 | 0 | *0* |
| Sharp-shinned Hawk | *Accipiter striatus* | 0 | 0 | 0 | 1 | *1* | 0 | 0 | 0 | 0 | *0* |

# RE Crimson Avian Summary Data

| Common Name | Scientific Name | Individuals | | | | | Flocks (# of individuals per flock)[1] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Winter | Spring | Summer | Fall | *Total* | Winter | Spring | Summer | Fall | *Total* |
| Swainson's Hawk | *Buteo swainsoni* | 0 | 0 | 0 | 2 | *2* | 0 | 0 | 0 | 0 | *0* |
| Townsend's Warbler | *Setophaga townsendi* | 0 | 3 | 0 | 0 | *3* | 0 | 0 | 0 | 0 | *0* |
| Tree Swallow | *Tachycineta bicolor* | 0 | 32 | 1 | 8 | *41* | 0 | 0 | 0 | 0 | *0* |
| Turkey Vulture | *Cathartes aura* | 0 | 203 | 0 | 4 | *207* | 0 | 1 (200) | 0 | 0 | *1* |
| Vaux's Swift | *Chaetura vauxi* | 0 | 2 | 0 | 0 | *2* | 0 | 0 | 0 | 0 | *0* |
| Verdin | *Auriparus flaviceps* | 10 | 12 | 1 | 28 | *51* | 0 | 0 | 0 | 0 | *0* |
| Violet-green Swallow | *Tachycineta thalassina* | 0 | 9 | 0 | 0 | *9* | 0 | 0 | 0 | 0 | *0* |
| Warbling Vireo | *Vireo gilvus* | 0 | 5 | 0 | 0 | *5* | 0 | 0 | 0 | 0 | *0* |
| White-crowned Sparrow | *Zonotrichia leucophrys* | 0 | 99 | 0 | 4 | *103* | 0 | 4 (12, 20, 20, 20) | 0 | 0 | *4* |
| Western Kingbird | *Tyrannus verticalis* | 0 | 2 | 0 | 2 | *4* | 0 | 0 | 0 | 0 | *0* |
| Western Meadowlark | *Sturnella neglecta* | 0 | 1 | 0 | 7 | *8* | 0 | 0 | 0 | 0 | *0* |
| Western Tanager | *Piranga ludoviciana* | 0 | 4 | 0 | 0 | *4* | 0 | 0 | 0 | 0 | *0* |
| Wilson's Warbler | *Cardellina pusilla* | 0 | 11 | 0 | 0 | *11* | 0 | 0 | 0 | 0 | *0* |
| White-throated Swift | *Aeronautes saxatalis* | 0 | 20 | 0 | 0 | *20* | 0 | 1 (20) | 0 | 0 | *1* |
| White-winged Dove | *Zenaida asiatica* | 0 | 9 | 1 | 1 | *11* | 0 | 0 | 0 | 0 | *0* |
| Yellow Warbler | *Setophaga petechia* | 0 | 1 | 0 | 0 | *1* | 0 | 0 | 0 | 0 | *0* |
| Yellow-rumped Warbler | *Setophaga coronata* | 11 | 16 | 0 | 37 | *64* | 0 | 0 | 0 | 0 | *0* |
| Unidentified Buteo Species | | 0 | 0 | 0 | 1 | *1* | 0 | 0 | 0 | 0 | *0* |

## RE Crimson Avian Summary Data

| Common Name | Scientific Name | Individuals | | | | | Flocks (# of individuals per flock)[1] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Winter | Spring | Summer | Fall | *Total* | Winter | Spring | Summer | Fall | *Total* |
| Unidentified Flycatcher Species | | 0 | 0 | 0 | 1 | *1* | 0 | 0 | 0 | 0 | *0* |
| Unidentified Hummingbird Species | | 0 | 2 | 0 | 0 | *2* | 0 | 0 | 0 | 0 | *0* |
| Unidentified Kingbird Species | | 0 | 0 | 0 | 1 | *1* | 0 | 0 | 0 | 0 | *0* |
| Unidentified Sparrow Species | | 0 | 0 | 0 | 1 | *1* | 0 | 0 | 0 | 0 | *0* |
| Unidentified Swallow Species | | 0 | 0 | 0 | 2 | *2* | 0 | 0 | 0 | 0 | *0* |
| Unidentified Warbler Species | | 0 | 2 | 0 | 2 | *4* | 0 | 0 | 0 | 0 | *0* |

[1] Flocks are defined as consisting of 10 individuals or more of the same species. The number of individuals reported for each flock is included in the sum of individuals in columns to the left.

# Appendix M

## Avian Species Summary Data for the Chuckwalla Valley State Prison Ponds

**Avian Species Detected at Chuckwalla Valley State Prison Wastewater Treatment Ponds in Spring 2017**

| Common Name | Scientific Name | Total Number of Individuals Detected Across all Surveys |
|---|---|---|
| **Birds** | | |
| **Anseriformes** | | |
| Cinnamon teal | *Spatula cyanoptera* | 45 |
| Northern shoveler | *Spatula clypeata* | 30 |
| American wigeon | *Mareca americana* | 5 |
| Mallard | *Anas platyrhynchos* | 3 |
| Northern pintail | *Anas acuta* | 2 |
| Ring-necked duck | *Aythya collaris* | 6 |
| Bufflehead | *Bucephala albeola* | 19 |
| Red-breasted merganser | *Mergus serrator* | 2 |
| Ruddy duck | *Oxyura jamaicensis* | 198 |
| **Podicipediformes** | | |
| Eared grebe | *Podiceps nigricollis* | 462 |
| Western grebe | *Aechmophorus occidentalis* | 1 |
| Clark's grebe | *Aechmophorus clarkii* | 1 |
| **Columbiformes** | | |
| Eurasian collared-dove | *Streptopelia decaocto* | 6 |
| White-winged dove | *Zenaida asiatica* | 5 |
| Mourning dove | *Zenaida macroura* | 16 |
| **Cuculiformes** | | |
| Greater roadrunner | *Geococcyx californianus* | 1 |
| **Apodiformes** | | |
| White-throated swift | *Aeronautes saxatalis* | 4 |
| **Gruiformes** | | |
| American coot | *Fulica americana* | 156 |
| **Charadriiformes** | | |
| Black-necked stilt | *Himantopus mexicanus* | 55 |
| American avocet | *Recurvirostra americana* | 3 |
| Black-bellied plover | *Pluvialis squatarola* | 1 |
| Killdeer | *Charadrius vociferus* | 53 |
| Least sandpiper | *Calidris minutilla* | 73 |
| Western sandpiper | *Calidris mauri* | 97 |
| Sandpiper species | *Calidris* sp. | 13 |
| Long-billed dowitcher | *Limnodromus scolopaceus* | 17 |
| Wilson's snipe | *Gallinago delicata* | 4 |
| Spotted sandpiper | *Actitis macularius* | 11 |
| Willet | *Tringa semipalmata* | 5 |
| Greater yellowlegs | *Tringa melanoleuca* | 8 |
| Yellowlegs species | *Tringa* sp. | 7 |
| Wilson's phalarope | *Phalaropus tricolor* | 9 |

**Avian Species Detected at Chuckwalla Valley State Prison Wastewater Treatment Ponds in Spring 2017**

| Common Name | Scientific Name | Total Number of Individuals Detected Across all Surveys |
|---|---|---|
| Western gull | *Larus occidentalis* | 1 |
| **Suliformes** | | |
| Double-crested cormorant | *Phalacrocorax auritus* | 3 |
| **Pelecaniformes** | | |
| Great blue heron | *Ardea herodias* | 2 |
| Snowy egret | *Egretta thula* | 3 |
| Cattle egret | *Bubulcus ibis* | 9 |
| White-faced ibis | *Plegadis chihi* | 31 |
| **Cathartiformes** | | |
| Turkey vulture | *Cathartes aura* | 19 |
| **Accipitriformes** | | |
| Sharp-shinned hawk | *Accipiter striatus* | 1 |
| Red-tailed hawk | *Buteo jamaicensis* | 2 |
| **Coraciiformes** | | |
| Belted kingfisher | *Megaceryle alcyon* | 1 |
| **Passeriformes** | | |
| ***Tyrannidae*** | | |
| Black phoebe | *Sayornis nigricans* | 1 |
| Say's phoebe | *Sayornis saya* | 1 |
| Western kingbird | *Tyrannus verticalis* | 2 |
| ***Corvidae*** | | |
| Common raven | *Corvus corax* | 7 |
| ***Alaudidae*** | | |
| Horned lark | *Eremophila alpestris* | 13 |
| ***Hirundinidae*** | | |
| Tree swallow | *Tachycineta bicolor* | 34 |
| Violet-green swallow | *Tachycineta thalassina* | 2 |
| Northern rough-winged swallow | *Stelgidopteryx serripennis* | 16 |
| Bank swallow[1] | *Riparia riparia* | 1 |
| Cliff swallow | *Petrochelidon pyrrhonota* | 9 |
| Barn swallow | *Hirundo rustica* | 2 |
| ***Mimidae*** | | |
| Northern mockingbird | *Mimus polyglottos* | 1 |
| ***Sturnidae*** | | |
| European starling | *Sturnus vulgaris* | 18 |
| ***Icteridae*** | | |
| Western meadowlark | *Sturnella neglecta* | 1 |
| Red-winged blackbird | *Agelaius phoeniceus* | 5 |
| Brown-headed cowbird | *Molothrus ater* | 1 |
| Great-tailed grackle | *Quiscalus mexicanus* | 33 |

**Avian Species Detected at Chuckwalla Valley State Prison Wastewater Treatment Ponds in Spring 2017**

| Common Name | Scientific Name | Total Number of Individuals Detected Across all Surveys |
|---|---|---|
| ***Cardinalidae*** | | |
| Blue grosbeak | *Passerina caerulea* | 1 |

[1] State threatened species and Bureau of Land Management sensitive species

# Appendix N

# Cumulative Projects Table

# RE Crimson Solar Cumulative Projects List

| Project Name/Applicant | Location | Status | Project Description |
|---|---|---|---|
| **Solar Projects** | | | |
| Blythe Airport Solar I Project<br>• U.S. Solar | 9 miles northeast of the project site | Approved by the County of Riverside, 2008. | 100 MW photovoltaic power plant; 640 acres; construct in five 20 MW phases; includes a 3,200-ft-long 33 kV generation tie. |
| Blythe Solar Power Project/<br>• NextEra | 8 miles northeast of the project site | Approved, as of July 2015 | 485 MW PV solar plant; 4,138 acres of BLM-administered public land. |
| Blythe Mesa Solar Project<br>• RRG | 9.5 miles northeast of the project site | County Certified Final EIR/EA<br>BLM Approved EIR/EA | 485 MW PV solar plant; includes a 8.4-mile-long gen-tie line to the Colorado River Substation; on 3,660 acres. |
| Genesis Solar Energy Project/<br>• NextEra Energy Resources | 10 miles west of the project site | Operational | 250 MW (two adjacent, independent solar plants with a 125 MW capacity each) solar thermal electric generating facility, using solar parabolic trough technology; includes 6-mile natural gas pipeline and 5.5-mile transmission line interconnecting Blythe Energy Center to Julian Hinds Transmission Line; on 1,950 acres. |
| Palo Verde Mesa Solar Project | 10 miles northeast of the project site | Under Environmental Review | 450 MW and 14.5 mile gen-tie line that would together occupy a total of 3,400 acres. |
| McCoy Solar Energy Project<br>• McCoy Solar, LLC | 10 miles northeast of the project site | Under construction | Up to a 750 MW PV solar power plant using photovoltaic technology; 16-mile-long 230 kV generation-tie and switchyard that would connect to SCE's Colorado River Substation. |
| Desert Quartzite/<br>• First Solar Development, Inc. | 5 miles southeast of the project site | A Notice of Intent to prepare an Environmental Impact Statement was published in the Federal Register on March 6, 2015. Under Environmental Review. | 600 MW, Photovoltaic, 7,245 acres disturbed, no transmission line |
| Mc Coy Soleil Project (different from the McCoy Solar Project CACA 48728)<br>• enXco, Inc. | 12 miles northeast of the project site | Plan of Development to Palm Springs BLM | 300 MW PV solar plant located on 1,959 acres. Requires a 14 mile transmission line to proposed SCE Colorado Substation south of I-10. |
| Blythe Solar Power Generation Station 1, LLC<br>• Southwestern Solar Power, LLC | 15 miles northeast of the project site | Approved | 4.76 MW solar PV facility; on 29.4 acres. |
| Mule Mountain III<br>• Solar Reserve | 2 miles southwest of the project site | Pre-NOI | 150 MW solar facility to occupy a total of 8,160 acres. |

## Crimson Solar Cumulative Projects List

| Project Name/Applicant | Location | Status | Project Description |
|---|---|---|---|
| Gypsum Solar Project | 15 miles northeast of the project site | Application withdrawn | 100 MW solar photovoltaic facility to occupy a total of 2,840 acres. |
| Desert Sunlight Project<br>• First Solar | 35 miles north west of the project site; 6 miles north of Desert Center | Operational | 550 MW, 4,144 acre, solar photovoltaic project located on 7,724 acres. Adjacent to DPV transmission line. |
| Desert Center 50 | Desert Center; 26 miles northwest of the project site | On hold | A planned 49.5 MW fixed flat panel photovoltaic solar power plant, on 452 acres, on APN 811-190-004, 811-231-001, 003, 004, and 008. |
| Sol Orchard | Desert Center; 31 miles northwest of the project site | Operational | 1.5 MW fixed flat panel photovoltaic power plant, on 10 acres, north of I-10, east of SR177, and west of Desert Center Airport. |
| Maverick Solar Project | North of I-10, 10 miles east of Desert Center; 33 miles northwest of Blythe | Under review by BLM and County of Riverside | 400 MW photovoltaic solar project |
| Wildcat Quartzsite<br>Wildcat Quartzsite LLC/Bright Source | La Paz County; along U.S. 395 south of Quartzsite; 38 miles southeast of the project site | Approved | 800 MW concentrating solar power plant on approximately 12,000 acres. |
| Quartzsite Solar Energy Project<br>Solar Reserve | 10 miles north of Quartz, AZ; 40 miles northeast of the project site | Approved. A Record of Decision (ROD) was signed on May 30, 2013. The ROD approves the use of 1,675 acres of BLM-managed land for development of a solar energy project. Construction date has not been given, scheduled as of March 2015. | 100 MW concentrating solar power plant; less than 1.5 mile transmission line. |
| **Wind Energy Projects** | | | |
| Graham Pass Wind Energy Project<br>• Graham Pass, LLC | Graham Pass Rd. between Desert Center & Blythe; 26 miles southwest of the project site | Testing | 30,855-acre, 600 MW wind farm that would include up to 200 three-megawatt wind turbines. |
| Eagle Mountain Wind | Eagle Mountain; 41 miles northwest of the project site | Testing | 3,500-acre wind facility with met towers |
| John Deere Renewables Type II | Chuckwalla; 22 miles southwest of the project site | Testing | 5,763-acre wind facility. |
| Riverside Wind Energy Black Hills Type II | Black Hills; 18 miles southwest of the project site | Application Denied | 11,537-acre wind facility |

# Crimson Solar Cumulative Projects List

| Project Name/Applicant | Location | Status | Project Description |
|---|---|---|---|
| **Electrical Facilities** | | | |
| Devers – Palo Verde 2 Transmission Line<br>• CUPC A. 05-04-015 | Western Riverside County to Blythe, CA | Notice to Proceed signed September 2011; under construction. Construction is complete; ongoing site restoration work through 2015 | 41.6-mile-long transmission line; second 500 kV transmission line between the Devers substation and SCE's Valley substation. |
| Desert Southwest Transmission Line | Palm Springs to Blythe | Approved June 2007 | 118-mile 500 kV transmission line from Blythe Energy Project substation to the existing Devers Substation. Located adjacent to SCE's existing 500 kV Devers – Palo Verde 1 transmission line. |
| SCE Red Bluff Substation | South of I-10 at Desert Center; 28 miles northwest of the project site | Operational | Proposed new 500/250 kV substation, two new parallel 500 kV transmission lines of about 2,500 to 3,500 feet each to loop the substation into the existing DPV 500 kV transmission line (DVPV1), and two parallel 500 kV transmission lines of about 2,500 to 3,500 feet each to loop the new substation into the proposed Devers-Colorado River 500 kV transmission line (DPV2) into the new substation with another two parallel lines of about 2,500 to 3,500 feet each. |
| Colorado River Substation | 2 miles east of the project site | Operational | 500/230 kV substation and would be constructed in an area approximately 1,000 feet by 1,900 feet |
| Eagle Mountain Pumped Storage Hydroelectric Project | Eagle Mountain iron ore mine, north of Desert Center; 42 miles northwest of the project site | Final EIS published Jan. 2012. | 1,300 MW pumped storage project on 1,524 acres, designed to store off-peak energy to use during peak hours. |
| Blythe Energy Project II | Blythe, CA. Near Blythe Municipal Airport & I-10; 9 miles east of the project site | Operational | 520 MW combined-cycle power plant located entirely within the Blythe Energy Project site boundary. Blythe Energy Project II would interconnect with the Buck Substation constructed by WAPA as part of the Blythe Energy Project. Project is designed on 20 acres of a 76-acre site. |
| **Other Construction** | | | |
| Eagle Mountain Landfill Project | Eagle Mountain, North of Desert Center; 40 miles northwest of the project site | Application denied by United States District Judge Robert Timlin on December 18, 2015. | Class III nonhazardous municipal solid waste landfill that would accept up to 20,000 tons of non-hazardous waste per day for 50 years. Project also involves the renovation and repopulation of Eagle Mountain Townsite. Project on approximately 3,500 acres. The proposal includes a land exchange and application for rights-of-way with the BLM and a Specific Plan, General Plan Amendment, Change of Zone, Development Agreement, Revised Permit to Reclamation Plan, and Tentative Tract Map with the County. |

| Project Name/Applicant | Location | Status | Project Description |
|---|---|---|---|
| Wiley's Well Communication Tower (Part of the Public Safety Enterprise Communication System) | 4 miles northwest of the project site | Final EIR published in August 2008 | The Public Safety Enterprise Communication project is the expansion of Riverside County's fire and law enforcement agencies approximately 20 communication sites to provide voice and data transmission capabilities to personnel in the field. |
| Agate Senior Housing Development | Blythe, CA; 16 miles northeast of the project | Approved in 2006 | This is an active Tax Credit Allocation Project. Active parcel Map extensions submitted since approval date. No construction is anticipated within the next fiscal year. |
| Residential developments[1] | Blythe, CA | Pending approval | Eight pending residential Tentative Tract Maps for 660 proposed new homes. Most of the maps were tentatively approved back in 2008 and 2009 and each has remained active by virtue of legislative extensions granted by the Governor. |
| 12 residential developments[1] | Blythe, CA | Approved or under construction | Nine residential development projects have been approved by the Blythe Planning Department including: Vista Palo Verde (83 Single Family Residential [SFR]), Van Weelden (184 SFR), Sonora South (43 SFR), Irvine Assets (107 SFR), Chanslor Village (79 SFR), St. Joseph's Investments (69 SFR), Edgewater Lane (SFR), the Chanslor Place Phase IV (57 SFR), Palo Verde Oasis Phase IV (29 SFR).<br><br>Three residential development projects have been approved and are under construction including: the Chanslor Phase II & III (78 SFR), River Estate at Hidden Beaches, Mesa Bluffs Villas (26 Attached SFR), Ranchette Estates (20 SFR). |
| Hampton Inn and Suites<br>• PP 2011-02 | Blythe; I-10 and Intake Blvd. ; 15 miles northeast of the project site | Under construction | Proposed 18,716-square foot, 81-room, three-story hotel and parking lot on an approximately 13-acre site (hotel would cover only 2.47 acres). Construction anticipated by third quarter 2012. Other site features include porte cochere, smoking shelter, and storage building. |

[1]Project location information not available.

BLM: U.S. Department of the Interior, Bureau of Land Management
CEC: California Energy Commission
DPV: Devers-Palo Verde
EIS: Environmental Impact Statement
I-10: Interstate 10
kV: kilovolt
MW: megawatt
POD: Plan of Development
PV: photovoltaic
ROW: right-of-way
SCE: Southern California Edison
SFR: single family residence
WAPA: Western Area Power Administration

# Appendix O

## Conservation Management Actions Consistency Determination

## RE Crimson Solar Project – Applicability of DRECP CMAs

The RE Crimson project is grandfathered from the Desert Renewable Energy Conservation Plan (DRECP) and associated Land Use Plan Amendment (LUPA); however, the applicant has designed the RE Crimson Solar Project to conform to the greatest extent feasible with the DRECP Conservation and Management Actions (CMAs), and proposes to employ management measures that are consistent with applicable construction- and operation-phase CMAs identified in the DRECP ROD whenever possible. Based on the identified location of the RE Crimson Solar Project, CMAs under the DRECP that may be applicable to the proposed solar project include those that apply to:

- *Land Use Plan Amendment (LUPA) Wide CMAs*, which are required for all activities within the California Desert Conservation Area (CDCA) and DRECP, as specified in individual CMAs;
- *Development Focus Areas (DFAs) and Variance Process Lands (VPLs) CMAs*, which are implemented in addition to LUPA-wide CMAs in the DFAs, VPLs, or both. The solar project is located within a DFA only; and
- *Transmission CMAs*, which apply to transmission activities, including the project's generation tie lines, and would be implemented in addition to LUPA-wide and DFA CMAs.

The following DRECP CMAs would not be applicable to the RE Crimson Solar Project, because the project would not be located on land under the following designations:

- *Ecological and Cultural Conservation CMAs,* which apply in addition to the LUPA-wide CMAs to all National Conservation Lands (NCLS), Areas of Critical Environmental Concern (ACECs), and Wildlife Allocations[1]. In addition, the following CMAs also apply to lands under each special designation:
  - *NLCS CMAs*
  - *ACECs CMAs*
  - *Wildlife Allocations CMAs*
- *Special Recreation Management Areas (SRMAs) CMAs,* which apply in addition to the LUPA-wide CMAs to all SRMAs;
- *Extensive Recreation Management Areas (ERMAs),* which apply in addition to the LUPA-wide CMAs to all ERMAs;
- *Unallocated BLM Land CMAs*, which apply to general unallocated BLM land within the LUPA.

The table below lists the biological resource related DRECP CMAs that would be applicable to the proposed RE Crimson Solar Project and, if appropriate, provides a brief explanation of why. All CMAs related to special-status species whose geographic ranges occur outside of the RE Crimson Solar Project are not included below. This includes all species of fish, Tehachapi slender salamander, flat-tailed horned lizard, Mojave ground squirrel, and California condor.

[1] NLCS, ACECs, SRMAs and ERMAs can overlap, in which case the most restrictive CMAs would apply.

**Table 1. DRECP CMAs Applicable to the RE Crimson Solar Project**

| DRECP CMA | CMA Summary | RE Crimson Consistency Determination |
|---|---|---|
| | **LUPA-wide CMAs** | |
| LUPA Wide LUPA-BIO-1: | Conduct a habitat assessment (see Glossary of Terms) of Focus and BLM Special- Status Species' suitable habitat for all activities and identify and/or delineate the vegetation types, rare alliances, and special features (e.g., Aeolian sand transport resources, Joshua tree, microphyll woodlands, carbon sequestration characteristics, seeps, climate refugia) present using the most current information, data sources, and tools (e.g., DRECP land cover mapping, aerial photos, DRECP species models, and reconnaissance site visits) to identify suitable habitat (see Glossary of Terms) for Focus and BLM Special Status Species. If required by the relevant species specific CMAs, conduct any subsequent protocol or adequate presence/absence surveys to identify species occupancy status and a more detailed mapping of suitable habitat to inform siting and design considerations. If required by relevant species specific CMAs, conduct analysis of percentage of impacts to suitable habitat and modeled suitable habitat.<br>▪ BLM will not require protocol surveys in sites determined by the designated biologist to be unviable for occupancy of the species, or if baseline studies inferred absence during the current or previous active season.<br>Utilize the most recent and applicable assessment protocols and guidance documents for vegetation types and jurisdictional waters and wetlands that have been approved by BLM, and the appropriate responsible regulatory agencies, as applicable. | Surveys were completed between 2011 and 2017 for the RE Crimson Solar Project.<br><br>Surveys were conducted in accordance with methods outlined agency approved work plans. |
| LUPA-BIO-2: | Designated biologist(s) (*see* Glossary of Terms), will conduct, and oversee where appropriate, activity-specific required biological monitoring during pre-construction, construction, and decommissioning to ensure that avoidance and minimization measures are appropriately implemented and are effective. The appropriate required monitoring will be determined during the environmental analysis and BLM approval process. The designated biologist(s) will submit monitoring reports directly to BLM. | Consistent with BRTR Measures BIO-1 through BIO-4. DBs may be supported by Biological Monitors as appropriate. |
| LUPA-BIO-3: Resource Setback Standards | Resource setbacks (*see* Glossary of Terms) have been identified to avoid and minimize the adverse effects to specific biological resources. Setbacks are not considered additive and are measured as specified in the applicable CMA. Allowable minor incursions (see Glossary of Terms), as per specific CMAs do not affect the following setback measurement descriptions. Generally, setbacks (which range in distances for different biological resources) for the appropriate resources are measured from:<br>▪ The edge of each of the DRECP vegetation types, including but not limited to those in the riparian or wetland vegetation groups (as defined by alliances within the vegetation type descriptions and mapped based on the vegetation type habitat assessments described in LUPA-BIO-1).<br>▪ The edge of the mapped riparian vegetation or the Federal Emergency Management Agency (FEMA) 100-year floodplain, whichever is greater, for the Mojave River.<br>▪ The edge of the vegetation extent for specified focus and BLM sensitive plant species.<br>The edge of suitable habitat or active nest substrates for the appropriate focus and BLM Special-Status Species. | 200-foot setbacks for microphyll woodlands have been incorporated into the project design except for the minor incursions from linear features which cross microphyll woodland at the least impacting location. |

**Table 1. DRECP CMAs Applicable to the RE Crimson Solar Project**

| DRECP CMA | CMA Summary | RE Crimson Consistency Determination |
|---|---|---|
| LUPA-BIO-4: Seasonal Restrictions | For activities that may impact focus and BLM Special-Status Species, implement all required species-specific seasonal restrictions on pre- construction, construction, operations, and decommissioning activities.<br><br>Species-specific seasonal restriction dates are described in the applicable CMAs.<br><br>Alternatively, to avoid a seasonal restriction associated with visual disturbance, installation of a visual barrier may be evaluated on a case-by-case basis that will result in the breeding, nesting, lambing, fawning, or roosting species not being affected by visual disturbance from construction activities subject to seasonal restriction. The proposed installation and use of a visual barrier to avoid a species seasonal restriction will be analyzed in the activity/project specific environmental analysis. | Seasonal restrictions have been included where applicable and are consistent with BIO-28, BIO-42, BIO-49, BIO-50, BIO-51, and BIO-66. |
| LUPA-BIO-5: Worker Education | All activities, as determined appropriate on an activity-by-activity basis, will implement a worker education program that meets the approval of the BLM. The program will be carried out during all phases of the project (site mobilization, ground disturbance, grading, construction, operation, closure/ decommissioning or project abandonment, and restoration/ reclamation activities). The worker education program will provide interpretation for non-English speaking workers, and provide the same instruction for new workers prior to their working on site. At a minimum, as appropriate, the program will contain information about:<br>▪ Site-specific biological and nonbiological resources.<br>▪ Information on the legal protection for protected resources and penalties for violation of federal and state laws and administrative sanctions for failure to comply with LUPA CMA requirements intended to protect site-specific biological and nonbiological resources.<br>▪ The required LUPA and project-specific measures for avoiding and minimizing effects during all project phases, including but not limited to resource setbacks, trash, speed limits, etc.<br>▪ Reporting requirements and measures to follow if protected resources are encountered, including potential work stoppage and requirements for notification of the designated biologist.<br>▪ Measures that personnel can take to promote the conservation of biological and nonbiological resources. | Consistent with BIO-2 and BIO-19. |
| LUPA-BIO-6: Subsidized Predators Standards | Subsidized predator standards, approved by BLM, in coordination with the USFWS and CDFW, will be implemented during all appropriate phases of activities, including but not limited to renewable energy activities, to manage predator food subsidies, water subsidies, and breeding sites including the following:<br>▪ Common Raven management actions will be implemented for all activities to address food and water subsidies and roosting and nesting sites specific to the Common Raven. These include identification of monitoring reporting procedures and requirements; strategies for refuse management; as well as design strategies and passive repellant methods to avoid providing perches, nesting sites, and roosting sites for Common Ravens.<br>▪ The application of water and/or other palliatives for dust | Consistent with BIO-8, BIO-12, BIO-37, BIO-40, and BIO-58. |

**Table 1. DRECP CMAs Applicable to the RE Crimson Solar Project**

| DRECP CMA | CMA Summary | RE Crimson Consistency Determination |
|---|---|---|
| | abatement in construction areas and during project operations and maintenance will be done with the minimum amount of water necessary to meet safety and air quality standards and in a manner that prevents the formation of puddles, which could attract wildlife and wildlife predators.<br>▪ Following the most recent national policy and guidance, BLM will take actions to not introduce, dispose of, or release any non- native species into areas of native habitat, suitable habitat, and natural or artificial waterways/water bodies containing native species.<br>All activity work areas will be kept free of trash and debris. Particular attention will be paid to "micro-trash" (including such small items as screws, nuts, washers, nails, coins, rags, small electrical components, small pieces of plastic, glass or wire, and any debris or trash that is colorful or shiny) and organic waste that may subsidize predators. All trash will be covered, kept in closed containers, or otherwise removed from the project site at the end of each day or at regular intervals prior to periods when workers are not present at the site.<br>▪ In addition to implementing the measures above on activity sites, each activity would provide compensatory mitigation that contributes to LUPA-wide raven management. | |
| LUPA-BIO-7: Restoration of Areas Disturbed by Construction Activities But Not Converted by Long-Term Disturbance | Where vegetation types or focus or BLM Special-Status habitats may be affected by ground- disturbance and/or vegetation removal during pre-construction, construction, operations, and decommissioning related activities but are not converted by long-term (i.e., more than two years of disturbance) ground disturbance, restore these areas following the standards, approved by BLM authorized officer, following the most recent BLM policies and procedures for the vegetation community or species habitat disturbance as appropriate, summarized below:<br>▪ Implement site-specific habitat restoration actions for the areas affected including specifying and using:<br>– The appropriate seed (e.g., certified weed- free, native, and locally and genetically appropriate seed)<br>– Appropriate soils (e.g., topsoil of the same original type on site or that was previously stored by soil type after being salvaged during excavation and construction activities)<br>– Equipment<br>– Timing (e.g., appropriate season, sufficient rainfall)<br>– Location<br>– Success criteria<br>– Monitoring measures<br>– Contingency measures, relevant for restoration, which includes seeding that follows BLM policy when on BLM administered lands.<br>▪ Salvage and relocate cactus, nolina, and yucca from the site prior to disturbance using BLM protocols. To the maximum extent practicable for short-term disturbed areas, the cactus and yucca will be re-planted back to the original site.<br>Restore and reclaim short-term disturbed areas, including pipelines, transmission projects, staging areas, and short-term construction-related roads immediately, or during the most biologically appropriate season as determined in the activity/project specific environmental analysis and decision following completion of construction activities to reduce the amount of habitat converted at any one time and promote | No temporary disturbance is currently proposed as part of the project that would trigger restoration following construction. |

**Table 1. DRECP CMAs Applicable to the RE Crimson Solar Project**

| DRECP CMA | CMA Summary | RE Crimson Consistency Determination |
|---|---|---|
| | recovery to natural habitats and vegetation as well as climate refugia and ecosystem services such carbon storage. | |
| LUPA-BIO-8: General Closure and Decommissioning Standards | All activities that are required to close and decommission the site (e.g., renewable energy activities) will specify and implement project-specific closure and decommissioning actions that meet the approval of BLM, and that at a minimum address the following:<br>▪ Specifying and implementing the methods, timing (e.g., criteria for triggering closure and decommissioning actions), and criteria for success (including quantifiable and measureable criteria).<br>▪ Recontouring of areas that were substantially altered from their original contour or gradient and installing erosion control measures in disturbed areas where potential for erosion exists.<br>▪ Restoring vegetation as well as soil profiles and functions that will support and maintain native plant communities, associated carbon sequestration and nutrient cycling processes, and native wildlife species.<br>▪ Vegetation restoration actions will identify and use native vegetation composition, native seed composition, and the diversity to values commensurate with the natural ecological setting and climate projections. | The RE Crimson Project will prepare a Decommissioning Plan that will outline the decommissioning and reclamation phase activities. Decommissioning impacts for biological resources are discussed in Section 5.3. |
| LUPA-BIO-9: Water and Wetland Dependent Species Resources | Implement the following general LUPA CMA for water and wetland dependent resources:<br>▪ Implement construction site standard practices to prevent toxic chemicals, hazardous materials, and other fluids from entering vegetation type streams, washes, and tributary networks through water runoff, erosion, and sediment transport by, at a minimum, implementing the following:<br>– On project sites, vehicles and other equipment will be maintained in proper working condition and only stored in designated containment areas where runoff is collected or controlled and that are located outside of streams, washes, and distributary networks to minimize accidental fluids and hazardous materials spills.<br>– Hazardous material leaks, spills, or releases will be immediately cleaned and equipment will be repaired upon identification. Removal and disposal of spill and related clean-up materials will occur at an approved off-site landfill.<br>– Maintenance and operations vehicles will carry the appropriate equipment and materials to isolate, clean up, and repair any hazardous material leaks, spills, or releases.<br>▪ Activity-specific drainage, erosion, and sedimentation control actions, which meet the approval of BLM and the applicable regulatory agencies, will be carried out during all appropriate phases of the approved project. These actions, as needed, will address measures to ensure the proper protection of water quality, site-specific stormwater and sediment retention, and design of the project to minimize site disturbance, including the following:<br>– Identify site-specific surface water runoff patterns and implement measures to prevent excessive and unnatural soil deposition and erosion.<br>– Implement measures to maintain natural drainages and to maintain hydrologic function in the event drainages are | The RE Crimson Project will comply with these measures as specified in BIO-6, BIO-13, BIO-15, BIO-16, and BIO-20 through BIO-23, BIO-34, BIO-59, and BIO-60. |

**Table 1. DRECP CMAs Applicable to the RE Crimson Solar Project**

| DRECP CMA | CMA Summary | RE Crimson Consistency Determination |
|---|---|---|
| | disturbed.<br>– Reduce the amount of area covered by impervious surfaces through use of permeable pavement or other pervious surfaces. Direct runoff from impervious surfaces into retention basins.<br>– Stabilize disturbed areas following grading in the manner appropriate to the soil type so that wind or water erosion is minimized.<br>– Minimize irrigation runoff by using low or no irrigation native vegetation landscaping for landscaped retention basins.<br>– Conduct regular inspections and maintenance of long-term erosion control measures to ensure long-term effectiveness.<br>– Project applicants for sites that may affect intermittent and perennial streams, springs, swales, ephemeral washes, wetland vegetation, other DRECP water land covers, or sites occupied by aquatic or riparian focus and BLM Special-Status Species due to groundwater or surface water extraction will conduct hydrologic studies during project planning to determine the potential effect of groundwater and surface water extraction on the hydro-logic unit. These studies will include both watershed effects as well as effects on perched, alluvial, and regional aquifers. Projects that are likely to affect ground-water resources in a manner that would result in substantial loss of riparian or wetland communities or habitat for riparian or aquatic Focus and BLM Special-Status Species are prohibited.<br>– The use of evaporation ponds for water management will be avoided when the water could harm birds or other terrestrial wildlife due to constituents of concern present in the wastewater (e.g., selenium, hypersalinity, etc.).<br>– Evaporation ponds will be configured to minimize attractiveness to shorebirds (e.g., maintain water depths over two feet; maintain steep slopes along edge; enclose evaporation ponds in long-term structures; or obscure evaporation ponds from view using materials that blend in with the natural surroundings).<br>▪ Ramps that allow the egress of wildlife from ponds or other water management infrastructure will be installed. | |
| LUPA-BIO-10: Standard Practices for Weed Management | Consistent with BLM state and national policies and guidance, integrated weed management actions, will be carried out during all phases of activities, as appropriate, and at a minimum will include the following:<br>▪ Thoroughly clean the tires and undercarriage of vehicles entering or reentering the project site to remove potential weeds.<br>▪ Store project vehicles on site in designated areas to minimize the need for multiple washings whenever vehicles re-enter the project site.<br>▪ Properly maintain vehicle wash and inspection stations to minimize the introduction of invasive weeds or subsidy of invasive weeds.<br>▪ Closely monitor the types of materials brought onto the site to avoid the introduction of invasive weeds and non-native species. | Consistent with BIO-18 and BIO-62. A Weed Management Plan will be prepared and implemented to manage invasive plants. |

**Table 1. DRECP CMAs Applicable to the RE Crimson Solar Project**

| DRECP CMA | CMA Summary | RE Crimson Consistency Determination |
|---|---|---|
| | ▪ Reestablish native vegetation quickly on disturbed sites.<br>▪ Monitor and quickly implement control measures to ensure early detection and eradication of weed invasions to avoid the spread of invasive weeds and non- native species on site and to adjacent off-site areas.<br>▪ Use certified weed-free mulch, straw, hay bales, or equivalent fabricated materials for installing sediment barriers. | |
| LUPA-BIO-11: Nuisance Animals and Invasive Species | Implement the following CMAs for controlling nuisance animals and invasive species:<br>▪ No fumigate, treated bait, or other means of poisoning nuisance animals including rodenticides will be used in areas where Focus and BLM Special-Status Species are known or suspected to occur.<br>▪ Manage the use of widely spread herbicides and do not apply herbicides effective against dicotyledonous plants within 1,000 feet from the edge of a 100- year floodplain, stream and wash channels, and riparian vegetation or to soils less than 25 feet from the edge of drains. Exceptions will be made when targeting the base and roots of invasive riparian species such as tamarisk and Arundo donax (giant reed). Manage herbicides consistent with the most current national and California BLM policies.<br>▪ Minimize herbicide, pesticide, and insecticide treatment in areas that have a high risk for groundwater contamination.<br>▪ Clean and dispose of pesticide containers and equipment following professional standards. Avoid use of pesticides and cleaning containers and equipment in or near surface or subsurface water.<br>▪ When near surface or subsurface water, restrict pesticide use to those products labeled safe for use in/near water and safe for aquatic species of animals and plants. | Consistent with BIO-18 and BIO-62. A Pesticide Use Proposal will be obtained to authorize the use of herbicides as part of the weed control program to be summarized in the Weed Management Plan. |
| LUPA-BIO-12: Noise | For activities that may impact focus or BLM Special-Status Species, implement the following LUPA CMA for noise:<br>▪ To the extent feasible, and determined necessary by BLM to protect Focus and BLM sensitive wildlife species, locate stationary noise sources that exceed background ambient noise levels away from known or likely locations of focus and BLM sensitive wildlife species and their suitable habitat.<br>▪ Implement engineering controls on stationary equipment, buildings, and work areas including sound-insulation and noise enclosures to reduce the average noise level, if the activity will contribute to noise levels above existing background ambient levels.<br>▪ Use noise controls on standard construction equipment including mufflers to reduce noise. | A noise study was conducted. Noise levels from operations of the RE Crimson Project are not anticipated to exceed current ambient levels. Noise monitoring will be a component of nesting bird management measures if required during project construction and/or operations. |
| LUPA-BIO-13: General Siting and Design | Implement the following CMA for project siting and design:<br>To the maximum extent practicable site and design projects to avoid impacts to vegetation types, unique plant assemblages, climate refugia as well as occupied habitat and suitable habitat for Focus and BLM Special-Status Species (*see* "avoid to the maximum extent practicable" in Glossary of Terms).<br>▪ The siting of projects along the edges (i.e. general linkage border) of the biological linkages identified in Appendix D (Figures D-1 and D-2) will be configured (1) to maximize the | The project was sited and modified to avoid sensitive resources during the initial design phase. Siting efforts were coordinated with resource agencies to identify and minimize impacts to sensitive habitats and resources in the Project vicinity, including dunes, |

**Table 1. DRECP CMAs Applicable to the RE Crimson Solar Project**

| DRECP CMA | CMA Summary | RE Crimson Consistency Determination |
|---|---|---|
| | retention of microphyll woodlands and their constituent vegetation type and inclusion of other physical and biological features conducive to Focus and BLM Special-Status Species' dispersal, and (2) informed by existing available information on modeled focus and BLM Special-Status Species habitat and element occurrence data, mapped delineations of vegetation types, and based on available empirical data, including radio telemetry, wildlife tracking sign, and road- kill information. Additionally, projects will be sited and designed to maintain the function of focus and BLM Special-Status Species connectivity and their associated habitats in the following linkage and connectivity areas:<br>– Within a 5-mile-wide linkage across Interstate 10 centered on Wiley's Well Road to connect the Mule and McCoy mountains (the majority of this linkage is within the Chuckwalla ACEC and Mule-McCoy Linkage ACEC).<br>– Within a 3-mile-wide linkage across Interstate 10 to connect the Chuckwalla and Palen mountains.<br>– Within a 1.5-mile-wide linkage across Interstate 10 to connect the Chuckwalla Mountains to the Chuckwalla Valley east of Desert Center.<br>– The confluence of Milpitas Wash and Colorado River floodplain within 2 miles of California State Route 78 (this linkage is entirely within the Chuckwalla ACEC).<br>▪ Delineate the boundaries of areas to be disturbed using temporary construction fencing and flagging prior to construction and confine disturbances, project vehicles, and equipment to the delineated project areas to protect vegetation types and focus and BLM Special-Status Species.<br>▪ Long-term nighttime lighting on project features will be limited to the minimum necessary for project security, safety, and compliance with Federal Aviation Administration requirements and will avoid the use of constant-burn lighting.<br>▪ All long-term nighttime lighting will be directed away from riparian and wetland vegetation, occupied habitat, and suitable habitat areas for focus and BLM Special- Status Species. Long- term nighttime lighting will be directed and shielded downward to avoid interference with the navigation of night-migrating birds and to minimize the attraction of insects as well as insectivorous birds and bats to project infrastructure.<br>▪ To the maximum extent practicable (see Glossary of Terms), restrict construction activity to the use existing roads, routes, and utility corridors to minimize the number and length/size of new roads, routes, disturbance, laydown, and borrow areas.<br>▪ To the maximum extent practicable (see Glossary of Terms), confine vehicular traffic to designated open routes of travel to and from the project site, and prohibit, within project boundaries, cross- country vehicle and equipment use outside of approved designated work areas to prevent unnecessary ground and vegetation disturbance.<br>▪ To the maximum extent practicable (see Glossary of Terms), construction of new roads and/or routes will be avoided within focus and BLM Special-Status Species suitable habitat within identified linkages for those focus and BLM Special-Status Species, unless the new road and/or route is beneficial to minimize net impacts to natural or ecological resources of concern. These areas will have a goal of "no net | microphyll woodlands, concentrations of special status plants, and occupied habitat for desert tortoise. The Project is sited within a Development Focus Area and has minimized impacts to the extent feasible to these resources and is expected to compensate for the loss of habitat as required by other mitigation measures in the NEPA document. Consistent with BIO-5, BIO-7, BIO-14, BIO-20, BIO-21, BIO-22, BIO-24, BIO-25, BIO-47, BIO-56, BIO-57, and BIO-61. |

**Table 1. DRECP CMAs Applicable to the RE Crimson Solar Project**

| DRECP CMA | CMA Summary | RE Crimson Consistency Determination |
|---|---|---|
| | gain" of project roads and/or routes<br>▪ To the maximum extent practicable (see Glossary of Terms), any new road and/or route considered within focus and BLM Special-Status Species suitable habitat within identified linkages for those focus and BLM Special-Status Species will not be paved so as not to negatively affect the function of identified linkages.<br>▪ Use nontoxic road sealants and soil stabilizing agents. | |
| LUPA-BIO-14: General Standard Practices | Implement the following general standard practices to protect Focus and BLM Special-Status Species:<br>▪ Feeding of wildlife, leaving of food or trash as an attractive nuisance to wildlife, collection of native plants, or harassing of wildlife on a site is prohibited.<br>▪ Any wildlife encountered during the course of an activity, including construction, operation, and decommissioning will be allowed to leave the area unharmed.<br>▪ Domestic pets are prohibited on sites. This prohibition does not apply to the use of domestic animals (e.g., dogs) that may be used to aid in official and approved monitoring procedures/protocols, or service animals (dogs) under Title II and Title III of the American with Disabilities Act.<br>▪ All construction materials will be visually checked for the presence of wildlife prior to their movement or use. Any wildlife encountered during the course of these inspections will be allowed to leave the construction area unharmed.<br>▪ All steep-walled trenches or excavations used during the project will be covered, except when being actively used, to prevent entrapment of wildlife. If trenches cannot be covered, they will be constructed with escape ramps, following up-to-date design standards to facilitate and allow wildlife to exit, or wildlife exclusion fencing will be installed around the trench(s) or excavation(s). Open trenches or other excavations will be inspected by a designated biologist immediately before backfilling, excavation, or other earthwork.<br>▪ Minimize natural vegetation removal through implementation of crush and drive or cut or mow vegetation rather than removing entirely. | RE Crimson would implement these measures as Best Management practices. BRTR measures BIO-9, BIO-10, BIO-11, BIO-25, and BIO-33, and BIO-65 are consistent with this CMA. |
| LUPA-BIO-15: | Use state-of-the-art construction and installation techniques, appropriate for the specific activity/project and site that minimize new site disturbance, soil erosion and deposition, soil compaction, disturbance to topography, and removal of vegetation. | The project will minimize grading to the extent feasible. LEID elements are proposed as part of an alternative design approach. Consistent with BIO-15. |
| LUPA-BIO-16: Activity-Specific Bird and Bat CMAs | For activities that may impact focus and BLM sensitive birds, protected by the ESA and/or Migratory Bird Treaty Act of 1918, and bat species, implement appropriate measures as per the most up-to-date BLM state and national policy and guidance, and data on birds and bats, including but not limited to activity specific plans and actions. The goal of the activity -specific bird and bat actions is to avoid and minimize direct mortality of birds and bats from the construction, operation, maintenance, and decommissioning of the specific activities.<br>Activity-specific measures to avoid and minimize impacts may include, but are not limited to:<br>▪ Siting and designing activities will avoid high bird and bat movement areas that separate birds and bats from their common nesting and roosting sites, feeding areas, or lakes and rivers. | The project has been designed to avoid microphyll woodlands which have the highest potential to support bird and bat species. The project has proposed several measures that are consistent with this CMA including BIO-51 through BIO-55, BIO-61, and BIO-66. |

**Table 1. DRECP CMAs Applicable to the RE Crimson Solar Project**

| DRECP CMA | CMA Summary | RE Crimson Consistency Determination |
|---|---|---|
| | ▪ For activities that impact bird and bat Focus and BLM Special-Status Species, during project siting and design, conducting monitoring of bird and bat presence as well as bird and bat use of the project site using the most current survey methods and best procedures available at the time.<br>▪ Reusing or co-locating new transmission facilities and other ancillary facilities with existing facilities and disturbed areas to reduce habitat destruction and avoid additional collision risks.<br>▪ Reducing bird and bat collision hazards by utilizing techniques such as unguyed monopole towers or tubular towers. Where the use of guywires is unavoidable, demarcate guywires using the best available methods to minimize avian species strikes.<br>▪ When fencing is necessary, use bird and bat compatible design standards.<br>▪ Using lighting that does not attract birds and bats or their prey to project sites including using non-steady burning lights (red, dual red and white strobe, strobe- like flashing lights) to meet Federal Aviation Administration requirements, using motion or heat sensors and switches to reduce the time when lights are illuminated, using appropriate shielding to reduce horizontal or skyward illumination, and avoiding the use of high-intensity lights (e.g., sodium vapor, quartz, and halogen).<br>▪ Implementing a robust monitoring program to regularly check for wildlife carcasses, document the cause of mortality, and promptly remove the carcasses.<br>▪ Incorporating a bird and bat use and mortality monitoring program during operations using current protocols and best procedures available at time of monitoring. | |
| LUPA-BIO-17: | For activities that may result in mortality to Focus and BLM Special–Status bird and bat species, a Bird and Bat Conservation Strategy (BBCS) will be prepared with the goal of assessing operational impacts to bird and bat species and incorporating methods to reduce documented mortality. The BBCS actions for impacts to birds and bats during these activities will be determined by the activity-specific bird and bat operational actions. The strategy shall be approved by BLM in coordination with USFWS, and CDFW as appropriate, and may include, but is not limited to:<br>▪ Incorporating a bird and bat use and mortality monitoring program during operations using current protocols and best procedures available at time of monitoring.<br>▪ Activity-specific operational avoidance and minimization actions that reduce the level of mortality on the populations of bird and bat species, such as:<br>– Use techniques that would minimize attraction of birds to hazardous situations that are mistaken to be or simulate natural habitats (e.g., bodies of water).<br>– Implement operational management techniques that minimize impacts to migratory birds during diurnal and seasonal cycles (e.g., positioning of heliostats to decrease surface area exposed to avian species).<br>– Evaluation and installation of the best available bird and bat detection and deterrent technologies available at the time of construction.<br>[The CMA lists known important focus and BLM Special-Status | Consistent with BIO-55. |

**Table 1. DRECP CMAs Applicable to the RE Crimson Solar Project**

<table>
<tr><th>DRECP CMA</th><th>CMA Summary</th><th>RE Crimson Consistency Determination</th></tr>
<tr><td></td><td>bird areas but none are in the Crimson Solar Project region.]</td><td></td></tr>
<tr><td>LUPA-BIO-RIPWET-1: Riparian and Wetland Vegetation Type CMAs</td><td>The riparian and wetland vegetation types and other features listed in Table 17 will be avoided to the maximum extent practicable except for allowable minor incursions (see Glossary of Terms for “avoidance to the maximum extent practicable” and “minor incursion”) with the specified setbacks.
<table>
<tr><th>Riparian and Wetland Vegetation Types or Features</th><th>Setback[1]</th></tr>
<tr><td colspan="2">Riparian Vegetation Types[1]</td></tr>
<tr><td>Madrean Warm Semi-Desert Wash Woodland/Scrub</td><td>200 feet</td></tr>
<tr><td>Mojavean Semi-Desert Wash Scrub</td><td>200 feet</td></tr>
<tr><td>Sonoran-Coloradan Semi-Desert Wash Woodland/Scrub</td><td>200 feet</td></tr>
<tr><td>Southwest ern North American Riparian Evergreen and Deciduous</td><td>0.25 miles</td></tr>
<tr><td>Southwestern North American Riparian/Wash Scrub</td><td>0.25 miles</td></tr>
<tr><td colspan="2">Wetland Vegetation Types[1]</td></tr>
<tr><td>Arid west freshwater emergent marsh</td><td>0.25 miles</td></tr>
<tr><td>Californian Warm Temperate Marsh/Seep</td><td>0.25 miles</td></tr>
<tr><td colspan="2">Other Riparian and Wetland Related Features</td></tr>
<tr><td>Managed Wetlands[2]</td><td>0.25 miles</td></tr>
<tr><td>Mojave River[3]</td><td>0.25 miles</td></tr>
<tr><td>Undifferentiated Riparian land cover[4]</td><td>200 feet</td></tr>
</table>
[1] Setbacks are measured from the edge of the mapped riparian or wetland vegetation or water feature per LUPA-BIO-3.<br>
[2] Setback is from managed wetlands including USFWS Refuges, state managed wetlands, and duck clubs in Imperial Valley. See specifications for the Salton Sea below.<br>
[3] Setback is measured from the edge of mapped riparian or edge of FEMA 100-year floodplain of the Mojave River, whichever is further from the center line of the Mojave River channel.<br>
[4] Undifferentiated “Riparian” land cover includes portions of major river courses (Mojave River and Colorado River) within the main channels where riparian vegetation groups were not mapped.<br><br>
For minor incursion (see “minor incursion” in the Glossary of Terms) to the DRECP riparian vegetation types, wetland vegetation types, or encroachments on the setbacks listed in Table 17, the hydrologic function of the avoided riparian or wetland communities will be maintained.<br><br>
Minor incursions in the riparian and wetland vegetation types or other features including the setbacks listed in Table 17 will</td><td>The Applicant has avoided all major drainages with microphyll woodlands and applied a 200-foot buffer around all microphyll woodlands regardless of vegetation classification, except for minor incursions from the linear features. Consistent with BIO-20 and BIO-21.</td></tr>
</table>

**Table 1. DRECP CMAs Applicable to the RE Crimson Solar Project**

| DRECP CMA | CMA Summary | RE Crimson Consistency Determination |
|---|---|---|
| | occur outside of the avian nesting season, February 1 through August 31, or otherwise determined by BLM, USFWS, and CDFW if the minor incursion(s) is likely to result in impacts to nesting birds. | |
| LUPA-BIO-RIPWET-3: BLM Special Status Riparian Bird Species | For activities that occur within 0.25-mile a riparian or wetland vegetation type and may impact BLM Special-Status riparian and wetland birds species conduct a pre-construction/activity nesting bird survey for BLM Special-Status riparian and wetland birds according to agency-approved protocols.<br><br>Based on the results of the nesting bird survey above, setback activities that are likely to impact BLM Special Status riparian and wetland bird species), including but not limited to pre-construction, construction and decommissioning, 0.25 mile from active nests of BLM Special-Status riparian and wetland bird species during the breeding season (February 1 through August 31 or otherwise determined by BLM, USFWS, and CDFW). For activities in these areas covered by this provision that occur during the breeding season and that last no longer than one week, nesting bird surveys may need to be repeated, as determined by BLM, in coordination with USFWS and CDFW, as appropriate . No pre-activity nesting bird surveys are necessary for activities occurring outside of the breeding season. | No BLM Special-Status riparian and wetland bird species are known to nest in the microphyll woodland between the RE Crimson Permitting Boundary. Therefore a 0.25 mile set-back is not necessary.<br><br>Consistent with BIO-51 and BIO-66 for nesting bird surveys to be conducted prior to vegetation clearing if conducted during the nesting bird season. |
| LUPA-BIO-DUNE-1: Aeolian Processes | Because DRECP sand dune vegetation types and Aeolian sand transport corridors are, by definition, shifting resources, activities that potentially occur within or bordering sand dune DRECP vegetation types and/or Aeolian sand transport corridors, must conduct studies to verify location (refer to Appendix D, Figure D-7), and extent of the sand resource(s) for the activity-specific environmental analysis to determine:<br>▪ Whether the proposed activity(s) would occur within a sand dune or an Aeolian sand transport corridor<br>▪ If the activity(s) is subject to dune/Aeolian sand transport corridor CMAs<br>▪ If the activity(s) needs to be reconfigured to satisfy applicable avoidance requirements | The RE Crimson Project has been designed to avoid active sand dune areas and a sand transport study is currently in progress to determine if the Project is within a sand transport corridor. |
| LUPA-BIO-DUNE-2: | Activities that potentially affect the amount of sand entering or transported within Aeolian sand transport corridors will be designed and operated to:<br>▪ Maintain the quality and function of Aeolian transport corridors and sand deposition zones, unless related to maintenance of existing [at the time of the DRECP LUPA ROD] facilities/operations/activities<br>▪ Avoid a reduction in sand-bearing sediments within the Aeolian system<br>▪ Minimize mortality to DUNE associated Focus and BLM Special-Status Species | The RE Crimson Project has been designed to avoid active sand dune areas and a sand transport study is currently in progress to determine if the Project is within a sand transport corridor. Consistent with BIO-47 and BIO-48. |
| LUPA-BIO-DUNE-3: | Any facilities or activities that alter site hydrology (e.g., sediment barrier) will be designed to maintain continued sediment transport and deposition in the Aeolian corridor in a way that maintains the Aeolian sorting and transport to downwind deposition zones. Site designs for maintaining this transport function must be approved by BLM in coordination with USFWS and CDFW as appropriate. | The RE Crimson Project has been designed to avoid active sand dune areas and a sand transport study is currently in progress to determine if the Project is within a sand transport corridor. Consistent with BIO-47. |

**Table 1. DRECP CMAs Applicable to the RE Crimson Solar Project**

| DRECP CMA | CMA Summary | RE Crimson Consistency Determination |
|---|---|---|
| LUPA-BIO-DUNE-4: Mojave Fringe-Toed Lizard | Dune formations and other sand accumulations (i.e., sand ramps, sand sheets) with suitable habitat characteristics for the Mojave fringe-toed lizard (i.e., unconsolidated blow-sand) will be mapped according to mapping standards established by the BLM National Operations Center.<br><br>For minor incursions (see "minor incursion" in the Glossary of Terms) into sand dunes and sand transport areas the activity will be sited in the mapped zone with the least impacts to sand dunes and sand transport and Mojave fringe- toed lizards. | The RE Crimson Project has been designed to pull away from and avoid active Aeolian sand dune areas and to pull away from areas with the highest density of Mojave fringe-toed lizards. |
| LUPA-BIO-DUNE-5: | If suitable habitat characteristics are identified during the habitat assessment, clearance surveys (see Glossary of Terms) for Mojave fringe-toed lizard will be performed in suitable habitat areas. | Specific clearance surveys for Mojave fringe-toed lizards are not proposed, however, through biological monitoring, the species will be moved out of harm's way during site clearing, grubbing, and grading. Consistent with BIO-4. |
| LUPA-BIO-IFS-14 | Activity-specific active translocation of burrowing owls may be considered, in coordination with CDFW | No western burrowing owls were detected during biological surveys, therefore the species is not anticipated to occur within the RE Crimson Permitting Boundary. BIO-42 through BIO-46 will be implemented if western burrowing owls are detected during construction. |
| LUPA-BIO-PLANT-1: Plant Species (PLANT): Plant Focus and BLM Special Status Species CMAs | Conduct properly timed protocol surveys in accordance with the BLM's most current (at time of activity) survey protocols for plant Focus and BLM Special Status Species. | The most recent focused botanical surveys were completed in spring 2017 and results included in the BRTR. |
| LUPA-BIO-PLANT-3: Suitable Habitat | Impacts to suitable habitat for Focus and BLM Special Status plant species should be avoided to the extent feasible, and are limited [capped] to a maximum of 1% of their suitable habitat throughout the entire LUPA Decision Area. The baseline condition for measuring suitable habitat is the DRECP modeled suitable habitat for these species utilized in the EIS analysis (2014 and 2015), or the most recent suitable habitat modeling.<br><br>For those plants with Species Specific DFA Suitable Habitat Impact Caps listed in Table 23, those caps apply in the DFAs only. Refer to CMA DFA-PLANT-1. | None of the plant species listed in Table 23 occur within the RE Crimson Permitting Boundary. |
| LUPA-BIO-SVF-1: Special Vegetation Features (SVF) | For activity-specific NEPA analysis, a map delineating potential sites and habitat assessment of the following special vegetation features is required: Yucca clones, creosote rings, Saguaro cactus, Joshua tree woodland, microphyll woodland, Crucifixion thorn stands. BLM guidelines for mapping/surveying cactus, yuccas, and succulents shall be followed. | Site surveys were completed in 2010-2017 and a figure of the mapped microphyll woodland is included in the BRTR. |
| LUPA-BIO-SVF-2 | Yucca clones larger than 3 meters in diameter (longest diameter if the clone forms an ellipse rather than a circular ring) shall be avoided. | Protocol surveys were already performed no yucca clones were found within the |

**Table 1. DRECP CMAs Applicable to the RE Crimson Solar Project**

| DRECP CMA | CMA Summary | RE Crimson Consistency Determination |
|---|---|---|
| | | RE Crimson Permitting Boundary. |
| LUPA-BIO-SVF-3: | Creosote bush rings (see Glossary of Terms) larger than 5 meters in diameter (longest diameter if the “ring” forms an ellipse rather than a circle) shall be avoided. | There are no creosote bush rings within the RE Crimson Permitting Boundary. |
| LUPA-BIO-SVF-4 | Saguaro cactus should be managed in such a way as to provide long- term habitat for the California populations not just individual plants, except in DFAs. | Protocol surveys were already performed for the Crimson Solar Project and no saguaro cactus were found within the RE Crimson Permitting Boundary. |
| LUPA-BIO-SVF-5 | Joshua tree woodland (Yucca brevifolia Woodland Alliance): impacts to Joshua Tree woodlands (*see* Glossary of Terms) will be avoided to the maximum extent practicable | Protocol surveys were already performed for the Crimson Solar Project and no Joshua tree woodlands were found within the RE Crimson Permitting Boundary. |
| LUPA-BIO-SVF-6: | Microphyll woodland: impacts to microphyll woodland (see Glossary of Terms) will be avoided, except for minor incursions (see Glossary of Terms). | The RE Crimson Solar Project has avoided all microphyll woodlands to the greatest extent feasible apart from minor incursions where the linear features cross microphyll woodlands. Consistent with BIO-20 and BIO-21. |
| LUPA-BIO-SVF-7 | Crucifixion thorn stands: (Castela emoryi Shrubland Special Stands) Crucifixion thorn stands with greater than 100 individuals will be avoided. | Protocol surveys were already performed for the Crimson Solar Project and no crucifixion thorn stands were found within the RE Crimson Permitting Boundary. |
| LUPA-BIO-VEG-1: General Vegetation Management (VEG) | Management of cactus, yucca, and other succulents will adhere to current up-to-date BLM policy. | The RE Crimson Permitting Boundary does not contain any special-status cactus, yucca, or other succulent species. |
| LUPA-BIO-VEG-2: | Promote appropriate levels of dead and downed wood on the ground, outside of campground areas, to provide wildlife habitat, seed beds for vegetation establishment, and reduce soil erosion, as determined appropriate on an activity- specific basis. | This measure is not applicable or appropriate within the solar development area. The microphyll woodlands will be avoided by the project. |
| LUPA-BIO-VEG-3: | Allow for the collection of plant material consistent with the maintenance of natural ecosystem processes. | The site will be secure from access for safety and security. No plant collection will occur on the site. |
| LUPA-BIO-VEG-5: | All activities will follow applicable BLM state and national regulations and policies for salvage and transplant of cactus, yucca, other succulents, and BLM Sensitive plants. | There are no BLM sensitive plant species within the RE Crimson Permitting Boundary that would require salvage and transport. |
| LUPA-BIO-BAT-1: | Activities, except wind projects, will not be sited within 500 feet of any occupied maternity roost or presumed occupied | No active bat roosts were documented within the RE |

**Table 1. DRECP CMAs Applicable to the RE Crimson Solar Project**

| DRECP CMA | CMA Summary | RE Crimson Consistency Determination |
|---|---|---|
| Bat Species (BAT) | maternity roost as described below. | Crimson Permitting Boundary and no bats are expected to have a substantial roost within the RE Crimson Permitting Boundary due to lack of suitable roosting habitat. |
| LUPA-BIO-BAT-2 | Mines will be assumed to be occupied bat roosts, unless appropriate surveys for bat use have been conducted during all seasons (including maternity, lekking or swarming, and winter use). | There are no mines within the RE Crimson Permitting Boundary or within 500 feet. |
| LUPA-BIO-IFS-1: Individual Focus Species (IFS): Desert Tortoise | Activities within desert tortoise linkages identified in Appendix D, that may have a negative impact on the linkage will require an evaluation, in the environmental document(s), of the effects on the maintenance of long-term viable desert tortoise populations within the affected linkage. The analysis will consider the amount of suitable habitat, including climate refugia, required to ensure long-term viability within each linkage given the linkage's population density, long-term demographic and genetic needs, degree of existing habitat disturbance/impacts, mortality sources, and most up-to-date population viability modeling. Activities that would compromise the long-term viability of a linkage population or the function of the linkage, as determined by the BLM in coordination with USFWS and CDFW, are prohibited and would require reconfiguration or re-siting. | The RE Crimson Solar Project is not within a desert tortoise linkage identified on Figure D-16 in Appendix D of the DRECP LUPA. |
| LUPA-BIO-IFS-2 | Construction of new roads and/or routes will be avoided to the maximum extent practicable (see Glossary of Terms) within desert tortoise habitat in tortoise conservation areas (TCAs) or tortoise linkages identified in Appendix D, unless the new road and/or route is beneficial to minimize net impacts to natural or ecological resources of concern for desert tortoise. TCAs and identified linkages should have the goal of "no net gain" of road density.<br><br>Any new road considered within a TCA or identified linkage will not be paved and will be designed and sited in order to minimize the effect to the function of identified linkages or local desert tortoise populations and shall have a maximum speed limit of 25 miles per hour.<br><br>Roads requiring the installation of long-term desert tortoise exclusion fencing for construction or operation will incorporate wildlife underpasses (e.g., culverts) to reduce population fragmentation | The RE Crimson Solar Project is not within a desert tortoise linkage or TCA identified on Figure D-16 in Appendix D of the DRECP LUPA. |
| LUPA-BIO-IFS-3 | All culverts for access roads or other barriers will be designed to allow unrestricted access by desert tortoises and will be large enough that desert tortoises are unlikely to use them as shelter sites (e.g., 36 inches in diameter or larger). Desert tortoise exclusion fencing may be utilized to direct tortoise use of culverts and other passages. | The RE Crimson Project would install Arizona crossings or culverts across main drainage channels. The main drainages are excluded from the RE Crimson Permitting Boundary and allow for wildlife movement. The microphyll woodlands would not have permanent desert tortoise-proof fencing across them and desert tortoises would be able to freely move |

**Table 1. DRECP CMAs Applicable to the RE Crimson Solar Project**

| DRECP CMA | CMA Summary | RE Crimson Consistency Determination |
|---|---|---|
| | | through the washes. |
| LUPA-BIO-IFS-4: | In areas where protocol and clearance surveys are required (see Appendix D), prior to construction or commencement of any long-term activity that is likely to adversely affect desert tortoises, desert tortoise exclusion fencing shall be installed around the perimeter of the activity footprint (*see* Glossary of Terms) in accordance with the Desert Tortoise Field Manual (USFWS 2009) or most up-to- date USFWS protocol. Additionally, short-term desert tortoise exclusion fencing will be installed around short-term construction and/or activity areas (e.g., staging areas, storage yards, excavations, and linear facilities), as appropriate, per the Desert Tortoise Field Manual (USFWS 2009) or most up-to-date USFWS protocol.<br>▪ Exemption from desert tortoise protocol survey requirements can be obtained from BLM, in coordination with USFWS, and CDFW as applicable, on a case-by-case basis if a designated biologist determines the activity site does not contain the elements of desert tortoise habitat, is unviable for occupancy, or if baseline studies inferred absence during the current or previous active season.<br>▪ Construction of desert tortoise exclusion fences will occur during the time of year when tortoise are less active in order to minimize impacts and to accommodate subsequent desert tortoise surveys. Any exemption or modification of desert tortoise exclusion fencing requirements will be based on the specifics of the activity and the site-specific population and habitat parameters. Sites with low population density and disturbed, fragmented, or poor habitat are likely to be candidates for fencing requirement exemptions or modifications. Substitute measures, such as on- site biological monitors in the place of the fencing requirement, may be required, as appropriate.<br>▪ After an area is fenced, and until desert tortoises are removed, the designated biologist is responsible for ensuring that desert tortoises are not being exposed to extreme temperatures or predators as a result of their pacing the fence. Remedies may include the use of shelter sites placed along the fence, immediate translocation, removal to a secure holding area, or other means determined by the BLM, USFWS, and CDFW, as applicable.<br>▪ Modification or elimination of the above requirement may also be approved if the activity design will allow retention of desert tortoise habitat within the footprint. If such a modification is approved, modified protective measures may be required to minimize impacts to desert tortoises that may reside within the activity area.<br>▪ Immediately prior to desert tortoise exclusion fence construction, a designated biologist (*see* Glossary of Terms) will conduct a clearance survey of the fence alignment to clear desert tortoises from the proposed fence line's path.<br>▪ All desert tortoise exclusion fencing will incorporate desert tortoise proof gates or other approved barriers to prevent access of desert tortoises to work sites through access road entry points.<br>▪ Following installation, long-term desert tortoise exclusion fencing will be inspected for damage quarterly and within 48 hours of a surface flow of water due to a rain event that may damage the fencing.<br>▪ All damage to long-term or short-term desert tortoise | Consistent with BIO-27 and BIO-28. If wildlife-friendly fencing is implemented during operations, the Applicant would use biological monitors, which is consistent with BIO-4. The Applicant will remain consistent with this CMA and follow the USFWS 2009 protocol (the most current regulations). |

**Table 1. DRECP CMAs Applicable to the RE Crimson Solar Project**

| DRECP CMA | CMA Summary | RE Crimson Consistency Determination |
|---|---|---|
| | exclusion fencing will be immediately blocked to prevent desert tortoise access and repaired within 72 hours. | |
| LUPA-BIO-IFS-5: | Following the clearance surveys (see Glossary of Terms) within sites that are fenced with long- term desert tortoise exclusion fencing a designated biologist (*see* Glossary of Terms) will monitor initial clearing and grading activities to ensure that desert tortoises missed during the initial clearance survey are moved from harm's way.<br><br>A designated biologist will inspect construction pipes, culverts, or similar structures: (a) with a diameter greater than 3 inches, (b) stored for one or more nights, (c) less than 8 inches aboveground and (d) within desert tortoise habitat (such as, outside the long-term fenced area), before the materials are moved, buried, or capped.<br><br>As an alternative, such materials shall be capped before storing outside the fenced area or placing on pipe racks. Pipes stored within the long-term fenced area after completing desert tortoise clearance surveys will not require inspection. | The Applicant will retain a DB to support the project. And implement applicable measures; BIO-1, BIO-2, BIO-11, and BIO-27 to BIO-31. |
| LUPA-BIO-IFS-6: | When working in areas where protocol or clearance surveys are required (see Appendix D), biological monitoring will occur with any geotechnical boring or geotechnical boring vehicle movement to ensure no desert tortoises are killed or burrows are crushed. | Consistent with BIO-4 and BIO-33. |
| LUPA-BIO-IFS-7: | A designated biologist (see Glossary of Terms) will accompany any geotechnical testing equipment to ensure no tortoises are killed and no burrows are crushed. | A Designated Biologist will accompany all equipment working in desert tortoise habitat outside any areas that have not been cleared for desert tortoise. |
| LUPA-BIO-IFS-8: | Inspect the ground under the vehicle for the presence of desert tortoise any time a vehicle or construction equipment is parked in desert tortoise habitat outside of areas fenced with desert tortoise exclusion fencing. If a desert tortoise is seen, it may move on its own. If it does not move within 15 minutes, a designated biologist may remove and relocate the animal to a safe location. | Consistent with BIO-33. |
| LUPA-BIO-IFS-9: | Vehicular traffic will not exceed 15 miles per hour within the areas not cleared by protocol level surveys where desert tortoise may be impacted. | Consistent with BIO-32, BIO-63, and BIO-65. |
| LUPA-BIO-IFS-11 | If Bendire's thrasher is present, conduct appropriate activity-specific biological monitoring to ensure that Bendire's thrasher individuals are not directly affected by operations (i.e., mortality or injury, direct impacts on nest, eggs, or fledglings). | The species is not present within the RE Crimson Permitting Boundary and no impacts are anticipated to this species. |
| LUPA-BIO-IFS-12: Burrowing Owl | If burrowing owls are present, a designated biologist (*see* Glossary of Terms) will conduct appropriate activity-specific biological monitoring (*see* Glossary of Terms) to ensure avoidance of occupied burrows and establishment of the 656 feet (200 meter) setback to sufficiently minimize disturbance during the nesting period on all activity sites, when practical. | The species is not currently present within the RE Crimson Permitting Boundary. BIO-42 through BIO-46 would be followed in the event that western burrowing owls are discovered within the RE Crimson Permitting Boundary at a later date. |
| LUPA-BIO-IFS-13: | If burrows cannot be avoided on-site, passive burrow exclusion by a designated biologist (*see* Glossary of Terms) through the | The species is not currently present within the RE |

**Table 1. DRECP CMAs Applicable to the RE Crimson Solar Project**

| DRECP CMA | CMA Summary | RE Crimson Consistency Determination |
|---|---|---|
| | use of one-way doors will occur according to the specifications in Appendix D, or the most up-to-date agency BLM or CDFW specifications. Before exclusion, there must be verification that burrows are empty as specified in Appendix H, or the most up-to-date BLM or CDFW protocols. Confirmation that the burrow is not currently supporting nesting or fledgling activities is required prior to any burrow exclusions or excavations. | Crimson Permitting Boundary. BIO-42 would be implemented in the event that western burrowing owls are discovered within the RE Crimson Permitting Boundary at a later date. |
| LUPA-BIO-IFS-24: Golden Eagle | Activities that may impact nesting golden eagles, will not be sited or constructed within 1-mile of any active or alternative golden eagle nest within an active golden eagle territory | The RE Crimson Project is over 5 miles from the closest known golden eagle nest. |
| LUPA-BIO-IFS-25 | Cumulative loss of foraging habitat within a 1- to 4 mile radius around active or alternative eagle nests (as identified or defined in the most recent USFWS guidance and/or policy) will be limited to less than 20%. See CONS-BIO-IFS 5 for the requirement in Conservation Lands. | No golden eagle nest sites have been documented within 5 miles of the RE Crimson Project during surveys. |
| LUPA-BIO-IFS-26: | For activities that impact golden eagles, applicants will conduct a risk assessment per the applicable USFWS guidance (e.g. the USFWS Eagle Conservation Plan Guidance) using best available information as well as the data collected in the pre-project golden eagle surveys. | No golden eagle nests are known to occur within 5-miles of the RE Crimson Permitting Boundary. The Project occurs within suitable golden eagle foraging habitat. |
| LUPA-BIO-IFS-27 | If a permit for golden eagle take is determined to be necessary, an application will be submitted to the USFWS in order to pursue a take permit. | The RE Crimson Project is unlikely to require a golden eagle take permit. |
| LUPA-BIO-IFS-28: | In order to evaluate the potential risk to golden eagles, the following activities are required to conduct 2 years of pre-project golden eagle surveys in accordance with USFWS Eagle Conservation Plan Guidance as follows:<br>▪ Wind projects and solar projects involving a power tower<br>▪ Other activities which the BLM, in coordination with USFWS, and CDFW as appropriate, determine take of golden eagle is reasonably foreseeable or there is a potential for take of golden eagle | Golden eagle surveys were conducting in 2012, and will be conducted again in 2018. The RE Crimson Project would only impact golden eagle foraging habitat as the closest nest is over 5 miles away. |
| LUPA-BIO-IFS-29 | For active nests with recreational conflicts that risk the occurrence of take, provide public notification (e.g., signs) of the sensitive area and implement seasonal closures as appropriate. | The RE Crimson Project is not in an active nest area and does not have recreational conflicts. |
| LUPA-BIO-IFS-30 | For activities where ongoing take of golden eagles is anticipated, develop advanced conservation practices per USFWS Eagle Conservation Plan Guidance. | Ongoing take of golden eagles is not anticipated at the RE Crimson Project. |
| LUPA-BIO-IFS-31 | As determined necessary by BLM in coordination with USFWS, and CDFW as appropriate, for activities/projects that are likely to impact golden eagles implement site-specific golden eagle mortality monitoring in support of the pre-construction, pre-activity risk assessment surveys. | The RE Crimson Project is not anticipated to cause direct golden eagle mortality, but will result in loss of foraging habitat for the species. |
| LUPA-BIO-IFS-32: Swainson's Hawk | Avoid use of rodenticides and insecticides within five miles of active Swainson's hawk nest. | The RE Crimson Project is outside geographic breeding range of the species, however Swainson's hawks migrate through the RE Crimson Project. |
| LUPA-BIO-IFS-33: Desert Bighorn Sheep | Access to, and use of, designated water sources for desert bighorn sheep will not be impeded by activities in designated and new utility corridors. | There are no designated water sources for desert bighorn sheep within or adjacent to the RE Crimson |

<table>
<caption>Table 1. DRECP CMAs Applicable to the RE Crimson Solar Project</caption>
<tr><th>DRECP CMA</th><th>CMA Summary</th><th>RE Crimson Consistency Determination</th></tr>
<tr><td></td><td></td><td>Project.</td></tr>
<tr><td>LUPA-BIO-IFS-34</td><td>Transmission projects and new utility corridors will minimize effects on access to, and use of, designated water sources for desert bighorn sheep.</td><td>There are no designated water sources for desert bighorn sheep within or adjacent to the RE Crimson Project.</td></tr>
<tr><td>LUPA-BIO-COMP-1: Compensation</td><td>Impacts to biological resources, identified and analyzed in the activity specific environmental document, from activities in the LUPA Decision Area will be compensated using the standard biological resources compensation ratio, except for the biological resources and specific geographic locations listed as compensation ratio exceptions, specifics in CMAs LUPA-BIO-COMP-2 through -4, and previously listed CMAs. Compensation acreage requirements may be fulfilled through non- acquisition (i.e., restoration and enhancement), land acquisition (i.e., preserve), or a combination of these options, depending on the activity specifics and BLM approval/authorization.<br><br>Compensation for the impacts to desert tortoise critical habitat will be in the same critical habitat unit as the impact (see Table 18). Compensation for impacts to desert tortoise will be in the same recovery unit as the impact.<br><br>Refer to CMA LUPA-COMP-1 and 2 for the timing requirements for initiation or completion of compensation.<br><br>Table 18<br>Compensation Ratios for the Impacts of Activities in the DRECP LUPA Decision Area
<table>
<tr><th>Standard</th><th colspan="2">Biological Resource Standard Compensation Ratio Exceptions</th></tr>
<tr><td rowspan="5">1:1</td><td>Desert tortoise designated critical</td><td>5:1 in same CH unit</td></tr>
<tr><td>Mohave ground squirrel: Key population centers</td><td>2:1</td></tr>
<tr><td>Flat-tailed horned lizard: FTHL</td><td>RMS</td></tr>
<tr><td>Wetlands</td><td>2:1</td></tr>
<tr><td>Desert riparian woodland vegetation</td><td>5:1</td></tr>
<tr><td colspan="3">RMS = Flat-Tailed Horned Lizard Rangewide Management Strategy</td></tr>
</table></td><td>The Applicant anticipates that compensatory mitigation will be required for desert tortoise occupied habitat. Consistent with BIO-41.</td></tr>
<tr><td>LUPA-BIO-COMP-2: Birds and Bats</td><td>The compensation for the mortality impacts to bird and bat Focus and BLM Special- Status Species from activities would be determined based on monitoring of bird and bat mortality and a fee re-assessed every 5 years to fund compensatory mitigation. Initial compensation fee for bird and bat mortality impacts would be based on pre- project monitoring of bird use and estimated bird and bat species mortality from the activity. The approach to calculating the operational bird and bat compensation is based on the total replacement cost for a given resource, a Resource Equivalency Analysis. This involves measuring the relative loss to a population (debt) resulting from an activity and the productivity gain (credit) to a population from the implementation of compensatory mitigation actions. The measurement of these debts and gains (using the same “bird years” metric as described in Draft DRECP and</td><td>Protection measures for avian and bat species would be specified in a Bird and Bat Conservation Strategy that will be submitted to BLM and CDFW and USFWS for review and approval. Consistent with BIO-55.</td></tr>
</table>

**Table 1. DRECP CMAs Applicable to the RE Crimson Solar Project**

| DRECP CMA | CMA Summary | RE Crimson Consistency Determination |
|---|---|---|
| | EIR/EIS Appendix D) is used to estimate the necessary compensation fee.<br><br>Each activity, as determined appropriate by BLM in coordination with USFWS, and CDFW as applicable, will include a monitoring strategy to provide activity-specific information on mortality effects on birds and bats in order to determine the amount and type of compensation required to offset the effects of the activity, as described above and in detail in Appendix D. Compensation may also be satisfied by non- restoration actions that reduce mortality risks to birds and bats (e.g., increased predator control and protection of roosting sites from human disturbance).<br><br>Compensation will be consistent with the most up to date DOI mitigation policy. | |
| LUPA-BIO-COMP-3: Golden Eagle | Activities, BLM and third-party initiated, will provide specific golden eagle compensation in accordance with the most up to date BLM's policies, and USFWS Eagle Conservation Plan Guidance. | Habitat compensation for resource impacts for other species would also provide permanent protection for golden eagle foraging habitat. |
| LUPA-BIO-COMP-4: Golden Eagle | Third-party applicant/activity proponents are required to contribute to a DRECP- wide golden eagle monitoring program if the activity/ projects(s) has been determined, through the environmental analysis, to likely impact golden eagles. | Habitat compensation for resource impacts for other species would also provide permanent protection for golden eagle foraging habitat. |
| | **Compensation** | |
| LUPA-COMP-1 | For third party actions, compensation activities must be initiated or completed within 12 months from the time the resource impact occurs (e.g. ground disturbance, habitat removal, route obliteration, etc. for construction activities; wildlife mortality, visual impacts, etc. due to operations).<br>▪ BLM will determine, in the environmental analysis, the activity/project-level timing of the compensation (i.e. initiated, completed or a combination) based on the specific resources being impacted, and scope and content of the activity.<br>▪ A 6 month extension may be authorized, subject to approval by the authorizing officer, dependent on the resources impacted and compensation due diligence of the project developer. | The Applicant will provide appropriate financial bonding. Habitat acquisition will proceed in coordination with the USFWS, CDFW, and BLM based upon final Project impacts and compensatory mitigation requirements. |
| | **Transmission CMAs** | |
| LUPA TRANS-BIO-1: | Where feasible and appropriate for resource protection, site transmission activities along roads or other previously disturbed areas to minimize new surface disturbance, reduce perching opportunities for the Common Raven, and minimize collision risks for birds and bats. | The RE Crimson Project gen-tie line was designed to be the shortest possible and is collocated adjacent to other existing transmission lines adjacent to the Colorado River Substation. Consistent with BIO-58. |
| LUPA-TRANS-BIO-2 | Flight diverters will be installed on all transmission activities spanning or within 1,000 feet of stream and wash channels, canals, ponds, and any other natural or artificial body of water. | The RE Crimson Project gen-tie line would not cross any such water bodies. Above ground linear features that cross microphyll woodlands may |

**Table 1. DRECP CMAs Applicable to the RE Crimson Solar Project**

| DRECP CMA | CMA Summary | RE Crimson Consistency Determination |
|---|---|---|
| | | have flight diverters installed per BRTR MM BIO-52. |
| LUPA TRANS-BIO-4: | Siting of transmission activities will be prioritized within designated utility corridors, where possible, and designed to avoid, where possible, and otherwise minimize and offset impacts to sand transport processes in Aeolian corridors, rare vegetation alliances and Focus and BLM Special-Status Species. Transmission substations will be sited to avoid Aeolian corridors, rare vegetation alliances, and sand-dependent Focus and BLM Special-Status Species habitats. | The RE Crimson Project gen-tie is the shortest possible and has been designed to reduce impacts to sensitive species. The gen-tie line is adjacent to existing access roads and the CRS. Facilities will be microsited to minimize impacts (BIO-47). |
| **Development Focus Areas and Variance Process Lands CMAs** | | |
| DFA-VPL-BIO-DUNE-1 | Activities in DFAs and VPLs, including transmission substations, will be sited to avoid dune vegetation (i.e., North American Warm Desert Dune and Sand Flats). Unavoidable impacts (see "unavoidable impacts to resources" in the Glossary of Terms) to dune vegetation will be limited to transmission projects, except transmission substations, and access roads that will be sited to minimize unavoidable impacts.<br>▪ For unavoidable impacts (see "unavoidable impacts to resources" in the Glossary of Terms) to dune vegetation, the following will be required:<br>– Access roads will be unpaved.<br>– Access roads will be designed and constructed to be at grade with the ground surface to avoid inhibiting sand transportation. | The RE Crimson Project has been sited to avoid dune vegetation, the access road is an existing paved road (Powerline Road), and all roads within the RE Crimson Permitting Boundary and linears will be unpaved. Consistent with BIO-47. |
| DFA-VPL-BIO-DUNE-2 | Within Aeolian corridors that transport sand to dune formations and vegetation types downwind inside and outside of the DFAs, all activities will be designed and operated to facilitate the flow of sand across activity sites, and avoid the trapping or diverting of sand from the Aeolian corridor. Buildings and structures within the site will take into account the direction of sand flow and, to the extent feasible, build and align structures to allow sand to flow through the site unimpeded. Fences will be designed to allow sand to flow through and not be trapped. | A sand transport study is currently in progress and will provide results on sand transport movement across the RE Crimson Permitting Boundary. Where possible and necessary, the Project features will be designed to allow sand to flow through and not be trapped. |
| DFA-VPL-BIO-IFS-1 | To the maximum extent practicable (see Glossary of Terms), activities will be sited in previously disturbed areas, areas of low quality habitat, and areas with low habitat intactness in desert tortoise linkages and the Ord-Rodman TCA, identified in Appendix D. | The RE Crimson Project is sited in an area that is low quality desert tortoise habitat as described by USFWS staff. The RE Crimson Project is not located within the Ord-Rodman TCA. |
| DFA-VPL-BIO-FIRE-1 | Implement the following standard practice for fire prevention/protection:<br>▪ Implement site-specific fire prevention/protection actions particular to the construction and operation of renewable energy and transmission project that include procedures for reducing fires while minimizing the necessary amount of vegetation clearing, fuel modification, and other construction-related activities. At a minimum these actions will include designating site fire coordinators, providing adequate fire suppression equipment (including in vehicles), and establishing emergency response information relevant to the construction site. | Consistent with BIO-17 and BIO-36. |
| DFA-VPL-BIO- | Impacts to biological resources from all activities in DFAs | DFA-VPL-BIO-COMP-2 |

**Table 1. DRECP CMAs Applicable to the RE Crimson Solar Project**

<table>
<tr><th>DRECP CMA</th><th>CMA Summary</th><th>RE Crimson Consistency Determination</th></tr>
<tr><td>COMP-1</td><td>and VPLs will be compensated using the same ratios and strategies as LUPA-BIO-COMP-1 through 4, with the exception identified below in DFA-VPL-BIO-COMP-2.</td><td>does not apply to the RE Crimson Solar Project since the Project is not located within the Ord-Rodman critical habitat unit to Joshua Tree National Park, and Fremont-Kramer critical habitat unit to the Ord-Rodman critical habitat unit linkages.</td></tr>
<tr><td colspan="3">Development Focus Areas CMAs</td></tr>
<tr><td>DFA - BIO-IFS-1 Individual Focus Species (IFS)</td><td>Conduct the following surveys as applicable in the DFAs as shown in Table 21.<br>Table 21. Individual Species DFA Survey Requirements
<table>
<tr><th>Species</th><th>DFA Survey Requirements</th></tr>
<tr><td colspan="2">Reptile</td></tr>
<tr><td>Desert tortoise</td><td>Protocol surveys in the desert tortoise habitat areas indicated in Appendix H.</td></tr>
<tr><td>Flat-tailed horned lizard</td><td>Protocol surveys as specified in the Rangewide Management Strategy (RMS).</td></tr>
<tr><td colspan="2">Bird</td></tr>
<tr><td>Bendire's thrasher</td><td>Pre-construction nesting bird survey during breeding season (March 1 through September 30) in suitable habitat on and within 500 feet of construction zone.</td></tr>
<tr><td>Burrowing Owl</td><td>Breeding season surveys (February 1through August 31) per Burrowing Owl Guidelines (CDFG 2012).<br>Clearance surveys (for direct take avoidance) no less than 14 days prior to ground disturbance per Burrowing Owl Guidelines.</td></tr>
<tr><td>California condor</td><td>None.</td></tr>
<tr><td>Gila woodpecker</td><td>None.</td></tr>
<tr><td>Golden eagle</td><td>Pre-project golden eagle surveys and pre-construction risk assessment surveys in LUPA-BIO-IFS-28, if applicable as described in golden eagle CMAs below.</td></tr>
<tr><td>Swainson's Hawk</td><td>Protocol surveys in the Antelope and Owens Valleys.</td></tr>
<tr><td colspan="2">Mammal</td></tr>
<tr><td>Desert bighorn</td><td>None.</td></tr>
</table></td><td>The RE Crimson Project has already completed biological surveys for the species listed in Table 21 that have a potential to occur.</td></tr>
</table>

**Table 1. DRECP CMAs Applicable to the RE Crimson Solar Project**

<table>
<tr><th>DRECP CMA</th><th>CMA Summary</th><th>RE Crimson Consistency Determination</th></tr>
<tr><td></td><td>
<table>
<tr><td>Mohave ground squirrel</td><td>Clearance surveys in the Mohave ground squirrel habitat areas indicated in Appendix H.<br>Protocol surveys in key population centers and linkages.</td></tr>
</table>
</td><td></td></tr>
<tr><td>DFA-BIO-IFS-2</td><td>Implement the following setbacks shown below in Table 22 as applicable in the DFAs.<br>Table 22. Individual Species DFA Setback Requirements
<table>
<tr><th>Species</th><th>DFA Survey Requirements</th></tr>
<tr><td colspan="2">Reptile</td></tr>
<tr><td>Desert tortoise</td><td>None.</td></tr>
<tr><td>Flat-tailed horned lizard</td><td>None.</td></tr>
<tr><td colspan="2">Bird</td></tr>
<tr><td>Bendire's thrasher</td><td>Setback pre-construction, construction, and decommissioning, and other activities 500 feet from active nests.</td></tr>
<tr><td>Burrowing Owl</td><td>656 feet (200 meters) from active nesting sites.</td></tr>
<tr><td>California condor</td><td>Setback wind and transmission projects 5 miles from nest sites.<br>Setback solar, geothermal, and other activities than may impact condors 1.5 miles from nest sites and out of direct line of site from nest sites.</td></tr>
<tr><td>Gila woodpecker</td><td>Setback pre-construction, construction, and decommissioning, and other activities that may impact the species 0.25 mile from suitable habitat during the breeding season (April 1 through July 31).</td></tr>
<tr><td>Golden eagle</td><td>Setback activities 1 mile from active or alternative nests within an active territory as described in LUPA-BIO-IFS-24.</td></tr>
<tr><td>Swainson's Hawk</td><td>0.5 mile from active nests.</td></tr>
<tr><td colspan="2">Mammal</td></tr>
<tr><td>Desert bighorn</td><td>None.</td></tr>
<tr><td>Mohave ground squirrel</td><td>None.</td></tr>
</table>
</td><td>There are no species in Table 22 within the RE Crimson Permitting Boundary where setbacks are necessary.</td></tr>
<tr><td>DFA - BIO-IFS-3: Desert Tortoise</td><td>Protocol surveys, as described in DFA- BIO-IFS-1 and shown in Table 21, are required for development in the desert tortoise survey areas (see Appendix D). Based on the results of the protocol surveys the identified desert tortoises will be translocated, or the activity will be redesigned/relocated as described below:<br>▪ If protocol surveys identify 35 or fewer desert tortoises in potential impact areas on an activity site, the USFWS and</td><td>Surveys were conducted in 2012 and 2016 and there are fewer than 35 desert tortoise within the RE Crimson Permitting Boundary. Depending upon the construction approach, the desert tortoise will either</td></tr>
</table>

**Table 1. DRECP CMAs Applicable to the RE Crimson Solar Project**

| DRECP CMA | CMA Summary | RE Crimson Consistency Determination |
|---|---|---|
| | CDFW (for third party activities) will be contacted and provided with the protocol survey results and information necessary for the translocation of identified desert tortoises. Pre-construction and construction, and other activities will not begin until the clearance surveys for the site have been completed and the desert tortoises have been translocated. Translocation will be conducted in coordination with the USFWS and CDFW, as appropriate, per the protocols in the Desert Tortoise Field Manual (USFWS 2009) and the most up-to- date USFWS protocol.<br>▪ If protocol surveys identify an adult desert tortoise density (i.e., individuals 160 millimeters or more) of more than 5 per square mile or more than 35 individuals total on a project site, the project will be required to be redesigned, re-sited, or relocated to avoid and minimize the impacts of the activity on desert tortoise | be translocated (per USFWS 2009 protocols), or will be relocated outside of the fenceline. Consistent with BIO-28. |
| **Wilderness Characteristics** | | |
| LUPA-WC-1 | Complete an inventory of areas for proposed activities that may impact wilderness characteristics if an updated wilderness characteristics inventory is not available. | There are no identified wilderness protection areas within the RE Crimson Permitting Boundary. |
| LUPA-WC-2 | Employ avoidance measures as described under DFAs and approved transmission corridors. | There are no identified wilderness protection areas within the RE Crimson Permitting Boundary. |
| LUPA-WC-3 | For inventoried lands found to have wilderness characteristics but not managed for those characteristics compensatory mitigation is required if wilderness characteristics are directly impacted. The compensation will be:<br>▪ 2:1 ratio for impacts from any activities that impact those wilderness characteristics, except in DFAs and transmission corridors<br>▪ 1:1 ratio for impact from any activities that impact the wilderness characteristics in DFAs and transmission corridors.<br>Wilderness compensatory mitigation may be accomplished through acquisition and donation, by willing landowners, to the federal government of (a) wilderness inholdings, (b) wilderness edge holdings that have inventoried wilderness characteristics, or (c) other areas within the LUPA Decision Area that are managed to protect wilderness characteristics. Restoration of impaired wilderness characteristics in Wilderness, Wilderness Study Area, and lands managed to protect wilderness characteristics could be substituted for acquisition. | There are no identified wilderness protection areas within the RE Crimson Permitting Boundary. |
| LUPA-WC-5 | Manage DRECP LUPA listed Wilderness Inventory Units to protect wilderness characteristics. | There are no Wilderness Inventory Units within the RE Crimson Permitting Boundary. |

# I.2 Jurisdictional Delineation Letter Report, November 2017

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November 17, 2017

Mr. Scott Dawson
Recurrent Energy
300 California Street, 7th Floor
San Francisco, CA 94901

**Re: RE Crimson Jurisdictional Delineation Letter Report**

Dear Mr. Dawson,

This letter report summarizes the methods and results of recent and historic jurisdictional delineation surveys conducted at the RE Crimson Solar Project (Project) in eastern Riverside County, California (Figure 1). Survey and desktop mapping were previously conducted for another project, Sonoran West Project (SWP) over a larger, overlapping area than the current project in 2011 and 2012. Additional surveys were conducted for the current Project in 2016. Details of both efforts are included in the discussion below.

**Introduction**

The Project is a utility-scale solar photovoltaic (PV) and energy storage project that would be located on federal lands managed by the BLM within the California Desert Conservation Area planning area. The Project would interconnect to the regional electrical grid at the SCE 230-kilovolt (kV) Colorado River Substation (CRS). The project would be located on up to 2,489 acres of public lands. It would generate up to 350 megawatts (MW) of renewable energy using PV technology and would include up to 350 MW of integrated energy storage capacity.

The total area for the Project (i.e., RE Crimson Permitting Boundary; 2,489 acres) includes a 2,465 acre solar field development area with approximately 1,859 acre of solar panels (array blocks) and 24 acres for linear facilities including access/perimeter roads assuming a 30 to 60 foot corridor width and gen-tie and powerline corridors at 150 feet. The proposed Project includes a traditional PV design, though the applicant is also considering the incorporation of potential low-environmental impact design (LEID) elements such as wildlife-friendly fencing during operations and maintenance, elevated inverter skids.

The Project is located in unincorporated eastern Riverside County, on Assessor parcel numbers 879030017, 879100006, 879100007, 879050007, 879080023, 879070006, 879080022, 879050004, 879080026, and 879080028. The Project is approximately 13 miles west of Blythe, just north of Mule Mountain and just south of I-10, including portions of Sections 1, 2, 11, 12, 13, 24, 25 within Township 7 South, Range 20 East, and portions of Sections 6, 7, 8, 17, 18 within Township 7 South, Range 21 East (Figure 1).

**Methods**

This section describes the approach to delineate wetlands and waters of the United States and State of California. The majority of the mapping effort was conducted in in 2011/2012 for the SWP Site, with field verification and updated mapping conducted for the Project in 2016.

U.S. Army Corps of Engineers Jurisdiction

The U.S. Army Corps of Engineers (USACE) and the Environmental Protection Agency (EPA) assert jurisdiction over non-navigable tributaries of traditional navigable waters that are relatively permanent where the tributaries typically flow year-round or have continuous flow at least seasonally via the Clean Water Act. The USACE and EPA decide jurisdiction over non-navigable tributaries that are not relatively permanent based on a fact-specific analysis to determine whether they have a significant nexus with a traditional navigable water (TNW). A tributary is a natural, man-altered, or man-made water body that carries flow directly or indirectly into a TNW. A tributary is the entire reach of a stream that is of the same order (i.e., from the point of confluence, where two lower order streams meet to form the tributary, downstream to the point such tributary enters a higher order stream). The entire reach of a stream is a reasonably identifiable hydrographic feature.

Swales or erosional features—including small washes characterized by low volume, infrequent, or short duration flow—are generally not waters of the U.S. because they are not tributaries or they do not have a significant nexus to downstream TNWs. However, certain ephemeral waters in the arid west are tributaries with a significant nexus to downstream TNWs because they serve as transitional areas between upland environments and TNWs. These washes may support nutrient cycling, sediment retention and transport, pollutant trapping and filtration, water quality improvement, and other functions that may significantly affect the chemical, physical, and biological integrity of downstream TNWs.

A thorough desktop analysis was conducted using topographic data and aerials to determine the direction of flows moving through the project area. Other jurisdictional determinations made by the USACE in the vicinity of the project were also reviewed to determine the potential jurisdiction of waters on the Project.

California Department of Fish and Wildlife Jurisdiction

In 2011 and 2012, a desktop level jurisdictional delineation was conducted as part of the Environmental Constraints Analysis for the SWP Site on a broad scale using National Wetlands Inventory (NWI) maps to highlight potentially jurisdictional waters. The SWP Site supports a broad alluvial fan that includes many braided washes and channels that converge into a primary channel that flows to an intra-state playa lake northwest of the SWP Site. This playa lake is not a TNW; therefore, the channels in the SWP Site do not qualify as federal jurisdictional waters. Any channels having well- defined bed and banks were mapped as jurisdictional waters of the State, subject to a Fish and Game Code Section 1602 Streambed Alteration Agreement and the Porter-Cologne Water Quality Act. Blue palo verde-ironwood woodlands that were adjacent to state-jurisdictional channels were also considered CDFW jurisdictional waters.

Use of higher resolution color aerial photography allowed for development of a more detailed topographic map (2-foot contours) and a refined delineation of CDFW jurisdictional waters. Field sampling along transects across the SWP Site were conducted to provide confirmatory information for the desktop delineation. Handheld GPS units were used to mark survey waypoints to help interpret state-jurisdictional boundaries. Final maps were prepared in GIS format.

Areas considered and assessed as potential waters of the State were evaluated based on delineation practices that were in compliance with requirements of Section 1600 of the California Fish and Game Code, Streambed Alteration Agreement.

Waters delineators followed CDFW's usual practice to interpret the jurisdictional limits of state jurisdictional waters to include any one of the criteria identified below.

1. At minimum, intermittent and seasonal flow through a well-defined bed or channel with banks and also supports fish or other aquatic life.
2. A watercourse having a surface or subsurface flow regime that supports or has previously supported riparian vegetation.
3. Hydrogeomorphically distinct top-of-embankment to top-of-embankment limits (i.e., well-defined bed and bank).
4. Outer ground cover and canopy extent of typical riparian associated vegetation beyond the top-of bank that would be sustained by surface and/or subsurface waters of the watercourse.

GIS field data was collected for subsequent analysis and mapping. Ten drainages were pre-chosen using high resolution aerial photographs, as representative of typical ephemeral washes found throughout the site. These 10 drainages were chosen based on size, flow direction, connectivity, flow patterns, vegetation composition, topography, and USGS "blue lines'. Waters delineation surveys were conducted along transects crossing the 10 drainages and included points representing locations of the middle of the drainage channel, OHWMs, locations of low and high banks, and the outer extent of vegetation typically associated with each drainage. Data were recorded using a Flint® BAP GPS.

Data points collected along transect lines were plotted on high-resolution aerial photographs having one to two foot resolution, and drainage features within the SWP Site were manually digitized into a GIS database using the nearest reference location data to aid in the mapping. When determining drainage acreages using desktop mapping, categories such as 1-3 feet wide, 3-6 feet wide, 6-9 feet wide, 9-12 feet wide, 12-15 feet wide, and greater than 15 feet wide, were used to quantify the acreage.

Features for each drainage system included single, large channels with well-defined bed and banks, as well as broad, but sometimes weakly expressed assemblages of shallow braided ephemeral channels. In addition to these channels, all mapped desert wash and associated microphyll woodland, considered a wash-dependent vegetation, were mapped as waters of the State.

In 2016, the CDFW requested field verification surveys of the jurisdictional delineation done previously in 2011/2012. Previous mapping of CDFW waters and microphyll (blue palo verde-ironwood) woodlands was used to focus the survey effort to previously mapped areas.

The mapping conducted for the SWP Site encompassed the RE Crimson Permitting Boundary and was the basis for further verification in 2016. AECOM verified the boundaries of the prior delineated waters per discussion with CDFW (via verbal and email correspondence with Magdalena Rodriguez in July/August 2016), and with their approval of the methods described below. AECOM also surveyed blue palo verde-ironwood woodlands that remained within the proposed development area (prior to further site refinement) to fine tune the extent of that vegetation community as it currently stands.

AECOM verified the conditions (extents and widths) of previously delineated waters by comparing the mapped extent of each mapped feature to actual conditions in the field. AECOM surveyed drainages in a loop, such that one direction hit the drainage ends, while the other direction hit the drainage midpoints. This simulated walking transects across the tips and midpoints of a representative sample of drainages onsite. AECOM walked across the ends of drainages to determine if they extended in length or width and noted changes in the field. To determine if any drainage increased in width further upstream, AECOM walked across the project site to intersect drainages near their midpoints and checked to verify if any new braids developed and/or if there were changes in width. Observed changes were used to update the mapping/acreage accordingly.

At the time of the survey, in August 2016, almost all of the blue palo verde-ironwood woodland areas were avoided by the proposed design at that time; however, those blue palo verde-ironwood woodland areas that still remained within the proposed development area at that time were called out for 100 percent surveys and were subsequently surveyed and remapped to determine the exact acreage within those areas. Proposed access routes connecting the various project areas were also 100 percent surveyed for waters and blue palo verde-ironwood woodlands, with the goal being to locate these crossings in areas that avoid waters and woodlands to the extent feasible. A GPS point was taken for individual trees with a diameter greater than four inches at breast height (roughly four feet from the ground) in the access corridors to facilitate avoidance of mature trees during placement of the drainage crossings (either Arizona crossings or box culverts).

GPS track logs were collected to document the survey routes. A GPS point and bank width measurement was also taken at each drainage crossed by the survey route. This data was compared to existing mapping to facilitate refinements, as necessary. Updates to the existing waters map were made based on the data collected.

**Results**

This section contains the results of the 2011/2012 initial mapping effort and 2016 verification surveys.

U.S. Army Corps of Engineers Jurisdiction

Based on desktop analysis and document review, combined with field verification, the Project will not impact USACE jurisdictional waters. The Project is located in two different watersheds. One portion of the project site is located in the  Southern Mojave-Salton Sea Subregion, Southern Mojave Basin, Southern Mojave Subbasin (HUC – 18100100), which does not contain any TNWs. The other portion of the project site is located in the Lower Colorado Subregion, Lower Colorado Basin, Imperial Reservoir Subbasin (HUC – 15030104), which contains the Colorado River, a TNW.

Washes in the Southern Mojave Subbasin (the majority of the Project) drain north and west toward Ford Dry Lake. Other approved jurisdictional determinations made by the USACE concluded that waters draining to Ford Dry Lake are isolated intrastate waters. Thus, the project waters located in the Southern Mojave Subbasin watershed are not waters of the U.S. because they cannot be direct or indirect tributaries to a TNW. The few washes located in the Imperial Reservoir Subbasin are not waters of the U.S. because they are isolated intrastate waters and lack a significant nexus connection to a TNW.

California Department of Fish and Wildlife Jurisdiction

Waters considered under the jurisdiction of the State (CDFW and Regional Water Quality Control Board [RWQCB]) include unvegetated streambed and associated riparian vegetation.

*CDFW Waters of the State*

A total of approximately 90.6 acres of CDFW waters in the form of unvegetated streambed is present within the RE Crimson Permitting Boundary (Figure 2).

*CDFW Associated Riparian Vegetation*

Although most of the CDFW riparian vegetation, consisting of blue palo verde-ironwood woodland vegetation, has been avoided, 1.24 acres (0.96 acre within CDFW waters and an additional 0.28 acre as CDFW associated waters) occurs within two road crossing corridors between development areas within the RE Crimson Permitting Boundary. These areas are mapped larger than necessary to allow the road to be microsited within this corridor as necessary to avoid impacts to existing riparian trees. All mature trees will be avoided during micrositing of the access roads. Therefore, the actual impact to this resource will likely be less than 1.24 acres.

*Vegetation Impacts*

Although the majority of CDFW waters impacts are to unvegetated streambed, these areas were not differentiated from the underlying mapped vegetation communities. Table 1 shows the acreages of vegetation that were intersected with the CDFW waters.

Although the majority of microphyll tree species were avoided as the Project avoided the bulk of the microphyll woodland containing CDFW regulated washes that move through the project site area, some tree species not associated with CDFW waters or associated riparian vegetation were observed within the Project boundary (Figure 2). A total of 21 trees were observed across the Project, seven ironwood trees (*Olneya tesota*) and 14 blue palo verde (*Parkinsonia florida*), all approximately between 10 and 20 feet tall, with a diameter at breast height of 6 to 12 inches. Efforts will be made to avoid these trees as feasible; otherwise they will likely be removed.

**Table 1. CDFW Vegetation Impacts**

| Vegetation Community | CDFW Unvegetated Streambed | | | CDFW Riparian Vegetation | Total |
|---|---|---|---|---|---|
| | Permitting Boundary | Project Road, Road Crossings and Gen-tie | Subtotal | Road Crossings | |
| Blue Palo Verde-Ironwood Woodland | - | 0.96 | 0.96 | 0.28 | **1.24** |
| Brittlebush Scrub | 0.14 | - | 0.14 | **-** | **0.14** |
| Creosote Bush Scrub | 4.69 | - | 4.69 | **-** | **4.69** |
| Creosote Bush-White Bursage Scrub | 50.81 | 0.47 | 51.28 | **-** | **51.28** |
| Creosote Bush-White Bursage-Big Galleta Grass Association | 28.71 | - | 28.71 | **-** | **28.71** |
| Creosote Bush-White Bursage-Ocotillo Association | 0.36 | - | 0.36 | **-** | **0.36** |
| White Bursage Scrub | 4.42 | - | 4.42 | **-** | **4.42** |
| **Total** | 89.13 | 1.43 | **90.56** | **0.28** | **90.84** |

**Summary**

Jurisdictional waters within the RE Crimson Permitting Boundary consist of 90.56 acres CDFW waters of the state and an additional 0.28 acre of CDFW associated riparian vegetation. There are no federal waters present within or immediately adjacent to the RE Crimson Permitting Boundary and therefore there will be no impacts to federal waters.

Approximately 1.24 acres of microphyll woodland vegetation may be impacted with the placement of access roads, however these areas were mapped larger than needed to allow for the micrositing of the roads to avoid trees and other sensitive resources in these areas and the actual impacted acreage will be much lower.

Please feel free to contact me at (619) 610-7646 if you have any questions regarding this letter.

Sincerely,

Sundeep Amin
Senior Biologist

Attachments: Figure 1 – Regional Map
Figure 2 –Jurisdictional Delineation Results


**Figure 1**
**Regional Map**

RE Crimson Solar - Riverside County, CA

*Path: U:\Projects\Recurrent Energy\60487757_Crimson\900-Work\920-GIS\map_docs\mxd\Bio\BTR\regional_map.mxd, 7/21/2017, lauren.rizzo*

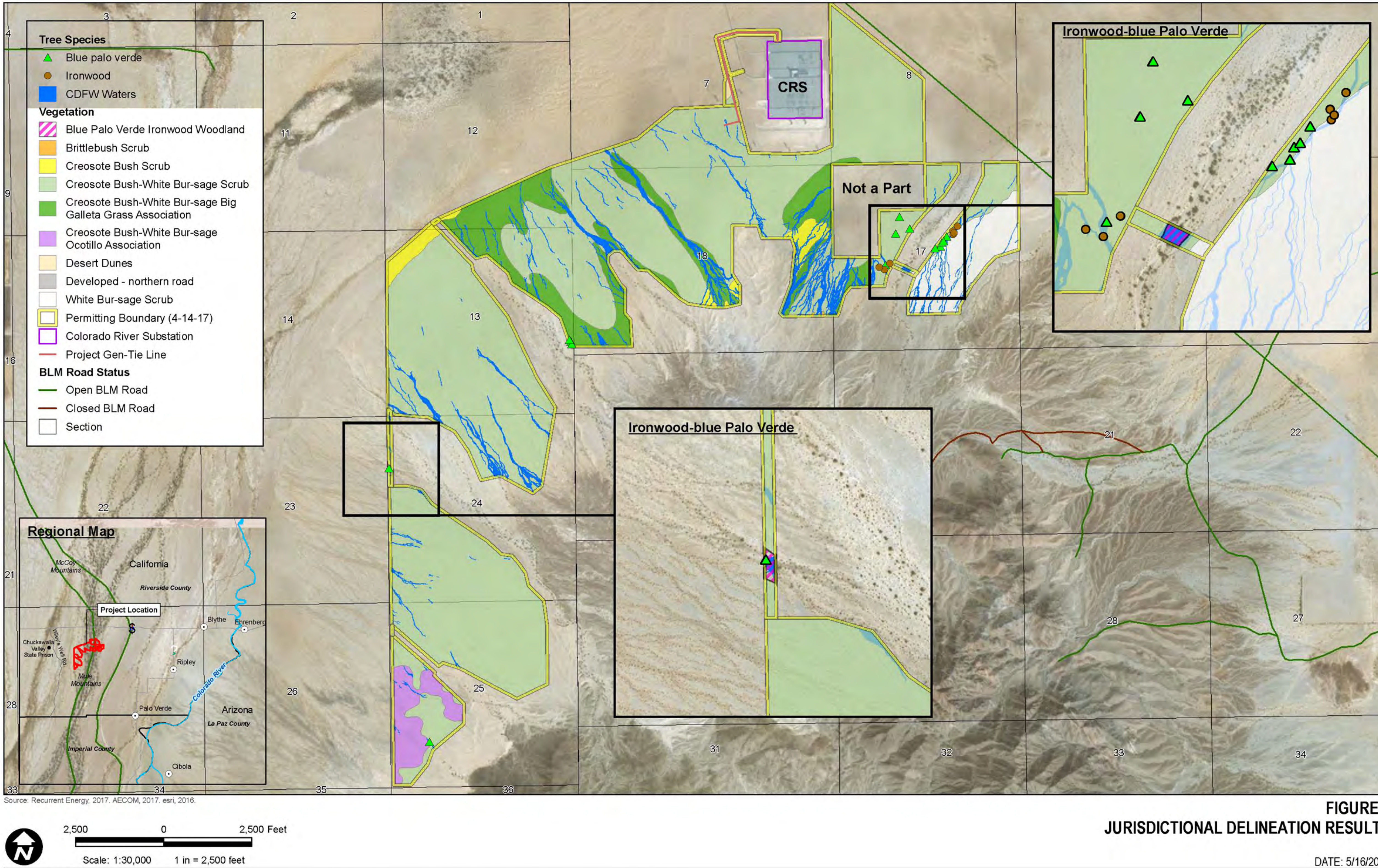


**FIGURE 2**
**JURISDICTIONAL DELINEATION RESULTS**

DATE: 5/16/2018

RE Crimson Solar - Riverside County, CA

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# I.3 Geomorphic, Stratigraphic & Geologic Eolian Evaluation Report, October 12, 2018

# Geomorphic and stratigraphic evaluation of the stable early to mid-Holocene eolian (windblown) dune systems for proposed Crimson Solar Project, eastern Chuckwalla Valley, Riverside County, California

PREPARED FOR:

AECOM
Crimson Solar Project
Project Manager: Jennifer Guigliano
401 West A Street, Suite 1200
San Diego, CA 92101

PREPARED BY:

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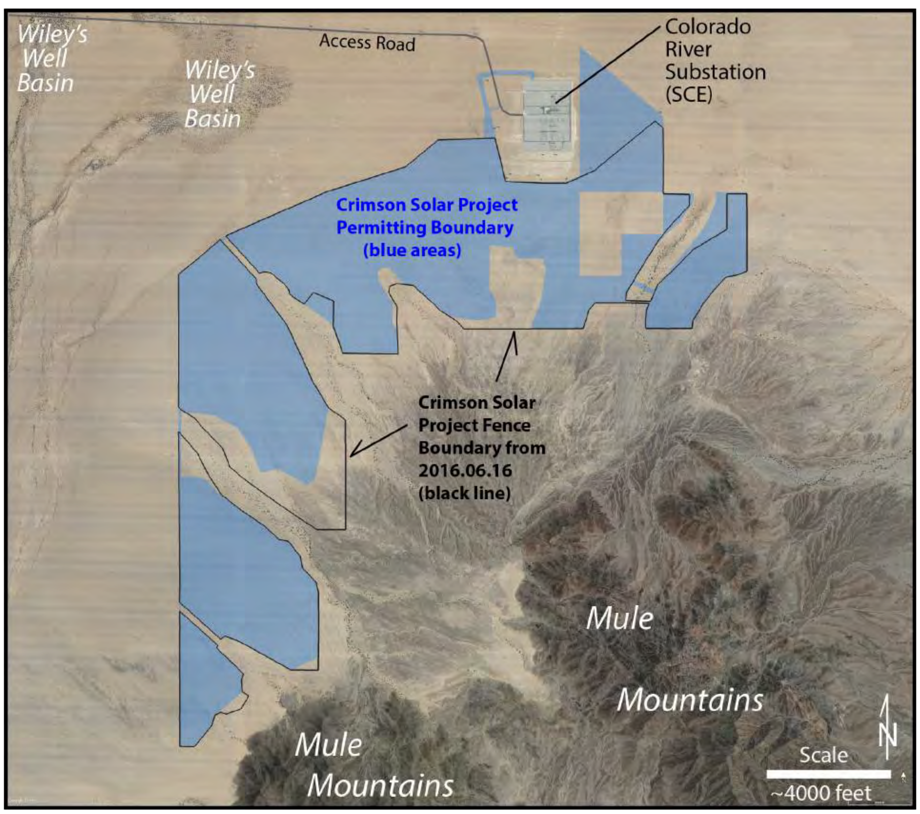

*Job Number: 737-16*
*Date: October 12, 2018*

To: AECOM
Crimson Solar Project
Project Manager: Jennifer Guigliano
401 West A Street, Suite 1200
San Diego, CA 92101

From Miles D. Kenney PhD, PG
Kenney GeoScience
Consulting Geologist & Geomorphologist
Oceanside, CA 92058
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Report Title:

**Geomorphic and stratigraphic evaluation of the stable early to mid-Holocene eolian (wind-blown) dune systems for the Crimson Solar Project, eastern Chuckwalla Valley, Riverside County, California**

Dear Ms. Guigliano:

Kenney GeoScience (KGS) is pleased to provide you this geomorphic and stratigraphic evaluation regarding eolian (windblown) systems in the region of the proposed Crimson Solar Project (RE Crimson) located west of Blythe California and south of Interstate Highway 10 in the eastern Chuckwalla Valley along the northern flanks of the Mule Mountains, Riverside County, California. The primary motivation for this study is to determine the value of the dune system(s) habitat in the vicinity of the RE Crimson to support analysis of the project impacts under the National Environmental Policy Act ("NEPA) and the California Environmental Quality Act ("CEQA"). This exercise is important because the dune deposits may provide habitat for the Mojave fringe-toad lizard (MFTL).

To address these questions, KGS has evaluated the geologic history near RE Crimson since the early Pliocene, evaluating regional and local eolian sand contributions, eolian sand pathways and their changes in connectivity, and proposed regional sand migration corridors throughout southeastern California. KGS has also evaluated eolian sand source changes and variations in dune stability/activity since the Latest Pleistocene associated with variations in global and regional climate, times of fan deposition, periods of increased upslope erosion of older depositional units, and hydrologic systems associated with dune systems that are strongly influenced by numerous factors associated with surface water flow. In terms of global and regional climate, comparing the relative importance of cooler storm systems emanating from the Pacific Ocean during winter months with more extreme "flood" events derived from Monsoonal storms occurring in summer months as led to insights regarding periods or regional dune stability or increased activity. KGS further researched potential impacts to the dunes from anthropogenic activities such as global climate change and diversion of flood waters from construction activities in the eastern Chuckwalla Valley.

This study contributes not just to the understanding of the RE Crimson site, but also to other dune systems throughout southeastern California. Few regional studies of dune systems exist for this region, however there is much literature regarding aspects of individual dune systems and sand migration corridors. Before now, these studies had not been evaluated comprehensively. The findings of this report are also consistent with previous KGS dune studies supporting the strong importance of evaluating surface water hydrology as it plays a critical role regarding eolian sand sources, dune depositional rates, and dune stability over time. These findings greatly assist in the evaluation of local dune systems whether they are similar or substantially dissimilar to regional dune systems across the southeastern California region.

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# EXECUTIVE SUMMARY

This study provides an evaluation of the processes, geologic history and current characteristics of wind-blown (eolian) sand transport and deposition in the eastern Chuckwalla Valley. The study was conducted to provide a site-specific assessment of existing dune systems in the vicinity of the proposed Crimson Solar Project (RE Crimson), (BLM project CACA-051967). This Project is a utility-scale solar photovoltaic (PV) and energy storage project that would be located on federal lands managed by the Bureau of Land Management (BLM) within the California Desert Conservation Area planning area in unincorporated eastern Riverside County, approximately 13 miles west of Blythe, California (CA). The Project would interconnect to the regional electrical grid at the Southern California Edison (SCE) 230-kilovolt (kV) Colorado River Substation (CRS). It would generate up to 350 megawatts (MW) of renewable energy using PV technology and would include up to 350 MW of integrated energy storage capacity. The proposed RE Crimson is located along the northern flanks of the Mule Mountains, at the eastern end of the approximately 50-mile long, east-west trending Chuckwalla Valley (Figure ES-1).

## ES 1.0 STUDY PURPOSE

The purpose of this study is to provide a more refined understanding of sand transport and dune systems in the RE Crimson area for use in evaluating current and potential future characteristics of the sand transport and dune systems as they relate to proposed RE Crimson development and biological resource habitats in the RE Crimson vicinity. To achieve this, the study evaluates existing dune systems regionally, near and within the proposed RE Crimson site to define the current aerial extent of the dune deposits and characterize the dynamic nature of the current dune system (i.e. active, stable, eroding), as well as how the dune system may evolve in the future. This study evaluates regional dune systems to better understand whether typical eolian conditions occur at the site or if something unusual may be occurring. Many natural processes associated with dune systems across southeastern California have remained poorly understood and not fully evaluated in a comprehensive way. A large purpose of this study was to evaluate the regional dune systems in a comprehensive way to improve our understanding as it relates to their current and past connectivity, and periods of increased activity and periods of stability.

## ES 2.0 STUDY ELEMENTS

Evaluation of the dune systems was accomplished using the following study elements: 1) a literature review of pertinent published geologic studies across a wide range of topics that directly or indirectly affect dune systems; 2) analysis of regional dune systems in terms of their geomorphology, connectivity, and sand sources, 3) geologic mapping comprised of geologic and geomorphic parameters, soil stratigraphy (age) and topographic components; 4) development of geomorphic, soil pedon and sand migration zone designations to assist in evaluating eolian geomorphology, age of geologic events, and eolian activity; 5) analysis of eolian systems to identify parameters and their importance in understanding the development of eolian systems; and 6) consideration of anthropogenic effects on dune systems including infrastructure development and climate change.

## ES 3.0 STUDY KEY FINDINGS

The study evaluated numerous issues (parameters) related to dune formation, relative sand migration rates and dune stability in the RE Crimson vicinity. A more detailed discussion of the study results is provided in Section ES 4.0; however, the key findings most relevant to characterization of the dune systems at the RE Crimson site are briefly presented below.

- *Sand migration zones are local not regional*

  The RE Crimson site is located along the northern flanks of the Mule Mountains, at the eastern terminus of the Chuckwalla Valley and western margins of the Palo Verde Mesa (Figure ES-1 and Plate ES-1). Primary issues regarding evaluating eolian systems is the identification of the source for their eolian sands both currently and in the past, relative sand migration rates both in the past and at present, the location of the sand migration zones and their relative sources, and what is the dune development history during the Holocene.

  A system of identifying individual sand migration zones, defined as a region where eolian sand is transported leading to the development of eolian deposits where the majority of the eolian sands are derived from an independent and local source, was conducted. In the study area, four relatively small and local sand migration zones are identified. Three of the designated sand migration zones occur along the northwestern and northern flanks of the Mule Mountains geomorphically located in the upper fan. The designated Sand Migration Zones (SMZs) are referred to from the southeast to the northeast as: Western Mule SMZ, Central SMZ and the Northern Mule SMZ (Plate ES-1 and Figure ES-1). The fourth identified SMZ is the Mule SMZ in the northeastern portion of the RE Crimson and geomorphically it resides primarily in a more distal fan region along the northeastern flanks of the Mule Mountains (Plate ES-1). The identification of SMZs in the study areas provides important information regarding the region of eolian deposits and their eolian sand source and therefore provides a very beneficial approach to evaluating dune systems.

  The study findings indicate that the dune systems within the RE Crimson area are and have been throughout the Holocene dominantly derived and influenced by local eolian sand sources associated with local fluvial systems. A small component of eolian sand source derived from the proposed regional Chuckwalla Valley sand migration corridor during robust periods of dune activity (i.e. early to mid-Holocene) cannot be ruled out by the existing data. However, local geomorphologic mapping suggests that if it occurred, the magnitude of eolian sands migrating from the northwest in the Chuckwalla Valley sand migration corridor to reach the RE Crimson site would have had to have occurred in the early Holocene (quite old) and represent a relatively small magnitude of eolian sand.

  The primary source of eolian sand deposits in the RE Crimson area is from the erosion of older formations outcropping along the northern flanks of the Mule Mountains. These include the Bullhead Alluvium (Pliocene age ~4.3 Ma), and older alluvial units designated as S4 and S5 soils (Figures ES-1 and ES-2). These units are deeply incised into over a wide area along the northern flanks of the Mule Mountains and contain a significant sand component. This is in contrast with typical upper fan alluvial deposits across the Mojave Desert that are quite coarse grained exhibiting abundant gravel size clasts as compared to sand grained deposits identified here.

Figure ES-1: Relative Sand Migration Zone map of the Crimson Solar Project area, northern flanks of the Mule Mountains, southeastern California. See Plate ES-2 for Sand Migration Zone descriptions. Blue line delineates the proposed Crimson Solar Project permitting boundary. Dune geomorphology and relative sand migration zone rates decrease from Zone AB (strongest) to Zone D representing the weakest. S0 areas represent washes and ponding areas.

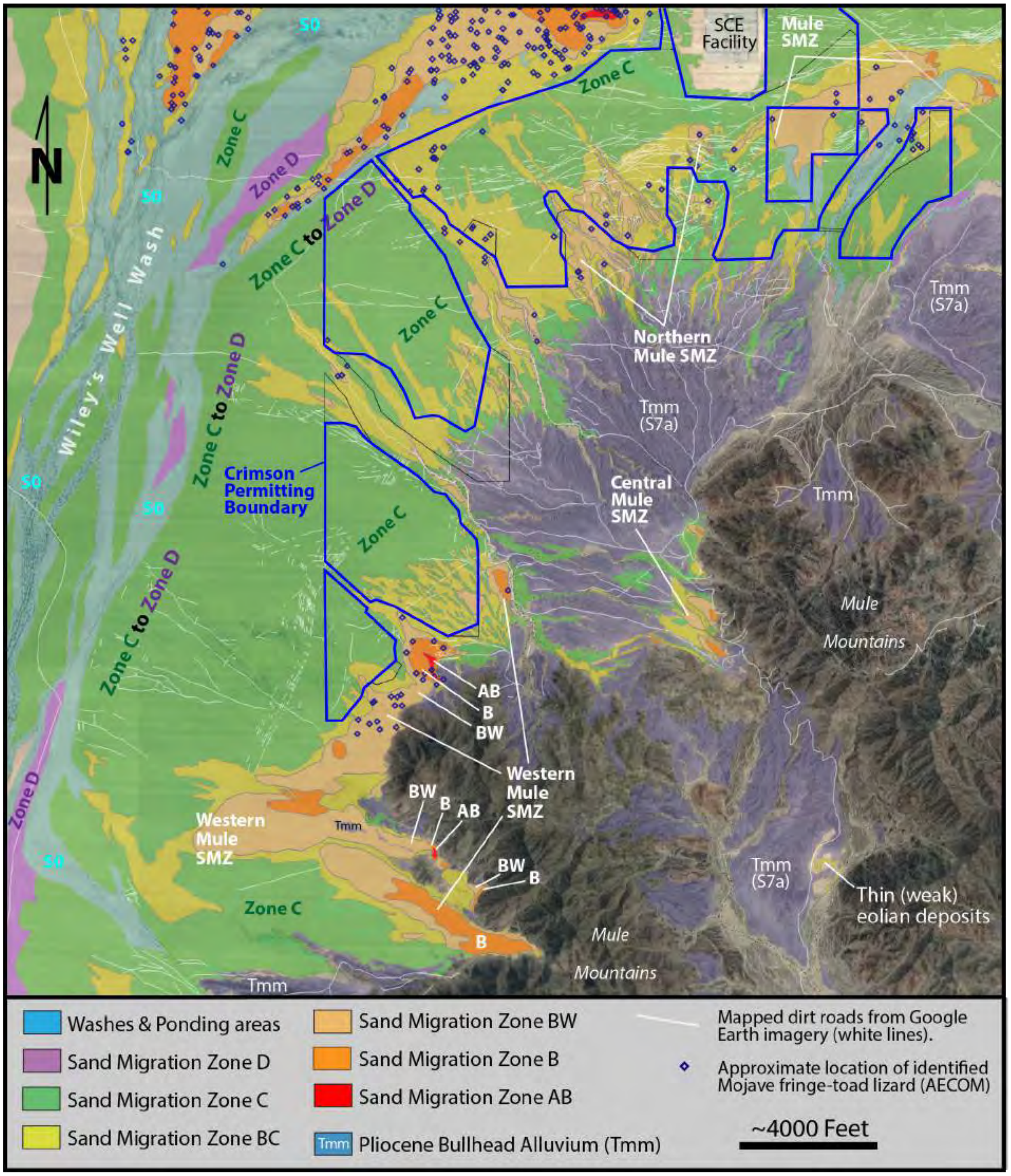
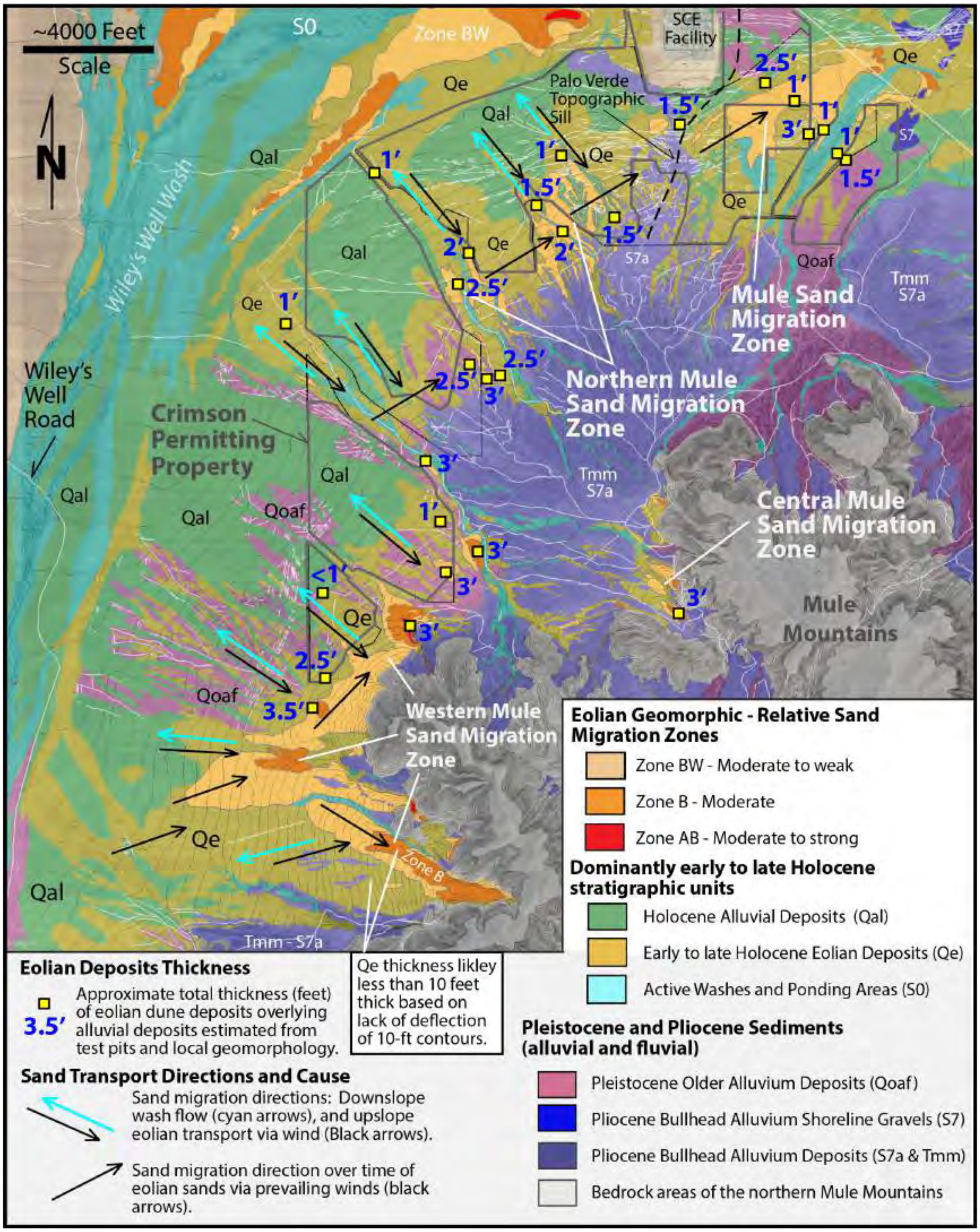


Figure ES-2: Map of the RE Crimson area identifying designated Sand Migration Zones AB, B and BW, and the areas of soil parent material that delineate regions of Holocene age alluvially derived sediments (Qal) and stable (mostly dormant) eolian deposits (Qe). Eolian (dune – Qe) stratigraphic thicknesses are shown in feet. Sand transport directions and mechanisms (fluvial vs. wind flow) are also identified.



The fluvial-eolian derived sands are "cycled" in that that they are initially eroded from local older sedimentary formations and transported downstream by the local washes, then entrained by the wind to be blown back up slope, some of which deposit as eolian sediments (Figure ES-2). Some of the eolian sands are again deposited in the ephemeral washes to subsequently be transported downstream by a wash once it flows. The fluvial-eolian cycling occurs along the northern flanks of the Mule Mountains alluvial fan region because the two prevailing wind directions flow "up" and "across" the washes. The cycling of sands in the eolian-fluvial system is an important process for the Western Mule, Central and Northern SMZ's in addition to other weak dune systems in these areas. The western and southwestern prevailing winds in this area tend to either move the eolian sands back up the northwest flowing washes or toward the northeast along the downwind side of the wash where the eolian sands are often deposited in a smaller wash or as eolian deposits mantling older alluvial fan deposits (terrace). Hence, the primary source of eolian sands is from the local washes, and more permanent eolian deposits occur in regions outside of the active ephemeral washes flow areas.

The exception to these fluvial-eolian cycling relationships is the Mule Sand Migration Zone (SMZ) in the eastern portion of the property (Figure ES-2 and Plate ES-1). In this area older sedimentary formations are also the primary source of eolian sands via erosion by washes; however, dune sands generally remain in the eolian geomorphic area once deposited and the prevailing winds and washes flow in the same direction. Hence, in the Mule SMZ the eolian sands are not cycled in the sense they are blown back toward the eolian source associated with the eroding older formation or upslope regions of the washes, but instead the eolian sands and fluvial systems both tend to migrate the sands toward the northeast. Field mapping data suggests that a minor amount of eolian sands were able to migrate over the Palo Verde Topographic Sill from the west to "feed" the Mule SMZ (Figure ES-2).

The local source of eolian sands from the erosion of older underlying formations is considered sufficient to provide essentially all the eolian sand deposits in the RE Crimson site area. This essentially is due to the paucity of dormant eolian deposits or active eolian sands along the southeastern region of the Wiley's Well Wash (areas shown as Zone C to Zone D in Figure ES-1) that indicate that these regions have not and currently do not allow for much eolian sand transport. However, the washes typically exhibit an increase in eolian sand deposits and eolian activity progressively upslope toward localities of eroded older formational units.

Eolian deposits in the RE Crimson area are very thin ranging from 1 to 3.5 feet in total stratigraphic thickness overlying older deposits (Figure ES-2). In most places, the thickest eolian deposits are at the highest elevations near the base of the Mule Mountains. Hence, the wind transported sands drop out of the wind as the wind speed decreases when they reach the mountain front. In a sense they are weak sand ramps. Wash systems are not sufficiently strong enough in these areas, much of which occur on abandoned older depositional surfaces, to remove the eolian sediments once deposited. This is particularly the case for the Western Mule and Central SMZ's. However, total stratigraphic thickness of the Northern and Mule SMZ's are also less than 3.5 feet thick (Figure ES-2). These data indicate that the rate of deposition of the eolian deposits is quite slow in the RE Crimson area which in turn infers that eolian sand migration rates have been low to very low in the region of RE Crimson.

These findings are supported by the observation based on soil profile stratigraphy that the eolian deposits are early to late Holocene in age.

- *Regional and local dunes are stable and degrading*

  Considerable evidence provided by published reports regarding the proposed regional sand migration corridors indicate that these systems no longer function as a continuous sand migration pathway due to many areas becoming stabilized. The findings in this report, based on regional mapping of regional dune systems, supports the discontinuous nature of the proposed regional sand migration corridors. In addition, many published reports since the time of the proposal of the regional sand migration corridors, and the findings of this report indicate that local eolian sand sources provided a significant if not dominant component to the dune systems of southeastern California. These findings indicate that local sources of eolian sands and other local dune processes play a critical role regarding dune geomorphic conditions and stability.

- *Future dune activity not expected to change existing mapping for at least a thousand years*

  <u>Factors affecting dune systems</u> - Dune systems experience aggradation (increase in dune deposit mass) during times when pluvial and playa lakes are drying up and/or experiencing repeated lake fluctuations, when alluvial fans are experiencing aggradational events (abundant fan deposition), when monsoonal storms are more frequent and with higher intensity and/or when older exposed sand bearing deposits upslope such as alluvial fans, and/or older sedimentary units are eroded into which results in washes transporting a larger volume of eolian size grains per flow and more frequently than typical washes emanating from bedrock regions of most regional mountain ranges. However, with these conditions being met, vegetation densities need to also decrease in order to allow dunes sands to migrate from their sources. Vegetation densities decrease on various time scales such as annually, during droughts, and during blooms of the invasive non-native Sahara Mustard. Dunes can experience variations in activity based on the additive nature of the parameter wavelengths when they collectively "add up" (aggradational events) or cancel each other out (times of stability).

  <u>Climate change</u> - The arid-semi arid climate conditions since the early to mid-Holocene across southeastern California have resulted in a geomorphic condition where slight changes in regional climate (i.e., monsoonal storm activity) is sufficient to result in local re-activation of dune systems, but not sufficient to produce a robust eolian system where sand migration corridors are continuous. Global climate affecting Pacific Storm strength and frequency and local monsoonal strength, frequency and magnitude can be reflected in changes in dune behavior on a cyclic scale. There is a strong correlation from prehistoric times with increased monsoonal extreme storm frequency and magnitude with increased alluvial fan and eolian activity (aggradational events) and/or with periods of time exhibiting a warmer global climate. Dune systems appear to significantly react to this type of climate change on the order of less than 1000 years.

  If the frequency and magnitude of cool winter Pacific storms decrease (decreases vegetation density) and warm summer monsoonal storms increase (extreme events causing erosion and abundant wash sand transport), then this can lead to an increase in eolian sand generation in the valley axis area. Based on the rate of past dune aggradational events indicated in the soil record for the SMZs in the RE Crimson area, it is likely that if dune parameter conditions changed that encouraged dune growth (i.e., a future dune aggradational event), the existing mapped areas of dunes would be able to "absorb" the additional dune sands for at least a thousand years prior to expanding beyond the current mapped footprint). Moreover, if current vegetative conditions persist, such as the presence of invasive Sahara Mustard, this could stabilize the dunes and even further hinder dune expansion in the future.

Research conducted regarding potential climate change for the southwestern United States indicates that the region is believed to get warmer and drier during the next 100 years and that this will lead to a decrease in soil moisture. A decrease in soil moisture could lead to an increase in dune activity via decreasing vegetation densities and increase in internal dune erosion. If this occurred it would likely lead to a moderate increase in eolian sand migration along older now stabilized sand migration zones and increase in deposition (weak aggradation) in dune depositional areas. In other words, it is not believed, based on the mapping of this study, that dune areas would expand beyond regions where they are mapped to have been more active during the early to mid-Holocene, when conditions were very conducive for dune development.

In the area of the RE Crimson, most relatively robust dune areas are outside the proposed project footprint. These relatively robust dune areas are typically located on elevated abandoned older formational surfaces that receive relatively minor wash flow providing stabilizing moisture for the dunes. This may be one reason that the dunes have not obtained thicker stratigraphic thickness over time. This indicates that the local RE Crimson dune systems (areas dominated by dune geomorphology) are likely in equilibrium with not receiving much stabilizing moisture from local drainages. Hence, these dune systems will likely remain fairly stable even if climate change leads to drier soil conditions because the dunes are already accustomed to little stabilizing moisture compared to dune systems in the valley axis.

## ES 4.0 DISCUSSION OF STUDY APPROACH AND RESULTS

The key elements of the study were implemented to develop a better understanding of the extent, nature and mechanisms controlling sand migration and dune systems in the RE Crimson vicinity. Important aspects of the study results that provide the basis for the above key findings are discussed below.

### ES 4.1 Findings and Limitations of Previous Dune Studies

Previous regional dune studies in southeastern California have proposed the existence of numerous regional Sand Migration Corridors occurring in valley axes and crossing over some mountain passes. Zimbelman et al. (1995) was the first to propose the possible existence of regional sand migration corridors in southeastern California, implying that eolian sand essentially migrated tens of miles from west to east, southeast down valley axes and over some mountain passes (sand ramps). Lancaster and Tchakerian (1996) evaluated numerous eolian sand ramps occurring where wind-blown sand was deposited in obstructing mountain passes or leeward side of mountains and assumed the existence of the regional sand migration corridors proposed by Zimbelman et al. (1995). Muhs et al. (2003), the most referenced scientific publication evaluating proposed regional sand migration corridors, perpetuated these beliefs, and since that time, the existence of the regional sand migration corridors has been assumed to exist, and in a sense to many readers, to have remained active throughout the Holocene. Lancaster and Tchakerian (2003) adopt the concept of the regional sand migration corridors but indicate that they have been essentially stabilized by vegetation and are no longer active in terms of a continuous eolian sand pathway (also see Bach, 1995).

Missing from the literature, however, was an evaluation that more accurately mapped the regional and potential local sand migration corridors, local eolian source contributions, and that further took into account a wide field of studies to determine the current state and past activity and/or stability of the sand migration corridors. Indeed, the California Geological Survey (CSG) February 5, 2015 comments on the DRECP (see Short and Lancaster, 2015) observed that prior to the previous "Eolian System Mapping Report" prepared by CGS (Aug. 4, 2014, see Lancaster, 2014), it was "a misstatement to call [wide swaths of the desert] 'Sand Transport Corridors.' Using this term implies that the mapping describes where the sand is coming from and where it is moving to (or source areas, zones of transport and zones of deposition)." The prior mapping efforts did not have enough specific detail to define how sand was moving within these corridors nor whether eolian sand sources were dominantly from tens of miles upwind or derived from more local sources along the length of the mapped sand migration corridors. The Lancaster (2014) report did not provide sufficient information from the findings of many existing publications regarding the inactivity and lack of connectivity of eolian systems within the proposed regional sand migration zones during the late Holocene.

To address the shortcomings of previous dune studies, the analysis provided by this study considers whether local sources of eolian sand (from alluvial washes and fans) have created local deposits during current times and the past. In addition, this study included a regional evaluation that more accurately mapped the proposed regional sand migration corridors and compiled published data to determine the current state of activity and/or stability of the regional sand migration corridors.

### ES 4.2 Study Approach

This study utilized a multi-disciplinary approach to evaluate the various factors that affect dune formation, stability and migration, including a thorough review of existing literature, evaluation of regional dune systems, geomorphic mapping, evaluation of the effect of long-term geologic processes and surface water flow on dune system dynamics, fluvial-eolian interactions, erosion of older sedimentary deposits as a source for dune aggradation and the potential effect of natural and anthropogenic changes on dune systems.

During the research phase of this project (and other eolian investigations by the author), it became clear that many fundamentally important aspects of the development of dune systems have not been sufficiently studied regionally to enable site-specific dunes studies. This report and other recent reports conducted by KGS in the Chuckwalla Valley, attempt to address these aspects of dune systems to better understand the dune dynamics in the RE Crimson vicinity.

An early step in this study and another recent KGS study was to complete an evaluation of regional dune systems throughout southeastern California which allows for a comparison with local dune development characteristics. Regional dune systems outside of Chuckwalla Valley were evaluated utilizing existing scientific publications referenced in Appendix A, and via mapping in Google Earth Pro, using current and historic imagery. This type of mapping was also conducted in Chuckwalla Valley in addition to utilizing the data and findings obtained during past studies (Plate ES-1, ES-2 and ES-3).

This analysis provided a framework in which to compare regional verses local sand systems according to characteristics including, but not limited to, general trends of the regional dunes in terms of when they developed, had aggradational events, their relative eolian sand sources, their connectivity along the path of the proposed sand migration zones, when they became stabilized and processes that led to dune re-activation. This analysis provided supportive evidence regarding the relative importance of various eolian sand sources (i.e. regional verses local sand sources). The evaluation of regional dune systems also identified some dunes areas that had not been previously mapped based on the literature reviewed in this study (one example includes the east Pinto Valley dune system). A regional analysis of eolian dune systems was essential to understanding how typical or unique a local dune system is, due to local variations in dune parameters.

Geomorphic mapping was conducted of the local and regional eolian dune systems utilizing a series of relative sand migration rate zone designations. These designations sequentially describe progressively decreasing dune activity, which is suggested to correlate with relative eolian sand migration rates (Figure ES-2 and Plate ES-2). Hence, this system provides a method for mapping a dune region showing variations in both dune geomorphology and relative migration of wind-blown sand.

Long-term geologic processes that impact the dynamic nature, development and sustainability of eolian dune systems were evaluated. Pluvial and playa lakes are considered a primary source for eolian sands where they occur. Eolian sands emanate from pluvial and playa lakes soon after they desiccate or experience repeated lake level fluctuations (intermittent lake levels) allowing for sand bearing wind abrasion to erode the lake surfaces and provide pathways for sand transport. This study evaluated the timing of pluvial and playa lake filling and receding periods in the southeastern California region to look for correlations with eolian dune aggradational and stability events.

The timing of alluvial fan aggradational events and fan-trenching (down cutting) are identified as periods of time when eolian dune systems undergo aggradational events. Washes are relatively one of the largest contributors of eolian sands in desert landscapes. This study also evaluated the relative importance of extreme storm events (monsoonal type climate) compared to cooler longer duration precipitation events associated with Pacific ocean derived storm. The analysis shows that alluvial fans and eolian systems both experience aggradational events during periods of relatively more frequent and strong extreme monsoonal storm events causing erosion and relatively large magnitudes of sand transport to valley axis. In contrast, Pacific Storms that result in long duration but less intense precipitation leads to increased vegetation densities, decreasing sand migration rates, less erosion upstream, and less frequently are able to reach the valley axis region.

The effect of water on dune systems was evaluated because maintaining dune internal moisture is critical for their stability. Although dunes may be considered "dry" systems, in fact, it is the moisture regime in the area that plays a very critical role in their development. This is the case not only for eolian sand sources, but also dune stability. Sand dunes often develop in areas not only because there is a sufficient eolian sand source, but also because there is sufficient infiltrating moisture to allow for the internal core of the dunes to remain moist which greatly decreases the potential for sand bearing wind abrasion (Kenney, 2012; Schaaf and Kenney, 2016). In addition, dunes that remain moist also have a higher likelihood of becoming stabilized via vegetation. A drainage and watershed analysis was conducted because washes are the primary mode of sand transport from upslope to the valley axis where most dune systems exist (areas of strongest prevailing winds).

The drainage and watershed analysis provides critical information because washes with larger watershed aerial extent flow more frequently and more often to the valley axis. The wash analysis also mapped the areas exhibiting distributary (often braided – depositional mode) vs tributary (erosional mode) drainage networks as it was discovered that wide braided wash systems common on distal and some medial alluvial fan areas do not result in significant eolian sand production in the valley axis. Whereas drainages that that have collected flow from abundant washes upslope, flow relatively frequently and sufficiently strong to reach the valley axis, unlike braided systems. In these instances, the wide channel in the valley axis that has accumulated the flow from abundant tributary drainages upslope may itself exhibit a braided channel network across a wide flow area, but its flow is dependent on the contribution of many other tributary channels upslope.

This study also considered potential future changes on existing dune systems associated with climate change. An assessment of the effect of the decrease in magnitude and frequency of cool-moist Pacific Storms and an increase in warm-moist extreme event monsoonal storms on regional dune development since the latest Pleistocene that led to preferable conditions for dune systems provides insights regarding potential changes in dune systems associated with global warming in the decades to come. However, an understanding regarding whether monsoonal storm systems (North American Monsoon system) will increase or decrease in the future is currently very poorly understood (Garfin et al., 2012). The southwestern United States is believed to become drier throughout this century which would lead to drier soil conditions (Garfin et al., 2012) which could lead to some dune re-activation.

Historical anthropogenic factors associated with changes to the surface of the earth (i.e., flood control berms, borrow pits, etc.) that potentially could affect local dune systems were also evaluated. This analysis is important primarily due to the understanding of the importance of surface water flow for eolian sand sources and stabilizing moisture. However, because the RE Crimson property is not located in the Chuckwalla Valley axis and instead upslope on alluvial fan surfaces and base of the Mule Mountains, water diversions essentially do not play a role in dune stability.

This comprehensive, multi-disciplinary approach led to many new insights regarding the history of dune systems across southeastern California since the late Pleistocene, the relative importance of local versus far afield eolian sand sources, and the identification of new eolian sand sources. It also provided insights for the importance of dune hydrology to dune stability, the timing of dune aggradational events, the nature of the proposed regional sand migration zones, the long-term behavior of dune systems and whether dramatic changes to the dune system may occur in the future.

### ES 4.3 Discussion of Study Results

#### *ES 4.3.1 Age of Alluvial and Eolian Sand Deposits*

It is important to understand the geologic history not only of the dune system itself, but also of the area bounding the dunes. A study of the geologic history allows for the understanding of what occurred in the area prior to the development of the dunes, which leads to understanding when the dunes began to be deposited in the area. For example, in the study area, the evaluation of the alluvial fan stratigraphy utilizing soil profiles in the RE Crimson dune system, allowed for the correlation of some of these deposits occurring beneath the dunes, which indicates that the local dunes must have begun their development after deposition of the underlying alluvial deposits. Hence, the creation of the local soil stratigraphic section with estimated minimum soil ages allows for an age estimate of the time in which the dunes encroached into the area.

Local mapping of older formational units such as those associated with the ancient Colorado River system when it had encroached (inundated) into Chuckwalla Valley and along the flanks of the Mule Mountains provides insights regarding the age and rates of geologic processes in the area. Ancient Colorado River deposits estimated to be early Pliocene in age occur under the older alluvial deposits along the northern flanks of the Mule Mountains. These deposits are extensively exposed within the RE Crimson. This indicates that geologic depositional rates of the alluvial deposits overlying the ancient Colorado River Deposits (Bullhead Alluvium) have been remarkably slow for well over 3 million years and that the area has generally been geomorphically stable.

It is important to determine what the parent material is during stratigraphic mapping of an area because it allows for the evaluation regarding where older eolian verses alluvial deposits occur. In many places, older dune deposits are exposed on the surface in areas that would not be mapped as dune deposits because the area had evolved to relatively planar surfaces with gravel lag. These areas are evaluated to represent older sand migration zones that have essentially shut down during the past several thousand years. Many of these areas are mapped as unit Qe on Figure ES-2).

Soil profiles develop when deposits are exposed to the surface of the earth and secondary soil processes occur such as development of soil horizons (A, B and C). Hence, designated soil profiles (i.e., S1, S2, S3a discussed in the report) developed in whatever sediments were exposed on the surface of the earth, whether it was alluvial or eolian once the surface stabilized. For example, if a S1 surface soil estimated to have a minimum age of 5 to 3 thousand years old (age of the surface) developed in eolian deposits and adjacent alluvial deposits, then this indicates that the alluvial and dune depositional contact has been stable for the past 5 to 3 kya (kya = 1,000 years) in that area. In other words, it shows strong evidence that approximately 5 to 3 kya that active eolian sands were depositing adjacent to active alluvial systems but that this system became dominantly inactive since that time (stable).

In the RE Crimson area, thin eolian deposits overlie older fluvial-alluvial units ranging from Pliocene to mid-Holocene in age. These data indicate that the area was dominated by fluvial and alluvial processes during the Pliocene and throughout the Pleistocene. In lower elevation areas very surficial eolian deposits in a few localities overly mid-Holocene alluvial deposits indicating that minor eolian transport and deposition occurred in these areas since the mid-Holocene. However, in these areas, many of the Holocene age soils show a combination of eolian and alluvial contribution to the sediments suggesting that the two processes were active at the same time. It appears however that in areas of relatively stronger eolian transport that sometime in the mid-to late Holocene eolian processes outpaced alluvial deposition allowing for the deposition and development of eolian dominated surfaces. The timing of this transition occurred at different times across the site but nearly all occurring sometime between the late to mid-Holocene. Data to support this finding is the alluvial bajada which occurs across large areas of the RE Crimson that exhibits extensive early to mid-Holocene alluvial deposits that are overlain by thin dune sands in some areas indicating a transition from an alluvial dominated system to an environment when eolian deposits could develop. In the upper elevations of the RE Crimson along the flanks of the Mule

Mountains, sand ramp type deposits occur overlying Pliocene Colorado River deposits (the Bullhead Alluvium, Unit Tmm or S7a).

*ES 4.3.2 Sand Corridor Continuity*

The proposal of regional sand migration corridors (Zimbelman et al., 1995), which can easily be mapped on small scale maps (i.e. covering relatively large regions), provides a simple model to conceptualize wind-blown sand migration in southeastern California. However, when the regional sand migration corridors are mapped as a continuous zone extending for tens of miles, it has the potential to imply that sand grains may have the ability to migrate along the entire mapped length of the regional sand migration corridor not only during current times, but continuously since its time of development. This subsequently may lead to the assumption that eolian sand sources along the regional sand migration corridor may be many miles upwind and not local. This is clearly not the case for most of the proposed regional sand migration corridors based on mapping during this and other KGS studies in the Chuckwalla Valley and across southeastern California, and based on published literature.

Pease and Tchakerian (2003), based on a geochemistry analysis of sand grains along the path of the proposed sand migration corridors in southeastern California, suggest that the corridors do not represent a continuous "river of sand." This finding is consistent with the conclusions in this report and with Lancaster and Tchakerian (2003) that the sand migration corridors have stabilized since the mid-Holocene.

Plate ES-1 is a map of Sand Migration Zones (SMZs) and Plate ES-2 is a geomorphic map of various dune deposits and stability (relative migration rates), along the Chuckwalla Valley, as identified by this study. As explained in more detail below, the conditions in southeastern California are more accurately described as a collection of local SMZs associated with their own local eolian sand source.

Regional mapping for this study included Dale Lake in eastern Chuckwalla Valley and identified areas where the sand migration pathway is essentially shut down. Specifically, historical Google Earth Pro imagery of the region of Dale Lake to the Eagle CoxComb Pass shows that this area is essentially shut down for through going eolian sand transport (Plate ES-3). In addition, this section exhibits very weak dune geomorphology in an area dominated by alluvial systems indicating it may not have ever been a significant eolian sand pathway (Plate ES-2). Instead, this report concludes that the Dale Lake sand system for the most part terminates near the Clarks Pass sand ramp (Figure ES-2) and that the abundant eolian sands occurring at the eastern end of the Pinto Basin (herein named the Pinto Basin Dunes) are derived primarily from the west to east flowing drainage system within the basin. Numerous other portions of the regional sand migration corridors also exhibit very weak dune geomorphology indicating that they were either never a strong sand pathway or are during the late Holocene strongly stabilized (Plate ES-3). These areas include western and eastern Ford Dry Lake, between Cadiz Dry Lake and northern Palen Dry Lake, and from Wiley's Well Wash to the RE Crimson site (Plate ES-3).

It appears based on review of all the data and research conducted by the author that during periods of strong eolian activity (dune aggradational events), eolian sands travel large distances when the regional sand migration corridors provide a more continuous pathway, and that these sands would be able to mix continuously with the significant local eolian sources. These conditions occur when vegetation densities are low at lower elevations, more readily allowing for sand movement, and relatively frequent monsoonal storms occur during dry periods of the year, providing for increased alluvial and dune aggradation. In terms of a regional and relatively robust dune aggradational event, it occurred from the latest Pleistocene to the end of the early Holocene (i.e. from 15 to 8 kya). This period of time also coincides with the Creosote bush migrating into the region (Sauer, 1988), which since the early mid-Holocene has been the dominant shrub plant in the southeastern California Desert. Hence, it is possible that the latest Pleistocene to early Holocene dune aggradational event was assisted by a paucity of the currently most common plant in the lower elevation desert areas (valleys).

During times of dune stability, the regional sand migration corridors become discontinuous and local sources primarily associated with playa lake beds and alluvial systems dominate. In addition, during periods of dune stability when the older dunes become relict, cannibalization of the older dunes associated with wind abrasion (eolian deposits re-working) often occurs, which provides an additional source for active eolian sands (Lancaster, 1995). This is the current condition throughout much of Chuckwalla Valley.

Within the RE Crimson and many other areas in the Chuckwalla Valley, erosion of older relict dune deposits are an important eolian sand source within dune systems poorly fed by a playa lake (or ponding area) and alluvial systems (Kenney, 2010a, 2010b and 2010e). The findings of this report and others (i.e. Kenney, 2017) indicate that a period of dune stabilization and associated dune abrasion (cannibalization) occurred in many dune systems in the Chuckwalla Valley during the late Holocene. Some small localized dune areas have remained relatively more active as a result of increased eolian sand source due to water diversions (Palowalla SMZ), and/or a relatively strong eolian source remains such as the near Wiley's Well Basin (Plate ES-1). Playa and ponding areas in addition to local washes that flow relatively frequently, particularly during monsoonal extreme events continue to provide local eolian sand sources. Much of this sand however has difficulty migrating great distances due to relatively high vegetation densities that in most areas exceed 10% aerial coverage.

Consistent with earlier work by Kenney (2010a, 2011 and 2016) identifying local independent sand migration zones (SMZ) in the Chuckwalla Valley (i.e., Palen Valley SMZ and Mule SMZ on Plate ES-1), the more detailed mapping conducted during this study led to the identification of numerous semi-local and local independent sand migration zones in the area (Plate ES-1 and Figures ES-1 and ES-2). One of the criteria for a dune system to be designated as an independent sand migration zone is that a dune system receives a significant source of sand from a local source that is independent from sources upwind associated with the regional valley axis sand migration corridor.

*ES 4.3.3 Dune System Stability*

The map shown on Plate ES-2 indicates regions of Qe-a exhibiting, the most active eolian areas, are isolated, only occurring in the Palen Dry Lake and eastern most Chuckwalla Valley areas in the Wiley's Basin (Plate ES-2). Areas exhibiting significant erosion in areas dominated by relict dunes (unit Qs-de) occur at numerous localities along the regional Chuckwalla Valley sand migration corridor suggesting that sand migration rates along the system have significantly decreased since the older more robust dune forms were originally deposited. Regions where older "more robust" relict dunes no longer receive sufficient sand to maintain their form and instead are dominated by active sand sheets with minor internal erosion (unit Qe-ds) also occur at numerous locations in the valley.

In the region of the RE Crimson, extensive areas of dormant eolian deposits exhibiting weak thin and patchy active eolian sand areas occur. In fact, this type of dune geomorphology represents the majority of the eolian deposits in RE Crimson. These geomorphic observations provide strong evidence of a decrease in sand migration rates since the deposition of the original more robust relict dunes. However, regions mapped as Qe-ds do allow for some eolian sand transport through the system (i.e. very low to low sand migration rate).

*ES 4.3.4 Factors Affecting Dune Activity*

Dune systems appear to experience aggradation (increase in size and magnitude of eolian sand production and movement) during times when pluvial and playa lakes are drying up and/or experiencing repeated lake fluctuations, when alluvial fans are experiencing aggradational events (abundant fan deposition), when monsoonal storms are more frequent and with higher intensity, and/or when older sedimentary deposits bearing considerable amounts of sand grains are eroded into (downcutting, fan trenching). It was determined that during the Holocene it was common that one of these parameters allowing for dunes to be more active was occurring at any particular time. Hence, dune system aggradational events do not appear to correlate to a single geologic parameter consistently throughout the Holocene, but instead, respond to numerous parameters each of which can vary over time. Dunes can experience variations in activity based on the additive nature of the parameter wavelengths when they collectively "add up" (aggradational events) or cancel each other out (times of stability).

The combination of a decrease in vegetation density at lower elevations associated with a decrease in cold/wet winter pacific storms intensity and frequency, an increase in monsoonal storms with relatively higher frequency and strength (extreme storm events), abundant available sediment in the mountains and its transport to distal fan areas (see Wells and Dohrenwend, 1985; Nichols et al., 2007), and pluvial and playa lakes experiencing fluctuating levels, all contributed to a regional strong dune aggradational event between 14 and 8 kya. In addition, periods of relatively strong monsoonal storm frequency and strength since the mid-Holocene have resulted in smaller scale dune aggradational and re-activation events. Dune systems appear to react to this type of climate change on the order of less than 1,000 years. It is interesting to note that the most common plant across valley regions in southeastern California is creosote and that this plant migrated into this region during the latest Pleistocene (Sauer, 1988). Although no published eolian report has discussed this idea, it is possible that the relatively robust eolian aggradational period from 14 to 8 kya may have been strongly influenced by the lack of creosote allowing for more efficient sand migration from eolian sources.

Relatively strong alluvial fan aggradational events correlate with periods of stronger and more frequent monsoonal storm strength (thunderstorm-extreme events; Reheis et al., 1996; Harvey et al., 1999; Reheis et al., 1996; McDonald et al., 2003; Miller et al., 2010) and a decrease in colder longer duration storms emanating from the Pacific which assist in denser vegetation. These periods of time also correlate with periods of dune aggradation. Hence, eolian system activity levels correlate well with that of alluvial fan systems. During periods of relatively intense monsoonal climate conditions, many of the playa and pluvial lakes can fill and desiccate which increases eolian sediment supply substantially. In contrast, the relatively wet period in the southwestern United States associated with the global Neo-Glacial from 4.5 to 2.5 kya that led to increased vegetation density at lower elevations assisted in stabilizing most eolian dune systems in the study region and decreasing the ability for eolian sand to migrate.

The arid/semi-arid climate conditions since the mid-Holocene have resulted in a geomorphic condition where slight changes in regional climate (i.e., monsoonal storm activity) are sufficient to result in local re-activation of dune systems, but not sufficient to produce a robust eolian system where sand migration corridors are continuous. Dune systems across the study region have been relatively stable since the mid Neo-Glacial period approximately 4.0 to 3.5 kya. However, the semi-arid climate occurring in the study region for much of the Holocene is near a critical threshold condition where small changes in dune parameters such as global climate affecting Pacific Storm strength and frequency and local monsoonal strength frequency and magnitude can be reflected in changes in dune behavior on a cyclic scale of approximately 1,000 to 500 years. There is a strong correlation with increased monsoonal extreme storm frequency and magnitude with increased eolian activity (aggradational events), and/or with periods of time exhibiting a warmer global climate).

Anthropogenic activities such as those that affect surface water flow can also affect dune dynamics; however, the flood control measures for construction of Highway 10 and older roads have existed for decades and have only led to subtle changes in the local dune systems occurring in the eastern Chuckwalla Valley axis area. The introduction of the invasive Sahara Mustard plant however does affect all the dune systems in that it increases dune stability and decreases sand migration rates.

*ES 4.3.5 RE Crimson Area Dune Activity*

The RE Crimson occurs along the alluvial fan slopes (bajada) along the north side of the Mule Mountains and not within the Chuckwalla Valley axis area. Dune systems across the RE Crimson are generally weak exhibiting primarily older stabilized dunes; areas of dune erosion or stable gravel lag surfaces. All the dune systems in the area of the RE Crimson range in total stratigraphic thickness of a few inches to a maximum of approximately 3.5 feet (Figure ES-2). Based on soil development and stratigraphy ages, the dunes in the area of the RE Crimson were deposited during the Holocene, but in most areas have become stabilized since the late mid-Holocene as sand migration rates decreased. Active eolian sand across the RE Crimson site consist of sand sheets and small coppice dunes, and the active eolian sands overlying stabilized dune deposits that are typically a minimum of over 1000 years old are generally only less than an inch to 3 inches thick.

Very minor eolian sands were observed to have ever migrated from the Wiley's Well Wash and Basin area to the dune systems of the RE Crimson (Figure ES-1). Hence, the dune systems in the RE Crimson are not part of the proposed Chuckwalla Valley sand migration corridor. Instead, the source for eolian sands in the RE Crimson, and especially since the mid-Holocene, are local washes emanating from the northern Mule Mountains. Four local small-scale sand migration zones are identified in the RE Crimson area that include the Western Mule, Central Mule, Northern Mule and Mule Sand Migration Zones (SMZ, Plate ES-1 and Figure ES-1). Each of these sand migration zones exhibit their own distinct eolian sand source from local washes. The local washes have produced more eolian sands than typical Mojave Desert washes due to the erosion of older formation units that contain a relatively large component of eolian size grains. These units include the Bullhead Alluvium (unit Tmm and Soil S7a) that is associated with inundation of the entire Chuckwalla Valley up to elevations of ~1,100 feet, and older alluvial units S4 and S5 (Figure ES-2). However, local older alluvial units S4 and S5 are in many localities composed of re-worked eroded sediments from the Bullhead Alluvium.

The Central Mule SMZ is a good example supporting the hypothesis that erosion of the older formational units provides eolian sands because the only exposed unit upwind from the Central Mule SMZ is exposed Bullhead Alluvium (Plate ES-1 and Plate ES-3). A similar case can be made for the Mule SMZ in the northeastern RE Crimson as this eolian system is not connected to the dune systems around Wiley's Well Basin, and field mapping data shows a strong correlation with its eolian sands emanating from local washes that have eroded into older formational units upslope.

*ES 4.3.6 Effects of Vegetation*

The density of vegetation in dune deposit areas is a very important parameter in terms of dune stability and sand migration rates. Lancaster and Baas (1998) conducted a significant, well controlled study evaluating the relationship between plant aerial coverage density and sand migration rates on a playa lake bed. Their results indicate that just a 10% aerial coverage of plants that are less than one foot tall decreases eolian sand migration rates by 90%. This result is quite astounding and indicates that minor vegetation densities essentially decrease eolian sand migration rates exponentially.

Vegetation densities in most eolian dominated depositional areas and particularly in areas of strongly stabilized dunes, are a minimum of approximately 10 to 15% during years of a paucity of Sahara Mustard (Brassica tournefortii) actively growing plants or dead plant litter of that species. This is particularly the case for eolian depositional areas of sand migration zones B, BW and BC, with zones A and AB exhibiting less dense vegetation and alluvial fan depositional areas where the fan surfaces are younger than soil S4. Vegetation densities of approximately 10% and more are shown to impede sand migration by more that 90% (Lancaster and Baas, 1998), which is consistent with estimated minimum vegetation densities in the RE Crimson site dune areas. These evaluated RE Crimson vegetation densities of a minimum of approximately 10% do not take into account non-native and invasive Sahara Mustard coverage that during bloom events can increase vegetation densities to well over 50% in a single season following a year of strong growth. Field mapping in December of 2010 indicated that a Sahara Mustard bloom had recently occurred, and mapping in April 2011 revealed that abundant dead Sahara Mustard plants remained across the dune fields still vertically in the place they had grown. Hence, once the Sahara Mustard plant dies, it remains "planted" in the ground and this was observed to remain the case for many months to possibly over a year from when the plant died. The dead plant stems break free and blow in the wind piling up on nearby dunes and coppice dunes, which means the plant continues to impede eolian sand transport after it has died and been uprooted. Hence, once there is a Sahara Mustard bloom, eolian sand migration rates are greatly diminished not only for the year of the bloom, but for a minimum of the next year, and most likely into a third year. During strong Sahara Mustard growth, eolian sand migration and internal dune erosion, is nearly completely shut down.

*ES 4.3.7 Potential Future Impacts*

The proposed RE Crimson development footprint occurs outside of most dune systems in the area, which for sake of discussion are mapped herein as relative Sand Migration Zones AB and B (SMZ, Figure ES-1). Some areas mapped as SMZ BW, which are dominated by older stabilized dune deposits with only thin active dune sands, do occur within the RE Crimson. These areas include the Mule and Northern Mule SMZ's. The source wash area of the northern SMZ is a wash system in the western region of this SMZ that is not within the RE Crimson proposed footprint and internal washes in the northern SMZ that occurs within the RE Crimson proposed footprint. Most of the eolian source for the Mule SMZ occurs both in the RE Crimson and outside of it where washes flowing into this SMZ erode into older formational units upslope both within and outside of the RE Crimson to the west, and southwest. Where fluvial-eolian cycling is proposed in the RE Crimson, the proposed development may impact these processes depending on the magnitude of surface geomorphologic disturbance occurs (i.e. removal-grading of existing washes and dune sands).

However, eolian sedimentation rates and rates of eolian sand migration are very slow for all the RE Crimson dune systems. This suggests that the local dune systems will likely not show an impact of a decrease of eolian sand source where impacted by development for decades.

Most of the areas dominated by dune geomorphology in the RE Crimson area (i.e. areas mapped as Zones AB, B and BW), and with the exception of the Mule SMZ, have developed during the Holocene without the benefit of stabilizing moisture provided by local drainages. This is because they developed on elevated topographic surfaces near wash headwaters. Hence, these dune systems are likely in equilibrium with relatively dry soil conditions indicating that they would likely not be adversely affected by potentially drier conditions due to climate change in the southwestern United States. The Mule SMZ has developed over time with the effects of flow waters entering the system, and these relatively thin dune deposits may experience drier soil conditions due to potential global climate change and depending on grading activities associated with construction of the RE Crimson.

## ES 5.0 CONCLUSIONS

Global and local climatic conditions and their secondary effects during the Holocene have been beneficial for dune growth at various periods of time and near a geomorphic threshold condition where relatively subtle changes in climate can lead to dune re-activation. However, dune systems across the southeastern California region have been dominantly stable since the mid-Holocene. The subtle dune-reactivation events since the mid-Holocene did not last long nor were sufficient to allow the regional sand migration corridors to become fully connected sand pathways. Eolian sand sources during times of dune aggradational events since mid-Holocene have primarily been local sources. Dune systems in the RE Crimson region however have received most if not nearly all of their eolian sands from local sources throughout the Holocene but do show variations in activity similar to that observed for the regional dune systems since the early Pleistocene due to variations in climate and vegetation.

Eolian sedimentation and sand migration rates have been very slow for dunes systems in the RE Crimson area. This indicates that if their local sources are disturbed by construction of the RE Crimson, they are not likely to be adversely affected for at least decades. Most dune systems in the RE Crimson area have developed without the aid of significant water flow providing stabilizing moisture suggesting that if the region exhibits drier soil conditions due to regional climate change, that the dunes will likely not be adversely affected.

Construction of the RE Crimson, depending on the magnitude of surface grading and decrease in wind speeds and wash flow, would potentially affect fluvial-eolian cycling of sands within the property and decrease moisture in the western portions of the Mule SMZ located in the northeastern part of the property.

**REPORT** *(DRAFT VERSION FOR CLEINT REVIEW AND COMMENT)*

# 1.0 SITE LOCATION, PROPOSED DEVELOPMENT AND TOPOGRAPHIC RELIEF

## 1.1 Site Location of the Crimson Solar Project

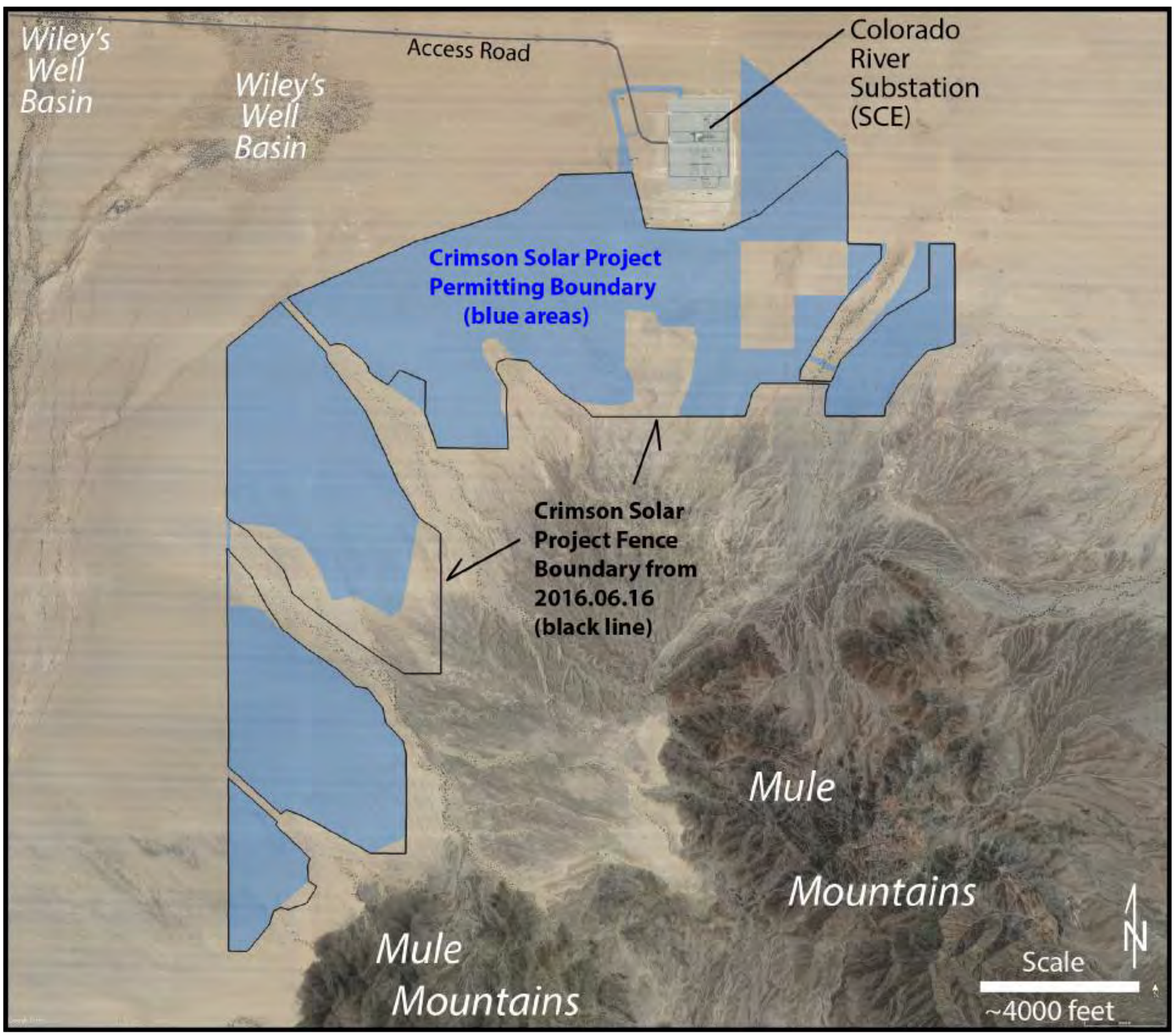
The Crimson Solar Project (RE Crimson) located in eastern California at the east end of the approximately 50-mile long, east-west trending Chuckwalla Valley, in southeastern California (Figure 1 and Figure 2). Palen Dry Lake (PDL) and Ford Dry Lake (FDL) occur at the western and eastern central areas respectively within the valley axis of the Chuckwalla Valley. In addition, the Wiley's Well Basin occurs immediately north of the RE Crimson within the Chuckwalla Valley axis. Pertinent mountain ranges occur to the north and south of the Chuckwalla Valley that include the Palen and McCoy Mountains to the north, and the Chuckwalla, Little Chuckwalla and Mule Mountains to the south. In terms of geomorphic position, most of the RE Crimson project area occurs on an alluvial bajada (fan) system along the northern flanks of the Mule Mountains.

**Figure 1:** Regional Crimson Solar Project site location and Geographic map. PDL is Palen Dry Lake, and FDL is Ford Dry Lake.

## 1.2 Proposed Development

The proposed Crimson Solar Project (RE Crimson) is a utility-scale solar photovoltaic (PV) and energy storage project that would be located on federal lands managed by the Bureau of Land Management (BLM) within the California Desert Conservation Area planning area in unincorporated eastern Riverside County, approximately 13 miles west of Blythe, California (CA, Figure 2). The Project would interconnect to the regional electrical grid at the Southern California Edison (SCE) 230-kilovolt (kV) Colorado River Substation (CRS). It would generate up to 350 megawatts (MW) of renewable energy using PV technology and would include up to 350 MW of integrated energy storage capacity.

**Figure 2:** Site map showing general siting of proposed Crimson Solar Project development. Two development boundaries are shown in this report. One is an older (now outdated) proposed fence line dated 2016.06.16 (black line), and the other is the Permitting Boundary for the development (blue areas).



### 1.3 Site topographic relief

Elevations across the region of the proposed solar field footprint range from approximately 710 feet above mean sea level (msl) along the south-southeastern boundary of the site, to approximately 420 feet above msl along the northwestern boundary of the site. This represents an approximate total relief of 290 feet. Most of the proposed development occurs along gentle northwest to northward slopes associated with alluvial fan surfaces (bajada) exhibiting northward flow in the southern to northern portions of the site, to northeastward flow in the northeastern portion of the site.

## 2.0 GEOLOGIC TIME SCALE (PERTINENT TO INVESTIGATION)

The age of most geologic events discussed in this report occurred during the Neogene and Quaternary Periods. The Neogene Period is subdivided into the Pliocene and Miocene Epochs and the Quaternary Period is subdivided into the Holocene and Pleistocene Epochs. The name and associated time interval designations utilized in this report include (kya = thousand years ago; Ma = million years ago).

| PERIOD | EPOCH | TIME PERIOD |
|---|---|---|
| QUATERNARY | HOLOCENE | |
| | *Latest* Holocene (Historical) | ~past 200 to 150 years |
| | *Late* Holocene | 4 kya to 200 years ago |
| | *Mid-* Holocene | 8 to 4 kya |
| | *Early* Holocene | ~12 to 8 kya |
| | PLEISTOCENE | |
| | *Latest* Pleistocene | ~15 to 12 kya |
| | *Late* Pleistocene | 125 to 20 kya |
| | *Middle* Pleistocene | 670 to 125 kya |
| | *Early* Pleistocene | ~2.6 Ma to 670 kya |
| NEOGENE | PLIOCENE | |
| | *Late* Pliocene | 3.6 to 2.6 Ma |
| | *Early* Pliocene | 5.3 to 3.6 Ma |
| | MIOCENE | |
| | *Late* Miocene | 11.6 to 5.3 Ma |
| | *Middle* Miocene | 16 to 11.6 Ma |
| | *Early* Miocene | 23 to 16 Ma |

Although not of critical importance to this study, it should be pointed out that the time of the boundary between the Pliocene and Pleistocene varies considerably in the literature. This dilemma has resulted from the definition of the boundary of the Pliocene/Pleistocene, which is supposed to coincide with the onset of the first northern hemisphere glaciation. The Pleistocene is the Epoch characterized as the "ice age", hence experiencing periods of major glaciations and interglacial periods of time. The date of the beginning of the Pleistocene has changed as new studies refine the age of the initiation of the ice ages and disagreements within the scientific community. Age ranges "accepted" for the beginning of the Pleistocene (and Quaternary) vary from 2.6 to 1.6 Ma. There is also disagreement regarding the end of the Pleistocene as it was a gradual transition from about 12 to 10 kya. However, the California Geological Survey utilizing primarily findings from Walker et. al (2009) adopted 11.7 kya as the "official" definition of the Holocene based on a proposal to the International Stratigraphic Commission reflecting a change in Oxygen isotopic ($O^{18/16}$) composition of an ice core from Greenland. For the purposes of this study, the end of the Pleistocene is simply rounded to 12 kya.

The Holocene Epoch is subdivided into four time intervals in this report that are not based on any internationally accepted time periods, but instead defined within this report to assist in presenting the findings. However, unintentionally, the Holocene Epoch time period subdivisions created for this report based on variations of geomorphic processes are very similar to those of Bull (1991).

## 3.0 PURPOSE OF STUDY

The primary purpose for this study is to geologically evaluate existing dune systems within and near the proposed RE Crimson to understand the current aerial extent of the dune deposits, and the potential regarding how dynamic or non-dynamic the current dune system is (i.e. active, stable, eroding). This exercise has been undertaken to supplement a report prepared by the California Geological Survey, which evaluated wind-blown (eolian) resources that serve as habitat for desert species within the Desert Renewable Energy Conservation Plan ("DRECP") area, including, without limitation, the Mojave fringe-toed lizard (MFTL). The author is not a professional Biologist, however, the results of this study can be utilized by Biologists to evaluate potential direct impacts on MFTL habitat associated with RE Crimson. Moreover, the analysis is warranted in its own right, as the CGS report, although comprehensive in terms of aerial extent, was not detailed or specific to the project site. It recognized that "Study area maps, developed at an interpretive scale of 1 inch equals 24,000 inches, are regional in nature and should not be used as a substitute for detailed studies in any specific area."

During the research phase of this project (and other recent eolian investigations by the author), it became clear that many fundamentally important aspects of the development of dune systems have not been sufficiently studied regionally to enable site-specific dunes studies. These aspects include:

- Variations in dune behavior over the course of thousands of years;
- Variety in local and regional sources of eolian sands;
- Relationship of dunes to the local geology, including alluvial fans and playa lakes;
- Fluvial-eolian relationships in terms of sand cycling,
- Several aspects of local hydrology, including availability of stabilizing moisture, watershed sizes, orientation of washes to prevailing winds, water flow diversions, and regions of ponding;
- When/whether upstream erosion of older sedimentary units results in some washes transporting increased volumes of eolian sands leading to an increase in locally derived eolian sand;

- Correlation of global and local variations in climate since the late Pleistocene;
- Soil stratigraphy data of near surface fluvial and eolian deposits that provide evidence of the geologic history of the dune systems (When did the dunes develop? Have the dunes advanced, stayed in the same region, or retracted during the Holocene?)
- The geologic history of the area with a focus on when the dunes may have developed.
- The continuation by Kenney GeoScience to create geomorphic-geologic stability designations, and relative sand migration zone designations that provide criteria for subtle but significant variations in dunes geomorphology and eolian dynamics.

## 4.0 APPROACH OF STUDY – FROM REGIONAL TO LOCAL

Over the course of two years, the author took several steps to evaluate the local and regional dune systems comprehensively in order to better understand whether or not dune processes identified in the eastern Chuckwalla Valley were similar or dis-similar to those throughout southeastern California. The geomorphic evaluation of the RE Crimson coincided with a KGS study of the proposed Desert Quartzite Solar Project located immediately to the northeast of the RE Crimson (Kenney, 2017). These steps include:

- Review of previous studies that include mapping:
  - Utilization of the eolian geomorphic data, analysis and findings from numerous other eolian and playa lake studies conducted by the author in Chuckwalla Valley. These include, from west to east, the Starlight, Palen, Genesis and Desert Quartzite solar projects, the Southern California Edison transfer station, and the proposed Desert Quartzite Solar Project.
  - Evaluation of scientific publications on many relevant topics, particularly the timing and magnitude of regional dune aggradational events, global and regional climatic variations, pacific storm vs extreme monsoonal storm impacts on dunes, periods of dune stability across southwestern north America, timing of alluvial fan deposition and trenching, fluvial-eolian sand cycling, eolian sand sources both in southeastern California but also worldwide, among others. Appendix A lists the references read and analyzed for this report.
- Project specific mapping including the following elements:
  - Local geologic and geomorphic mapping involving the evaluation and documentation of site conditions. Work included geomorphic description, visual estimate of aerial vegetation density, taking photographs, excavation and evaluation of soil pits at some sites, and applying a geologic description designation and relative sand migration zone designation at every site. A total of 389 geomorphic sites were obtained for the RE Crimson site and hundreds of other geomorphic field sites were utilized from other KGS eolian studies in Chuckwalla Valley.
  - Utilization and evaluation of 5-foot USGS topographic contours of most of the project area. These data are utilized in Google Earth Pro.

- The first detailed evaluation of the proposed Dale Dry Lake and Cadiz Dry Lake to eastern Chuckwalla Valley Sand Migration Corridor system including the region of the Ford Dry Lake to Palo Verde Mesa. Other regional proposed sand migration corridors in southeastern California were also mapped via Historical Imagery on Google Earth Pro, and scientific publications.
- Evaluation of the local soil stratigraphy and associated minimum ages of the local dunes and alluvial deposits, which provides an understanding of the geologic development of the current landscape since the early Pleistocene.
- Compiling field mapping data of 389 geomorphic sites into Google Earth Pro for analysis. These data greatly assist in mapping sand migration zones and soil stratigraphy in the RE Crimson area.
- Producing relative Sand Migration Rate Zone and Soil Stratigraphy maps in Google Earth Pro.
- Analysis of regional dune systems and proposed regional sand migration zones (corridors) across southeastern California to compare to local dune systems. Regionally, much of this mapping was conducted utilizing various years of Historical imagery in Google Earth Pro and scientific publications. This analysis also included mapping of some dune systems previously not mapped on acquired geologic maps and literature and the evaluation of local geologic history of the area extending back to the early Pliocene. This assists in placing the geologic history of the dune systems identified at the surface into context over geologic time.

- Continued evolution of new geomorphic designations to assist in evaluating eolian geomorphology including sand migration rates. This is brand new work. To the knowledge of the author and a noted expert in the field (personal communication, N. Lancaster), no formal or published recommendations exist regarding how to map subtle variations in eolian desert geomorphology. The method devised in this report and evolved by KGS primarily from studies in Chuckwalla Valley, builds on numerous eolian reports in the southwestern United States and utilizes primarily three geomorphic criteria (categories):
  - **Relative Sand Migration Rate Zones**

    (Zone A, Zone AB, Zone B, Zone BW, Zone BC and Zone C)
  - **Relative soil profile (horizon) development** minimum ages for near surface soils and if stacked (buried) soils occur, cumulative stratigraphic ages.

    (S0, S1, S2, S3a, S3b, S4, S5, S6 and S7)
  - **Soil parent materials - Geologic unit designations** for eolian vs fluvially dominated geomorphic areas.

    (Qe units vs. Qal units)
- Analyses of eolian systems, to identify parameters and their relative importance in understanding eolian systems, focused on evaluation of:

- Eolian sand sources of the regional and local dune systems, which revealed the relative importance of various eolian sand sources currently and over time.
- Alluvial fan aggradational events, areas of deposition, and timing of alluvial fan-head trenching and erosion of older formational units (i.e. Bullhead Alluvium).
- Eolian sand sources such as eroded older dissected fluvial-alluvial deposits (fan head trenching), erosion of Pliocene Colorado River deposits (Bullhead Alluvium), fluvial-eolian sand cycling, ponding areas, local washes, and erosion of older dune deposits.
- The relative magnitude of eolian sand production from washes depending on the width and inset depth (local relief – bar and swale) of the wash system, orientation of the wash relative to local prevailing winds, and whether the wash may carry relatively more eolian size sand grains depending on what sediments/deposits the wash has eroded during flow upstream.
- Watershed regions and mapping of areas of distributary and tributary drainages systems. These parameters are important regarding their potential to generate eolian sands for local dune systems and whether these local drainages may in fact produce sufficient eolian sand to result in creating their own sand migration zones.
- Previously proposed eolian sand sources such as playa lake surfaces, granitic rock exposures in the local mountains, and washes.
- Erosional surfaces exposed across valley floors (some are pediment surfaces) exposing older sediments rich in eolian size grains. Where these sediments erode, they provide another source for eolian sand for downwind dune systems.
- Various proposed sand migration corridors in southeastern California, their sand sources, timing of development and whether the sand corridors continue to remain continuous sand migration corridors since the mid-Holocene.
- Variations in timing and magnitude, and the relative importance of Pacific "northwestern" winter storm events (global climate variations) verses monsoonal extreme storm events (regional climatic variations) in the development of not only alluvial fans, but also their newly proposed contribution to the development of eolian dune systems in the region.
- Vegetation density at the site that provide insights on sand migration rates and dune stability. Includes discussion regarding the invasive Sahara Mustard plant that has and will, unless mitigated, greatly decrease sand migration rates in existing dune systems. A discussion of a correlation between the relatively robust eolian aggradational events occurring during the latest Pleistocene to early Holocene and the paucity of the currently ubiquitous Creosote plant prior to its migration to the area.

- Consideration of anthropogenic effects on dune systems:
  - Evaluate potential impacts of human activity such as water diversions in the local drainages.

- Evaluate how susceptible dune systems may be to climatic change in the future, which involved evaluating climate data for the southwestern United States since the latest Pleistocene and regarding how much moisture the local dunes have been accustomed to receiving during their development.
- Discussion regarding sand migration rates and stability associated with the introduction of the invasive Sahara Mustard plant.

This comprehensive, multi-disciplinary approach provided many new insights regarding the history of dune systems across southeastern California since the late Pleistocene, the relative importance of local versus far afield eolian sand sources, the identification of new eolian sand sources, the importance of dune hydrology to dune stability, timing of dune aggradational events, the nature of the proposed regional sand migration zones, the long-term behavior of dune systems, and potential changes to the dune system in the future due to natural (climate change) or anthropogenic influences.

A regional analysis of eolian dune systems was essential to understanding how typical or unique a local dune system is, due to local variations in dune parameters. These aspects are discussed in more detail in the following sections. In addition, this study provides its results primarily via a series of Plates that comprise maps and tables (Plates 1 through 8C).

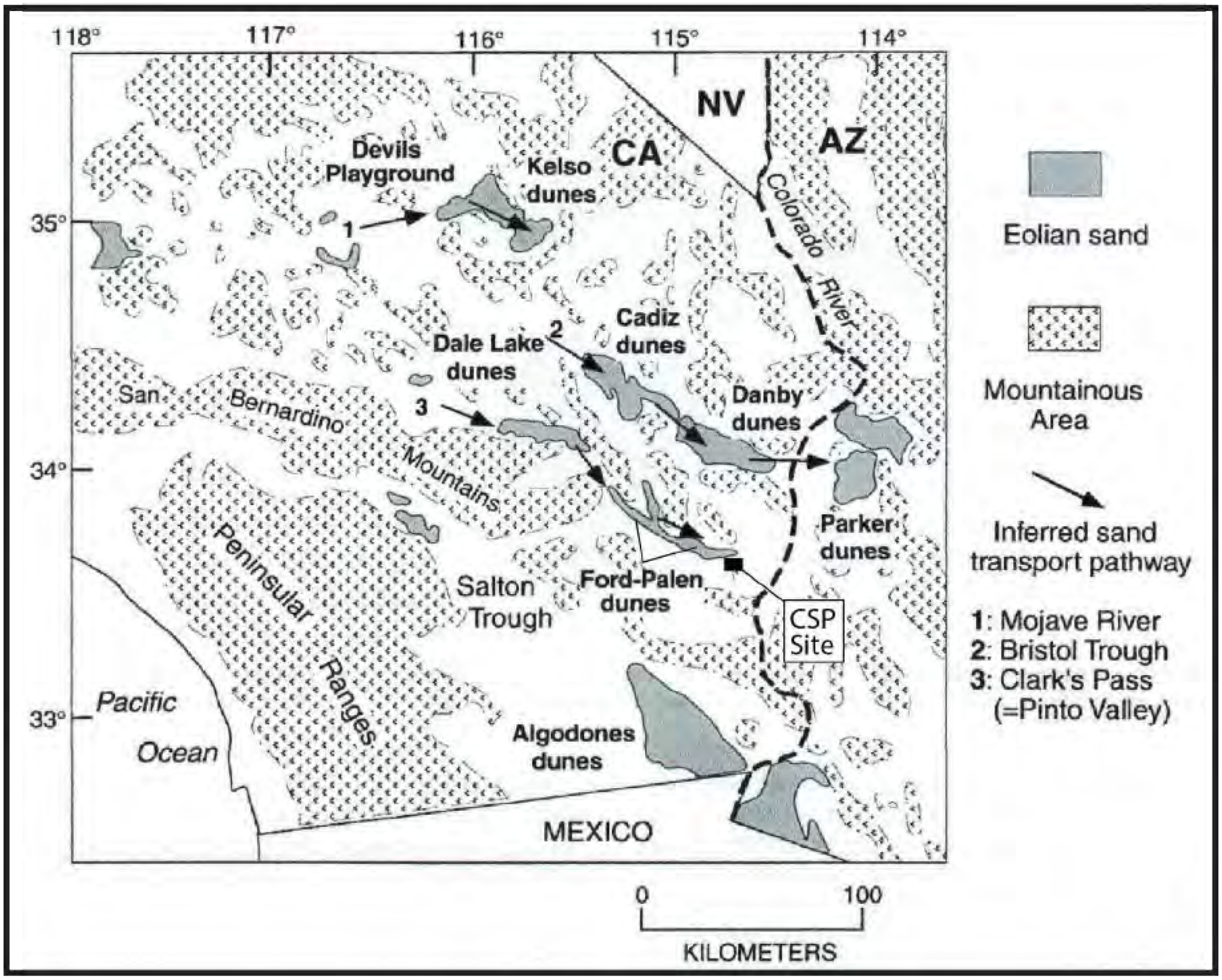
### 4.1 Regional dune systems and proposed regional sand migration corridors via mapping in Google earth and scientific literature

This study began with an evaluation of regional dune systems throughout southeastern California, allowing comparison to the local dunes to determine if some aspect of dune development and stability may have occurred locally that could be considered "out of the ordinary", or if the local dunes near and within the project should be considered "normal". Regional dune systems were evaluated utilizing existing scientific publications referenced in Appendix A, and via mapping in Google Earth Pro (utilizing the "historical imagery" in the region). An important aspect of this study was to evaluate whether or not the "sand ramp" type dune systems associated in the area of the RE Crimson are or were ever connected to the valley axis dune systems within Chuckwalla Valley.

Previous regional dune studies in southeastern California have proposed the existence of numerous Sand Migration Corridors occurring in valley axes and crossing over some mountain passes via sand ramps. Zimbelman et al. (1995) was the first to propose the possible existence of through going regional sand migration corridors in southeastern California, implying that eolian sand essentially migrated to tens of kilometers from west to east, southeast down valley axis and over some mountain passes (sand ramps). Lancaster and Tchakerian (1996) evaluated numerous eolian sand ramps occurring where wind-blown sand was deposited in obstructing mountain passes or leeward side of mountains and assumed the existence of the regional sand migration corridors proposed by Zimbelman et al. (1995). Muhs et al. (2003), the most referenced scientific publication evaluating proposed regional sand migration corridors (Figure 3), perpetuated these hypotheses, and since that time, the existence of the regional sand migration corridors has been assumed to exist, and in a sense, to have remained active throughout the Holocene. Bach (1995) indicates that the proposed regional sand migration corridors have been shut down since the mid-Holocene and that the Dale Lake to eastern Chuckwalla sand corridor dune system consists of Mostly Dormant Dunes based on his Field Index of Sand Mobility (FISM) dune activity criteria.

Missing from the literature, however, was an evaluation that more accurately mapped the local sand migration corridors, local eolian source contributions, and that further took into account a wide field of studies to determine the current state and past activity and/or stability of the regional sand migration corridors. Indeed, the CGS February 5, 2015 comments on the DRECP (see Short and Lancaster, 2015) observed that prior to the aforementioned "Eolian System Mapping Report prepared by CGS (Aug. 4, 2014, see Lancaster, 2014), it was "a misstatement to call [wide swaths of the desert] 'Sand Transport Corridors.' Using this term implies that the mapping describes where the sand is coming from and where it is moving to (or source areas, zones of transport, and zones of deposition)." The prior mapping efforts did not have this granular level of detail to draw this conclusion. The Lancaster (2014) report did not provide sufficient information from the findings of many existing publications regarding the inactivity and lack of connectivity of eolian systems within the proposed regional sand migration zones during the late Holocene. The analysis in this report, however, considers whether local sources of eolian sand (from alluvial washes and fans) have created local deposits during current times and the past. In addition, this study performed a regional evaluation that more accurately mapped the proposed regional sand migration corridors, compiled published data from a wide field of studies to determine the current state of activity and/or stability of the regional sand migration corridors.

**Figure 3**: Proposed regional sand migration corridors in the southeastern California region by Muhs et al. (2003). Note that this map implies that eolian sands are migrating great distances along the proposed sand migration corridors suggesting that local eolian sand sources along their mapped lengths contribute relatively minor eolian sands. RE Crimson is Crimson Solar Project.




## 4.2 Current and past geologic conditions of local dune system via an onsite geomorphic, geologic, and soil stratigraphic field investigation (mapping)

Geomorphic mapping, which is the evaluation of types of processes and deposits that occur at the surface, and the evaluation of relative ages of the near surface sediments via soil profile stratigraphy was conducted during this study. Geomorphic and soil stratigraphic mapping included the evaluation and documentation of "geomorphic sites" where the local geomorphology and stratigraphy was evaluated and documented including a GPS latitude and longitude location via a Garmin GPSmap 60Cx 149. For the RE Crimson study, 389 geomorphic site evaluations were obtain primarily located in the area of the proposed development. Additional geomorphic site data was utilized for this study obtained by KGS for other projects in the Chuckwalla Valley. These include 149 for the KGS Southern California Edison facility (SCE, Colorado River Substation) eolian report (Kenney, 2010d) located immediately north of the RE Crimson, and 171 from the Desert Quartzite Solar Project located northeast of the RE Crimson. The vast majority of these geomorphic sites occur within and outside of the RE Crimson project boundary, extending westward to near Wiley's Well Road. Geomorphic field sites in the eastern Chuckwalla Valley qualitatively documenting current geomorphic and vegetation densities were conducted from 2010 to 2016 and at various times of the year. Field work was conducted during or soon after strong wind storms exhibiting variations in local prevailing winds, soon after a bloom of invasive Sahara Mustard, after prolonged cool Pacific storm rains, and after summer monsoonal storm flooding events that infiltrated the dunes.

In addition, geomorphic and geologic data was also utilized for this report from numerous other KGS eolian projects in the Chuckwalla Valley that include the Genesis (Kenney, 2010a and 2013), Palen (Kenney, 2010b), Desert Quartzite (Kenney, 2016), and Desert Sunlight (Kenney, 2010c) solar projects, and the Southern California Edison – Colorado River Substation (Kenney, 2010d and 2010e; Plate 2 and Plate 3A).

### 4.3 Geologic history of the project area since the Early Pliocene

Review of existing scientific literature including published geologic and eolian maps (i.e. Stone, 2006; Lancaster, 2014), and geologic mapping during the project allowed for an assessment of the geologic history of the site since the early Pliocene (i.e. ~4.5 million years ago). Regional stratigraphic reports for older formational units (Pliocene) exposed in the study area were utilized that described and regionally mapped Pliocene age sediments associated with the ancient Colorado River in the Chuckwalla Valley (Metzger et al., 1973; House et al., 2008; Spencer et al., 2008, Fenton and Pelletier, 2013, and Howard et al., 2015).

The analysis of these studies and their incorporation into the mapping and evaluation for this study assisted in understanding both the long term geologic history of the study area, and potential sediment sources for the local dune and alluvial systems. In addition, some of the publications provided stratigraphic-formational numerical ages for some of the ancient Colorado River deposits in the Chuckwalla Valley that clearly occurred prior to the development of the local dune systems.

### 4.4 Long-term behavior of desert geologic processes – pluvial and playa lakes, alluvial fans, eolian systems, climate changes via scientific publications

The dynamic nature, development and sustainability of eolian dune systems is closely associated with many geologic and climatic processes occurring both locally and regionally. Hence, dune development and long term behavior is directly connected to many parameters that are both local and occurring outside their actual areas of deposition.

Pluvial and playa lakes are considered a primary source for eolian sands worldwide, and many reports provided in the references (Appendix A) substantiate this. Eolian sands emanate from pluvial and playa lakes soon after they desiccate allowing for sand bearing wind abrasion to erode the lake surfaces and provide pathways for sand transport. This study evaluated publications regarding the timing of pluvial and playa lake filling and receding periods in the southeastern California region to look for correlations with eolian dune aggradational and stability events.

Numerous secondary factors also effect dune development as well. Some of these include the timing of alluvial fan aggradational events and fan-trenching/older sedimentary formations (down cutting) that are considered periods of time herein when eolian dune systems also undergo aggradational events. During times of alluvial fan aggradational events, washes typically flow with increased relative frequency and magnitude. It is evident that washes are one of the largest contributors of eolian sands in desert landscapes. The combination of older upper fan slope down cutting and deposition of alluvial fan deposits in distal portions of the fans in the early Holocene across southeastern California also assisted in the development of local dune systems.

These analyses led to the evaluation of the relative importance of periods of time of increased frequency and magnitude of cool and moist Pacific Northwest storms, and warm and moist monsoonal storms that represent local extreme storm events. The analysis shows that alluvial fans and eolian systems both experience aggradational events during periods of relatively more frequent and strong extreme monsoonal storm events and relatively weaker longer duration Pacific Storms. This has been the general case for the southeastern California region during the Holocene, but the data also indicates that the climate is near a critical geomorphic threshold point where a slight variation in the relative strength and frequency of Pacific verses monsoonal storm events can trigger increased or decreased alluvial and eolian activity.

### 4.5 Drainage surface waters flow analysis – Eolian sand sources and dune stability

Not only does surface flow water, from washes and into basins (pluvial lakes, playa lakes, and ponding areas), provide surface instabilities that lead to increased eolian sand supply, but surface flow waters also provide critical stabilizing moisture to dune systems. Sand dunes often develop in areas not only because there is a sufficient eolian sand source, but also because there is sufficient infiltrating moisture to allow for the internal core of the dunes to remain moist which greatly decreases the potential for sand bearing wind abrasion (Kenney, 2012). In addition, dunes that remain moist also have a higher likelihood of becoming stabilized via vegetation.

The evaluation of surface water flow is also critically important regarding the size of the watersheds for local wash systems. Larger water shed drainage systems have a higher probability of experiencing sufficient flow strength to reach valley axis regions. This report provides evidence showing that there is a general correlation with the size of the local watershed and the amount of eolian sands that emanate from that wash at the local base level area occurring most often in the valley axis where prevailing winds are the strongest.

Hence, although dune systems may be considered “dry” systems, in fact, it is the moisture regime in the area that often plays a very critical role in their development, sand source, form and stability over time. This was shown to be the case for the Keeler Dunes in the eastern Owens Lake region where water flow across a medial to distal portion of the alluvial fan was diverted by flood control berms for over 50 years. This forced stabilizing infiltrating waters away from the downslope playa edge (shoreline) dune system causing the dunes to deeply abrade by sand bearing winds (Kenney, 2012).

The drainage analysis is also very important because as identified in this report, typical distributary drainage systems developing on active alluvial fans flow infrequently in distal fan areas, and therefore do not provide significant eolian sand to valley axis systems. However, it is proposed that tributary drainages systems that represent additive flow from many upslope contributing drainages that typically occur where older formational down cutting has occurred, tend to flow more frequently and stronger in addition to typically providing a relatively wide braided flow area downslope. All of these factors contribute significantly in providing more eolian sands than distributary "sheet flow" systems consisting of abundant small scale washes that progressively bi-furcate causing decrease in flow downslope.

### 4.6 Comparison of local and regional dune systems

Regional dune systems across southeastern California were evaluated via existing publications and extensive aerial mapping via Historical imagery provided on Google Earth Pro. Some areas in the Chuckwalla Valley had previously been mapped by the author for other projects and in particular for the Desert Quartzite Solar Project (Kenney, 2016). This analysis provided a framework in which to compare regional versus local sand systems, such as general trends of the regional dunes in terms of when they developed, had aggradational events, their relative eolian sand sources, and when they became stabilized, among others characteristics. This analysis also provided supportive evidence regarding the relative importance of various eolian sand sources and identified some previously undocumented eolian sand sources. The evaluation of regional dune systems also identified some dunes areas that had not been previously mapped based on the literature reviewed in this study (i.e. the East Pinto Basin Dunes; Plate 1 and Plate 2).

The regional mapping of dune systems across southeastern California provided additional supportive evidence that the proposed regional sand migration corridors are essentially shut down during the late Holocene and were more active-robust during the early to mid-Holocene (also see Bach, 1995). In addition, it provided evidence that local eolian sand sources from actively flowing water in washes and onto playa surfaces are the dominant eolian sand source along the sand migration corridors systems. For example, detailed eolian mapping by the author in eastern Chuckwalla Valley has identified a minimum of eight independent sand migration zones that infer that the vast majority of their eolian sands are derived by local sources (Plate 3A). These include the East Palen Mountains SMZ, Palen Valley SMZ, Ironwood SMZ, Wiley's Well Basin SMZ, Mule SMZ, Northern Mule SMZ, Central Mule SMZ and Western Mule SMZ (Plate 3A).

### 4.7 Potential impacts and future changes to the local dune system associated with the proposed development, climate change and historical anthropogenic activities

The geomorphic and soil stratigraphic mapping conducted in this study provide data to assist in evaluating potential impacts to existing dune systems associated with the footprint of the proposed RE Crimson development. However, with future climate change, the question arises regarding how the dunes may change over time and if the dunes may grow beyond their current aerial extent. However, the development of dune systems as a function of climate had to this time not been fully evaluated and is poorly understood and it is not fully understood what the nature and extent of future climate changes will be. Dune systems across the study region of southeastern California did experience a growth period at the end of the last ice age when pluvial and playa lakes desiccated, but this does not explain intermittent dune development in the region extending through the mid-Holocene.

The review of climate related publications allowed for a better understanding of the relationship of what leads to dune system activity and stability but questions remain. This review allowed for an assessment of the effect of the increase in magnitude and frequency of cool-moist Pacific Storms and warm-moist monsoonal storms on regional dune development since the latest Pleistocene. This question provides insights regarding potential changes in dune systems associated with global warming in the decades to come.

Historical anthropogenic factors associated with changes to the surface of the earth (i.e. flood control berms, borrow pits, etc.) that potentially could affect local dune systems were also evaluated. This analysis is important primarily due to the understanding of the importance of surface water flow for eolian sand sources and stabilizing moisture.

## 5.0 DUNE DEVELOPMENT AND STABILITY PARAMETERS

### 5.1 Prevailing wind directions

The prevailing wind direction is considered the direction in which wind has sufficient energy to cause both soil erosion and sand transport. One method to analyze annual wind data to determine potential sand entrainment and migration direction is the evaluation of the Resultant Drift Potential (RDP). Tsoar, (2004) indicates that a better index for wind erosion is the drift potential (DP) of the wind.

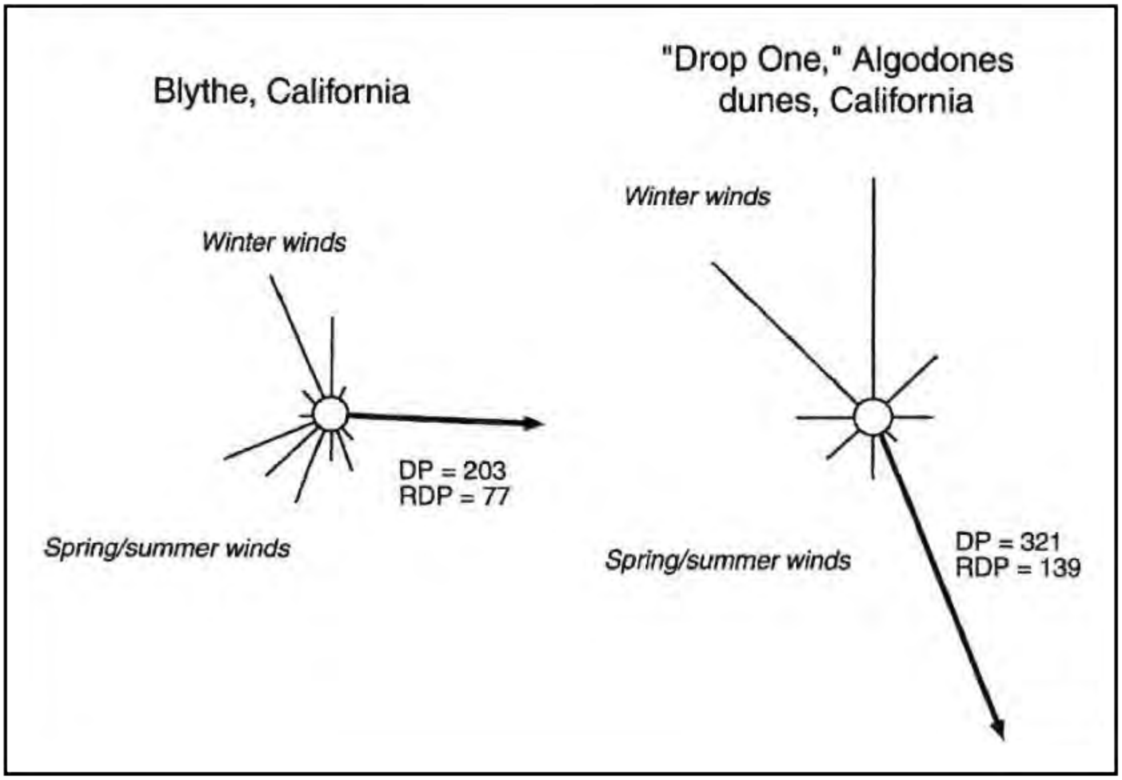
The Drift Potential (DP) = $\sum \boldsymbol{q} = \mathbf{U^2(U\text{-}U_t)/100 * t}$

**U** is the wind velocity (in knots), measured at a height of 10 m, $\mathbf{U_t}$ is the threshold wind velocity (=12 knots), and **t** is equal to the degree of "windiness" expressed as the annual percentage of days experiencing winds above the threshold velocity for sand movement. Essentially, **t** is the time the wind blew above the threshold velocity in percent. Dividing from 100 is for reducing the result to a smaller number (Tsoar, 2004).

**q** is calculated separately for each wind direction which is experiencing wind above the threshold velocity ($\mathbf{U_t}$) and its value is a vector unit. All vector units from all the wind directions form a sand rose diagram. DP, the total annual q for all wind directions, is a parameter of the potential maximum amount of sand that could be eroded by the wind during a year for all wind directions. Hence, DP is a measure of the potential wind power in a sandy area (Tsoar, 2004). The vector units from different directions can be resolved into a single resultant known as the resultant drift potential (RDP; Tsoar, 2004).

This method requires temporal velocity wind data from throughout the year measuring how fast the wind moved and for how long. To determine the RDP the Drift Potential (DP) vector for each wind that occurred during the year exceeding the threshold wind velocity (~12 knots or ~14 mph) is evaluated; the DP vector is proportional to the length of time the wind blew greater than the threshold wind velocity (Tsoar, 2004). Thus, an individual DP value and vector is determined for each wind direction that blew greater than the wind threshold velocity. The DP values are proportional to how much stronger it was relative to the threshold wind velocity and how long it blew at those speeds. Adding all the DP vector unit values provides a resulting vector called the Resultant Drift Potential (RDP). The RDP vector provides a measure of the primary direction of sand transport if there is one. Adding up all the DP values provides a parameter of the potential maximum amount of sand that could be eroded by the wind during a year for all wind directions (Tsoar, 2004).

**Figure 4**: Resultant Drift Potential (RDP) Data from Blythe and the Algodones regions from Muhs et al. (2003). The Algodones dune field is located at the south end of the Salton Trough. These data indicate that the Pacific Cell winter weather fronts in combination with topographic features (mountains and valleys) dominate the orientation of the RDP.




Annual and seasonal wind rose diagrams data from Blythe (ASOS data from its believed the Blythe Airport), which is located approximately 5.5 miles northeast of the Project site at the eastern most end of the Chuckwalla Valley (Plate 1), indicate two dominant wind directions during typical years. During the Spring and Summer months, the strongest winds are from the south associated with monsoonal storm events. During the Fall and Winter, the strongest winds are from the north-north west associated with Pacific Ocean derived weather fronts. Determining the primary wind direction responsible for sand migration can be evaluated by geomorphic mapping of dune types, orientations, and locations, which is described later in the report, and by determining the RDP from appropriate wind data (Toar, 2004).

Muhs, et. al. (1995) determined the RDP for the Chuckwalla Valley to Blythe region for wind data collected at the Blythe Airport. Muhs, et. al., (1995) determined a RDP for the Blythe Airport that points nearly due east, parallel to the Chuckwalla Valley (left diagram) and for the Algondones dunes in the Imperial Valley region (Salton Trough) of southern California (Figure 4).

It can be seen in Figure 4 that the RDP, and thus the primary direction of migrating sand in the valley axis, is from the west for the Blythe area (eastern Chuckwalla Valley). This indicates that the Pacific Cell winter storms provide the dominant wind systems in terms of long term sand migration in the region. In addition, the nearly due east resultant vector RDP for the Blythe airport located near the eastern outlet of the

Chuckwalla Valley (Palo Verde Mesa) is very consistent with geomorphic field mapping data in the region regarding the dominant direction of migrating sand (including long term field indicators such as ventifacts and dune alignment) in the Chuckwalla Valley axis corridor. However, it is also evident based on seasonal switching of avalanche face directions, occurrence of linear dunes, and complex dune forms observed in the region in both Winter and early Fall, that the southwesterly winds play an important role on local dune morphology. This was also observed to be the case in the dune field within Palen Dry Lake during KGS mapping in October 9, 2010.

Although wind data for areas of the region indicate that strong summer monsoonal winds from the southwest occur, they apparently do not play a large role in terms of large long term sand transport within the Chuckwalla Valley axis. However, the southwest prevailing winds do play an important role in eolian sand migration in the region of the RE Crimson where eolian sands are moved northeastward and out of northwest flowing drainages. Once the eolian sands are out of the washes these sands are moved by westward and southwestward prevailing winds.

Most of the dune systems however do occur in valley axis, and in these areas westward prevailing winds travelling down the valleys (i.e. topographic control) are the dominant pervasive wind direction (Muhs, et al., 2003; Lancaster and Tchakerian, 2003). Geomorphic evidence for this is provided by the form of the dunes. For example, well developed transverse dunes (some of which are barchan, meaning moving crescent-shaped) within Palen Dry Lake clearly indicate that the dominant wind transporting directions responsible for the majority of eolian sand transport ranges from the west to northwest within the Chuckwalla Valley. In addition, a discussion with Cal-Trans workers responsible for removing sand from the Wiley Well rest area (Plate 4) near the east end of Ford Dry Lake indicated that without question the vast majority of sand moved from the north down the Palen Pass is associated with winter and early spring wind events and not from the south. One of the two Cal-Trans employees had been performing the sand clean up at Wiley Well rest area for over ten years.

In places along Chuckwalla Valley, multiple prevailing wind directions occur to the extent of affecting dune morphology. Variations in prevailing winds in any one area arise from two sources. First, they can occur when two topographically controlled prevailing winds collide as is the case in eastern Palen and Ford Dry Lakes, and second, where the storm related prevailing winds, mostly involving when the W to NW and SW seasonal prevailing winds occur. Evidence that multiple prevailing wind directions are significant in Chuckwalla Valley is provided by work conducted by Tsoar (2004). His work indicates that vegetation densities on dunes increase when the area experiences competing prevailing wind directions. Tsoar (2004) identified that vegetated dunes and unvegetated dune occurrences could be explained via the relationship of dividing the resultant drift potential by the drift potential (RDP/DP). The RDP/DP provides a measure of the variability of the wind where values close to one indicate a narrow unidirectional drift potential, and values close to zero indicate a wide multidirectional drift potential. Tsoar (2004) indicates based on utilizing data from 43 sand dunes sites from all over the world, that unvegetated dunes exhibit a high RDP/DP (they may nearly equal each other) due to most wind power being exerted on the same dune faces (mostly uni-directional), and vegetated dunes exhibit low RDP/DP (RDP $<<$ DP) exhibit wind power exerted on multiple dune faces allowing the vegetation a better opportunity to grow (multiple prevailing wind regime).

In other words, when there are competing prevailing winds, vegetation has a higher likelihood of establishment on the dunes, thus causing them to become more stabilized. Dune systems in the Chuckwalla Valley support this finding. In the central Palen Dry Lake area exhibiting mobile barchan dunes, a dominantly west prevailing wind is evident based on field mapping in the area at various times of the year. However, the dunes in the eastern Palen Lake area are much more stabilized and this region exhibits "prevailing winds" from both the west and from the north-northwest where the East Palen Lake and Palen Lake sand migration zones merge. A similar condition occurs in eastern Ford Dry Lake. In the eastern Chuckwalla Valley immediately east of Wiley's Well Basin, subtle linear dunes occur that are very stabilized via vegetation where there is clear geomorphic evidence from field mapping of competing prevailing winds that also support the development of linear dunes.

### 5.2 Geologic history – Placing dune development in context

It is important to understand the geologic history not only of the dune systems itself, but also of the area bounding the dunes. Understanding the geologic history allows for the understanding of what occurred in the area prior to the development of the dunes which leads to understanding when the dunes began to be deposited in the area. Local soil stratigraphic mapping with estimated minimum soil ages allows for an age estimate of the time in which the dunes encroached into the area (see next section).

Local mapping of older formational units such as those associated with the ancient Colorado River system (i.e. Bullhead Alluvium) when it had encroached (inundated) into Chuckwalla Valley and across the Palo Verde Mesa area provides insights regarding the age and rates of geologic processes in the area. For example, ancient Colorado River deposits estimated to be early Pliocene in age occur either at the surface or within 1 to 6 feet of the surface across most of the Palo Verde Mesa, and under older alluvium deposits along the northern flanks of the Mule Mountains (i.e. the Bullhead Alluvium, unit Tmw and Tmm, soils S7 and S7a). Extensive exposures of the Bullhead Alluvium occur immediately south of the RE Crimson and in places exposed are at very shallow depths within the RE Crimson. This indicates that geologic depositional rates have been remarkably slow for well over 3 million years and that the area is Geomorphically stable not only across the RE Crimson but throughout the eastern Chuckwalla Valley. Knowledge of the exposure area of these units as well provides insights regarding their contribution to eolian dune and alluvial systems as a sediment source.

### 5.3 Surface and near surface soil and sedimentary stratigraphic evaluation

An "area specific" stratigraphic section needs to be developed for dune studies of the dune and alluvial deposits to provide a temporal and special context for the local deposits. This can be conducted by the construction of a soil profile stratigraphic section that consists of various soil profiles and their associated age of development, in addition to identifying the parent materials of the sediments prior to the development of the soil profile.

#### *5.3.1 Local Formational stratigraphic section*

Designated Formational depositional units typically comprise those that are named and described in published geologic maps and reports which extend over a regional area. Formational units occur not only within the study area, but also regionally which is generally the criteria to justify the formal "formational" name. The primary formational unit in the RE Crimson area is the Pliocene age Bullhead Alluvium. For dune studies, the identification of formations such as the Bullhead Alluvium, is important as it provides a structural-stratigraphic marker where exposed across the eastern Chuckwalla Valley, but also because it provided a relatively strong eolian sand source upon erosion along the flanks of the local mountain ranges. The identification of the exposures of the Bullhead Alluvium provides a stratigraphic marker allowing for the interpretation regarding geologic process rates (i.e. depositional rates and geomorphic stability) since the time of its deposition.

Formational units identified in the study area have been assigned various names although some are the same geologic depositional unit. In addition, mapping during this study identified new exposures of some regionally mapped formational units which assists in understanding the local geologic history.

#### *5.3.2 Subdivide Quaternary Alluvium (Qal) and Quaternary Older Alluvium (Qoaf) utilizing surface and near surface (buried) soil profile stratigraphy*

On most published geologic maps, alluvium is quite often simply subdivided into younger versus older alluvial units of Quaternary age (i.e. past 2.6 million years). Consequently, a few members of the relatively younger Quaternary Alluvium (Qal) and relatively older Quaternary Older Alluvium Fan (Qoaf) are identified, which are too poorly defined to be useful for eolian dune studies. Hence, a local alluvial stratigraphic section typically needs to be constructed specifically for a project such as the RE Crimson. Because many dune studies are most interested in the relatively recent geologic past (Holocene), it is prudent to identify numerous alluvial soil stratigraphic members that developed since the latest Pleistocene. This is important to understand when the dune encroached into the region, which is accomplished by evaluating minimum soil ages for the various alluvial deposits. This can usually be accomplished because alluvial fans have been depositing somewhat consistently since the latest Pleistocene across southeastern California, and particularly in distal fan areas. This is not the case necessarily for older alluvial deposits where a hiatus of alluvial fan deposition occurs between approximately 45 kya to the latest Pleistocene across much of southeastern California. This hiatus of deposition is observed at the site by examining the estimated minimum soil ages of Soil S4 of >35 kya and the next younger Soil S3b estimated to be ~12 to 8 kya (Figure 7A).

Alluvial deposits can be subdivided in most cases based on the evaluation of alluvial terraces that exhibit particular soil profiles (soil horizons). In this way, a stratigraphic section of alluvial deposits can be developed based on the age of the soil and its stratigraphic position. The characteristics of each designated soil profile (i.e. S1, S2, S3a, S3b, S4, etc.) are described in places where that soil occurs at the surface and has not been buried. In this way it maximizes the development of that soil. However, during the study, these designated soil profiles are typically identified buried beneath younger soils. This is a powerful tool for the evaluation of alluvial fans and dune systems.

#### *5.3.3 Alluvial vs. eolian soil parent materials (Original depositional environment)*

Soil profiles develop when deposits are exposed to the surface of the earth and secondary soil processes occur such as development of soil horizons (A, B and C). Hence, designated soil profiles (i.e. S1, S2, S3a, etc.) developed in whatever sediments were exposed on the surface of the earth whether it was alluvial or eolian. The origin of the original sediments in which a soil profile develops is referred to as the "parent materials". It is important to determine what the parent material is during stratigraphic mapping of an area because it allows for the evaluation regarding where older eolian verses alluvial deposits occur. For example, if a S2 surface soil estimated to have a minimum age of 5,000 to 3,000 years old (age of the surface) developed in eolian deposits and adjacent alluvial deposits, then this indicates that the alluvial and dune depositional contact has been stable for the past 5 to 3 kya (kya = 1000 years) in that area. In other words, it shows strong evidence that approximately 5 to 3 thousand years ago that active eolian sands were depositing adjacent to active alluvial systems but that this dune and alluvial system became dominantly inactive since that time (stable).

#### *5.3.4 Sediment source evaluation*

It can be important to evaluate the source of the parent material in alluvial deposits as well. For example, on the Palo Verde Mesa region and distal fan areas, the soil profiles (secondary soil properties) were relatively juvenile (young) relative to the ubiquitous pinkish red color that the sediments exhibited. Typically, soils exhibiting pinkish reddish colors are generally interpreted as being older as the reddish hues are assumed to develop over time. However, it is likely that these near surface alluvial deposits exhibited a reddish hue at the time of their deposition because the parent sediments themselves were slightly reddish in color. The source for the pinkish red parent soil sediments was identified as the Bullhead Alluvium that had eroded along the flanks of the local mountain ranges (McCoy and Mule mountains).

### 5.4 Geomorphic evaluation during field mapping (Surface mapping)

A Geomorphic evaluation is one that involves identifying geologic features on the surface of the Earth that indicate the genesis of that environment and for dune deposits, the relative activity-stability of the dune areas.

#### *5.4.1 Fluvial vs. eolian Geomorphology (qualitative)*

Mapping for an eolian dune study requires identifying specific areas that are dominated by fluvial or eolian geomorphic features. This can simply be done qualitatively by estimating in the field or aerial photographs if a region exhibits predominantly fluvial or eolian characteristics. For example, bar and swale topography indicates that washes (fluvial processes) dominate an area. In contrast, a hummocky, non-draining region exhibiting internal basins (interdune basins) indicate that the landscape is dominated by eolian processes and/or older dune deposits. These data provide important criteria for mapping the contacts between eolian vs. alluvial depositional areas (i.e. the extent of dune deposits). Hence, dune systems are quite complex and bounding areas of relatively thicker dune deposits typically exhibit a gradual change from an eolian dominated area to a fluvial dominated area. To add to the complexities, in some areas of relatively "active" and robust dune systems, surface hydrology such as on occasional ponding in playa lakes and ponding areas in addition to infiltrating washes occur that are critical in providing eolian sand source and stabilizing moisture.

### *5.4.2 Evaluation of the extent and type of active vs. eroding-stabilized dunes (qualitative)*

Within dune systems, an assessment (either quantitative or qualitative) of the relative activity of the dunes needs to be determined. For example, are older dune sands eroding and providing an internal eolian sand source for downwind dunes? What is the type of active eolian sands migrating within the system – new eolian deposits compared to possibly older dune forms that once were active and are now eroding? Answers to these questions provide very important information regarding the current "health" of the dunes and about the history of the dunes. For example, if the only active eolian sands (migrating via the wind) are sand sheets (surface ripples) and small coppice dunes, and relatively larger dune mounds or linear dunes are eroding away or strongly stabilized, then this indicates that the dune system was more robust in the past than it is today. This is the case for most dune systems across the southeastern California region. These criteria are described later in this report utilizing the Geomorphic Unit Designations. In this study, a qualitative assessment of the extent and type of active vs. eroding-stabilized dunes was conducted.

### *5.4.3 Relative sand migration zone rates (qualitative)*

In dune systems, sand migration rates vary considerably. This is evident by the types of active eolian sands (i.e. sand sheets, coppice, dune mounds, linear dunes, transverse dunes, etc.) that occur in an area, and of course, sand migration rates decrease remarkably near the edges of the dune system. Evaluating dunes systems utilizing relative sand migration zone rate designations based on dune geomorphology and types of active dune forms is very useful in that it provides data that can be mapped allowing for a relatively quick assessment within a dune system regarding where the fastest and slowest sand migration zones occur and their respective geomorphology. Combining the relative sand migration rate zones with the Geomorphic Unit Designations indicating which areas are active, stable or eroding provides a system where once mapped, the geomorphology of an area can be more readily interpreted and assessed.

### *5.4.4 Local topography across eolian dune systems*

An evaluation of the local topography and even subtle variations in topographic relief results in variations in wind speed which leads to areas of relatively increased or decreased eolian deposition and/or erosion of older dune deposits (abrasion). For example, if the wind is forced to rise as it encounters an upward slope, it can increase in velocity which increases its potential to carry more eolian sand and its ability to erode previously deposited "relict" dunes; however, as the wind moves over the topographic high, the wind speed will lower, which decreases its ability to transport eolian sands leading potentially to an increase in eolian deposition on the leeward site. As shown in this study at the topographic sill associated with the eastern termination of Chuckwalla Valley and the western boundary of the Palo Verde Mesa occurring in the northeastern portion of the RE Crimson, a subtle topographic rise has affected the depositional areas and lateral extent of the relatively weak eolian dune systems.

## 5.5 Eolian sand sources

The evaluation of eolian sand sources was a large component of this study. Sand dunes have had a sense of mystery about them regarding why they occur in some places, and not in others, or why some dune systems appear to be more robust than would likely seem to be the case. Some of this mystery however is answered by conducting more comprehensive investigations of eolian sand sources and combining the results of these with existing documentation on established eolian sand sources. In terms of "dune mitigation and conservation", it is critical to understand the origin of the eolian sands and particularly whether the sand was derived from near-field source (local) or far-field sources (regional). Over the course of the Holocene, it is likely that eolian sands within a dune system are both from near-field and potential relative far-field sources. Indeed, Pease and Tchakerian (2003) indicate that eolian sand sources can vary between fluvial and playa sources, but also suggest that these sources were "local". Ramsey et al. (1999) evaluating the Kelso Dunes indicate that eolian sands derived from local and far-field sources fluctuated over time and both played an important role during the development of the large Kelso Dune system. Based on the findings of this report, it is likely that most newly generated eolian sands (late Holocene) across most of southeastern California are dominantly generated from local sources and this is particularly the case in the RE Crimson.

### *5.5.1 Washes*

Washes that flow from the desert mountains to local base level along the valley axis provide a significant source for eolian sands. Numerous publications indicate that washes are a very important if not dominant source of eolian sands in the southeastern California region (Lancaster, 1997; Muhs et al., 2003; Pease and Tchakerian, 2003). Washes are also important as they transport sand to pluvial, playa lakes and ponding areas. Blackwelder (1931) indicated that playa lake beds in the southwestern United States are a strong eolian sand source due to his observation of deep abrasion across their surfaces.

Drainage system flow transports eroded eolian size sand grains to a region where the sands can be picked up by the topographically controlled prevailing winds commonly occurring within the valley axis. It is easily observed in the field, that fresh eolian sands emanate from a wash soon after it flows once a sufficiently strong wind is available to mobilize the sand. This is observed not only for relatively large washes that are hundreds of feet across but also washes as small as 3 feet across and less than one foot bar and swale (or terrace) relief. Within hours to a couple of days of strong winds occurring after a flow, a surface capping layer of gravel size clasts develop on the surface. Once the capping protective layer forms, eolian sand production from the wash via entrainment by the wind dramatically decreases. Hence, washes that flow more often will produce more eolian sands, and washes associated with larger drainage areas (watershed aerial extent) tend to flow more frequently to the valley axis than smaller ones. In contrast to washes that primarily produce eolian sand soon after flow, pluvial and playa lake beds can continue to abrade resulting in ongoing eolian sand production for years once dry, or the abrasion continues until moist sediments are exposed.

There are numerous parameters regarding how much eolian sand washes will produce. Important eolian sand generating parameters for drainage systems is their local relief (bar and swale relief – how deeply entrenched), its style of flow (tributary vs. distributary), size of their water shed, density of vegetation, its orientation to prevailing winds, and volume of eolian size grains being transported due to upstream erosion of older sandy deposits (i.e. older alluvium, ancient Colorado River or older fan deposits). Relatively low bar and swale relief between the wash and channel wall elevation allows stream wash derived eolian sands to migrate outside of the wash system.

Wide sheet flow distributary drainage systems associated with active alluvial fan areas generally do not result in relatively strong eolian sand generation. In addition, distributary drainage systems occurring in the distal portion of the fan do not flow frequently as the channel flow continues to decrease as the channels bifurcate downslope. Tributary drainage systems occurring where older sediments are being eroded into and their flow is progressively concentrated downslope from the merging of upslope washes (either from tributary or distributary systems) can produce relatively large volumes of sediment that can produce eolian sand, particularly when they reach the valley axis. Tributary drainages systems, due to concentrating flow from a large area, flow more frequently and with larger water volumes. This allows these robust washes the ability to reach the valley axis more often resulting in more abundant eolian sand production. In addition, if the cumulated tributary flow that reaches the valley axis consists of a braided wash system with relatively low bar and swale relief, it results in relatively strong eolian sand generation presuming vegetation densities are not high.

The orientation of washes is also important. Wash systems that flow sub-parallel to the prevailing wind direction and/or in the region of the valley axis are observed to produce more eolian sands than washes that flow perpendicular to the prevailing wind. However, washes that flow at high angles to the prevailing winds will typically have more eolian sands pushed out of the wash system and onto adjacent surfaces where the eolian sand can then be transported in a sand migration zone.

### *5.5.2 Granitic rocks in the mountains*

Granitic rocks erode mechanically to "decomposed granite" which are predominantly sand size grains. Hence, when granitic rocks erode, they generally produce a relatively large component of eolian size sand grains to be potentially transported by local washes. Numerous publications indicate or suggest the importance of granitic rocks as a source for eolian sands in southeastern California (Ramsey et al., 1999; Zimbelman and Williams, 2002; Pease and Tchakerian, 2003). It is observed that dune systems across southeastern California that occur downstream from abundant granitic rocks are generally more robust than would be the case if the granitic rocks did not occur. Granitic rocks are exposed throughout the study area and typically, relatively robust eolian systems do occur in valleys and sand ramps (passes) adjacent to mountains exhibiting large exposures of granitic rocks (Plate 1 and Plate 2). The granitic rocks shown on Plates 1 and 2 are considered relatively significant local sources for eolian sands for valley dune systems.

### *5.5.3 Playa and pluvial lakes*

Playa and pluvial lakes are lacustrine areas considered to possibly be the most important source of eolian sands for dune systems across southeastern California, or it may be that strong eolian aggradational events or re-activation periods simply correlate with when pluvial lakes dry up and their contribution to eolian systems may be approximately equal with that of washes. Pluvial lakes are those that filled with water and remain relatively full for thousands of years during the major glaciation events. Playa lakes, or also referred to as "dry lakes" are basins that are believed to have not filled up for thousands of years during glaciation periods but did fill and recede regularly during those times. Pluvial lakes provide eolian sands during the relatively warmer inter-glacial periods when they have dried up but also result in robust eolian production during times of intermittent fluctuating lake levels as discussed later. Numerous publications indicate that lacustrine surfaces are an important source of eolian sands or simply surfaces that can erode by abrasion suggesting an eolian source via the production of dust storms (Blackwelder, 1909; Ward and Greeley, 1984; Tchakerian, 1991; Gill and Cahill, 1992; Zimbelman, et al., 1995; Cahill, et al., 1996; Gill, 1996; Lancaster, 1997; Lancaster and Tchakerian, 1996; Rendell and Sheffer, 1996; Pease and Tchakerian, 2003; Orme, 2004; Reynolds et al., 2009; Whitney et al., 2015). The studies provide very strong evidence that lacustrine environments (playas and pluvial lake beds) provide large magnitudes of eolian sand for dune systems occurring on the lake beds and downwind.

Many moderate to major dune systems in southeastern California emanate from relatively large lake basins exhibiting pluvial and playa lake areas. These include Lake Manix (pluvial lake for Coyote, Troy and Afton basins/lakes), Lake Mojave (pluvial lake Soda and Silver lake basins), Salt, Bristal, Cadiz, Danby, Dale, Palen and Ford dry lakes (Plate 1). Bristal, Cadiz and Danby lakes (basins) may have experienced lake levels for sufficiently long enough periods of time during glacial maximums to be considered pluvial lakes (Enzel et al., 2003). Lake Manix is interesting in that it was a "pluvial lake" up until approximately 19 kya (Miller, 2005) when it may have drained relatively quickly through Afton Canyon, but did fill to lower levels periodically as sub-lakes (including Soda Lake) up to about 13 kya. However, Enzel et al. (2003) and Wells et al. (2003) believe that Afton Canyon eroded via time transgressive incision lasting over a few thousands of years, but indicate that this is also a geologically rapid event. Lake Manix was part of a pluvial lake system including Silver Lake and Soda Lake appears to have dried up by approximately 13 kya (Plate 1).

Lake Manix is believed to have fed the Silver and Soda lake basins sufficiently to result in the development of the pluvial Lake Mojave (Enzel et al, 2003; Wells et al., 2003). The data indicates periods of intermittent lake levels where Lake Mojave filled and receded numerous times for more than several thousand years and periods of time where the lake remained relatively full. These are important data for the evaluation of eolian systems because as discussed in Kenney (2012) and Schaaf and Kenney (2016), dune systems immediately just outside the playa area receive a "pulse" of new eolian sands soon after lake levels recede, such as in the case of Keeler Dunes at Owens Lake, California. This is because soon after lake levels drop, the lake bed is fully exposed allowing for high wind-blown sand mobility (low vegetation) and the recent lacustrine deposits are also easily mobilized. In addition, washes flowing over the newly exposed lacustrine deposits produce more eolian sands compared to them flowing on a lake surface that had been exposed for longer periods of time due to the exposure of recent and loose deposits over a large area. Eolian systems adjacent and downwind from playa and pluvial lakes receive an order of magnitude more eolian sand during times when the lakes are "intermittent" with multiple rising and falling water levels compared to more stable lake level. For example, it is proposed that this is the case for Kelso Dune aggradational events that correlate temporally with the intermittent lake levels documented for Lake Mojave by Enzel et al, (2003; Plate 8A, Plate 8B and Plate 8C).

Playa lake beds, like pluvial lake beds, as a source of eolian sand are complex as some are considered wet, and others dry, which plays a role in the type and magnitude of eolian sands emanating from their surfaces (see Reynolds et al., 2007). Dune systems can form downwind from salt-pan surfaces associated with "wet" playa and pluvial lakes that result in the development of clay and lunette dunes as described by Bowler (1973) and Thomas et al. (1993) respectively. Groundwater levels across the lakebed surface is also a critical factor. Sand bearing wind abrasion of lakebed sediments will occur rapidly but will decrease in rate exponentially once the abrasion depth reaches moist sediments. Other factors include the composition of the lakebed sediments, for example, their relative factions of clay, silt and sand and of course, variations of wind speeds across the lake bed surfaces.

It is important to point out that two playa lakes (Ford and Palen) and ponding areas (Wiley's Well Basin and the Palowalla ponding area) occur in the Chuckwalla Valley that produce their own eolian sand source locally when they fill and dry periodically. These areas also receive new eolian sand-sized sediment from local washes in the sense that more eolian sand is generated in regions of the playas where wash systems flow onto the playa that both transport new sand to the playa and the washes themselves generate fluvially derived eolian sands. These are Palen and Ford dry lakes in the western and eastern Chuckwalla Valley respectively. As a side note, it has been observed by the author in the Chuckwalla Valley, that relatively heavy rain landing on playa surfaces are sufficient to cause minor wash flow on the subtle drainage system on the lakes and result in the production of new eolian sands once sufficiently strong winds occur. For cool Pacific storms, strong but dry prevailing winds commonly occur within a week after the passing of the storm. Heavier flooding and associated erosion from warmer dry-season summer monsoonal storms disturb playa surfaces and erode into existing playa lake bed dunes providing new eolian sands to be mobilized during the next prevailing wind. The author has observed first hand where an extreme flood event in eastern Ford Dry Lake caused interdune depressions within a dune system to fill up producing a series of small ponds. In places, the ponds overflowed into an adjacent pond causing erosion into the dune systems. Numerous ponds were observed to have overflowed into lower lying areas resulting in increased flow and dune disruption. This process re-activated older dune sands and provides an example of the fluvial and eolian (cycling) relationships.

### *5.5.4 Ponding areas*

Ponding areas and playa lakes described above are similar in that they are areas that flood and dry out relatively frequently. The only difference and defined herein, is that "ponding areas" are not sufficiently large enough to be mapped as a playa lake bed. The term "ponding areas" is utilized herein because these smaller scale "lake beds" are locally significant for dune systems but can be overlooked as an area behaving as a playa surface. For example, most of the eolian sands in the eastern Chuckwalla Valley and Palo Verde Mesa are derived from local ponding areas and their associated washes. These include the Wiley's Well Basin west of the site (Plate 4), the Palowalla Wash ponding area immediately west of the Blythe 21 solar facility (Plate 3A). Ponding areas in the eastern Chuckwalla Valley dominantly impact valley axis dune systems and not those associated with alluvial fan ramp style dunes identified in the RE Crimson.

### *5.5.5 Washes and Alluvial fan aggradational events*

Based on the review of alluvial fan aggradational events in southeastern California since the late Pleistocene (discussed later in the report), it is evident that eolian systems receive more eolian sand during relatively strong alluvial fan aggradational events. Hence, there is a positive correlation with alluvial fan and eolian dune system deposition (See Plate 8A, Plate 8B and Plate 8C). Publications such as Harvey et al. (1999) and Miller et al. (2010) indicate that alluvial fan aggradational events occurred during periods of time when cool/wet Pacific storm systems subsided and warm Monsoonal (thunderstorm) storm frequency of events increased across the southwestern United States. Leeder et al. (1998) identified that alluvial fans in the southwestern United States received reduced sediment supply, despite increased runoff (i.e. precipitation) evident from local lake (lacustrine) levels. They indicate that these periods of times occurred during glacial maximum climates and were characterized by higher effective moisture (presumably from Pacific storm systems) and the spread of woods and forests to lower elevations. Hence, the findings by Leeder et al. (1998) indicate that alluvial fans likely did not undergo aggradational events during times of stronger Pacific Storm systems. Therefore, alluvial fans likely aggraded under different climatic conditions, which occurred during periods of increased monsoonal storm activity.

It is proposed that similar conditions for alluvial fan aggradational events proposed by Harvey et al. (1999) and Miller et al. (2010) also lead to eolian aggradational and re-activation events.

### *5.5.6 Alluvial fan trenching (down cutting)*

Lancaster (1997) observed that eolian systems may be closely tied to geomorphic instability and channel cutting. This led to the evaluation of the timing of alluvial fan trenching in the upper reaches of alluvial fans across southeastern California and that may correlate with eolian aggradational or re-activation events due to an increase in eolian sand generation. The results of this analysis are consistent with that of Lancaster (1997) indicating that channel cutting (alluvial fan trenching) is an important parameter in re-activation and/or small dune aggradational events since the end of the early Holocene (i.e. past ~8,000 years). It is evident that if washes are eroding into older alluvial fan deposits that contain a relatively high concentration of eolian size sand grains, that those washes would contribute more eolian sands than if the washes simply flowed from the mountains to base level without erosion of the older fan deposits.

Miller et al. (2010) indicate that cool-season (winter) Pacific frontal storms cause river flow, ephemeral lakes, and alluvial fan incision, whereas periods of intense warm-season storms (monsoonal) cause hillslope erosion and alluvial fan aggradation. These conclusions indicate that washes even during periods of increased cool Pacific storm systems (i.e. frequency and magnitude at latitudes of the study region) likely transport a significant amount of eolian sands that potentially could increase eolian source. This potential increase in eolian sand generation during this type of climate could occur during times of decreased monsoonal storm frequency and strength. However, the increase in vegetation density at lower elevations where dune systems reside may inhibit eolian sand migration, and it is possible that during periods of more intense Pacific storm systems and associated fan-trenching that eolian sands are stored up near fluvial base levels. These sediments could then re-mobilized to contribute to eolian systems when Pacific storms subside and monsoonal storm systems increase spatially and temporally.

### *5.5.7 Exposed and eroding older sedimentary units*

In the Chuckwalla Valley, and other valleys as well across southeastern California, older relatively fine grained sediments are exposed within the valleys and flanks of the mountain ranges that can erode easily by sand bearing wind abrasion and channel down cutting. Hence, where exposed and eroded, these older sediments can provide a strong source of eolian sands. Muhs and Holliday (2001) indicate that the primary source for eolian sands for the dune fields on the Southern High Plains of Texas and New Mexico was from the erosion of older formational units exposed locally. This significant source of eolian sands was identified during this study by observing increased and sometimes isolated areas of eolian sands in regions of exposed Bullhead Alluvium along the edges of the Chuckwalla Valley. For example, exposures of Bullhead Alluvium which deposited during the early Pliocene when the Colorado River engulfed the Chuckwalla Valley, occurs along the flanks and within the valleys of the Mule Mountains. It is evident that where this formation is exposed and eroding, that it produces significant volumes of locally derived eolian sands. In some places, older and abandoned pluvial and playa lake deposits also produce abundant eolian sands. An example of this is proposed to occur west of Dale Lake (Plate 1). The same process of the erosion of sandy older sediments contributing significant eolian sand to local dunes occurs east of the Colorado River in the Parker Dunes (Plate 1). In this area, older Colorado River system deposits are exposed and commonly occur along the flanks and beneath the dune deposits which are eroding resulting in the production of eolian sands.

#### *5.5.8 Alluvial fan depositional areas*

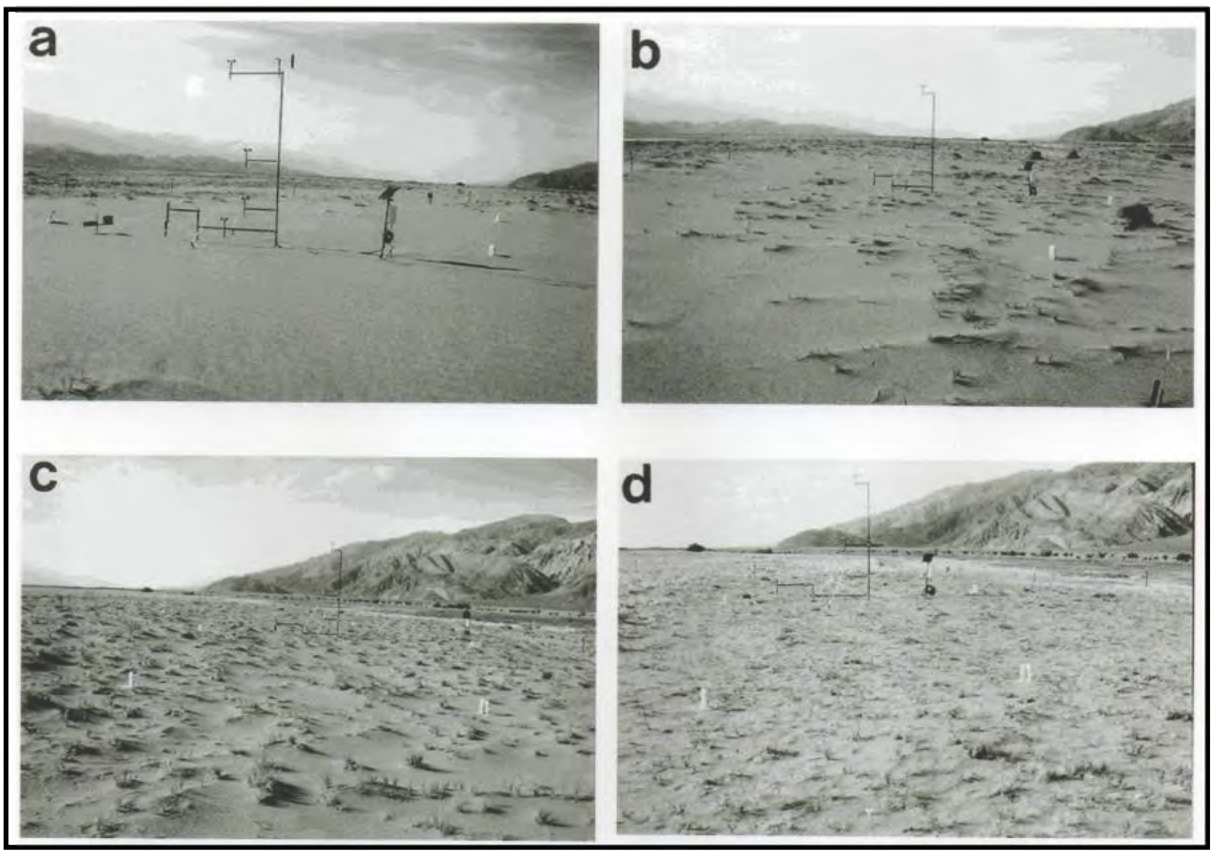
Alluvial fan processes likely contribute relatively more eolian sand to valley axis dune systems if the alluvial fans are aggrading in the distal fan portion of the fan system which typically occurs near the valley axis. During these times, sediment transport by the washes carries the sediment all the way to the valley axis where the sand is then deposited. Wells and Dohrenwend (1985) indicate that it was during the latest Pleistocene to mid Holocene that alluvial fans in the southwestern United States region primarily deposited in the distal portions of the fan and not near the mountain front as they had done previously (periods of glaciation). This is an important aspect of fan deposition in terms of eolian systems because most dune systems exhibited aggradational events during the same time period that Wells and Dohrenwend (1985) indicated that alluvial fans were also aggrading near the valley axis. This time period from the late Pleistocene to early Holocene also coincides with sporadic alluvial fan head trenching (proximal area of the fan) which is proposed to result in washes transporting relatively more sand size grains to the valley axis region. This makes sense because if the alluvial fans are depositing in the distal fan areas, they are also likely eroding in the proximal to medial fan areas at the same time. Collectively, all of these processes lead to an increase in eolian sand production. Keep in mind that if drainages are eroding in the proximal and distal fan areas exhibiting tributary drainage systems, that the likelihood that their flow extends further downslope is increased. For example, to the valley axis where dune systems typically reside.

### 5.6 Dune vegetation - Dune stabilization and sand migration rates

The density of vegetation in dune deposit areas is a very important parameter in terms of dune stability and sand migration rates. Lancaster and Baas (1998) conducted a significant well controlled study evaluating the relationship between plant aerial coverage density and sand migration rates on a playa lake bed (Figure 5). Their results indicate that just an approximately 10% aerial coverage of plants that are less than one foot tall (i.e. ~4-inches tall in their study) decreases eolian sand migration rates by 90%. This result is quite astounding and indicates that minor vegetation densities essentially decrease eolian sand migration rates exponentially.

In the dunes immediately north of the RE Crimson in the valley axis dunes systems, vegetation densities were estimated to be a minimum of 10 to 15%, during years of essentially no growth of the invasive species "Sahara Mustard" (*Brassica tournefortii)*, but can increase to well over 50% during a season and the following year of strong Sahara Mustard growth (Kenney, 2016). Field mapping in December of 2010 and April 2011 identified a dense population of non-native and invasive Sahara Mustard (*Brassica tournefortii)* extending within the dune system east of Wiley Well Road to RE Crimson. During strong Sahara Mustard growth, eolian sand migration, and internal dune erosion, is nearly completely shut down. Vegetation densities in typical dune areas in the RE Crimson as discussed later in the report also range from approximately 10 to 15%. These vegetation density evaluations do not take into account very low lying shrubs/plants that are less than 3 to 6 inches tall. Hence, they should be considered minimum values.

**Figure 5**: Images from Lancaster and Baas (1998) evaluating the relationship of vegetation densities and eolian sand migration rates on Owens Lake, California.



### 5.7 Types of dune forms (Sand Sheets, Coppice, Mounds, Linear, Transverse, Star Dunes - Complex)

Various types of eolian dune deposits occur in the Chuckwalla Valley and each provides evidence regarding prevailing wind directions and relative sand migration rates. Sand sheets are active sand moving across relatively planar surfaces. Ripple marks are quite common on active sand sheet deposits. If the amount of active eolian sands present are very low, sand sheets will be the only active type of active dune deposits identified.

Coppice dunes form at the base of a single plant and can be a few inches tall to over 4 feet. If moderate amounts of eolian sand are migrating through the system, active dune sands will be in the form of sand sheets and small coppice dunes. Dune mounds can be large coppice dunes but at the base of multiple plants, or simply a relatively wide mound of dune sands that do not exhibit any avalanche faces. They appear to form in areas of relatively dense vegetation where the active sand sheets are attempting to navigate through the system.

Linear dunes develop at moderate angles to the prevailing wind and in areas with competing prevailing winds. Linear dunes occur north of the Colorado River Substation and the eastern Chuckwalla Valley east of the Wiley's Well Basin (Plate 4). It is believed that these linear dunes result from the competing southwesterly and westerly prevailing winds. The high vegetation density of the dunes and star dunes (described below) in the area support this conclusion. Linear dunes when robust typically migrate via extending in the direction of the prevailing wind and parallel to sub-parallel to their dune axis. However, the linear dunes in the Wiley's Well Basin dune system are strongly stabilized and only exhibit seasonal, scattered, and less than 2 feet tall avalanche faces.

Transverse dunes form at high angles to the prevailing winds and generally exhibit avalanche faces when active. They can be as small as just a foot tall, but in some places in the study area are over 8 feet tall (i.e. west of Wiley's Well Road).

Star dunes form locally when competing prevailing winds occur in the area and there is a relatively robust amount of eolian sand in the system. For this reason, star dunes are also sometimes called complex dunes. These types of dunes occur in the northeastern region of Wiley's Well Basin where the basin itself is a ponding area providing a relatively robust amount of eolian sand locally. In fact, this area of dunes exhibits the strongest designated relative sand migration zone in the eastern Chuckwalla Valley (i.e. Zone A on Plate 4).

In many places in the study area, and observed across southeastern California, dune types that require relatively more eolian sands migrating through the system (i.e. star dunes, transverse, linear, mounds, and even coppice in some places) are eroding away, and the only active eolian sands are associated with sand sheets. This indicates that most eolian dune systems across southeastern California were more robust during the early to mid Holocene in terms of the magnitude of eolian sand migration than they have been since that time (also see Bach, 1995).

## 5.8 Surface water hydrology – Eolian sand source, dune stability, and fluvial-eolian cycling

The evaluation of surface water hydrology in terms of the location of drainages, types of drainage systems, drainage system watersheds aerial extent, and potential erosion into older sedimentary units greatly assists in understanding local sources of eolian sand for local dune systems. Hence, this analysis provides evidence and an avenue to recognize "micro" sand migration zones. Surface water flow, and near surface groundwater in playa areas also provide important stabilizing moisture for dune systems and this moisture is likely the reason that most areas exhibiting dunes over 4 to 5 feet tall occur adjacent to washes and/or ponding areas in the eastern Chuckwalla Valley. Hence, there is a clear fluvial-eolian connectivity where these two processes affect the other.

### *5.8.1 Drainage Analysis*

A drainage analysis consisting of mapping individual drainages from its base level to its head waters provides valuable information regarding dune development, eolian sand sources, and dune stability. Washes transport at one time most of the eolian sand that ends up within dune systems whether to playa, pluvial or ponding areas, or from eolian sands being entrained directly from the wash itself. Drainages are evaluated to determine areas dominated by distributary or tributary systems. Wash systems that display an overall tributary flow system to the valley axis are identified as resulting in an increase of eolian sand production. In other words, tributary drainage systems near the valley axis that provide flow from nearly the entire watershed area will flow more frequently, stronger, and will more often flow to the valley axis (base level) which leads to production of more eolian sand to dune systems in this area. Regional and local mapping of wash and dune systems across the study region (southeastern California) shows strong evidence that the terminal tributary wash systems that drain most of the watershed area provide relatively abundant eolian sands compared to distributary drainage systems across active alluvial fan surfaces. It is interesting to note that mapping by the author has observed that "blue line" ephemeral drainages shown on USGS topographic maps in the region of dune systems across southeastern California quite often are sufficient to provide a significant source of eolian sand to the local dunes.

A drainage analysis will allow for an understanding of relative magnitudes of sand the drainages are transporting. For example, mapping can identify drainages eroding into older sediments (i.e. alluvial fan trenching or erosion into local Pliocene sediments) consisting of abundant eolian size grains to be transported to dune systems downslope.

### *5.8.2 Local watershed areas*

Evaluation of the watershed area for various local drainage systems in this study indicates that there is a correlation between the size of the water shed, and the relative amount of sediment produced by that drainage system which correlates with the potential volume of eolian sand that can be produced from these sediments. Hence, identifying the aerial extent of the watershed to relatively major terminal drainage systems provides supportive evidence regarding the eolian sand contribution that wash system can provide to valley axis dune systems. Cloud bursts from thunderstorms quite often downpour heavy rains in relatively small areas. Hence, if the watershed is larger, the likelihood of that drainage system experiencing heavy flow sufficient to reach the valley axis (base level) increases accordingly.

If dune systems occur in areas where they are not infiltrated by abundant wash flow or downslope from a large watershed, they then likely have a higher probability of drying out, which could lead to minimizing the size to which the dunes can grow. This is likely the case for the dune systems in the majority of the RE Crimson site as the relatively more robust dune systems occur in the proximal (higher elevations) alluvial fan terraces.

*5.8.3 Bar and swale relief – braided vs. channelized*

Eolian sand is transported out of a wash area to enter eolian systems if the topographic relief of the washes (bar and swale relief) is relatively low and vegetation densities do not obstruct eolian sand movement. If the channel walls are over 3 to 4 feet tall, eolian sands are often produced in the wash between storms, but quite often these eolian sands remain within the drainage system and are unable to escape to enter an eolian system beyond its banks. In these cases the eolian sands can again be entrained by water flow resulting in fluvial-eolian sand cycling. The process of fluvial-eolian cycling associated with wind and water erosion have the greatest overlap and potential for amplified sediment transport in regions (see Belnap et al., 2011). Bar and swale relief generally decreases downslope to coincide with area near the valley axis where prevailing winds are strongest.

*5.8.4 Ponding areas*

Ponding areas are where surface flow waters stop flowing and pond within a relatively small basin, but not large enough to be considered or previously mapped as a playa lake. Some ponding areas are natural which locally include the Wiley's Well Basin in the eastern Chuckwalla Valley north of the RE Crimson (Plate 3A). However, some ponding areas are man-made which include numerous borrow pits associated with the construction of Interstate Highway 10, portions of the north side of Highway 10, and a ponding area west and south of the Blythe 21 Solar Facility. However, anthropogenic ponding areas only affect the valley axis dune systems located north of the RE Crimson.

Ponding areas, and particularly those associated with flow from numerous and/or large watershed drainage systems are an important source for eolian sands. This is because they are frequently flooded and this dynamic nature of its surface (disturbed frequently) allows for eolian sands to be blown out of the ponding area. Ponding areas are mapped as Soil S0 as well as the washes in this report. Many of the ponding areas in the valley axis area exhibit relatively thick vegetation that would limit the ability of new eolian sands to migrate out of the ponding source area.

*5.8.5 Extent to which water infiltrates (reaches) dunes – Anthropogenic effects*

A local drainage analysis evaluating drainages from their headwaters (entire watershed) to the base level typically near the valley axis where most dunes and ponding areas occur is an important parameter to evaluate during dune studies. This evaluation allows for not only providing insights regarding a qualitative assessment of how significant a wash and ponding area may be in terms of providing a source of eolian sand for dune systems (discussed earlier), but also in terms of providing stabilizing moisture to the dunes. For many dune systems across southeastern California, overland wash flow reaches the dunes and ponds up either along the edge of the dune depositional area, or flow slowly through the dune system to pond within interdune depressions. This allows for infiltration of the water into the dune systems and increase their stability.

Dune systems, which may be naively assumed to develop in "dry environments" and thought to not require moisture for their stability, do in fact require moisture for their long-term stability. This is often the case because the relatively large dunes only occur in many instances because of the stabilizing effects of the infiltrating waters. It is observed throughout Chuckwalla Valley were "side channel" dunes bound the edge of washes that flow relatively frequently. Some examples include the Ironwood and Palen Valley Sand Migration Zones (Plate 3A). In addition, nearly all the other relatively robust dune systems in Chuckwalla Valley either have washes that flow through them, or occur on playa surfaces that flood fairly frequently. Examples of this include the East Palen Lake, Palen Lake, Ford Dry Lake and Wiley's Well Basin areas.

Wind abrasion within dune systems can erode older dune deposits quite rapidly if the dune sediments are dry, but the rate of erosion decreases exponentially to very low rates once the abrasion encounters moist dune sands. In addition, the dune systems vegetation which increases dune stability have also developed over time due to receiving moisture from natural drainage flow. Dune systems can react quickly (decadal scale) to a decrease in moisture allowing for older dune deposits to erode. It was proposed by Kenney (2012; also see Shaaf and Kenney, 2016) that abrasion rates into older relict dunes was initiated and continued to increase over the course of over three decades in the Keeler Dunes of eastern Owens Lake and was associated with water flow diversion berms constructed upslope in the 1940s that caused associated drying of the dunes. Hence, dune systems can adjust relatively quickly (i.e. faster than alluvial fan systems) to variations in moisture either due to anthropogenic or climate variations. Changes in the overland flow waters received or not received by a dune system can thus lead to relatively fast changes in dune stability and dynamics.

#### *5.8.6 Fluvial-Eolian sand cycling*

Field mapping in the RE Crimson site indicates that fluvial-eolian cycling is a very important process where eolian sands are created within a wash and some of these sands are able to escape the wash to then migrate with the potential to become an eolian deposit, but some deposit as eolian sands in the wash. Then when the wash flows again it entrains the eolian sands to lower elevations wherever the stream flows. In this way, a single sand grain can go back and forth as an eolian sand grain or a fluvially deposited sand grain. No fluvial-eolian cycling studies are known to have been conducted in southeastern California, however, it has become a relatively new area of research for dunes in different parts of the world (Breshears, et al., 2003; Bullard and McTainsh, 2003; Belnap et al., 2011; East et al., 2015; and Liu and Coulthard, 2015). Another process that is occurring in many locations in the RE Crimson is that eolian sands migrate across the alluvial surfaces once escaping their source wash and are then deposited in another wash that is a topographic low on the alluvial fan surface. In some of the higher elevation areas of the RE Crimson, dune sands have accumulated within ancient swales eroded into Older Alluvium (i.e. Soils S4 and S5) or Bullhead Alluvium (Soil S7a). In many of these instances, the flow power of a very small upper watershed area is insufficient to erode out all of the accumulated eolian sands resulting in a small washed shaped eolian depositional area. Hence, the fluvial-eolian cycling geomorphology exhibits a spectrum where on one extreme, and typically at lower elevations, the wash flow is sufficient to clean out all the previously deposited eolian sands, and the other extreme, typically at higher elevations, the wash flow is not sufficient to remove all the eolian sands.

## 6.0 DESIGNATIONS FOR RELATIVE SAND MIGRATION RATE ZONES, SOIL STRATIGRAPHY, AND GEOLOGIC UNITS FOR EOLIAN SYSTEMS

The approach of this study is consistent with previous geomorphic and stratigraphic evaluations of eolian systems written by the author that define various relative sand migration zone designations and soil profile stratigraphy designations (Kenney, 2010a, 2010b, 2010c, 2010d, 2010e, 2011 and 2016). The approach of establishing a series of geomorphic and soil stratigraphic designation greatly assists in the ability to map areas utilizing the designations, and processing the vast data into coherent maps that can be relatively easy to interpret. Hence, they assist in the ability to map and characterize variations in the alluvial and dune geomorphology, activity and age. In addition, new Geologic unit designations are utilized to allow for communication of the geomorphic eolian activity and/or stability of various regions. Hence, the sand migration zone designations provide an understanding of the general eolian activity level, the soil profile stratigraphy provides information on the sediments age, history, and parent material, and the Geologic unit designations indicate if a region is dominated by eolian vs. fluvial systems, and if the eolian dominated area is stable or exhibiting net erosion.

### 6.1 Relative Sand Migration Rate Zones designations

Geomorphic mapping was conducted of the local and regional eolian dune systems utilizing a series of relative sand migration rate zone designations that sequentially describe progressively decreasing dune activity which is suggested to correlate with relative eolian sand migration rates. Hence, this system provides a method for mapping a dune region showing variations in both dune geomorphology and relative sand migration of wind-blown sand. The method also allows for mapping areas dominated by fluvial versus eolian geomorphology. For example, Zones A, AB, B, and BW are dominated by eolian geomorphology. Hence, they exhibit hummocky topography, with interdune depressions (basins), and typically no fluvial drainages extending through their systems. Zone BW is commonly utilized in areas that exhibited stronger sand migration rates in the past (i.e. early to mid Holocene) than since the mid Holocene. Hence, Zone BW is typically used for areas once believed to be a Zone AB or B that has evolved to a Zone BW. Zone BC typically exhibits a mixture of fluvial and eolian geomorphology but in most instances, exhibits over 50% in aerial extent eolian geomorphology. Areas mapped as Zone C are dominated by fluvial geomorphology however, minor eolian sands do migrate in these areas but not sufficiently strong to allow for significant eolian deposits.

One advantage to this method of mapping compared to Lancaster (2014) is that even regions where the eolian deposits may be less than 1-foot thick, if the area exhibits actively moving sands, and the area is dominated by eolian geomorphology, the region will likely be mapped as a dune depositional area. Lancaster (2014) defines actives dunes a being at least 1.5 meters thick, which for the regional mapping he conducted may be sufficient, but is not sufficient for the scale of a single project site dune evaluation.

It has been observed throughout Chuckwalla Valley that many dune systems are dominated by relict (dormant) dunes that once received more eolian sands during times of increased eolian sand migration. The designated sand migration zone system utilized herein provides mapping criteria to delineate areas that once received more eolian sand and have subsequently become more stabilized. Namely, Zone BW represents areas that are dominated by older relict dune forms associated with a past dune aggradational event but since that time have primarily only exhibited active eolian sands associated with thin sand sheets and small coppice dunes.

Photographs of the various relative sand migration rate zones within the RE Crimson are provided in Appendix C.

**Figure 6A:** Descriptions of Relative Sand Migration Rate Zones from the strongest to weakest – Zone A, Zone AB and Zone B.

## RELATIVE SAND MIGRATION RATE ZONES
## GEOMORPHIC DESCRIPTIONS

**ZONE A - Relative Strong Sand Migration Rate (SMR)**
Zone A is the most robust eolian dune system areas mapped for this study. The region is dominated by dune geomorphology with the majority of exposed surfaces exhibiting active moble eolian sands. Zone A exhibits active stabilized and non-stabilized sand dunes ranging from 2 to over 15-feet tall. A Zone A is very limited in the study area but one area occurs 3 miles west of the study nestled within the robust eolian sand source associated with wash and ponding areas of the Wiley's Well Basin. Avalanche faces occur as well as active sand sheets, coppice and possibly dune mounds. Avalanche face directions vary seasonally due to seasonal variations in prevailing wind directions. Hence, the dunes in Zone A are typically complex (Star Dunes) characteristic of multi-prevailing wind regimes. Region dominated by active eolian dune sand deposits, interdune depressions, and a paucity of fluvial drainages other than infiltrating drainages bounded by eolian sands.

**ZONE AB - Moderately Strong SMR**
Exhibits dune geomorphology indicating relatively moderately strong eolian sand transport compared to Zones B and BC. Dune types and geomporpholgy of Zone AB varies along Chuckwalla Valley and could be separated into two separate zones but was not for simplicity and no Zone AB occurs in the Site. Two distinct types of dune geomorphology occur in Zone AB. One on Palen Dry Lake, and the other in the eastern Chuckwalla Valley. The dune geomorphology varies likely due to whether two "prevailing winds" may occur in a particular region of a single much more dominant single prevailing wind occurs. For example, Zone AB dunes on Palen Lake exhibit migratory transverse barchan dunes that due to a pronounced relatively strong west to east valley axis prevailing wind regime exhibit strong dune forms and less vegetation. In contrast, in the eastern Chuckwalla Valley west of the Site, Zone AB areas are generally dominated by active sand sheets (loose sand-ripple deposits), dune mounds, coppice dunes, and weak, low relief, highly stabilized linear dunes trending approximatley east-west. The increased vegetation and linear nature of the dunes west of the Site are believed to occur due to two relatively dominent prevailing wind regimes. Namely, from the south-southwest and west. West of the site, Zone AB exhibits scattered small 2 to 4 foot tall avalanche faces (dunes) that likely only occur during seasonal strong windy periods. Zone AB is dominated by eolian dune sand deposits, interdune depressions, and a paucity of fluvial drainages west of the Site. Active and connected network of dune mounds generally occur with taller more ancient dune mounds eroding within the system suggesting the dune area was more robust in the past (early to mid Holocene).

**ZONE B - Moderate SMR**
Area dominanted by dune geomorphology (paucity of stream washes) which in most cases clearly exhibited a higher sand migration rate in the past (early to mid-Holocene) than in Historical times. Zone B generally consists small active coppice dunes and tails, and sand sheets. Older, inactive and relatively taller dune mounds and relatively taller coppice dunes often occur that are generally eroding which provides an internal and downwind eolian source for active sand sheets and small coppice. Vegetation density is qaulatatively generally greater than 10 to 30% in Zone B at all times, and varies depending on recent precipitation and whether a Sahara Mustard bloom occurs which if it does, increases vegetation aerial densities to over 90% for upwards of 2 to 3 years following the bloom. Region exhibits a paucity of tributary drainages if any, and the aerial extent of interdune depressions with gravel lag is greater than in Zones A and AB. Gernerally, the aerial extent of interdune lag surfaces varies but in places can be over 30%. In many locations, alluvial deposits exhibiting S2 to S4 soils (3,000 to over 35,000 years old) often occur at depths of less than 1 foot within the interdune depresions. In addition, dune deposit-interdune depression relief is generally 3 to 6 feet. These observations indicate that the eolian deposits within the majority of Zone B are only 3 to 6 feet thick and were dominantly deposited during the Holocene. Loose - active eolian sand are generally sand sheet sediments and are typically less than 1 to 3 inches thick with older stabilized eolian deposits of approximately late Holocene age occuring imediately below the active sand sheets. Avalanche faces are rare, scattered and seasonal, and typically 1 to 3 feet tall. Dunes mounds and coppice dunes are strongly stabilized.

**Figure 6B:** Descriptions of Relative Sand Migration Rate Zones from the strongest to weakest – Zone BW, Zone BC, Zone C, and Zone D. Note that Zone D is not mapped on the plates and figures within this report is for the most part assumed to occur outside of the mapped regions of the other relative sand migration rate zones.

## RELATIVE SAND MIGRATION RATE ZONE GEOMORPHIC DESCRIPTIONS - CONTINUED

**ZONE BW - Moderate to Weak SMR**
Area dominanted by dune geomorphology (paucity of stream washes) however evidence of remnant washes often occur. Zone BW is characterized by relatively dense vegetation (stabilized coppice and dune mounds), interdune basins with gravel lag surfaces, and relatively thin active eolian sands in the form of sand sheets overlying older dune deposits. Zone BW exhibits an older dune system that was once more robust than it has been during the late Holocene, and coppice dunes and relatively taller dune mounds are eroding by wind abrassion to produce active eolian sands for downwind areas. No avalanch faces occur in Zone BW. Zone BW represents regions inwhich more active robust dunes have receded from during mid to late Holocene.

**ZONE BC - Weak with some areas exhibiting Moderate SMR**
Region exhibits characteristics of dune and fluvial-fan geomorphology suggesting relatively weak to moderate eolian sand migration rates. Most of the exposed eolian deposits are older and inactive eolian sands (Qe-ds) and active eolian deposits are domianlty in the form of sand sheets, and seasonal small dune tails. Active eolian sands are generally only 1 to 2 inch thick sand sheets overlying relatively firm older eolian sands. Older and relatively taller coppice dunes and occossional mounds often occur in small areas indicating relatively stronger sand migration rates in the past (i.e. early to mid Holocene) and the eroding older dune sands provide a local minor source for downwind dune systems.

**ZONE C - Weak to Very Weak SMR**
Exhibits weak dune geomporphology indicating weak to very weak eolian sand migration rates. Active dune sands occur as scattered and disconnected active sand sheets and small coppice; in general however, most plants do not exhibit active coppice dunes. Typically, Zone C is generally dominated by fluvial geomorphology with bar (fan-terraces) and swales relief. Zone C is generally dominated by gravel lag surfaces. Some active eolian sands occur within some washes and tens of feet downwind resulting from the wash itself providing the local eolian sand source. In some cases these washes are fairly minor only exhibiting an active wash approximately 10 to 20 feet wide with a bar and swale relief of 6 inches to 2 feet.

**ZONE D - Very Weak with minor areas near active washes exhbiting Weak to Moderate SMR**
Exhibits nearl geomorphology and geology dominated by fluvial processes and non-eolian processes. Active loose sand coppice dunes typically do not exist, and if they do are degrading. However, similar to Zone C, some minor areas of active eolian sands do occur within washes where the eolian sands are derived from the local wash itself. Most areas mapped as Zone D do not exhibit ancient dune deposits suggesting that these regions were never dominated by eolian processes.

### 6.2 Soil stratigraphy

A soil stratigraphic evaluation of an area is the identification of various members in terms of relative and numerical ages. Minimum numerical ages for the alluvial fan and eolian deposits are estimated based on the soil development of surficially exposed portions of each unit on an abandoned fan terrace and within near surface eolian deposits respectively. Relative ages of the stratigraphic units are determined by observing older units buried by younger units.

Soil profiles develop in sediments (or even rocks) when they are exposed to mechanical and chemical weathering processes, and wind-blown dust accumulates in surficial deposits. Over time, soil profiles exhibiting a more yellowish brown to reddish color develops, and increases in secondary silt, clay and carbonate. Soil profiles, and particularly their B horizons tend to get denser with secondary minerals such as silt, clay and carbonate in addition to exhibiting a blocky structure. On the surface, desert pavement, desert varnish, and rubification (reddening under clasts) all generally increase over time if the surface is not disturbed. In desert environments, the A horizon is commonly a vesicular Av horizon that if not disturbed can locally attain thicknesses of a little over an inch for the older soils (i.e. Soil S3b and older, Figure 7a). In many local soil profiles, due to the location of the project within a valley axis that exhibits dune systems, the relative amount of wind-blown dust and even sand in alluvial soils is higher than in other environments.

A very important aspect to the soil stratigraphic evaluation herein was identifying the type of parent materials that the soils developed in. This was critical because it allowed for more detailed mapping of contacts between older alluvium and eolian deposits in the study area. In other words, it allowed for the construction of soil maps that also delineate areas of eolian vs alluvial deposits. However, because the eolian dune systems are youthful in the study area (mid-Holocene), the lateral limits of eolian deposits mapped via soil stratigraphy (parent material) are similar with the those of relative geomorphic sand migration Zone BC, which is essentially the edge of mapped dune deposits in this study.

For alluvial deposits, the best soil descriptions for each soil unit are those obtained in test pits on the preserved fan terraces where that designated soil has remained exposed to surficial dynamic soil forming processes for the longest time. For example, from the time of cessation of deposition to current times. These exposures are considered the “type location and description” for each designated soil. The soil descriptions provided in Figure 7A and Figure 7B are from type location descriptions. However, once type location descriptions are obtained, the same soils units are also identified as buried soils where younger sediments have deposited over them. This assists in further developing the relative soil stratigraphy and cumulative ages for the various units. For example, older alluvium members are generally exposed on preserved, elevated and abandoned fan terraces progressively further up the fan, but become buried by younger alluvial deposits at progressively lower reaches of the fan. This relationship of older vs younger alluvial fan units is referred to as their morphostratigraphic relationship.

**Figure 7A:** Designated soils for the region of the project S0, S1, S2, S3a, and S3b.

**SOIL STRATIGRAPHY DESIGNATIONS (HOLOCENE)**
**ESTIMATED AGE, AND DESCRIPTION**

| | |
|---|---|
| **S0** | **S0 <1000 years (1 kya)** Essentially no to very weak readily apparent secondary soil properties. Very week secondary carbonate (CaCO3). S0 soils are assumed to occur (hen |
| **S1** | **S1 1 to 3 kya** No desert varnish on clasts, weak chemical and wind abrasion weathing of surficial gravel lag clasts, weak surface gravel packing. Essentially no rubification under gravel lag clasts, very weak secondary carbonate under clasts. Secondary soil properties include an ~1/8" Av horizon but quite often does not exist, a weak Cambic Bw horizon commonly to a depth of ~3" depth identified by "yellowing" (strong brown 7.5 YR 5.6 dry common) and weak cementation (firmer) than underlying C Horizon parent material. Very weak blocky structure and moderate carbonate fizz occurs in relatively strong S1 soils. In these instances the B horizon is more readily identifiable as a firmer, darker color zone that is commonly 1 to 3 inches thick. |
| **S2** | **S2 3 to 5 kya** No to very weak desert varnish with weak cheminal and wind abrasion weathering of surficial gravel lag clasts. Slightly perceptible rubification and ~1/16" thick carbonate rings along beneathgravel lag clasts. Av horizons occur in places that when maximized exhibit 1/4" to1/2" thick gray to light yellowish brown (10YR 6/4 dry) vesicular layer. Cambic Bw horizons (3 to 4 inches) occur below the Av horizon exhibiting minor secondary fines (silts and clays), penetrative carbonate (moderate acid fizz, Stage I) and slight hardening of B horizon (very weak blocky structure) relative to underlying C horizon parent material. Well developed S2 soils exhibit weak horizontal secondary silt-clay carbonate lamelae. |
| **S3a** | **S3a 5 to 8 kya** Weak to moderately developed desert pavement and varnish, faint but clearly visible rubification, carbonate coating along clast-surface contact, softening of exposed clast surfaces from wind abrasion. Av horizon is more common in S3a soils than younger soils and and is generally ~1/4"thick, clearly vesicular, and pink (7.5YR7/3 dry). The B horizon is generaly Reddish Brown (5YR 7/3 dry) when developed in parent sandy silt deposits to light yellowish brown (10YR 6/4 dry) to light brown (7.5YR 6/4 dry) in gravelly sand parent material, medium dense, blocky, iron oxide staining along vertical joints (moderate blocky structure),Bwk horizon within 8" to 10" of surface, visible stage I- to I carbonate stringers-concentrations and/or carbonate 1/8" to 1/4" blebs (concretions). Moderately developed secondary silt-clay-carbonate horizontal lamelae can occur. Note that in the southern Palo Verde Mesa region, the parent material likely originallyexhibited a pale reddish color due to the source of this material from the erosion of the pale reddish brown Bullhead Alluvium (Soil S7) along the northern flanks of the Mule Mountains. |
| **S3b** | **S3b 8 -12 kya** Moderate developed desert pavement and desert varnish on gravel lag clasts. Thin carbonate coatings are visible underlying gravel lag clasts and some clasts exhibit moderate rubification that is stronger than for S3a soils. Chemical and wind abrasiion erosion of surface gravel lag clasts is stronger than for S3a soils. Av horizons are common and are generally 1/4" pink (5YR 7/3 dry). B horizons when undisturbed are generally 6 +/-3 inches thick, redish yellow (5YR 5/6 dry) to reddish brown (5YR 6/4 dry to damp) with with secondary translocated clays and silt exhibiting a moderate to strong blocky structure and vertical fractures extending through the B horizon. Btk horizon members occur with stage I to stage II carbonate stringers, and horizontal Bk horizons. Horizontal, very thin clay-silt-carbonate lamelae are common. Carbonate acid reaction fizz is typically violent in the B and underlying C horizons. Cabonate 1/8" concretion blebs are also common in the C horizon extending to depths of over 2 feet. Note that in the southern Palo Verde Mesa region, the parent material likely originallyexhibited a pale reddish color due to the source of this material from the erosion of the pale reddish brown Bullhead Alluvium (Soil S7) along the northern flanks of the Mule Mountains. |

Eolian depositional areas are more complex typically compared to alluvial fan systems due to the dynamic nature of dunes in terms of not necessarily being deposited in horizontal layers, hummocky terrain with interdune basins, and that abrasion and deposition within dune systems is common (re-mobilization of dune sands over time). However, mapping in the dune system clearly identified in most areas, older soil profiles developed in eolian deposits (parent material), located within less than 6 inches to a foot of the surface if not exposed on the surface indicating that eolian depositional rates dramatically decreased allowing for the soil profile to form (remain close to the surface). In many localities across the site and eastern Chuckwalla Valley, the eolian deposits are commonly only 2 to 3 feet thick and overly Older Alluvial deposits (Qoaf). This indicates that a hiatus in deposition occurred between the older alluvium and the younger eolian deposits and that a transition occurred in eolian dominated areas from a alluvial dominated deposition to an eolian dominated depositional period. For the RE Crimson area and across the eastern Chuckwalla Valley, this transition occurred during the early Holocene.

**Figure 7B:** Designated soils for the region of the project S4, S5, S6, and S7.

## SOIL STRATIGRAPHY DESIGNATIONS (PLEISTOCENE AND PLIOCENE) ESTIMATED AGE, AND DESCRIPTION

**Note: There are no identified soils with an age less than 35 kya (S4) and 8 to 12 kya (S3b), suggesting that minor deposition occured during the late Pleistocene in the area. This is similar to soil stratigraphy in the southeastern California region.**

S4

**S4 > 35 kya (likely 35 to 70 kya, Late Pleistocene)**
Moderate to well developed desert varnish and pavement. Av horizon is common and typically ¼ to 1 ½ inch thick, pink (5YR 7/3 dry). Bt horizon is commonly 4 to 8 inches thick, yellowish red (5YR 5/6 dry), but often overlies a buried Bt horizong of soil S5 that is also reddish in color. Bt horizon is medium dense to dense, exhibits pinhole porosity, abundant carbonate (moderate to violent acid fizz), secondary clay, clay ped bridging with blocky structure from 8 to 13 inches depth. Numerous vertical joints filled with Av material spaced at 3 to 8 inches and extending 3 to 6 inches deep occur. Btk horizons occur and vary depending on the parent material. 1/8 inch in diameter carbonate concretions in fine grained parent materials and crude parallel to surface carbonate lamellae in coarse grained parent materials. Carbonate coatings on the underneath side of clasts, are common. S4 soils identified are typically very dense. S4 parent sediments likely deposited during the 55 kya regional alluvial fan aggradiational event (Bull, 2000). The S4 soil is widespread across the eastern Chuckwalla Valley and underlies all dune deposits indicating the local dune systems were deposited after soil S4. The late Pliestocene S4 soil is easily distinguished from Holocene age soils (S0 through S3b) due to its deep red color and density.

S5

**S5 > 100 kya. Likely Early to Mid Pleistocene**
Well developed desert pavement and varnish. Relatively strong rubification underlying clasts. Bt horizon is yellowish red (2.5 - 7.5YR 5/6 dry, 4/6 moist), very dense, blocky, abundant secondary translocated silts and clays. Btk horizons occure exhibiting stage II carbonate, 1/4 to 1/2 inch diameter carbonate concretions. Soil profile is a minimum of 2 ft thick, but nowhere was the entire profile examined. S5 soils commonly occur in the Chuckwalla Valley immediately below S4 soils with unconformity; however, S5 terrace surfaces upslope occur at relatively higher relief (vertically) above S4 terraces.

S6

**S6 < 3.5 mya (million years ago) Early Pleistocene or possibly Late Pliocene**
Older alluvium deposits shed from the Mule Mountains with strongly developed soil profile resting unconformably on top of the Bullhead Alluvium Colorado River deposits (Soil S7 below) extending to upper elevations at a minimum of 850 feet. This soil was not examined in detail but was mapped in the field in several locations. The preserved terrace surfaces of soil S6 exhibits very strong desert pavement and desert varnish. Well developed Stage II to III carbonate and a well developed B horizon occurs.

S7
S7a

**S7 & S7a ~ 4.3 mya Early Pliocene (Tmw - S7 and Tmm - S7a)**
Colorado River Gravels of the Bullhead Alluvium identified along the western margins of the Palo Verde Mesa in the eastern most Chuckwalla Valley from elevatons 430 t 450 ft. Unit correlates with unit QTmw of Stone (2006; herein designated as Tmw-S7 as the unit is likely early Pliocene) and Unit B of Metzger et al.,1973. Soil development consists of minimum Stage IV carbonate that fills the cobble matrix nearly 100%. The gravels are exotic, mostly well rounded indicating thawleg river tansport, however, many cobbles are also weakly oblate indicating some "beach" type back and forth erosion occured possibly associated with an ancient Colorado River edge beach bar environment. Unit Tmm-S7a represents quiet water and fluvial deposits associated with the Colorado River inundated Chuckwalla Valley up to elevations over 1,100 feet. These deposits are extensively exposed along the northern flanks and within the Mule Mts.

The soil stratigraphy developed during this study was conducted for the purposes of evaluating the Holocene and latest Pleistocene in more detail than the early to late Pleistocene and the Pliocene. This is because the eolian dune deposits exposed at the surface clearly overlie late Pleistocene older alluvial deposits (Soil S4) and other older soil units that are widespread across the Chuckwalla Valley, and across the southeastern California region. In many places, particularly at lower elevations, Holocene age eolian dune deposits overly early to mid-Holocene alluvial deposits indicating that the dune sediments were deposited since the mid-Holocene.

Example photographs of the various designated soils exhibiting both alluvial and eolian parent materials are provided in Appendix D.

### 6.3 Geomorphic-Geologic eolian unit designations for eolian systems

Performing a Geomorphic and Geologic evaluation of an area, and particularly regions as dynamic as eolian and active wash systems, led to the development of terms that describe both the geologic unit, and its geomorphology. That is the motivation for the Geomorphic-Geologic terms provided in Figure 8A and Figure 8B. The root terms of Qe and Qal describe whether an area is dominated by eolian processes, or alluvial-fluvial processes respectively. These terms are then modified to describe various geomorphic parameters. For example, the following terms are used to describe eolian areas (Figure 8A): “-a” for active eolian area, “-d” for dormant, “-ds” for stable dormant eolian sands, “-de” for dormant eolian sands that are eroding, and “-df” for an area dominated by older dormant eolian sands with a component of fluvial geomorphology. A similar approach was taken for alluvial depositional areas shown in Figure 8B.

**Figure 8A:** Geomorphic-Geologic eolian unit designations to assist in described not only the type of geologic units are exposed at the surface, but also about the geomorphic dynamics as well.

# GEOMORPHIC-GEOLOGIC EOLIAN UNIT DESIGNATIONS

**EOLIAN GEOMORPHICALLY DOMINATED AREAS**

Areas qualitatively field assessed to exhibit >50% eolian surficial deposits (geomorphology) are designated as Qe- (eolian depositional area), and regions exhibiting >50% fluvial deposits(geomorphology) are designated as Qal (fluvial depositional area)


**Eolian Dune Deposits (e)**

**Qe** Mapped areas via qualtitative field assessment that are dominated by eolian deposits-geomorphology (>50%) vs. fluvial deposits. Areas dominanted by interdune depressions, ripples, coppice, mounds, and/or dunes.


**Active Dune Areas (a):**

**Qe-a** Aeolian sand areas exhibit >50% active sands. Areas generally exhibit active sand sheets (ripples), coppice, and possibly mounds and/or dunes. If dune deposit areas exhibit <50% active sand, then the area is designated as a Dormant Dune Area (below). Qe-a regions may still have recieved more aeolian sand input in the past than has been the case in the late Holocene (i.e. degrading older dune deposits are permissable).


**Dormant-Dune Areas (d):**

**Qe-d** Eolian sand areas exhibit>50% "dormant" eolian deposits that is currently stable (not eroding (Qe-de) or exhibit significant erosion of older dune deposits to provide a source for downwind dune systems (Qe-de). Qe-d areas once recieved more eolian sand in the past than during the late Holocene. These area generally coincide with Sand Migration Zone C but can occur locally within stronger sand migration zones.

**Qe-ds** Area dominated by "dormant" eolian deposits that is currently stable (s) and not exhibiting significant erosion (i.e. providing a current source for eolian deposits (downwind).

**Qe-de** Area exhibiting significant abrasion (erosion - e) of older "dormant" dune deposits resulting in a source of "new" eolian sands for downwhin dune system.

**Qe-df** Area dominated by dormant (d) eolian sand deposits (Qe-d) in the near surface but active fluvial (f) features have begun to develop during the late Holocene. Hence, an older dune system that had received sufficient eolian sand flux to support a dune dominated system in the past (i.e. latest Pleistocene to mid Holocene), but due to a decrease in sand migration rates, fluvial processes have become the dominant active geomorphic process in the area.

**Figure 8B:** Geomorphic-Geologic alluvial unit designations to assist in described not only the type of geologic units are exposed at the surface, but also about the geomorphic dynamics as well.

## GEOMORPHIC-GEOLOGIC ALLUVIAL UNIT DESIGNATIONS

### ALLUVIAL - FLUVIAL GEOMORPHICALLY DOMINATED AREAS

Surface Geomorphology dominated by alluvial-alluvial depositional and erosional processes (>50%.)
For example: Qualitatively fluvial (i.e. drainages, bar and swale, fan -terraces >50% aerial extent) geomorpholgy vs. eolian (dune deposits, interdune depressions, etc areas <50% aerial extent).


**Qal** Quaternary alluvial deposits (Holocene age, < 10 to 12 kya) Area is dominated geomorphically and geologically by fluvial processes (~ >50% of surface area). Hence ~ > 50% of area qualitatively exhibits drainages, washes, bar and swale, fan-terrace surfaces, and/or gravel lag surfaces. Coincides with Soil Designations S0 through S3b.

**Qal-a** Active alluvial wash and a source for new eolian sands. These areas are mapped as S0 soils on the Sand Migration Zone and Soil Stratigraphy.

**Qal-eda** Subordinate minor active eolian deposits typically in the form of very thin not contiguous active sand sheets and/or coppice dunes. In Qal-eda mapped regions, the active eolian sands areas are >50% of the total eolian depositional areas and indicate an area of moderate active eolian sand transport (these regions generally coincide with San Migration Zones BC or C.

**Qal-eds** Subordinate stable (dormant) eolian deposits in the area that are stable and generally not abrading (erode). Hence, Qal-eds areas are a poor (weak) source of new eolian sands if at all. These areas indicate that the area once recieved more eolian sand than they do during recent times. Hence, that the eolian system is less robust-active than it once was during the Holocene. Qal-eds regions generally coincide with either relative Sand Migration Zones C or D.

**Qal-ede** Subordinate minor eolian sands that are eroding resulting in the area producing an eolian sand source for down wind dune systems. Qal-ede regions also indicate that the eolian system is less robust-active than it once was during the Holocene. Qal-ede typically coincides with relative sand migration zone C.

Quaternary Older Alluvial Fan deposits (Qoaf) represent alluvial sediments that were deposited primarily during the Pleistocene (Figure 8C). These deposits represent soil units S4, S5 and S6 described in Figure 7. Two older units designated as Tmw and Tmm (Soils S7 and S7a respectively; derived from Stone, et al., 2006 units QTmw and QTmm) are also utilized in this report (Figure 8C). These formations are described in more detail in report section 8.1 below, but are important for this study because understanding their age of late Miocene to early Pliocene indicates that most geologic actively in the study area has been quite minimal since their deposition, and because the erosion of these units provided an important source for eolian sands and alluvial deposits locally.

**Figure 8C:** Geologic unit descriptions for Older Alluvium (Qoaf) and units of primarily the Bullhead Alluvium (Tmw - Soil S7 and Tmm – S7a).

# GEOLOGIC UNITS

**Qoaf** Quaternary older alluvium-fan deposits (late Pleistocene age; ie. >12 kya). Where exposed at the surface, area is dominated geomorphically and geologically by fluvial processes. In most instances this unit is shown exposed at the surface as abandoned terraces. Coincides with Soil Designations S4, S5, and S6.

**Tmw (S7)** Tmw represents ancient Colorado River shoreline berm (beach) deposits of the Bullhead Alluvium. Tmw also designated as as soil S7 on many plates and figures. Tmw consists of rounded, and oblate exotic cobbles generally range in size of 2 to 4 inches. Similar age sediments likely occur along the ancient river cutbank located along the eastern margin of the Palo Verde Mesa as mapped as Unit B of Metzger et al. (1973). Tmw provide stratigraphic evidence associated with a receding ancient Colorado River and associated lake basins from the Chuckwalla Valley and PaloVerde Mesa. The unit outcrops in the range between elevations of ~400 to 450 foot elevation from the northeastern Mule Mountains, across Chuckwalla Valley, and east of the southeastern McCoy Mountains. Relatively prominent outcrops of Tmw immediately above the 430 foot elevation exhibit tear drop cross-sectional profiles that resemble beach "shoreline" berms (lake subbasins). Stratigraphically, Tmw (soil S7) occurs at lower elevations than the ancient Colorado River derived unit Tmm described below.

Tmw occurs at relatively shallow depths (less than 1 to 5 feet in many areas) across the Palo Verde Mesa. This indicates that Palo Verde Mesa has remained a very stable Geologic and Geomorphic region for well over 2 million years having only recieved relative thin alluvial and subsequent very thin eolian deposits since that time (less than 5 feet in many areas). Tmw herein to correlates with map unit QTmw of Stone (2006), however in this study, Tmw is likely Pliocene in age and not Quaternary. Tmw correlates with the Bullhead Alluvium of Fenton and Pelletier (2013) and Howard et al. (2014), and Unit B of Metzger et al. (1973). Tmw is mapped in this report as the younger member (Soil S7) of unit Tmm (Soil S7a) described below. Unit Tmw is interpreted herein to have deposited soon after the dominant aggredational event of the Bullhead Alluvium (unit Tmm below) in the early Pliocene when the ancient Colorado River inundation of Chuckwalla Valley receded estimated to have occured between 4.5 to 3.5 million years ago by Howard et al., (2015).

**Tmm (S7a)** Tmm represents ancient Colorado River "sub-basin lake" sediments and are shown as soil S7a in many plates and figures in this report. Tmm deposited when the acient Colorado River engulfed Chuckwalla Valley during the early Pliocene (4.5 to 3.5 million years ago, Howard et al., 2014). The ancient Colorado River completely filled Chuckwalla Valley to a minimum highest elevation of 850 feet(Howard et al., 2014). However, based on aerial imagery mapping in this study of similar sediments, the "lake" levels may have achieved an upper elevation of approximatley 1200 feet.

Tmm correlates with map unit QTmm of Stone (2006), however as described herein, Tmm is likely Pliocene in age. Tmm correlates with the Bullhead Alluvium of Fenton and Pelletier (2013) and Howard et al. (2014), and Unit B of Metzger et al. (1973). Howard et al. (2014) indicate that the Bullhead Alluvium (unit Tmm) was deposited between 4.5 and 3.5 million years ago (early Pliocene). Howard et al. (2014) indicates that the Bullhead Alluvium contains fossilized wood and this was identified in local outcrops of unit Tmm in the eastern Chuckwalla Valley project area.

Based on the evaluation of wash cut banks along the northwestern flanks of the Mule Mountains, Tmm is composed of light reddish silty sand members with occassional small gravel channel deposits. Some, but not all of the clasts are of exotic origin, suggesting that gravel clasts were derived from distances tens of kilometers away (Colorado River watershed) and local mountainranges, but further analysis is needed.

## 7.0 GEOLOGY AND GEOLOGIC HISTORY SINCE THE EARLY PLIOCENE

Understanding the geologic history of an area prior to the development of the surficial eolian dune system places the development of the dunes in temporal and spatial context. For example, the findings of this report indicate that the landscape of the eastern Chuckwalla Valley and Palo Verde Mesa has experienced on average about 5 to 6 feet of alluvial deposition in many areas during the entire Quaternary (i.e. past 1.7 million years) and since the late Pliocene. Hence, most of the general topography in the study area was already in place by the end of the Pliocene, and has changed very little since that time.

The simplified Geologic History of the region of the RE Crimson in the eastern Chuckwalla Valley and Palo Verde Mesa area includes:

- *Pliocene:* Deposition of sedimentary deposits in Late Miocene through Early Pliocene associated with large water bodies of the ancient Colorado River up to elevations of over 1,200 feet. These deposits occur along the flanks and nestled within the local mountain ranges and at depths of several feet across the RE Crimson (units Tmw – Soil S7 and Tmm, Soil S7a). Note that Tmw is younger than unit Tmm and represents a recessional shoreline of the ancient Colorado River system.

- *Pliocene:* Deposition of coarse grained older alluvium (Soil S6) on top of unit Tmm in unconformity along the northeastern flanks of the Mule Mountains during recession of the ancient Colorado River inundation of the Chuckwalla Valley. May be close in age with the ancient Colorado River shoreline berm deposits of unit Tmw (Soil S7).

- E*arly to Mid Pleistocene:* Deposition of older alluvial unit S5 (Qoaf) along the flanks of the local mountains during the Early to mid-Pleistocene. These units were not identified in the valley axis nor the Palo Verde Mesa and were possibly eroded away as soils S3b and S4 were observed to be deposited directly on top of the Pliocene age unit Tmw (Soil S7) in several localities on the Palo Verde Mesa area. S5 consists of coarse grained debris flows and finer members composed of reworked unit Tmm (Soil S7a).

- *Late Pleistocene:* Deposition of a series of older alluvial fans in the Pleistocene, the most significant member being a 70 to 35 kya deposit (Soil S4) that extended across Chuckwalla Valley and under the local dune systems. S4 typically consists of minor debris flows and abundant finer members composed or reworked unit Tmm (Soil S7a)

- *Late to Latest Pleistocene:* Deposition of a series of alluvial fan deposits in the latest Pleistocene and early Holocene that were deposited across eastern Chuckwalla Valley and the Palo Verde Mesa region. Units correlate with Soil S3b. There is no evidence that any eolian deposition occurred during this time. There was cessation of alluvial deposition during the Latest Pleistocene between approximately 35 to 12 kya.

- *Early Holocene:* Initiation of deposition of eolian deposits in the region of the RE Crimson in the early Holocene in small areas in terms of being preserved. Eolian sands are added to alluvial soils (mix) indicating eolian sands are created in higher magnitudes than the past but not quite dominating. Cumulate soil stratigraphic ages of eolian deposits indicate that the oldest eolian deposits are early Holocene in age. However, no eolian deposits were identified that exhibited an early Holocene age soil (i.e. S3b) suggesting that ongoing eolian activity occurred in dune systems extending to the end of the mid Holocene and possibly extending into the late Holocene. Alluvial deposition occurred across wide areas of the distal portion of local alluvial fans identified by abundant preserved S3b alluvial preserved surfaces (bars). Numerous test pits exhibit a clear transition from alluvial deposition to dominantly eolian deposition in the RE Crimson area occurring during the early Pleistocene.

- *Mid Holocene:* Eolian deposition occurred in dune areas in addition to alluvial fan deposition in distal portions of the fan. Alluvial deposits of S3a age were deposited over large areas of the distal fan region. Eolian source magnitudes and depositional rates in dune areas and migration zones increased during this time. This lead to the dominant component of the eolian deposits identified today occurring at this time (dune aggradational event). Many eolian deposits in the RE Crimson area and across the eastern Chuckwalla Valley exhibit mid Holocene soils (i.e. Soil S2) at the surface indicating that the end of the mid Holocene to early Late Holocene was likely the end of a dune aggradational period. Alluvial deposition occurred across wide areas on the distal portion of the local alluvial fans exhibited by Soil S2 and S3a preserved fan surfaces.

- *Late Holocene:* During the Late Holocene eolian depositional systems began to shut down with only minor activity similar to that observed today. This is documented by relatively abundant S1 soils in eolian surface deposits. Minor alluvial deposition continued during this time as washes were constrained within washes created during the Mid Holocene which allowed for the preservation of abundant older S3a and S3b alluvial surfaces across the northern Mule Mountain bajada.

The next few sections describe the geologic history of the eastern Chuckwalla Valley and Palo Verde Mesa region in more detail.

### 7.1 Geologic History from the Late Miocene to Early Pliocene

The oldest pertinent geologic units in the region of the RE Crimson are associated with relatively quiet and large water bodies that engulfed the Chuckwalla Valley during the latest Miocene to early Pliocene. The oldest of these deposits include the Late Miocene to earliest Pliocene Bouse Formation, which was deposited in quiet waters similar to lake conditions that inundated basins up to an elevation of ~1,100 to 1,800 feet along the course of the lower Colorado River (House et al., 2008). In the Chuckwalla Valley, the Bouse Formation was deposited to at least 1,130-foot elevation (House et al., 2008; Spencer at al., 2008). This water body filled the Bristol, Cadiz, Dandby, Rice, Palen, and Ford dry lakes (Plate 1; House et al., 2008; Spencer et al., 2008). It is unknown how many outcrops of the Bouse Formation may occur in the Chuckwalla Valley area as the unit is not shown on published maps, but some outcrops of this unit may be mapped via Google Earth Pro historical imagery during this study as unit Tmm (also soil S7a; Plate 2 and Plate 4).

During the early Pliocene, the Bullhead Alluvium was deposited along the lower Colorado River and represents a strong alluvial aggradational event occurring between 4.5 to 3.5 million years ago (Ma; Howard, et al., 2015). The Bullhead Alluvium was deposited on top of an erosional surface into the Bouse Formation and was deposited as part of the lower Colorado River system when it inundated Chuckwalla Valley up to elevations of 850 feet (Howard et al., 2015). The Bullhead Alluvium in many places is deposited on top of the Bouse Formation but because the Bouse Formation was deposited to elevations of 1,130 feet and the Bullhead Alluvium to an elevation of 850 feet, the Bouse Formation can occur at elevations higher than the

Bullhead Alluvium. A distinctive quality of the Bullhead Alluvium is the presence of petrified wood (Howard et al., 2015), which was identified in outcrops south of the SCE Colorado River Substation (Plate 4).

The Bullhead Alluvium is mapped in this report as two members. These include unit Tmm (soil S7a) which was deposited between 4.5 to 3.5 Ma up to elevations of 850 feet (Howard et al., 2015) but possibly to elevations close to 1200 feet (Kenney, 2016), and unit Tmw (soil S7) which is proposed to represent recessional river edge bars that were likely deposited soon after or near the age of 3.5 Ma (Figure 8C, and Plate 4). Unit Tmw occurs in the region of elevations of 430 to 450 feet and the occurrence of oblate exotic clasts indicates beach erosional processes as well as having been transported a great distance respectively (Plate 4).

Stone (2006) designates two units in the area that he described primarily as alluvial deposits that include QTmm and QTmw (Figure 9). Unit QTmw of Stone (2006) mapped southwest of the McCoy Mountains (Figure 9) as composed of rounded gravels occurring at elevations above Palo Verde Mesa but did not indicate that these deposits were directly related to deposition associated with the ancient Colorado River. However, this unit is the same as the Bullhead Alluvium described by Howard et al. (2015). It is also a member of Unit B of Metzger et al. (1973) who indicates that it is exposed in the cobble rock quarry north of the Blythe 21 solar facility (Plate 4) and along the Colorado River cut bank along the eastern margin of Palo Verde Mesa. The findings of this report provide for the first time the identification of unit Tmw across the eastern Chuckwalla Valley along one of the lower elevation wave cut benches in the northeastern Mule Mountains near elevation 450 feet where unit Tmw cuts into unit Tmm (Plate 4). Other river edge cut banks occur into the older Tmm (Bullhead Alluvium) along exposures of unit Tmm along the northern flanks of the Mule Mountains. Hence, where shown, Tmw (also Bullhead Alluvium) represents deposits along one of the lower elevation river cut banks in the elevation range of 420 to 450 feet (Plate 4) but remnants of others occur at higher elevations as well along the northern flanks of the Mule Mountains where unit Tmm is exposed.

Stone (2006) mapped unit QTmm as an older alluvium unit in and along the flanks of the northern Mule Mountains (Figure 9). Based on the findings of this report and review of scientific literature, it is likely that units QTmm and QTmw of Stone (2006) correlate with the Bullhead Alluvium of Pliocene age. Because of this, within this report these units are labeled as Tmw and Tmm (also as Soil S7 and S7a in this report) as they are likely not deposited during the Quaternary (i.e. Pleistocene). Additional description of these units is provided in Figure 8C.

In many places, older Pleistocene age alluvium is deposited on the Bullhead Alluvium across an erosional unconformity. This is the case in the northeastern Mule Mountains where the older alluvium of Soil S6 is deposited on top unit Tmm of the Bullhead Alluvium, although for clarity, Soil S6 is not shown on plates and figures. This relationship is described by Stone (2006), who mapped the unit as QTmm, and not as the Bullhead Alluvium. It is proposed that unit Soil S6 may have deposited near the time of deposition of unit S7 (Tmw), hence, was deposited as the ancient Colorado River inundation of Chuckwalla Valley still occurred but had receded from its high stand of approximately 850 feet associated with unit Tmm (Soil S7a, Bullhead Alluvium).

Geologic formational units Tmw (soil S7) and Tmm (Soil S7a) are important regarding the eolian evaluation in the RE Crimson area. It is useful that the Bullhead Alluvium has been identified across the eastern Chuckwalla Valley and its age has been well documented to be early Pliocene. This is because it is the oldest positively identified unit across the valley which provides essentially a beginning point for a pertinent Geologic history for the site. Unit Tmw of the Bullhead Alluvium was identified at depths of 1 to 6 feet across the Palo Verde Mesa and at the surface indicating that the total depth of Pleistocene to Holocene age alluvium across the Palo Verde Mesa is relatively thin (i.e. 1 to 6 feet). However, relatively significant erosion of Bullhead Alluvium (unit Tmm – soil S7a) occurring prior to deposition of unit Tmw cannot be ruled out in the valley axis sill and the Palo Verde Mesa. Lastly, more recent (i.e. Holocene) erosion of unit Tmm provided an important local source for the alluvial and eolian systems in the region of the RE Crimson and local valley axis regions. In many places, older alluvial units S4 and S5 are dominantly composed of re-worked unit Tmm. In addition, the erosion of formational unit Tmm is proposed to be the primary source for the eolian sands in the local dune systems and in particular, in the RE Crimson.

### 7.2 Geologic History during the Pleistocene

The approximate time interval of the Pleistocene occurred between 2.6 Ma to ~12 kya. In the Chuckwalla Valley and Palo Verde Mesa area, geologic events occurring during the Pleistocene consisted of deposition of alluvial fans along the flanks of the local mountains (proximal and medial fan areas – soils S4 and S5), but minor net deposition (i.e. slow depositional rates or magnitudes) within the valley axis and Palo Verde Mesa area. Older alluvial units were deposited in the eastern Chuckwalla Valley area during the Pleistocene that are referred to as Soils S4 and S5 (Figure AD-2 in Appendix D). Older alluvial units S4 and S5 in the eastern Chuckwalla Valley are composed of coarse grained debris flows (Figure AD-2 in Appendix D) and some finer grained members that are re-worked unit Tmm. These units extend to distal portions of the alluvial fans (Figure 13). In many places exposed in local washes within and near the RE Crimson project, units S4 and S5 are observed deposited across an erosional unconformity overlying unit Tmm of the Bullhead Alluvium (Figure AD-4 in Appendix D). The age of soil unit S5 is unknown, but based on well developed carbonate concretions is well over 100,000 years. In some places, Soil S5 has developed in Bullhead Alluvium once exposed due to an erosional surface (unit Tmm; Figure AD-11 in Appendix D). Soil unit S4 is estimated to have a minimum age of 35 kya, and may be as old as 70 kya.

### Geologic History in the Holocene

During the Holocene in Chuckwalla Valley, sediments were deposited via alluvial fan, playa lake, and eolian processes, and alluvial deposition dominated across Palo Verde Mesa and the distal fan portions of the northern Mule Mountains bajada. Near and within the site, alluvial deposition has occurred throughout the Holocene but with two periods of increased deposition (aggradation events). These occurred in the early Holocene during deposition of soil unit S3b (12 to 8 kya) and extending into S3a (8 to 5 kya), and the second associated with deposition of soil unit S2 (5 to 3 kya). Alluvial sediments of Sol S2 age appear to be last time that alluvial deposition spread across relatively wide areas on the distal fan areas of the northern Mule Mountain Bajada. After this alluvial channels appear to have been primarily "entrenched" in existing channel systems. The entrenchment of channels since S2 time has provided large fan surface areas relatively "open" for eolian sand migration.

During the early Holocene, soil unit S3b (12 to 8 kya) was deposited across most of the Palo Verde Mesa and local RE Crimson distal fan portion of the northern Mule Mountains bajada. Soil unit S3b mainly consists of alluvial sediments that in places near current eolian activity show evidence of a relatively weak eolian flux-input possibly occurring after deposition as the soil formed on its preserved surfaces. No S3b soils were identified during this study composed of a relatively pure eolian (Qe) source (older dunes) nor were strong S3b soils identified beneath areas of dune dominated deposits. However, in relatively strong eolian depositional areas (areas mapped as Zone AB, B and BW) in the area of the RE Crimson, cumulate soil stratigraphic ages (i.e. age of adding up the age of the surface soil and all buried soils) of the eolian sediment sections indicate that eolian deposition likely began during the early Holocene (Figure 14). For example, soil stratigraphic cumulative ages in eolian systems across the RE Crimson generally range from 11 to 5 kya (Figure 14). In addition, alluvial deposits typically occur below the eolian deposits that are generally about 11 kya (Figure 14). These findings are significant as they indicate that similar to dune systems across southeastern California, eolian systems experienced an aggradational event during the early Holocene and that it was not until the early Holocene, at least locally, that eolian processes were able to become more dominant than fluvial processes in areas of relatively strong eolian sand source and transport (i.e. where sand migration zones are mapped herein; see Figure 12).

During the mid to late Holocene, the age of S3a and to S1 soils ranging from 8 to 1 kya, eolian systems were dynamic in the region of the RE Crimson dune systems. In places older dune deposits were eroded away, some continued to receive a relatively slow but steady influx of new sand (aggradation, See Figure AD-3 in Appendix D), and some show fluxes of aggradation then stability as shown by numerous buried soils). This finding is supported by numerous buried S1 and S2 eolian parent material soil profiles in test pits in the local dune systems. Examples of these are shown on Figures AD-7, AD-8, AD-12, AD-13 and AD-15 in Appendix D. It is also clear that the eolian systems in some areas were competing with alluvial systems during this period of time. Examples of this are shown by an S3a soil developed in a unit exhibiting a mixture of alluvial and eolian sources (Figure AD-6 and AD-9 in Appendix D).

These data indicate that eolian systems began to produce permanent eolian depositional areas in the RE Crimson area in the early Holocene and continued through most of the Holocene. However, eolian sand flux feeding these systems, was very low throughout the Holocene which is supported by very thin total stratigraphic thicknesses of the dunes. The thickest eolian deposits occur along the flanks of the northern Mule Mountains which slow down the wind sufficiently for essentially all the eolian sand to drop out. Drainage systems and watershed areas for the drainages at these elevations are minimum, which is partly due to the fact that many of these deposits occur on abandoned fan terraces. This indicates that once eolian sand deposits in these areas, there are few mechanisms (wind or water) to remove it. These eolian deposits generally range from 1 to 3 feet thick and exhibit cumulative stratigraphic ages dating back to the early Holocene. Hence the eolian depositional rate is approximately 1 to 3 feet in 12 thousand years. This provides strong evidence that the eolian systems in the RE Crimson exhibit very slow dynamics and are quite stable.

Two publications show dune areas in the eastern Chuckwalla Valley area (Stone, 2006 and Lancaster, 2014). A Geologic map of the eastern Chuckwalla by Stone (2006) identifies scattered, non-connected eolian sand depositional areas (Qs on Figure 9). In fact, Stone (2006) shows no dune deposits between central Ford Dry

Lake and just west of the Welly's Well Basin (Figure 9). Stone (2006) indicates that these deposits were mapped primarily from aerial imagery, and it may have been difficult to identify relatively weaker dune depositional areas based on the resolution of the imagery utilized and relatively dense vegetation associated with older very stabilized dune deposits.

Lancaster (2014) published an eolian geologic map that emphasized mapping of eolian dune systems (Figure 10). This map references the author of this report and much of the mapped limits of dune deposits shown in Lancaster (2014) are somewhat consistent with reports published by the author. However, the Lancaster (2014) map "active windblown deposits consisting primarily of dunes and sand sheets" in a much larger and extensive area than is likely the case. Additional eolian dune name designations would have allowed for a more detailed and accurate depiction of the level of dune stability and activity.

Lancaster (2014) inconsistently mapped regions of scattered eolian deposits across the surface of ponding areas and dry lake beds that leads the reader to believe that the dune systems are more extensive, more connected, and active than is the case. This is supported by comparing Figure 10 (Lancaster, 2014) with the mapping conducted in this study (Plate 3B and Plate 4). Lancaster (2014) does indicate a lack of conductivity of the eolian sand system in Ford Dry Lake with the dune systems south of Highway 10 and southeast of the Wiley's Well Rest stop (Figure 10). However, Lancaster (2014) does not clearly indicate that because segments of the local sand migration zones have shut down that this implies that the more regional sand migration zones (corridors) have also shut down.

In the area of the RE Crimson site, Lancaster (2014) shows an area of "Potential Eolian Sources" in the northwestern portion of the site. Although the findings herein agree that the local washes are the primary source for local dune systems, the aerial extent of eolian and alluvial deposits in the northwestward portion of the RE Crimson by Lancaster (2014) is not considered to be as large as he shows (compare Figure 10 and Figure 12).

The Lancaster (2014) map does not show the Mule Sand Migration Zone (SMZ) in the northeastern RE Crimson. This is consistent with his mapping criteria of only mapping dunes where the eolian deposits are a minimum of 1.5 meters thick (~5 feet). As shown in Figure 13, eolian deposits in the Mule SMZ in the RE Crimson site average 1 to 3 feet thick, and likely only in a few localities if at all are thicker than 4 feet. Within the other areas of the RE Crimson, there is general agreement with the mapping of Lancaster (2014) and this report (compare Figure 10 with Figure 12). When comparing these two figures, it is good to keep in mind that most areas mapped as Zone BC (yellow areas on Figure 12) do not exhibit sufficient dune morphology or stratigraphic thickness to meet Lancaster's mapping criteria of a minimum of 1.5 m eolian stratigraphic thickness.

The Lancaster map (2014) of the RE Crimson area (Figure 10) does not show an eolian source area (i.e. Que/Qal) for dune systems along the flanks of the northern Mule Mountains. This interpretation suggests that Lancaster (2014) did not believe that the Wiley's Well Wash is the source of eolian sands for the RE Crimson dune systems. If this interpretation is correct, it is agreed upon herein.

Lancaster (2014) does not indicate the timing regarding when the segments demonstrating much less eolian activity along the regional sand migration corridors occurred other than implying it took place after the end of the early Holocene dune aggradational event. Lancaster (2014) indicates that dune systems were more robust during the eolian aggradational event during the latest Pleistocene to early Holocene, but does not discuss many of the ramifications regarding weaker eolian systems consisting primarily of active sand sheets and coppice dunes since that time occurring over eolian geomorphic landscapes exhibiting ancient-dormant more robust dune forms (large dune mounds, degraded linear and transverse dunes, etc.).

An issue with the Lancaster (2014) report is their definition of active dune systems exhibiting a stratigraphic thickness of at least 1.5 meters (m, ~5 feet). This is misleading for many reasons. First, active sand sheet and coppice dune dominated regions and particularly in the northwestern Palo Verde Mesa area, are less than 1.5 m thick. This is particularly the case as well along the fringes of dunes systems where dune deposits gradually get thinner as they approach an alluvially dominated geomorphic landscape. This is one reason that in this study, geomorphic mapping criteria was done dependent on whether an area was dominated by eolian or alluvial-fluvial geomorphology regardless of the thickness of the eolian deposits. Because Kenney, M (author herein) is referenced in the Lancaster (2014) map shown in Figure 10, it should be made clear that the findings of Lancaster (2014) are not considered consistent with the findings of eolian deposits provided in this report.

**Figure 9**: Modified Geologic map of the study region by Stone (2006).

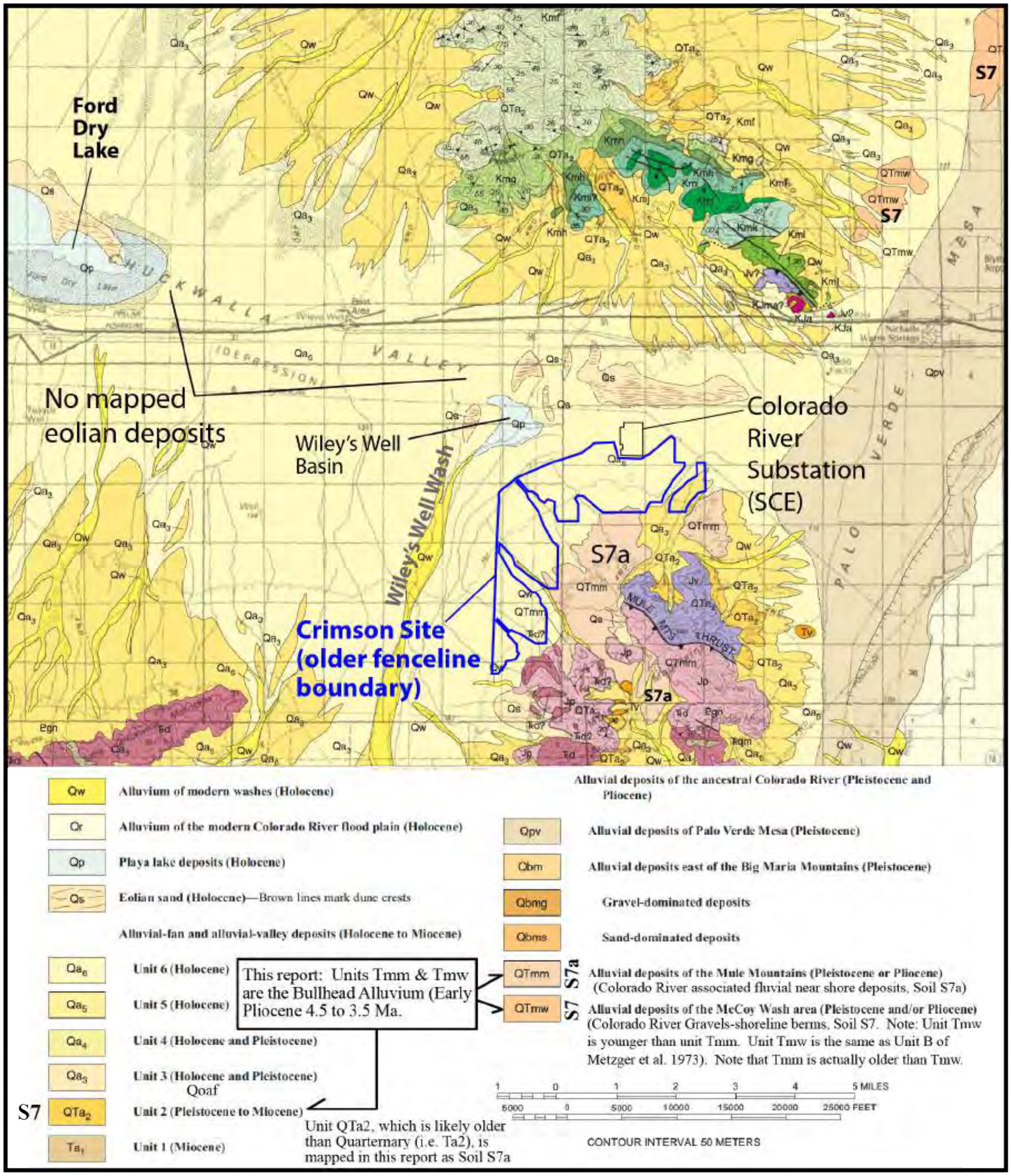
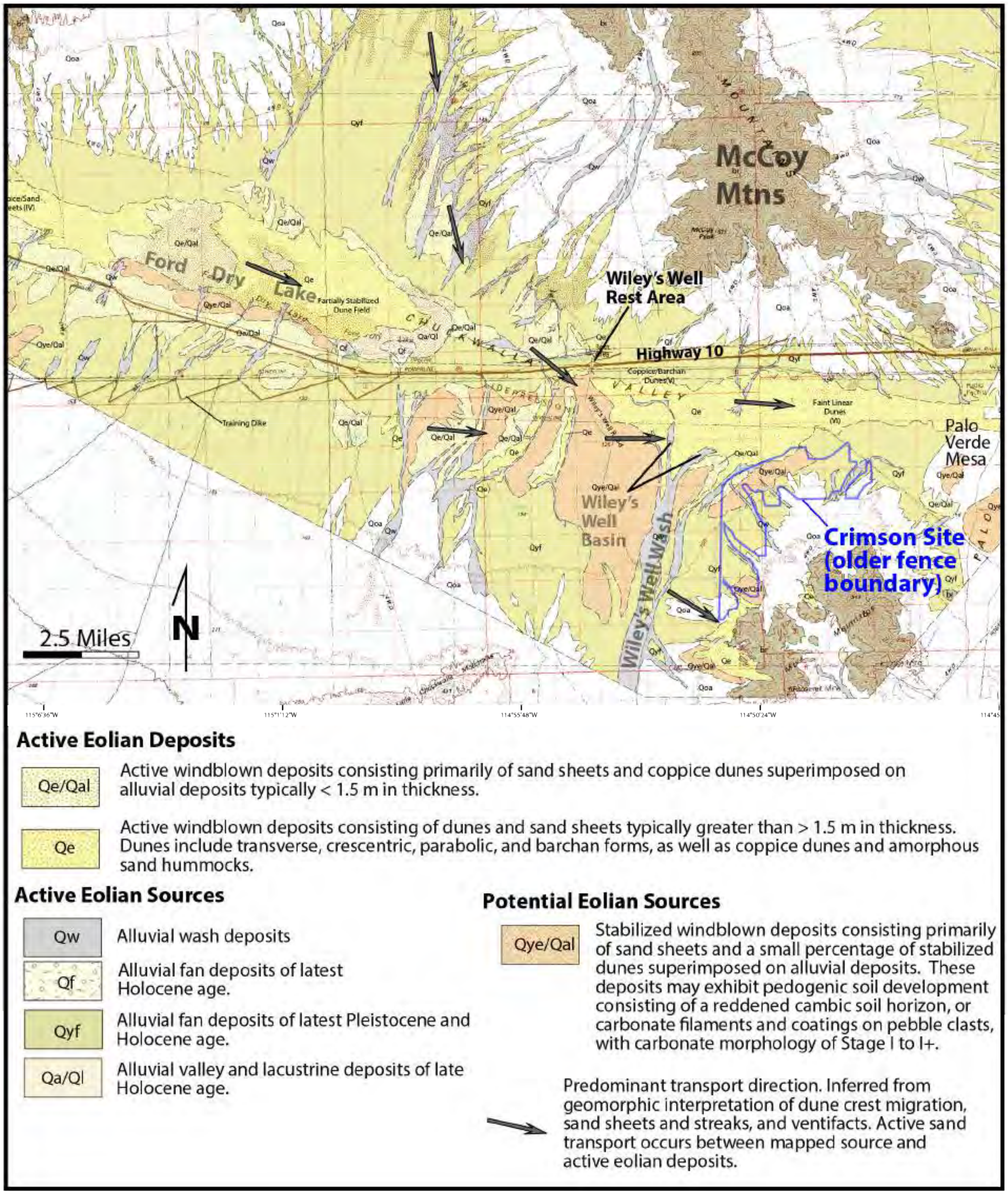


**Figure 10**: Eolian Geologic map by Lancaster (2014). The RE Crimson "fenceline" project boundary is shown.



### 7.3 Geologic History in Historical Times

Generally speaking in desert regions of southeastern California, the primary variation in the local geology during Historical times of approximately the past 100 to 150 years is related to the effects on the dunes from human activity. Namely, the diversion of surface water flow via construction activities and the invasive Sahara Mustard plant. Changes in surface water flow has caused some dune and alluvial areas to receive either an increase or decrease in water flow compared to pre-Historical times in the region of the Chuckwalla Valley axis. Most of these changes are associated with the construction of Interstate Highway 10 and older major roadways in the same general location since the mid-20th Century and do not impact any dune systems in the RE Crimson. The water flow diversions have allowed for additional water to reach some dune areas, and a bit less in others. This is discussed in more detail later in the report, but from the evaluation herein, there is no net impact within the RE Crimson associated with anthropogenic water diversions.

Likely the largest impact to dune systems in the study area and possibly regionally, during Historical times and likely into the future is the invasion of the non-indigenous Sahara Mustard plant. This species experiences dense bloom episodes across eolian dominated depositional areas that may occur approximately every 4 to 7 years based on limited field work data by the author. If this plant persists, it will slow down sand migration rates likely more than an order of magnitude and lead to dune sands depositing closer to their sources.

## 8.0 REGIONAL EOLIAN SAND MIGRATION CORRIDORS IN SOUTHEASTERN CALIFORNIA

Regional sand migration corridors (sand pathways) have been proposed in southeastern California (Zimbelman et al., 1995). These sand migration corridors are proposed to allow eolian sands to migrate east to southeastward within valleys, and even navigating over mountain passes associated with sand ramps in some instances. The proposed regional sand migration pathways occur in regions where the wind-blown sand is transported over various geomorphic landscapes including playa lakes, alluvial fans, and mountain terrains. However, based on mapping provided in this report, the proposed sand migration corridors consist of a series of individual eolian systems that align via connectivity associated with topographically controlled prevailing winds. In terms of sand source, alluvial fans (washes), playa lakes, and migrating wind-blown sand are concurrently active geologic processes which impart their respective geomorphology to the landscape and occur along the length of the proposed sand migration corridors. Lacustrine (playa and pluvial lake beds) and alluvial fan processes are believed to provide the largest source of eolian sand systems. Hence, sand migration corridors receive substantial eolian sands from local sources along their mapped lengths and the proposed regional sand migration corridors were likely originally mapped as such due to connecting a series of relatively distinct dune systems.

The proposal of regional sand migration corridors, which can easily be mapped on small scale maps covering relatively large regions provide a simple model to conceptualize wind-blown sand migration in southeastern California. However, when the regional sand migration corridors are mapped as a continuous zone extending for tens of miles, it has the potential to imply that sand grains may have the ability to migrate along the entire mapped length of the regional sand migration corridor not only during current times, but continuously since its time of development. This subsequently may lead to the assumption that eolian sand sources along the regional sand migration corridor may be many miles upwind and not local. This possible assumption therefore infers that each proposed sand migration corridor has a "Lake Victoria to the Nile River" (source of the Nile River) type source at the northwestern beginning of the regional sand transport zone. This is clearly not the case for most of the proposed regional sand migration corridors.

Since the proposal by Zimbelman et al. (1995) of the regional sand migration corridors in southeastern California, considerable research has been conducted to better understand when the regional eolian systems essentially began to develop, dune activity variations over time, and what are the primary eolian sand sources. However, to the author's knowledge, there is not a publication that attempts to integrate these publications collectively.

### 8.1 Published work regarding regional sand migration corridors (transport pathways)

Numerous geologic, geomorphic and stratigraphic studies have adopted the existence of regional sand transport pathways (sand migration zones) throughout southeastern California (Figure 1, Plate 1 and Plate 2). The initial eolian research in southeastern California that may have provided the concept of regional sand migration corridors was the Sharp (1966) study of the Kelso Dunes. His findings indicate that sand grains migrated 35 miles from their source at Afton Canyon (Lake Manix; Plate 1) toward the east to the Kelso Basin that is bounded by obstructing mountains to the east. Sharp (1966) indicated that the westerly winds transporting the dune sands were topographically controlled by connectivity of local valleys and adjacent mountain ranges.

Based on regional mapping of dune systems in southeastern California, Zimbelman et al. (1995) expanded the findings by Sharp (1966) for the Lake Manix-Afton Canyon to Kelso Dune sand transport zone, that two other regional sand transport pathways occur in southeastern California (Mojave Desert). These include one extending from Bristol Playa through the Cadiz and Danby playa lakes and Rice Valley to the Colorado River, and the other from Dale Lake, across the eastern Pinto Basin, and then continuously down Chuckwalla Valley (Palen and Ford playa lakes) to terminate near the Mule Mountains west of the Colorado River (Plate 1 and Plate 2). Zimbelman et al. (1995) proposed that previously identified eolian dune depositional areas in their proposed regional sand migration pathways are interconnected via a series of wind-blown sand migration zones and intermittent eolian sand source areas.

Lancaster and Tchakerian (1996) evaluated the geomorphology and sediments of sand ramps that occur along the flanks of mountains and mountain passes in the region and indicate that they occur next to regional and local sand transport corridors. These findings indicate that sand ramps, which in a sense exhibit a topographic obstruction to eolian sand migration did allow for continuous connectivity of their respective sand transport pathway.

Bach (1995) studied most of the regional sand systems in southeastern California and determined that they have been stabilized along many portions of their proposed pathways since essentially the mid Holocene. Zimbelman and Williams (2002) indicate that the eolian sands east of the Colorado River in the Parker Dunes are chemically indistinguishable from the Colorado River Sands. This provides strong evidence that eolian sands from the eastern Rice Valley have not been able to migrate across the Colorado River system. Lancaster and Tchakerian (2003) adopted the idea of regional sand migration corridors in southeastern

California but their work did not test this hypothesis and indicate that the regional sand migration corridors have been essentially shut down since the mid Holocene. Muhs et al. (2003) adopted the regional eolian sand transport pathways proposed by Zimbelman et al. (1995) and evaluated whether the eolian sands from the eastern end of these sand transport corridors crossed over the Colorado River in northwestern Arizona as proposed by Zimbelman et al. (1995). Their findings indicate that eolian sands from the eastern end Bristol Lake to eastern Rice Valley sand migration zone were unable to migrate across the Colorado River.

Pease and Tchakerian (2003), based on a geochemistry analysis of sand grains along the path of the proposed sand migration corridors in southeastern California, suggest that the corridors do not represent a continuous "river of sand". Hence, suggesting that eolian sands are likely unable to migrate the entire lengths of the proposed regional sand corridors at any time, but particularly not since the mid-Holocene.

Lancaster (2014) conducted eolian mapping of some of these dune systems and adopted the proposed regional sand migration pathways (corridors). Work conducted by the author (Kenney, 2010a, 2010b and 2010c) for solar energy projects adopted the regional sand migration transport corridors showing a continuous transport pathway along eastern Chuckwalla Valley. Mapping by Lancaster (2015) adopted the regional sand migration corridor model associated with his geomorphic mapping of dune systems in Chuckwalla Valley.

The hypothesis of the regional sand migration corridors in southeastern California by Zimbelman et al. (1995) appears to have provided the benefit of conceptualizing all the dune systems collectively suggesting that they all likely have many commonalities in terms of age, sand sources, relationships with alluvial fan and playa lake activity, and climate variations. Some local parameters have been studied, and they include the clear importance of playa lakes as a source of eolian sands once the playa lakes desiccate, which in turn indicates a correlation of dune activity and climate. Another is the correlation of increased eolian sand production associated with erosion of granitic rocks in the local mountains. However, few detailed geomorphic studies have been conducted to the authors knowledge that evaluate the potential effect on dune systems of local parameters that may result in variations of eolian behavior along particular sections of the regional sand migration corridors. This study attempted to do this by mapping the regional sand migration corridors in sufficient detail such that subtle variations in the dune systems could be identified with the hope that a cause for the variation could be identified that presumably would also be local. This is very important for geomorphic eolian studies for proposed developments due to their "local" scale.

### 8.2 Latest Pleistocene to present activity of regional sand migration corridors

Numerous published papers provide evidence regarding the timing of dune development and activity since the late Pleistocene in southeastern California. Most dunes systems are dynamic and typically re-cycle older dune deposits via erosion and re-mobilization, and therefore do not provide a continuous stratigraphic record of their geologic history to evaluate long term behavior. Lancaster and Tchakerian (1996), point out that sand ramps however, located along some of the sand migration corridors provided a relatively complete stratigraphic record alternating between eolian and fluvial dominated periods. As they point out, this relatively complete stratigraphic record occurs because the sand ramps deposit upwards (vertically) over time which minimizes erosion of older dunes.

The findings of Bateman et al. (2012) suggest that the palaeoenvironmental information provided by several southeastern California sand ramps may be more complex and less complete than first believed. Based on their review of existing regional sand ramp data and a focus of the Soldier Mountain sand ramp (Plate 1) near Lake Manix, they determined that these eolian deposits accumulated quickly (< 5ky), probably in a single phase before becoming relict (dormant). They indicate that the dune deposits at Soldier Mountain appear strongly controlled by a "window of opportunity" when the plentiful sand is available and cease to develop when this sediment supply diminishes and/or the accommodation space is filled with the confines of the sand ramp depositional area. Their findings are consistent with those of this report indicating that most of the mass of the RE Crimson site dune systems were primarily deposited during the early to mid-Holocene and are primarily relict geomorphic terrains since that time.

Age data from numerous sand ramps in southeastern California (i.e. Solder Mountain near Lake Manix, Clark Pass, Iron Mountain, and Big Maria Mountains) indicate that a regional strong eolian aggradational event occurred from the latest Pleistocene till near the end of the early Holocene (i.e. 8 to 7 kya; see Plate 8A, 8B and 8C; Lancaster and Tchakerian, 1996; Rendell and Sheffer, 1996; Pease and Tchakerian, 2001; McDonald et al., 2003; Bateman et al., 2012). Eolian deposit age data across southeastern California also indicate that a regional dune aggradational event (strong sand flux and migration rates) occurred from the latest Pleistocene to about 8 kya (Lancaster, 1997l; Lancaster and Tchakerian, 1991). This period of dune aggradation is similar to that observed in the RE Crimson site however, dune systems continued to grow very slowly through the mid Holocene in the RE Crimson site.

Lancaster (1994) provides a summary of eolian systems in arid regions that indicates that many dune fields have accumulated episodically, with changes in sediment supply and dune mobility occurring throughout time and likely driven by climatic change. This is consistent with the findings of this report for the RE Crimson area dune systems that exhibit a number of pulses of eolian deposition, separated by periods of stability. This is exhibited by numerous buried relatively weak soils in numerous test pits across the site (See photographs of test pits in Appendix D). Lancaster's (1004) findings regarding dune fields around the world indicate that there is abundant evidence that eolian activity has been both more extensive and/or intense than it is at present (latest Holocene). Lancaster (1994) indicates that evidence to support a significant decrease in eolian activity during the later Holocene include dormant and relict dunes and sand sheets that are stabilized by vegetation and soil development among others processes. Bach (1995), Pease and Tchakerian (2002), and Lancaster and Tchakerian (2003) indicate, along with numerous other studies of eolian dune systems across southeastern California (see Plate 8A, Plate 8B and Plate 8C), that the regional sand migration corridors have dramatically slowed down since the mid-Holocene. These findings are consistent with those of Kenney (2016 and other Chuckwalla Valley dune reports), and this report that sand migration rates are weaker during the late Holocene. This is discussed more below.

Regional mapping of the Dale Lake to eastern Chuckwalla Valley for this study identified areas where the sand migration pathway is essentially shut down. The region of Dale Lake to the Eagle CoxComb Pass was mapped via historical Google Earth Pro imagery and this section appears essentially shut down for through going eolian sand transport (red dashed line on Plate 1). In addition, this section exhibits very weak dune geomorphology in an area dominated by alluvial systems indicating it may not have ever been a significant eolian sand pathway (Plate 1 and Plate 2). Instead, it is proposed that the Dale Lake sand system for the most part terminates near the Clarks Pass sand ramp (Plate 1) and that the abundant eolian sands occurring at the eastern end of the Pinto Basin (herein named the Pinto Basin Dunes) were derived primarily from the west to east flowing drainage system within the basin. Hence, the Pinto Basin Dunes are proposed to have developed not by west to east sand migration from the Dale Lake areas, but instead by the local robust Pinto Basin wash system. This wash produces more eolian sands than typical washes due to numerous factors. The wash occurs in the valley axis and flows parallel to the topographically controlled prevailing winds. The water shed (not mapped) for the Pinto Basin wash is relatively large and extends beyond the limits of the basin and local bounding mountain ranges. The large watershed causes this wash to flow more frequently than washes associated with smaller water sheds. Interesting to note that the Pinto Basin Wash system flows into the western Chuckwalla Valley to affect dunes along the southwestern margin of the CoxComb Mountains. The occurrence of abundant granitic rocks as well in the local mountains assists the washes to produce a relatively larger magnitude of eolian sand than washes emanating from other types of bedrock.

Aerial image mapping also indicates a fluvial dominated system and that eolian sand migration is hindered over Eagle CoxComb Pass causing the eolian sand migration rate to be relatively slow to the southeast in the eastern Chuckwalla Valley (red dashed line on Plate 1). A series of active dunes along the west flank of the southwestern CoxComb Mountains (Plate 2) likely receive abundant eolian sands from the local wash that is proposed to carry more eolian size sand grains than typical desert washes. This wash may carry an order of magnitude more eolian sand size bedload than typical washes emanating from bedrock dominated mountain ranges because it is the eastern extent of the Pinto Basin wash system. Hence, this wash has flowed through the eastern Pinto Basin dune system and entrained abundant eolian sand that had deposited within the wash leading to fluvial-eolian cycling. In addition, this wash is also provided higher than usual eolian size sand grains due to erosion of older (Pliocene) fluvial sediments (dark blue units on Plate 2) and granitic rocks exposed in the local mountains. The wash then flows to Palen Dry Lake and provides eolian sand to that system due to its orientation down the valley axis parallel to prevailing winds and its wide braided drainages with subtle bar and swale geomorphology. Hence, the Pinto Basin wash system has essentially resulted in a series of eolian dunes that connect the Pinto Basin Dunes with those of the northwestern Palen Dry Lake dune system. In this model, sand transport from the Pinto Basin to the northwestern Palen Dry Lake likely includes episodes of fluvial and eolian transport (i.e. fluvial-eolian sand cycling). Episodic forms of transport of eolian size sand grains may very well be the case on playa lake beds.

Eolian Geomorphic mapping via field work and analysis of historical Google Earth Pro imagery between Palen and Ford dry lake bed areas, and in the eastern Ford Dry Lake area indicate that sand migration rates are very low and that older relict dune systems are eroding (Plate 1 and Plate 3B). Hence, these areas represent eolian sand migration "breaks" essentially along the Chuckwalla Valley sand corridor system. As discussed in other portions of this report, numerous local sources of eolian sand occur in the Ford Dry Lake area. In addition, the Wiley's Well and Mule SMZ's no longer extend across Palo Verde Mesa, hence, these eolian systems do not reach the Colorado River Plain (Plate 1).

### 8.3 Published eolian sand sources for regional sand migration corridors

The southern eolian dune systems collectively occur within a relict landscape that developed during Basin and Range extensional tectonics of the late Miocene through possibly early Pliocene. The extensional tectonics pulled the crust apart resulting in a series of exposed mountain ranges and adjacent valleys. This region is referred to as the Basin and Range geomorphic province due to this phase of deformation and that the valleys are in fact internal continental basins with flow from local and most regional drainages terminating within local valleys. This is important because most of the eolian sands in the regional dune systems originally are created by erosion of the local mountain ranges. The mountain derived eolian sands then migrate downslope, primarily associated with alluvial processes, although some grains are picked up by the wind to become available for the local eolian system.

However, evaluating specific eolian sand sources is complex due to the relatively common mineral composition of most of the rocks exposed in the local mountain ranges. Granitic rocks, which are common in the region (Plate 1 and Plate 2), easily erode to produce a relatively large magnitude of eolian size sand grains compared to other rock types, suggesting that washes emanating from granitic rock exposures may be a relatively larger source of eolian sands than other mountain ranges. This was found to be the case by mapping during this project where a good example of a primarily granitic eolian sand source was identified in the Pinto Mountains (Plate 1).

Many research articles have indicated that the primary source for eolian sand is from playa lake surfaces and alluvial processes (Sharp, 1966; Zimbelman et al., 1995; Lancaster and Tchakerian, 1996; Lancaster, 1997; Ramsey et al., 1999; Pease and Tchakerian, 2002; Zimbelman and Williams, 2002; Pease and Tchakerian, 2003; Muhs et al., 2003). Playa lake beds result in the production of relatively high volumes of eolian sands once they desiccate, providing not only a pathway for eolian sand but also a sand source from sand baring wind abrasion. Alluvial processes (fluvial) produce eolian sands quite readily soon after a wash flows and experiences wind speeds sufficient to pick up sand and transport it. This process assists in the supply of new eolian sands to an eolian system outside of the wash where the bar and swale relief of the wash is sufficiently small to allow the eolian sand grains to exit the fluvial system. This is typically the case in the distal portion of fans or where washes flow along valley axis.

Playa lakes occur sporadically, and alluvial washes occur essentially along the entire length of the regional sand migration corridors (Plate 1 and Plate 2). This suggests that local eolian sources are very important sources, if not the most important source, of eolian sands along the regional sand migration corridors and this is proposed by numerous regional eolian studies referenced previously. For example, Pease and Tchakerian (2003) agree with other work that the local sources along the corridor system provide the primary source of eolian sands (Zimbelman and Williams, 2002; Muhs et al., 2003). Hence, the regional sand migration corridors clearly receive eolian sands along their path with strong influxes near and downwind from playa lakes and by washes that occur in most valley regions. These findings are consistent with those of this report based on regional eolian mapping shown on Plate 1 and Plate 2. But as explained in more detail below, these conditions are not present in and around the RE Crimson site.

Ramsey et al. (1999) evaluating the Kelso Dunes provide evidence not only of eolian sands having migrated from the Mojave River-Lake Manix source areas 35 miles to the west, but also from local mountain ranges (alluvial processes) bounding the Kelso Dune themselves. However, the proposed Lake Mojave that occurs only 20 miles to the west and the final flow destination for the Mojave River-Lake Manix hydrologic system (Enzel et al., 2003 and Wells et al., 2003; Plate 1) also provides substantial eolian sands to the Kelso Dune system.

During periods of strong eolian activity (i.e. dune aggradational events), eolian sands are able to travel large distances when the regional sand migration corridors provide a more continuous pathway, that these sands would be able to mix with the continuously provided local eolian sources. These conditions occur when vegetation densities at lower elevations are less (dry periods), but relatively frequent monsoonal storms occur during dry periods of the year that provide an eolian sand source via erosion, washes, and intermittent flooding of playa surfaces. During times of dune stability, the regional sand migration corridors become discontinuous and local sources primarily associated with playa lake beds and alluvial systems dominate. In addition, during periods of dune stability when the older dunes become relict, they often begin to cannibalize the older dunes associated with wind abrasion (eolian deposits re-working) that provides an additional source for active eolian sands (Lancaster, 1995). Within the eastern Chuckwalla Valley, erosion of older relict dune deposits are an important source for the minimal active eolian sands occurring within dune systems poorly fed by a playa lake (or ponding area) and alluvial systems (Kenney, 2010a, 2010b, and 2010e). This is particularly the case for the southeastern portion of the Mule Sand Migration Zone (SMZ) and the eastern most Wiley's Well SMZ (Plate 3A). The findings of this report indicate that a period of dune stabilization and associated dune abrasion (cannibalization) has been occurring in many dune systems in the Chuckwalla Valley during the late Holocene. As discussed earlier in the report and in the next section, some localized dune areas remain relatively active due to continuous input of new eolian sands from local sources that generally occur near playa lake beds, ponding areas, and strong alluvial systems.

### 8.4 Eolian sand sources along the regional sand migration corridors

As discussed above, playa lake beds and alluvial systems represent the primary sources for newly generated eolian sands. Regional eolian system mapping during this project provided on Plate 1 and Plate 2 provided insights regarding local parameters associated with playa lakes (and ponding areas) and alluvial processes that play a role in newly derived eolian sand. These concepts assist in the understanding of the relative importance of local eolian sources versus far afield from upwind areas along the proposed regional sand migration corridors. Some previously unrecognized eolian sand sources have also been recognized.

Playa lakes for example are generally described as a strong eolian source primarily after they have desiccated when the climate changes from wet to drying (i.e. at the end of the last ice age). However, playa lakes in the southeastern California region routinely flood to shallow depths that provide surface instabilities resulting in eolian sand production both on the playa surfaces but also within existing playa dune systems. This is the case for local Palen and Ford dry lake beds that receive significant flow from local drainages. In fact, subdued drainage systems occur across these playas allowing for relatively frequent surface disturbance that greatly increases eolian sand production. It is not necessary for playa lakes to fill completely for extended periods of time and then finally desiccate to provide a significant eolian sand source for local dune systems. This locally observed process is likely the case for other playa lake beds in the region. There is also evidence of eolian aggradation events occurring across southeastern California during periods of intermittent filling and desiccation of playa lakes (Plate 8A). In fact, regular filling and drying of a playa lake likely leads to increased eolian activity than simply filling once and drying once. The important parameter as well for eolian aggradation associated with playa sources is the ability of the eolian sands to migrate, which is more favorable during times of decreased vegetation (i.e. long term droughts).

Water flow through dune systems erodes into older dune sands allowing these sands the potential to be re-entrained by the wind back into an eolian system. Precipitation and surface water flow can fill interdune basins and disturb dune deposits, and as observed on Ford Dry Lake in 2012, can overflow their depressions leading to flow from one depressional "pond" to another. Precipitation from rain and surface water flow provide fluids that assist in providing ongoing dune stabilizing moisture, however, dune study at the Keeler Dunes (Kenney, 2012) indicates that it is infiltrating waters from overland flow that plays a larger role.

Another eolian sand source is from the erosion of older sedimentary deposits. This source has not been identified in the southeastern California region in the literature, but has been proposed to be a primary source of eolian sands in other regions. For example, Muhs and Holliday (2001) determined that the dominant source of eolian sands for the dune fields on the Southern High Plains of Texas and New Mexico was the erosion of an older formation. This local eolian sand source is proposed to be significant to many dune systems along the Dale Lake to eastern Chuckwalla Valley sand migration corridor. It is logical that contribution of eolian sands from the erosion of older formational units would increase proportionally to the magnitude of erosion of the older sediments by washes. Hence, eolian aggradation events or dune re-activation events can occur during periods of fan-head entrenchment (Plate 8C).

In the west, the Dale Lake dune system occurs primarily east (downwind from prevailing winds) of Dale Dry Lake, which based on aerial imagery mapping in Google Earth Pro is only approximately 3 square miles in size. However, eolian deposits are also identified upwind from Dale Dry Lake across a surface of eroding older sedimentary deposits via a series of tributaries and wind abrasion (brown areas on Plate 1 and Plate 2). The fluvial networks erode into the older sedimentary units that are exposed across a large surface area (i.e. piedmont) resulting in fluvial erosion where the drainages produce loose sediment bearing large quantities of eolian size sand grains that can then be transported by the wind once flow ceases. In addition, sand bearing wind across the sedimentary piedmont surface induces additional erosion of the exposed older sedimentary deposits resulting in the production of additional eolian sands which can be easily transported toward the east to become part of the Dale Dry Lake dune system. These observations suggest that an important source for eolian sands to the Dale Dry Lake dune system is upwind from the dry lake itself.

Within the Chuckwalla Valley, erosion of exposures of the mostly Pliocene fluvial and quiet water deposits associated with the Colorado River engulfment of the valley provide a significant source of eolian sands. These deposits are dominantly unit Tmm of this report (also referred to as the Bullhead Alluvium, Soil S7a) and are clearly a source of eolian sand based on their isolated exposure in the Mule Mountains where erosion of this unit appears to be the only reasonable source of eolian sands for the local dune system (Plate 4) and essentially the only source of sand for the Central Mule Sand Migration Zone (Plate 6B). Erosion of this and other similar units (i.e. older alluvium associated with soils S4 and S5(Plate 6A) essentially cause local washes eroding into them to provide a larger source of eolian sands than typical washes emanating from bedrock mountain ranges and across typical alluvial fans composed of courser debris flows. For example, most of the dune systems in the eastern Chuckwalla Valley have received much more eolian sand due to the erosion and fluvial transport of the older sedimentary deposits (Tmm, Soil S7a) than would have been the case for typical Mojave Desert washes. This has been an important factor in the development of Ironwood, Wiley Well Basin, and all RE Crimson sand migration zones (Plate 3A). In fact, it is proposed that the essentially all the sand migration zones in the RE Crimson would not exist if it were not for the robust sand transport of the local washes carrying eroded older sediments from unit Tmm and a smaller component of erosion of older alluvial units associated with soils S4 and S4 which contain a large component of re-worked unit Tmm (Soils S7a).

Lancaster (1997) provides insightful concepts by indicating that eolian deposits are a product of climatic changes that increase sediment supply from fluvial and lacustrine (playa and pluvial lake beds) sources and may be closely tied to periods of channel cutting and geomorphic instability. This idea was explored in this report and Kenney (2016) via compiling numerous potential dune parameters in an attempt to identify correlations between dune aggradational events. As discussed later in the report, but in summary, it was determined that eolian systems across southeastern California exhibited much higher magnitudes of activity (aggradational events) during times of alluvial fan aggradational events, during times of alluvial fan trenching, relatively stronger periods of monsoonal storms when colder Pacific Storm activity is relatively low (Plate 8A, Plate 8B and Plate 8C). The process of alluvial fan trenching may be one parameter that allowed dune systems to be more sporadic over time than alluvial fan aggradational events as the two processes can occur independent of the other. However, one subtle variation regarding alluvial fan deposition that is believed herein (and Kenney, 2016), is that Holocene age alluvial fans deposited in medial and distal portions of the fans in southeastern California provided eolian sands close to the valley axis where prevailing winds are strongest. Regarding storm types (i.e. monsoonal vs Pacific Storms), the evaluation indicates that eolian dunes across southeastern California experienced dune aggradational events during periods of relatively stronger and more frequent monsoonal storms (cloud burst, isolated thunder storms) when colder Pacific storms systems were occurring less frequently. This climate condition occurred during the early Holocene and mid to late Holocene and correlates with periods of time of increased eolian activity (Plate 8B). Increased monsoonal storm activity and decreased Pacific storm activity most strongly occurred in southeastern California, and are recently being discovered to be the driving agent for regional alluvial fan aggradational events.

## 9.0 CHUCKWALLA VALLEY DUNE SYSTEMS - SAND MIGRATION ZONES AND STABILITY

Detailed geomorphic eolian mapping via field work and aerial imagery (Google Earth Pro) in the Chuckwalla Valley was conducted utilizing the designated relative geomorphic sand migration zones (Appendix C; Plate 2) that have evolved as a method of eolian mapping by the author (2010b, 2010d, 2010e, 2011 and 2016). In addition, general mapping was conducted for this region utilizing the geologic-geomorphic designations (Report Section 7.3) that have also evolved over time by the author in an attempt to construct descriptive terms for geomorphic variations within dune systems that to the author's knowledge had not been done previously. For example, the early use and creation by the author of eolian map units Qsa, Qsad and Qsr to designate regions dominated by active, active and stable mix, and stable eolian sediments exposed on the surface was new (2010a, 2010b, 2010d, and 2011). These designations were useful in dune dominated areas but did not include aspects involving fluvial systems, and in particular, areas where there was a mix of fluvial and eolian geomorphic features often occurring in relatively weak eolian systems. The new Geomorphic-Geologic designations provided in Figures 8A and 8B (Kenney, 2016) provide a revised set of unit criteria attempting to incorporate fluvial-eolian system complexities. The results of this mapping are provided below.

### 9.1 Identified local sand migration zones

One criteria for a dune system to be designated as an independent sand migration zone is that it receives a significant source of sand from a local source that is independent from sources upwind associated with the regional valley axis sand migration corridor. Consistent with earlier work by Kenney (2010a, 2011 and 2016) identifying local independent sand migration zones (SMZ) in the Chuckwalla Valley (i.e. Palen Valley SMZ and Mule SMZ on Plate 3A), the more detailed mapping conducted during this study led to the identification of numerous semi-local and local independent sand migration zones in the eastern Chuckwalla Valley and more specifically, the Crimson Solar Project (RE Crimson). Most of the SMZ's in the eastern Chuckwalla Valley are natural, and others result from or have a significant Historical eolian source from anthropogenic activities. However, in the RE Crimson, all the SMZ's are evaluated to be "natural"; hence not impacted by previous man activities such as wash flow diversions. The sand migration zones of the Chuckwalla Valley are shown on Plate 3A, and are each described below from the west to the east:

#### 9.1.1 *Palen Lake Sand Migration Zone*

The Palen Lake SMZ occurs along the southwestern region of the Palen Dry Lake, more specifically along the alluvial fan and playa lake bed contact (Kenney, 2010b and 2016). Hence, most of the dune deposits associated with the Palen Lake SMZ occur on top of playa lake bed deposits (Kenney, 2010b and 2016).

Eolian sands migration over time in the Palen Lake SMZ is dominantly from NWW to SWW along the southern portion of Palen Dry Lake in a region. However, each year strong prevailing winds emanating down the Palen-CoxComb Valley from the NNW west cause eolian sands to migrate toward the SSE, which assists in concentrating the Palen Lake SMZ eolian deposits along the southwestern portion of the playa.

The primary source of eolian sands for the Palen Lake SMZ is from the northwest associated with the sand migration system along the western flank of the CoxComb Mountains, but also the wash that flows along the western margin of that dune system. This wash system is connected to Pinto Basin and represents a very large watershed area. Southeast moving water flows along this drainage system into the southwestern region of the Palen Lake SMZ dune system (Plate 3A and Plate 3B). Most alluvial washes flowing northward from the Chuckwalla Mountains flow through the dunes to reach the playa lake bed and these washes may reach the playa area more frequently compared to historical times due to flood control berms associated with Highway 10 that concentrate and increase channel flow. There is clear evidence of relatively frequent flooding on Palen Dry Lake, indicating that the lake bed itself is a significant eolian sand source. In addition, flood waters are able to penetrate vast areas of the Palen Lake dune system which provides critical stabilizing moisture allowing the dunes to resist sand bearing wind abrasion. However, barchan dunes on portions of the dune system on the lake bed do migrate over time. It is important to point out that tranverse barchan dunes develop in an environment of relatively strong "single direction" prevailing wind and a paucity of eolian sand source. In the area of barchan dunes in the eastern region of Palen Dry Lake, the barchan structure is often seasonally destroyed by NW prevailing winds and then reconstructed.

Most of the eolian sands of the Palen Lake SMZ exhibit a distinctive pale orange color, particularly along the southwestern two-thirds of the SMZ (Plate 3A). This is in contrast to the light grayish color of the East Palen Lake SMZ that intersects the Palen Lake SMZ to the southeast. Some of the dunes along the northeastern region of the Palen Lake SMZ exhibit colors that are not distinctly orange nor light gray. This suggests that some eolian sands enter the northeastern region of the Palen Lake SMZ from the north from the erosion of lakebed sediments and/or across the entire exposed playa surface.

The Palen Lake SMZ is the most robust dune system in Chuckwalla Valley and represents an interconnected network of transverse dunes exhibiting seasonal avalanche faces (i.e. they face various directions). These areas are mapped as Zone AB on Plate 3B. Active barchan dunes over 10 feet tall that exhibit avalanche faces occur in eastern Palen Dry Lake, indicating a prevailing wind from the NWW to SSE; however, as discussed earlier, the barchan form often is destroyed due to NW prevailing winds leading to the development of a barchan-complex dune form. In some areas the barchan dunes, which develop in areas of relatively low eolian sand input flux, commonly occur as independent dunes separated by playa lake surfaces. As observed on various years of historical imagery, dune activity levels and stability vary significantly depending on precipitation.

*9.1.2 East Palen Lake Sand Migration Zone*

The East Palen Lake SMZ transports sand southward down the Palen-CoxComb Valley axis and then along the eastern edge of Palen Dry Lake along the contact between the lake bed surface to the west, and alluvial fan deposits to the east. Portions of the East Palen Lake SMZ are deposited on older alluvial fan surfaces and alluvial washes flow through and within the dune system providing additional eolian sand source, dune stabilizing moisture, and destabilization as it reworks eolian sands (Plate 2 and Plate 3A). The most robust dune form in the area are weak transverse dunes generally less than 5 feet tall that exhibit seasonal avalanche faces indicating a north to south prevailing wind (NW prevailing wind).

The East Palen Lake SMZ merges with the Palen Lake SMZ in the easternmost area of the Palen Dry Lake playa lake beds. The East Palen Lake SMZ dunes exhibit light grayish hues similar with the Palen Lake playa surface to the west suggesting that the playa lake beds are a significant eolian sand source. This is supported by the identification of a braided wash system flowing southward across the entire length of the playa west of the East Palen Lake dune system and seasonally variable amounts of migrating eolian sands identified on the lakebed. Toward the north, the primary eolian sand source for the East Palen Lake dune system is from a series of southward flowing braided washes along the Palen-CoxComb Valley wash system north of Palen Lake (Plate 2). These washes likely carry significant eolian size sand grains due to erosion of the granite rich CoxComb and Granite Mountains bounding the Palen-Coxcomb Valley. Hence, the East Palen Lake SMZ is provided eolian sands from two local sources including erosion of Palen Dry Lake beds and local washes.

Immediately north of Palen Dry Lake, a series of very stabilized dune mounds exists essentially located on fan terraces bounded by active washes of various sizes. This dune area is shown as geomorphic relative sand migration zones B, BW and BC (Plate 2) and is separated immediately to the north from the Cadiz Dry Lake SMZ by an extensive area of much weaker sand migration and dune forms to the north within the Palen-CoxComb Valley axis dune system (Plate 2). Hence, the Cadiz Dry Lake to eastern Palen Lake "regional" sand migration corridor was either never truly connected as a significant eolian pathway or has shut down during the later Holocene (red line on Plate 1).

### *9.1.3 Palen Lake-Western Ford Lake Sand Migration Zone*

The Palen Lake-Western Ford Lake SMZ occurs in the western region of Ford Dry Lake and receives eolian sands from the merging of the Palen Lake and Eastern Palen Lake SMZ's to the west along a relatively narrow SMZ along the Palen-Ford Dry Lakes Pass (Plate 3A). Another source of eolian sands for the Palen Lake-Western Ford Lake SMZ is erosion of Ford Dry Lake, and erosion of relict dunes. The dune system is very weak and non-continuous, stabilized, and in many areas degrading. The most robust dunes in the area are converging relict strongly stabilized mounds exhibiting active sand sheets that are less than 5 feet thick.

Aerial mapping of various years indicates that many upwind relict dune deposits in the eastern portion of this dune system are eroding via sand bearing wind transported over the lakebed in the west. Numerous low bar and swale washes occur on the Ford Dry lake bed which in terms of aerial coverage represents well over 50% of the region of the Palen Lake-Western Ford Lake SMZ. Ponding also occurs in the central region of the Palen Lake-Western Ford Lake SMZ immediately west of a stabilized, relict, and degrading dune system. These areas are observed on Plate 3B where the ponding area is shown as unit Ql-de (playa erosional area, blue areas) to the west of unit Qe-de (stabilized dunes mapped as Zones B and BW). Hence, in terms of the regional sand migration corridor extending down the Chuckwalla Valley, the exposed playa lake bed in western Ford Dry Lake represents a section where sand migration rates have not been sufficient certainly during the late Holocene, but possibly during the entire Holocene, to allow for the development of a dune depositional area that could geomorphically overcome playa processes. In the central and eastern Ford Dry Lake area the dune and playa processes compete geomorphically in more equal proportions.

### *9.1.4 East Palen Mountains Sand Migration Zone*

The East Palen Mountains SMZ receives eolian sand from a drainage system emanating from the southeastern Palen Mountains west of the Genesis Solar Project (Plate 3A). Eolian sands produced by this wash system immediately north of the playa surface of Ford Dry Lake migrate southeastward to merge with eolian sands migrating eastward in the Palen Lake-Western Ford Lake SMZ (Plate 3A). A region of exposed playa surface that frequently floods occurs between the Palen Lake-Western Ford Lake and East Palen Mountains SMZ. This playa area provides a source for new eolian sands for the southeastern portion of the East Palen Mountains SMZ. The most robust dunes in the area are seasonally active interconnected and non-migrating dune mounds. In many areas activity levels of the dunes decreases outward toward the edges of the system where the relict dune mounds erode providing an internal source of eolian sands. The East Palen Mountains SMZ represents a local eolian source that feeds the Chuckwalla Valley SMZ system.

### *9.1.5 East Ford Lake Sand Migration Zone*

The East Ford Lake SMZ receives eolian sands from the East Palen Mountains SMZ to the west, a ponding and water flow drainage system that flows to the north located at the western mapped boundary of the East Ford Lake SMZ (upwind area), and erosion of older relict dune deposits and lakebed surfaces (Plate 3A and Plate 3B). The dune system is stable and in many areas degrading which provides an internal source of eolian sands. The dune system consists of an interconnected dune mound system generally less than 5 feet thick exhibiting a network of ponding areas within interdune depressions many of which are interconnected themselves. The interdune depressions are filled with water relatively frequently allowing for the infiltration of stabilizing moisture for the dune system. In addition, these flooding events, as observed by the author in the field in 2012, are sufficient to fill the interdune depression such that they breach from one depression to another which then can develop into internal flood-flow events as one basin drains into another in a cascade fashion. These flood events represent fluvial-eolian interactions involving the remobilization of relict eolian sand deposits which provide a new eolian sand source.

Eolian sands within the East Ford Lake SMZ migrate ESE (see Windrose Direction in the Glossary, Appendix B) to where it merges with eolian sands migrating toward the SE within the Palen Valley SMZ (Plate 3A). However, sand migration rates in the central portion of the East Ford Lake SMZ are very low (Zone C) and the region primarily consists of exposed playa lake beds as shown on Plate 3B. This indicates that the East Ford Lake SMZ likely contributes minor eolian sand to the Palen Valley SMZ since the mid-Holocene.

#### *9.1.6 Palen Valley Sand Migration Zone*

The Palen Valley SMZ occurs on the southeastern region of Palen Valley and receives its eolian sand from a braided channel system that flows from north to south in Palen Valley (Kenney, 2010a). The Palen Valley wash system flows relatively frequently to terminate in Ford Dry Lake. The most robust dune type in the zone are linear dunes that exhibit avalanche faces that are in places over 5 feet tall. Two areas exhibiting linear dunes occur with one in the northern region, fed by eolian sands from the Palen Valley wash system, and the other in the southeast, fed by the combination of the merging of the Palen Valley and East Ford Lake SMZ's. In the two linear dune areas, they are commonly bounded by washes, particularly along their eastern side, and separated by zones of weak sand migration rates over alluvial fan surfaces. The linear dunes are likely able to develop as a relatively large dune in terms of mass due to a continued source of eolian sand from the adjacent drainage systems and also the stabilizing moisture that the washes provide.

Between the two linear dune areas, alluvial fan washes and deposits dominate the geomorphology. These alluvial fan drainages flow toward the SSW across the Palen Valley SMZ to terminate in Ford Dry Lake. Some of these washes emanate from exposures of unit Tmm which upon erosion provide an increased eolian sand input for the Palen Valley SMZ but this source is considered relatively minor compared to sediments transported down the length of the Palen Valley washes (Plate 4). Hence, the Palen Valley SMZ represents a local eolian source to the Chuckwalla Valley axis dune systems.

Toward the southeast, the more robust Palen Valley SMZ merges with the weaker East Ford Lake SMZ, which as discussed previously, produced a new set of linear dunes exhibiting avalanche faces which extend all the way to just north of the Wiley's Well Rest Stop (Plate 3A). Geomorphic and soil stratigraphic field mapping immediately south of Highway 10 within the Palen Valley SMZ indicates that sand migration rates in this area have been low for a minimum of the past 3 to 5 thousand years (kya). This indicates that the easternmost portion of the Palen Valley SMZ exhibited a sufficient decrease in sand migration approximately 3 to 5 kya to no longer result in the development of dunes in the region of and south of Highway 10. In Historical times, anthropogenic activities have greatly reduced the already slow natural sand migration rate in the southeastern Palen Valley SMZ as well. For example, construction of Highway 10, which consists of two elevated berms over 10 feet tall with a middle depression and associated parallel shallow fill borrow pits, has greatly diminished the ability of eolian sands to migrate to the previous natural termination at the western end of the Wiley's Well Basin dune system (Plate 3A).

#### *9.1.7 Ironwood Sand Migration Zone*

The Ironwood SMZ occurs north of the Ironwood State Prison and south of Highway 10 (Plate 3A). The primary source of eolian sand for this zone is from a series of south to north flowing washes emanating from the Little Chuckwalla Mountains (see Plate 7A). These washes transport more eolian size sand than typical Mojave Desert washes due to the erosion upstream of the Pliocene age Colorado River deposits unit Tmm (see Plate 4). In addition, the erosion of granitic rock exposures in the region between the eastern Chuckwalla Mountains and western Little Chuckwalla Mountains allows these washes to carry a larger magnitude of eolian size sands than typical Mojave Desert washes which also provides a source of eolian sands to the Ironwood SMZ (Plate 7A). A very minor component of eolian sands within the Ironwood SMZ may have emanated from the regional Chuckwalla Valley Sand Migration Corridor system during the early to mid Holocene but this sand pathway if it ever existed has been essentially shut down since the mid Holocene. A minor component of eolian sands in the eastern region of the Ironwood SMZ merge with the Wiley's Well Basin eolian system. Hence, the Ironwood SMZ represents another source of local eolian sands contributing to the dune systems along the Chuckwalla Valley axis.

The most robust dune type in the Ironwood SMZ are transverse to the linear dunes due to variable prevailing wind regimes. The linear dunes are commonly bounded by active washes on their eastern side and eastward migration of the dunes has resulted in eastward migration of the washes. Between the more robust linear-transverse dune areas are regions dominated by alluvial geomorphology where relative sand migration rates are low. Similar to the Palen Valley SMZ, the washes provide both an eolian source and stabilizing moisture that allow localized dunes to grow in size and assist in them remaining in essentially one location.

#### *9.1.8 Wiley's Well Basin Sand Migration Zone*

The Wiley's Well Basin SMZ dune system occurs in the region of the Wiley's Well Basin and the northern limit of the Wiley's Well Wash in the west, and extends eastward to terminate where it merges with the Polowalla SMZ (Plate 3A). The Wiley's Well Basin SMZ extends along the northern most portion of the RE Crimson site and represents the local Chuckwalla Valley axis dune system (Figure 11A and Figure 11B). The majority of eolian sands in the Wiley's Well Basin SMZ system were generated locally not only during the early Holocene regional eolian aggradational event, but also since the mid-Holocene (Kenney, 2016). Smaller components of eolian sands over time contributed to the Wiley's Well Basin SMZ from the west in the region where the Palen Valley, East Ford Lake and Ironwood SMZ's have fully merged.

Eolian sands in the Wiley's Well Basin SMZ are generated from the wide, north flowing Wiley's Well Wash braided wash system, south flowing washes from the southern McCoy Mountains, and Wiley's Well Basin ponding area where all these wash systems terminate. The Wiley's Well Basin floods frequently from monsoonal cloud burst "thunderstorm" events that, based on mapping in the region since 2010, have occurred a minimum of two times. As discussed later in this report, the watershed drainage area for the Wiley's Well Wash is large extending over 16 miles to the south allowing for drainage of the western Mule Mountains (Plate 7A).

The Wiley's Well Basin SMZ is provided a relatively higher amount of eolian sands from the local washes due to erosion of older silty-sand sedimentary deposits of the ancient Colorado River (unit Tmm) located in the "alluvial fan" regions in the southern McCoy Mountains "embayment" (Plate 7B), and western Mule Mountains (Plate 2 and Plate 4).

The most robust dune form in the Wiley's Well Basin SMZ are complex dunes that are over 15 to 20 feet tall and exhibit seasonal avalanche faces (Zone A on Plate 4 and Figure 11B). The Zone A area is bounded on the eastern side by washes emanating from the southern McCoy Mountain embayment area (Plate 7B and Figure 11B). Over time, the wash along the eastern side of Zone A has migrated eastward likely tens of feet as the dunes migrated. The wash continues to flow southward to pond in the Wiley's Well Basin, hence, to mix with waters from the Wiley's Well Wash system. During a relatively large flood, waters flow through the Zone A and Zone AB region that also allow for infiltration of stabilizing moisture.

Toward the east of Zone A in the Wiley's Well Basin SMZ and its corresponding east bounding wash, the most robust eolian dunes are small low-relief stabilized linear dunes that are typically less than 3 feet tall and only occasionally exhibit seasonal and alternating direction avalanche faces. These occur in areas mapped as Zone AB on Figure 11A. These dunes are likely relatively more vegetated due to competing prevailing winds from the west and southwest than if they experienced a more mono-directional prevailing wind (see Tsoar, 2004). Some very weak and not fully developed transverse dunes occur in the northern most region of the Wiley's Well Basin SMZ, however, this area is delineated as the North Wiley's Well Basin SMZ discussed separately later.

The dune deposits in the Wiley's Well Basin SMZ are less than 5 feet thick typically, and gradually get thinner toward the east where in some areas mapped as Zone BC and Zone BW are less than 3 feet. In areas mapped as Zone BC, older alluvium of Soil S4 occur at depths of only a few inches within interdune depressions and the dune deposits represent relict dune mounds that vary from full connectivity to scattered connectivity. Eolian deposits are generally thinner for progressively less active geomorphic eolian sand migration zone designations. In addition, the eolian deposits associated with Zone BC which bounds the limits of an eolian dominated area, gradually thin toward its contact with mapped Zone C. Hence, in contrast to Lancaster (2014) eolian mapping for this project was not based on dune deposit thickness, but instead, on observed eolian geomorphology on the surface.

The Wiley's Well Basin SMZ gradually narrows from a width proportional to that of the Wiley's Well Basin (~3.5 miles), to approximately 0.5 mile in the northwestern region of the Palo Verde Mesa (Plate 5). The dunes activity also decreases toward the east with the eastern portion of the Wiley's Well Basin SMZ receiving very little sand flux input from the west (Zone BW on Figure 11B, Plate 4 and Plate 5). The primary cause for the decrease in width of the sand migration zone is the Palo Verde Topographic Sill, which is the geographic/geomorphic boundary between the eastern Chuckwalla Valley and the Western Palo Verde Mesa (Plate 5 and Figure 11B). The Palo Verde Topographic Sill, is located approximately in the middle region of the Wiley's Well SMZ and extends across Chuckwalla Valley in an approximate north-south trend (Plate 5 and Figure 11B). The Palo Verde Topographic Sill consists of rise from an elevation of ~438 feet in the Wiley's Well Basin in the west, to the sill itself at an elevation of ~488 feet (high point), and then back down to an elevation of ~400 feet near the Palowalla SMZ (Figure 11B). Hence, eolian sands migrating eastward from the Wiley's Well Basin move uphill approximately 50 feet in relief, and this rise causes eolian sands to deposit. On the downwind leeward side of the topographic sill, eolian sands are also encouraged to deposit as wind speeds decrease. The sill has likely allowed for relatively more eolian sands to be deposited on the western side, crest and immediate eastern side than would have deposited if the topographic sill did not exist. In addition, the amount of wind-blown sand reaching the eastern most area of the Wiley's Well Basin SMZ is dramatically decreased because most of the transporting sand is encouraged to deposit to the west associated with the topographic sill (see area Zone BW on Plate 5 and Figure 11A). Most of the active eolian sands in Zone BW (Plate 5) are produced by the erosion (cannibalization) of older relict (dormant) dune deposits.

**Figure 11A:** Eolian Geomorphic & Relative Sand Migration Zone map of "Valley Axis" eolian deposits in the eastern Chuckwalla Valley.

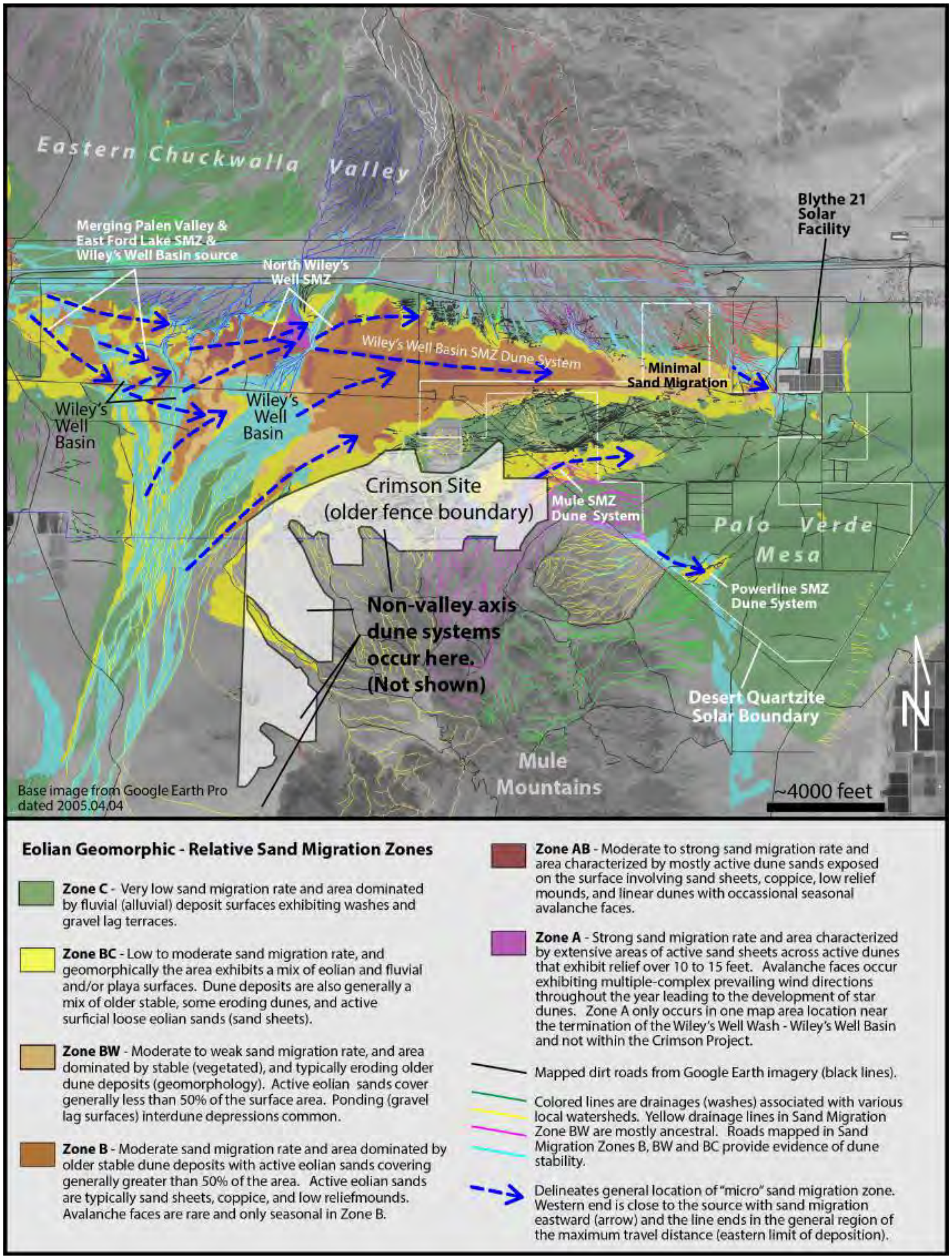
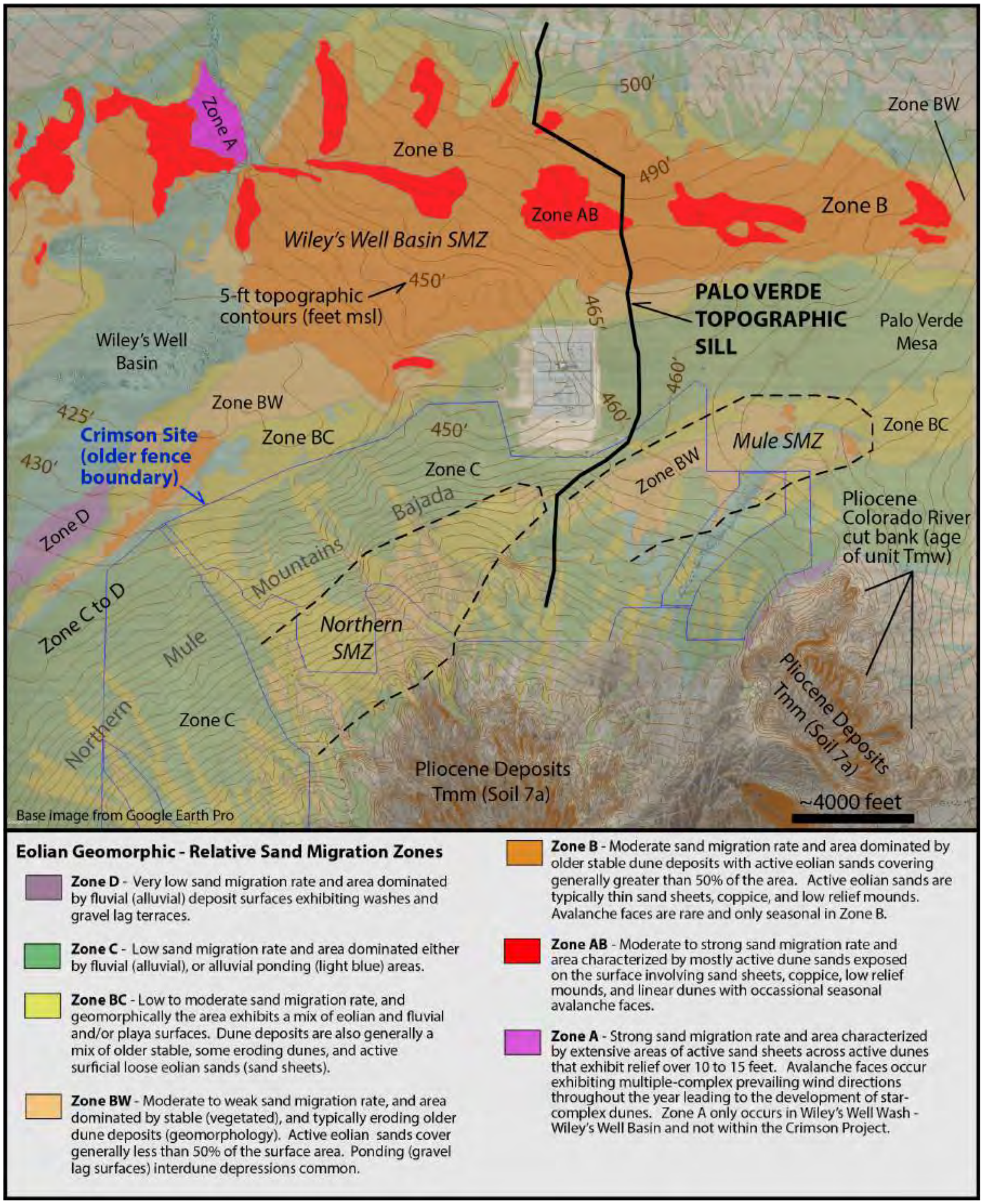


**Figure 11B:** Relative Sand Migration Zone Map of the Wiley's Well Basin, Northern Mule, and Mule Sand Migration Zones. Map identifies the general location of the Palo Verde Mesa Topographic Sill that had affected eolian deposition in the Wiley's Well Basin SMZ, and partitioned the Northern Mule and Mule Sand Migration Zones.



### *9.1.9 North Wiley's Well Basin Sand Migration Zone (anthropogenic)*

The North Wiley's Well Basin SMZ occurs within the Wiley's Well Sand Migration Zone and is designated as a separate system based on the interpretation that this dune area has been affected by anthropogenic activities related to water flow diversions. Most drainages from the southern McCoy Mountain embayment are diverted since construction of Highway 10, as shown on Plate 7B. This has caused some of the northern areas of the Wiley's Well Basin dune system to receive more and less drainage flow (Plate 7B). The water flow diversions have resulted in more water entering the western region of the North Wiley's Well Basin SMZ leading to an increase in eolian sand generation, and relatively dryer conditions in the eastern portion of the North Wiley's Well Basin SMZ leading to a region exhibiting less vegetation density where eolian sands can migrate further distances than would be the case naturally (Plate 7B). These conditions have led to a historical increase in sand migration from the southward flowing wash along the eastern side of Zone A in northern Wiley's Well Basin area (Plate 4), toward the ENE within the North Wiley's Well Basin SMZ. A series of low relief, active, poorly vegetated transverse dunes occur in this area (Zone A areas on Plate 5), that may have resulted from ablation erosion of older more pronounced linear dunes due to a decrease in internal dune stabilizing moisture. This area receives less moisture in historical times due to water flow diversions (Plate 7B). Alternatively, these weak linear dune forms may have developed during historical times due to the increase in eolian sand production downwind and increase in the ability for sand to migrate in the area due to a decrease in vegetation. The North Wiley's Well Basin Sand Migration Zone is located well north of the proposed Crimson Solar Project.

### *9.1.10 Palowalla Sand Migration Zone (Anthropogenic)*

The Palowalla SMZ occurs at the eastern end of the Wiley's Well SMZ and is designated as a separate zone based on anthropogenic water flow diversions associated with the construction of Highway 10 to the north. Construction of level farm fields involving the development of over 5 foot high berms across Palowalla Wash in the same parcel of land in which the Blythe 21 Solar Facility has been constructed, cut off water flow that historically ran through the area of the current facility site resulting in creation of, or increase in, ponding (Plate 3A and Plate 7B). Test pit and field mapping data indicate that the area of ponding west and south of the Blythe 21 facility is modern (man-induced) and did not occur prior to construction of the property berms.

The Palowalla Ditch drainage systems has experienced an increase in drainage flow due to diversion of watershed area K1 and a portion of K, which since construction, is completely diverted to flow through the Palowalla Ditch (flow under Highway 10, Plate 7B). In addition, a north-south trending flood control berm extending from Palowalla Ditch at Highway 10 to just northwest of the Blythe 21 Solar Facility has also focused flow that would have continued to flow to the east across Palo Verde Mesa "under" the Blythe 21 facility.

It is proposed that the water diversions from upper fan areas and the ponding during recent historical times has led to an increased flux of eolian sand to this local area of the Wiley's Well Basin SMZ. The increase in eolian sand flux has resulted in an isolated area that was likely a Zone BC, consistent with regions to the west, to become a Zone B during Historical times.

The Palowalla Sand Migration Zone is located well north of the proposed Crimson Solar Project within the valley axis.

*9.1.11 Mule Sand Migration Zone*

The Mule SMZ was originally mapped by Kenney (2011) and studied in more detail in Kenney (2016) during eolian studies for the proposed Desert Quartzite Solar Project (Figure 11B, Plate 2 and Plate 3A). The Mule SMZ extends from the Palo Verde Topographic Sill (Figure 11B and Figure 12) within the northeastern region of the Crimson Solar Project (RE Crimson) eastward where it exits the RE Crimson. Field mapping indicates that only a minor magnitude of eolian sands are transported over the local Palo Verde Topographic Sill from the eastern end of the Northern Mule SMZ to enter into the Mule SMZ (Figure 11B).

The earlier Kenney studies identified the sand transport zone as emanating from a drainage system along the northern flanks of the Mule Mountains (Figure 11A, Plate 3A and Plate 6A). The Mule SMZ is weak, and sufficiently weak to have not been mapped by Lancaster (2014; Figure 10), which is consistent with the dunes being less than 5 feet thick, which was his criteria for mapping dune systems. The stratigraphic thickness of the Mule SMZ dunes in the RE Crimson generally range from 1 to 3 feet thick (Figure 13).

The watershed area for the drainage system producing the eolian sands for the Mule SMZ is relatively small (Plate 7A - Watershed P) and believed to be too small to be able to produce the magnitude of eolian sands identified in the zone if this drainage system was a typical wash system emanating from a local Mojave Desert mountain range. However, field mapping in the area indicates that the washes of watershed P have eroded into the ancient Colorado River deposits (unit Tmm - Soil 7a, Plate 6A) and carry a larger bedload of eolian size grains during flood events compared to typical desert washes emanating from bedrock dominated mountain ranges. Nearly all the washes in Watershed P exhibit abundant eolian sands that are interpreted as being generated along the wash cut banks where the older formational units (i.e. Bullhead Alluvium - Unit Tmm) exhibit numerous cliffs indicating significant erosion (see Figure AD-11 in Appendix D). Once sand material is eroded from unit Tmm along the cut-banks, it can experience fluvial-eolian cycling via being entrained by wash flow, then entrained by the wind (eolian), and then again potentially be re-entrained by wash flow. Eventually, the sand grains can reach the eastern upwind area of the Mule SMZ where a larger component of the sands are deposited as eolian dune deposits leading the creation of the Mule SMZ. However, most of the washes in the Tmm source area exhibit stabilized dunes with surface soils that are approximately 5 to 1 thousand years old. Hence, the washes contain abundant stabilized dunes that experienced an aggradational event during the mid Holocene and eolian sand source rate and eolian sand migration rates likely decreased during the late Holocene.

The generation of eolian sands from the upwind formational source is assisted by the orientation of the prevailing winds trending in a similar direction as the wash system, low bar and swale relief, and that the relatively larger drainages are wide and braided.

The most robust dune form in the Mule SMZ are active sand sheets in a small region on the leeward (downwind) side of a topographic high associated with remnants of an ancient shoreline berm of the receding Colorado River in Pliocene (unit Tmw, Soil S7, Plate 5). This area is mapped as Zone B and comprises an area of only ~3.5 acres and is located east of the RE Crimson. Most of the Mule SMZ exhibits relict dune mounds with active eolian sands representing sand sheets and small coppice dunes (Figure AC-4-2 in Appendix C). The upwind area of the Mule SMZ within the RE Crimson that is mapped as Zone C, exhibits numerous strongly stabilized old dune mound systems similar with most dune systems in the area of the RE Crimson (Figure 12), but in most areas exhibits wisps of active eolian sands on lag surfaces and in washes (Figure AC-6-2, Appendix C). The occurrence of the stabilized old dune mound systems indicates that eolian sand migration rates emanating from the Tmm formational source was stronger in the past. The old dune mound systems exhibit mid to late Holocene surface soils indicating that eolian sand migration rates and likely eolian sand source generation was higher during the early to mid Holocene as discussed earlier.

As shown in Figure 13, the thickness of the dune deposits in the Mule SMZ within the RE Crimson generally range from 1 to 3 feet thick (Figure 13). These thicknesses occur in areas mapped as Zone BC and Zone BW. Soil stratigraphic ages indicate that the dune deposits are early to mid Holocene in age (i.e. 10 to 5 kya; Figure 14).

Figure 12: Sand migration zone map of the RE Crimson region.

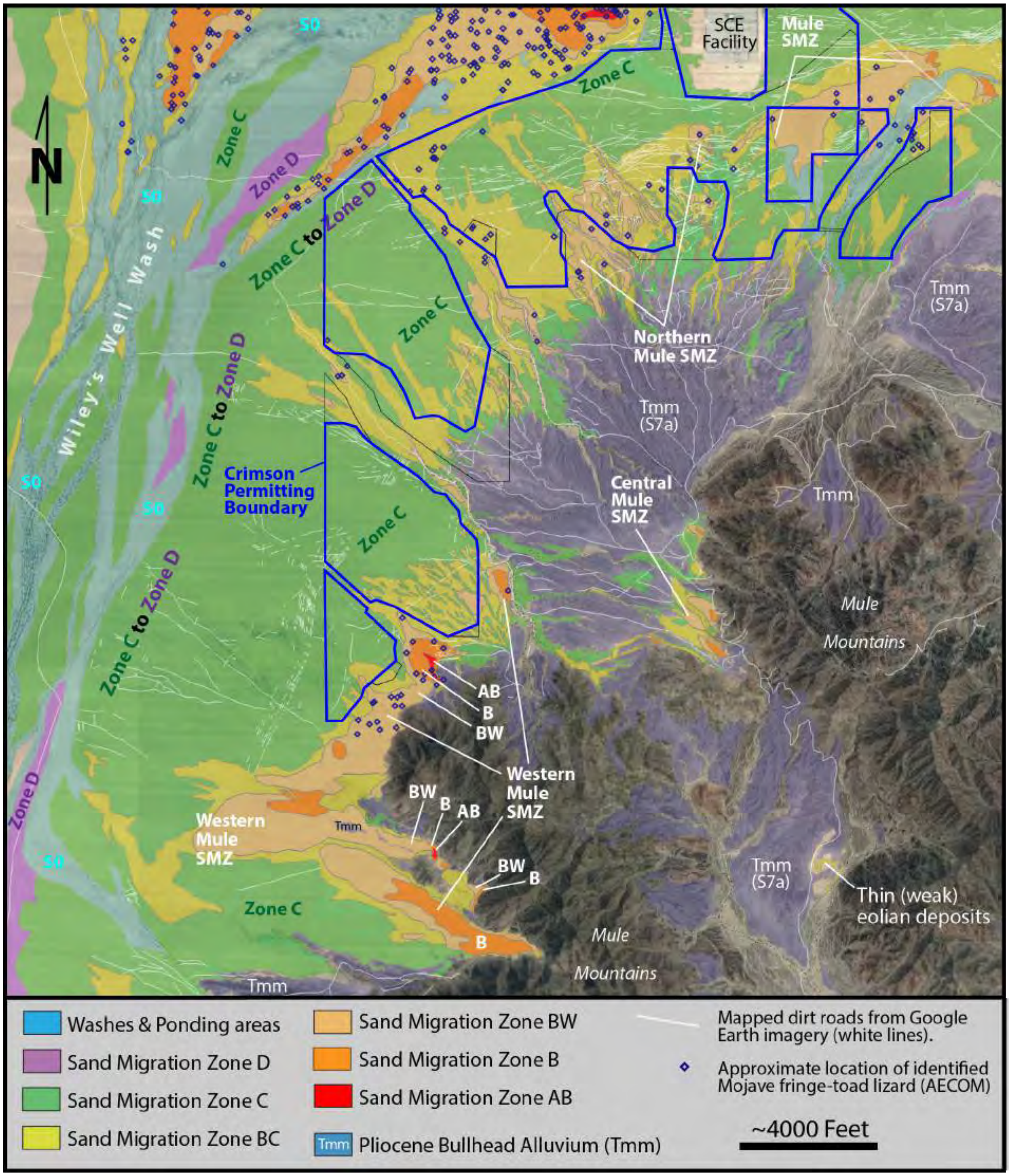


Figure 13: Sand migration zone map and soil stratigraphy map of the RE Crimson region and showing total thickness of eolian deposits.

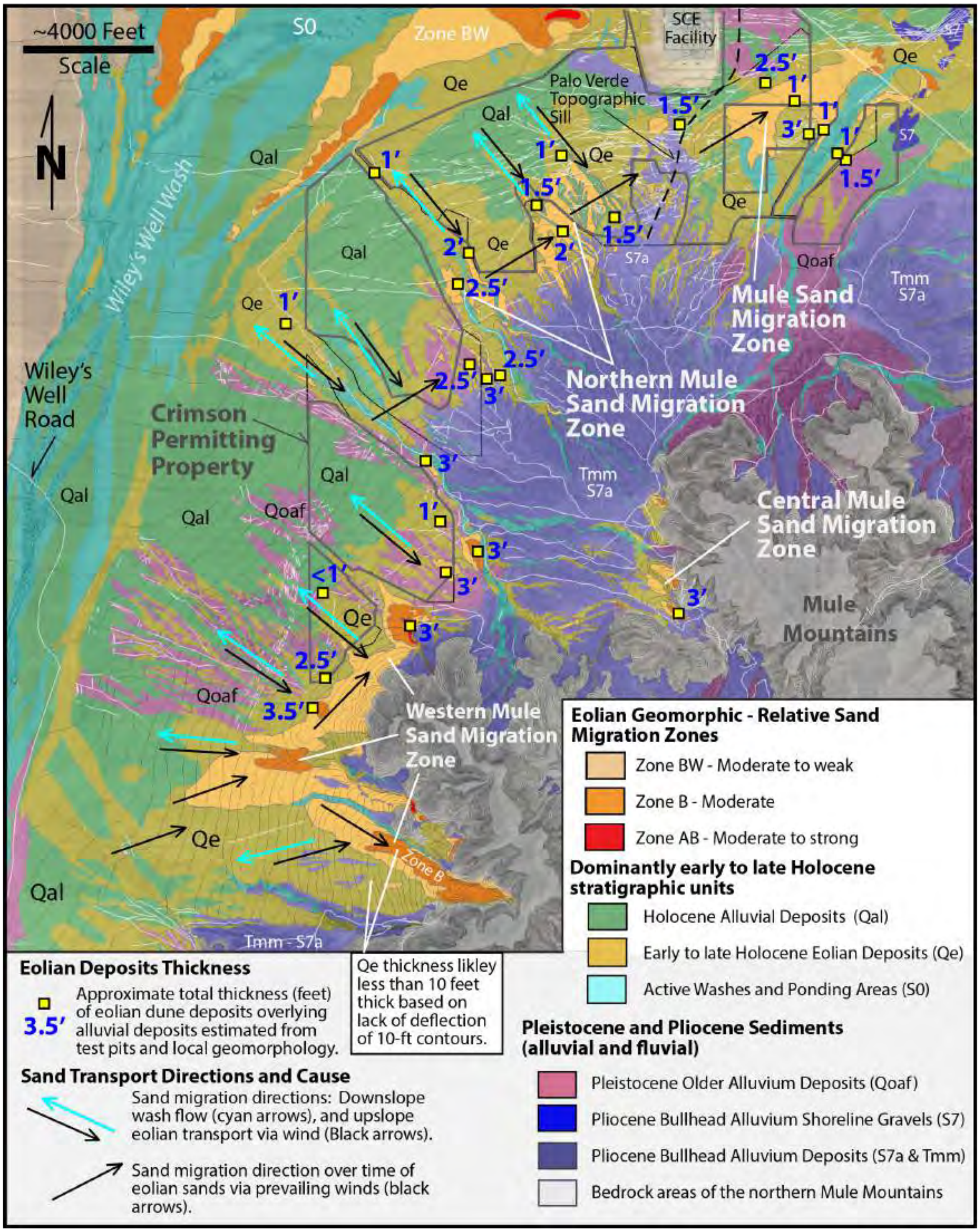
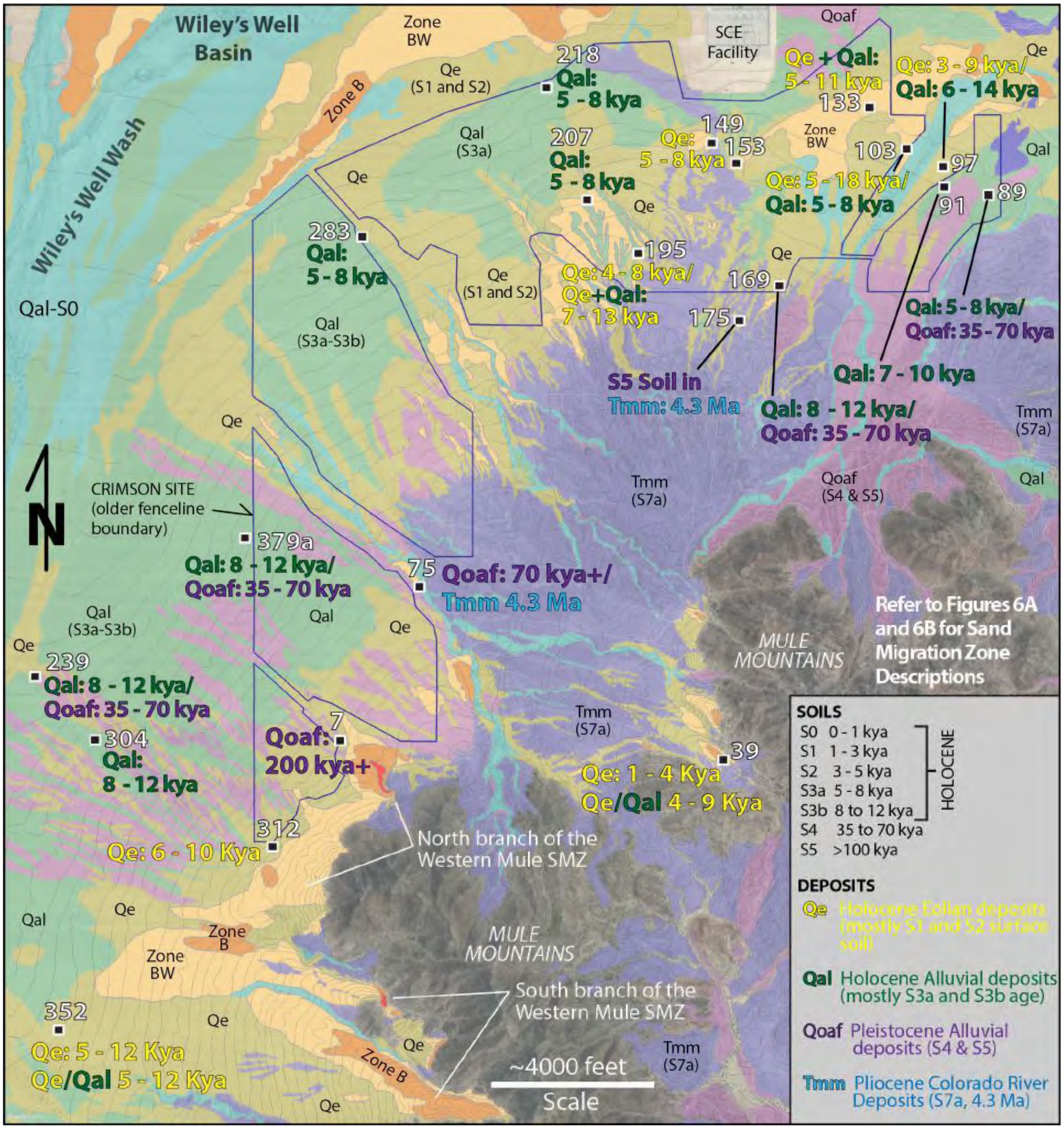


**Figure 14.** Soil stratigraphic sections cumulative ages in the Crimson Solar Project.



#### *9.1.12 Northern Mule Sand Migration Zone*

The Northern Mule SMZ exists in the central portion of the RE Crimson along the topographic "toe" of surface exposures of the Bullhead Alluvium (i.e. unit Tmm – Soil S7a (Figure 12). The Northern Mule SMZ is a weak sand migration zone as it is mapped as exhibiting only Zone BW and Zone BC (Figure 11B and Figure 12). Active eolian sands consist of primarily thin sand sheets and coppice dunes and the area never appears to have had more robust type dune forms other than dune mounds that are now strongly stabilized (Figure 12).

The source for eolian sands is from northwest flowing washes emanating from the northern Mule Mountains and gently northward sloping eroded exposures of the Bullhead Alluvium (Figure 12 and Figure 13). As is the case with all of the RE Crimson dune systems, the eolian sands are primarily derived from the erosion of the Bullhead Alluvium exposures upslope. Fluvial-eolian cycling occurs where eolian sands are transported by drainages, then potentially entrained by the wind to either be deposited as an eolian deposit or re-entrained by flowing water. Eolian sands that are eventually deposited as dune sands usually occur if the wind born sand is able to escape the source channel via northeastward transport sub-parallel to local contour lines (Figure 11B). Only minor eolian sands occur in the Northern Mule SMZ derived from the Wiley's Well Wash system located immediately northwest of the RE Crimson. This finding is supported by low to very low sand migration rates between the dune systems on alluvial surfaces northwest of the Northern Mule SMZ in the northwestern portion of the RE Crimson (Figure AC-6-1 and AC-6-3 in Appendix C).

Eolian-Fluvial cycling occurs in the Northern Mule SMZ via eolian sands being deposited in low relief areas of active washes along the entire length of the washes (Figure AC-5-1 in Appendix C). Then wash flow entrains the eolian sands and migrates them further downslope to feed the dunes along the southeastern margin of the Wiley's Well wash system located just northwest of the northwestern boundary of the RE Crimson. Hence, instead of the presumed eolian source of the Wiley's Well Basin dune system to the dunes along the flank of the northern Mule Mountains, it is the washes of the northern Mule Mountains that provide eolian sediments to the Wiley's Well Basin eolian system. Some sands transported downslope by the washes are then re-entrained by the wind and are pushed back up the slope via prevailing winds down Chuckwalla and Palen Valleys (Plate 5). Once eolian sands are entrained on the upper alluvial slopes within the Northern Mule SMZ, they are less likely to be entrained by washes and thus have a higher likelihood of being deposited as eolian sediment. The southwest to northeast prevailing winds are responsible for the dominant net eolian sand migration direction within the Northern Mule SMZ (black NE pointing arrows on Plate 5).

The eolian sands primarily migrate toward the northeast sub-parallel to topographic contours across the northern Mule Mountains bajada (Plate 5 and Plate 6A). The sands typically deposit in topographically low areas such as along the edges of channels or within ancient northward trending wash swales occurring on the abandoned alluvial deposits (Figure AC-4-2 and Figure AC-5-1 in Appendix C). Hence, the thickest eolian deposits occur along the flanks of more deeply inset channels which are the eolian primary source, and smaller swales that may or may not exhibit active flow during the late Holocene.

Numerous areas in the dune system exhibit strongly stabilized ancient dune mound systems (Figure 12) and areas of very stabilized thin dune sands. Hence, as is typical of all the dunes systems in the area of the RE

Crimson, eolian sand migration rates were stronger in the past than during late Holocene times. Eolian deposition in the Northern Mule SMZ began during the early Holocene and was episodic in the sense that periods of dune aggradation followed by stabilization occurred during the mid to late Holocene. This finding is supported by the soil stratigraphy of Figure AD-12 (Site 195, Appendix D) that shows a period of alluvial-eolian mix in the early Holocene (~13 to 7 kya) to dominantly eolian deposition from 8 to 4 kya . Recent eolian sands (Latest Holocene) are very thin (surface S0 soil member) indicating that the latest Holocene has not been a period of dune aggradation (Figure AD-12 in Appendix D).

Dune stratigraphic thicknesses on the Northern Mule SMZ range from 3 to 1 foot thick (Figure 13 and Plate 6C). Thickest sections in areas mapped as Zone BW and areas mapped as Zone BC are considerably thinner. These areas generally coincide with thicker dunes in topographic lows mapped as Zone BW and thinner areas on areas of higher local relief mapped as Zone BC. These data indicate that the depositional rate for the Northern Mule SMZ is very low throughout the Holocene as is the case for all the dune systems in the RE Crimson.

*9.1.13 Central Mule Sand Migration Zone*

The Central Mule SMZ is essentially a sand ramp in that exists at the flanks and within a mountainous embayment of the northern Mule Mountains and east of the RE Crimson (Figure 12). The Central Mule SMZ is small in aerial extent and occurs on an abandoned elevated surface of exposed but eroded unit Tmm (Plate 6B and Plate 6C). The only reasonable source for the eolian sands feeding the Central Mule SMZ is erosion of the extensive exposures and deeply incised Bullhead Alluvium (unit Tmm) located immediately northwest of the Central Mule SMZ (Plate 6B and Plate 6C). Hence, the Central Mule SMZ provides strong evidence supporting the finding that erosion of the Bullhead Alluvium provides the primary source for eolian systems in the area of the RE Crimson.

The strongest relative geomorphic sand migration zone mapped in the Central Mule SMZ is Zone B which occurs at the highest elevations and most eastern portions of the dune system. Hence, the dune deposits thicken toward the east within the system and the easternmost portions of the Central Mule SMZ. The dunes forms consist of the ongoing deposition of sand sheets exhibiting some coppice and mound systems on the surface (Figure AC-3-1 in Appendix C). The prevailing wind direction responsible for transporting eolian sands to the Central Mule SMZ is from the northwest and across large exposures of the Bullhead Alluvium (Plate 6B).

The total stratigraphic thickness of dune deposits in the Central Mule SMZ is approximately 2 feet which overlies a mixed member composed of alluvium and eolian sediments that is about 1-foot thick (Figure AD-3 in Appendix D; Figure 13). The local transition from an alluvial-eolian period of deposition to an eolian dominated depositional environment may have occurred during the mid Holocene (i.e. ~4 kya, Figure AD-3 in Appendix D; Figure 14). The isolation of the Central Mule SMZ may have led to it receiving relatively significant eolian deposition during primarily the mid-Holocene and then a decrease in eolian sand input since that time (Figure AD-3 in Appendix D). This finding is based on the paucity of buried soils in the test pit of Site 39 (Figure AD-3) and instead exhibiting essentially one relatively thick eolian member that makes up the bulk of the stratigraphic section.

*9.1.14 Western Mule Sand Migration Zone*

The Western Mule SMZ occurs primarily south and southeast of the southern RE Crimson, however, the northeastern most region of the Western Mule SMZ does occur within the southern RE Crimson (Plate 6B, Plate 6C, Figure 12 and Figure 13). The Western Mule SMZ represents sand ramps as the thickest and most robust areas of deposition coinciding with relative geomorphic sand migration Zones BW and Zone B occur along the base of bedrock highlands in the northern Mule Mountains (Plate 6B and Figure 13). This is because the prevailing winds from the northwest and southwest slow down considerably as they approach the mountain front. The Western Mule SMZ is split downwind and toward higher elevations due to the sands bounding a curved portion of the northwestern Mule Mountains (Plate 6B and Figure 12).

The Western Mule SMZ eolian deposits exhibit a total stratigraphic thickness of 3.5 to 1 foot similar for other local dune depositional areas (Figure 13 and Plate 6C). The dune deposits typically thicken upslope and further downwind with the thickest deposits generally occurring at the highest elevations, or within inset channels in upper elevation areas (Figure 13). However, the current project boundary of the RE Crimson excludes area of the thickest eolian deposits (i.e. 3.5 to 3 feet thick) and within the proposed development generally exhibit dune thicknesses of less than 2 feet.

Examples of relatively thick eolian deposits occurring outside the RE Crimson are along the flanks of inset washes and are provided on Figure AC-2 and Figure AC-3-3 in Appendix C. The most robust mapped sand migration zone areas are two small areas mapped as Zone AB occurring at the eastern and northeastern limits of sand migration zones within topographic lows associated with inset channels located at contact of the base of the mountain range and alluvial surface terraces (Plate 6B). Eolian sands are deposited in these areas due to a dramatic decrease in wind speed as the wind blows over the alluvial surface and over the drop in topography associated with the channel edge.

Eolian deposits are much thinner where the sands migrate over abandoned alluvial terrace or Tmm surfaces downwind from the relatively thicker depositional areas. In these areas the eolian sands similar to the Norther Mule SMZ primarily deposit in ancient swales on the abandoned surfaces as shown on Figure AC-4-1, Figure AC-5-3 and Figure AC-3-2 in Appendix C. In some areas, the ancient erosional swale topographic relief is more subdued which has allowed for a relatively even thickness of eolian deposition in the zone and a wide swath of an area mapped as Zone BW with the exception of some relatively wide topographic lows leading to small patches of areas mapped as Zone B (Figure AC-3-2 in Appendix C, Figure 13). As can be seen in Figure AC-3-2 and Figure AC-4-3 of Appendix C, a weak gravel lag on the surface is quite common indicating that eolian sand migration rates are slow.

In terms of eolian sand source, there are insufficient exposures of the Bullhead Alluvium or significant washes in the immediate vicinity of the Western Mule SMZ to provide sufficient eolian sands to this dune system similar to other dune systems in the RE Crimson area. For example, the Western Mule SMZ is located at the base of the Mule Mountains bedrock escarpment which is different than the Northern Mule SMZ and Mule SMZ (Figure 12). There are extensive surface exposures of older alluvium northwest of the northern branch of the Western Mule SMZ (Figure 13 and Figure 14) that upon erosion by inset younger drainages has likely contributed some sand to the eolian system. It is clear that fluvial-eolian cycling is occurring in the region of the exposed older alluvium upwind from the dune system (Plate 5), but it is unknown if those eolian sands are eroded from the underlying older alluvium or from transport downslope by the washes from the dune system.

Two other potential sources for the eolian sand are the Wiley's Well Wash system and/or a significant wash system emanating from the northwestern Mule Mountains. Significant eolian sands generated by Wiley's Well Wash seems surprisingly unlikely as the area immediately east of the wash shows very few dune geomorphic features and even alluvial surfaces within the braided system exhibit nearly no dune geomorphic features (see areas mapped as Zone D on Figure 12). In the area immediately east of this portion of the Wiley's Well Basin, a region mapped as Zone C to Zone D occurs, where the only eolian sands in the area are associated with some washes that have flowed from the dune deposits upslope in the Western Mule SMZ (Fluvial-eolian cycling; Figure 12). Photographs of this region are provided in Figure AC-6-6 and Figure AC-6-8 in Appendix C. Hence, there is no evidence of an active or relict-dormant sand migration zone connecting the Wiley's Well Wash system and the Western Mule SMZ down-wind (i.e. toward the southeast).

A more likely source of the eolian sands feeding the Western Mule SMZ is a significant wash system flowing out of the northwestern Mule Mountains. Two drainage systems (shown on Plate 4) fed by a dense tributary drainage system (i.e. an erosion style of drainages), have deeply eroded into an ~1.5 square mile region of exposed Qoaf overlying Bullhead Alluvium (unit Tmm – S7a, Plate 4; see Figure AD-15 in Appendix D). In addition, a relict-dormant sand migration zone was identified connecting these washes with the western limits of the mapped Western Mule SMZ (Plate 4).

Regardless of the eolian sand source and similar to other dune systems in the RE Crimson area, the depositional rate for eolian deposits during the Holocene, and hence, sand migration rates as well, indicate that whatever the eolian source is and was, it was not generating much eolian sand to begin with. In the northern branch of the Western Mule SMZ, the total stratigraphic thickness of eolian deposits is approximately 3.5 feet (Figure 14 and Plate 6C). Total stratigraphic thickness of the southern branch of the Western Mule SMZ was not directly evaluated in the field during this study, but is likely similar to other mapped areas. This finding is based on USGS 5-foot topographic contours that do not indicate a change in topography where the most robust eolian geomorphic zones are mapped (Plate 6C). Dunes in this area were deposited on an ancient depositional surface of likely Bullhead Alluvium (Unit Tmm – S7a) and older alluvium and the topographic contours remain consistent with these units original surface.

The timing of eolian deposition occurred as a number of pulses (small aggradational events) during the early to late Holocene as shown in Figure AD-14 in Appendix D. Evidence for numerous pulses of dune sands (times of increased sand migration rates) is shown by numerous buried soils in the upwind "source area" of the Western Mule SMZ (see Figure AD-14 in Appendix D). Similar to the other dune systems in the RE Crimson area (Mule Mountain dune systems), the source region sand migration pathway for the Western Mule SMZ was dominated by alluvial processes in the early Holocene and then sufficiently developed in the early Holocene to result in preserved eolian deposits (See Site 352 on Figure 14). Note that on Figure 14, areas mapped as Qe indicate that the parent sediments in which a soil developed is primarily eolian in origin. Hence, many areas mapped on Figure 14 as unit Qe represent early to mid Holocene age sand migration zones that have subsequently become stable exhibiting slower sand migration rates. Additional evidence that the sand migration rates near the source washes for the Western Mule SMZ exhibit numerous stabilized old mound systems (Figure 12).

### *9.1.15 Highway 10 Sand Migration Zones (Anthropogenic)*

Several relatively small areas were identified north of the modern Highway 10 where eolian sand generation has increased associated with construction of the old and modern Highway 10. These include the Highway 10-Palen-Ford Dry Lake Pass, Highway 10-South Ford Dry Lake, and SE Ford Dry Lake SMZ's (Plate 3A). These regions receive newly generated eolian sands from washes that flow toward the north from the Chuckwalla and Little Chuckwalla Mountains (Plate 3A). This region is part of the regional Chuckwalla Valley sand migration corridor; however, it has received additional eolian sand input since construction activities of the modern and old Highway 10 (Plate 3A). In Pre-historical times, the drainages flowing northward from the Chuckwalla Mountains would have gradually fanned out into a dense braided network of progressively weaker flowing drainages. In this condition, flow would have reached the valley axis much less frequently resulting in a smaller magnitude of eolian sand generation in the valley axis dune system.

Since highway construction, water flow has been diverted by flood control berms for both the older and newer Highway 10 and this has increased flow rates at specific points (i.e. subdrains) along both freeway systems (Plate 3A). The increased flow rates have allowed water to more frequently reach the valley axis and have increased channel erosion. These processes transport more alluvial sand to the valley axis area where prevailing winds are the strongest. The sand is subsequently mobilized by the wind to produce eolian sands. The increased flow of these drainages may also cause portions of the Ford Dry Lake bed to inundate, which would result in an additional, but slight, increase in eolian sand generation.

### *9.1.16 Powerline Sand Migration Zone*

The Powerline SMZ is a small and weak eolian system that has developed naturally, but may be slightly affected by minor water diversions and surface disturbances along the graded (dirt) powerline road to the southwest (Figure 11A and Plate 3A). No portion of the Powerline SMZ resides within the RE Crimson. The Powerline SMZ was not mapped by Lancaster (2014), which is consistent with the findings herein as the total dune thickness is less than 3 to 5 feet. The dune system receives eolian sands from wash flow in the southwest and ponding areas to the northwest and southeast (Plate 5). The area exhibits thin, relict and subdued dune mounds with active eolian sands consisting of scattered sand sheets and small coppice dunes. The eolian deposits are less than 1 foot thick. The Powerline SMZ occurs east of the Crimson Solar Project.

## 9.2 Mid to Late Holocene dune connectivity of local sand migration zone

Mapping of eolian systems is complex due to many factors. Some of these include lateral gradational changes in dune forms and activity, variations in dune activity over time that results in relict dune forms that are no longer active, and degree of internal erosion of relict dunes. However, these are important criteria when evaluating dune activity and stability. The eolian geomorphic relative sand migration zones provide a method for showing various degrees of dune form and activity, but various degrees of internal dune erosion or dune migration are not indicated sufficiently. The Geologic and Geomorphic symbols for eolian, fluvial and playa systems discussed in Section 7.3 assist in the communication regarding variations of ground surface stability. For example, simply indicating that a dune system is stable does not provide information whether internal erosion of older relict dunes is a significant source of eolian sands. For playa lake surfaces, it is beneficial to be able to characterize whether the playa lake surface is primarily just a pathway for eolian sands (i.e. unit Ql), or if the playa lake surface is eroding resulting in a source of eolian sands as well (i.e. unit Ql-de).

General regions of the dune systems in Chuckwalla Valley were mapped utilizing the Geologic and Geomorphic eolian, fluvial (alluvial) and playa designations in combination with the relative sand migration zone designations (Plate 3B). Due to their importance as regions of eolian sand production, areas of frequent water disturbance are also shown (i.e. soils S0).

The map shows that regions of Qe-a exhibiting the most active eolian areas are isolated, only occurring in the Palen Dry Lake and eastern most Chuckwalla Valley areas (Plate 3B). Areas exhibiting significant erosion in areas dominated by relict dunes (unit Qs-de) occur at numerous localities along the regional Chuckwalla Valley sand migration corridor suggesting that sand migration rates along the system have significantly decreased since the older more robust dune forms were originally deposited. Regions where older more robust relict dunes no longer receive sufficient sand to maintain their form and instead are dominated by active sand sheets with minor internal erosion (unit Qe-ds) also occur at numerous locations in the valley. This also indicates a decrease in sand migration rates since the original more robust relict dunes were deposited. However, regions mapped as Qe-ds do allow for eolian sand transport through the system.

Review of the entire map shown on Plate 3B indicates that the Ford Dry Lake eolian system represents a significant obstacle for through going eolian sand transport. In addition, it is more likely that throughout the Holocene, Ford Dry Lake eolian systems have received most of their sand from local sources as discussed in the previous section.

### 9.3 Correlation of watershed size and drainage flow type (tributary vs. distributary) with sand migration zones

Water flow within washes and in ponding regions is the most important source of eolian sand generation in addition to providing stabilizing moisture for dune systems. It seems reasonable that the size of the watershed (drainage system aerial extent) of a wash system would be an important parameter in terms of the wash systems ability to generate eolian sands. Larger watershed areas capture more precipitation that leads to stronger water flow. Drainage systems that remain primarily tributary systems where water flow merges downstream also allow for increased flow rates downstream which increases the probability that water flow to the valley axis will occur leading to production of eolian sands. One characteristic that many of the wash systems have that lead to the production of sufficient eolian sands to produce a local sand migration zones in the valley axis is that they flow primarily as a braided wash system but that their flow has accumulated from an erosional tributary drainage system over an extensive aerial extent within their watersheds. This is the case for essentially all the significant identified local sand migration zones in the Chuckwalla Valley. For example, drainage areas A, C, B, R1, Q, and P (Plates 7A and 7B) all focus their overland water flow into a relatively narrow drainage zone that reaches the valley axis.

In areas of alluvial fan distributary drainage systems (i.e. depositional wash system), much less eolian sand is produced in the valley axis as flow from these wash systems much less frequently reaches the strength required to reach the valley axis and most have deposited their sand bedload prior to reaching the valley axis. This is the case along the northern Chuckwalla Mountains where flow across a very wide and dense distributary system across the alluvial fan (bajada) has not led to significant eolian sand production (Plate

7A). This is also the case for some of the washes along the northern Mule Mountains bajada where fluvial-eolian cycling is occurring.

There is also a correlation of the magnitude of the relative sand migration zone (SMZ) in terms of eolian sand production and the size of its associated watershed (Plate 7A). For example, comparing the relative strength of the Ironwood and the Wiley's Well Basin sand migration zones with their watershed areas S+R1 and Q respectively, which are relatively robust eolian systems, with the North Ford Dry Lake SMZ (Cz) resulting from flow in watershed area C shows a correlation of sand migration zone robustness and watershed size (Plate 7A). These watersheds appear to be of sufficient size to generate the magnitude of eolian sand deposits observed in the downwind regions of their respective SMZ's. Another example is the relatively weak Mule SMZ (area Pz on Plate 7A) and its relatively small watershed P (Plate 7A).

### 9.4 Prevailing winds and effects on sand migration zones

Prevailing winds are those that are sufficient to transport eolian sands. In Chuckwalla Valley and western Palo Verde Mesa, the prevailing winds vary locally due to the type of storms producing the winds and from local topography. Within the valley axis, prevailing winds, are from the west and southwest which generally coincide with storms generated in the Pacific during the winter (westerly prevailing winds) and summer monsoonal storms (southwesterly prevailing winds; Plate 2 and Plate 4). However, the north-south trend of the Palen and McCoy Mountains results in strong north to south prevailing winds in the Palen Valley causing sands within the Palen Sand Migration Zone (SMZ) to migrate south-southeastward in the northern area and curved toward the southeast as the zone enters the Chuckwalla Valley axis (Plate 7B).

Prevailing winds from the west and southwest play a very important role for the Wiley's Well Basin dune system as it has caused the formation of complex-star dunes in the northern Wiley's Well Basin area, and stabilized small linear dunes down the axis of the dune system. The linear dunes occur in the western and central areas mapped as Zone A on Plate 7B within the Wiley's Well Basin Dune System.

In the Crimson Solar Project (RE Crimson), the important prevailing winds are similar to those observed in the eastern Chuckwalla Valley region. Namely, winds from the west and from the southwest. Both of these wind directions play an important role at the RE Crimson site. Winds from the west are observed to push eolian sands up the northern Mule Mountain bajada (Plate 4), which is in the opposite direction compared to the northwestern flow of the local washes. This causes local sands to be transported down the slope via the washes and back up the slope via the wind in a process referred to as fluvial-eolian cycling (Plate 5, Plate 6A and Plate 6B). Prevailing winds from the southwest that are particularly strong through the pass of the Little Chuckwalla Mountains and Mule Mountains are critical in that they have the ability to transport eolian sand out of the northwest flowing washes and onto alluvial surfaces where the sand can migrate and eventually deposit. It is the southwesterly wind that is responsible for the northeast trend of the northern branch of the Western Mule, the Central Mule, and Mule Sand Migration Zones (Plate 5, Plate 6A and Plate 6B).

The dune systems of the RE Crimson all occur where the west prevailing winds are not obstructed by other mountain ranges, and thus, are "hit" by the full force of the wind. For example, the southernmost sand migration in the RE Crimson area (i.e. the Western Mule SMZ – south branch) resides north of where westerly winds are obstructed be the eastern end of the Little Chuckwalla Mountains (Plate 4).

## 10 AGE OF DUNE SYSTEMS IN THE EASTERN CHUCKWALLA VALLEY AND PALO VERDE MESA AREA

The recent Kenney (2016) eolian report for the Desert Quartzite Solar Project (DQSP; Plate 2) examined the age of the dune systems in the eastern Chuckwalla Valley axis region (i.e. Wiley's Well Basin SMZ) in detail. The Kenney (2016) report identified a transition from alluvial to eolian deposition occurring during the early Holocene approximately 8 to 5 kya. This was identified by the identification of S3a soils at the stratigraphic base of the eastern Wiley's Well Basin dune system suggesting that wind-blown sediments (sands) had begun to reach the area in the early mid-Holocene. The identification of widespread 5 to 3 kya S2 surface and near surface soils in eolian parent sediments in the Wiley's Well Basin SMZ indicates that a relatively robust period of dune deposition occurred during the early to mid-Holocene. Since 5 to 3 kya, the eastern Wiley's Well Basin SMZ received less eolian sands (area mapped as Zone BW on Plate 4) indicating that the previous eolian aggradational event had greatly subsided. The western region of the Wiley's Well SMZ continued to receive sufficient new eolian sands during the late Holocene to maintain thin active sand sheets covering most of the area. These areas are mapped as Zone AB and Zone B on Plate 4.

Dune systems across the RE Crimson along the northern flanks of the Mule Mountains experienced a similar development history as that determined for the Wiley's Well Basin SMZ in the Chuckwalla Valley axis. The RE Crimson area during the latest Pleistocene to earliest Holocene experienced minor eolian deposition as alluvial processes dominated. During the early Holocene, approximately 11 kya, the eolian sand migration zones identified in the area of the RE Crimson were sufficiently strong to allow for eolian deposition. This is observed by numerous soil test pits that show a transition from alluvial to an alluvial-eolian mix, then to eolian sediment dominated deposits within the local sand migration zones around 11 kya (Figure 14). Most of the eolian deposited mass associated with the local RE Crimson dune systems were deposited between 5 and 11 kya, similar to that observed for the valley axis dunes and many dunes across southeastern California.

# 11 LOCAL VEGETATION DENSITY AND SAND MIGRATION RATES

Vegetation density is a very important eolian parameter in that vegetation provides stability for the dunes and small increases in vegetation aerial density dramatically decreases sand migration rates (mobility). As discussed earlier in the report, just approximately 10% vegetation aerial coverage increase from a landscape with no vegetation decreases sand migration rates by 90% (Lancaster and Baas, 1998). Estimates of aerial vegetation densities in the dune areas is problematic due to order of magnitude variations from relatively low values when no Sahara Mustard exists (dead or alive) compared to times when Sahara Mustard plants occur either dead or alive. In addition, vegetation densities change seasonally with the highest often occurring during spring after winter rains which happens to coincide with the time of year exhibiting the strongest prevailing winds. Although not studied in detail to the author's knowledge, it may be that more sand migrates during the summer months of June and August when Monsoonal storm systems peak and Pacific Ocean storms are at their lowest. Hence during the time of year that strong winds do occur but seasonal-annual vegetation densities are at their lowest. Regardless of these complexities however, it has been examined by the author mapping in the field that vegetation densities in all the dune systems in Chuckwalla Valley rarely if ever drop below approximately 10% throughout the year. This indicates that sand migration rates throughout Chuckwalla Valley are greatly reduced during modern times.

Aerial vegetation densities were evaluated in the RE Crimson dune systems focusing on two approximately 15 acre parcels that exhibit typical vegetation densities within the site. The analysis was conducted via evaluating Google Earth imagery for the two parcels of land with one located in the western region of the Mule SMZ and the second in the western Northern Mule SMZ (Figure 15A and Figure 15B). These images were then analyzed in Adobe Photoshop via pixel color capturing of all areas exhibiting typical colors for vegetation. This approach to analyzing vegetation density only captures all the Creosote and other relatively dark circular shaped shrubs that are at least 2 feet in diameter (darkest colors in the images), and some areas of lighter colored shrubs where relatively thick and exhibit a relatively dark gray color. However, this approach is not able to pick up abundant areas that exhibit very small plants that commonly occur throughout site dune areas. These small low lying plants are shown in a number of photographs shown in Appendix C and Appendix D (see Figure AC-4-3, AC-5-2, AC-5-3, AC-6-3, AC-6-5, AC-6-6, AC-6-7 and AC-7 in Appendix C; AD-3, AD-7, AD-12, AD-13, and AD-14 in Appendix D).

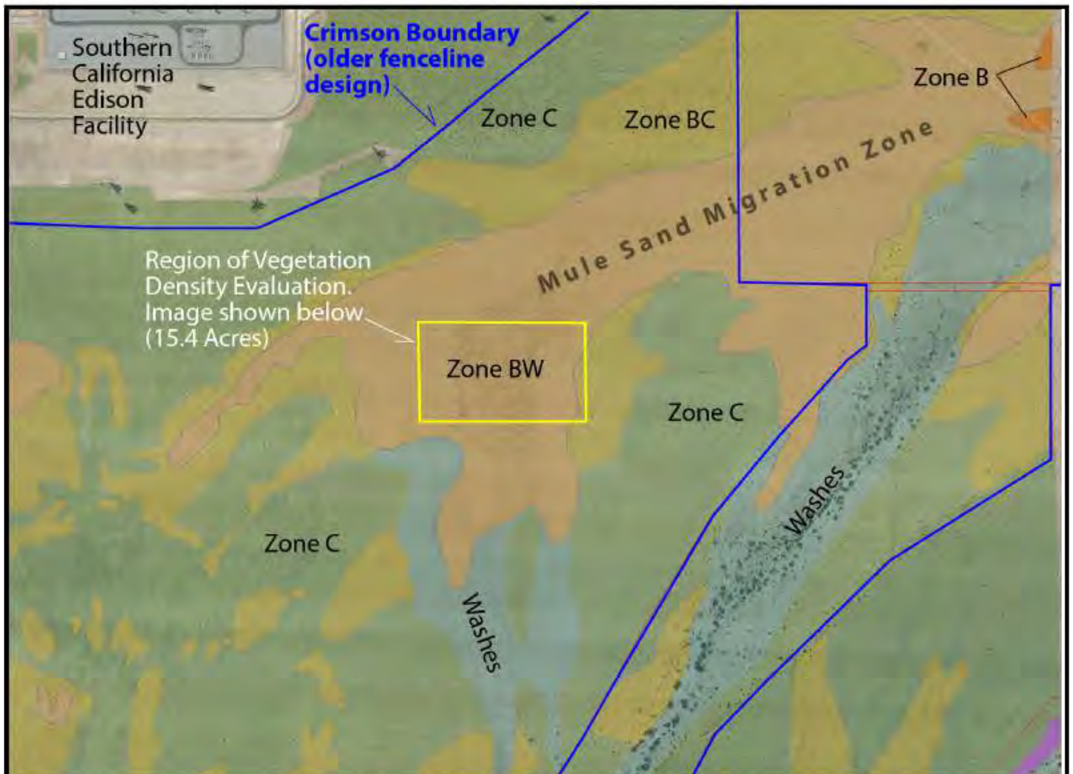
It is interesting to note that Creosote is the most common relatively tall shrub throughout the Mojave Desert and in Chuckwalla Valley. Hence, it is the dominant native plant reducing wind speeds and thus, decreasing eolian sand mobility. The strongest regional dune aggradational events occurred during the latest Pleistocene to early Holocene which coincides with the time that Creosote migrated to the Mojave Desert region (Sauer et al., 1988). Although the correlation of the "invasion" of Creosote during the most robust dune aggradational events in southeastern California has not yet been proposed to the knowledge of the author, it may be a significant parameter and an area worthy of additional research.

The onsite RE Crimson aerial vegetation analysis of the two approximately 15 acre size parcels determined a minimum of 14% in the western region of the Mule SMZ, and 14% in the western Northern Mule SMZ (Figure 15A and Figure 15B). The western Mule SMZ analysis shown in Figure 15A occurs in an area that frequently floods which introduces new eolian sands, and stabilizing moisture. The western Northern Mule SMZ analysis shown in Figure 15B occurs on a typical alluvial fan surface sand migration pathway that is elevated above the source located to the west. Vegetation densities of a minimum of approximately 10 to 14% identified in typical sand migration zones within the RE Crimson indicates that sand migration rates are decreased by 90% of what it would be if no vegetation existed in these areas.

Based on field mapping by the author in the eastern Chuckwalla Valley, dune systems have experienced a minimum of 1, but likely 2 Sahara Mustard blooms since 2010. When the invasive Sahara Mustard blooms in the area it results in essentially 100% vegetation aerial density as observed in Figure 16. The plant grows to heights of over a foot and is so thick that it binds on legs inhibiting walking. As shown in Figure 16, once the Sahara Mustard plant dies, it remains “planted” in the ground and this was observed to remain the case for many months to possibly a year from when the plant died. The dead plant stems break free and blow in the wind piling up on nearby dunes and coppice dunes, which still impedes eolian sand transport. Hence, once there is a Sahara Mustard bloom, eolian sand migration rates are greatly diminished not only for the year of the bloom, but for a minimum of the next year, and most likely into a third year.

The influence of the invasive Sahara Mustard on dunes systems where they have encroached will change the dunes long term behavior dramatically. It is anticipated that eolian sands will likely continue to be created at their sources, but will have much more difficulty transporting as far within the dune system away from their source. This model suggests that due to the invasive Sahara Mustard, new eolian sands will primarily deposit near their source causing near source aggradational events (increased sand near the source, compared to the past), and downwind dune systems will receive less eolian sands than they had in the past.

**Figure 15A:** Vegetation density analysis figures. Upper image shows the area evaluated in the Mule Sand Migration Zone in the northeastern region of the Crimson Solar Project. The lower image is a close up of the region evaluated.



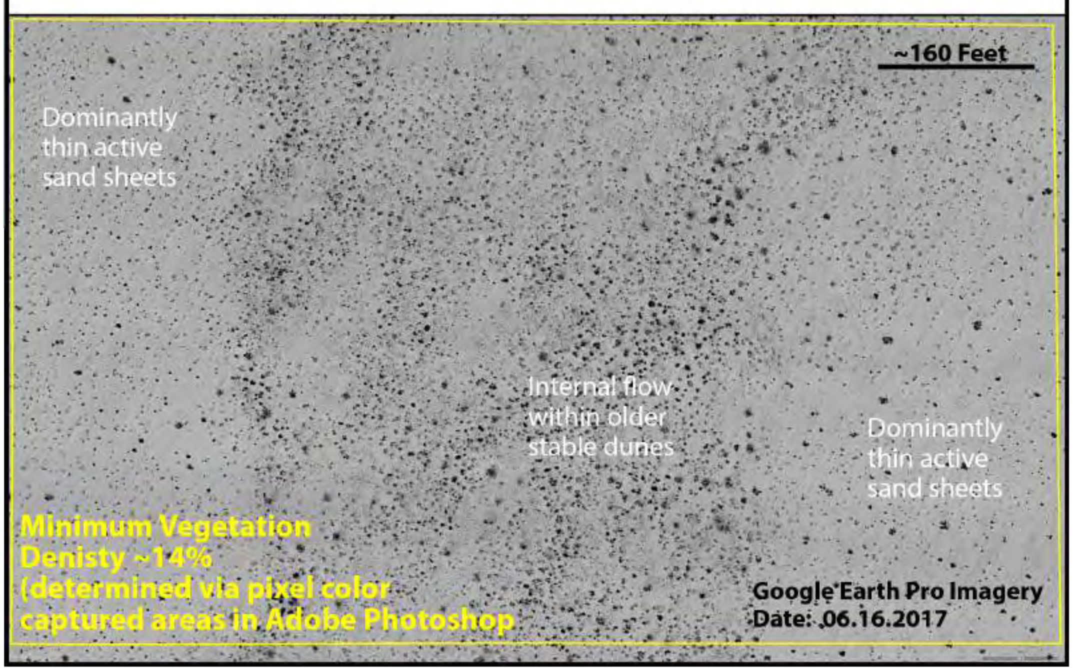
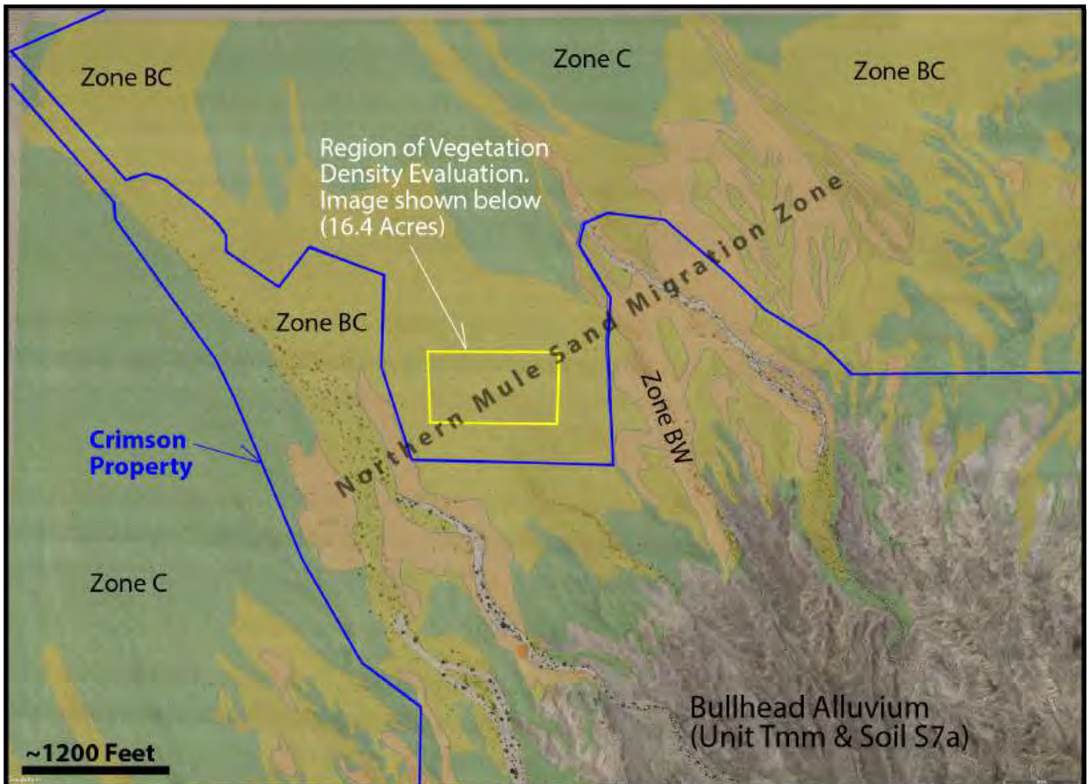



**Figure 15B:** Vegetation density analysis figures. Upper image shows the area evaluated in the Northern Mule Sand Migration Zone in the Crimson Solar Project. The lower image is a close up of the region evaluated.



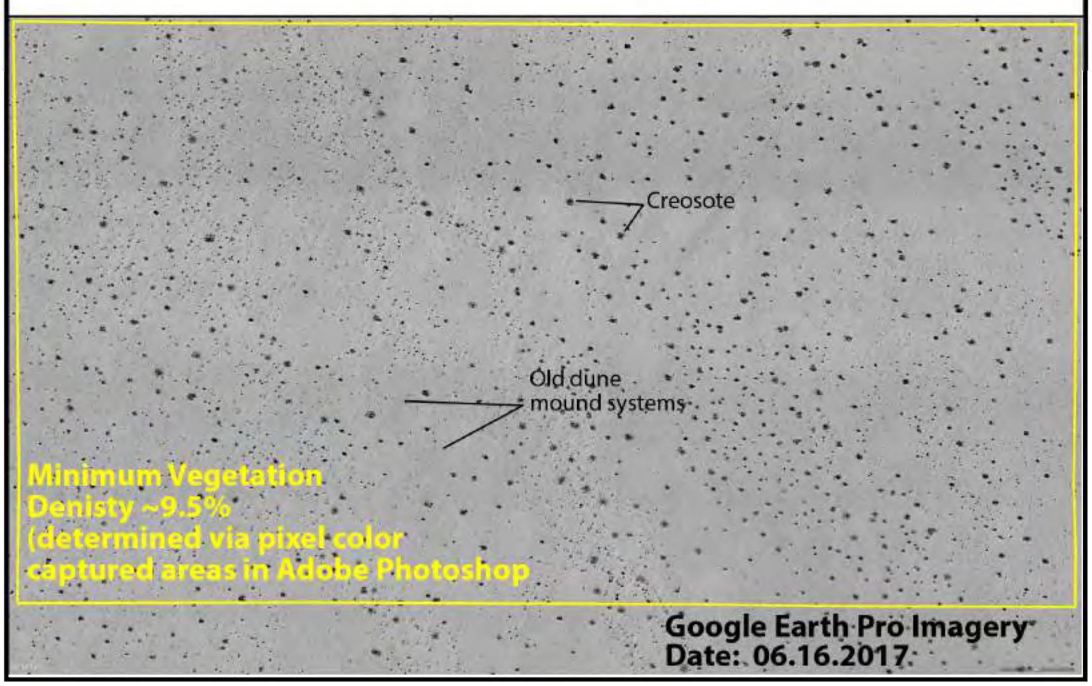
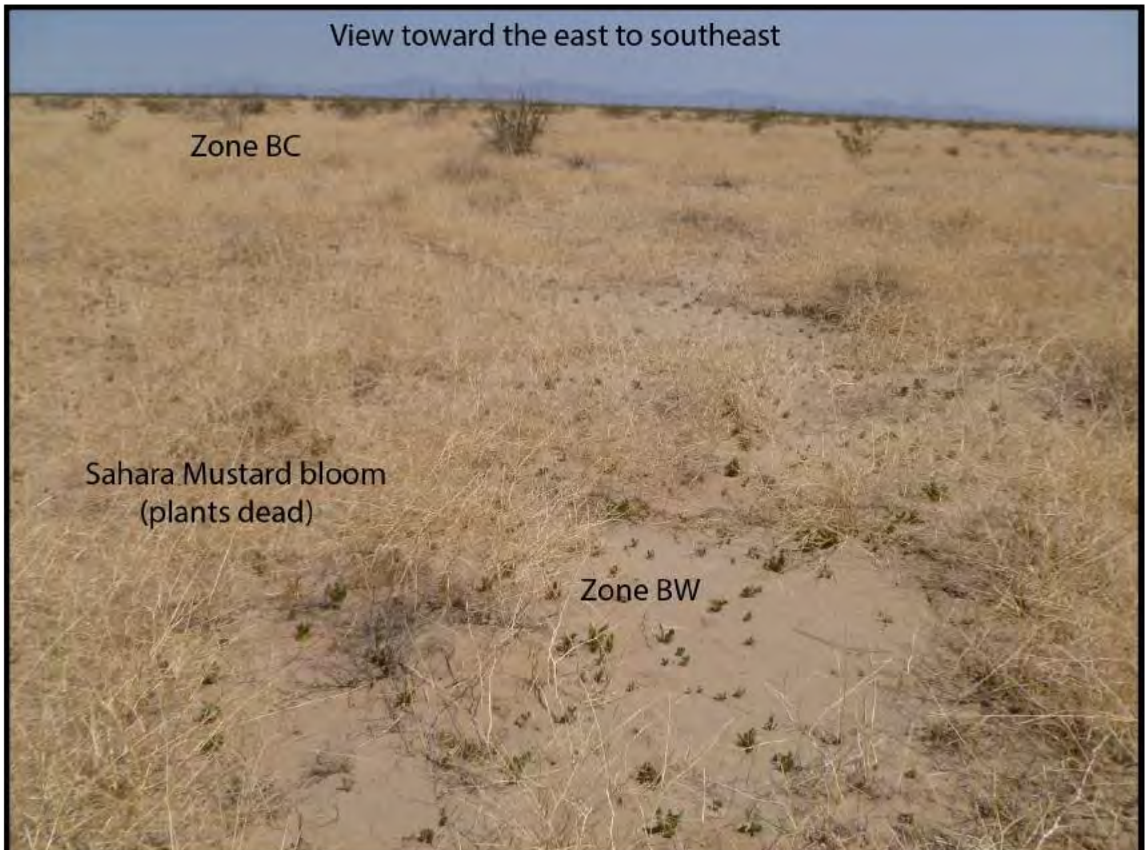



**Figure 16:** Field photograph of geomorphic field Site 53 (map location shown on Plate 5) in the Wiley's Well Basin Sand Migration Zone. The photograph was taken on April, 4, 2011, and several months after a Sahara Mustard bloom. In this image, the Sahara Mustard plants, have died but remain emplaced in the ground. During and for many months to over a year of a Sahara Mustard bloom, the vegetation density increases to nearly 100% which essentially shuts down eolian sand migration in the area.




Site 53 Latitude 33 35.622
Longitude 114 46.813

Date of photograph: 2011.04.04

Geomorphic Eolian Sand Migration Zone is Zone BW in foreground, turns to Zone BC in the background.

See Plate 5 for photograph location.

## 12 LOCAL HISTORIC VS. PRE-HISTORIC SURFACE WATER FLOW

As discussed throughout this report, one key dune parameter is local water flow both in terms of natural flow, and Historic flow if construction activities have occurred. Water flow is critical for the generation of new eolian sands and infiltrating waters for dune stability (Kenney, 2012, Schaaf and Kenney, 2016). The findings of the surface water flow analysis conducted in this report in terms of waters reaching the dune areas in the eastern Chuckwalla Valley and western Palo Verde Mesa are provided on Plate 7B and much of this analysis was conducted for both the Desert Quartzite Solar Project (Kenney, 2016) and this report. Generalized areas that may be receiving more and less water flow than in the past are identified on Plate 7B with blue stipple dots and red stipple dots respectively. This analysis is pertinent to the RE Crimson because if water diversions were found to be sufficient to grossly destabilize valley axis dunes then all those eolian sands could potentially be remobilized. However, as discussed below, this is not found to be the case as historic water diversions have subtlety changed some dune areas by either providing a slight increase or decrease in flood waters, none are considered sufficiently significant to dramatically alter current dune stability and sand migration rates in an areas large enough to cause dune expansions.

Water diversions from north flowing drainages emanating from the Little Chuckwalla Mountains and Mule Mountains have not experienced water diversions significant enough to significantly affect dune systems within the eastern Chuckwalla Valley axis area (Plate 7A and Plate 7B). The only possibly significant water diversion with north flowing drainages is the construction of an east west trending paved access road which was constructed sometime during the past 5 to 6 years (Plate 7B). The road transects the important Wiley's Well Basin ponding area that is considered the primary source for eolian sands for the Wiley's Well Basin dune system. Portions of this road are constructed on a man-made berm with a series of sub-drains allowing for water to continue flowing north of the road to the northern portion of the Wiley's Well Basin. However, it is not known if the sub-drains impede northward water flow compared to natural conditions prior to the road being constructed. Regardless, increased water flow to the northern portion of the Wiley's Well Basin has been occurring from south flowing drainages emanating from the southern McCoy Mountains since construction of water diversions associated Highway 10 (Plate 7A and Plate 7B).

Diversion of water flow associated with watershed E (Plate 7B) has caused less water flow to a region northwest-west of the Wiley's Well Basin area. Some relict dune areas in this "dry area" are abrading and vegetation densities on the relict dunes may have decreased. It is possible based on this limited research that older eolian sands are being re-mobilized in this area and able to travel greater distances due to a decrease in historical moisture.

Water flow diversion of washes from watershed F and G (Plate 7A and Plate 7B) are concentrated to the northern central portion of the Wiley's Well Basin which is interpreted as increasing moisture to this area. The most prominent dunes in the Wiley's Well Basin dune system occur in this area and it is possible that these dunes have grown due to increased eolian sand source and stabilizing moisture during historic times. Water flow diversions of watersheds F and H (Plate 7B) have been diverted from a dune area in the north-central region of the Wiley's Well Basin dune system. This area is shown as a red "dryer" region on Plate 7B. Although more research would need to be conducted to resolve the matter, the dunes in this area appear more "dried out", and less vegetated than other dune areas and active dune areas may be encroaching into areas where pre-Historical dunes had not occurred or the sand migration rate has increased during Historical times.

Water flow diversions of watershed K1 along the north side of Highway 10 to the Palowalla Ditch has caused less water flow to watersheds M and L south of Highway 10 (Plate 7B). The region of the dunes that is receiving less water is shown as a dry area on Plate 7B occurring along the northern portion of the Wiley's Well Basin dune system at the southern limits of watersheds M and L. Although the drainage analysis of the area had not been completed prior to field mapping, review of field data including notes and photographs does not suggest that the dunes are being negatively impacted by the water diversions. In the western portion of the dry area, flow within watershed M is concentrated by Highway 10 borrow pits allowing for more regular flow to the dune system near the Zone AB-Zone B to the west and Zone BW to the east contact. The area of increased flow is shown as light blue Soil S0 in the southern portion of Watershed M (Plate 7B).

In the eastern most Wiley's Well Basin dune system, an increase in water flow has occurred in Historic times associated with water diversions of watersheds K and K1 under Highway 10 via the Palowalla Ditch (Plate 7B). In addition, un-natural water ponding occurs along the western and southwestern region of the Blythe Solar Facility due to construction of the facility intersecting and diverting flow from a drainage that previously flowed through the footprint of the facility. The increased water flow to this area and ponding has increased eolian sand production leading to an increase in sand migration in the eastern most portion of the Wiley's Well Basin dune system.

In summary, based on the Historic water flow analysis, most of the eastern Chuckwalla Valley axis dune systems continue to receive sufficient water flow that allows the dunes to remain stable.

For the dune systems in the RE Crimson that occur along the northern flanks of the Mule Mountains and are not part of the valley axis dune systems, no water diversions were identified. The construction footprint for the RE Crimson (Figure 2) resides outside of most of the prominent local washes, hence, allowing for continued flow. Most of the dune systems in the RE Crimson reside on abandoned "fan" terraces and in a region associated with the upper fan with many occurring along the toe of the exposed Bullhead Alluvium or the base of the bedrock slopes associated with the Mule Mountains (Plate 6A and Plate 6B). This indicates that most dune areas of the RE Crimson do not receive significant flood waters and have therefore been in equilibrium in terms of stability via surface area precipitation. This was observed in test pits in the RE Crimson area dune systems that generally exhibited less inherent moisture than those in the valley axis dune systems. This observation also suggests that the RE Crimson dune systems are likely less prone to destabilization if dryer climatic conditions were to occur, which is anticipated for future climate in the southwestern United States during the next century. This aspect is discussed in more detail below.

## 13 EOLIAN RESPONSE TO GLOBAL AND LOCAL CLIMATE

Eolian dune systems across southeastern California (the regional study area) have clearly not experienced a steady and consistent growth rate since the latest Pleistocene (Lancaster, 1995). Instead, eolian systems have experienced dramatic variations in development since the Last Glacial Maximum (LGM). The LGM is defined as the time when the continental ice sheets reached their maximum positions, which is believed to have occurred about 33 to 26.5 kya and that these magnitudes of ice were maintained to 19 to 20 kya (Clark et al., 2009).

Schmidt and Hertzberg (2011) indicate that unlike the relatively stable climate Earth has experienced over the last 10,000 years, Earth's climate system underwent a series of abrupt oscillations and reorganizations during the last ice age between 18,000 and 80,000 years ago. They also indicate that the Holocene climate was markedly warmer than the previous 80,000 years in addition to not exhibiting strong temperature fluctuations.

Eolian systems across the southeastern California region experienced a strong aggradational event that began approximately 15 kya, which coincides with the timing of many of the playa and particularly pluvial glacial lakes desiccating across the southwestern United States (Plate 8A, Plate 8B and Plate 8C). Hence, there is a correlation between eolian dune development and climate (Tchakerian, 1991; Lancaster, 1992; Lancaster, 1994, Lancaster, 1995; Zimbelman et al., 1995; Lancaster and Tchakerian, 1996; Lancaster, 1997, Lancaster and Helm; 2000; Lancaster et al., 2003; Pease and Tchakerian, 2003; Tsoar, 2004; Bateman et al., 2012).

Strong eolian aggradational events correlate with periods of time when relatively abundant eolian sand is generated and the sands can migrate and deposit within dune systems away from their source. This is clearly the case on a large regional scale soon after pluvial and playa lakes desiccate or experience intermittent lake level fluctuations which provide both an eolian sand source from playa erosion and pathways for the sand migration. However, review of dune ages, times of dune re-activation, aggradational events and periods of dune stability since the late Pleistocene indicate a complex story suggesting that numerous climatic factors and their related secondary effects play a role in dune activity (Plate 8A, Plate 8B and Plate 8C).

Numerous possible parameters were evaluated during this study including Global Climate variations, regional climate variations, pluvial lake levels, alluvial fan depositional periods, areas of alluvial fan deposition, upper fan trenching (down-cutting), vegetation variations, monsoonal vs. Pacific Storm frequencies and magnitude variations, dune aggradational and re-activation periods (Plate 8A, Plate 8B and Plate 8C). These data suggest that dune systems react to both global and local changes in climate and the secondary effects of climate such as vegetation density, and alluvial fan behavior in terms of upper fan trenching and fan location of deposition. Dune systems experienced aggradational events once pluvial lakes and playa lakes desiccated after the last global glaciation period occurring during the Latest Pleistocene (~15 kya). For the most part, the Holocene has been a period of time allowing for the development of dune systems to both aggrade by re-activation and then to become stable. This is likely due to the Holocene climate across the study region that has been semi-arid but close to the hyper-arid climate. Annual precipitation criteria for semi-arid and hyper-arid is ~4 inches/year, which is the amount of average rainfall that the desert valley regions of southeastern California have received in historical times (Figure 17A and Plate 1).

Zimbelman et al. (1995) indicates that semi-arid regions can preserve evidence of substantial eolian deposits via vegetation stabilization as a variety of desert flora are adapted to the intermittent rainfall. However, it seems reasonable that if rainfall decreased slightly and for an extended period of time to cause the region to experience hyper-arid conditions, that it may be sufficient to cause stabilizing vegetation to die off allowing for an increase in dune instability (increase active sand transport), increase the ability for sand transport and increase eolian sand production. If the decrease in annual precipitation were associated primarily with a decrease in cool-wet Pacific storms (Figure 17B) then the vegetation die off particularly at lower elevations may be more dramatic causing a greater increase in eolian activity. And finally, if all that were to occur but at the same time the magnitude and frequency of extreme but highly intermittent monsoonal storms increased in the region causing increased alluvial fan (washes) deposition in distal fan areas and upper fan erosion, and fluctuating water levels on playa surfaces, then the conditions would be appropriate for eolian re-activation. This eolian re-activation model suggesting relatively small climatic changes can lead to an eolian aggradational event from a "dormant period" may support findings by Bateman et al. (2012) that indicate that eolian systems can accumulate quickly (<5 kya) in a single-phase event before becoming relict.

The Holocene climate across the southeastern California region is therefore close to a critical geomorphic threshold where subtle changes in climate over the course of millennia can lead to either dune re-activation or stability. The combination of the global warming event of the Bølling-Allerød interstadial from 15 to 13 kya that decreased cooler Pacific Storm events in the study area (Plate 8A) with the onset of more frequent and intense gulf Monsoonal storm events in the study region (Plate 8B) led to a robust regional dune aggradational event. Similar conditions occurred again beginning with a global warming period from 10 to 8 kya decreasing Pacific Storm strength in the study region aligning with either continued or increased monsoonal storm frequency and magnitude compared to recent times. These conditions or close approximation continued to about 4 kya which allowed for relatively robust eolian activity from about 10 to 4 kya across southeastern California. The cooler conditions associated with the global Neo-Glacial period from 4.5 to 2.5 that increased cool Pacific Storm and coincides with a decrease in monsoonal storm magnitude and frequency led to a period of dune stability across the study region including all the regional sand migration corridors.

However, southeastern California region (southwestern United States) has experienced local climate variations that do not correlate exactly with changes in global climate. For example, regional dry-warm periods occurring in the southwestern United States encroach into the global cooling New-Glacial period occurring from 4.5 to 2.5 kya. Dune re-activation and some continued dune aggradational behavior continued in southeastern California during the Neo-Glacial likely due to local climate exhibiting drier-warmer conditions and higher monsoonal storm strength and frequency (Plate 8B). Note that alluvial fan deposition across the study region also increased from about 6 to 2 kya (Plate 8A). Hence, it appears that both global and local variations in climate can affect regional dune systems.

Dune systems appear to experience aggradational (increase in size and magnitude of eolian sand production and movement) during times when pluvial and playa lakes are drying up and/or experiencing repeated lake fluctuations, when alluvial fans are experiencing aggradational events (abundant fan deposition), when monsoonal storms are more frequent and with higher intensity, and when upper wash regions of alluvial fans and other formational are eroded into (fan trenching). It turns out that during the Holocene it is common that one of these parameters allowing for dunes to be more active is occurring at any particular time. Hence, dune system aggradational events do not appear to correlate to a single geologic parameter consistently throughout the Holocene, but instead, responding to numerous parameters each of which vary over time. Dunes can experience variations in activity based on the additive nature of the parameter wavelengths when they collectively "add up" (aggradational events), or cancel each other out (times of stability).

The combination of decrease in vegetation density at lower elevations associated with a decrease in cold/wet winter pacific storms intensity and frequency, increase in monsoonal storms with relatively higher frequency and strength (extreme storm events), abundant available sediment in the mountains and its transport to distal fan areas (see Wells and Dohrenwend, 1985; Nichols et al., 2007), and pluvial and playa lakes experiencing fluctuating levels, all contributed to a regional strong dune aggradational event between 14 and 8 kya. In addition, periods of relatively strong monsoonal storm frequency and strength (Figure 17B) since the mid-Holocene have resulted in dune aggradational and re-activation events (Plate 8B). Dune systems appear to react to this type of climate change on the order of less than 1000 years. Geomorphic response times of dune systems are likely faster than that of other desert processes and may provide the "canary in the coal mine" process indicating that desert systems are changing relatively significantly.

Relatively strong alluvial fan aggradational events correlate with periods of stronger and more frequent monsoonal storm strength (thunderstorm-extreme events; Reheis et al., 1996; Harvey et al., 1999; Reheis et al., 1996; McDonald et al., 2003; Miller et al., 2010). Hence, eolian systems activity level correlates well with that of alluvial fan systems. It is important to point out that during periods of relatively intense monsoonal climate across that many of the playa and pluvial lakes can fill and desiccate which increases eolian sediment supply substantially (Plate 8). In contrast, the relatively wet period in the southwestern United States associated with the global Neo-Glacial from 4.5 to 2.5 kya that led to increased vegetation density at lower elevations assisted in stabilizing most eolian dune systems in the study region (Plate 8A).

Harvey et al. (1999) provide a strong case for alluvial fan aggradational events across the southwestern United States during periods of time of strong monsoonal (extreme storm events) climate in terms of increased frequency and magnitude. The observation that torrential rains in the deserts play a critical role to increased erosion and flow to playa regions was also suggested by Tolman (1909). Eolian dune systems experience aggradational events when relatively strong monsoonal storm periods correlate with periods of relatively weaker Pacific Storms that provide long duration rains leading to increased lake filling (Miller et al., 2010) and higher vegetation density at lower valley axis elevations. These processes lead to dune stability. Monsoonal storms are extreme events that allow for strong flow carrying abundant sediment and moisture to the valley axis (playas and distal fan areas) in addition to increased erosion, but soon dry up to not allow for more dense vegetation to occupy the landscape. Therefore, the most productive climate for dune development (growth) is the combination of relatively strong monsoonal extreme storm frequency and magnitude in combination with relatively weaker but longer duration cold/wet Pacific Storm events.

The findings of Harvey et al. (1999) indicate that the southwestern most region of the United States experienced relatively stronger monsoonal storm strength and frequency compared to regions to the northwest, north and northeast. In fact, the region they show as experiencing stronger and more frequent monsoonal storms and relatively weaker cold/wet Pacific Storms correlates very well with the region of the numerous regional sand migration corridors shown on Plate 1 and Plate 2. This indicates that one of the principle reasons that the southeastern California region, in addition to western Arizona, have resulted in extensive dune systems is that these regions have experienced strong monsoonal storm strength and frequency during the Holocene. Other factors include the difficulty of Pacific storms to reach southeastern California due to rain shadow effects, and the local topography in southeastern California exhibiting Basin and Range extensional tectonic mountain ranges and valleys that provide strong and controlled prevailing winds. It is likely that even a small decrease in the strength and frequency of cool winter Pacific storm systems hitting the southern California coast may lead to a substantial drop in precipitation in southeastern California due to the difficulty of these storms maintaining moisture over a series of mountain ranges to the west.

Monsoonal storms that migrate into the region from the south, in addition to their ability to create flows that carry sediment to the valley axis allowing for the distal fan regions to grow, also have a much larger ability to cause erosion upstream and carry more sediment, as first described by Tolman (1909). This indicates that extreme flood events have an ability to generate much more eolian sand than long duration Pacific Storm events. It has been observed that during the Holocene, alluvial fan deposition has primarily occurred in the distal regions of the fan (Wells and Dohrenwend, 1985; Nichols et al., 2007), and this observation is consistent with increased monsoonal storm frequency and strength relative to Pacific Storms in the southwestern United States. Hence, periods of strong monsoonal storm frequency and strength will erode more deeply into the upper fan regions (fan trenching) and into older non-fan sediments and have a highly probability of transporting those sands to valley axis areas with strong prevailing winds. This proposal for increased eolian sand production associated with monsoonal storm periods is supported by work on alluvial fan deposition by McFadden and McAuliffe (1997). They identified a correlation between alluvial fan depositional-aggradational events with the lithology of the materials that the alluvial fan washes eroded into. This observation regarding alluvial fan depositional rates increasing due to the washes carrying additional sediment from the erosion of older sediments is consistent with the hypothesis proposed herein for heavily sand laden washes emanating from eroding fan-trench areas and/or older non-fan sediments increasing eolian sand source to dune systems. Alluvial fan-trenching in the proximal and mid-fan portions of the fan increased from approximately 14 kya and extending to the mid-Holocene (~6 to 7 kya, Plate 8C). Hence, washes during this time carried a relatively large abundance of eolian size sand grains assisting in eolian dune development.

The arid-semi arid climate conditions since the mid-Holocene has resulted in a geomorphic condition where slight changes in regional climate (i.e. monsoonal storm activity) is sufficient to result in local re-activation of dune systems, but not sufficient to produce a robust eolian system where sand migration corridors are continuous. Dune systems across the study region have been relatively stable since the mid Neo-Glacial period approximately 4.0 to 3.5 kya. In addition, most of the identified sand ramps along the proposed regional sand migration corridors have been shut down since about 8 to 7 kya (see Plate 8A). However, the semi-arid climate occurring in the study region for much of the Holocene is near a critical threshold condition where small changes in dune parameters such as global climate affecting Pacific Storm strength and frequency and local monsoonal strength frequency and magnitude can be reflected in changes in dune behavior on a cyclic scale of approximately 1000 to 500 years.

As discussed earlier, there is a strong correlation with increased monsoonal extreme storm frequency and magnitude with increased eolian activity (aggradational events), and/or with periods of time exhibiting a warmer global climate (Plate 8B). However, Garfin et al. (2012) indicate that forecasting variations in monsoonal behavior in the southwestern United States (i.e. the North American monsoon - NAM) is fraught with difficulties and essentially not possible at present. Therefore, it is unknown whether NAM will increase or decrease in the future.

Garfin et al. (2012) do forecast that the southwestern United States will likely get drier and hotter in the coming century which is believed will lead to a soil moisture. As discussed throughout this report, dune moisture is very important in terms of dune stability if the dunes developed acquiring moisture directly for washes and playa surfaces. In Chuckwalla Valley, the largest dunes in terms of mass all have developed where they receive water from washes or in playa environments which indicates that if they receive less water than that which they had developed, that it may lead to dune re-activation. Although monsoonal storm systems do not provide sufficient water to maintain a robust vegetation density at lower elevations, they do provide water flow that reaches the valley axis where the fluids can infiltrate into the dunes. It was shown for the Keeler Dunes on the eastern side of Owens Lake, California that extreme monsoonal type storm events occurring every 3 to 5 years was sufficient to maintain critical stabilizing moisture to the dune system and once these waters were diverted from the dunes, they eroded away within 40 to 50 years (Kenney, 2012). As mentioned earlier, it is unknown whether the frequency and magnitude of NAM events will change associated with future climate change (Garfin et al., 2012).

As discussed earlier, most of the dune systems mapped in the area of the RE Crimson have developed with a paucity of infiltrating flow waters and therefore are essentially in equilibrium with low amounts of inherent soil moisture. This was observed in soil test pits within the eolian systems of the RE Crimson (see Appendix D). This may be one reason in addition to a very slow eolian sand source production rate and sand migration rate, that the RE Crimson dune systems are quite weak in the sense of their total dune mass and form. It is anticipated that even if there is a "drying" of soil moisture across southeastern California during the remainder of this century, that the local dunes will remain stable.

**Figure 17A:** Average annual precipitation in the southwestern United States. The area of the site Crimson Solar Project (RE Crimson) and the regional sand migration corridors correlate well with low elevation regions experiencing <4 inches/years, which are areas that receive the least amount of rain in the southeastern California region. The bounding mountain areas are experiencing between 4 to 8 inches/year.

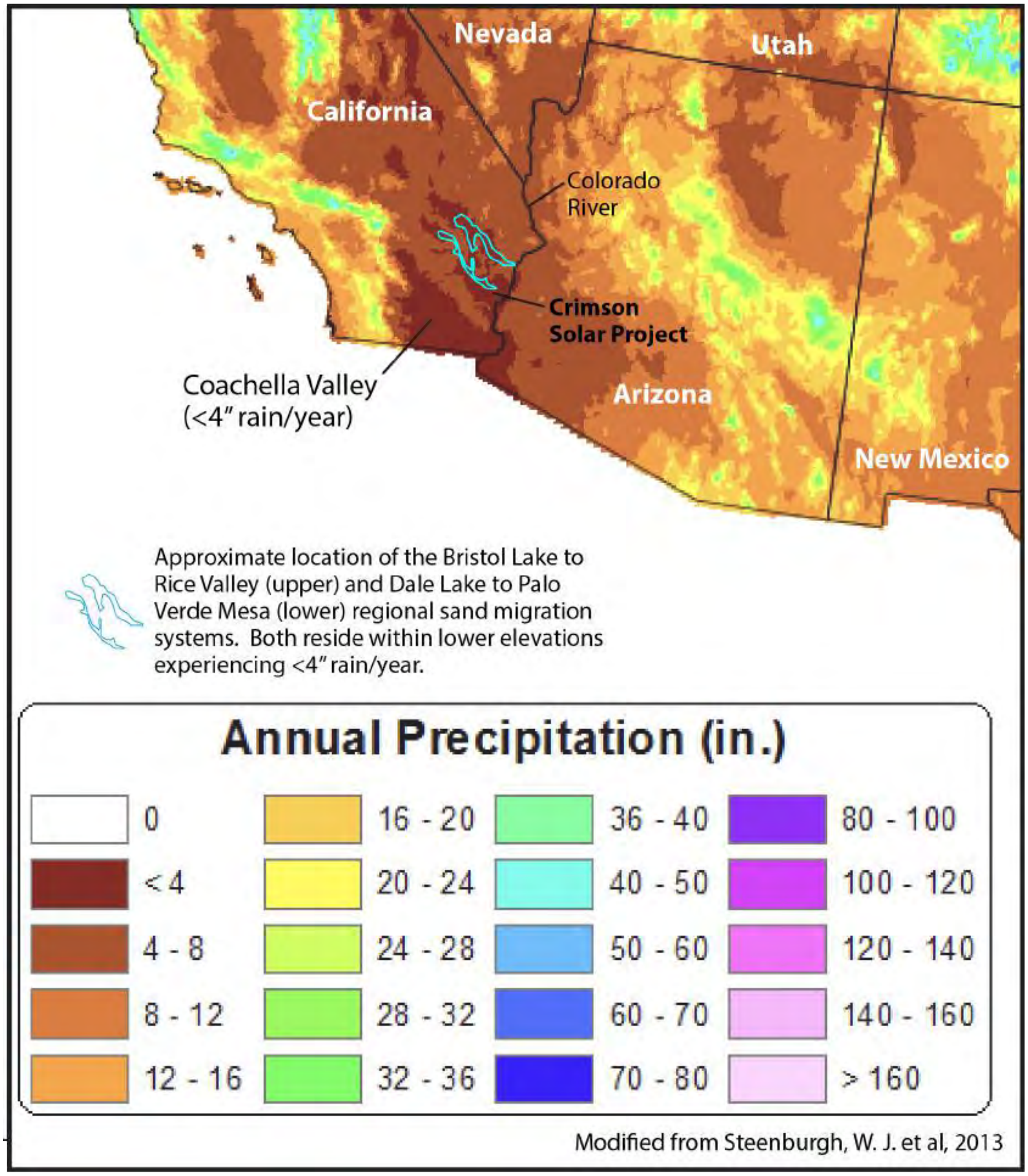
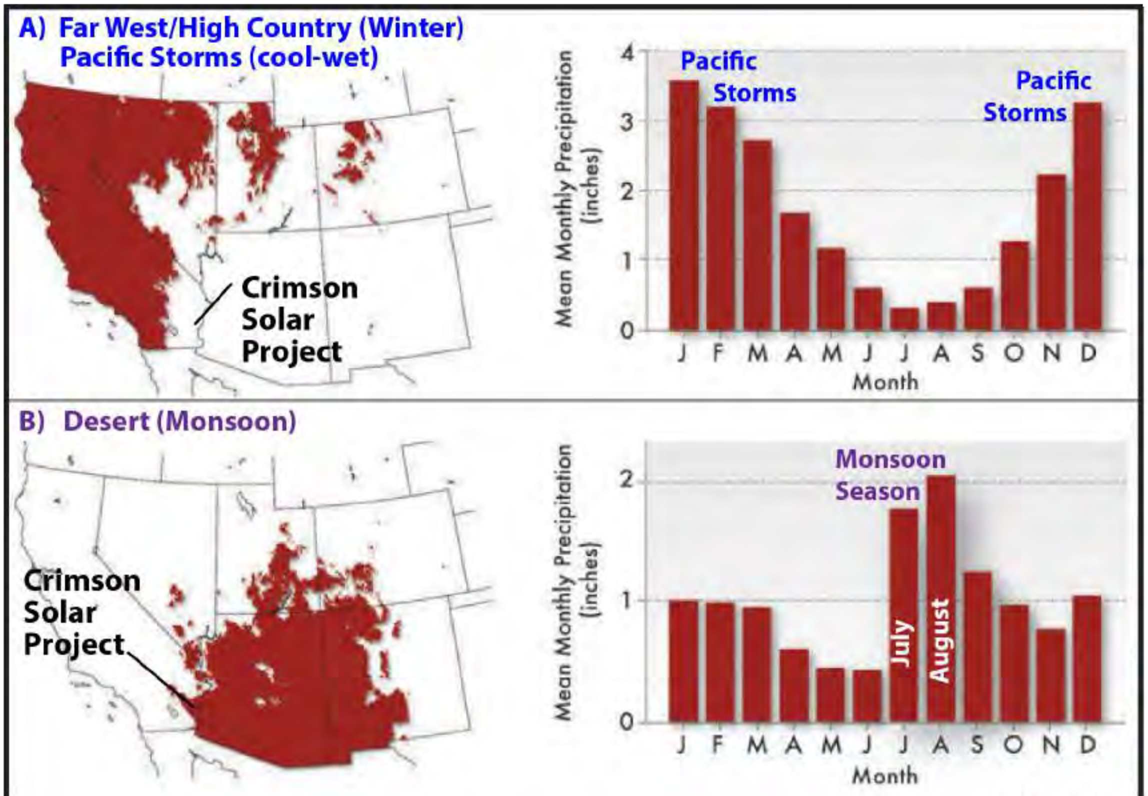


**Figure 17B:** Regional climate data for the southwestern United States showing: A) Upper-Figure – areas receiving significant "far west/high country" winter Pacific storm precipitation and the mean monthly precipitation per month; B) Middle-Figure – areas receiving significant desert monsoonal "thunderstorm" precipitation and the mean monthly precipitation per month; and C) Lower-Figure – average wind speed for various times of the year measured in Blythe, California located approximately 20 miles east of the project site.

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**C) Average Wind Speed in Miles Per Hour (MPH) at Blythe, California**

| | | |
|---|---|---|
| January | **6.5** | **Winter - Strong Pacific Storms (low winds & wet)** |
| April | 8.9 | Spring - (strong winds, mostly dry) |
| July | **9.4** | **Summer - Strong Monsoon (strong winds & dry)** |
| August | **8.8** | **Summer - Strong Monsoon (strong winds & dry)** |
| October | 6.7 | Fall - (low winds) |

https://pubs.usgs.gov/of/2004/1007/weather.html

## 14 POTENTIAL FUTURE IMPACTS

The design of the Crimson Solar Project (RE Crimson, Figure 2) avoids most of the dune systems in the immediate area including the major washes that are areas of dune deposits and eolian sand source, and areas exhibiting the most robust geomorphic relative sand migration rates (i.e. Zones AB and B shown on Plate 6A and Plate 6B). The most robust mapped dune geomorphic environment occurring within the proposed RE Crimson development footprint is Zone BW, which consists of very stabilized dunes that have experienced a decrease in sand migration rates since the mid Holocene.

The most impacted dune system in terms of the proposed development is the Mule Sand Migration Zone (Mule SMZ). A portion of the watershed and drainage system feeding the western Mule SMZ (watershed P feeding sand migration zone Pz on Plate 7A) occurs within the RE Crimson design footprint. Hence, a portion of the source area (exposures of the Bullhead Alluvium – Tmm Soil S7a) are within the property in addition to the western portions of the dune system (areas mapped as Zone BC and Zone BW in Plate 6A). Some eolian sands in the Mule SMZ are generated by the wash system shown as Soil S0 occurring between portions of the proposed RE Crimson border (Plate 6A). This will supply some continued eolian sands to the Mule SMZ over time, but the western portion of this dune system located within the site could observe a decrease in eolian sand source depending on the construction design.

Eolian sands will continue to be produced by most of the prominent washes that cut through the RE Crimson which these wind-blown sands will attempt to enter the site over time. However, sand migration rates in the area are very low and the magnitude of generated eolian sands would likely be easily managed with ongoing site maintenance.

Most of the dunes within the proposed RE Crimson design range in thickness of 2 to 1 feet occurring on ancient depositional surfaces (i.e. alluvial fan abandoned terraces or Bullhead Alluvium). Hence, the RE Crimson dune systems as described within this report do not occur with the Chuckwalla Valley axis. The RE Crimson dune systems are generally thicker in ancient drainage swales that exhibit lower topographic relief from their adjacent bars. This may have a potential impact of footing designs for fences and the solar array.

Dune systems in the area and within the RE Crimson have been stable for a minimum of several thousand years since the end of the mid Holocene aggradational event. As discussed in the report, the sand migration rates throughout the Holocene have varied leading to periods of aggradation and stabilization; however, they have always been quite low as they have led to the deposition of only 3.5 to 2 feet of dune stratigraphic thickness deposited over thousands of years in the RE Crimson area. So, even during periods of robust eolian activity, the sand migration and depositional rates were quite low indicating that the rate of eolian sand generation is quite low in the RE Crimson area.

If the frequency and magnitude of cool winter Pacific storms decrease and warm summer monsoonal storms increase, then this is proposed to lead to an increase in eolian sand generation across southeastern California. Many of the existing dune systems in the eastern Chuckwalla Valley have been degrading (internally eroding mostly) or have been strongly stabilized for several thousand years. This indicates that the local dune systems have the ability to "absorb" newly derived eolian sands for hundreds of years or more without expanding outside of the mapped dune areas where the dunes had originally expanded to in the mid-Holocene (i.e. beyond the contact of sand migration Zones BC/Zone C). In addition, the invasion of Sahara Mustard has greatly diminished the ability for sand to migrate from their sources during the past several decades. Hence, if Sahara mustard persisted, it is proposed that it would primarily lead to thicker and more robust dune systems near their sources during the next century as the eolian sands generated at the sources would have more difficult migrating through the older sand migration zones. This finding suggests that dune mass and forms would increase near eolian sand sources such as the local washes in the area of the RE Crimson.

The drought of the 1930s across the Midwestern United States is observed to have re-activated dune systems in the Midwest (Muhs and Holliday, 1995). This is considered the worse drought to impact this part of the United States in 300 years and was sufficient to destabilize dune systems such that older dunes eroded and eolian sands were remobilized over a large area. Griffin and Anchukaitis, (2014) indicate that the California drought of 2012 to 2014 has been the most severe drought conditions of the last century but also indicate that it has been the most severe drought in California since the last 1200 years. They indicate that the current California drought is exceptionally severe in the context of at least the last millennium and is driven by reduced though not unprecedented precipitation and record high temperatures. If these findings are correct, it indicates that southeastern California has already been experiencing severe drought conditions since 2012, which is a year after the author began conducting eolian studies in the eastern Chuckwalla Valley. However, the author has not observed dramatic changes to the dune systems in the region of the RE Crimson or eastern Chuckwalla Valley from 2011 to the present. This indicates that the dune systems in the eastern Chuckwalla Valley have been able to remain stable even during an extreme drought that California has not observed for the last 1200 years.

## 15 CONCLUSIONS

Global and local climatic conditions and their secondary effects during the Holocene has been beneficial for dune growth at various periods of time, but particularly during the early Holocene. Climatically, the region has been near a geomorphic threshold condition where relatively subtle changes in climate can lead to dune re-activation. However, dune systems across the southeastern California region have been dominantly stable since the mid-Holocene and the sand migration corridors have essentially shut down since that time (i.e. ~8 kya). Eolian sand sources during times of dune aggradational events similar to that of the early Holocene and during times of dune stability have primarily been from local sources with the possible exception of the Kelso dune system that was likely provided relatively large magnitudes of eolian sands during the early Holocene when dune parameter conditions greatly favored eolian sand production and migration.

Dune systems in the area of the RE Crimson have received nearly all of their eolian sands from local sources throughout the Holocene. Areas of preserved dune deposits in the RE Crimson indicate that their deposition began during the early Holocene (~11 kya) and continued to become thicker until the end of the mid Holocene (~5 kya). Since the mid-Holocene (~5 kya), existing dune systems across the southeastern California region are degrading or are strongly stabilized and relying in large degree on the erosion of older dune deposits for new eolian sands where distant from the sand source, or "piling up" near their sand sources due to increased vegetation limiting mobility. However, in the RE Crimson, which is a "dry dune system" as they have developed and are in equilibrium with not receiving significant infiltrating stabilizing moisture, eolian sands may still be able to travel within the designated sand migration zones sufficiently to not "pile up" near their source. It appears clear however that the sand migration zones areas near their source in the region of the RE Crimson are strongly stabilized and are essentially starved of eolian sands compared to the early to mid Holocene.

If there is an increase in eolian sand production due to climate change via a decrease Pacific storms and increase in monsoonal storms frequency and magnitude, then these newly derived sands will be deposited for likely a minimum of a hundred years within the existing mapped dune system area. This is because these dune areas were at one time accustomed to receiving more eolian sands than they have for over 3 kya.

The reach of the deposits is likely to be furthermore constrained by the incursion of the invasive Sahara Mustard plant, which blooms relatively frequently (estimated to be 2 to 3 times per decade) and has decreased sand migration rates by over an order of magnitude where it occurs. These blooms will cause newly derived eolian sands to deposit closer to their sources and within mapped eolian dune systems, altering only the dune forms and increase in localized eolian sediment mass.

The potentially most impacted sand migration zone (dune system) in the RE Crimson due to its development is the Mule SMZ which the current design may impact areas of eolian sand source and the dune system itself. However, the most robust regions of the Mule SMZ occur east of the site near the Power Line Road.

The Northern Mule SMZ occurs both within and outside the proposed design of the RE Crimson. The eolian source washes for the Northern Mule SMZ have been avoided by the RE Crimson design (areas of exposed Bullhead Alluvium upslope) indicating that eolian sands will be generated over the lifetime of the facility and may need to be mitigated over time.

The Central SMZ located in an embayment of the northern Mule Mountains will not be impacted by the RE Crimson development as its eolian sand source of eroding Bullhead Alluvium west of its mapped limits will not be impacted by the proposed design.

The Western Mule SMZ is the least impacted eolian system by the RE Crimson. This is understandable since the vast majority of this dune system does not occur within the RE Crimson design footprint. Geomorphic mapping indicates that this system had received the majority of its eolian sand from a wash system that is located outside of the proposed RE Crimson design. The northeastern most portion of the Western Mule SMZ is located east of the property boundary but the source for eolian sand for this area is located in the RE Crimson. However, sand migration rates in this area a likely sufficiently low such that the relatively more robust and relatively small dune area immediately east of the RE Crimson would not be negatively impacted for many decades.

The findings of this report indicate that very minor eolian sands in the RE Crimson are or were generated by the Wiley's Well Wash system. It is acknowledged that this is a surprising result, but the findings of this report provide strong evidence that the source of the eolian sands, which only need to be weak to moderate in strength over time (i.e. Holocene) to sufficiently feed the existing dune systems, are from the erosion of upslope older alluvium and formational units. Fluvial-eolian cycling is a robust geomorphic process occurring in the RE Crimson area due to the local source for the eolian sands, and drainages that flow against and perpendicular (orthogonal) to the two prevailing winds. Deposition of early to mid Holocene fans in the distal portions of the fans assisted in the production of eolian sands and the fluvial-eolian cycling process. Eolian sand mitigation may need to be conducted in the RE Crimson facility as the eolian sources, most of which are preserved by the RE Crimson design, will continue to produce eolian sands.

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REPORT END

# APPENDIX A

## REFERENCES

# APPENDIX A

## REFERENCES

***Note:*** *This is a partial reference list of publications available to the author during preparation of this report; however, not all the references provided below were formally referenced in the report.*

Al-Masrahy, M.A., and Mountney, N.P., 2015; A classification scheme for fluvial-aeolian system interaction in desert-margin settings; Aeolian Research, vol. 17, pp. 67-88.

An, C., Z. Feng, and L. Barton. 2006; Dry or humid? Mid-Holocene Humidity Changes in Arid and Semi-arid China. Quaternary Research 25:351–361.

Andreotti, B., Claudin, P., and Pouliquen, O., 2010; Measurements of the aeolian sand transport saturation length; Geomorphology v. 123, p. 343-348.

Bach, A.J., 1995; Climatic controls on aeolian activity in the Mojave and Colorado Deserts, California; Dissertation for PhD.: Arizona State University, p. 184.

Bacon, S.N., Burke, R. M., Pezzopane, S. K., and Jayko, A. S., 2006; Last glacial maximum and Holocene lake levels of Owens Lake, eastern California, U.S.A.; Quaternary Science Reviews v. 25, p. 1264-1282.

Barrows, C.W., 1997; Habitat relationships of the Coachella Valley fringe-toed lizard (Uma inornata); The Southwestern Naturalist v. 42, p. 218-223.

Barrows, C.W. and Allen, M.F., 2007; Persistence and local extinctions of endangered lizard Uma inornata on isolated habitat patches; Endangered Species Research v. 3, p. 61-68.

Barrows, C.W., Allen, M.F., and Rotenberry, J.T., 2006; Boundary processes between a desert sand dune community and an encroaching suburban landscape; Biological Conservation v. 131, p. 486-494.

Barrows, C.W., Allen, E.B., Brooks, M.L., and Allen, M.F, 2009; Effects of an invasive plant on a desert sand dune landscape; Biologic Invasions, v. 11, p. 673-686.

Bateman, M.D., Bryant, R.G., Foster, I.D.L., Livingstone, I., and Parsons, A., 2012; On the formation of sand ramps: A case study from the Mojave Desert; Geomorphology, v. 161-162, p. 93-109.

Belnap, J., Munson, S.M., and Field, J.P., 2011; Ecohydrology bearings – Invited Commentary Aeolian and fluvial processes in dryland regions: the need for integrated studies; Ecohydrology, v.4, pp. 615-622.

Benson, L.V., Currey, D.R., Dorn, R.I., Lajoie, K.R., Oviatt, C.G., Robinson, S.W., Smith, G.I., and Stine, S., 1990; Chronology of expansion and contraction of four great basin lake systems during the Past 35,000 years; Palaeogeography, Palaeoclimatology, Palaeoecology, p. 241-286

Birkeland, P. W., Machette, M. N., and Haller, K. M., 1991; Soils as a tool for applied Quaternary geology; Utah Geological and Mineral Survey, Misc. Publication 91-3, p. 1-63.

Blackwelder, E., 1931; The lower of playas by deflation; American Journal of Science, Vol. Series 5, Vol. 21, No. 122, p.140-144.

Blair, T. C. and McPherson, J. G., 2009; Processes and forms of alluvial fans; Geomorphology of Desert Environment, 2nd Edition, p. 413-422.

Blakemore, T.E, Hjalmarson, H.W., and Waltemeyer, S.D., 1997; Methods for estimating magnitude and frequency of floods in the Southwestern United States; U.S. Geological Survey Water-Supply Paper 2433, p. 195

Blount, G., Smith, M.O., Adams, J.B., Greeley, R., and Christensen, P.R., 1990; Regional aelian dynamics and sand mixing in the Gran Desierto: evidence from Landsat Thematic Mapper images; Journal of Geophysical Research, v. 95, n. B10, p. 15,463-15,482.

Blumberg, D.G. and Greeley, R., 1993; Field studies of aerodynamic roughness length; Journal of Arid Environments, v. 25, p. 39-48.

Bowler, J.M., 1973; Clay dunes: their occurrence, formation and environmental significance; Earth Science Review, v. 9, p. 315-338.

Breshears, D.D., Whicker, J.J., Johansen, M.P., and Pinder III, J.E.; 2003; Wind and water erosion and transport in semi-arid shrubland, grassland and forest ecosystems: quantifying dominance of horizontal wind-driven transport; Earth Surface Processes and Landforms, v. 28, pp. 1189-1209.

Bull, W.B., 1979; Threshold of critical power in streams; Geological Society of America Bulletin, v. 90, n. 5, p. 453-464.

Bull, W.B., 1990; Stream-terrace genesis: implications for soil development; Geomorphology, v. 3, p. 351-367.

Bull, W.B., 1991; Geomorphic responses to climate change; United States: New York, NY (United States); Oxford University Press; reprint in 2009.

Bull, W.B., 2000; Correlation of fluvial aggradation events to times of global climate change; Quaternary Geochronology: Methods and Applications, AGU Reference Shelf v. 4, p. 456-464.

Bullard, J.E., and McTainsh, G.H., 2003; Aeolian-fluvial interactions in dryland environments: examples, concepts and Australia case study; Progress in Physical Geography, v. 27, no. 4, pp. 471-501.

Bush, A.B.G., and Philander, S.G.H.; 1999; The climate of the Last Glacial Maximum: Results from a coupled atmosphere-ocean general circulation model; Journal of Geophysical Research, v.104, n. D20; pp. 24,509-24,525.

Cahill, T.A., Gill, T.E., Reid, J.S., Gearheart, E.A., and Gillette, D.A., 1996; Saltating particles, playa crusts and dust aerosols at Owens (Dry) Lake, California; Earth Surface Processes and Landforms, v. 21, p. 621-639.

Cahill, T.A., Gill, T.E., Copeland, S.A., Taylor, M.S., Noderer, K.S., White, B.R., Cho, H.M., Patterson, M.A., Yau, M.L., Torres, G.A., Dutcher, D.D., and Niemeyer, T., 1996; Mitigation of windblown dusts and reclamation of public trust values, Owens Lake, California: partial mitigation of PM10 episodes through control of saluting particles and reduction of wind shear; Air Quality Group, University of California, p. 1-21, 123-128.

Cahill, T.A., Gill, T.E., Reid, J.S., Gearhart, E.A., and Gillette, D.A., 1995; Saltating particles, playa crusts and dust aerosols from Owens (Dry) Lake, California; Earth Surface Processes and Landforms, in press version.

Cahill, T.A., Gill, T.E., Gillette, D.A., Gearhart, E.A., Reid, J.S., and Yau, M., 1994; Generation, characterization and transport of Owens (Dry) Lake dusts; California Environmental Protection Agency, Air Resources Board, Research Div., Contract No. A132-105, Final Report.

Castiglia, P.J. and Fawcett, P.J., 2005; Large Holocene lakes and climate change in the Chihuahuan Desert; Geology, v. 34, n. 2, p. 113-116.

Cavazos, T. and Arriaga-Ramirez, S., 2012; Downscaled climate change scenarios for Baja California and the North American Monsoon During the twenty-first century; Journal of Climate; vol. 25, p.5904 – 5915.

Clark, P.U., Dyke, A.S., Shakun, J.D., Carlson, A.E., Clark, J., Wohlfarth, B., Mitrovica, J.X., Hostetler, S.W., McCabe, A.M., 2009, Science; The Last Glacial Maximum, v. 325, August 7, 2009, p. 710-714.

Clarke, M.L. and Rendell, H.M., 1998; Climate change impacts on sand supply and formation of desert sand dunes in the southwest U.S.A.; Journal of Arid Environments, v. 39, p. 517-531.

Cochran, G.F., Mihevc, T.M., Tyler, S.W., and Lopes, T.J., 1988; Study of salt crust formation mechanisms on Owens (Dry) Lake, California; Desert Research Institute, Publication #41108.

Collins, B.D., Bedford, D.R., Corbett, S.C., Cronkite-Ratcliff, C., and Fairley, H.C., 2016; Relations between rainfall-runoff-induced erosion and aeolian deposition at archaeological sites in a seim-arid dam-controlled river corridor; Earth Surfce Processes and Landforms, vol. 41, Issue. 7, pp. 899-917.

Coulthard, T.J., 2014; Mapping the interactions between rivers and sand dunes: Implications for fluvial and aeolian geomorphology; Geomorphology, v. 231, pp. 246-257.

Dohrenwend, J.C., Bull, W.B., McFadden, L.D., Smith, G.I., Smith, R.S.U., and Wells, S.G.; 1991; Quaternary geology of the Basin and Range Province in California; in The Geology of North America Vol. K-2, Quaternary Nonglacial Geology: Conterminous U.S.; The Geological Society of America, p. 21-352.

East, A.E., Clift, P.D., Carter, A., Alizai, A., and VanLaningham; 2015; Fluvial-Eolian interactions in sediment routing and sedimentary signal buffering: and example from the Indus Basin and Thar Desert; Journal of Sedimentary Research, v. 85, pp. 715-728.

Ely, L.L., Enel, Y., Baker, V.R., and Cayan, D.R., 1993; A 5000-year record of extreme floods and climate change in the Southwestern United States; Science, v. 262, p. 410-412.

England, A.S., 1983; The Coachella Valley, an endangered ecosystem progress report on conservation and management efforts; Cal-Neva Wildlife Transactions, p. 148-156.

Enzel, Y., Cayan, D.R., Anderson, R.Y., and Wells, S.G., 1989; Atmospheric circulation during Holocene lake stands in the Mojave Desert: evidence of regional climate change; Nature v. 341, p. 44-47.

Enzel, Y., Wells, S.G., Lancaster, N., 2003; Late Pleistocene lakes along the Mojave River, southeast California; in Geological Society of America Special Paper 368, edited by Enzel Y., Wells, S.G., and Lancaster, N., p. 61-77.

Etyemezian, V., King, J., Zitzer, S., Nikolich, G., Gillies, J., and Mason, J., 2010; Sediment transport to White-Margined Penstemon habitat (Penstemon albomarginatus); Department of Air Quality and Environmental Management, Desert Conservation Program, Clark County, Nevada.

Fahu, C., Wei, W.U., Holmes, J.A., Madsen, D.B., Yan, Z.H.U., Min, J., and Oviatt, C.G., 2003; A mid-Holocene drought interval as evidenced by lake desiccation in the Alashan Plateau, Inner Mongolia, China; Chinese Science Bulletin, v. 48, n. 14, p. 1401-1410.

Fenton, C.R. and Pelletier, J.D., 2013; Cosmogenic 3He age estimates of Plio-Pleistocene alluvial-fan surfaces in the Lower Colorado River Corridor, Arizona, U.S.A.; Quaternary Research v. 79, p. 86-99.

Fitzsimmons, K.E. and Telfer, M.W., 2008; Sedimentary history and the interpretation of late Quaternary dune records: examples from the Tirari Desert, Australia and the Kalahari, South Africa; Chungara, Chilean Magazine of Anthropology, v. 40, p. 295-308.

Forman, S. L., Oglesby, R., and Webb, R. S., 2001; Temporal and spatial patterns of Holocene dune activity on the Great Plains of North America: megadroughts and climate links; Global and Planetary Change, v. 29, p. 1-29.

Friggens, M.M., Warwell, M.V., Chambers, J.C., and Kitchen, S.G., 2012; Modeling and predicting vegetation response of western U.S.A. grasslands, shrublands, and deserts to climate change; U.S.D.A. Forest Service.

Fuller, J.E., 2012; Evaluation of avulsion potential on active alluvial fans in central and western Arizona; Arizona Geological Survey, Contributed Report CR-12-D, 83 p.

Garfin, G., A. Jardine, R. Merideth, M. Black, and S. LeRoy, eds. 2013. Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment. A report by the Southwest Climate Alliance. Washington, DC: Island Press.

Gill, T.E., 1996; Dust generation resulting from desiccation of playa systems: studies of Mono and Owens Lakes, California; UMI Microforce 9608845, p. 207-213.

Gill, T.E. and Cahill, T.A., 1992a; Drying saline lake beds: a regionally significant PM10 source; in J.C. Chow and D.M. Ono, ed., PM10 Standards and Nontraditional Particulate Source Controls; Air Waste Management Association, Trans. 22, p. 440-454.

Gill, T.E. and Cahill, T.A., 1992b; Playa-generated dust storms from Owens Lake; in C.A. Hall Jr., Doyle-Jones, V., and Widawski, B., ed.; The History of Water: Eastern Sierra Nevada, Owens Valley, White-Inyo Mountains; White Mountain Research Station Symposium, University of California, Los Angeles, v. 4, p. 63-73.

Gill, T.E., 1996; Eolian sediments generated by anthropogenic disturbance of playas: human impacts on the human system; Geomorphology, v. 17, p. 207-228.

Gilles, J.A., Nickling, W.G., and King, J., 2006; Eolian sediment transport through large patches of roughness in the atmospheric intertial sublayer; Journal of Geophysical Research, v. 111.

Gillette, D.A., Herbert, G., Stockton, P.H., and Owen, P.R., 1996; Causes of the fetch effect in wind erosion; Earth Surface Processes Landforms, v. 21, p. 641-659, in press version.

Goudie, A.S., 2013; Arid and Semi-Arid Geomorphology; Cambridge University Press, pp. 454.

Griffin, D., Anchukaitis, K.J., 2014; How unusual is the 2012-2014 California drought?; Geophysical Research Letters, v. 41, Issue 24, pp. 9017-9023.

Griffiths, P.G., Webb, R.H., Lancaster, N., Kaehler, C.A., and Lundstrom, S.C., 2002; Long-term sand supply to Coachella Valley fringe-toed lizard habitat in the northern Coachella Valley, California; U.S. Geology Survey.

Halvorson, W.L. and Guertin, P., 2013; Factsheet for: Brassica tournefortii Gouan; United States Geological Survey Weeds in the West project: Status of Introduced Plants in Southern Arizon Parks; United States Geological Survey and National Park Service, pp. 31.

Harrison, S.P., Kutzbach, J.E., Liu, Z., Bartlein, P.J., Otto-Bliesner, B., Muhs, D., Prentice, I.C., and Thompson, R.S., 2003; Mid-Holocene climates of the Americas: a dynamical response to changed seasonality; Climate Dynamics, v. 20, p. 663-688.

Harvey, A. M. and Wells, S. G., 2003; Late Quaternary variations in alluvial fan sedimentological and geomorphic processes, Soda Lake Basin, eastern Mojave Desert, California; in Enzel, Y., Wells, S.G., and Lancaster, H., ed., Paleoenvironments and paleohydrology of the Mojave and southern Great Basin Deserts, Geological Society of America Special Paper 368, p. 207-230.

Harvey, A.M., Wigand, P.E., and Wells, S.G., 1999; Response of alluvial fan systems to the late Pleistocene to Holocene climatic transition: contrast between the margins of pluvial Lakes Lahontan and Mojave, Nevada and California, U.S.A.; Catena, v. 36, p. 255-281.

Harvey, A. M., Mather, A. E., and Stokes, M., 2005; Alluvial fans: geomorphology, sedimentology, dynamics – introduction. A review of alluvial-fans research; Geological Society of London Special Publications, v. 251, p. 1-7.

Helms, J., 2007; Soil stratigraphy study and relative age determinations for a fault rupture hazard Assessment of the 746-Acre Stone Wash Project, area east of Dillon Road and south of Fargo Road, Riverside County, California , High Desert Consulting.

Helms, J.G., McGill, S.F., and Rockwell, T.K., 2003; Calibrated, late Quaternary age indices using class rubification and soil development on alluvial surfaces in Pilot Knob Valley, Mojave Desert, southeastern California; Quaternary Research, v. 60, p. 377-393.

Higgens, R.W., and Shi, W., 2001; Intercomparison of principal modes of interannual and intraseasonal variability of the North American Monsoon System; American Meteorological Society, Vol. 14, p.403 to 417.

Horton, T.W., Defliese, W.F., Tripati A.K., and Oze, C.; 2015; Evaporation induced 18O and 13C enrichment in lake systems: A global perspective on hydrologic balance effects; Quaternary Science Reviews, p. 1-15.

Herweijer, C., Seager, R. Cook, E.R., and Geay, J.E., 2007; North American droughts of the last millennium from a gridded network of tree-ring data; American Meteorological Society, v. 20, p. 1353-1372.

Holmgren, C.A., Norris, J., and Betancourt, J.L., 2006; Inferences about winter temperatures and summer rains from the late Quaternary record of C4 perennial grasses and C3 desert shrubs in the northern Chihuahuan Desert; Journal of Quaternary Science, v.22, p. 141-161.

Horton, T.W., Defliese, W.F., Tripati, A.K., and Oze, C., 2015; Evaporation induced 18O and 13C enrichment in lake systems: A global perspective on hydrologic balance effects; Quaternary Science Reviews.

House, P.K., Pearthree, P.A., and Perkins, M.E., 2008; Stratigraphic evidence for the role of lake spillover in the inception of the lower Colorado River in southern Nevada and western Arizona; Geological Society of America Special Paper 439, p. 335-353.

Howard, K.A., House, P.K., Dorsey, R.J., and Pearthree, P.A., 2015; River-evolution and tectonic implications of a major Pliocene aggradation on the lower Colorado River: the bullhead alluvium; Geosphere, v. 11, n. 1.

Huckleberry, G., 1997; Rates of Holocene soil formation in South-Central Arizona; Arizona Geological Survey Open-File Report 97-7.

Jenny, B., Valero-Garces, B., Villa-Marinez, R., Urrutia, R., Geyh, M., and Veit, H., 2002; Early- to mid-Holocene aridity in central Chile and the southern Westerlies: The Laguna Aculeo record (34o); Quaternary Research, v. 58, p. 160-170.

Johnson, D. L., Keller, E. A., and Rockwell, T. K., 1990; Dynamic pedogenesis: new views on some key soil concepts, and a model for interpreting Quaternary soils, Quaternary Research, v. 33, p. 306-319.

Kenney, M.D., 2010a; Eolian transport evaluation and ancient shoreline delineation report, Genesis Solar Energy Project, Riverside County, CA; Report prepared for Worley Parsons; report dated February 5, 2010, Worley Parsons Project Number 52011206, Kenney GeoScience Job Number 706-09.

Kenney, M.D., 2010b; Geomorphology report of the aeolian sand system in the Palen Dry Lake region, proposed Palen Solar I Energy Project, Chuckwalla Valley, Riverside County, CA; report prepared for AECOM Environment; Kenney GeoScience Job Number 708-09; report dated April 16th, 2010.

Kenney, M.D., 2010c; Geomorphic aeolian evaluation report, Desert Sunlight Solar Farm Project, Chuckwalla Valley, Riverside County, CA; report prepared for AECOM Environment; report dated April 26, 2010, Job Number 714-09.

Kenney, M.D., 2010d; Preliminary geomorphic eolian report, Colorado River Substation, Riverside County, CA; report prepared for Southern California Edison (SCE); Job Number 717-10; report dated October 15, 2010.

Kenney, M.D., 2010e; Geomorphology Report of the Aeolian Sand System in the Palen Dry Lake Region, Proposed Palen Solar I Energy Project, Chuckwalla Valley, Riverside County, CA; prepared for AECOM Environment; Job Number 708-09; Draft report dated June 8, 2010.

Kenney, M.D., 2011, Preliminary eolian sand migration report, Desert Quartzite Power Project, near Blythe, Riverside County, CA; prepared for First Solar; Kenney GeoScience Job Number 721-11, report dated January 25, 2011.

Kenney, M.D., 2012; Preliminary report on the detrimental effects of flood control berms on the Keeler Dunes, Inyo County, California; Report prepared for City of Los Angeles Department of Water and Power; Kenney, M. prepared the report while hired AECOM; report dated December 12, 2012; p. 25.

Kenney, M.D., 2013; Preliminary Geomorphic evaluation of July 2012 flood events at the Genesis Solar Energy Project, Chuckwalla Valley, CA; prepared for Genesis Solar, Inc.; Kenney GeoScience Job Number 729-12, report dated July 16, 2013.

Kenney, M.D., 2016; Geomorphic and stratigraphic evaluation of the stable early to mid-Holocene eolian (wind-blown) dune systems for proposed Desert Quartzite Solar Project, eastern Chuckwalla Valley and Palo Verde Mesa area, Riverside County, California; Report prepared for First Solar; Kenney GeoScience Job No. 721-11, Report dated September 22, 2016, pp. 170.

Kirby, M.E., Lund, S.P., Anderson, M.A., and Bird, B.W., 2007; Insolation forcing of Holocene climate change in Southern California: a sediment study from Lake Elsinore; Journal of Paleolimnology, v.38, issue 3, p. 395-417.

Konrad, S. K. and Clark, D.H. 1998; Evidence for an early Neoglacial glacier advance from rock glaciers and lake sediments in the Sierra Nevada, California, U.S.A.; Arctic and Alpine Research, v. 30, n. 3, p. 272-284.

Lancaster, J., 2014; Project summary and transmittal, California Geological Survey Identification of Surficial Processes for Desert Renewable Energy Conservation Plan (CDFW Ecosystem Processes Grant No. P1382002/01), Department of Conservation - California Geological Survey; report dated August 4, 2014, Eolian System Map of the East Riverside Area - Map Plate 1. (See Short and Lancaster (2015) for comments and additional information to this publication)

Lancaster, N., 1992; Controls on aeolian activity: some new perspectives from the Kelso Dunes, Mojave Desert, California; Journal of Arid Environments, v. 27, p. 113-115.

Lancaster, N., 1994a; Arid geomorphology; Progress in Physical Geography, v. 18, issue 4, p. 582-587.

Lancaster, N., 1994b; Controls on aeolian activity: some new perspectives from the Kelso Dunes, Mojave Desert, California; Journal of Arid Environments, v. 27, p. 113-125.

Lancaster, N., 1995; Geomorphology of desert dunes; Routledge Publishing, p. 290.

Lancaster, N., 2009; Aeolian features and processes; in Young, R., and Norby, L., ed., Geological Monitoring; Geological Society of America.

Lancaster, N. and Tchakerian, V.P., 1996; Geomorphology and sediments of sand ramps in the Mojave Desert; Geomorphology v. 17, p. 151-165.

Lancaster, N. and McCarley-Holder, G., 2012; Decadal-scale evolution of a small dune field: Keeler Dunes, California 1944-2010; Geomorphology, v,180-181, January 2013, p. 281-291.

Lancaster, N., 1997; Response of eolian geomorphic systems to minor climate change: examples from the southern Californian deserts; Geomorphology, v. 19, issue 3-4, p. 333-347.

Lancaster, N. and Baas, A.; 1998; Influence of vegetation cover on sand transport by wind: field studies at Owens Lake, California; Earth Surface Processes and Landforms, v. 23, p. 69-82.

Lancaster, N. and Tchakerian V.P., 2003; Late Quaternary eolian dynamics, Mojave Desert, California; in Enzel, Y., Wells, S.G., and Lancaster, N., ed., Paleoenvironments and paleohydrology of the Mojave and Southern Great Basin Deserts, Geological Society of America Special Paper 368, p. 231-249.

Lancaster, N. and Helm, P., 2000; A test of a climatic index of dune mobility using measurements from the southwestern United States; Earth Surface Processes and Landforms, v. 25, p. 197-207.

Lancaster, N., 2010; Evaluation of interactions between infrastructure and sand transport corridors in the Mojave Desert; Desert Research Institute.

Lawson, M.P. and Thomas, D.S.G., 2000; Late Quaternary lunette dune sedimentation in the southwestern Kalahari desert, South Africa: luminescence based chronologies of aeolian activity; Sheffield Center for International Drylands Research.

Leeder, M.R., Harris, T., and Kirkby, M.J., 1998; Sediment supply and climate change: implications for basin stratigraphy; Basin Research, v. 10, p. 7-18.

Liu, T., Broecker, W.S., Bell, J.W. and Mandeville, C.W., 2000; Terminal Pleistocene wet event recorded in rock varnish from Las Vegas Valley, southern Nevada; Paleogeography, Palaeoclimatology, Palaeocology, v. 161, p. 423-433.

Loope, D.B., Swinehart, J.B., and Mason J.P., 1995; Dune-dammed paleovalleys of the Nebraska Sand Hills: Intrinsic versus climate controls on the accumulation of lake and marsh sediments; GSA Bulletin, v. 107, no. 4, pp. 396-406.

Lopes, T.J., 1998; Hydrology and water budget of Owens Lake, California; Water Resources Center Publication 341107, p. 1-8.

Madsen, D.B., Rhode, D., Grayson, D.K., Broughton, J.M., Livingston, S.D., Hunt, J., Quade, J., Schmitt, D.N., and Shaver III, M.W., 2001; Late Quaternary environmental change in the Bonneville basin, western U.S.A.; Palaeogeography, Palaeoclimatology, Palaeoecology, v.167, p. 243-271.

Maliva, R. and Missimer, T., 2012; Arid lands water evaluation and management; Environmental Science and Engineering, p. 21-25.

Malmon, D.V., Howard, K.A., and Priest, S.S., 2009; Geologic map of the Needles 7.5' Quadrangle, California and Arizona; U.S. Geological Survey Scientific Investigations Map 3062.

Marchand D.E., 1970; Soil contamination in the White Mountains, eastern California; Geological Society of America Bulletin, v. 81, p. 2497-2505.

Mather, A. E. and Hartley, A., 2005; Flow events on a hyper- arid alluvial fan: Quebrada Tambores, Salar de Atacama, northern Chile; Geological Society of London Special Publication 251, p. 9-29.

Mayhew, W.W., 1983; Conflicts between the fringe-toed lizard and development in the Coachella Valley; Cal-Neva Wildlife Transactions, p. 144-147.

McCarley, G.A. and Holder, R.G., 1997; Off-lake dust sources, Owens Lake basin; Great Basin Unified Air Pollution Control District, p. 1-6.

McCoy, F.W., Nokleberg, W.J., and Norris, R.M., 1967; Speculations on the origin of the Algodones Dunes, California; Geological Society of America Bulletin, v. 78, p. 1039-1044.

McDonald, E. V., McFadden, L. D., and Wells, S. G., 2003; Regional response of alluvial fans to the Pleistocene-Holocene climatic transition, Mojave Desert, California; in Enzel, Y., Wells, S.G., and Lancaster, N., ed., Paleoenvironments and paleohydrology of the Mojave and Southern Great Basin Deserts, Geological Society of America Special Paper 368, p. 189-205.

McDowell, P.F. and Bartlein, P.K.; Environmental controls of playa status and processes, Western U.S., Quaternary/Geomorphology Division Symposium, Session 115.

McDowelll, P.F., Bartlein, P.J., and Harrison, S.P., 1991; Environmental controls of playa status and processes, western U.S.; Geological Society of America abstracts and programs; v. 23(5): A283, 1 p.

McFadden, L. D. and Weldon, R. J. II; 1987; Rates and processes of soil development on Quaternary terraces in Cajon Pass, California; Geological Society of America Bulletin, v. 98, p. 280-293.

McFadden, L.D. and McAuliffe, J.R., 1997; Lithologically influenced geomorphic responses to Holocene climatic changes in the southern Colorado Plateau, Arizona: a soil-geomorphic and ecologic perspective; Geomorphology, v. 19, issue 3-4, p. 303-332.

McKee, E.D., 1966; Structures of dunes at white sands national monument, New Mexico (and a comparison with structures of dunes from other selected areas); Sedimentology, v. 7, p. 1-69.

Metzger, D.G., Loeltz, O.J., and Irelna, B., 1973; Geohydrology of the Parker-Blythe-Cibola Area, Arizona and California; Geological Survey Professional Paper 486-G.

Miller, D.M., 2005, Summary of the evolution of the Mojave River; in Reheis, M.C., 2005; Geologic and biotic perspectives on late Cenozoic drainage history of the southwestern Great Basin and lower Colorado River Region; Conference Abstracts; U.S. Geological Survey Open File Report 2005-1404, Desert Studies Center, Zzyzx, California Workshop held from April 12-15, 2005; p. 10.

Miller, D.M., Schmidt, K.M., Mahan, S.A., McGeehin, J.P., Owen, L.A., Barron, J.A., Lehmkuhl, F., and Lohrer, R., 2010; Holocene landscape response to seasonality of storms in the Mojave Desert; Quaternary International, v. 216, p. 45-61.

Mock, C.J. and Bartlein, P.J., 1995; Spatial variability of Late-Quaternary paleoclimates in the western United States; Quaternary Research, v. 44, p. 425-433.

Muhs, D. R., and Holliday, V.T., 1995; Evidence of Active Dune Sand on the Great Plains in the 19th Century from Accounts of Early Explorers; Quaternary Research, v. 43, pp. 198-208.

Muhs, D. R., and Holliday, V.T.; 2001; Origin of late Quaternary dune fields on the Southern High Plains of Texas and New Mexico; GSA Bulletin, v. 113, no. 1; p. 75-87.

Muhs, D.R., Stafford T.W., Cowherd, S.D., Mahan, S.A., Kihl, R., Maat, P.B., Bush, C.A., and Nehring, J.; 1996; Origin of the late Quaternary dune fields of northeastern Colorado; Geomorphology, v.17, issues 1-3, pp. 129-149.

Muhs, D.R., Reynolds, R.L., Been, J., Skipp, G.; 2003; Eolian sand transport pathways in the southwestern United States: importance of the Colorado River and local sources; Quaternary International, v. 104, p. 3-18.

Muhs, D.R., Swinehart, J.B., Loope, D.B, Been, J., Mahan, S.A., and Bush, C.A., 2000; Geochemical evidence for an eolian sand dam across the North and South Platte Rivers in Nebraska; Quaternary Research, v. 53, p. 214-222.

Neal, J.T. and Motts, W.S., 1967; Recent geomorphic changes in playas of western United States; Journal of Geology; v. 75, p. 511-525.

Nickling, W.G., Luttmer, C., Crawley, D.M., Gillies, J.A., and Lancaster, N., 2001; Comparison of on-and off-lake PM10 dust emissions at Owens Lake, CA; Wind Erosion Laboratory, Final Report, p. 51

Nichols, K.K., Bierman, P.R., Eppes, M.C., Kaffee, M., Finkel, R., and Larsen, J., 2007; Timing of surficial process changes down a Mojave Desert piedmont; Quaternary Research, v. 68, p. 151-161.

Nichols, K.K., Bierman, P.R., Foniri, W.R., Gillespie, A.R., Caffee, M., and Finkel, R., 2006; Dates and rates of arid region geomorphic processes; GSA Today, v.16, p. 4-9.

Nield, J.M. and Baas, A.C.W., 2007; Investigating parabolic and nebkha dune formation using a cellular automaton modeling approach; Earth Surf. Process. Landforms, in press version.

NOAA - National Oceanic and Atmospheric Administration – National Weather Service; Date of upload July 15, 2017; http://www.cpc.ncep.noaa.gov/products/outreach/Report-to-the-Nation-Monsoon_aug04.pdf

Norris, R.M. and Norris, K.S., 1961; Algodones Dunes of southeastern California; Geological Society of America Bulletin, v. 72, p. 605-620.

Okin, G.S. and Gillette, D.A.; 2001; Distribution of vegetation in wind-dominated landscapes: implications for wind erosion modeling and landscape process; Journal of Geophysical Research, v. 106, n. D9, p. 9673-9683.

Okin, G.S., 2008; A new model of wind erosion in the presence of vegetation; Journal of Geophysical Research, v. 113.

Ono, D.M., 2006; Application of the Gillette model for windblown dust at Owens Lake, CA; Atmospheric Environment, v. 40, p. 3011-3021.

Ono, D.M. and Cox, B.G. Jr., 1990; Controlling dust storms due to water diversions from Owens and Mono Lakes; Air and Waste Management Association Annual Meeting Proceedings, Paper 90-69.5, 14 p.

Orme, A.R., 2004; Lake Thompson, Mojave Desert, California; Cold Regions Research and Engineering Laboratory, p. 1-50.

Paisley, E.C.I., Lancaster, L., Gaddis, L.R., and Greeley, R., 1991; Discrimination of active and inactive sand from remote sensing: Kelso Dunes, Mojave Desert, California; Remote Sens. Environment, v. 37, p. 153-166.

Peterson, F.F., Bell, J.W., Dorn, R.I., Ramelli, A.R., and Ku, T.L., 1995; Late Quaternary geomorphology and soils in Crater Flat, Yucca Mountain area, Southern Nevada; Geological Society of America Bulletin, v. 107, n. 4, p. 379-395.

Pease, P.P. and Tchakerian, V.P., 2003; Geochemistry of sediments from Quaternary sand ramps in the southeastern Mojave Desert, California; Quaternary International, v. 104, p. 19-29.

Pelletier, J.D., 2014; The linkages among hillslope-vegetation changes, elevation, and the timing of late-Quaternary fluvial-system aggradation in the Mojave Desert revisited; Earth Surface Dynamics, v. 2, p. 455-468.

Pelletier, J.D., 2009; Controls on the height and spacing of eolian ripples and transverse dunes: a numerical modeling investigation; Geomorphology, v. 105, p. 322-333.

Pelletier, J.D., Nichols, M.H., and Nearing, M.A., 2016; The influence of Holocene vegetation changes on topography and erosion rates: a case study at Walnut Gulch Experimental Watershed, Arizona; Earth Surf. Dynam., v. 4, p. 471-488.

Prehoda, V., 2001; Mojave Desert Invasive Species Awareness; The Changing Face of the East Mojave Desert, Abstracts from the 2001 Desert Symposium; pp. 56-57.

Ragona, D., Minster, B., Rockwell, T., and Jussila, J., 2006; Field imaging spectroscopy: a new methodology to assist the description, interpretation, and archiving of paleoseismological information from faulted exposures; Journal of Geophysical Research, v. 111, p. 1-11.

Ramsey, M.S., Christensen, P.R., Lancaster N., and Howard, D.A., 1999; Identification of sand sources and transport pathways at the Kelso Dunes, California using thermal infrared remote sensing; Geological Society of America Bulletin, v. 111, n. 5, p. 646-662.

Reheis, M.C., 2005; Geologic and biotic perspectives on late Cenozoic drainage history of the southwestern Great Basin and lower Colorado River Region; Conference Abstracts; U.S. Geological Survey Open File Report 2005-1404, Desert Studies Center, Zzyzx, California Workshop held from April 12-15, 2005.

Reheis, M.C., Budahn, J.R., and Lamothe, P.J., 2002; Geochemical evidence for diversity of dust sources in the southwestern United States; Geochimica et Cosmochimica Acta, v. 66, n. 9, p. 1569-1587.

Reheis, M.C., Miller, D.M., Redwine, J.L., 2007; Quaternary stratigraphy, drainage-basin development, and geomorphology of the Lake Manix Basin, Mojave Desert; Guidebook for fall file trip, Friends of the Pleistocene, Pacific Cell, October 4-7, 2007.

Reheis, M.C., Slate, J.L., Throckmorton, C.K., McGeehin, J.P., Sarna-Wojcicki, A.M., and Dengler, L., 1996; Late Quaternary sedimentation on the Leidy Creek fan, Nevada-California: geomorphic responses to climate change; Basin Research, v. 12, p. 270-299.

Reheis, M.C., 2012; Owens (Dry) Lake, California: A human-induced dust problem; U.S. Geological Survey, p. 1-11, http://geochange.er.usgs.gov/sw/impacts/geology/owens/

Rendell, H.M. and Sheffer, N.L., 1996; Luminescence dating of sand ramps in the Eastern Mojave Desert; Geomorphology, v. 17, issue 1, p. 187-197.

Rendell, H.M., Lancaster, N., and Tchakerian, V.P., 1994; Luminescence dating of late Quaternary aeolian deposits at Dale Lake and Cronese Mountains, Mojave Desert, California; Quaternary Science Reviews, v. 13, issue 5-7, p. 417-422.

Reynolds, R.E., Jefferson, G.T., and Lynch, D.K., 2008; Trough to trough, The Colorado River and the Salton Sea; Desert Symposium, p. 5-143.

Reynolds, R.L., Bogle, R., Vogel, J., Goldstein, H., and Yount, J., 2009; Dust emission at Franklin Lake Playa, Mojave Desert (U.S.A.): response to meteorological and hydrologic changes 2005-2008; Natural Resources and Environmental Issues, v. 15, issue 1, p. 1-11.

Reynolds, R.L., Yount, J.C., Reheis, M., Goldstein, H., Chavez Jr., P., Fulton, R., Whitney, J., Fuller, C., and Forester, R.M., 2007; Dust emission from wet and dry playas in the Mojave Desert, USA; Earth Surface Processes and Landforms, v. 32, issue 12, p. 1811-1827.

Russell, J.M., 2006; Mid-to-late Holocene climate change in tropical Africa: regional patterns, rates, and timing; American Geophysical Union, Fall Meeting, abstract #PP42A-06.

Sanders, D. and Ostermann, M., 2011; Post-last glacial alluvial fan and talus slope associations (Northern Calcareous Alps, Austria): a proxy for late Pleistocene to Holocene climate changes; Geomorphology, v. 131, p. 85-97.

Sauer, Jonathan D., 1988; Plant Migration: The Dynamics of Geographic Patterning in Seed Plant Species. Berkeley: University of California Press, pp.281.

Schmidt, M. W. and Hertzberg, J. E., 2011; Abrupt Climate Change During the Last Ice Age. *Nature Education Knowledge* 3(10):

Seager, R., Ting, M., Held, I., Kushnir, Y., Lu, J., Vecchi, G., Huang, H., Harnik, N., Leetmaa, A., Lau, N., Li, C., Velez, J., and Naik, N.; 2007; Model projections of an imminent transition to a more arid climate in southwestern North America. Science 316, pp. 1181–1184.

Schultz, B.W., 2001; Extent of vegetated wetlands at Owens Dry Lake, California, U.S.A., between 1977 and 1992; Journal of Arid Environments, v. 48, p. 69-87.

Schaaf, M. and Kenney, M.D., 2016; Investigation into the origin and development of the modern Keeler Dunes, Inyo County, California; report prepared by Air Science and the Owens Lake Science, Technology and Regulatory Project Team for Los Angeles Department of Water and Power; Schaaf, M. and Kenney M. principle investigators and editors; report dated February, 2016.

Sharp, S.P., 1966; Kelso Dunes, Mojave Desert, California; Geological Society of America Bulletin, vo. 77, p. 1045-1074.

Sheidt, S., Lancaster, N., Ramsey M., 2011; Eolian dynamics and sediment mixing in the Gran Desierto, Mexico, determined from thermal infrared spectroscopy and remote-sensing data; GSA Bulletin, v. 123, no. 7/8; p. 1628-1644.

Short, W.R., and Lancaster, J.T., 2015; Comments and additional information for incorporation into the Draft Desert Renewable Energy Conservation Plan (DRECP) and Environmental Impact report/Environmental Impact Statement (EIR/EIS); Report prepared by the authors with the Department of Conservation - California Geological Survey; report prepared for the California Energy Commission, Dockets Office, MS-4, Docket No. 09-RENEW EO-01; Report dated February 5, 2015.

Shuman, B. and Webb, T. III, 2002; The anatomy of a climatic oscillation: vegetation change in eastern North America during the Younger Dryas chronozone; Quaternary Science Reviews, v. 21, p. 1777-1791.

Sohn, M.F., Mahan, S.A., Knott, J.R., and Bowman, D.D., 2007; Luminescence ages for alluvial-fan deposits in Southern Death Valley: implication for climate-driven sedimentation along a tectonically active mountain front; Quaternary International, v. 166, p. 49-60.

Spencer, J.E., Pearthree, P.A., and House, P.K., 2009; An evaluation of the evolution of the latest Miocene to earliest Pliocene Bouse Lake system in the lower Colorado River valley, southwestern U.S.A., in Reheis, M.C., Hershler, R., and Miller, D.M., ed., Late Cenozoic Drainage History of the Southwestern Great Basin and Lower Colorado River Region: Geologic and Biotic Perspectives; Geological Society of America Special Paper 439, p. 375-390.

Steenburgh, W. J., K. T. Redmond, K. E. Kunkel, N. Doesken, R. R. Gillies, J. D. Horel, M. P. Hoerling, and T. H. Painter. 2013. “Present Weather and Climate: Average Con-ditions.” In Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment, edited by G. Garfin, A. Jardine, R. Merideth, M. Black, and S. LeRoy, 56–73. A report by the Southwest Climate Alliance. Washington, DC: Island Press.

Stout, J.E. and Arimoto, R., 2010; Threshold wind velocities for sand movement in the Mescalero Sands of southeastern New Mexico; Journal of Arid Environments, v. 74, p. 1456-1460.

Stone, P., 2006; Geologic map of the west half of the Blythe 30’ by 60’ Quadrangle, Riverside County, California and La Paz County, Arizona; United States Department of the Interior and Geological Survey Scientific Investigations Map 2922.

Stow, D.W. and Chang, H.H., 1987; Magnitude-frequency relationship of coastal sand delivery by a Southern California stream; Geo-Marine Letters, v. 7, p. 217-222.

Tchakerian, V.P., 1991; Late Quaternary aeolian geomorphology of the Dale Lake sand sheet, Mojave Desert, California; Physical Geography, v. 12, issue 4.

Tchakerian, V. and Lancaster, N., 2002; Late Quaternary arid/humid cycles in the Mojave Desert and western Great Basin of North America; Quaternary Science Reviews; Volume 21, Issue 7, March 2002, Pages 799-810

Thomas, D.S.G., Nash, D.J., Shaw, P.A., and Van der Post, C., 1993; Present day lunette sediment cycling at Witpan in the arid southwestern Kalajari Desert; Catena, v. 20, p. 515-527.

Thomas, B.E., Hjalmarson, H.W., and Waltemeyer, S.D., 1997; Methods for estimating magnitude and frequency of floods in the southwestern United States; U.S. Geological Survey Water-Supply Paper 2433, p. 195.

Thompson, R.S. date unknown; Late Quaternary paleoclimatic variations in the deserts of Western North America; Quaternary/Geomorphology Division Symposium, Session 115.

Tolman, C.F., 1909; Erosion and deposition in the Southern Arizona Bolson Region; Journal of Geology, v. 17, n. 2, p. 136-163.

Turk, J.K., Houdeshell, C., and Graham, R.C., 2016; A proposed Master V horizon for near surface horizons with vesicular porosity; University of Riverside and U.S. Department of Agriculture-NRCS Victorville, California, 18 p. www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_050966.pdf.

Turner, F.B., Weaver, D.C., and Rorabaugh, J.C., 1984; Effects of reduction in windblown sand on the fringe-toed lizard (Uma inornata) in the Coachella Valley, California; Copeia, p. 370-378.

Tsoar, H., 2004; Sand dunes mobility and stability in relation to climate; dated October 17, 2004, preprint version as submitted to Physica A.

Umbanhowar, C.E. Jr., Camill, P., Geiss, C.E., and Teed, R., 2005; Asymmetric vegetation responses to mid-Holocene aridity at the Prairie-forest ecotone in south-central Minnesota; Quaternary Research, v. 66, p. 53-66.

Walker, M.; Johnsen, S.; Rasmussen, S. O.; Popp, T.; Steffensen, J.-P.; Gibbard, P.; Hoek, W.; Lowe, J.; Andrews, J.; Bjo; Cwynar, L. C.; Hughen, K.; Kershaw, P.; Kromer, B.; Litt, T.; Lowe, D. J.; Nakagawa, T.; Newnham, R.; Schwander, J. (2009); Formal definition and dating of the GSSP (Global Stratotype Section and Point) for the base of the Holocene using the Greenland NGRIP ice core, and selected auxiliary records" (PDF). Journal of Quaternary Sci. V. 24: p. 3–17.

Ward, A.W. and Greeley, R., 1984; Evolution of the yardangs at Rogers Lake, California; Geological Society of America Bulletin, v. 95, n. 7, p. 829-837.

Waters, M.R., 1988; Holocene alluvial geology and geoarchaeology of the San Xavier reach of the Santa Cruz River, Arizona; Seismological Society of America Bulletin, v. 100, p. 479-491.

Waters, M.R. and Haynes, V., 2001; Late Quaternary arroyo formation and climate change in the American Southwest; Geology, v. 29, n. 5, p. 399-402.

Webb, T. III and Bartlein, P.J., 1992; Global changes during the last 3 million years: climatic controls and biotic responses; Annual Reviews of Ecology and Systematics, v. 223, p. 141-173.

Weldon, R. J., 1986; Late Cenozoic geology of Cajon Pass; implications for tectonics and sedimentation along the San Andreas Fault; California Institute of Technology, Ph.D. thesis, 400 pp.

Wells, S.G. and Dohrenwend, J.C., 1985; Relict sheetflood bed forms on late Quaternary alluvial-fan surfaces in the southwestern United States; Geology, v. 13, p. 512-516.

Wells, S.G., Brown, W.J., Enzel, Y., Anderson, R.Y., McFadden, L.D., 2003; Late Quaternary geology and paleohydrology of pluvial Lake Mojave, southern California; ; in Geological Society of America Special Paper 368, edited by Enzel Y., Wells, S.G., and Lancaster, N., p. 79-114.

White, B.R. and Roney, J., 2000; Simulation and analysis of factors leading to high PM10 emissions fluxes at Owens Dry Lake using an environmental wind tunnel; University of California at Davis, Environmental Aerodynamics Laboratory, Mechanical and Aeronautical Engineering, Final Report.

Whitney, J.W., Breit, G.N., Buckingham, S.E., Reynolds, R.L., Bogle, R.C., Luo, L., Goldstein, H.L., and Vogel, J.M., 2015; Aeolian responses to climate variability during the past century on Mesquite Lake Playa, Mojave Desert; Geomorphology, v. 230, p. 13-25.

Wilford, D.J., Sakals, J.L., Innes, J.L., and Sidle, R.C., 2005; Fans with forests: contemporary hydrogeomorphic processes on fans with forests in west central British Colombia, Canada; Geological Society of London Special Publications 251, p. 25-40.

Williams, M., 2014; Climate Change in Deserts, Past, Present and Future; Cambridge University Press, pp. 629.

Wright, J., 2000; Global climate change in marine stable isotope records; Quaternary Geochronology: Methods and Applications, AGU Reference Shelf 4, p. 433.

Zimbelman, J.R., Williams, S.H., and Tchakerian, V.P., 1995; Five sand transport paths in the Mojave Desert, southwestern United States; In: Tchakerian, V.P. (Ed.), Desert Aeolian Processes. Chapman and Hall, London, pp. 101–129.

Zimbelman, J.R. and Williams, S.H., 2002; Geochemical indicators of separate sources for eolian sands in the eastern Mojave Desert, California, and western Arizona; Geological Society of America Bulletin, v. 114, n. 4, p. 490-496.

Zimbelman, J.R., Williams, S.H., and Tchakerian, V.P., 1995; Sand transport paths in the Mojave Desert, southwestern United States; in Tchakerian, V.P., ed., Desert Eolian Processes; Chapman and Hall, New York, p. 101-130.

# APPENDIX B

## GLOSSARY OF TERMS

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## GLOSSARY OF TERMS

**ABRASION:** Erosion of a surface when coarser sediments move across the surface in a saltation process. For example, when the wind transports sand grains and the sand grains dislodge bits of the ground surface, that is abrasion.

**ACTIVE AEOLIAN (EOLIAN) LANDFORMS**: Active eolian landforms are features on which contemporary surface sand and, locally, avalanche faces at the angle of repose. Primary sedimentary structures are preserved. Depending on their morphological type, active dunes may be migrating in the net transport direction (e.g. concentric or transverse dunes), extending (e.g. linear dunes), or vertically accreting (e.g. star dunes-complex dunes). The degree of aeolian activity may vary seasonally, annually or decadally in response to changes in sand supply, wind velocity, vegetation cover and moisture contents. Definition from Lancaster, 1992. Also see Dormant and Relict dune definitions below from Lancaster, 1992. Note however, that this definition does not take into account where active sands requiring nominal active eolian sands (i.e. sand sheets, small coppice, weak dune mounds) are currently occurring in an ancient dune system representing an ancient more robust eolian system in the past.

**AEOLIAN/EOLIAN**: Alternate spelling of eolian. See Eolian.

**AGGRADATION**: Aggradation (or alluviation) is the term used in geology for the increase in land elevation, typically in a river system, due to the deposition of sediment. Aggradation occurs in areas in which the supply of sediment is greater than the amount of material that the system is able to transport. The mass balance between sediment being transported and sediment in the bed is described by the Exner equation. The term *aggradational event* is used by eolian scientists to describe a period of time when a dune systems increases its mass of eolian sands indicating that the eolian sand sources are producing sufficient sand to allow for dune deposition. Hence, a perio9d of time when the wind supplies more sand than leaves the dunes system. In alluvial environments, when washes and streams deposit sediments it is referred to as *alluviation*.

**ALLUVIAL/ALLUVIAL DEPOSITS:** Sediments deposited by flowing water.

**ALLUVIATION:** Another name for aggradation but specific to alluvial processes (washes, channels, streams, stream terrace, etc).

**ANGLE OF REPOSE:** The angle, from 0 to 90 degrees, of a slope that marks the last stable slope angle. If the angle gets any steeper, material on the slope will move downhill.

**BAJADA**: An alluvial plain that forms along the flanks of a mountain where fan-shaped alluvial deposits overlap. Often, numerous alluvial fans from an individual valley within a mountain range merge to form a relatively smooth surface referred to as a bajada. A Bajada is a type of Piedmont Surface.

**BARCHAN DUNES**: A **barchan** or **barkhan dune**, (from Kazakh бархан [bɑrˈ.χɑn]), is a crescent-shaped dune. The term was introduced in 1881 by Russian naturalist Alexander von Middendorf,[1] for crescent-shaped sand dunes in Turkestan and other inland desert regions. Barchans face the wind, appearing convex and are produced by wind action predominately from one direction. They are a very common landform in sandy deserts all over the world and are arc-shaped, markedly asymmetrical in cross section, with a gentle slope facing toward the wind sand ridge, comprising well-sorted sand. This type of dune possesses two "horns" that face downwind, with the steeper slope known as the slip face, facing away from the wind, downwind, at the angle of repose of sand, approximately 30–35 degrees for medium-fine dry sand.[2] The upwind side is packed by the wind, and stands at about 15 degrees. Barchans may be 9–30 m (30–98 ft) high and 370 m (1,210 ft) wide at the base measured perpendicular to the wind. Simple barchan dunes may appear as larger, compound barchan or megabarchan dunes, which can gradually migrate with the wind as a result of erosion on the windward side and deposition on the leeward side, at a rate of migration ranging from about a meter to a hundred meters per year. Barchans usually occur as groups of isolated dunes and may form chains that extend across a plain in the direction of the prevailing wind. Barchans and megabarchans may coalesce into ridges that extend for hundreds of kilometers. Dune collisions and changes in wind direction that spawn new barchans from the horns of the old govern the size distribution in a given field.[3] As barchan dunes migrate, smaller dunes outpace larger dunes, catching-up the rear of the larger dune and eventually appear to punch through the large dune to appear on the other side. The process appears superficially similar to waves of light, sound, or water that pass directly through each other, but the detailed mechanism is very different. The dunes emulate soliton behavior, but unlike solitons, which flow through a medium leaving it undisturbed (think of waves through water), the sand particles themselves are moved. When the smaller dune catches up the larger dune, the winds begin to deposit sand on the rear dune while blowing sand off the front dune without replenishing it. Eventually, the rear dune has assumed dimensions similar to the former front dune which has now become a smaller, faster moving dune that pulls away with the wind.[4]

**BASIN AND RANGE PROVINCE:** A vast region that covers much of the inland Western United States and northwestern Mexico. It is defined by unique topography: abrupt changes in elevation that alternate between narrow faulted mountain chains and flat arid valleys or basins.

**BATHYMETRIC:** Related to bathymetry.

**BATHYMETRY:** The features of land when it lies underwater. Underwater equivalent of topography.

**CAMBIC HORIZON (Bw Horizon):** A weakly developed mineral layer in the middle part (B horizon) of a soil profiles. The Bw horizon can be recognized by minor chemical weathering (a yellowish stain due to oxidation), and minor secondary flux of wind-blown dust. In desert regions such as the Mojave Desert, southeastern California, Bw horizons generally require a couple of thousand years to develop, but are typically less than several thousand years old.

**COPPICE DUNES**: Vegetated sand mounds that are often scattered throughout sand sheets in semi-arid regions where shrubs and blowing sand are abundant. Any shrub sticking up into the airborne stream of sand impedes the flow. The resulting turbulence and lost speed cause sand grains to settle on the downwind side of the shrub and around its base. Coppice dunes range from about 1.5 – 9 feet high and 3 – 45 feet wide. Within any given field of coppice dunes, however, the dune size tends to be uniform. Because the sand accumulates in piles around the plants and is swept from the surfaces between the plants, a hummocky, rough topography develops that is very different from sand sheets without vegetation (which are typically smooth, flat, and gently undulatory). Under certain conditions, individual or clusters of coppice dunes become very large and are then called vegetation mounds. Coppice dunes are commonly associated with parabolic dune fields.

**COPPICE TAIL:** On the leeward (downwind) side of the coppice mound, at the base of the plant, is a triangular tail; the wide end attaches to the mound and points (narrows) downwind. The coppice tails are generally 3 inches to 3 feet long and provide excellent wind vector data for the past 1 to 10 years. A lack of active coppice tails (or degraded and/or vegetated coppice mounds) is an excellent indicator that sand is not currently migrating within that area. Most active coppice dunes in the Chuckwalla Valley region do exhibit coppice tails.

**CORRIDOR SYSTEM, EOLIAN:** Proposed eolian sand pathways that may allow wind-blown sand to travel for tens of miles and involve numerous sub-basins and possibly sand ramps. A corridor system allows wind-blown sand to travel tens of miles via topographic valleys and playa lake basins. It is clear that the proposed sand migration corridors in southeastern California are provided significant amounts of local sands.

**TEMPORAL AND SPATIAL SCALE - CYCLIC**: A way to measure the evolution of large dune field areas over time (Lancaster, 1995). A cyclic temporal scale spans periods of 1 thousand to 10 thousand years and its spatial scale corresponds to that of large dune field areas. These large dune field areas developed over thousands of years during major aggradational events of the latest Pleistocene to mid Holocene. Cyclic scale covers the formation of most of the larger dunes within the Chuckwalla eolian system.

**TEMPORAL AND SPATIAL SCALE - GRADED**: A way to measure the dynamics and morphology of dunes, including the migration of individual dunes within a dune system. Graded temporal scale spans time periods of 1 to 100 years. During those time frames, dunes tend to be in full or partial equilibrium with the rates and directions of sand movements generated by surface winds (Lancaster, 1995). In the Mojave Desert, graded time structures include small active dunes and medium to larger active coppice dunes and their respective tails.

**TEMPORAL AND SPATIAL SCALE - INSTANTANEOUS:** Instantaneous temporal and spatial scale involves very short periods of time and small areas. Eolian structures that form within instantaneous scale include the formation of sand ripples – which can develop in a few minutes - and very small coppice dune tails behind shrubs.

**DEFLATION**: A process in which wind picks up loose, fine particles, such as whitish, powdery mineral salts, and the particles then move suspended in the airstream. Deflation is common on "wet" playa surfaces where the groundwater is within 15 feet of the surface and routinely produces new salt crusts on the surface.

**DISTRIBUTARY DRAINAGE SYSTEM**: A **distributary**, or a **distributary channel**, is a stream that branches off and flows away from a main stream channel. They are a common feature of river deltas. The phenomenon is known as river bifurcation. The opposite of a distributary is a tributary. Distributaries usually occur as a stream nears a lake or an ocean, but they can occur inland as well, such as on alluvial fans or when a tributary stream bifurcates as it nears its confluence with a larger stream. In some cases, a minor distributary can divert so much water from the main channel that it can become the main route.

**DORMANT AEOLIAN (EOLIAN) LANDFORMS**: Dormant aeolian landforms are those on which surface sand transport and deposition are currently absent or at low level, yet are capable of reverting to an active condition as a result of minor climate changes (e.g. prolonged regional drought). Wind rippled surfaces are rare or absent, as are avalanche faces at the angle of repose. The former avalanche slope may be degraded, so that lee face slope angles of 20 degrees or less are common on crescentic dunes. Primary sedimentary structures are still present, but may be partially destroyed by bioturbation. Vegetation cover is usually well developed and includes a high percentage of perennial plants, including shrubs. The sand surface may be stabilized with biogenic crusts. Sand mobility may be reduced by a low=energy wind regime, lack of sand supply, and/or presence of a well-developed vegetation cover. Dormant dunes may revert to active features as a result of minor cyclic or secular environmental changes. A wide variety of degrees of dune dormancy can occur, but this class of aeolian landforms implies that they have not experienced active sand transport on time-scales of decades or greater. This definition is from Lancaster, 1992. Within Kenney GeoScience reports, the term "dormant dunes" and "relict dunes" is utilized to represent an eolian system that exhibits older dunes that are no longer receiving sufficient eolian sands to maintain those dune forms. In these areas, active sand in the form of sand sheets and coppice dunes that require minor magnitudes of eolian sand are transported over the older dune system. In addition, areas mapped by Kenney GeoScience as dormant or relict dunes also exhibit internal abrasion providing an internal source of eolian sand.

**EOLIAN/(AEOLIAN):** Wind blown. Eolian refers to processes associated with the wind, such as ventifacts, abrasion, wind-blown sand transport, and dune deposition. Aeolus was ruler of the winds in Greek mythology.

**EOLIAN DEPOSITS**: Sediments transported and subsequently deposited by moving air. Sand dunes form by eolian deposits.

**EROSION**: In earth science, erosion is the action of surface processes (such as water flow or wind) that remove soil, rock, or dissolved material from one location on the Earth's crust, then transport it away to another location.[1] The particulate breakdown of rock or soil into clastic sediment is referred to as physical or mechanical erosion; this contrasts with chemical erosion, where soil or rock material is removed from an area by its dissolving into a solvent (typically water), followed by the flow away of that solution. Eroded sediment or solutes may be transported just a few millimeters, or for thousands of kilometers.

**GEOLOGIC TIMESCALE**: A way to measure time and compare ages over millions of years. Geologists often need to compare the ages of rocks or landscapes, or discuss how long before the present something occurred. The geologic timescale provides a standardized reference. Thus, for example, when someone says a formation developed in "Late Pliocene", everyone else knows it developed between 12,000 and 126,000 years ago. In the geologic timescale, the longest divisions of time are the three eras, (from oldest to youngest) the Paleozoic, Mesozoic, and Cenozoic. Each era is divided into periods, and the periods are divided into epochs.

**GEOMORPHIC**: Related to geomorphology.

**GEOMORPHIC PROVINCE**: An area with common geologic or geomorphic attributes. A province may include a single dominant structural feature.

**GEOMORPHOLOGIST:** Scientists who seek to understand why landscapes look the way they do, to identify landform history and dynamics, and to predict future landscape changes through a combination of field observations, physical experiments, and numerical modeling. Geomorphologists work within a broad base of disciplines, including physical geography, geology, geodesy, engineering geology, archaeology and geotechnical engineering – which contributes to varied research styles and interests.

**GEOMORPHOLOGY:** The scientific study of landscapes – how they form and change, what their topographic and bathymetric features say about physical, chemical, and biological processes operating at or near the Earth's surface.

**HOLOCENE:** A measure of geologic time. In the geologic timescale, the Holocene is the current epoch, which began about 11,700 years ago (10,000 $^{14}C$ years ago).

**HORIZON, SOIL:** A layer generally parallel to the soil crust, whose physical characteristics differ from the layers above and beneath. Typically, soil horizons develop once a surface becomes stable, and thus affected by near-surface and surficial processes. Each soil type usually has three or four horizons defined by color, texture, or other obvious physical features. Typical soil horizons, from shallowest to deepest, are called: A, B, and C horizons. In many cases, particularly for buried soils, only the B and C horizons remain. Soil horizons change over time due to chemical and mechanical weathering, percolating water, plant and animal activity, wind-blown influx of material, and more. The soil changes occur over predictable time intervals, which allows soil scientists to estimate ages of the surfaces. Also see Soil Profile.

**INTERDUNE AREAS:** Desert floor between dunes in dune fields. Closed interdune areas may be poorly drained, contain playas, and are typically flat. Where dry and floored by sandy sediment, interdune areas have many of the same characteristics as sand sheets. With near-surface moisture, interdune areas may contain grasses, shrubs, trees, or even settlements. Interdune areas range in size from a few to tens of square miles. In any given locality, the sizes and shapes of the interdune areas are similar, as are those of the intervening dunes.

**Kya:** Abbreviation for "thousand years ago". Sometimes shown as ka or KYA.

**LACUSTRINE:** Lacustrine deposits are sedimentary rock formations which formed in the bottom of ancient lakes.[1] A common characteristic of lacustrine deposits is that a river or stream channel has carried sediment into the basin. Lacustrine deposits form in all lake types including rift graben lakes, oxbow lakes, glacial lakes, and crater lakes. Lacustrine environments, like seas, are large bodies of water. They share similar sedimentary deposits which are mainly composed of low-energy particle sizes. Lacustrine deposits are typically very well sorted with highly laminated beds of silts, clays, and occasionally carbonates.[2] In regards to geologic time, lakes are temporary and once they no longer receive water, they dry up and leave a formation. In desert environments, lacustrine environments include both playa and pluvial lakes.

**LAST GLACIAL MAXIMUM:** The Last Glacial Maximum (LGM) was the last period in the Earth's climate history during the last glacial period when ice sheets were at their greatest extension. Growth of the ice sheets reached their maximum positions in about 24,500 BCE. Deglaciation commenced in the Northern Hemisphere between approximately 18,000 to 17,000 BCE and in Antarctica approximately 12,500 BCE, which is consistent with evidence that it was the primary source for an abrupt rise in the sea level in about 12,500 BCE.[1] Vast ice sheets covered much of North America, northern Europe, and Asia. The ice sheets profoundly affected Earth's climate by causing drought, desertification, and a dramatic drop in sea levels.[2] It was followed by the Late Glacial.

**LARGE SCALE MAPS:** Large scale maps show a smaller amount of area with a greater amount of detail. The geographic extent shown on a large scale map is small. A large scaled map expressed as a representative scale would have a smaller number to the right of the ratio. Also see small scale map.

**LEE(WARD) SIDE OF A DUNE** : Leeward is downwind from the dominant wind direction that is primarily responsible for a dune's form. The lee side of a dune exists between the crest and the base of the avalanche face. Many active dunes (geologic unit Qsa), exhibit a free avalanche face where sand sediment is deposited near the angle of repose. (Lee side is opposite of stoss side, which is upwind)

**LINEAR DUNES:** One of the most common dune types, linear dunes are straight to irregularly sinuous, elongate, ridges of loose, well-sorted, very fine to medium sand. The straight varieties are often called *sand ridges*, and the sinuous varieties are often called *seifs*. Sinuosity and alternate slip faces develop because crosswinds change direction and shepherd the sand to one side then the other of the dune axes. The length of a linear dune, can range from several feet to many miles and is much greater than its width. The long axes of the linear dunes align within 15° of the prevailing wind or with the drift direction of the local winds. Linear dunes form in at least two environmental settings: where winds of bimodal direction blow across loose sand, and where single-direction winds blow over sediment that is locally stabilized (through vegetation, sediment cohesion, or topographic shelter from the winds). Linear dunes do exist in areas with varied wind speeds and directions. Most are probably "fossil" dunes formed during the Pleistocene, which had similar wind directions but more vigorous winds. Where linear dunes are active today, they are becoming more complex, with secondary dunes. Long standing opinion is that linear dunes migrate parallel to and along the downwind axis of the dune. However, new evidence indicates that linear dunes move about 15° oblique to the dune axis.

**Ma:** Abbreviation for "million years ago".

**MINERALOGY:** A field of geology specializing in the chemistry, crystal structure, and physical (including optical) properties of minerals and mineralized artifacts. Mineralogy studies classification of minerals, the processes of mineral origin and formation, their geographical distribution, and their utilization.

**PARABOLIC DUNES:** In plan view, these are U- or V-shaped mounds of well-sorted, very fine to medium sand with elongated arms that extend upwind (opposite of Barchan dunes). Slip faces occur on the outer (convex) side of the nose of the dune and on the outside slopes of its elongated arms. Parabolic dunes are always associated with vegetation--grasses, shrubs, and occasional trees anchor the trailing arms. Most parabolic dunes do not grow taller than tens of feet except at their forward portions. There, vegetation halts or slows the sand and it piles up. In inland deserts, parabolic dunes extend downwind from blowouts in sand sheets that are only partly anchored by vegetation. They can also originate from beach sands and on shores of large lakes. Parabolic dunes, like crescentic dunes (i.e. barchan), are characteristic of areas where winds were strong and unidirectional during their growth and migration.

**PALEOSOL:** (*palaeosol* in Great Britain and Australia) A former or "fossil" soil, preserved by burial underneath sediments or volcanic deposits, which may have lithified into rock.

**PENETROMETER:** An instrument for determining the consistency or hardness of a substance by measuring the depth or rate of penetration when a rod or needle is driven into the substance by a known force.

**PIEDMONT SLOPE:** An "apron" of sediment debris that lies between a mountain and a valley floor. A piedmont slope characteristically slopes away from the mountains, and flow directions are transverse to flow directions in the valley floor, so a piedmont slope indicates where the mountain and valley were at the time of the slope's formation. The piedmont slope is subdivided into five types based on morphology and relative age. Each of the five types forms by similar processes. Three of the types are relevant to this study: debris flows (fluidized slurries that flow downslope following intense downpours), grain flow (gravity-driven grain-to-grain downslope movement of sediment), and traction currents (sediments entrained by streams or sheet flows).

**PLAN VIEW:** Also known as map view. Looking at a feature or area from directly above it.

**PLAYA LAKE – DRY LAKES:** A playa lake is formed when water from rain or other sources, like intersection with a water table, flows into a dry depression in the landscape, creating a pond or lake. If the total annual evaporation rate exceeds the total annual inflow, the depression will eventually become dry again, forming a playa. Salts originally dissolved in the water precipitate out and are left behind, gradually building up over time. A playa appears as a flat bed of clay, generally encrusted with precipitated salts. These evaporite minerals are a concentration of weathering products such as sodium carbonate, borax, and other salts. In deserts, a playa may be found in an area ringed by bajadas. Dry lakes are typically formed in semi-arid to arid regions of the world. The largest concentration of dry lakes (nearly 22,000) is in the southern High Plains of Texas and eastern New Mexico. Most dry lakes are small. However, Salar de Uyuni in Bolivia, near Potosí, the largest salt flat in the world, comprises 4,085 square miles (10,582 square km).[2] Also see Pluvial Lakes.

**PLIOCENE:** A measure of geologic time. In the geologic timescale, the Pliocene epoch extends from 5.3 to 2.58 Ma. It is the second and youngest epoch of the Neogene period in the Cenozoic Era. From youngest to oldest, the epochs in the Cenozoic Era are Holocene, Pleistocene, Pliocene, Miocene, Oligocene, Eocene, Paleocene. In the Mojave Desert, most formations are Pliocene or younger.

**PLEISTOCENE:** A measure of geologic time. In the geologic timescale, the Pleistocene epoch extends from 2.58 million to ~12,000 years before present. The Pleistocene includes the world's most recent period of repeated glaciations and is subdivided into *Early* (2.6 million to 781k years ago), *Middle* (781k to 126k years ago) and *Late* (126k to 12k years ago. This report refers to *Latest* Pleistocene, which began 50k to 60k years ago.

**PLUVIAL LAKES:** A **pluvial lake** is a landlocked basin (endorheic basin) that fills with rainwater during times of glaciation, when precipitation is higher.[1] Pluvial lakes that have since evaporated and dried out may also be referred to as paleolakes.[2]

**QUATERNARY:** A measure of geologic time. The present day is part of the Quaternary period of the Cenozoic Era. The Quaternary began about 2.588 million years ago (Ma) and is divided into two epochs: the Pleistocene and the Holocene. The end of the Pleistocene is considered to occur at 11.7 Ma. The Quaternary continues to this day.

**RELICT AEOLIAN (EOLIAN) LANDFORMS**: Relict aeolian landforms are those that are clearly a product of past climatic regimes or depositional environments and have been stabilitzed for a period of at least 1000 years. They include dunes and sand sheets that are stabilized by soil development (including calcic horizons, early stages of diagenesis (partial cementation), deflation lag surfaces, colluvial cover, and woodland vegetation. Relict features may revert to an active state only as a result of major environmental changes. This definition is from Lancaster, 1992. Within Kenney GeoScience reports, the term "relict dunes" is utilized to represent an eolian system that exhibits older dunes that during their development required more eolian sand migration than is currently taking place. In these areas, active sand in the form of sand sheets and coppice dunes that require minor magnitudes of eolian sand are transported over the older dune system. In addition, areas mapped by Kenney GeoScience as dormant or relict dunes also exhibit internal abrasion providing an internal source of eolian sand. The Lancaster, 1992 relict dune definition is reasonable for dunes that developed during interglacial period prior to the Holocene interglacial as it takes tens of thousands of years for well developed calcic soil horizons to developed. However, it is a useful definition for quite ancient relict dune systems.

**RUBIFICATION**: Rubification refers to a substance becoming more reddish in color. For the purposes of eolian geomorphic and stratigraphic reports, the term rubification is utized as a soil profile term where reddening under surficial clasts increase over time which assists in estimating a surficial soils minimum age.

**SAND SHEETS (SAND PLAINS):** Flat, or gently undulatory, broad floors of windblown sand deposits that lie in thin layers that are gently inclined or horizontal. Sand sheets have fine grained material separated by layers – only one grain thick! - of coarser, "wind lag" particles. The latter are the coarsest particles that can be shifted by the wind. In any one place, the sizes of the wind lag particles are remarkably uniform, and may be so closely packed that the layer forms a miniature desert pavement. Sand sheets give information about the strength of the winds. Inactive sand sheet deposits provide evidence of past wind sand migration corridors.

**SALTATION:** The movement of loose, hard particles in a turbulent flow of wind or water over an uneven surface. Examples include pebbles in rivers, sand drift over deserts, and soil blowing over prairies.

**SAND RIDGE:** see Linear Dunes.

**SEDIMENT: Sediment** is a naturally occurring material that is broken down by processes of weathering and erosion, and is subsequently transported by the action of wind, water, or ice, and/or by the force of gravity acting on the particles. For example, sand and silt can be carried in suspension in river water and on reaching the sea be deposited by sedimentation and if buried this may eventually become sandstone and siltstone, ( sedimentary rocks). Sediments are most often transported by water (fluvial processes), but also wind (aeolian processes) and glaciers. Beach sands and river channel deposits are examples of fluvial transport and deposition, though sediment also often settles out of slow-moving or standing water in lakes and oceans. Desert sand dunes and loess are examples of aeolian transport and deposition. Glacialmoraine deposits and till are ice-transported sediments.

**SEIF**: see Linear Dunes.

**SMALL SCALE MAP:** Small scale maps show a larger amount of area with less amount of detail. The geographic extent shown on small scale maps is relatively larger than for large scale maps. A small scaled map expressed as a representative scale would have a larger number to the right of the ratio compared to large scale maps. Also see large scale map.

**SOIL PROFILE:** The **soil profile** is a vertical section of the **soil** that depicts all of its horizons**.** A **soil** horizon makes up a distinct layer of **soil**. The horizon runs roughly parallel to the **soil** surface and has different properties and characteristics than the adjacent layers above and below.

**STABILIZED DUNES:** Sand dunes that are unable to migrate due to vegetation growth on the dune. Stabilized dunes often develop due to limited eolian sand input. However, some dunes evaluated by the author appear to be stabilized not by vegetation, but by moisture. (The moisture may come from underlying springs, precipitation on the dunes that penetrates into the dune, or storm runoff that seeps into the dune mass. This process is poorly studied, although critical to the stability of dunes.) Within this study, stabilized dunes dominate dune areas mapped as Qsad and Qsr. Also referred to as vegetated dunes.

**STOSS SIDE OF A DUNE:** The stoss side of a dune points in the direction of the dominant wind, responsible for the primary dune form. The stoss side lies between the toe and the crest of the dune, on the upwind side (opposite of the lee side, which is downwind).

**TOPOGRAHIC**: relating to topography.

**TOPOGRAPHY:** The arrangement of the physical features of an area. For example, the location and elevations of valleys and mountains are part of an area's topography.

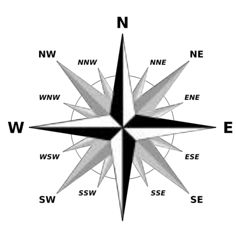
**TRIBUTARY DRAINAGE SYSTEM:** A **tributary**[1] or **affluent**[2] is a stream or river that flows into a larger stream or main stem (or parent) river or a lake.[3] A tributary does not flow directly into a sea or ocean.[4] Tributaries and the main stem river drain the surrounding drainage basin of its surface water and groundwater, leading the water out into an ocean. A confluence, where two or more bodies of water meet together, usually refers to the joining of tributaries. The opposite to a tributary is a distributary, a river or stream that branches off from and flows away from the main stream.[5] Distributaries are most often found in river deltas.

**VEGETATION MOUND:** A large Coppice Dune.

**VENTIFACTS:** Rocks that have been abraded, pitted, etched, grooved, or polished by wind-driven sand. Ventifacts typically occur on gravel-size rocks exposed to sand-bearing wind. Ventifacts are identified by rounded edges and a soft feel on the gravel side exposed to the atmosphere. Ventifacts provide information regarding the prevailing wind direction.

**WIND DIRECTIONS:** Meteorologists always define the wind direction as the direction the wind is coming from. If you stand so that the wind is blowing directly into your face, the direction you are facing names the wind.

**WINDROSE DIRECTIONS FOR WIND AND SAND MIGRATION DIRECTIONS:** The windrose figure below provides the direction nomenclature for the direction wind is moving, and within this report, the direction eolian sands are migrating. The wind direction is described by the direction the wind is coming from, and for eolian sand migration, it's the direction that the sand is toward. Hence, for sand migration moving ESE, the sand is moving from the WNW toward the ESE.



# APPENDIX C

## SAND MIGRATION ZONE DESIGNATION PHOTOGRAPHS

# APPENDIX C

## PHOTOGRAPHS OF DESIGNATED GEOMORPHIC RELAVITVE SAND MIGRATION ZONES

Photograph of geomorphic sites across the site to provide documentation of the geomorphic characteristics of the various sand migration zones within the property, but also to document the dune conditions at a particular time. The photographs also provide evidence of a Sahara Mustard bloom exhibiting abundant dead plants months after had grown and died.

***PHOTOGRAPH LOCATIONS***

**Figure AC-1:** Location map for selected Geomorphic Sites in which photographs of typical geomorphic sand migrations zones are provided as following figures.

***ZONE AB PHOTOGRAPHS – Relatively strong sand migration***

**Figure AC-2:** Photographs of Geomorphic Sand Migration Zone AB of Site 9.

***ZONE B PHOTOGRAPHS***

**Figure AC-3-1:** Photographs of Geomorphic Sand Migration Zone B of Site 39.
**Figure AC-3-2:** Photographs of Geomorphic Sand Migration Zone B of Site 317.
**Figure AC-3-3:** Photographs of Geomorphic Sand Migration Zone B of Site 56.

***ZONE BW PHOTOGRAPHS***

**Figure AC-4-1:** Photographs of Geomorphic Sand Migration Zone BW of Site 61.
**Figure AC-4-2:** Photographs of Geomorphic Sand Migration Zone BW of Site 141 and 200.
**Figure AC-4-3:** Photographs of Geomorphic Sand Migration Zone BW of Site 364.

***ZONE BC PHOTOGRAPHS***

**Figure AC-5-1:** Photographs of Geomorphic Sand Migration Zone BC of Site 211.
**Figure AC-5-2:** Photographs of Geomorphic Sand Migration Zone BC of Site 262.
**Figure AC-5-3:** Photographs of Geomorphic Sand Migration Zone BC of Site 65.

***ZONE C AND ZONE C TO ZONE D PHOTOGRAPHS***

**Figure AC-6-1:** Photographs of Geomorphic Sand Migration Zone C of Site 18.
**Figure AC-6-2:** Photographs of Geomorphic Sand Migration Zone C of Site 155.
**Figure AC-6-3:** Photographs of Geomorphic Sand Migration Zone C of Site 219.
**Figure AC-6-4:** Photographs of Geomorphic Sand Migration Zone C of Site 90.

**Figure AC-6-5:** Photographs of Geomorphic Sand Migration Zone C to Zone D of Site 295.
**Figure AC-6-6:** Photographs of Geomorphic Sand Migration Zone C to Zone D of Site 389.
**Figure AC-6-7:** Photographs of Geomorphic Sand Migration Zone C to Zone D of Site 298.
**Figure AC-6-8:** Photographs of Geomorphic Sand Migration Zone C to Zone D of Site 304.

***ZONE D PHOTOGRAPHS – Very weak sand migration***

**Figure AC-7:** Photographs of Geomorphic Sand Migration Zone D of Site 294.

**Figure AC-1:** Location map for selected Geomorphic Sites in which photographs of typical geomorphic sand migrations zones are provided as following figures. The property boundary show (blue line) is for an older proposed location for a fence line.

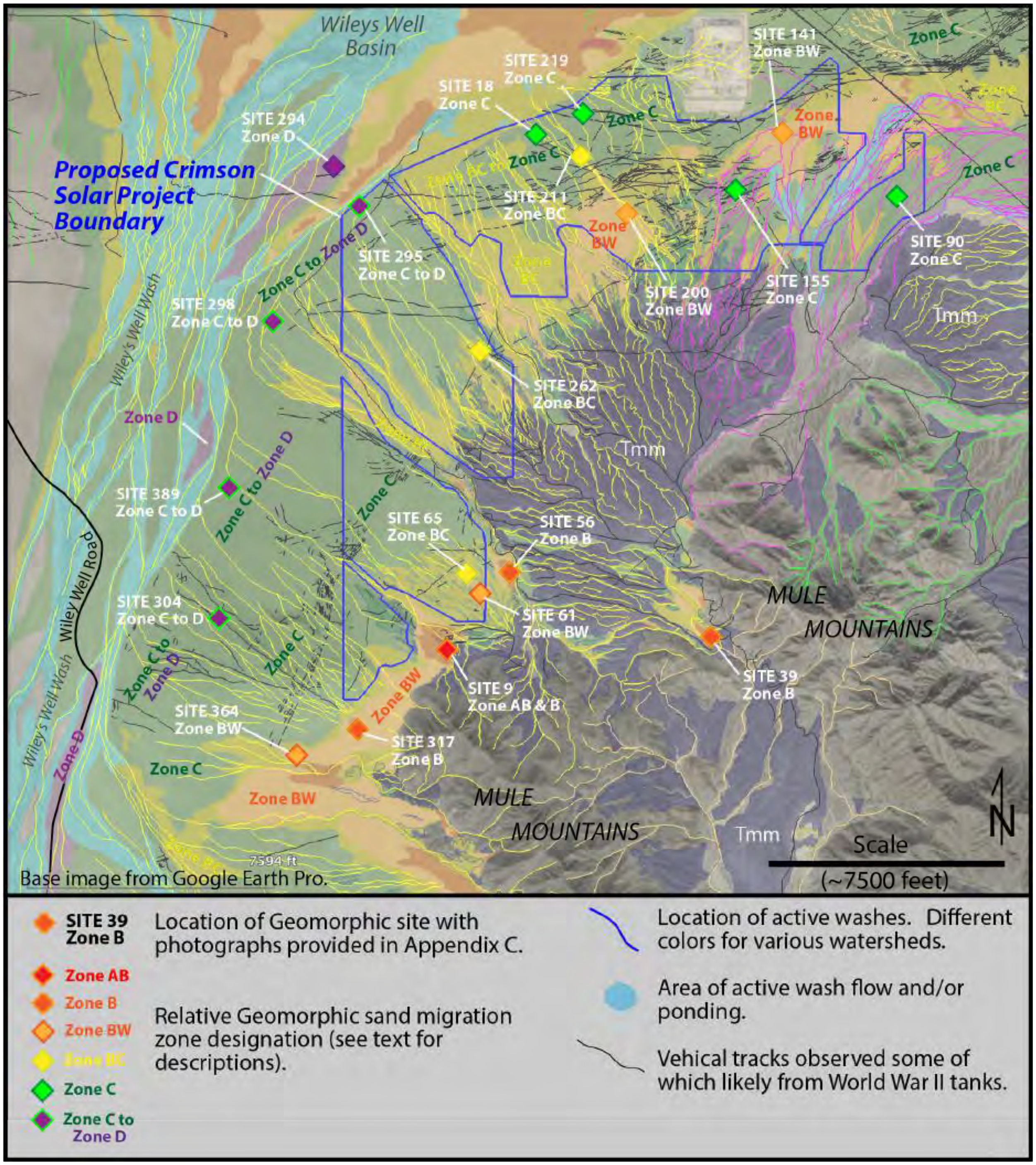


**Figure AC-2:** Photographs of Geomorphic Sand Migration Zone AB of Site 9.

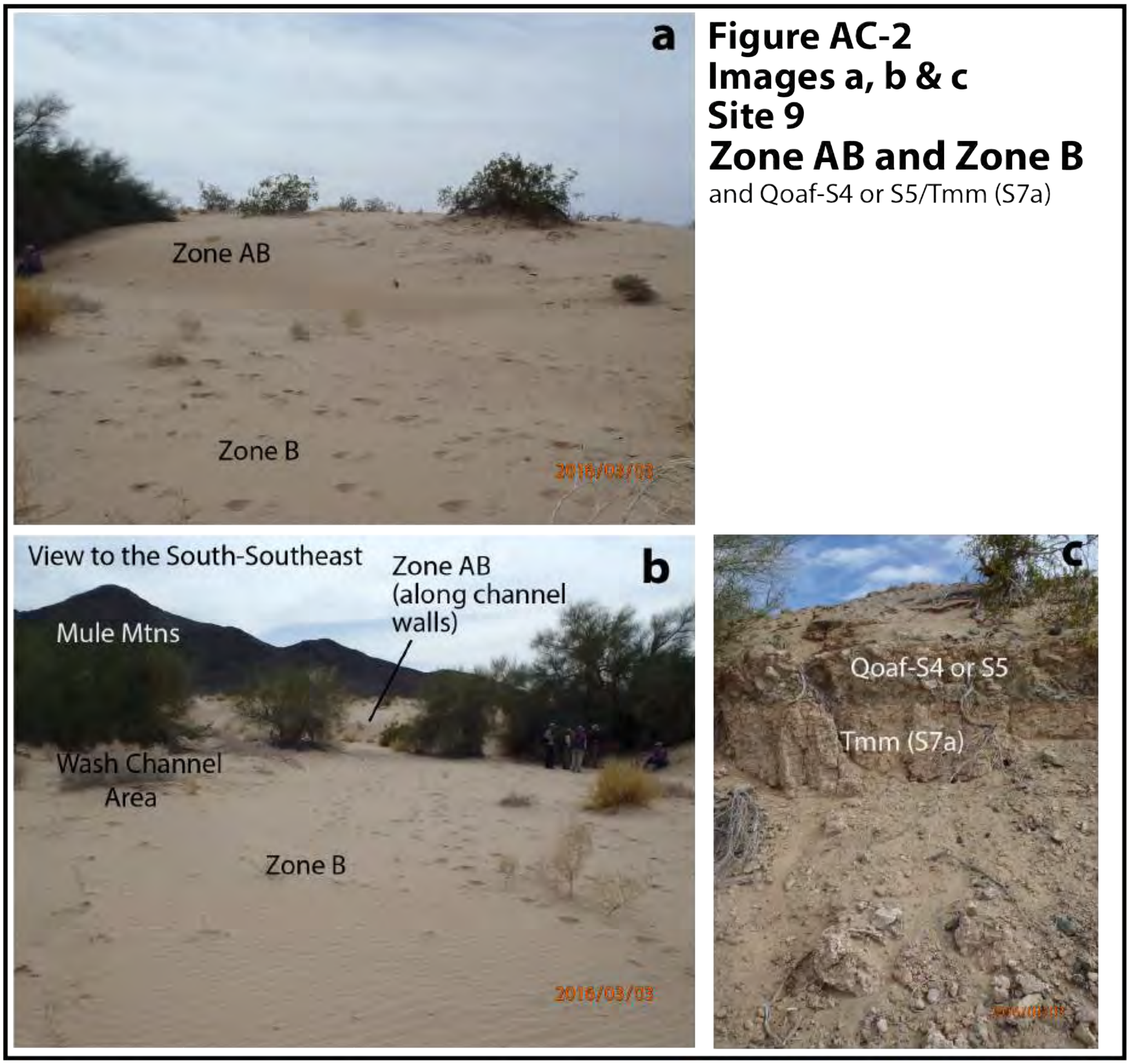


**Figure AC-3-1:** Photographs of Geomorphic Sand Migration Zone B of Site 39.

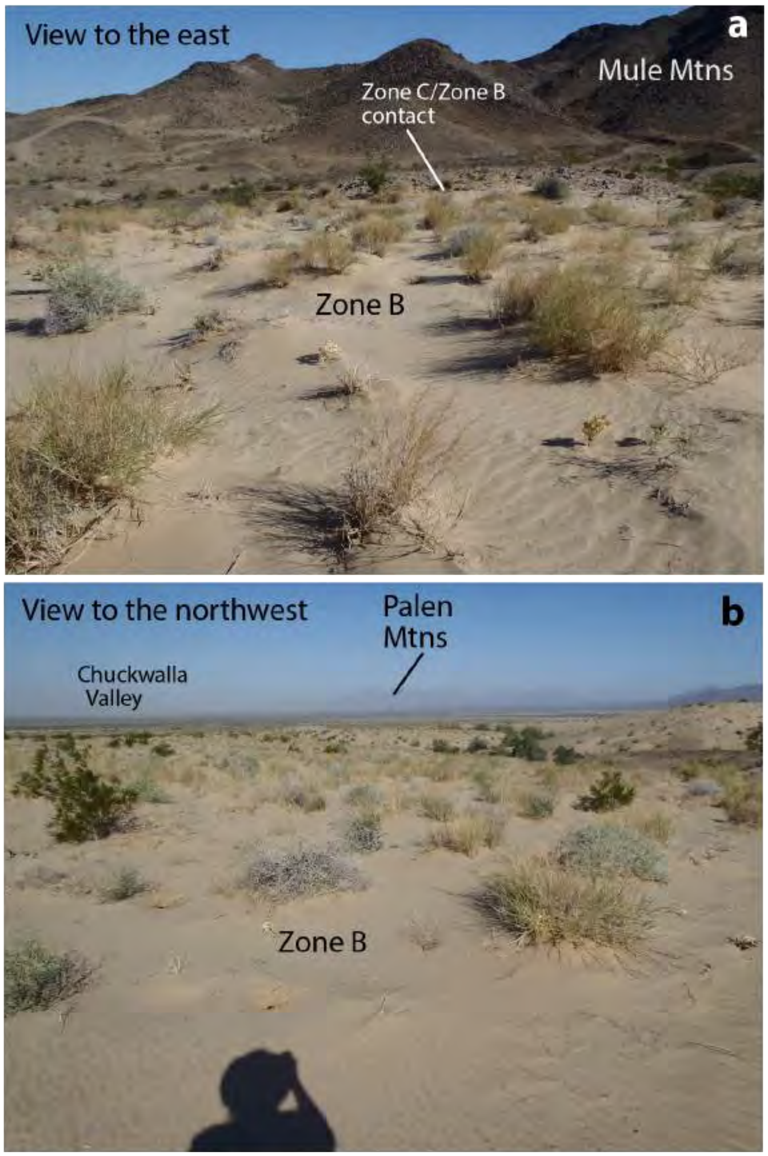



**Figure AC-3-1**
**Images a and b**
**Site 39**
**Zone B**

**Figure AC-3-2:** Photographs of Geomorphic Sand Migration Zone B of Site 317.

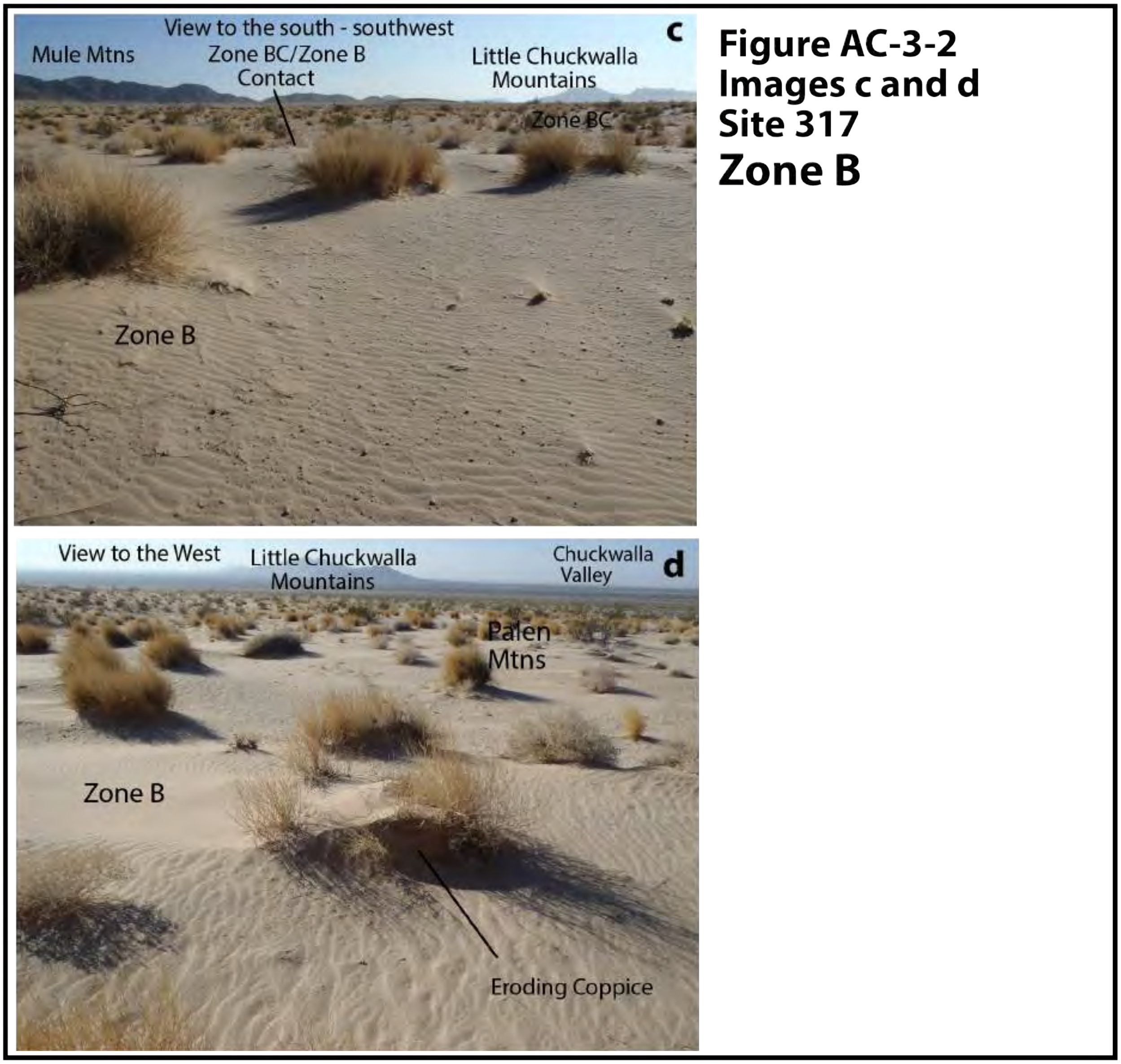


**Figure AC-3-3:** Photographs of Geomorphic Sand Migration Zone B of Site 56.


**Figure AC-3-3**
**Image e and f**
**Site 56**
**Zone B**

**Figure AC-4-1:** Photographs of Geomorphic Sand Migration Zone BW of Site 61.

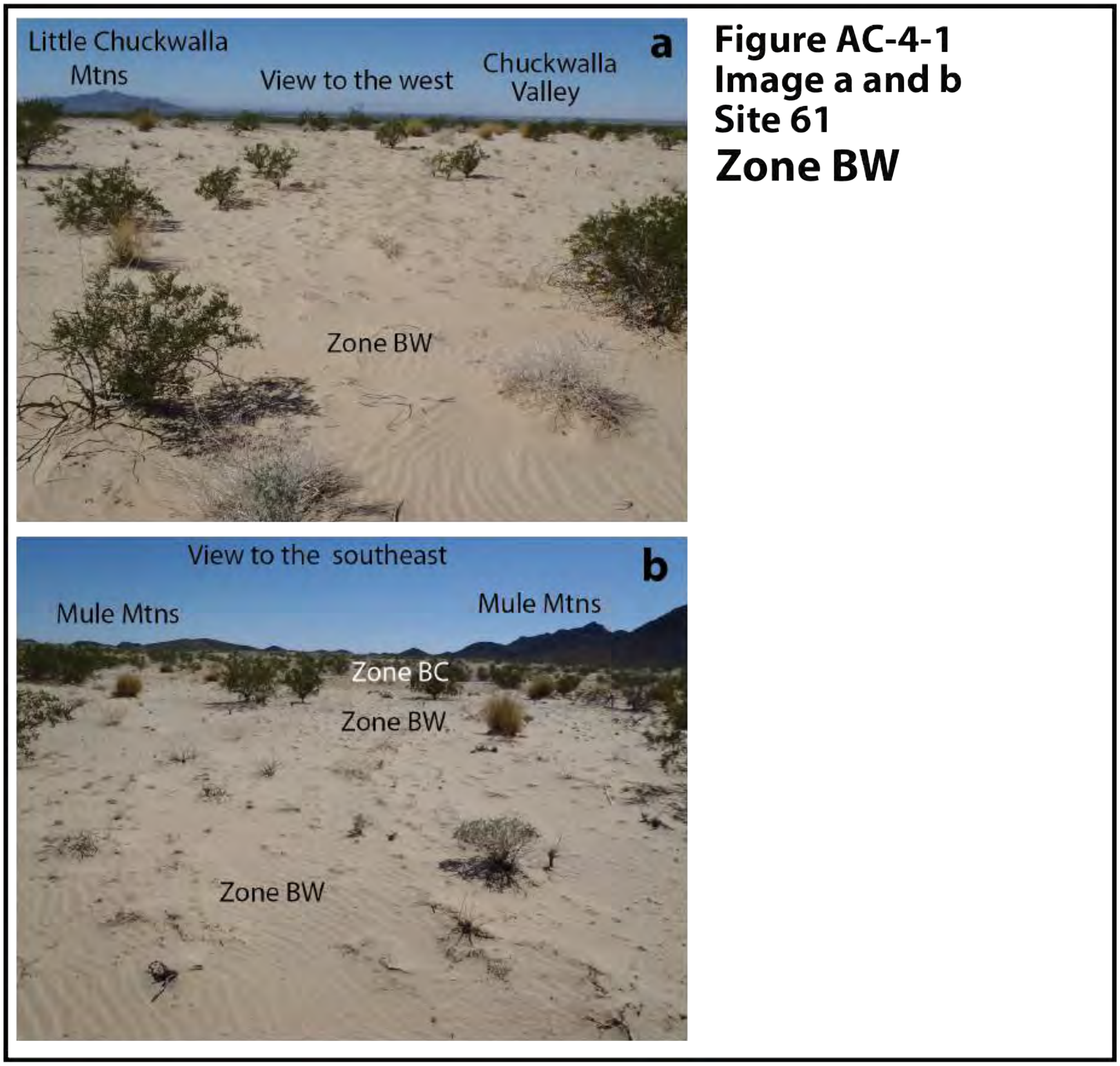


**Figure AC-4-2:** Photographs of Geomorphic Sand Migration Zone BW of Sites 141 and 200.

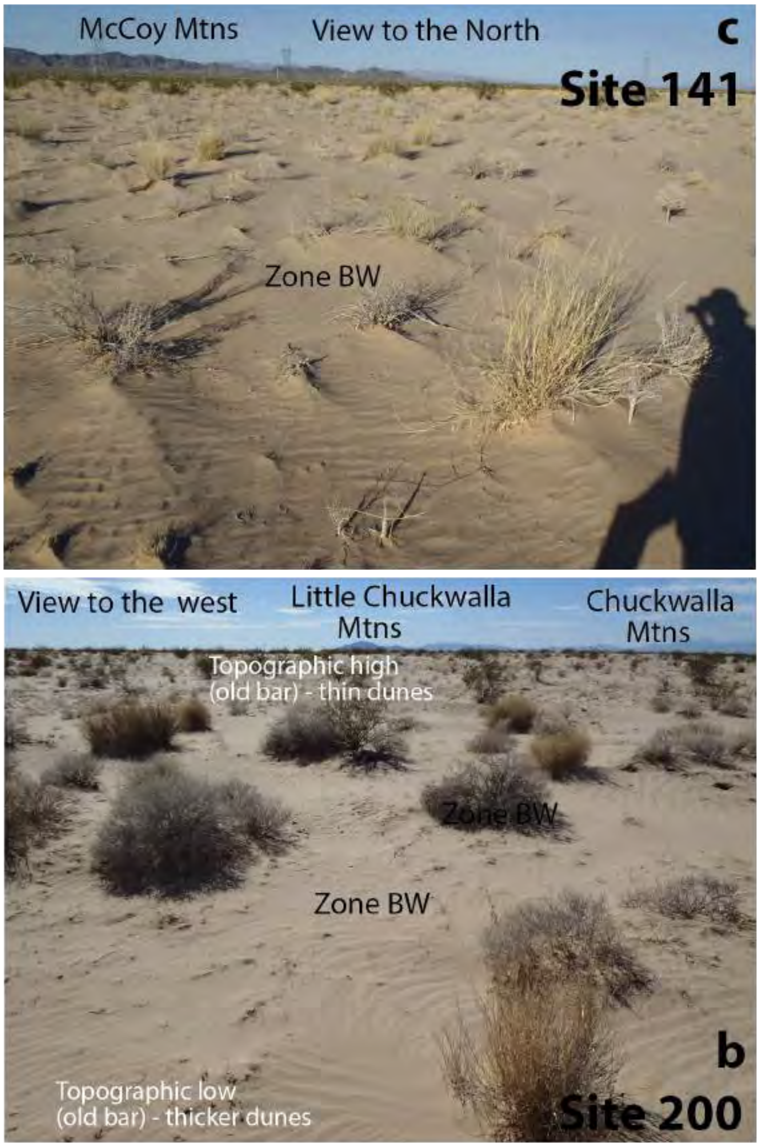



**Figure AC-4-2**
**Image c and d**
**Sites 141 and 200**
**Zone BW**

**Figure AC-4-3:** Photographs of Geomorphic Sand Migration Zone BW of Site 364.


**Figure AC-4-3**
**Image e and f**
**Site 364**
**Zone BW**

**Figure AC-5-1:** Photographs of Geomorphic Sand Migration Zone BC of Site 211.

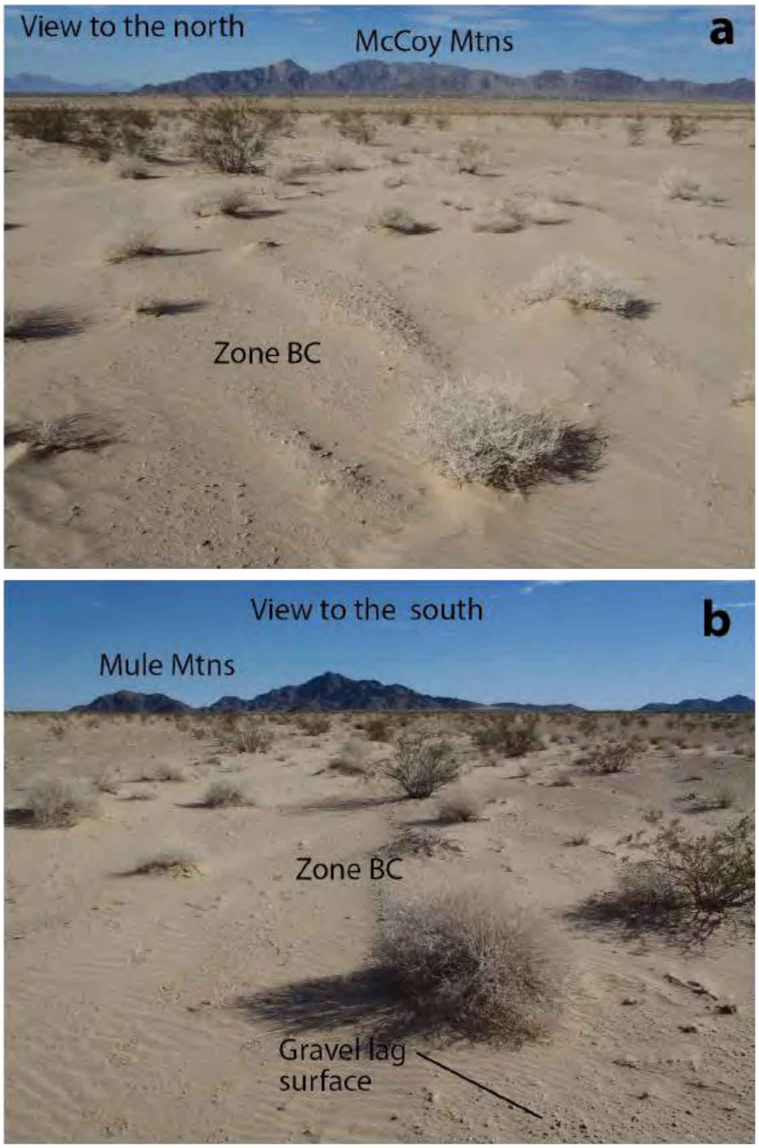



Figure AC-5-1
Images a and b
Site 211
Zone BC

**Figure AC-5-2:** Photographs of Geomorphic Sand Migration Zone BC of Site 262.

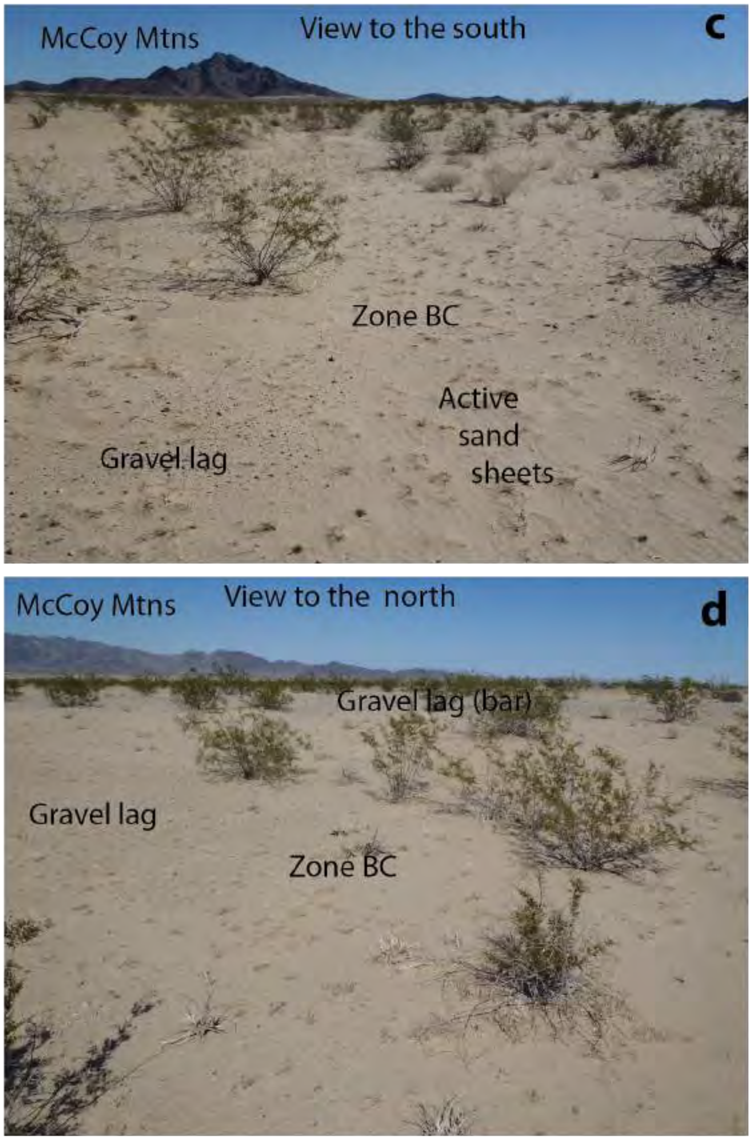



**Figure AC-5-2**
**Images c and d**
**Site 262**
**Zone BC**

**Figure AC-5-3:** Photographs of Geomorphic Sand Migration Zone BC of Site 65.

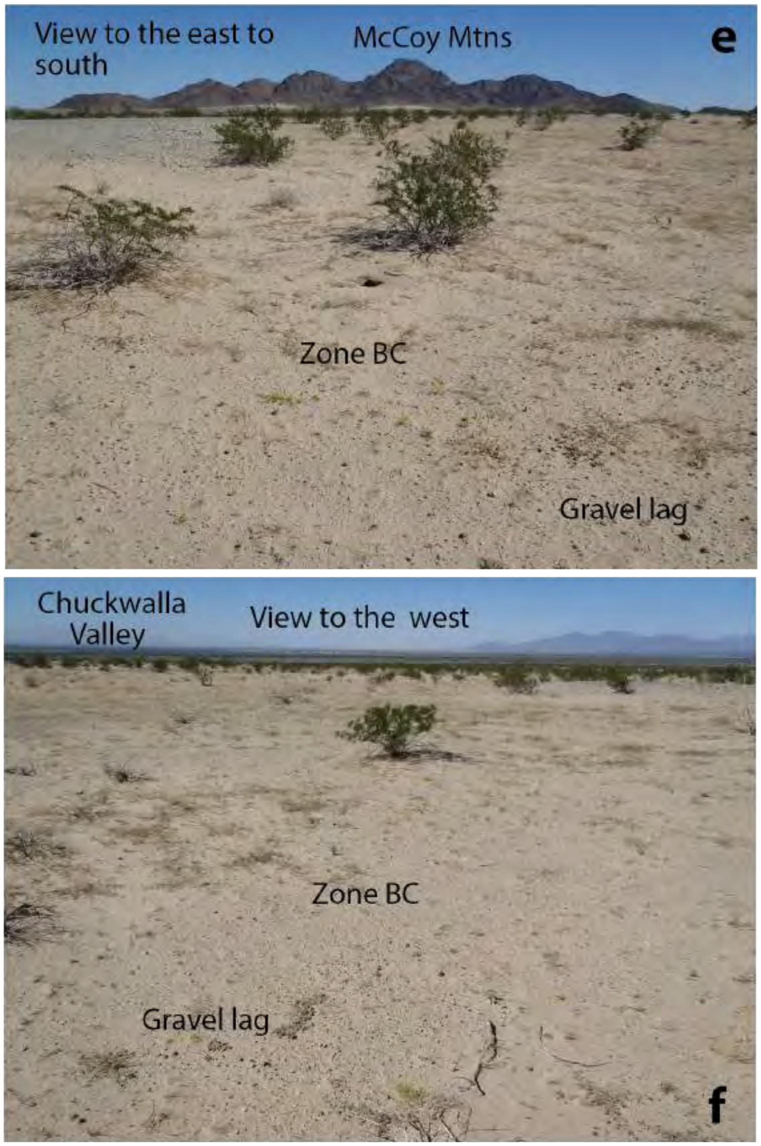



**Figure AC-5-3**
**Images e and f**
**Site 65**
**Zone BC**

**Figure AC-6-1:** Photographs of Geomorphic Sand Migration Zone C of Site 18.

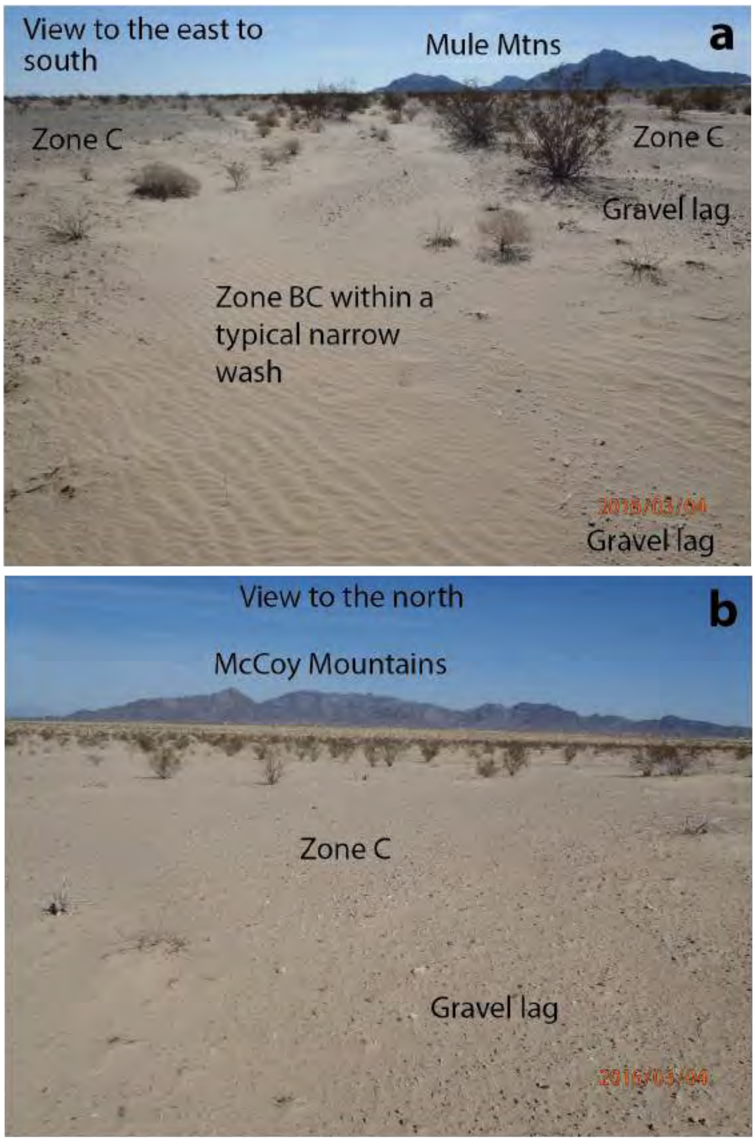



**Figure AC-6-1**
**Images a and b**
**Site 18**
**Zone C**

**Figure AC-6-2:** Photographs of Geomorphic Sand Migration Zone C of Site 155.

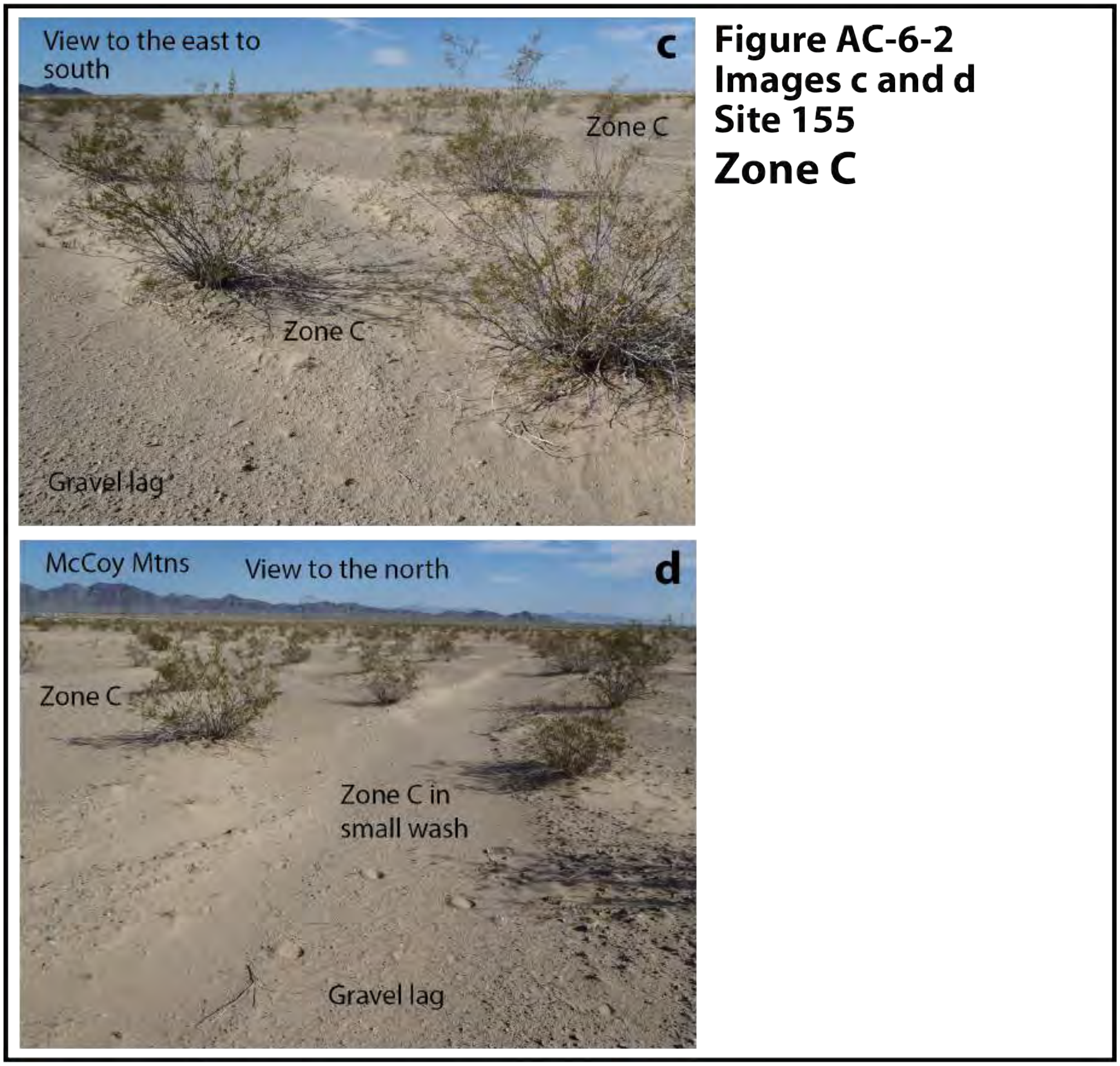


**Figure AC-6-3:** Photographs of Geomorphic Sand Migration Zone C of Site 219.

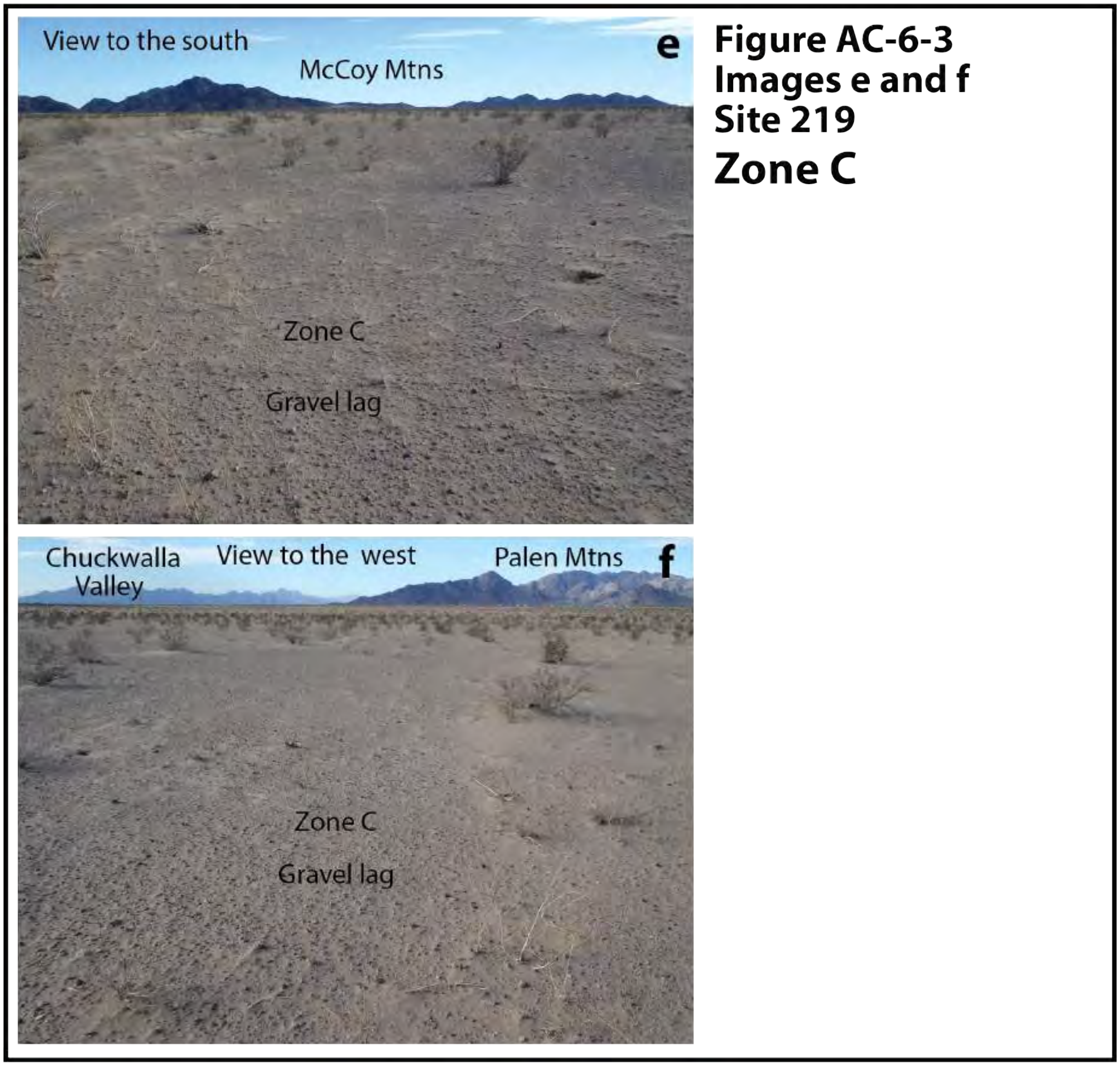


**Figure AC-6-4:** Photographs of Geomorphic Sand Migration Zone C of Site 90.

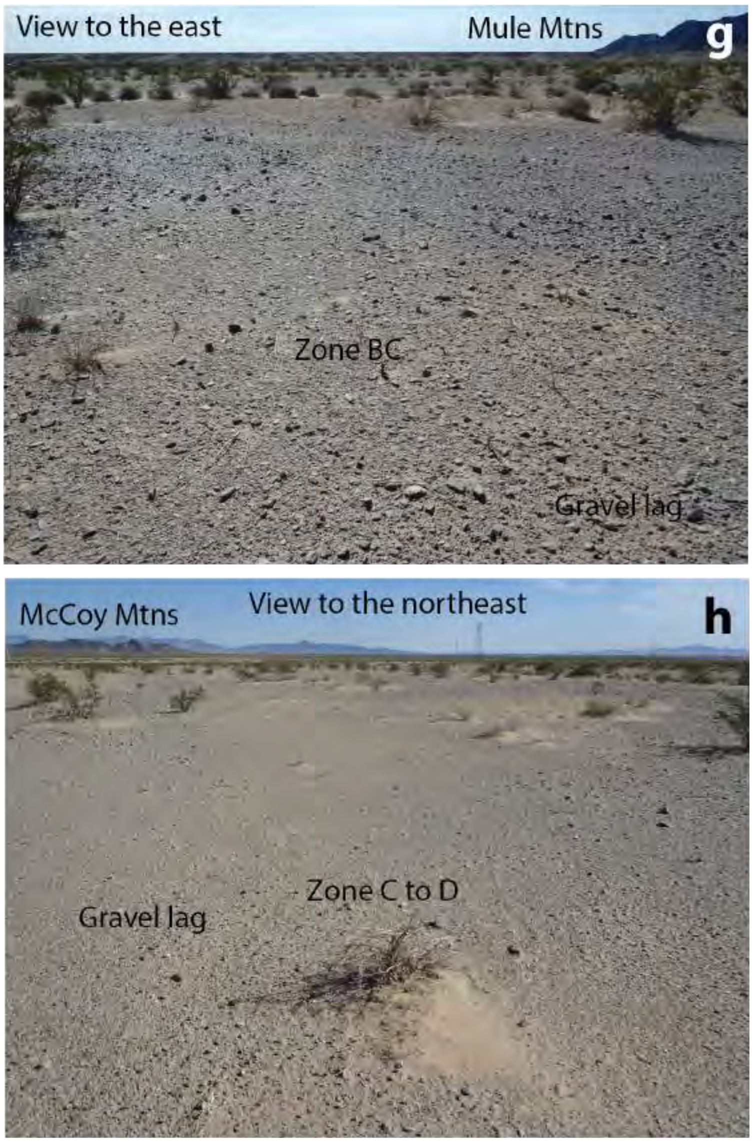
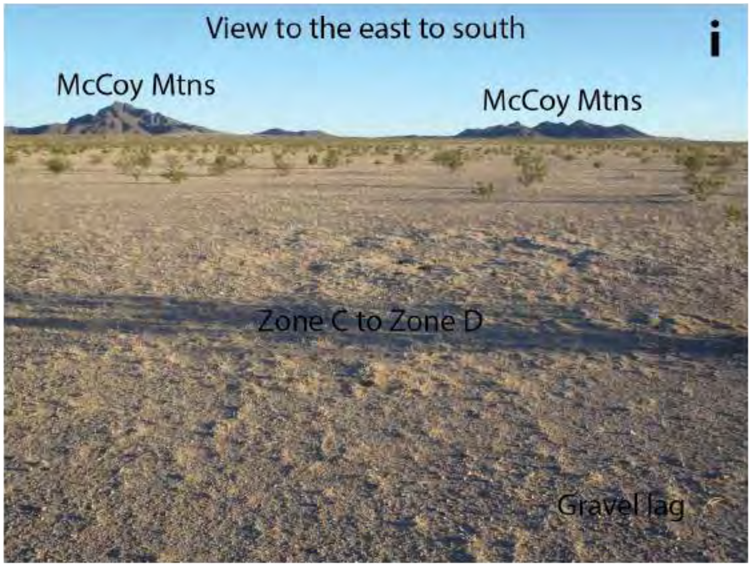



**Figure AC-6-4**
**Images g and h**
**Site 90**
**Zone C**

**Figure AC-6-5:** Photographs of Geomorphic Sand Migration Zone C to Zone D of Site 295.



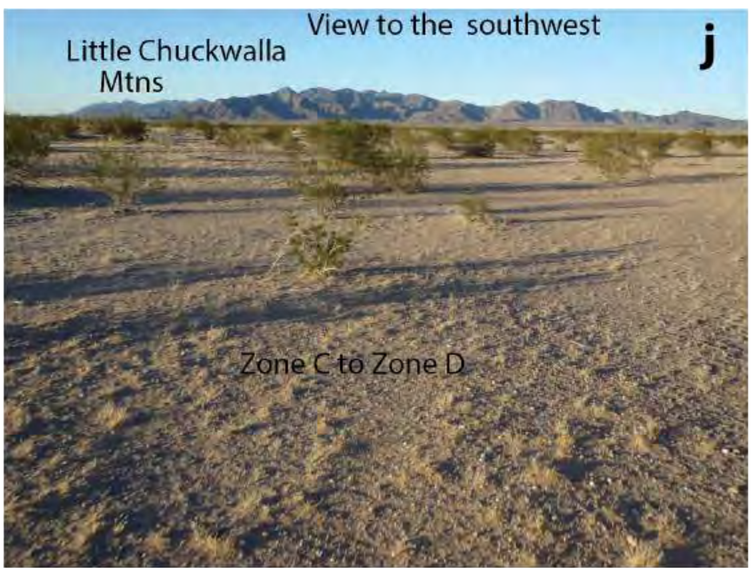




**Figure AC-6-5**
**Images i and j**
**Site 295**
**Zone C to Zone D**

**Figure AC-6-6:** Photographs of Geomorphic Sand Migration Zone C to Zone D of Site 389.

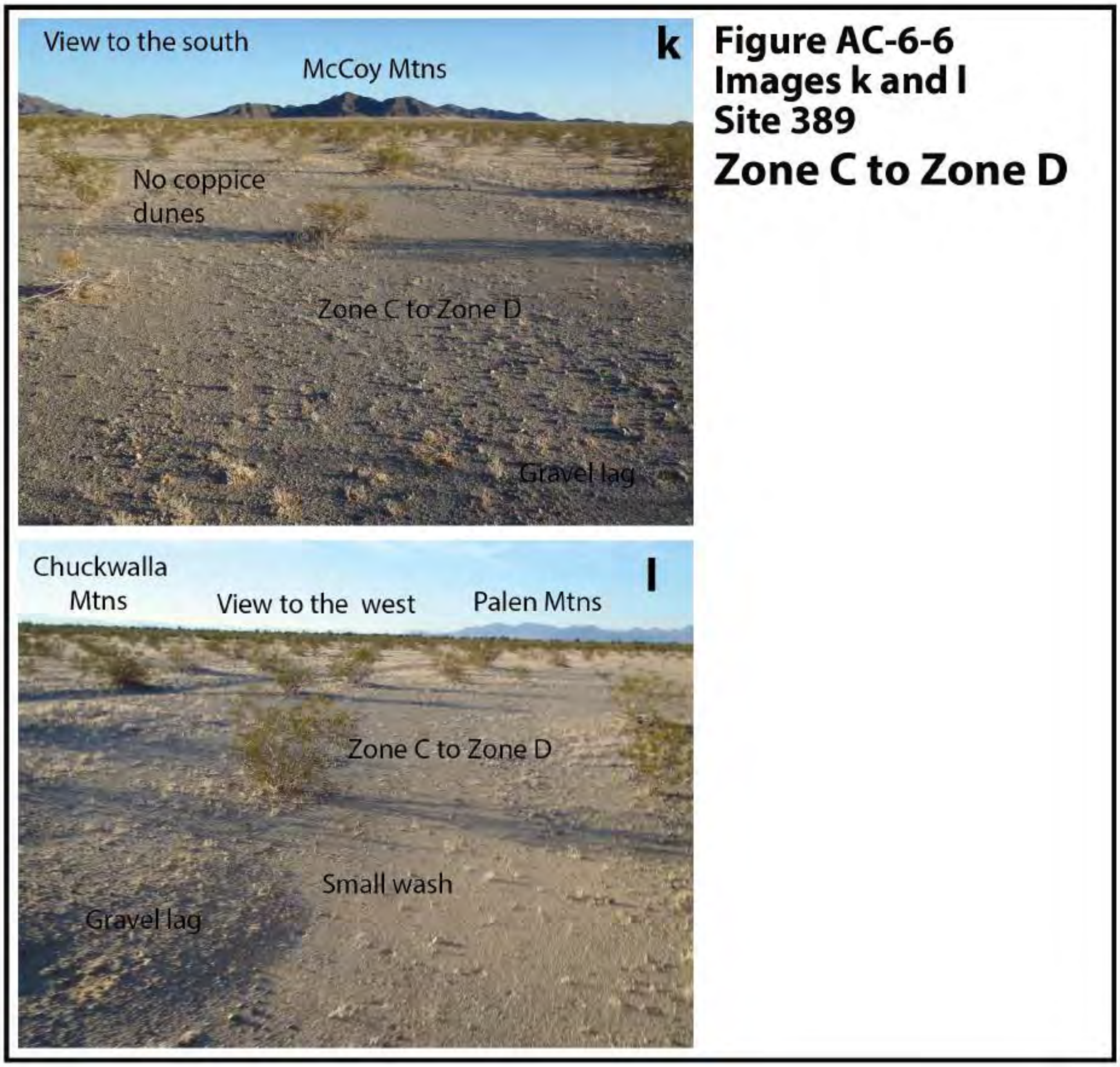


**Figure AC-6-7:** Photographs of Geomorphic Sand Migration Zone C to Zone D of Site 298.

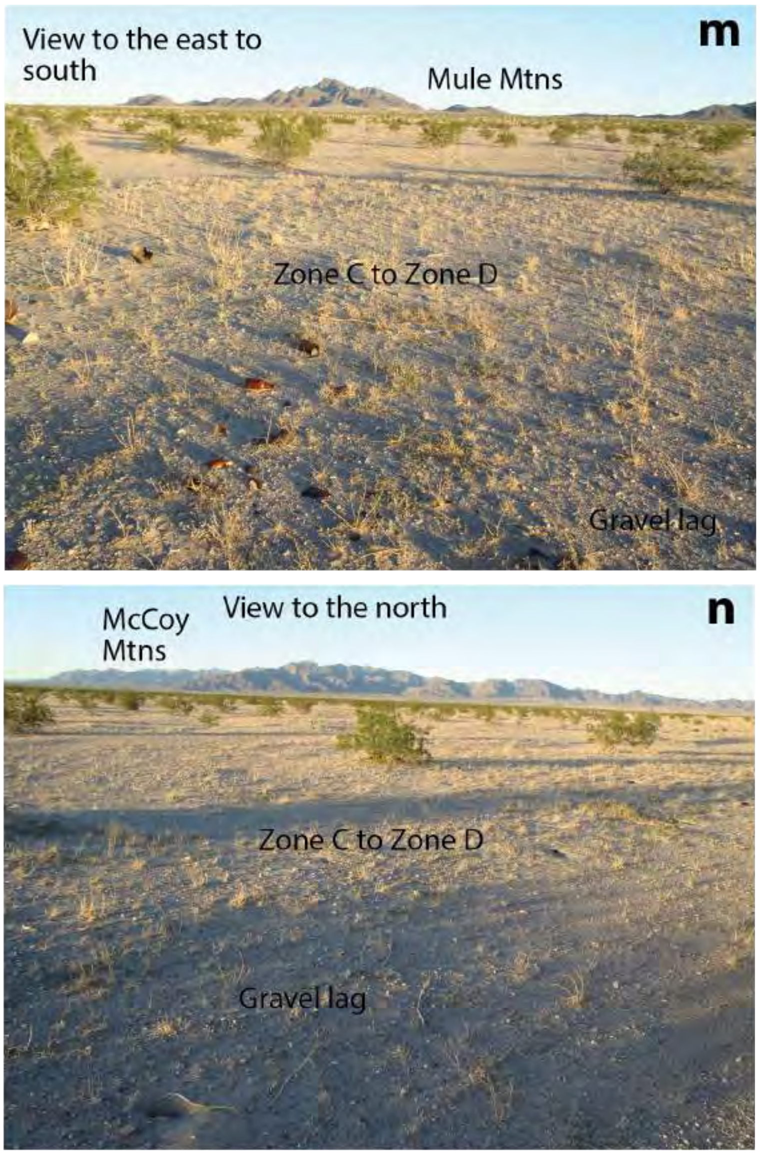



**Figure AC-6-7**
**Images m and n**
**Site 298**
**Zone C to Zone D**

**Figure AC-6-8:** Photographs of Geomorphic Sand Migration Zone C to Zone D of Site 304.

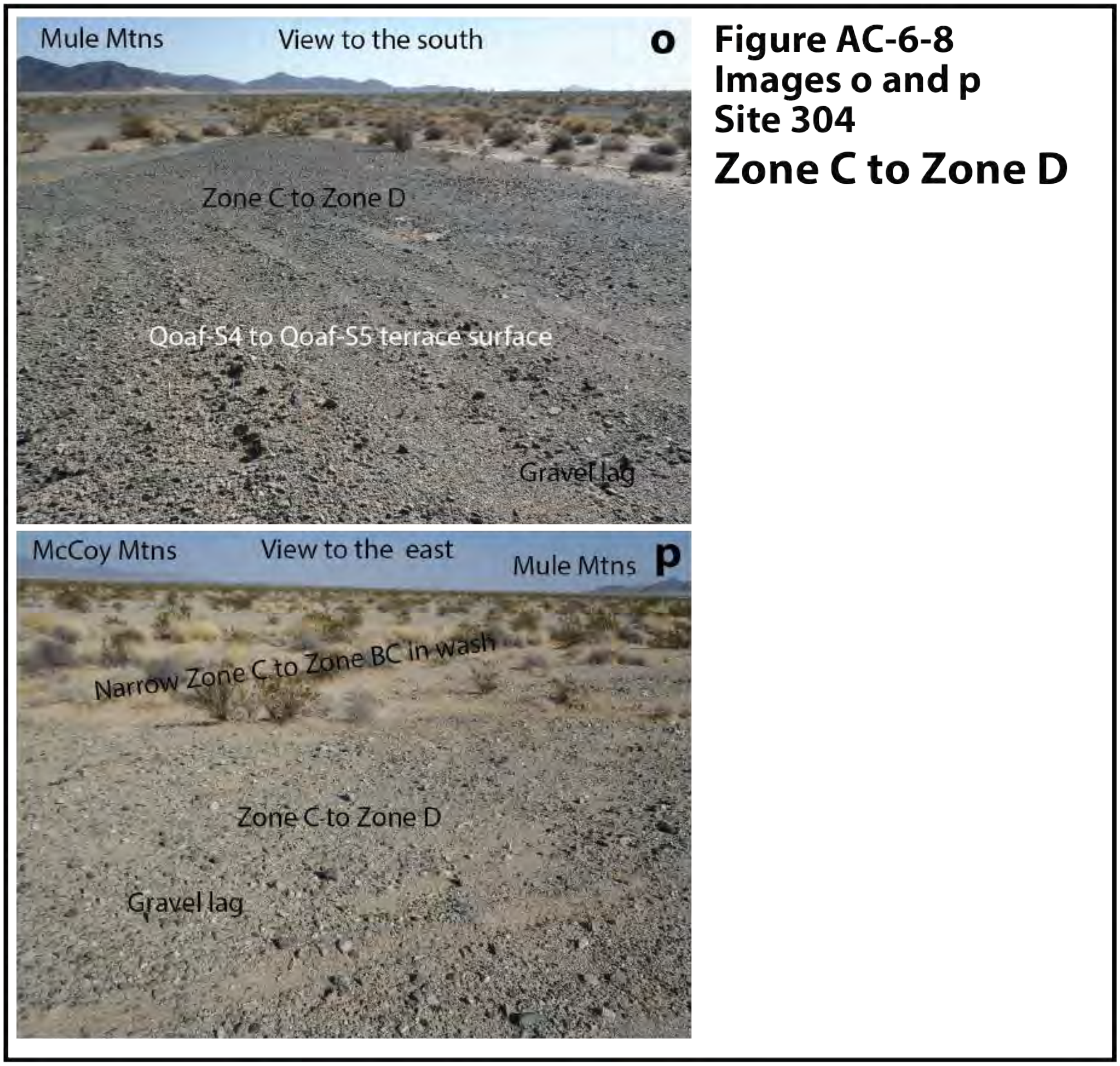
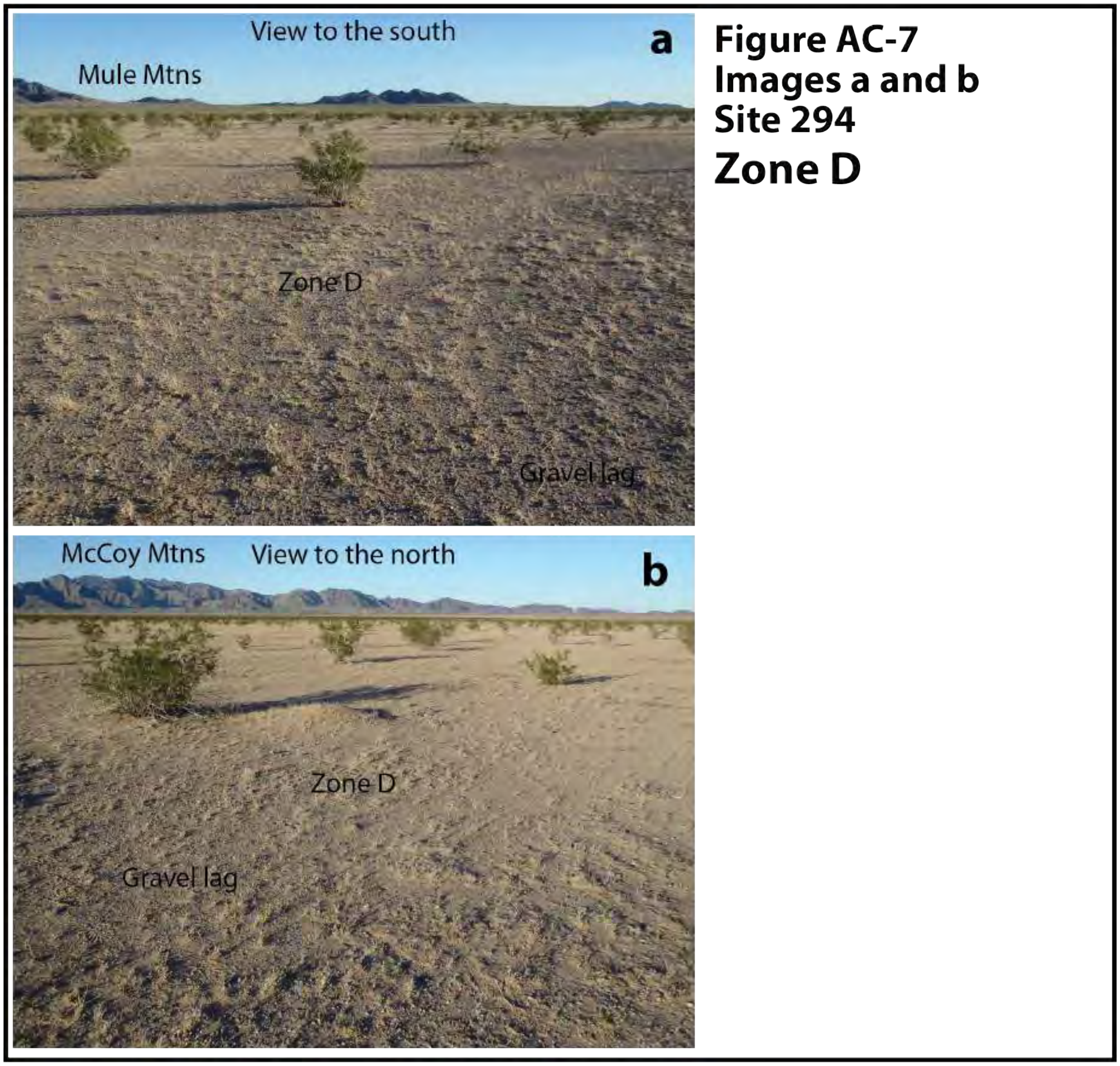


**Figure AC-7:** Photographs of Geomorphic Sand Migration Zone D of Site 294.



# APPENDIX D

## PHOTOGRAPHS OF SOIL TEST PITS & EXPOSURES – LOCAL SOIL STRATIGRAPHY

# APPENDIX D

## PHOTOGRAPHS OF SOIL TEST PITS & EXPOSURES - LOCAL SOIL STRATIGRAPHY

Photographs of various soils of the designated soil stratigraphy utilized in this study. The photographs are organized by providing eolian parent material soils first, then alluvial parent soils second and in increasing age.

Soil stratigraphy nomenclature example: Qe-S2/Qal-S3a/Qoaf-S4 describes a surface soil with eolian parent material of S2 development (age of 5 to 3 kya), overlying a soil with alluvial parent material soil of S3a development (8 to 5 kya), that overlies the deepest soil with older alluvium parent material of S4 development (age of ~35 to 65 kya).

**FIGURE LIST:**

**Figure AD-1:** Location map for selected Geomorphic Sites in which photographs of the test pits with soil stratigraphy evaluated. Base map shows areas of alluvial deposition (Qal, Qoaf and Tmm, and eolian dominated depositional that include early to mid-Holocene relict dune areas (Qe) and Sand Migration Zones AB, B, and BW. Property boundary shown is for an outdated proposed fenceline.

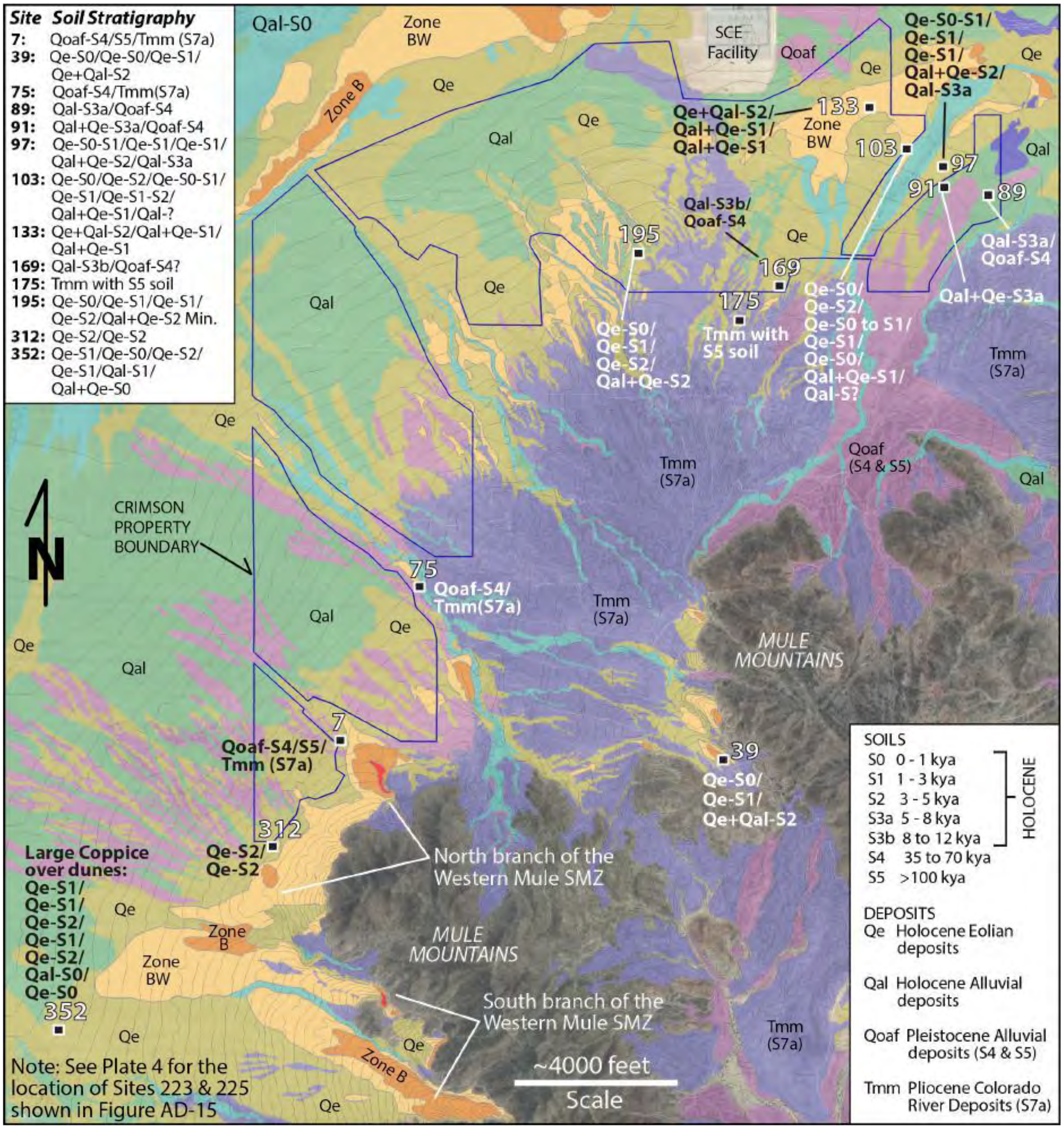
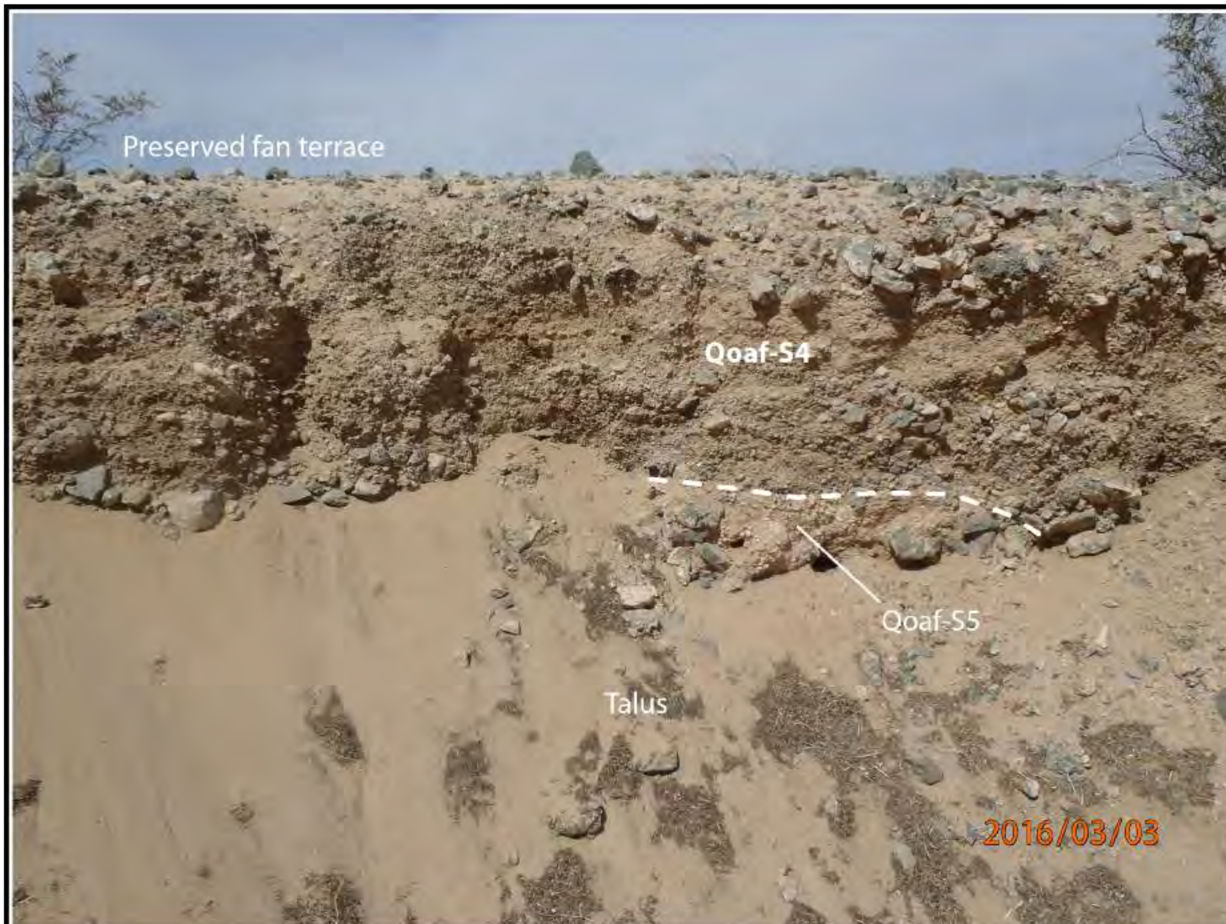


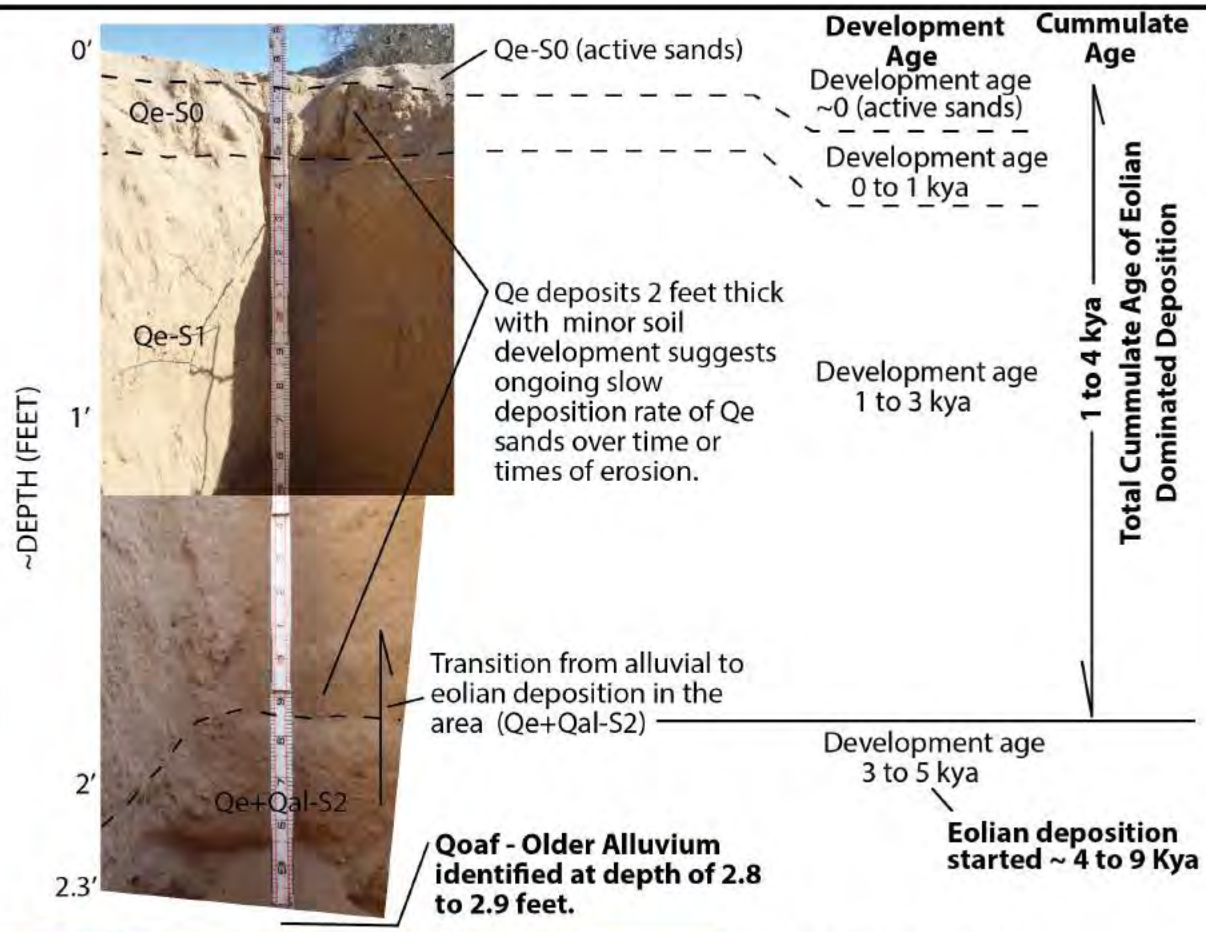
**Figure AD-2:** Geomorphic Site 7 Soil Stratigraphy: Qoaf-S4/S5/Tmm (S7a)





**Site 7**
**Location:**
**33 31.943 114 50.898**
**Photo date: 2016.03.03**

**Figure AD-3:** Geomorphic Site 39 Soil Stratigraphy: Qe-S0/Qe-S0/Qe-S1/Qe+Qal-S2

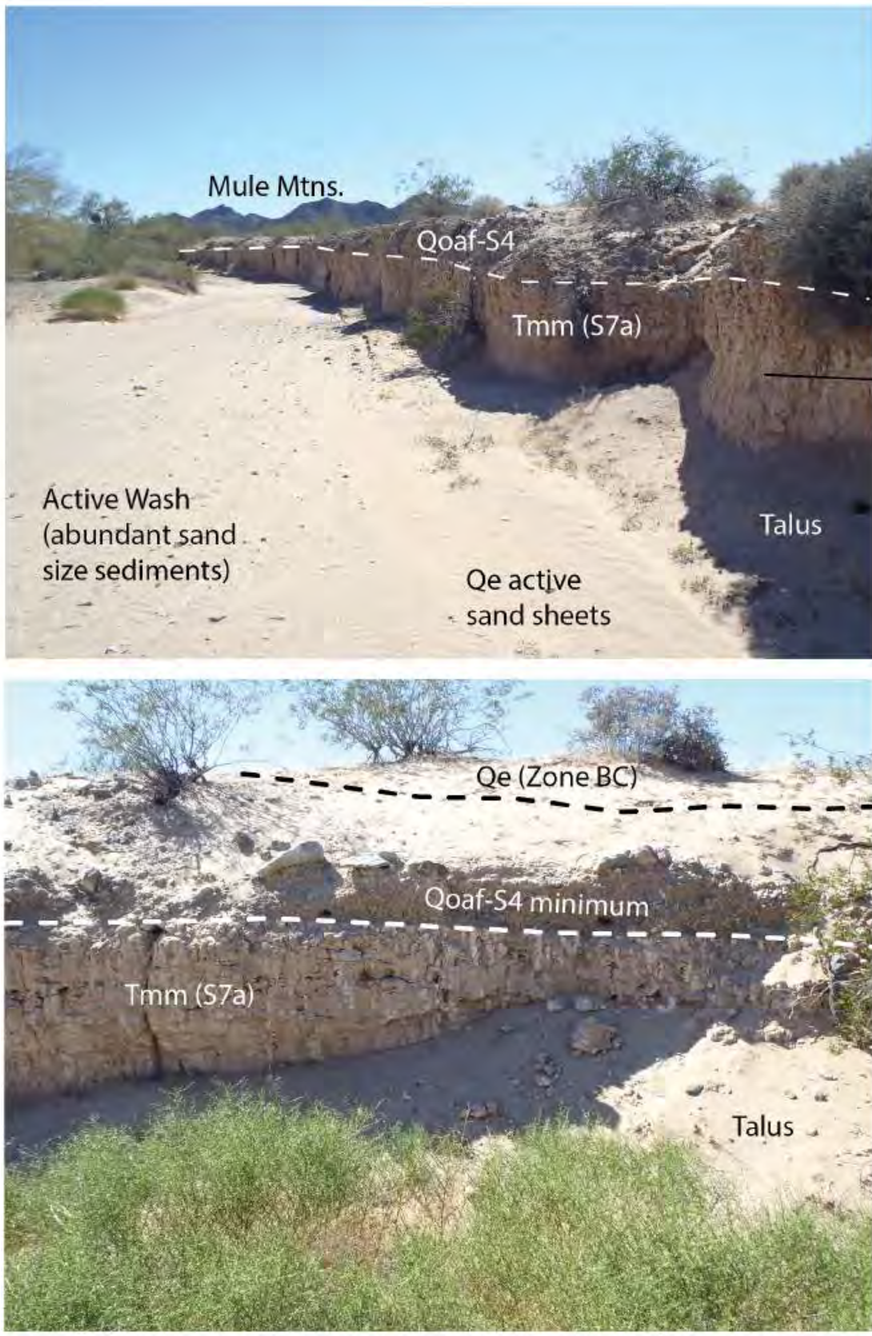




Central Mule Mountains Sand Migration Zone (sand ramp system).

**Site 39**
**Location:**
**33 31.874 114 49.079**
**Photo date: 2017.10.09**

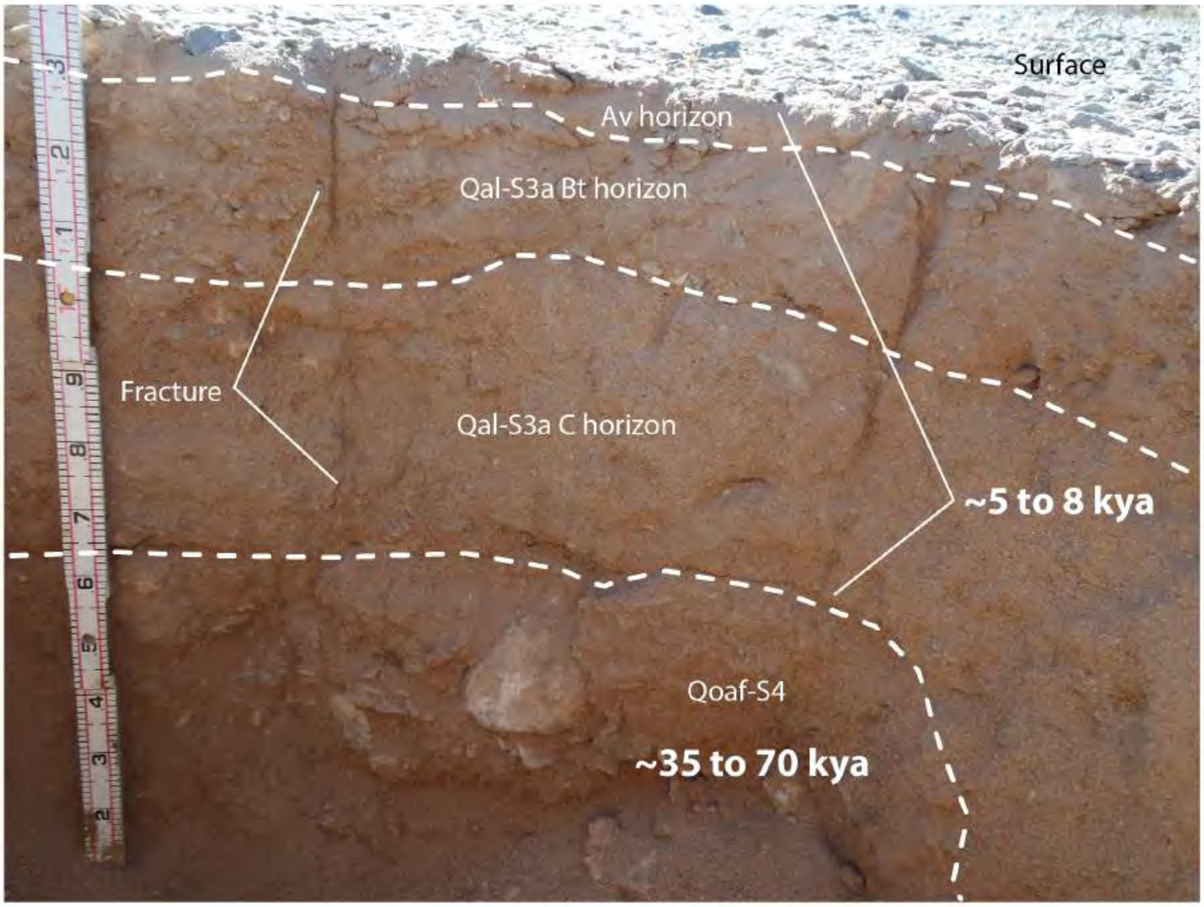
**Figure AD-4:** Geomorphic Site 75 Soil Stratigraphy: Qoaf-S4/Tmm(S7a)




Note erosion of unit Tmm that provides a source during the Holocene for eolian sands

**Site 75**
**Location:**
**33 32.515**
**114 50.515**
**Photo date:**
**2017.10.09**

**Figure AD-5:** Geomorphic Site 89 Soil Stratigraphy: Qal-S3a/Qoaf-S4





Site 89
Location:
33 34.081
114 47.872
Photo date:
2017.10.10

**Figure AD-6:** Geomorphic Site 91 Soil Stratigraphy: Qal+Qe-S3a/Qoaf-S4

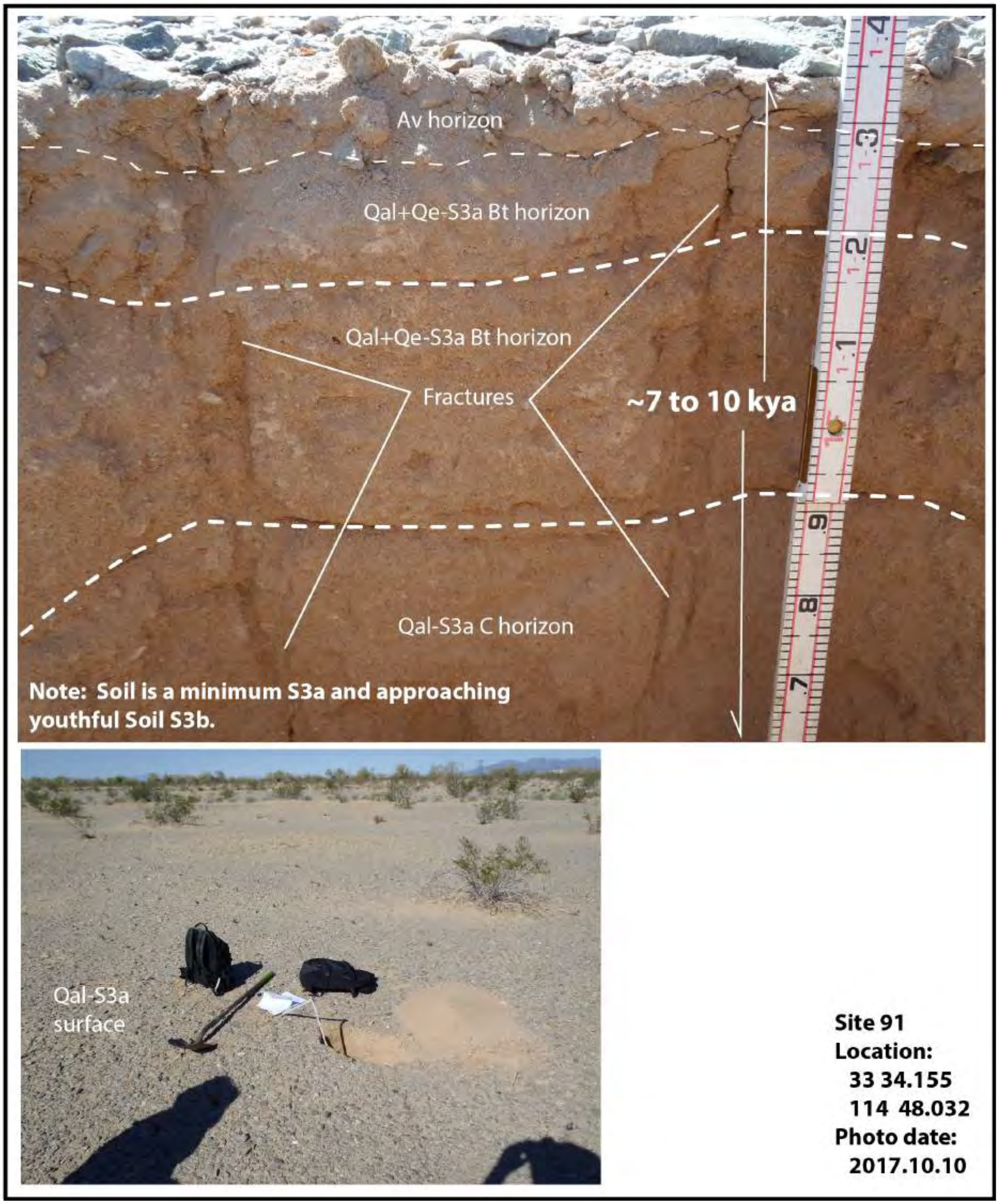


**Figure AD-7:** Geomorphic Site 97 Soil Stratigraphy: Qe-S0-S1/Qe-S1/Qe-S1/Qal+Qe-S2/Qal-S3a

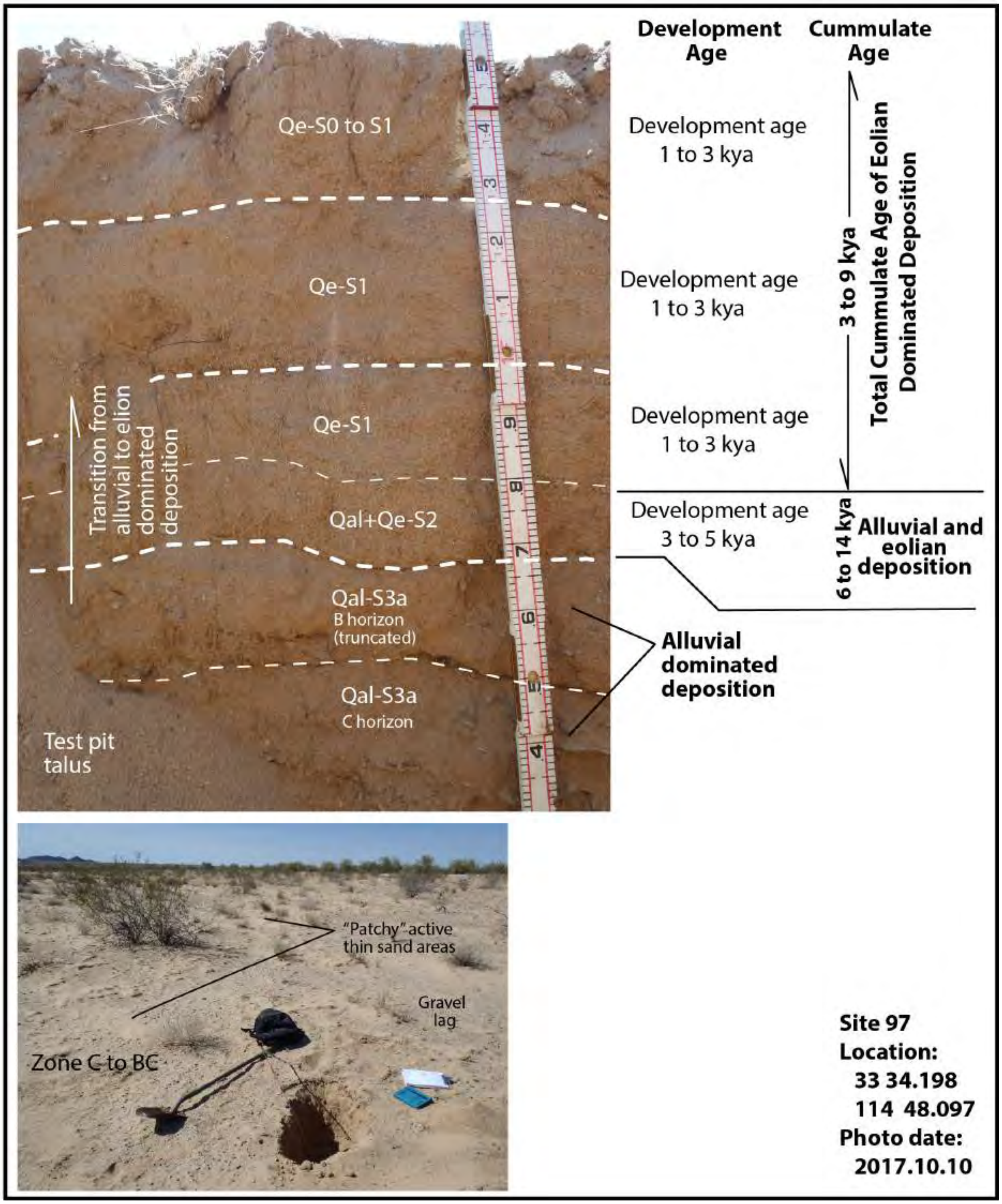


**Figure AD-8:** Geomorphic Site 103 Soil Stratigraphy: Qe-S0/Qe-S2/Qe-S0-S1/Qe-S1/Qe-S1-S2/Qal+Qe-S1/Qal-?

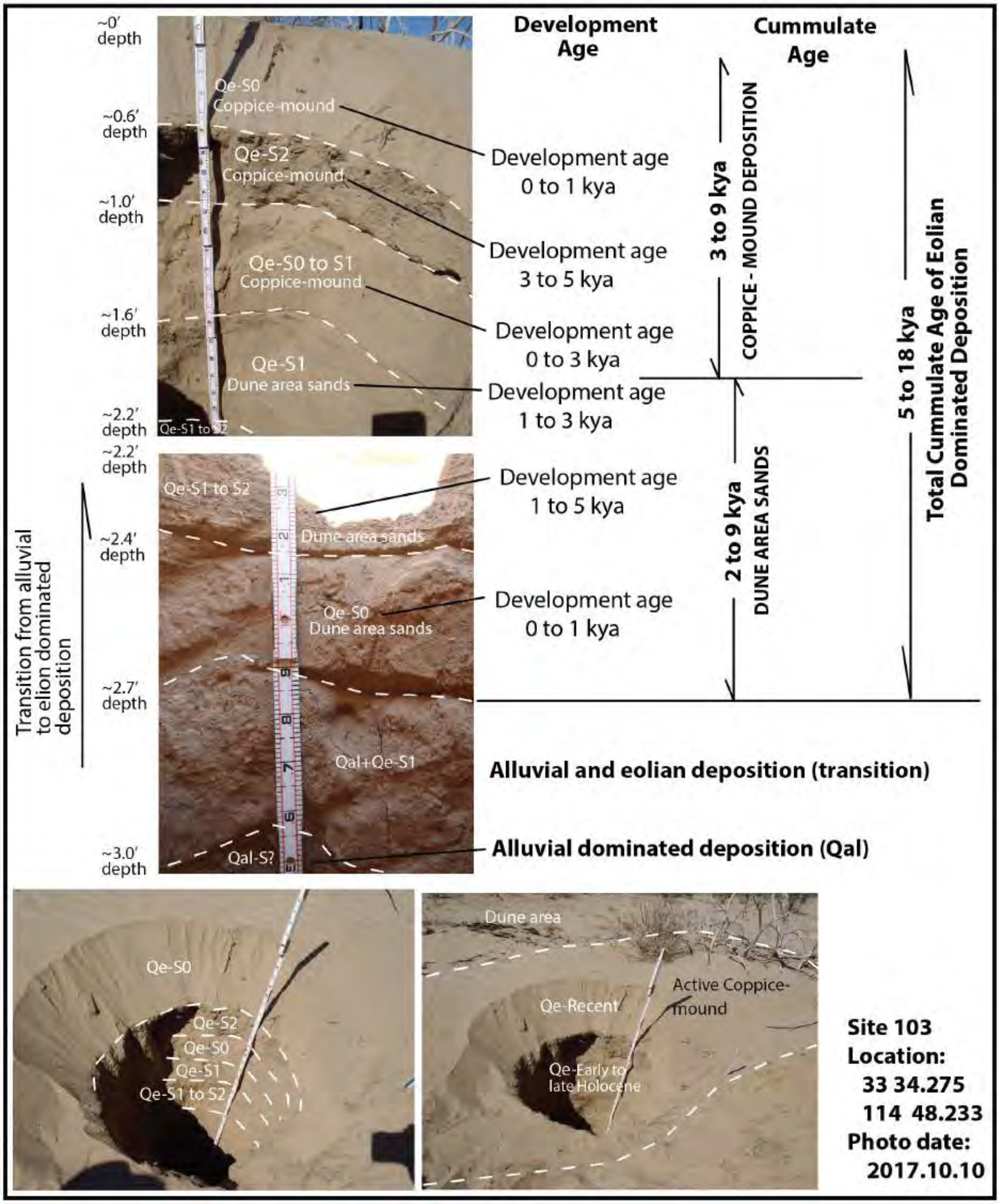


**Figure AD-9:** Geomorphic Site 133 Soil Stratigraphy: Qe+Qal-S2/Qal+Qe-S1/Qal+Qe-S1

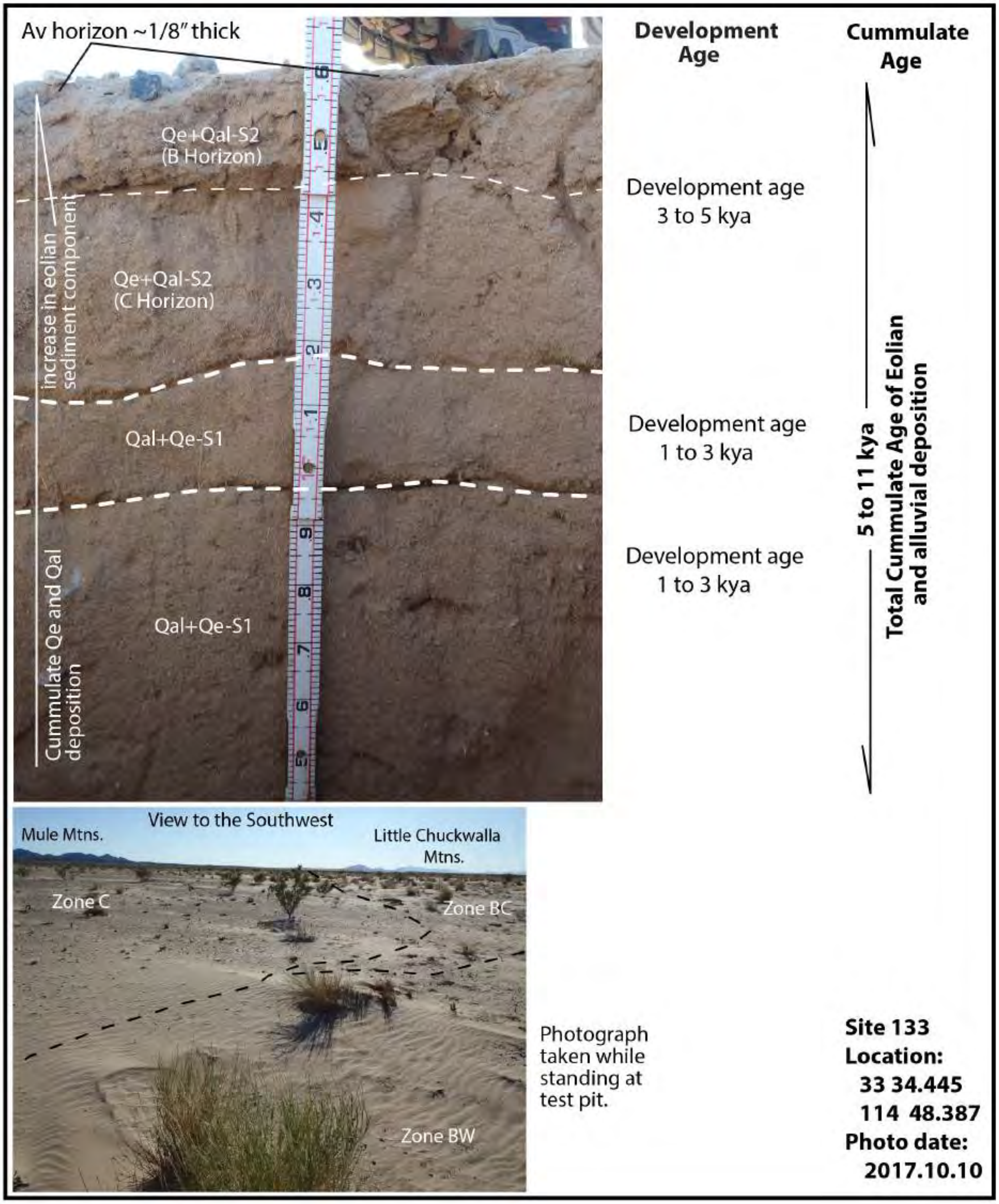
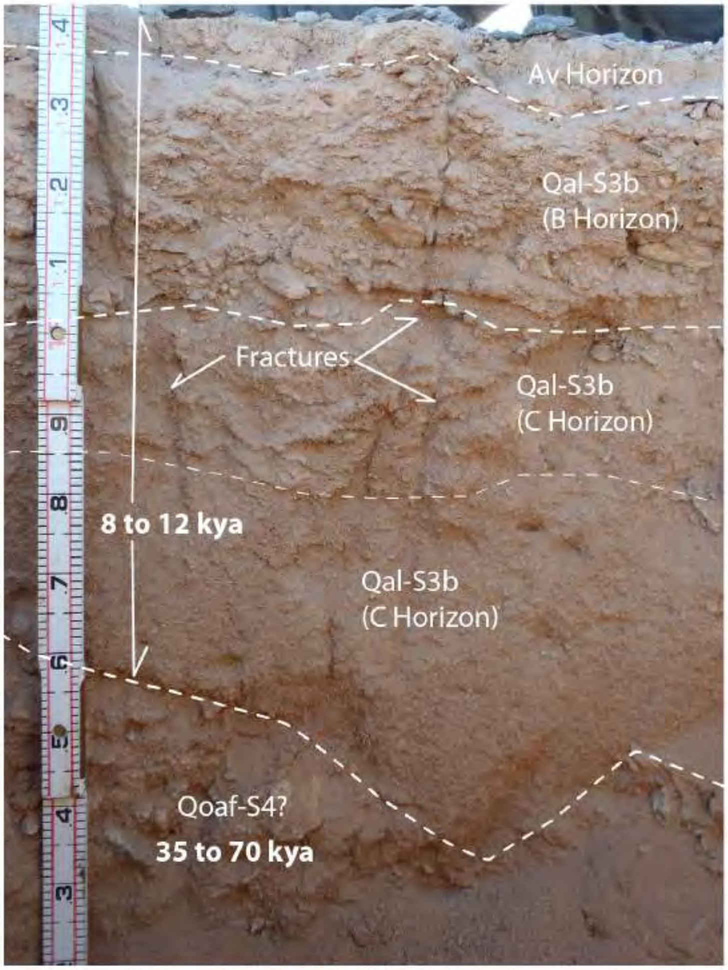


**Figure AD-10:** Geomorphic Site 169 Soil Stratigraphy: Qal-S3b/Qoaf-S4?




**Soil S3b 8 to 12 kya.**


**Site 169**
**Location:**
**33 33.706**
**114 48.833**
**Photo date:**
**2017.10.11**

**Figure AD-11:** Geomorphic Site 175 Soil Stratigraphy: Tmm with S5 soil

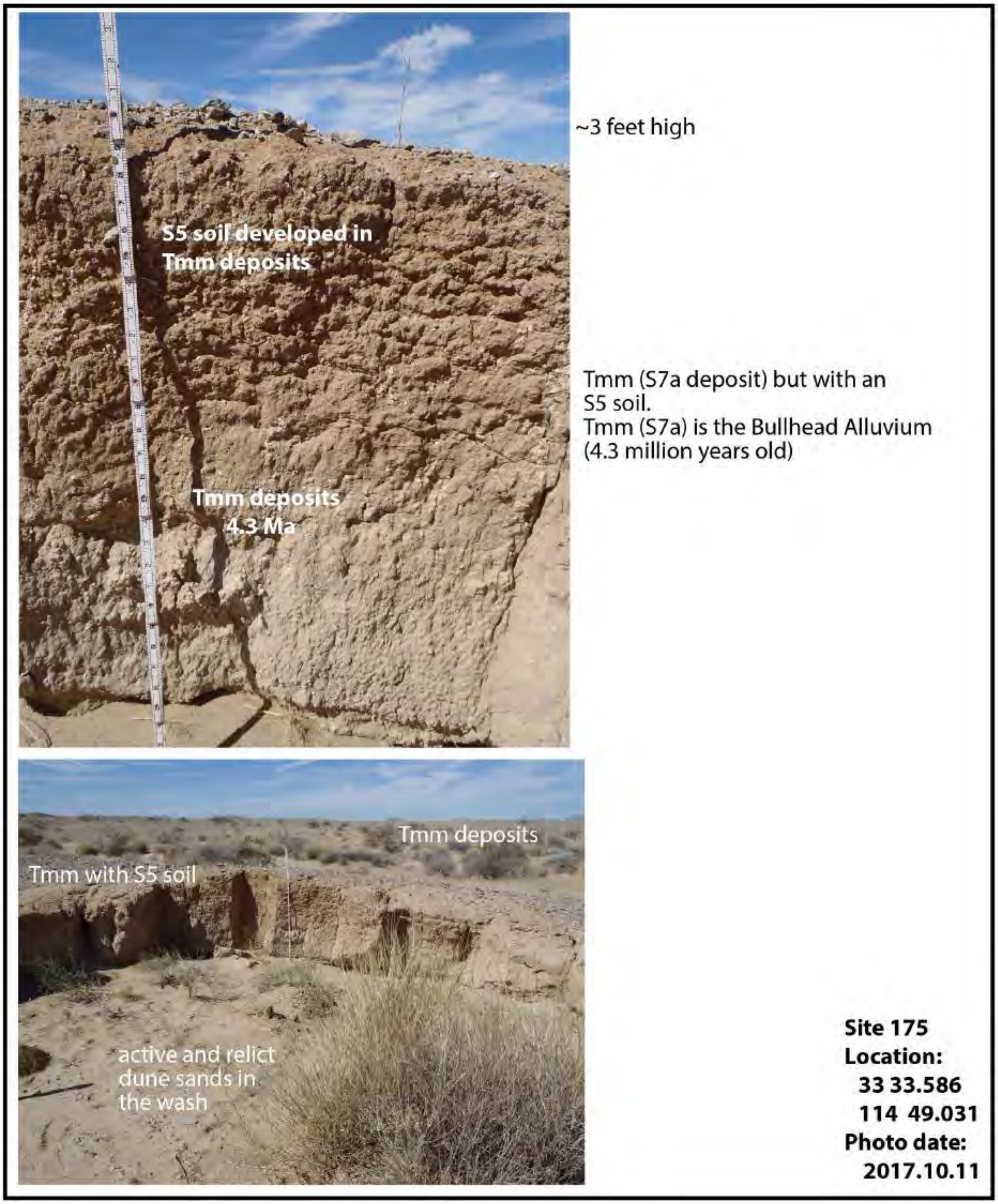


**Figure AD-12:** Geomorphic Site 195 Soil Stratigraphy: Qe-S0/Qe-S1/Qe-S1/Qe-S2/Qal+Qe-S2 Min.

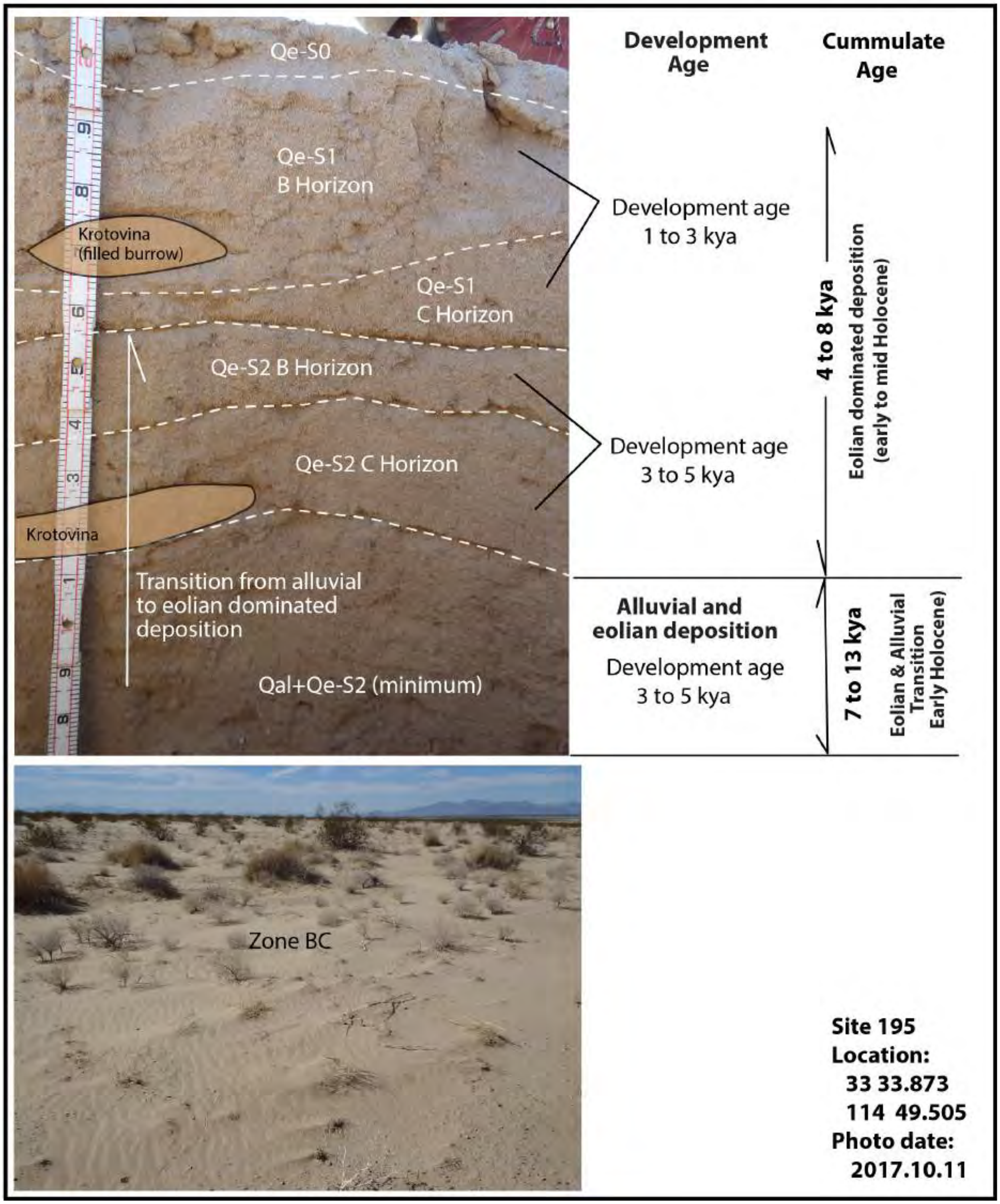


**Figure AD-13:** Geomorphic Site 312 Soil Stratigraphy: Qe-S2/Qe-S2

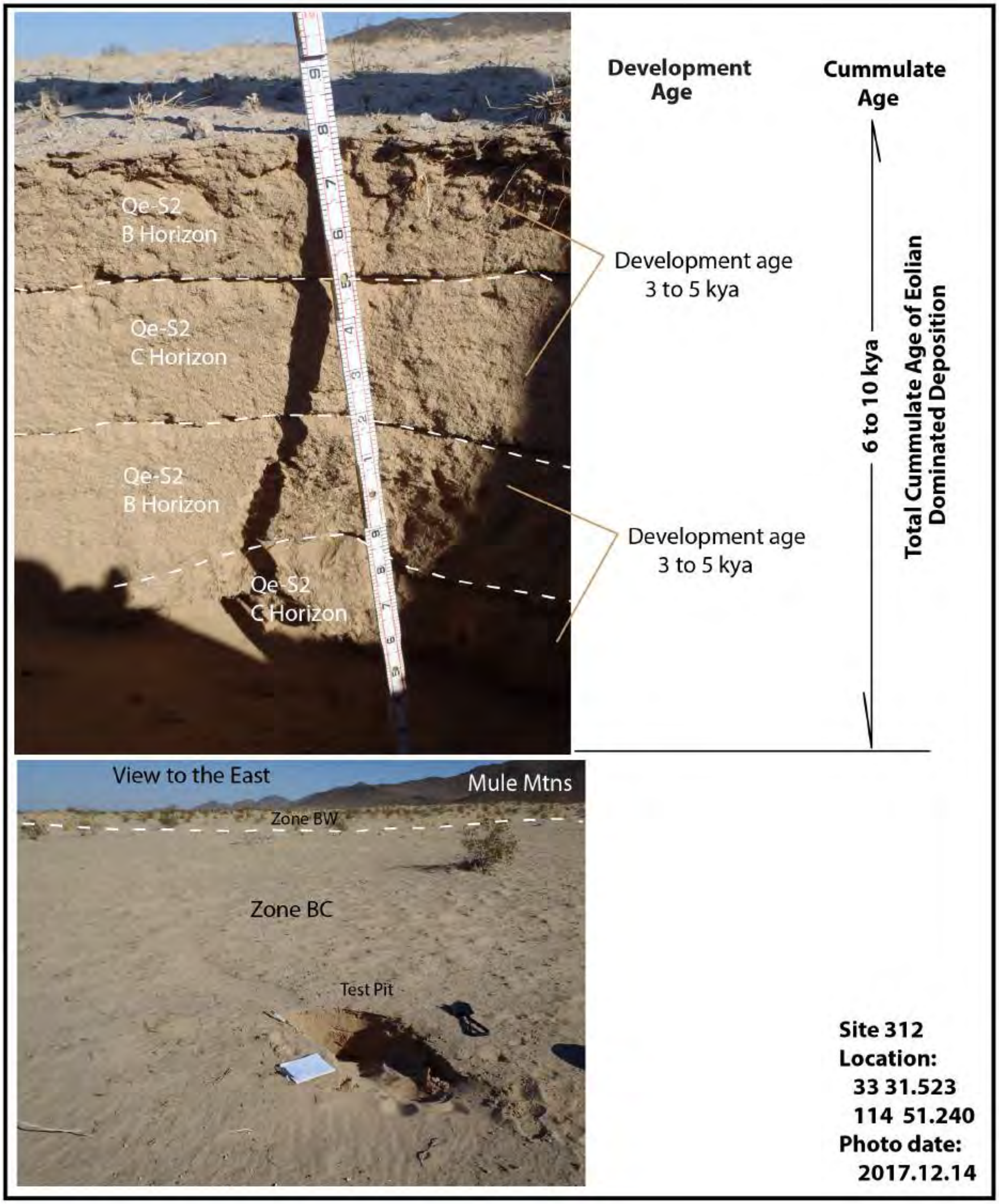


**Figure AD-14:** Geomorphic Site 352 Soil Stratigraphy: Qe-S1/Qe-S0/Qe-S2/Qe-S1/Qal-S1/Qal+Qe-S0

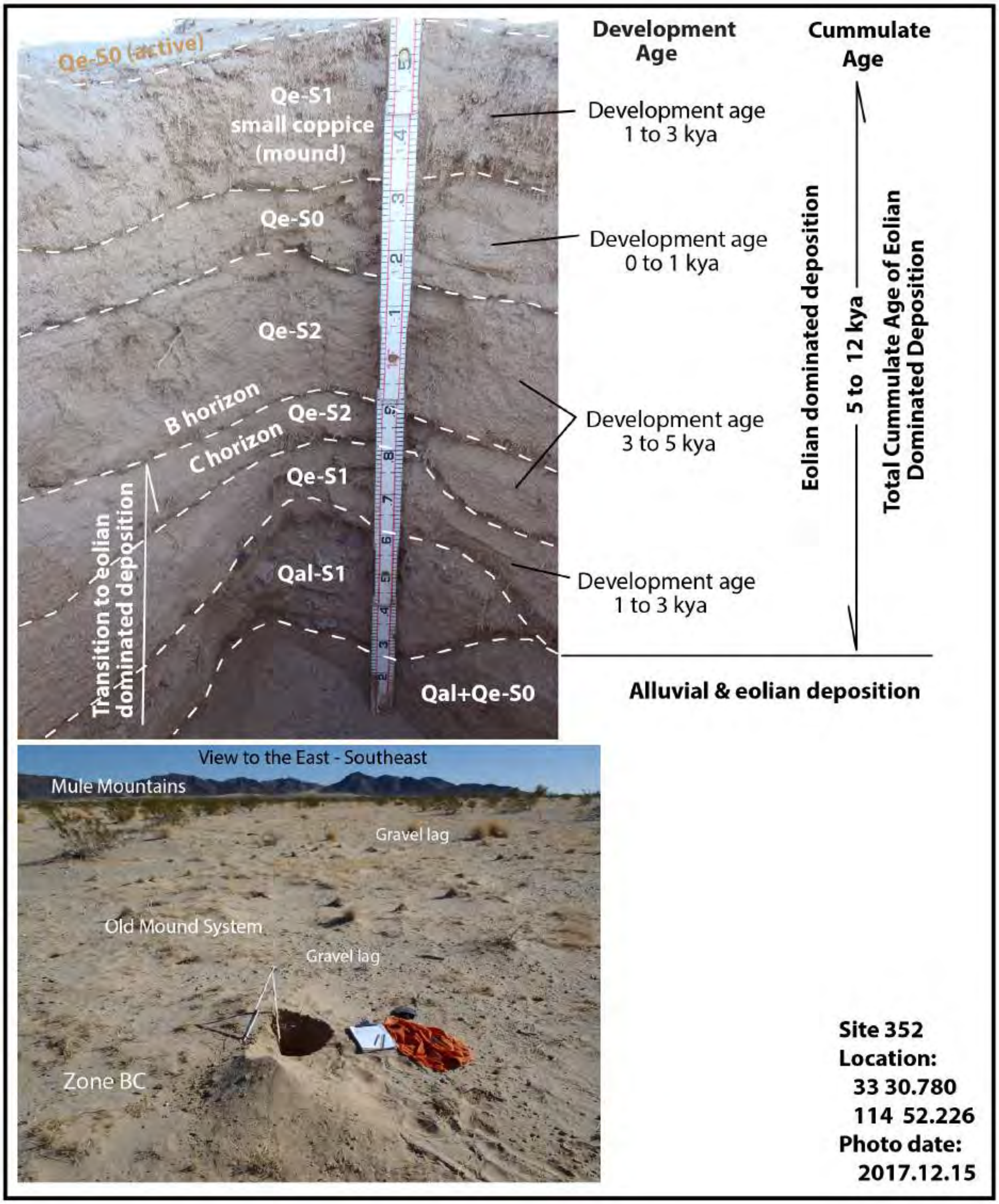
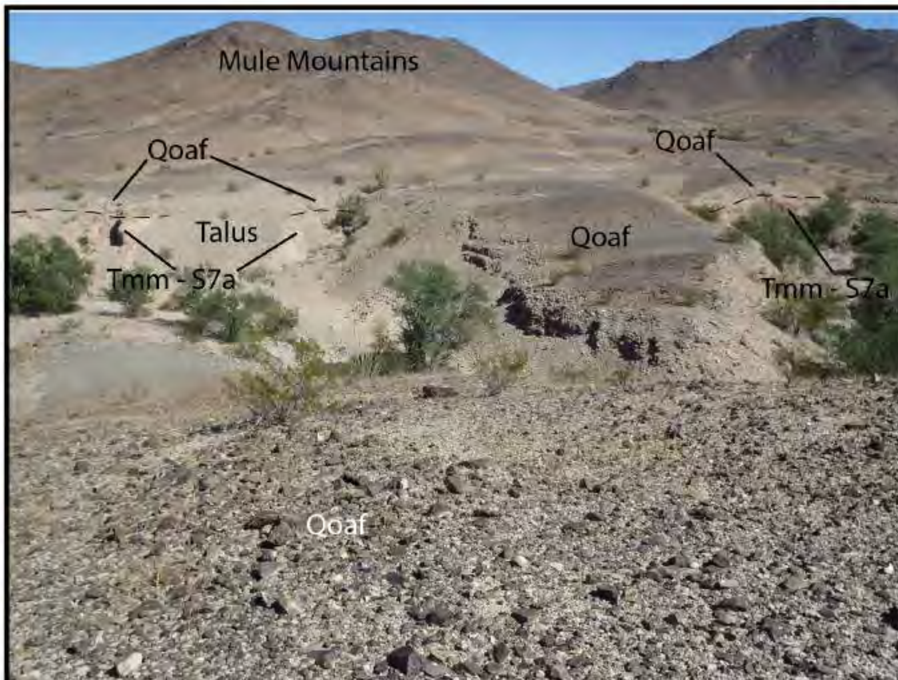


**Figure AD-15:** Geomorphic Sites 223 & 225 Soil Stratigraphy: Qoaf/Tmm – S7a (Bullhead Alluvium)




**Site 223**
**Location:**
**33 30.018**
**114 51.090**
**Photo date:**
**2017.10.12**


**Sites 225**
**Location:**
**33 29.926**
**114 51.957**
**Photo date:**
**2017.10.12**

Note: See Plate 4 for Site - photograph locations.

# APPENDIX E

## REPORT PLATES

## RELATIVE GEOMORPHIC EOLIAN (DUNE) SAND MIGRATION ZONES

***Generalized Eolian Deposits (where not mapped via Eolian Zones below)***

- Eolian deposits mapped in regions outside of the Dale Lake-Palo Verde Mesa, and Cadiz Dry Lake to Rice Valley sand migration zones

***Eolian Zones Dominated by Dune Geomorphology***

- *Zone AB*
- *Zone B and Zone BW (weak B)*

***Eolian Zones Exhibiting Mixed Eolian and Fluvial Geomorphology***

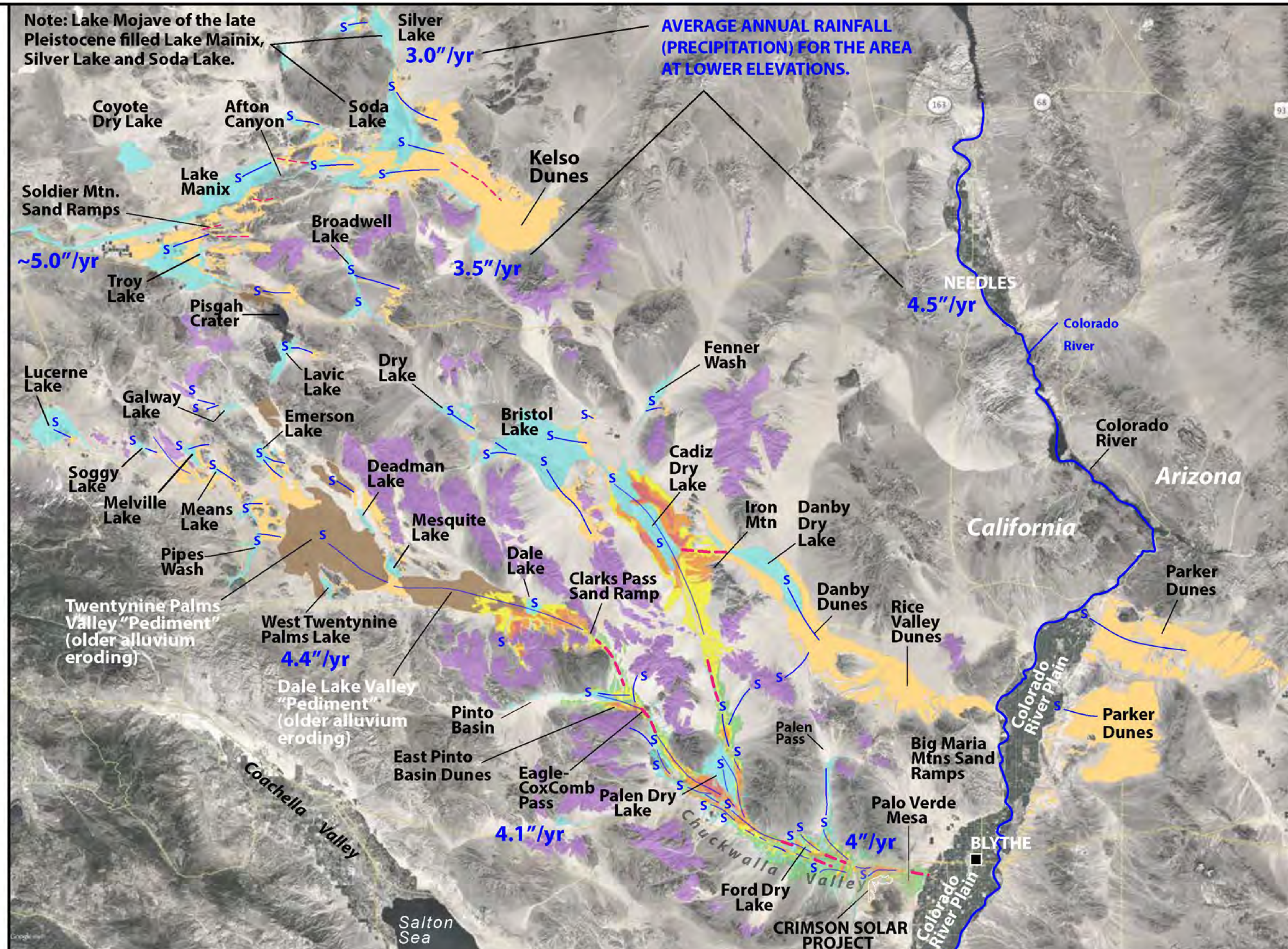
- *Zone BC*
- *Zone C (fluvially dominated)*

***Eolian Sand Sources***

- Generalized unit representing active playa lake surfaces (Lacustrine), active washes, and ponding areas. These areas are important for eolian systems as a sand source and transport. Hence, new sand is generated in these areas and is transported from and/or across these areas.
- Valley fill sedimentary units eroding and providing an eolian sand source
- Granitic rocks in the region mapped by CGS (1964 & 1967). Identified as regional and local eolian sand source upon erosion and transport via local washes by Muhs et al. (2003).

***Eolian Sand Migration Zones & Sources***

- S — Approximate locations of "micro" localized eolian sand migration zones along the paths of some proposed regional and continuous sand migration zone; however these zones have not been continuous paths for sand migration since the early Holocene (~8 kya). "S" placed near eolian sand source.
- Portions of the proposed regional sand migration zones that are essentially shut down to eolian sand transport.



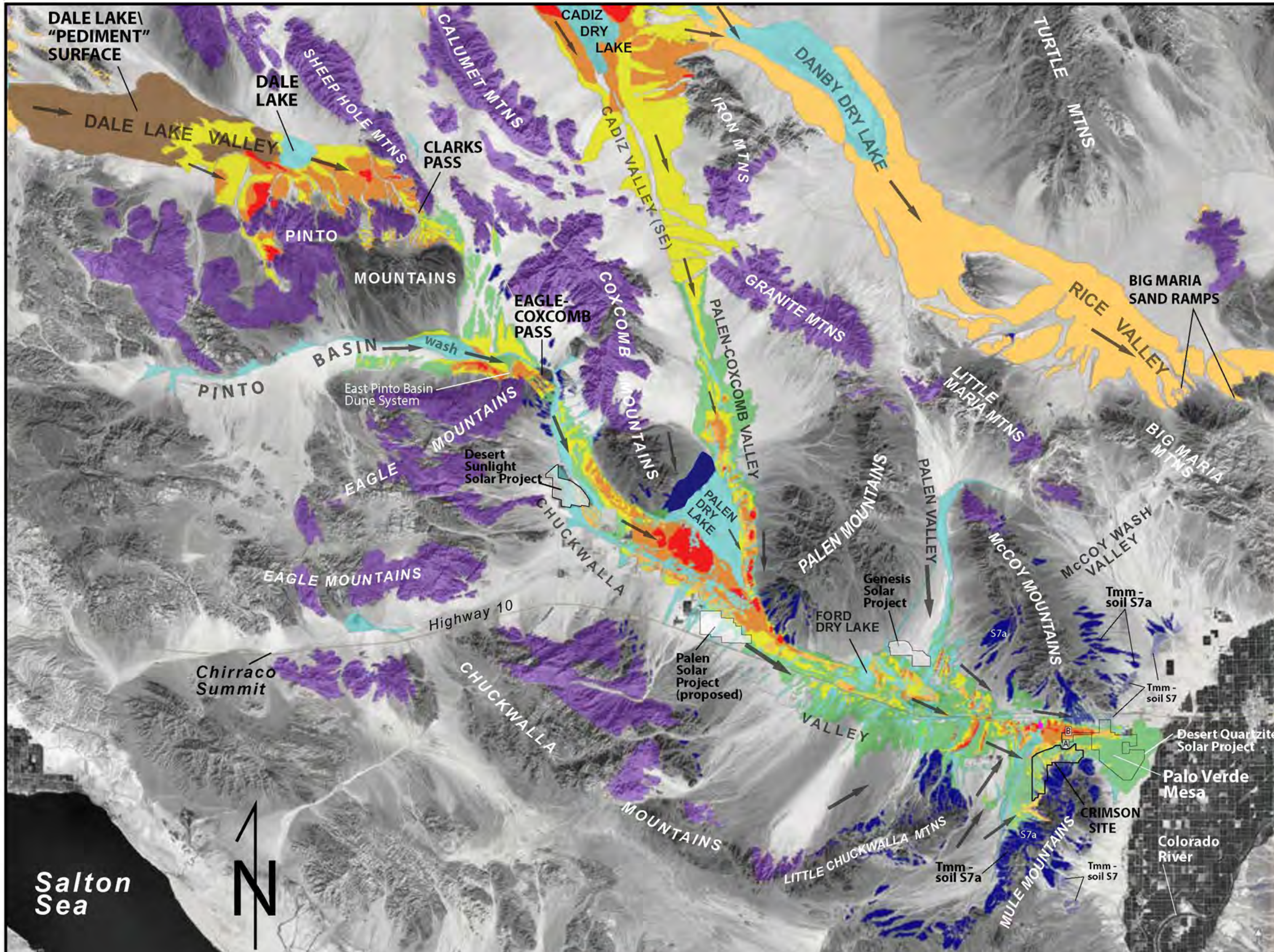

~ 20 Miles

N

Mapping conducted by M. Kenney via Google Earth Pro utilizing various years of their Historical Imagery. Image created with Google Earth Pro (10.2016 to 03.2018).

Kenney GeoScience

| CLIENT: AECOM | PROJECT: CRIMSON SOLAR PROJECT, NEAR BLYTHE, CA | Job No. 737-16 |
|---|---|---|
| | | Date: October, 2018 |
| | | Drafted by: MDK |
| Regional Sand Migration Systems-Corridors in Southeastern California | | PLATE 1 |




### *Eolian Geomorphic Zones Dominated by Dune Geomorphology*

*Zone A and Zone AB*

*Zone B and Zone BW (weak)*

### *Eolian Geomorphic Zones Exhibiting Mixed Eolian and Fluvial Geomorphology*

*Zone BC*

*Zone C (fluvially dominated)*

### *Generalized Eolian Deposits (where not mapped via Eolian Zones below)*

Eolian deposits mapped in regions outside of the Dale Lake-Palo Verde Mesa, and Cadiz Dry Lake to Rice Valley sand migration zones

### *Eolian Sand Sources*

Generalized unit representing active playa lake surfaces (Lacustrine), active washes, and ponding areas. These areas are important for eolian systems as a sand source, sand transport and stabilizing moisture.

Tmw S7 / Tmm S7a — Fluvial, ancient playa-lake, and Colorado River Deposits that produce relatively abundant eolian sands upon erosion. Unit primarily correlates with the **Bullhead Alluvium** of Howard et al.(2015), unit QTmm of Stone (Tmw & Tmm here, 2006), Unit B of Metzger et al.(1973). Mapped as units Tmw (Soil S7) & Tmm (Soil S7a) in this study. Some **Bouse Formation** of Spencer (2008) may occur near Palen Dry Lake. Tmw is proposed to be receding shoreline berms of the ancient Colorado River inundation. Pliocene in age.

Granitic rocks in the region mapped by CGS (1964 & 1967). Identified as regional and local eolian sand source upon erosion and trasonport via local washes by Muhs et al. (2003).

### *General Prevailing Wind Direction*

Generalized direction of "prevailing" winds most of which are altered by local valley-mountain topography

B A — Location of the existing Sothern California Edison substation [A] and initially proposed Southern California Edison substaion [B] (Kenney, 2010d and 2010e).

Job No. 737-16

Mapping conducted by M. Kenney via Google Earth Pro utilzing various years of their Hisorical Imagery.Image created with Google Earth Pro (10.2016).

~ 5 Miles

Kenney GeoScience

CLIENT: AECOM

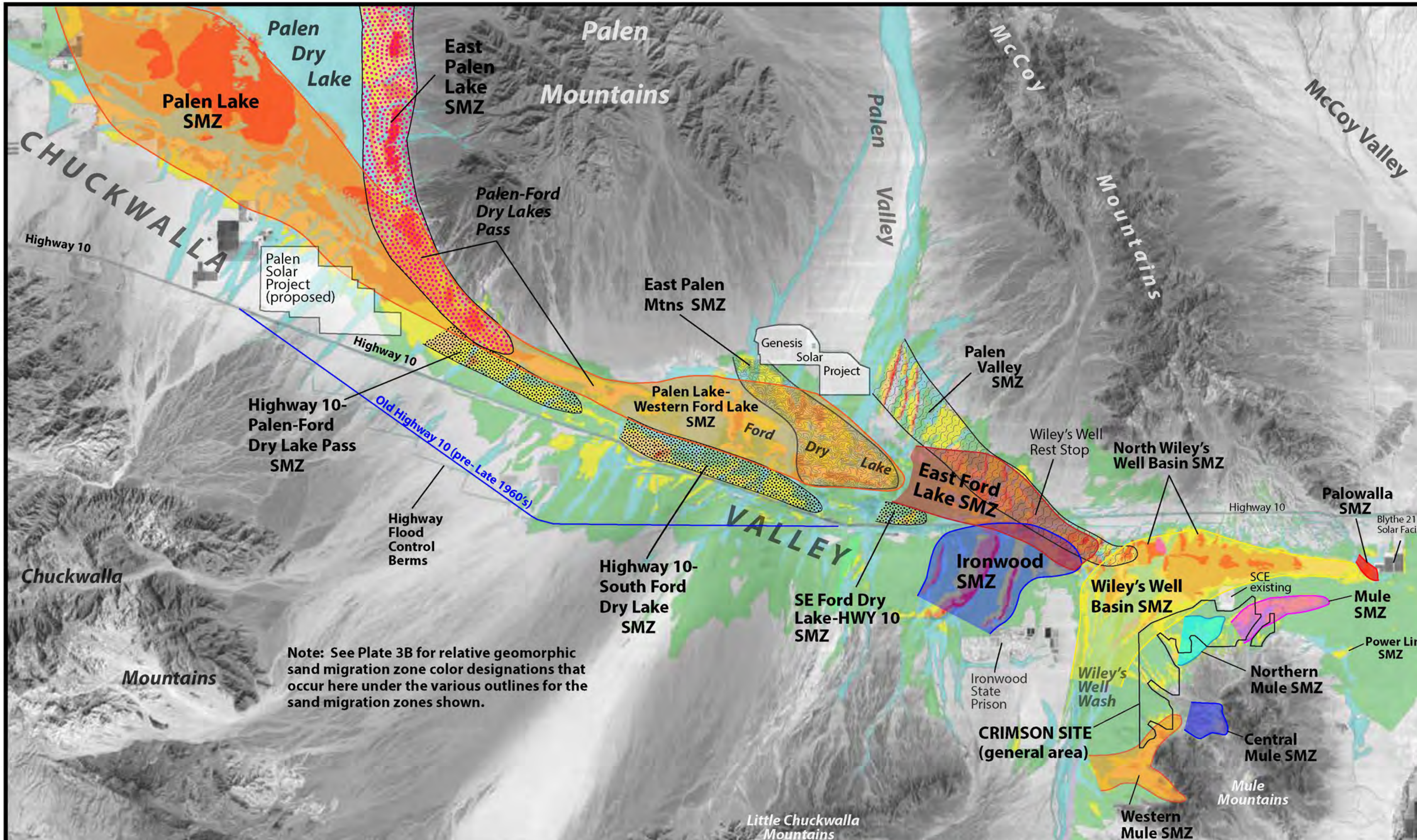
PROJECT: CRIMSON SOLAR PROJECT, NEAR BLYTHE, CA

Regional Eolian Sand Migration Zones (Corridors) in Southeastern California

Date: October, 2018

Drafted by: MDK

**PLATE 2**




Kenney GeoScience

CLIENT: AECOM

PROJECT (SITE): CRIMSON SOLAR PROJECT

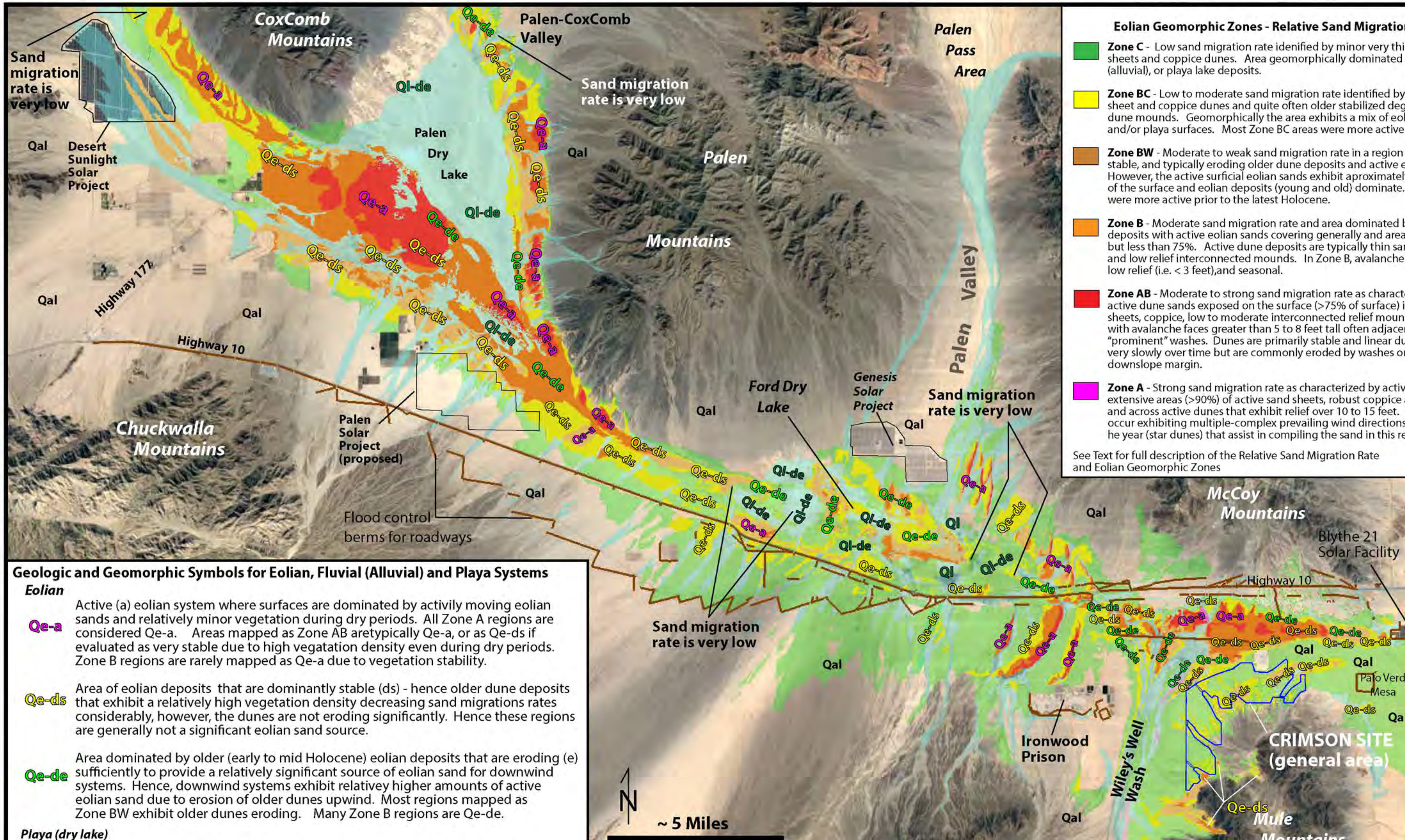
Local Geomorphic Eolian Sand Migration Zones along the Chuckwalla Valley and Wiley's Well Wash Eolian Systems

Job No. 737-16

Date: October, 2018

Drafted by: MDK

**PLATE 3A**




## Eolian Geomorphic Zones - Relative Sand Migration Rates

**Zone C** - Low sand migration rate idenified by minor very thin and sparce sand sheets and coppice dunes. Area geomorphically dominated by either fluvial (alluvial), or playa lake deposits.

**Zone BC** - Low to moderate sand migration rate identified by minor active sand sheet and coppice dunes and quite often older stabilized degraded low profile dune mounds. Geomorphically the area exhibits a mix of eolian and fluvial and/or playa surfaces. Most Zone BC areas were more active in the past.

**Zone BW** - Moderate to weak sand migration rate in a region dominated by stable, and typically eroding older dune deposits and active eolian sands. However, the active surficial eolian sands exhibit aproximately less than 50% of the surface and eolian deposits (young and old) dominate. Zone BW areas were more active prior to the latest Holocene.

**Zone B** - Moderate sand migration rate and area dominated by older stable dune deposits with active eolian sands covering generally and area greater than 50% but less than 75%. Active dune deposits are typically thin sand sheets, coppice, and low relief interconnected mounds. In Zone B, avalanche faces are rare, of low relief (i.e. < 3 feet),and seasonal.

**Zone AB** - Moderate to strong sand migration rate as characterized by mostly active dune sands exposed on the surface (>75% of surface) involving sand sheets, coppice, low to moderate interconnected relief mounds, linear dunes with avalanche faces greater than 5 to 8 feet tall often adjacent to some "prominent" washes. Dunes are primarily stable and linear dunes likely migrate very slowly over time but are commonly eroded by washes on their imediate downslope margin.

**Zone A** - Strong sand migration rate as characterized by active dunes with extensive areas (>90%) of active sand sheets, robust coppice and mounds, and across active dunes that exhibit relief over 10 to 15 feet. Avalanche faces occur exhibiting multiple-complex prevailing wind directions throughout he year (star dunes) that assist in compiling the sand in this region.

See Text for full description of the Relative Sand Migration Rate and Eolian Geomorphic Zones

## Geologic and Geomorphic Symbols for Eolian, Fluvial (Alluvial) and Playa Systems

***Eolian***

**Qe-a** Active (a) eolian system where surfaces are dominated by activily moving eolian sands and relatively minor vegetation during dry periods. All Zone A regions are considered Qe-a. Areas mapped as Zone AB aretypically Qe-a, or as Qe-ds if evaluated as very stable due to high vegatation density even during dry periods. Zone B regions are rarely mapped as Qe-a due to vegetation stability.

**Qe-ds** Area of eolian deposits that are dominantly stable (ds) - hence older dune deposits that exhibit a relatively high vegetation density decreasing sand migrations rates considerably, however, the dunes are not eroding significantly. Hence these regions are generally not a significant eolian sand source.

**Qe-de** Area dominated by older (early to mid Holocene) eolian deposits that are eroding (e) sufficiently to provide a relatively significant source of eolian sand for downwind systems. Hence, downwind systems exhibit relativey higher amounts of active eolian sand due to erosion of older dunes upwind. Most regions mapped as Zone BW exhibit older dunes eroding. Many Zone B regions are Qe-de.

***Playa (dry lake)***

**Ql** Relatively stable playa lake bed deposits that typically provide a pathway for sand migration, an eolian source after flooding, but generally the playa surface is not eroding significantly to provide a relatively strong eolian sand source.

**Ql-de** Playa lake bed deposits that are evaluated as eroding; hence, providing a source for eolian sand deposits for downwind (toward the southeast) dune systems. These surfaces also provide eolian sands after flooding.

***Alluvial (Fan Deposits)***

**Qal** Regions dominated by alluvial deposits shown only in the Palo Verde Mesa area

Kenney GeoScience

CLIENT: AECOM

PROJECT: CRIMSON SOLAR PROJECT, NEAR BLYTHE, CA

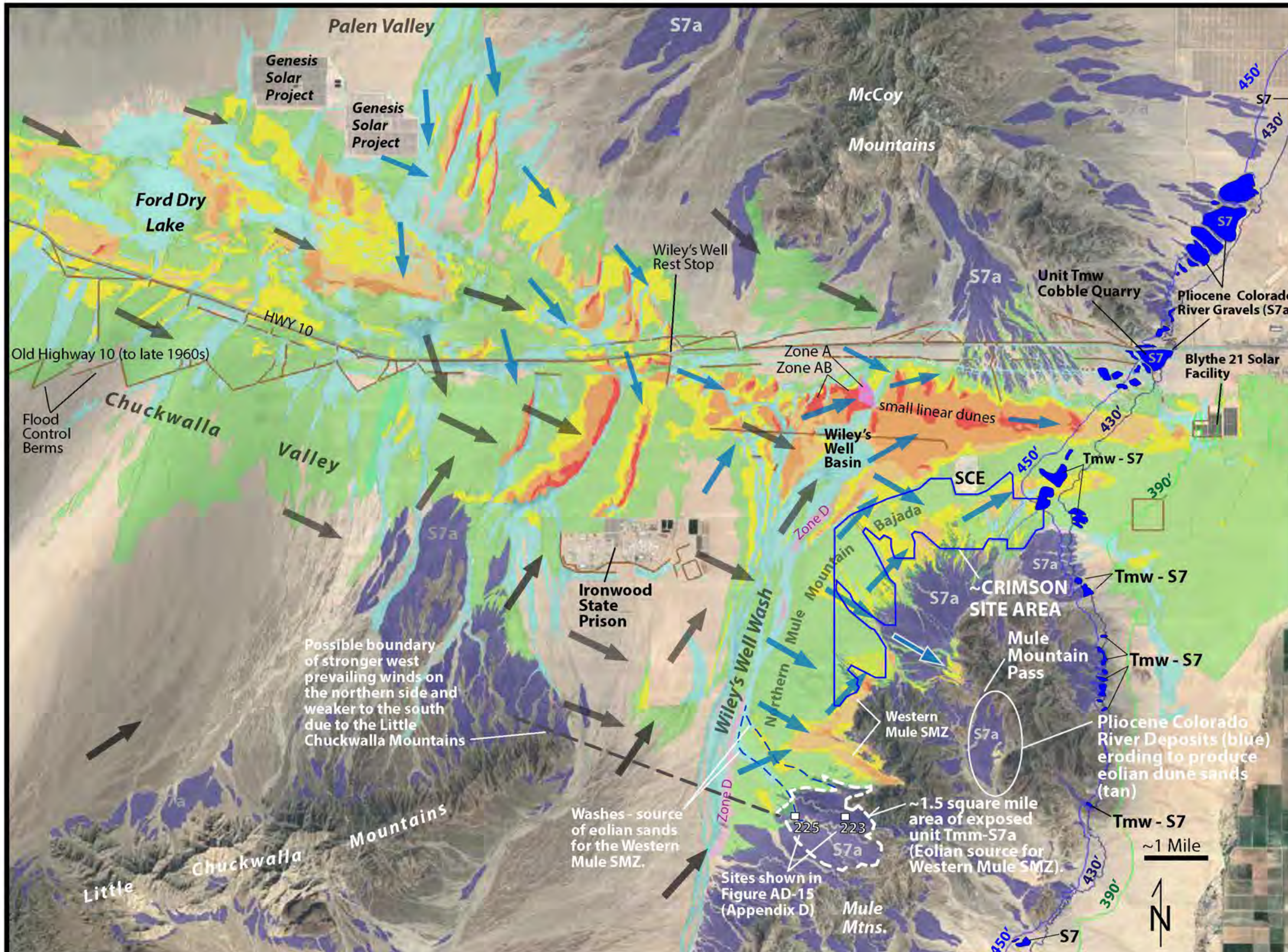
Geomorphic map showing variations in dune deposit Activity and Stability along the Chuckwalla Valley Eolian Sand System

Job No. 737-16

Date: October, 2018

Drafted by: MDK

**PLATE 3B**




**Eolian Geomorphic - Relative Sand Migration Zones**

**Zone D** - Very low eolian both during present times and likely througought the Holocene. Unit only shown along portions of Wiley's Well Wash although it occurs extensively adjacent to Zone C.

**Zone C** - Low eolian sand migration rate idenified by minor very thin and sparce sand sheets and coppice dunes. Area geomorphically dominated by either fluvial (alluvial), or playa lake deposits.

**Zone BC** - Low to moderate eolian sand migration rate identified by minor active sand sheet and coppice dunes and quite often older stabilized degraded low profile dune mounds. Area exhibits a mix of eolian and fluvial geomorphology.

**Zone BW** - Moderate to weak eolian sand migration rate in a region dominated by stable, and typically eroding older dune deposits and active eolian sands. However, the active surficial eolian sands exhibit aproximately less than 50% of the surface and eolian deposits (young and old) dominate. Zone BW areas were more active prior to the latest Holocene. Area dominated by eolian geomorphology.

**Zone B** - Moderate eolian sand migration rate and area dominated by older stable dunedeposits with active eolian sands covering generally and area greater than 50% but less than 75%. Active dune deposits aretypically thin sand sheets, coppice, and low relief interconnected mounds. In Zone B, avalanche faces are rare, of low relief(i.e. < 3 feet), and seasonal.

**Zone AB** - Moderate to strong eolian sand migration rate as characterized by mostly active dune sands exposed on the surface (>75% of surface) involving sand sheets, coppice, low to moderate interconnected relief mounds, linear dunes with avalanche faces greater than 5 to 8 feet tall often adjacent to some "prominent" washes. Dunes are primarily stable and linear dunes likely migrate very slowly over time but are commonly eroded by washes on their imediate downslope margin.

**Zone A** - Strong eolian sand migration rate as characterized by active dunes with extensive areas (>90%) of active sand sheets, robust coppice and mounds, and across active dunes that exhibit relief over 10 to 15 feet. Avalanche faces occur exhibiting multiple-complex prevailing wind directions throughout the year (star dunes) that assist in compiling the sand in this region.

**Eolian Source Geologic Deposits - Formations**

Generalized unit representing active playa lake surfaces (Lacustrine), active washes, and ponding areas. These areas are important for eolian systems as a sand source, sand transport and stabilizing moisture.

**S7 Tmw** Fluvial Colorado River Gravels associated with an ancient "shoreline-river edge) near elevavation 430 to 450 feet above sea level (msl, blue lines). This unit is correlated stratigraphically to unit QTmw of Stone (2006), Unit B (Quarry Gravels) of Metzger et al. (1973), and member of the **Bullhead Alluvium** of Howard et al. (2015). Units are early Pliocene in age (Bullhead Alluvium - 4.5 to 3.5 Ma; Howard et al., 2015).

**S7a Tmm** Fluvial, ancient playa-lake, and Colorado River Deposits that producerelatively abundant eolian sands upon erosion. Unit primarily correlates with the **Bullhead Alluvium** of Howard et al. (2015), unit QTmm of Stone (2006), possibly some Bouse Formation of Spencer (2008), and Unit B of Metzger et al.(1973). Units are early Pliocene in age (Bullhead Alluvium - 4.5 to 3.5 Ma; Howard et al., 2015). Petrified wood bearing uper slope member extending to elevations over 850 feet.

Mapping conducted by M. Kenney via Google Earth Pro utilizing various years of their Hisorical Imagery.Image created with Google Earth Pro (2016). Sand migration rates varied considerably across Ford Dry Lake and near the site due to large magnitude changes in vegetation density (wet vs dry years). Mapping was conducted where possible that exhibited the strongest sand migration rates that corresponded to relatively low vegetation densities.

**"Prevailing" Wind Directions Influencing Eolian Systems**

Generalized direction of pertinent "prevailing" wind directions resulting in eolian sand movement as observed in the field during strong wind events (blue arrows) and dune structures and deposits (gray arrows). The wind directions are controlled by local valley-mountain topography and seasonal storm track directions. These occur from the SW along Wiley's Well Wash, from the west (W) down the Chuckwalla Valley, and from the NNW down Palen Valley. The SW to NE winds have commonly been observed to flow over the Chuckwalla Mountains. Blue arrows were observed and measured in the field, gray arrows are generalized based on field experience and dune forms.

Kenney GeoScience

CLIENT:
AECOM

PROJECT:
CRIMSON SOLAR PROJECT,
NEAR BLYTHE, CA

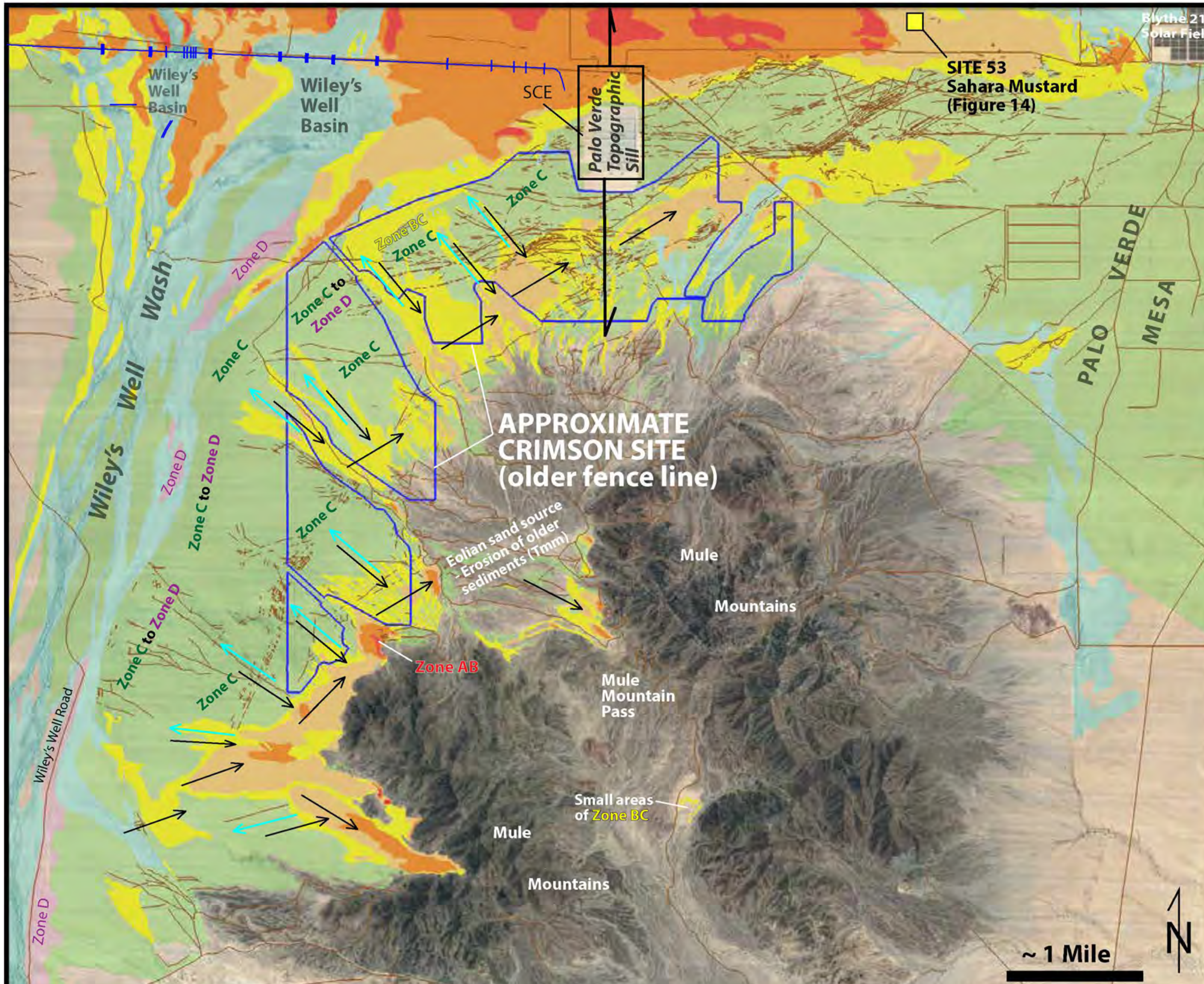
Geomorphic Eolian Zone Map, Wind Direction & Geologic Map of the Eastern Chuckwalla Valley

Job No. 737-16

Date: October, 2018

Drafted by: MDK

**PLATE 4**




**Eolian Geomorphic - Relative Sand Migration Zones**

**Zone D** - Very low eolian sand migration rate both at the present time but also in the past as the region exhibits nearly no dune geomorphology. Only mapped in selected areas.

**Zone C** - Low sand migration rate and area dominated either by fluvial (alluvial), or playa lake surfaces (deposits).

**Zone BC** - Low to moderate sand migration rate, and geomorphically the area exhibits a mix of eolian and fluvial and/or playa surfaces. Dune deposits are also generally a mix of older stable, some eroding dunes, and active surficial loose active eolian sands (sand sheets).

**Zone BW** - Moderate to weak sand migration rate, and area dominated by stable (vegetated), and typically eroding older dune deposits (geomorphology). Active eolian sands cover generally less than 50% of the surface area. Ponding (gravel lag surfaces) interdune depressions common.

**Zone B** - Moderate sand migration rate and area dominated by older stable dune deposits with active eolian sands covering generally greater than 50% of the area. Active eolian sands are typically sand sheets, coppice, and low reliefmounds. Avalanche faces are very rare and only seasonal in Zone B.

**Zone AB** - Moderate to strong sand migration rate and area characterized by mostly active dune sands exposed on the surface involving sand sheets, coppice, low relief mounds, and linear dunes with occassional seasonal avalanche faces.

**Fluvial - Washes and Ponding Areas**

Generalized unit representing active playa lake surfaces (Lacustrine), active washes, and ponding areas. These areas are important for eolian systems as a sand source, sand transport and stabilizing moisture.

**Other Symbols**

Subdrains and flood control berms. Thin blue lines are flood control berms and thicker orthogonal lines are subdrains allow flow to pass.

Mapped dirt roads. Many of the dirt roads in close proximity and within the Site are surmised to have been produced during General Pattons tank war excersises in the early 1940's. These roads provide evidence supporting eolian geomorphic zones stability on a decadal scale, particularly for Zone BC, and Zone C.

Sand migration directions depicting via downslope migration by wash flow (cyan arrows), and upslope eolian transport via wind (Black arrows). A large component of wash flow sands were previously deposited eolian sands (recycled).

Sand migration direction over time of eolian sands via prevailing winds (black arrows).

Mapping conducted by M. Kenney via Google Earth Pro utlizing various years of their Hisorical Imagery. Image created with Google Earth Pro.

Kenney GeoScience

CLIENT: AECOM

PROJECT: CRIMSON SOLAR PROJECT

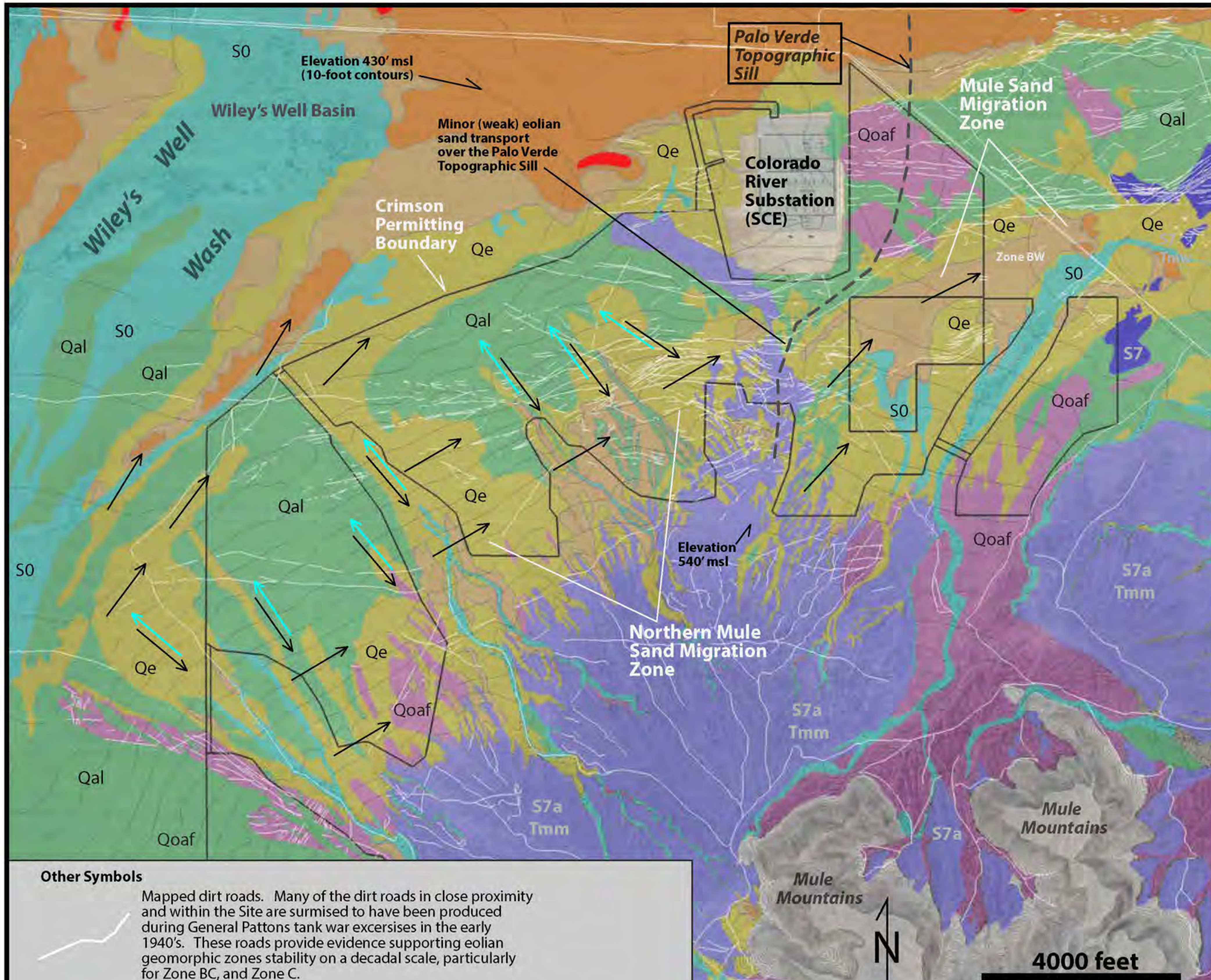
Geomorphic Relative Eolian Sand Migration Zone Map for the Crimson Solar Project

Job No. 737-16

Date: October, 2018

Drafted by: MDK

**PLATE 5**




## Eolian Geomorphic - Relative Sand Migration Zones

**Zone BW** - Moderate to weak eolian sand migration rate, and area dominated by stable (vegetated) and eroding older dune deposits. Active eolian sands generally cover much less than 50% of the surface area. Dunes are thin, generally less 1 to 2 feet thick. Interdune ponding areas.

**Zone B** - Moderate eolian sand migration rate and area dominated by older stable dune deposits with active eolian sands covering generally 50% or more of the area. Active eolian sands are thin (less than 1 to 3 inches thick) sand sheets, coppice, and low relief mounds. Zone B areas cover small areas. Fluvial washes are not common.

**Zone AB** - Moderate to strong eolian sand migration rate and area characterized by mostly active dune sands exposed on the surface involving sand sheets, coppice, low relief mounds, and in places weak linear dunes with occassional seasonal avalanche faces. No areas of Zone AB were mapped within the proposed Crimson project boundary.

## Holocene Stratigraphic Units

Qal — **Holocene Alluvial Deposits - Soils** - Areas exhibiting primarily alluvial deposits of Holocene age corresponding to designated soils S0, S1, S2, S3a and S3b. Fluvial activity on these areas provided eolian sources and recycling of eolian sands throughout the Holocene.

Qe — **Holcocene Eolian Deposits - Soils** - Areas exhibiting relatively abundant stable and relict eolian deposits that are mid to late Holocene in age. Hence, in these areas, the eolian deposits are primarily relict (dormant) sediments deposited prior to the latest Holocene. Most designated soils identified are S1 and S2 and in areas where eolian deposits are greater than 1.5 feet, a series of stacked S1 and S2 soils indicating cummulate ages dating back to the early to mid Holocene for initiation of deposition. These regions primarily represent areas of older more robust eolian sand migration zones and the eolian sand migration rate has slowed considerably during the late Holcoene.

S0 — **Active Washes and Ponding Areas** - Generalized unit representing active washes and ponding areas. These areas are important for eolian systems as a sand source, sand transport and stabilizing moisture. Correlates with designated soil S0. Washes of many scales occur across the site; hence, only some are mapped.

## Pleistocene and Pliocene Sediments (alluvial and fluvial)

Qoaf — **Pleistocene Older Alluvium Deposits** - correlates with designated Soils S4 and S5. Erosion of these units upslope provided a source for eolian sands.

S7 Tmw — Fluvial Colorado River Gravels associated with an ancient "shoreline-river edge) near elevation 430 to 450 feet above sea level (msl, blue lines). This unit is correlated stratigraphically to unit QTmw of Stone (2006), Unit B (Quarry Gravels) of Metzger et al. (1973), and member of the **Bullhead Alluvium** of Howard et al. (2015). Units are early Pliocene in age (Bullhead Alluvium - 4.5 to 3.5 Ma; Howard et al., 2015).

S7a Tmm — Fluvial, ancient playa-lake, and Colorado River Deposits that produce relatively abundant eolian sands upon erosion. Unit primarily correlates with the **Bullhead Alluvium** of Howard et al. (2015), unit QTmm of Stone (2006), possibly some Bouse Formation of Spencer (2008), and Unit B of Metzger et al.(1973). Units are early Pliocene in age (Bullhead Alluvium - 4.5 to 3.5 Ma; Howard et al., 2015). Petrified wood bearing upper slope member extending to elevations over 850 feet.

Bedrock areas of the northern Mule Mountains.

**Other Symbols**

Mapped dirt roads. Many of the dirt roads in close proximity and within the Site are surmised to have been produced during General Pattons tank war excersises in the early 1940's. These roads provide evidence supporting eolian geomorphic zones stability on a decadal scale, particularly for Zone BC, and Zone C.

Sand migration directions depicting via downslope migration by wash flow (cyan arrows), and upslope eolian transport via wind (Black arrows). A large component of wash flow sands were previously deposited eolian sands (recycled).

Sand migration direction over time of eolian sands via prevailing winds (black arrows).

Mapping conducted by M. Kenney via Google Earth Pro utilzing various years of their Hisorical Imagery. Image created with Google Earth Pro.

**Contour lines are at 10-foot intervals**

Kenney GeoScience

CLIENT: AECOM

PROJECT: CRIMSON SOLAR PROJECT

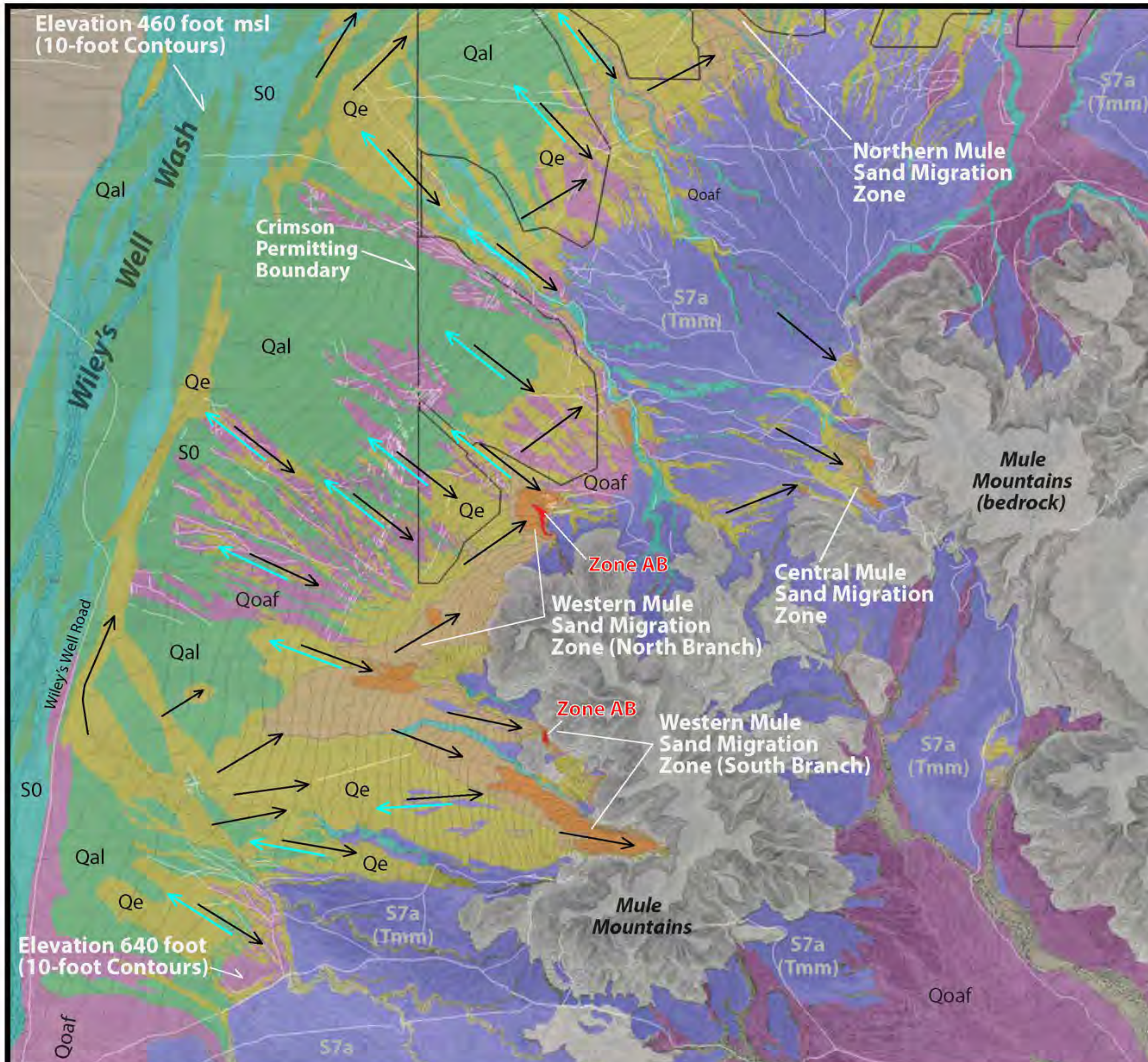
Soil Stratigraphic & Sand Migration Zone Map - Northern Region of Crimson Solar Project

Job No. 737-16

Date: October, 2018

Drafted by: MDK

**PLATE 6A**




Drafting conducted by M. Kenney via Google Earth Pro utilzing various years of their Hisorical Imagery. Image created with Google Earth Pro.

**Contour lines are at 10-foot intervals**

N

**4000 feet**

### Eolian Geomorphic - Relative Sand Migration Zones

**Zone BW** - Moderate to weak eolian sand migration rate, and area dominated by stable (vegetated) and eroding older dune deposits. Active eolian sands generally cover much less than 50% of the surface area. Dunes are thin, generally less 1 to 2 feet thick. Interdune ponding areas. Weak fluvial systems occur in places.

**Zone B** - Moderate eolian sand migration rate and area dominated by older stable dune deposits with active eolian sands covering generally 50% or more of the area. Active eolian sands are thin (less than 1 to 3 inches thick) sand sheets, coppice, and low relief mounds. Fluvial washes are not common. Zone B areas cover small areas.

**Zone AB** - Moderate to strong sand migration rate and area characterized by mostly active dune sands exposed on the surface involving sand sheets, coppice, low relief mounds, and in places weak linear dunes with occassional seasonal avalanche faces. No areas of Zone AB were mapped within the proposed Crimson project boundary.

### Holocene Stratigraphic Units

Qal **Holocene Alluvial Deposits - Soils** - Areas exhibiting primarily alluvial deposits of Holocene age corresponding to designated soils S0, S1, S2, S3a and S3b. Fluvial activity (erosion and transport) on these areas provided eolian sources and recycling (fluvial movement downslope then up or across slope movement by the wind) of eolian sands throughout the Holocene.

Qe **Holocene Eolian Deposits - Soils** - Areas exhibiting relatively abundant stable and mid to late Holocene (relict, dormant) eolian sand deposits. Hence, in these areas, the exposed surface deposits are dominated by relict eolian sediments deposited prior to the latest Holocene. Most designated soils identified are S1 and S2 and in areas where eolian deposits are greater than 1.5 feet, a series of stacked S1 and S2 soils indicating cummulate ages dating back to the early to mid Holocene for initiation of deposition. These regions primarily represent areas of older more robust eolian sand migration zones and the eolian sand migration rate has slowed considerably during the late Holcene.

S0 **Active Washes and Ponding Areas** - Generalized unit representing active washes and ponding areas. These areas are important for eolian systems as a sand source, sand transport and stabilizing moisture. Correlates with designated soil S0. Washes of many scales occur across the site; hence, only some are mapped.

### Pleistocene and Pliocene Sediments (alluvial and fluvial)

Qoaf **Pleistocene Older Alluvium Deposits** - correlates with designated Soils S4 and S5. Erosion of these units upslope provided a source for eolian sands.

**S7a Tmm** Fluvial, ancient playa-lake, and Colorado River Deposits that produce relatively abundant eolian sands upon erosion. Unit primarily correlates with the **Bullhead Alluvium** of Howard et al. (2015), unit QTmm of Stone (2006), possibly some Bouse Formation of Spencer (2008), and Unit B of Metzger et al.(1973). Units are early Pliocene in age (Bullhead Alluvium - 4.5 to 3.5 Ma; Howard et al., 2015). Petrified wood bearing uper slope member extending to elevations over 850 feet.

Bedrock areas of the northern Mule Mountains.

Sand migration directions depicting via downslope migration by wash flow (cyan arrows), and upslope eolian transport via wind (Black arrows). A large component of wash flow sands were previously deposited eolian sands (recycled).

Sand migration direction over time of eolian sands via prevailing winds (black arrows).

Mapped dirt roads. Many of the dirt roads in close proximity and within the Site are surmised to have been produced during General Pattons tank war excersises in the early 1940's. These roads provide evidence supporting eolian geomorphic zones stability on a decadal scale, particularly for Zone BC, and Zone C.

Kenney GeoScience

CLIENT: AECOM

PROJECT: CRIMSON SOLAR PROJECT

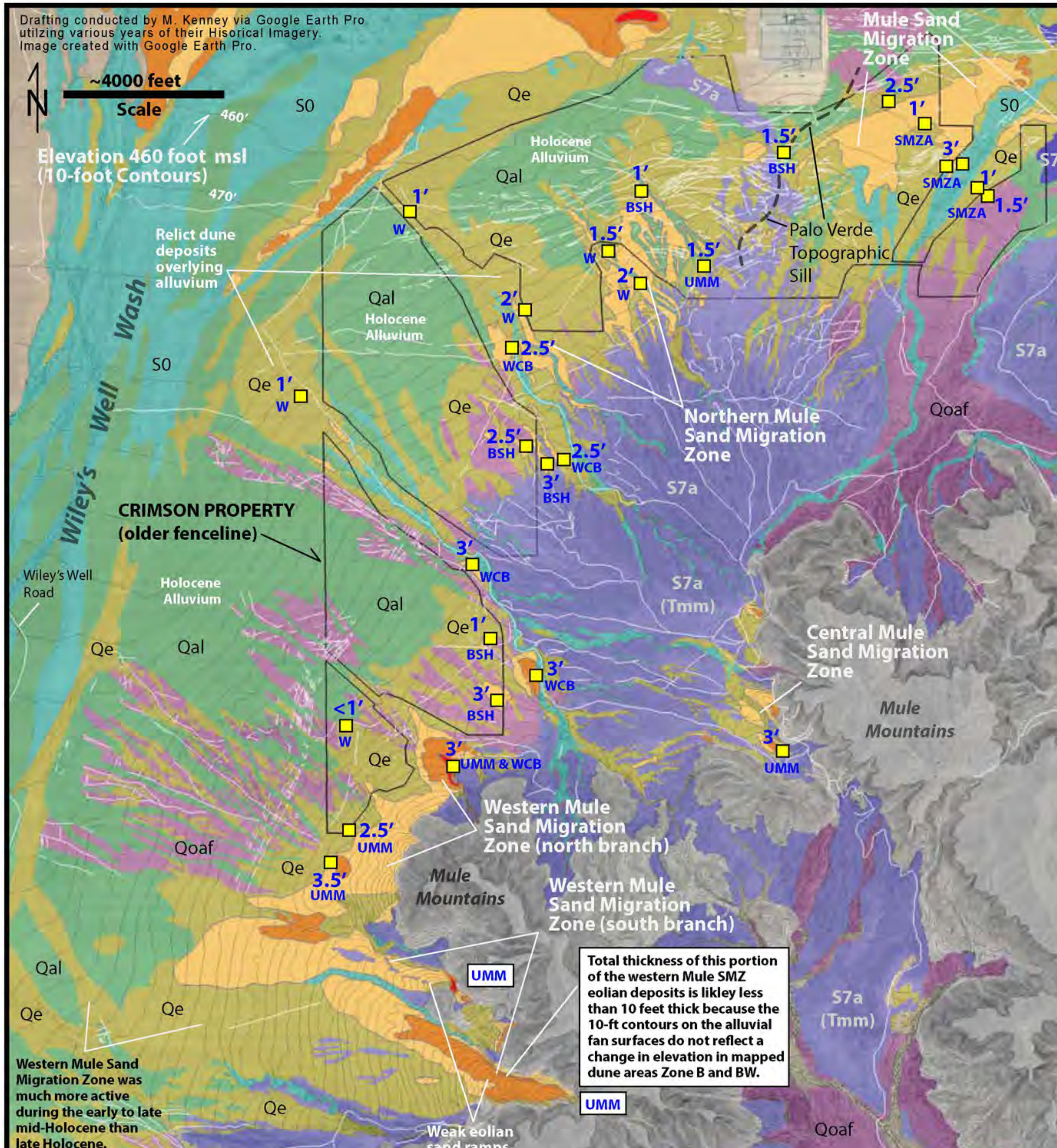
Soil Stratigraphic & Sand Migration Zone Map - Southern Region of Crimson Solar Project

Job No. 737-16

Date: October, 2018

Drafted by: MDK

**PLATE 6B**




## Eolian Deposits Thickness overlying alluvial deposits

**3'** WCB — Approximate thickness (feet) of eolian dune deposits estimated from test pits and local geomorphology. Geomorphic environment of the dune sands provided as either: within Sand Migration Zone area (SMZA), Wash (W), Wash Cutbank (WCB), Bar & Swale or topographic "hallow" (BSH), or upslope impedence associated with the Mule Mountains (UMM). All eolian deposits evaluated based on soil profile development (stacked-buried) soils to be Holocene age with majority of the eolian sand mass having been deposited between the early to late mid-Holocene. Active late Holocene sands are generally only an inch to 3 inches thick. A transition from alluvial deposition dominating the area to subsequent eolian deposition sufficient to result in eolian dominated (geomorpically) areas occured in the area in the early Holocene.

## Eolian Geomorphic - Relative Sand Migration Zones

**Zone BW** - Moderate to weak eolian sand migration rate, and area dominated by stable (vegetated) and eroding older dune deposits. Active eolian sands generally cover much less than 50% of the surface area. Dunes are thin, generally less 1 to 2 feet thick. Interdune ponding areas. Weak fluvial systems occur in places.

**Zone B** - Moderate eolian sand migration rate and area dominated by older stable dune deposits with active eolian sands covering generally 50% or more of the area. Active eolian sands are thin (less than 1 to 3 inches thick) sand sheets, coppice, and low relief mounds. Fluvial washes are not common. Zone B areas cover small areas.

**Zone AB** - Moderate to strong sand migration rate and area characterized by mostly active dune sands exposed on the surface involving sand sheets, coppice, low relief mounds, and in places weak linear dunes with occassional seasonal avalanche faces. No areas of Zone AB were mapped within the proposed Crimson project boundary.

## Holocene Stratigraphic Units

Qal — **Holocene Alluvial Deposits - Soils** - Areas exhibiting primarily alluvial deposits of Holocene age corresponding to designated soils S0, S1, S2, S3a and S3b. Fluvial activity (erosion and transport) on these areas provided eolian sources and recycling (fluvial movement downslope then up or across slope movement by the wind) of eolian sands throughout the Holocene.

Qe — **Holocene Eolian Deposits - Soils** - Areas exhibiting relatively abundant stable and mid to late Holocene (relict, dormant) eolian sand deposits. Hence, in these areas, the exposed surface deposits are dominated by relict eolian sediments deposited prior to the latest Holocene. Most designated soils identified are S1 and S2 and in areas where eolian deposits are greater than 1.5 feet, a series of stacked S1 and S2 soils indicating cummulate ages dating back to the early to mid Holocene for initiation of deposition. These regions primarily represent areas of older more robust eolian sand migration zones and the eolian sand migration rate has slowed considerably during the late Holcene.

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## Pleistocene and Pliocene Sediments (alluvial and fluvial)

Qoaf — **Pleistocene Older Alluvium Deposits** - correlates with designated Soils S4 and S5. Erosion of these units upslope provided a source for eolian sands. Deposited in unconformity of unit Tmm in most places.

S7 Tmw — Fluvial Colorado River Gravels associated with an ancient "shoreline-river edge) near elevation 430 to 450 feet above sea level (msl, blue lines). This unit is correlated stratigraphically to unit QTmw of Stone (2006), Unit B (Quarry Gravels) of Metzger et al. (1973), and member of the **Bullhead Alluvium** of Howard et al. (2015). Units are early Pliocene in age (Bullhead Alluvium - 4.5 to 3.5 Ma; Howard et al., 2015).

S7a Tmm — Fluvial, ancient playa-lake, and Colorado River Deposits that produce relatively abundant eolian sands upon erosion. Unit primarily correlates with the **Bullhead Alluvium** of Howard et al. (2015), unit QTmm of Stone (2006), possibly some Bouse Formation of Spencer (2008), and Unit B of Metzger et al.(1973). Units are early Pliocene in age (Bullhead Alluvium - 4.5 to 3.5 Ma; Howard et al., 2015). Petrified wood bearing uper slope member extending to elevations over 850 feet.

Bedrock areas of the northern Mule Mountains.

Mapped dirt roads. Many of the dirt roads in close proximity and within the Site are surmised to have been produced during General Pattons tank war excersises in the early 1940's. These roads provide evidence supporting eolian geomorphic zones stability on a decadal scale, particularly for Zone BC, and Zone C.

Kenney GeoScience

CLIENT: AECOM

PROJECT: CRIMSON SOLAR PROJECT

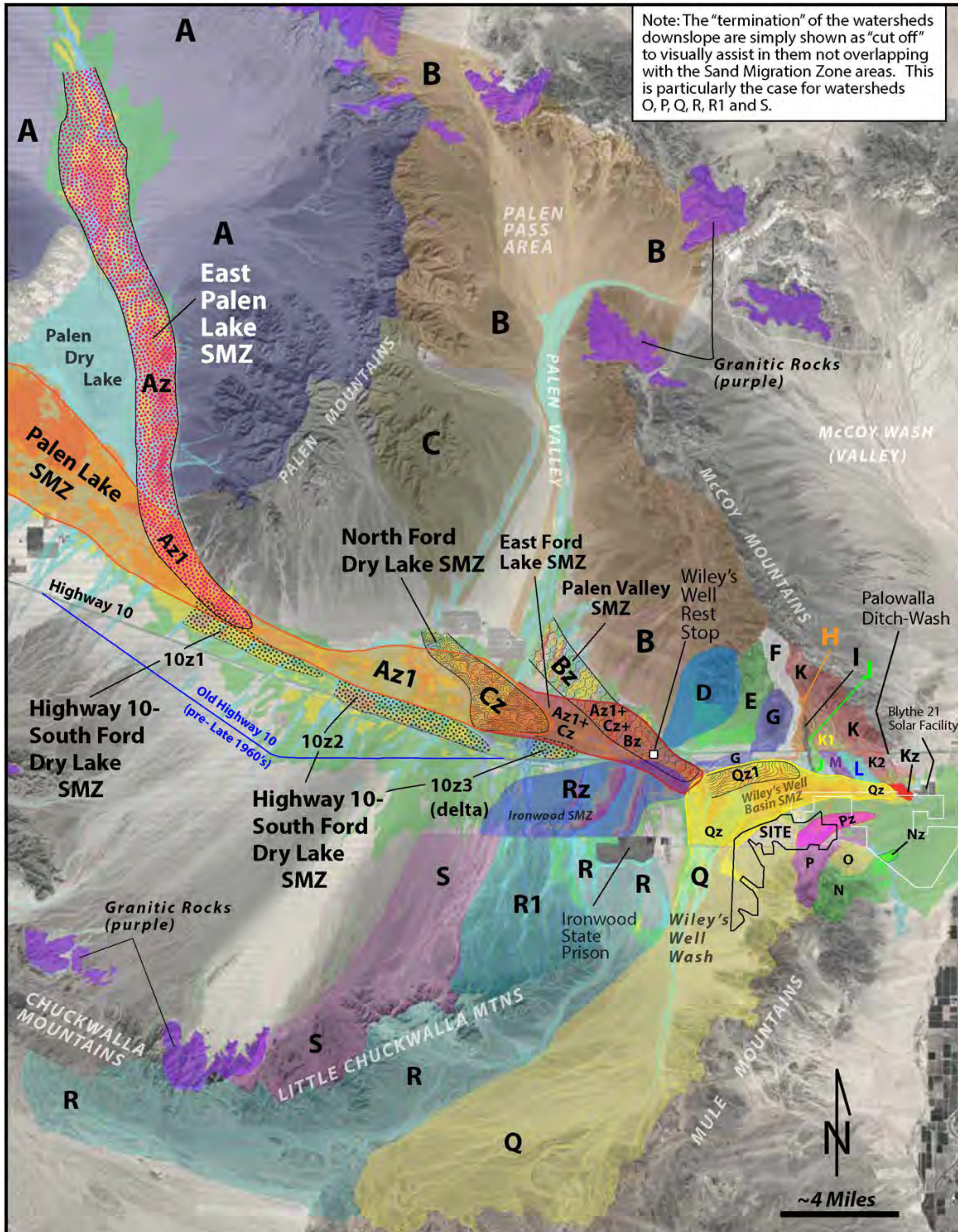
Soil Stratigraphic & Sand Migration Zone Map Showing Total Thickness of Eolian Deposits

Job No. 737-16

Date: October, 2018

Drafted by: MDK

**PLATE 6C**




| Water-shed | Square Miles | What Sand Migration Zone the watershed feeds | Notes Regarding Sand Migration Zones Interactions and Eolian Sand Sources |
|---|---|---|---|
| A | 265 | Az | **East Palen Lake SMZ** - mixes with Palen Lake SMZ to create SMZ Az1 |
| B | 127 | Bz | **Palen Valley SMZ** - mixes with East Ford Lake SMZ to the souteast (Az1+Cz+Bz) |
| C | 26 | Cz | **North Ford Dry Lake SMZ** - mixes with SMZ Az1 and East Ford Lake SMZ to the east |
| | | Az1+Cz | **East Ford Dry Lake SMZ** - mix of Az1+Cz SMZ's, and sands from erosion of playa sediments & older degrading dunes from the west |
| | | Az1+Cz+Bz | **East Ford Dry Lake SMZ** - mix of Az1+Cz +Bz SMZ's, and sands from erosion of playa sediments & older degrading dunes from the west |
| D | 5.4 | Az1+Cz+Bz | Watershed D flow is diverted to provide sand to SMZ's Az1+Cz+Bz |
| E | 3.7 | Az1+Cz+Bz | Watershed E flow is diverted to under Highway 10 to provide sand to SMZ's Az1+Cz+Bz |
| F | 1.9 | Qz1 | Watershed F flow is diverted to Wiley's Well Basin to provide sand to SMZ's Qz1 & Qz |
| G | 2.3 | Qz1 | Watershed G flow is diverted to Wiley's Well Basin adding sand to SMZ's Qz1 & Qz |
| H | 0.4 | Qz1 | Watershed H flow is diverted to Wiley's Well Basin adding sand to SMZ's Qz1 & Qz |
| I | 0.3 | Qz | Watershed I flows close to natural course under HWY10 to north central SMZ Qz |
| J | 0.3 | Qz | Watershed J flows close to natural course under HWY10 to north central SMZ Qz |
| K | 4.0 | Kz | **Pallowalla SMZ** - Watershed K flow diverted to Palowalla Ditch adding sand to SMZ Kz |
| K1 | 1.3 | Kz | **Pallowalla SMZ** - Watershed K1 flow diverted to Palowalla Ditch adding sand to SMZ Kz |
| K2 | 1.0 | Kz | **Pallowalla SMZ** - Watershed K2 flows mostly naturally adding sand to SMZ Kz |
| L | 0.6 | Qz | **Wiley's Well Basin SMZ** |
| M | 0.5 | Qz | **Wiley's Well Basin SMZ** |
| N | 3.1 | Nz | **Powerline SMZ** - Watershed N flows with slight dirt road diversion to ponding area Nz |
| O | 1.1 | Nz | **Powerline SMZ** - Watershed O flows with slight dirt road diversion to ponding area Nz |
| P | 1.7 | Pz | **Mule SMZ** - Watershed P flows without diversion (naturally) providing sand to SMZ Pz |
| Q | 71 | Qz | **Wiley's Well Basin SMZ** - Watershed Q flows naturally along Wiley's Well Wash providing abundant eolian sands to SMZ Qz |
| R | 68 | Rz | **Ironwood SMZ** - Most flow in Watershed R occurs naturally west of Ironwood Prison. Relatively minor flow diversions in Watershed R flows and ponds around Ironwood Prison. These flows, primarily on west side of R provided abundant eolian sand to SMZ Rz |
| R1 | 16.4 | Rz | **Ironwood SMZ** - Watershed R1 flows naturally to the west side of SMZ Rz and provides relatively abundant eolian sand to SMZ Rz. Further downslope, flow in the western part of watershed R1 is focused by flood control berms of HWY10 providing sands to SMZ 10z3. |
| S | 26.3 | Rz | Watershed S provides flows naturally to provide minor eolian sand to the western upwind western region of the Ironwood SMZ. Downslope, watershed S is focussed by flood control berms and flows onto Ford Dry Lake providing sands to East Ford Dry Lake SMZ. |
| | 10z1 | I | Increased and focussed drainage flow associated with HWY 10 flood control berms (old and new highways) resulted in increased eolian sand production north of HWY 10 where flow rate is increased substantially leading to the creation of SMZ 10z2. |
| | 10z2 | | ISame description as for SMZ 10z1. |
| S | 10z3 | | Eolian sands eminating from the delta in SE Ford Dry Lake with historical drainage flow increaseed due to flood control berms associated with HWY 10 |

Mapping conducted by M. Kenney via Google Earth Pro utilzing various years of their Hisorical Imagery. Image created with Google Earth Pro (10.2016).

Kenney GeoScience

CLIENT: AECOM

PROJECT: CRIMSON SOLAR PROJECT

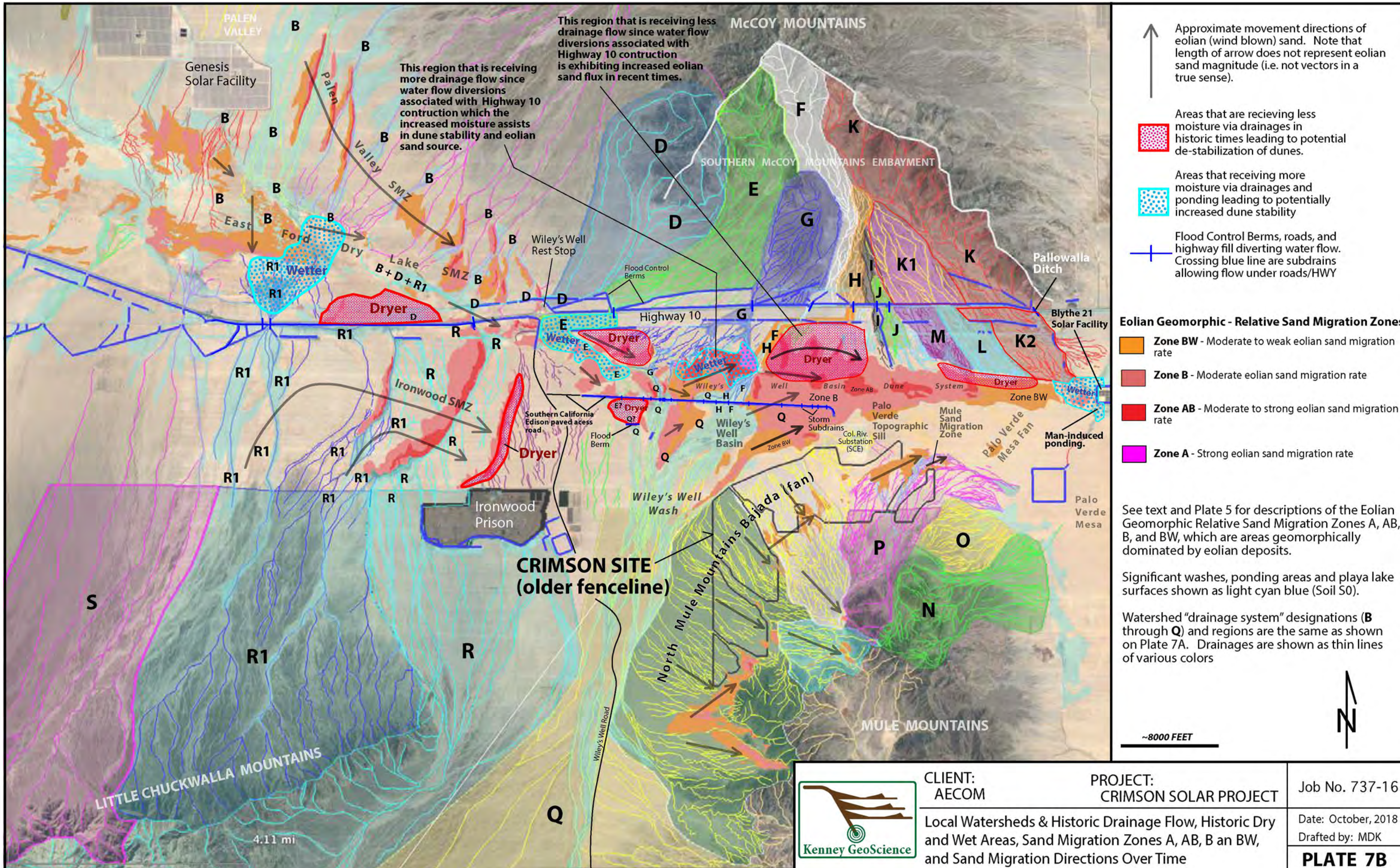
Watershed and Respective Eolian Sand Migration Zones (SMZ) of the Chuckwalla Valley Region

Job No. 737-16

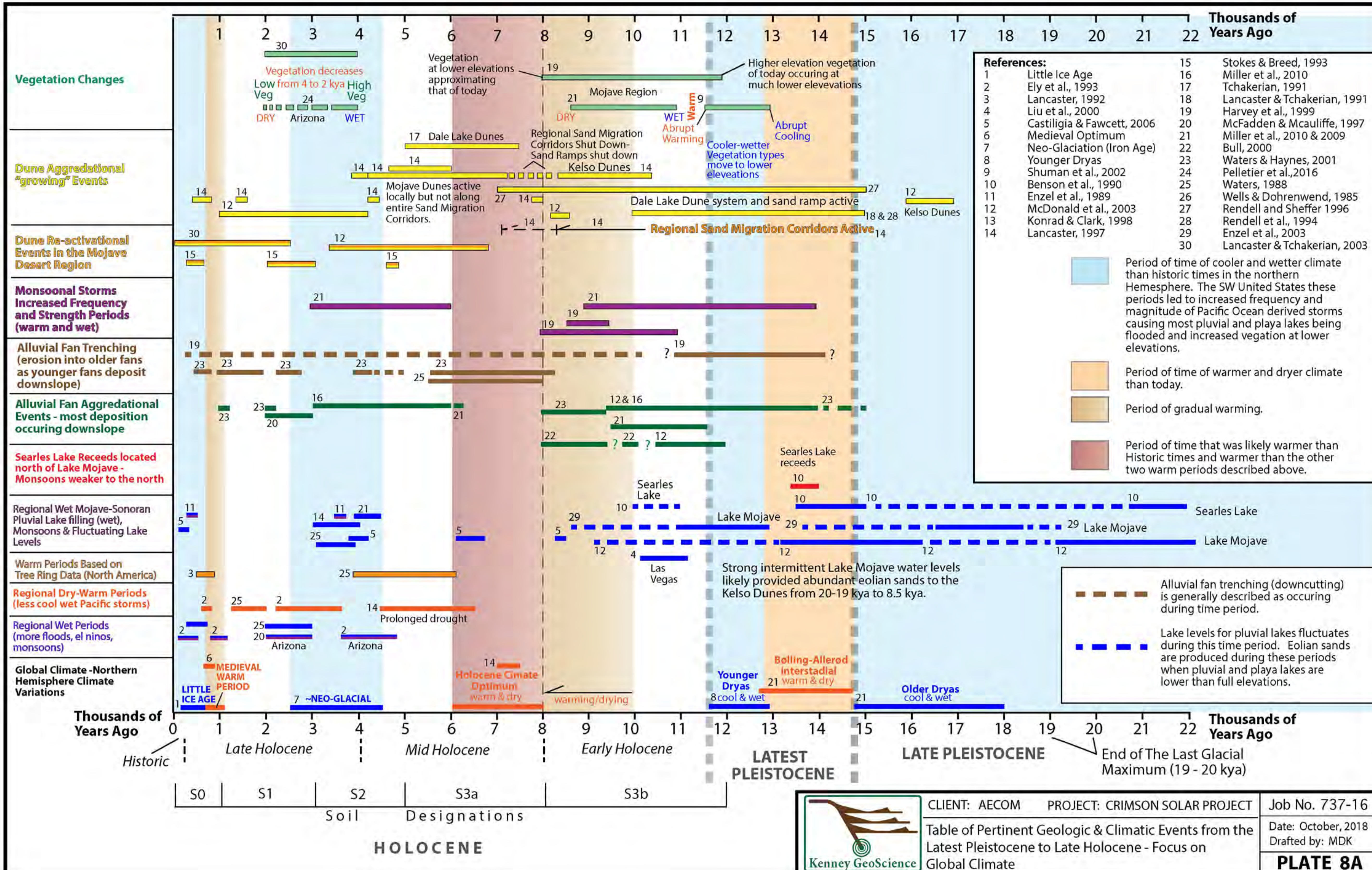
Date: October, 2018

Drafted by: MDK

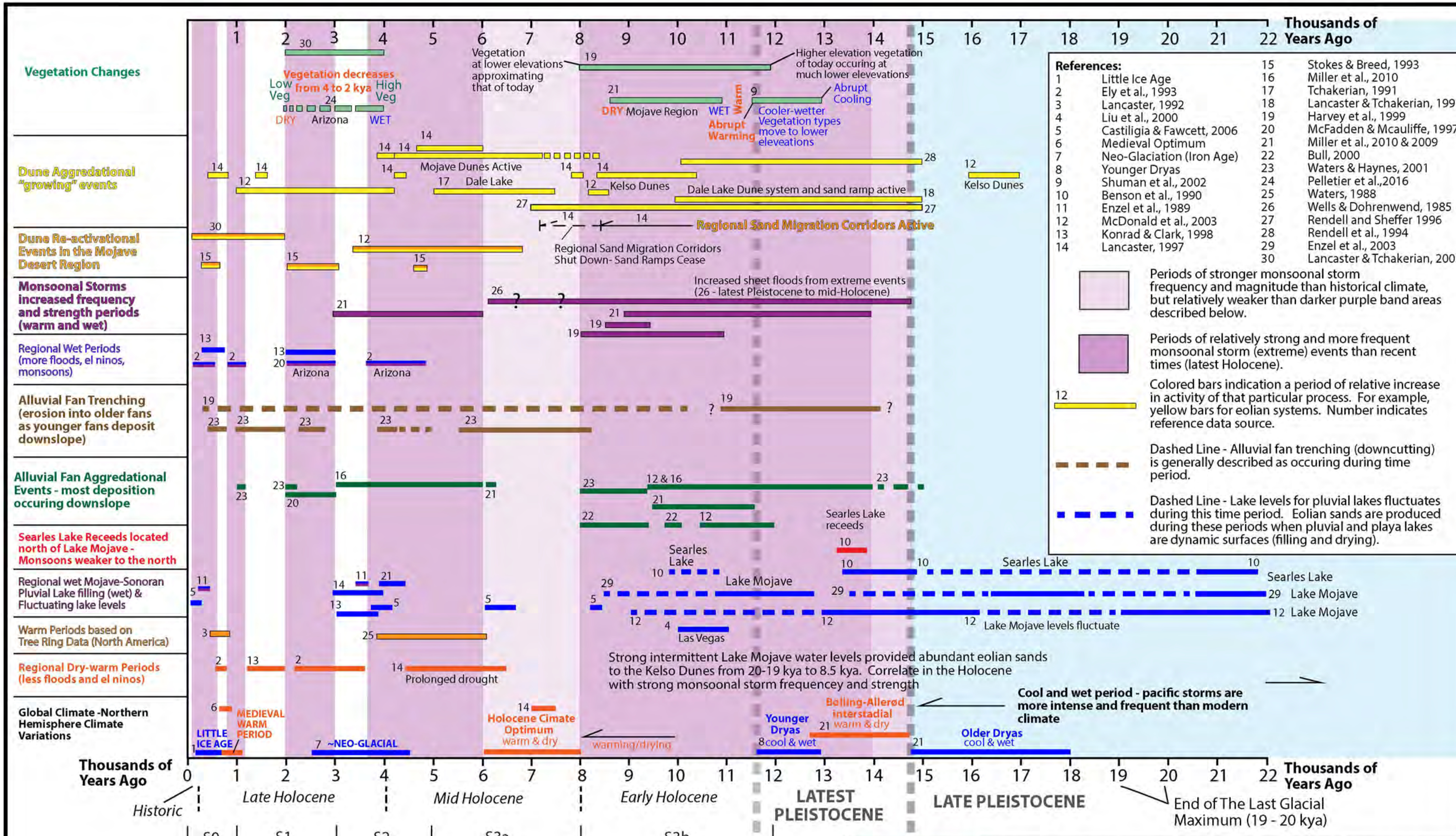
PLATE 7A



McCOY MOUNTAINS
SOUTHERN McCOY MOUNTAINS EMBAYMENT
MULE MOUNTAINS
LITTLE CHUCKWALLA MOUNTAINS
PALEN VALLEY
Genesis Solar Facility
Blythe 21 Solar Facility
Pallowalla Ditch
Palo Verde Mesa
Palo Verde Mesa Fan
Palo Verde Topographic Sill
Mule Sand Migration Zone
Col. Riv. Substation (SCE)
Storm Subdrains
Man-induced ponding.
Zone B
Zone BW
Zone AB
Wiley's Well Basin
Wiley's Well Basin Dune System
Wiley's Well Wash
Wiley's Well Road
Wiley's Well Rest Stop
Flood Control Berms
Flood Berm
Southern California Edison paved acess road
Ironwood Prison
Ironwood SMZ
Palen Valley SMZ
East Ford Dry Lake SMZ
B+D+R1
Highway 10
North Mule Mountains Bajada (fan)
CRIMSON SITE (older fenceline)
Dryer
Wetter
This region that is receiving more drainage flow since water flow diversions associated with Highway 10 contruction which the increased moisture assists in dune stability and eolian sand source.
This region that is receiving less drainage flow since water flow diversions associated with Highway 10 contruction is exhibiting increased eolian sand flux in recent times.
B D E F G H I J K K1 K2 L M N O P Q R R1 S
4.11 mi
Approximate movement directions of eolian (wind blown) sand. Note that length of arrow does not represent eolian sand magnitude (i.e. not vectors in a true sense).
Areas that are recieving less moisture via drainages in historic times leading to potential de-stabilization of dunes.
Areas that receiving more moisture via drainages and ponding leading to potentially increased dune stability
Flood Control Berms, roads, and highway fill diverting water flow. Crossing blue line are subdrains allowing flow under roads/HWY
Eolian Geomorphic - Relative Sand Migration Zones
Zone BW - Moderate to weak eolian sand migration rate
Zone B - Moderate eolian sand migration rate
Zone AB - Moderate to strong eolian sand migration rate
Zone A - Strong eolian sand migration rate
See text and Plate 5 for descriptions of the Eolian Geomorphic Relative Sand Migration Zones A, AB, B, and BW, which are areas geomorphically dominated by eolian deposits.
Significant washes, ponding areas and playa lake surfaces shown as light cyan blue (Soil S0).
Watershed "drainage system" designations (B through Q) and regions are the same as shown on Plate 7A. Drainages are shown as thin lines of various colors
N
~8000 FEET
Kenney GeoScience
CLIENT: AECOM
PROJECT: CRIMSON SOLAR PROJECT
Job No. 737-16
Local Watersheds & Historic Drainage Flow, Historic Dry and Wet Areas, Sand Migration Zones A, AB, B an BW, and Sand Migration Directions Over Time
Date: October, 2018
Drafted by: MDK
PLATE 7B



Thousands of Years Ago
Vegetation Changes
Dune Aggredational "growing" Events
Dune Re-activational Events in the Mojave Desert Region
Monsoonal Storms Increased Frequency and Strength Periods (warm and wet)
Alluvial Fan Trenching (erosion into older fans as younger fans deposit downslope)
Alluvial Fan Aggredational Events - most deposition occuring downslope
Searles Lake Receeds located north of Lake Mojave - Monsoons weaker to the north
Regional Wet Mojave-Sonoran Pluvial Lake filling (wet), Monsoons & Fluctuating Lake Levels
Warm Periods Based on Tree Ring Data (North America)
Regional Dry-Warm Periods (less cool wet Pacific storms)
Regional Wet Periods (more floods, el ninos, monsoons)
Global Climate -Northern Hemisphere Climate Variations
Vegetation decreases
Low from 4 to 2 kya High
Veg Veg
DRY Arizona WET
Vegetation at lower elevations approximating that of today
Mojave Region
Higher elevation vegetation of today occuring at much lower elevevations
Abrupt Cooling
Abrupt Warming
Warm
Cooler-wetter Vegetation types move to lower eleveations
Dale Lake Dunes
Regional Sand Migration Corridors Shut Down-Sand Ramps shut down
Kelso Dunes
Mojave Dunes active locally but not along entire Sand Migration Corridors.
Dale Lake Dune system and sand ramp active
Kelso Dunes
Regional Sand Migration Corridors Active
Searles Lake receeds
Searles Lake
Lake Mojave
Searles Lake
Lake Mojave
Lake Mojave
Las Vegas
Strong intermittent Lake Mojave water levels likely provided abundant eolian sands to the Kelso Dunes from 20-19 kya to 8.5 kya.
Arizona
Arizona
Prolonged drought
LITTLE ICE AGE
MEDIEVAL WARM PERIOD
~NEO-GLACIAL
Holocene Climate Optimum warm & dry
warming/drying
Younger Dryas cool & wet
Bølling-Allerød interstadial warm & dry
Older Dryas cool & wet
Historic
Late Holocene
Mid Holocene
Early Holocene
LATEST PLEISTOCENE
LATE PLEISTOCENE
End of The Last Glacial Maximum (19 - 20 kya)
S0 S1 S2 S3a S3b
Soil Designations
HOLOCENE
References:
1 Little Ice Age
2 Ely et al., 1993
3 Lancaster, 1992
4 Liu et al., 2000
5 Castiglia & Fawcett, 2006
6 Medieval Optimum
7 Neo-Glaciation (Iron Age)
8 Younger Dryas
9 Shuman et al., 2002
10 Benson et al., 1990
11 Enzel et al., 1989
12 McDonald et al., 2003
13 Konrad & Clark, 1998
14 Lancaster, 1997
15 Stokes & Breed, 1993
16 Miller et al., 2010
17 Tchakerian, 1991
18 Lancaster & Tchakerian, 1991
19 Harvey et al., 1999
20 McFadden & Mcauliffe, 1997
21 Miller et al., 2010 & 2009
22 Bull, 2000
23 Waters & Haynes, 2001
24 Pelletier et al.,2016
25 Waters, 1988
26 Wells & Dohrenwend, 1985
27 Rendell and Sheffer 1996
28 Rendell et al., 1994
29 Enzel et al., 2003
30 Lancaster & Tchakerian, 2003
Period of time of cooler and wetter climate than historic times in the northern Hemesphere. The SW United States these periods led to increased frequency and magnitude of Pacific Ocean derived storms causing most pluvial and playa lakes being flooded and increased vegation at lower elevations.
Period of time of warmer and dryer climate than today.
Period of gradual warming.
Period of time that was likely warmer than Historic times and warmer than the other two warm periods described above.
Alluvial fan trenching (downcutting) is generally described as occuring during time period.
Lake levels for pluvial lakes fluctuates during this time period. Eolian sands are produced during these periods when pluvial and playa lakes are lower than full elevations.
Kenney GeoScience
CLIENT: AECOM PROJECT: CRIMSON SOLAR PROJECT
Table of Pertinent Geologic & Climatic Events from the Latest Pleistocene to Late Holocene - Focus on Global Climate
Job No. 737-16
Date: October, 2018
Drafted by: MDK
PLATE 8A



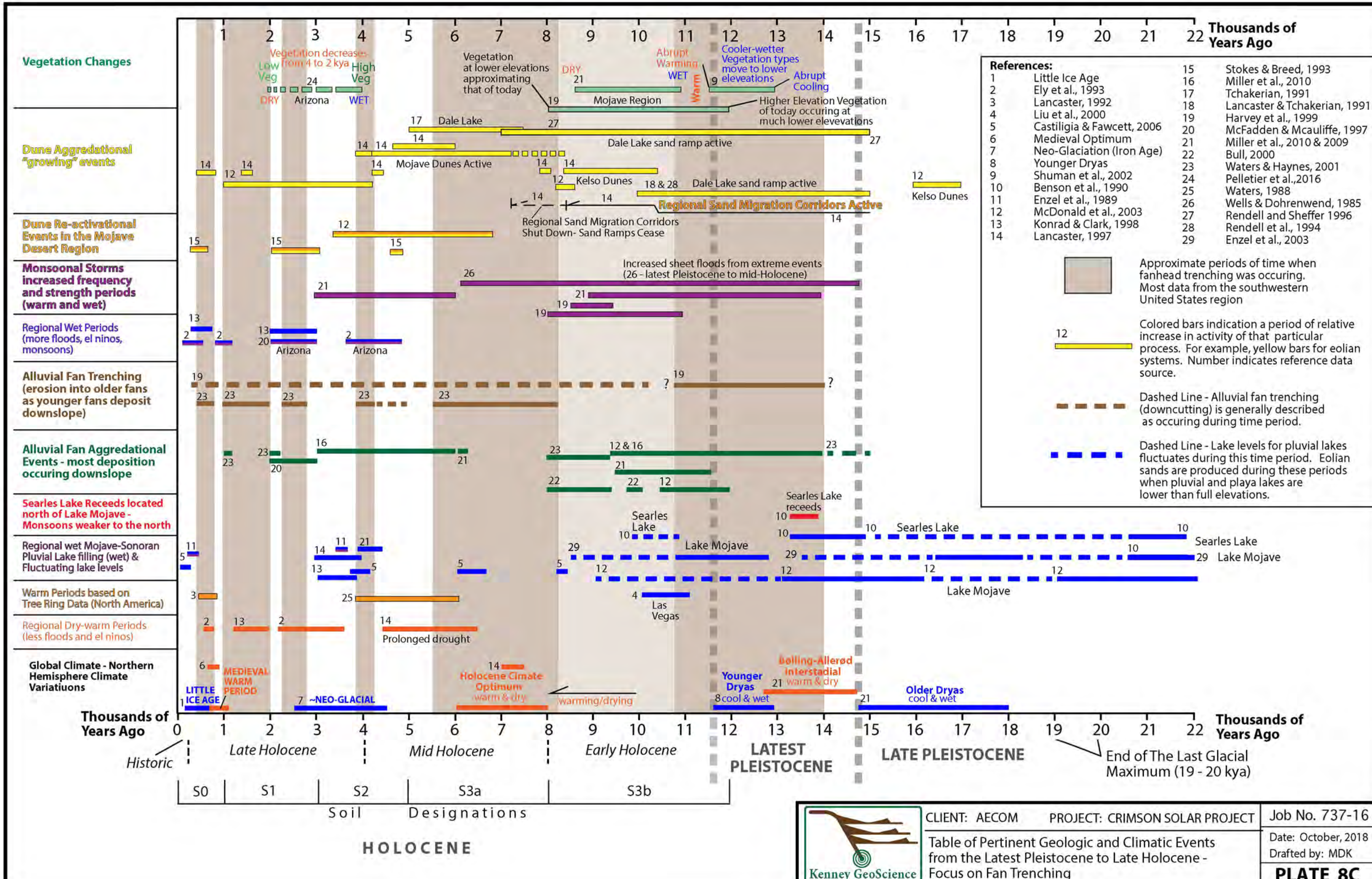

Kenney GeoScience

CLIENT: AECOM | PROJECT: CRIMSON SOLAR PROJECT | Job No. 737-16

Table of Pertinent Geologic and Climatic Events From the Latest Pleistocene to Late Holocene - focus on North American Monsoonal Climate

Date: October, 2018
Drafted by: MDK

**PLATE 8B**



Thousands of Years Ago
Vegetation Changes
Dune Aggradational "growing" events
Dune Re-activational Events in the Mojave Desert Region
Monsoonal Storms increased frequency and strength periods (warm and wet)
Regional Wet Periods (more floods, el ninos, monsoons)
Alluvial Fan Trenching (erosion into older fans as younger fans deposit downslope)
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Searles Lake Receeds located north of Lake Mojave - Monsoons weaker to the north
Regional wet Mojave-Sonoran Pluvial Lake filling (wet) & Fluctuating lake levels
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Global Climate - Northern Hemisphere Climate Variatiuons
Low Veg
Vegetation decreases from 4 to 2 kya
High Veg
DRY
Arizona
WET
Vegetation at lower elevations approximating that of today
Abrupt Warming
Warm
Cooler-wetter Vegetation types move to lower eleveations
Abrupt Cooling
Mojave Region
Higher Elevation Vegetation of today occuring at much lower elevevations
Dale Lake
Dale Lake sand ramp active
Mojave Dunes Active
Kelso Dunes
18 & 28
Regional Sand Migration Corridors Active
Regional Sand Migration Corridors Shut Down- Sand Ramps Cease
Kelso Dunes
Increased sheet floods from extreme events (26 - latest Pleistocene to mid-Holocene)
Arizona
Searles Lake receeds
Searles Lake
Lake Mojave
Searles Lake
Lake Mojave
Lake Mojave
Las Vegas
Prolonged drought
LITTLE ICE AGE
MEDIEVAL WARM PERIOD
~NEO-GLACIAL
Holocene Climate Optimum warm & dry
warming/drying
Younger Dryas cool & wet
Bølling-Allerød Interstadial warm & dry
Older Dryas cool & wet
Historic
Late Holocene
Mid Holocene
Early Holocene
LATEST PLEISTOCENE
LATE PLEISTOCENE
End of The Last Glacial Maximum (19 - 20 kya)
S0
S1
S2
S3a
S3b
Soil Designations
HOLOCENE
References:
1 Little Ice Age
2 Ely et al., 1993
3 Lancaster, 1992
4 Liu et al., 2000
5 Castiligia & Fawcett, 2006
6 Medieval Optimum
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14 Lancaster, 1997
15 Stokes & Breed, 1993
16 Miller et al., 2010
17 Tchakerian, 1991
18 Lancaster & Tchakerian, 1991
19 Harvey et al., 1999
20 McFadden & Mcauliffe, 1997
21 Miller et al., 2010 & 2009
22 Bull, 2000
23 Waters & Haynes, 2001
24 Pelletier et al.,2016
25 Waters, 1988
26 Wells & Dohrenwend, 1985
27 Rendell and Sheffer 1996
28 Rendell et al., 1994
29 Enzel et al., 2003
Approximate periods of time when fanhead trenching was occuring. Most data from the southwestern United States region
Colored bars indication a period of relative increase in activity of that particular process. For example, yellow bars for eolian systems. Number indicates reference data source.
Dashed Line - Alluvial fan trenching (downcutting) is generally described as occuring during time period.
Dashed Line - Lake levels for pluvial lakes fluctuates during this time period. Eolian sands are produced during these periods when pluvial and playa lakes are lower than full elevations.
Kenney GeoScience
CLIENT: AECOM
PROJECT: CRIMSON SOLAR PROJECT
Table of Pertinent Geologic and Climatic Events from the Latest Pleistocene to Late Holocene - Focus on Fan Trenching
Job No. 737-16
Date: October, 2018
Drafted by: MDK
PLATE 8C

# I.4 Decommissioning & Reclamation Plan, November 2018

Environment

Prepared for:
Sonoran West Solar Holdings, LLC
San Francisco, California

Prepared by:
AECOM
San Diego, CA
60487757
November 2018

# Final

# Decommissioning & Reclamation Plan

## RE Crimson Solar Project

AECOM Environment

Prepared for:
Sonoran West Solar Holdings, LLC
San Francisco, California

Prepared by:
AECOM
San Diego, CA
60487757
November 2018

AECOM Environment

Prepared for:
Sonoran West Solar Holdings, LLC
San Francisco, California

Prepared by:
AECOM
San Diego, CA
60487757
November 2018

# Final

# Decommissioning & Reclamation Plan

**RE Crimson Solar Project**

Prepared By: Amy Gardner

Reviewed By: Jennifer Guigliano

# Contents

# List of Figures



# List of Appendices

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# List of Abbreviations and Acronyms

| | |
|---|---|
| AB | Authorized Biologist |
| AC | alternating current |
| Applicant | Sonoran West Solar Holdings, LLC |
| bgs | below ground surface |
| BLM | Bureau of Land Management |
| BMP | best management practice |
| CDFW | California Department of Fish and Wildlife |
| CFR | Code of Federal Regulations |
| CRS | Colorado River Substation |
| DC | direct current |
| DESCP | Drainage, Erosion, and Sediment Control Plan |
| DRP | Decommissioning and Reclamation Plan |
| EIR | Environmental Impact Report |
| EIS | Environmental Impact Statement |
| HASP | Health and Safety Plan |
| HMBP | Hazardous Materials Business Plan |
| IM | (BLM) Instruction Memorandum |
| kV | kilovolt |
| LEID | Low-environmental impact design |
| LORS | Laws, Ordinances, Regulations, and Standards |
| MW | megawatt |
| NEPA | National Environmental Policy Act |
| O&M | operation and maintenance |
| Plan | Decommissioning and Site Reclamation Plan |
| POD | Plan of Development |
| Project | RE Crimson Solar Project |
| PV | photovoltaic |
| RCE | Reclamation Cost Estimate |
| ROD | Record of Decision |
| ROW | right-of-way |
| Solar Facility | RE Crimson Solar Project |
| SCADA | Supervisory Control and Data Acquisition |
| SCE | Southern California Edison |

| | |
|---|---|
| SPCC | Spill Prevention Control and Countermeasure (Plan) |
| U.S. | United States |
| USFWS | U.S. Fish and Wildlife Service |

# 1.0 Introduction

This document presents a Decommissioning and Reclamation Plan (DRP or Plan) for the RE Crimson Solar Project (Project), a utility-scale solar photovoltaic (PV) and energy storage project constructed on an approximately 2,489-acre parcel of Bureau of Land Management (BLM) administered land in an unincorporated area of eastern Riverside County, California. This DRP was prepared by AECOM for Sonoran West Solar Holdings, LLC (Applicant), a wholly owned subsidiary of Recurrent Energy, LLC. The Project is approximately 13 miles west of Blythe, just north of Mule Mountain and just south of Interstate 10.

The Project would interconnect to the regional electrical grid at the Southern California Edison (SCE) 230-kilovolt (kV) Colorado River Substation (CRS). It would generate up to 350 megawatts (MW) of renewable energy using PV technology and would include up to 350 MW of integrated energy storage capacity. The Project boundary and features are shown for reference in Figure 1. The siting of the Project is dependent on the outcome of the Applicant's application with the BLM for issuance of a right-of-way (ROW) grant to construct and operate the Project on federal lands managed by the BLM. The BLM is expected to make its determination concerning the Applicant's request for the use of federal lands in summer 2019.

## 1.1 Plan Purpose and Objectives

The purpose of this Plan is to set forth the procedures and practices that will be employed by the Project to meet federal and state requirements associated with reclamation of the Project site affected during construction activities, and for the rehabilitation and revegetation of the Project site after decommissioning. Reclamation activities will restore vegetative cover and hydrologic function, control erosion, and minimize habitat and landform alteration during and after the life of the Project at a level commensurate with the proposed use of the lands at the time.

The objective of Project decommissioning and site reclamation is to remove any installed Project equipment at the time of decommissioning and return the site to a condition as close to its pre-construction state as practicable as further discussed in Section 5.0. The procedures outlined herein are formulated to ensure public health and safety, environmental protection, and compliance with applicable regulations. The procedures described identify the proposed activities to restore the site upon operation completion.

### 1.1.1 Regulatory Criteria

The Applicant is responsible for implementing aspects of reclamation and decommissioning in accordance with applicable federal, state, and local permits. Because the Project is proposed on federally managed public lands, compliance with the National Environmental Policy Act (NEPA) is required. At the time of this writing, the BLM is in the process of completing its NEPA review and, pending completion, is expected to issue a Record of

Decision (ROD) in the summer of 2019. In addition, the California Department of Fish and Wildlife (CDFW) is conducting a state environmental review under the California Environmental Quality Act and will administer the resulting mitigation measures contained in the final Environmental Impact Statement (EIS)/Environmental Impact Report (EIR) upon certification. Federal and State biological resources agencies (i.e., U.S. Fish and Wildlife Service [USFWS] and the CDFW) are active participants in reviewing the Project plans and reports, including providing assistance in development of mitigation measures related to the protection of environmentally sensitive species and habitats during construction, operations, and decommissioning. The USFWS is a cooperating agency in the development of the EIS/EIR.

BLM Regulation 43 Code of Federal Regulations (CFR) 2804.25(b) authorizes the BLM to require ROW applicants (applying for ROW under Title V of Federal Land Policy and Management Act) to submit a DRP that defines the reclamation, revegetation, restoration, and soil stabilization requirements for the Project area as a component of the Plan of Development (POD). This DRP will be incorporated into the POD upon BLM approval.

### 1.1.2 Policy

The BLM's Instruction Memorandum (IM) No. 2011-003 provides updated guidance on the processing of ROW applications and the administration of ROW authorizations for solar energy projects on public lands. The IM describes required elements of this Plan and states that it will be used as the basis for determining the standard for reclamation, revegetation, restoration, and soil stabilization of the Project area and, ultimately, in determining the full bond amount. The IM requires that utility-scale solar projects include in its plan a Reclamation Cost Estimate (RCE) consistent with BLM Surface Management Regulations (43 CFR 3809) and Policy (IM 2009-153, dated June 19, 2009). The RCE plays a key role in determining a bond amount for a project and determining the appropriate financial guarantees for intensive land uses on the public lands. A description of bonding requirements associated with decommissioning activities and costs are included in Section 6 of this Plan.

If a ROW grant is issued for this project, the Applicant will submit to the BLM an RCE for the Project prior to the issuance of a Notice to Proceed. The RCE will address the following components.

- Earthwork/Recontouring: Roads, substation area, and mobilization/demobilization
- Revegetation/Stabilization: Roads, substation area, and mobilization/demobilization
- Structure, and Equipment Removal: Poles/pads, substation area, and mobilization/demobilization
- Administrative Costs

### 1.1.3 Plan Requirements

The purpose of this DRP is to set forth the procedures and practices that will be employed by the Project owner to meet federal and state requirements for the reclamation of the site affected during construction of the Project, and for the rehabilitation and revegetation of the Project area. This DRP may be modified to include requirements that would be defined in the final EIS/EIR for the Project or in the ROW grant, should one be issued.

The primary objectives of this Plan are that it shall include a cost estimate for implementing the proposed decommissioning and reclamation activities, and shall be consistent with the guidelines in BLM's 43 CFR 3809.550 et seq. In addition, all Project activities will be in compliance with the requirements of the BLM ROD and ROW grant, if issued, and associated environmental reviews. Components pertinent to this DRP include the following:

**Facility Closure Plan** – The BLM requires that a Provisional Closure Plan and Estimate of Permanent Closure Costs be provided within 60 days after the start of commercial operation. The Provisional Closure Plan is required to be updated every 5 years. Each updated Provisional Closure Plan shall reflect the most current regulatory standards; best management practices (BMPs); and applicable regulations and standards. Because conditions can change during the course of a 30-year project life, a Final Closure Plan will be submitted to the BLM at least 3 years prior to initiating a permanent facility closure for review and approval based on conditions as found at the time of facility closure.

**Health and Safety Plan (HASP)** – To comply with regulations set forth by the Occupational Health and Safety Administration, a HASP for decommissioning will be submitted to the BLM for approval within 30 days after notifying the BLM of intent to decommission the project, and at least 60 days prior to any decommissioning activities on the ground. The HASP will document health and safety requirements for establishing and maintaining a safe working environment during the implementation of the planned site decommissioning activities.

**Storm Water Management** – The Project will implement storm water management actions to minimize the potential for impacts to water quality and flow resulting from the Project. Storm water management will be defined through preparation and implementation of appropriate BMPs. Proposed storm water management measures and/or BMPs for decommissioning will be submitted to the BLM for approval within 30 days after notifying the BLM of intent to decommission the project, and at least 60 days prior to any decommissioning activities on the ground. If a single storm water management plan is prepared for the Project that combines decommissioning with construction and O&M phases, that plan will be submitted to the BLM for approval during finalization of the Project design and at least 90 days before a Notice to Proceed for construction is issued. In either case, the storm water management plan will include procedures to be followed during decommissioning to prevent erosion and sedimentation, non-storm water discharges, and contact between storm water and potentially polluting substances.

**Dust Control Plan** – Standard and enhanced (if needed) dust control mitigation measures will be implemented to reduce fugitive dust emissions during decommissioning activities. The Dust Control Plan will be submitted to the BLM for approval at least 90 days prior to issuance of a Notice to Proceed for construction if a single plan is prepared to cover all Project phases. The project owner will review and update the Dust Control Plan and submit it to the BLM for approval at least 90 days prior to the issuance of an NTP for each phase not covered by the prior Dust Control Plan.

**Hazardous Materials Business Plan (HMBP) –** A plan will be prepared detailing procedures for managing the facility's hazardous materials as listed in the HMBP. This plan will include procedures for handling, storing and removing hazardous substances at the Project site, their removal, their ultimate disposition, and any required confirmation soil sampling. The same plan may apply to decommissioning as to the construction, operation, and maintenance of the Project. The project owner will either update the existing HMBP, or create a new HMBP for decommissioning, and submit it to the BLM for approval 90 days prior to issuance of a Notice to Proceed for decommissioning.

**Spill Prevention Control and Countermeasure (SPCC) Plan** – The SPCC Plan for the Project site will include spill prevention, control, removal procedures, and countermeasures to be implemented during the construction, operation, maintenance, and decommissioning of the Project. The SPCC Plan will contain several key items, including (but not limited to) a spill record, description of facilities, spill response procedures, personnel training, and spill prevention. The same plan may apply to decommissioning as to the construction, operation, and maintenance of the Project. The project owner will either update the existing SPCC, or create a new SPCC for decommissioning, and submit it to the BLM for approval 90 days prior to issuance of a Notice to Proceed for decommissioning.

**Fire Prevention Plan –** A fire prevention plan will be prepared that outlines procedures and equipment to be used for fire detection and prevention during construction, operations and maintenance, and decommissioning. The Fire Prevention Plan will be submitted to the BLM for approval prior to issuance of a Notice to Proceed for construction. The project owner will review and update the existing Fire Prevention Plan and submit it to the BLM for approval 90 days prior to issuance of a Notice to Proceed for decommissioning.

**Transportation Plan –** A transportation plan for decommissioning will be prepared that outlines approved routes of travel and times and procedures for permit-required loads, as well as procedures to comply with applicable Department of Transportation regulations. The plan will be submitted to the BLM for approval 90 days prior to issuance of an NTP for decommissioning.

## 1.2 Future Land Use

It is anticipated that Sonoran West Solar Holdings, LLC, may request a renewal of the ROW grant prior to the end of the 30-year term. However, if a ROW grant renewal either was not requested or not granted, then the site will be decommissioned and reclaimed according to the terms and conditions of the ROW grant and the approved plans.

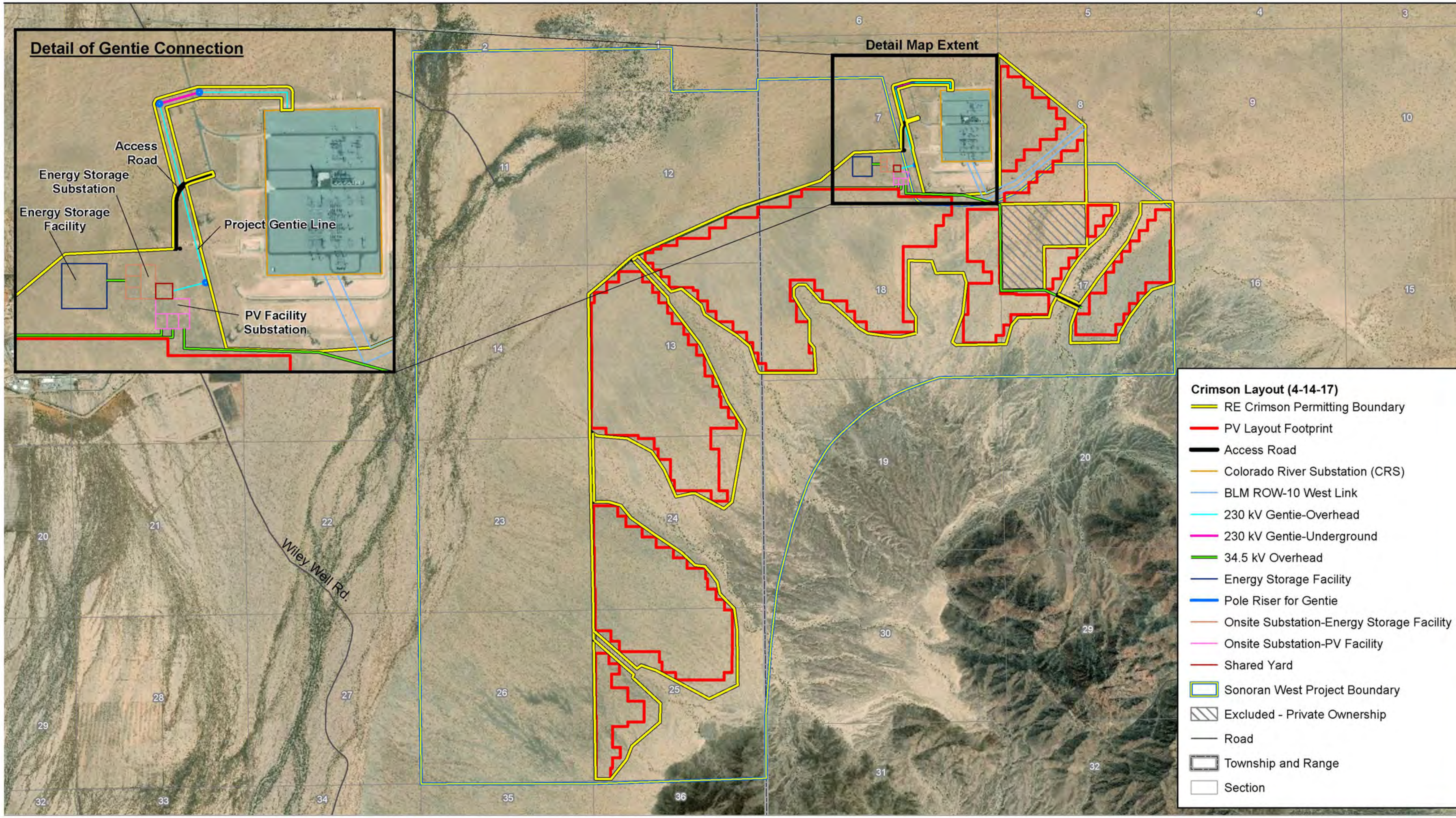
## 1.3 Plan Overview

The purpose of this DRP is to set forth the procedures and practices that will be employed by the Project owner to meet federal and state requirements for the reclamation of the site affected by construction, operation, maintenance, and decommissioning of the Project, and for the rehabilitation and revegetation of the Project upon permanent closure.

The nature and size of the disturbed areas described in this Plan are based on the POD prepared by the Applicant in January 2016 (Recurrent Energy 2016) and subsequently updated in several revisions through November 2017. There are always potential changes that may affect the POD and operational measures that may be occasioned by unanticipated constructability measures or other factors. Because these changes could affect the rehabilitation and revegetation measures, and anticipated schedules, this Plan should be accepted as a preliminary draft, subject to ongoing modifications to the Project during detailed design, construction, and/or facility operation. This Plan also includes procedures for modifying reclamation methods or criteria, if the Project owner or the responsible agencies find the need to do so. A final plan will be submitted when a Notice to Proceed for decommissioning work is requested.

The following components are included in this Plan:

- Section 1 contains the objectives and regulatory requirements for this Plan, as well as how the Plan may be affected by future land use.
- Section 2 provides a summary of the components of the Project that will be decommissioned.
- Section 3 discusses temporary and permanent closure, including procedures for temporary closure.
- Section 4 provides the decommissioning plan for the Project components, including health and safety procedures, and demolition debris management, disposal, and recycling plans.
- Section 5 details the revegetation and reclamation plan that includes conceptual plans for soil and drainage restoration, revegetation, and weed management, plus monitoring and reporting strategies to determine reclamation success.
- Section 6 and Appendix A (to be provided) detail the cost estimate methodology and cost breakdown, including activities to decommission, demolish, remove, and/or reclaim the structures within the Project and the site to acceptable conditions as outlined within this Plan.
- Section 7 lists references cited in this Plan.




Source: ESRI; AECOM.

3,000 1,500 0 3,000 Feet

1:36,000 1 inch = 3,000 feet

**Figure 1**
**Project Features**

RE Crimson Solar - Riverside County, CA

*Path: U:\Projects\Recurrent Energy\60487757_Crimson\900-Work\920-GIS\map_docs\mxd\Project_Features\Site_Layout_wCallOuts.mxd, 8/28/2018, paul.moreno*

# 2.0 Project Components

The Project's components subject to decommissioning are outlined below. These Project components are discussed in detail in the POD for the Project. The decommissioning activities associated with these components, and the reclamation activities are discussed in Section 4 and Section 5, respectively, of this Plan.

The proposed Project would interconnect to the regional electrical grid at the existing SCE 230-kV CRS. It would generate up to 350 MW of renewable energy using PV technology and would include up to 350 MW of integrated energy storage capacity. The Project would be located on federal lands managed by the BLM within the California Desert Conservation Area planning area. The Applicant filed a ROW grant application, serialized as CACA 051967, with the BLM to construct, operate, maintain, and decommission the RE Crimson Solar Project. As part of the ROW grant application process, the Applicant submitted a POD for the Project to the BLM on January 19, 2016 (Recurrent Energy 2016), followed by several revisions of the POD to clarify the range of alternatives evaluated.

The total expected disturbance area of the proposed Project is approximately 2,489 acres. RE Crimson continues to optimize the design of the Project. The Project layout has been refined to reduce the Project footprint. In addition to layout considerations, several design elements are being evaluated that have the potential to reduce environmental impacts. The alternative low-environmental impact design (LEID) elements would further minimize grading, trenching, and vegetation removal beyond traditional design approaches for PV projects with the objective of reducing overall long-term impacts for the Project. Although the incorporation of LEID elements could result in slight modifications to the module block locations due to topographic constraints, the permitting boundary or limits of development would be the same with LEID elements incorporated.

Below is a summary of the Project components subject to decommissioning:

- Photovoltaic Modules and Support Structures
- Inverters, Transformers, and Electrical Collection System
- Energy Storage System
- Meteorological Data Collection System
- Telecommunication Facilities
- Access Roads
- O&M Support Facilities

Decommissioning activities associated with the Project will depend upon the final design of the site which will be documented in the Final POD and the future proposed use at the end of the Project life.

# 3.0 Project Closure

This section discusses both temporary and permanent closure of the Project facility. The principal materials incorporated into the PV arrays include glass, steel, and various semiconductor metals. The module production process is designed to minimize waste generation and maximize the recyclability and reusability of component materials.

## 3.1 Temporary Closure

A contingency plan for temporary closure of the facility is provided below. Temporary closure is defined as stopping operations longer than would be required for routine maintenance (generally considered up to two weeks at a given time, multiple times per year), overhaul, or replacement of major equipment, but with the intent to restart. Temporary closure could result from facility damage following natural occurrences (e.g., earthquake), fire, or for short-term economic reasons. The BLM, CDFW, and other responsible agencies will be notified of the temporary closure.

The contingency plan will be implemented for the temporary halting of operations. The contingency plan will ensure compliance with all applicable Laws, Ordinances, Regulations, and Standards (LORS) and appropriate protection of public health, safety, and the environment. Depending on the expected duration of the temporary shutdown, the contingency procedures implemented will include measures as needed to ensure protection of on-site workers, the public, and the environment.

### 3.1.1 Emergencies

Any temporary closure or stoppage of the Project required due to an emergency, such as an earthquake, fire, or other unanticipated event that qualifies as an emergency, will employ procedures outlined in the Operational Hazardous Materials Business Plan, Site Security Plan, Project and Worker Safety Management Plans and/or Project Construction Safety and Health Program, Process Safety Management Plan and related site evacuation plans, and shut-down procedures and programs. Additionally, procedures outlined in Section 3.1.2 will be implemented if needed.

Once the site or Project is deemed safe and access is unrestricted, subsequent temporary or permanent closure of the Project will employ the activities identified in either the temporary closure procedures in the plans listed above, or the permanent closure procedures in Section 4 of this Plan.

### 3.1.2 Removal of Hazardous Materials/Hazardous Waste

If the temporary closure involves an actual or threatened release of hazardous materials, the procedures followed will be those provided in the HMBP and/or SPCC Plan that will be developed for the Project (see Section 4). Hazardous materials could include accidental fuel spills from equipment. Procedures will include, at a minimum:

- Measures to control the release of hazardous materials
- Notifications to the appropriate agencies and the public as required
- Emergency response procedures
- Training requirements for on-site personnel in hazardous materials release response and control

When all issues related to the hazardous materials release have been resolved, temporary closure will proceed as described above for temporary closure without a hazardous materials release.

### 3.1.3 Site Security

If temporary closure occurs, security for the Project shall be maintained on an as-needed basis. Site security shall be provided as required by the RE Crimson Solar Project Construction and Operations Site Security Plans. The security measures in place for the Project will be maintained during a temporary closure. The security measures include perimeter fencing, possibly guards, alarms, site access procedures for employees and vendors, site personnel background checks, and law enforcement contact in the event of a security breach.

## 3.2 Permanent Closure

Permanent closure is defined as stopping operations with no plans to restart. Plans for permanent closure of the RE Crimson site generally include the following steps:

- Dismantling of equipment and demolition of above-ground structures, and
- Site stabilization and reclamation.

Procedures for decommissioning and reclamation are provided in Sections 4 and 5 of this Plan. A detailed plan would be provided according to Section 1.3.

# 4.0 Decommissioning and Recycling

The planned operational life of the Project is 30 years, but the facility conceivably could operate for a longer or shorter period depending on economic or other circumstances. In any case, a Final Decommissioning and Reclamation Plan will be prepared and put into effect prior to a permanent closure occurring.

Prior to any decommissioning work on the site occurring, an updated Decommissioning and Reclamation Plan will have been finalized and submitted to the BLM for approval. Additionally, the Applicant will demonstrate that an Authorized Biologist (AB) and/or appropriate qualified biologist will be retained for the decommissioning phase of the Project to ensure that all environmental protection measures are implemented. The Applicant will submit the names and qualifications of all proposed biologists to the BLM, USFWS, and CDFW for review and approval at least 30 days prior to decommissioning activities and prior to initiation of decommissioning activities on the ground. Decommissioning activities will not begin until the ABs or qualified biologists are approved by the aforementioned agencies.

In general, decommissioning will attempt to maximize the recycling of all facility components. Specific opportunities for recycling (i.e., PV solar modules) are discussed below. The Project components to be decommissioned will be recycled to the maximum extent possible.

The key Project components to be affected by decommissioning activities are discussed below. The general decommissioning approach will be the same whether a portion of the Project or the entire Project will be decommissioned.

## 4.1 Implementation Strategy

In general, decommissioning will include the removal of all improvements. This will be done in preparation for restoration of the lines and grades in the disturbed areas to match the natural gradients outside of the disturbed areas (which will be conducted as part of the Reclamation Plan as described in Section 5).

The proposed implementation strategy to achieve the goals for Project decommissioning is as follows:

- Use industry standard deconstruction means and methods to decrease personnel and environmental safety exposures to the extent practical.
- Plan each component of the decommissioning such that personnel and environmental safety are maintained while efficiently executing the work.
- Train field personnel for decommissioning actions to be taken in proportion to the personnel, Project, or environmental risk for those actions.
- Evaluate the execution of the DRP through Project oversight and quality assurance.

- Document implementation of the Plan and compliance with environmental requirements.

The Decommissioning Plan for the Project consists of the following major elements:

- Documentation and establishment of health and safety requirements and procedures.
- Performance of pre-decommissioning planning activities such as preparing the final decommissioning and restoration plans and schedules that address the "as-found" site conditions at the start of the Project.
- Dismantling and removal of improvements and materials.
- Soils cleanup and disposal requirements.
- Disposal of materials in appropriate facilities for treatment, disposal, or recycling.

Although various types of decommissioning/demolition equipment will be used to dismantle each type of structure or equipment, dismantling will proceed according to the following general staging process. The first stage will consist of dismantling/demolition and removal of any installed structures. The second stage will consist of site contouring to return the originally disturbed area of the site to near original conditions while disturbing as little of the other site areas as is practical (Section 5).

## 4.2 Health and Safety Procedures

The health and safety procedures to be established prior to decommissioning are listed below:

- General safety and hazard responsibilities
- Establishment of an effective hazard communications program
- Task hazard analysis and control
- Personal protection equipment requirements
- Occupational and environmental monitoring requirements
- Medical and other emergency procedures
- Personnel training
- Incident reporting
- Self-audit and compliance procedures

As previously discussed, a site-specific HASP or equivalent will document health and safety requirements for establishing and maintaining a safe working environment during the implementation of the planned site decommissioning activities. Any additional procedures needed to decrease a potential release of contaminants to the environment and contact with storm water will be specified in the Drainage, Erosion, and Sediment Control Plan (DESCP; AECOM 2018a).

## 4.3 Decommissioning Planning and Preparation

The first step in the decommissioning process will be to assess existing site conditions and prepare the site for demolition. Site decommissioning and equipment removal can take a year or longer. Therefore, access roads, fencing, electrical power, and raw/sanitary water facilities will remain in place for use by the decommissioning and restoration workers until no longer needed. Demolition debris will be placed in temporary storage area(s) within the ROW pending final transportation and disposal/recycling according to the procedures listed below. The detailed plan will specify methods and timing of each phase of decommissioning activities.

## 4.4 Decommissioning of Project Components

During decommissioning, all Project components unless otherwise stipulated by the BLM will be dismantled, removed from the site and recycled or legally disposed of. Each of the various Project components is discussed below.

### 4.4.1 Photovoltaic Modules and Support Structures

The PV solar modules and all support structures will be removed, and all underground conductors will be removed. Removal of the solar modules will include disassembly and removal of the racks on which the solar modules are attached, and removal of the structures supporting the racks. The racks and structures supporting the racks will then be recycled or disposed of at an appropriately licensed disposal facility. Solar modules will be removed from the site and transported to another solar electrical generating facility or a recycling facility, disposed of at an appropriately licensed disposal facility, or refurbished to extend their estimated 30-year lifespan for use at this site or at another solar facility. The demolition debris and removed equipment may be cut or dismantled into pieces that can be safely lifted or carried with the on-site equipment being used. The majority of glass and steel will be processed on site for transportation and delivery to an off-site recycling center. All steel, aluminum, and copper will be recycled, and PV panels will be recycled in accordance with the manufacturer's recycling program.

As noted in Section 2.2, the Applicant has not yet chosen the type of PV panels to be used. Some manufacturers employ the compound cadmium telluride (CdTe) as the semiconductor material. Cadmium telluride is a stable compound consisting of cadmium (Cd) and tellurium (Te). Cadmium, produced primarily as a byproduct of zinc refining, is a human carcinogen as an independent element; however, when combined with telluride, a byproduct of copper refining, it forms the stable, non-hazardous compound CdTe. In module manufacturing, the CdTe is safely sequestered for the over 30-year lifetime of the module, after which it is recycled for use in new solar modules or other new products. If RE Crimson selects panels that incorporate CdTe, the Applicant will participate in the manufacturer's recycling program.

### 4.4.2 Inverters, Transformers, and Electrical Collection System

All Project structures will be removed from the ground on the Project site. Aboveground and any underground equipment will be removed including gen-tie poles that are not shared with third parties and the overhead collection system within the Project site, inverters, transformers, electrical wiring, equipment on the inverter pads, and related equipment and concrete pads, and any O&M facilities and related equipment and infrastructure.

At decommissioning, the prefabricated control enclosure and electronic components of the substation equipment will be electrically disconnected and made safe for removal. The control enclosure will then be disassembled and removed from the site. The transformers, breakers, buswork, and metal dead-end structures will also be disassembled and removed. Concrete foundations and containment berms/curbs for the transformers will be broken into pieces, and all debris and aggregate rock will be removed from the site or crushed into gravel and hauled from the site. The area will be revegetated as described in Section 5.

Transformers using insulating oils will be removed from the site and recycled or disposed of at an appropriately licensed disposal facility. Site personnel involved in handling these materials will be trained appropriately.

As part of the preparation for closure, the SPCC Plan for the site will be updated to cover spill prevention and countermeasures for handling these materials during decommissioning. Procedures to decrease the potential for release of contaminants to the environment and contact with storm water will be specified in a decommissioning DESCP.

The DC power collection system will be dismantled and removed. All underground cables will be removed. All equipment and cabling removed will be recycled. The underground AC power collection system will similarly be removed. The overhead AC power collection system will be dismantled and the poles will be removed. The AC collection system poles and aluminum conductors will be recycled or salvaged as appropriate for the material. Pole foundations will be removed to their full depth.

### 4.4.3 Transmission Line, Distribution Lines, and Energy Storage System

The gen-tie line and on-site distribution lines will remain in place for the life of the Solar Facility. At the time of decommissioning, the lines will be decommissioned unless use by a third party is authorized by the BLM. Decommissioning of the aboveground portion of the line will consist of removal of the overhead conductors and removal of poles. All steel will be recycled, and the aluminum from overhead conductors will be recycled. Concrete foundations will be removed to their full depth, and the concrete will be transported off-site.

Similarly, the energy storage system will be decommissioned unless another use is authorized by the BLM prior to decommissioning. Decommissioning will depend upon the type of system installed, but will consist of removal of the aboveground and underground structures and proper management of the energy storage materials (i.e., recycling and/or hazardous waste management). Concrete foundations will be removed, and the concrete will be transported off-site.

### 4.4.4 Operations and Maintenance Building

The O&M building will be dismantled and recycled. The concrete foundation and parking area will be broken up and removed from the site to an appropriately licensed disposal facility. All equipment will be removed and recycled to the extent practical. The area will be revegetated as described in Section 5.

### 4.4.5 Access Roads

On-site roads will remain in place to accomplish decommissioning at the end of the facility's life. At the time of decommissioning, for any new linear service road constructed by the Project on public lands, the BLM will determine, at its discretion or in accordance with current law or policy, whether it would like the service road to remain open to limited or general public use, or whether it would like the road to be closed. Road segments not authorized to remain will be restored to pre-construction conditions. The ground surface will be restored and revegetated as described in Section 5.

### 4.4.6 Dismantling and Demolition of Fencing

Demolition of permanent fencing will entail breakdown and removal of gates and fencing materials. Residual materials from these activities will be transported via heavy haul dump trucks to a central recycling/staging area where the debris will be processed for transport to an off-site recycler. A Project recycle center (either at each power unit as the work progresses or at the central O&M building area) will be established to reduce size and stage materials for transport to an off-site recycler. The materials could include barbed wire, steel fence bracing and stretcher bars, galvanized steel hardware fabric, chain-link fabric, posts, and concrete post supports.

The strategy for demolition consists of use of mechanized equipment and trained personnel in the safe dismantling and removal of the desert tortoise exclusion fence and/or any installed security gates and fencing in the Project.

The belowground materials to be removed for the tortoise exclusion fence include wood or metal posts and concrete backfill surrounding the temporary tortoise guards. The permanent security fence belowground materials include concrete fence post supports and concrete backfill surrounding the permanent tortoise guards. Fence post supports will be physically removed. This concrete will be excavated and either transported to the recycling area for processing and ultimate recycling, or crushed into gravel and disposed off-site. The resulting trenches will be backfilled with suitable material of similar consistency and permeability as the surrounding native materials and compacted to 85 percent relative compaction.

## 4.5 Demolition Debris Management, Disposal and Recycling

The Applicant will implement procedures for maximizing the recycling of all facility components. All nonhazardous wastes shall be collected and disposed of in appropriate waste areas. Hazardous wastes shall be disposed of according to all applicable LORS. Demolition debris will be piled or placed in temporary storage area(s) in the ROW, pending processing at a recycling center and transportation/disposal/recycling, in accordance with the procedures listed below.

For the purpose of this Plan, it is assumed that the removal of all equipment and appurtenant facilities from all site areas will be required; removal activities will be achieved in conformance with all applicable LORS and local/regional plans. Aboveground structures will be removed through mechanical or other approved methods, and trucked off-site. Belowground materials will be removed as described in the sections above. Once all structural elements are removed, the ground surface will be recontoured to minimize the topographic variability between on- and off-ROW areas, and to ensure that the gradient across the alluvial fans is restored.

Demolition and removal activities shall include:

- The demolition debris and removed equipment will be cut or dismantled into pieces that can be safely lifted or carried with the on-site demolition equipment. It is anticipated that the vast majority of steel and concrete rubble will be processed at a recycling center.
- A front-end loader, backhoe, or equivalent appropriate equipment will be used to crush or compact compressible materials. These materials will be laid out in a staging area or other approved area to facilitate crushing or compacting with equipment pending disposal/recycling.
- Materials such as steel and chain-link fabric will be temporarily stockpiled at or near a staging area pending transport to an appropriate off-site disposal or recycling facility.
- Concrete foundations and post supports will be removed. Upon removal of any steel material from concrete rubble, the residual crushed concrete will be removed from the site.

# 5.0 Site Reclamation

The decommissioning process will remove Project-related structures and infrastructure as described in the previous sections. Following decommissioning, site reclamation activities shall occur. Reclamation will restore landform features, vegetative cover, and hydrologic function after closure of the facility, as well as soil profiles and functions that will support and maintain native plant communities. The process will involve replacement of topsoil, brush, rocks, and natural debris over disturbed areas so that the site blends with the surrounding landscape and is functionally equivalent to its preconstruction condition. Restoring these features to a natural condition compatible with the adjacent surroundings will inherently restore the basic visual elements of line, form, texture, and color of the site to pre-disturbance conditions in accordance with Project approvals and mitigation requirements.

If soils are determined to be compacted at levels that would affect successful revegetation, decompaction would occur. The method of decompaction will depend on how compacted the soil has become over the life of the Project. Following decompaction, recontouring of the site will be conducted, if necessary, to return the land to approximately match the pre-construction surface conditions and the surrounding alluvial fan grade and function. The original site drainage features will be restored where they have been substantially modified. It is unlikely that a significant amount of earthwork will be required as the construction plan calls for limited disturbance of the Project site. Grading activities will be limited to previously disturbed areas that necessitate recontouring to restore functionality and visual blending. Efforts will be made to disturb as little of the natural drainages and existing natural vegetation as possible to achieve the objectives of restoration.

After the recontouring, microtopography will be restored to the site. The natural character of undulating hummocks, mounds, depressions, swales, and runnels will be returned with microcontouring the final surface. The microcontouring will be completed with equipment with low pressure (expressed as pounds per square inch) to avoid soil compaction. The soil surface will be left rough to retain microcatchments to capture water and seeds to facilitate water infiltration and seed germination.

A combination of seeding, planting of nursery stock, transplanting of local vegetation within the proposed disturbance areas, and staging of decommissioning activities enabling direct transplanting, will be considered. Native vegetation will be used for revegetating to establish a composition consistent with the preconstruction plant communities of the site.

The approach for successful restoration will continue to be augmented based on new information on restoration techniques and lessons learned from the rapidly expanding base of experiential knowledge gained from desert restoration associated with similar facilities.

The detailed decommissioning plan developed prior to decommissioning activities will include measurable criteria for establishing that restoration is successful. The success of the restoration effort will be based on the development of the target vegetation communities relative to undisturbed reference sites. The reference sites should represent intact, native vegetative communities with similar species composition and conditions that occurred prior to impacts. The success standards should include metrics for evaluating the comparative structure and function of the plant community in the reference area. The seed mix composition will include native pioneer and early-successional species. Success will be linked to seedling establishment and survival, the amount of cover and appropriate species presence and distribution of perennial shrubs, and development of the target vegetation community. Success of revegetation efforts will take into consideration the weather conditions as they relate to seed germination and plant growth.

## 5.1 Closure and Restoration Strategy

The overall closure and restoration strategy includes the following major elements:

- Conducting pre-closure activities, such as final closure and restoration planning, that addresses the “as-found” site conditions at the start of the Project.
- Documenting and establishing health and safety procedures (see Section 4.2).
- Recontouring lines and grades to match the natural gradient and function.
- Cleanup of soils in accordance with the approved Spill Prevention, Control, and Countermeasures Plan (SPCC) and Hazardous Materials Business Plan (HMBP), if needed, to ensure that clean closure is achieved.
- Evaluating the execution of the decommissioning and restoration plan through Project oversight, quality assurance, and attainment of established success criteria standards.
- Documenting implementation of the DRP and compliance with environmental requirements.

It is the responsibility of the Project owner to ensure the Project is constructed, commissioned, operated, and decommissioned according to federal, State, and local regulations and mitigation measure requirements as imposed by the BLM ROD for the Project.

## 5.2 Restoration Activities

### 5.2.1 Site Recontouring

As described briefly above, upon removal of Project features, recontouring of the site will be conducted using standard grading equipment to return the land to reasonably match the previously existing surface and surrounding alluvial fan grade and function. Grading activities will be limited to previously disturbed areas that require recontouring to restore the pre-construction appearance and function. Efforts will be made to disturb as little of the natural drainage and vegetation as possible. Fills will be compacted to approximately 85 percent relative compaction by wheel or track rolling to avoid overcompaction of the soils.

The level of revegetation and habitat restoration will depend upon the level of impact to existing vegetation. Revegetation/restoration may include seeding and or container planting of native plants in a seed mix approved by the Resource Agencies, where needed, to supplement the reestablishment of existing vegetation. Monitoring of the drainage for signs of erosion and sedimentation will be conducted with the vegetation and habitat monitoring. An updated Construction DESCP will be prepared and appropriate BMPs will be implemented to provide an effective combination of erosion and sediment control until revegetation efforts have sufficiently stabilized the soil.

### 5.2.2 Restoration of Drainage

Drainage restoration, if required, will be one of the last decommissioning activities, however, it is expected that the pre-construction flow conditions will be maintained throughout the life of this Project and engineered drainage features are not anticipated. It is assumed that the removal of all equipment will be required and will be achieved in conformance with all applicable regulations and local/regional plans. Aboveground structures shall be removed through mechanical or other approved methods and transported off-site for either disposal or reuse. Fence post supports shall be physically removed through excavation, breakup, and pulling. Once all structural elements are removed, the ground surface shall be re-contoured to minimize the topographic variability between on- and off-site areas and to ensure that the gradient across the alluvial fans is restored.

### 5.2.3 Revegetation

A key component of the reclamation activities is revegetation of the site. The purpose of revegetation will be to restore the disturbed areas from the Project to a condition that is physically and functionally similar to the original, pre-construction conditions. A Revegetation Plan for revegetation associated with decommissioning will be submitted to the BLM for approval prior to an NTP being issued for closure and decommissioning. The plan will include the plant species to be planted, the planting methods to be used, any other measures such as proposed irrigation schedules during plant establishment, and the performance standards needed to assure successful revegetation.

### 5.2.4 Soil Restoration

As part of the decommissioning planning, determination of the depth and lateral extent of contaminated soil (if present) will be conducted as needed. Any required general soil cleanup will be based on visual observations, a review of spill records and daily operating practices, and results of chemical analyses performed on soil samples collected during site closure, for instance, at the recycling and/or waste storage areas used during decommissioning. If needed, a sampling and analysis plan would be developed and incorporated into a Soil Rehabilitation Plan. The sampling and analysis plan would be prepared based on site conditions and records review as well as current regulatory requirements, and would identify areas of potential concern, the chemicals handled in these areas, soil sampling frequency and methods, laboratory analytical methods, and field and laboratory quality assurance/quality control methods. At this time, no soil sampling is proposed to be conducted.

For the purposes of this preliminary Plan, no cleanup or removal of contaminated soil is assumed to be needed because soil cleanup or removal will be conducted throughout the Project life as required to meet regulatory cleanup criteria for the protection of groundwater and the environment. Appropriate soil cleanup and rehabilitation methods during decommissioning will be selected to meet Project objectives and regulatory requirements based on criteria contained in applicable federal, State, and County guidance. Appropriate methods could include removal, bioremediation, stabilization, or other suitable methods that are acceptable that meet these requirements. If contaminated soil removal is necessary, the resulting excavations will be backfilled with native soil of similar permeability and consistency as the surrounding materials and compacted to 85 percent relative compaction.

Soil restoration will be one of the last decommissioning activities implemented (following removal of site equipment, in accordance with all applicable regulations and local/regional plans). A Soil Restoration Plan will be submitted to the BLM for approval prior to the issuance of an NTP for decommissioning. The plan will provide guidance for restoration of soil impacted with chemical substances to acceptable regulatory thresholds that are protective of groundwater, human health, and the environment. Preparation of an effective Soil Restoration Plan will require an understanding of pre-Project conditions, i.e., conditions that may lead to potential soil contamination and soil restoration activities.

### 5.2.5 Weed Management

Weed management for the Project during construction and operation is detailed in the draft Weed Management Plan (AECOM 2018b). Similar measures will be applied to reclamation activities, namely to ensure that populations of existing weed species do not increase due to the Project closure, and if possible will be suppressed below current levels.

General measures to prevent spread of weed propagules and inhibit their germination, which will be applied during closure, decommissioning, and reclamation activities, include the following:

- Limiting disturbance areas during closure activities to the minimum required to perform work
- Limiting ingress and egress to defined routes
- Maintaining vehicle wash and inspection stations to minimize the potential for weed introduction

A weed management survey will be conducted at the completion of closure, decommissioning, and reclamation activities to summarize the weed status at the site. The results of this report will be used to determine whether additional monitoring or control measures are necessary to achieve the success criteria defined for successful reclamation.

## 5.3 Monitoring and Reporting Methods

Quantitative field monitoring of measurable restoration success criteria will be conducted using a combination of line or belt transects and quadrat or circular plot techniques. Data from line transects will provide cover data, whereas data from quadrats more effectively evaluate density and reflect the species richness of the plant community. The transect length and quadrat area should be representative of the plant community and large enough to capture 90 percent of the species that are present. A minimum of three 100-foot transects and three 100-square-foot quadrats, equally spaced across each revegetated area, should be identified. These permanent monitoring locations within the restoration area shall be recorded using global positioning system technology and will be staked in the field. A map will be created, using an aerial photograph as a base layer, showing each monitoring site and photo documentation locations within the sites.

Visual inspections will be conducted to document germination, growth, and survival of seeded species, and growth and survival of transplanted succulents. Data collected will include species composition and cover, general size and vigor of the plants, percent live versus dead plants for succulents, observed soil erosion, evidence of wildlife use, and any other information useful in evaluating success. The monitoring program will also include photographic documentation at permanent photo locations.

Long-term monitoring reports are required for evaluating monitoring results to determine if revegetation and weed control are successful. Annual monitoring reports will document the success of the weed control and revegetation. Monitoring of ecosystem function could include soil moisture, soil strength using penetrometer measurements, soil organic matter, insect activity measurements (i.e., count of ant mounds), mycorrhizae assays, litter decomposition rates, establishment rates of cryptobiotic crusts, and establishment of native versus invasive species. Ecosystem structure includes factors such as density, diversity, richness, cover, and seedling establishment.

Monitoring will be conducted for a period of 5 years from the date of reclamation and revegetation, except at sites where revegetation is not proceeding satisfactorily, based on success criteria developed in coordination with the BLM and CDFW. In that case, monitoring may be extended on a year-by-year basis up to 10 years until success criteria are met. Monitoring will be performed annually during the first 3 years following revegetation, and biannually thereafter. Monitoring sessions will occur generally between March 15 and April 15.

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# 6.0 Financing of Decommissioning and Restoration Activities

## 6.1 Cost Estimate

A decommissioning RCE will be prepared to demonstrate the costs associated with the decommissioning activities expected for the Solar Project. This estimated RCE for the Project will be appended to this Plan prior to the start of decommissioning. This cost estimate will be completed by a Professional Engineer under the accepted standards of an order of magnitude engineer's cost estimate.

On the decommissioning side, the cost estimate will address the pre-decommissioning activities; the dismantling of equipment and demolition of aboveground structures; removal of belowground facilities and utilities; debris management and disposal/hauling; recontouring of the land; and hazardous materials and waste management. On the restoration side, the cost estimates will address the cost of site preparation; plant and soil management; testing and monitoring; and site revegetation, as applicable.

## 6.2 Financial Assurances

The Applicant is responsible for all costs associated with decommissioning and reclamation of the Project. As required by the BLM, the Applicant will provide decommissioning security in the form of either:

- cash, cashier's or certified check,
- certificate or book entry deposits,
- negotiable U.S. Treasury securities (notes, bills, or bonds) equal in value to the bond amount,
- surety bonds from the approved list of sureties (U.S. Treasury Circular 570) payable to the BLM,
- irrevocable letters of credit payable to the BLM issued by financial institutions that have the authority to issue letters of credit and whose operations are regulated and examined by a federal agency, or
- a policy of insurance that provides the BLM with acceptable rights as a beneficiary and is issued by an insurance carrier that has the authority to issue insurance policies in the applicable jurisdiction and whose insurance operations are regulated and examined by a federal or state agency.

The Applicant will work closely with the BLM to develop the financial instrument for funding decommissioning and restoration. The decommissioning security for the Project will be structured so the funds will be returned to the Project owner upon completion of the decommissioning and restoration activities (with an amount held in reserve until the restoration monitoring is completed). It will also be structured in such a manner that the BLM will be able to access those funds to pay for the decommissioning and restoration of the site, in the event that the Project owner becomes insolvent, or that the duration of a temporary closure continues long enough that the closure is considered permanent.

# 7.0 References

AECOM. 2018a. *Drainage, Erosion, and Sediment Control Plan*.

AECOM. 2018b. *Weed Management Plan*.

Recurrent Energy. 2016. *Plan of Development for the RE Crimson Solar Project*. January 19.

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# APPENDIX A

# RECLAMATION COST ESTIMATE

(to be provided prior to start of construction)

# I.5 Bird and Bat Conservation Strategy, February 2019

# Bird and Bat Conservation Strategy

# RE Crimson Solar Project

# Riverside County, California

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**February 2019**

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# 1.0 INTRODUCTION

The RE Crimson Solar Energy Project (CSEP or Project), an alternating current (AC) photovoltaic (PV) solar power generation facility, in Riverside County, California is proposed to be constructed and operated by Sonoran West Solar Holdings, LLC (Applicant), a wholly owned subsidiary of Recurrent Energy (RE). The CSEP will generate up to 350 megawatts (MW) of electricity and will provide renewable energy to the regional electrical grid through an interconnection at Southern California Edison's (SCE) Colorado River Substation (CRS).

This Bird and Bat Conservation Strategy (BBCS) is based on the results of the Project's biological resource surveys and other publicly available information. The BBCS provides a written record of efforts to understand potential project impacts to birds and bats and to document conservation measures that have or will be taken to avoid, minimize, and/or mitigate for those potential impacts. After introductory material on project description, purpose, and regulatory framework, the remaining sections of this BBCS address the following:

- Baseline Conditions
- Risk Assessment
- Conservation Measures
- Post-Construction Monitoring
- Adaptive Management

## 1.1 Project Description

The Project site is located in unincorporated eastern Riverside County, approximately 20.9 kilometers (km; 13 miles) west of the City of Blythe, California (Figure 1.1). The Project site consists of 1,007 hectares (2,489 acres) of Bureau of Land Management (BLM)-administered land. The primary access to the site would be provided via the existing paved Wiley's Well Road and Powerline Road to the SCE's CRS from Interstate 10 (I-10) to the north (Figure 1.1). The Project site was originally surveyed for biological resources in 2011 and 2012 as part of the larger Sonoran West Solar Electric Generating System Project (hereafter referred to as the SWP) as proposed by BrightSource Energy. The proposed development boundary was refined and reduced from the original BrightSource Energy proposal to reflect a smaller footprint as part of an effort to avoid potential impacts to sensitive resources. Additional biological surveys for the Project were conducted in 2016 and 2017.

The Project will consist of the construction, operation, maintenance, and eventual decommissioning of the solar power generation facility. The total Project area (i.e., Crimson Permitting Boundary; 1,007 hectares) includes an approximately 998-ha (2,465-acre) solar field development area with approximately 752 ha (1,859 acres) of solar panels (array blocks) and 9.7

ha (24 acres) for linear facilities including access/perimeter roads and gen-tie and powerline corridors at 45.7-meter (m; 150 feet) widths (Figure 1.2). The Project design would utilize an estimated 2 million solar modules arranged in the form of solar arrays (fixed-tilt or tracking systems). Project components include on-site facilities, offsite facilities, and temporary facilities needed to construct the Project. Major on-site facilities are the solar arrays, a project substation, and operations and maintenance (O&M) facilities. The perimeter of the occupied portions of the Project will be fenced to limit public access. The entrance to the completed Project will be gated and restricted to unauthorized entry, and the Project will be surrounded by a permanent, up to 8-foot tall, chain-link security fence topped with barbed wire and a desert tortoise exclusion fence. The exclusion fence would be buried at least 12 inches below ground surface. The offsite facilities include a 230 kilovolt (kV) gen-tie located within a 45.7-m wide operational right-of-way (ROW). Temporary facilities, which will be removed or restored at the end of the construction period, include the on-site mobilization, laydown, and construction areas and, if needed, water storage tanks utilized for dust suppression.

Construction of the Project will occur in three phases and will require approximately 17 months to complete. Phase 1 of the construction will include site preparation and grubbing and will last approximately 16 weeks. Phase 2 will begin with the pouring of foundations and the installation of the PV module support structure. Phase 2 will last approximately 46 weeks. Phase 3 of construction will include the stringing of cable along module rows to a trunk cable system and the installation of AC and DC collector poles at inverter/transformer pad sites. This construction phase will last approximately 32 weeks.

The facility layout and the overall site plan, including other infrastructure, are presented in Figure 1.2. Pertinent Project details are explained below:

- Main Generation Area – Photovoltaic (PV) arrays
    - Inverters
    - Transformers
    - Switchgear
    - Overhead lines
    - Access corridors
- Operation and Maintenance (O&M) Facility
- On-site substation
- Fencing and lighting
- A main access road.

The Project applicant is proposing to construct the Project using traditional construction methods consisting of desert tortoise exclusion fencing, mow-and-roll vegetation for site preparation, compacted roads, and trenching for electrical lines. The applicant is also actively investigating alternative low environmental impact design (LEID) elements and the potential for those to reduce Project impacts. LEID elements include several potential design changes, including the following:

- Minimizing grading during site preparation and maintaining more onsite vegetation to facilitate post-construction residual habitat value and post-operations/site reclamation success.
- Avoiding or limiting trenching by placing electrical wiring aboveground.
- Placing transformer/inverter groups on elevated support structures in lieu of cement foundations.

The LEID elements would minimize grading, trenching, and vegetation removal beyond traditional design approaches for PV projects with the objective of reducing overall long-term impacts for the Project. At this time, it has not be decided which, if any, LEID elements may be incorporate into the final Project construction design. Therefore, this BBCS assumes a traditional construction approach is taken and that no LEID elements are incorporate. This BBCS may need to be modified or amended once final construction, operations and maintenance, and decommissioning designs are determined.

The Project is located in Riverside County, California, approximately 2 miles south of I-10 and 4.5 miles southwest of the Blythe Airport (Figure 1.1). The Project site slopes gently to the north and to the west, away from the base of the Mule Mountains, with elevation ranging from about 430 to 710 feet above mean sea level (amsl). The Project site is situated on a broad alluvial fan that features braided washes draining to the northwest into a larger channel. Similar conditions exist in the surrounding vicinity, with additional features including the McCoy Mountains to the north, the Mule Mountains to the south, and the Palo Verde Valley and the Colorado River to the east of the Project (Figure 1.1).

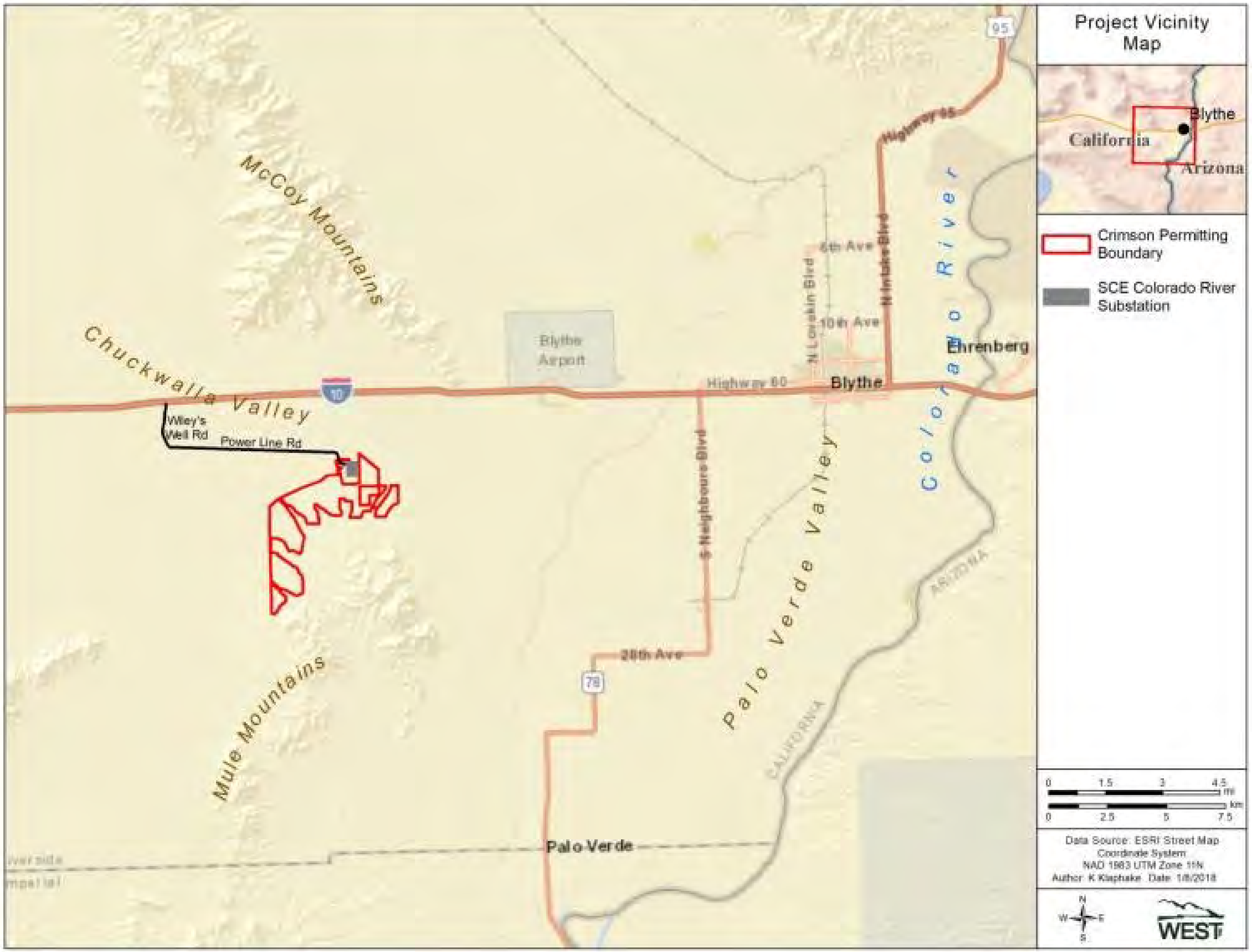


**Figure 1.1 Location of the Crimson Solar Energy Project, Riverside County, California.**

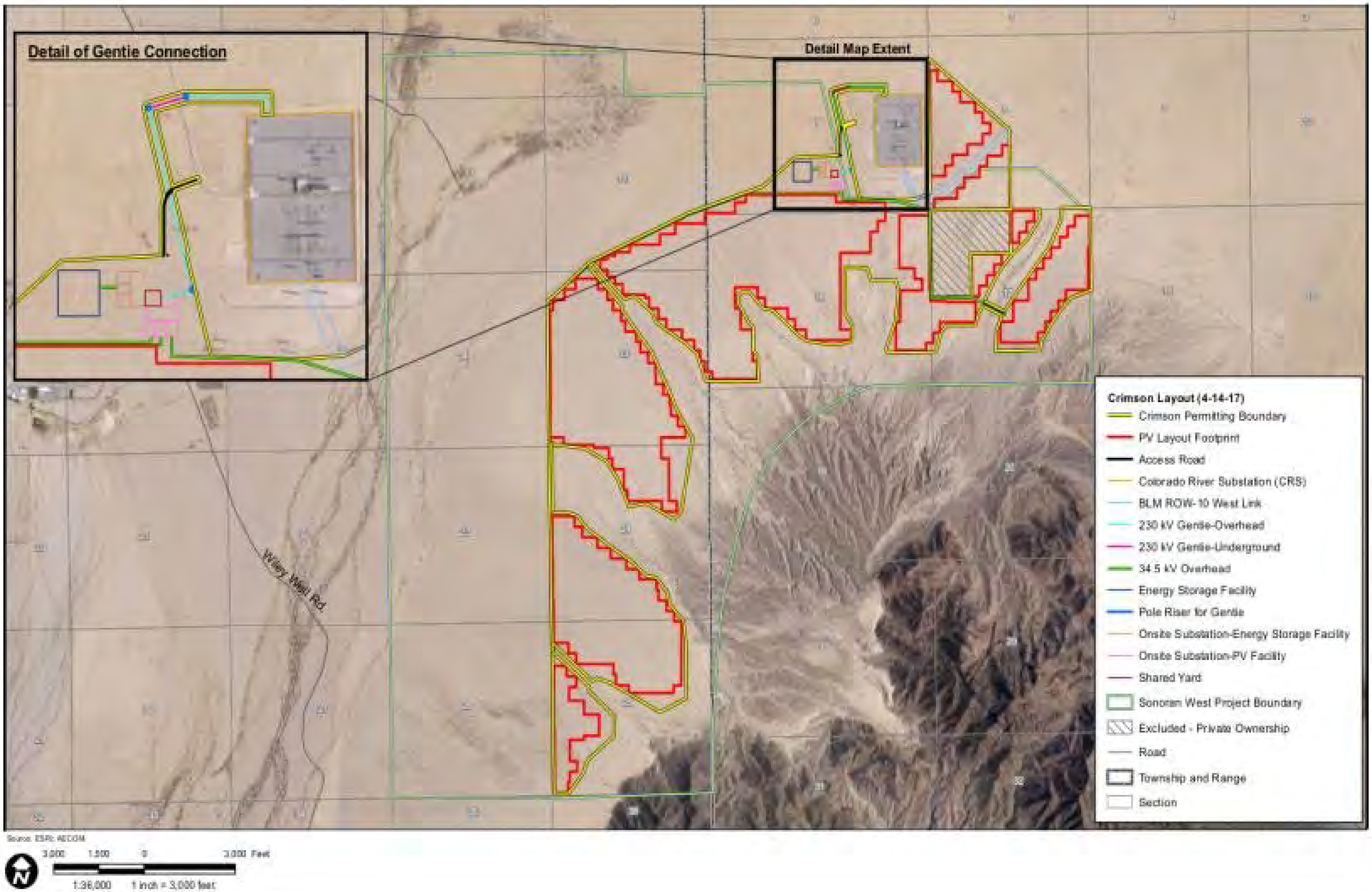


**Figure 1.2 Proposed features of the Crimson Solar Energy Project, Riverside County, California (AECOM 2018).**

## 1.2 BBCS Purpose

The US Fish and Wildlife Service (USFWS) and the California Department of Fish and Wildlife (CDFW) currently recommend the development of a project-specific BBCS, formerly called an Avian and Bat Protection Plan (ABPP), for renewable energy projects that may impact bird and bat resources. This BBCS will be implemented within the Project site and will be updated, as needed, if aspects of the Project change. Information in this BBCS is intended to correspond to the Applicant's proposed measures and mitigation described in environmental review documentation prepared for the Project pursuant to the National Environmental Policy Act (NEPA). The purpose of this BBCS is to:

- Assess potential risk to birds and bats based on the proposed activities
- Specify the adaptive management process that will be used to address potential adverse effects on avian and bat species
- Describe baseline conditions for bird species present within the Project site, including results of site-specific surveys;
- Specify conservation measures that will be employed to avoid, minimize, and/or mitigate potential adverse effects to birds and bats;
- Describe the incidental bird and bat monitoring and reporting that will take place during construction; and
- Provide details for following systematic post-construction bird and bat monitoring and reporting.

## 1.3 Regulatory Setting

Several federal and state laws and regulations, including National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), the California Endangered Species Act (CESA), the Migratory Bird Treaty Act (MBTA), the Bald and Golden Eagle Protection Act (BGEPA), California Fish and Game Codes, the Federal Land Policy Management Act (FLPMA), and the California Environmental Quality Act (CEQA), provide the foundation for the development of this BBCS. This document represents a comprehensive plan to meet the requirements of these regulatory mechanisms as they apply to birds and bats in the Project area.

### *1.3.1 National Environmental Policy Act*

Under NEPA (42 United States Code [USC] §§ 4321 *et seq*.), federal agencies are required to prepare an Environmental Impact Statement (EIS) for any major federal action significantly affecting the quality of the human environment. A final programmatic EIS was developed by the BLM for solar energy development on BLM lands in six southwestern states that included designated solar energy zones (SEZ). The CSEP is proposed in the Riverside East SEZ, designated in the Record of Decision based on the final programmatic EIS. The CSEP is undergoing further site-specific NEPA review through preparation of an EIS by BLM. Design features and/or potential mitigation and conservation actions related to birds and bats identified in the EIS will be included in this BBCS.

### *1.3.2 Endangered Species Act*

Certain species at risk of extinction, including many birds and some bats, are protected under the federal ESA of 1973, as amended (16 U.S.C. §§ 1531, *et seq*.). The ESA defines and lists certain species as "endangered" and "threatened" and provides regulatory protection for these listed species. The federal ESA provides a program for conservation and recovery of threatened and endangered species. Section 7(a)(2) directs all federal agencies to insure that any action they authorize, fund, or carry-out does not jeopardize the continued existence of listed species or designated or proposed critical habitat (collectively, referred to as protected resources), and Section 9 prohibits the "take" of listed species, as defined pursuant to the federal ESA and its implementing regulations.

### *1.3.3 Migratory Bird Treaty Act*

The MBTA (16 USC §§ 703, *et seq*.) makes it unlawful to "pursue, hunt, take, capture or kill; attempt to take capture or kill; possess; offer to or sell, barter, purchase, or deliver; or cause to be shipped, exported, imported, transported, or received any native migratory bird, part, nest, egg, or product." The MBTA, enforced by the USFWS, protects all MBTA-listed migratory birds within the United States. In the continental US, native non-covered species generally belong to the Order Galliformes. Common non-native species not protected by the MBTA include rock pigeon (*Columba livia*), Eurasian collared-doves (*Streptopelia decaocto*), European starling (*Sturnus vulgaris*), and house sparrow (*Passer domesticus;* USFWS 2005). A recent legal opinion (M-Opinion [37050]) issued by the Department of the Interior on December 22, 2017 and subsequent guidance issued by the USFWS identified that the MBTA's prohibitions on take do not apply to the incidental, non-purposeful take of MBTA-listed birds. The guidance memorandum states that "the take of birds, eggs or nests occurring as the result of an activity, the purpose of which is not to take birds, eggs or nests, is not prohibited by the MBTA." This legal opinion reverses the prior interpretation of the MBTA that prohibited not only the intentional take of migratory birds but also the take of migratory birds that is incidental to an otherwise lawful activity (i.e., unintentional).

### *1.3.4 Bald and Golden Eagle Protection Act*

The BGEPA (16 USC §§ 668, *et seq*.) prohibits the take, defined as to "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb," of any bald eagle (*Haliaeetus leucocephalus*) or golden eagle (*Aquila chrysaetos*). Through recent regulation (50 Code of Federal Regulations [CFR] § 22.26; USFWS 2009), the USFWS can authorize take of bald and golden eagles when the take is associated with, but not the purpose of, an otherwise lawful activity and cannot practicably be avoided. The USFWS has issued Eagle Conservation Plan Guidance (USFWS 2013) for land-based wind energy projects to help project proponents avoid unanticipated take of bald and golden eagles and comply with the BGEPA. Although the guidelines were developed for land- based wind energy projects, certain components of eagle surveys and monitoring are applicable to other renewable energy projects, including PV solar plants, and have been incorporated into this BBCS.

### *1.3.5 California Environmental Quality Act*

The California Environmental Quality Act (CEQA) requires identification of significant environmental effects of proposed projects (including impacts on biological resources) and avoidance (where feasible) or mitigation of the significant effects. CEQA applies to "projects" proposed to be undertaken or requiring approval by state and/or local governmental agencies. "Projects" are activities that have the potential to have a physical impact on the environment. The Project is undergoing CEQA review through preparation of an Environmental Impact Report (EIR) by CDFW that will be issued as a joint EIS/EIR with BLM.

### *1.3.6 California Endangered Species Act*

The CESA (Fish and Game Code Sections [§§] 2050, *et seq*.) protects and preserves species designated by the Fish and Game Commission as either threatened or endangered in the state of California. These protected resources include those native species of fishes, amphibians, reptiles, birds, mammals, invertebrates, and plants, and their habitats, that are threatened with extinction, as well as those experiencing a significant decline which, if not halted, would lead to a threatened or endangered designation. The CESA also allows for take that is incidental to otherwise lawful development projects.

### *1.3.7 California Fish and Game Codes*

Sections 3503 and 3503.5 (protection of birds and raptors) – These sections provide that it is unlawful to take, possess, or needlessly destroy the nest or eggs of any native bird (§ 3503) and birds of prey (§ 3503.5), except as otherwise provided by this code or any regulation made pursuant thereto. These sections do not apply to non-native species.

Sections 3511, 4700, 5050, and 5515 (fully protected species) – These sections classify and prohibit the take of "fully protected" bird, mammal, amphibian/reptile, and fish species in California.

Section 3513 (migratory birds) – This section prohibits any take or possession of birds that are designated by the MBTA as migratory non-game birds except as allowed by federal rules and regulations promulgated pursuant to the MBTA.

Sections 4150 (mammals) – This section defines all mammals that naturally occur in California as non-game mammals, with exceptions for those defined as game mammals, fully protected mammals, or fur-bearing mammals. Non-game mammals or parts thereof may not be taken or possessed except as otherwise provided by this code or any regulation made pursuant thereto.

## 2.0 BASELINE CONDITIONS

The Project is located entirely on lands managed and administered by the BLM. There is a 48.8-ha (120.5-acre) private parcel located within Project site that is not planned for use by the Project. The Project area slopes gently to the north and to the west, away from the base of the Mule Mountains, with elevation ranging from about 131 meters (m; 430 feet) to 216.4 m (710 feet) above mean sea level (amsl). The Project site is situated on a broad alluvial fan that features many braided washes draining to the northwest into a larger channel. Similar conditions exist in the surrounding vicinity, with additional features including the McCoy Mountains to the north and the Palo Verde Valley and the Colorado River to the east of the Project (Figure 1.1). The dominant vegetation community type across the Project site is Sonoran Creosote Bush Scrub. This community is primarily composed of creosote bush (*Larrea tridentata*), but burro bush (*Ambrosia dumosa*) is relatively common. Predominantly annual grasses and forbs, and scattered cactus and smaller shrub species occur in the scrub community. Stabilized and partially stabilized desert sand dunes occur within the Project. The dominant species within this herbaceous alliance is big galleta grass (*Hilaria rigida*). Commonly occurring species include creosote bush, desert sand verbena (Abronia villosa), many-flowered mentzelia (*Mentzelia longiloba*), desert lantern (*Oenothera deltoides*), desert wire lettuce (*Stephanomeria pauciflora*), desert lily (*Hesperocallis undulata*) and Russian thistle (*Salsola tragus*), an invasive annual herb. Desert dry wash woodlands occur adjacent to and within the Project, however, the Project was designed to avoid multiple woodlands interspersed within the Project boundary. This woodland community is primarily composed of leguminous trees that occur in association with gravelly washes with often braided channels. Dominant species include ironwood (*Olneya tesota*), blue palo verde (*Parkinsonia florida*), and occasionally honey mesquite (*Prosopis glandulosa*). Within the Sonoran Desert Creosote Bush Scrub community there are relatively small expanses of desert pavement, a distinctive but largely unvegetated habitat. The gen-tie crosses creosote scrub and partially stabilized sand dune communities.

There are no perennial water features located in or immediately adjacent to the Project that are known to attract bird or bat species. The nearest large bodies of water that could be considered major bird or bat attractants are the Colorado River (22.5 km [14 miles] east of the Project), the Salton Sea (77 km [48 miles] southwest of the Project), and Lake Havasu (104.6 km [65 miles] northeast of the project). There are however three wastewater treatment ponds at the Chuckwalla Valley State Prison, 2.6 miles west of the Project, that could attract birds. The region around the Project is considered part of the Pacific Flyway, which may increase flyovers seasonally. Because of this, and because the Project is located within the Pacific Flyway, migrating birds may pass over the Project and vicinity during the spring and fall. The Pacific Flyway refers to a general migratory front that includes states west of the Rocky Mountains. Stopover areas listed above are crucial to successful migration; however, birds may occur throughout the region depending on resource availability and weather conditions (Newton 2010; Ruth et al. 2012). In particular, the various microphyll woodlands located in washes interspersed directly adjacent to the Project (but avoided in the Project design), are known to have higher levels of bird diversity and abundance than most habitats within the desert southwest (e.g., Mcreedy 2011) and thus pre-construction surveys (see below) included a focus on these habitats.

## 2.1 Pre-Siting Avian Data Collection

In an effort to place the Project infrastructure in locations that would result in the least risk to populations of birds and bats, data on site characteristics and wildlife occurrence were collected and evaluated. A full description of surveys, methods, and results can be found in the *RE Crimson Solar Project Biological Resources Technical Report* (BTR; AECOM 2018). The relevant information provided in BTR has been summarized for use in this document.

### *2.1.1 Avian Studies*

Special-status avian species have the potential to occur within the CSEP (Table 2.1). To understand baseline conditions of avian use at the Project, including use by sensitive species, and support project planning decisions, avian field surveys were initiated in 2011/2012 for the SWP site, and then were updated in 2016 and 2017 for the proposed Project (CSEP). The results of both survey efforts are detailed in this BBCS and based on information provided in the BRTR (AECOM 2018). In some cases, surveys were only conducted in one year and at other times surveys spanned multiple years. This is indicated in the text where applicable. To avoid confusion on the survey locations, the report figures include both the SWP and CSEP project boundaries.

Multiple survey techniques were used to target all special-status avian species and their habitats, including: avian point count and transect surveys, avian nocturnal radar monitoring, raptor and eagle use surveys, aerial golden eagle nest surveys, Gila woodpecker (*Melanerpes uropygialis*) surveys, burrowing owl (*Athene cunicularia*) surveys, and elf owl (*Micrathene whitneyi*) surveys.

All survey methods were reviewed and agreed to by the BLM, USFWS, and CDFW prior to implementation (AECOM 2016). The methods and results of all Project-specific baseline avian surveys conducted for the Project are summarized in the sections below.

**Table 2.1 Special-status bird species with the potential to occur within the Crimson Solar Energy Project vicinity, Riverside County, California.***

| Common Name | Scientific Name | Resident Classification[1] | Observed within the CSEP[2] | USFWS Status[3] | CDFW Status[4] | BLM Status[5] |
|---|---|---|---|---|---|---|
| American white pelican | *Pelecanus erythrorhynchus* | Migrant | No | -- | SSC | -- |
| bald eagle | *Haliaeetus leucocephalus* | Winter | No | Delisted 2007 | Endangered | Sensitive |
| bank swallow | *Riparia riparia* | Migrant | Yes | -- | Threatened | Sensitive |
| black skimmer | *Rynchops niger* | Summer | No | -- | SSC | -- |
| Brewer's sparrow | *Spizella breweri* | Winter | No | -- | SSC | -- |
| burrowing owl | *Athene cunicularia* | Migrant, Winter | Off-Site | -- | SSC | Sensitive |
| Bendire's thrasher | *Toxostoma bendirei* | Summer | No | -- | SSC | Sensitive |
| California black rail | *Laterallus jamaicensis cotorniculus* | Year-round | No | -- | Threatened | Sensitive |
| Costa's hummingbird | *Calypte costae* | Summer | No | -- | -- | -- |
| crissal thrasher | *Toxostoma crissale* | Year-round | No | -- | SSC | -- |
| elf owl | *Micrathene whitneyi* | Summer | No | -- | Endangered | Sensitive |
| ferruginous hawk | *Buteo regalis* | Migrant, Winter | Yes | -- | -- | -- |
| Gila woodpecker | *Melanerpes uropygialis* | Year-round | No | -- | Endangered | Sensitive |
| gilded flicker | *Colaptes chysoides* | Year-round | No | -- | Endangered | Sensitive |
| golden eagle | *Aquila chrysaetos* | Winter | No | -- | Fully Protected-- | Sensitive |
| gray vireo | *Vireo vicinior* | Rare | No | -- | -- | Sensitive |
| greater sandhill crane | *Grus Canadensis tabida* | Migrant | No | -- | Threatened/Fully Protected | Sensitive |
| gull-billed tern | *Sterna nilotica* | Summer | No | -- | -- | -- |
| Lawrence's goldfinch | *Carduelis lawrencei* | Winter | No | -- | -- | -- |
| least bittern | *Ixobrychus exilis* | Winter | No | -- | -- | -- |
| Le Conte's thrasher | *Toxostoma lecontei* | Year-round | Yes | -- | -- | -- |
| loggerhead shrike | *Lanius ludovicianus* | Year-round | Yes | -- | -- | -- |
| long-billed curlew | *Numenius americanus* | Winter | No | -- | -- | -- |
| long-eared owl | *Asio otus* | Winter | Off-Site | -- | SSC | -- |
| Lucy's warbler | *Vermivora luciae* | Summer | No | -- | -- | Sensitive |
| marbled godwit | *Limosa fedoa* | Rare | No | -- | -- | -- |
| mountain plover | *Charadrius montanus* | Winter | No | -- | -- | Sensitive |

**Table 2.1 Special-status bird species with the potential to occur within the Crimson Solar Energy Project vicinity, Riverside County, California.***

| Common Name | Scientific Name | Resident Classification[1] | Observed within the CSEP[2] | USFWS Status[3] | CDFW Status[4] | BLM Status[5] |
|---|---|---|---|---|---|---|
| northern harrier | *Circus cyaneus* | Winter | Yes | -- | -- | -- |
| American peregrine falcon | *Falco peregrinus anatum* | Migrant, Winter | No | Delisted 1999 | Delisted 1999 | -- |
| olive-sided flycatcher | *Contopus cooperi* | Migrant | Off-site | -- | SSC | -- |
| prairie falcon | *Falco mexicanus* | Year-round | Yes | -- | -- | -- |
| purple martin | *Progne subis* | Migrant | No | -- | SSC | -- |
| short-eared owl | *Asio flammeus* | Migrant | No | -- | SSC | -- |
| Southwestern willow flycatcher | *Empidonax traillii extimus* | Migrant | No | Endangered | Endangered | -- |
| Swainson's hawk | *Buteo swainsonii* | Migrant | Yes | -- | Threatened | Sensitive |
| Vaux's swift | *Chaetura vauxi* | Migrant | Yes | -- | SSC | -- |
| vermillion flycatcher | *Pyrocephalus rubinus* | Migrant | No | -- | SSC | -- |
| western yellow-billed cuckoo | *Coccyzus americanus occidentalis* | Nesting | No | Threatened | SSC | Sensitive |
| yellow-breasted chat | *Icteria virens* | Summer, Migrant | No | -- | SSC | -- |
| Yellow-headed blackbird | *Xanthocephalus xanthocephalus* | Year-round | No | -- | SSC | -- |
| yellow warbler | *Dendroica petechia* | Winter, migrant | Yes | -- | SSC | -- |
| Yuma Ridgway's rail | *Rallus obsoletus yumanensis* | Winter | No | Endangered | SSC | Sensitive |

*List derived from California Special Animals list (CDFW 2016) and IPaC (USFWS 2017).

[1]Resident classification taken from Sibley 2000.

[2]Crimson Solar Energy Project, Riverside County, California. Yes=observed within Project site during protocol surveys; No=not observed within Project site during protocol surveys; Off-Site=observed outside of Project site during protocol surveys.

[3]Designated by USFWS as Threatened, Endangered or Candidate species under ESA.

[4]Designated by CDFW as Threatened, Endangered or Species of Special Concern under CESA.

[5]Designated by the BLM as a sensitive species.

### *2.1.2 Migratory Bird Observation Points*

Migratory bird observation points were conducted within the SWP site during 2012 and within the CSEP site in 2016 and 2017 (AECOM 2018). The results of both the 2012 and 2016/2017 migratory bird observation points and migratory bird transects are presented together in this section.

#### *2012 Surveys*

In 2012, surveys for all species of birds were conducted from seven fixed observation points (four focused on non-raptors and three focused on raptors) within the SWP site (Figure 2.1). The observation point surveys were used to complement the 2012 transect surveys with information regarding migratory bird activity and flyover events. The four non-raptor observation points were located in areas that provided a wide range of observation while being concentrated in areas with high potential for bird activity (e.g., adjacent to microphyll woodlands and areas with higher vegetation density). The points were surveyed for eight hours per day on three consecutive days each week between April 10, 2012 and May 31, 2012. Each non-raptor observation point was surveyed by a qualified biologist in one day. The surveyor scanned the sky and surrounding area recording every raptor and non-raptor seen or heard at an unlimited distance from the observation point.

Raptor observation points were focused on gathering local raptor migration information. Three points were located at least 3.2 km (2 miles) apart in areas with broad, unobstructed views to provide maximum visual coverage of the SWP site (Figure 2.1). The three raptor observation points were monitored for eight hours per day, four days per week between April 17 and April 27, 2012. The methodology was based on the Hawk Migration Association of North America Field survey Technique (HMANA 2010). The following reflects the combined results of the migratory bird observation points and migratory bird transects conducted in 2012.

- A total of 2,638 bird observations, consisting of 84 species, were made during the spring 2012 point surveys.
- The most common species observed were cliff swallow (*Petrochelidon pyrrhonata*; 255 observations), horned lark (*Eremophila alpestris*; 231 observations), loggerhead shrike (*Lanius ludovicianus*; 178 observations), ash-throated flycatcher (*Myiarchus cinerascens*; 164 observations), mourning dove (*Zenaida macroura*; 153 observations), barn swallow (*Hirundo rustica*; 143 observations), cactus wren (*Campylorhynchus brunneicapillus*; 116 observations) and turkey vulture (*Cathartes aura*; 113 observations).
- Waterbirds observed included 81 observations of double-crested cormorant (*Phalacrocorax auritus*) and two observations of long-billed curlew (*Numenius americanus*) flying east towards the Lower Colorado River on April 11, 2012.
- Songbirds were the most commonly observed species group accounting for 76.3 percent of all observations followed by non-passerines other than raptors and waterbirds (12.3 percent of all observations), raptors (8.2 percent of all observations), and waterbirds (3.1 percent of all observations).

- A total of ten special-status bird species were observed during the spring 2012 point and transect surveys (Figure 2.2). No federally listed endangered or threatened species or state endangered species were observed. Two state threatened species were observed within the CSEP, bank swallow and Swainson's hawk.

***2016/2017 Surveys***

Migratory bird observation point surveys were conducted for two migratory seasonal periods (fall 2016 – 18 weeks and spring 2017 – 16 weeks) for a total of 34 weeks of surveys. For the 2016/2017 surveys, there was no distinction between non-raptor and raptor observation points. Surveys were conducted in accordance with the Agency-approved RE Crimson Avian Work Plan (AECOM 2016). Each survey consisted of observations from four stations over an eight hour window, so that there were 576 hours of observation during fall 2016 and 512 hours of observation during spring 2017.

- A total of 3,396 birds, consisting of 60 distinct species, were recorded during both migratory seasonal periods. Avian groups observed included: corvids, doves and pigeons, gamebirds, nighthawks, passerine (non-corvids), raptors and vultures, swifts and hummingbirds, and waterbirds.
- The most common bird species observed were turkey vulture (863 observations [i.e., number of individuals]), horned lark (783 observations), barn swallow (259 observations), common raven (*Corvus corax*; 194 observations), tree swallow (*Tachycineta bicolor*; 193 observations), and Swainson's hawk (183 observations).
- Five large flocks (over 50 birds) were encountered during migratory observation point surveys, consisting of two flocks of turkey vultures (approximately 400 and approximately 75) observed during fall 2016, two flocks of Swainson's hawks (approximately 80 each) during spring 2017, and a single flock of tree swallows (approximately 75) observed during spring 2017.
- Small flocks of over 10 individuals (but less than 50) were seen during the point surveys (less than three percent of all observations). Species observed in these flocks included barn swallow (maximum of 15 individuals), horned lark (maximum of 19 individuals), red-winged blackbird (*Agelaius phoeniceus*; maximum of 20 individuals), Swainson's hawk (one flock of 15 individuals), tree swallow (maximum of 30 individuals), turkey vulture (maximum of 40 individuals), and a flock of waterbirds of unknown species (a single flock of 16 individuals). With the exception of horned lark, which may breed within the CSEP, all of these species are migratory.

### *2.1.3 Migratory Bird Observation Transects*

***2012 Surveys***

In 2012, 12 transects containing eight observation points per transect were established in the SWP site following the methodology of Ralph *et al.* 1995 and the 2009 BLM Solar Facility Point

Count Protocol (BLM 2009b) which recommends: one transect per square mile and eight point count locations per transect with points spaced 250 meters apart (Figure 2.1). No buffer around the SWP Site was included.

Transect locations were chosen to sample multiple habitats across the SWP site, with a preference for microphyll woodlands where higher bird densities were expected. Transects were surveyed on a weekly basis from April 19 to June 1, 2012. Surveys started at sunrise and ended no later than 11:00 A.M., or if the temperature exceeded 90°F at the start of a transect. All points along each transect were surveyed by one biologist on the same day. Biologists began the survey at one end of a transect on the first point and surveyed systematically through the eight points in numerical order (recording any incidental sightings observed during transit between survey points). At each point, passive surveying for birds occurred for ten minutes. All birds seen or heard at unlimited distance from the point were recorded. The results of the 2012 migratory bird observation transects are combined with the migratory bird observation point results and reported in Section 2.2.2.

***2016/2017 Surveys***

Migratory bird observation transect surveys were conducted within the CSEP and adjacent microphyll woodlands and desert dune areas along four walking transects. The surveys were conducted throughout the year with surveys conducted weekly in the spring (February 1 through May 31; approximately 16 weeks) and fall (July 18 through November 18; approximately 18 weeks), and every other week the remaining portion of the year (18 weeks, or 9 weeks of survey; AECOM 2018). Surveys were conducted in accordance with the Agency-approved RE Crimson Avian Work Plan (AECOM 2016). Surveys began in July 2016 and continued as noted above. Surveys for February through June were conducted in 2017 so that an entire year of data was collected for the Project. Transects were concentrated in areas with high potential for bird activity (e.g., washes and microphyll woodlands), and distributed across the CSEP and adjacent area to achieve a representative sample of avian activity (Figure 2.1). Transect length, start times, and durations were standardized to allow for future analysis using the distance sampling approach (Bibby et al. 2000; Thomas et al. 2010). Transect surveys were conducted in the morning to coincide with the period when birds are most active. The surveys rotated days each week to account for any temporal variability. Each survey consisted of approximately two hours of walking and observing.

- A total of 2,603 bird observations consisting of 76 species were made during the migratory bird transect survey efforts from July 2016 – July 2017.
- Avian groups observed included: corvids, doves and pigeons, gamebirds, nighthawks, owls, passerine (non-corvids), raptors and vultures, swifts and hummingbirds, waterbirds, and woodpeckers.

- The most common bird species observed include: horned lark (347 observations), turkey vulture (207 observations), LeConte's thrasher (197 observations), mourning dove (191 observations), Brewer's sparrow (*Spizella breweri*; 187 observations), black-throated sparrow (*Amphispiza bilineata*; 133 observations), loggerhead shrike (125 observations) and barn swallow (113 observations).
- A single large flock (over 50 birds) of an estimated 200 turkey vultures was observed during spring 2017.
- Small flocks of over 10 individuals were seen occasionally (less than three percent of all observations). Species observed in these flocks include: horned lark (maximum of 25 individuals), Brewer's sparrow (maximum of 20 individuals), white-crowned sparrow (*Zonotrichia leucophrys*; maximum of 20 individuals), Gambel's quail (*Callipepla gambelii*; one flock of 15 individuals) and white-throated swift (*Aeronautes saxatalis*; one flock of 20 individuals).

#### *2.1.4 Avian Nocturnal Radar Monitoring*

Nocturnal avian radar monitoring was conducted in 2012 for the SWP site. No nocturnal avian radar monitoring was conducted in 2016/2017 as the 2012 data were considered sufficient. The monitoring protocol followed the protocol and methodology guidance contained in the National Wind Siting Committee Nocturnal Monitoring Methods (Kunz et al. 2007), which recommends that a radar unit be deployed for 30-45 days within a given migration season (i.e. spring or fall). As a result, one mobile radar lab composed of two radar units was deployed within the SWP site during part of the spring migration season, over a 52-day period from April 9 through June 1, 2012. However, due to the large size of the SWP site, sampling time was split between two survey stations (one on the west and one on the east side of the SWP site) to cover a larger proportion of the site (Figure 2.1; AECOM 2018). The mobile radar lab consisted of two marine radar units mounted on a 4-wheel drive pickup/mobile radar lab. The radars used were Furuno 1510 (X-band) transmitting at 9,410 MHz, and with a power output of 12 kW. One radar unit was horizontally positioned to obtain data on flight direction, flight behavior, overall flight path, movement rates (birds/hour [hr]/7.1 $km^2$), and ground speed of birds (km/hr). The other radar unit was tilted 90 degrees to survey in vertical mode to collect data on bird altitudes across the landscape. The passage rate was defined as the average number of detected events per square kilometer of radar sampled area per hour.

- The average hourly passage rate was 3.5 targets/7.1 $km^2$/hr; mean flight speed was 21.0 mph; mean flight direction was 6 degrees; and, mean flight altitude was 320+/- 0.6 m (1,050+/- 2 ft) above ground level.
- 33.6 percent of targets detected on the vertical radar were recorded below 229 m.
- The results show a bell-shaped curve skewed to earlier in the season for targets detected per hour across the sampling period.
- There were several pulses of migratory birds detected with the highest pulse at over 45 targets/hr on April 23, 2012; there was another peak on May 1, 2012, and then a slightly smaller peak on May 8, 2012.

- The mean flight direction for both stations was 6 degrees north, with Station 1 at 115 degrees and Station 2 at 264 degrees.
- Peak activity (highest number of targets/hr) was recorded early in the season (April 23) and then flattened out toward the end of the sampling period, indicating that the majority of migratory activity during the 2012 spring season was likely captured by the study.

### *2.1.5 Burrowing Owl Surveys*

#### ***2012 Surveys***

Focused breeding season surveys for the burrowing owl (*Athene cunicularia*) were conducted in 2012 for the SWP site and an approximately 152-m (500-ft) buffer. Surveys were conducted in accordance with the 1993 California Burrowing Owl Consortium's (CBOC) *Burrowing Owl Survey Protocol and Mitigation Guidelines*. The protocol outlines three survey phases.

In the Phase I survey it was determined that suitable habitat for the burrowing owl occurred within the SWP and buffer. Non-breeding season burrowing owl surveys were not conducted. Focused surveys were conducted during Phase II of the protocol, in which the entire site was surveyed during the breeding season from March 27 to April 8, 2012. During Phase II biologists walked parallel transects at 20-m (66-ft) spacing to provide 100 percent visual coverage. All burrows potentially used by burrowing owls (i.e., presence of one or more owls, pellets, prey remains, whitewash, nesting materials or decoration) were recorded during the survey. For the Phase III surveys, biologists made four separate site visits to each potentially active burrow to detect owl activity.

Surveyors maintained a minimum distance of 50 m (approximately 160 ft) from burrows on the first approach. If no burrowing owls or owl sign were observed from 50 m after 30 minutes of observation, the biologist moved in carefully for closer observation. If burrowing owls were observed, the burrow would be documented as occupied, the biologist would leave quickly, and the burrow was not revisited. If recent burrowing owl sign was observed before arriving at the burrow, the biologist would continue observing from a safe distance for another 30 minutes. If, after the 30 minutes, no owls were observed, the biologist moved carefully into the burrow area and examined the sign closely. Burrows that were identified as inactive (historically used by burrowing owls but contained no recent sign) were observed for 30 minutes during each subsequent visit to determine if they were eventually used by burrowing owls during the breeding season (AECOM 2018).

- During the Phase II surveys in 2012 27 burrows that exhibited burrowing owl activity during the last three years were identified and mapped (Figure 2.3).
- The 27 burrows were subsequently observed on four separate site visits during the Phase II surveys.

- There were no observations of burrowing owls or sign during either the Phase II or Phase III surveys suggesting no recent breeding season activity; however, two burrowing owls were incidentally observed during the fall 2011 botanical survey. The observations were both located in the northwestern portion of the SWP site (Figure 2.3).

***2017 Surveys***

Per direction from the CDFW and the USFWS, burrowing owl surveys were required at the CSEP site in 2017, but did not require full protocol level surveys. A single spring survey conducted at the height of breeding season (April 15 through June 15) was considered acceptable to provide additional information on current burrowing owl status for the Project.

Thus, biologists followed Appendix D of the 2012 *Staff Report on Burrowing Owl Mitigation* survey protocol (CDFG 2012b) for breeding season, but modified it per agency input to include only one survey visit, as opposed to four as stated. The single visit was conducted during the peak part of the breeding season between April 15 and June 15. The survey area included the current Crimson Permitting Boundary only and did not include any buffer areas or the microphyll woodlands (Figure 2.3). The survey area was walked on foot at a spacing of 20 m. Surveys were conducted between morning civil twilight and 10am, and/or two hours before sunset to evening civil twilight. Aside from modifying the survey to one visit instead of four, the protocol in Appendix D of the 2012 staff report was followed consistent with previous burrowing owl surveys.

- No owls or active burrows were observed during the 2017 modified-protocol survey that was restricted to the Crimson Permitting Boundary (CSEP site).
- However, several individual burrowing owls were detected during October 2016 desert tortoise surveys (Figure 2.3). The owls appeared to be using the tortoise burrows and there was no indication of nesting in the area and a limited amount of sign. It appeared that either the burrowing owls were migrating through the area and using the burrows as temporary shelter, or wintering in the area (AECOM 2018).
- Based on the evidence around the burrows where owls were detected, it appears that the CSEP site does not support breeding burrowing owls, but provides suitable wintering and migration habitat (AECOM 2018).

### *2.1.6 Elf Owl Surveys*

***2012 Surveys***

Elf owl surveys were conducted in spring and summer 2012 within the SWP site and an approximately 0.8 km (0.5 mile) buffer (elf owl survey area; Figure 2.4) within areas of microphyll woodland habitat. Microphyll woodland provides potentially suitable elf owl habitat. A total of three surveys were conducted within the elf owl survey area from April 10 to June 6, 2012. The surveys followed the protocol for the cactus ferruginous pygmy-owl (*Glaucidium barsilianum cactorum*) developed by the Arizona Game and Fish Department and USFWS (USFWS 2000b), with modification by Dr. John Boone of the Great Basin Bird Observatory who recently developed a survey protocol for the elf owl. Modification allowed for increased spacing between call/broadcast stations; decreased playback and listening duration at each station; reduction of the buffer size; and altered survey timing. Surveys were conducted throughout the night from twilight until five hours after twilight while the moon was visible on full moon nights and the two nights on either side of the full moon.

- There were no elf owl observations during the three rounds of spring 2012 surveys (Figure 2.4).
- If present on more than a transient basis, elf owls would likely have been detected during the surveys.
- The microphyll woodland within the elf owl survey area lacks the saguaro-dominated or riparian areas that comprise the species' preferred habitats, and it sustains a low number of nesting cavities and a generally smaller prey base as compared with the preferred habitats.
- Elf owl use of the non-saguaro-dominated and non-riparian woodlands on site would be atypical, particularly considering the species' preferred habitat is located and accessible in other locations in close proximity to the site (e.g., Colorado River).

**2017 Surveys**

Nocturnal surveys were conducted in 2017 to determine the presence/absence of elf owl. A similar protocol from 2012 was followed, with several modifications. A modified survey protocol was approved by BLM on April 20, 2017 in which two surveys would be conducted between April and June with the surveys occurring on separate months (Rodriguez pers. comm. 2017b). Instead of four surveys across four survey months as done in 2012, only two surveys would be necessary across the same survey period (April through June). Surveys were conducted in washes with trees large enough to support woodpecker cavities. Surveys were recommended in 2017, because elf owls had been detected as far west as Joshua Tree National Park and 2017 was an above average rainfall year in the desert (Rodriguez pers. comm. 2017b). Surveys occurred on May 30 and 31, 2017, and June 20 and 21, 2017. Surveys focused on surveying the microphyll woodlands between the RE Crimson Permitting Boundary with the largest trees. Given the large size, distance between microphyll woodlands, and limited evening hours, it took two biologists two days to cover all four of the major washes with potential elf owl habitat. No buffer around the microphyll woodlands between the RE Crimson Permitting Boundary was surveyed. Surveys consisted of walking a meandering transect through dense stands of microphyll woodland and playing calls of the elf owl approximately every 150 to 200 meters (Figure 2.4). After a series of calls were broadcast, observers listened for two to three minutes before moving on to the next call location. Biologists listened for calls of elf owls while walking away from a call station, in case an owl decided to call after biologists had left. Only elf owl vocalizations were broadcast, but all avian species detected were recorded. Any known tree cavities were checked carefully, and the elf owl call was played a short distance away from each cavity and biologists watched the entrance to each cavity while the call was played to see if any owls emerged. Surveys were generally conducted during nights with light winds and when the moon was between one-quarter and three-quarters full to maximize detectability and probability of response. Surveys took take place between one-half hour after sunset and midnight.

- There were no elf owls observed during the surveys

### *2.1.7 Golden Eagle Surveys*

Golden eagle surveys were conducted by Bloom Biological, Inc. from March 24 to May 26, 2012. The survey area included the SWP site and an approximately 16 km (10 mile) radius (Figure 2.5). The survey methodology followed the USFWS *Interim Golden Eagle Inventory and Monitoring Protocol* (Pagel et al. 2010), which recommends at least two surveys for eagle nests by helicopter. The first survey flights are designed to detect and report territory occupancy and are to be conducted in March. The second survey flights are to be conducted in late April/early May with the primary goal of observing and reporting on the productivity of nests identified during the initial survey flights in March.

Particular emphasis was placed on topographic features where golden eagles might nest (e.g., Mule Mountains, McCoy Mountains, and Little Chuckwalla Mountains; Figure 2.5) and large power lines where they may perch and nest. The first flights were conducted on March 24-26, 2012 with the helicopter portion of the second survey conducted on April 8 and 8, 2012. Subsequent ground surveys were conducted on May 5 and May 26, 2012 to look for potential post-breeding dispersants from adjacent areas.

No project-specific focused golden eagle surveys were conducted in 2016/2017. Historical golden eagle nest location data within a 16 km (10 mile) radius of the CSEP site were compiled from surveys conducted for other projects in the region and were included on Figure 2.5. Golden eagle surveys via helicopter were conducted during winter and spring 2018; these surveys encompassed a 10-mile radius surrounding the RE Crimson Permitting Boundary. Surveys followed Pagel et al. 2010 in similar fashion as the aerial surveys described from 2012 above with the exception that timing of surveys occurred earlier in the breeding season per request by the USFWS and documented in the golden eagle survey work plan approved by the resource agency.

- No golden eagle individuals were observed during protocol level surveys conducted in the spring of 2012.
- No active or occupied golden eagle nests were identified within a 16 km (10 mile) spatial buffer of the SWP site for the 2012 breeding season (January through June).
- Three inactive nests were identified within the survey area, two in the northern portion of the survey area in the McCoy Mountains and one in the western portion of the survey area in the Little Chuckwalla Mountains (Figure 2.5).
- One of the nests (cliff nest) in the McCoy Mountains was documented on March 24, 2012, located 4.8 miles from the SWP site; another cliff nest in the McCoy Mountains was documented on March 24, 2012 approximately 8.2 miles from the SWP site; a third cliff nest was documented on March 25, 2012 in the Little Chuckwalla Mountains, approximately 7.1 miles from the SWP site (Figure 2.5).

- Although no focused golden eagle surveys were conducted in 2016/2017, no golden eagles were detected during migratory bird observation points and transects conducted within the SWP site during a time of year when resident, migratory, and wintering golden eagles would be present.
- One potential golden eagle kill (a desert kit fox carcass) was documented on the morning of March 3, 2017 by a biologist returning from an avian transect outside the southwest corner of the CSEP site (Figure 2.2).
- Although no focused raptor nest surveys were conducted, the locations of 41 other raptor or corvid nests were documented during the golden eagle surveys. The 41 include; red-tailed hawk (27), turkey vulture (3), and common raven (11).
- During 2018, nine golden eagle nests were found. No active golden eagle nests were confirmed. Two of the seven nests had fresh material added, however, species of nest occupant was not confirmed.
- 50 (18 active) red-tailed hawk nests, 15 (2 active) common raven nests, 5 (0 active) prairie falcon nests, and 5 (0 active) turkey vulture nests were also found during the 2018 surveys.

### *2.1.8 Gila Woodpecker Surveys*

In California, gila woodpeckers tend to be restricted to dense riparian woodlands along the Lower Colorado River and eastern Imperial Valley where sufficient nesting habitat exists. There are no known gila woodpecker occurrences documented within 16 km (10 Miles) of the SWP site, but the species is known to occur to the west of the site at Lake Tamarisk in Desert Center, Corn Springs, and to the east in and around Blythe and along the Colorado River (eBird 2017).

Six full coverage surveys were conducted for gila woodpecker within microphyll woodlands on the SWP site. The breeding season surveys were conducted from April 12 to June 1, 2012. No focused surveys were conducted for the gila woodpecker in 2016/2017.

- No gila woodpeckers were detected during the 2012 gila woodpecker focused surveys or during any of the 2017 avian surveys or other biological surveys conducted within the SWP site.
- The gila woodpecker may occasionally fly through the Project site since there are known locations to the east and west of the site, but the site lacks trees large enough to support nesting cavities for the species and no tree cavities large enough to support the gila woodpecker were detected.

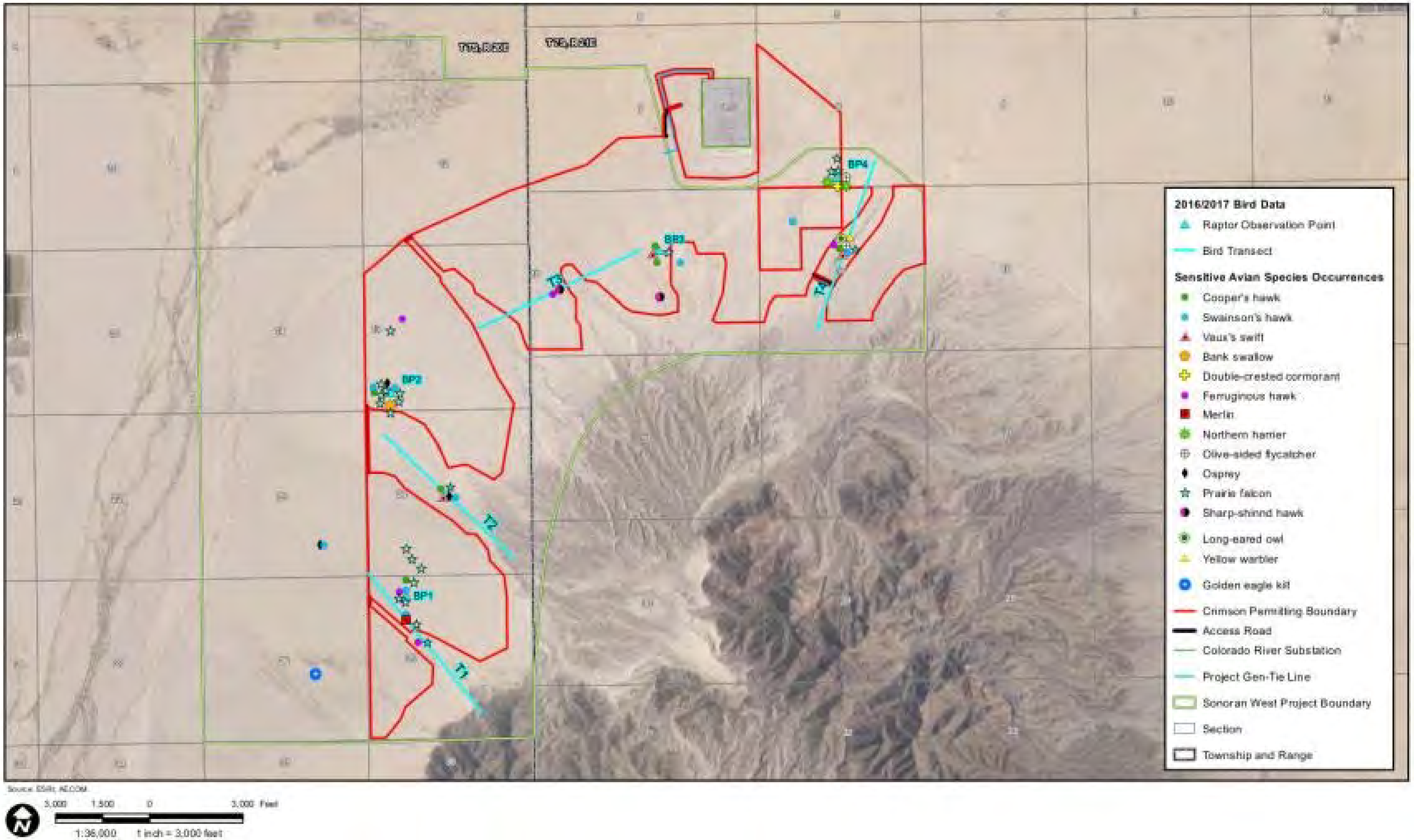


**Figure 2.1 Location of special-status bird observations recorded during 2016/2017 baseline studies at the Crimson Solar Energy Project, Riverside County, California (AECOM 2018).**

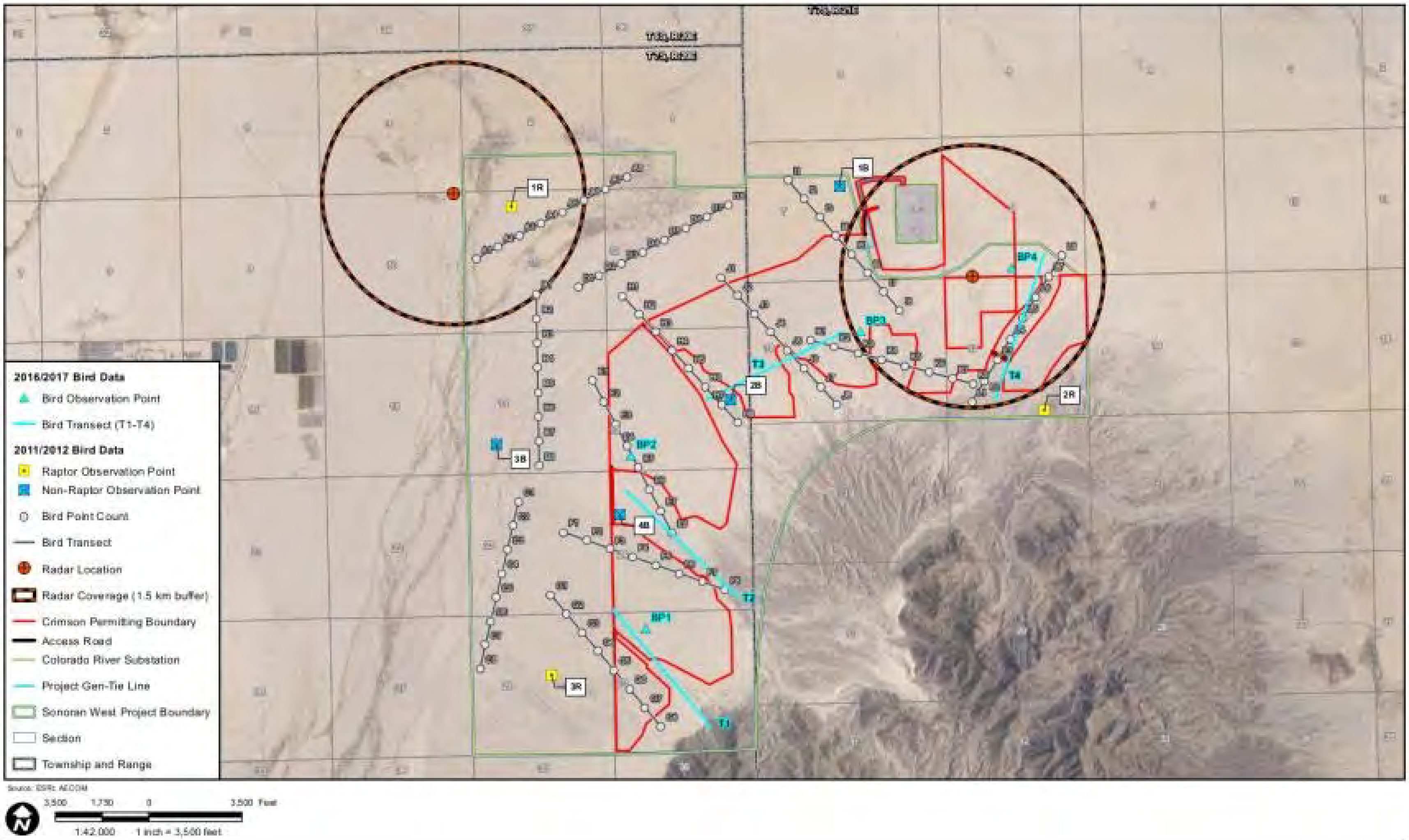


**Figure 2.2 Locations of avian surveys conducted in 2016/2017 at the Crimson Solar Energy Project, Riverside County, California (AECOM 2018).**

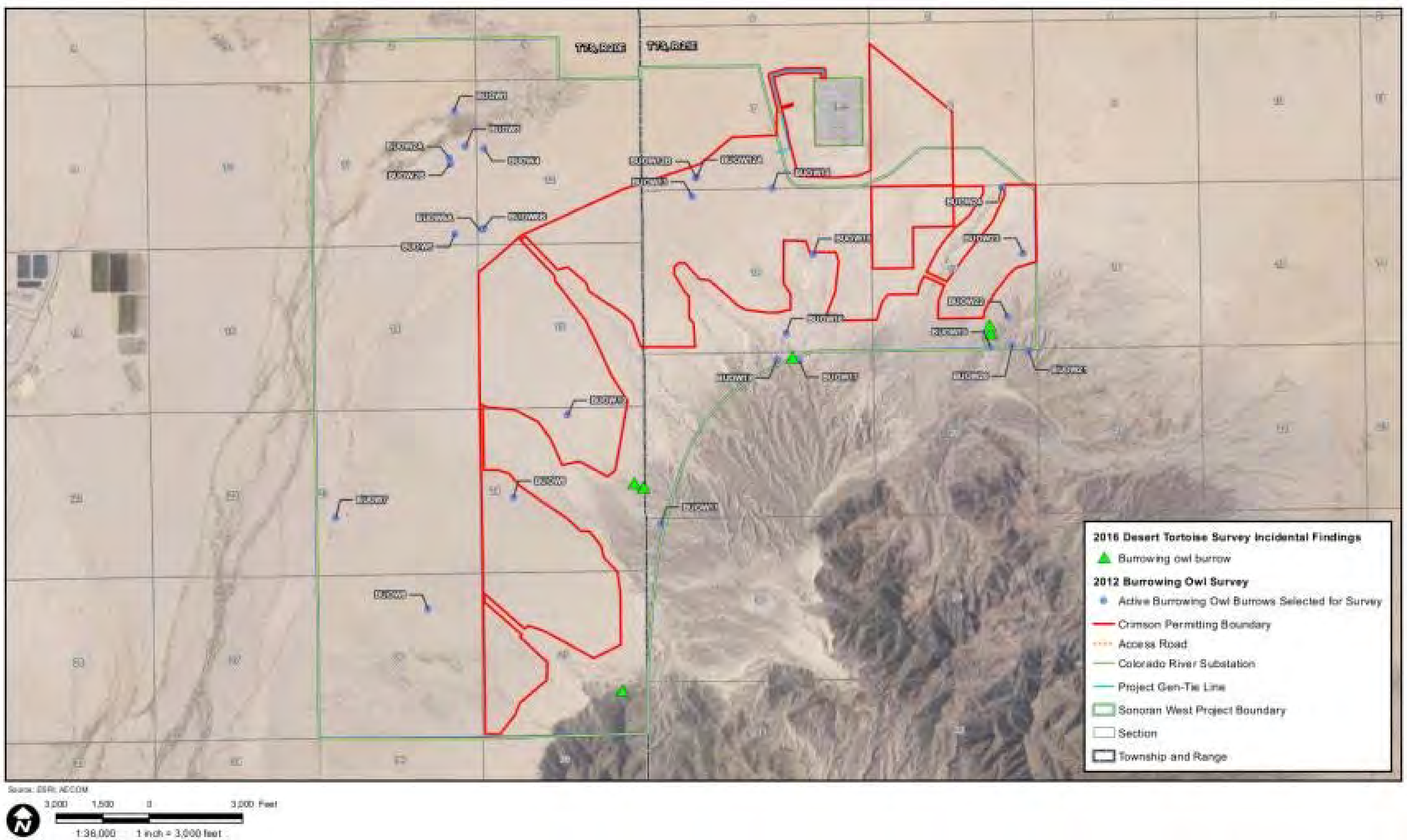


**Figure 2.3 Burrowing owl nests and species observation locations documented during 2012 burrowing owl surveys and 2016 desert tortoise surveys within and adjacent to the Crimson Solar Energy Project, Riverside County, California.**

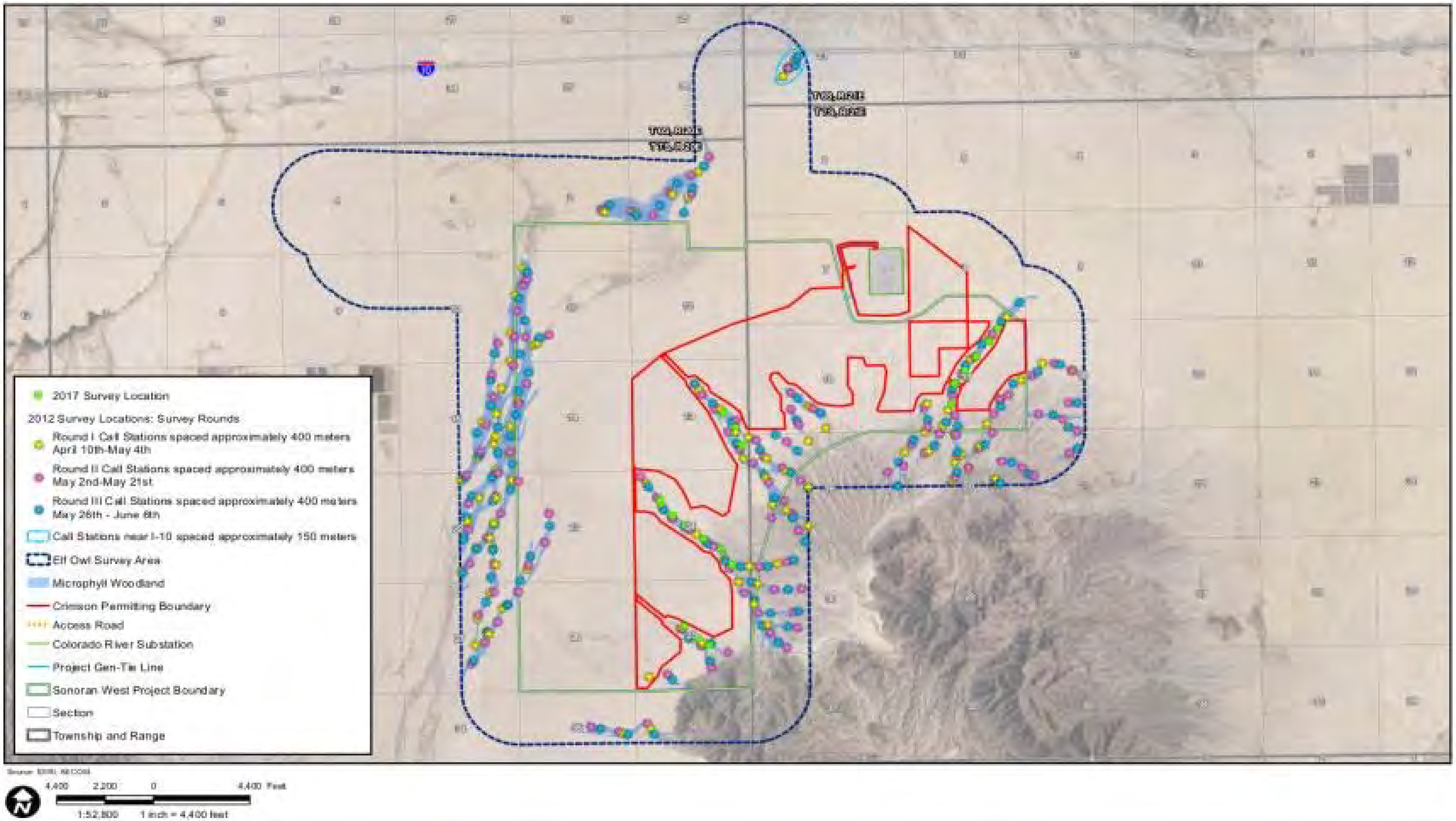


**Figure 2.4 Elf owl survey locations for the 2012 and 2017 elf owl surveys at the Sonoran West Solar Energy Project and the Crimson Solar Energy Project, Riverside County, California.**

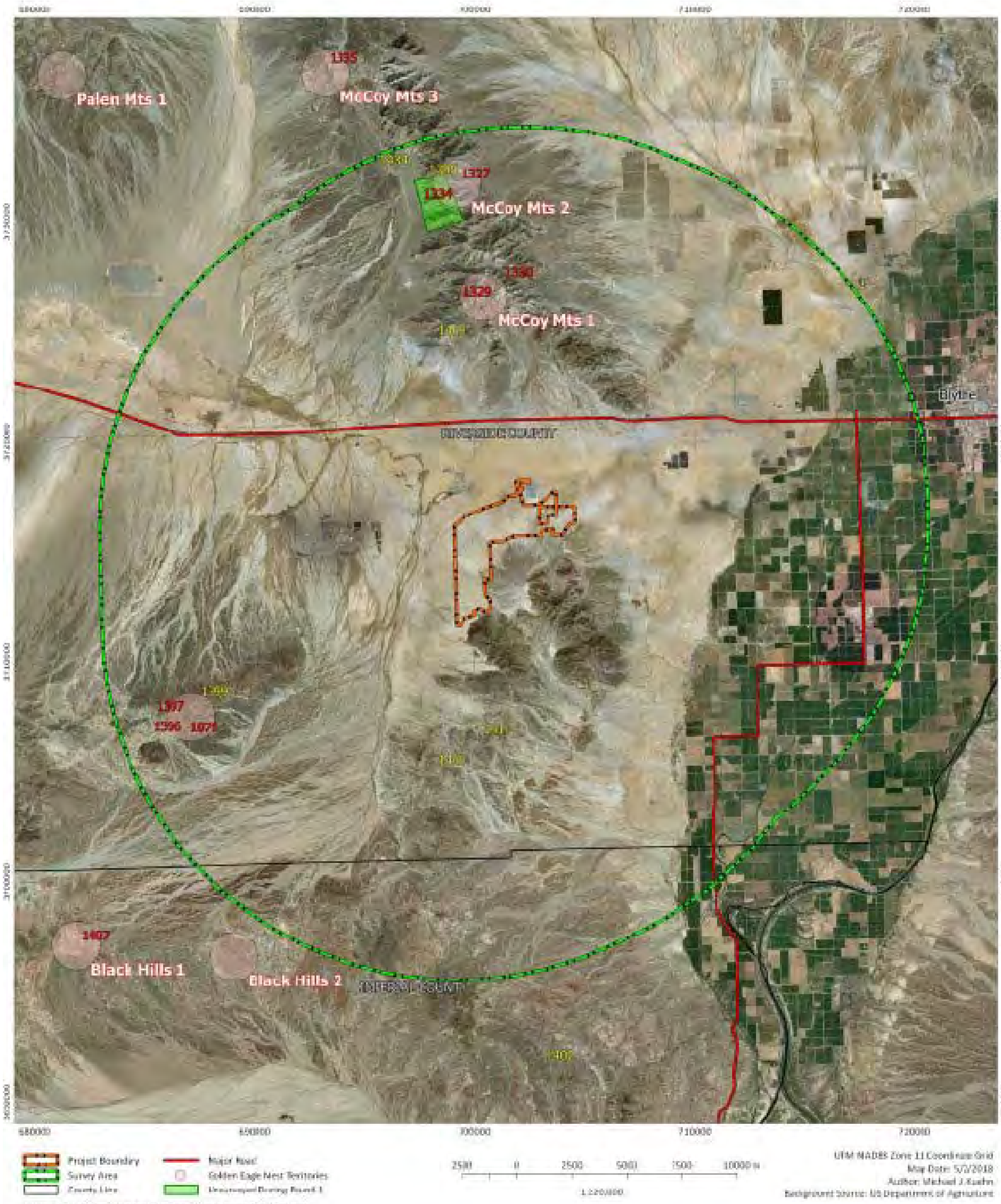


**Figure 2.5 Golden eagle survey results within a 10 mile buffer of the Sonoran West Solar Energy Project (area includes the Crimson Solar Energy Project), Riverside County, California.**

## 2.2 Pre-Siting Bat Data Collection

### *2.2.1 Bat Acoustic Monitoring Survey*

Acoustic bat monitoring surveys were conducted form April 17 through July 30, 2012 and from September 1, 2016 – August 31, 2017. The objective of these surveys were to identify the species of bats that utilize the Project.

During the 2012 surveys, three Anabat acoustic bat detectors were set up within the Project in microphyll woodland habitat (Figure 2.6). The detectors were mounted on ironwood trees, four to six ft above ground and set to record from one hour before the earliest sunset of the year to on hours after the latest sunrise of the year. The same was done during the 2016 – 2017 surveys, except that the set-up configuration was modified to increase efficiency of recording and reduce potential interference. Anabat locations during the 2016 – 2017 surveys are provided in Figure 2.6. After the 2012 and 2016 – 2017 surveys, all recorded bat calls were reviewed. Anabat call files were reviewed and categorized into groups with similar call characteristics.

A total of 14 potential bat species were recorded. Thirteen of these have the potential to occur with the Project area (Table 2.2). Of the thirteen species with the potential to occur within the Project area, all thirteen species have special status designations, but none are state or federally threatened or endangered species (Table 2.2).

**Table 2.2 Special-status bat species with the potential to occur within the Crimson Solar Energy Project vicinity, Riverside County, California.***

| Common Name | Scientific Name | CDFW Status[1] | BLM Status[2] | NECO Status[3] |
|---|---|---|---|---|
| California leaf-nosed bat | *Macrotus californicus* | SSC | SS | SS |
| Pallid bat | *Antrozous pallidus* | SSC | SS | SS |
| Townsend's big-eared bat | *Corynorhinus townsendii* | SSC | SS | SS |
| Western red bat | *Lasiurus blossevillii* | SSC | - | - |
| Western yellow bat | *Lasiurus xanthinus* | SSC | - | - |
| Western small-footed bat | *Myotis ciliolabrum* | - | SS | - |
| Arizona myotis | *Myotis occultus* | SSC | - | - |
| Fringed myotis | *Myotis thysanodes* | - | SS | SS |
| Cave myotis | *Myotis velifer* | SSC | SS | SS |
| Yuma myotis | *Myotis yumanensis* | - | SS | - |
| Western mastiff bat | *Eumops perotis californicus* | SSC | SS | SS |
| Pocketed free-tailed bat | *Nyctinomops femorosaccus* | SSC | - | SS |
| Big free-tailed bat | *Nyctinomops macrotis* | SSC | - | - |

*List derived from California Special Animals list (CDFW 2016) and IPaC (USFWS 2017).

[1]Designated by CDFW as Threatened, Endangered or Species of Special Concern (SSC) under CESA.

[2]Designated by the BLM as a sensitive species.

[3]Designated by NECO (Northern Eastern Colorado Desert Coordinate Management Plan ) as sensitive species

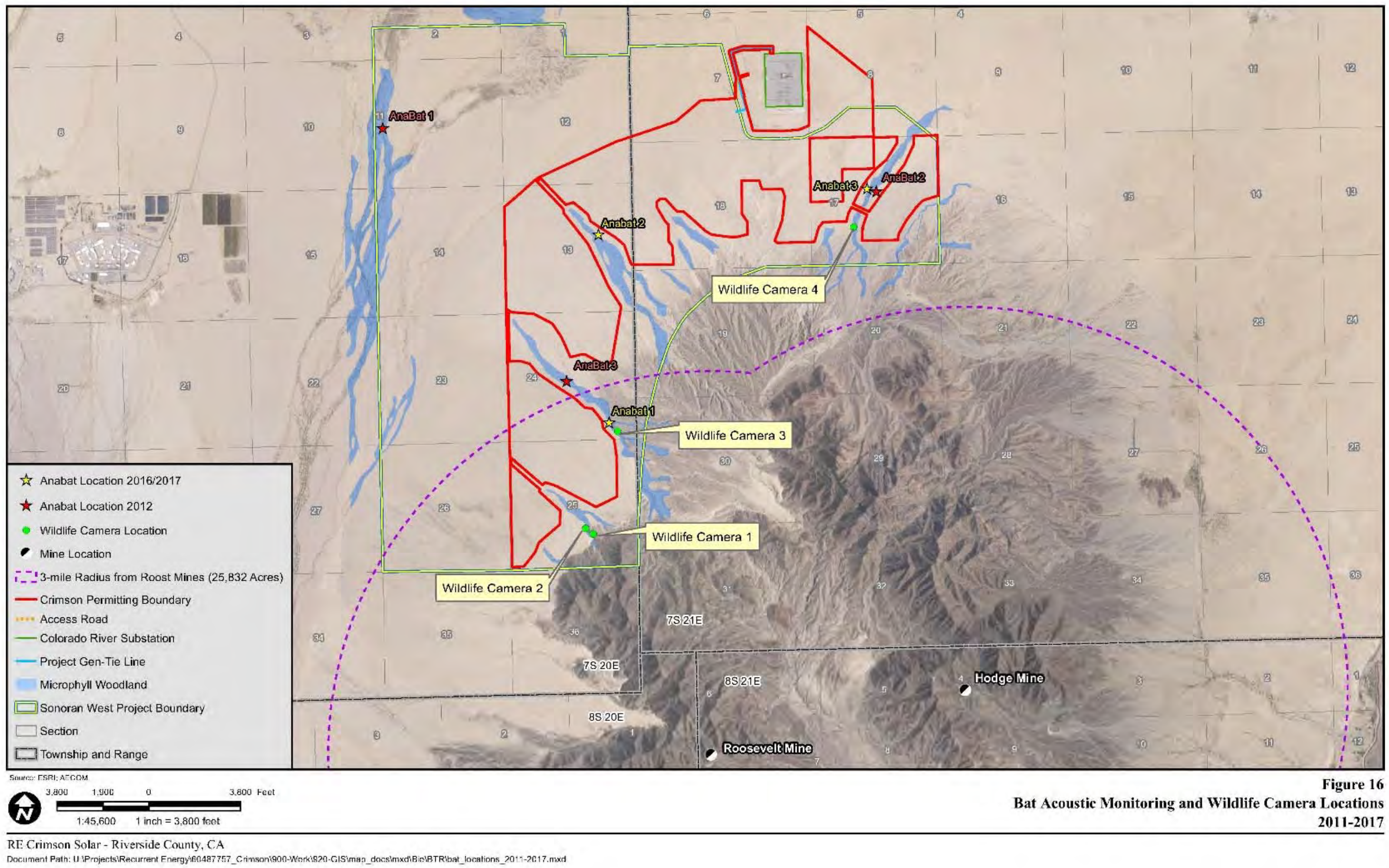


**Figure 2.6 Locations of anabat detectors during 2012 and 2016/2017 surveys conducted at the Crimson Solar Energy Project, Riverside County, California (AECOM 2018).**

# 3.0 RISK ASSESSMENT

The prediction of impacts to birds and bats from the construction and operation of various types of solar facilities is preliminary in nature, as systematic studies detailing the impacts to birds and bats from these facilities are in an early stage of development and relevant information is presently being collected, analyzed, and documented. The following section discusses potential risks by referring to known information regarding impacts to birds from other types of facilities (e.g., transmission facilities) as well as presenting some information that is just beginning to become available from a number of new and existing solar facilities where efforts have been made to collect data regarding impacts to birds and bats.

## 3.1 Birds

### *3.1.1 Direct Impacts*

Direct impacts include disturbances to the landscape, which potentially pose immediate threats to resident and migratory bird populations. Some potential direct impacts include:

- collision risk – transmission lines, solar modules, fence lines, meteorological towers or guy lines, vehicle and equipment collisions, or other stationary and permanent structures constructed for the project;
- electrocution; and
- habitat loss or alteration.

#### <u>3.1.1.1 Avian Mortality at PV Solar Facilities</u>

The science of avian impacts from utility-scale PV solar energy facilities is still fairly new. The understanding of potential risks posed by PV solar development has increased as more studies have been conducted at facilities ranging in size from 250 to 550 megawatts (MW), and standardized methods have been implemented more uniformly across studies. Although there has been an increase in the understanding of the spatial and temporal patterns of bird fatalities as well as the species that occurred as fatalities, risk factors that drive fatality patterns at solar facilities have not been fully investigated.

Bird collisions with solar panels have been documented at PV solar facilities. Data from studies conducted at three solar facilities (California Valley Solar Ranch, Topaz, and Desert Sunlight) have demonstrated that solar panel impacts to birds are distributed across many species (see Appendix I in Ironwood 2017). Most species found among the solar arrays are common species that are typical of the local avifauna and are often ground-dwelling or shrub-associated species. (see Appendix I in Ironwood 2017). Additionally, Kagan et al 2014 categorized 19 bird mortalities at Desert Sunlight as blunt trauma, suggesting collision with project infrastructure. Seventeen species were identified as part of this analysis. Other bird mortalities were categorized as scavenging or undetermined (Kagan et al 2014).

The causal mechanism for bird collisions with panels is not clear. Presently, one hypothesis regarding why birds may collide with panels, is the idea that birds, particularly water-dependent species may be attracted to solar panels, mistaking them for water features, especially at night. Such mistakes could lead to collision or other harms (e.g. strandings). However, this hypothesis has not yet been tested. As such, the causal mechanism for bird collisions with solar panels is presently unknown and it is not possible to determine if the conditions present at the Project would facilitate an attraction by water-dependent birds and/or at what level impacts may occur.

Other publications have also cited considerably less impacts documented at solar facilities in Southern California when compared to more typical sources (roadways, fossil fuel plants, communication towers; Waltson et al 2016). Among solar facilities types, PV facilities appear to have lower impact levels when compared to trough systems and solar power towers (Kagan et al 2014). It should be noted that comparison between other sources, solar facility types, and across PV facilities can be problematic due to the variety of configurations and components constructed. While additional studies are needed to fully understand the impact ranges, current studies suggest bird and bat impacts at PV solar facilities are low.

#### 3.1.1.2 Power Line Collision Risk

Potential avian collision risk or the relative exposure of at-risk bird species to overhead power line collisions (all voltages) is not uniform and based on a number of site-specific factors including line design and voltage, line orientation and placement, topography, surrounding habitats, weather, bird morphology, flight characteristics, and human influences. Biological variables that influence a bird species' susceptibility to line collision include bird size, maneuverability, flight and morphological characteristics, vision, and behavior (Anderson 1978; Beaulaurier et al. 1982; Faanes 1987; Bevanger 1994; Janss 2000; Bevanger and Brøseth 2001; Rollan et al. 2010; APLIC 2012). Lines that bisect bird movement corridors between roosting and foraging habitats may increase the avian collision risk or potential exposure (Bevanger 1994, APLIC 2012), particularly near locations where birds are descending or ascending from daily use areas or migratory stopover habitats (Faanes 1987, Stehn and Wassenich 2008). Assessing collision risk can be quantitatively or qualitatively assessed by line segment for transmission, subtransmission, and distribution voltages.

At this Project, risk associated with the interior lines should be assumed, but is difficult to predict as final design plans are not currently available. Preconstruction surveys did not demonstrate obvious flight patterns in or around the areas (AECOM 2018); however, potential congregation features (i.e., water sources) are located away from the Project. The generation transmission line (gen-tie) is likely to results in less relative risk due to the line's short distance (less the 1 km). Additionally, the gen-tie is currently sited near other larger transmission lines that may have greater impact potential and results in a consolidation of barriers.

#### 3.1.1.3 Electrocution Potential

The electrocution risk to birds on power line structures is related to the line's voltage, structure configuration, and the potential for birds to use these structures (APLIC 2006). Line or pole location, bird size, age of a bird, social behavior, habitats, weather, aerial contaminants, prey abundance, and propensity of certain bird species to perch or nest on power line structures help to define electrocution risk, with bird dimensions being an integral part of this equation. Research has found that bird electrocution risk is higher on distribution and sub-transmission voltages (12.47/7.2 to 60 kV) where reduced phase-to-phase and phase-to-ground clearances present an increased risk. The potential for electrocution on lower transmission voltages (e.g., 115 kV, 138 kV) is low, but will depend on structure configurations (APLIC 2006). APLIC standards (APLIC 2006) are specified in section 4.1, in an effort to minimize potential avian electrocution risk.

#### 3.1.1.4 Habitat Loss or Alteration

Clearing and grubbing construction practices result in habitat loss and displacement of local bird populations as vegetation communities and existing habitats are altered to support Project development. Altering the landscape through Project development may result in the loss of cover, perches, breeding habitat, shelter and foraging sites used by resident species and the loss of perches, roost sites and foraging sites for migratory species.

### *3.1.2 Indirect Impacts*

Indirect impacts include changes to the landscape with unintended and often unforeseen consequences to bird populations. Indirect impacts associated with habitat loss, land alterations and Project development on existing bird populations within the vicinity of the Project are not easily assessed or determined.

Potential indirect impacts include:

- territory abandonment, nest and roost site abandonment;
- increased opportunities for predators of special status species;
- habitat fragmentation;
- habitat type conversion;
- potential increase in invasive species
- wildlife avoidance due to increased human presence, noise and light;
- dust and hazardous materials; and
- altered hydrology.

#### 3.1.2.1 Territory Abandonment, Nest and Roost Site Abandonment

Most wildlife species are susceptible to visual and noise disturbances caused by the presence of humans and construction equipment. Such disturbances can result in the alteration of species' behavior. Noise and visual disturbance caused by construction and vehicles would have the potential to cause nest abandonment or habitat avoidance directly adjacent to and within the proposed Project footprint. Birds avoiding habitat in the vicinity of the Project may opt for less suitable habitat that could increase stress on these species as a result of increased energetic costs. This would also place additional stress on available resources through increased density of birds in off-site areas.

Without the inclusion of conservation measures, direct nest removal during vegetation clearing activities could result in nest and roost site disturbances and territory abandonment.

#### 3.1.2.2 Increased Opportunities for Predators of Special Status Species

The Project may indirectly result in mortality to wildlife through an increased risk of predation. Some predator species such as ravens and coyotes are attracted to human activity. Installation of fencing and transmission towers create additional perching structures from which ravens and raptors may hunt for prey and carrion. Construction, operation, and maintenance of the Project could result in trash and debris that would further attract species, such as ravens (*Corvus corax*) and coyotes (*Canis latrans*). To avoid or minimize human impacts a Worker Environmental Awareness Program (WEAP) and trash abatement program will be implemented (see Section 4).

#### 3.1.2.3 Human Presence, Noise, and Light

Indirect impacts to wildlife species would result from human presence, noise, and light in the Project site. Increased levels of noise and human activity could be detrimental to many wildlife species. Noise from construction activities could temporarily discourage wildlife from foraging and nesting immediately adjacent to the Project site. Many bird species rely on vocalization during the breeding season to attract a mate within their territory. Noise levels from certain construction, operations, and decommissioning activities could reduce the reproductive success of nesting birds.

The most common wildlife response to noise and human presence is avoidance. Avoidance would result in displacement of wildlife from an area larger than the actual disturbance area. The total extent of habitat lost as a result of wildlife avoidance response is impossible to predict because the degree of this response varies from species to species, and can even vary between different individuals of the same species. In addition, after initial avoidance of human activity and noise producing areas, certain wildlife species may acclimate to the activity and begin to reoccupy areas formerly avoided.

Artificial lighting impacts on wildlife species may include disorientation from and attraction to artificial light, collision-related mortality due to disorientation, and effects on the light-sensitive cycles of many species (Saleh 2007). Lighting plays a substantial role in collision risk because lights attract nocturnal migrant songbirds, bats, and major bird kill events have been reported at lighted communications towers (Manville 2001). Bright night lighting close to the ground can attract bats and flying insects and disturb wildlife (e.g., nesting birds, foraging mammals).

Impacts associated with human presence, noise, and light would be reduced through implementation of conservation measures (see Section 4).

#### 3.1.2.4 Dust and Hazardous Materials

Direct habitat loss and degradation both inside and outside of the Project site could also occur if Project activities resulted in release of dust or hazardous materials, resulted in modification of soil erosion or sedimentation rates, or introduced or encouraged the growth of noxious weeds. Hazardous material and pollutant releases could occur as a result of the Project. Materials released could include fuels and other materials used by work crews as part of routine construction and maintenance activities. Hazardous materials could also be released if construction-related excavation were to disturb areas that have existing environmental contamination. Hazardous materials release could impact biological resources by injuring or killing vegetation and wildlife through either short-term acute exposure or long-term chronic exposure. Soil erosion from site grading and use of heavy equipment affects vegetation and soil properties, which could adversely affect wildlife foraging and burrowing habitat on lands outside of the Project boundaries. Noxious weeds could impact wildlife species by displacing native vegetation species necessary for forage or cover.

Impacts associated with dust and hazardous materials would be reduced through implementation of conservation measures for dust control and the management of hazardous materials (see Section 4).

#### 3.1.2.5 Altered Hydrology

Biological resources could potentially be impacted if the Project were to modify the availability or quality of surface water and/or groundwater. The baseline hydrologic conditions in the Project area, as described in the BRTR suggests that effects on water resources or hydrology resulting from implementation of the Project may result in permanent indirect impacts to jurisdictional waters (AECOM 2018). Erosion and stormwater contaminant runoff may degrade adjacent jurisdictional waters. There may need to be minor repairs to access roads between the development areas (that cross washes) following a major storm event.

Conservation measures designed to protect and mitigate for impacts to intermittent/ephemeral water features and groundwater depletion/quality are described in Section 4.

### *3.1.3 Potential Impacts to Special Status Species*

This evaluation was based on the desktop analysis completed for the project and observations recorded during baseline wildlife surveys as well as review of current regional scientific literature and assessing public biological databases and resources that include US Fish and Wildlife

Service (USFWS), USGS topographic maps, NNHP database, and aerial imagery as well as review of existing reports that were conducted for similar projects at or near the Project site. The Information for Planning and Conservation (IPaC) list of federally threatened or endangered species was reviewed for potential occurrence in and around the Project area. One species listed under the BGEPA was identified, golden eagle.

#### 3.1.3.1 Golden Eagle

The Project area does not contain any nesting habitat for golden eagles. During the 2018 nest surveys conducted within 10 miles of the Project, there were nine golden eagle nests found within 10 miles of the site. (AECOM 2018). No active golden eagle nests were confirmed. Two of the nests were considered active based upon fresh nest material, however, species of nest occupant was not confirmed. One of these two nests was located 14.01 miles southwest of the Project while the other was located 5.59 miles north of the Project. Based on the lack of confirmed active golden eagle nesting activity observed during the surveys, it is possible that the area surrounding the project does not provide suitable eagle nesting habitat  or quality forage habitat that would attract eagles to the Project area. The Project area and 10 mile buffer may have limited prey abundance due to recent long-term droughts. The 2,489 acres of habitat that would be lost as foraging habitat is small (1.2 percent assuming 10-mile foraging area) in comparison to available habitat in the survey area. Golden eagles would be susceptible to visual and noise disturbance, potentially resulting in alteration of behaviors.

Golden eagles would be susceptible to injury and/or mortality from collision or electrocution associated with the overhead lines (e.g., gen tie) that are part of the Project. The Project gen tie would represent a small percentage of the existing transmission lines currently in the vicinity of the Project area and would comply with the Avian and Power Line Interaction Committee (APLIC) standards (APLIC 2006). Collision impacts to eagles have not been observed at other PV facilities.

Potential impacts to golden eagles would be reduced through implementation of conservation measures and mitigation measures required for protection of wildlife and other resources (see Section 4).

### *3.1.4 State Listed Wildlife and BLM Sensitive Wildlife Species*

#### 3.1.4.1 Burrowing Owl

Burrowing owls are a California species of special concern and a BLM-sensitive species. They are found in open dry shrub/steppe grasslands, agricultural and range lands, and desert habitats associated with burrowing animals. Likely suitable habitat for burrowing owls includes burrows, (including those abandoned by desert tortoise and other mammals, and artificial “burrows” such as culverts) for roosting and nesting and relatively short vegetation with only sparse shrubs and taller vegetation. The burrowing owl may be affected by the loss of suitable desert tortoise burrows as a result of the proposed Project.

Burrowing owl numbers are declining despite protection under the MBTA (USFWS 2007). The owls are not listed as threatened or endangered in California, but biologists are starting to see a range-wide decline due to loss of habitat and collisions with vehicles.

During Phase II surveys in 2012 within the SWP site, 27 burrows that exhibited burrowing owl activity were documented. However, there were no observations of burrowing owls or sign during the Phase II or Phase III surveys suggesting no recent breeding activity. No burrowing owls or active burrows were observed during the 2017 surveys within the CSEP site. However, several individual burrowing owls were detected during October 2016 desert tortoise surveys. The owls appeared to be using the tortoise burrows, and it appeared that the owls were either migrating through the area and using the burrows as temporary shelter, or wintering in the area.

Suitable burrowing owl burrows exist in the Project area. The entire site is considered suitable foraging habitat for burrowing owls and the species may occur on the site and along the linear facilities, though in very low densities. Impacts to the species may result during construction activities and habitat may be impacted. The potential for impacts to these species would be reduced through implementation of conservation measures (see Section 4).

#### 3.1.4.2 Elf Owl

Elf owls are considered endangered in California by the CDFW. They nest in desert riparian habitat with cottonwood, sycamore, willow, or mesquite, or in areas where saguaro cactus are plentiful. Nests in California are concentrated along the Colorado River in cottonwood-willow and mesquite riparian zones. They are also known to sporadically occur at Desert Center and Corn Springs palm oasis in the 1970's (eBird 2017), and most recently, at Joshua National Park (Rodriguez pers. Comm. 2017 [with AECOM]).

Elf owls were not observed within the SWP site during three rounds of springs 2012 surveys, nor during two rounds of 2017 surveys. The microphyll woodland within the elf owl survey area lacks the appropriate tree species or riparian habitat that comprises the species' preferred habitat. The site also sustains a low number of nesting cavities and a generally smaller prey base as compared with preferred habitats. Impacts from the Project on the species are expected to be limited to none.

Suitable habitat is absent from the Project area, therefore no conservation measures specific to the elf owl are recommended, although other general conservation measures identified in Section 4 would likely benefit the owl, if present.

#### 3.1.4.3 Gila Woodpecker

In California, gila woodpeckers tend to be restricted to dense riparian woodlands along the Lower Colorado River and eastern Imperial Valley where sufficient nesting habitat exists. There are no known gila woodpecker occurrences documented within 10 miles of the Project area, but the species is known to occur to the west of the site at lake Tamarisk in Desert Center, Corn Springs, and to the east of the site in and around Blythe and along the Colorado River (eBird 2017).

No gila woodpeckers were detected during six full coverage breeding season surveys conducted within microphyll woodlands at the SWP site in 2012 or during any of the 2017 avian or other biological surveys conducted within the SWP site. Since there are known locations of the gila woodpecker to the west and east of the site, the species may occasionally fly through the Project area, but the site lacks trees large enough to support nesting cavities and no tree cavities large enough to support the woodpecker were detected on site. Impacts from the Project on the species are expected to be limited to none.

Since suitable habitat is absent from the Project area, therefore no conservation measures specific to the gila woodpecker are recommended, although other general conservation measures identified in Section 4 would likely benefit the species, if present.

### *3.1.5 Avian Risk Reduction Measures*

Impacts to wildlife resulting from construction activities and post-construction operation will be reduced through the implementation of applicant-proposed design features and Bird Conservation Measures (BCMs). Final design features will be identified in the EIS/EIR as well as any Project-specific management plans. The EIS/EIR and management plans are in preparation at this point in time. If necessary, the BBCS will be updated when the documents are finalized.

Detailed BCMs consisting of exclusion zones for bird nests or other areas of high bird use (see Section 4) address general conservation measures to be implemented for the Project. In addition, BCMs provide measures specific to each Project phase such as facility design and construction, operations and maintenance, and reclamation and decommissioning. The current BCMs were developed based on common industry practices, and taken from the BRTR (AECOM 2018).

## 3.2 Bats

### *3.2.1 Direct Impacts*

Solar energy development is a relatively new anthropogenic feature on the landscape for bats to encounter, and responses are not well studied. Bats are susceptible to collisions with moving structures such as wind turbines (Arnett et al. 2008, Roemer et al. 2017), but infrequently collide with stationary structures (Van Gelder 1956, Crawford 1981). Bat mortality could also occur if individuals became trapped in other infrastructure. There are currently no tools or assessments available to predict how many bat fatalities might occur at a solar facility or which species will be affected. However, bat mortality monitoring data is available from several solar energy facilities located in southern California. These data provide insight regarding potential impacts to bats at solar energy facilities in southern California.

Post-construction bat mortality monitoring data is available from three PV facilities, each located in southern California. These includes California Valley Solar Ranch (CVSR; 250 MW), Topaz (550 MW), and Desert Sunlight (DS; 550 MW). Mortality monitoring data is also available from two concentrated solar power (CSP) facilities in southern California; these include Genesis Solar Energy Project (GSEP; 250 MW) and Ivanpah Solar Electric Generating System (ISEGS; 377 MW). Monitoring efforts, methods, study years, and land cover differed at each Project. Mortality monitoring data is available for one year of monitoring at Topaz (2012 – 2013), DS (2015 – 2016), and GSEP (2015 – 2016), two years at CVSR (2012 – 2014) and three years at ISEGS (2013 – 2016).

Mortality monitoring carcass searches at CVSR included the solar arrays, perimeter fence, medium-voltage overhead lines (MVOH), gen-tie line, evaporation pond, and reference sites; monitoring at Topaz included the solar arrays, MVOH, and substation; Desert Sunlight monitoring included the solar arrays, fence line, and gen-tie line; monitoring at Genesis included solar collector assemblies, air cooled condensers (ACC), the perimeter of the power blocks, fence line, gen-tie line, and the perimeter of the evaporation ponds; monitoring at ISEGS included the power block, ACC, inner high-density heliostat area, a sample of the outer heliostat area, and a complete survey of the fence line and generation tie line. Fence line and generation tie line surveys were not conducted at ISEGS during the second monitoring year.

During the first year of monitoring at CVSR (which included the transition from construction to operations), there were zero bats found during weekly post-construction monitoring at all components (H.T.Harvey and Associates [HTH] 2014). Similarly, during the second year of monitoring, when all monitored components were surveyed during the entire year, there were zero bats found (HTH 2015). While no formal bat surveys were conducted at CVSR prior to construction, the biological assessment for CVSR notes that pallid bats (*Antrozous pallidus*) were seen onsite and suitable foraging and roosting habitat is present on site (HTH 2010); furthermore, at Topaz (located nearby in similar habitat), where acoustic bat surveys were conducted, bat activity was recorded. Thus, taken together, there is evidence that bats were present at CVSR but no bat fatalities were detected.

Mortality monitoring at Topaz began during construction (October 2012) and continued through October 2013. One bat carcass was found; however, the bat was found in a shipping container transported form the port of Los Angeles, and later determined to be a Malaysian fruit bat, not endemic to North America (Althouse and Meade 2014). During acoustic monitoring conducted at Topaz, there were at least six distinct bat species detected, including Big Brown (*Eptesicus fuscus),* Silver-haired Bat (*Lasionycteris noctivagans)*, Western Small-footed Bat (*Myotis ciliolabrum)*, Yuma Bat (*Myotis yumaensis)*, Canyon Bat (*Parastrellus Hesperus),* and Mexican Free-tailed Bat (*Tadarida brasiliensis*); furthermore, bats were found roosting under construction tarps on two occasions. Thus, taken together, there is evidence that bats were present at Topaz but no bat fatalities were detected.

Zero bats were found during carcass searches at all components at DS (WEST 2016a). Prior to construction of the site, a local bat biologist surveyed DS to determine potential for bat species to occur in the area (Ironwood 2010). The survey concluded that habitat suitable for roosting or foraging by several species existed within or near DS. Roosts of at least two species of bats were known to exist in mines located within 16 km of DS. Although there is no direct evidence that bats occur at DS, the site characterization and habitat suggests that bats should have occurred at DS prior to construction.

Prior to construction of GSEP, in spring 2009, biologists conducted baseline surveys for potential roosts and hibernacula within 1 mile of the original disturbance area identified for the project. During those surveys, no bat roosts or hibernacula were detected. Incidental bat activity was observed through the project, and one roost was observed during construction, in a temporary structure. Furthermore, there were a total of 14 bat carcasses reported during construction, including one California myotis (*Myotis californicus*), one Yuma myotis, five canyon bats, one unidentified *Myotis*, and six unidentified bats. All bats were found in temporary structures used to build facility components. Thirteen bat carcasses were found at GSEP during post-construction mortality monitoring (WEST 2017a). All but one bat was detected during the summer or fall, and of the 13 found, two were found during evaporation pond surveys, one during a fence survey, three at project buildings, one during SCA surveys, and six at the power blocks. Species detected included big brown bat, long-legged bat (Myotis Volans), Mexican free-tailed bat, and pallid bat. None of the carcasses were detected at features shared with PV solar facilities.

During the first year of monitoring at ISEGS, there were 32 bat carcasses, of which all were found in the power block or ACC (HTH 2015c). Species detected were big brown bat, canyon bat, California Myotis, Mexican free-tailed bat, pallid bat, and western small-footed bat. During the second year of monitoring 17 bats were detected, all within the ACC units of the facility (WEST 2016b). Detections during the second year included canyon bat, California Myotis, and Mexican free-tailed bat. For the monitoring conducted during the third year at ISEGS, there were 18 bat detections, of which 10 were in ACC units, seven within power block areas, and one within other buildings associated with the tower area (WEST 2017b). The 18 bats were reported to represent species observed in previous years, or be unidentifiable to species. Thus, none of the carcasses were detected at features shared with PV solar facilities.

In summary, bats carcasses were rarely detected at utility-scale solar energy facilities with standardized monitoring, and no native bats were detected during surveys at any of the PV solar facilities with available monitoring data. Bats carcasses were detected each year at the CSP facilities with available data, and the species detected were common species in the desert southwest. Moreover, nearly all of the bats found at the CSP facilities were found associated with the power block or ACC, which is infrastructure unique to CSP technologies and would not be present at a PV facility.

As acoustic monitoring was not conducted prior to or concurrently with fatality monitoring at all sites, it is not possible to determine the activity level of bats at all sites; however surveys during preconstruction at DSL and CVSR, and during construction at Topaz indicated the presence of bats or suitable bat habitat at each facility. Thus, within the limitations of the data currently available, there is little evidence from monitored projects that utility scale PV solar infrastructure poses a significant, direct fatality risk to bats. Furthermore, during the acoustic bat surveys conducted at CSEP, none of the thirteen bats with the potential to occur in the Project area were state or federally threatened or endangered species. The results of these initial studies are consistent with observations that bats infrequently collide with stationary structures (Van Gelder 1956, Crawford 1981), and to the extent that bat fatalities do occur they are typically associated with enclosed structures, such as the power blocks of Ivanpah and Genesis. There were no data available from projects in Oregon, and there are no data which would allow for a prediction of bat fatality risk at a specific project, in any region of the country. However, based on the patterns in the data at PV solar facilities, bat collision fatalities should be uncommon at this type of solar energy technology.

#### *3.2.2 Indirect Impacts*

Little data exists regarding indirect effects of PV solar on bats. PV solar facilities may indirectly affect bats through potential changes in insect activity, however, understanding this is complicated by the many unstudied responses of insects to PV solar development. Several studies have shown that insects that oviposit on water (polarotactic) are attracted to PV solar panels as a result of the polarized light reflected from the panels (Horváth et al 2010, Száz et al. 2016). However, not all insects are polarotactic, and many oviposit on vegetation. Thus, the vegetation at PV solar facilities likely affects insect abundance in the area, but insect abundance pre- and post-construction at PV solar facilities has not been studied. Attempting to infer indirect impacts from PV solar on bats mediated through insects is limited by data and would require many assumptions regarding the pathways from insect abundance and behavior to bat fatalities.

# 4.0 CONSERVATION MEASURES

Crimson Solar will implement avoidance and minimization measures (MM) during the construction, operations, and decommissioning phases to avoid and minimize Project-related bird and bat injuries and fatalities. To avoid duplication, specific plans pertaining to monitoring, management, and control of resources during construction and operations are referred to within this document. Additionally, a full list of MM are provided in the BRTR (AECOM 2018). This document summarizes and highlights MM that will be employed specifically to address potential avian and bat related impacts.

## 4.1 Facility Design

#### *4.1.1 Utility Poles and Lines*

In order to minimize impacts on birds, the utility lines will be designed to minimize or prevent bird injury and fatalities due to electrocution to perching birds. Contractors responsible for utility line will be required to certify the design and construction to ensure they are following Avian Power

Line Interaction Committee (APLIC) guidelines (APLIC 2006) to minimize electrocution. APLIC's suggested practices include recommended clearances for both phase-to-phase and phase-to-ground contacts, depending on voltages. Transmission Lines > 138kV maintain safety clearances greater than required to protected birds; therefore 230-kV transmission does not present an electrocution risk to birds.

#### *4.1.2 Lighting*

The Project has been designed to minimize lighting. To the extent feasible, consistent with safety and security considerations, all permanent exterior lighting and all temporary construction lighting have been designed to minimize night-sky impacts to the extent practicable during construction and operations. Lighting for facilities will not exceed the minimum number of lights and brightness required for safety and security and will not cause excessive glare. Specific design features include the following:

- Full cut-off luminaires will be used to minimize uplighting.
- Lights will be directed downward or toward the area to be illuminated.
- Light fixtures will not spill light beyond the Project boundary.
- Lights in highly illuminated areas that are not occupied on a continuous basis will have switches, timer switches, or motion detectors so that the lights operate only when the area is occupied.
- Where practicable, vehicle mounted lights will be used for night maintenance activities.
- Where practicable, consistent with safety and security, lighting will be kept off when not in use.

### 4.2 General Avoidance Measures and Management Practices

Crimson Solar will implement several general measures to reduce or avoid potential Project impacts on birds, bats and other wildlife during construction and/or operations.

<u>Speed Limits</u>. To minimize the likelihood for vehicle strikes of wildlife during construction, and the occurrence of carcasses that may attract eagles, ravens, or other scavengers, a speed limit of 40 km per hour (kph; 25 miles per hour [mph]) has been established for Power Line Road and 24 km per hour (15 mph) on all roads within the Project. Speed limits on the paved main access road is 56 kph (35 mph). Signs are posted at appropriate locations.

<u>Trash Abatement</u>. During construction, all trash and food-related waste will be contained in secure, closed lid (raven- and coyote- [*Canis latrans*] proof) containers to reduce the attractiveness of the site to opportunistic predators, such as common ravens and coyotes, and to prevent trash from being exposed or blown around the Project. During construction, all trash will be removed at least once a week, or more often as needed if it attracts wildlife.

<u>Raven Management:</u> The Project will prepare and implement a Raven Management Plan. The plan may include monitoring, control, and general management. The goal of the plan is the minimize increases in raven population and use at the project with the intent to reduce impacts on other resources, not to necessarily reduce impacts on ravens.

<u>Minimize Disturbance Impacts</u>. Equipment and vehicle travel will be limited to existing roads or specific construction pathways during construction. Construction traffic, parking, and lay-down areas occur within previously disturbed lands to the extent feasible.

<u>Worker Environmental Awareness Program (WEAP)</u>. A site-specific WEAP informs Project personnel about biological constraints of the Project. Information on the WEAP will be posted in common areas. The WEAP includes information regarding sensitive biological resources, common invasive weeds, restrictions, protection measures, individual responsibilities associated with the Project, and the consequences of non-compliance.

<u>Minimize Standing Water</u>. The minimal amount of water needed will be applied to dirt roads and construction areas (trenches or spoil piles) for dust abatement to meet safety and air quality standards in an effort to prevent the formation of puddles, which could attract birds, bats and other wildlife.

<u>Dispose of Road-Killed Animals</u>. During construction and operations, road killed animals or other carcasses detected by personnel on roads associated with the Project will be reported and removed promptly. Birds will be collected under a Federal Special Purpose Utility (SPUT) permit and state Scientific Collection Permit (SCP).

<u>Weed Control</u>. Minimization of the spread of weeds and introduction of new weed species will be managed by implementing the Weed Management Plan.

<u>Cleanup and Restoration</u>. All unused material and equipment will be removed upon completion of construction and maintenance activities outside the permanently fenced site. A re-vegetation plan will be implemented to restore temporarily disturbed areas. Equipment and debris piles will be removed from site to reduce the potential for small mammal and scavenger attraction.

## 4.3 Other Avian-Specific Measures

### *Burrowing Owl*

In accordance with the Burrowing Owl Management Plan (AECOM 2018b), avoidance, minimization, and mitigation of impacts to burrowing owl shall consist of the following if burrowing owls are discovered during desert tortoise clearance surveys, or within the RE Crimson Permitting Boundary:

- If during preconstruction surveys burrowing owl activity is detected at a burrow during the nonbreeding season (September 1 through January 31), a 160-foot buffer shall be flagged surrounding the occupied burrow and all Project-related activity shall remain outside of the flagged area. Burrowing owl shall be excluded from active burrows during the nonbreeding season (September 1 through January 31) and encouraged to passively relocate to suitable, unoccupied habitat at least 160 feet outside of the exclusion area. Burrowing owl shall be excluded by installing one-way doors in burrow entrances. One-way doors shall be left in place 48 hours to insure owls have left the burrow before excavation. Two to three alternate natural or artificial burrows shall be provided for each burrow that shall be excavated in the disturbance area. The excluded burrows shall be monitored daily for one week to confirm owl use of alternate burrows before excavating burrows. After burrows are confirmed to no longer be in use (1 week), the burrow shall be excavated using hand tools and refilled to prevent reoccupation. Sections of flexible plastic pipe 4-inches in diameter or greater shall be inserted into the tunnels during excavation to maintain an escape route for any burrowing owl inside the burrow.

- If during preconstruction surveys burrowing owl activity is detected at a burrow during the breeding season (February 1 through August 31), a 656-foot non-disturbance buffer shall be flagged surrounding the occupied burrow and all Project-related activity shall remain outside of the flagged area. Burrowing owl shall not be moved or excluded from burrows during the breeding season. Disturbance may only occur if a Designated Biologist verifies through noninvasive methods that the birds have either not begun egg-laying or incubation or juveniles from the occupied burrow are foraging independently and are capable of independent survival.
- A Designated Biologist shall be on-site during all construction activities in potential burrowing owl habitat (the entire 2,489 acre RE Crimson Permitting Boundary is considered potential habitat).
- During construction activities, quarterly and final compliance reports shall be provided to the Resource Agencies documenting the effectiveness of mitigation measures and the level of take associated with the Project. Biological issues also shall be covered in the ongoing compliance reporting required by the BLM.
- At this time, no mitigation is required for impacts to burrowing owl, as none have been detected within the RE Crimson Permitting Boundary. If burrowing owls are detected at a later date, then mitigation may be necessary and will follow the latest CDFW *Staff Report on Burrowing Owl Mitigation* (State of California 2012). Habitat mitigation acreage will likely be coincident with desert tortoise mitigation site acreage.

### *Migratory Birds*

Conservation measures will be implemented in an effort to minimize impacts to migratory birds in and around the Project site although not required pursuant to the MBTA and recent Interior Department and USFWS guidance. These conservation measures apply to all birds protected under the MBTA, which includes species that are not necessarily migratory species. These will include construction and operational phase measures as detailed below.

- In accordance with the RE Crimson Solar Nesting Bird Monitoring and Management Plan (AECOM 2018c), to the extent possible, vegetation clearing will occur outside of the breeding season for avian species protected under the MBTA (e.g., February 1 through July 31). If vegetation clearing must occur during the general avian breeding season, pre-construction nest surveys will be conducted within the construction footprint and surrounding 500-foot buffer by a qualified biologist(s). At least two pre-construction surveys should be conducted, separated by a minimum of 10 days between surveys with one survey occurring at least 14 days prior to the start of construction in any given area of the project footprint and the other conducted within 24 hours prior to when the construction is scheduled to occur. If no active nests are discovered, construction may proceed. If active nests are observed that could be disturbed by construction activities, these nests and an appropriately sized buffer will be avoided until the young have fledged and/or the monitor determines that no impacts are anticipated to the nesting birds or their young. If construction ceases for seven or more consecutive days during the nesting season, and there is suitable nesting habitat present within 500 feet of that area that would be disturbed by construction activities, repeat nesting bird surveys will be required to verify that new nesting locations have not been established within the construction footprint and a 500-foot buffer.
- When above-ground lines are necessary, power line/wire marking devices, including aerial marker spheres, swinging plates, bird diverters, paint, and other bird avoidance devices, will be used as an adaptive management measure if determined necessary to avoid or minimize avian collisions as outlined in the APLIC's Reducing Avian Collisions with Power Lines: State of the Art (2012).
- When above-ground lines, transformers, or conductors are necessary, all will be spaced and designed to comply with the Avian Power Line Interaction Committee's (APLIC) suggested practices to reduce avian electrocutions (APLIC 2012).
- Lattice structures, if used, will be designed and/or fitted to prevent raptors and other birds from nesting in accordance with 2012 APLIC guidelines to the extent practicable.

- Birds may utilize Project facilities for nesting. Any bird nests found will not be touched until the on-site Manager or appropriate biological representative is consulted. If a nest is found, a qualified biologist on-site Manager or appropriate biological representative will check the nest for activity. Nests that contain eggs or young are considered active and are protected for species listed under the MBTA. Therefore, active nests will be left in place. If the safety of the migratory birds, nest, or eggs is at risk or the migratory birds, nest, or eggs pose a threat to serious bodily injury or a risk to human life, including a threat of fire hazard, mechanical failure or power outage, RE will consult with the appropriate federal and state agency representative to determine the appropriate course of action. Similarly, RE will consult the appropriate federal and state agency representatives if an active nest or a nest belonging to an eagle or threatened or endangered species is found. Nests that are confirmed to be inactive (i.e., do not contain eggs or young), do not belong to eagles or other threatened or endangered species, and will cause operational problems, will be removed.

# 5.0 CONSTRUCTION AND POST-CONSTRUCTION MONITORING

A monitoring program that meets the conservation measures listed above will be implemented throughout the construction phase of the Project and for a minimum of two years post-construction as specified below. The ongoing monitoring may inform adaptive management decisions regarding any additional appropriate and practicable mitigation measures to avoid, minimize, and mitigate for observed impacts.

## 5.1 Construction Monitoring

### *5.1.1 Incidental Mortality Observations during Construction*

Throughout the construction phase of the Project, all incidentally discovered carcasses of birds and bats (i.e., incidental fatality discoveries by trained construction facility workers and staff as well as environmental staff when on site) will be documented. Facility workers and staff will be instructed during training to document and report mortalities to the appropriate supervisor who will in turn contact the biological monitor or site biologist, if present. Documentation will include species identification, location information, photographing the carcasses, and assessing a cause of death if possible. Collection will not occur unless permits have been obtained.

## 5.2 Post-construction Avian and Bat Mortality Monitoring Plan

Appendix A provides details of the avian and bat mortality study to be conducted during the post-construction phase of the Project. This study will be implemented for a minimum of two years post-construction. The study will include standard and accepted methods used to evaluate project impacts on birds and bats. The monitoring will follow a distance sampling approach in the solar arrays, supported by searcher efficiency and carcass persistence trials. The monitoring in the solar arrays will include formal adjusted fatality estimates. Data and results of the study will serve as a basis for avian mortality comparisons across other regional renewable energy projects.

### *5.2.1 Adaptive Management*

Adaptive management will be an integral component of the monitoring plan. The goal of adaptive management is to evaluate the monitoring results and identify the need for potential avoidance and minimization measure as warranted and feasible. It is important for stakeholders and resource managers to incorporate statistically sound modeling into any iterative feedback cycle prior to implementation of additional or modified control measures (Williams and Brown 2012). However, the dearth of information pertaining to avian and bat mortality at large-scale photovoltaic solar energy facilities makes the establishment of adaptive management recommendations and trigger thresholds difficult to assign prior to data collection and evaluation. The triggers listed below are provided as a starting point to guide the adaptive management discussions, but are not assumed to be stagnant or clearly defined. The adaptive management process and actions should be fluid based on study plan results and currently available data from other publically available studies.

Adaptive management will be initiated prior to kicking off the monitoring program and will be based on discussion with the TAG. A monitoring plan has been proposed assuming site conditions (infrastructure configuration, ground cover, etc.) will be appropriate to implement the distance sampling approach as detailed. It is assumed that the site conditions will be evaluated before initiating the monitoring plan, and if necessary, changes to the plan will be made. If the site is conducive to the proposed monitoring, it will be assumed that the methods are sufficient to support future adaptive management discussion. It should be acknowledged that the plan assumes a higher level of precision and greater focus on large birds than small birds and subsequent discussions should be cognizant of this assumption.

Adaptive management will be evaluated following the discussion points listed below:

- Results suggest that the avoidance and minimization measures proposed in Section 4 have not been sufficient in reducing project impacts to a comparable level to other solar and/or renewable energy project impact levels
- The results suggest species are being impacted beyond the typical level of a development project
- A large scale mortality event (greater than 25 individuals) is recorded during a single monitoring event (day)
- Water-associated bird estimates are greater than other solar or renewable energy projects

A review of Project data will be critical at the end of each survey year to identify if any adaptive management strategies or additional conservation measures are appropriate. If impacts to birds are shown to be low, no additional monitoring is proposed. Ultimately, the goal of adaptive management is to identify and evaluate the need and/or feasibility for conservation measures.

# 6.0 POST-CONSTRUCTION REPORTING

## 6.1 Reporting During Construction

The Project will report all documented bird injuries and fatalities to the BLM, CDFW, and USFWS using the required Avian Injury and Mortality Reporting Form that is a reporting requirement of the USFWS SPUT Permit issued to the Project to authorize the handling of dead or injured birds. SPUT Permit reporting will be submitted monthly or in accordance with the terms of the permit. Similar reporting to the CDFW will be accomplished as a condition of any relevant Scientific Collecting Permit that the CDFW may issue to authorize the handling of dead or injured birds under state law at the Project. All bat injuries and fatalities will documented as well.

## 6.2 Reporting During Operations

All injury and fatality incidents will be documented and reported to the USFWS and CDFW as part of the SPUT Permit process. Special status or listed species will also be handled in a way that is consistent with project-specific SPUT Permit conditions.

# 7.0 REFERENCES

AECOM. 2018. Biological Resources Technical Report for the RE Crimson Solar Project. Prepared by Sonoran West Solar Holdings, LLC. January 2018.

AECOM. 2018b. RE Crimson Solar Project Burrowing Owl Management Plan. Prepared for Sonoran West Solar Holdings, LLC. Prepared by AECOM, San Diego, California, August, 2018.

AECOM, 2018c. RE Crimson Solar Project Nesting Bird Monitoring and Management Plan. Prepared for Sonoran West Solar Holdings, LLC. prepared by AECOM, San Diego, California, August, 2018.

AECOM. 2016. Avian Survey Work Plan, RE Crimson Solar Project, Riverside County, California. May 2017.

Althouse and Meade, Inc. 2014. Topaz Solar Farms 2013 Fourth Quarter/Second Annual Report for Avian and Bat Protection Plan and Bird Monitoring and Avoidance Plan. Prepared for Topaz Solar Farms LLC, Santa Margarita, California. Prepared by Althouse and Meade, Inc., Paso Robles, California. March 2014.

Anderson, W. L. 1978. Waterfowl Collision with Power Lines at a Coal-Fired Power Plant. Wildlife Society Bulletin 6(2):77-83.

Arnett, E. B., K. Brown, W. P. Erickson, J. Fiedler, B. L. Hamilton, T. H. Henry, A. Jain, G. D. Johnson, J. Kerns, R. R. Koford, C. P. Nicholson, T. O'Connell, M. Piorkowski, and R. Tankersley, Jr. 2008. Patterns of Bat Fatalities at Wind Energy Facilities in North America. Journal of Wildlife Management 72:61-78.

Avian Power Line Interaction Committee (APLIC). 2006. Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006. Public Interest Energy Research Program (PIER) Final Project Report CEC-500-2006-022. Edison Electric Institute, APLIC, and the California Energy Commission. Washington D.C. and Sacramento, California.

Beaulaurier, D. L., B. W. James, P. A. Jackson, J. R. Meyer, and J. M. Lee. 1982. Mitigating the Incidence of Bird Collisions with Transmission Lines. Presented at the Third International Symposium on Environmental Concerns in Rights-of-Way Management. San Diego, California.

Bevanger, K. 1994. Bird Interactions with Utility Structures: Collision and Electrocution, Causes and Mitigating Measures. Ibis 136: 412-425.

Bevanger, K. and H. Brøseth. 2001. Bird Collisions with Power Lines - An Experiment with Ptarmigan (Logopus spp.). Biological Conservation 99: 341-346.

Avian Power Line Interaction Committee (APLIC). 2012. Reducing Avian Collisions with Power Lines: The State of the Art in 2012. Edison Electric Institute and APLIC, Washington D.C.

Bibby, C.J., N.D. Burgess, D.A. Hill, and S.H. Mustoe. 2000. Bird Census Techniques, 2nd ed. Academic Press, London.

California Department of Fish and Game, Natural Resources Agency. 2012. Staff Report on Burrowing Owl Mitigation. March 7, 2012; 34 pp.

California Department of Fish and Wildlife, Natural Diversity Database. 2016. Special Animals List. Periodic Publication. 65 pp.

Crawford, R.L. and W.W. Baker. 1981. Bats Killed at a North Florida Television Tower: A 25-Year Record. Journal of Mammalogy 62:651-652.Hawk Migration Association of North America (HMANA). http://hmana.org

Faanes, C. A. 1987. Bird Behavior and Mortality in Relation to Power Lines in Prairie Habitats. U.S. Fish and Wildlife (USFWS) General Technical Report 7. Washington D.C. 24 pp.

Horváth G1, M. Blahó, A. Egri, G. Kriska, I. Seres, and B. Robertson. 2010. Reducing the maladaptive attractiveness of solar panels to polarotactic insects. Conservation Biology. 24:1644-53

H.T. Harvey and Associates (HTH). 2010. Biological Assessment for the California Valley Solar Ranch Project, San Luis Obispo County, California. Information available online at: https://www.energy.gov/sites/prod/files/2014/04/f14/CVSR_BA_11_08_10_Final.pdf

H.T. Harvey & Associates(HTH). 2014. California Valley Solar Ranch Project Avian and Bat Protection Plan Annual Postconstruction Fatality Report: 16 August 2012 – 15 August 2013. Prepared for HPR II, LLC California Valley Solar Ranch, San Luis Obispo, California.

H. T. Harvey and Associates(HTH). 2015a. California Valley Solar Ranch Project Avian and Bat Protection Plan Final Postconstruction Fatality Report. Prepared for HPR II, LLC, California Valley Solar Ranch, Santa Margarita, California. Prepared by H.T. Harvey and Associates. Project # 3326-03. March 4, 2015.

Ironwood Consulting, Inc. 2010. Biological Resources Technical Report, Desert Sunlight Solar Farm Project, BLM Case File Number CACA-48649, Riverside County, California. https://eplanning.blm.gov/epl-frontoffice/projects/nepa/65802/79685/92430/Desert_Sunlight_FEIS_appendix_H.pdf

Janss, G. F. E. 2000. Avian Mortality from Power Lines: A Morphological Approach of a Species-Specific Mortality. Biological Conservation 95:353-359.

Kunz, T.H., E.B. Arnett, B.M. Cooper, W.P. Erickson, R.P. Larkin, T. Mabee, M.L. Morrison, M.D. Strickland, and J.M. Szewczak. 2007. Assessing Impacts of Wind-Energy Development on Nocturnally Active Birds and bats: A Guidance Document. The Journal of Wildlife Management. 2007 Nov; 71(8):2449-2486.

Pagel, J. E., D. M. Whittington, and G. T. Allen. 2010. Interim Golden Eagle Technical Guidance: Inventory and Monitoring Protocols; and Other Recommendations in Support of Golden Eagle Management and Permit Issuance. US Fish and Wildlife Service (USFWS). February 2010. Available online at: http://steinadlerschutz.lbv.de/fileadmin/www.steinadlerschutz.de/terimGolden EagleTechnicalGuidanceProtocols25March2010_1_.pdf

Roemer, C., T. Disca, A. Coulon, and Y. Bas. 2017. Bat Flight Height Monitored from Wind Masts Predicts Mortality Risk at Wind Farms. Biological Conservation 215:116-122.

Rollan, A., J. Real, R. Bosch, A. Tinto, and A. Hernandez-Matias. 2010. Modeling the Risk of Collision with Power Lines in Bonelli's Eagle (*Hieraaetus fasciatus*) and Its Conservation Implications. Bird Conservation International 20: 279-294.

Sibley, D. A. 2000. The Sibley Guide to Birds. Chanticleer Press, Inc., New York.

Stehn, T. V. and T. Wassenich. 2008. Whooping Crane Collisions with Power Lines: An Issue Paper. Pp. 25-36. In: Proceedings of the 10th North American Crane Workshop. February 7-10, 2006, Zacatecas City, Zacatecas, Mexico. North American Crane Working Group.

Száz, D., D. Mihályi, A. Farkas, Á. Egri, A. Barta, G. Kriska, B. Robertson, G. Horváth. 2017. Polarized light pollution of matte solar panels: anti-reflective photovoltaics reduce polarized light pollution but benefit only some aquatic insects. Journal of Insect Conservation 20:663-675.

Thomas, L., S.T. Buckland, E.A. Rexstand, J.L. Laake, S. Strindberg, S.L. Hedley, J.R. Bishop, T.A. Marques, and K.P. Burnham. 2010. Distance software: design and analysis of distance sampling surveys for estimating population size. Journal of Applied Ecology. 2010 Feb; 47(1):5-14.

US Fish and Wildlife Service (USFWS). 2009. Title 50 - Wildlife and Fisheries. Chapter I - United States Fish and Wildlife Service, Department of the Interior (Continued). Subchapter B - Taking, Possession, Transportation, Sale, Purchase, Barter, Exportation, and Importation of Wildlife and Plants (Continued). Part 22 - Eagle Permits. Subpart C - Eagle Permits: Permits for Eagle Take That Is Associated with, but Not the Purpose of, an Activity. 50 CFR § 22.26 (a)(2). October 1, 2009.

US Fish and Wildlife Service (USFWS). 2013. Eagle Conservation Plan Guidance. Module 1 - Land-Based Wind Energy. Version 2. Division of Migratory Bird Management, USFWS. April 2013. Information available online at: http://www.fws.gov/migratorybirds/Eagle_Conservation_Plan_Guidance-Module%201.pdf

US Fish and Wildlife Service (USFWS). 2018. IPaC - Information, Planning, and Conservation System. IPaC, Environmental Conservation Online System (ECOS), USFWS. January 2, 2018. Information available online at: http://ecos.fws.gov/ipac/

Van Gelder, R.G. Echo-location failure in migratory bats. Transactions of the Kansas Academy of Science 59:220-222.

Western Ecosystems Technology, Inc. (WEST). 2016a. Avian and Bat Monitoring at the Desert Sunlight Solar Farm Project Riverside County, California, 2015 - 2016 Annual Report [Draft]. Prepared for Desert Sunlight 250, LLC and Desert Sunlight 300, LLC, Juno Beach, Florida. Prepared by WEST, Cheyenne Wyoming.

Western EcoSystems Technology, Inc. (WEST) 2016b. Ivanpah Solar Electric Generating System Avian & Bat Monitoring Plan, 2014 – 2015 Annual Report and Two Year Comparison, 21 October 2014-20 October 2015.

Western EcoSystems Technology, Inc. (WEST) 2017a. Post-Construction Monitoring at the Genesis Solar Energy Project, Riverside County, California, First Annual Report 2015-2016.

Western EcoSystems Technology, Inc. (WEST) 2017b. Ivanpah Solar Electric Generating System Avian & Bat Monitoring Plan, 2015 – 2016 Annual Report.

**Laws, Acts, And Regulations**

16 United States Code (USC) 703. 1918. Title 16 - Conservation; Chapter 7 - Protection of Migratory Game and Insectivorous Birds; Subchapter II - Migratory Bird Treaty; § 703 - Taking, Killing, or Possessing Migratory Birds Unlawful. (July 3, 1918, ch. 128, § 2,40 Stat. 755; June 20, 1936, ch. 634, § 3,49 Stat. 1556; Pub. L. 93–300, § 1,June 1, 1974, 88 Stat. 190; Pub. L. 101–233, § 15,Dec. 13, 1989, 103 Stat. 1977; Pub. L. 108–447, div. E, title I, § 143(b),Dec. 8, 2004, 118 Stat. 3071.).

16 US Code (USC) 668. 1940. Bald and Golden Eagles. (June 8, 1940, Ch. 278, § 1,54 Stat. 250; Pub. L. 86–70, § 14, June 25, 1959, 73 Stat. 143; Pub. L. 87–884, Oct. 24, 1962, 76 Stat. 1246; Pub. L. 92–535, § 1,Oct. 23, 1972, 86 Stat. 1064.)

42 United States Code (USC) 4321-4370h. 1970. Title 42 - the Public Health and Welfare; Chapter 55 - National Environmental Policy; Subchapters I (Policies and Goals) and II (Council on Environmental Quality); Sections (§§) 4321-4370h. Public Law 91–190, § 2, January 1, 1970, 83 Statute 852.

50 Code of Federal Regulations (CFR) 10.13. 1973. Title 50 - Wildlife and Fisheries; Chapter I -United States Fish and Wildlife Service, Department of the Interior; Subchapter B Taking, Possession, Transportation, Sale, Purchase, Barter, Exportation, and Importation of Wildlife and Plants; Part 10 - General Provisions; Subpart B - Definitions; Section (§)10.13. List of Migratory Birds. 50 CFR 10.13; 38 Federal Register (FR) 22015, August 15, 1973, as amended 50 FR 52889, December 26, 1985.

50 Code of Federal Regulations (CFR) 22.26. 2009. Title 50 - Wildlife and Fisheries; Chapter I -United States Fish and Wildlife Service, Department of the Interior; Subchapter B - Taking, Possession, Transportation, Sale, Purchase, Barter, Exportation, and Importation of of Wildlife and Plants; Part 22 - Eagle Permits; Subpart C - Eagle Permits; Section (§) 22.26 - Permits for Eagle Take That Is Associated with, but Not the Purpose of, an Activity. (74 Federal Register (FR) 46877, September 11, 2009, as amended at 79 FR 73725, December 9, 2013).

Bald and Golden Eagle Protection Act (BGEPA). 1940. 16 United States Code (USC) § 668-668d. Bald Eagle Protection Act of 1940, June 8, 1940, Chapter 278, § 2, 54 Statute (Stat.) 251; Expanded to include the related species of the golden eagle October 24, 1962, Public Law (PL) 87-884, 76 Stat. 1246. As amended: October 23, 1972, PL 92-535, § 2, 86 Stat. 1065; November 8, 1978, PL 95-616, § 9, 92 Stat. 3114.

California Endangered Species Act (CESA). 1984. Fish and Game Code § 2050 - 2115.5.

California Fish and Game Code, § 3511. California Fish and Game Code; Division 4. Birds and Mammals; Part 2. Birds; Chapter 1. General Provisions; § 3511. Fully Protected Birds. California Department of Fish and Game (CDFG). Available online at California Attorney References: http://law.onecle.com/california/fish/3511.html

California Fish and Game Code, § 3513. California Fish and Game Code; Division 4. Birds and Mammals; Part 2. Birds; Chapter 1. General Provisions; § 3513. California Department of Fish and Game (CDFG). Available online at California Attorney References: http://law.onecle.com/california/fish/3513.html

California Fish and Game Code, § 4150. California Fish and Game Code; Division 4. Birds and Mammals; Part 3. Mammals; Chapter 3. Nongame Mammals and Depredators; Article 1. Nongame Mammals; § 4150. California Department of Fish and Game (CDFG). Available online at California Attorney References: http://law.onecle.com/california/fish/4150.html

California Fish and Game Code, § 4700. California Fish and Game Code; Division 4. Birds and Mammals; Part 3. Mammals; Chapter 8. Fully Protected Mammals; § 4700. California Department of Fish and Game (CDFG). Available online at California Attorney References: http://law.onecle.com/california/fish/4700.html

California Fish and Game Code, § 5050. California Fish and Game Code; Division 5. Protected Reptiles and Amphibians; Chapter 2. Fully Protected Reptiles and Amphibians; § 5050. California Department of Fish and Game (CDFG). Available online at California Attorney References: http://law.onecle.com/california/fish/5050.html

California Fish and Game Code, § 5515. California Fish and Game Code; Division 6. Fish; Part 1. Generally; Chapter 1. Miscellaneous; § 5515. California Department of Fish and Game (CDFG). Available online at California Attorney References: http://law.onecle.com/california/fish/5515.html

California Fish and Game Code, §§ 2050-2097. California Fish and Game Code; Division 3. Fish and Game Generally; Chapter 1.5. Endangered Species. California Department of Fish and Game (CDFG). Available online at California Attorney References: http://law.onecle.com/california/ fish/index.html

California Fish and Game Code, §§ 3503 and 3503.5. California Fish and Game Code; Division 4. Birds and Mammals; Part 2. Birds; Chapter 1. General Provisions. California Department of Fish and Game (CDFG). Available online at California Attorney References: http://law.onecle.com/california/fish/sec-3500-3516.html

Endangered Species Act (ESA). 1973. 16 United States Code (USC) § 1531-1544, Public Law (PL) 93-205, December 28, 1973, as amended, PL 100-478 [16 USC 1531 *et seq.*]; 50 Code of Federal Regulations (CFR) 402.

Executive Order (EO) 13186. 2001. Responsibilities of Federal Agencies to Protect Migratory Birds. EO 13186 of January 10, 2001. 66 Federal Register (FR) 11: 3853-3856. Published in the FR January 17, 2001. Available online at: https://www.fws.gov/migratorybirds/ Partnerships/migbrdeo.pdf

Migratory Bird Treaty Act (MBTA). 1918. 16 United States Code (USC) § 703-712. July 13, 1918.

National Environmental Policy Act (NEPA). 1970. 42 United States Code (USC) 4321-4370h. Public Law 91–190, § 2, January 1, 1970, 83 Statute 852.

## Appendix A. Crimson Solar Project Avian and Bat Post-Construction Mortality Monitoring Plan

# Avian and Bat Post-Construction Fatality Monitoring Plan
# Crimson Solar Project

## Riverside County, California

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**February 2019**

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Western EcoSystems Technology, Inc. (WEST). 2019. Avian and Bat Post-Construction Fatality Monitoring Plan for the Crimson Solar Project. Riverside County, California. Prepared for Recurrent Energy, San Francisco, California. Prepared by WEST, Cheyenne.

# 1.0 INTRODUCTION

The Crimson Solar Energy Project (CSEP or Project), an alternating current (AC) photovoltaic (PV) solar power generation facility, in Riverside County, California is proposed to be constructed and operated by Sonoran West Solar Holdings, LLC (Applicant), a wholly owned subsidiary of Recurrent Energy (RE) (Figure 1). The CSEP will generate up to 350 megawatts (MW) of electricity and will provide renewable energy to the regional electrical grid through an interconnection at Southern California Edison's (SCE) Colorado River Substation (CRS). The Project site is located in unincorporated eastern Riverside County, approximately 20.9 kilometers (km; 13 miles) west of the City of Blythe, California (Figure 1). The Project site consists of 1,007 hectares (2,489 acres) of Bureau of Land Management (BLM)-administered land.

The Project will consist of the construction, operation, maintenance and eventual decommissioning of the solar power generation facility. The total Project area (i.e., Crimson Permitting Boundary; 1,007 hectares) includes an approximately 998-ha (2,465-acre) solar field development area with approximately 752 ha (1,859 acres) of solar panels (array Blocks) and 9.7 ha (24 acres) for linear facilities including access/perimeter roads and generation tie line (gen-tie) and powerline corridors at 45.7-meter (m; 150 feet) widths (Figure 2).

This Post-Construction Mortality Monitoring Plan (hereafter referred to as the "Plan") establishes search protocols to monitor avian and bat fatalities at the site, and establishes analytic methods to estimate post-construction avian and bat fatality rates associated with development of the Project. In particular, the Plan outlines a practical, statistically rigorous spatial and temporal study design, including protocols for determining adjustments for detection biases associated with estimating fatality rates, including searcher-efficiency and scavenger removal biases. It describes specific data to collect during scheduled carcass searches, protocols to address any injured birds and bats that are found, and procedures for reporting detections involving federally or state-listed species to US Fish and Wildlife Service (USFWS) and/or the California Department of Fish and Wildlife (CDFW), as appropriate. The plan is modeled after other monitoring programs currently being employed at solar facilities across the southwest U.S., but has been tailored to this specific Project.

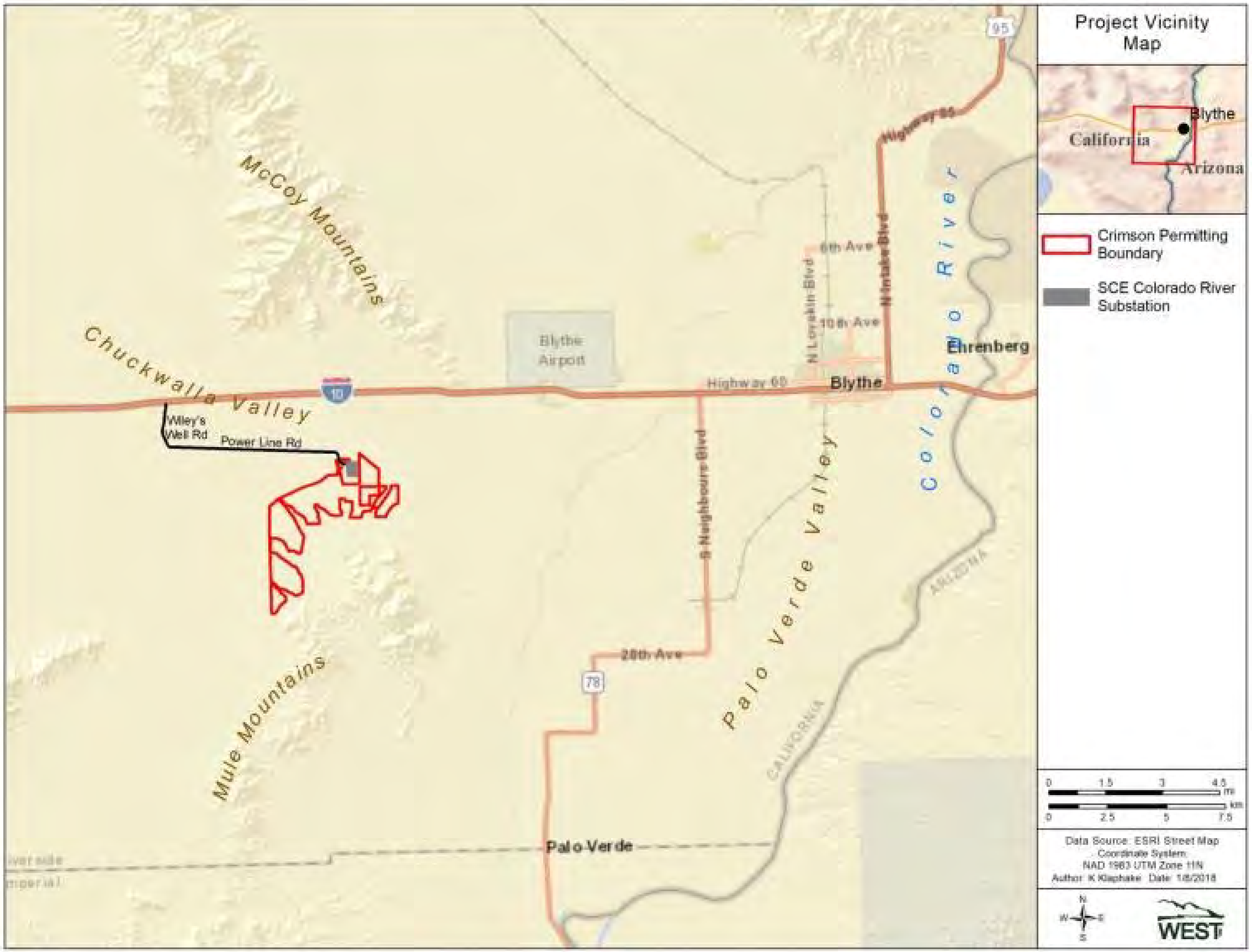


**Figure 1. Location of the Crimson Solar Project, Riverside County, California.**

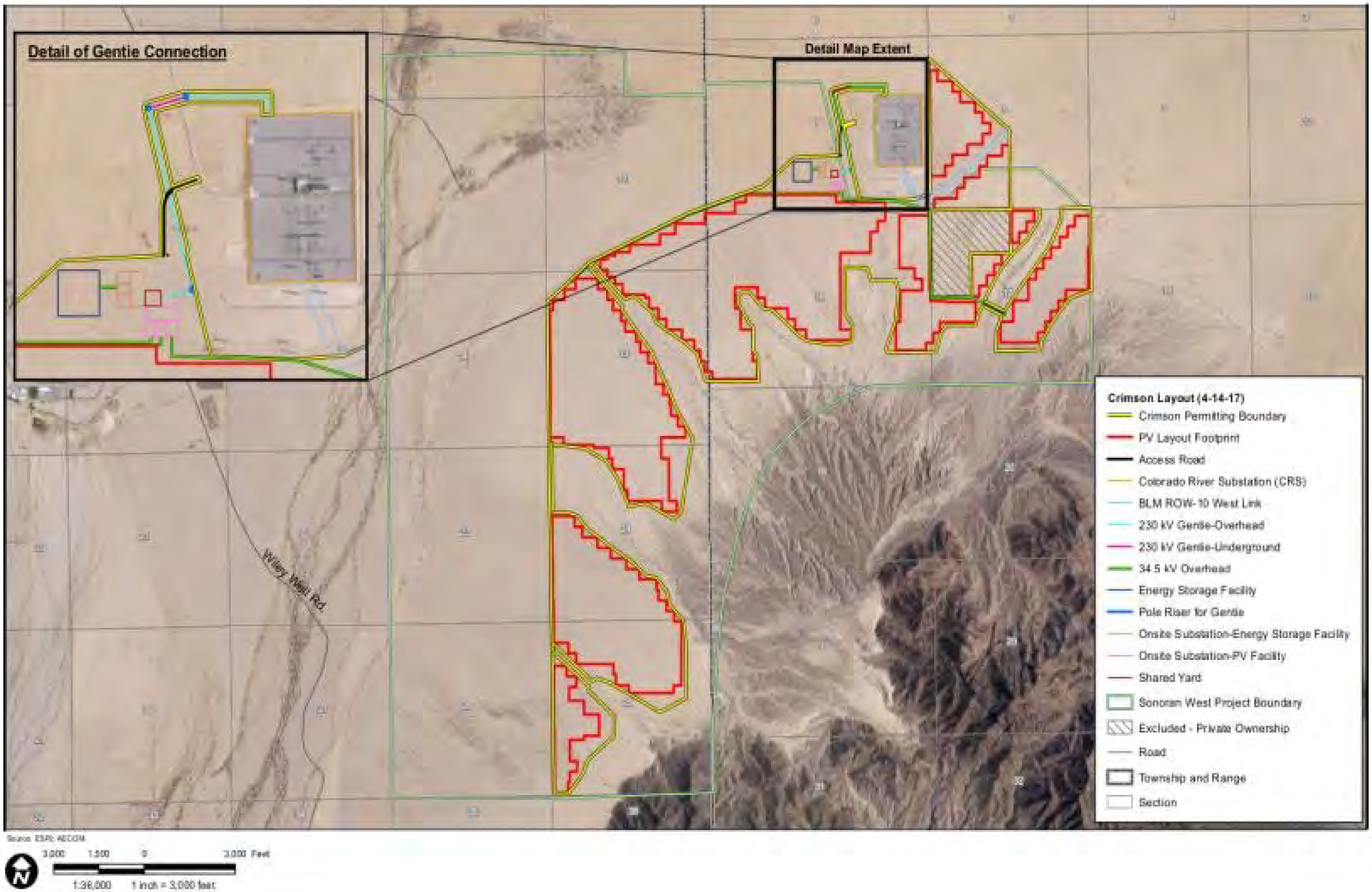


**Figure 2. Crimson Solar Project Layout with Solar Array and Associate Infrastructure Locations.**

## 1.1 Goals and Objectives

Primary goals of the post-construction fatality monitoring program are to:

1. Estimate overall annual avian fatality rates and species composition associated with the Project infrastructure. This estimate will include mortality associated with solar arrays and the perimeter fence.
2. Determine whether there are spatial and temporal/seasonal patterns of mortality associated with project infrastructure.
3. Provide information that will assist the BLM, in consultation with the USFWS and CDFW, in understanding if sensitive species or specific species groups (e.g., passerines, waterfowl, etc.) are at risk.
4. Collect data in such a way that comparisons can be made with other solar sites and/or anthropogenic impacts.

These goals are structured in a way that provide information on seasonal differences in detection, and information about which taxonomic groups are most vulnerable. Monitoring methods will be evaluated on a semi-annual basis to address carcass persistence and searcher efficiency trends as they become apparent.

Consistent with the above goals, the specific objectives of post-construction monitoring are as follows:

1. Conduct fatality searches for a minimum of two years according to a spatial and temporal sampling plan that provides representative and statistically sound coverage of the project infrastructure, including the solar arrays and perimeter fence, consistent with monitoring required of other industries. It is assumed the Project will be fully operational prior to initiating the monitoring plan and all defined sample units will follow the same survey schedule.
2. Prepare a semi-annual (six-month) report that provides an overview of the data collected to date. The report should not include a full statistical analysis (i.e., no fatality estimates), but should provide summary information on detections, searcher efficiency, and carcass persistence trials. Annual reports will be prepared that includes a full statistical analysis of each monitoring year.
3. Use current, scientifically validated and accepted methods for calculating fatality rates adjusted for searcher-efficiency, carcass removal rates, and spatial and temporal sampling intensity. At present, the best methods are distance sampling combined with searcher efficiency and carcass persistence bias adjustments and a fatality estimator such as the Huso et al. (2010) estimators, but it should be noted that fatality estimation is an area of active research and 'best methods' are changing rapidly. Therefore, as data are collected, adaptive management of the study design and monitoring protocol may be necessary.

4. Summarize bat species composition of fatalities and summarize avian species composition of fatalities according to taxonomic family, and ecological guild (e.g., raptors, water-associated birds, passerines, etc.) to aid in understanding species or types at risk.
5. To the extent possible, summarize the composition of fatalities according to their likely propensity to collide with project components during the day versus during the night based on known migratory patterns for the particular species.
6. As appropriate, efforts will be made to identify fatality causes or changes in fatality rates between seasons and years. Correlations may include climatic events, construction activities in the Project vicinity, or other tangible factors where datasets are available.
7. Meet reporting expectations beyond the interim and annual report at a standard required by permits. This may include USFWS SPUT reporting, CDFW scientific collection permit reporting, or other reports as required by permits.

# 2.0 MONITORING METHODS

## 2.1 Post-Construction Monitoring

The fundamental components of a sampling program designed to produce reasonably precise estimates of fatality rates for a solar facility include sampling methods, spatial sample coverage, temporal sample coverage, adjustment of counts for search efficiency, adjustment of counts for carcass removal, and selection of an appropriate statistical fatality estimator.

The following hierarchical terminology is useful for describing the spatial and temporal sampling design outlined here. These terms may be further defined as built design plans are available:

1) **PV module:** the basic unit of a photovoltaic solar facility consisting of a semiconductor material sandwiched between two layers of glass.
2) **Row:** A collection PV modules that are mounted on long steel and aluminum support structures.
3) **Array:** A collection of rows treated as a single electrical system.
4) **Block**: Collections of commonly energized arrays.
5) **PV Array Field:** The composition of all of the blocks/arrays that comprise the solar facility.

### *2.1.1 Sampling Methods*

Sampling strategies used in carcass searches have typically involved transect sampling, whereby searchers walk or drive along pre-defined transects and search for carcasses in a swath where width depends on visibility, target taxa, and other factors. The layout of PV facilities presents problems for a transect-sampling approach because rows of panels are close together (i.e., less than five m [16 ft.] at the Project). When panels track the sun, a searcher walking or driving a transect between two rows can only effectively search one side of the transect (a 2.5-m [8.2-ft] swath) in the morning, and the other side is obscured by the edge of a PV cartridge; the other side of the transect would need to be searched in the evening when the panels were in a different position. While feasible, this method typically requires a much greater level of effort. However, traveling perpendicular to panel rows along the edges of the rows allows observers to see a greater distance of the ground beneath the panels. Surveyors will drive the lines in vehicles. Driving has been an approved method of survey at other regional solar facilities with no apparent reduction reduce in detection rates. Other accommodations may be required to enable completion of surveys during high temperatures, such as shifting surveys to dawn and dusk.

The layout of PV facilities is well-suited to a distance-sampling approach. The landscape at the Project is flat and relatively clear of vegetation, which should support a distance sampling design. Distance sampling is a methodology that is well equipped to estimate population sizes even when the detection function indicates a rapid decay in detectability with distance, and is ideally suited to situations in which animals (or carcasses) are sparsely distributed across a landscape (Buckland et al. 1993). On this basis, fatality sampling will proceed using distance-sampling survey techniques and analytical methods, which include estimating and accounting for distance-related variation in searcher efficiency based on the carcass data. Carcass removal bias trials will address carcass persistence and are described below. Methods will be used to determine the effective viewshed, which will be determined using a point at which the detection is not zero (Buckland et al. 1993).

Distance sampling adjusts carcass counts for variable searcher efficiency by calculating the effective searcher efficiency along a transect. Effective searcher efficiency is the average probability of detection in the searched area, derived from the detection function. As a simplified example, if a searcher walks a 10-m (33-ft) long transect line and detects 90% of all carcasses within 10-m of the line, and 60% of carcasses that are 10 to 30 m (33 to 99 ft) from the line, then the effective searcher efficiency between zero and 10 m would be 0.9 and the effective searcher efficiency between 10 and 30 m would be 0.6. For the total 10 by 30-m area, the effective searcher efficiency would be (0.9+ 0.6)/(100 m^2+ 200 m^2) = 0.5. In practice, searcher efficiency is modeled as a continuous function of distance, and the detection function can be estimated from the carcass data or a bias trial. The searcher efficiency bias trials can be used to augment or replace carcass data for the detection function. An advantage to the use of data from bias trials is that the assumption that carcasses are randomly distributed within the search area (typical of most distance sampling designs) becomes unnecessary. An advantage to a data-driven detection function is that it is not necessary to specify a transect width: the detection function includes information about the distance at which searcher efficiency drops to zero. The detection function is used to determine the overall probability of detection as well as to inform the approximate effective viewshed of non-zero detection probability for observers.

An alternative survey strategy may be used if conditions at the Project are not conducive to distance sampling. The alternative survey strategy may require walking parallel to rows of panels, searching the ground between and beneath panels.

### *2.1.2 Spatial Sampling Design*

The sampling design is intended to generally follow the USFWS Land-Based Wind Energy Guidelines (USFWS 2012), which states that "the carcass searching protocol should be adequate to answer applicable Tier 4 questions at an appropriate level of precision to make general conclusions about the project, *and is not intended to provide highly precise measurements of fatalities*" (p. 45; emphasis added). Under the proposed sampling plan, precision is expected to vary based on carcass detectability: less precision is expected for estimates of bat and small-bird fatality compared to estimates of large-bird fatality.

The monitoring program will kick off after the Project is fully operational. For this Project, 40% of the solar arrays will be sampled (Table 2.1). While 40% of the individual solar arrays will be surveyed, the area correction may be modified by size class based on the effective viewshed identified from the searcher efficiency trials. Specifically, different viewsheds may be applied to bats/small birds and large birds depending on the individual detection rates. Ground cover visibility after construction will need to be evaluated to ensure viewsheds and area coverage is appropriate to achieve the goals and objectives of the Plan.

**Table 2.1 Solar array sampling area characteristics.**

| | |
|---|---|
| Total fenced area | 918 ha |
| Total solar panel area | 760 ha |
| Proportion sampled | 40% ± 2% of each array type |
| Sampling unit | ~1.35 ha spatial equivalent of 1 sub-array |
| Number of sampling units | 225 |
| Migration season search interval (March 1 - May 31, September 1 - October 31) | 7 days |
| Non-migration season search interval (June 1 - August 31, November 1 - Feb 28/29) | 21 days |
| Anticipated surveys per year | Approximately 31 surveys |
| Duration of sampling | 2 years |

Because both the layout of the solar arrays and the landscape of the CSEP (i.e., mostly flat and not dense vegetation) are largely uniform, a relatively simple random sampling design is likely to be adequate for sampling the arrays. However, without clear data to support this assumption, a spatial component will be used to select the survey area. Samples will be selected in a stratified random design to ensure a spatially balanced sampling design and an approximately 40% sample of the total array area. Because spatially balanced designs ensure that sample effort is distributed over the whole study area, they help to ensure that spatially organized trends in mortality–should they exist–can be extracted from the data. To achieve spatially balanced sampling, the site will be divided into four approximately equal-sized sampling areas and sampling will be stratified among those areas. The four areas will be defined based on the geographically grouped Project sections. The drivers of spatial variation in avian or bat activity may be important to the statistical sampling design if avian and bat use patterns affect the distribution of mortalities on the Project site. As an example, factors that may affect avian use patterns include: 1) habitat variation around the Project site; 2) the possibility that distinct movement corridors variably concentrate birds over certain areas of the Project site (e.g., migrating or commuting water-associated birds); or 3) use of distribution lines (and other transmission line infrastructure) as roosting sites. Distribution lines within the solar field may also pose a collision risk to birds and bats.

The sampling units for the surveys consist of areas equivalent in size to 1.35-ha sub-arrays (approximately 116-m x 116-m [381-ft x 381-ft]; Figure 2). Within sampling areas, individual sampling units will be randomly selected to compose a 40% sample (± 2%).

Sampling units will be surveyed from the outer edges of sub-arrays (collections of continuous solar panel rows) and scanned between each row for fatalities, with each side-specific survey covering at least half the width of the sampling unit, depending on the length of the row. Observers will drive along east-west roads that bisect sampling units and scan left (out of the driver's window), and then turn around at either an inverter or main road where space allows. Travel speed will be no greater than 5 mph (eight kph) while searching to ensure quality detection and safety. The observer will look left on the return trip, searching the opposite side of the unit. However, alternatively, to potentially reduce the risk of vehicle incidents, the observer may survey the unit from the south looking north, and then drive to the north side of the unit and survey looking south. Most sampling units consist of 1.35-ha sub-arrays, each forming a structurally continuous unit composed of approximately 15 panel rows that are approximately 58-m (190-ft) long. In these cases, two east-west routes will comprise the sampling-unit survey, with each route involving scanning across the entire length of a single subarray row (4-m) (Figure 3). For a few other sampling units with different layouts at CSEP, the analysis will need to take into account the potentially different row lengths and sample unit widths (i.e., different number of rows). Distance sampling and resulting data will be used to calculate detectability curves to calculate the average detection probabilities, and taking into account the potential for different detection curves depending on the direction of the survey viewshed.

The perimeter-only survey design reflects two concerns:

1. Minimizing movement between rows of solar panels. Because the area between electrified panel rows is an area of elevated risk, best safety practices dictate that personnel do not enter elevated risk zones unnecessarily; and
2. Achieving an effective balance between logistic efficiency and sampling rigor given the constraints of transect spacing due to the width of panel rows.

This survey methodology has been effective on other solar projects with effective viewshed for large birds extending well beyond 100 m, and beyond 50 m for small birds. The sampling approaches, specifically the effective viewshed, may be appropriately varied based on the existing ground conditions at the start of the study period or post-hoc based on the results of the searcher efficiency trials.

Not being able to detect most small-sized carcasses over a substantial portion of the solar facility would comprise a problematic bias if the probability of carcass occurrence was non-random within arrays (i.e., within sample units). In other words, the bias would create a problem for achieving representative sampling if the probability of mortality due to panel collisions varied in some predictable fashion relative to the distance from array edges, or if there was a tendency for fatalities to be clustered in the interior of the panel areas. Whether or not such conditions may apply to this facility is currently unknown; however, initial post-construction monitoring at another large PV solar facility in central California has not demonstrated any particular spatial bias in the distribution of fatalities documented there (H.T. Harvey and Associates 2014).

On this basis, fatality sampling will proceed using distance-sampling survey techniques and analytical methods, which include estimating and accounting for distance-related variation in the probability of detection based on the carcass data and bias trial data. In addition, searcher-efficiency trials that are tailored to include evaluating the influence of distance on the probability of detection will be conducted to ensure that searcher efficiency can be calculated.

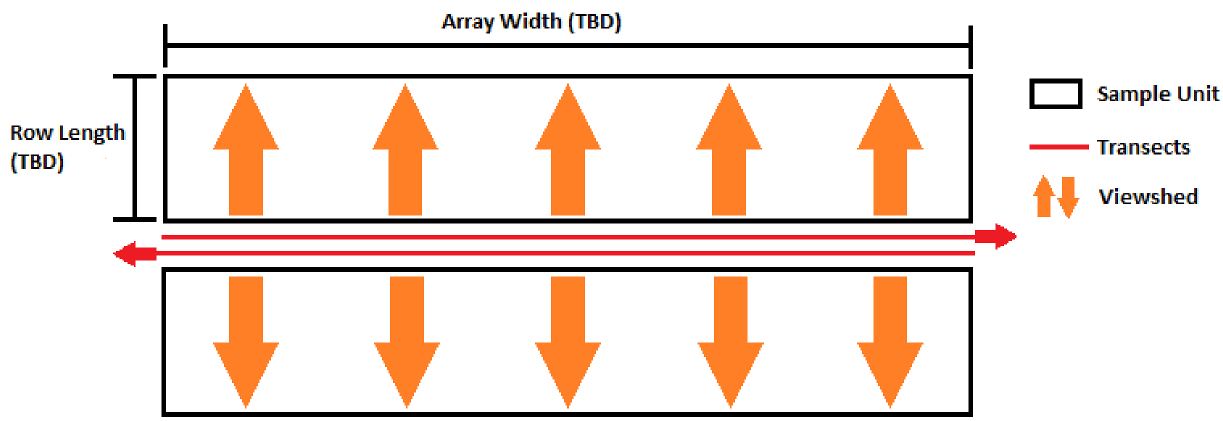


**Figure 3. Illustration of a typical distance sampling method with sample units and transect survey. The viewsheds and transect length may vary depending on the dimensions of the arrays.**

### *2.1.3 Temporal Sampling Design*

The appropriate frequency of fatality surveys depends on the species of interest and average carcass persistence times (Smallwood 2007, Strickland et al. 2011, USFWS 2012). Large birds, such as raptors, tend to persist and remain detectable for extended periods (weeks to months) due to low scavenging rates and relatively slow decay rates. If only large species were of interest, extended search intervals of 30 days might be appropriate; however, smaller birds typically disappear at much faster rates, so shorter search intervals are required to ensure effective documentation of fatality rates among these species.

Publicly-available data is available the Blythe Solar Power Project. The Blythe Solar Power Project reported median removal times of 5.0 days for small birds, 6.8 days for medium birds, and 47.6 days for large birds during the summer monitoring period (WEST 2018). The probability of a bird persisting to the next search interval was 42% for small birds, 48% for medium birds, and

87% for large birds. During the fall monitoring period, median removal times were 4.6 days for small birds, 7.0 days for medium birds, and 51.7 days for large birds (WEST 2018b). The probability of a bird persisting to the next search was 61.1% for small birds, 68.1% for medium birds, and 95.5% for large birds. If the median carcass-persistence time for small-sized birds on the Project site is low, a shorter search interval may be required to effectively document fatality rates for small birds. If, however, median small-sized bird carcass persistence rates are greater than seven days, then a longer search interval may be appropriate.

Based on these considerations and preliminary data the search interval for fatality monitoring will be variable depending on season (Table 2.1). Searches will be conducted every seven days during standard spring and fall migration periods (March 1 – May 31 and August 16 – October 31, respectively), and every 21 days during summer and winter (June 1 – August 15 and November 1 – February 28/29, respectively). After the first six months of fatality monitoring and concurrent carcass removal trials have been conducted, the search interval may be adjusted based on estimates of carcass persistence. The search intervals address the desire to be more precise during the migratory periods, while less precision may be allowable during the non-migratory periods. Migration for some species may occur outside these periods and this will be considered when evaluating the data regarding timing of mortality for species found as fatalities. Additionally, the actual dates used for the monitoring seasons may be modified to support analysis (i.e., seasons will ideally start on the same week day to allow consistent search round, which may not always coincide with proposed dates).

Adjusting fatality counts for carcass removal works best when the search interval remains constant through time (Huso 2010); however, within survey periods, season-specific estimates of carcass persistence can be calculated and incorporated in the overall estimation process when variable search intervals are used in different seasons (Shoenfeld 2004, Huso 2010, Huso et al. 2012; and other estimators all have facility to accommodate season-specific estimates). In addition, efforts will be made to evenly space survey schedules in time to maximize detection of potential, unusual fatality events (Strickland et al. 2011). The schedule may be modified depending on other logistical factors (weather, holidays, and surveyor availability).

Monitoring will begin once the entire site is operational. To reduce potential bias associated with carcasses that may be older than the defined search interval, a clearance survey will be conducted prior to initiating the formal study period. The clearance survey will be conducted prior to the first search at the same time interval as subsequent searches (i.e., either 7 or 21 days prior to the first search depending on season).

#### *2.1.4 Survey and Data Collection Protocols*

Fatality surveys will be conducted with the observers striving for a consistent pace/speed and approach, and a uniform search effort throughout the search. Searchers will visually scan for detections to survey for carcasses between each row of panels, using binoculars as needed (e.g. searcher observes an object and is not certain whether it is a carcass). When a potential carcass is detected, the observer will immediately proceed down the row to confirm the detection and, if valid, fully document and bag it according to standard protocols (see below). Depending on the size and nature of the carcass, the observer will either immediately collect the carcass (smaller, easily collected and transported packages) or flag it for pick-up once the sampling-unit survey is completed (larger, messier, or otherwise complicated collections) or to identify it to species. A bucket will be placed over carcass not immediately collected and secured with a rock. All carcasses will be stored in freezers on-site or as dictated by the scientific collection permits. If allowed by permits, carcasses will be used as trial carcasses.

All bird and bat injuries and fatalities discovered during, or incidental to, the standard carcass surveys will be documented according to the requirements and standards reflected in the USFWS Avian Injury and Mortality Reporting Form. The form is a reporting requirement of the USFWS SPUT Permit issued to the Project to authorize the handling of dead or injured birds. In addition, finds will be classified as a fatality according to standards commonly applied in California (Altamont Pass Avian Monitoring Team 2007, CEC and CDFG 2007). For detections that only include feathers, to be classified as a fatality, each find must include a feather spot of at least five tail feathers or two primary flight feathers within five m or less of each other, or a total of 10 feathers. Searchers will make their best attempt to classify feather spots by bird size according to the sizes or identifying features of the feathers. If a size class cannot be determined, the detection will default to the size class most commonly detected during the study. Digital photographs will be taken to document all incidents in the field, showing the dorsal, ventral, and head area. When possible, plausible cause of death will be indicated on data sheets based on evidence (such as blood or fecal smears on solar panels, burns that may indicate electrocution, or blunt trauma that may indicate collisions). An experienced biologist will make decisions on likely cause of death and this will be reviewed by the biologist overseeing the program. If a clear cause of death is not apparent, this will also be noted. Also, incidental carcasses found within survey plots during the course of the study will be processed as required and included as carcasses found within the systematic study.

Data records for each survey will also include: 1) names of all relevant surveyors in case of future questions; 2) a description of the weather conditions during each search day; 3) a standardized description of the current habitat and visibility classes represented within each sampling unit; and 4) a description of any search-area access issues, if relevant. Data collected will also include all appropriate fields contained in the SPUT Permit.

All avian fatalities will be assigned to one of three size class based on weight categories (e.g., small birds = 0 – 100 grams, medium birds = 101 – 999, and large birds = 1,000+ grams), a taxonomic family, and an ecological guild. Species will also be classified as resident, overwintering, or whether they are diurnal or nocturnal migrants (or both). These designations may be assigned during the data analysis process and will be taken from a common and consistent literature source such as The Birds of North America (Rodewald, P. (Editor). 2015. The Birds of North America: https://birdsna.org. Cornell Laboratory of Ornithology, Ithaca, NY.)

Additional protocols will be followed to ensure accurate distance-based estimation of fatality densities. First, to ensure accurate delineation of the injury/fatality locations, the observer will record a Global Positioning System (GPS) coordinates of the detection, using a handheld device accurate to ± three to four meters (9.8 to 13.1 ft). Second, when an observer proceeds down panel rows to confirm and document detected fatalities, they may detect other fatalities that they did not observe based on the perimeter-only survey. Including such detections in the fatality estimate will confound estimation of fatality density based on application of standard distance-sampling analytical methodology. Therefore, all such supplementary detections will be classified as "incidental" finds and will be excluded from calculation of adjusted fatality estimates. Other incidentals detections that occur may be included in the analysis if they are located in a sampled unit. Examples of other incidental detections may include operational staff detections or detections that occur during bias trial work. This is a conservative approach that may result in overestimates, but is the typical protocol implemented across other post-construction monitoring studies at solar and wind projects.

All personnel (qualified biologists) involved in implementing this Plan will be included as sub-permittees under the Project's USFWS SPUT Permit, issued either to the Project or Project operator. It is assumed that all biologists participating in search efforts will have a degree in biology (or similar field), have demonstrable bird identification and scientific method experience, and will receive training from a biologist with specific experience working on similar projects/methods in the region. All personnel implementing this Plan will also be covered under any applicable CDFW Scientific Collecting Permit. Ideally, the relevant state and federal permits will allow fatalities discovered during the study to be removed from the field, stored on-site in a freezer, and used in searcher-efficiency and carcass-removal bias trials. Necessary exceptions will apply to all special-status species. Otherwise, surveyors will place all discovered carcasses or body parts that are not of a special-status species and are not part of an ongoing bias trial in plastic zipper storage bags, clearly label each bag with the incident number, and deliver the bags for storage in the designated freezer at the Project facility

### *2.1.5 Fence Line Monitoring*

The inside perimeter fence will be searched approximately once every seven days during spring and fall migration and once every 21 days during winter and summer periods with intervals adjusted as necessary based on carcass persistence trials. A searcher will drive areas accessible by vehicle close to the perimeter fence, scanning for fatalities within an approximate 6-m (20-ft) strip transect centered on the fence. Travel speed will be no greater than 5 mph (8 kph) while searching to ensure quality detection and safety. Personnel conducting fence checks will document birds and bat injuries and fatalities discovered along the inner fence line. Injuries and fatalities along the fence line will be documented in the same manner as used for those discovered during the solar array carcass surveys, and will be reported to the USFWS and CDFW as part of the same overall reporting process. Searcher efficiency trials will be conducted along the inside of the fence. Carcass removal trials will include areas near the inside of the fence as well.

### *2.1.6 Clearance Surveys*

A one-time clearance survey will be conducted prior to initiating the formal study period. The purpose of this survey will be to clear the survey area of any accumulated carcasses that may be present. The sequence of clearance surveys will mirror the schedule for the first official survey to ensure that the interval between the clearance survey and the first standard survey is the same for all sampling units. This is necessary to ensure that carcasses detected during the first round of surveys represent only fatalities that occurred during a preceding interval equivalent to the search interval that will apply afterward. Carcasses that are missed during the clearance survey may cause an upward (conservative) bias in the fatality estimate. Additionally, some estimators (such as the Huso estimator described above) become biased if carcasses that are not detected during a trial are still available during subsequent trials. This “bleed through” effect can be ameliorated by including only fresh carcasses in the fatality estimate, where “fresh” means a carcass that has arrived since the previous search. Carcasses that cannot reliably be aged (probably most carcasses) will be assumed to be fresh; this will cause an upward (conservative) bias in the fatality estimate. Carcasses that are only bones will not be considered fresh and will not be included in the fatality analysis.

#### *2.1.7 Searcher-Efficiency*

Estimating searcher-efficiency (distance-related detection functions) is a standard component of the distance-sampling approach. Moreover, because estimating detection functions is applied to all survey data and can be organized to variably adjust in relation to covariates of interest (e.g., season, habitat, and carcass size classes), application of this approach can account for typical factors of interest for fatality studies (CEC and CDFG 2007, Huso 2010, Korner-Nievergelt et al. 2011, USFWS 2012, Smallwood 2013). In this case, independent searcher-efficiency trials per season will be conducted to help assess and adjust for potential spatial bias in the distribution of fatalities among arrays.

The desert landscape in which this Project is located generally changes little with the seasons, save for brief periods following winter and spring rains when floods may occur and blooming plants may flourish. A recent meta-analysis involving data from more than 70 wind-energy projects suggested that including habitat visibility class as a predictive variable generally eliminated any otherwise apparent seasonal effects on searcher efficiency (Smallwood 2013). Nevertheless, the supplementary searcher efficiency trials for this Project will be repeated seasonally (winter, spring, summer, and fall) and trials will be organized so that all search personnel participate in bias trials. Placement of trial specimens will be timed to limit the number of trial carcasses placed on the landscape at any one time (minimizing the chance of artificially attracting scavengers or, conversely, scavenger swamping; Smallwood 2007). This approach will also ensure that any new surveyors that join the crew participate in searcher efficiency trials. The trials will also be managed to ensure effective quantification of searcher efficiency in relation to predefined habitat visibility classes (low, medium, and high, if relevant), size classes of birds (small, medium, and large), and detection distance.

The bias-trial sample sizes required to produce precise, adjusted fatality estimates are not well established, in part because needs may vary substantially depending on actual project-specific searcher efficiency, carcass removal, and fatality rates. However, using searcher-efficiency trials to help evaluate the efficacy of perimeter-only surveys and the distance-sampling approach used in this investigation will require larger sample sizes to produce a sampling design that effectively accounts for distance as a key covariate of interest. In addition, if growth of new ruderal vegetation, or substrate heterogeneity caused by flood events, is sufficient to create a new visibility class under the arrays, the specimen numbers would need to increase to effectively account for this factor. It will also be necessary to ensure that the estimates of searcher efficiency encompass variation among multiple surveyors. The influence of individual surveyors will not be accounted for in a formal, statistical sense by including "surveyor" as a covariate in the estimation model; however, efforts will be made to test all surveyors similarly. A minimum of 40 trial samples per season, 20 small birds, 10 medium birds, and 10 large birds is proposed within the solar array, while 15 small birds, 10 medium birds, and 10 large birds are proposed along the fence line each season. No searcher efficiency trials are proposed for the gen-tie or along the fence line. Other studies have shown high detection rates along linear features when ground cover is sparse.

Besides representing birds of different sizes, another important factor to consider in searcher-efficiency and carcass-removal trials is the bird species to use as trial specimens. Ideally, all carcasses used for both searcher-efficiency and carcass-removal trials should reflect the range of species likely to be encountered as fatalities in the Project area (CEC and CDFG 2007). Because obtaining sufficient samples of "natural" carcasses often is difficult, researchers frequently resort to using readily available, non-native surrogate species in bias trials; however, this practice may result in biased results when compared to studies that use only "natural" specimens (Smallwood 2007). For all bias trials, this program will maximize use of representative native or naturalized species authorized by permits, either found during the study or gathered elsewhere, as needed, and from diverse sources where possible, but all trial carcasses will be obtained and deployed in a manner that are consistent with applicable regulatory requirements. Additionally, the use of artificial trials is proposed to minimize the number of real bird carcasses placed in the field. Artificial trials may be solely used or supplement the trials to reduce real birds requirements. This will hopefully reduce the potential for scavenger learning and lower raven (or other scavengers) activity at the Project and still allow detection rates to be defined. It is assumed that authorization from the overseeing agencies will be required to use artificial trials.

Another factor that influences carcass detectability is how fresh and intact the carcass is (Smallwood 2007, 2013). If multiple pieces of a depredated or scavenged carcass are scattered over a modest area, in some cases the fatality may be more easily detected; however, detectability generally decreases when only remnants of a carcass are present, or when the carcass is aged and degraded. Nevertheless, in contrast to wind energy projects, there is little expectation that this Project will cause injuries and fatalities that result in dismembered carcasses, so this factor is not expected to influence searcher efficiency bias or carcass removal rates (Smallwood 2013). Therefore, bias trials conducted in this study will involve primarily intact carcasses. The searcher-efficiency trial specimens may range from freshly thawed to partially decayed (i.e., selected, subject to availability, to mimic the range of carcass decay that typically accrues over 7-day periods).

A field supervisor or other technician not involved in the standard surveys will place the trial specimens and will recover any specimens missed by the surveyors. All trial specimens will be placed according to a sampling plan that randomly allocates carcasses of different sizes among survey plots and survey days within the assessment areas, but is stratified to ensure equitable representation of different surveyors. To minimize the possibility of unnecessarily attracting scavengers or, conversely, contributing to scavenger swamping, which could affect ongoing carcass-removal trials (Smallwood 2007, Smallwood et al. 2010), placement of searcher-efficiency trial specimens will be distributed throughout the year (appropriately organized to provide season-specific estimates with adequate samples to provide a robust estimate of searcher efficiency), with less than 10 specimens placed at any one time. Carcasses will be placed carefully to minimize disturbance of substrates that may bias carcass detection. Sample size and frequency of trials in the second year (if required) may be reduced if the overseeing agencies deem the action appropriate.

All trial specimens will be inconspicuously marked with a piece of black electrical tape (or similar method) wrapped around one leg, in a manner that allows the surveyor to readily distinguish trial specimens from new fatalities, but without rendering the specimen unnaturally conspicuous (Smallwood 2007, USFWS 2012). To ensure a degree of “natural” placement, carcasses need to be represented by placing them between rows of panels, under panels, near I-beams supporting the panels, or in the open. Therefore, carcasses will be tossed towards the designated, randomly chosen placement spot from a distance of three to six m (10 to 20 ft). Documentation of each location will include GPS coordinates, notes about the substrate and carcass placement, and a digital photo of the placement location.

Surveyors will have only one opportunity to discover placed specimens. Any missed specimens will be recovered as quickly as possible after surveys have been completed in a given area, and after the surveyor(s) have become aware of the trial through discovery of one or more specimens. Some researchers have argued for leaving missed specimens in place to enable possible discovery in a subsequent survey and thereby mimic the natural situation in which “bleed-through” is possible (e.g., Smallwood 2013, Warren-Hicks et al. 2013; discussed further below). Although this approach may have merit in some situations, its potential value for this Project is offset by the need to avoid attracting ravens because they may prey on desert tortoises living in the area (Tetra Tech 2014b).

#### *2.1.8 Carcass Persistence Trials*

The degree to which carcasses persist on the landscape depends on a variety of factors reflecting seasonal and inter-annual variation in landscape/climatic conditions and the scavenger community. The composition and activity patterns of the scavenger community often vary seasonally as birds migrate, new juvenile birds and mammals join the local population, and mammalian scavengers variably hibernate or estivate. The scavenger community may also vary substantially from year to year because of variation in annual reproduction and survival related to changes in landscape condition. Seasonally and annually variable climatic conditions also may contribute to variation in carcass decay and removal rates due to variation in temperatures, solar insolation, wind patterns, and the frequency of flooding events. Therefore, to ensure accurate treatment of this bias factor, carcass-removal rates typically are assessed on a quarterly basis during each year that fatality surveys are conducted (USFWS 2012, Smallwood 2013). It is also imperative that carcass-removal trials effectively account for the influence of carcass type/size, given that persistence times may vary widely depending on the species and size class involved (Smallwood 2013).

To quantify carcass removal rates, the Plan proposes to place 20 small bird trial carcasses, 10 medium bird carcass, and 10 large bird trial carcasses per season in the solar field (solar arrays + fence line). The carcasses will be distributed in each season to assess carcass removal throughout the year, and carcasses will be dispersed to random locations throughout the study site. The carcasses will be monitored using either motion-triggered, digital trail cameras (e.g., see Smallwood et al. 2010), or visited (day 1, 2, 3, 4 and approximately every 7 days thereafter) for 30 days or until the carcass has been removed to the point where it would no longer qualify as a documentable fatality. Fake cameras or cameras without bias trial carcasses will also be placed to avoid training scavengers to recognize cameras as “feeding stations”. To minimize potential bias caused by scavenger swamping (Smallwood 2007, Smallwood et al. 2010), carcass-removal specimens will be distributed across the entire Solar Facility, not just in areas subject to standard surveys and will be placed on multiple dates. Sample size and frequency of trials in the second year may be reduced or increased if the data suggests these changes are needed to better inform the objectives.

Trial specimens will include only intact, fresh (i.e., estimated to be no more than one or two days old and not noticeably desiccated) bird carcasses that are either discovered during the study or are acquired from other sources after having been frozen immediately following death. If permits allow, preference will be to use carcasses of species that occur in the area. Surrogates (such as upland game birds and waterfowl) that are similar in size and appearance to species that occur in the area, will be obtained from commercial sources and used if necessary to meet the required sample sizes. However, domestic waterfowl or upland game birds that are white or brightly colored (e.g., male ring-necked pheasants [*Phasianus colchicus*]) will not be used. Scavenging rates for some surrogates (e.g. medium to large sized game birds that are used to represent raptors) may be artificially high (Smallwood 2007, 2013) and may lead to conservative fatality estimates (i.e., an overestimate) for some taxa/bird types.

To reduce possible biases related to leaving scent traces or visual cues that may unnecessarily alert potential scavengers, all carcasses used in carcass-removal trials will be handled with latex gloves, and handling time will be minimized. If allowed by the site operation plan, efforts will be made to place trials throughout the day, including dawn and dusk. Trial administrators will also implement BMP tactics that may include using different vehicles, traveling different routes in the site, rotating head gear and clothing, or other methods deemed appropriate to reduce potential scavenger learning. All trial specimens will be inconspicuously marked with a small piece of electrical tape (or similar material) wrapped around a leg to distinguish them from unmarked fatalities.

Upon conclusion of the relevant monitoring period, each trial specimen will be classified into one of the following categories:

**Intact:** Whole and un-scavenged other than by insects

**Scavenged/depredated:** Carcass present but incomplete, dismembered, or flesh removed

**Feather spot:** Carcass scavenged and removed, but sufficient feathers remain to qualify as a fatality, as defined above

**Removed:** Not enough remains to be considered a fatality during standard surveys, as defined above

### *2.1.9 Estimating Adjusted Fatality Rates*

The sampling design will enable calculation of fatality estimates adjusted for searcher-efficiency, carcass-removal rates, and proportion of area sampled. The adjustment for searcher efficiency will occur by virtue of applying standard methods for analyzing detection data collected using distance-sampling methods, with the data partitioned by season and standardized carcass size classes. The fatality estimates will be adjusted for variation in carcass persistence, by applying seasonal and carcass-size-specific correction factors to the fatality estimates that have been adjusted for distance-related variation in the probability of detection.

The analytical approach used to calculate adjusted fatality estimates will be similar to that applied in cases where the fatality estimates are derived from strip transects. For illustrative purposes, we summarize here the basic formulation of the Huso estimator (Huso 2011), the first part of which pertains to fatality estimation for different strata, or groups. Essentially, the smallest group for which fatalities are estimated can be considered a stratum, with stratum *k* representing, for example, a set of similarly sized birds within a defined habitat visibility class. Note that strata should be defined to ensure minimum variance in detection probabilities within individual strata, whereas probabilities may vary considerably among strata (e.g., for small versus large birds, or in habitats of low versus high visibility). Depending on the circumstances, there can be strata based on species groups, size classes, seasons, habitats, and/or infrastructure types (also could conceivably model distance categories as another covariate).

For a particular stratum *k* for a given survey plot and search interval, fatality can be estimated as:

$$\hat{F}_k = \frac{c_k}{\hat{\pi}_k}$$

where $c_k$ is the number of observed carcasses and $g_k$ is the probability of detecting a carcass. The detection probability *g* typically is the product of three variables: the probability of a carcass persisting (*r*), the probability of a carcass being observed given that it persists (*p*), and the effective proportion of the interval sampled (*v*):

$$\widehat{\pi_k} = \widehat{p_k} \cdot \widehat{r_k} \cdot \hat{v}_k$$

Adjusted fatality estimates for the Project will be provided as raw numbers by size class, total birds, and as per MW of nameplate capacity per year. Seasonal estimates will be provided as warranted.

### 2.1.10 Estimation of Searcher Efficiency Rates

Searcher efficiency rates, $\hat{p}$, are estimated for each size class using a logistic regression model. Additional covariates for this logistic regression model may include season, ground visibility, and the interactions between these variables. The logistic regression models the natural logarithm of the odds of finding an available carcass as a function of the above covariates. The model assumes that searchers have a single opportunity to discover a carcass. The best model is selected using an information theoretic approach known as AICc, or corrected Akaike Information Criteria (Burnham and Anderson 2002).

### 2.1.11 Estimation of Carcass Persistence Rates

Estimates of carcass persistence rates are used to adjust carcass counts for removal bias. Carcass persistence is modeled as a function of carcass size, and possibly other variables including plot type, season, ground visibility, and the interactions between these variables. The average probability of persistence of a carcass, $\hat{r}$, is estimated from an interval censored survival regression model. Exponential, log-logistic, lognormal, and Weibull distributions are fit and the best model is selected with AICc.

### 2.1.12 Carcasses Excluded from Fatality Estimation

One of the underlying assumptions of the Huso model is that searchers have a single opportunity to discover a carcass (Huso et al. 2016a). In practice, particularly when carcass persistence times are long, carcasses may be discovered that have been available for more than one search. In order to meet the assumptions of the Huso model, the estimated time since death is determined for each carcass, in the field. A carcass is excluded from fatality estimation if the estimated time since death is longer than the search interval associated with that carcass; in other words, a carcass with estimated time since death longer than the search interval is assumed to have been available for more than one search.

### 2.1.13 Adjusted Facility-Related Fatality Rates

The estimated probability that a carcass in category *k* was available and detected is:

$$\widehat{\pi_k} = \widehat{p_k} \cdot \widehat{r_k} \cdot \hat{v}_k$$

where $\widehat{v_k} = \min(1, \tilde{I}_k/I_k)$. The model assumes that searchers have a single opportunity to find each carcass, even though some carcasses may persist through multiple searches before being detected. Therefore, a carcass is included in adjusted fatality estimates if it has been available since the last search, and no longer. The probable time since death, recorded in the field, is used to evaluate each carcass for inclusion in the final fatality estimates.

The total number of fatalities $(\hat{f}_k)$ in category *k,* based on the number of carcasses found in category *k* is given by:

$$\hat{f}_k = \frac{c_k}{\widehat{\pi_k}}.$$

Adjusted fatality estimates for the Project may be expressed per unit area (e.g., acres or arrays) per year, or overall (extrapolated from the sample units) per year.

## 2.2 Bird Rescue

Searchers will record any injured or rescued birds or bats located during surveys. Birds will be assessed by a qualified biologist to determine if it is appropriate to transport the individual to the nearest permitted rehabilitation facility for proper care, or to release them. Injured raptors will be handled only by experienced personnel and will be taken only to rehabilitation facilities that are permitted to handle raptors; this provision is particularly important for eagles. From the Project site, the closest rehabilitation facilities capable of handling all avian and bat species are:

- Almquist Tracks and Tails, 632 Riviera Dr., Blythe, California 92225; (760) 552-3239
- Coachella Valley Wild Bird Center, 46500 Van Buren, Indio, California, 92201; Phone: 760-347-2647; Contact: Linda York, Executive Director; Hours of Operation: 9:00am-12:00pm, seven days a week. http://coachellavalleywildbirdcenter.org/
- The Living Desert Zoo & Gardens, 47900 Portola Avenue, Palm Desert, California, 92260; Phone: 760-346-5694 x8 x1; Contact: Sheila Lindquist, North American Manager; Hours of operation: 8:00am-1:30pm (June-September), 9:00am-5:00pm (October-May), seven days a week (closed Christmas Day). http://www.livingdesert.org/ animals/wildlife-rehabilitation/
- Hope Wildlife Rescue, 18950 Consul Avenue, Corona, California 92881; Phone: 951-279-3232; Contact: Bill Anderson or Cyndi Floreno.
- All God's Creatures Wildlife Rescue & Rehabilitation, Chino Hills, California, Phone: 909-393-1590; Contact: Lori Bayour; http://www.allgodscreatures.net/index.html; no address available, contact by phone.

- International Bird Rescue, Los Angeles Center, San Pedro, California, 90731; Phone: 310-514-2573; Hours: 8:00 am - 5:00 pm. International Bird Rescue specializes in waterbird rescue.
- A list of wildlife rehabilitators maintained by the CDFW: https://www.wildlife.ca.gov/Conservation/Laboratories/Wildlife-Investigations/Rehab/Facilities

If stranded, but apparently uninjured, water-associated birds that are discovered at any time during surveys will be secured and transferred to the nearest body of water for release. Given the Project location, public access along the Colorado River is a likely release location. If a qualified biologist is not available, all stranded birds (injured or apparently uninjured) should be immediately taken to a rehabilitator for evaluation. Injured or exhausted water-associated birds should be taken to International Bird Rescue, which specializes in the care and rehabilitation of water-associated birds. If a mass event involving many such birds is observed, all available biologists will identify injured versus non-injured birds and transport injured birds to the nearest rehabilitation facility. International Bird Rescue can also assist with mass stranding events (25 or greater. Rehabilitation facilities would be compensated by Crimson Solar Energy Project for the costs associated with each bird put under their care. Final disposition of each bird found will be documented and noted in the monthly SPUT form shared with the agencies.

### 2.3 Sensitive Species

If a searcher discovers a dead individual of a species that is fully protected by the state or federally or state-listed as threatened or endangered, and for which handling is not specifically authorized under the applicable salvage permits, he/she will collect data and photos as for any other fatality, but then flag the carcass to mark its location, cover it with a bucket or another way to secure its location, and leave it in place. If it has been confirmed as a federally listed species under the ESA or as a bald eagle or golden eagle, the searcher will immediately call the Project's assigned liaison. The Project liaison will be responsible for contacting a USFWS Office of Law Enforcement special agent within 24 hours to determine the appropriate follow-up action as well as notifying CDFW such that CDFW can coordinate with USFWS.

## 3.0 Reporting

Reporting for the monitoring plan will occur in two primary ways. Permit required reporting will follow the guidelines detailed in the issued state and federal permits. (e.g., SPUT permit). This will most likely include a spreadsheet with associated data delivered to the appropriate parties (i.e., resource agencies) .as specified by the SPUT permit conditions. The spreadsheet will be populated as needed and delivered to meet any permit stipulations. The second reporting methods will be technical reports associated with the monitoring plan.

This Plan proposes an interim report prepared after six months of survey efforts, a year 1 annual report, an interim prepared after 6 months of year 2 survey efforts, and a year 2 annual report. It is assumed that the interim report will be a summary report that provides a brief overview of the monitoring conducted during the first six month. The report may include a list of detections, searcher efficiency and carcass persistence results, and other relevant information that may inform potential adaptive management. The interim report will not include a full statistical analysis or fatality estimates. Due to variability of results over a monitoring year and potential for changes in final results, it is recommended that the full analysis not be completed until an entire monitoring year has finished. The goal of the interim report is simply to provide the Project team and representative agencies with an update and to identify any potential critical issues related to monitoring methods and bird impacts.

The Year 1 and 2 annual reports will be full technical reports that analyze any Project-related bird and bat fatalities or injuries detected; and provide context for the findings in the form of fatality rates at similar PV solar facilities or suitable reference sites. These annual reports will include a full statistical analysis as described above and specifically address the objectives developed as part of the monitoring plan (Section 1.0). These reports will include a typical introduction, methods, results, and conclusion. Tables and figures will be prepared to help demonstrate and interpret the monitoring results. The Year 2 annual report will include comparisons to year 1 results where appropriate.

Reports will be shared with the technical advisory group (TAG) and follow up discussion will occur as needed. It is assumed that a webinar will occur after each year of monitoring to present and discuss the results and determine if adaptive management is warranted. Other conference calls will occur as needed throughout the monitoring period.

## 4.0 Adaptive Management and Technical Advisory Group

Adaptive management will be an integral component of the monitoring plan. The goal of adaptive management is to evaluate the monitoring results and identify the need for potential avoidance and minimization measure as warranted and feasible. A TAG will monitor Project activities, including fatality data, to provide recommendation to the BLM and CDFW on the need for any adaptive management based on reported data. The TAG will consist of members of the BLM, USFWS, and CDFW. Two additional non-voting members representing the Project owner, will serve as members of the TAG. Representative from the Project and the consultants involved in the conduct of the studies will typically be invited to attend and participate in TAG meetings. The TAG will provide advice and recommendation to the BLM and CDFW on developing and implementing effective measure to monitoring, avoid, minimize, and mitigate impacts to wildlife species and their habitats related to operations. The BLM and CDFW will evaluate any recommendations of the TAG, including discussion with project owner concerning new measures or measures that are not completely detailed in this BBCS, requisite effectiveness monitoring, and make a decision on what measure(s) and monitoring to require for implementation.

The guiding principles, duties, and responsibilities of the TAG including the following:

- The TAG is only an advisory group;
- Recommendations will be made based on best available science and existing approvals and permits to address specific issues resulting from the Project;
- Review results of fatality monitoring;
- Determine if additional management action, including changes to the monitoring protocol are needed based upon the initial results of the mortality surveys;
- Review annual report after each year of monitoring and provide suggested adaptive management actions;
- Meetings will be held following each monitoring year.

It is important for stakeholders and resource managers to incorporate statistically sound modeling into any iterative feedback cycle prior to implementation of additional or modified control measures (Williams and Brown 2012). However, the dearth of information pertaining to avian and bat mortality at large-scale photovoltaic solar energy facilities makes the establishment of adaptive management recommendations and trigger thresholds difficult to assign prior to data collection and evaluation. The triggers listed below are provided as a start point to guide the adaptive management discussions, but are not assumed to be stagnant or clearly defined. The adaptive management process and actions should be fluid based on study plan results and currently available data from other publically available studies.

Adaptive management will be initiated prior to kicking off the monitoring program and will be based on discussion with the TAG. A monitoring plan has been proposed above assuming site conditions (infrastructure configuration, ground cover, etc.) will be appropriate to implement the distance sampling approach as detailed. It is assumed that the site conditions will be evaluated before initiating the monitoring plan, and if necessary, changes to the plan will be made. If the site is conducive to the proposed monitoring, it will be assumed that the methods are sufficient to support future adaptive management discussion. It should be acknowledged that the plan assumes a higher level of precision and greater focus on large birds than small birds and subsequent discussions should be cognizant of this assumption.

Adaptive management will be evaluated by the TAG following the discussion points listed below:

- Results suggest that the avoidance and minimization measures proposed in Section 4 have not been sufficient in reducing project impacts to a comparable level to other solar and/or renewable energy project impact levels.
- The results suggest species are being impacted beyond the typical level of a development project
- A large scale mortality event (greater than 25 individuals) is recorded during a single monitoring event (day)

- Water-associated bird estimates are greater than other solar or renewable energy projects

A review of Project data will be critical at the end of each survey year to identify if any adaptive management strategies or additional conservation measures are appropriate. If impacts to birds are shown to be low, no additional monitoring is proposed. Ultimately, the goal of adaptive management is to ensure the monitoring methods are appropriate and evaluate the need for conservation measures.

## 5.0 LITERATURE CITED

Altamont Pass Avian Monitoring Team. 2007. Altamont Pass Wind Resource Area Bird and Bat Monitoring Protocols. Accessed June 2013. Available online at: http://www.altamontsrc.org/alt_doc/m1_apwra_monitoring_protocol_6_5_07.pdf

Arnett, E. B., M. R. Schirmacher, M. M. P. Huso, and J. P. Hayes. 2009. Patterns of Bat Fatality at the Casselman Wind Project in South-Central Pennsylvania. 2008 Annual Report. Annual report prepared for the Bats and Wind Energy Cooperative (BWEC) and the Pennsylvania Game C ommission. Bat Conservation International (BCI), Austin, Texas. June 2009. Available online at: http://www.batsandwind.org/pdf/2008%20Casselman%20Fatality%20Report.pdf

Avian Power Line Interaction Committee (APLIC). 2005. Avian Protection Plan (APP) Guidelines. Edison Electric Institute and US Fish and Wildlife Service (USFWS), Washington, D.C.

Avian Power Line Interaction Committee (APLIC). 2006. Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006. Public Interest Energy Research Program (PIER) Final Project Report CEC-500-2006-022. Edison Electric Institute, APLIC, and the California Energy Commission. Washington D.C. and Sacramento, California.

Avian Power Line Interaction Committee (APLIC). 2012. Reducing Avian Collisions with Power Lines: The State of the Art in 2012. Edison Electric Institute and APLIC, Washington D.C.

Baerwald, E. F. and R. M. R. Barclay. 2009. Geographic Variation in Activity and Fatality of Migratory Bats at Wind Energy Facilities. Journal of Mammalogy 90(6): 1341–1349.

Buckland, S. T., D. R. Anderson, K. P. Burnham, and J. L. Laake. 1993. Distance Sampling: Estimating Abundance of Biological Populations. Chapman & Hall, London, United Kingdom.

Bureau of Land Management (BLM). 1998. Las Vegas Resource Management Plan and Final Environmental Impact Statement. US Department of the Interior BLM, Las Vegas, Nevada. Available online at: http://www.blm.gov/nv/st/en/fo/lvfo/blm_programs/planning/las_vegas_field_office.html

California Energy Commission (CEC) and California Department of Fish and Game (CDFG). 2007. California Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development. Commission Final Report. CEC, Renewables Committee, and Energy Facilities Siting Division, and CDFG, Resources Management and Policy Division. CEC-700-2007-008-CMF.

Chatfield, A., W. Erickson, and K. Bay. 2009. Avian and Bat Fatality Study, Dillon Wind-Energy Facility, Riverside County, California. Final Report: March 26, 2008 - March 26, 2009. Prepared for Iberdrola Renewables, Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, California. June 3, 2009.

Chatfield, A., W.P. Erickson, and K. Bay. 2010. Final Report: Avian and Bat Fatality Study at the Alite Wind-Energy Facility, Kern County, California. Final Report: June 15, 2009 – June 15, 2010. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, California. Prepared for CH2M HILL, Oakland, California.

Erickson, W. P., J. Jeffrey, K. Kronner, and K. Bay. 2004. Stateline Wind Project Wildlife Monitoring Annual Report. July 2001 - December 2003. Technical report peer-reviewed by and submitted to FPL Energy, the Oregon Energy Facility Siting Council, and the Stateline Technical Advisory Committee. Western EcoSystems Technology, Inc. (WEST), Cheyenne, California, and Northwest Wildlife Consultants, Inc. (NWC), Pendleton, Oregon. December 2004.

Erickson, W. P., G. D. Johnson, M. D. Strickland, and K. Kronner. 2000. Avian and Bat Mortality Associated with the Vansycle Wind Project, Umatilla County, Oregon: 1999 Study Year. Final report prepared for Umatilla County Department of Resource Services and Development, Pendleton, Oregon. February 7, 2000.

ESRI. ArcInfo 10.0. ESRI, producers of ArcGIS software. Redlands, California.

H.T. Harvey and Associates. 2013. Desert Sunlight Solar Farm Carcass Detectability Study. Fresno, California. Prepared for Desert Sunlight Holdings, LLC, Oakland, California.

H.T. Harvey and Associates. 2014a. Avian and Bat Protection Plan Annual Postconstruction Fatality Report for the California Valley Solar Ranch Project Covering 16 August 2012 to 15 August 2013. Prepared for High Plains Ranch II, LLC, Carlsbad, California.

H.T. Harvey and Associates. 2014b. Ivanpah Solar Electric Generating System Avian & Bat Monitoring Plan 2013 – 2014 Winter Report (29 October – 21 March2014). Prepared for Solar Partners l, ll, and Vlll.

H.T. Harvey and Associates. 2014c. Ivanpah Solar Electric Generating System Avian & Bat Monitoring Plan 2014 Spring Report. Prepared for Solar Partners l, ll, and Vlll.

Huso, M. 2010. An Estimator of Wildlife Fatality from Observed Carcasses. Environmetrics 22(3): 318-329. doi: 10.1002/env.1052.

Huso, M., N. Som, and L. Ladd. 2012. Fatality Estimator User's Guide. US Geological Survey (USGS) Data Series 729. Accessed April 2013. Available online at: http://pubs.usgs.gov/ds/729/pdf/ ds729.pdf

Johnson, G. D., W. P. Erickson, M. D. Strickland, M. F. Shepherd, and D. A. Shepherd. 2000. Avian Monitoring Studies at the Buffalo Ridge Wind Resource Area, Minnesota: Results of a 4-Year Study. Final report prepared for Northern States Power Company, Minneapolis, Minnesota, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, California. September 22, 2000. 212 pp. http://www.west-inc.com

Johnson, G. D., W. P. Erickson, M. D. Strickland, M. F. Shepherd, D. A. Shepherd, and S. A. Sarappo. 2003. Mortality of Bats at a Large-Scale Wind Power Development at Buffalo Ridge, Minnesota. The American Midland Naturalist 150: 332-342.

Kerns, J. and P. Kerlinger. 2004. A Study of Bird and Bat Collision Fatalities at the Mountaineer Wind Energy Center, Tucker County, West Virginia: Annual Report for 2003. Prepared for FPL Energy and the Mountaineer Wind Energy Center Technical Review Committee. February 14, 2004. 39 pp. http://www.wvhighlands.org/Birds/MountaineerFinalAvianRpt-%203-15-04PKJK.pdf

Korner-Nievergelt, F., P. Korner-Nievergelt, O. Behr, I. Niermann, R. Brinkmann, and B. Hellriegel. 2011. A New Method to Determine Bird and Bat Fatality at Wind Energy Turbines from Carcass Searches. Wildlife Biology 17: 350-363.

Shoenfeld, P. 2004. Suggestions Regarding Avian Mortality Extrapolation. Technical memo provided to FPL Energy. West Virginia Highlands Conservancy, HC70, Box 553, Davis, West Virginia, 26260.

Smallwood, K. S. 2007. Estimating Wind Turbine-Caused Bird Mortality. Journal of Wildlife Management 71: 2781-2791.

Smallwood, K. S. 2013. Comparing Bird and Bat Fatality-Rate Estimates among North American Wind-Energy Projects. Wildlife Society Bulletin 37(1): 19-33.

Smallwood, K. S., D. A. Bell, S. A. Snyder, and J. E. DiDonato. 2010. Novel Scavenger Removal Trials Increase Wind Turbine-Caused Avian Fatality Estimates. Journal of Wildlife Management 74: 1089-1097.

Strickland, M. D., E. B. Arnett, W. P. Erickson, D. H. Johnson, G. D. Johnson, M. L. Morrison, J. A. Shaffer, and W. Warren-Hicks. 2011. Comprehensive Guide to Studying Wind Energy/Wildlife Interactions. Prepared for the National Wind Coordinating Collaborative (NWCC), Washington, D.C., USA. June 2011. Available online at: http://www.batsandwind.org/pdf/Comprehensive_Guide_to_Studying_Wind_Energy_Wildlife_Interactions_2011.pdf

TerraStat Consulting Group. 2013. Estimation of 90% Confidence Bounds for Avian Mortality Estimates at Ivanpah 1. Seattle, Washington. Technical memorandum prepared on 13 August 2013 for H.T. Harvey and Associates, Los Gatos, California. Accessed June 5, 2014. Available online at: ftp://lgftp.harveyecology.com/DesertSun/TerraStat_Estimation%20of%20CIs%20for%20avian%20mortality%20studies%20at%20Ivanpah%20I_HTH%20Tech%20Memo%20Aug2013.pdf

Thompson, S. K. 1992. Sampling. John Wiley and Sons, Inc., New York, New York.

US Fish and Wildlife Service (USFWS). 2012. Final Land-Based Wind Energy Guidelines. March 23, 2012. 82 pp. Available online at: http://www.fws.gov/windenergy/docs/WEG_final.pdf

Warren-Hicks, W., J. Newman, R. Wolpert, B. Karas, and L. Tran. 2013. Improving Methods for Estimating Fatality of Birds and Bats at Wind Energy Facilities. Public Interest Energy Research (PIER) Program CEC-500-2012-086. Final Project Report. Prepared for the California Energy Commission, Prepared on behalf of the California Wind Energy Association (CalWEA). February 2013. Available online at: http://www.energy.ca.gov/2012publications/CEC-500-2012-086/CEC-500-2012-086.pdf

Western EcoSystems Technology, Inc. (WEST). 2018. Post-Construction Monitoring at the Blythe Solar Power Project, Riverside County, California. 2016 Summer Quarterly Interim Report. Prepared for Blythe Solar, LLC, Juno Beach, Florida. Prepared by Western EcoSystems Technology, Inc. (WEST). Cheyenne, Wyoming.

Western EcoSystems Technology, Inc. (WEST). 2018b. Post-Construction Monitoring at the Blythe Solar Power Project, Riverside County, California. 2016 Fall Quarterly Interim Report. Prepared for Blythe Solar, LLC, Juno Beach, Florida. Prepared by Western EcoSystems Technology, Inc. (WEST). Cheyenne, Wyoming.

# I.6 Burrowing Owl Management Plan, February 2019

# FINAL
# RE CRIMSON SOLAR PROJECT
# BURROWING OWL MANAGEMENT PLAN

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February 2019

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## 1.0 INTRODUCTION

The RE Crimson Solar Project (Project) is located in Riverside County, approximately 13 miles west of Blythe, California. Sonoran West Solar Holdings, LLC (applicant), a wholly owned subsidiary of Recurrent Energy, proposes to construct and operate the Project. The Project is a utility-scale solar photovoltaic (PV) and energy storage project that would be located on federal lands managed by the Bureau of land Management (BLM) within the California Desert Conservation Area and the Desert Renewable Energy Conservation Plan (DRECP) area. The Project intends to implement a Burrowing Owl Management Plan (Plan) should burrowing owls (*Athene cunicularia*) be found at the Project during any point in the construction, operations and maintenance, and decommissioning phases..

### 1.1 Purpose of the Plan

This Plan describes the strategy and methodology for passive relocation of burrowing owls during the nonbreeding (winter) season (September 1 through January 31), if determined necessary. Passive relocation will not occur during the breeding season (February 1 through August 31). This Plan specifies a passive relocation approach that, when implemented, will facilitate avoidance of burrowing owls within the Project impact area during construction (and potentially other phases of the Project). Specific objectives addressed by this Plan are to describe exclusion methodology, burrow excavation procedures, and monitoring.

### 1.2 Project Background

A large area (7,600 acres) consisting of the RE Crimson Project area and surrounding BLM and private lands was originally proposed for development by BrightSource Energy, Inc., as the Sonoran West Solar Energy Generating Facility (Sonoran West Project [SWP] Site). Burrowing owl surveys for the SWP Site were conducted in 2012. Biological surveys were conducted in 2016 and 2017 for a significantly smaller portion of the SWP Site in support of the Project, including surveys for desert tortoise (*Gopherus agassizii*) and rare plants and avian surveys. Incidental observations of burrowing owls were recorded during these surveys. Modified burrowing owl surveys were repeated again in spring 2017 following California Department of Fish and Wildlife (CDFW) approval of the survey approach. The details of the burrowing owl surveys in 2012 and 2017 along with incidental sightings during other biological surveys form the basis of the existing conditions for burrowing owls within the Project and surrounding area.

### 1.2.1 Project Description

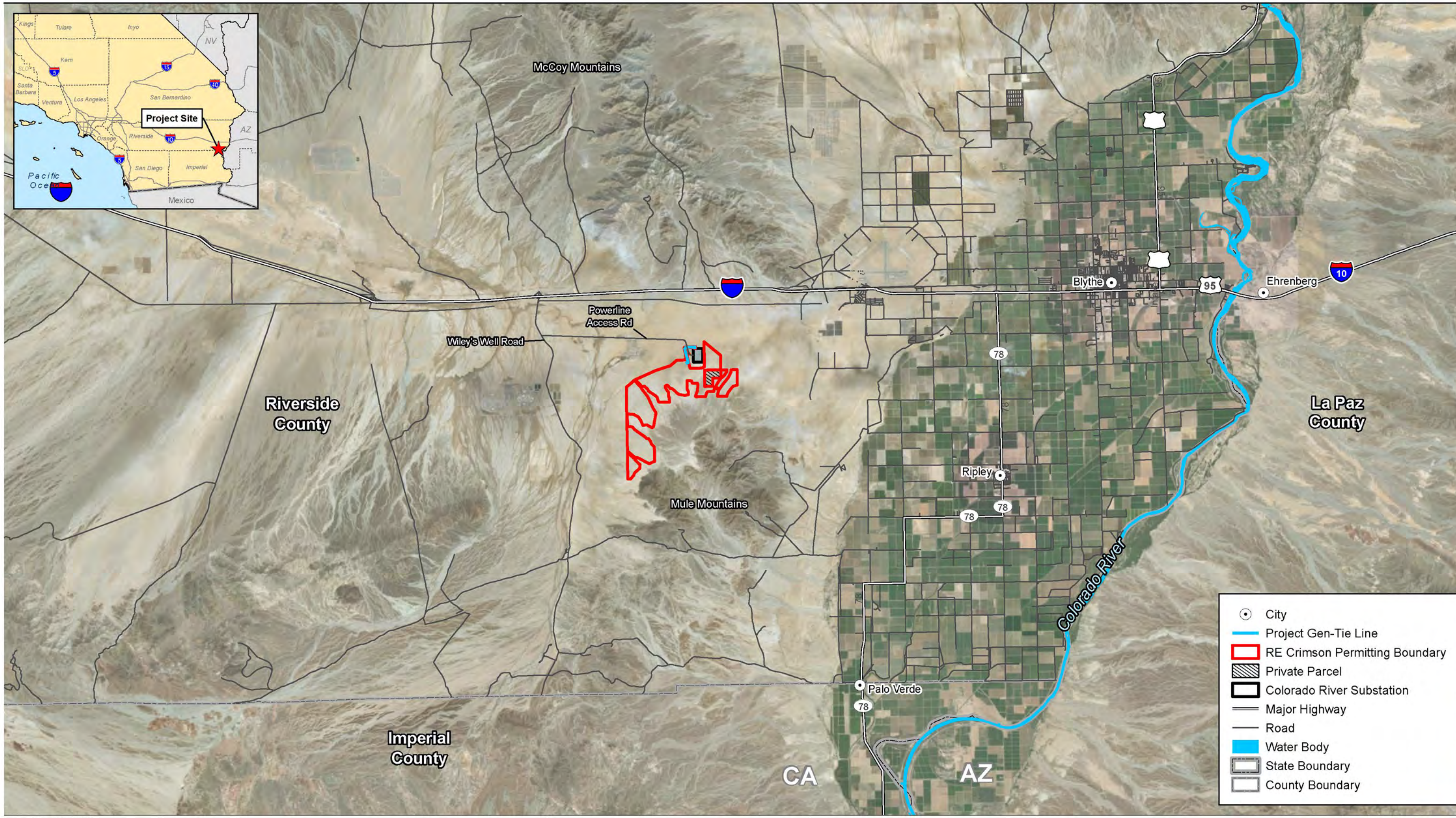
The proposed Project is located in unincorporated eastern Riverside County, approximately 13 miles west of Blythe, just north of the Mule Mountains and just south of Interstate 10 (I-10) (Figure 1). The Project site consists of approximately 2,489 acres of BLM-administered land within the Riverside East Solar Energy Zone/Development Leasing Area and within the DRECP Development Focus Area (BLM 2015). The Project would interconnect to the regional electrical grid at Southern California Edison's (SCE's) Colorado River Substation (CRS). It would generate up to 350 megawatts (MW) of renewable energy using PV technology and would include up to 350 MW of integrated energy storage capacity.

The total area for the Project (i.e., RE Crimson Permitting Boundary; 2,489 acres) includes a 2,465-acre solar field development area with approximately 1,859 acres of solar modules (array blocks) and 24 acres for linear facilities, including access/perimeter roads assuming a 30-to 60-foot corridor width and gen-tie and powerline corridor at 150 feet. The Project applicant is proposing to construct the Project using traditional construction methods consisting of desert tortoise exclusion fencing, mow-and-roll of vegetation for site preparation, compacted roads, and trenching for electrical lines. The applicant is also actively investigating alternative low environmental impact design (LEID) elements and the potential for those to reduce Project impacts.

LEID elements include several potential design changes, including the following:

- Minimizing grading during site preparation and maintaining more onsite vegetation to facilitate post-construction residual habitat value and post-operations/site reclamation success.
- Avoiding or limiting trenching by placing electrical wiring aboveground.
- Placing transformer/inverter groups on elevated support structures in lieu of cement foundations.

The LEID elements would minimize grading, trenching, and vegetation removal beyond traditional design approaches for PV projects with the objective of reducing overall long-term impacts for the Project. At this time, it has not been decided which, if any, LEID elements may be incorporated into the final Project construction design. Therefore, this Plan assumes a traditional construction approach is taken and that no LEID elements are incorporated. This Plan




Source: ESRI; AECOM.

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**Figure 1**
**Regional Map**

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may need to be modified or amended once the final construction, operations and maintenance, and decommissioning designs are determined.

While this Plan is generally geared towards the construction phase of the Project, depending upon the final design, there may be several LEID elements incorporated into the Project, which may provide suitable habitat for burrowing owls (especially if vegetation is retained onsite). The methods for burrowing owl exclusion would apply to any phase of the Project, but may need to be adapted or modified depending upon the phase of the Project, if burrowing owls are detected. Changes to the methods for exclusion defined in this plan would be reviewed with the resource agencies prior to implementation.

### 1.2.2 Site Description

The Project site consists of undeveloped land that is owned by the federal government and administered by the BLM. There is a 120.5-acre private parcel in the center of the Project site that currently is not planned for use by the Project, and surveys were not conducted within the private parcel. There are no existing structures within the Project that would need to be demolished, and no existing roads are present within the proposed Project solar development area. Existing SCE transmission lines and a paved access road (Power Line Road) oriented east-west that lead to the CRS are location just north of the Project site. The unpaved portion of Power Line Road then continues from the CRS in a southwesterly direction on the east side of the Project site. I-10 is just over 1 mile north of the northern Project boundary, and the western edge of the Colorado River Valley is approximately 4.5 miles to the east (Figure 1).

The site is located at the northern foot of the Mule Mountains Area of Critical Environmental Concern. The SCE high-voltage transmission line and CRS are directly north of the Project site, and I-10 is north of and parallel to those facilities. Federally designated critical habitat for desert tortoise within the Chuckwalla Critical Habitat Unit and the vast Chuckwalla Desert Wildlife Management Area are west of the Project site.

Regionally, the Project site is situated within the Colorado Desert on gently rolling open terrain dominated by desert scrub vegetation. Desert scrub vegetation (e.g., creosote bush scrub) covers most of the site, except for sparsely vegetated desert dunes and more heavily vegetated desert washes (with microphyll woodlands). The Project site has a gentle slope north and west, away from the base of the Mule Mountains, with elevation ranging from a high of about 710 feet above mean sea level (AMSL) around the base of the Mule Mountains to a low of about 430 feet AMSL near the northwestern corner closest to I-10. Terrain onsite generally slopes down from higher land at the base of the Mule Mountains to the south.

The Project site has experienced some historical disturbance from military training during World War II, including tank and off-road vehicle use. During World War II, the site was part of the General George S. Patton Desert Training Center, officially the California-Arizona Maneuver Area, a simulated theater of operations. More recent disturbance from recreational off-road vehicle users is evident within the Project site, even though there are no BLM-designated routes within the Project site. Most off-road vehicle use was evident within the washes with vehicle tracks leading toward the Mule Mountains.

### 1.3 Burrowing Owl Survey Results

*2012 Surveys*

Focused breeding season burrowing owl surveys were conducted in 2012 at the larger SWP Site with a 500-foot buffer. Protocol surveys were conducted per the 1993 California Burrowing Owl Consortium's (CBOC) *Burrowing Owl Survey Protocol and Mitigation Guidelines*. Three survey phases, outlined in the CBOC Burrowing Owl Survey Protocol, were followed (CBOC 1993; CDFG 2012). Nonbreeding season surveys were not conducted.

During the focused burrowing owl surveys, 27 burrows that exhibited burrowing owl activity during the previous 3 years were identified and mapped (Figure 2). These 27 burrows were subsequently observed on four separate site visits following protocol, and no breeding season activity was detected. No burrowing owls or fresh sign was detected; hence, no burrowing owls appeared to breed within the SWP Site in 2012. However, two burrowing owls were incidentally observed during the fall 2011 botanical survey, both in the northwestern portion of the SWP Site. None of the burrowing owls incidentally detected during 2012 surveys were within the RE Crimson Permitting Boundary. Additionally, only eight of the 27 potential burrowing owl burrows were within the RE Crimson Permitting Boundary.

*2017 Surveys*

Per communication from CDFW, burrowing owl surveys were required for the Project in 2017 but did not require full protocol-level surveys. One spring survey conducted at the height of the breeding season (April 15 through June 15) was the approved approach by CDFW to provide additional information on the current status of burrowing owl on the Project (Rodriguez pers. comm. 2017). To implement this requirement, qualified biologists followed Appendix D of the 2012 *Staff Report on Burrowing Owl Mitigation* survey protocol (CDFG 2012) for breeding season surveys, but modified it to include only one survey visit. The survey area included the current reduced RE Crimson Permitting Boundary only and did not include any buffer areas or the microphyll woodlands. No burrowing owls or active burrows were observed during the 2017.

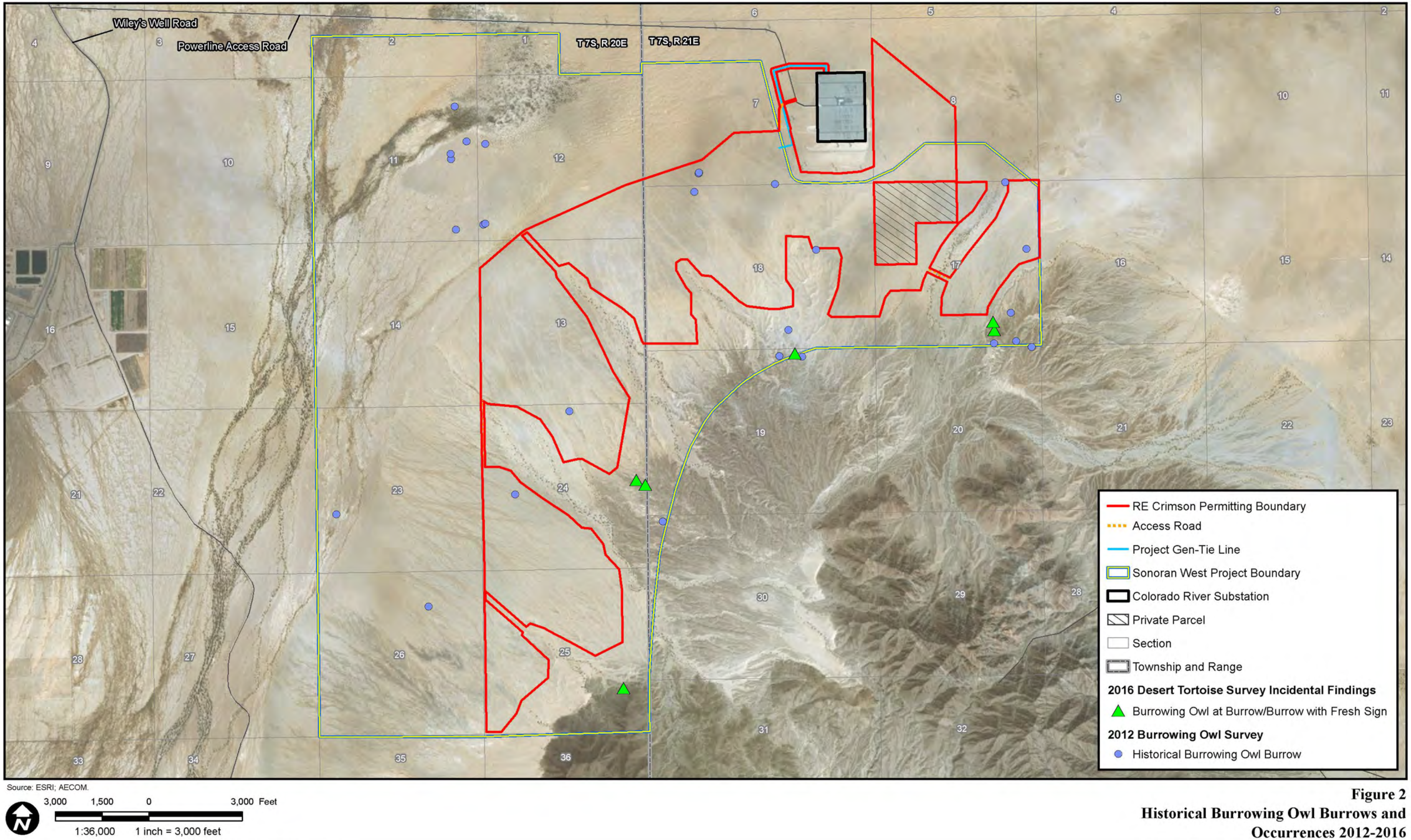


**Figure 2**
**Historical Burrowing Owl Burrows and Occurrences 2012-2016**

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modified-protocol burrowing owl survey that occurred within the RE Crimson Permitting Boundary; hence, no burrows were mapped during the 2017 surveys.

Six individual burrowing owls were incidentally detected during October 2016 desert tortoise surveys (Figure 2). These burrowing owls appeared to be using desert tortoise burrows and there was no indication that they had been nesting in the area. Rather, based on the limited amount of sign (pellets, white wash, prey remains, burrow decorations) outside of the burrows where they were detected, the burrowing owls appeared to be migrating through the area and using burrows as temporary shelter, or wintering in the area. None of the burrows showed characteristic burrow decorations (small sticks, coyote and other mammalian scat, prey remains, etc.) that are often visible at burrow entrances where burrowing owls are residing. All six of the burrowing owls detected during desert tortoise surveys were located around the foothills of the Mule Mountains outside of the RE Crimson Permitting Boundary.

Based on incidental burrowing owl detections during fall 2011 botanical surveys and fall 2016 desert tortoise surveys, and the absence of burrowing owls during breeding season 2012 and 2017 surveys, it appears that the Project does not support breeding burrowing owls, but provides suitable wintering and migration habitat for the species.

## 2.0 EXCLUSION METHODS

The *Staff Report on Burrowing Owl Mitigation* (CDFG 2012) requires pre-construction clearance surveys within permanent and temporary impact areas by a qualified wildlife biologist (i.e., a wildlife biologist meeting the minimum qualifications. An initial burrow search of the RE Crimson Permitting Boundary and a surrounding 300-foot buffer will be conducted no less than 14 days prior to initiating ground-disturbing activities (CDFG 2012). This burrow search will document any potential burrowing owl sign (pellets, prey remains, feathers, etc.) and if no burrows with owl sign or no burrowing owls are detected, then no further surveys or mitigation is necessary. This burrow search may be conducted concurrently with other surveys (such as desert tortoise or American badger [*Taxidea taxus*]/desert kit fox surveys) provided that transects provide 100 percent visual coverage. Subsequent surveys will be conducted in areas with potentially active burrows to determine which burrows are being used by owls and how they might be affected by Project construction. If burrowing owls are detected during the breeding season (February 1 through August 31) active burrows must be avoided. A 656-foot (200 meters) non-disturbance buffer will be delineated around the burrow, and individuals will not be excluded from burrows (CDFG 2012). If burrowing owls are detected during the nonbreeding (winter) season (September 1 through January 31), individuals that will be directly impacted by the Project may be passively relocated. This section discusses the specific procedures and methods to be used to exclude burrowing owls during the nonbreeding season from the Project.

## 2.1 Qualified Biologist

At least one qualified biologist will be responsible for implementing and overseeing burrowing owl exclusion efforts, including passive relocation and burrow excavation. This qualified biologist will meet the minimum requirements defined in the *Staff Report on Burrowing Owl Mitigati*on (CDFG 2012)

## 2.2 Passive Relocation

If a burrowing owl or an occupied burrowing owl burrow is identified during clearance surveys or during construction monitoring (most likely during the nonbreeding season since historical surveys have only detected burrowing owls during that season), the area will be assessed by a qualified biologist prior to passive relocation efforts to evaluate the feasibility of passive relocation. The residency status of the burrowing owl and use of burrows or other features onsite will be examined to the extent feasible. The qualified biologist will:

1. Determine if the burrowing owl is associated with a burrow onsite.
2. Assess the presence of primary and satellite burrows that may be associated with the burrowing owl detection and that are within approximately 160 feet (50 meters).
3. Assess the area for other structures that may support burrowing owl (e.g., pipes, culverts, desert tortoise burrows).
4. Determine if there are sufficient burrows (defined as burrows greater than approximately 4 inches [10 centimeters] in diameter [height and width] and greater than approximately 60 inches [150 centimeters] in depth [Johnson et al. 2010]) within a reasonable distance (between 50 to 100 meters [CDFG 2012]) from the burrowing owl detection and buffer area that would be acceptable for both primary and satellite burrows and are within or contiguous with suitable foraging habitat. Sufficient and preferred burrow sites are often previously dug burrows made by fossorial mammals composed of loose soil and with an opening of at least 4-6 inches; however, caliche caves are commonly used as well in rockier habitat types. Most burrows provide some elevation to avoid flooding and are nearby lookouts such as dirt mounds, bushes, fence posts, or road signs (Poulin et al. 2011).
5. Monitor the area to verify that potential replacement burrows are not currently occupied.
6. Assess the need for creation of artificial burrows, if necessary.
7. Identify burrows for collapsing, and other structures that may need to be removed or blocked from use.

The qualified biologist will verify that there is an acceptable "recipient" area between 50 and 210 meters from the construction activity and/or impact area that provides the necessary attributes (suitable burrows and foraging habitat) to support burrowing owls with the goal to minimize the stress of relocation (CDFG 2012). Recipient site attributes to be considered include the presence of suitable burrows (primary and satellite), habitat quality (e.g., vegetation cover, diversity) that is equal to or greater than that from which they were relocated, contiguous foraging habitat, and potential hazards/risks to the burrowing owl (i.e., suitable burrows are not part of an active desert kit fox complex).

Once passive relocation is determined practicable, it will be implemented via use of one-way doors (i.e., modified dryer vents with a clear plastic flap on one end and fitted within the burrow entrance) that allow burrowing owls to leave the burrow but prohibit re-entrance, as described by Trulio (1995) and Clark and Plumpton (2005). A one-way door will be installed at the entrance to the active burrow and at other potentially active burrows within 160 feet of the active burrow only if they occur within the RE Crimson Permitting Boundary. Any burrows outside of the RE Crimson Permitting Boundary will not have one-way doors installed. One-way doors will be left in place for 48 hours to confirm that burrowing owls have left the burrow before excavation. The doors will be monitored twice daily to verify they are functioning properly (and not stuck in the "open" position). The lead QB will check for evidence that burrowing owls are inside by looking for burrowing owl sign immediately inside the door. After 48 hours, the vent will be removed and the burrow will be scoped with a fiber-optic scope to determine occupancy. If burrowing owls are observed, vents will be reinstalled for an additional 48 hours.

Passive relocation will only occur between September 1 and January 31, unless otherwise authorized by CDFW. If relocation is to occur immediately prior to the breeding season, focused monitoring will be conducted prior to relocation efforts to verify that egg-laying has not begun. Focused monitoring will occur daily for 1 week from dawn to 10:00 AM or 2 hours prior to sunset when burrowing owls are more active and easier to detect. If visual monitoring efforts are not sufficient in determining the breeding status of the burrowing owls, fiber-optic scopes cameras may be used to confirm that egg-laying has not yet begun. Likewise, if relocation occurs immediately after the breeding season, focused monitoring of burrowing owls will be conducted daily for 1 week to confirm that juveniles from the occupied burrows have fledged prior to relocation efforts.

### 2.3 Burrow Excavation

Burrows that need to be closed due to construction activity will be identified and marked using a Global Positioning System (GPS) unit during the pre-construction survey. Burrow excavations will only be completed by qualified biologists, where at least one qualified biologist has prior experience with excavating burrowing owl burrows. When it is determined that the burrow is vacant, the qualified biologist will excavate the burrow using hand tools and refill the burrow with soil to prevent reoccupation by burrowing owls. To the extent feasible, sections of flexible plastic pipe will be inserted into the burrow(s) during excavation to maintain an escape route for any animals still inside the burrow(s). Photographs will be taken during and at the completion of each burrow excavation. All suitable burrowing owl burrows within 160 feet of active burrows inside the RE Crimson Permitting Boundary will be excavated to remove potential burrow surrogates from inside the RE Crimson Permitting Boundary. Inactive suitable burrows will be investigated (e.g., with a fiber-optic scope camera) to verify that other wildlife do not occupy the burrow, excavated with hand tools using flexible pipe to allow wildlife to escape, and refilled to prevent occupation by burrowing owls. If verification of the burrow status is not feasible via the use of a fiber optic scope, additional excavation restrictions may apply. Because many of these burrows may also be occupied by desert tortoise and/or desert kit fox, specific protocol listed within the 2009 Desert Tortoise (Mojave Population) Field Manual and that suggested by the Resource Agencies following further consultation, will be implemented to verify no negative impacts to non-target species.

## 2.4 Artificial Burrow Installation

In the event that burrowing owls will be excluded from the Project and active burrows will be impacted, a recipient area with suitable burrows and habitat must be secured prior to excluding burrowing owls from burrows. The recipient area identified for the Project should have a minimum of two to three suitable burrowing owl burrows (including artificial and natural burrows) for each occupied burrow directly impacted (Johnson et. al 2010). Ideally the recipient area is adjacent to the RE Crimson Permitting Boundary but the exact location of the recipient area must be determined in coordination with the Resource Agencies. If an adequate number of naturally occurring suitable unoccupied burrows are present on the recipient area, then artificial burrows may not be necessary. Suitable burrows are defined as burrows greater than approximately 4 inches (10 centimeters) in diameter (height and width) and greater than approximately 60 inches (150 centimeters) in depth (Johnson et al. 2010).

Should artificial burrows be required and following approval from the Resource Agencies prior to installation, a minimum of two to three artificial burrows will be installed for each occupied burrow directly impacted. The qualified biologist will be responsible for choosing the specific burrow locations within the recipient area; however, areas will generally be avoided where soil could blow away and expose the artificial burrow, any vegetation is present that obstructs the burrow, elevated perching structures (such as powerlines or tall trees) may be present for raptors, and burrows may be subject to flooding. Artificial burrows will be located beyond 50-meters from active burrows within the impact area but ideally remaining within 100-meters of the burrows intended for excavation, a distance generally within a pair's territory (CDFG 2012). If it is not feasible to install artificial burrows within adjacent suitable habitat, then, pending dialogue with the Resource Agencies, artificial burrows may be installed on mitigation lands elsewhere to augment the regional burrowing owl population. A general design schematic for the artificial burrow design is provided in Figure 3 (design by Barclay 2008), but this may be altered depending upon terrain, topography, soil conditions, and recommendations from the Resource Agencies. Artificial burrows will be created using an irrigation valve box that will be placed approximately 2 feet below the surface. A corrugated pipe will be connected to the irrigation valve box to allow access to the burrow (i.e., valve box) from the surface. The corrugated pipe will be adjusted to extend to the surface with no kinks or sharp angles (approximately 20% upward slope). The corrugated pipe will be placed through a cement block at the surface to anchor it. Thick-gauge chicken wire or other material will be buried underground over the top of the artificial burrow to ensure that desert kit foxes or other predators do not dig up the artificial burrow. The overall disturbance footprint for an artificial burrow is approximately 4 by 10 feet, but this may vary depending upon the number of burrow entrances and final burrow configuration.

## 3.0 MONITORING

Monitoring of the excluded burrows will be conducted within the Project to evaluate the success of passive relocation and, if needed, to implement remedial measures to prevent subsequent burrowing owl use. Additionally, artificial or natural burrows within the recipient area will be monitored to document burrowing owl use. This section discusses the monitoring that will occur after burrowing owl exclusion.

### 3.1 Areas Left Idle After Burrowing Owl Exclusion

Areas where passive relocation is conducted will be monitored twice weekly before construction activities start to ensure that they remain inhospitable to burrowing owls and that burrowing owls do not move back into the area prior to construction (or that desert kit foxes do not dig out/excavate and occupy previously collapsed burrows). A final pre-construction clearance survey will be conducted within 24 hours prior to initiation of construction activities in areas where burrowing owls were passively excluded. Should burrowing owls move back into the impact area, the methods described in Section 2 will be repeated to exclude burrowing owls.

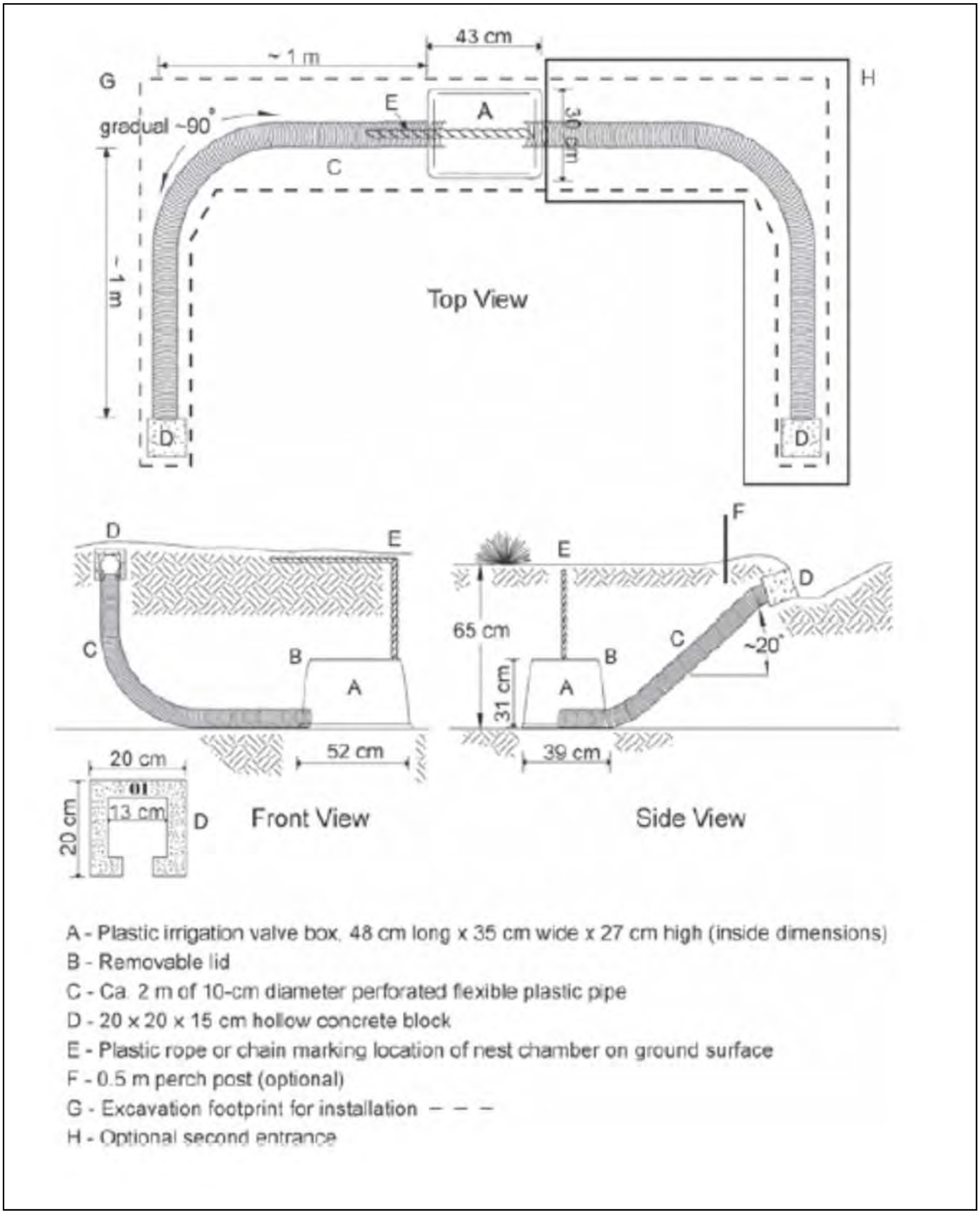


**Figure 3. Example Artificial Burrow Design**

### 3.2 Recipient Site Burrow Monitoring

Post-relocation monitoring will include a single spring and winter survey of the recipient area to determine if burrowing owls are using natural and/or artificial burrows. Surveys will be conducted using the CDFW survey protocol (CDFG 2012) for the first spring and winter seasons following relocation. Maintenance of artificial burrows, if installed, will occur three to four times during the year immediately following installation to ensure that boxes are usable for the breeding and nonbreeding seasons and to make necessary repairs prior to the start of these seasons.

## 4.0 REPORTING

All pre-construction survey data, passive relocation techniques and results, artificial burrow construction (if necessary), and monitoring will be documented in specific reports at intervals required by the Resource Agencies, which include summary reports, monthly compliance reports, and Annual Compliance Reports, as summarized below:

1. A report will be submitted to BLM and CDFW within 30 days of completion of burrowing owl pre-construction surveys and any supplemental clearance surveys. At a minimum, the report will describe survey methods, results, exclusion methods and monitoring (if necessary).
2. Monthly reports will be submitted to BLM and CDFW for the duration of construction on the status of any burrowing owls and/or active burrows in the RE Crimson Permitting Boundary and buffer, and the implementation of any exclusion methods, artificial burrow construction, or monitoring, if conducted.
3. Each Annual Compliance Report provided to BLM and CDFW will describe the results of all burrowing owl surveys, exclusion methods, and monitoring for that year, if conducted.

## 5.0 REFERENCES

Barclay, J.H. 2008. A simple artificial burrow design for Burrowing Owl. Journal of Raptor Research 42(1):53-57.

Bureau of Land Management (BLM). 2015. Desert Renewable Energy Conservation Plan Proposed Land Use Plan Amendment and Final Environmental Impact Statement. October.

California Burrowing Owl Consortium (CBOC). 1993. *Burrowing Owl Survey Protocol and Mitigation Guidelines*. April.

California Department of Fish and Game (CDFG). 2012. *Staff Report on Burrowing Owl Mitigation* (March 7, 2012). Available at https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=83843&inline.

Clark, H. O., Jr., and D. L. Plumpton. 2005. A Simple One-Way Door Design for Passive Relocation of Western Burrowing Owls. *California Fish and Game* 91:286–289.

Gervais, J. A., D. K. Rosenberg, and R. G. Anthony. 2003. Space Use and Pesticide Exposure Risk of Male Burrowing Owls in an Agricultural Landscape. *Journal of Wildlife Management* 67:155–164.

Johnson, D. H., D. C. Gillis, M. A. Gregg, J. L. Rebholz, J. L. Lincer, and J. R. Belthoff. 2010. Users Guide to Installation of Artificial Burrows for Burrowing Owls. Unpublished report. Tree Top Inc., Selah, Washington.

Poulin, Ray G., L. Danielle Todd, E. A. Haug, B. A. Millsap and Mark S. Martell. 2011. Burrowing Owl (*Athene cunicularia*), version 2.0. In The Birds of North America (P. G. Rodewald, editor). Cornell Lab of Ornithology, Ithaca, New York, USA.

Rodriguez, Magdalena. 2017. Personal email communication regarding RE Crimson burrowing owl surveys. Email approval of modified burrowing owl survey approach for one visit during the height of the breeding season. February 14.

Rosenberg, D. K., and K. L. Haley. 2004. The Ecology of Burrowing Owls in the Agroecosystem of the Imperial Valley, California. *Studies in Avian Biology* 27:120–135.

Trulio, L. A. 1995. Passive Relocation: A Method to Preserve Burrowing Owls on Disturbed Sites. *Journal of Field Ornithology* 66:99–106.

# I.7 Nesting Bird Monitoring and Management Plan, December 2018

**FINAL**
**RE CRIMSON SOLAR PROJECT**
**NESTING BIRD MONITORING AND MANAGEMENT PLAN**

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December 2018

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# 1.0 INTRODUCTION

The RE Crimson Solar Project (Project) is located in Riverside County, approximately 13 miles west of Blythe, California. Sonoran West Solar Holdings, LLC (applicant), a wholly owned subsidiary of Recurrent Energy, proposes to construct and operate the Project. The Project is a utility-scale solar photovoltaic (PV) and energy storage project that would be located on federal lands managed by the Bureau of land Management (BLM) within the California Desert Conservation Area and the Desert Renewable Energy Conservation Plan (DRECP) area. The Project intends to implement a Nesting Bird Monitoring and Management Plan (Plan) in order to outline the procedures for pre-construction clearance surveys prior to the start of construction, and for general management during Project operations and maintenance (O&M), and decommissioning.

## 1.1 Purpose of the Plan

This Plan describes the strategy and methodology to survey for and monitor nests within the RE Crimson Permitting Boundary and nearby areas to avoid impacts during construction, O&M, and decommissioning of the Project. Specifically, the Plan aims to:

1. Identify bird species that may potentially nest within or adjacent to the RE Crimson Permitting Boundary by reviewing the avian survey data from 2012 and 2016/2017;
2. Specify pre-construction nest survey guidelines to detect nests during the breeding season, should vegetation clearing occur between February 1 and July 31; and
3. Outline guidelines for nest monitoring if active nests are detected during the avian breeding season at any point in the Project life cycle (construction, O&M, and decommissioning) and have the potential to be impacted by Project activities.

This Plan focuses on potential impacts to nesting birds other than burrowing owls (*Athene cunicularia*), which are addressed under a separate Burrowing Owl Management Plan (AECOM 2018a). Additionally, this Plan does not include management of nests located farther than 500 feet from the RE Crimson Permitting Boundary, such as golden eagle (*Aquila chrysaetos*) nests, which are located over 5-miles away. Golden eagle nest surveys conducted in winter/spring 2018 found no active golden eagle nests within 5-miles of the Project (Bloom Biological 2018). This plan focuses on management of nesting birds only. General avian protection measures are addressed separately as part of the overall Bird and Bat Conservation Strategy for the RE Crimson Project.

## 1.2 Project Background

A larger area (7,600 acres) consisting of the RE Crimson Project area and surrounding BLM and private lands was originally proposed for development by BrightSource Energy, Inc., as the Sonoran West Solar Energy Generating Facility (Sonoran West Project [SWP] Site). Avian surveys for the SWP Site were conducted in 2012. Avian surveys were conducted in 2016 and 2017 for a smaller portion of the SWP Site in support of the Project (2,489 acres). The details of the avian surveys in 2012 and 2016/2017, along with incidental sightings during other biological surveys, form the basis of the existing conditions for nesting birds within the Project and surrounding area.

### 1.2.1 Project Description

The proposed Project is located in unincorporated eastern Riverside County, approximately 13 miles west of Blythe, just north of the Mule Mountains and just south of Interstate 10 (I-10), (Figure 1). The Project site consists of approximately 2,489 acres of BLM-administered land within the Riverside East Solar Energy Zone/Development Leasing Area and within the DRECP Development Focus Area (BLM 2015). The Project would interconnect to the regional electrical grid at Southern California Edison's (SCE's) Colorado River Substation (CRS). It would generate up to 350 megawatts (MW) of renewable energy using PV technology and would include up to 350 MW of integrated energy storage capacity.

The total area for the Project (i.e., RE Crimson Permitting Boundary; 2,489 acres) includes a 2,465-acre solar field development area with approximately 1,859 acres of solar modules (array blocks) and 24 acres for linear facilities including access/perimeter roads assuming a 30-to 60-foot corridor width and gen-tie and powerline corridor at 150 feet. The Project applicant is proposing to construct the Project using traditional construction methods consisting of permanent desert tortoise exclusion fencing, mow-and-roll of vegetation for site preparation, compacted roads, and trenching for electrical lines. The applicant is also actively investigating alternative low impact environmental design (LEID) elements and the potential for those to reduce Project impacts.

LEID elements include several potential design changes including the following:

- Minimizing grading during site preparation and maintaining more onsite vegetation to facilitate post-construction residual habitat value and post-O&M/site reclamation success.
- To reduce ground disturbance, avoid or limit trenching by placing electrical wiring aboveground.

- To reduce ground disturbance, place transformer/inverter groups on elevated support structures in lieu of cement foundations.

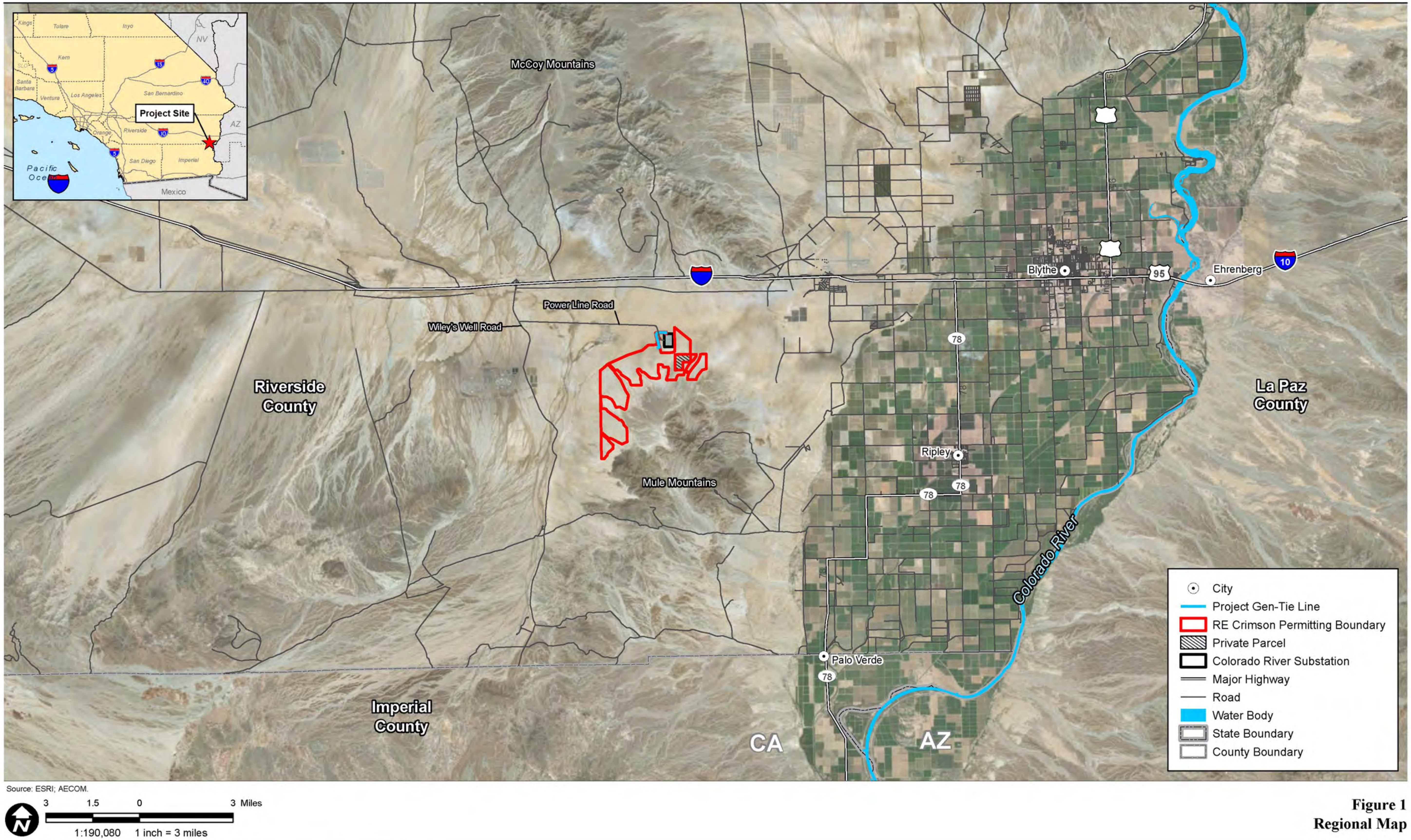


**Figure 1**
**Regional Map**



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The LEID elements would minimize grading, trenching, and vegetation removal beyond traditional design approaches for PV projects with the objective of reducing overall long-term impacts for the Project. Since one of the LEID elements is to maintain more onsite vegetation, there is an increased potential for ground-nesting birds and birds that prefer low-growing vegetation to nest within the RE Crimson Permitting Boundary throughout the life of the Project. While this may be beneficial for some avian species, it may also pose an O&M dilemma if maintenance is needed in an area where birds are nesting. The addition of solar arrays and infrastructure may provide a matrix of potential nesting areas for some species that are more adapted to human-altered environments. At this time, it has not been decided which, if any, LEID elements may be incorporated into the final Project construction design. Therefore, this Plan may need to be modified or amended once the final construction and operations design are determined, especially regarding the incorporation of LEID elements.

### 1.2.2 Site Description

The Project site consists of undeveloped land that is owned by the federal government and administered by the BLM. There is a 120.5-acre private parcel in the center of the Project site that currently is not planned for use by the Project, and surveys were not conducted within the private parcel. There are no existing structures within the Project that would need to be demolished, and no existing roads are present within the proposed Project solar development area. Existing SCE transmission lines and a paved access road (Power Line Road) oriented east-west are located along the northern boundary of the Project site that lead to the CRS. I-10 is just over 1 mile north of the northern Project boundary, and the western edge of the Colorado River Valley is approximately 4.5 miles to the east (Figure 1).

The site is located at the northern foot of the Mule Mountains Area of Critical Environmental Concern. The SCE high-voltage transmission line and CRS are directly north of the Project site, and I-10 is north of and parallel to those facilities. Federally designated critical habitat for desert tortoise within the Chuckwalla Critical Habitat Unit and the vast Chuckwalla Desert Wildlife Management Area are west of the Project site.

Regionally, the Project is situated within the Colorado Desert on gently rolling open terrain dominated by desert scrub vegetation. Desert scrub vegetation (e.g. creosote bush scrub) covers most of the Project area, except for sparsely vegetated desert dunes and more heavily vegetated desert washes (with microphyll woodlands). The Project has been sited to avoid the majority of desert washes and microphyll woodlands; hence, there are no tall trees directly within the RE Crimson Permitting Boundary. The Project site has a gentle slope north and west, away from the base of the Mule Mountains, with elevation ranging from a high of about 710 feet above mean sea level (AMSL) around the base of the Mule Mountains to a low of about 430 feet AMSL near the northwestern corner closest to I-10. Terrain onsite generally slopes down from higher land at the base of the Mule Mountains to the south.

### 1.3 Avian Survey Methods

Several types of both specific and general avian surveys were conducted within the SWP Site and the RE Crimson Permitting Boundary and adjacent microphyll woodlands. The species-specific avian surveys included surveys for burrowing owl, elf owl (*Micrathene whitneyi*), gila woodpecker (*Melanerpes uropygialis*), and golden eagle. The specific survey methods and results for these species are included in the RE Crimson Biological Resources Technical Report (AECOM 2018b), and not included here. Impacts to burrowing owls are discussed in the Burrowing Owl Management Plan (AECOM 2018a). Elf owls and gila woodpeckers were not detected during any surveys in 2012 or 2016/2017; hence, they are not expected to occur and are not included in this Plan. Golden eagle surveys were conducted in 2012 and 2018. Documented historical nest locations are located greater than 5-miles away from the RE Crimson Permitting Boundary and hence will not be discussed within this Plan (Bloom Biological 2018). General avian survey methods and results that are not specific to any particular species are discussed herein. The full details of the survey methods and results are located within the RE Crimson Biological Resources Technical Report (AECOM 2018b).

Migratory bird observation points and migratory bird transects were conducted in 2012 within the SWP Site, and in 2016/2017 within the RE Crimson Permitting Boundary. The 2012 migratory bird transects were conducted in accordance with the methodology of Ralph et al. 1995 and the 2009 BLM Solar Facility Point Count Protocol (BLM 2009). Surveys in 2016/2017 were conducted in accordance with the agency-approved RE Crimson Avian Survey Work Plan (AECOM 2016). The details of the methods and results of these surveys are included in the RE Crimson Biological Resources Technical Report (AECOM 2018b).

### 1.4 Avian Survey Results

The following section combines the results of both the migratory bird observation points and transects and is separated by results from spring 2012 surveys, and year-long surveys conducted in 2016 and 2017.

#### 1.4.1 Migratory Bird Observation Points and Transects

The following section details the results of the migratory bird observation points and transects that were conducted in 2012 and 2016/2017. The data from 2012 from the SWP Site encompass a much larger area than the RE Crimson Permitting Boundary; therefore, the data from

2016/2017 depict a more refined view of the level of avian abundance and diversity within the RE Crimson Permitting Boundary.

*2012 Survey Results*

A total of 2,638 bird observations consisting of 84 species were made during the spring 2012 bird surveys. The most common bird species observed were cliff swallow (*Petrochelidon pyrrhonota*; 255 observations), horned lark (*Eremophila alpestris*; 231 observations), loggerhead shrike (*Lanius ludovicianus*; 178 observations), ash-throated flycatcher (*Myiarchus cinerascens*; 164 observations), mourning dove (*Zenaida macroura*; 153 observations), barn swallow (*Hirundo rustica*; 143 observations), cactus wren (*Campylorhynchus brunneicapillus*; 116 observations), and turkey vulture (*Cathartes aura*; 113 observations).

As anticipated in a desert environment, a significantly higher use of microphyll woodlands compared to desert upland habitats was found for both the number of observations and species between each habitat. Of the 12 migratory bird transects, the locations closest to the base of the Mule Mountains and the transect placed in the easternmost wash had the highest number of avian observations. Generally, washes contained the most dense and mature microphyll woodlands and vegetation near the base of the Mule Mountains and then gradually spread out and ended in open desert scrub with increasing distance from the Mule Mountains. Therefore, it is not surprising that the highest numbers of birds were recorded in the areas where the microphyll woodlands were the densest. The easternmost wash had the highest number of observations, at over 40 bird observations.

*2016/2017 Survey Results*

A total of 3,396 birds were recorded during both migratory seasonal periods consisting definitively of 60 species during the migratory bird observation point survey efforts during fall 2016 and spring 2017. The most common bird species observed were turkey vulture (863 observations), horned lark (783 observations), barn swallow (259 observations), common raven (*Corvus corax*; 194 observations), tree swallow (*Tachycineta bicolor*; 193 observations), and Swainson's hawk (*Buteo swainsoni*; 183 observations).

Migratory birds transect survey efforts were conducted for just over 1 year beginning in July 2016 and ending in July 2017. A total of 2,603 bird observations, consisting definitively of 76 species, were made during the migratory bird transect survey efforts from July 2016 through July 2017. The most common bird species observed include horned lark (347 observations), turkey vulture (207 observations), LeConte's thrasher (*Toxostoma lecontei*; 197 observations), mourning dove (191 observations), Brewer's sparrow (*Spizella breweri*; 187 observations), black-throated sparrow (*Amphispiza bilineata*; 133 observations), loggerhead shrike (125 observations) and barn swallow (113 observations).

*Summary*

In summary, 107 bird species have been detected within and adjacent to the RE Crimson Permitting Boundary. Many of these species were seen during migration, or in very few numbers. Some of the most commonly detected bird species in the Project area include turkey vulture, horned lark, loggerhead shrike, LeConte's thrasher, barn swallow, mourning dove, and ash-throated flycatcher. While no federally listed avian species were detected, several special-status avian species, including two state threatened species (Swainson's hawk and bank swallow [*Riparia riparia*]), and four BLM sensitive species (Swainson's hawk, burrowing owl, bank swallow, and Lucy's warbler [*Oreothlypis luciae*]) were detected in 2016/2017 within and adjacent to the RE Crimson Permitting Boundary and are listed in Appendix A (Figure 2).

To assess the potential for bird species to nest within the RE Crimson Permitting Boundary, or the adjacent microphyll woodlands, a table of all species detected to date was generated, along with a rank (none, low, moderate, or high) to indicate the biologically perceived nesting potential for each species (Appendix A). Avian species potential to nest was defined as follows:

1. None: bird species that migrate through the RE Crimson Permitting Boundary, species whose breeding range does not include the Colorado Desert, or species for which no suitable nesting habitat is present, were considered to have no potential to nest.
2. Low: bird species that have marginal, low-quality habitat (habitat that lacks a large majority of the necessary breeding elements for a species) within or adjacent to the RE Crimson Permitting Boundary. These species were detected few times during the breeding season, or have higher-quality suitable nesting habitat elsewhere outside of the Project area (i.e., along the Colorado River and adjacent agricultural areas).
3. Moderate: bird species that have a reasonable potential to nest in discrete locations (due to pockets of suitable habitat) within the RE Crimson Permitting Boundary or nearby adjacent areas, but the species was not documented nesting during 2012 to 2017 surveys.
4. High: bird species that were common and widespread, and readily breed within the Colorado Desert and were either documented breeding, or there was a high potential to breed, but it was not explicitly documented. These species were present on multiple surveys throughout the breeding season.

## 2.0 PRE-CONSTRUCTION SURVEYS

To the extent possible, vegetation clearing (e.g., via mowing or grading) within the RE Crimson Permitting Boundary will occur outside of the breeding season for avian species protected under the Migratory Bird Treaty Act (MBTA) and California Department of Fish and Wildlife (CDFW) Codes 3503, 3511 and 3513. If vegetation clearing (including maintenance mowing of vegetation during O&M within the RE Crimson Permitting Boundary) must occur during the general avian breeding season (February 1 through July 31), pre-construction nest surveys will be conducted by qualified biological monitors (as defined below).

### 2.1 Roles and Responsibilities

Implementation of this Plan will involve several levels of oversight, including qualified biologists, biological monitors (BMs), a Project compliance lead, and the Resource Agencies (BLM, CDFW, and the U.S. Fish and Wildlife Service [USFWS]). A qualified biologist is responsible for the day-to-day implementation of all Plan stipulations, and directs the BMs to conduct the necessary pre-construction surveys ahead of construction. A qualified biologist reports to the Project compliance lead to understand the construction schedule, to ensure that pre-construction nest clearance surveys have been conducted sufficiently ahead of time and ensures that any necessary buffers are placed, maintained, and monitored around any nests that are discovered during surveys. A qualified biologist and Project compliance lead dialogue with the Resource Agencies to determine the appropriate nest buffer needed to prevent harassment or take as defined under the MBTA, and to report the findings of pre-construction surveys.

A qualified biologist may include a Designated Biologist, biological monitor, or other biologist qualified to conduct nesting bird surveys. A resume of each qualified biologist will be submitted to the BLM for approval in consultation with the CDFW and USFWS. The qualified biologist will have the following background and training:

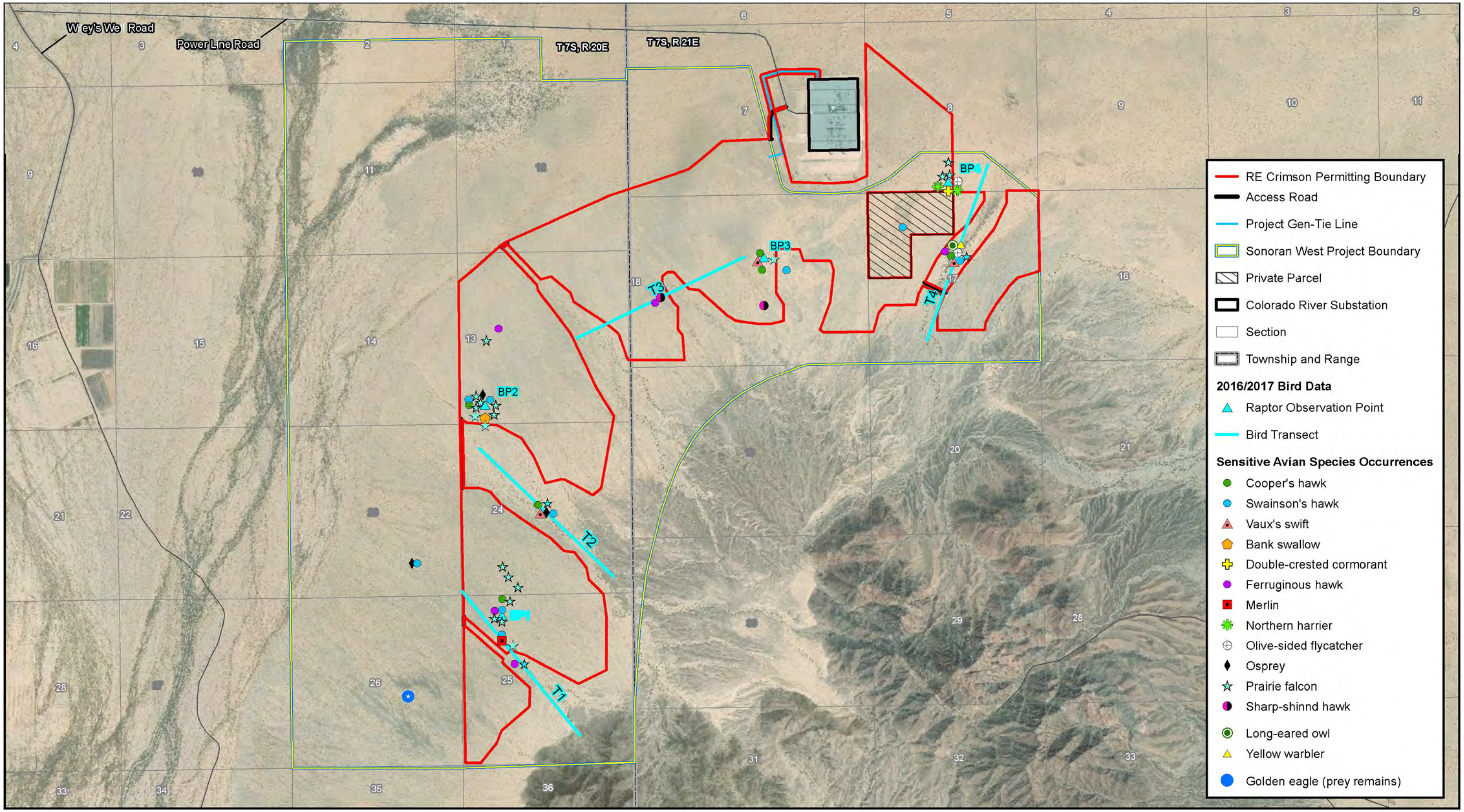
- Bachelor's degree in biological sciences, zoology, botany, ecology, or a closely related field; and 3 years of experience in field biology or current certification of a nationally recognized biological society, such as The Ecological Society of America or The Wildlife Society; and
- At least 1 year of cumulative field experience with bird species found in or near the Project area (such as in desert environments in the Southwest).

The BMs will be responsible for implementing and overseeing pre-construction nesting bird surveys. Each BM will have at least a B.A. or B.S. in wildlife biology, wildlife ecology, ornithology, or wildlife management or, alternatively, been mentored or supervised for at least one field season by a biologist with extensive field experience with avian species. BMs will have nesting bird survey experience and the ability to identify avian species known to occur on site by sight and sound and familiarity with the nesting/breeding behavior of species in the region.

## 2.2 Survey Methods

*Preconstruction Surveys*

The biologists will conduct pre-construction nesting bird surveys in potential nesting habitat (this will vary depending upon species potential to nest within the RE Crimson Permitting Boundary; see Appendix A to review the list of species with a potential for nesting) within the construction footprint and surrounding 500-foot buffer. Survey should be conducted whenever construction activities may occur during the nesting season (defined as February 1 through July 31) and when construction activities may impact nesting bird species through vegetation removal, or through noise disturbance. If vegetation is removed outside of the nesting season, and the habitat has been bladed or graded and there is no longer any vegetation, then pre-construction surveys will not be necessary unless 1 month or more of inactivity has passed. Since some avian species prefer to nest in sparsely vegetated areas, removal of all potential nesting habitat outside of the nesting season is crucial. However, if an area is left without construction activity for 1 month or longer, a single pre-construction sweep should be conducted to verify no ground-nesting birds have started nesting.




Source: ESRI; AECOM.

3,000 1,500 0 3,000 Feet

1:36,000 1 inch = 3,000 feet

**Figure 2**
**Sensitive Avian Species Occurrences**
**2016/2017**

RE Crimson Solar Project Nesting Bird Monitoring and Management Plan

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At least two pre-construction surveys should be conducted, separated by a minimum of 10 days between surveys. One survey should occur at least 14 days prior to initiation of construction activities, and the second survey should be conducted within 24 hours prior to when construction is slated to occur. This is crucial, especially since birds can often build nests very quickly, particularly near the height of the nesting season (in late spring/early summer). A qualified biolgist will coordinate with the Project compliance lead to understand the construction timeline and mobilize BMs to conduct the necessary pre-construction nesting bird surveys in the necessary areas.

Pre-construction nesting surveys will cover all potential nesting habitat in the portions of the RE Crimson Permitting Boundary (where construction is slated to occur) and an adjacent 500-foot buffer. BMs will conduct surveys using a variety of methods that may be tailored to the specific habitat type, and particular bird species that may occur. BMs will use Appendix A to determine which species are most likely to nest in the RE Crimson Permitting Boundary and nearby microphyll woodland to familiarize themselves with the avian nests they have a potential to encounter. Surveys will include the following:

1. Will not be conducted concurrently with any other pre-construction surveys.
2. Surveys will generally be conducted in the early morning hours (often starting pre-dawn) when avian activity is highest and will cease once avian activity significantly decreases, which is dependent upon temperature, wind, etc., but surveys will generally cease by 11 a.m.
3. Biologists will slowly walk meandering transects spaced adequately apart (starting with 25 meters apart) to account for different vegetation densities and terrain. Biologists may space out farther in open areas with sparse vegetation and in sand dunes, and have tighter transects when walking through washes and microphyll woodland. Biologists will check every tree, large shrub, or other location where a nest could be placed (including on the ground for ground nesting species).
4. Biologists will also scan ahead of them with binoculars to look for perched birds that may be vocalizing above a nest location (LeConte's thrashers often perch directly above their nest). Biologists will look for nesting behavior such as breeding calls, courtship displays, aggressive behavior when approached, distracted display behaviors, carrying nesting material, and feeding young, etc.
5. Surveys will be conducted using standard techniques described in Martin and Geupel 1993, and Ralph et al. 1993.

6. The goal is not necessarily to find the exact nest location, but to know the general location of an active nest such that an appropriately sized buffer as detailed in Appendix B can be placed around the nest and it can be monitored.
7. Once a potential nest location is detected based on bird behavior (or a nest or tree cavity is observed), biologists will observe the nest location to determine if birds are still in the process of nest building, egg laying, feeding young, etc. Biologists will record the location with a global positioning system (GPS) point and record as much detailed information (including species, nesting stage, and a unique tracking number) as possible to help determine an appropriately sized buffer. Extreme care will be taken near all nest locations to prevent birds from flushing off their nests and from attracting predators.

If no active nests are discovered, construction may proceed. If active nests are observed that could be disturbed by construction activities, these nests will have an appropriately sized buffer placed around them to be avoided until the young have fledged and/or it is determined that no impacts are anticipated to the nesting birds or their young. If construction ceases for 7 or more consecutive days during the nesting season, and there is suitable nesting habitat present within 500 feet of an area that would be disturbed by construction activities, repeat nesting bird surveys will be required to verify that new nesting locations have not been established within the construction footprint and a 500-foot buffer.

*Operations and Maintenance Surveys*

During O&M of the solar facility, routine mowing and vegetation maintenance are likely, especially following summer and winter rain events. Additionally, if LEID elements include leaving vegetation within the RE Crimson Permitting Boundary, nesting bird surveys will be necessary prior to vegetation mowing, if conducted during the avian nesting season (February 1 through July 31). If remnant vegetation is permitted within the RE Crimson Permitting Boundary, it will be maintained no greater than 18 inches tall (to avoid impacts to panel function)and will be mowed or trimmed only after annual plants have flowered and set seed, to maintain a viable seed bank within the solar fields. If vegetation mowing must occur during the general avian breeding season, a single pre-vegetation mowing nest survey (using methods detailed above) will be conducted within the area to be trimmed or mowed by qualified biologist(s) 48 hours prior to the start of O&M activities.

## 3.0 NEST AVOIDANCE

To prevent impacts to nesting birds outside of the RE Crimson Permitting Boundary during the nesting season, it may be necessary to limit the construction noise to prevent birds from being startled, flushing off their nests, or from using the habitat for nesting. Noise levels above 60 A-weighted decibels (dBA) (averaged over a time period such as one hour or 24 hours) are a starting point at which potential impacts on nearby nesting birds may occur (Bioacoustics Research Team 1997). Therefore, at the discretion of a qualified biologist, it may be necessary to conduct nesting bird surveys in adjacent habitat (within a 500-foot buffer) outside of the RE Crimson Permitting Boundary if loud construction activities are planned during the breeding season in proximity. If an active nest or potential nest location is detected outside of the RE Crimson Permitting Boundary, and is likely to be impacted by noise levels in excess of 65 dBA, a non-disturbance buffer may be needed.

Since birds have varying levels of tolerance to human activity, including noise levels, and flush distances, the buffer area for each nest will be established on a case-by-case basis by a qualified biologist with sufficient avian experience. The buffer distance will need to be confirmed with the Resource Agencies. USFWS has provided guidance on non-disturbance buffer distances for a variety of construction activities on other projects in the desert, including ground-based and helicopter-based work for previous projects. A table that outlines suggested non-disturbance buffer distances is provided in Appendix B and details buffers for horizontal and vertical ground construction and helicopter construction (SCE 2015). Any activities that have a potential to cause nest disturbance will be prohibited within the non-disturbance buffer area until the nestlings have fledged or dispersed, or the nest fails.

Nest non-disturbance buffers will be established through the placement of laminated placards indicating “environmentally sensitive area” stapled to wooden lathe or stakes. The signs will be placed 100-feet apart (or closer depending up the vegetation density) and face the direction of construction/towards any roads or work areas. The fewest number of signs will be temporarily placed at the outer edge of a non-disturbance buffer, or along the access road or other location clearly visible to construction crews. During the WEAP training, all construction crews will be notified of activities prohibited within environmentally sensitive areas, and during daily tailgate meetings any non-disturbance buffers near construction activities will be clearly communicated to construction crews. Generally signage for non-disturbance buffers will be the minimal amount to clearly define the buffer area where construction activities need to be restricted or redirected.

## 4.0 NEST MONITORING

The biologists will monitor all known nests within the RE Crimson Permitting Boundary, and within 500 feet, at least weekly to determine the status of the nest, and if the buffer distance is sufficient. They will use binoculars and a spotting scope (if necessary) to monitor active nests from a safe distance and to observe bird behavior in relation to construction activities. Nests will not be approached when a potential predator is nearby, including common ravens. Data to be recorded for each nest will include:

- Bird species
- Unique nest identification number
- Date and surveyor
- Weather information
- Types of nearby construction activity and any Project-related noise sources
- Nest status/stage (as best determined without actually disturbing the nest, nest building, incubating, nestlings present, fledglings present)
- Condition of the nest
- Changes in bird behavior that may indicate disturbance
- Nest outcome (fledged, failed, predated, etc.)

When a nest becomes inactive during the non-nesting season, it no longer needs to monitored. A previously active nest becomes inactive when it no longer contains viable eggs and/or living young and is not being used by a bird as part of the reproductive cycle. This includes birds no longer adding vegetation or decorating the nest, and it is no longer being attended, visited, or sat upon, and any young are no longer dependent upon the nest. Egg inviability will be inferred if eggs are present or believed present, but the adult birds have stopped brooding the eggs or abandoned the nest, based upon repeated observations of inactivity at the nest location when required. In some cases, a nest can be abandoned by the bird constructing it and become inactive prior to egg laying. In such cases, determination that the nest is inactive is made on a case-by-case basis based on consistent observations and the determination of a qualified biologist. Care must be exercised to determine if a nest is truly inactive, as some species, such as cactus wrens (*Campylorhynchus brunneicapillus*), construct roost nests that adults use at night. Any nest suspected of being a roost nest will be considered active.

## 5.0 REPORTING

The results of pre-construction surveys will be included in a summary report with figures to be submitted to the Project compliance lead and Resource Agencies prior to initiation of construction work in a given surveyed area. The report will summarize the findings of the pre-construction surveys and outline any nest non-disturbance buffers that were instituted, nesting bird monitoring efforts, and any recommendations to protect nesting birds moving forward. The report may be combined with other preconstruction clearance and/or compliance reports for the Project.

## 6.0 REFERENCES

AECOM. 2016. *Avian Survey Work Plan RE Crimson Solar Project Riverside County, California*. Prepared for Sonoran West Solar Holdings, LLC. May.

AECOM. 2018a. *Draft RE Crimson Solar Project Burrowing Owl Management Plan*. Prepared for Sonoran West Solar Holdings, LLC. March.

AECOM. 2018b. *RE Crimson Solar Project Biological Resources Technical Report*. Prepared for Sonoran West Solar Holdings, LLC. January.

Bioacoustics Research Team. 1997. Environmental effects of transportation noise, a case study: noise criteria for the protection of endangered passerine birds. University of California, Davis, Transportation Noise Control Center (TNCC) Technical Report 97-001.

Bloom Biological. 2018. Crimson Solar Golden Eagle Nest Survey Results. 2018 Draft Report. July 24.

Bureau of Land Management (BLM). 2009. Solar Facility Point Count Protocol. Unpublished.

Dietsch, T. 2014. Personal communication with AECOM Biologist Lyndon Quon regarding USFWS recommended nesting bird construction buffers for MBTA compliance. March 24.

Martin, T. E. and G. R. Geupel. 1993. Nest-Monitoring Plots: Methods for Locating Nests and Monitoring Success. Journal of Field Ornithology. 64(4): 507-519.

Ralph, C. J., G. R. Geupel, P. Pyle, T. E. Martin, and D. F. DeSante. 1993. *Handbook of Field Methods for Monitoring Landbirds*. Gen. Tech. Rep. PSW-GTR-144. Albany, CA: Pacific Southwest Research Station, Forest Service, USDA.

Ralph, C.J., S. Droege and J.R. Sauer. 1995. Managing and Monitoring Birds Using Point Counts: Standards and Applications. Pages 161-168 in C. J. Ralph, J. R. Sauer, and S. Droege, Eds. Monitoring Bird Populations by Point Counts, USDA Forest Service, Pacific Southwest Research Station, General Technical Report PSW-GTR-149.

Southern California Edison (SCE). 2015. Nesting Bird Management Plan for West of Devers. August.

# APPENDIX A

## Avian Species Detected within the RE Crimson Project Area and Nesting Potential

## Appendix A

## Avian Species Detected Within the RE Crimson Project Area and Nesting Potential

| Common Name | Scientific Name | Sensitivity Status[1] | SWP Site (2012) | RE Crimson Project Area (2016/2017) | Potential to Nest in RE Crimson Permitting Boundary and Adjacent Washes in Microphyll Woodland |
|---|---|---|---|---|---|
| **Birds** | | | | | |
| **Galliformes** | | | | | |
| Gambel's Quail | *Callipepla gambelii* | | X | X | High, particularly along washes in areas of dense vegetation |
| **Columbiformes** | | | | | |
| Eurasian Collared-Dove | *Streptopelia decaocto* | | X | X | Moderate, primarily in microphyll woodlands |
| Mourning Dove | *Zenaida macroura* | | X | X | High, primarily in microphyll woodlands |
| White-winged Dove | *Zenaida asiatica* | | X | X | High, primarily in microphyll woodlands |
| **Cuculiformes** | | | | | |
| Greater Roadrunner | *Geococcyx californianus* | | X | X | High, primarily in microphyll woodlands |
| **Caprimulgiformes** | | | | | |
| Common Poorwill | *Phalaenoptilus nuttallii* | | X | X | High, particularly in open bare desert with scattered rocky substrate |
| Lesser Nighthawk | *Chordeiles acutipennis* | | X | X | High, particularly in open bare desert with scattered rocky substrate |
| **Apodiformes** | | | | | |
| Vaux's Swift | *Chaetura vauxi* | State: SSC (nesting) | X | X | None, no suitable nesting habitat |
| White-Throated Swift | *Aeronautes saxatalis* | | X | X | None, no suitable nesting habitat |
| Anna’s Hummingbird | *Calypte anna* | | | X | Low, possibly within microphyll woodland |
| Black-chinned | *Archilochus alexandri* | | X | | Moderate, potentially within |

| Common Name | Scientific Name | Sensitivity Status[1] | SWP Site (2012) | RE Crimson Project Area (2016/2017) | Potential to Nest in RE Crimson Permitting Boundary and Adjacent Washes in Microphyll Woodland |
|---|---|---|---|---|---|
| Hummingbird | | | | | microphyll woodland |
| Costa's Hummingbird | *Calypte costae* | | X | X | Moderate, potentially within microphyll woodland |
| **Charadriiformes** | | | | | |
| Long-billed Curlew | *Numenius americanus* | | X | | None, no suitable nesting habitat |
| **Suliformes** | | | | | |
| Double-crested Cormorant | *Phalacrocorax auritus* | | X | X | None, no suitable nesting habitat |
| **Pelecaniformes** | | | | | |
| Great Blue Heron | *Ardea herodias* | | | X | None, no suitable nesting habitat |
| White-faced Ibis | *Plegadis chihi* | | | X | None, no suitable nesting habitat |
| Cattle Egret | *Bubulcus ibis* | | | X | None, no suitable nesting habitat |
| **Cathartiformes** | | | | | |
| Turkey Vulture | *Cathartes aura* | | X | X | None, no suitable nesting habitat |
| **Accipitriformes** | | | | | |
| Osprey | *Pandio haliaetus* | | | X | None, no suitable nesting habitat |
| Northern Harrier | *Circus hudsonius* | State: SSC (nesting) | X | X | None, no suitable nesting habitat |
| Cooper's Hawk | *Accipiter cooperii* | | X | X | None, no suitable nesting habitat |
| Sharp-shinned Hawk | *Accipiter striatus* | | | X | None, no suitable nesting habitat |
| Red-tailed Hawk | *Buteo jamaicensis* | | X | X | High, common species in area that nests along transmission towers along Powerline Access Road |
| Swainson's Hawk | *Buteo swainsoni* | State: THR (nesting)<br>BLM: SS<br>DRECP: FS | X | X | None, no suitable nesting habitat |
| Ferruginous Hawk | *Buteo regalis* | NECO: SS | | X | None, no suitable nesting habitat |
| **Strigiformes** | | | | | |
| Great Horned Owl[2] | *Bubo virginianus* | | X | X | Low, few trees large enough to |

| Common Name | Scientific Name | Sensitivity Status[1] | SWP Site (2012) | RE Crimson Project Area (2016/2017) | Potential to Nest in RE Crimson Permitting Boundary and Adjacent Washes in Microphyll Woodland |
|---|---|---|---|---|---|
| | | | | | support nesting |
| Short-eared Owl | *Asio flammeus* | State: SSC (nesting) | X | | None, no suitable nesting habitat |
| Long-eared Owl | *Asio otus* | State: SSC (nesting) | | X | Low, few trees large enough to support nesting |
| Burrowing Owl[2] | *Athene cunicularia* | State: SSC (burrow sites and some wintering sites)<br>BLM: SS<br>NECO: SS<br>DRECP: FS | X | X | Low, no individuals have been detected during breeding season surveys |
| **Piciformes** | | | | | |
| Ladder-backed Woodpecker | *Picoides scalaris* | | X | X | High, tree cavity confirmed within microphyll woodland |
| Northern Flicker | *Colaptes auratus* | | | X | None, no suitable nesting habitat |
| **Falconiformes** | | | | | |
| American Kestrel | *Falco sparverius* | | X | X | None, no suitable nesting habitat |
| Merlin | *Falco columbarius* | | | X | None, no suitable nesting habitat |
| American Peregrine Falcon | *Falco peregrinus anatum* | Fed: DL<br>State: DL, FP | X | | None, no suitable nesting habitat |
| Prairie Falcon | *Falco mexicanus* | NECO: SS | X | X | None, no suitable nesting habitat |
| **Passeriformes** | | | | | |
| ***Tyrannidae*** | | | | | |
| Ash-throated Flycatcher | *Myiarchus cinerascens* | | X | X | High, multiple suitable tree cavities present within microphyll woodland |
| Black Phoebe | *Sayornis nigricans* | | X | X | Low, very limited nesting structures in area |
| Cassin's Kingbird | *Tyrannus vociferans* | | X | | None, no suitable nesting habitat |

| Common Name | Scientific Name | Sensitivity Status[1] | SWP Site (2012) | RE Crimson Project Area (2016/2017) | Potential to Nest in RE Crimson Permitting Boundary and Adjacent Washes in Microphyll Woodland |
|---|---|---|---|---|---|
| Gray Flycatcher | *Empidonax wrightii* | | X | | None, no suitable nesting habitat |
| Pacific Slope Flycatcher | *Empidonax difficilis* | | X | X | None, no suitable nesting habitat |
| Say's Phoebe | *Sayornis saya* | | X | X | Moderate, limited nesting structures in area |
| Western Kingbird | *Tyrannus verticalis* | | X | X | Moderate, limited nesting structures in area |
| Western Wood-Pewee | *Contopus sordidulus* | | X | | None, no suitable nesting habitat |
| Olive-sided flycatcher | *Contopus cooperi* | State: SSC (nesting) | | X | None, no suitable nesting habitat |
| ***Laniidae*** | | | | | |
| Loggerhead Shrike | *Lanius ludovicianus* | State: SSC (nesting) | X | X | High, species detected breeding in many of the microphyll woodlands |
| ***Vireonidae*** | | | | | |
| Warbling Vireo | *Vireo gilvus* | | X | X | None, no suitable nesting habitat |
| ***Corvidae*** | | | | | |
| American Crow | *Corvus brachyrhynchos* | | X | | None, no suitable nesting habitat |
| Common Raven | *Corvus corax* | | X | X | High, common species in area that often nests along transmission towers along Powerline Access Road |
| ***Alaudidae*** | | | | | |
| Horned Lark | *Eremophila alpestris* | | X | X | High, commonly detected species that prefers open, low growing desert for nesting. |
| ***Hirundinidae*** | | | | | |
| Bank Swallow | *Riparia riparia* | State: THR BLM: SS | X | X | None, no suitable nesting habitat |
| Barn Swallow | *Hirundo rustica* | | X | X | None, no suitable nesting habitat |
| Cliff Swallow | *Petrochelidon pyrrhonota* | | X | X | None, no suitable nesting habitat |

| Common Name | Scientific Name | Sensitivity Status[1] | SWP Site (2012) | RE Crimson Project Area (2016/2017) | Potential to Nest in RE Crimson Permitting Boundary and Adjacent Washes in Microphyll Woodland |
|---|---|---|---|---|---|
| Northern Rough-winged Swallow | *Stelgidopteryx serripennis* | | X | X | None, no suitable nesting habitat |
| Tree Swallow | *Tachycineta bicolor* | | X | X | None, no suitable nesting habitat |
| Violet-green Swallow | *Tachycineta thalassina* | | X | X | None, no suitable nesting habitat |
| ***Remizidae*** | | | | | |
| Verdin | *Auriparus flaviceps* | | X | X | High, nests in microphyll woodland |
| ***Troglodytidae*** | | | | | |
| House Wren | *Troglodytes aedon* | | | X | Low, lack of preferred nesting habitat |
| Bewick's Wren | *Thryomanes bewickii* | | X | | Low, lack of preferred nesting habitat |
| Cactus Wren | *Campylorhynchus brunneicapillus* | | X | X | High, nests in microphyll woodland |
| Canyon Wren | *Catherpes mexicanus* | | X | | Moderate, generally washes are not incised and steep enough for nesting. |
| Rock Wren | *Salpinctes obsoletus* | | | X | Moderate, few large boulder sections where the species may nest |
| ***Polioptilidae*** | | | | | |
| Black-tailed Gnatcatcher | *Polioptila melanura* | | X | X | High, nests in microphyll woodland |
| Blue-gray Gnatcatcher | *Polioptila caerulea* | | X | X | None, no suitable nesting habitat |
| ***Regulidae*** | | | | | |
| Ruby-crowned Kinglet | *Regulus calendula* | | X | | None, no suitable nesting habitat |
| ***Turdidae*** | | | | | |
| Mountain Bluebird | *Sialia currucoides* | | | X | None, no suitable nesting habitat |
| ***Mimidae*** | | | | | |
| Crissal Thrasher | *Toxostoma crissale* | State: SSC<br>NECO: SS | X | | None, no suitable nesting habitat |
| LeConte's Thrasher | *Toxostoma lecontei* | NECO: SS | X | X | High, nests in microphyll woodland |
| Northern Mockingbird | *Mimus polyglottos* | | X | X | High, nests in microphyll woodland |
| Sage Thrasher | *Oreoscoptes montanus* | | X | X | None, no suitable nesting habitat |

| Common Name | Scientific Name | Sensitivity Status[1] | SWP Site (2012) | RE Crimson Project Area (2016/2017) | Potential to Nest in RE Crimson Permitting Boundary and Adjacent Washes in Microphyll Woodland |
|---|---|---|---|---|---|
| ***Bombycillidae*** | | | | | |
| Phainopepla | *Phainopepla nitens* | | X | X | High, nests in microphyll woodland |
| ***Motacillidae*** | | | | | |
| American Pipit | *Anthus rubescens* | | | X | None, no suitable nesting habitat |
| ***Passerellidae*** | | | | | |
| Abert's Towhee | *Pipilo aberti* | | X | | Low, lack of preferred brushy desert habitat |
| Bell’s Sparrow | *Artemisiospiza belli* | | X | X | Moderate, limited suitable habitat |
| Black-Headed Grosbeak | *Pheucticus melanocephalus* | | X | X | None, no suitable nesting habitat |
| Black-throated Sparrow | *Amphispiza bilineata* | | X | X | High, species common within low brush desert habitats |
| Blue Grosbeak | *Passerina caerulea* | | X | X | None, no suitable nesting habitat |
| Brewer's Sparrow | *Spizella breweri* | | X | X | None, no suitable nesting habitat |
| Chipping Sparrow | *Spizella passerina* | | X | X | None, no suitable nesting habitat |
| House Finch | *Carpodacus mexicanus* | | X | X | Moderate, potential to nest in microphyll woodland |
| Lark Sparrow | *Chondestes grammacus* | | X | X | None, no suitable nesting habitat |
| Lazuli Bunting | *Passerina amoena* | | X | X | None, no suitable nesting habitat |
| Lesser Goldfinch | *Spinus psaltria* | | X | | Low, lack of preferred nesting habitat |
| Lincoln’s Sparrow | *Melospiza lincolnii* | | | X | None, no suitable nesting habitat |
| Sagebrush sparrow | *Artemisiospiza nevadensis* | | | X | None, no suitable nesting habitat |
| Savannah Sparrow | *Passerculus sandwichensis* | | X | X | None, no suitable nesting habitat |
| White-crowned Sparrow | *Zonotrichia leucophrys* | | X | X | None, no suitable nesting habitat |
| ***Icteridae*** | | | | | |
| Brewer's Blackbird | *Euphagus cyanocephalus* | | X | X | Low, lack of preferred nesting habitat |

| Common Name | Scientific Name | Sensitivity Status[1] | SWP Site (2012) | RE Crimson Project Area (2016/2017) | Potential to Nest in RE Crimson Permitting Boundary and Adjacent Washes in Microphyll Woodland |
|---|---|---|---|---|---|
| Brown-headed Cowbird | *Molothrus ater* | | X | X | Low, species lays eggs in nests of other species |
| Bullock's Oriole | *Icterus bullockii* | | X | X | None, no suitable nesting habitat |
| Hooded Oriole | *Icterus cucullatus* | | X | X | None, no suitable nesting habitat |
| Scott's Oriole | *Icterus parisorum* | | X | X | Low, lack of preferred nesting habitat |
| Red-winged Blackbird | *Agelaius phoeniceus* | | X | X | None, no suitable nesting habitat |
| Yellow-headed Blackbird | *Xanthocephalus xanthocephalus* | State: SSC (nesting) | X | | None, no suitable nesting habitat |
| Great-tailed Grackle | *Quiscalus mexicanus* | | | X | Low, lack of large trees and dense shrubs preferred for nesting |
| Western Meadowlark | *Sturnella neglecta* | | | X | High, commonly detected species that nests in open desert environments |
| ***Parulidae*** | | | | | |
| Black-throated Gray Warbler | *Setophaga nigrescens* | | X | X | None, no suitable nesting habitat |
| Common Yellowthroat | *Geothlypis trichas* | | X | | None, no suitable nesting habitat |
| Hermit Warbler | *Setophaga occidentalis* | | X | | None, no suitable nesting habitat |
| Lucy's Warbler | *Oreothlypis luciae* | State: SSC<br>BLM: SS | X | | None, no suitable nesting habitat |
| MacGillivray's Warbler | *Geothlypis tolmiei* | | X | X | None, no suitable nesting habitat |
| Nashville Warbler | *Oreothlypis ruficapilla* | | X | | None, no suitable nesting habitat |
| Orange-crowned Warbler | *Oreothlypis celata* | | X | X | None, no suitable nesting habitat |
| Townsend's Warbler | *Setophaga townsendi* | | X | X | None, no suitable nesting habitat |
| Wilson's Warbler | *Cardellina pusilla* | | X | X | None, no suitable nesting habitat |
| Yellow Warbler | *Setophaga petechia* | State: SSC (nesting)<br>NECO: SS | X | X | None, no suitable nesting habitat |

| Common Name | Scientific Name | Sensitivity Status[1] | SWP Site (2012) | RE Crimson Project Area (2016/2017) | Potential to Nest in RE Crimson Permitting Boundary and Adjacent Washes in Microphyll Woodland |
|---|---|---|---|---|---|
| Yellow-rumped Warbler | *Setophaga coronata* | | X | X | None, no suitable nesting habitat |
| ***Cardinalidae*** | | | | | |
| Western Tanager | *Piranga ludoviciana* | | X | X | None, no suitable nesting habitat |

[1] **Federal Designations (Federal Endangered Species Act, USFWS):**
END: federally listed, endangered
THR: federally listed, threatened
FC: federal candidate species
FSC: federal species of concern
FPD: federal proposed for delisting
DL: federal delisted

**Other Designations:**
BLM: Bureau of Land Management sensitive species (SS)
NECO: Northern and Eastern Colorado Desert Coordinated Management Plan: special-status species (SS)
DRECP: Desert Renewable Energy Conservation Plan: focus species (FS); planning species (PS)

**State Designations (California Endangered Species Act, CDFW):**
END: endangered
THR: threatened
CT: candidate threatened
SSC: California species of special concern
FP: fully protected species
CCR: California Code of Regulations

Sensitivity status taken from:

California Department of Fish and Wildlife. 2017. Natural Diversity Database. Special Animals List. Periodic publication. 51 pp. October.

[2] Detected adjacent to, but outside the Project Area. Species could still forage within the Project Area and RE Crimson Permitting Boundary.

# APPENDIX B

# Buffers for Horizontal and Vertical Ground and Helicopter Construction

| Buffers for Horizontal and Vertical Ground and Helicopter Construction[1] | | | | |
|---|---|---|---|---|
| Avian Group (nest type /location) | Species Potentially Nesting within WOD Limits and Survey Area[2] | Minimum Buffers for Ground Construction Per Disturbance Level (feet) | Horizontal Buffer for Helicopter Construction (feet) | Vertical Buffer for Helicopter Construction (feet)[3] |
| Waterfowl and rails | Canada goose, wood duck, mallard, cinnamon teal, ruddy duck, Virginia rail, sora, American coot, pied-billed grebe | 150 | 300 | 150 |
| Quail | California quail, Gambel's quail | 150 | 200 | 150 |
| Herons | Great blue heron, great egret, snowy egret, cattle egret, black-crowned night-heron | 250 | 500 | 300 |
| Birds of prey (category 1) | American kestrel, barn owl, western screech-owl | 300 | 200 | 150 |
| Birds of prey (Category 2) | Osprey, Cooper's hawk, red-tailed hawk (2); some urban/suburban), red-shouldered hawk, great horned owl, burrowing owl[4] | 300 | 300 | 200 |
| Birds of prey (Category 3) | Turkey vulture, red-tailed hawk (2; some rural/ remote), white-tailed kite, northern harrier, long-eared owl | 500 | 500 | 300 |
| | Peregrine falcon, prairie falcon, | Consult CDFW & USFWS | Consult CDFW & USFWS | Consult CDFW & USFWS |
| Eagles | Golden eagle | 1 mile Consult CDFW & USFWS | 1 mile Consult CDFW & USFWS | 1 mile Consult CDFW & USFWS |
| Shorebirds | Killdeer | 200 | 200 | 200 |
| Pigeons | Band-tailed pigeon | 150 | 200 | 200 |
| Doves | Mourning dove, white-winged dove, common ground-dove | 150 | 200 | 150 |
| Roadrunners | Greater roadrunner | 300 | 200 | 150 |
| Nightjars | Lesser nighthawk, common poorwill | 150 | 200 | 150 |
| Swifts | White-throated swift | 200 | 200 | 150 |
| Hummingbirds | Black-chinned hummingbird, Anna's hummingbird, Costa's hummingbird, Allen's hummingbird | 100 | 200 | 150 |

| Buffers for Horizontal and Vertical Ground and Helicopter Construction[1] | | | | |
|---|---|---|---|---|
| Avian Group (nest type /location) | Species Potentially Nesting within WOD Limits and Survey Area[2] | Minimum Buffers for Ground Construction Per Disturbance Level (feet) | Horizontal Buffer for Helicopter Construction (feet) | Vertical Buffer for Helicopter Construction (feet)[3] |
| Woodpeckers | Acorn woodpecker, ladder-backed woodpecker, Nuttall's woodpecker, downy woodpecker, northern flicker | 150 | 200 | 150 |
| Passerines (cavity and crevice nesters) | Say's phoebe, ash-throated flycatcher, brown-crested flycatcher, tree swallow, rock wren, canyon wren, house wren, Bewick's wren (2), mountain chickadee, oak titmouse, western bluebird | 100 | 150 | 100 |
| Passerines (bridge, culvert, and building nesters) | Black phoebe, Say's phoebe, northern rough-winged swallow, cliff swallow, barn swallow, house finch (3) | 100 | 150 | 100 |
| Passerines (ground nesters, open habitats) | Horned lark, rock wren, western meadowlark, orange-crowned warbler, lark sparrow, grasshopper sparrow | 150 | 200 | 150 |
| Passerines (understory and thicket nesters) | Bushtit, Bewick's wren (2), blue-gray gnatcatcher (2), black-throated gray warbler, yellow-breasted chat, spotted towhee, black-chinned sparrow, sage sparrow, song sparrow, black-headed grosbeak, blue grosbeak, lazuli bunting, American goldfinch | 150 | 200 | 150 |
| Passerines (shrub and tree nesters) | Pacific-slope flycatcher, Cassin's kingbird, western kingbird (2), loggerhead shrike (2),* Hutton's vireo, western scrub-jay, American crow, common raven, verdin, bushtit, black-tailed gnatcatcher, blue-gray gnatcatcher (2), cactus wren (2),* American robin, northern mockingbird, Le Conte's thrasher, phainopepla, yellow warbler, black-throated gray warbler, yellow-breasted chat, California towhee, black-throated sparrow, song sparrow, summer tanager, great-tailed grackle, hooded oriole, Bullock's oriole, house finch (3), Lawrence's goldfinch, lesser goldfinch | 150 (300 for species marked with an *) | 200 | 150 |
| Passerines (open scrub nesters) | Loggerhead shrike (2),* verdin, cactus wren (2),* black-tailed gnatcatcher, wren tit, northern mockingbird, California thrasher, Le Conte's thrasher, Phainopepla, orange-crowned warbler, southern rufous-crowned sparrow, California towhee, black-throated sparrow, Brewer's blackbird, lesser goldfinch | 150 (300 for species marked with an *) | 200 | 150 |
| Passerines (tower nesters) | Western kingbird (2), common raven, house finch (3) | 150 | 200 | 150 |
| Passerines (marsh nesters) | Common yellowthroat, red-winged blackbird, tricolored blackbird,* great-tailed grackle | 150 (300 for species marked with an *) | 200 | 150 |

| Buffers for Horizontal and Vertical Ground and Helicopter Construction[1] | | | | |
|---|---|---|---|---|
| Avian Group (nest type /location) | Species Potentially Nesting within WOD Limits and Survey Area[2] | Minimum Buffers for Ground Construction Per Disturbance Level (feet) | Horizontal Buffer for Helicopter Construction (feet) | Vertical Buffer for Helicopter Construction (feet)[3] |
| Species not covered under MBTA. | Domestic waterfowl, including domesticated mallards, feral (rock) pigeon, ring-necked pheasant, chukar, Eurasian collared-dove, spotted dove, parrots, parakeets, European starling, house sparrow | NA | NA | NA |

1. Buffer distances may be modified if appropriate in consultation with the Resource Agencies.
2. For species listed under two or more categories, the number of categories is indicated in parentheses, e.g., "red-tailed hawk (2)."
3. Standard distances applicable only to small helicopters, which typically cause a down draft of 15 to 18 mph at up to 150 feet, operating in nest vicinity for up to 3 minutes once or twice per day, with a minimum of 4 hours between helicopter activities. Larger helicopters or longer work periods will require additional agency review.
4. Burrowing owl buffers will be specified in a separate Burrowing Owl Management Plan.

# I.8 American Badger and Desert Kit Fox Monitoring and Management Plan, December 2018

# FINAL
# RE CRIMSON SOLAR PROJECT
# AMERICAN BADGER AND DESERT KIT FOX MONITORING AND MANAGEMENT PLAN

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December 2018

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**Appendix**

## 1.0 INTRODUCTION

The RE Crimson Solar Project (Project) is located in Riverside County, approximately 13 miles west of Blythe, California. Sonoran West Solar Holdings, LLC (applicant), a wholly owned subsidiary of Recurrent Energy, proposes to construct and operate the Project. The Project is a utility-scale solar photovoltaic (PV) and energy storage project that would be located on federal lands managed by the Bureau of land Management (BLM) within the California Desert Conservation Area and the Desert Renewable Energy Conservation Plan (DRECP) area. The Project will implement an American Badger (AB; *Taxidea taxus*) and Desert Kit Fox (DKF; *Vulpes macrotis*) Monitoring and Management Plan (Plan) to minimize the potential for impacts to these species for the life of the Project.

### 1.1 Purpose of the Plan

This Plan describes the actions to be taken to protect resident American badger or desert kit fox known to occur or that may occur within the Project impact area (hereafter referred to as the RE Crimson Permitting Boundary). Both American badger and desert kit fox are discussed concurrently throughout this Plan and for simplicity are collectively referred to as AB/DKF. This Plan specifies a monitoring and passive relocation approach that, when implemented, will facilitate avoidance and minimization of impacts to these species that are relocated from the RE Crimson Permitting Boundary.

The primary purpose of this Plan is to provide strategies to avoid direct and indirect impacts to AB/DKF as a result of construction, operations and maintenance (O&M), and decommissioning of the Project. The Plan provides strategies to facilitate the protection of AB/DKF. The Plan addresses pre-construction surveys; classification of dens; excavation of inactive dens in the construction area to prevent reuse; monitoring of potentially or active dens; use of passive techniques to exclude AB/DKF from those dens; and protocols for handling sick, injured, or dead AB/DKF. This Plan incorporates several adaptive measures recommended by the California Department of Fish and Wildlife (CDFW) to enhance avoidance and minimize impacts to AB/DKF, and incidentally provide supplemental data to assess the health of these species in the region. The following specific objectives for AB/DKF protection are addressed in this Plan:

1. Pre-construction den surveys for all construction activities, as follows:
    - Establishing the locations of and classifying AB/DKF dens within the RE Crimson Permitting Boundary and within a 500-foot buffer of all Project facilities, utility corridors, and access roads.

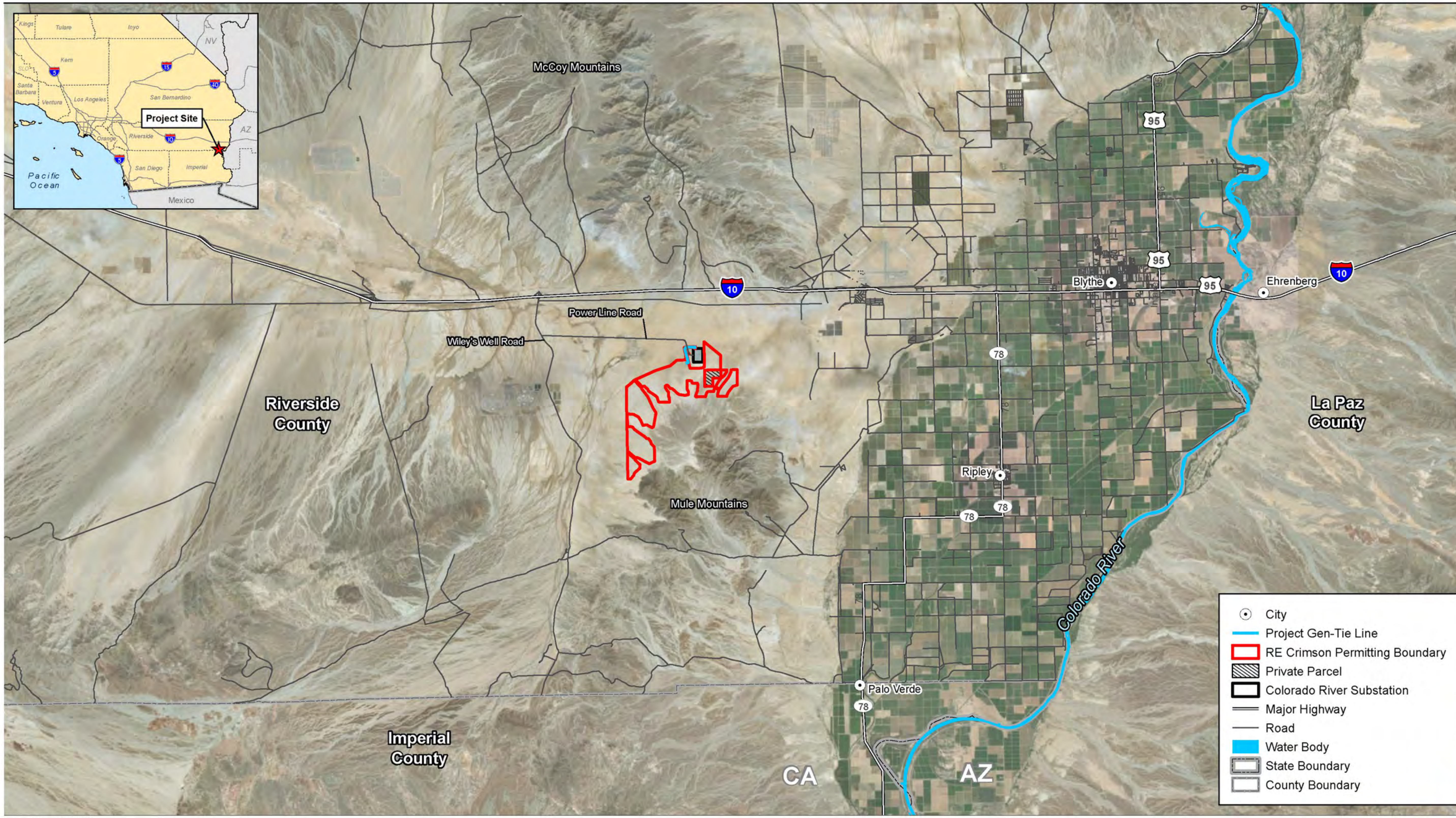
- Establishing an appropriate non-disturbance buffer (where activities will be limited and/or avoided to prevent disturbance) for AB/DKF during the pupping season.
- Monitoring AB/DKF dens occupied or known to be visited by AB/DKF within the RE Crimson Permitting Boundary and buffer (500 feet).
- Defining passive hazing procedures (techniques and implementation) to relocate AB/DKF occupying or visiting identified AB/DKF den complexes in the RE Crimson Permitting Boundary.

2. Protocols for dealing with injured, sick, or dead AB/DKF, as follows:
   - Notification process (date, time, and location of detection, persons involved, and details relating to injury, death, or health issue observed) if an injured, sick, or dead AB/DKF is found in the RE Crimson Permitting Boundary or adjacent 500-foot buffer.
   - Protocols for trapping and transporting injured or sick AB/DKF if found in any area associated with the Project.
   - Protocols for dealing with an AB/DKF that is injured or killed as a result of Project construction, operation, or decommissioning.
3. Best management practices (BMPs) to facilitate continued protection of AB/DKF during construction, operation, and decommissioning.
4. Reporting requirements.

## 1.2 Project Location and Description

The proposed Project is within unincorporated eastern Riverside County, approximately 13 miles west of Blythe, just north of the Mule Mountains and just south of Interstate 10 (I-10) (Figure 1). The Project site consists of approximately 2,489 acres of BLM-administered land within the Riverside East Solar Energy Zone/Development Leasing Area and within the DRECP Development Focus Area (BLM 2015). The Project would interconnect to the regional electrical grid at Southern California Edison's (SCE's) Colorado River Substation (CRS). It would generate up to 350 megawatts (MW) of renewable energy using PV technology and would include up to 350 MW of integrated energy storage capacity.

The total area for the Project (i.e., RE Crimson Permitting Boundary; 2,489 acres) includes a 2,465-acre solar field development area with approximately 1,859 acres of solar modules (array blocks) and 24 acres for linear facilities, including access/perimeter roads assuming a 30-to 60-foot corridor width and gen-tie and powerline corridor at 150 feet. The Project applicant is proposing to construct the Project using traditional construction methods consisting of permanent desert




Source: ESRI; AECOM.

3 1.5 0 3 Miles

1:190,080 1 inch = 3 miles

**Figure 1**
**Regional Map**

RE Crimson Solar Project American Badger and Desert Kit Fox Monitoring and Management Plan

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tortoise (*Gopherus agassizii*) proof exclusion fencing, mow-and-roll of vegetation for site preparation, compacted roads, and trenching for electrical lines. The applicant is also actively investigating alternative low environmental impact design (LEID) elements and the potential for those to reduce Project impacts.

LEID elements include several potential design changes including the following:

- Minimizing grading during site preparation and maintaining more onsite vegetation to facilitate post-construction residual habitat value and post- O&M /site reclamation success.
- To reduce ground disturbance, avoid or limit trenching by placing electrical wiring aboveground.
- To reduce ground disturbance, place transformer/inverter groups on elevated support structures in lieu of cement foundations.

The LEID elements would minimize grading, trenching, and vegetation removal beyond traditional design approaches for PV projects with the objective of reducing overall long-term impacts for the Project. At this time, it has not been decided which, if any, LEID elements may be incorporated into the final Project construction design. Therefore, this Plan assumes a traditional construction approach is taken and that no LEID elements are incorporated. This Plan may need to be modified or amended once the final construction and operations design are determined.

### 1.3 Site Description

The Project site consists of undeveloped land that is owned by the federal government and administered by the BLM. There is a 120.5-acre private parcel in the center of the Project site that currently is not planned for use by the Project, and surveys were not conducted within the private parcel. There are no existing structures within the Project that would need to be demolished, and no existing roads are present within the proposed Project solar development area. Existing SCE transmission lines and a paved access road (Power Line Road) oriented east-west that lead to the CRS are located just north of the Project site. The unpaved portion of Power Line Road then continues from the CRS in a southwesterly direction on the east side of the Project site. I-10 is just over 1 mile north of the northern Project boundary, and the western edge of the Colorado River Valley is approximately 4.5 miles to the east (Figure 1).

The site is located at the northern foot of the Mule Mountains Area of Critical Environmental Concern. The SCE high-voltage transmission line and CRS are directly north of the Project site, and I-10 is north of and parallel to those facilities. Federally designated critical habitat for desert tortoise within the Chuckwalla Critical Habitat Unit and the vast Chuckwalla Desert Wildlife Management Area are west of the Project site (Figure 1).

Regionally, the Project site is situated within the Colorado Desert on gently rolling open terrain dominated by desert scrub vegetation. Desert scrub vegetation (e.g., creosote bush scrub) covers most of the site, except for sparsely vegetated desert dunes and more heavily vegetated desert washes (with microphyll woodlands). The Project site has a gentle slope north and west, away from the base of the Mule Mountains, with elevation ranging from a high of about 710 feet above mean sea level (AMSL) around the base of the Mule Mountains to a low of about 430 feet AMSL near the northwestern corner closest to I-10. Terrain onsite generally slopes down from higher land at the base of the Mule Mountains to the south.

The Project site has experienced some historical disturbance from military training during World War II, including tank and off-road vehicle use. During World War II, the site was part of the General George S. Patton Desert Training Center, officially the California-Arizona Maneuver Area, a simulated theater of operations. More recent disturbance from recreational off-road vehicle users is evident within the Project site, even though there are no BLM-designated routes within the Project site. Most off-road vehicle use was evident within the washes with vehicle tracks leading toward the Mule Mountains.

## 1.4 Project Background

A larger area (7,600 acres) consisting of the RE Crimson Project area and surrounding BLM and private lands was originally proposed for development by BrightSource Energy, Inc., as the Sonoran West Solar Energy Generating Facility (Sonoran West Project [SWP] Site). Biological surveys for the SWP Site were conducted in 2011 and 2012. Biological surveys were conducted again in 2016 and 2017 for a significantly smaller portion of the SWP Site in support of the Project. While no specific AB/DKF surveys were conducted, their burrows, scat, tracks, carcasses, and other sign were recorded incidentally during other biological surveys, as detailed below.

## 1.5 American Badger and Desert Kit Fox Historical Surveys

*2012 Surveys*

In 2012, biologists recorded potential AB/DKF burrows while conducting desert tortoise, burrowing owl (*Athene cunicularia*), and/or other biological surveys. For example, this recording was done while biologists were walking 10-meter-wide transects during desert tortoise surveys.

AB/DKF burrows, tracks, scat, and remains were recorded if identifiable to provide evidence of their presence.

No live ABs were observed within the SWP Site; however, surveyors recorded six potential burrows and the remains of one AB (recorded as sign in Figure 2).

Live DKF, burrows, burrow complexes, and sign (tracks, scat, and carcasses) were observed within the SWP Site (Figure 2). While DKF den complexes were prevalent in the SWP Site (26 active and 27 inactive complexes observed), many den complexes occur within the home ranges of each single female and can be used for birthing or as refuges from coyotes (*Canis latrans*). In addition to the 53 observed complexes (i.e. dens with multiple entrances), an additional 271 single potential DKF burrows were also recorded throughout the SWP Site (32 active and 239 inactive). When comparing all active and inactive complexes and burrows that were located within the SWP Site to the RE Crimson Permitting Boundary, there were eight active DKF burrows, nine active DKF complexes, 72 inactive DKF burrows, and four inactive DKF complexes within the limits of the RE Crimson Permitting Boundary. Since the SWP Site covered a much larger area than the RE Crimson Permitting Boundary, the number of active DKF burrows and complexes is much smaller within the RE Crimson Permitting Boundary. There were no active or inactive AB burrows or dens within the RE Crimson Permitting Boundary.

*2016/2017 Surveys*

During the October 2016 desert tortoise surveys, biologists walked 10-and 20-meter-wide transects across the entire desert tortoise survey area and recorded any potential AB/DKF burrows, or other sign such as tracks and carcasses. In spring 2017, biologists conducting burrowing owl surveys walked 20-meter-wide transects across the entire RE Crimson Permitting Boundary and recorded any AB/DKF burrows or other sign.

Potential burrows, burrow complexes, and other AB/DKF sign were recorded, including two AB skulls, and one live AB was captured on a wildlife camera as it traveled through one of the washes/microphyll woodlands. AB/DKF burrows and other sign are depicted in Figure 2. In 2016/2017, there were seven AB burrows and 25 DKF complexes/burrows within the RE Crimson Permitting Boundary. Many of these burrows and complexes appeared active due to the presence of recent tracks, scat, or claw-marks, but since burrow/complex monitoring was not conducted in 2016/2017, it is not possible to conclusively determine which burrows/complexes were active.

The 2012 and 2016/2017 survey data likely represent some of the same AB/DKF burrows/complexes and illustrate that both species are present within the RE Crimson Permitting Boundary. All burrows/complexes within the RE Crimson Permitting Boundary are considered potential burrows/complexes since their level of activity may change throughout the year, and from year to year.

## 1.6 Historical Canine Distemper Virus

Historically, starting in October 2011, CDFW confirmed the presence of canine distemper virus (CDV) mortalities in DKF populations on the north side of I-10 during construction of the Genesis Solar Energy Project (Appendix A). CDV is transmitted by contact with body fluids containing the virus, and can be transmitted by and affect many carnivore species, including AB, DKF, and coyotes (all of which are present in the Project area). The virus is killed by direct sunlight, heat, drying, and cleaning with a 10% bleach solution. While signs or evidence of CDV have not been detected in any AB/DKF observed within the RE Crimson Permitting Boundary, since the disease has been well documented on the north side of I-10 north of Wiley's Well Road Rest Area around the Genesis Solar Energy Project (approximately 11 miles northwest of the RE Crimson Permitting Boundary), there is still a potential for the disease to persist in the surrounding AB/DKF populations. The majority of the CDV outbreak at the Genesis Solar Energy Project lasted from fall 2011 through summer 2012, which overlaps with the time period that the SWP Site was being surveyed (2011–2012).No dead DKF were detected; however, the remains of one dead AB was observed but cause of death could not be confidently determined Therefore, the potential for CDV still exists and precautions will be implemented to reduce the potential for the disease to spread during pre-construction clearance surveys.

# 2.0 ROLES AND RESPONSIBILITIES

Implementation of this Plan will be overseen by a qualified biologist(s) that has relevant and sufficient experience with the species.

Minimum qualifications for a qualified biologist include:

- A university degree in wildlife biology or a related science;
- Prior and extensive field experience (at least one year of field experience in the deserts of the Southwestern U.S.) in AB/DKF survey techniques (den surveys, wildlife camera and scent stations, and spotlighting);
- Experience excavating AB/DKF dens and burrow complexes and biological compliance monitoring experience.

The Resource Agencies for this plan are defined as both CDFW and BLM who have jurisdictional oversight for AB/DKF. A qualified biologist will be responsible for verifying compliance with and implementation of this Plan and will coordinate with the Project compliance lead to verify that the Project proponent and Resource Agencies are apprised of all necessary activities on the Project. Multiple biological monitors (BMs) may assist with implementation of biological surveys and monitoring under the direction of a qualified biologist.

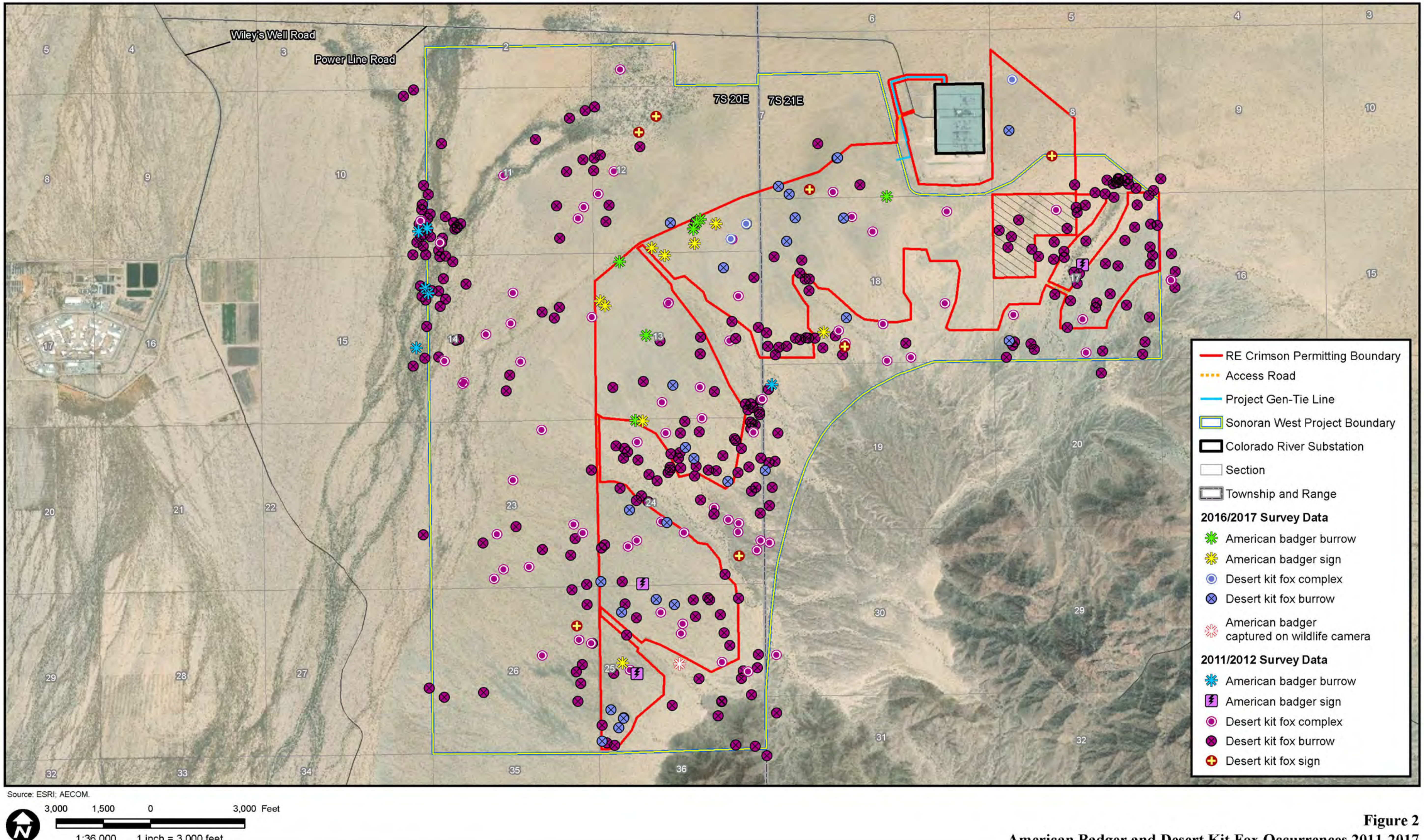


**Figure 2**
**American Badger and Desert Kit Fox Occurrences 2011-2017**

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## 3.0 SURVEY, MONITORING, AND RELOCATION METHODS

This section discusses the specific procedures and methods to be used to achieve the purposes and objectives of this Plan, including pre-construction detection surveys, den monitoring, passive relocation protocols, and RE Crimson Permitting Boundary exclusion fencing.

For the purpose of this Plan, since DKF use multi-entrance burrow complexes, a den may include multi-entrance burrow complexes. The term den will be used in this Plan to include all types of burrows that may be used by AB/DKF for any purpose within their life cycle, including multi-entrance burrow complexes.

### 3.1 Pre-Construction Survey Protocol

Pre-construction surveys serve two primary purposes:

1. Determine the number of AB/DKF dens, identify and classify the dens and determine where construction exclusion buffers and passive monitoring equipment will be installed. Den monitoring is discussed in Section 3.2.
2. Identify AB/DKF dens that will need to be passively relocated or excluded. Passive relocation of AB/DKF is discussed in Section 3.3.

Pre-construction surveys for AB/DKF can be conducted independently of other project surveys within the RE Crimson Permitting Boundary and 500-foot buffer of all Project facilities, utility corridors, and access roads; however, surveys may also be conducted concurrently with desert tortoise or burrowing owl surveys if timing is suitable. Initial surveys will be conducted no more than 60 days prior to the start of construction activities in order to identify potentially active burrows ahead of time, should they need to be monitored with wildlife cameras; however, if done concurrently with burrowing owl surveys, then no less than 14 days prior to ground disturbance. Pre-construction surveys will be conducted to provide enough time to determine den status and allow for passive relocation of active dens outside of the pupping season. Dens will be classified as inactive, potentially active, or active. These surveys will be directed by a qualified biologist and supported by BMs. Specific requirements of this survey stipulate that walking transects will be spaced to allow 100% visual coverage of the ground surface; that the distance between transect center lines will be no more than 20 meters; and that transect size will be reduced to account for differences in terrain, vegetation density, and ground surface visibility. Pre-construction surveys for AB/DKF will be conducted by walking through all habitat within the RE Crimson Permitting Boundary and a 500-foot buffer around the RE Crimson Permitting Boundary. The 500-foot survey buffer is included to account for adjacent dens outside of the RE

Crimson Permitting Boundary that may be affected by factors such as noise and vibration due to heavy equipment, which may impact AB/DKF outside the RE Crimson Permitting Boundary.

Any potential AB/DKF dens within the RE Crimson Permitting Boundary will be monitored (through tracking methods and/or wildlife cameras) to determine if they are active. All potential AB/DKF dens within the RE Crimson Permitting Boundary that would be impacted by construction would eventually need to be excavated and filled in for construction to progress. Passive relocation of AB/DKF cannot occur while young are in a den and still dependent upon their parents. AB and DKF have slightly different pupping seasons (generally March through August for AB and January 15 through July 1 for DKF) which may vary depending upon environmental conditions; however, the majority of the pupping season overlaps between both species. Disturbance to active dens must be avoided (from March through August for AB and January 15 through July 1 for DKF) and a 500-foot non-disturbance buffer will be placed around every active den during that period. Depending on the location of the den, a 500-foot buffer of intact vegetation may need to be maintained all the way up to the fence line to allow cover for AB/DKF to get on and off the site before they can be passively relocated. The 500-foot buffer can be reduced by a qualified biologist with concurrence from the Resource Agencies, if it is determined that activities in the area will not cause disturbance and potential den abandonment. Once den monitoring confirms that AB/DKF are no longer using a den (as determined by 3 consecutive nights with no AB/DKF using the den), it can be excavated and backfilled before site grading in that area commences. It may be necessary to conduct additional den monitoring surveys to verify that dens are not re-occupied by AB/DKF following the excavation of a previously occupied den.

### 3.1.1 Supplemental Clearance Surveys

Supplemental surveys may be triggered by a lapse in construction activities (greater than 30 days) and will be conducted by walking transects within areas with intact vegetation using the protocol described above. Surveys may also be necessary within the 500-foot buffer to verify that no new AB/DKF are present (which would require establishment of non-disturbance buffers).

### 3.1.2 Den Classification

If an AB/DKF den is detected within the RE Crimson Permitting Boundary and would be directly impacted by construction, it must be classified as inactive, potentially active, or active to determine the correct course of action.

*Inactive*

A den can only be classified as inactive when the end of the den can clearly be seen, no side tunnels are present, and the den is completely or mostly silted in. Generally, this type of inactive den has no recent sign, no tracks, is extremely weathered, may have vegetation growing in the entrance, or represents an old dig location (where an AB/DKF was trying to dig out a prey item).

*Potentially Active*

To determine whether a den is potentially active or active, an investigation should start by searching each entrance (if there are multiple entrances in the vicinity) for recent sign of AB/DKF presence and by placing a camera facing the entrances to determine presence. Sign of AB/DKF presence includes tracks, scat, prey remains, recent excavation, claw marks, and AB/DKF remains. If any of these are present, the den may potentially be active and further investigation is needed.

*Active*

Any den that is confirmed to have AB/DKF present by conclusive footprints and/or camera photos of AB/DKF going into and out of the den is considered active. In addition to inactive, potentially active, and active classifications, active dens will also be classified as natal or non-natal. A natal den is any den used by AB/DKF to whelp and/or rear their pups. Natal dens may be larger with more numerous entrances than dens occupied exclusively by adults, but can also have one or two entrances. These dens typically have more AB/DKF tracks, scat, and prey remains in the vicinity of the den, and may have a broader apron of matted dirt and/or vegetation at one or more entrances. Natal dens are discussed further in Section 3.2 below.

## 3.2 Den Monitoring

AB/DKF dens in the RE Crimson Permitting Boundary or within the gen-tie line corridor identified as potentially active or active will be monitored for 3 consecutive nights using a combination of two methods to determine the status of each den. These two methods may be used in synchrony, or separately depending upon the situation and as determined most appropriate by a qualified biologist.

*Tracking Material*

The first method is to use a tracking material (e.g., diatomaceous earth, clay, or sifted nearby soil) placed around each den entrance to record the footprints of AB/DKF moving into or out of each entrance. Each den entrance will have the apron to the den smoothed out with a handheld broom (rocks, sticks, etc., will be removed) and then a fine material will be sifted over the apron to form a thin layer of soft substrate that is easily depressed when touched. The tracking material should be spread widely enough so that an AB/DKF would have to step on the material when entering/exiting the den. The tracking material will be spread with a disinfected sifter around all entrances associated with the den. The broom and sifter will be disinfected when moving between dens by showering them with a spray bottle of 10% bleach following the guidelines outlined in Appendix B. The sifter will be allowed to dry to prevent clumping in the tracking media. During subsequent monitoring visits to a den (after tracking information is collected), the same sifting procedures will be used to prepare all den entrances for the next monitoring period. If sifting becomes a problem due to windy weather conditions, infrared motion sensor wildlife cameras may be put in place to determine if a den is being used. Should this alternative method be employed following agency approval, wildlife camera methods and protocols are described in greater detail in the section below..

*Wildlife Cameras*

A second method for den monitoring is the use of infrared motion sensor wildlife cameras (hereafter "camera"). At least one camera will be placed within the nighttime range of every den entrance. For complex dens with multiple entrances, a ring of several cameras may be necessary to determine the status of each den entrance. Cameras must be installed, checked, and monitored to ensure that they are adequately sampling the intended viewshed and that no wildlife can slip past the cameras undetected. Therefore, it is important to know the trigger speed, time between photos, maximum range both in terms of width and depth of camera viewshed, memory card size, battery life, etc. Knowing the limitations of the camera(s) will allow biologists to adequately cover every den entrance. Biologists should position the cameras to capture the largest viewshed possible; secure them adequately to a fence post, stake, etc. so that they will not move during high wind events; and ensure the cameras are working correctly (it may be necessary to remove some vegetation [tall grass blades, tumble weeds, small sticks, etc.] in front of the camera to prevent false triggers and to confirm that the camera is angled correctly). The biologist will ensure there is sufficient power remaining in the batteries and sufficient space remaining on the memory card for the camera to operate until the next visit. They will turn on/arm the camera(s) and leave the area. They will check each camera the following morning or several days later, and reposition the cameras as necessary. All wildlife camera equipment will be disinfected prior to moving it to a new location following the guidance in Appendix B.

The two methods, when used together, can provide a greater level of understanding of AB/DKF activity at a den then a single method. Sometimes use of tracking material is more accurate in capturing AB/DKF tracks, particularly if the cameras have a slow trigger speed. Occasionally an AB/DKF is able to slip past a camera undetected if the camera is not angled correctly, runs low on batteries, or has a slow trigger speed and is placed too close to a den to take a photograph before an animal enters or exits the den. Alternatively, cameras are particularly useful at determining the number and approximate age of AB/DKF using a den. They are also able to provide a visual health assessment (are the AB/DKF observed scratching, do they look mangy or skinny, etc.), document AB/DKF prey items, and provide other useful information regarding the status and occupancy of a den. Cameras can help ascertain whether AB/DKF in photos are actively using a den (such as carrying prey items into the den), or are just visiting dens within their home range. If, after 3 consecutive nights, no AB/DKF sign (tracks, scat, or prey remains) are found at the den entrance, or no photos of the target species using the den are observed, the den may be excavated and backfilled by hand, as discussed in Section 3.3.

*Natal/Non-Natal Dens*

If AB/DKF sign is detected during the 3-day monitoring period (tracks on the tracking material and/or conclusive photographs), the den would be considered active and the den will be avoided during the pupping season (or until the pups are independent). If possible, active dens should be further classified as non-natal or natal dens (pups are present and dependent on the den group for forage, cover, etc.) to determine the appropriate next steps. As mentioned previously, the pupping season for DKF is typically January 15 through July 1 and typically March through August for AB. The general term “pupping season” is used throughout the document with slightly different time frames depending upon the species.

Potential natal dens are to be monitored as long as necessary using cameras and/or tracking material in order to determine whether pups are present, quantify the number of pups, and determine if they are dependent upon parents. If the den is determined to be natal, a 500-foot non-disturbance buffer zone will be established surrounding the natal den and depending on the location of the den within the RE Crimson Permitting Boundary, a 500-foot vegetation buffer may be left from the den up to the fence to allow the animal cover to leave the site to forage. The den will be monitored by cameras (at an appropriate frequency determined by a qualified biologist to not cause unnecessary harassment or stress) until it has been determined that the young have dispersed and are fully independent and no longer reliant upon their natal den. No construction or equipment use will occur within the 500-foot non-disturbance buffer area around the den, and natal dens will not be excavated until it is safe to do so without harm to AB/DKF. The final buffer distance around an active den will be determined in consultation with the Resource Agencies and will likely depend on the location of the den in relation to proposed construction activities.

Once pups have dispersed and dens within the RE Crimson Permitting Boundary are deemed inactive, they will be excavated and then backfilled under the direction of a qualified biologist, and the area will be approved for future construction impacts. If the pups have dispersed and the adults remain at the den, the den may be treated as a non-natal den and passive relocation may occur followed by excavation of the den as described below.

If a den within the RE Crimson Permitting Boundary is determined to be active but non-natal outside of the pupping season, passive hazing techniques may be used to discourage AB/DKF from using the den, as discussed in Section 3.3, below. If an active non-natal den is detected outside of the RE Crimson Permitting Boundary (i.e., in the survey buffer), a minimum 100-foot non-disturbance buffer will be established and the den will be left alone. Should construction access be necessary within the occupied buffer area outside of the RE Crimson Permitting Boundary, additional consultation with the Resource Agencies will be required. The final non-disturbance buffer distance and/or activity limitations will be determined in consultation with the Resource Agencies.

### 3.3 Passive Relocation and Burrow Excavation

AB/DKF must be excluded from all dens within the RE Crimson Permitting Boundary that will be subject to construction. Inactive dens that are within the RE Crimson Permitting Boundary, and will be impacted by construction, will be excavated by hand to verify no AB/DKF are present and then backfilled to prevent reuse by AB/DKF. Inactive dens will be excavated and collapsed prior to implementing hazing or passive exclusion to remove potential dens that AB/DKF could re-excavate within the RE Crimson Permitting Boundary. Prior to den excavation, a qualified biologist will determine that the den is not being used by any other species such as burrowing owls or desert tortoise. If there is a den that is being used by a burrowing owl, refer to the Burrowing Owl Management Plan for the correct course of action (AECOM 2018). If there is a den that may contain a desert tortoise, refer to the Desert Tortoise Translocation/Relocation Plan for the appropriate course of action. It is important that a potential AB/DKF den is not mistaken for a burrow being used by a desert tortoise (since a plugged desert tortoise burrow may look like an inactive burrow). If the inactive den is determined to not be occupied by any species, then the following method for excavating and collapsing the den will be followed:

1. Using a fiber-optic scope camera, the entire den will be inspected to ensure that no AB/DKF (or other species) are present.
2. Upon confirmation that the den is unoccupied, each entrance will be slowly excavated by hand using hand tools. This excavation will start at the opening of the least used den entrance (or the entrance that is most deteriorated/partially filled in) and will continue until excavation reaches the den chamber. At the discretion of a qualified biologist, appropriate-diameter flexible, corrugated drainage pipe will be held at the opening of the

den being excavated to allow AB/DKF to escape. All other entrances to the den will be excavated using the same procedure. When all entrances to the den are excavated, the sidewalls will be collapsed into the excavated den and the entire den will be refilled with the excavated material to prevent reoccupation by AB/DKF and other species.

3. BMs will periodically visit the den after the den is excavated and collapsed until ground disturbance commences in the immediate area to verify that AB/DKF do not re-excavate burrows and reoccupy the den. This may include the placement of cameras to determine nighttime activity in an area, as AB/DKF may return to collapsed den to re-excavate them.

*Hazing*

If AB/DKF tracks are observed on the tracking material or AB/DKF are captured in camera photos then various hazing techniques may be implemented to deter AB/DKF from using the den, prior to passive relocation and burrow excavation. Hazing is used most effectively if potential dens already occur offsite and, if not, artificial dens may be installed to attract AB/DKF to offsite habitat before hazing. Hazing can only be used during the non-pupping season, unless the Resource Agencies concur otherwise based on specific circumstances. If an active den is present in the RE Crimson Permitting Boundary during the pupping season and construction is slated to occur within the area during the pupping season, a qualified biologist and Project compliance lead will consult with the Resource Agencies on a den-by-den basis to determine the course of action. Hazing options to deter AB/DKF from an area may include the following:

- application of citronella-based deterrents at the den entrance;
- installation of electronic noise-based deterrents at the den;
- placement of objects, leaves, mulch, or soil in den entrances;
- placement of items with strong human scent at den entrances,
- placement of commercially available non-toxic and biodegradable dog repellents such as "Scoot" or "Get off My Garden" at den entrances (Foxolutions 2018, Stoppestinfo 2018); and/or
- placement of battery-operated motion-sensitive alarms at den entrances (provided there are no nearby nesting birds).

Hazing of AB/DKF at active dens outside of the pupping season is meant to encourage AB/DKF to vacate the den on their own and prevent the need for passive relocation. The placement of objects such as vegetative material, soil, stones, etc. used to make the den entrance harder and harder to access should be done incrementally greater each day over a 3-day period. After a qualified biologist determines that AB/DKF have stopped using active dens within the RE

Crimson Project Boundary, the dens will be hand-excavated with a shovel and then back-filled to prevent reuse during construction.

Coyote urine will not be used to haze AB/DKF, as it can attract coyotes to the den and lead to unnecessary predation on AB/DKF. Hazing and relocation techniques will not be implemented if there are known CDV cases in the Project area (if sick or dead AB/DKF with confirmed CDV are detected in the area); therefore, if a den is identified where passive relocation is warranted, a qualified biologist and Project compliance lead will consult with CDFW on the status of CDV in the Project area prior to implementation of having or other passive relocation techniques (Appendix B).

*Passive Relocation*

When a den is determined to be non-natal, and the AB/DKF must be relocated prior to construction in the area, the preferred method for passively relocating or excluding AB/DKF from a den is described below. Passive relocation using one-way doors is a last option after hazing techniques have not worked. Hazing is always the preferred method as it allows AB/DKF time to find/dig alternative dens outside of the construction area prior to forced eviction, where they are susceptible to predation and prolonged exposure. Additional methods may be employed, as appropriate, for the specific situation, pending approval from the Resource Agencies. Passive relocation (outside of the pupping season unless otherwise authorized by the Resource Agencies) may include the following methods:

1. Install one-way doors in all suitably sized den entrances. This may involve the use of large PVC pipe sections with a clear Plexiglas door hinged at the top to allow AB/DKF to exit the den, but prevent them from re-entry.
2. Install one-way doors during the afternoon and while the AB/DKF are inactive and deep within the den. If any AB/DKF leave the den in response to one-way door installation, door installation will cease until after the AB/DKF have voluntarily left the vicinity of the den.
3. After one-way doors are installed, monitor the den with tracking material and/or cameras for 3 days to determine whether AB/DKF have left the den.
4. On the third day following one-way door installation, using a fiber-optic scope camera, all den entrances will be inspected to ensure that AB/DKF no longer occupy the den.
5. Upon confirmation that the den is unoccupied, excavate each entrance slowly using hand tools. This excavation will start at the opening of the least used den entrance and will continue until excavation reaches the den chamber. At the discretion of qualified

biologist, appropriate-diameter flexible, corrugated drainage pipe will be held at the opening of the den being excavated to allow AB/DKF to escape. All other entrances to the den, least to most used (as observed by wildlife cameras), will be excavated using the same procedure. When all entrances to the den are excavated, the sidewalls will be collapsed into the excavated den and the entire den will be refilled with the excavated material to prevent reoccupation by AB/DKF.

6. Periodically visit the den after the passive relocation effort is complete until ground disturbance commences in the immediate area to verify that AB/DKF do not re-excavate burrows and reoccupy the den. This may include the placement of cameras to determine nighttime activity in an area, as AB/DKF may return to collapsed den to re-excavate them.

When a den is determined to be natal, passive relocation will not be conducted until it is proven that the pups are functioning independently and are no long reliant on the den. The status of natal dens will continue to be monitored weekly, no construction or equipment use will occur within the 500-foot non-disturbance buffer area around the den or intact vegetation buffer strip, and natal dens will not be excavated. Once pups are no longer reliant on a natal den (that is they are no longer being fed by their parents at the den location, and have been observed on the wildlife cameras no longer using the den on a daily/nightly basis), it may be reclassified as a non-natal den. The Resource Agencies will be consulted prior to hazing or passive relocation at a non-natal den that was formally designated as natal. However, a general recommendation for non-natal dens with grown pups that are behaving independently but will not disperse even after implementing hazing/passive relocation techniques, is to systematically excavate vacant dens. Prior to excavating a non-natal den under these circumstances, artificial dens should be placed offsite with approval from BLM (at least 14 days ahead of time to acclimate) if potentially suitable and unoccupied dens are not already present outside the RE Crimson Permitting Boundary. A qualified biologist and BM(s) will begin visually observing the den around sunset to watch for DKF leaving the den. Daytime temperatures must be 95 degrees Fahrenheit or cooler. Individual dens will be manually excavated in the evening when DKF are most likely out foraging, and use of an underground fiber-optic scope camera will be used if possible.

If AB/DKF are present and passive relocation techniques fail, the Resource Agencies will be contacted to explore other relocation options. A qualified biologist should also verify that there are suitable dens located outside of the RE Crimson Permitting Boundary for AB/DKF to utilize. If no suitable dens are located within an approximate 2,300-foot radius from the active den (including areas outside of the RE Crimson Permitting Boundary), creation of artificial dens may assist in facilitating passive relocation efforts and should be considered as a possible relocation option. If used, artificial dens should be installed at least 14 days prior to passive relocation to allow time for acclimation.

### 3.4 RE Crimson Permitting Boundary Exclusion Fencing

Under the traditional construction approach, the perimeter fencing around the RE Crimson Permitting Boundary will consist of a 6-foot-high security chain-link fence that includes a desert tortoise exclusion fence installed at least 18 inches high and buried to a depth of 12 inches. The desert tortoise exclusion fence should be installed around the entire RE Crimson Permitting Boundary while hazing or passive relocation of AB/DKF is in process. If possible, the desert tortoise clearance survey should be completed or be in process while AB/DKF relocation is occurring. The permanent security fence should not fully encompass the RE Crimson Permitting Boundary until all AB/DKF dens have been closed from within the RE Crimson Permitting Boundary. The permanent security fence will help deter AB/DKF from entering the RE Crimson Permitting Boundary. If a natal den is found within the permanent security fence boundary then an opening (above the height of the desert tortoise exclusion fence) will be created in the permanent security fence to allow AB/DKF to leave and return to the site. If necessary, small steps may be placed on the inside of the permanent desert tortoise exclusion fence to allow young AB/DKF to exit the site. This opening will not affect the integrity of the permanent desert tortoise exclusion fence. Once the pups are independent and AB/DKF are passively relocated, the den will be excavated and collapsed and any openings in the permanent security fence will be closed. Once installed, if the permanent security fence is not sufficient to exclude AB/DKF, additional measures may be required to exclude AB/DKF from the RE Crimson Permitting Boundary, if determined necessary.

AB/DKF have deep burrows, therefore even with permanent fencing in place, there is the possibility that AB/DKF could dig under the fence to access the Project site. The fence lines will be checked for tracks and/or digs during fence monitoring activities to assist in assessing fence crossing activity (i.e., ingress/egress by AB/DKF). The desert tortoise exclusion fencing (temporary and/or permanent) should be inspected at least once a month and within 24 hours following major rainfall events. Any potential AB/DKF burrows that may extend below the desert tortoise exclusion fencing would be detected during these fence inspections. If AB/DKF are found within active construction areas inside of the RE Crimson Permitting Boundary after completion of the permanent security fence, activities in that area will stop until the animal has left the construction area. It is possible that AB/DKF may choose to remain onsite generally unaffected by construction activities in which case they will be monitored by biologists onsite; however, access gates may be elevated during or after construction to allow ingress/egress of AB/DKF while preventing passage of desert tortoise with the use of desert tortoise grates.

Additional coordination with the Resource Agencies will likely be necessary to develop standard operating procedures for ways to handle natal and non-natal dens within the RE Crimson Permitting Boundary during O&M.

## 4.0 DISPOSITION OF SICK, INJURED, OR DEAD ANIMALS

The Project compliance lead and Resource Agencies will be notified by a qualified biologist within 24 hours if an injured, sick, or dead AB/DKF is found anywhere within the RE Crimson Permitting Boundary (including linear facilities) or along Power Line Road. Written follow-up notification via fax or electronic communication will be submitted to the Resource Agencies within 24 hours of the incident. Additional actions are summarized below based on the type of incident.

### 4.1 Injured Animals

If an AB/DKF is injured because of any Project-related activities, a qualified biologist will notify the Project compliance lead and BLM, and contact CDFW personnel for immediate capture and transport of the animal to a CDFW-approved wildlife rehabilitation and/or veterinarian clinic. CDFW, in consultation with BLM, will determine the final disposition of the injured animal, if it recovers. Written notification of the incident will contain, at a minimum, the date, time, location (as specific as possible, including approximate global positioning system [GPS] coordinates [estimate with Google Earth if necessary]), circumstances of the incident, and outcome, if known.

### 4.2 Sick Animals

If an AB/DKF is found sick and incapacitated on any area associated with the Project or linear facilities, a qualified biologist will notify the Project compliance lead and BLM, and contact CDFW personnel for guidance, which may include immediate capture and transport of the animal to a CDFW-approved wildlife rehabilitation and/or veterinarian clinic[1] (CDFW 2018). CDFW, in consultation with BLM, will determine the final disposition of the sick animal, if it recovers. If the AB/DKF recovers and is approved to be released back into the wild, it will be taken to the location where it was captured (or closest location outside the RE Crimson Permitting Boundary) and released back into the desert. If the animal dies, a necropsy will be performed by a CDFW-approved facility per section 4.3 below to determine the cause of death.

1 The Living Desert Zoo has a veterinarian and staff experienced in wild animal care, a quarantine facility, and is a licensed wildlife rehabilitation facility by CDFW (47900 Portola Ave, Palm Desert, CA 92260; Phone: (760) 346-5694). The project may also coordinate with CDFW veterinarian, Deana Clifford: dclifford@dfg.ca.gov, 916-616-0809.

Results will be provided to both RE Crimson and CDFW with a copy to a qualified biologist, Project compliance lead, and BLM. Written notification of the incident will contain, at a minimum, the date, time, location (with GPS coordinates), circumstances of the incident, and outcome.

### 4.3 Fatalities

If an AB/DKF is killed because of any Project-related activities during construction, O&M, or decommissioning (including roadkill), or is found dead on the Project site or along associated linear facilities, a qualified biologist will collect and immediately refrigerate the carcass (dry ice will not be used) and notify the Project compliance lead, BLM, and CDFW. CDFW will be notified within 8 hours of the discovery to provide further instructions on the handling of the animal. The full details of how to deal with fatalities are specified in Appendix B. During O&M of the Project, the Project compliance lead will collect the carcass and notify the Resource Agencies as described above. A necropsy will be performed by a CDFW-approved facility to determine the cause of death. Once the full necropsy report is received, CDFW will send a summarized report (including cause of death, significant findings, and relevance to Project activities) to a qualified biologist, Project compliance lead, and BLM.

The purpose of the necropsy effort associated with AB/DKF, or other wild carnivores, is to determine the cause of death or illness. Not only does a thorough necropsy assist with efforts to monitor the impacts of CDV in AB/DKF and other wild carnivore populations, it will substantially reduce the probability of incorrectly assigning the cause of death. If the number of CDV cases increases or the geographic area spreads, management options to reduce potentially significant impacts to AB/DKF will be determined by CDFW.

## 5.0 GENERAL BEST MANAGEMENT PRACTICES

In addition to the specific AB/DKF protocols defined above, the Project will implement general best management practices (BMPs) to avoid and minimize impacts to these species. The BMPs summarized below will be verified by a qualified biologist or BM during site monitoring activities.

1. Spoils, trash, or any debris shall be collected and removed offsite to an approved disposal facility. A trash abatement program shall be established. Trash and food items shall be contained in closed containers, prevented from overflowing, and removed as necessary to reduce the attractiveness to opportunistic predators such as common ravens (*Corvus corax*), coyotes, DKF, and other predators that may prey on sensitive species.

2. Workers shall be prohibited from bringing pets and firearms to the site.

3. Wildlife pitfalls shall be avoided:

    a. At the end of each workday, a qualified biologist or BM shall ensure that all potential wildlife pitfalls (trenches, bores, and other excavations) outside the area fenced with desert tortoise exclusion fencing have been backfilled (such as along the gen-tie line). If backfilling is not feasible, all trenches, bores, and other excavations shall be sloped at a 3:1 ratio at the ends to provide wildlife escape ramps, or covered completely to prevent wildlife access. All trenches, bores, and other excavations outside the areas permanently fenced with desert tortoise exclusion fencing will also be inspected periodically throughout the day, by a qualified biologist, or a BM. Should wildlife become trapped, a qualified biologist, or BM shall remove and relocate the individual out of harm's way (outside of the desert tortoise exclusion fence). Any wildlife encountered during the course of construction shall be allowed to leave the construction area.

4. Minimize standing water. Water applied to dirt roads and construction areas (trenches or spoil piles) for dust abatement shall use the minimal amount needed to meet safety and air quality standards in an effort to prevent the formation of puddles, which could attract wildlife to construction sites. A BM shall patrol these areas to ensure water does not puddle and shall take appropriate action (e.g., coordinating with the contractor to remedy the situation.

5. If construction activities occur at night, all Project lighting (e.g., staging areas, equipment storage sites, roadway) shall be directed onto the roadway or construction site and away from sensitive habitat. Light glare shields shall also be used to reduce the extent of illumination into adjoining areas.

6. BMPs shall be employed to prevent loss of habitat due to erosion caused by Project-related impacts (i.e., grading or clearing for new roads). The Project inspector shall periodically monitor the work area to ensure that construction-related activities do not generate erosion or excessive amounts of fugitive dust. All detected erosion shall be remedied within 2 days of discovery.

7. Wildfires shall be prevented by exercising care when driving and by not parking vehicles where catalytic converters could ignite dry vegetation. In times of high fire hazard (e.g., drought conditions and/or high wind), trucks will carry water and shovels or fire extinguishers in the field, or high fire risk installations (e.g., electric lines) may need to be delayed. The use of shields, protective mats, or other fire prevention equipment shall be used during grinding and welding to prevent or minimize the

potential for fire. No smoking or disposal of cigarette butts shall take place within vegetated areas.

8. The Project proponent shall develop a Worker Environmental Awareness Training (WEAP) to be approved by BLM. The WEAP shall contain information on all special-status species and vegetation communities, and associated protection measures. The WEAP shall be administered to all Project personnel and shall include documentation of training with training acknowledgements signed by each worker. The WEAP shall be implemented during site pre-construction, construction, operation, and decommissioning. The WEAP will be administered by a qualified biologist or by media acceptable to a qualified biologist and approved by the Resource Agencies.

9. To minimize the likelihood for vehicle strikes of wildlife species, a speed limit of 25 miles per hour shall be established for travel along Power Line Road, and a speed limit of 15 miles per hour shall be adhered to for travel within the RE Crimson Permitting Boundary.

## 6.0 OPERATIONS AND MAINTENANCE

Monitoring and relocation activities during the non-pupping season may apply during O&M if an active AB/DKF burrow is found within the RE Crimson Permitting Boundary in an area that may inhibit operations. If an AB/DKF is found within the Project area during O&M, the Project compliance lead will be contacted to assess the situation and determine what further action is warranted. This is particularly important if LEID elements are incorporated. The Project compliance lead and Resource Agencies may need to develop protocols for dealing with dens (including natal and non-natal) within the RE Crimson Permitting Boundary if the potential for impact to DKF/AB is identified during O&M.

## 7.0 DECOMMISSIONING

Decommissioning will involve many similar activities to construction, with similar potential dangers to AB/DKF that may have taken up residence within the Project during O&M. Depending on the extent, if any of the LEID elements are incorporated into the Project construction and operation design, there may already be AB/DKF using the Project on a regular basis. The approach to protecting AB/DKF during decommissioning will be similar to the methods outlined in this Plan; however, the Plan will likely require updating that is coordinated among RE Crimson and the Resource Agencies prior to decommissioning to remain relevant.

## 8.0 REPORTING

Individual reporting requirements are required for specific incidents or circumstances, as summarized in the sections above. Relevant information will be included in specific reports at intervals as required by the Resource Agencies, which include summary reports, monthly compliance reports, and Annual Compliance Reports, as summarized below:

1. Monthly reports will be submitted to BLM and CDFW for the duration of construction on the status of any dens in the RE Crimson Permitting Boundary and implementation of AB/DKF impact avoidance and minimization measures.
2. A report will be submitted to BLM and CDFW within 30 days of completion of AB/DKF pre-construction and any supplemental clearance surveys. At a minimum, the report will describe survey methods, results, impact avoidance and minimization measures implemented, and the results of those measures.
3. Each Annual Compliance Report provided to BLM and CDFW will describe the results of implementation of AB/DKF avoidance and minimization measures for that year.

## 9.0 REFERENCES CITED

AECOM. 2018. Final RE Crimson Solar Project Burrowing Owl Management Plan. August.

Bureau of Land Management (BLM). 2015. Desert Renewable Energy Conservation Plan Proposed Land Use Plan Amendment and Final Environmental Impact Statement. October.

California Department of Fish and Widlife. 2018. List of Wildlife Rehabilitation Facilities. https://www.wildlife.ca.gov/Conservation/Laboratories/Wildlife-Investigations/Rehab/Facilities. Accessed August 8, 2018.

Foxolutions. 2018. The Humane Approach to Urban fox Control. http://www.foxolutions.co.uk/. Accessed August 8, 2018.

Stoppestinfo. 2018. Fox Repellents and Deterrents: Comparison Review. https://stoppestinfo.com/419-top-fox-repellents-deterrents.html. Accessed August 8, 2018.

# APPENDIX A

## Canine Distemper Virus: Information for Agency Personnel and Renewable Energy Projects, California Department of Fish and Game, November 2011

**Canine Distemper Virus: Information for Agency Personnel and Renewable Energy Projects**

Prepared by: Deana Clifford – 29 November 2011
Contact information: dclifford@dfg.ca.gov, 916-616-0809

Starting in October 2011, the California Department of Fish and Game has observed confirmed and suspect cases of Canine Distemper Virus (CDV) in at least 5 desert kit foxes near Blythe, CA. Although distemper infections have not been reported previously in this species, most of California's carnivore species are susceptible to the virus.

Canine Distemper Virus infects both domestic dogs and wild carnivores. The virus is transmitted among carnivores by contact with oral, respiratory and ocular (eye) fluids, and other body fluids (urine, feces) containing the virus. Animals with the virus may not show clinical signs, but can still shed virus for up to 90 days. Although acquired infections in domestic dogs have been reduced through preventative vaccinations, infected dogs that have contact with or share food with wild carnivores can transmit the virus to wildlife. The virus also spreads among wild carnivores mostly affecting susceptible young animals. Canine distemper virus is not transmissible to people.

CDV is easily killed by direct sunlight, heat, drying and cleaning with 10% bleach solution.

Distemper can cause respiratory, neurologic and gastrointestinal illness. Disease can progress quickly, and in wildlife, often just deaths are observed. Clinical signs include, but are not limited to: depression, fever, respiratory distress, diarrhea, anorexia, seizures, uncoordination, circling, yellow to clear discharge from the nose and eyes, and crusting on the nose, eyes, mouth or footpads. There is no treatment or cure for sick animals except supportive care.

Signs of neurologic distemper often resemble rabies, a disease of great public health importance. Therefore, even if distemper is suspected, all carnivores with neurologic disease should also be tested for rabies.

Vaccination can prevent disease, but the efficacy of vaccines developed for domestic animals is not known for most wildlife species, and should not be assumed to be 100%. Furthermore, vaccination during an outbreak may not be effective if animals receiving the vaccine are currently infected with the virus, and often repeat vaccinations are needed to ensure protection.

General strategies for CDV prevention include keeping domestic dogs up to date on all vaccinations, discouraging pet owners from feeding their dogs and cats outdoors, keeping dogs on leash when visiting wild areas and cleaning up after pets, and discouraging people from feeding wild carnivores as this increases local carnivore density and may increase interactions between wild and domestic carnivores.

# APPENDIX B

## Interim Monitoring and Mitigation Plan to Address Canine Distemper Virus Mortalities in the Desert

**Interim Monitoring and Mitigation Plan to Address Canine Distemper Virus Mortalities in Desert**

Prepared by: Deana Clifford, DVM, MPVM, PhD
Contact information: dclifford@dfg.ca.gov, 916-616-0809

## Summary

Since October 5th there have been at least 6 documented desert kit fox mortalities on or adjacent to a 2,000 acre solar energy development approximately 20 miles west of Blythe, CA just north of Interstate 10. Four of these deaths have occurred since November $10^{th}$. One of these foxes was observed alive with convulsions and extreme weakness, but died en route to a rehabilitation facility.

Five carcasses in good condition were necropsied by pathologists at the California Animal Health and Food Safety Lab (CAHFS) in Davis and San Bernardino. Canine distemper viral inclusion bodies were present in tissues from all 5 foxes. CDV infection has been confirmed by immunohistochemistry (IHC) assay on the first fox; IHC test results are pending on the 4 additional animals, but pathology signs indicate CDV is the most likely cause of death.

Given the familial nature of kit foxes, their high degree of home range overlap, and the disease transmission dynamics of canine distemper virus there is potential for additional mortalities and geographic spread of the disease. Coyotes are also present in the area and may be affected or involved in disease transmission and spread.

It is too early to know whether or not we will see additional distemper cases. Accordingly, timely case detection, diagnosis and mapping are our best tools for tracking this situation. To detect additional cases and track the spread of disease we need cooperation from numerous agencies, contracted biologists and developers.

If the number of cases increases and/or the geographic area spreads, population impacts for desert kit foxes could be significant. In such a scenario, various management options to help stop disease spread may need to be implemented as additive mortality from disease may exacerbate any population impacts from development activities in the desert.

For now the DFG nongame wildlife program recommendation is to be proactive in monitoring and, if warranted based on the data, consider potential management responses. One issue of current concern involves passive relocation of kit foxes that inhabit burrows on land slated for development. If passive relocation activities are being conducted in an area experiencing or adjacent to distemper cases, these activities may enhance disease transmission and spread through multiple mechanisms. First, animals stressed by disturbance or relocations may be more susceptible to illness and death because CDV infection decreases immune function. Second, passive relocation activities in an area experiencing CDV deaths may result in increased movement of animals shedding virus, thereby increasing disease transmission into new areas. Given this scenario, case by case evaluation of passive relocation activities in light of the most recent data about the occurrence and locations of cases is warranted.

On the next page is a brief outline and suggested interim approach for monitoring and potentially mitigating spread of disease. The approach by nature should be adaptive and re-evaluated continuously as new information becomes available. Recommendations are based on published population

demographic and home range data from kit foxes, disease ecology of CDV, and experience from other CDV outbreaks in free-ranging carnivores.

**Interim Recommendations 29 Nov 2011:**

**A. Actively monitor kit fox dens in and adjacent to the affected area and in areas determined to be at high risk for disease spread based on best available data, and rapidly report known mortalities and submit for disease testing.**

1. Begin immediate daily monitoring of all known active burrows in GSEP area and burrows adjacent (within 1 km) of GSEP site. Monitoring can be a combination of remote cameras, visual observations.
2. Report all mortalities or observations of sick/injured animals immediately to DFG veterinarian. DFG veterinarian will facilitate necropsy or animal care. Guidelines for handling sick or dead animals are attached. Note – other carnivores may be affected, so a finding of sick or dead coyotes would also be important and reportable.
   - i. Diagnostic lab: CAHFS San Bernardino (M. Massar and D. Clifford have submission forms).
   - ii. Nearest licensed wildlife rehabilitator: Living Desert Zoo, Palm Springs
3. Map locations of all known burrows onto current disease map – DFG WIL can do this if given data files.
4. Overlay data regarding kit fox home range, dispersal distances and movements onto project map to help determine areas for prioritizing fox monitoring and case detection activities.
   - i. First overlay minimum and maximum home range buffers (approximately 4 – 13 $km^2$) around dens that have had mortalities. Add additional zones 2 and 3 home range distances away.
   - ii. Second overlay buffer of dispersal distance and daily movements to get a complimentary idea of the area where infected foxes may have moved.
   - iii. Note: this data assumes that the disease would be primarily spread via contact between infected kit foxes. It does not consider potential disease transmission by coyotes or other carnivores (domestic and wild).
5. Informal reporting on these activities twice weekly, with a minimum of once weekly written update in the absence of mortality.
   - i. Note: incubation period for CDV may be up to 2 weeks, thus over the next 30 days its critical to monitor the population for additional sick and dead animals. This period of time would roughly represent 2 incubation cycles. If additional mortalities are detected, the monitoring time period is basically reset as we can assume the virus is continuing to be transmitted in the population.

**B. Temporary cessation of passive relocation and disturbance to kit foxes within and immediately adjacent to areas where mortalities have occurred.**

1. CDV suppresses the immune function of infected animals. Additional stressors to infected animals may increase their chances of illness and death, and the duration of shedding of the virus. Furthermore, stressed animals are likely to be more susceptible to infection and subsequent illness.
2. If infected animals are disturbed to the point of den abandonment they are more likely to contact foxes in adjacent territories and transmit disease into new areas.

3. Accordingly, all efforts should be made to 1) reduce any disturbance to kit foxes currently inhabiting the area where mortalities have occurred, and 2) temporarily cease passive relocation activities until data is supportive of a cessation of new cases.
    i. Suggestions: temporarily increase protective buffer around active kit fox dens. Minimum recommendation – double buffer from 75 ft to 150 ft?
    ii. Only enter area for monitoring activities
    iii. Temporarily cease passive relocation activities.
    iv. Initial period for this action would be 2 weeks (one incubation cycle), with re-evaluation at that time.

**C. Employ precautionary measures to eliminate risk of human-induced disease spread**

1. Ensure domestic animals do not enter disease risk area and are not on site.
2. Employ simple disinfection protocol (attached) during fox monitoring activities.
3. For current dig down (Den 17 where 3 mortalities occurred) – do not move soil from Den 17 to other locations during dig down; soil should remain at that location and be exposed to sunlight to kill the virus. Although risk is low, CDV can persist in the environment if out of direct sunlight and in a cool place (like the underground burrow).

**Overall Plan:** Suggest once weekly conference call update with designated biologist and key agency representatives for coordination and data evaluation.

**Appendices:**

**A. Sick and injured animal recommendation**

**B. DRAFT disinfection recommendations**

**Appendix A: Draft guidance for reporting and handling sick or dead foxes**

**DEAD FOXES:**
Please handle any carcass with gloves. After recording an incident form, location of the carcass (UTM) and taking a photo, place the carcass into a plastic bag and tie or seal the bag. Place the carcass into a second plastic bag. Place the bagged carcass on ice or with ice packs into a cooler or styrofoam container and give me a call. The carcass should be submitted to the CAHFS lab in San Bernardino as soon as possible. Carcasses can be shipped via Fed Ex overnight or other overnight carrier from Blythe to the CAHFS lab. Make sure to place the double bagged carcass with ice packs into a hard sided or Styrofoam container, then into a second cardboard box. Check priority overnight AM delivery. The address is on the submission form. Include one copy of the submission form with the airbill, and place a second copy of the form with an incident report inside the box inside a separate plastic bag so the paper does not get wet from the ice packs. Depending on the location of the carcass, Mark Massar or I will give guidance on the account to be charged and provide a submission form for the lab. Please send myself, Mark and Magdalena a copy of the incident form. Be sure to disinfect any items used to handle, process, or transport the carcass. Place the cooler containing the bagged carcass in the trunk or in the back of a truck whenever possible.

**SICK FOXES:**
If you encounter a live, but sick fox -- please call. If the fox is exhibiting neurologic signs (seizing, circling, stumbling), use extreme caution to not get bit when moving the animal. It is highly advised that only persons vaccinated for rabies handle carnivores exhibiting neurologic signs. You may be able to work with local animal control to assist. If possible - try to have the animal enter a transport kennel without directly touching the animal. Otherwise cover the fox with a towel, use thick gloves and quickly place the animal into the transport kennel. During transport, make sure to cover the kennel with a towel or blanket to reduce stress for the fox. The Living Desert Zoo has a veterinarian and staff experienced in wild animal care, a quarantine facility, and is a licensed wildlife rehabilitation facility by the Department of Fish and Game. I can facilitate arranging for care and assist with transport if needed. Be sure to disinfect all kennels or items used to handle and transport the animal, and ensure that transport kennels are adequately locked during travel.

Contact information: Dr. Deana Clifford 916-616-0809, dclifford@dfg.ca.gov

**Canine Distemper Virus (CDV): Prevention of Spread during Fox Monitoring Activities**

**CDV is easily inactivated using common household bleach. The important point is to let the bleach have adequate contact time with the surface you want to disinfect. Depending on disinfection activity spray bottles with 10% bleach solution or Clorox disinfectant wipes can be used.**

**Disinfectant Types:** 10% solution of Sodium Hypochlorite (Bleach)
Clorox Bleach Disinfectant Wipes

**Contact Time:** 10 – 30 minutes

**Proper Dilution for 10% Bleach solution:** Mix 1 part household bleach with 9 parts of water (ie. 1 quart of bleach with 9 quarts of water). Use caution as this solution is corrosive and irritating in contact with eyes or skin. If solution gets into your eyes, immediately flush eyes with copious amounts of water or saline solution for contact lenses. If skin exposure, rinse with copious amounts of water. Please follow manufactures recommendations for skin or other bodily exposure.

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**Directions for Bleach Use as a Disinfectant:** Good hygienic practices should be instituted to reduce the spread of disease between den sites. Any object that comes into contact with the ground or surrounding landscape needs to be disinfected before moving to the next site. These recommendations are simple and can be done quickly, requiring only a spray bottle with bleach solution, a small plastic bag to place used bleach wipes into, and bleach wipes.

- **Shoes:** Spray the soles of all shoes with a 10% bleach solution prior to moving to another burrow site. Ideally wait at least 10 minutes before wiping/rinsing off with water. Avoid stepping on fecal material or in wet soil that could be contaminated with urine.

- **Camera/Camera Stands:** If the camera stands are made of wood, the stands should be discarded and replaced when the camera is moved to a new burrow. If camera stands are metal or plastic then spray the stand with a 10% bleach solution; allow 10 minutes for contact time; then rinse with water. If using bleach wipes, wipe down legs completely, allow 10 minutes to pass before installing at next site.

- **Other Equipment** (digging equipment): Wipe equipment with bleach wipes or spray with 10% bleach, allowing 10 minutes to pass before rinsing with water.

- **Hands:** Use hand sanitizer or if available wash with soap and water in between burrow visits (handling cameras etc).

- Be mindful of clothing. If you have puppies at home, we suggest changing clothes in between work and home to reduce any risk of infecting your pets or vice versa, as puppies are most susceptible to CDV infection. If working in burrows or digging burrows, be mindful of soil contamination on your clothing.

# I.9 Couch's Spadefoot Protection Plan, April 2019

**FINAL**

# RE CRIMSON SOLAR PROJECT
# DRAFT COUCH'S SPADEFOOT PROTECTION PLAN
# RIVERSIDE COUNTY, CALIFORNIA

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January 2019
Revised April 2019

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# 1.0 INTRODUCTION

The RE Crimson Solar Project (Project) is located in Riverside County, approximately 13 miles west of Blythe, California. Sonoran West Solar Holdings, LLC (Project Proponent), a wholly owned subsidiary of Recurrent Energy, proposes to construct and operate the Project. The Project is a utility-scale solar photovoltaic (PV) and energy storage project that would be located on federal lands managed by the Bureau of land Management (BLM) within the California Desert Conservation Area and the Desert Renewable Energy Conservation Plan (DRECP) area. The Project Proponent intends to implement a Couch's Spadefoot Protection Plan (Plan) to minimize the potential for impacts to the species for the life of the Project.

## 1.1 Purpose of the Plan

This Plan describes the actions to be taken to protect Couch's spadefoot (CS) (*Scaphiopus couchii*), a toad that is a California Species of Special Concern, and BLM sensitive species, which has potential to occur within and in the vicinity of the Project. The purpose of this Plan is to specify an approach that, when implemented, will facilitate avoidance and minimization of impacts to CS that may occur within and/or adjacent to the RE Crimson Permitting Boundary (Figure 1). In addition, this Plan includes the results of habitat surveys and includes an assessment of potential Project impacts.

Specific activities for CS protection addressed by this Plan include:

- Habitat surveys focusing on areas that are subject to ponding due to natural features and/or have been artificially compacted and thus are susceptible to ponding to identify potential CS breeding habitat in relation to Project features.
- Assessment of potential CS impacts resulting from construction and operations and maintenance activities including changes in breeding habitat due to changes in flow levels and flow patterns to breeding ponds, and increased risk of predation.
- Avoidance and minimization measures designed to avoid impacts to potential breeding ponds, including designation of CS Management Areas, installation of protective fencing or other barriers, worker's education program, minimizing construction and operations and maintenance traffic within the vicinity of potential breeding ponds, and biological monitoring.

## 1.2 Project Background

A large area (7,600 acres) consisting of the RE Crimson Project area and surrounding BLM and private lands was originally proposed for development by BrightSource Energy, Inc., as the

Sonoran West Solar Energy Generating Facility (Sonoran West Project [SWP] Site). Biological surveys were conducted in 2011/2012 across the SWP Site, after which a smaller area was chosen for the current Project (2,489 acres). A variety of biological resource surveys for the SWP Site were conducted in 2011 and 2012. These surveys included a general vegetation survey, invasive plant species survey, special-status plant species surveys, various wildlife species surveys, and a jurisdictional waters delineation. Wildlife species surveys included desert tortoise (*Gopherus agassizii*), Mojave fringe-toed lizard (*Uma scoparia*), CS, burrowing owl (*Athene cunicularia*), elf owl (*Micrathene whitneyi*), gila woodpecker (*Melanerpes uropygialis*), golden eagle (*Aquila chrysaetos*), migratory bird surveys, nocturnal avian radar, desert kit fox (*Vulpes macrotis*) and American badger (*Taxidea taxus*), and bat surveys. Some of these surveys were repeated again in 2016 and 2017 to inform the Project, while others were determined to be sufficient and therefore not repeated. In 2016 and 2017, surveys were conducted for special-status plant species, an updated jurisdictional waters delineation, desert tortoise, burrowing owl, elf owl, migratory bird surveys, desert kit fox and American badger, bat surveys, and wildlife camera surveys.

### 1.2.1 Project Description

The Project is located in unincorporated eastern Riverside County, approximately 13 miles west of Blythe, just north of the Mule Mountains and just south of Interstate 10 (I-10) (Figure 1). The Project site consists of approximately 2,489 acres of BLM-administered land within the Riverside East Solar Energy Zone/Development Leasing Area and within the DRECP Development Focus Area (BLM 2015). The Project would interconnect to the regional electrical grid at Southern California Edison’s (SCE’s) Colorado River Substation (CRS). It would generate up to 350 megawatts (MW) of renewable energy using PV technology and would include up to 350 MW of integrated energy storage capacity.

The total area for the Project (i.e., RE Crimson Permitting Boundary; 2,489 acres) includes a 2,465-acre solar field development area with approximately 1,859 acres of solar modules (array blocks) and 24 acres for linear facilities, including access/perimeter roads assuming a 30-to 60-foot corridor width and gen-tie and powerline corridor at 150 feet. The Project Proponent is proposing to construct the Project using traditional construction methods consisting of permanent desert tortoise exclusion fencing (per USFWS 2009), mow-and-roll of vegetation for site preparation, compacted roads, and trenching for electrical lines.

The Project Proponent is also actively investigating alternative low environmental impact design (LEID) elements and their potential to reduce impacts. LEID elements include several potential design changes, including the following:

- Changing to wildlife-friendly fencing during operations to allow desert tortoise, desert kit fox, and other wildlife access to the site.
- Minimizing grading during site preparation and maintaining more onsite vegetation to facilitate post-construction residual habitat value and post-operations/site reclamation success.
- To reduce ground disturbance, avoid or limit trenching by placing electrical wiring aboveground.
- To reduce ground disturbance, place transformer/inverter groups on elevated support structures in lieu of cement foundations.

The LEID elements would minimize grading, trenching, and vegetation removal beyond traditional design approaches for PV projects with the objective of reducing overall long-term impacts for the Project. At this time, it has not been decided which, if any, LEID elements may be incorporated into the final Project construction design. Therefore, this Plan assumes a traditional construction approach is taken and that no LEID elements are incorporated. This Plan may need to be modified or amended once the final construction, operations and maintenance, and decommissioning designs are determined.

### 1.2.2 Site Description

The Project site consists of undeveloped land that is owned by the federal government and administered by the BLM. There is a 120.5-acre private parcel in the center of the Project site that currently is not planned for use by the Project, and surveys were not conducted within the private parcel. There are no existing structures within the Project that would need to be demolished, and no existing roads are present within the proposed Project solar development area. Existing SCE transmission lines and a paved access road (Power Line Road) oriented east-west that lead to the CRS are location just north of the Project site. The unpaved portion of Power Line Road then continues from the CRS in a southwesterly direction on the east side of the Project site. I-10 is just over 1 mile north of the northern Project boundary, and the western edge of the Colorado River Valley is approximately 4.5 miles to the east (Figure 1).

The site is located at the northern foot of the Mule Mountains Area of Critical Environmental Concern. The SCE high-voltage transmission line and CRS are directly north of the Project site, and I-10 is north of and parallel to those facilities. Federally designated critical habitat for desert tortoise within the Chuckwalla Critical Habitat Unit and the vast Chuckwalla Desert Wildlife Management Area are west of the Project site.

Regionally, the Project site is situated within the Colorado Desert on gently rolling open terrain dominated by desert scrub vegetation. Desert scrub vegetation (e.g., creosote bush scrub) covers most of the site, except for sparsely vegetated desert dunes and more heavily vegetated desert washes (with microphyll woodlands). The Project site has a gentle slope north and west, away from the base of the Mule Mountains, with elevation ranging from a high of about 710 feet above mean sea level (AMSL) around the base of the Mule Mountains to a low of about 430 feet AMSL near the northwestern corner closest to I-10. Terrain onsite generally slopes down from higher land at the base of the Mule Mountains to the south.

The Project site has experienced some historical disturbance from military training during World War II, including tank and off-road vehicle use. During World War II, the site was part of the General George S. Patton Desert Training Center, officially the California-Arizona Maneuver Area, a simulated theater of operations. More recent disturbance from recreational off-road vehicle users is evident within the Project site, even though there are no BLM-designated routes within the Project site. Most off-road vehicle use was evident within the washes with vehicle tracks leading toward the Mule Mountains.

### 1.3 Definitions

The following terms will be used throughout this report:

- Project Area: The Project Area includes the RE Crimson Permitting Boundary and associated buffers, including microphyll woodland drainages between solar development areas.
- RE Crimson Permitting Boundary: Includes the area of anticipated ground disturbance associated with implementation of the Project. This includes the entire Project footprint (area within solar plant site perimeter security fence [i.e., chain-link] including solar fields, battery storage, on-site transmission facilities, office and maintenance buildings, laydown area) and linear areas outside the perimeter security fence (i.e., chain-link) including access roads and transmission and utility corridors.

### 1.4 Roles and Responsibilities

The Project Proponent, is ultimately responsible for implementing this CS plan. It is anticipated that Project contractors and other parties responsible for implementing components of this CS plan will include the following:

**Construction Manager:** The Construction Manager (CM) will have ultimate oversight of the construction contractor to ensure compliance with the provisions of this CS plan.

**Environmental Compliance Manager:** The Project Proponent will designate an Environmental Compliance Manager (ECM) to provide oversight of construction practices and verify compliance with the provisions of this CS plan. The ECM and any support staff will be either direct employees or contracted by the Project Proponent, and will coordinate with the Construction Manager to verify contractor compliance with environmental requirements during construction. The ECM will be responsible for implementation and oversight of this Plan throughout the life of the Project.

**Qualified Biologist:** A qualified biologist may include a Designated Biologist, biological monitor, or other biologist qualified to conduct surveys and handle (if needed) CS. A resume of the qualified biologist(s) will be submitted to the BLM for approval in consultation with the California Department of Fish and Wildlife (CDFW) and U.S. Fish and Wildlife Service (USFWS). The qualified biologist will have the following background and training:

- Bachelor's degree in biological sciences, zoology, botany, ecology, or a closely related field; and 3 years of experience in field biology or current certification of a nationally recognized biological society, such as The Ecological Society of America or The Wildlife Society; and
- At least 1 year of cumulative field experience with biological resources found in or near the Project area (such as in desert environments in the Southwest). A qualified biologist's field experience will include compliance monitoring, experience with desert species in similar habitat, and working with construction crews in desert environments.

In lieu of the above requirements, the resume will demonstrate to the satisfaction of the BLM, in consultation with CDFW and USFWS, that the proposed qualified biologist has the appropriate training and background to effectively implement the Plan.

**Biological Monitor**: A Biological Monitor(s) will be designated to provide oversight of CS Management Area monitoring and to ensure compliance with the provisions of this CS plan. The Biological Monitor will be contracted by the Project Proponent and must be knowledgeable about the Project, CS plan obligations, and the ecology and life history of the CS.

### 1.5 Habitat Survey Methods

CS, a California Species of Special Concern, BLM Sensitive, and sensitive species per the BLM's Northern and Eastern Colorado Desert Coordinated Management Plan, is generally active at night during spring and early summer rains and can be found in temporary desert rain pools. Breeding generally occurs from May through September during summer monsoonal rains. CS is hard to detect except when it comes above ground to breed in ephemeral pools during intense monsoonal summer rain events (Thompson *et al.* 2016). CS emerge from deep (20 to 90 centimeter) burrows on the first night following the first heavy summer rains, with most breeding occurring during the first night, followed by up to 2 months of intermittent foraging (Shoemaker *et al.* 1969, Dimmit and Ruibal 1980). The low frequency sound of the rain on the desert ground draws CS out of their deep burrows (Dimmitt and Ruibal 1980). Otherwise, the species remains below ground in burrows, and may remain below ground during suboptimal years with insufficient rainfall (Mayhew 1962). The aquatic lifecycle of this species (i.e., the time it takes the eggs to hatch into tadpoles and then metamorphose into toadlets) is approximately 8 to 10 days. They require friable soil for burrowing where they typically spend up to 11 months underground until sufficient rainfall has accumulated. CS occupies a variety of habitat types, including desert dry wash woodland, creosote bush scrub, desert riparian, palm oasis, desert succulent scrub, shortgrass plains, mesquite savannah, and alkali sink scrub. In California, the CS habitat lies within Imperial, Riverside, and San Bernardino Counties between 500 to 3,000 feet. The distances traveled between upland retreats and breeding sites is unknown, likewise, the precise terrestrial habitat requirements of adults or juveniles are also unknown (Thompson *et al.* 2016). The area in southern California where CS occur receives on average 6.5 centimeters of rainfall per year, and the distribution of CS may be linked to the amount of runoff that collects in localized area suitable for CS breeding (Mayhew 1965).

As part of the DRECP, a CS species distribution model was created by Conservation Biology Institute to depict the statistical model outputs for CS distribution in southern California based on California Natural Diversity Database (CNDDB) records (CBI 2014). Predictions of habitat occupancy were generated from Maxent models for the DRECP using a variety of environmental predictors and are shown on Figure 2. This data shows potentially suitable habitat scattered around the RE Crimson Permitting Boundary, primarily in the washes and around the base of the Mule Mountains. While this distribution model is useful at identifying potential areas where CS may occur, site specific surveys are much more informative, as discussed below.

***2012 Surveys***

In 2012, focused surveys for CS were conducted after summer monsoonal rain events (generally June through August) in all areas determined to have the potential to be breeding pools identified during other field surveys. After rain events, areas previously identified as having the potential to pond water were visited to determine if they actually ponded water. Sites observed to have ponded water were surveyed on foot at night for at least 20 minutes in order to aurally determine if CS were breeding and calling in the area. The same pools were checked the following day for eggs, tadpoles, toadlets, and toads.

A second round of CS surveys was conducted approximately 8 days after the initial storm event to determine if the pools remained inundated for the amount of time necessary for CS to complete their aquatic life cycle (transition from eggs to tadpoles to toadlets). Pools still inundated were monitored again for calling/breeding toads and checked for signs of eggs, tadpoles and toadlets.

***2016/2017 Surveys***

No focused surveys for CS were conducted in 2016/2017; however, any areas that had the potential to pond and retain water long enough for breeding were mapped during other resource surveys, including desert tortoise surveys in October 2016 and during burrowing owl surveys in 2017.

## 1.6 Survey Results

***2012 Survey Results***

Potential CS habitat was mapped within the SWP Site in areas with dense creosote bush scrub and evidence of previously ponded water (such as dried, cracked, silty areas). Potentially suitable habitat was located along the north section of the gen-tie line corridor and along the access road from Wiley's Well to the CRS. After the onset of summer monsoonal rains between July 12 and 15, 2012 (when a total of 1.47 inches [3.73 centimeters] of rain fell as recorded at the Blythe Airport [The Weather Company 2018]), biologists visited all potential pool habitat to document ponding and survey for CSs. Due to the large amount of permeable sand in the area, no pools were documented to hold water for more than a few days and no CS were detected during focused surveys.

One CS was incidentally detected on August 27, 2012, by a biologist walking to an avian point count (CDFW 2017b). This point is located at the western end of a broad wash on the western side of the Project (Figure 2). Therefore, it is assumed that CS may be present within wash areas in the western part of the Project area. Information for this observation in the CNDDB is limited, noting only that the toad was observed in the large wash with a global positioning system point provided (as shown on Figure 2). There is no documentation related to this observation provided within any of the SWP site data.

***2016/2017 Survey Results***

While CS surveys were not conducted during 2016/2017, potentially suitable habitat was mapped in an unnamed large, broad wash along the eastern-most side of the Project (Figure 2). This area showed cracked soils and small depressions that indicate the presence of surface water for some period of time. This wash is outside of the RE Crimson Permitting Boundary (located between solar array blocks) and, therefore, would not be directly impacted during construction. This area of potentially suitable habitat is located approximately 300 feet away from either side of the RE Crimson Permitting Boundary. Similarly, the potential CS habitat that was documented within the SWP Site in 2012 (along the north section of the gen-tie line corridor near Power Line Road) is located north of, and outside of the Project and would not be impacted. The CS found in August 2012 is located in a wash that would also be avoided by the Project (i.e., outside of the RE Crimson Permitting Boundary). The specific location where the CS was found in early August 2012 is approximately 250 feet east of the access road between solar array blocks. Therefore, the species is considered to be present within the Project area, but is more likely to occur in the wash areas and adjacent uplands between the solar blocks of the RE Crimson Permitting Boundary than within the open desert scrub which characterizes the majority of the RE Crimson Permitting Boundary.

# 2.0 PROJECT IMPACTS AND AVOIDANCE AND MINIMIZATION MEASURES

This section discusses the specific areas that may potentially pond provided sufficient rainfall is present in the RE Crimson Permitting Boundary and within 300 feet that can be avoided with implementation of minimization measures. Avoidance and minimization measures designed to protect these ponds are also described.

## 2.1 <u>Impact Assessment</u>

Since rainfall in this portion of the desert is intermittent and summer monsoonal rains do not occur every year, mapping potential ponded locations can be difficult. Locations in the general vicinity of the Project that support CS, are characterized by shallow depressions that pond water and contain invertebrate communities (such as species of branchiopods) that tadpole CS feed on. There were no locations within the RE Crimson Permitting Boundary that looked similar to any of the reference locations (such as at Ford Dry Lake and around Wiley's Well Road) where CS are known to occur. Since no potential ponding areas were identified within the RE Crimson Permitting Boundary during 2012 – 2018 surveys, no pools would be directly impacted by the Project. Although no CS or potential pools were documented within the RE Crimson Permitting Boundary, there is a moderate to high potential for ponding to occur within adjacent microphyll woodlands that are being avoided. One potentially ponded area was observed within a wash on the eastern side of the RE Crimson Permitting Boundary, but this wash will be avoided (Figure 2). Per a CNDDB point from 2012, Couch's spadefoot was previously detected in a wash outside of the RE Crimson Permitting Boundary. No potential pools or ponding were observed in this area during 2016/2017 survey.

As noted, the one potential ponded area identified in the eastern wash will be avoided. Additionally, adequate upland refugia and dispersal habitat will be maintained around the ponded area with Project implementation given the avoidance of the wash. The washes will also remain connected to habitat both upstream and downstream with only a single road/utility crossing to allow access between development areas.

Construction noise and vibration, increased vehicle traffic and human presence during construction and operation that may attract predators has potential to disturb CS if they occur underground or disperse through upland habitats adjacent to avoided pools or indirectly affected pools. Minimization measures to reduce these potential impacts during construction and operation are outlined below. It is expected that desert tortoise fencing installed around the perimeter of the RE Crimson Permitting Boundary may deter CS from accessing active construction areas and site features (such as the solar blocks) post-construction.

## 2.2 Avoidance and Minimization Measures

Measures that will be implemented to avoid and minimize the potential for construction and operational impacts on potential ponding areas and CS that may occur on adjacent lands are outlined below.

### 2.2.1 Preconstruction Phase:

- Establish CS Management Areas. Throughout the life of the Project, no vehicle access will be permitted through washes apart from the 30-foot wide perimeter access roads that connect the various portions (solar blocks) of the RE Crimson Permitting Boundary. During construction, highly visible signage will be installed along the edges of the access roads that bisects each wash. The signage will designate the washes as environmentally sensitive areas, and no vehicles will be permitted outside of established roads. The Eastern Wash Area, and Western Wash Area will be designated CS Management Areas (Figure 2) and will be monitored during construction to verify no off-road vehicle travel occurs. All personnel will be instructed to stay out of the CS Management Areas.

- Worker Environmental Awareness Program (WEAP). Worker education training will be conducted for all onsite personnel prior to the onset of construction and also to all operational personnel for the life of the project. Training will include CS identification, habitat description, limits of construction activities in the Project area, and guidance regarding general measures being implemented to conserve CS as they relate to the Project. The potential CS pools to be avoided will be discussed and a map of these areas provided. Photos and a description of the life history and ecology of CS will also be provided as part of the WEAP.

- Limit Disturbance Areas. The boundaries of areas to be disturbed (including staging areas, access roads, and sites for temporary placement of spoils) will be delineated with stakes and flagging prior to construction activities in consultation with a qualified biologist. Spoils and topsoil will be stockpiled in disturbed areas lacking native vegetation and that do not provide habitat for special-status species. Parking areas, staging, and disposal site locations will similarly be located in areas without native vegetation or special-status species habitat. All disturbances, and Project vehicles and equipment will be confined to the flagged areas during construction and delineated CS Management Areas during operations.

- Monitor Ground-Disturbing Activities Prior to Preconstruction Site Mobilization. If preconstruction site mobilization requires ground-disturbing activities such as for geotechnical borings or hazardous waste evaluations, a qualified biologist or Biological Monitor will be present to monitor any actions that could disturb soil, vegetation, or wildlife.

### 2.2.2 Construction Phase

While these measures are specific to the construction phase of the Project, they would also apply to the decommission phase of the project. Therefore there are no new measures specific to the decommission phase.

- Minimize Road Impacts. New and existing roads that are planned for construction, widening, or other improvements will not extend beyond the flagged impact area as described above. Vehicles passing or turning around would do so within the planned impact area or in previously disturbed areas. Where new access is required outside of existing roads or the construction zone, the route will be clearly marked (i.e., flagged and/or staked) prior to the onset of construction. The 30-foot wide access roads between the components of the Project (between solar blocks) that cross desert washes will be constructed so as not to impede the flow of water through the wash.

- Minimize Traffic Impacts. Vehicular traffic during Project construction will be confined to existing routes of travel to and from the Project site, and cross-country vehicle and equipment use outside designated work areas will be prohibited. To minimize the likelihood for vehicle strikes of wildlife species, a speed limit of 25 miles per hour shall be established for travel along Power Line Road. A speed limit of 15 miles per hour shall be adhered to for travel within the RE Crimson Permitting Boundary, including while crossing through washes between parts of the Project. To minimize the potential for vehicle impacts to CS during monsoon season, it may be necessary to erect temporary fencing only in areas where ponding is observed adjacent to access roads. This fencing would not be trenched into the ground, rather silt fence would be placed along the edges of the road with sand bags to hold down the bottom of the fence and prevent CS from crossing the access road at night. Temporary fencing would be erected only on a case-by case basis to protect CS and would only be erected during active monsoon season. The fence would be monitored daily to verify it does not impeded movement for any other wildlife species (such as desert tortoise), and would be removed once any adjacent ponds have dried up.

- Monitor During Construction. In areas that have not been fenced with desert tortoise exclusion fencing and cleared for desert tortoise, a qualified biologist and/or Biological Monitor will be present at the construction site during all Project activities that have potential to disturb soil, vegetation, and wildlife. The biologists will walk ahead of equipment during brushing and grading activities. Additionally, during active construction in applicable areas, a biologist will conduct daily sweeps of actively used access roads between solar blocks to verify that any water applied to the roads and vibration of vehicles traveling along the access roads are not causing CS to emerge from aestivation. Immediately following a rain event large enough to cause surface water flows, a biologist will check wash areas around the access roads to verify that water is not ponding on either side of the access road as this ponded water may attract CS to these ponded areas. If water is found to pond on either side of the access roads due to access road design, the water will be drained to prevent attracting CS to the area around the access road.

- Monitoring of Eastern and Western CS Management Areas. If summer monsoonal rains provide sufficient water for ponding within the washes between the RE Crimson Permitting Boundary, a qualified biologist will conduct a reconnaissance survey to determine if CS are using any ponded areas within the washes and determine if any potential ponded areas are near the access roads or other areas that may be impacted by the Project. The goal of monitoring potentially ponded areas within the Eastern and Western CS Management Areas is to determine if CS occur in the washes, and if construction activities may impact breeding, foraging, or dispersing toads. To protect breeding pools and prevent crushing of CS, if CS are found breeding, or potentially suitable ponded water is located within 500 feet of an access road nighttime travel (between dusk and dawn) by any project personnel (including security staff) will only be permitted if escorted by a qualified biologist or Biological Monitor.

- No construction is proposed within the CS Management Area with the exception of the road crossings. If CS are detected breeding within pools in the CS management areas, a 50 foot (or otherwise appropriately sized) buffer would be established by a qualified biologist to minimize the potential for impacts.

- Minimize Impacts of Staging Areas. Staging areas for construction of the Project will be within the area that has been fenced with desert tortoise exclusion fencing and as far from microphyll woodlands and wash areas as feasible.

- Avoid Use of Toxic Substances. Soil bonding and weighting agents used on unpaved surfaces will be nontoxic to wildlife and plants.

- Minimize Lighting Impacts. Facility lighting will be designed, installed, and maintained to prevent side casting of light toward wildlife habitat.

- Avoid Vehicle Impacts to CS. Parking and equipment storage will occur within the area enclosed by desert tortoise exclusion fencing to the extent feasible. No vehicles or construction equipment parked outside the fenced area will be moved prior to an inspection of the ground beneath the vehicle for the presence of CS. If a CS is observed, it would be left to move on its own. If it does not move within 15 minutes, a qualified biologist or Biological Monitor may relocate the animal to a safe location with appropriate habitat for the species where it will not dessicate out.

- Backfill Trenches. At the end of each workday, a qualified biologist or Biological Monitor will verify that all potential wildlife pitfalls (trenches, bores, and other excavations) have been backfilled, sloped at a 3:1 ratio at the ends to provide wildlife escape ramps, or covered completely to prevent wildlife access. All open trenches, bores, and other excavations will be inspected periodically throughout the day, at the end of each workday, and at the beginning of each workday by a Biological Monitor. Should wildlife become trapped, a qualified biologist or Biological Monitor will remove and relocate the individual as appropriate. Any wildlife encountered during the course of construction will be allowed to leave the construction area unharmed.

- Minimize Standing Water. Water applied to dirt roads and construction areas (trenches or spoil piles) for dust abatement will use the minimal amount needed to meet safety and air quality standards in an effort to prevent the formation of puddles, which could attract CS and common ravens to construction sites. A Biological Monitor will patrol these areas to ensure water does not puddle and will take appropriate action to reduce water application where necessary.

- Minimize Spills of Hazardous Materials. All vehicles and equipment will be maintained in proper working condition to minimize the potential for fugitive emissions of motor oil, antifreeze, hydraulic fluid, grease, or other hazardous materials. A qualified biologist will be informed of any hazardous spills immediately as directed in the Project Hazardous Materials Plan. Hazardous spills will be immediately cleaned up and the contaminated soil properly disposed of at a licensed facility. Servicing of construction equipment will take place only at a designated area. Service/maintenance vehicles will carry a bucket and pads to absorb leaks or spills. No equipment maintenance involving hazardous materials (e.g., re-fueling, oil changes) will take place within 150 feet of any ephemeral drainage which includes potential spadefoot habitat."

- Worker Guidelines. During construction all trash and food-related waste will be placed in containers with lids that will be closed when not in use and removed daily from the site. Workers will not feed wildlife or bring pets to the Project site. Except for law enforcement personnel, no workers or visitors to the site will bring firearms or weapons. Vehicular traffic will be confined to existing routes of travel to and from the Project site, and cross-country vehicle and equipment use outside designated work areas will be prohibited. The speed limit when traveling on dirt access routes within potential CS habitat will not exceed 25 miles per hour.

- Implement Erosion Control Measures. Standard erosion control measures will be implemented for all phases of construction where sediment runoff from exposed slopes threatens to enter a CS Management Area. Sediment and other flow-restricting materials will be moved to a location where they will not be washed back into the pool. All disturbed soils and roads within the Project site will be stabilized to reduce erosion potential, both during and following construction. Areas of disturbed soils (access and staging areas) with slopes toward a drainage will be stabilized to reduce erosion potential.

### 2.2.3 Operations Phase

- Minimize Traffic Impacts. Vehicular traffic during Project operation will be confined to existing routes of travel to and from the Project site, and cross-country vehicle and equipment use outside designated work areas will be prohibited. To minimize the likelihood for vehicle strikes of wildlife species, a speed limit of 25 miles per hour shall be established for travel along Power Line Road. A speed limit of 15 miles per hour shall be adhered to for travel within the RE Crimson Permitting Boundary, including while crossing through washes between parts of the Project.

- Implement Erosion Control Measures. Standard erosion control measures will be implemented for all phases of operation where sediment runoff from exposed slopes threatens to enter a CS Management Area. Sediment and other flow-restricting materials will be moved to a location where they will not be washed back into any potential ponding area within the CS Management Area. All disturbed soils and roads within the Project site will be stabilized to reduce erosion potential, both during and following construction. Areas of disturbed soils (access and staging areas) with slopes toward a drainage will be stabilized to reduce erosion potential.

## 3.0 REPORTING

Monthly reports will be submitted to BLM and CDFW for the duration of construction on the status of any CS in the RE Crimson Permitting Boundary and buffer, and the implementation of any exclusion methods or biological monitoring of access roads, washes, and CS Management Areas, if conducted. The reports may be combined with other compliance reports for the Project.

In addition to the monthly reports, an Annual Compliance Report(s) provided to BLM and CDFW will describe the results of all surveys, exclusion methods, and monitoring for that year. If any impacts to CS are witnessed during any phase of the project, the owner will notify the BLM Authorized Officer in writing within 24 hours of the incident.

## 4.0 REFERENCES


Dimmitt, M. A. and R. Ruibal. 1980. Environmental correlates of emergence in spadefoot toads (*Scaphiopus*). Journal of Herpetology 14:21-29.

Mayhew, W.W. 1965. Adaptations of the amphibian, *Scaphiopus couchii*, to desert conditions. The American Midland Naturalist 74:95-109.

Shoemaker, V. H. , McClanahan, L., and Ruibal, R. 1969. Seasonal changes in body fluids in a field population of spadefoot toads. Copeia 1969:585-591.

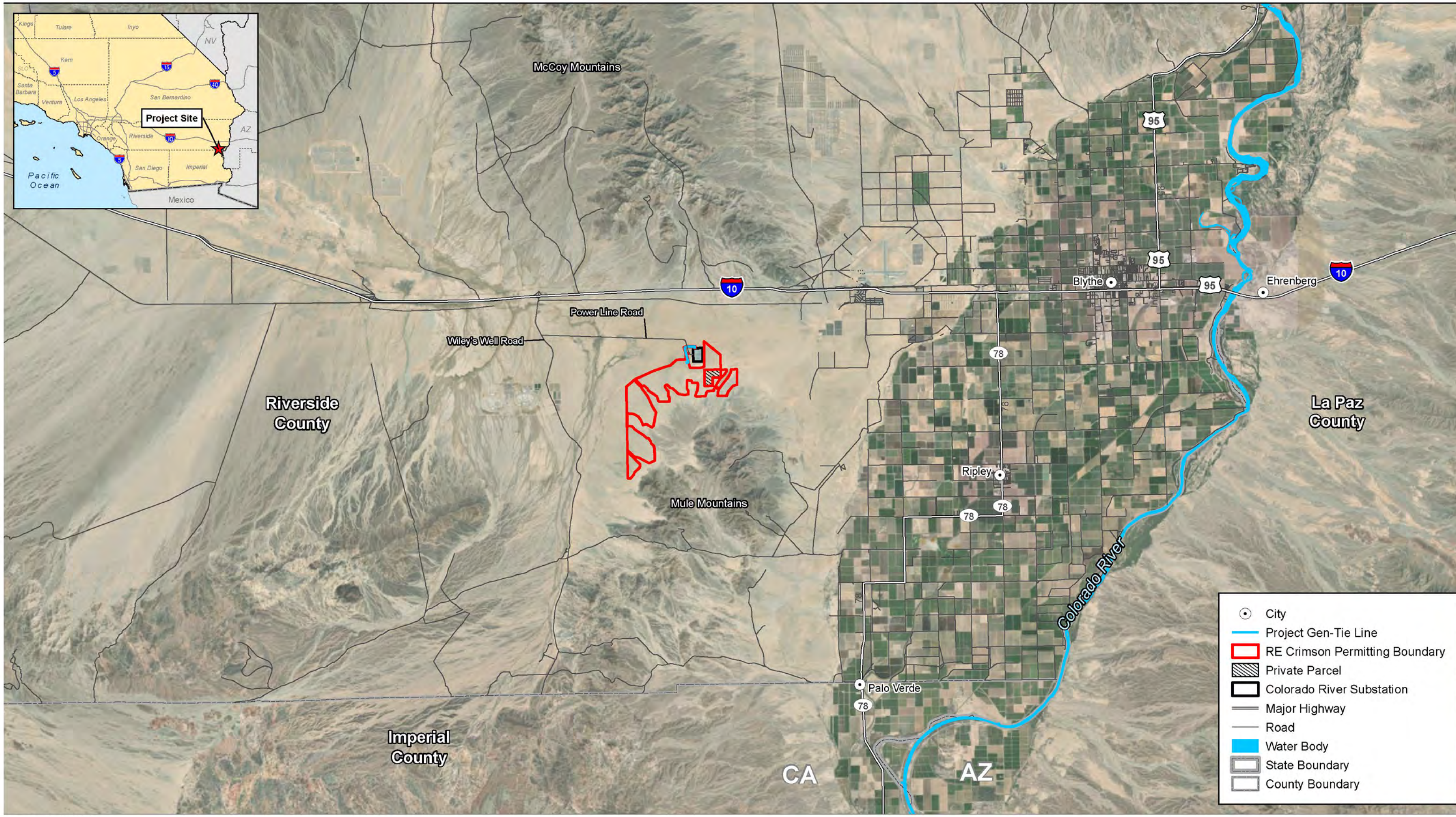
Stebbins, R. 2003. A Field Guide to Western Reptiles and Amphibians. 3rd Edition.

The Weather Company. 2018. Weather Underground historical rainfall data recorded at Blythe Municipal Airport for July 2012. https://www.wunderground.com/history/monthly/us/ca/blythe/KBLH/date/2012-7 Accessed on July 7, 27, 2018.

Thompson, R.C., A. N. Wright, and H. B. Shaffer. 2016. California Amphibian and Reptile Species of Special Concern. California Department of Fish and Wildlife. University of California Press: Oakland, California.

U.S. Fish and Wildlife Service. 2009. Desert Tortoise (Mojave Population) Field Manual: (Gopherus agassizii). Region 8, Sacramento, California.

# FIGURES




Source: ESRI; AECOM.

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1:190,080 1 inch = 3 miles

**Figure 1**
**Regional Map**

RE Crimson Solar Project Couch's Spadefoot Protection Plan

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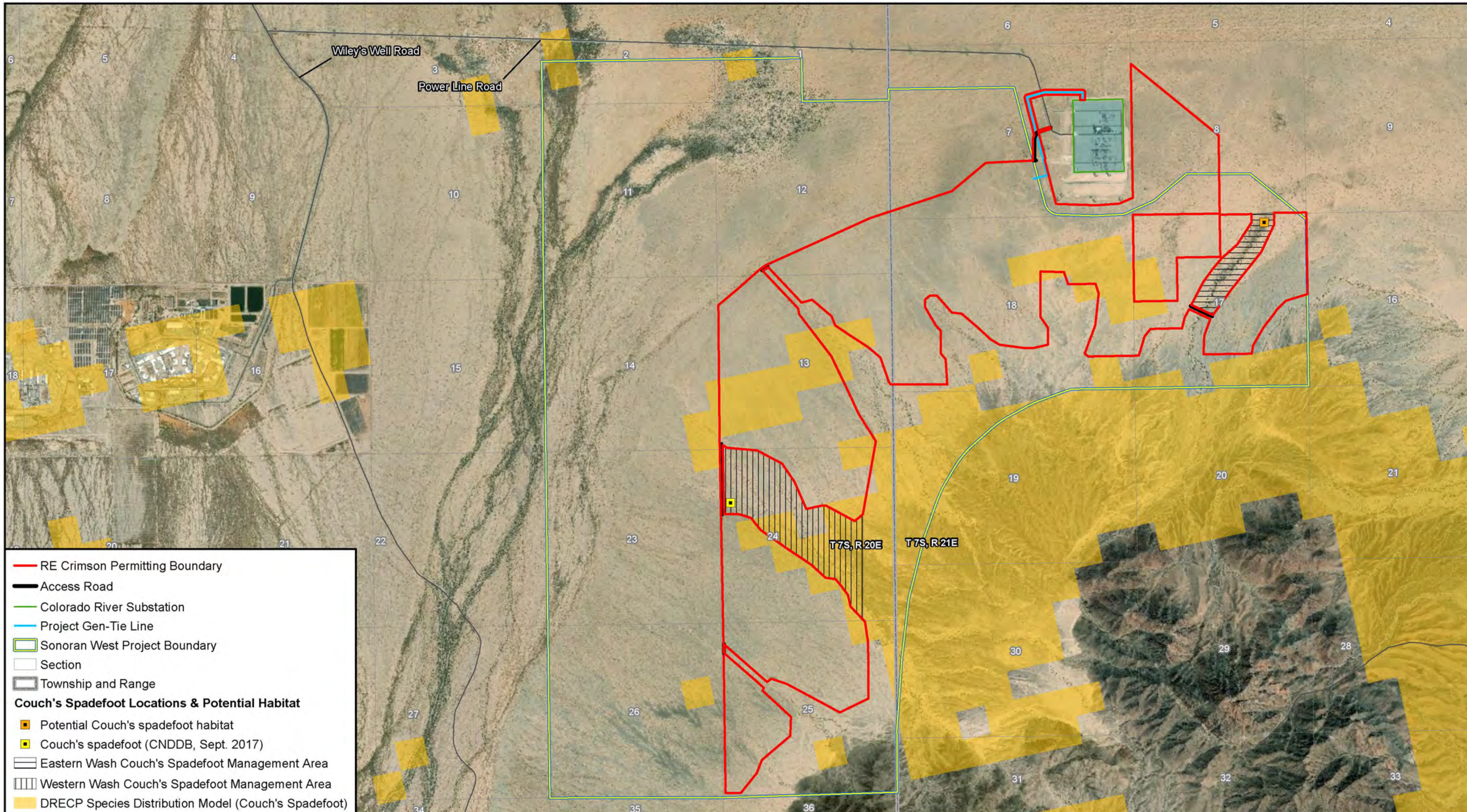


Source: ESRI; AECOM; Conservation Biology Institute 2014; CDFW 2017

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**Figure 2**
**Couch's Spadefoot Locations & Potential Habitat**



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# I.10 Weed Management Plan, March 2019

# FINAL
# RE CRIMSON SOLAR PROJECT
# WEED MANAGEMENT PLAN

***Prepared for:***

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March 2019

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## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| applicant | Sonoran West Solar Holdings, LLC |
| BLM | Bureau of Land Management |
| Cal-IPC | California Invasive Plant Council |
| CDCA | California Desert Conservation Area |
| County | Riverside County |
| CRS | Colorado River Substation |
| DPR | Department of Pesticide Regulation |
| DRECP | Desert Renewable Energy Conservation Plan |
| GIS | geographic information system |
| LEID | low environmental impact design |
| MW | megawatts |
| PAR | Pesticide Application Records |
| PEIS | Programmatic Environmental Impact Statement |
| Plan | Weed Management Plan |
| PPA | Plant Protection Act of 2000 |
| Project | RE Crimson Solar Project |
| PUP | Pesticide Use Proposal |
| PV | photovoltaic |
| RE | Recurrent Energy LLC |
| SWP | Sonoran West Project |
| U.S.C. | United States Code |
| WEAP | Worker Environmental Awareness Program |
| WCS | Weed Control Specialist |

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# 1.0 INTRODUCTION

The RE Crimson Solar Project (Project) is located in Riverside County (County), approximately 13 miles west of Blythe, California (Figure 1). Sonoran West Solar Holdings, LLC (applicant), a wholly owned subsidiary of Recurrent Energy, proposes to construct and operate the Project. The Project is a utility-scale solar photovoltaic (PV) and energy storage project that would be located on federal lands managed by the Bureau of land Management (BLM) within the California Desert Conservation Area (CDCA) and the Desert Renewable Energy Conservation Plan (DRECP) area. All Project permanent and temporary disturbance will occur within the boundaries of the RE Crimson Permitting Boundary. This area encompasses all areas of disturbance associated with the Project, which are considered in this Weed Management Plan (Plan).

## 1.1 Purpose of the Plan

The Plan focuses on the monitoring of introduced, invasive, and noxious weed species for both the temporary and permanent disturbance areas and the whole of the Project area. The Plan will remain in effect for the life of the Project, including construction, operations and maintenance (including weed control as needed), and decommissioning.

The goals of the Plan are to protect the landscape surrounding the RE Crimson Permitting Boundary from the expansion of existing weeds, reduce the spread of new weeds that may result from Project activities, and avoid unintended harm to biological and other sensitive resources from implementation of weed management techniques. The Plan is consistent with all applicable laws, ordinances, regulations, and standards (see Section 2.0).

This Plan has been prepared to comply with the analyses and mitigation measures in the RE Crimson Biological Resources Technical Report (AECOM 2018), the *Final Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic Environmental Impact Statement (PEIS) and Record of Decision (ROD)* (BLM 2007), the *Final Programmatic Environmental Impact Statement for Vegetation Treatments Using Aminopyralid, Fluroxypyr, and Rimsulfuron on Bureau of Land Management Lands in 17 Western States* (BLM 2016), and the National Invasive Species Management Plan (National Invasive Species Council 2008). The Plan also will be in compliance with the BLM Manual 9015 (BLM 1992) Memorandum of Understanding.

Weed management objectives are consistent with existing and proposed future site conditions, biology of the identified weed species, and environmental context of the Project. Weed management objectives and the measurements for the success of the Plan for the life of the Project include the following:

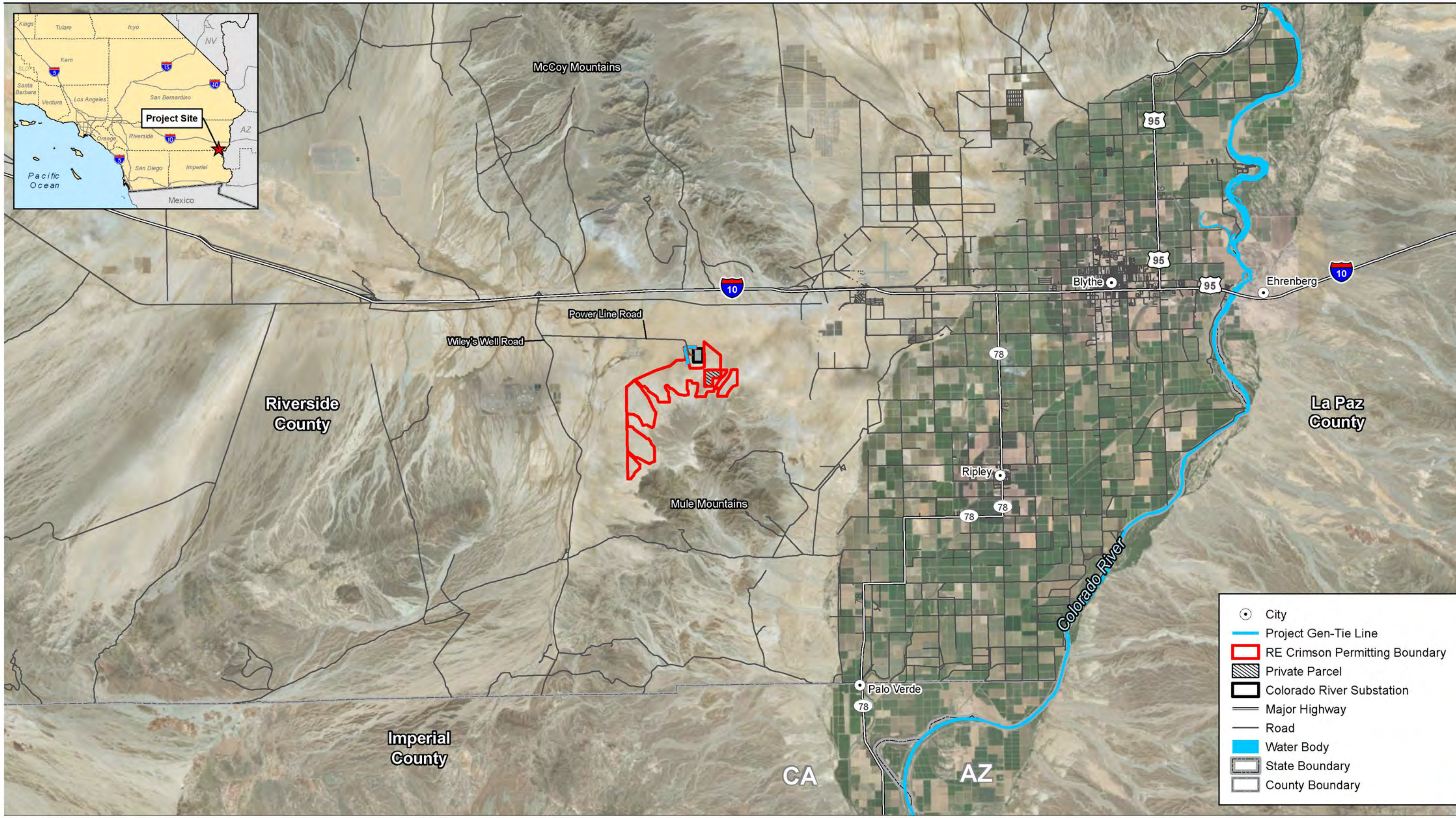
- **Identification and Risk Assessment:** This objective identifies presence, location, and abundance of weed species in the Project area, both existing conditions and conditions over time.
- **Control:** This objective is to implement weed control measures such that populations of existing weed species do not increase due to the Project construction, operations and maintenance, and decommissioning.
- **Containment:** This objective involves preventing the spread of existing weeds to new areas and preventing the introduction and spread of weed species not currently present in the Project area.

## 1.2 Project Background

A larger area (7,600 acres) consisting of the Project area and surrounding BLM and private lands was originally proposed for development by BrightSource Energy, Inc., as the Sonoran West Solar Energy Generating Facility (Sonoran West Project [SWP] Site). Biological surveys were conducted in 2011/2012 across the SWP Site, after which a smaller area was chosen for the current Project (2,489 acres). Biological surveys were conducted again in 2016/2017 for the smaller current Project area. Fall 2011, spring 2012, fall 2012, spring 2016, and spring 2017 botanical surveys were conducted within the Project area and are detailed where applicable in this Plan (AECOM 2018). Baseline weed surveys will be conducted prior to the start of construction.

### 1.2.1 Project Description

The proposed Project is located in unincorporated eastern Riverside County, approximately 13 miles west of Blythe, just north of the Mule Mountains and just south of Interstate 10 (Figure 1). The Project site consists of approximately 2,489 acres of BLM-administered land within the Riverside East Solar Energy Zone/Development Leasing Area and within the DRECP Development Focus Area. The Project would interconnect to the regional electrical grid at Southern California Edison's Colorado River Substation (CRS). It would generate up to 350 megawatts (MW) of renewable energy using PV technology and would include up to 350 MW of integrated energy storage capacity.




Source: ESRI; AECOM.

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1:190,080 1 inch = 3 miles

**Figure 1**
**Regional Map**

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The total area for the Project (i.e., RE Crimson Permitting Boundary; 2,489 acres) includes a 2,465-acre solar field development area with approximately 1,859 acres of solar modules (array blocks) and 24 acres for linear facilities including access/perimeter roads, assuming a 30- to 60-foot corridor width and generation tie line and powerline corridor at 150 feet. The Project applicant is proposing to construct the Project using traditional construction methods consisting of permanent desert tortoise exclusion fencing, mow-and-roll of vegetation for site preparation, compacted roads, and trenching for electrical lines. The applicant is also investigating alternative low environmental impact design (LEID) elements and the potential for those to reduce Project impacts.

LEID elements include several potential design changes, including the following:

- Minimizing grading during site preparation and maintaining more onsite vegetation to facilitate post-construction residual habitat value and post-operations/site reclamation success.
- To reduce ground disturbance, avoid or limit trenching by placing electrical wiring aboveground.
- To reduce ground disturbance, place transformer/inverter groups on elevated support structures in lieu of cement foundations.

The LEID elements would minimize grading, trenching, and vegetation removal beyond traditional design approaches for PV projects with the objective of reducing overall long-term impacts from the Project. At this time, it has not been decided which, if any, LEID elements may be incorporated into the final Project construction design. Therefore, this Plan assumes a traditional construction approach is taken and that no LEID elements are incorporated. This Plan may need to be modified or amended once the final construction and operations design are determined.

# 2.0 RELATED AND APPLICABLE LAWS, ORDINANCES, REGULATIONS, AND STANDARDS

## 2.1 Federal Laws and Regulations

### 2.1.1 Federal Noxious Weed Act of 1974

The Federal Noxious Weed Act (7 United States Code [U.S.C.] §§ 2801–2814, January 3, 1975, as amended 1988 and 1994) provides for the control and management of nonindigenous weeds that injure, or have the potential to injure, the interests of agriculture and commerce, wildlife resources, or public health. The act gives the Secretary of Agriculture broad powers in regulating transactions in the movement of noxious weeds. It states that no person may import or move any noxious weed identified by regulations of the Secretary of Agriculture into or through the United States except in compliance with the regulations, which may require that permits be obtained. The act also requires each federal agency to develop a management program to control undesirable plants on federal lands under the agency's jurisdiction and to establish and adequately fund the program. Some of the provisions of this act were repealed by the Plant Protection Act of 2000 (PPA), including U.S.C. §§ 2802–2813. However, Section 1 (findings and policy) and Section 15 (requirements of federal land management agencies to develop management plans) were not repealed (7 U.S.C. 2801 note; 7 U.S.C. 2814).

### 2.1.2 Plant Protection Act of 2000

The PPA, as amended (7 U.S.C. 7701–7786), states that the detection, control, eradication, suppression, prevention, or retardation of the spread of plant pests or noxious weeds is necessary for the protection of the agriculture, environment, and economy of the United States. This act defines the term ‘‘noxious weed’’ (7 U.S.C. 7702 § 403) to mean "any plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry, or other interests of agriculture, irrigation, navigation, the natural resources of the United States, the public health, or the environment" (USDA 2000). This act specifies that the Secretary of Agriculture may prohibit or restrict the importation, entry, exportation, or movement in interstate commerce of any noxious weed if it is determined "that the prohibition or restriction is necessary to prevent the introduction into the [U.S.] or the dissemination of a plant pest or noxious weed within the [U.S.]," and authorizes the issuance of implementing regulations. Subsequent regulations implemented by the Noxious Weed Control and Eradication Act of 2004 amended the PPA.

### 2.1.3 Bureau of Land Management

To address the use of chemical treatment of noxious weed and invasive terrestrial plant species t, BLM prepared the Vegetation Treatments PEIS (BLM 2007) and the 2016 PEIS to add three additional herbicides (Aminopyralid, Fluroxypyr, and Rimsulfuron; BLM 2016). These documents were the result of extensive public involvement and outlined the specific decisions, standard operating procedures, and mitigation measures for use of herbicides on BLM-administered lands. The selected alternative of the Vegetation Treatments PEIS identifies the active herbicidal ingredients approved for use on BLM land and the herbicidal ingredients that are no longer approved for use. The Record of Decision for the Vegetation Treatments PEIS defers the determination of areas that are to be treated through BLM's integrated pest management program to approved land use plans, and makes no land use or resource allocations in this regard. Appendix B of the Vegetation Treatments PEIS, *Herbicide Treatment Standard Operating Procedures*, specifies management of noxious weeds through prevention and application of pesticides on BLM-administered land. These procedures are incorporated as requirements of this Plan and are thoroughly identified within the Pesticide Use Permit (PUP) for the proposed RE Crimson Project as well as the associated site-specific National Environmental Policy Act analysis.

### 2.1.4 Executive Order 13112

Executive Order 13112 requires executive departments and agencies to take steps to prevent the introduction and spread of invasive species, and to support eradication efforts and control invasive species that are already established. In addition, Executive Order 13112 created a coordinating body referred to as either the Invasive Species Council or Native Invasive Species Council to oversee implementation of the order, develop recommendations for internal cooperation, and encourage proactive actions and other steps to improve the federal response to invasive species (National Invasive Species Information Center 1999). This order was amended on December 8, 2016, by Executive Order 13751, which continues coordinated federal prevention and control efforts related to invasive species (USDA 2018).

## 2.2 State and Local Laws and Regulations

The California Food and Agricultural Code contains some detail on noxious weed management. Specifically, Food and Agricultural Code Section 403 states that the Department of Food and Agriculture should prevent the introduction and spread of injurious insect or animal pests, plant diseases, and noxious weeds. Under Sections 7270 through 7224, the California Commissioner of Agriculture is granted the authority to investigate and control noxious weeds, and specifically to provide funding, research, and assistance to weed management entities, including eligible weed management areas or County agricultural commissioners, for the control and abatement of noxious weeds according to an approved integrated weed management plan.

California Food and Agriculture Code Sections 5101 and 5205 provide for the certification of weed-free forage, such as hay, straw, and mulch. This portion of the code recognizes that many noxious weeds are spread through forage and ground covers. The code allows for in-field inspection and certification of crops to ensure that live roots, rhizomes, stolons, seeds, or other propagative plant parts of noxious weeds are not present in the crop to be harvested. All erosion control methods using straw or other agricultural products will be certified weed-free.

## 3.0 NOXIOUS AND INVASIVE SPECIES PLAN DEFINITIONS

### 3.1 Noxious Weed Definitions

According to 7 U.S.C. 7702 (Title 7 Agriculture; Chapter 104, PPA), the term "noxious weed" means "any plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry, or other interests of agriculture, irrigation, navigation, the natural resources of the United States, the public health, or the environment" (USDA 2000). A noxious weed is any plant designated by a federal, state, or county government as injurious to public health, agriculture, recreation, wildlife, or property (Sheley et al. 1999). A noxious weed is "competitive, persistent, and pernicious" (James et al. 1991).

Many noxious weeds are invasive but not all invasive weeds are necessarily noxious. Therefore, a distinct separation of noxious weeds and invasive weeds is recognized in this Plan through the identification and risk assessments, as well as the approaches used for the intensified control measures used for treatment or eradication of any noxious weed species within the Project boundary.

Both noxious and invasive weed species are typically characterized as able to aggressively colonize new areas and can outcompete native plant communities, thereby changing the physical and chemical composition of the soils and requiring major eradication and restoration efforts if left uncontrolled. The California Invasive Plant Council (Cal-IPC) categorizes invasive plants as high, moderate, or limited according to the severity of their ecological impact (Cal-IPC 2018).

**High –** Invasive plants classified as high consist of species that have severe ecological impacts on physical processes, plant and animal communities and vegetation structure, and have a moderate to high rate of dispersal and establishment.

**Moderate –** These species consist of species that have substantial and apparent (but not severe) ecological impacts and have a moderate to high rate of dispersal and establishment, although establishment is generally dependent upon a disturbance regime such as soil disruption or fire.

**Limited –** These consist of species that are invasive, but their ecological impacts are minor on a state-wide level. Dispersal and establishment of species classified as limited are generally low to moderate.

These classifications are based on cumulative state-wide trends and can vary at local scales. As a result, a species classified as limited may be more invasive on a local scale than a species classified as high, depending on local conditions (Cal-IPC 2018). For this reason, all plants Cal-IPC classified as invasive, even those classified as limited, can potentially impact a local ecosystem.

## 3.2 Weed Species of Concern

Specific baseline weed surveys will be conducted prior to the start of construction. In addition, rare plant surveys were conducted for the Project and invasive weeds observed were recorded (see Table 1). The bulk of the invasive weeds found onsite occur along the northern and eastern edges of the site, along areas of previous disturbances, and also corresponding to the sandier areas of the site. If other weed species are found during the baseline weed surveys and/or Project development, they will also be mapped and incorporated into the Plan's monitoring program and will be targeted for control measures. Table1 below identifies invasive and noxious species of concern specifically identified within the Project area, as well as other prevalent invasive species found within the Colorado Desert region of the larger Sonoran Desert, where the Project is situated.

**Table 1**
**Invasive Weeds Present or with Potential to Occur in the Project Area**

| Species[1] | | Cal-IPC Rating | CA State Noxious List |
|---|---|---|---|
| **Mediterranean grass** | ***Schismus barbatus*** | **Limited** | **No** |
| **Puncturevine** | ***Tribulus terrestris*** | **Limited** | **Yes** |
| Red brome | *Bromus madritensis rubens* | High | No |
| **Russian thistle** | ***Salsola tragus*** | **Limited** | **Yes** |
| **Sahara mustard** | ***Brassica tournefortii*** | **High** | **No** |
| Tamarisk | *Tamarix aphylla* | Limited | No |
| Red-Stemmed filaree | *Erodium cicutarium* | Limited | No |

[1] Target invasive weed species present within the Project area are shown in bold; remaining species are those not found within the Project area but with potential to occur.

### 3.2.1 Mediterranean Grass

Mediterranean grass (*Schismus barbatus*) is one of four species identified as present within the Project's disturbance area. It grows in the open and among shrubs, reaching its greatest biomass under shrubs where nutrients and moisture accumulate. Threats to the native environment include the exclusion of native species and spread of fire from burning dead stems. Mediterranean grass germinates earlier than many native species occupying the same inter-shrub niche and responds quickly to favorable moisture and temperature conditions. Competition with native species for resources is plausible (Cal-IPC 2018; Halvorsen and Guertin 2003). Stems and leaves of Mediterranean grass senesce to a straw color, standing for approximately 2 years after death. Stems then will eventually detach at the roots and blow across the ground. Mediterranean grass reproduces by seed only, and seeds disperse by wind and water (sheet flooding) (Brooks 2000). Although a very common and often the dominant understory species in the desert, Cal-IPC has determined that this plant has a limited invasiveness rating in California (Cal-IPC 2018). Although Mediterranean grass is present within the Project disturbance area, BLM and other agencies recognize that, because this species is widespread and dominant, eradicating it is not considered feasible. Weed abatement efforts for Mediterranean grass will be required to reduce the population if cover increases beyond baseline absolute cover (as described in Section 5.3).

### 3.2.2 Puncturevine

Puncturevine (*Tribulus terrestris*) can impact the ecosystem by excluding native plant species where dense mats of puncturevine form (Cal-IPC 2018; Legner 2006). Seeds form in dry pods that break off the plant in three- to five-seeded single pods with sharp spines that disperse by attaching to objects such as automobile tires or animals. Spines are known to puncture the soles of shoes and bicycle tires. Seeds may remain viable in buried seed banks for several years (Cal-IPC 2018). Once established, puncturevine can tolerate excessively dry soils by establishing a deep taproot. Areas where it is most likely to spread include agricultural land, waste places, and roadsides (Cal-IPC 2018).

Cal-IPC has determined that this plant has a limited invasiveness rating in California (Cal-IPC 2018). Additionally, its ability to become established in desert settings within disturbance sites has elevated this species to the noxious weed species list of California (USDA 2003). Puncturevine was observed within the Project area during rare plant surveys in very small numbers, mostly near the CRS.

### 3.2.3 Red Brome

Red brome (*Bromus madritensis*) is well established throughout the County and reaches into parts of the CDCA. Red brome invades disturbed areas and is spreading rapidly in desert shrublands and rangelands. It is also highly flammable and can facilitate the spread of wildfires. Potential impacts to the ecosystem are suppression of native annuals germination, alteration of forage for wildlife, and increased wildfire potential.

Cal-IPC has determined that this plant has a high invasiveness rating in California (Cal-IPC 2018). Red brome was not observed within the Project area during rare plant surveys but will be treated if observed on the Project site.

### 3.2.4 Russian Thistle

Russian thistle (*Salsola tragus*) is common in agricultural settings where soil disturbances are frequent; it establishes itself along the field edges and tilled fields. Russian thistle is also referred to as "tumble weed;" the entire above-ground plant breaks away from its roots once mature and "tumbles" with the wind spreading seed as it travels. Threats to the natural environment are mainly caused by the plant's ability to move easily throughout the landscape; dead plants can create a fire hazard and can even impede traffic in large densities. Increased fire hazard occurs when dry plants pile up in a location or blow around while on fire.

Cal-IPC has determined that this plant has a limited invasiveness rating in California (Cal-IPC 2018). Russian thistle is also listed as a noxious weed in California and was observed within the Project area during rare plant surveys (most notably along the access road from Wiley's Well Road to CRS. Therefore, special attention will be paid to this species should it be observed within the Project area during future surveys.

### 3.2.5 Sahara Mustard

Sahara mustard (*Brassica tournefortii*) is a winter annual and flowers early in the spring setting seed earlier than many native species in the Colorado Desert. It aggressively exploits available soil moisture and nutrients, thereby outcompeting native plants, especially in years with good precipitation. Sahara mustard often germinates faster and grows larger than other winter annuals and therefore shades out smaller native seedlings (Barrows et al. 2009). In years of increased precipitation, populations can explode and expand rapidly into adjacent habitat. Seed transport is mainly caused by tumbling plants or by windblown dry fruits. Automobiles may also transport seeds during and after rain events (Cal-IPC 2018). Potential impacts to the ecosystem include depletion of soil nutrients making native habitat recovery difficult, alteration of forage for wildlife, and increased wildfire potential due to the large size of Sahara mustard individuals (Cal-IPC 2018).

Cal-IPC has determined that this plant has a high invasiveness rating in California (Cal-IPC 2018). Sahara mustard was observed within the Project area during rare plant surveys and will be targeted for treatment and control within the Project area.

### 3.2.6 Tamarisk

The potential for tamarisk (*Tamarix aphylla*) to grow within the Project area is limited; its presence should be monitored, especially within dry washes where the species could become established and outcompete native plants by appropriating available soil moisture, thereby lowering the water table should it become established. The species also increases surrounding soil salinity by excreting salt from glands on the surface of its leaves. This, in combination with the utilization of soil moisture, severely limits the growth of other species, and few, if any, other plant species grow under tamarisk. Dense stands also accumulate sediments within streambeds, which narrow the channels, causing increased water velocity during floods and scouring, among other effects. Tamarisk readily resprouts quickly after fires. Tamarisk stands can affect the local biodiversity of wildlife by severely altering the native plant community and habitat qualities (Cal-IPC 2018; Carpenter 2010).

The Cal-IPC has determined that this species has a limited invasiveness rating in California (Cal-IPC 2018). Tamarisk was not observed within the Project area during rare plant surveys but is the only listed weed tree species with the potential to occur in this area (Table 1). Tamarisk will be treated and controlled if observed on the Project site.

### 3.2.7 Redstem Filaree

Redstem filaree (*Erodium cicutarium*) is an aggressive annual/biannual that is widespread throughout the County and, to a lesser degree, the Colorado Desert region. It proliferates in disturbed areas and can quickly outcompete any native grass and forbs species. Cal-IPC has given the species a limited rating. Redstem filaree was not observed within the Project area during rare plant surveys but will be targeted for control within the Project area if observed in the future.

## 4.0 NOXIOUS AND INVASIVE WEED MANAGEMENT

This section points out the details of the RE Crimson weed management program by examining the roles and responsibilities of the applicant regarding the BLM Manual 9015 (BLM 1992).

Weed-specific management goals (Table 2) will focus, during the life of the Project, on prevention, early detection, and control or eradication depending on the rating at the onset of recordable weed spread within the Project area. Although the entire Project area will be subject to this Plan, there are a few areas of the site where prevention and control efforts should be focused. Weeds were most notably observed along the northern and northeastern edges of the proposed Project near CRS. Although weeds may occur in any of the vegetation communities mapped across the entire site, vegetation communities where weeds were observed in higher numbers and are more likely to occur include desert dunes and creosote bush-white bursage/big galleta grass associations (Figure 2). Weed control efforts will also be focused in these vegetation communities.

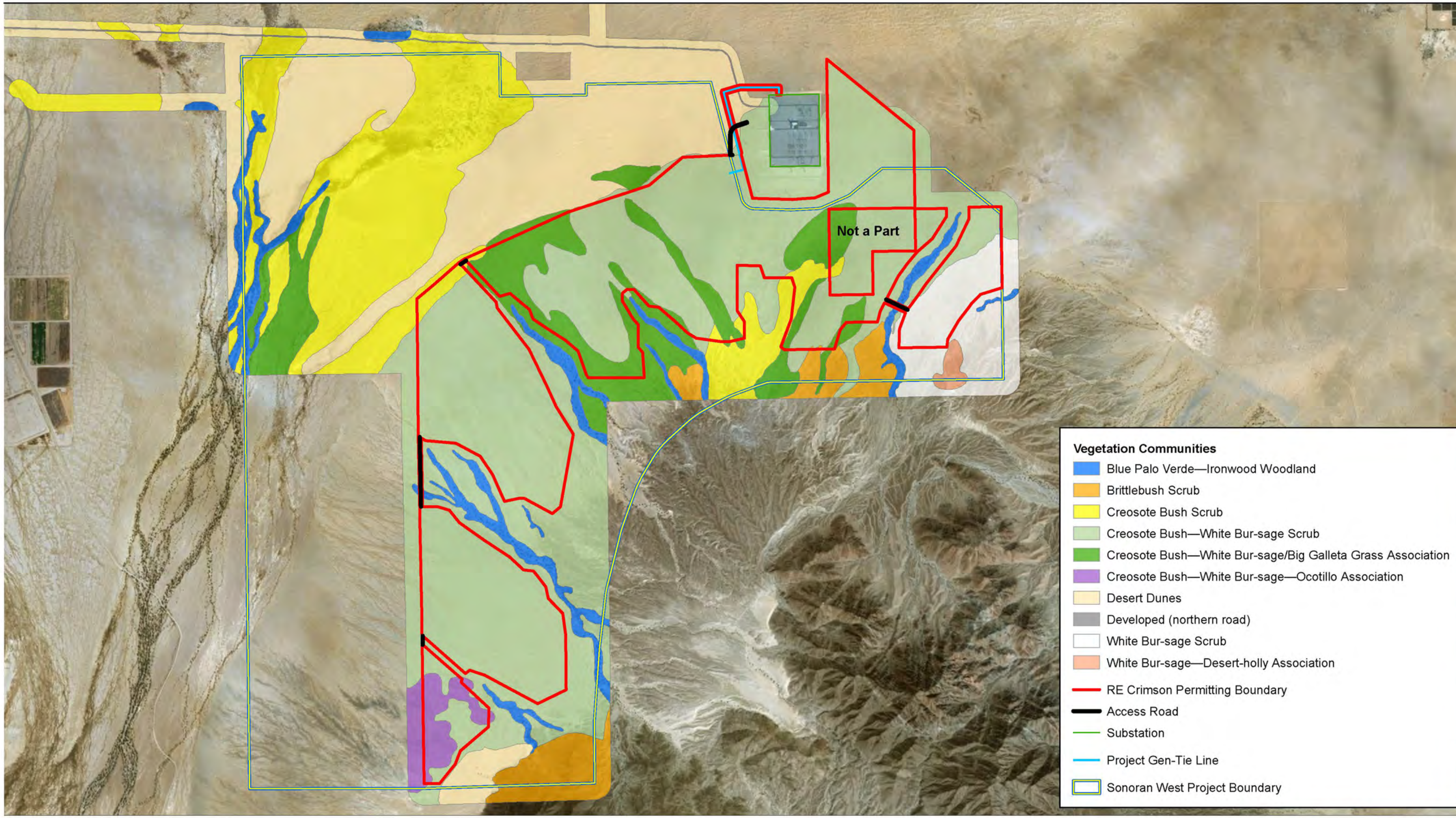


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**Figure 2**
**Vegetation Communities Map**

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## 4.1 Roles and Responsibilities

The applicant will appoint a Weed Control Specialist (WCS) to oversee all aspects of this Plan, which includes reporting to BLM. The WCS will also assess whether control techniques need to be incorporated if monitoring efforts find populations of invasive weed species increasing and/or spreading within the Project boundary or if new populations of weeds are found.
These responsibilities are discussed in detail in Section 5.0.

## 4.2 Weed-Specific Management Goals

The Plan will focus on recommended approaches from BLM when referring to noxious and invasive weed species prevention and control methods. BLM's recommended approach is listed below (BLM 2007, pg. 2-11):

- Take actions to prevent or minimize the need for vegetation controls (where feasible).
- Use effective nonchemical methods of vegetation control (where feasible).
- Use herbicides only after considering the effectiveness of all potential methods.

Target weed species management is presented in Table 2.

**Table 2**
**Target Weed and Other Nonnative Species Management Goals**

| Species | Management Goal |
|---|---|
| **Target Weed Species** | |
| Mediterranean grass | To the extent possible, minimize additional expansion and transport of this species offsite linked to construction and operation of this Project. Eradicate in revegetation areas. |
| Puncturevine | Prevent transport of seeds into the Project boundary from construction equipment and minimize expansion within the Project area. Eradicate in revegetation areas. |
| Red brome | Monitor for introduction of this species and control within the Project disturbance area. Eradicate in revegetation areas should it appear. |
| Russian thistle | Prevent transport of additional seeds into the Project disturbance area from construction equipment and minimize expansion within the Project disturbance area. Eradicate in revegetation areas. |
| Sahara mustard | Prevent transport of additional seeds into the Project disturbance area from construction equipment and minimize expansion within the Project disturbance area. |
| Tamarisk | Monitor for the introduction of this species and eradicate and monitor any future or potential expansion the plant may represent. Eradicate in revegetation areas should it appear. |
| Redstem filaree | Monitor for introduction of this species and control within the Project disturbance area. Eradicate in revegetation areas. |
| **Other Nonnative Species** | |
| | Identify, monitor, and control expansion within the Project disturbance area. |

## 4.3 Prevention

It is important to reduce or eliminate any new weed species from being introduced, becoming established, and spreading from the Project site into the surrounding landscape. Because the inherent ecological characteristics of invasive and noxious weed species allow them to exploit growth conditions invasion of disturbance areas, there is higher potential for weed species to occur in disturbed areas than in undisturbed areas within the region. This will warrant intensified monitoring efforts and awareness training for all personnel associated with the Project. General measures to prevent the spread of weed include the following:

- Clean equipment (e.g., air compressors [high pressure] or washing station or offsite cleaning with certification) prior to personnel, vehicles, and equipment entering site (each time a vehicle enters and exits the site).
- Ensure that all equipment and materials brought onto the site are certified as weed-seed free.
- Limit disturbance areas during construction to the minimum required to perform work.
- Limit ingress and egress to defined routes.
- Vegetate temporarily disturbed areas with appropriate native species as soon as possible after construction is complete to prevent weed establishment.
- Use certified weed-free products for erosion control.
- Employ manual, mechanical, and chemical control methods as appropriate to target species.
- Include information regarding the Plan in the Worker Environmental Awareness Program (WEAP).

### 4.3.1 Weed Management Training (All Personnel)

The Plan will be incorporated as a part of the Project's mandatory WEAP training, which will help all personnel focus on prevention of weed spread chiefly by staying within all designated work areas and, wherever possible, limiting the Project disturbance areas to those required for Project construction only. Personnel tasked with weed control operations will receive training, which includes identification of the weed species listed in Table 1 (and any other weed species discovered on the Project site in the future), as well as knowing the Plan and assisting construction crews with weed prevention measures where applicable. The training will also detail a discussion of the impacts of weeds on native plants, wildlife, fire frequencies, and the importance of preventing the spread of weeds to and from the site and controlling the proliferation of existing weeds onsite.

#### 4.3.2 Cleaning Equipment (Construction Phase)

All vehicles and equipment will be cleaned offsite prior to entering the Project area and inspected for dirt and debris prior to exiting the Project site. Implementation of a sign-in log along with approval and oversight from the WCS will serve as documentation of vehicle and equipment cleaning. Special attention should be given to cleaning vehicle tires and the undercarriage and any visible dirt or debris clinging to the vehicle.

#### 4.3.3 Weed-Free Products

The contractor will ensure that any fencing or erosion control materials used for sediment barrier installations are obtained from reliable sources that can certify the products as free of primary noxious weeds. Other products, such as gravel, mulch, and soil (all of which may also carry weed seeds) will be obtained from suppliers who can provide certified weed-free materials.

### 4.4 Manual Control

Because the Project site has relatively few existing weed populations, manual weed removal methods may be the preferred control option. Manual weed removal will focus on removing plants, preferably prior to seed formation, using small motorized equipment such as a line trimmer or hand tools, or pulling weeds by hand. Manual removal will be a viable option, when monitoring indicates an increase in an invasive species or the presence of any noxious species within the Project, area or if the weed population is so small that hand removal is the most effective and economical means of control. Weed line trimmers can be effective if invasive weed species have passed the flowering stage (thus too late for chemical application) by knocking down the plant at its base prior to seed set.

All invasive and noxious weeds manually removed will be bagged and removed offsite, and disposed of in an authorized waste facility. If weed seed is present on the plants, extra care will be taken to ensure the plant remains intact and the species does not come in contact with the ground.

## 4.5 Mechanical Control

Mechanical control activities, such as chaining, disking, grubbing, and mowing using tractors or other heavy equipment may be used for woody species, but are not likely needed due to the low numbers of this weed type observed onsite.

## 4.6 Chemical Control

The use of chemicals (herbicide) is proposed for the Project. Herbicides will be used on BLM lands if, and only after, a PUP has been approved by BLM. If the PUP is approved, herbicidal control methods would be used within the Project area. With appropriately timed monitoring (see Section 5.1), weed treatment needs can be identified and performed early, which reduces overall chemical usage and the chances of noxious or invasive weed species reaching maturity.

Pre-emergent herbicides (e.g., Diuron) should not be necessary due to the relatively low volume of existing populations of weed species. Also, pre-emergents can affect the germination of native and invasive plant seed alike thereby hampering the revegetation of temporary disturbed areas on the Project site. If permitted for use, then use should be limited within the disturbance areas and not within buffer areas. Only post-emergent herbicides should be needed at the recommended rate of the manufacturer. Post-emergent herbicides (e.g., glyphosate or triclopyr) are applied directly to plants in those areas where mechanical removal is impractical due to a high presence of native species. If the weed populations are extensive, then a manual approach would be impractical as well, and chemical treatment would be most effective. Herbicides proposed for use and their proposed application rates are summarized in Table 3.

**Table 3**
**Proposed Herbicides**

| Trade Name | Round-Up PRO Herbicide | AquaMaster | Garlon 4 |
|---|---|---|---|
| **Common name** | Glyphosate | Glyphosate | Triclopyr |
| **EPA registration number** | 524-475 | 524-343 | 62719-40 |
| **Manufacturer** | Monsanto | Monsanto | Dow AgroSciences |
| **Max. rate (formulated)** | 1.25 gal/acre | 1.0 gal/acre | 2.0 gal/acre |
| **Max. rate (lbs.)** | 5 lbs. a.e./acre | 4.0 lbs. a.e./acre | 8.0 lbs. a.e./acre |
| **Intended rate (formulated)** | 0.25–1.25 gal/acre | 0.2-1.0 gal/acre | 0.5 gal/acre |
| **Intended rate (lbs.)** | 1.5 lbs. a.e./acre | 1 lbs. a.e./acre | 2.0 lbs. a.e./acre |

a.e. = acid equivalent; gal/acre = gallons per acre; lbs. = pounds

The licensed applicator and a trained crew would only apply herbicides as California law directs through the Department of Pesticide Regulation (DPR). This includes knowing the current environmental conditions that could affect herbicide application. For example, if wind speeds exceed 10 miles per hour sustained gusts, then spraying of herbicides is not legal due to the potential of having harmful spray drift impact non-targeted native species. If a rain event is scheduled to commence within 24 hours of application, herbicide would not be applied. The lead applicator will know how to read label rates and be thoroughly familiar with the PUP. The lead applicator will also stay up to date on current and upcoming weather conditions and ensure the application crew has a pocket weather station to measure wind speeds and not apply herbicides contrary to California state law. The lead applicator will also be required to fill out any additional daily application reports and provide to BLM that will document what herbicides were used and where the herbicides were applied. The lead applicator will also document which species were targeted in a Pesticide Application Record (PAR), which may be in addition to the typical reporting of monthly herbicide use to the County Agriculture Department, once the yearly application fee has been accepted by the County.

Application of herbicides would be by trained applicators under the direct oversight of a Qualified Applicator who has their herbicide applicator license using low-pressure sprayers at an application rate equal to, or less than, the manufacturer's recommendation. In no instance would using the maximum rate of herbicide for direct use exceed the maximum allowable rate per acre.

Herbicides will only be applied using targeted methods (i.e., backpack sprayers or a spray rig with a handheld wand method); no broadcast treatment methods will be employed. This targeted application reduces potential impacts associated with application of herbicides to non-targeted vegetation and wildlife. The vegetation clearance procedures of Project disturbance areas will further reduce the potential for direct adverse effects to non-targeted native plants and wildlife from herbicide application. The most likely effect would be associated with the drift of herbicides into adjacent habitat. Drift is controllable by employing experienced weed control applicators who perform the weed control at a high level of efficiency while using less pressure on a backpack sprayer or boom sprayer to keep the droplet size of the herbicide mix solution larger and, therefore, heavier and less prone to movement from the tip of the wand to the basal leaves of the targeted weed species. Also, applying herbicide consistent with the labels created by the manufacturer as well as the DPR's requirements for safe and effective herbicide application will greatly reduce herbicide drift.

Added reporting requirements for all herbicide applications throughout the life of the Plan should be performed using a PAR, which could be two different forms: one that would be provided to BLM, and another that would be provided to the County.

Herbicide availability and formulations may change over time; therefore, the approach may be refined or modified to allow for use of the best available technologies and herbicide formulations. The PUP would be updated as appropriate to obtain necessary authorizations. Changes to chemicals, per BLM approval, are not expected to substantially alter the analysis of herbicide use by the Project.

Larger tree-sized weeds (i.e., tamarisk individuals) would be controlled using a "cut stump" chemical method of removal. If the cut stump method is necessary, the following procedures should be followed:

- Apply Triclopyr (e.g., Garlon™ Ultra) herbicides at a 100 percent rate to the cut stump within 2 minutes of cutting the stem (recommended label rates).
- Cover all loads to be trucked offsite using a tarpaulin and dispose at an authorized waste facility. Alternate methods of disposal may be coordinated with BLM (e.g., burning).
- Continue monitoring cut stems for as long as necessary; if regrowth appears, use Triclopyr as a foliar spray (using recommended label rates).

## 5.0 MONITORING AND REPORTING

The Project will be monitored for the presence of noxious and invasive weed species for the life of the Project; this includes the potential for follow-up weed control if the Plan's weed abatement triggers warrant this.

Monitoring requirements will apply to the RE Crimson Permitting Boundary survey plots and reference survey plots described in Section 5.1. The purpose of construction and operational monitoring and reporting will be to determine if weed populations identified prior to construction have increased in cover as a result of Project activities or if new weeds are detected that were not recorded during previous weed surveys.

### 5.1 Baseline Weed Surveys

Documenting baseline (pre-construction) conditions is an important component of the weed management program, as the performance criteria for the 5-year weed management program will be based on baseline data. For this weed management program, two types of baseline condition data will be collected: pre-impact data for impact areas and baseline conditions for adjacent reference sites (reference site). Pre-construction data collected for each impact area will consist of the total vegetation cover; nonnative vegetation cover (including species and percent cover for each species); and representative photographs.

Modified relevé data collection methods will be used to estimate nonnative vegetation cover. Below is a description of these methods modified from the California Native Plant Society's (CNPS) Relevé Protocol (CNPS Vegetation Committee 2007)

The relevé method was developed in Europe, and CNPS published a vegetation sampling protocol in *A Manual of California Vegetation* (Sawyer and Keeler-Wolf 1995) that was developed as a quantitative sampling technique applicable to vegetation communities in California (CNPS Vegetation Committee 2007). The relevé method is generally considered a "semiquantitative" method. It relies on ocular estimates of plant cover rather than on counts of the "hits" of a particular species along a transect line or on precise measurements of cover/biomass by planimetric or weighing techniques.

**Table 4**
**Relevé Categories for Percent Cover**

| Relevé Category |
|---|
| 0% |
| >0-1% |
| >1-3% |
| >3-6% |
| >6-9% |
| >9-12% |
| >12-15% |
| >15-20% |
| >20-30% |
| >30-40% |
| >40-50% |
| >50-60% |
| >60-70% |
| >70-80% |
| >80-90% |
| >90-100% |

All nonnative plants (whether annual or perennial) observed will be included in one comprehensive nonnative cover estimate for that site.

The RE Crimson baseline weed surveys would consist of surveying 31 representative survey plots, measuring 50 x 50 meters, within the area located between the RE Crimson permitting boundary (permitting boundary) and PV layout footprint. The representative survey plots were randomly selected using geographic information system (GIS) technology and are located within the permitting boundary and mapped vegetation communities (see Figure 3, labeled as Impact

Plots). Baseline surveys will include estimating absolute cover of nonnative vegetation species within each of these representative survey plots.

Reference survey plots will also be established to document the nonnative vegetation cover directly adjacent to the permanent impact areas of the Project prior to construction. An additional 31 reference survey plots, measuring 50 x 50 meters, were established (Figure 3, labeled as Reference Plots). These 31 reference survey plots correspond to each randomly selected representative survey plot mapped within a native vegetation community (within the permitting boundary). As a general rule, the representative survey plots and corresponding representative reference plots will be approximately 20 meters apart. Data collected for the reference survey plots will include all of the pre-impact data characteristics/categories described above.

Five additional 50-x-50-meter reference survey plots will be placed within the Blue Palo Verde-Ironwood Woodland vegetation communities that were specifically avoided by the Project and located between several of the permitting boundaries (Figure 3, labeled as Woodland Plots). These additional 50-x-50-meter reference survey plots will be used to collect baseline data for this adjacent vegetation community and monitor to determine if the adjacent construction activities have an indirect impact.

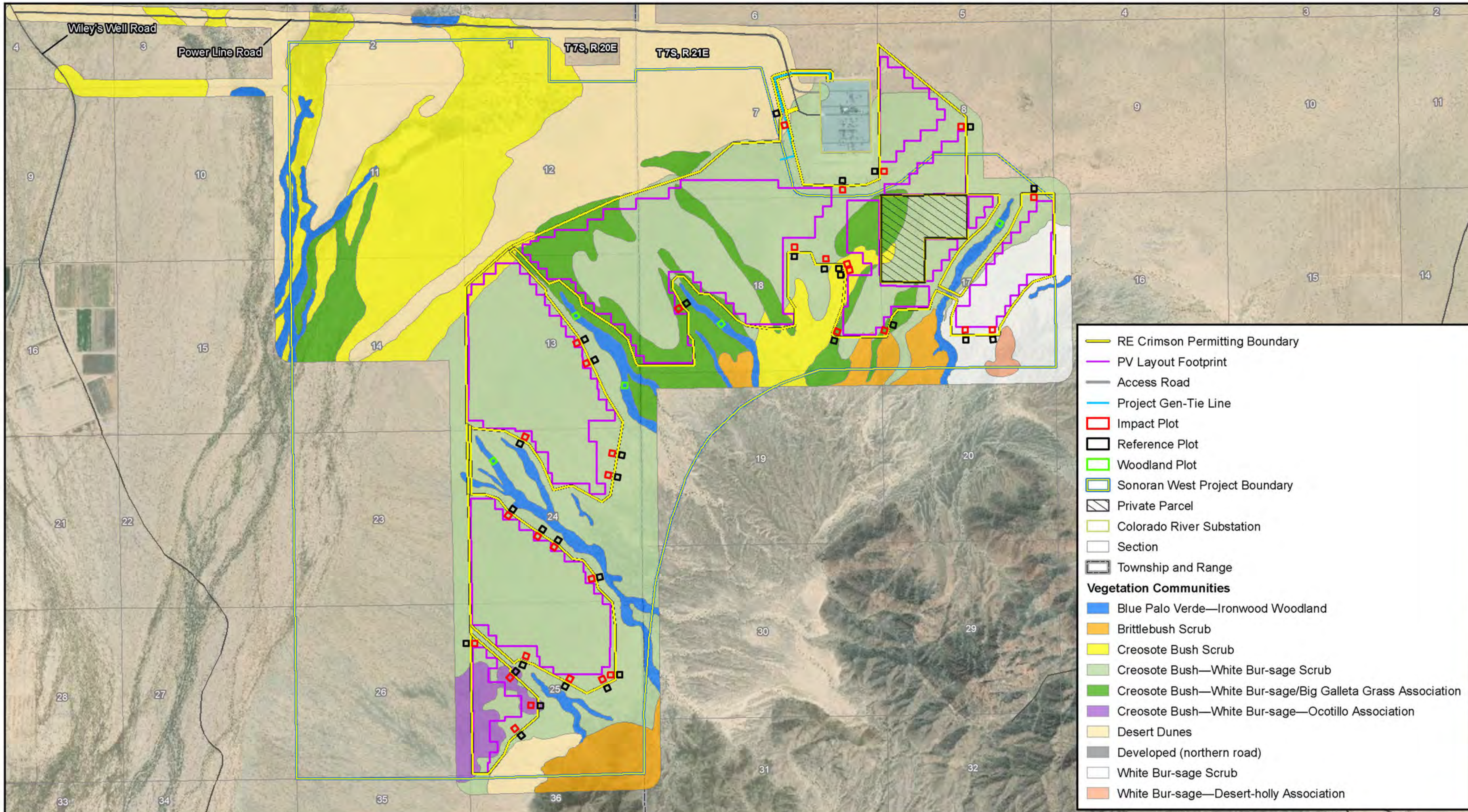
Pre-impact data collected during the proposed baseline surveys will be used to determine weed-specific management goals as described in Section 4.2. Nonnative vegetation cover will be determined for each plot using relevé and will consist of absolute cover.

An initial set of permanent photo points will be established during the baseline surveys for the representative impact and reference survey plots. These photo points will be used to visually document changes over time and verify onsite conditions. Photo points will be visited and photographed annually during the spring, at the height of the flowering season for most species throughout the weed management program.

Once the baseline survey data collection effort is complete, a letter report summarizing the baseline survey data will be submitted to BLM within 60 days.

## 5.2 Construction Monitoring

During construction, monitoring records incorporating incidental observations including relevant information regarding weed presence and population size and spread will be maintained for the duration of the construction period. A monthly visual survey will be performed that will include all of the Project's disturbance areas and adjacent reference survey plots established in support of




Source: ESRI; AECOM

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**Figure 3**
**Baseline & Post-Construction Weed Monitoring Survey**
**Relevé Unit Locations**

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baseline surveys (Figure 3). These surveys will be conducted by the WCS and crew, and timing will be adjusted based on determined need during construction activities. The WCS and crew will have substantial knowledge regarding the floristic make-up and extent of weeds on the Project site. If the WCS does not recognize a species, it will be the WCS's responsibility to collect the species and have it identified by an expert to determine if a new weed species is present. Onsite weed populations will be mapped using GIS technology.

### 5.3 Post-Construction Monitoring

For the first 5 years following completion of construction, monitoring will be conducted once during the spring (generally late March or early April through May) and after the occurrence of substantial monsoonal rains that could allow for weed seed germination. The monitoring schedule will be adjusted based on need, as determined after construction has been completed and after the first post-constructing monitoring survey. The post-construction monitoring efforts will include visiting the 67 survey plots (31 impact survey plots and 36 reference survey plots) surveyed during the weed baseline surveys. If any of the following parameters are met, the weed population should be treated:

- Nonnative vegetation cover (absolute cover) has increased more than 10 percent within any of the plots, and this increase is a result of construction activities and not a result of ubiquitous weeds already present in the surroundings.
- Any weeds not identified prior to construction have been identified within any of the plots.

After 5 years post-construction, BLM will review the weed management data. Any changes to the frequency of the weed monitoring program will be based on the evaluation of the data to determine if the success criteria have been met.

### 5.4 Operations and Maintenance

During the 5-year post-construction monitoring period, weed treatment operations may be needed to reduce or control weed populations. Once the maintenance period has commenced and the 5-year period has passed, the success criteria can be measured to determine that the level of monitoring and treatment controls was sufficient. Then BLM should revisit the Plan with the applicant. If success criteria are not met, then adaptive management efforts may be called for or increased control measures will be applied for another 2 years to satisfy BLM Manual 9015 (BLM 1992) requirements.

## 5.5 Adaptive Management

Adaptive management may be used whenever new weed species are identified or control methods are not effective within the Project or if success criteria have not been met due to the increased population spread of a targeted invasive weed. The Project will update the potential noxious and invasive weed list during the operations and maintenance phase and provide monitoring and management appropriate to any new species in coordination with BLM. At any point during the construction phase or during the operations and maintenance phase, adaptive management measures such as the following could be incorporated: dethatching of weed species using line trimmers and a blower, physically putting all plant material in piles, and then hauling all plant material including the bulk of the weed seed to an authorized landfill.

## 5.6 Reporting

Reports are required to evaluate monitoring results and document whether success criteria are being met and, if not, what additional measures should be implemented and why. The Project will provide routine monitoring reports to BLM as described below. The monitoring reports will include, but are not limited to, a summary of invasive plant species control activities conducted during construction or operations and maintenance activities within the Project site during the reporting year and an evaluation of the effectiveness of control activities conducted the previous year. Implementation of the Plan will also include the data collection and reporting elements found below.

### 5.6.1 Weed Surveys

Weeds identified during weed monitoring surveys will be mapped and recorded using GIS technology Species names and approximate weed cover will be estimated and mapped to monitor weed spread during construction and post-construction monitoring activities.

### 5.6.2 Construction Reporting

During the construction phase, weed management activities will be documented as part of monthly and/or the annual compliance reports. Construction weed monitoring reports will include the following information:

- Findings on location, type, extent, and cover of invasive weeds observed at the Project site.

- Management efforts, including date, location, type of treatment implemented, and results. Ongoing evaluation of success of treatment will be included.
- Information on implementation and success of preventative measures. Vehicle wash logs will be included in this section.

### 5.6.3 Annual Reporting

Assuming weed prevention and control measures were effective during construction, annual reporting can then commence following post-construction. Reporting should continue for a minimum of 5 years. This should include photographs and GIS spatial information that would then be provided to BLM. If weed prevention and control measures were not at an effective level then control measures would need to continue until the success criteria are met. After meeting this level, annual monitoring can commence.

### 5.6.4 Final Monitoring Report

A final monitoring report will be prepared by the Project owner at the end of 5 years of post-construction monitoring. The 5-year monitoring report will identify which measures identified in the Plan have been completed, include a summary of any adaptive management measures implemented during all phases of the Project and identify measures that continue to be needed. BLM will use the results of the final monitoring report (as well as the annual reports) to determine whether any additional monitoring or control measures are necessary.

## 6.0 REFERENCES


AECOM. 2018. *Biological Resources Technical Report for RE Crimson Solar Project, Riverside County*. January.

Barrows, C.W., E. B. Allen, and M. F. Brooks. 2009. Effects of an Invasive Plant on a Desert Sand Dune Landscape. *Biological Invasions* 11:673–686.

Brooks, M. 2000. *Schismus arabicus* in Bossard, C. C., J. M. Randall, and M. C. Hoshovsky. *Invasive Plants of California's Wildlands*. University of California Press. Berkeley, CA.

Bureau of Land Management (BLM). 1992. *Integrated Weed Management Manual*. Available at http://www.blm.gov/ca/st/en/prog/weeds/9015.html.

Bureau of Land Management (BLM). 2007. *Final Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States. Programmatic Environmental Impact Statement (PEIS) and Record of Decision (ROD)*. September.

Bureau of Land Management (BLM). 2016. *Final Programmatic Environmental Impact Statement for Vegetation Treatments Using Aminopyralid, Fluroxypyr, and Rimsulfuron on Bureau of Land Management Lands in 17 Western States*. April.

California Invasive Plant Council (Cal-IPC). 2018. California Invasive Plant Inventory, Invasive Plants of California's Wildlands. California Invasive Plant Council, Berkeley. Available at https://www.cal-ipc.org/plants/inventory/. Accessed August 2018.

California Native Plant Society (CNPS) Vegetation Committee. 2007. Relevé Protocol.

Carpenter A. T. 2010. *Element Stewardship Abstract-Tamarisk spp*. Global Invasive Species Team, The Nature Conservancy. Available at http://wiki.bugwood.org/Tamarix_spp.

Halvorsen, W. L., and P. Guertin. 2003. USGS Weeds in the West Project: Status of Introduced Plants in Southern Arizona Parks. Factsheet for *Schismus barbatus*. U.S. Geological Survey/Southwest Biological Science Center. Available at http://sdrsnet.srnr.arizona.edu/data/sdrs/ww/docs/schibarb.pdf.

James, L., J. Evans, M. Ralphs, and R. Child, editors. 1991. *Noxious Range Weeds*. Westview Press, Boulder, CO.

Legner, E. F. 2006. Puncture vine, Tribulus terrestris L. – Zygophyllaceae. Biological-Integrated Pest Control & Insect Identification. Available at http://www.faculty.ucr.edu/~legneref/biotact/ch-88.htm.

National Invasive Species Information Center. 1999. Laws and Regulations – Executive Order 13112. National Invasive Species Information Center, Available at http://www.invasivespeciesinfo.gov/laws/execorder.shtml.

Sawyer, J. O., and T. Keeler-Wolf. 1995. *A Manual of California Vegetation*. California Native Plant Society, Sacramento. 471 pp.

Sheley, R., J. Petroff, and M. Borman. 1999. *Introduction to Biology and Management of Noxious Rangeland Weeds*. Corvallis, OR.

The National Invasive Species Council. 2008. 2008-2012. National Invasive Species Management Plan. August.

United States Department of Agriculture (USDA). 2000. Public Law 106-224 Title IV – Plant Protection Act; June 20, 2000.

United States Department of Agriculture (USDA). 2003. Pest Ratings of Noxious Weed Species and Noxious Weed Seed. October.

United States Department of Agriculture (USDA). 2018. National Agriculture Library. Laws and Regulations. Executive Orders. Available at https://www.invasivespeciesinfo.gov/laws/execorder.shtml. Accessed August 2, 2018.

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# I.11 Common Raven Monitoring, Management, and Control Plan, December 2018

# FINAL
# RE CRIMSON SOLAR PROJECT
# COMMON RAVEN MONITORING, MANAGEMENT, AND CONTROL PLAN

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December 2018

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# 1.0 INTRODUCTION

The RE Crimson Solar Project (Project) is located in Riverside County, approximately 13 miles west of Blythe, California. Sonoran West Solar Holdings, LLC (applicant), a wholly owned subsidiary of Recurrent Energy (the Project proponent), proposes to construct and operate the Project. The Project is a utility-scale solar photovoltaic (PV) and energy storage project that would be located on federal lands managed by the Bureau of land Management (BLM) within the California Desert Conservation Area (CDCA) and the Desert Renewable Energy Conservation Plan (DRECP) area. The Project intends to implement a Common Raven Monitoring, Management, and Control Plan (Plan) to monitor and manage the population of common ravens (*Corvus corax*; hereafter "raven") in and around the Project to minimize the risk of predation to the federally listed threatened desert tortoise (*Gopherus agassizii*) and other sensitive wildlife species during Project construction, operations and maintenance (O&M), and decommissioning.

## 1.1 Purpose and Objectives

The purpose of the Plan is to identify the conditions of concern specific to the Project that may attract ravens to the Project (and potentially increase their numbers above the current baseline population estimate) and to ensure that the construction, O&M, and decommissioning do not attract ravens to the Project by creating food or water subsidies, perch sites, roost sites, or nest sites. The Plan includes monitoring, management, and control measures that will (1) monitor raven activity and (2) specify management and control measures that will avoid, minimize, or mitigate impacts from construction through decommissioning of the Project. The monitoring effort is intended to provide data that can be interpreted to determine if the baseline raven population has increased and if management practices (detailed in Section 4.0) are effective at discouraging raven use of the Project, or if additional management and control measures are necessary.

Specific Plan objectives include:

1. Clearly identify how the Project management practices would manage the conditions of concern specific to the Project that may attract ravens to the area. The goal of these management practices is to ensure there is no substantial increase above baseline in the number of ravens observed (including fly-overs) (exceeding 4 ravens during the winter [mid-November through January 31] and 19 ravens during the spring [February 1 through May 31]) using the Project on an annual basis.

2. Document the effectiveness of management practices implemented for the Project.

3. Specify how, when, and what mitigation measures would be selected and implemented if the monitoring suggests the need for additional controls.
4. Define triggers for modification of management and control measures using adaptive management principles.

Without the implementation of monitoring, mitigation, and adaptive management, the Project has the potential to indirectly adversely impact populations of the desert tortoise and other wildlife detected at the Project including Mojave fringe-toed lizard (*Uma scoparia*) and burrowing owl (*Athene cunicularia*). The Mojave population of desert tortoise is listed as threatened under the federal Endangered Species Act (ESA) and California ESA. The Mojave fringe-toed lizard and burrowing owl are BLM Sensitive Species as well as California Species of Special Concern. Attracting ravens to the areas (and potentially increasing the population of ravens in the area) could thereby increase potential raven predation on juvenile desert tortoise and other wildlife.

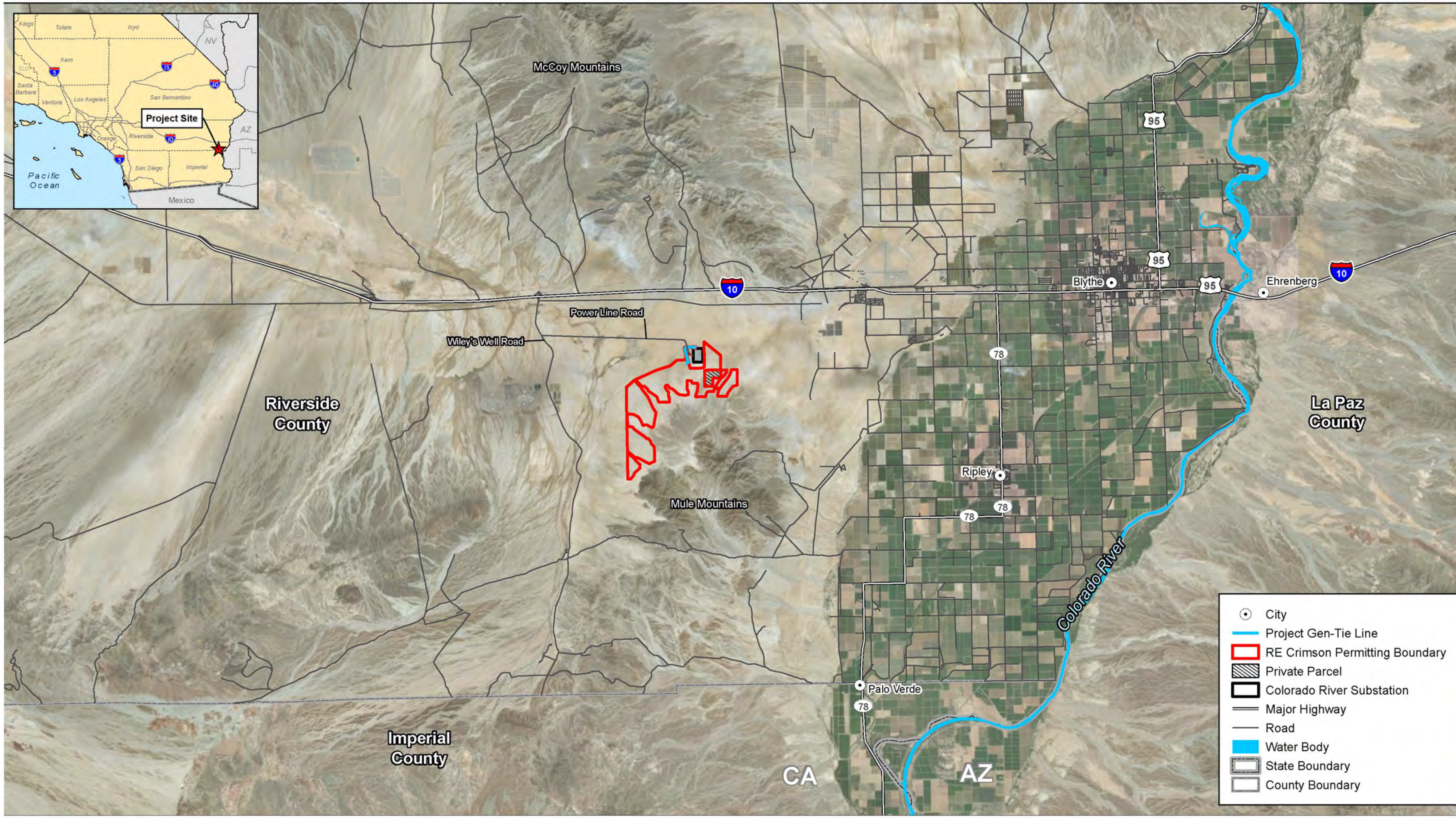
## 1.2 Background

A larger area (7,600 acres) consisting of the Project area and surrounding BLM and private lands was originally proposed for development by BrightSource Energy, Inc., as the Sonoran West Solar Energy Generating Facility (Sonoran West Project [SWP] Site). Biological surveys were conducted in 2011/2012 across the SWP Site, after which a substantially smaller area was chosen for the current Project (2,489 acres). Biological surveys were conducted again in 2016/2017 for the smaller current Project area to establish a baseline estimate of raven occurrence and density in the area to later compare with raven numbers post-construction of the Project. The results of the baseline surveys are included herein to establish a baseline occurrence and density estimate prior to construction.

## 1.3 Project Description

The proposed Project is located in unincorporated eastern Riverside County, approximately 13 miles west of Blythe, just north of the Mule Mountains and just south of Interstate 10 (I-10), (Figure 1). The Project site consists of approximately 2,489 acres of BLM-administered land within the Riverside East Solar Energy Zone/Development Leasing Area and within the DRECP Development Focus Area (BLM 2015). The Project would interconnect to the regional electrical grid at Southern California Edison's (SCE's) Colorado River Substation (CRS). It would generate up to 350 megawatts (MW) of renewable energy using PV technology and would include up to 350 MW of integrated energy storage capacity. Since the Project would utilize PV technology, no evaporation ponds, or other temporary or permanent surface water storage ponds are necessary.

The total area for the Project (i.e., RE Crimson Permitting Boundary; 2,489 acres) includes a 2,465-acre solar field development area with approximately 1,859 acres of solar modules (array blocks) and 24 acres for linear facilities, including access/perimeter roads assuming a 30-to 60-foot corridor width and gen-tie and powerline corridor at 150 feet. The Project applicant is proposing to construct the Project using traditional construction methods consisting of permanent desert




Source: ESRI; AECOM.

3 1.5 0 3 Miles

1:190,080 1 inch = 3 miles

**Figure 1**
**Regional Map**

RE Crimson Solar Project Common Raven Monitoring, Management, and Control Plan

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tortoise exclusion fencing (per USFWS 2009), mow-and-roll of vegetation for site preparation, compacted roads, and trenching for electrical lines. The applicant is also actively investigating alternative low environmental impact design (LEID) elements and the potential for those to reduce Project impacts.

LEID elements include several potential design changes, including the following:

- Minimizing grading during site preparation and maintaining more onsite vegetation to facilitate post-construction residual habitat value and post-operations/site reclamation success.
- To reduce ground disturbance, avoid or limit trenching by placing electrical wiring aboveground.
- To reduce ground disturbance, place transformer/inverter groups on elevated support structures in lieu of cement foundations.

The LEID elements would minimize grading, trenching, and vegetation removal beyond traditional design approaches for PV projects with the objective of reducing overall long-term impacts for the Project. At this time, it has not been decided which, if any, LEID elements may be incorporated into the final Project construction design. Therefore, this Plan assumes a traditional construction approach is taken and that no LEID elements are incorporated. This Plan may need to be modified or amended once the final construction and operations design are determined as several of the LEID elements may influence the attractiveness of the Project to ravens.

### 1.4 Site Description

The Project site consists of undeveloped land that is owned by the federal government and administered by the BLM. There is a 120.5-acre private parcel in the center of the Project site that currently is not planned for use by the Project, and surveys were not conducted within the private parcel. There are no existing structures within the Project that would need to be demolished, and no existing roads are present within the Project solar development area. Existing SCE transmission lines and a paved access road (Power Line Road) oriented east-west are located along the northern boundary of the Project site that lead to the CRS. The unpaved portion of Power Line Road then continues from the CRS in a southwesterly direction on the east side of the Project site. I-10 is just over 1 mile north of the northern Project boundary, and the western edge of the Colorado River Valley is approximately 4.5 miles to the east (Figure 1).

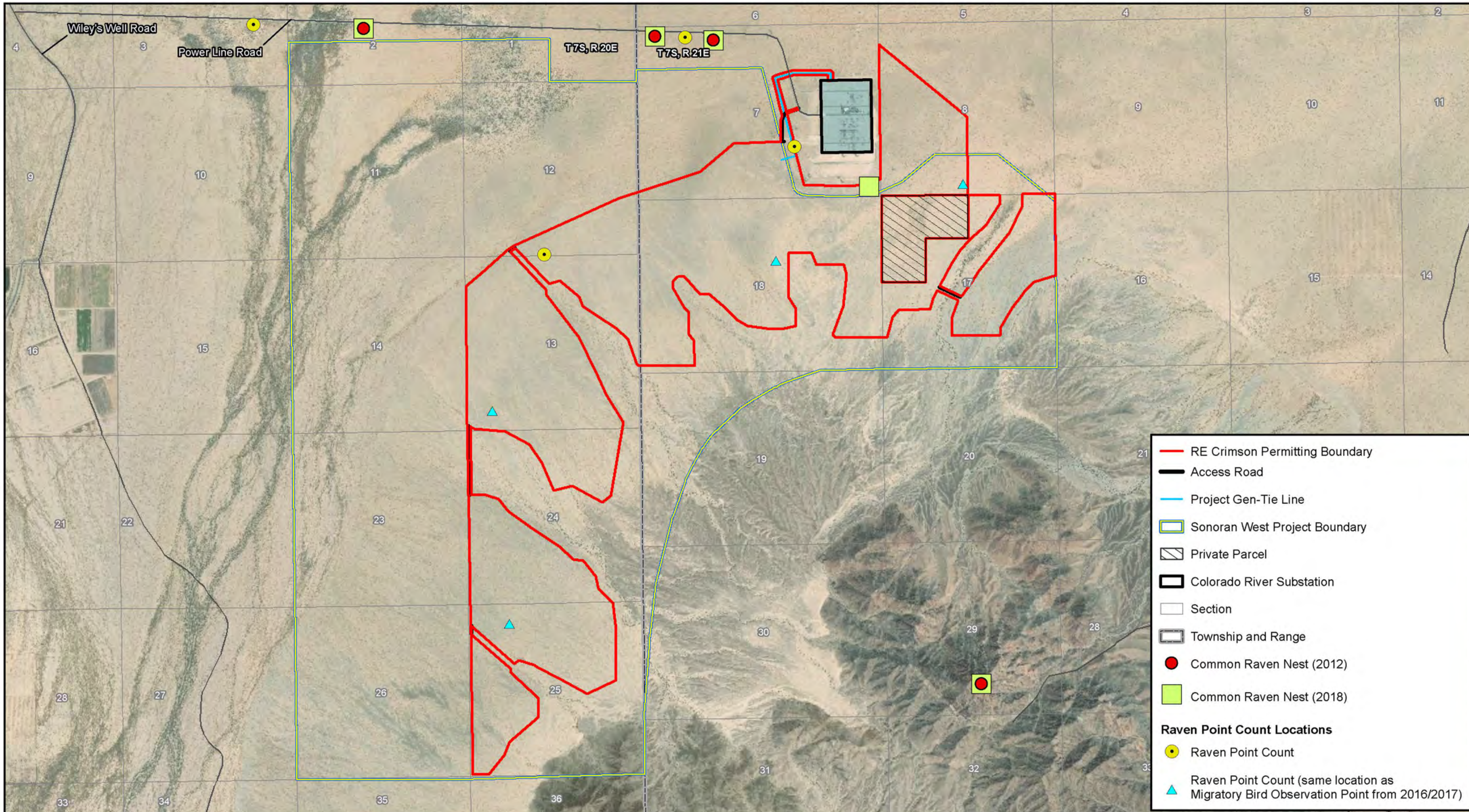
The site is located at the northern foot of the Mule Mountains Area of Critical Environmental Concern. The SCE high-voltage transmission line and CRS are directly north of the Project site, and I-10 is north of and parallel to those facilities. Federally designated critical habitat for desert tortoise within the Chuckwalla Critical Habitat Unit and the vast Chuckwalla Desert Wildlife Management Area are west of the Project site.

Regionally, the Project is situated within the Colorado Desert on gently rolling open terrain dominated by desert scrub vegetation. Desert scrub vegetation (e.g., creosote bush scrub) covers most of the Project area, except for sparsely vegetated desert dunes and more heavily vegetated desert washes (with microphyll woodlands). The Project has been sited to avoid the majority of desert washes and microphyll woodlands; hence, there are no tall trees within the RE Crimson Permitting Boundary. The Project site has a gentle slope north and west, away from the base of the Mule Mountains, with elevation ranging from a high of about 710 feet above mean sea level (AMSL) around the base of the Mule Mountains to a low of about 430 feet AMSL near the northwestern corner closest to I-10. Terrain onsite generally slopes down from higher land at the base of the Mule Mountains to the south.

## 1.5 Baseline Common Raven Population Estimates

### 1.5.1 2012 Survey Methods and Results

During golden eagle aerial surveys in spring 2012, nests of all corvid and raptor species were recorded and several raven nests were located along Power Line Road in SCE transmission towers that connect to the CRS (Bloom Biological 2012 as cited in AECOM 2018; Figure 2). No nests were documented within the SWP Site; however, several raven nests were located on cliff substrate with one nest in the Mule Mountains, and several within the Palo Verde Mountains. No density estimate for ravens was calculated in 2012, rather 43 raven observations occurred during the various biological surveys from April through May of 2012. Some of these observations may be of the same individuals, and since these data were not collected in a standardized way, the data are not used as part of the baseline raven density for the Project. The density and abundance of ravens in and around the SWP Site is likely limited by the lack of permanent standing water. The closest permanent above-ground easily accessible water source is located at the Ironwood and Chuckwalla Valley State Prisons, approximately 2.6 miles to the west of the RE Crimson Permitting Boundary. There are other scattered water sources along Wiley’s Well Wash, however it is not known if they contain water year-round. The full details of the 2012 survey methods and results are detailed in the *RE Crimson Solar Project Biological Resources Technical Report* (AECOM 2018).




Source: ESRI; AECOM. Bloom Biological, Inc. 2018

3,000 1,500 0 3,000 Feet

1:36,000 1 inch = 3,000 feet

**Figure 2**
**Historical Common Raven Nest and Point Count Locations**

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### 1.5.2 2016/2017 Survey Methods and Results

To estimate the number and density of ravens within the RE Crimson Permitting Boundary, two types of avian surveys were conducted during 2016 and 2017. While recording all avian species detected within the RE Crimson Permitting Boundary, ravens were recorded during migratory bird observation point surveys and migratory bird transect surveys, which are detailed briefly in the following paragraphs.

Migratory bird observation point surveys were conducted by biologists surveying at each of four points spread evenly across the RE Crimson Permitting Boundary for two migratory seasonal periods: fall 2016 (July 18 through November 18) and spring 2017 (February 1 through May 31). Each of the four observation points was surveyed for a total of two surveys per point per week during spring and fall migration with the ideal mix being once in the morning (5 a.m. to 11 a.m. window) and once in the afternoon (1 p.m. to 8 p.m. window) each week. Hence, each of the four migratory bird observation points was surveyed for 8 hours total per week. Survey results were analyzed to estimate detections based on number of birds detected per hour of observation then multiplied by 100 to avoid detection estimates less than 1. Thus, the unit of measure for detection estimates was detections per 100 hours of observation. The number of raven observations during fall 2016 and spring 2017 was estimated as the number of ravens observed per 100 hours of survey time. During migratory bird observation point surveys, the rate of detection for ravens was less than 1 bird (0.87 ravens) per 100 hours of observation during fall 2016 and 4.49 birds per 100 hours of observation for spring 2017. There are no baseline data for the number of ravens detected per 100 hours of observation during summer and winter since baseline data were collected only during spring and fall periods.

Migratory birds transect survey efforts were conducted for 1 year (July 2016 through July 2017). Surveys consisted of biologists walking four 1,750-meter transects on a weekly basis during spring (February 1 through May 31) and fall (July 18 through November 18), and on a biweekly (every 2 weeks) basis during summer (June 1 through July 17) and winter (November 19 through January 31). Raven density estimates were calculated using distance sampling methods from transect survey data as detailed in the *RE Crimson Solar Project Biological Resources Technical Report* (AECOM 2018). Analyses were conducted using distance sampling methods and distance software (Thomas et al. 2010) to estimate raven density during different seasonal periods. The density estimate for ravens during fall 2016 was 0.22 birds per 100 acres, during winter 2016/2017 was 0.15 birds per 100 acres, and during spring 2017 was 0.77 birds per 100 acres. No ravens were detected within 100 meters of transects during summer 2017 or fall 2017 surveys and, therefore, have an estimated density of 0 birds per 100 acres. Density estimates across the entire RE Crimson Permitting Boundary range from 3.7 (or 4 birds) during winter when observed densities were lowest, to 19.2 (or 19 birds) during spring when densities were the highest due to birds breeding. These numbers are estimates (generally of birds flying overhead), and the actual density of ravens would vary across the RE Crimson Permitting Boundary (based primarily on resource distribution); however, they provide a baseline of raven density prior to Project construction.

No raptor or raven nest surveys were conducted during 2016/2017, and no raven nests were observed during any biological surveys within the RE Crimson Permitting boundary during 2016/2017. Golden eagle nest surveys were conducted in early 2018, including mapping of all known raptor or large corvid nests (Bloom Biological 2018). These data are included on Figure 2. Many of the same raven nests that were occupied in 2012 were still present during 2018 golden eagle surveys.

### 1.6 Conditions of Concern

The conditions of concern are those Project features and/or activities that, when not properly managed, provide subsidies that may result in changes in raven population or behavior that could potentially adversely affect desert tortoise, Mojave fringe-toed lizard, and other wildlife species population in the vicinity of the Project. Four basic conditions of concern have been identified for the Project and have been considered in developing this Plan:

1. Potential creation of new perching/roosting/nesting sites;
2. Water ponding or puddle potential from construction, O&M, and decommissioning activities (e.g., dust suppression, etc.);
3. Food and waste management (including management of roadkill); and
4. Food sources from soil disturbance (e.g., rodents, insects, etc.).

The study design for raven monitoring, as well as measures for raven management and control, is dependent upon the conditions of concern, as detail below.

#### 1.6.1 Perching, Roosting, and Nesting Sites

The majority of raven predation on juvenile desert tortoise is thought to take place during the spring, most likely by breeding birds that have been shown to spend most of their time foraging within 1,300 feet of their nests (Kristan and Boarman 2003). Therefore, structures that facilitate nesting may pose a danger to nearby desert tortoise populations as ravens forage around their nest locations to provide food for their young. Project components, such as transmission poles and lines, buildings, water towers, transformers, and support structures provide elevated perching sites that have the potential to increase raven use of the Project site. Currently, three transmission lines run parallel to Power Line Road and connect to the CRS. Two of these transmission lines, operated by SCE (known as Devers to Palo Verde No. 1 and Devers to Palo Verde No. 2) are lattice-type transmission towers that have existing raven nests on some of the towers (Figure 2). The third transmission line connects the Genesis Solar Energy Project to the CRS and consists of cement monopoles that are less suitable nesting structures than the adjacent SCE towers. The Project would add a short gen-tie line adjacent to these existing lines to connect the solar arrays to the CRS, which would provide additional nesting structures for ravens.

Project features such as buildings and structures, and solar panels within the boundary of the solar facility provide a matrix of structures for ravens to use different from and lacking in the adjacent desert landscape. Since ravens are an opportunistic species, they have learned to perch, roost, and nest on anthropogenic structures, which are often times higher in elevation than the naturally occurring vegetation. This provides ravens with the advantage of perching and scanning for food at a higher level than the surrounding desert scrub.

Solar panels throughout the solar fields provide raven perching locations, shade, and opportunities to prey on other species using the arrays for shade. Additionally, solar fields provide protection from the wind that ravens can use during the heat of the day, or during high wind events. The solar panels also provide nesting opportunities for other avian species, which can attract ravens as prospective predation opportunities.

#### 1.6.2 Ponding Water

During construction, water will be applied to graded areas, construction rights-of-way, dirt roads, trenches, spoil piles, and other areas of ground disturbance to minimize dust emissions and topsoil erosion. Ponding water resulting from these dust suppression activities has the potential to attract ravens (for drinking, particularly in the desert where water is a limited resource), thereby attracting ravens to the Project and increasing the opportunity for ravens to encounter desert tortoise, potentially resulting in increased desert tortoise predation. During O&M, solar modules will be washed with water as needed to maintain optimal electricity production (up to four times per year) using light utility vehicles with tow-behind water trailers or an equivalent approach. The water will be permitted to flow off the panels onto the ground with a minimal amount of water that is not anticipated to result in ponding below the panels. Decommissioning is assumed to have a similar risk as construction depending upon the proposed final use.

### 1.6.3 Human Food and Waste Management, including Roadkill

Ravens have a diverse prey base and are very adept at locating, remembering, and finding new food sources. They eat carrion; small animals from the size of mice and baby tortoises to medium-sized birds; eggs; grasshoppers, beetles, scorpions, and other arthropods; insects; vegetation; fish; berries; pet food; and many types of human food including unattended picnic items and garbage (Cornell University 2017). Ravens are considered scavengers that obtain food from human subsidies such as food brought onsite by employees, garbage thrown into the back of pickup trucks, and roadkill. In addition, construction waste piles (packaging material, wooden pallets, etc.) also attract small mammals (e.g., rodents) that become an additional food source for ravens. The construction, O&M, and decommissioning phases of the Project will result in increased food and waste generation in the Project site, which may attract ravens.

### 1.6.4 Raven Food Sources from Soil Disturbance

During construction (especially during clearing and grubbing the site), O&M, and decommissioning, disturbance of the soil will occur from heavy equipment operation. This may include activities such as grading, blading, leveling, and trenching, where the soil is mixed and churned up. This disturbance will result in the "unearthing" and exposure of natural food sources for ravens such as insects, reptiles, and rodents. Biologists supporting various solar projects in the Mojave and Colorado Deserts have observed ravens being attracted to soil disturbance areas to prey on unearthed, injured, and dead animals. Ravens are often observed walking or flying behind ground-disturbing vehicles and picking off prey items as the soil is disturbed.

## 2.0 REGIONWIDE RAVEN MANAGEMENT AND MONITORING PROGRAM

The U.S. Fish and Wildlife Service (USFWS), along with several other cooperating agencies, have developed a regional raven management and monitoring program in the CDCA to address the potentially significant regional threat that increased raven populations pose to desert tortoise recovery efforts (USFWS 2010). The purpose of the region-wide program is to mitigate for the cumulative effects of the Project and other projects in the range of the desert tortoise. Pursuant to this program, the Project Proponent will contribute to the region-wide effort by a payment of $105 per acre of estimated total disturbance (including temporary and permanent disturbance totaling 2,489 acres). The funds contributed by the Project Proponent will be deposited into the sub-account of the Renewable Energy Action Team account held by the National Fish and Wildlife Foundation as part of a Desert Conservation Fund until needed to implement the region-wide program. Prior to construction, the Project Proponent will contribute a total of $261,345 to the fund to avoid, minimize, and mitigate potential impacts to desert tortoise resulting from increased raven predation associated with the Project.

# 3.0 ROLES AND RESPONSIBILITIES

## 3.1 Environmental Compliance Manager

The Project Proponent will assign an Environmental Compliance Manager (ECM) to the Project. The ECM is responsible for facilitating implementation of the environmental conditions of the Project. Typical ECM duties involve managing, supervising, and/or providing advice on work affecting air quality, water/streambed permits, and the biological resources environmental compliance program.

The ECM must have experience in the implementation of general environmental compliance measures and must have specific training by designated qualified biologist (as defined below) to conduct biological monitoring activities specified in this Plan. The ECM will be present, or available as appropriate, to manage compliance activities during all phases of the Project and will work closely with the qualified biologist to facilitate implementation of this Plan, and to coordinate between the Project proponent and the various Resource Agencies (BLM, USFWS, and California Department of Fish and Wildlife). The ECM will conduct the raven monitoring surveys during the O&M phase of the Project.

## 3.2 Qualified Biologist

The Project Proponent will assign a qualified biologist to the Project. The qualified biologist is responsible for the daily implementation of this Plan primarily during the construction phase of the Project. The qualified biologist will train the ECM in the proper data collection methods for raven monitoring so that the ECM can conduct the raven monitoring surveys once the Project is in the O&M phase.

A qualified biologist may include a Designated Biologist, biological monitor, or other biologist qualified to conduct raven surveys. A resume of each qualified biologist will be submitted to the BLM for approval in consultation with the CDFW and USFWS. The qualified biologist will have the following background and training:

- Bachelor's degree in biological sciences, zoology, botany, ecology, or a closely related field; and 3 years of experience in field biology or current certification of a nationally recognized biological society, such as The Ecological Society of America or The Wildlife Society; and

- At least 1 year of cumulative field experience with biological resources found in or near the Project area (such as in desert environments in the Southwest).

In lieu of the above requirements, the resume will demonstrate, to the satisfaction of the Resource Agencies, that the proposed qualified biologist or alternate has the appropriate training and background to effectively implement this Plan.

The Project Proponent will ensure that the qualified biologist performs the activities specified in this Plan and they will designate an alternate biologist (to fulfill the role of the qualified biologist during any absence) with the same qualifications as the qualified biologist outlined above.

# 4.0 MANAGEMENT PRACTICES

This section specifies management practices that the Project Proponent proposes to implement to accomplish the purpose of this Plan as identified in Section 1.1. The management practices are designed to avoid creation of new subsidies and thus reduce the use of the Project site by ravens. The goal is to have no substantial increase in the resident raven population using the Project (and not just flying overhead/in transit), including no nesting on any Project-related structures, during construction and O&M compared to baseline observation numbers (0.87 ravens per 100 hours of observation during fall 2016 and 4.49 birds per 100 hours of observation for spring 2017; density of 4 ravens during the winter and 19 ravens during the spring), understanding that baseline numbers are a snapshot in time (2016/2017) and will fluctuate over time. The four basic conditions of concern identified in Section 1.6 have been grouped into construction and O&M phase conditions, as appropriate for the Project. Construction phase conditions are considered temporary and are anticipated to be avoided or minimized mainly by the implementation of management measures as defined in Section 4.1 below. O&M conditions will include management measures to minimize potential impacts and may require additional control measures based on the results of the monitoring program (Section 4.2). If these management practices are not effective in accomplishing the goals of this Plan, modifications to these practices and/or additional practices will be implemented and monitored under adaptive management to ensure effectiveness of the Plan’s purpose.

## 4.1 Construction

Construction phase impacts are considered more temporary in nature than O&M impacts and would therefore require temporary management practices to avoid or minimize the potential to attract ravens to the Project. Construction phase conditions of concern for the Project include ponding water, creation of potential nest and roost sites, food and waste management, and food sources from soil disturbance. Construction phase impacts would be similar during the decommissioning phase of the Project, and therefore decommissioning impacts are not discussed separately.

#### 4.1.1 Perching, Roosting, and Nesting Sites

Construction activities may create temporary perch, roost, or nest sites for ravens by introducing equipment or materials to the landscape that provide height and suitable nest platforms for ravens. Monitoring, as detailed in Section 5.1, will evaluate the presence of ravens during construction. If ravens are identified then perching, roosting, or nesting on building materials, equipment, waste piles, or other construction debris, hazing, or other techniques, will be employed to discourage use.

#### 4.1.2 Ponding Water

To minimize the occurrence of ponded water associated with dust control activities, the application rates of water for dust suppression activities will be predetermined to minimize excessive application. The application rate should consider soil infiltration and evaporation rates. The ECM or designated monitors will patrol areas to verify water does not puddle for long periods (more than 1 hour) and make recommendations for reduced water application rates where necessary, as discussed in Section 6.0. Ponded water may also occur at fill stations established at the Project to fill water trucks. The fill station will be designed to adequately drain water to prevent ponding.

#### 4.1.3 Human Food and Waste Management, including Roadkill

A trash abatement program will be established during the construction phase and continue for the life of the Project. Trash and food items will be contained in closed, secured containers and removed routinely (no less than weekly), to prevent the attractiveness to opportunistic predators such as ravens. A mandatory Worker Environmental Awareness Program (WEAP) for all personnel working on the Project will assist in facilitating proper waste management, such that trash is not placed in the open beds of pickup trucks, stored in open containers, or otherwise accessible to ravens. Additionally, the WEAP will cover the posted speed limit on Power Line

Road (25 miles per hour [mph]), and all roads within the Project (15 mph) to reduce the potential for roadkill. Ravens are known to fly along roads in search of roadkill, and monitoring roadkill with immediate proper removal/burial/disposal of all encountered roadkill will reduce food subsidies for ravens[1]. Monitoring of the construction site as well as access roads will be conducted daily to expedite proper disposal of all trash and any encountered roadkill. Generally, the qualified biologist will slowly drive Power Line Road several times throughout the day (but at a minimum in the morning while driving to the site, and in the afternoon while leaving the site) to check and remove any roadkill, as well as verify personnel are maintaining the posted 25 mph speed limit.

#### 4.1.4 Raven Food Sources from Soil Disturbance

During construction activities, specifically vegetation clearing, grubbing, and grading, insects, rodents, and reptiles will be unearthed, providing a food subsidy and increased attraction for ravens to the Project site. Monitoring during soil-disturbing activities will be essential to move species out of harm's way (to the extent feasible to prevent them from becoming raven prey) and to deter ravens from actively foraging during vegetation clearing and grubbing. Some wildlife species unearthed, or discovered during soil disturbance may be captured safely by hand using various tools and methods and relocated offsite. Any special-status species that are injured or killed as a result of soil disturbance will be documented in daily compliance reports. Any dead wildlife will be buried off-site, or disposed of in closed containers. Where determined necessary by the qualified biologist, any injured wildlife may be taken to a local wildlife rehabilitation facility.

### 4.2 Operations and Maintenance

O&M phase impacts are considered ongoing impacts and would therefore require ongoing management practices to avoid or minimize the potential to attract ravens to the Project. O&M phase conditions of concern for the Project include perching, roosting, and nesting sites, and food and waste management, including minimizing roadkill.

#### 4.2.1 Ponding Water

To minimize the occurrence of ponding water, the application rates of water for dust suppression activities, if necessary, will be predetermined to minimize excessive application. The application

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1 Management of avian mortalities will be managed in accordance with the Bird and Bat Conservation Strategy for the Project.

rate should consider soil infiltration and evaporation rates. The ECM or designated monitor will patrol areas to ensure water does not puddle for longer than 1 hour and will make recommendations for reduced water application rates where necessary. During O&M, water will be used to wash PV panels (up to four times annually); however, the amount of water used will be minimal and is not anticipated to result in ponded water onsite. If water is ponding for longer than a few hours, changes will be made through adaptive management. This does not include water that ponds as part of normal rainfall patterns.

### 4.2.2 Perching, Roosting, and Nesting Sites

Management practices would be implemented to avoid introducing new subsidies by minimizing the attractiveness of Project components for perching, roosting, and nesting by ravens. This may include consultation with the Avian Power Line Interaction Committee (APLIC) (2006) guidelines during the design and construction of the gen-tie line. Potential management practices that would be considered to reduce impacts from these Project components primarily include the use of physical bird deterrents such as, but not limited to, anti-perching (e.g. bird spikes) and nesting devices, and auditory and visual deterrents. In addition, raven nest removal (Section 5.3 below) or nest management (e.g. egg oiling) would occur in conjunction with monitoring.

### 4.2.3 Human Food and Waste Management, including Roadkill

The trash abatement program developed for the construction phase will also include O&M phase measures to be implemented for the life of the Project. Trash and food items will be placed in closed, secured containers and removed routinely and no less than weekly, to reduce the attractiveness to opportunistic predators such as ravens. No food or trash (or trash bags) will be permitted to be stored in the open bed of pickup trucks or other exposed area. The ECM will continue to verify that these practices are enforced and make recommendations for improvements where applicable as discussed in Section 6.0.

During O&M, the ECM will conduct informal monitoring of roadkill along Power Line Road (recorded incidentally each time they drive to and from the Project site) and throughout the access roads within the Project (incidentally while driving around the Project).

## 5.0 MONITORING PRACTICES

Generally qualitative monitoring will be implemented to assess the efficacy of management practices and to determine the need for implementing additional control measures. Monitoring practices are intended to evaluate the potential impacts that construction and O&M may have on raven activity and populations, which could result in potential impacts to nearby desert tortoise, Mojave fringe-toed lizards, and other sensitive species. Raven monitoring will be implemented during the construction, O&M, and decommissioning phases of the Project. Decommissioning phase monitoring practices would be similar to the construction phase of the Project, and therefore decommissioning monitoring practices are not discussed separately.

The monitoring program is aimed at monitoring the effectiveness of the management practices implemented with the goal of avoiding new subsidies for ravens at the Project and evaluating the overall effects of the Project and specific Project components (i.e., PV panels) on the raven population (e.g., activity or presence). To understand the potential effects of the Project on the raven population, the baseline data from 2016/2017 will be compared with data recorded during monitoring to determine if there is a substantial increase in the number of ravens detected per observational hour, as detailed below.

## 5.1 Construction Phase

To identify potential increases in raven activity (above baseline conditions), the qualified biologist and/or biological monitors will conduct surveys using the same four migratory bird observation points where baseline surveys were conducted in 2016/2017 (Figure 2). Conducting surveys at the same four locations as baseline surveys (using standardized survey locations) allows for direct comparison between the datasets by removing the confounding variable of changing survey location. Four additional survey locations will be chosen that are specific to potential raven subsidy locations, such as along Power Line Road, water truck filling stations, materials yards, trailers, etc. Some potential examples of monitoring points are depicted in Figure 2. Both weekly breeding season and biweekly nonbreeding season surveys will be conducted as outlined in Sections 5.3 and 5.4 below during construction. Monitoring efforts will be more focused on recording raven activities/behavior in relation to Project activities by careful raven observation from the standardized survey locations. This may allow for detection of more "big picture" data such as observations of ravens foraging along roads, perching on equipment, etc., and more opportunities for implementing preventative management. Conducting raven surveys at the same level of effort during both construction and O&M will allow for accurate estimates of raven detections across time, which can be compared to the baseline data.

In addition to raven breeding and nonbreeding season surveys at fixed observation points, surveys for raven nests will be conducted during the construction phase. While the qualified biologist or biological monitors are conducting the raven breeding and nonbreeding season surveys at fixed observation points, they will record any raven nests that are observed on any structures within the RE Crimson Permitting Boundary, or along Power Line Road, or around the Colorado River Substation, including any structures related to the Project. Historical nests detected in 2012 and 2018 are shown on Figure 2. These nests are likely to be used in the future, unless they are removed. Any unoccupied nests will be removed as outlined in Section 5.5, below. Any nests documented within SCE transmission towers cannot be removed by Project personnel but will be monitored. If predated juvenile desert tortoise, Mojave fringe-toed lizards, or other sensitive species are detected at the base of the towers, SCE and the Resource Agencies will be contacted and the transmission tower location will be provided to allow SCE to take the appropriate course of action as outlined in the SCE Raven Control Plan (CH2MHILL 2011).

## 5.2 Operations and Maintenance Phase

To identify potential increases in raven activity during the O&M phase of the Project, the qualified biologist/ECM will conduct the following: (1) breeding season monitoring surveys (weekly surveys between February 1 through June 30), and (2) nonbreeding season monitoring (biweekly surveys from July 1 through January 31) at the Project site for the first 5 years of Project O&M.

### 5.2.1 Breeding Season Monitoring Surveys

Breeding season raven monitoring surveys will occur weekly starting at the beginning of the breeding season (February 1) and continue through June 30 for a total of 22 surveys per year, as recommended by Berg (1999). Since ravens can construct a typical nest in about 9 days and begin to lay eggs shortly thereafter, weekly surveys during the breeding season are suggested to observe potential nest building and allow for nest removal prior to egg-laying (if determined necessary). Surveys will be conducted by the qualified biologist during the first breeding season survey period. The ECM will accompany the qualified biologist during the first few surveys to understand how surveys are conducted and be familiar with data collection. Any new ECM would need to receive training by the qualified biologist. These surveys will be conducted by the ECM for the first 5 years of Project O&M.

Surveys will be conducted at the four raven point count locations shown in Figure 2, plus up to four other locations that will be selected by the qualified biologist/ECM for a total of eight raven point count locations. Four of the raven point count locations will be identical to the migratory bird observation points surveyed in 2016/2017 and the other four points will be new locations where ravens have a potential to be attracted. Each point count location will be surveyed for 10 minutes. The point count locations will be surveyed at different times of the day to obtain a sample of raven activity throughout the day. The surveys will be conducted in the early morning (dawn to 3 hours after dawn), mid-day (11 a.m. to 2 p.m.), and late afternoon hours (3 hours prior to dusk). Surveys will not be conducted during substantial sustained wind (over 20 miles per hour) or rain that interferes with audible or visual detection of ravens. Data will be entered into a Microsoft Excel (or similar) database and will include the following information:

- date and time of survey
- observer
- weather conditions (average wind, temperature, percent cloud cover)
- monitoring point number
- approximate age (if known) and number of ravens
- raven behavior (flying [differentiate between foraging flights, and transit flights], perching, carrying nest material, foraging, etc.)
- horizontal distance and direction of raven from the monitoring point
- any follow-up actions required (trash that needs to get cleaned up, roadkill that needs to be removed, raven nest that needs to be removed, any dead or dismembered desert tortoise or Mojave fringe-toed lizards or other sensitive species, etc.)

All utility poles and other structures within the RE Crimson Permitting Boundary and along Power Line Road will be searched for nests while driving between raven monitoring points. A global positioning system (GPS) coordinate, as well as nesting substrate and current breeding status (if detectable), will be recorded for each nest located. Once data have been collected, the ECM will determine if the nest is unoccupied (i.e., no eggs in the nest or nestlings have fledged), in which case, the nest will be removed if feasible (see description of nest removal below in Section 5.5). The ECM will search a 30-meter radius surrounding each nest or perch site for evidence of desert tortoise, Mojave fringe-toed lizard, and other sensitive species predation. Any predated desert tortoise will be photographed, a GPS coordinate collected, and the length measured (or estimated). In addition, each desert tortoise carcass will be marked to avoid duplication of data recording on subsequent surveys. If occupied nests are detected during surveys, the Resource Agencies will be notified for assistance to determine if control measures (e.g., egg oiling) discussed in Section 6.4.1, below, are warranted and feasible at a particular nest..

An increase in the number of raven and raven nests in the Project vicinity may suggest the potential need for revisions to management practices or additional control measures (as described in Section 6.0).

### 5.2.2 Nonbreeding Season Monitoring Surveys

Nonbreeding season surveys cover the rest of the year when birds are not breeding but may be using the Project site for foraging, perching, and roosting. The qualified biologist/ECM will conduct biweekly surveys during the nonbreeding season to record raven activity at the same eight permanent monitoring points as the breeding season surveys for the first 5 years of Project O&M (Figure 2). The ECM will be accompanied by the qualified biologist during the first four surveys to facilitate appropriate data collection. Proposed raven monitoring points are shown in Figure 2. Surveys will occur on a biweekly basis during the nonbreeding season (defined as a 7-month period from July 1 through January 31) for a total of 15 surveys per year. The same methods used in breeding season surveys will be used for nonbreeding season surveys, apart from conducting surveys on a biweekly basis. Data from the nonbreeding season surveys will be entered into the same Excel database as the breeding season surveys to track raven populations and identify potential problem areas that need attention.

### 5.3 Nest Removal

The majority of raven predation on juvenile desert tortoise most likely occurs in the spring, from April through May, when desert tortoise are most active and ravens are feeding young (Boarman and Heinrich 1999). As such, the removal of unoccupied raven nests would be utilized to control desert tortoise predation. Nests will be removed only from within the RE Crimson Permitting Boundary and the transmission line right-of-way. If nests are observed on adjacent lands, the Resource Agencies will be notified. The removal of unoccupied nests will occur simultaneously with the nonbreeding season raven surveys. Evidence suggests that birds with no nest in their territory at the beginning of the breeding season were less likely to commence nesting than those who already had an intact nest (Kristan and Boarman 2003).

## 6.0 ADAPTIVE MANAGEMENT

This section defines how adaptive management principles will be applied to this Plan, specifically in reference to management practices and control/mitigation measure implementation. This section defines potential changes to the mitigation and conditions that may trigger them.

### 6.1 Definition

Adaptive management is typically used in environmental management efforts to facilitate more effective management of resources to achieve desired objectives. Adaptive management can be defined as an iterative and structured optimal decision-making process intended to reduce uncertainty through system monitoring. The decision-making process simultaneously maximizes one or more resource objectives and accrues information needed to improve future management, either actively or passively. Using current knowledge, passive adaptive management involves the use of conceptual modeling to guide management actions. The model is adjusted as new knowledge is obtained and management decisions are subsequently modified. Active adaptive management involves testing alternative hypotheses through system manipulation employing management strategies. Thus, passive adaptive management is based on information gained from observational studies, whereas active adaptive management is based on information gained from experimental manipulation (Holling 1978). This Plan will focus on passive adaptive management but may ultimately apply both passive and active adaptive management.

## 6.2 Data Analysis to Inform Adaptive Management

It is important to document the population of ravens using the RE Crimson Permitting Boundary during construction and O&M and compare it to baseline numbers. The baseline data from 2016/2017 (0.87 ravens per 100 hours of observation during fall 2016 and 4.49 birds per 100 hours of observation for spring 2017) can be compared with the data collected at the raven point count locations to determine if the numbers of raven observations per 100 hours are increasing across the Project. One method to determine if raven numbers have increased from the Project is to compare the numbers of ravens observed at the four raven point count locations that are at the same location where the 2016/2017 migratory bird observation data were collected. By comparing data from the exact same location, one of the main differing variables that may influence the number of ravens is the construction and O&M of the Project. If the numbers of ravens detected at the four raven point count locations are summed and then divided by the total number of hours of observation, an estimate of ravens per hours of observation can be obtained that can be directly compared with the baseline data. Even though baseline surveys lasted much longer (4 hours per point) than the 10-minute raven point count surveys, since the same geographical location is being used for both surveys, the data are generally comparable and can be scaled accordingly.

In addition to estimating the number of ravens observed per 100 hours, the actual density of ravens using the RE Crimson Permitting Boundary may be another technique to determine how the Project is influencing raven populations in the area. It is more difficult to correlate the density of ravens detected during construction and O&M to baseline raven densities because the density of ravens during baseline surveys was determined from transect data collected in 2016/2017 (AECOM 2018). Since transects are not proposed as part of this Plan, the distance data from the raven point counts may be used to determine a rough density of ravens across the RE Crimson Permitting Boundary during construction and O&M (since the distance to each raven will be approximated during point count surveys). Analyses may be conducted using distance sampling methods and distance software (Thomas et al. 2010) to estimate raven density during the construction, O&M, and decommissioning phases of the Project. Estimating raven densities is another metric in addition to estimating the number of raven detections per 100 hours of observation to determine how the Project may be altering the raven population in the area.

### 6.3 Adaptive Management Triggers

To facilitate meeting Plan objectives, it may be necessary to make changes to the management practices or initiate the implementation of additional control measures. Implementation of adaptive management measures (described below in Section 6.4) would occur if both of the following conditions are met:

a. The results of the breeding and nonbreeding season raven monitoring events suggest that current management practices are ineffective at controlling substantial and sustained increases in raven occurrences within the Project site (including the detection of any raven nests on Project structures [i.e. gen-tie line]), thereby increasing the potential for desert tortoise predation. If the number of ravens per 100 hours of observation (from raven point counts) increases to >1 raven per 100 hours of observation during the fall (defined as July 18 through November 18), or >5 ravens during the spring (defined as February 1 through May 31), then the baseline number of ravens will be exceeded. If the raven density estimate across the entire RE Crimson Permitting Boundary exceeds 4 ravens during the winter and 19 ravens during the spring, then the baseline density of ravens will be exceeded. If the above analysis indicates baseline raven population levels have increased above the thresholds defined here, or if any raven nests are detected on Project structures, then the Project Proponent may need to meet with the Resource Agencies to determine appropriate adaptive management measures prior to implementation.
b. The Project Proponent will attempt to adjust management practices to control raven occurrences and avoid the need for additional control measures, and has contacted and worked with the qualified biologist/ECM and the Resource Agencies to identify other sources of ravens and/or management measures; however, increased raven occurrences continue.

### 6.4 Adaptive Management Measures

Adaptive management measures will be identified during implementation of the monitoring program but would be discussed with the Project Proponent, and the Resource Agencies, before any decisions are made. Adaptive management measures may include modifications to management practices, monitoring strategies, or implementation of control measures. Key examples may be (1) modifications to the monitoring program survey frequency, including increase or reduction of the monitoring frequency and survey points, should results of surveys deem it warranted, (2) eliminating or refining a management practice or measure if it is not working, or (3) incorporating a defined control measure, if impacts are observed, that would not otherwise be implemented. Some of the potential control measures are discussed in more detail below.

### 6.4.1 Control Measures

If the results of the monitoring efforts suggest that there is a substantial and sustained (e.g., consecutive years) increase in raven activity that may result in juvenile desert tortoise predation, even with the implementation of management practices as defined in Section 4.0, then it may be necessary to implement additional measures to further control ravens at the Project site. This section defines the types of control measures that may be implemented if additional measures are determined necessary based on the adaptive management triggers described above.

As stated above, prior to the implementation of any control measure, the qualified biologist/ECM and the Project Proponent will coordinate the discussion and approval of control measures with the Resource Agencies. If no identified control measures accomplish appropriate raven management objectives, additional control measures will be reassessed for potential implementation.

*Roadkill Removal*

Ravens are well known for eating animals that have been killed along roads and highways, which are often abundant in the desert region (Boarman and Heinrich 1999). Roadkill provides a food source for ravens, which facilitates increased raven nesting near roads and highways in areas that might otherwise offer little food (Kristan et al. 2004). Due to the potential for incidences of roadkill along Power Line Road, roadkill removal is considered necessary. The qualified biologist/ECM will document the occurrence of roadkill during raven monitoring. O&M staff will also report roadkill on a daily basis if found. Monitoring of roadkill will focus primarily along Power Line Road, which is the primary ingress and egress route. Even though the posted speed limit is 25 mph, and there are some speed bumps present along the road, the road bisects desert habitat (including washes and desert dunes) where the potential for roadkill for a variety of species (from reptiles to mammals and birds) is present. The speed limit within the Project will be restricted to 15 mph, and therefore the potential for roadkill is likely to be lower than along Power Line Road. If ravens are noted feeding on roadkill on a regular basis (at least once a month for two months during the spring/summer (i.e., an indication that ravens are scavenging roadkill to feed young), or if ravens are observed carrying roadkill to a nearby nest), it may be necessary to formally implement a roadkill removal program that would be designed by the ECM in coordination with the qualified biologist, and the Resource Agencies. The roadkill removal program may involve more routine monitoring of Power Line Road to remove roadkill (above and beyond removal of roadkill incidentally encountered during raven monitoring surveys), or measures to prevent roadkill, such as additional speed bumps, signage, or other methods.

*Hazing*

Hazing may use any number of visual and/or auditory devices designed to scare birds, including air or gas cannons, human flushing, bioaccoustic deterrents, green lasers, and/or flags and streamers to create an integrated system of negative stimuli. Some of these hazing techniques target the roosting location of ravens, and others target nesting, and perching locations. These techniques may need to consider the time of year to prevent disturbance to other nesting avian species nearby. Because many birds will become accustomed to methods quickly, many of these techniques are used in combination. If deemed appropriate, a hazing program would be designed by the qualified biologist in coordination with the ECM and the Resource Agencies to target specific locations where ravens have been documented nesting, perching, or roosting.

*Methyl Anthranilate*

Methyl anthranilate (MA) is a naturally occurring and generally recognized as safe-listed compound used as a food flavoring and fragrance additive. Chemical formulations containing MA have been found to be effective bird aversion agents as MA acts as chemosensory repellent, irritating pain receptors associated with taste and smell (Umeda and Sullivan 2001). When applied as a formulated spray, MA has been found effective in repelling birds from feeding on crops such as cherries, blueberries, and table grapes. In addition, MA is used as a repellent for Canada geese on lawns and in small pools of water. Several laboratory and field studies have shown MA to be non-toxic and non-lethal to birds and fish (Clark et al. 1993). Therefore, it is assumed that MA is safe to use around other vertebrate species.

To date, MA is thought to have limitations for topical application as it is considered highly volatile and breaks down readily under exposure to ultraviolet light. MA can be applied topically to a nesting structure, after an inactive nest has been removed, to deter ravens from repeat nesting at the same location. Repeat topical application would be necessary due to the breakdown of the chemical with exposure but may still prove useful as a short-term deterrent. Prior to the use of MA at the Project, research into the most current application of MA to deter raven activity should be conducted by the qualified biologist and then methods could be designed in coordination with the ECM and the Resource Agencies.

*Lethal Removal (Depredation)*

If ravens are still attracted to the Project even after the implementation of management practices, modification to management practices, and implementation of control measures, it may be necessary to consider lethal removal. Identifying, targeting, and successfully removing individuals is time consuming. However, lethal removal is often used in management plans when specific raven pairs are determined as responsible for killing relatively large numbers of desert tortoise (Boarman 2002). Any territorial raven should be targeted for removal if it is found within 1.6 kilometers of at least one tortoise shell showing evidence of being killed by a raven within the prior 15 months (Boarman 2002). These individuals can often be identified by the presence of juvenile desert tortoise shells beneath their nests, which are often used for consecutive years by the same pair of breeding ravens (Boarman and Heinrich 1999). By removing those birds known to prey on desert tortoise, survival of juvenile desert tortoise in that vicinity may increase.

Under this control method, targeted ravens may be shot by rifle or shotgun, or poisoned with the avicide DRC-1339, or similar product (Boarman 2002). Poisoned raven carcasses should be removed. If shooting is not possible (e.g., on power lines) or has been unsuccessful, ravens may be trapped and humanely euthanized. Young ravens found in nests of removed adults need to be euthanized humanely if they can be captured safely. Additionally, once ravens have laid eggs in a nest, the eggs may be covered in oil to kill the embryos, as detailed in the following section.

*Egg Oiling*

A new approach to managing nesting ravens is to apply oil to raven eggs. This renders eggs inviable but the adults continue to tend the eggs without trying to rebuild a nest or replace a lost clutch and the increase in raven foraging (and desert tortoise predation) following hatching of eggs to provision chicks doesn’t occur. Also, a nesting pair of ravens are generally territorial and thus keep other ravens away from the area during breeding, which limits the overall number of ravens in an area. Egg-oiling is a USFWS approved approach to raven management. However, egg oiling has not been approved for use by CDFW yet. Therefore, close coordination with the Resource Agencies is necessary if this approach is to be used.

## 7.0 REPORTING

During construction, the ECM will prepare routine monitoring reports that summarize the results of the biweekly and breeding season monitoring events as well as observations reported by O&M staff and describing any noted raven activity in the Project. These reports may be combined with the biological compliance reports. The reports will detail if the number/density of ravens detected during raven monitoring has increased beyond the numbers/density thresholds defined above. These reports will summarize the survey results, discuss the success or failure of management practices, and make recommendations for modification of management practices or implementation of control measures as necessary.

During the first five years of O&M, a summary of monitoring data will be provided at the end of the breeding season surveys and a second report at the end of the nonbreeding season surveys. After the completion of the five years of raven surveys, annual compliance reports will be submitted that detail any issues from the previous year. All of the above monitoring reports will be submitted to the qualified biologist for review and then sent to the Project Proponent to forward to the Resource Agencies.

## 8.0 REFERENCES


AECOM. 2018. *RE Crimson Solar Project Biological Resources Technical Report*. January.

Avian Power Line Interaction Committee (APLIC). 2006. Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006. Edison Electric Institute, APLIC., and the California Energy Commission. Washington, D.C and Sacramento, CA.

Berg, R. 1999. "Corvus corax" (On-line), Animal Diversity Web. Accessed April 05, 2016 at http://animaldiversity.org/accounts/Corvus_corax/.

Bloom Biological. 2012. Results of protocol surveys to determine occupancy by nesting Golden Eagle (*Aquila chrysaetos*) within ten miles of the proposed Sonoran West Solar Project located in the vicinity of Blythe, Riverside County, California. Summary report of survey findings to URS Corporation. August 27.

Bloom Biological. 2018. Crimson Solar Golden Eagle Nest Survey Results. 2018 Draft Report. July 24.

Boarman, William I. 2002. *Reducing Predation by Common Ravens on Desert Tortoises in the Mojave and Colorado Deserts*. Prepared for the Bureau of Land Management (BLM) by the U.S. Geological Survey (USGS), Western Ecological Center.

Boarman, W., and B. Heinrich. 1999. Common Raven. *The Birds of North America*. Eds. A. Poole, and F. Gill., No. 476. The Birds of North America, Inc., Philadelphia, PA.

Bureau of Land Management (BLM). 2015. Desert Renewable Energy Conservation Plan Proposed Land Use Plan Amendment and Final Environmental Impact Statement. October.

CH2MHILL. 2011. *Final Devers-Palo Verde No. 2 500-kV Transmission Line Project Raven Control Plan*. August. Prepared for Southern California Edison.

Clark, L., J. Cummings, S. Bird, and E. Aronov. 1993. Acute toxicity of the bird repellent, methyl anthranilate, to fry of *Salmo salar, Oncorhynus mykiss, Ictalurus punctatus,* and *Lepomis macrochirus*.

Cornell University. 2017. https://www.allaboutbirds.org/guide/Common_Raven/lifehistory#at_nesting. Accessed March 12, 2018.

Holling, C. S. 1978. *Adaptive Environmental Assessment and Management*. Chichester: Wiley.

Kristan, W. B., III, and W. I. Boarman. 2003. Spatial Pattern of Risk of Common Raven Predation on Desert Tortoises. *Ecology* 84(9):2432–2443.

Kristan, W. B., III, W. I. Boarman, and J. J. Crayon. 2004. Diet Composition of Common Ravens across the Urban-Wildland Interface of the West Mojave Desert. *Wildlife Society Bulletin* 32(1):244–253.

Thomas, L., S. T. Buckland, E. A. Rexstad, J. L. Laake, S. Strindberg, S. L. Hedley, J. R. Bishop, T. A. Marques, and K. P. Burnham. 2010. Distance Software: Design and Analysis of Distance Sampling Surveys for Estimating Population Size. *Journal of Applied Ecology* 47:5–14.

Umeda K., and L. Sullivan. 2001. *Evaluation of Methyl Anthranilate for Use as a Bird Repellent in Selected Crops*. University of Arizona College of Agriculture 2001 Vegetable Report. Available at http://ag.arizona.edu/pubs/crops/az1252/.

U.S. Fish and Wildlife Service (USFWS). 2009. Desert Tortoise (Mojave Population) Field Manual: (Gopherus agassizii). Region 8, Sacramento, California.

2010. *U.S. Fish and Wildlife Service – Renewable Energy Development and Common Raven Predation on the Desert Tortoise Summary*. May.

# I.12 Desert Tortoise Translocation Plan, May 2019

# DESERT TORTOISE TRANSLOCATION PLAN
# RE CRIMSON SOLAR PROJECT
# BLM CASE FILE NUMBER CACA-051967
# RIVERSIDE COUNTY, CALIFORNIA

**Prepared for:**
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March 1, 2019

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## List of Acronyms

| | |
|---|---|
| AB | Authorized Biologist |
| BLM | Bureau of Land Management |
| BM | Biological Monitor |
| CDFW | California Department of Fish and Wildlife |
| CRS | Colorado River Substation |
| ELISA | Enzyme-Linked Immunosorbent Assay |
| MCL | Midline Carapace Length |
| mm | Millimeter |
| MW | Megawatt |
| PV | Photovoltaic |
| RE | Recurrent Energy |
| TRP | Translocation Review Package |
| URTD | Upper Respiratory Tract Disease |
| USFWS | United States Fish and Wildlife Service |

# 1 INTRODUCTION

Sonoran West Solar Holdings, LLC (Applicant), a wholly owned subsidiary of Recurrent Energy (RE), proposes to construct and operate the RE Crimson Solar Project (Project). The Project is in Riverside County, approximately 13 miles west of Blythe, California (Figure 1). The Project site is located entirely on lands administered by the United States (U.S.) Bureau of Land Management (BLM). The Project's Plan of Development (POD) includes two options: the proposed Project, a traditional photovoltaic (PV) design referred to as Option A, and an option with low environmental impact design (LEID) elements, referred to as Option B. This plan has been developed to address procedures associated with the traditional PV design (Option A), which would include traditional tortoise exclusion fencing, full site clearance, and translocation.

## 1.1 Purpose

Relocation and translocation of Mojave desert tortoises (*Gopherus agassizii*) may be necessary during fence construction, generator tie-in line (gen-tie line) construction, facility site clearance, initial grading, or operations at the Project site. For the purpose of this plan, the following definitions have been developed:

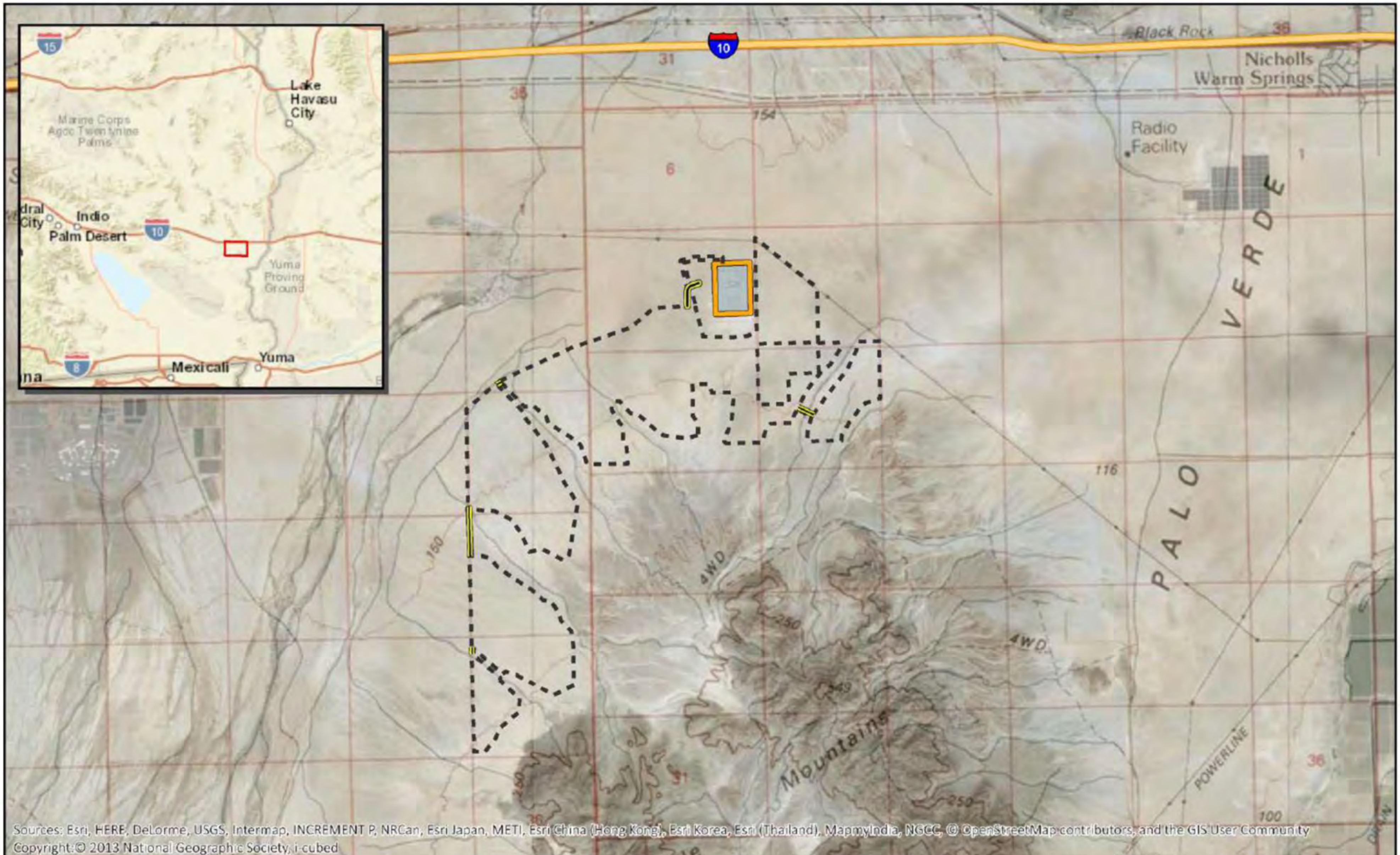
- *Relocation (temporary)* – the action of moving a desert tortoise out of harm's way along linear project components (e.g., access road, gen-tie line, and fence alignment). Relocated tortoises would be moved less than 300 meters (990 feet) from where they were detected.
- *Translocation* – the action of moving a desert tortoise from within the solar facility footprint to a pre-established recipient site.

This plan summarizes the current standards set forth by the California Department of Fish and Wildlife (CDFW) and U.S. Fish and Wildlife Service (USFWS) for the relocation and translocation of desert tortoise (USFWS 2009; 2017) and has been developed pursuant to the anticipated requirements of the Project and will be submitted as part of the Proposed Action to the USFWS for consideration in their issuance of a Biological Opinion (BO) and the CDFW for consideration in their issuance of an Incidental Take Permit (ITP).

## 1.2 Goals and Objectives

The goals and objectives of this plan include:

- Establish procedures to successfully relocate or translocate at-risk tortoises to suitable habitat located adjacent to the Project, or to an approved regional augmentation site (USFWS 2017);
- Implement measures to minimize effects of relocation and translocation on resident desert tortoises outside the Project; and
- Collect data to monitor the effectiveness of translocation.




Ironwood Consulting

0 1 2
Kilometers

Crimson Project Boundary

Access Road

Colorado River Substation

**FIGURE 1**

**Site Location**

Riverside County, CA

**RE CRIMSON SOLAR PROJECT**

C:\Users\ChrisBlandford\Desktop\Projects - Local\Recurrent\Crimson\GIS\DETOTP\DETOTP Fig 01 - Site Location.mxd | 5/24/2018

# 2 BACKGROUND

## 2.1 Project Description

The Project is a utility-scale solar PV and energy storage project that would be located on up to 2,489 acres of public lands. It would generate up to 350 megawatts (MW) of renewable energy using PV technology and would include up to 350 MW of integrated energy storage capacity. The Project would interconnect to the regional electrical grid at the Southern California Edison (SCE) 220-kilovolt (kV) Colorado River Substation (CRS).

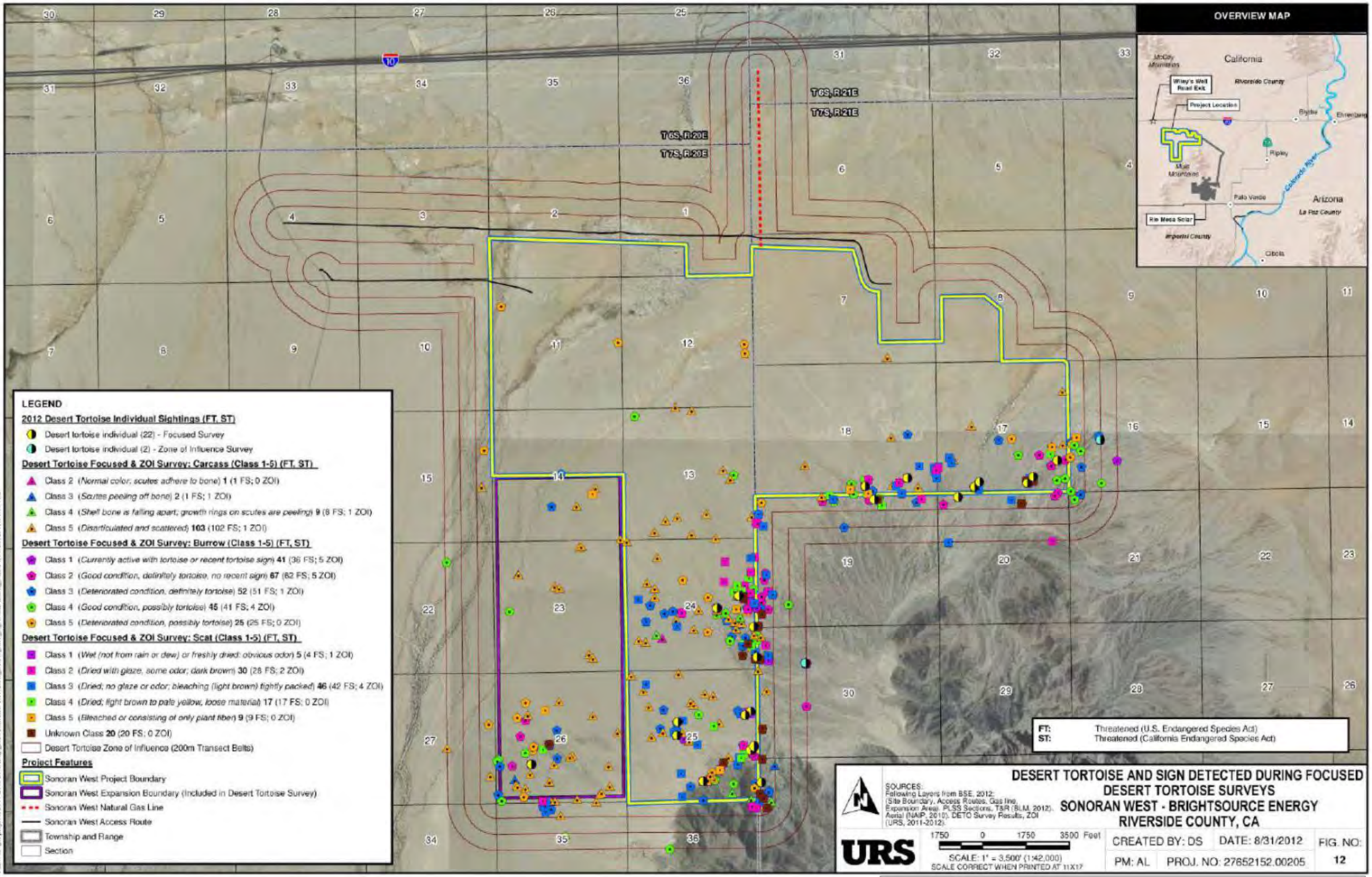
The total area for the Project would include a 2,465-acre solar field development area with approximately 1,859-acre of solar panels (array blocks) and 24 acres for linear facilities including access/perimeter roads assuming a 30 to 60-foot corridor width and gen-tie and powerline corridors at 150 feet (Figure 1). The proposed Project includes traditional PV design and would include an estimated 2 million panels arranged on either fixed-tilt or tracking systems.

Access to the Project site would be provided via the existing paved Wiley's Well Road and Powerline Road to the CRS from Interstate 10 (I-10) to the north. The Project's on-site roadway system would include a perimeter road, access roads, and internal roads.

The Applicant is expected to receive authorizations and permits with 30-year terms. At the end of the term, including any extensions, the Project would cease operation. At that time, the facilities would be decommissioned and dismantled and the site restored. Upon decommissioning, the Project site could be converted to other uses in accordance with applicable land use regulations in effect at that time.

## 2.2 Desert Tortoise Survey Results and Density Estimates

Protocol desert tortoise surveys were conducted in spring 2012 for the former BrightSource Sonoran West Solar Energy Generating Facility, which totaled 9,115 acres. The 2012 survey area included the current Crimson site and large areas that were associated with the former site but no longer relevant to the Crimson project (Figure 2). The 2012 surveys utilized 100 percent coverage of all suitable habitat using 10-meter (30-foot) wide belt transects, plus Zone of Influence (ZOI) transects. ZOI surveys were not mandated due to desert tortoise presence within the site; however, ZOI surveys were completed to help further understand the distribution of the species in the surrounding areas.



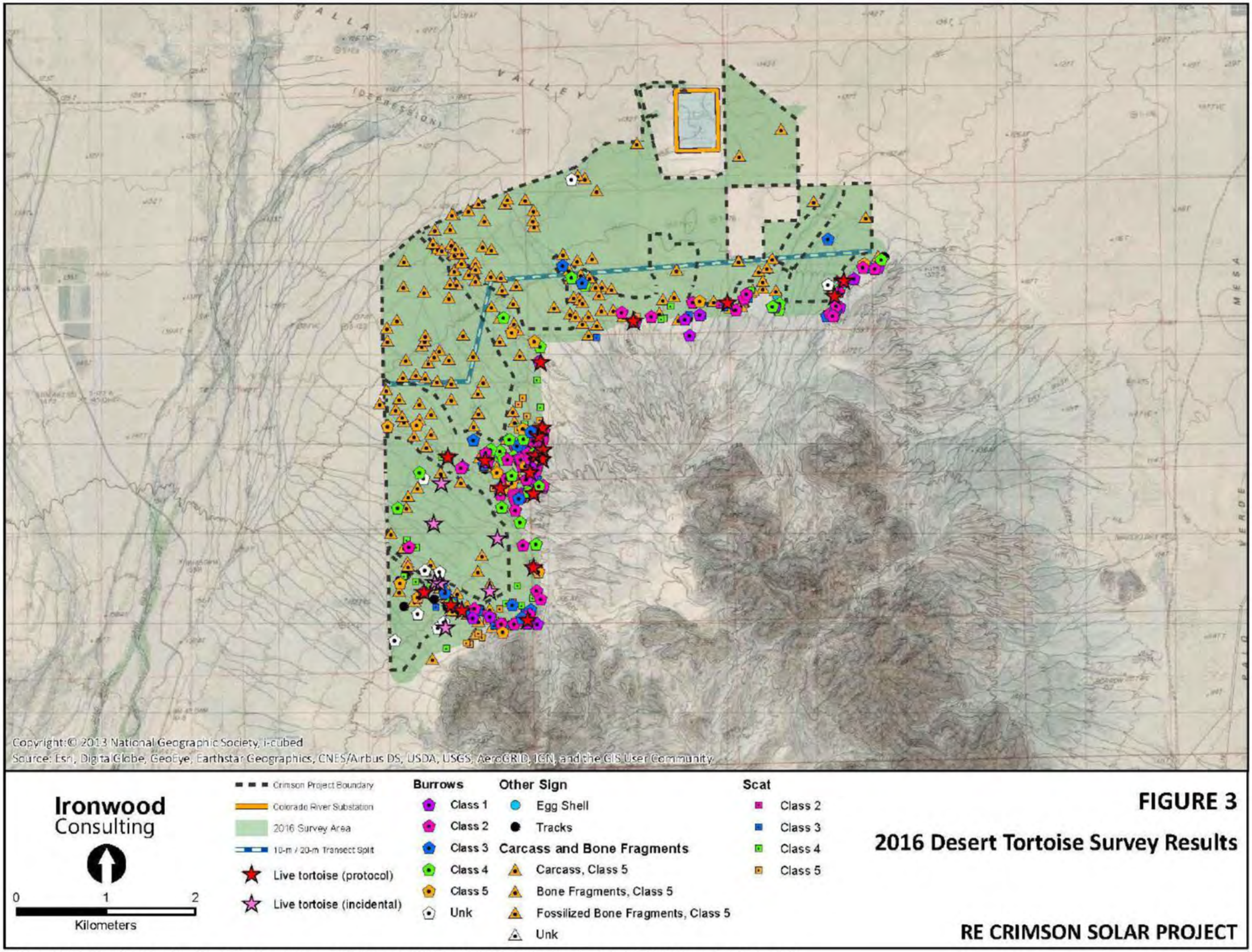
OVERVIEW MAP
California
Arizona
LEGEND
2012 Desert Tortoise Individual Sightings (FT, ST)
Desert tortoise individual (22) - Focused Survey
Desert tortoise individual (2) - Zone of Influence Survey
Desert Tortoise Focused & ZOI Survey: Carcass (Class 1-5) (FT, ST)
Class 2 (Normal color; scutes adhere to bone) 1 (1 FS; 0 ZOI)
Class 3 (Scutes peeling off bone) 2 (1 FS; 1 ZOI)
Class 4 (Shell bone is falling apart; growth rings on scutes are peeling) 9 (8 FS; 1 ZOI)
Class 5 (Disarticulated and scattered) 103 (102 FS; 1 ZOI)
Desert Tortoise Focused & ZOI Survey: Burrow (Class 1-5) (FT, ST)
Class 1 (Currently active with tortoise or recent tortoise sign) 41 (36 FS; 5 ZOI)
Class 2 (Good condition, definitely tortoise, no recent sign) 87 (82 FS; 5 ZOI)
Class 3 (Deteriorated condition, definitely tortoise) 52 (51 FS; 1 ZOI)
Class 4 (Good condition, possibly tortoise) 45 (41 FS; 4 ZOI)
Class 5 (Deteriorated condition, possibly tortoise) 25 (25 FS; 0 ZOI)
Desert Tortoise Focused & ZOI Survey: Scat (Class 1-5) (FT, ST)
Class 1 (Wet (not from rain or dew) or freshly dried: obvious odor) 5 (4 FS; 1 ZOI)
Class 2 (Dried with glaze, some odor; dark brown) 30 (28 FS; 2 ZOI)
Class 3 (Dried; no glaze or odor; bleaching (light brown) tightly packed) 46 (42 FS; 4 ZOI)
Class 4 (Dried; light brown to pale yellow, loose material) 17 (17 FS; 0 ZOI)
Class 5 (Bleached or consisting of only plant fiber) 9 (9 FS; 0 ZOI)
Unknown Class 20 (20 FS; 0 ZOI)
Desert Tortoise Zone of Influence (200m Transect Belts)
Project Features
Sonoran West Project Boundary
Sonoran West Expansion Boundary (Included in Desert Tortoise Survey)
Sonoran West Natural Gas Line
Sonoran West Access Route
Township and Range
Section
FT: Threatened (U.S. Endangered Species Act)
ST: Threatened (California Endangered Species Act)
SOURCES:
Following Layers from BSE, 2012:
(Site Boundary, Access Routes, Gas line, Expansion Area). PLSS Sections, T&R (BLM, 2012). Aerial (NAIP, 2010). DETO Survey Results, ZOI (URS, 2011-2012).
DESERT TORTOISE AND SIGN DETECTED DURING FOCUSED DESERT TORTOISE SURVEYS
SONORAN WEST - BRIGHTSOURCE ENERGY
RIVERSIDE COUNTY, CA
URS
1750 0 1750 3500 Feet
SCALE: 1" = 3,500' (1:42,000)
SCALE CORRECT WHEN PRINTED AT 11X17
CREATED BY: DS
DATE: 8/31/2012
FIG. NO: 12
PM: AL
PROJ. NO: 27652152.00205

Modified protocol surveys were conducted in fall 2016 using a survey design intended to update the results of the 2012 surveys. CDFW authorized 20-meter wide transects in areas where there was a low historical desert tortoise density. These 20-meter spaced transect surveys were conducted in the northern and western part of the site, over 46 percent (1,679 acres) of the total survey area (3,636 acres). These areas contained no live desert tortoise or active burrows in 2012 (Figure 2). Concurrently 10-meter spaced transects were implemented on the remaining 54 percent of the survey area (1,957 acres) in the southern and eastern part of the site around the base of the Mule Mountains where the majority of active desert sign was observed in 2012. The location of desert tortoise sign observed during the 2012 and 2016 surveys is depicted in Figures 2 and 3, respectively. A summary of desert tortoise sign observed during the updated 2016 surveys is described in the Biological Resources Technical Report (AECOM 2018).

**Table 1 - Desert Tortoise Sign Observed in the Desert Tortoise Survey Area (2016)[1]**

| Desert Tortoise Sign | Type[2] | RE Crimson Project Boundary | Outside of the Project Boundary)[3] | Total |
|---|---|---|---|---|
| **Live desert tortoise** | Adult | 2 | 13 | 15[4] |
| | Subadult/Juvenile (less than 160 mm) | 0 | 3 | 3 |
| ***Total*** | | 2 | 16 | 18[2] |
| **Burrows** | Class 1 | 0 | 24 (4 occupied) | 24 |
| | Class 2 | 2 | 69 | 71 |
| | Class 3 | 1 | 17 | 18 |
| | Class 4 | 2 | 28 | 30 |
| | Class 5 | 3 | 12 | 15 |
| ***Total*** | | 8 | 150 | 158 |
| **Scat** | Class 1 | 0 | 0 | 0 |
| | Class 2 | 0 | 8 | 8 |
| | Class 3 | 1 | 27 | 28 |
| | Class 4 | 4 | 37 | 41 |
| | Class 5 | 2 | 34 | 36 |
| ***Total*** | | 7 | 106 | 113 |
| **Carcasses (Shell Remains)** | Class 1 | 0 | 0 | 0 |
| | Class 2 | 0 | 0 | 0 |
| | Class 3 | 0 | 0 | 0 |
| | Class 4 | 0 | 0 | 0 |
| | Class 5 (intact carcass) | 1 | 1 | 2 |
| | Class 5 (scattered bone/shell fragments) | 89 | 98 | 187 |
| ***Total*** | | 90 | 99 | 189 |
| **Tortoise Fossilized Bones** | | 3 | 0 | 3 |
| **Tortoise Tracks** | | 4 | 6 | 10 |
| **Tortoise Egg Shell Fragments** | | 0 | 3 | 3 |

[1] *Source: AECOM 2017*
[2] *Classified using the Information Index for Desert Tortoise Sign: Burrows and Dens, Scats and Shell Remains as in the USFWS Protocol (USFWS 1992).*
[3] *Includes 500-foot buffer.*
[4] *Two adult desert tortoise were found just outside of the 500-foot buffer, and therefore are not included here.*




Ironwood Consulting

**FIGURE 3**

**2016 Desert Tortoise Survey Results**

**RE CRIMSON SOLAR PROJECT**

C:\Users\ChrisBlandford\Desktop\Projects - Local\Recurrent\Crimson\GIS\DETOTP\DETOTP Fig 03 - deto DATA 2016.mxd | 11/20/2018

Density estimates were calculated from live tortoise observations recorded during surveys (10-m wide belt transects) in 2016. The estimated number of tortoises within a given area was calculated using the imbedded formula in Table 3 of the revised protocol, *Preparing for Any Action That May Occur within the Range of The Mojave Desert Tortoise* (USFWS 2010) and are presented in Table 1. There were an estimated 37 desert tortoises (greater than 160mm midline carapace length [MCL]) within the desert tortoise survey area, with a lower 95% confidence value of 14 tortoises and an upper 95% confidence value of 100 tortoises. Using the subadult and adult estimates and applying the size class breakdown per the Goff's life table (Turner et al. 1987 [Table 32]), an estimate of each size class within the survey area and Project boundary is shown in Table 1.

**Table 2 – Point Estimates by Size Class**

| | Size Class (MCL mm)[1] | | | | | |
|---|---|---|---|---|---|---|
| | >180 | 160 – 179 | 140 – 159 | 100 – 139 | 60 - 99 | < 60[2] |
| | 13.2 | 2.2% | 2.2% | 10.7% | 32.0% | 39.7% |
| **Desert Tortoise Survey Area (3,636 acres)** | 36 | 6 | 6 | 29 | 87 | 108 |
| **Permitting Boundary (2,489 acres)** | 4 | 1 | 1 | 3 | 10 | 13 |

[1] *Immature size class estimate ratios based on Goff's life table (Turner et al. 1987). Percentage of total population is also shown. Size classes based on the point estimates of large tortoises (>160mm). A greater range of estimated individuals would result if the 95% confidence intervals are used.*
[2] *Includes hatchling and eggs.*

# 3 PRE-CLEARANCE RESEARCH PROPOSAL

A research proposal to obtain preliminary ecological data for up to 50 desert tortoises in the Chuckwalla Valley by determining home range size, habitat use, and health status of tortoises in the region of the Crimson solar project has been approved by the BLM, USFWS, and CDFW. The study began fall 2018 and will provide information prior to clearance and translocation activities for the RE Crimson Project. Research will occur under USFWS Permit TE-218901-6 and CDFW MOU 2081a-2018-003-R6, issued to Danna Hinderle, Ironwood Consulting. Tortoises in this 18-month research project will be numbered, transmittered, and given a health assessment (with collection of biological samples) spring and fall through spring 2020; additional animals will be added to the study group as they are encountered during research activities. Tortoises will be radio tracked at least monthly, and data will be collected on location, tortoise behavior, and shelter type. Additional information on predator sign (scat, dens, live individuals) will be collected during the research phase in order to help inform future translocation efforts in this region. This research effort would help confirm existing densities in the Project boundary and adjacent habitat, provide movement data and activity areas, health status, inform the translocation process, and provide additional habitat data (perennial vegetation structure and soils). This data may be used to determine the extent tortoises are using the Project site, increase certainty of the total number of tortoises that may be translocated, and assist in the determination of the most-appropriate recipient site.

# 4 TORTOISE HANDLING

Only persons permitted by the USFWS and CDFW under the Biological Opinion and Incidental Take Permit would handle tortoises. All tortoise handling would be conducted by, or under the direct supervision of an Authorized Biologist (AB), in accordance with the Desert Tortoise Field Manual (USFWS 2009). Health assessments will be conducted by those with additional authorization to do so (USFWS 2016). All activities will be recorded on standardized data sheets and/or on digital data recorders. A record of all tortoises encountered, relocated, or translocated during Project activities would be maintained. This information would include location, date of observations, burrow data, gender, midline carapace length, mass (if handled), health observations, any apparent injuries and state of healing, and diagnostic markings (i.e., identification numbers). All tortoises handled would be photographed and closely examined for clinical signs of disease at the time of capture.

## 4.1 Temperature Restrictions

Handling of tortoises for processing, relocation, or translocation would occur when ambient temperatures are below 35°C (95°F) and not anticipated to rise above 35°C (95°F) before handling and processing desert tortoises are completed (USFWS 2009). The USFWS translocation guidance recommends releases will occur when temperatures range from 18-30°C (65-85°F) and are not forecasted to exceed 32°C (90°F) within 3 hours of release or 35°C (95°F) within 1 week of release. Additionally, forecasted daily low temperatures will not be cooler than 10°C (50°F) for one-week post-release (USFWS 2017). Temperatures will be measured in the shade and protected from the wind at a height of 2 inches (5 centimeters) above the ground.

If a tortoise is found under a shrub in a proposed disturbance area and the temperature is greater than 35°C (95°F), moving the tortoise would be avoided until temperatures subside in the late afternoon/early evening, at which time the tortoise can be moved or allowed to move of its own accord.

## 4.2 Temporary Penning

As necessary, a temporary pen may be erected around a tortoise and shrub it is taking cover under per the USFWS (2009) guidelines. Pens could potentially be used if an animal is located in a disturbance area when temperatures are > 35°C (95°F), or during clearance activities. The pen would be removed once the tortoise is relocated or translocated. All penned or avoided tortoises must be monitored to ensure their safety.

## 4.3 Inactive Tortoises

Clearance surveys will be conducted during the typical spring (April - May) or fall (September - October) desert tortoise active seasons (USFWS 2009); any tortoises found during these surveys would likely be active, however, it is possible that inactive tortoises would also be found even in the more-active seasonal windows. It is also possible that tortoises may be deep within burrows or caliche caves that requires several days to excavate. Tortoises may also be found during the less-active season during construction of linear project components. If these situations occur, the tortoise may be left in place and temporarily contained or blocked in its natural burrow (USFWS 2009). Tortoises blocked in burrows will be monitored for activity and safety daily for at least one week; then weekly at minimum until relocation, translocation or, in the case of linear project components, work activities in the immediate area cease. If a tortoise within a burrow must be moved, every effort will be made to cause it to leave the burrow on its own (e.g., pounding the ground, "tapping," or repeated visits to the burrow at warmer or cooler times of day) prior to using the less-preferred method of carefully excavating the burrow by hand (USFWS 2009).

## 4.4 Transport

Tortoises will be transported using methods consistent with the most recent USFWS and CDFW guidance and best management practices. The following general guidelines are excerpted from USFWS (2009). For relocation/translocation, each tortoise will be transported via an individual, sterilized tub with a taped, sterilized lid. Every effort will be made while handling tortoises to release each animal within 30 minutes of its capture.

When live desert tortoises are transported by vehicle, a means of cushioning the desert tortoise will be used to minimize jarring, bumping, and sliding. Tortoises will not be placed in automobile trunks, on floorboards in an unconfined manner, in the bed of a truck over the exhaust system or left unattended in vehicles. Transport by vehicle will involve only designated open routes, with speeds limited to 15 miles per hour on unpaved roads. The vehicle transporting the tortoise will be in good working order with working air conditioning and the driver will keep the container with the animal inside the vehicle at all times with temperatures remaining under 27 °C or (80 °F) until it is removed. Tortoises that void their bladders will be rehydrated as per USFWS guidelines.

## 4.5 Health Assessments and Sample Management

Health assessments are a critical part of the translocation process. Several diseases have been documented in wild desert tortoise populations in the Sonoran Desert. These include an upper respiratory tract disease (URTD) commonly associated with *Mycoplasma agassizii* (Rostal and Lance 2003) and *M. testudineum* (Jacobson and Berry 2004), shell disease (e.g. cutaneous dyskeratosis; Berry and Christopher 2001), and oral herpes.

Health assessments will generally include two parts: (1) physical examination and (2) typically, collection of biological samples (which may include oral swabs, blood samples, parasites). Health assessments will only be performed by ABs permitted by the USFWS and CDFW, and data collection will use the standard health assessment data sheet (USFWS 2016).

A component to these health assessments includes diagnostic tests (e.g., Enzyme-linked immunosorbent assay [ELISA] testing for exposure to *M. agassizii* and *M. testudineum;* Brown et al. 2003) within a year of translocation. USFWS guidance states translocation eligibility will be determined by the physical condition of each tortoise per the algorithm in Appendix G of USFWS guidelines (2016). Tortoises that have a positive ELISA result for *M. agassizii* and *M. testudineum* need additional review and approval by CDFW prior to translocation.

Individual tortoises eligible for translocation are those that exhibit appropriate attitude and activity; acceptable body condition (Body Condition Score of 4–7); no mucoid and not more than mild, serous nasal discharge; no oral lesions; and no other condition that may impact its survival (Appendix G of the USFWS Health Assessment Procedures: USFWS 2016). Tortoises that are not eligible for translocation will have their disposition managed in coordination with USFWS, CDFW, and BLM.

The research study (commencing fall 2018) will have numbered and affixed transmitters on the majority of tortoises that would likely be found on the project site during clearance activities. Approximately 18 months of data (location, habitat type, health assessments, ELISA results) will be recorded for these individuals; this 'known' group of animals will be translocated off-site after Translocation Review Package (TRP) approval, and ideally before clearance activities begin. If naïve ('unknown') tortoises are found during clearance activities, a health assessment including biological sample collection will occur, with translocation occurring after TRP approval. All data (tortoise ID, transmitter number, MCL, weight, health findings, etc.) will be recorded on paper data sheets, digital hand-held device, and stored in a database. Relocated tortoises will be subject to a visual examination without venipuncture, unless signs of disease are present at time of relocation.

Following USFWS (2017) guidelines, visual examination of clinical signs of disease may occur at any time after tortoises in the population generally have emerged from hibernation, but it is important that the desert tortoise's immune system is actively responsive when blood samples are drawn. Blood may be drawn beginning May 15 or, upon specific approval from USFWS and CDFW, four weeks after the date that the individual of interest left its hibernaculum or was first found active and above ground. The last date for blood sampling is October 31 (USFWS 2017).

Prior to translocation, a minimum of two health assessments will be completed 14–30 days apart. Individuals that are large enough (i.e., (approx. >100mm MCL and > 100g) will have at least one health assessment including venipuncture and testing of blood samples, within one year before translocation. Additional assessments (outside of 30 days) may be conducted, but a narrow window is necessary to discover animals with intermittent clinical signs. The final assessment will occur immediately prior to the translocation date and would involve a visual examination without venipuncture samples, from tortoises for which samples were previously collected. The final assessment will serve as the baseline condition with which to compare post-translocation assessments and as a final check against the algorithm (USFWS 2016) that the tortoises are suitable for translocation. Any tortoises that were previously approved for translocation, but on the final assessment do not pass the health algorithm (USFWS 2016) would not be translocated and would remain in quarantine for a maximum of 12 months, until a final disposition is determined in coordination with USFWS, CDFW, and BLM.

During the monitoring period, all monitored tortoises will have samples collected twice per full calendar year, generally in the spring and fall seasons. All tortoises will be given a final health assessment (with sample collection) prior to having their transmitter removed at the conclusion of the monitoring period, which would coincide with the completion of construction activities, or after 5 years, depending on the number of tortoises translocated. See Section 7.

Biological samples will be collected and banked as follows: Venipuncture (plasma) samples will be submitted to the Mycoplasma Research Laboratory, University of Florida (Gainesville, FL) to be tested for antibodies to *M. agassizii* and *M. testudineum*. Additional venipuncture (plasma and red blood cell) samples will be banked with USFWS through University of California Los Angeles (Los Angeles, CA) or other agency-approved facility. Oral swabs, and parasites will also be banked at UCLA for future testing if needed. One oral swab will be required to be sent to the Amphibian/Molecular Diagnostics Lab at San Diego Zoo (Escondido, CA) for qPCR for *M. agassizii*, *M. testudineum*, and testudinid herpesvirus 2, or other pathogens.

## 4.6 Quarantine Guidelines

If unknown tortoises are encountered during clearance activities, they will either be fitted with a transmitter and monitored *in situ* or placed in an onsite pen until TRP approval is acquired. Penned tortoises will be monitored regularly. The research phase will mark and transmitter most tortoises in the region, so it is unlikely an ‘unknown’ tortoise will be encountered during clearance activities.

If any tortoises do not meet the translocation criteria (e.g. do not pass the health assessment algorithm) quarantine pens will be constructed according to husbandry procedures in accordance with the most recent USFWS guidance (See Attachment 2 in USFWS 2017). The pens will be at least 6m × 6m (19ft × 19ft) for adult tortoises and 2m x 2m (6ft x 6ft) for juvenile tortoises. Additional health examinations would be performed as necessary to determine their final disposition. Adult tortoises found healthy and clinically disease-free after a period of quarantine, not to exceed 12 months, to be determined in coordination with the agencies, would be moved to the selected translocation site. Tortoises assessed as clinically ill or diseased would not be placed in situations where contagion can spread to healthy tortoises. If the tortoise is unable to be returned to the wild, the final disposition will be determined by USFWS and CDFW.

## 4.6 Transmitters

Radio transmitters would be attached only to tortoises that are to be translocated, and in some cases relocated out of harm’s way, similar to the manner described in Boarman et al. (1998) and other acceptable best management practices. Holohil R1-2B transmitters in the 10-gram and 15-gram versions, as well as the Telonics receivers (TR-4 and TR-5 models) with RA-2AK with very high frequency antennas, or other suitable equipment may be considered for use.

Every effort would be made to ensure that the well-being of the desert tortoise is not compromised by either the process of attaching radio transmitters and operation of these devices. Care will be taken to place the transmitters so that they do not impede normal behavior.

The total mass of the instrumentation that is attached to each tortoise including antenna, epoxy, etc., will not exceed 10 percent of the animal's body mass. Radio transmitters that contain weak batteries will be removed or replaced before the batteries are likely to fail. Attachments of transmitters will be performed by Authorized Biologists only. Additional radio transmitter use direction pertinent to this plan is detailed below:

- Radio transmitters may temporarily (up to 48 hours) be attached to tortoises with duct tape, in situations in which full processing cannot be completed to comply with temperature guidelines, or when light levels do not allow for final transmitter attachment.
- Any shell damage resulting from attachment or removal of radio transmitters will be reported in writing within three working days to the USFWS and CDFW and recorded on data sheets/handheld data recording devices.
- Where transmitters are affixed to tortoises, these animals will be monitored at agency-approved intervals year-round to ensure that animals are not lost due to long-range movements beyond the area capable of being detected by telemetry equipment. If it is determined that a desert tortoise has a malfunctioning transmitter it will be replaced before the animal becomes active.
- Transmitters and other equipment will be removed from all tortoises that can be located prior to end of monitoring timeframes. Every effort will be made to locate and remove non-functioning transmitters and other equipment from tortoises that are handled under this Project's relocation/translocation program.

# 5 CLEARANCE AND TRANSLOCATION

The following section applies to formal clearance and translocation from the solar facility. Linear project components (e.g., gen-tie line, access road, and fence line) that involve relocation out of harm’s way are discussed in Section 6.

## 5.1 Exclusion Fencing

Tortoise exclusion fencing will be installed around the perimeter of the entire solar facility prior to undertaking clearance surveys and translocation. Permanent chain link security fence attached to the tortoise exclusion fence may be installed at the onset of fencing. Alternatively, temporary exclusion fencing may be installed initially in order to perform clearance surveys and permanent fencing attached to tortoise fence would follow clearance surveys and be installed prior to solar facility construction.

Specifications for desert tortoise exclusion fence are provided in the Desert Tortoise Field Manual (USFWS 2009). Tortoise exclusion fencing will involve the installation of 3-foot high, approximately 1-by-2-inch mesh hardware cloth, installed to a height of at least 24 inches above ground. Permanent fencing requires 12 inches of the fence material to be buried, while temporary fencing may be buried or folded at the ground surface and secured with soil, rocks, and/or rebar stakes spaced 4 to 5 feet apart. All fencing would be constructed with durable materials (i.e., 16-gauge or heavier) suitable to resist desert environments, alkaline and acidic soils, wind, and erosion. If any tortoises <100 mm MCL are translocated within 500 meters of the Project site, tortoise fencing shall have a mesh opening of ½ inch horizontal by ½ inch vertical.

Any modifications to mesh size noted herein will require concurrence from the BLM, USFWS, and CDFW.

Temporary fencing may be installed around other work areas (e.g., materials yard, access road and gen-tie line) on an as-needed basis depending on site-specific activities and proximity to known live tortoises. Work areas that can be completely fenced will be surveyed to ensure no tortoises are present. Inspections of the temporary fencing, and enclosed work area would ensure there were no tortoises in harm's way. Areas or equipment that are not able to be completely fenced would be monitored by a biological monitor. If temporary fencing is to be installed around other work areas, then the hardware cloth described earlier, may be used in designated areas to reduce encounters with tortoises on short-term construction activities. In this case, the fencing material would be attached to metal posts with a minimum of 12-gauge steel wire. The grid opening of the wire would not exceed 1-by-2 inches and the fence height would be no less than 24 inches. Posts would be approximately 40 inches long. Concrete footings for metal posts would not be required. Because of the short duration of the work, the fencing need not be buried and may be folded at the ground surface. Any high or low points along the fence line would be hand-excavated or weighed down by rocks or soil to maintain integrity with the ground.

No more than ten days prior to the initiation of fence construction, a pre-activity desert tortoise survey would be conducted using techniques providing 100-percent coverage of the disturbance area, including a buffer equaling approximately 30-feet wide centered on the fence alignment. Transects would be no greater than 15 feet apart. All desert tortoise burrows, and burrows constructed by other species that might be used by desert tortoises, would be examined to determine occupancy. Any burrow along and inside the fence line would be collapsed after confirmation that it is not occupied by a desert tortoise, or if occupied, that the desert tortoise has been relocated by the AB per this plan. All fence construction will be monitored to verify that no tortoises are harmed. An AB would be available at all times to move any desert tortoises from harm's way that are within the path of the fence line work.

The exclusion fence alignment may cross an existing home range of a desert tortoise, preventing tortoises from accessing part of their normal range and subsequently resulting in a desert tortoise pacing the fence. The exclusion fence will be monitored twice daily during fence construction and for 7 days following completion of its construction to locate any tortoise that may be pacing the fence. Thereafter, the exclusion fence will be inspected daily during the typical active seasons (April 1 to May 31 and September 1 to October 31) and summer months (June – September) for one year after fence completion. If tortoise activity levels are reduced (e.g. no fence walking behavior), less frequent inspections may be implemented (e.g., one to three times per week). During the less-active winter season (November – March), and for the remainder of the life of the Project, the fence will be inspected monthly and maintained as needed. There may be portions of the fence that are excluded from higher-frequency inspections, but will still be inspected monthly, if limited tortoise activity along the fence warrants less frequent inspections (e.g., on the north and western portions of the site). Any damage to the fence that could allow a tortoise to enter the site will be repaired upon detection, as feasible. The fence will also be inspected during and within 24 hours following any significant rainfall event or high wind event to ensure that storms have not damaged the fence, potentially allowing access by desert tortoises. Any damage to the fence shall be temporarily repaired immediately using hand tools as feasible, and permanently repaired within 48 hours.

Shade structures will be installed along the interior and exterior of the exclusion fence where tortoises are likely to encounter newly installed fence. Shade structures would be set at regular intervals on the interior and exterior of the fence at a minimum of every 300 meters and maintained to provide refuge to tortoises that may be fence-walking, and at risk of hyperthermia (USFWS 2018a). Best management practices on similar projects (Dry Lake SEZ, NV, Stateline, CA, Silver State, NV) have shown that setting them slightly below the surface and covering or partially burying the shade structures helps maintain an environment suitable to provide emergency shelter.

## 5.2 Clearance Surveys

Clearance surveys will be conducted after tortoise exclusion fencing is fully installed around the perimeter of the solar facility. Surveys will be conducted in accordance with this plan and recent guidance from USFWS including the *Desert Tortoise Field Manual* (USFWS 2009). The following conditions will apply:

a) Clearance survey timing will coincide with the more-active tortoise season (late March through May and from September through October). This will maximize the probability of finding all desert tortoises and ensure handling of tortoises occurs within preferred temperatures.
b) Temperature restrictions described in Section 4.1 will apply to handling of all tortoises. Surveys may be performed in temperatures up to 40 degrees C (104 degrees F) (USFWS 2009).
c) Clearance surveys would be conducted/ by agency approved ABs, with support from Biological Monitors (BM) supervised by the ABs.
d) Clearance surveys will be conducted using belt transects at a maximum of 5 meter (15 foot) spacing, using tighter spacing if vegetation becomes denser (USFWS 2009).
e) During the first survey pass, all sign (scat, carcasses, tracks, etc.) will be removed from the clearance area. All burrows will be inspected and carefully excavated, including canid complexes that have been determined to be unoccupied. Burrows will be excavated in a manner to detect tortoise nests (USFWS 2009). If a viable nest is located, procedures will follow those in the Desert Tortoise Field Manual (USFWS 2009).
f) Larger burrows, caliche caves, and den complexes that take longer/require equipment to excavate (and are not completely excavated on the first pass) are recommended to be fenced with temporary exclusion fencing in the event it is occupied by a tortoise. Temporary in-situ pens will be sized based on size of penned tortoise and installed with shade cloth. Daily monitoring of pens will be performed to detect tortoise activity and, if present, ensure tortoise well-being.

g) Clearance surveys at the project site must consist of at least 2 consecutive, perpendicular surveys of the site. If desert tortoises are found during the second pass, the USFWS and CDFW may require a third survey (USFWS 2009).
h) When an unmarked tortoise that is large enough to have a transmitter affixed to it (approx. >100 mm and 100 g) is found during clearance surveys, an AB will:
    a. Assign and apply a unique number to the tortoise;
    b. Perform a visual health assessment and enter results into the algorithm for evaluating if desert tortoises are suitable for translocation (USFWS 2016);
    c. Collect biological samples including a blood sample for serology testing; and
    d. Place a transmitter on the carapace using approved methods
    e. Tortoise will be left *in situ* where they were found until translocation occurs.
    f. Tortoises will only be included in the long-term monitoring program if the affixed transmitter is large enough to last through the winter (approximately > 100 mm MCL, and 100g); otherwise the transmitter will be removed prior to winter hibernation.
i) When a tortoise too small to transmitter is found during clearance surveys, an AB will:
    a. Assign and apply a unique number to the tortoise;
    b. Perform a visual health assessment and enter results into the algorithm for evaluating if desert tortoises are suitable for translocation (USFWS 2016);
    c. Tortoises too small to be transmittered will be translocated as soon as possible after detection to maximize their chance of survival and preclude holding them *in situ* (via temporary transmitter or temporary pen) for an extended period of time.
j) Any tortoise showing clinical signs of disease will be transported to an agency-approved quarantine facility as described in Section 4.5. The BLM, CDFW, and USFWS will be contacted within 24 hours by phone and in writing if any individual tortoise is determined to be *recommended against translocation* per the algorithm for evaluating if desert tortoises are suitable for translocation (USFWS 2016).
k) Tortoise nests identified during clearance survey burrow excavation would be moved to a microsite (e.g., shrub cover, soil type, substrate cover, etc.) as similar to the locality found as possible (e.g., same degree of vegetative cover, plant species, soil substrate, aspect) in the recipient site, using standard techniques (USFWS 2009).

## 5.3 Translocation Review Package

A Translocation Review Package (TRP) addressing each tortoise proposed for translocation will be submitted to USFWS and CDFW, generally at least two weeks in advance of planned translocation. All tortoises transmittered and monitored prior to clearance (as part of a Desert Tortoise Pre-Clearance Research Proposal, see Section 3.0) will be included in the first TRP, and are a cohort of *known* animals. This allows the TRP to be submitted to the agencies early in the translocation process and animals to be moved as early as possible in the season. Tortoises discovered during clearance (previously *unknown*) will be transmittered and monitored *in situ* or held in pens until blood test results are received and the TRP is approved, with husbandry practices for captive desert tortoise (USFWS 2017); therefore, it will be necessary for swift coordination to occur between the Project Owner and the agencies to minimize holding time and expedite translocation and acclimation. The TRP will include the following:

- Photographs of individual tortoises as specified on the health assessment data sheet;
- Health assessment data and tables present in USFWS guidance for disposition plans;
- Maps of the recipient site illustrating current distribution and health status of resident tortoises;
- Characteristics of the recipient site vegetation and any unique landscape features; and
- Proposed disposition location for each individual.

## 5.4 Recipient Sites

### 5.4.1 Primary Recipient Site: Mule Mountain

The Project has been designed to avoid occupied habitat in the bajada below the Mule Mountains; previous survey data indicates that the majority of live tortoise observations, including incidental records, were located within 300 meters of the proposed fence line. Consequently, it is expected that the majority of tortoises found on the Project site will be able to be released less than 300 meters from their capture location. Translocating tortoises less than 300 meters increases the chances that they will remain in their existing home range and are expected to move less than 1.5 kilometers following translocation (USFWS 2017); therefore, the recipient site has been mapped consistent with USFWS (2017) guidance and is situated adjacent to the south-eastern boundary of the Project fence line and includes a 300 meter translocation release zone and 1.5-kilometer post-translocation movement buffer, for a total of 1.8 kilometers from the edge of the project(Figure 4).

The primary recipient site supports the following elements:

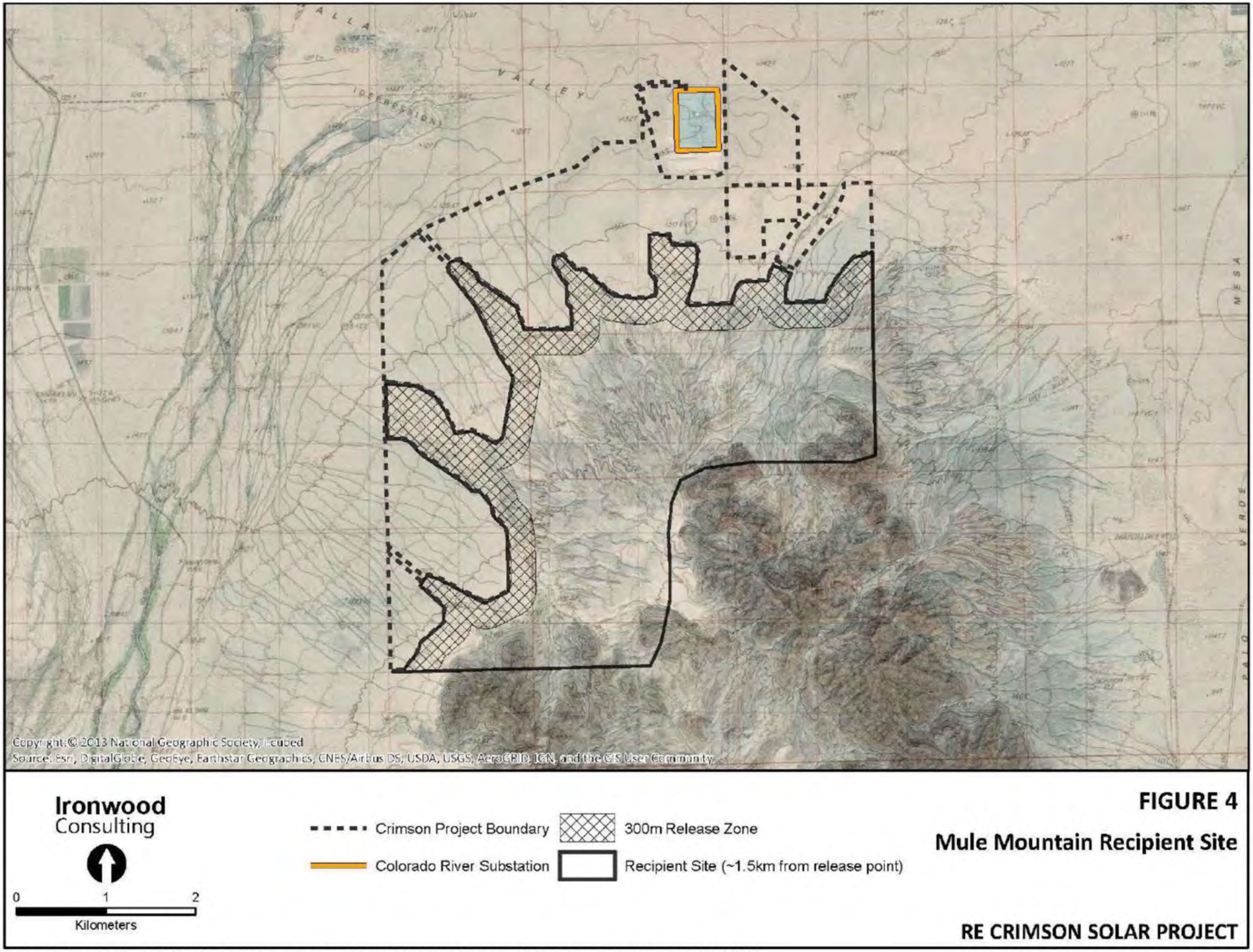
- Contiguous public lands that include the Mule Mountain ACEC;
- High likelihood of being within the existing home range of translocated tortoises;
- Habitat suitable for all life stages of the desert tortoise;
- Documented occurrence of resident tortoises;
- Low incidence of reported disease based on available data (additional data will become known through the research study); and
- No detrimental rights-of-way, unfenced paved roads, or other encumbrances within 1.5 kilometers.

The Mule Mountain Recipient Site provides habitat which is similar, or more vegetated and varied than the project site. The recipient site supports creosote bush and white bursage vegetation and several areas of blue palo verde – ironwood - smoke tree series vegetation (desert dry wash woodland). Soils are varied, and include large rocks towards the mountains, desert pavement, cobble, and friable soils suitable for digging burrows. The topography in the region is also varied, and includes gently sloping terrain, washes with near-vertical walls, and steeper, hilly terrain as the site approaches the mountains.

In 2016, 1,957 acres were surveyed for desert tortoises using 10 meter transects. The survey area encompassed approximately 676 acres of the project site (southern and western extent) and 1,281 acres of the 3,500-acre Mule Mountain recipient site. Densities calculated within the survey area were presumed to be characteristic of the full recipient site. Distribution of tortoises within the survey area varied, with higher densities in the upper mid-upper bajada, characterized by a stabilized alluvial fan, compared to lower elevation, distal extent of the fan characterized by sandy washes and sand fields. Sandy washes and sand fields are also present upslope of the stabilized fan bajada, between the fan outcrop and the peaks associated with the Mule Mountains lie further upslope of the bajada. Steep terrain constitutes less than 100 acres of the 3,500-acre recipient site and although these areas are expected to be suitable to desert tortoises, densities are likely relatively lower than in the bajada downslope.

A point estimate of 42 subadult and adult tortoises (>160mm) was calculated for the 1,957-acres survey area, providing a density estimate of 5.3 subadult and adult tortoises/km$^2$. Correcting the density to include only adult tortoises greater than 180mm mean carapace length results in 4.6 adult tortoises/km$^2$. The translocation guidance (USFWS 2017) indicates that the 2014 mean tortoise density in the Colorado Desert Recovery Unit is approximately 3.7 adult tortoises/km$^2$ and the maximum population density after translocation should be 4.9 adult tortoises/km$^2$. Therefore, the Mule Mountain recipient site currently supports tortoise densities higher than the mean density for the recovery unit and supports densities slightly less than the maximum population density after translocation. Using the density of 4.6 adult tortoises/km$^2$across the 3,500-acre (14.2-square kilometer) recipient site as baseline, the Mule Mountain recipient site is expected to support approximately 65 adult tortoises under baseline conditions. The translocation of five tortoises from the Project site into the adjacent Mule Mountain recipient site would increase the density to 4.9 adult tortoise/km$^2$, which equals the post-translocation threshold for the Colorado Desert Recovery Unit per USFWS (2017) guidance. Each subsequent adult tortoise translocated into the recipient would increase the density by a factor of 0.07 adult tortoises/km$^2$.

USFWS (2017) states that exceptions to the post-translocation threshold must be supported by scientific justification and monitoring. The incremental increase in density as calculated above would exceed the threshold if more than five adult tortoises were to be translocated into the recipient site; however, if the research study indicates low to no disease in the translocated and resident population and translocated tortoise would remain in their existing home ranges, the benefits to individual tortoises translocated a short distance compared to the effects of long distance translocation to a secondary recipient site may outweigh the minor exceedance of the post-translocation threshold. Continued coordination between the Applicant, BLM, USFWS, and CDFW should occur during the research study period to discuss health results and updated expectations as to the number of adult tortoises potentially requiring translocation in order to determine the most favorable outcome for individual tortoises and the population as a whole. Based on the future findings of the research study, it may be decided that all tortoises may be translocated into the primary recipient site, or that a specific number of tortoises would be translocated to the primary and then remainder to the secondary recipient site.




Ironwood Consulting

**FIGURE 4**

**Mule Mountain Recipient Site**

**RE CRIMSON SOLAR PROJECT**

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### 5.4.2 Secondary Recipient Site: Desert Sunlight

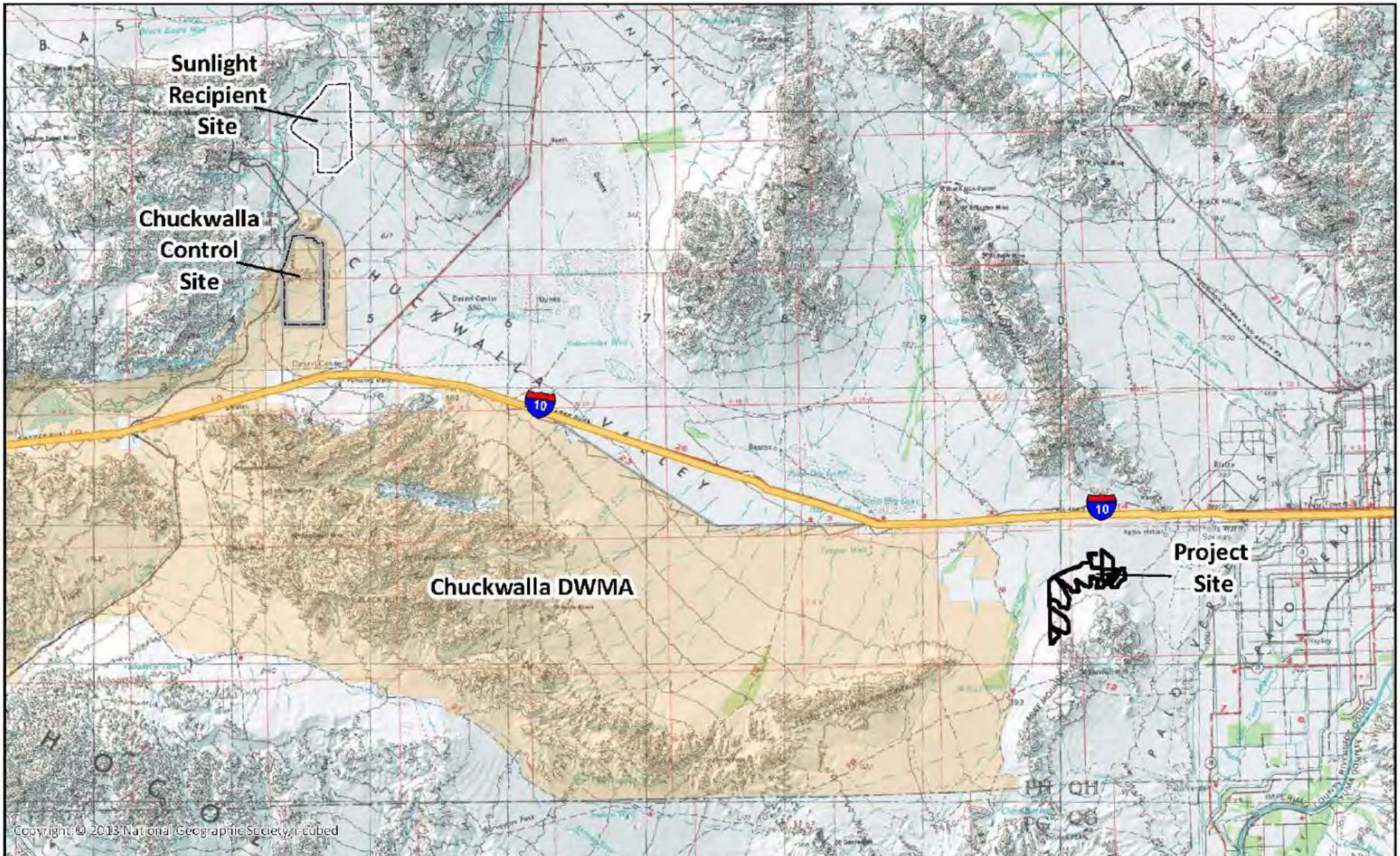
If the primary selected recipient site of Mule Mountains, adjacent to the Project, is not suitable based on agency recommendations, a second recipient site is proposed. The Sunlight Recipient site is approximately 1,866-ha (4,612-ac), with similar, or more vegetated, habitat to the Project site (Figure 5). The Sunlight Recipient Site supports creosote bush and white bursage vegetation and several areas of blue palo verde-ironwood-smoke tree series vegetation (desert dry wash woodland). Furthermore, the site contains:

- Habitat suitable for all life stages of the desert tortoise;
- Documented occurrence of resident tortoises;
- Low incidence of reported disease based on available data;
- Limited existing rights-of-way, unfenced paved roads, or other encumbrances within 4.5 kilometers;
- The Sunlight Recipient Site is located on BLM-managed lands within the Colorado Desert Recovery Unit for the desert tortoise that BLM has committed to managing as a solar exclusion area;
- Moderate to high probability of occurrence potential (Nussear et al. 2009);
- Lands where tortoise densities were relatively low yet still support suitable habitats; and
- Site access.

The estimated density of the Sunlight Recipient Site is approximately 3.4 tortoises/km$^2$, less than the estimated mean of 3.7 tortoises/km$^2$ for the Colorado Desert Recovery Unit (USFWS 2018b; USFWS 2017). Tortoises have been monitored at this recipient site starting in 2011; monitoring included radio tracking and health assessments. This site was previously used as a recipient site for the Desert Sunlight project, which supported seven translocated tortoises and seven resident tortoises. Information resulting from ongoing monitoring of the Sunlight tortoise population provides assurance that the site can serve as a suitable recipient site for other regional projects. The Sunlight Recipient Site is currently proposed as the primary recipient site for the Palen and Desert Harvest Solar Projects, which are estimated to involve only a few adult tortoises in total (USFWS 2013; USFWS 2018b). Based on these factors, the Sunlight Recipient Site is expected to be a viable recipient site for Palen, Desert Harvest, and Crimson; however, because the actual number of tortoises and timing of translocations are unknown at this time, the viability of the site will be reassessed prior to any future translocation to the Sunlight Recipient Site. Desert tortoise density estimates and site surveys would be updated and submitted to agencies for approval prior to using this area as a recipient site.

### 5.4.3 Regional Augmentation Site

The USFWS approach to translocation has evolved recently to emphasize the potential benefits of using a regional population augmentation site. This is a site where the USFWS has identified a desert tortoise population that is in specific need of augmentation for recovery purposes. Tortoises from nearby development sites may be translocated to the recipient site to augment these depleted populations. At this time, no regional augmentation sites have been identified; however, such sites would be considered as recipient sites if presented by USFWS.




Ironwood Consulting

0 10 20
Kilometers

Sunlight (Recipient)

Chuckwalla (Control)

Chuckwalla DWMA

**FIGURE 5**

**Alternative Recipient Sites**

**RE CRIMSON SOLAR PROJECT**

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### 5.4.4 Release Locations

Specific release locations for individual tortoises will be selected based on the identification of like-for-like shelter resources. Every attempt will be made to find similar cover sites and habitat to that at the location where each individual is on the Project site, otherwise all translocatees will be released at the most appropriate and available unoccupied shelter sites (e.g., soil burrows, caliche caves, rock caves, and shade of shrubs). Potential release locations within the recipient site will be investigated to ensure presence of vegetation for shelter and appropriate soils that provide for existing burrows or creation of new burrows by tortoises.

### 5.4.5 Predator Sign Concentrations

All available predator sign data, including scat, tracks, nests, and dens from ravens, coyote and badger will be reviewed for the proposed recipient site prior to selecting release locations for both relocated and translocated tortoises. While some predator sign is expected across any desert landscape, areas where sign is concentrated may indicate a poor choice for a tortoise release location. Fresh sign will be noted during ground-truthing for shelter sites, and release locations will be preferentially located away from known areas of concentrated predator sign, if any.

## 5.5 Control Site - Chuckwalla

Translocation of more than five subadult or adult tortoises from the Project site would require identifying a control site and initiating a 5-year effectiveness monitoring program. Based on pre-project survey data it is not anticipated more than 5 tortoises will be translocated off the project site.

The proposed control site would be located within the boundary, or contiguous to, of the existing Chuckwalla control site that was used as the control site for the Desert Sunlight Solar Farm. This site includes similar habitat to the recipient site, it has not previously been used as a recipient site, and it is a minimum distance of 10km from the recipient site and/or has fencing or other movement barrier between sites. The Chuckwalla Control Site supports habitats very similar to those on the portion of the site that supports higher densities of desert tortoise, such as upland areas of stabilized desert pavement and channelized drainages with soft banks and higher vegetation density.

## 5.6 Post-Clearance Procedures

After clearance and translocation are completed, there remains a possibility of finding tortoises within the Project site, especially juvenile tortoises. A BM would conduct pre-construction sweeps or surveys prior to initial clearing and grading activities in an effort to find any tortoises that could have been missed during the clearance survey. Should a tortoise be discovered, an AB would be responsible for relocating it outside the fence or translocating it per this plan.

Juvenile tortoises (less than 100mm MCL) that are found after clearance will be relocated or translocated upon detection if they pass the visual health assessment and handling would occur within the temperature limits (USFWS 2009). For tortoises that are greater than 100mm MCL, translocation will occur after TRP approval is received.

Any tortoise found after construction and during operations is most likely to have entered the site through an opening in the exclusion fence, and would be relocated or translocated per this plan.

# 6 TEMPORARY RELOCATION

The following section applies to Project activities that occur in open habitat, not enclosed by the exclusion fence (e.g., gen-tie line, access road, and fence line) and may involve relocation out of harm's way. No more than ten days prior to the initiation of fence construction, a pre-activity desert tortoise survey would be conducted using techniques providing 100-percent coverage of the disturbance area, including a buffer equaling approximately 30-feet wide centered on the fence alignment. Transects would be no greater than 15 feet apart. All desert tortoise burrows, and burrows constructed by other species that might be used by desert tortoises, would be examined to determine occupancy.

All construction activities that would occur for linear project features located in open habitat will be monitored by a BM to verify that no tortoises are harmed. An AB would be available at all times to move desert tortoises out of harm's way if necessary. Construction activities in open habitat may occur at any time of the year; therefore, all handling of tortoises will adhere to the temperature restrictions as noted in Section 4.

Vehicles parked in open habitat will be inspected immediately prior to being moved. If a tortoise is found within the proposed disturbance area or under a parked vehicle, it will first be allowed to vacate the work area on its own accord while construction activities in the immediate area are halted by the AB or BM. If the tortoise does not vacate the work area on its own accord, an AB will move the animal out of harm's way.

Relocation procedures will follow the Desert Tortoise Field Manual (USFWS 2009). Relocated tortoises will be subjected to a detailed visual health assessment and marked with a unique number. Tortoises that show signs of disease would have biological samples collected (e.g. venipuncture for ELISA testing, oral swabs). Tortoises may be temporarily fitted with transmitters and monitored to ensure their wellbeing until construction activities are complete. Relocated tortoises would be placed out of harm's way, in suitable habitat, in the direction they were going if determinable. If no suitable habitat/shelter is immediately apparent (e.g. a tortoise using the site as a transit corridor and is found on the north or west portions of the site), the tortoise will be monitored until it finds suitable habitat/shelter. Tortoises will not be excluded or relocated into areas of poor habitat. They will be relocated as close to the capture location as possible given the proposed construction activities, but no greater than 300 meters from the work area (generally within its existing home range) in BLM-managed land. Relocated tortoises will be released in the shade of a large shrub or a suitable burrow. The tortoises that are excavated from burrows may be released into an unoccupied natural or artificial burrow.

# 7 MONITORING AND REPORTING

## 7.1 Effectiveness Monitoring

All translocated tortoises will be transmittered and monitored (via radio telemetry) for a specified duration and frequency to (1) allow time for health assessment results and decision-making, and (2) ensure animal well-being immediately following release. Relocated tortoises will be monitored until they are out of harm's way (e.g. construction is complete in the area). A 5-year post-translocation effectiveness monitoring would not be required if the Project were to translocate five or fewer subadult and adult desert tortoises (USFWS 2011). Juvenile tortoises that are too small to have a transmitter affixed and tortoises temporarily moved out of harm's way (relocated) would not count towards the 5-tortoise threshold.

### 7.1.1 Five Tortoises or Less

If the fewer than five adult or subadult tortoises are translocated, they will be monitored at the following frequency:

- Once within 24 hours of release;
- Twice weekly for the first two weeks after release;
- Weekly during the more-active season;
- Biweekly during the less-active season; and
- For the duration of the construction period until the site is in O&M.

### 7.1.2 More Than Five Tortoises

If more than five tortoises are translocated, then a 5-year effectiveness monitoring program, including resident and control population monitoring, will be implemented. The effectiveness monitoring program will include all translocated desert tortoises and an equal number of resident individuals at the recipient and control sites (equal gender ratios and size, as possible). Tortoises would be monitored at the same frequency as stated above; however, these groups will be monitored for a duration of 5 years after the initial translocation date.

Transmitters will be changed as necessary throughout the monitoring period to maintain battery life. At the end of the monitoring period, coordination with BLM, USFWS and CDFW will determine whether transmitters should be removed and decommissioned or if another entity will assume the monitoring role.

## 7.2 Health Monitoring

If more than five tortoises are translocated, then a formal effectiveness monitoring program will include twice-annual health assessments. Health assessments, including serology testing, will be conducted for all transmittered translocated, resident, and control tortoises. A final visual health assessment will be completed for each translocated individual at the end of the monitoring period.

Any health problems or mortalities observed will be reported to USFWS and CDFW verbally and in writing within 48 hours of discovery, and will include unique identifier, location, suspected health issue and/or cause of death (if known). Fresh carcasses will be brought for necropsy as directed by USFWS and CDFW. Animals showing severe clinical signs of disease at any time will be addressed following the guidelines provided in this plan.

## 7.3 Reporting

Documentation of all tortoise relocation or translocation activities will be compiled throughout duration of the monitoring period. Reports will be submitted by the Project Owner directly to the BLM, USFWS and CDFW on a quarterly basis. . Minimum data requirements will conform to the current translocation and health assessment guidance (USFWS 2011 and 2016). All activities will be recorded on standardized data sheets and/or on digital data recorders. Annual reports will summarize tortoise relocation, translocation, and effectiveness monitoring activities conducted during the previous calendar year.

# 8 ADAPTIVE MANAGEMENT

Adaptive management measures will be implemented as needed. Generally, adaptive management measures would be implemented if there is evidence of project-related disturbance or increased risk to desert tortoises, where initial protection methods have been deemed ineffective.

If there are valid concerns *in the field regarding immediate threat to one or more tortoises*, field staff will make adaptive management decisions in the best interest of the tortoise through 1) coordination in the field, 2) phone calls to agency personnel and the proponent designated representative made within 24 hours to describe the actions taken and results of the actions, and finally 3) a brief email report from field staff that describes the adaptive management actions taken and reasons for and results of these actions.

If there are valid concerns in the field *that do not pose an immediate threat to one or more tortoises*, proponents field staff and designated proponent management representative will notify the agencies of proposed adaptive management decisions via email and field personnel will wait up to one week for concurrence or additional direction and response from agency personnel before actions are taken.

Triggers for adaptive management may include behaviors putting a tortoises' well-being at risk (e.g. pacing a fence, a tortoise repeatedly observed within a construction area not surrounded by a fence).

Adaptive management measures may include the following:

- Additional fencing/temporary fencing
- Temporarily penning or blocking a tortoise in its burrow
- Additional worker education
- Vehicle escorts (pedestrian or vehicle)
- Temporarily decreased project speed limits
- Increased monitoring of individual tortoises perceived to be in harm's way

# 9 REFERENCES

AECOM. 2018. Draft Biological Resources Technical Report for the RE Crimson Solar Project, Riverside County, California. Prepared for Sonoran West Solar Holdings, LLC. c/o Recurrent Energy.

Berry, K.H. and M.M. Christopher. 2001. Guidelines for the Field Valuation of Desert Tortoise Health and Disease. Journal of Wildlife Diseases 37:427-450.

Boarman, W., Goodlett, T., Goodlett, G., Hamilton, P. 1998. Review of radio transmitter attachment techniques for turtle research and recommendations for improvement. Herpetological Review 29, 26 - 33.

Brown, D.R., I.M. Schumacher, G.S. McLaughlin, L.D. Wendland, M.B. Brown, P.A. Klein, and E.R. Jacobson. 2003. Application of diagnostic tests for mycoplasmal infections of desert and gopher tortoises with management recommendations. Chelonian Conservation Biology. 4(2):497-507.

Jacobson and Berry. 2004. Necropsies of Six Desert Tortoises (Gopherus agassizii) from California. Abstract in Proceedings of the 2004 (29th Annual) Desert Tortoise Council Symposium, Las Vegas, Nevada.

Karl, A.E. and Resource Design Technology. 2006. Desert Tortoise Translocation Study – Mesquite Regional Landfill. Submitted to the Los Angeles County Sanitation Districts, Whittier, California and the U.S. Department of the Interior, Fish and Wildlife Service, Carlsbad, California. 8 pp.

Rostal D.C. and V.A. Lance. 2003. The History of Upper Respiratory Tract Disease in the Eastern Mojave Desert Tortoise: Observations from the Desert Tortoise Conservation Center, Las Vegas, Nevada. Abstract. Page 147 in Proceedings of the 2003 (28th Annual) Desert Tortoise Council Symposium, Las Vegas, Nevada.

Turner, F.B., Berry. K.H., Randall D.C. and White G.C. (1987). Population Ecology of the Desert Tortoise at Goffs, California, 1983-1986. Prepared for the Southern California Edison Company.

U.S. Fish and Wildlife Service (USFWS). 2009. Desert Tortoise Field Manual. https://www.fws.gov/nevada/desert_tortoise/documents/field_manual/Desert-Tortoise-Field-Manual.pdf

U.S. Fish and Wildlife Service (USFWS). 2010. Preparing for any Action that may Occur within the Range of the Mojave Desert Tortoise.

U. S. Fish and Wildlife Service (USFWS). 2013. Section 7 Biological Opinion on the Proposed Desert Harvest Solar Project, Riverside County, California [CACA 044919). January 15, 2013.

U.S. Fish and Wildlife Service (USFWS). 2016. Draft Revised Health Assessment Procedures for the Desert Tortoise (Gopherus agassizii): A Handbook Pertinent to Translocation. Desert Tortoise Recovery Office. U.S. Fish and Wildlife Service, Reno, Nevada. May 2016.

U.S. Fish and Wildlife Service (USFWS). 2017. Translocation of Mojave Desert Tortoises from Project Sites: Plan Development Guidance (draft). U.S. Fish and Wildlife Service, Las Vegas, Nevada.

U.S. Fish and Wildlife Service (USFWS). 2018a. Shade Structures for Desert Tortoise Exclusion Fence: DRAFT Design Guidance. U.S. Fish and Wildlife Service, Palm Springs, California.

U. S. Fish and Wildlife Service (USFWS). 2018b. Section 7 Biological Opinion on the Palen Solar Power Project, Riverside County, California. FWS-ERIV-09BO I87-II F0244. May 31, 2018.

# Appendix J
## Greenhouse Gas Emissions

1. Greenhouse Gas Emissions Technical Report, March 2019
2. Supplemental GHG Calculations, July 2019

# J.1 Greenhouse Gas Emissions Technical Report, March 2019

# RE Crimson Solar Project

by Sonoran West Solar Holdings, LLC

## Greenhouse Gas Emissions Technical Report

Project Number: 60487757

March 2019

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## Revision History

| Revision | Revision date | Details | Authorized | Name | Position |
|---|---|---|---|---|---|
| A | April 19, 2018 | Response to CDFW & BLM Comments | Jennifer Guigliano | Paola Peña | Author |
| B | March 8, 2019 | Response to CDFW Comments and Construction Scope Changes | Jennifer Guigliano | Paola Peña | Author |
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# Table of Contents

## Appendices

# 1. Project Overview

## 1.1 Introduction

Sonoran West Solar Holdings, LLC (Applicant) proposes to construct and operate the RE Crimson Solar Project (Project). This Project is a utility-scale solar photovoltaic (PV) and energy storage project that would be located in the Riverside east Solar Energy Zone/Development Leasing Area and within a Development Focus Area on federal lands managed by the Bureau of Land Management (BLM) within the California Desert Conservation Area planning area. The Project would interconnect to the regional electrical grid at the Southern California Edison (SCE) 230-kilovolt (kV) Colorado River Substation (CRS). It would generate up to 350 megawatts (MW) of renewable energy using PV technology and would include up to 350 MW of integrated energy storage capacity. The project site is located in unincorporated eastern Riverside County, approximately 13 miles west of Blythe, California (CA) (BLM CACA-051967) in the Mojave Desert Air Basin. The air quality district that monitors the area is the Mojave Desert Air Quality Management District (MDAQMD). This greenhouse gas (GHG) analysis was prepared to support the environmental review process and provide information regarding potential impacts to global climate change associated with the construction and operation of the Project.

GHG emissions have the potential to adversely affect the environment because such emissions contribute, on a cumulative basis, to global climate change. Global climate change also has the potential to result in sea level rise (resulting in flooding of low-lying areas), affect rainfall and snowfall (leading to changes in water supply and runoff), affect temperatures and habitats (affecting biological and agricultural resources), and result in many other adverse effects.

Legislation, regulations, and executive orders (EO) on the subject of climate change have established federal and statewide contexts and processes for developing an enforceable cap on GHG emissions. Given the nature of environmental consequences from GHGs and global climate change, the National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) require that lead agencies evaluate the cumulative impacts of GHGs, even relatively small additions, on a global basis.

The purpose of this report is to discuss global climate change and existing GHG emissions sources; summarize applicable federal, state, and local regulations; and analyze the impacts from construction and operation of the Project. This study is submitted to the BLM (the federal lead agency) and the California Department of Fish and Wildlife (CDFW; the state lead agency) to support their independent review and evaluation of the environmental impacts of the Project pursuant to applicable Federal, State, and local laws. The Plan of Development (POD) is part of the BLM Right-of-Way (ROW) grant application process which for this Project includes preparation of an Environmental Impact Statement in accordance with the NEPA. The proposed Project is also expected to require a Streambed Alteration Agreement and an Incidental Take Permit from the State through CDFW which would require compliance with CEQA (e.g., Environmental Impact Report). Therefore, it is currently assumed that a joint Environmental Impact Statement/Environmental Impact Report (EIS/EIR) will be prepared by the BLM and CDFW.

## 1.2 Project Description

The Project would generate up to 350 MW of renewable energy using PV technology and would include up to 350 MW of integrated energy storage capacity. The purpose of the Project is to generate up to 350 MW of clean electricity to assist the State of California in achieving its 50 percent renewable portfolio standard for 2030 and assist California utilities in meeting their obligations under the California Public Utilities Commission Energy Storage Framework and Design Program. Additionally, the Project would facilitate grid interconnection of intermittent and variable PV generation while minimizing line losses associated with off-site storage by collocating substantial electrical storage capacity at the PV facility site.

The Project applicant is proposing to construct the project using a traditional construction approach consisting of desert tortoise exclusion fencing, a mow and roll approach to site preparation, compacted roads, and trenching for electrical lines; however, the applicant is actively investigating alternative low-environmental impact design (LEID) elements and the potential for those to reduce Project impacts. LEID elements include several potential design changes including:

1. Minimizing grading during site preparation and maintaining more onsite vegetation to facilitate post-construction residual habitat value and post-operations/site reclamation success.

2. Avoiding or limiting trenching by placing electrical wiring aboveground.

3. Placing transformer/inverter groups on elevated support structures in lieu of cement foundations.

The LEID elements would further minimize grading, trenching, and vegetation removal beyond traditional design approaches for PV projects with the objective of reducing overall long-term impacts for the Project. Although the incorporation of LEID elements could result in slight modifications to the panel block locations due to topographic constraints, the permitting boundary or limits of development would be the same with LEID elements incorporated. The design scenarios are summarized below and are described in more detail in the POD.

The Project site consists of approximately 2,489 acres of BLM-administered land. A vicinity map showing the Permitting (Development) Boundary is presented on Figure 1-1. The total area for the Project (i.e., Permitting Boundary; 2,489 acres), includes a 2,465 acre solar field development area with approximately 1,859 acre of solar panels (array blocks) and 24 acres for linear facilities including access/perimeter roads with a 30 to 60 foot corridor width and gen-tie and powerline corridors at 150 feet.

## 1.3 Design Option Scenarios

### 1.3.1 Traditional Design

An estimated 2 million panels would be arranged on the site in the form of solar arrays. Structures supporting the PV modules would consist of steel piles (e.g., cylindrical pipes, H-beams, or similar), which would be driven into the soil using pneumatic techniques, such as a hydraulic attachment on the boom of a backhoe tractor.

The proposed traditional design is laid out primarily in 2-MW increments, each 2-MW increment would include an inverter-transformer station constructed on a concrete pad or steel skid, and would be centrally located within the PV module arrays. Each inverter-transformer station would contain up to four inverters, a transformer, a battery enclosure, and a switchboard. Underground cables would be installed to convey the direct current (DC) electricity from the panels to the inverters to convert the DC to alternating current (AC). Between 300 and 500 wooden poles would be installed across the entire site to convey energy to a central substation location which would transform voltage from 34.5 kV to 230 kV.

Energy storage may be achieved by either a battery or flywheel storage system capable of storing up to 350 MW of electricity. The storage system would consist of banks of batteries or flywheels housed in electrical enclosures located indoors within the Project energy storage facilities.

Access to the Project site would be provided via the existing paved Wiley's Well Road and Powerline Road to the CRS from Interstate 10 (I-10) to the north. The Project's on-site roadway system would include a perimeter road, access roads, and internal roads. These roads would be surfaced with gravel, compacted dirt, or another commercially available surface and would accommodate the Project operations and maintenance activities.

### 1.3.2 Low Environmental Impact Design Elements

As presented above, the applicant has proposed potential LEID elements for the Project for consideration with the objective of evaluating alternative design approaches that may reduce environmental impacts or negative effects from the project. These elements include changes to the grading approach, trenching and wiring, and elevation of inverter pads. To facilitate adequate analysis of potential design alternatives for the technical study, changes to the design were assessed for the potential LEID elements to determine the worst-case scenario. The design details with the incorporation of potential LEID elements are identical to those provided above for the traditional design, except for the following differences should LEID elements be incorporated:

- Solar blocks may be laid out in larger, 3- to 4-MW block sizes, requiring fewer inverter/transformer structures.

- Inverter/transformer equipment areas may be mounted on steel skids and installed on steel piers above the ground surface.
- Approximately 300 to 400 wooden AC transmission poles would be required in addition to the poles referenced under the traditional design to eliminate most trenching, which would result in the installation of up to 900 wooden poles in total.
- Access to the Project site would still be provided via the existing paved Wiley's Well Road and Powerline Road to the CRS via I-10; however, if the incorporation of elements results in fewer solar blocks, slightly fewer roads would be compacted and graded on-site.

The comparative impacts of the tradition design approach versus design with LEID elements incorporated are not known; therefore, this technical report includes the evaluation of both the traditional PV design and an alternative with the incorporation of LEID elements. The Project under either design scenario as described above would include an estimated 2 million solar panels. The Project as proposed (traditional design) consists of the following components:

- Installation of the PV modules and construction of the support structures
- Construction of the inverters, transformers, and electrical collection system;
- Construction of project substations and gen-tie line;
- Construction of the operations and maintenance building;
- Construction of the Supervisory Control and Data Acquisition and Meteorological Data Collection Systems;
- Construction of the storage system and telecommunications facilities; and
- Surfacing of access roads.

The incorporation of one or more LEID elements would result in design differences including the design of the inverters, transformers, and Electrical Collection System, design of the Supervisory Control and Data Acquisition System, amount of access roads, and installation of fencing. Traditional design (referred to in the POD as Option A) would involve construction practices such as clearing and grubbing of vegetation, grading of the majority of the project site, and trenching for underground cable installation. Incorporation of all proposed LEID elements, as described in the POD as Option B, would place nearly all DC and AC electrical wiring in aboveground cable trays or mounted on overhead poles, allowing grading, trenching, and vegetation removal to be largely avoided during construction.

Operation of the Project would include operational and maintenance activities including panel repairs; solar module washing; maintenance of transformers, inverters and other electrical equipment; vegetation, weed, and pest management; and security.

The Applicant is expected to receive authorizations and permits with 30-year terms. At the end of the term, including any extensions, the Project would cease operation. At that time, the facilities would be decommissioned and dismantled and the site restored. Decommissioning activities would be very similar to construction and would be expected to have similar impacts. Upon decommissioning, the Project site could be converted to other uses in accordance with applicable land use regulations in effect at that time.

Additional details on Project construction and operation are provided in the POD and Appendix A.

## 1.4 Integrated Energy Storage System

The planned energy storage system (ESS) will be capable of storing up to 350 megawatts (MW), or 1,400 megawatt-hours (MWh) of energy. The two energy storage systems under consideration consist of a flywheel energy storage system (FESS), which stores kinetic energy using banks of rotors that are spun continuously in a low-friction environment, and a battery energy storage system (BESS), which relies on banks of high-capacity batteries stored in a temperature-controlled environment.

The ESS would either be dispersed throughout the project site or concentrated in one central location on the site. If selected, the singular "concentrated" energy storage system would be located at the northern end of the Project site near the site access gate and Project substation. The final system chosen for installation will depend on market conditions and the availability of commercial options at the time of construction.

## 1.5 Construction Details

Construction of the Project will occur in three planned phases and will require approximately 23 months to complete with construction expected to begin in late-2020. Both the traditional design and incorporation of LEID elements are expected to feature similar quantities of construction equipment and total workforce size; thus, construction assumptions in this GHG analysis consider only construction details associated with the traditional design, which were determined to be representative of both approaches and provide a worst-case scenario for the construction emissions and air quality assessment.

### 1.5.1 Preconstruction Activities

Prior to the start of construction, several activities would be undertaken to prepare the site for crews and construction including:

1. Geotechnical and Hazards investigations. The applicant would conduct a geotechnical investigation utilizing subsurface scientific testing and analysis, and would use ground penetrating radar to identify potential subsurface unexploded ordnance and Munitions and Explosives of Concern that may need to be stabilized or removed prior to construction
2. Surveying, Staking, Flagging, and Preconstruction Resource Surveys. Prior to construction the site boundary would be staked to demarcate the limits of disturbance, following which biologists would conduct preconstruction surveys to flag areas for avoidance as appropriate.
3. Fence Installation. The Project will be fenced with security fencing (chainlink topped with barbed wire) and desert tortoise exclusion fencing. The security fencing would be up to 8-feet tall. The exclusion fencing would be buried at least 12 inches below ground surface.
4. Resource Clearance Surveys. Following fence installation, likely in a phased approach, the project development area would be cleared for special status species.
5. Staging Area Establishment. One or more secure staging areas would be established in support of construction activities.

Site preparation activities may vary in order depending upon the incorporation of LEID components, the timeline for start of construction (e.g., survey windows), and other factors. In general, pre-construction activities have limited ground-disturbing impacts; but are necessary before full mobilization to support construction of the Project.

### 1.5.2 Phase 1 – Site Preparation and Grading

Phase 1 of construction will begin with the grubbing, grading, re-contouring, compacting, and graveling of access roads, followed by grading at the substation site. For Traditional Design, additional grading would be carried out at inverter and transformer pad locations where necessary. This construction phase will last approximately 19 months and will require an average daily workforce of approximately 251 workers on the Project site. Construction equipment operating on the site will include dozers, graders, skid steers, front-end loaders, vibratory rollers, scrapers, water pumps, and water trucks. The detailed construction air analysis spreadsheets are in Appendix A and include construction equipment assumptions.

### 1.5.3 Phase 2 – PV System Installation

Phase 2 of construction will begin with the pouring of foundations and the installation of the PV module support structure, which would consist of steel piles (e.g., cylindrical pipes, H-beams, or similar) being driven into the soil. To achieve ground preservation beneath the arrays, the incorporation of LEID elements will require individually sized piles to achieve a uniform elevation between module rows; thus, the duration of pile driving activities during this phase will last longer than those anticipated for Traditional Design. However, the incorporation of LEID elements that would reduce ground disturbance (e.g., no or reduced grading) is expected to require the use of track-mounted pile drivers, as opposed to the backhoe-mounted pneumatic pile drivers proposed in Traditional Design , to reduce tire passes over natural vegetation. Construction of the structural support systems will be followed by the installation of the PV modules. This construction phase will last approximately 19 months and require an average daily workforce of approximately 320 workers on the Project site. Construction equipment operating on the site will include post machines, skid steers, flatbed trucks, cranes, vibratory rollers, dump trucks, water trucks, forklifts, generators, air compressors, cable trenchers, and mini-trenchers.

### 1.5.4 Phase 3 – Inverter, Transformer, Substation, and Electrical Collector System Commissioning

Phase 3 of construction will include the stringing of cable along module rows to a trunk cable system and the installation of AC and DC collector poles at inverter/transformer pad sites. If inverter/transformer pads will be elevated on piers as an LEID element, additional pile driving will be required during this phase for elevated pad installation. This construction phase will last approximately 18 months and require an average daily workforce of approximately 102 workers on the Project site. Construction equipment operating on the site will include graders, cranes, backhoes, aerial lifts, forklifts, trenchers, generators, and flatbed trucks.

### 1.5.5 Site Deliveries During Construction Phases

Deliveries of materials and resources will occur throughout all construction phases. Water deliveries will occur a maximum of 14 times per day throughout all three construction phases, module and foundation deliveries will occur at a rate of approximately 10 times per day between construction Phases 1 and 2, tracker system delivery will occur at a rate of approximately 9 times per day during Phase 2, and inverter delivery will occur at a rate of approximately 2 times per day between Phases 2 and 3.

## 1.6 Operations and Maintenance

The solar modules and BESS are expected to be in operation during daylight and non-daylight hours, respectively, for 7 days per week, 365 days per year. Operational activities include solar module washing, maintenance of transformers, inverters, power conditioning systems, or other electrical equipment, road and fence repairs, vegetation/pest management, and site security. Solar modules would be washed as needed to maintain optimal electricity production (up to four times each year) using light utility vehicles with tow-behind water trailers. If LEID elements are incorporated into the design, the Project may also be visited regularly by a biological resource monitor, who will monitor applicable O&M activities and conduct periodic site assessments for the first 5 years of Project operation as part of a residual habitat study.

## 1.7 Decommissioning

The Applicant is expected to receive authorizations and permits with 30-year terms. At the end of the term, including any extensions, the Project would cease operation. At that time, the facilities would be decommissioned and dismantled and the site restored. Decommissioning activities would require approximately 9,883 truck trips, a workforce of approximately 320 workers, and would take approximately 17 months to complete. Upon decommissioning, the Project site could be converted to other uses in accordance with applicable land use regulations in effect at that time.

It is anticipated that during project decommissioning, project structures would be removed from the ground on the project sites. Aboveground and any underground equipment would be removed including module posts and support structures, gen-tie poles that are not shared with third parties and the overhead collection system within the project sites, inverters, transformers, electrical wiring, equipment on the inverter pads, and related equipment and concrete pads, and any O&M facilities and related equipment and infrastructure. The substation would be removed if it is owned by the project operator, however if a public or private utility assumes ownership of the substation, the substation may remain onsite to be used as part of the utility service to supply other applications.

Equipment would be de-energized prior to removal. Equipment would be shipped offsite by truck (after first being placed in secure transport enclosures as necessary) to be salvaged, recycled or disposed of at an appropriately licensed disposal facility. Removal of the solar modules would include disassembly and removal of the racks on which the solar modules are attached, and removal of the structures supporting the racks, and their placement in secure transport enclosures and a trailer for storage; the racks and structures supporting the racks would then be recycled or disposed of at an appropriately licensed disposal facility. Solar modules would be removed from the site and either transported to another solar electrical generating facility or a recycling facility, or disposed of at an appropriately licensed disposal facility. In conjunction with any solar modules which may be transported to another solar electrical generating facility, such solar modules may undergo a refurbishing process to extend their estimated 30-year lifespan. The demolition debris and removed equipment may be cut or dismantled into pieces to be safely lifted or carried with the equipment being used. The fence and gates would be removed and all materials would be recycled to the extent feasible. It is anticipated the project roads would be restored to their pre-construction condition unless the landowner elects to retain the improved roads for access throughout that landowner's property. The area would be thoroughly cleaned and all debris removed. As discussed above, most materials would be recycled to the extent feasible, with minimal disposal to occur in landfills in compliance with all applicable laws.

# 2. Greenhouse Gases – Regulatory Setting

## 2.1 Federal

The U.S. Environmental Protection Agency (USEPA) is the federal agency responsible for implementing the federal Clean Air Act (CAA). The Supreme Court of the United States ruled on April 2, 2007, that carbon dioxide ($CO_2$) is an air pollutant as defined under the CAA, and that USEPA has the authority to regulate emissions of GHGs.

### 2.1.1 Greenhouse Gas Findings under the Federal Clean Air Act

On December 7, 2009, USEPA signed two distinct findings regarding GHGs under section 202(a) of the CAA:

- Endangerment Finding: The Administrator finds that the current and projected concentrations of the six key well-mixed GHGs—carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride ($SF_6$)—in the atmosphere threaten the public health and welfare of current and future generations.

- Cause or Contribute Finding: The Administrator finds that the combined emissions of these well-mixed GHGs from new motor vehicles and new motor vehicle engines contribute to the GHG pollution which threatens public health and welfare.

Although these findings did not themselves impose any requirements on industries or other entities, this action was a prerequisite to finalizing USEPA's Proposed Greenhouse Gas Emission Standards for Light-Duty Vehicles. On May 7, 2010, the final Light-Duty Vehicle Greenhouse Gas Emissions Standards and Corporate Average Fuel Economy Standards were published in the Federal Register. The emissions standards will require model year 2016 vehicles to meet an estimated combined average emissions level of 250 grams of $CO_2$ per mile, which is equivalent to 35.5 miles per gallon if the automobile industry were to meet this $CO_2$ level solely through fuel economy improvements.

On August 28, 2012, the U.S. Department of Transportation (USDOT) and USEPA issued a joint Final Rulemaking requiring additional federal GHG and fuel economy standards for model year 2017 through 2025 passenger cars and light-duty trucks. The standards would require these vehicles to meet an estimated combined average emissions level of 163 grams of $CO_2$ per mile in model year 2025, which is equivalent to 54.5 miles per gallon if the improvements were made solely through fuel efficiency.

In addition to the standards for light-duty vehicles, USDOT and USEPA adopted complementary standards to reduce GHG emissions and improve the fuel efficiency of heavy-duty trucks and buses on September 15, 2011. These standards together form a comprehensive heavy-duty national program for all on-road vehicles rated at a gross vehicle weight at or above 8,500 pounds for model years 2014 through 2018. The standards phase in with increasing stringency in each model year from 2014 to 2018. The USEPA standards adopted for 2018 will represent an average per-vehicle reduction in GHG emissions of 17 percent for diesel vehicles and 12 percent for gasoline vehicles (USEPA, 2011).

### 2.1.2 Mandatory Greenhouse Gas Reporting Rule

On September 22, 2009, USEPA published the Final Mandatory Greenhouse Gas Reporting Rule (Reporting Rule) in the Federal Register. The Reporting Rule requires reporting of GHG data and other relevant information from fossil fuel and industrial GHG suppliers, vehicle and engine manufacturers, and all facilities that would emit 25,000 MT carbon dioxide equivalents ($CO_2e$) or more per year. Facility owners are required to submit an annual report with detailed calculations of facility GHG emissions on March 31 for emissions from the previous calendar year. The Reporting Rule also mandates recordkeeping and administrative requirements to enable USEPA to verify the annual GHG emissions reports.

## 2.2 State

CARB is the agency responsible for coordination and oversight of state and local air pollution control programs in California and for implementing the California CAA.

### 2.2.1 Assembly Bill 1493

AB 1493 requires CARB to develop and implement regulations to reduce automobile and light truck GHG emissions. These stricter emissions standards were designed to apply to automobiles and light trucks beginning with model year 2009. In June 2009, the USEPA Administrator granted a CAA waiver of preemption to California. This waiver allowed California to implement its own GHG emissions standards for motor vehicles beginning with model year 2009. California agencies worked with federal agencies to conduct joint rulemaking to reduce GHG emissions for passenger car model years 2017 to 2025.

### 2.2.2 Executive Order S-3-05

EO S-3-05, signed in June 2005, proclaimed that California is vulnerable to the impacts of climate change. EO S-3-05 declared that increased temperatures could reduce the Sierra Nevada's snowpack, further exacerbate California's air quality problems, and potentially cause a rise in sea levels. To combat those concerns, the EO established total GHG emissions targets. Specifically, emissions are to be reduced to the 2000 level by 2010, the 1990 level by 2020, and to 80 percent below the 1990 level by 2050.

### 2.2.3 Assembly Bill 32

In 2006, California passed the California Global Warming Solutions Act of 2006 (AB 32; California Health and Safety Code Division 25.5, Sections 38500, et seq.). AB 32 further details and puts into law the mid-term GHG reduction target established in EO S-3-05, which is to reduce statewide GHG emissions to 1990 levels by 2020 and 80 percent below 1990 levels by 2050. AB 32 also identifies CARB as the state agency responsible for the design and implementation of emissions limits, regulations, and other measures to meet the target.

In December 2008, CARB adopted its Climate Change Scoping Plan (Scoping Plan), which contains the main strategies California will implement to achieve the required GHG reductions required by AB 32 (CARB, 2008). The Scoping Plan also includes CARB-recommended GHG reductions for each emissions sector of California's GHG inventory. CARB further acknowledges that decisions about how land is used will have large impacts on the GHG emissions that will result from the transportation, housing, industry, forestry, water, agriculture, electricity, and natural gas emissions sectors.

CARB is required to update the Scoping Plan at least once every five years to evaluate progress and develop future inventories that may guide this process. CARB approved the first update to the Climate Change Scoping Plan:

Building on the Framework in June 2014 (CARB, 2014a). The Scoping Plan update includes a status of the 2008 Scoping Plan measures and other federal, state, and local efforts to reduce GHG emissions in California, and potential actions to further reduce GHG emissions by 2020. On January 21, 2017, CARB released a proposed Scoping Plan update for public review. The proposed 2017 Scoping Plan update has not been adopted as the time of this analysis.

### 2.2.4 Executive Order S-1-07

EO S-1-07, which was signed by then California Governor Arnold Schwarzenegger in 2007, proclaims that the transportation sector is the main source of GHG emissions in California, at more than 40 percent of statewide emissions. EO S-1-07 establishes a goal that the carbon intensity of transportation fuels sold in California should be reduced by a minimum of 10 percent by 2020. CARB adopted the low carbon fuel standard on April 23, 2009.

### 2.2.5 Senate Bill 97

Senate Bill (SB) 97 required the Governor's Office of Planning and Research to develop recommended amendments to the CEQA Guidelines for addressing GHG emissions. The amendments became effective on March 18, 2010.

### 2.2.6 Senate Bill 1078, SB 107, and SB X1-2

SB 1078 established California's Renewable Portfolio Standard (RPS) in 2002. SB 1078 required retail sellers of electricity, including investor-owned utilities and community choice aggregators, to provide at least 20 percent of their supply from renewable sources by 2017. SB 107 changed the target date to 2010. Executive Order S-14-08 expanded the state's Renewable Energy Standard to 33 percent renewable power by 2020. This new goal was codified in 2011 with the passage of SB X1-2.

SB 1078 did not apply directly to municipally-owned utilities, such as LADWP; however, it did require those utilities to develop their own RPS. LADWP has met its goal of 20 percent by 2010 and has identified a goal to increase the supply of renewable energy to 35 percent by 2020.

### 2.2.7 Executive Order B-30-15

In April 2015, Governor Edmund Brown issued an EO establishing a statewide GHG reduction goal of 40 percent below 1990 levels by 2030. The emission reduction target acts as an interim goal between the AB 32 goal (i.e., achieve 1990 emission levels by 2020) and Governor Brown's EO S-03-05 goal of reducing statewide emissions 80 percent below 1990 levels by 2050. In addition, the EO aligns California's 2030 GHG reduction goal with the European Union's reduction target (i.e., 40 percent below 1990 levels by 2030) that was adopted in October 2014.

### 2.2.8 Senate Bill 32

SB 32, signed on September 8, 2016, requires California to reduce GHG emissions to 40 percent below 1990 levels by 2030. The SB 32 2030 target represents reductions needed to ensure California can achieve its longer-term 2050 target of a reduction of greenhouse gases 80 percent below 1990 levels per Executive Order B-30-15.

## 2.3 Regional and Local

CARB also acknowledges that local governments have broad influence and, in some cases, exclusive jurisdiction over activities that contribute to significant direct and indirect GHG emissions through their planning and permitting processes, local ordinances, outreach and education efforts, and municipal operations.

### 2.3.1 Mojave Desert Air Quality Management District

In eastern Riverside County, the MDAQMD is the agency responsible for protecting public health and welfare through the administration of federal and state air quality laws and policies. The MDAQMD has developed an annual GHG emissions significance threshold of 100,000 tons of $CO_2e$ and a daily threshold of 548,000 pounds of $CO_2e$ (MDAQMD 2016).

### 2.3.2 Riverside County

The County of Riverside has also been addressing the need to implement energy efficiencies through its General Plan process. The Multipurpose Open Space Element of the Riverside County General Plan contains several policies which indirectly address global climate change, including development of solar energy use and development (County of Riverside, 2015c). In addition to the Multipurpose Open Space Element amendment, the Air Quality Element also includes Alternative Energy Objectives. Air Quality Element policy AQ 20.19 calls for increasing the use of alternative energy sources to reduce the amount of GHG by facilitating development and siting of renewable energy facilities and transmission lines in appropriate locations (County of Riverside, 2015b).

In December 2015, Riverside County adopted the Climate Action Plan (CAP; County of Riverside, 2015). The CAP was developed with the purposes to create a GHG emissions baseline from which to benchmark GHG reductions, guide the development, enhancement, and implementation of actions that reduce GHG emissions, and provide a policy document with specific implementation measures meant to be considered as part of the planning process for future development projects. This planning effort provides a plan that is consistent with and complementary to the GHG emissions reduction efforts being conducted by the State of California through AB 32, the actions of the USEPA, and the global community through the Kyoto Protocol. The Kyoto Protocol (Protocol) is a treaty made under the United Nations Framework Convention on Climate Change (UNFCCC) and was the first international agreement to regulate GHG emissions. However, the U.S. Congress has not ratified the Protocol and the U.S. is not bound by the commitments established in the Protocol (County of Riverside, 2015). The CAP provides a list of specific actions that will reduce GHG emissions throughout the County and establishes a qualified reduction plan for which future development within the County can tier from (County of Riverside, 2015).

# 3. Existing Conditions

## 3.1 Scientific Basis of Climate Change

Certain gases in the earth's atmosphere, classified as GHGs, play a critical role in determining the earth's surface temperature. A portion of the solar radiation that enters the earth's atmosphere is absorbed by the earth's surface, and a smaller portion of this radiation is reflected back toward space. This infrared radiation (i.e., thermal heat) is absorbed by GHGs within the earth's atmosphere. As a result, infrared radiation released from the earth that otherwise would have escaped back into space is instead "trapped," resulting in a warming of the atmosphere. This phenomenon, known as the "greenhouse effect," is responsible for maintaining a habitable climate on the earth.

GHGs are present in the atmosphere naturally, are released by natural and anthropogenic sources, and are formed from secondary reactions taking place in the atmosphere. Natural sources of GHGs include the respiration of humans, animals and plants, decomposition of organic matter, and evaporation from the oceans. Anthropogenic sources include the combustion of fossil fuels, waste treatment, and agricultural processes. The following are GHGs that are widely accepted as the principal contributors to human-induced global climate change:

- $CO_2$
- $CH_4$
- $N_2O$
- HFCs
- PFCs
- $SF_6$
- Nitrogen Trifluoride ($NF_3$)

The majority of $CO_2$ emissions are byproducts of fossil fuel combustion. $CH_4$ is the main component of natural gas and is associated with agricultural practices and landfills. $N_2O$ is a colorless GHG that results from industrial processes, vehicle emissions, and agricultural practices. HFCs are synthetic chemicals used as a substitute for chlorofluorocarbons in automobile air conditioners and refrigerants. PFCs are produced as a byproduct of various industrial processes associated with aluminum production and the manufacturing of semiconductors. $SF_6$ is an inorganic, odorless, colorless, nontoxic, nonflammable GHG used for insulation in electric power transmission and distribution equipment, and in semiconductor manufacturing. $NF_3$ is used in the electronics industry during the manufacturing of consumer items, including photovoltaic solar panels and liquid-crystal-display (i.e., LCD) television screens.

Global warming potential (GWP) is a concept developed to compare the ability of each GHG to trap heat in the atmosphere relative to $CO_2$. The GWP of a GHG is based on several factors, including the relative effectiveness of a gas in absorbing infrared radiation and length of time (i.e., lifetime) that the gas remains in the atmosphere ("atmospheric lifetime"). The reference gas for GWP is $CO_2$; therefore, $CO_2$ has a GWP of 1. The other main GHGs that have been attributed to human activity include $CH_4$, which has a GWP of 28, and $N_2O$, which has a GWP of 265 (IPCC, 2013). For example, one ton of $CH_4$ has the same contribution to the greenhouse effect as approximately 28 tons of $CO_2$. GHGs with lower emissions rates than $CO_2$ may still contribute to climate change because they are more effective at absorbing outgoing infrared radiation than $CO_2$ (i.e., high GWP). The concept of $CO_2e$ is used to account for the different GWP potentials of GHGs to absorb infrared radiation.

Although the exact lifetime of any particular GHG molecule is dependent on multiple variables, it is understood by scientists who study atmospheric chemistry that more $CO_2$ is emitted into the atmosphere than is sequestered by ocean uptake, vegetation, and other forms of sequestration. GHG emissions related to human activities have been determined as "extremely likely" to be responsible (indicating 95 percent certainty) for intensifying the greenhouse effect and leading to a trend of unnatural warming of the earth's atmosphere and oceans, with corresponding effects on global circulation patterns and climate (CARB, 2014a).

## 3.2 GHG Sources

GHG emissions contributing to global climate change are attributable in large part to human activities associated with the transportation, industrial/manufacturing, electric utility, residential, commercial, and agricultural categories. The majority of $CO_2$ emissions are byproducts of fossil fuel combustion, and $CH_4$, a highly potent GHG, is the primary component in natural gas and is associated with agricultural practices and landfills. $N_2O$ is also largely attributable to agricultural practices and soil management.

For purposes of accounting for and regulating GHG emissions, sources of GHG emissions are grouped into emission categories. CARB identifies the following main GHG emission categories that account for most anthropogenic GHG emissions generated within California:

- Transportation: On-road motor vehicles, off-road equipment, recreational vehicles, aviation, ships, and rail
- Electric Power: Use and production of electrical energy
- Industrial: Mainly stationary sources (e.g., boilers and engines) associated with process emissions
- Commercial and Residential: Area sources, such as landscape maintenance equipment, fireplaces, and consumption of natural gas for space and water heating
- Agriculture: Agricultural sources that include off-road farm equipment; irrigation pumps; crop residue burning ($CO_2$); and emissions from flooded soils, livestock waste, crop residue decomposition, and fertilizer volatilization ($CH_4$ and $N_2O$)
- High GWP: Refrigerants for stationary and mobile-source air conditioning and refrigeration, electrical insulation (e.g., $SF_6$), and various consumer products that use pressurized containers
- Recycling and Waste: Waste management facilities and landfills; primary emissions are $CO_2$ from combustion and $CH_4$ from landfills and wastewater treatment

### 3.2.1 California

CARB performs an annual GHG inventory for the seven major GHGs ($CO_2$, $CH_4$, $N_2O$, HFCs, PFCs, $SF_6$, and $NF_3$). California produced 440 million metric tons (MT) of CO2e in 2015. Combustion of fossil fuel in the transportation category was the single largest source of California's GHG emissions in 2015, accounting for 39 percent of total GHG emissions in the State. The transportation category was followed by the industrial category, which accounts for 23 percent of total GHG emissions in California, and the electric power category (including in-state and out of-state sources), which accounts for 19 percent of the State's total GHG emissions (CARB, 2017).

### 3.2.2 Riverside County

Riverside County emitted approximately 7 million MT of GHG emissions in 2008. The largest portion of Riverside County's 2008 emissions were from transportation (41%), followed by agriculture (29%), and electricity and natural gas use in buildings (22%) (County of Riverside, 2015a).

# 4. Methodology

## 4.1 Evaluating CEQA Impacts

According to Appendix G of the CEQA Guidelines, a project's GHG emissions and its incremental contribution to global climate change would be considered significant if it would do either of the following:

- Generate GHG emissions, either directly or indirectly, that may have a significant cumulative impact on the environment, or
- Conflict with an applicable plan, policy, or regulation of an agency adopted for the purpose of reducing the emissions of GHGs.

### 4.1.1 Screening Thresholds

The California Supreme Court, in Center for Biological Diversity v. Department of Fish and Wildlife (Case No. S217763), held that the lead agencies must connect the thresholds of significance to individual project emissions. The BLM and CDFW have not adopted a screening threshold related to GHG emissions. The County of Riverside CAP included a threshold level above 3,000 MT CO2e per year used to identify residential and commercial projects that require the use of screening tables or a project-specific technical analysis to quantify and mitigate project emissions. The County of Riverside recommends that construction emissions associated with a project be amortized over the life of the project (typically 30 years) and added to the operational emissions.

As the County of Riverside has not established applicable screening thresholds for GHG emissions for industrial processes, the analysis also uses the applicable significance thresholds developed by the MDAQMD. The MDAQMD has adopted a significance threshold of 100,000 tons of carbon dioxide equivalents (CO2e) per year for industrial (stationary source) projects or a daily significance threshold of 548,000 pounds of CO2e (MDAQMD 2016).

The project type is closest to an industrial project (i.e., does not contain residential or commercial land uses). As explained in Appendix F of the County of Riverside CAP, the Screening Tables are not recommended for evaluation of industrial processes (e.g. electric generating stations, heavy manufacturing, etc.) (County of Riverside 2015). However, the CEQA analysis conservatively compares the amortized construction and operational emissions to both the County of Riverside threshold of 3,000 MT CO2e per year and compares the total construction and operational emissions to the MDAQMD threshold of 100,000 tons CO2e per year. It is not the intent of BLM or CDFW to adopt these thresholds as a mass emissions limit for this or other projects, but rather to provide this additional information to put the Project-generated GHG emissions in the appropriate statewide context.

### 4.1.2 Evaluating Impacts Related to Climate Action Plans

In December 2015, the County of Riverside adopted a CAP. The County of Riverside developed the CAP in order to address emissions associated with sources under Riverside County's jurisdiction, and to provide a plan that is consistent with and complementary to: the GHG emissions reduction efforts being conducted by the State of California through the Global Warming Solutions Act (AB 32), federal government through the actions of the USEPA, and the global community through the Kyoto Protocol. The CAP creates a GHG emissions baseline from which to benchmark GHG reductions and guides the development, enhancement, and implementation of actions that reduce GHG emissions.

The CAP provides a list of specific actions that will reduce GHG emissions, giving the highest priority to actions that provide the greatest reduction in GHG emissions and benefits to the community at the least cost. Therefore, for the purposes of this analysis, the applicable GHG reduction plans to evaluate and compare the Project to are the AB (Assembly Bill) 32 CARB Scoping Plan, and the County of Riverside CAP. If the Project is consistent with the goals and strategies of these plans, it would not be considered to conflict with the plan's purpose of reducing GHG emissions

## 4.2 Evaluating NEPA Impacts

The NEPA analysis is based on the emissions reporting limit of 25,000 MT $CO_2$e per year as required by the Mandatory Greenhouse Gas Reporting Rule. If the Proposed Action exceeds 25,000 MT $CO_2$e per year, the Proposed Action would have a substantial adverse effect on the environment. On August 1, 2016, the Council on Environmental Quality (CEQ) released final guidance that applies to all proposed federal agency actions, including land and resource management actions, which explains that agencies should consider both the potential effects of a proposed action on climate change, as indicated by its estimated GHG emissions, and the implications of climate change for the environmental effects of a proposed action (CEQ 2016). However, EO 13783, *Promoting Energy Independence and Economic Growth,* signed on March 28, 2017, directed that CEQ rescind the 2016 Final Guidance. As noted in the Federal Register notice, the withdrawn guidance was not a regulation, and does not change any law, regulation, or other legally binding requirement (CEQ 2017). Therefore, in order to evaluate the Project's effects on climate change as indicated by the estimated GHG emissions, the NEPA analysis is based on the emissions reporting limit of 25,000 MT $CO_2$e per year as required by the Mandatory Greenhouse Gas Reporting Rule.

## 4.3 Emissions Methodology

### 4.3.1 Construction Emissions

Construction-related exhaust emissions for the Project were estimated for construction worker commutes, haul trucks, and the use of off-road equipment. Construction-related emissions for the Project were estimated using emission factors from USEPA Emission Factors for GHG Inventories, The Climate Registry 2018 Default Emission Factors, and California Air Resources Board's (CARB) OFFROAD and Emissions Factor Model (EMFAC2014) inventory models (CARB, 2013; TCR 2018; USEPA, 2018). Construction emissions from the operation of diesel-fueled off-road equipment were estimated by multiplying daily usage (i.e., hours per day) and total days of construction by OFFROAD equipment-specific emission factors. GHG emissions from on-road motor vehicles were estimated using vehicle trips, vehicle miles traveled, and EMFAC2014 and USEPA mobile source emission factors. The emission factors for $CO_2$ and $CH_4$ represent the fleet-wide average emission factors within Riverside County. Emissions of $N_2O$ from on-road diesel medium and heavy-duty vehicles were estimated using U.S. Environmental Protection Agency (EPA) Emission Factors for Greenhouse Gas Inventories (USEPA 2018). All of the off-site road travel was assumed to be within the MDAQMD jurisdiction area.

Construction activities would commence in the fourth quarter of 2020 and would be expected to be complete by December of 2022. Preconstruction activities would include conducting geotechnical and unexploded ordinance/munitions of concern field investigations, training of construction crews, site survey and staking, installation of perimeter security and desert tortoise exclusion fencing, and clearance of the site for sensitive resources. Phase 1 of construction will begin with the grubbing, grading, re-contouring, compacting, and graveling of access roads, followed by grading at the substation site. Phase 2 of construction will begin with the pouring of foundations and the installation of the PV module support structure, which would consist of steel piles (e.g., cylindrical pipes, H-beams, or similar) being driven into the soil. Phase 3 of construction will include the stringing of cable along module rows to a trunk cable system and the installation of AC and DC collector poles at inverter/transformer pad sites.

Both the traditional design and incorporation of LEID elements are expected to feature similar quantities of construction equipment and total workforce size; thus, construction assumptions in this air quality analysis consider only construction details associated with the traditional design. It was determined to be representative of both approaches and provide a worst-case scenario for the construction emissions and air quality assessment. The assumptions used in calculating emissions from construction are as follows:

**Construction Assumptions - Traditional Design**

| Construction Element | Site Preparation | Photovoltaic Panel System Installation | Installation of Inverters, Substation, and Connection |
|---|---|---|---|
| Average Number of Workers | 251 | 320 | 102 |
| Maximum Number of Workers | 334 | 427 | 180 |
| Length of Phase (work days) | 399 | 399 | 378 |

NOTES:
Construction assumptions are based on information in the POD (April 2017) and updated by the Applicant in 2019.
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Construction activities will include site preparation and grading, solar array foundation installation, equipment installation, and gen-tie line tower and conductor installation along the gen-tie route. During the construction phase, up to 1,000 acre-feet of water would be used for dust suppression (including truck wheel washing) and other purposes. The worst-case water trucking scenario is included in the emission estimates.

#### 4.3.2 Operational Emissions

Operational GHG emissions were estimated using emission factors from the USEPA Emission Factors for GHG Inventories, OFFROAD and EMFAC2014 inventory models as described for construction-related GHG emissions. The Project would be designed with a comprehensive Supervisory Control and Data Acquisition (SCADA) system to allow remote monitoring of facility operation and/or remote control of critical components. The maximum number of staff on-site at any time would be 50 (40 temporary staff and 10 permanent staff). The perimeter road and main access roads would be surfaced with gravel, compacted dirt, or another commercially available surface and would accommodate Project operation and maintenance activities such as cleaning of solar panels, and facilitate on-site circulation for emergency vehicles. Water for operations would be obtained from several potential sources, including an on-site or off-site groundwater wells, or trucked from an off-site water purveyor. During operations and maintenance up to 22 acre-feet (7.3 million gallons) of water would be required for panel washing and maintenance, and for substation restroom facilities.

At the end of the operational term of the Project, the Project would cease operation. Decommissioning activities and impacts are anticipated to be similar to those determined for the construction phase of the Project. The actual impacts would be dependent upon the proposed decommissioning action and final use of the site; thus, emissions associated with decommissioning are discussed qualitatively. Applicable construction phase applicant proposed measures (APMs) would be implemented during the decommissioning phase to minimize associated impacts.

# 5. Impact Analysis

## 5.1 Generate GHG Emissions

#### 5.1.1 Construction Impacts

Construction-related GHG exhaust emissions would be generated by sources such as heavy-duty diesel off-road equipment, trucks used to transport fuel, water, and deliver materials and equipment to and from the project site, and construction worker commutes. Construction emissions were estimated using the earliest calendar year when construction could begin (i.e., 2020) to generate conservative estimates. If construction occurs in later years, advancements in engine technology, retrofits, and turnover in the equipment fleet may result in lower levels of emissions. The annual construction emissions include all construction phases are shown in Table 1.

**TABLE 1**
**CONSTRUCTION-RELATED**
**GHG EMISSIONS (MT $CO_2$e/year)**

| Year | Emissions (MT $CO_2$e) |
|---|---|
| 2020 | 872 |
| 2021 | 11,224 |
| 2022 | 6,258 |
| Total | 18,354 |
| **30-Year Amortized Emissions** | **612** |

Notes:
Totals may not add due to rounding.
$CO_2$e = carbon dioxide equivalent
Additional details available in Appendix A.
Source: AECOM, 2019

As shown in Table 1, the maximum annual emissions would be 11,224 MT $CO_2$e in 2021. Total emissions over the entire construction period for the Project would be approximately 18,354 MT $CO_2$e. When this total is amortized over the 30-year life of the Project, annual construction emissions would be approximately 612 MT $CO_2$e per year. As shown in Table 1, both the total and amortized construction-related $CO_2$e emissions associated with this design would be less than the 100,000 MT $CO_2$e per year, the threshold of significance recommended by the MDAQMD. As explained previously, both the traditional design and incorporation of LEID elements are expected to feature similar quantities of construction equipment and total workforce size; thus, emissions are expected to be similar and would not exceed the MDAQMD threshold for GHG emissions under either option. As discussed above, the County of Riverside recommends that construction emissions associated with a project be amortized over the life of the project (typically 30 years) and added to the operational emissions. Therefore, those emissions are then amortized and evaluated as a component of the operational emissions over the 30-year life of the project.

The maximum annual GHG emissions of 11,224 MT $CO_2$e would also not exceed the threshold of 25,000 MT $CO_2$e per year applied for the Project's NEPA analysis. Therefore, under NEPA, construction of the Project, under either option, would not result, either directly or indirectly, in a substantial adverse effect related to the generation of GHG emissions.

### 5.1.2 Operational Impacts

Operation of Project, under either option, would include operational and maintenance activities, including panel repairs; panel washing; maintenance of transformers, inverters or other electrical equipment; road and fence repairs; vegetation, weed, and pest management; and security. The analysis assumed that solar modules would be washed four times each year using light utility vehicles with tow-behind water trailers. Mobile source emissions were also estimated based on the vehicle trips that would result from maintenance activities. Table 3 shows the annual operational emissions and amortized construction emissions to present the total GHG emissions generated by the proposed Project.

**TABLE 3**
**OPERATIONAL**
**GHG EMISSIONS (MT $CO_2$e/year)**

| Source | $CO_2$e/year (MT) |
|---|---|
| Operations | 171 |
| Amortized Construction | 612 |
| **Total** | 783 |
| **County of Riverside Significance Threshold** | **3,000** |

**TABLE 3**
**OPERATIONAL**
**GHG EMISSIONS (MT $CO_2$e/year)**

| Source | $CO_2$e/year (MT) |
|---|---|
| Operations | 171 |
| **MDAQMD Significance Threshold** | **100,000** |
| **Exceeds Threshold?** | **No** |

Notes:
Totals may not add due to rounding.
$CO_2$e = carbon dioxide equivalent
Additional details available in Appendix A.
Source: AECOM, 2019

The total GHG emissions generated by the Project would not exceed the recommended significance thresholds. Therefore, impacts related to generation of GHG emissions during operations, either directly or indirectly, would be less than significant.

Decommissioning impacts are anticipated to be similar to those determined for the construction phase of the Project as described above. As such, activities during decommissioning will result in similar or less emissions as identified during construction of the Project.

The annual operational GHG emissions of 783 MT $CO_2$e would also not exceed the threshold of 25,000 MT CO2e per year applied for the Project's NEPA analysis. Therefore, under NEPA, operation of the Project would not result, either directly or indirectly, in a substantial adverse effect related to the generation of GHG emissions.

## 5.2 Conflict with Applicable Plan

Measures included in the CARB Scoping Plan update would indirectly address GHG emissions levels associated with construction activities, including the phasing-in of cleaner technology for diesel engine fleets (including construction equipment) and the development of a low-carbon fuel standard. According to CARB, the 2020 goal was established as an achievable, mid-term target, and the 2050 GHG emissions reduction goal represents the level scientists believe is necessary to stabilize the climate. However, the CARB Scoping Plan does not recommend additional measures for meeting specific GHG emissions limits beyond 2020. Policies formulated under the mandate of AB 32 that apply to construction-related activity, either directly or indirectly, are assumed to be implemented statewide and would affect construction of Project should those policies be implemented before construction begins. Construction of the Project would include activities to reduce landfill waste, such as waste sorting on site, transporting recyclable materials to a designated recycling facility, and selling, recycling, or composting wooden construction waste. Therefore, it is assumed that Project's construction and operation would not conflict with the CARB Scoping Plan update.

Although construction and operation of the Project would result in an increase of GHG emissions, it is aligned with the goals of AB 32 and SB 32. Consistent with SB 1078, the purpose of the Project is to generate renewable energy to assist the State of California in achieving the 50 percent RPS goal by 2030 and assist California utilities in meeting their obligations under the CPUC's Energy Storage and Framework Design Program. The Project would also assist California utilities in meeting their obligations under the CPUC's Energy Storage Framework and Design Program, including the procurement target of 1,325 MWs by 2020, by providing up to 350 MW of storage capacity.

As described in the County of Riverside CAP and Air Quality Element of the County of Riverside General Plan, renewable energy sources can significantly reduce GHG emissions. Thus, the Project is consistent with the goals of the County of Riverside CAP and General Plan. The County of Riverside CAP has established goals and policies to address GHG emissions from transportation, energy, area, water, solid waste, agriculture, and industrial sources. The CAP includes GHG inventories of community-wide and municipal sources based on the most recent data available for the years 2008, 2020 and 2035. Consistent with AB 32, The County of Riverside has set a goal to reduce emissions back to 1990 levels by the year 2020. That goal was estimated as a 15% decrease from 2008 levels, as recommended in the AB 32 Scoping Plan. The measures included in the CAP that relate to the Project include:

- R2-S1: County Diversion Program. Countywide waste diversion plan to further exceed the state requirements by diverting 75% of all waste from landfills by 2020.
- R2-E6: Commercial/Industrial Renewable Energy Program. Incorporate onsite renewable (solar or other renewable) energy generation into the design and construction of new commercial, office and industrial development.

Although the measures in the CAP do not directly relate to the Project, the goals of the Project, with and without LEID elements, would be consistent with the goals of the General Plan and the CAP to increase the use of alternative energy sources to reduce the amount of GHG by facilitating development and siting of renewable energy facilities and transmission lines in appropriate locations.

The Project would generate up to 350 MW of clean electricity; thus avoiding the GHG emissions associated with generation of the same power from a nonrenewable energy source. In order to demonstrate that the Project is aligned with and supporting the goals of AB 32, the Scoping Plan, and the RPS, the amount of carbon savings that would be derived from implementation of the Project, as opposed to implementation of a carbon-based power plant, was estimated for this report.

The total amount of carbon savings from implementation of the Project is estimated at 355,836 MT CO2e per year. Carbon savings were estimated using SCE's 2015 average CO2e intensity factor of 0.23 MT CO2e per megawatt-hour (MWh)[1]. Additional calculation details are available in Appendix A. After accounting for annual operational emissions and amortized construction emissions of 783 MT $CO_2$e per year, the Project would result in a net carbon savings of 355,053 MT $CO_2$e per year. As these emissions reductions are accounted for by a utility that will be using them to meet its RPS goal, the reductions are not factored into the significance findings for this report;

[1] MWh estimated assuming operation of the Project would occur 365 days per year during daylight hours.

however, quantifying them does demonstrate that the Project will assist the State in meeting its RPS goal. Therefore, the intent, purpose, and functions of the Project are consistent with the goals of the AB 32 Scoping Plan and County of Riverside General Plan and CAP to protect against the detrimental effects of climate change.

The Project would not conflict with the CARB Scoping Plan update or any other plans, policies, or regulations for the purpose of reducing GHG emissions. The Project would, instead, reduce the amount of GHG emissions that would have been generated by non-renewable sources of energy. As discussed earlier, the Project would also not generate GHG emissions that would have a significant impact on the environment. Therefore, impacts related to conflict with any applicable plan, policy, or regulation for the purpose of reducing GHG emissions would not occur.

### 5.3 Cumulative Impacts

The analysis of GHG emissions is inherently a cumulative impact analysis. Therefore, no additional analysis is required, and as described above, it is not anticipated that construction and operation of the Project would generate GHG emissions that would cause a significant impact on the environment. Therefore, the Project would not result in a considerable incremental contribution to a significant cumulative impact.

## 6. Mitigation Measures

There are no significant impacts related to construction and operation of the Project, with or without LEID elements incorporated and, therefore, no mitigation measures are required.

## 7. CEQA Significance Conclusions

The Project would not generate GHG emissions, but not at a level that would not have a significant impact on the environment. The Project would not conflict with any applicable plan, policy, or regulation for the purpose of reducing GHG emissions. Therefore, impacts related to climate change would be less than significant.

## 8. NEPA Impacts Summary

As described above, the Project would not exceed the annual threshold for GHG emissions. The Project would not result in, either directly or indirectly, a substantial adverse effect related to the generation of GHG emissions.

## 9. References

California Air Resources Board (CARB), 2008. Climate Change Scoping Plan. Available at www.arb.ca.gov/cc/scopingplan/document/scopingplandocument.htm, accessed August 2017.

________, 2013. Mobile Source Emission Inventory – Current Methods and Data. Available at

http://www.arb.ca.gov/msei/modeling.htm, accessed August 2017.

________, 2014a. First Update to the Climate Change Scoping Plan: Building on the Framework. Pursuant to AB 32, the California Global Warming Solutions Act of 2006. Available at http://www.arb.ca.gov/cc/scopingplan/2013_update/first_update_climate_change_scoping_plan.pdf, accessed August 2017.

________, 2017. California Greenhouse Gas Inventory for 2000–2015. Available at https://www.arb.ca.gov/cc/inventory/data/data.htm, accessed August 2017.

Council on Environmental Quality (CEQ). 2016. Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews. Available at https://ceq.doe.gov/docs/ceq-regulations-and-guidance/nepa_final_ghg_guidance.pdf, accessed August 2017.

________, 2017. Withdrawal of Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews.

Available at https://www.federalregister.gov/documents/2017/04/05/2017-06770/withdrawal-of-final-guidance-for-federal-departments-and-agencies-on-consideration-of-greenhouse-gas, accessed August 2017.

County of Riverside. 2015a. Climate Action Plan. Available at http://planning.rctlma.org/ZoningInformation/GeneralPlan/RiversideCountyClimateActionPlan%E2%80%93December2015.aspx, accessed August 2017.

________, 2015b. Air Quality Element. General Plan. Available at http://planning.rctlma.org/Portals/0/genplan/general_plan_2016/elements/Ch09_AQ%20%20Element_120815.pdf?ver=2016-04-01-100811-943, accessed August 2017.

________, 2015c. Multipurpose Open Space Element. General Plan. Available at http://planning.rctlma.org/Portals/0/genplan/general_plan_2016/elements/Ch05_MOSE_120815.pdf?ver=2016-04-01-100801-367, accessed August 2017.

Intergovernmental Panel on Climate Change (IPCC), 2013. Climate Change 2013: The Physical Science Basis. Available at http://www.ipcc.ch/report/ar5/wg1/, accessed January 2016.

Mojave Desert Air Quality Management District (MDAQMD), 2016. CEQA and Federal Conformity Guidelines. . Available at http://www.mdaqmd.ca.gov/home/showdocument?id=192, accessed August 2017.

The Climate Registry (TCR). 2018. Default Emission Factor Document. Available at https://www.theclimateregistry.org/wp-content/uploads/2018/06/The-Climate-Registry-2018-Default-Emission-Factor-Document.pdf, accessed November 2018.

United States Environmental Protection Agency (USEPA), 2011. EPA and NHTSA Adopt First-Ever Program to Reduce Greenhouse Gas Emissions and Improve Fuel Efficiency of Medium- and Heavy-Duty Engines and Vehicles. Available at https://www.epa.gov/sites/production/files/2016-10/documents/420f10038.pdf, accessed August 2017.

________, 2018. Center for Corporate Climate Leadership. Emission Factors for Greenhouse Gas Inventories. Available at https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf, accessed November 2018.

## 10. List of Abbreviations and Acronyms

| | |
|---|---|
| AB | Assembly Bill |
| AC | alternating current |
| APMs | applicant proposed measures |
| BLM | Bureau of Land Management |
| CAA | Clean Air Act |
| CAP | Climate Action Plan |
| CARB | California Air Resources Board |
| CDFW | California Department of Fish and Wildlife |
| CEQ | Council on Environmental Quality |
| CEQA | California Environmental Quality Act |
| CH4 | methane |
| CO2 | carbon dioxide |
| CO2e | carbon dioxide equivalents |
| County | County of Riverside |
| CRS | Colorado River Substation |
| DC | direct current |
| EIS/EIR | Environmental Impact Statement/Environmental Impact Report |
| EMFAC | EMissions FACtor model |
| EO | Executive Order |
| ESS | energy storage system |
| GHG | greenhouse gases |

| | |
|---|---|
| GWP | Global Warming Potential |
| HFC | hydrofluorocarbons |
| IPCC | International Panel on Climate Change |
| kV | kilovolt |
| LADWP | Los Angeles Department of Water and Power |
| LEID | Low Environmental Impact Design |
| MT | Metric Tons |
| MDAQMD | Mojave Desert Air Quality Management District |
| MW | megawatts |
| MWh | megawatt-hour |
| NEPA | National Environmental Policy Act |
| NF3 | Nitrogen Trifluoride |
| N2O | Nitrous oxide |
| POD | Plan of Development |
| PFC | perfluorocarbons |
| PV | photovoltaic |
| Reporting Rule | Mandatory Greenhouse Gas Reporting Rule |
| ROW | right-of-way |
| RPS | Renewables Portfolio Standard |
| SB | Senate Bill |
| SCADA | Supervisory Control and Data Acquisition |
| SCE | Southern California Edison |
| State | State of California |
| SF6 | sulfur hexafluoride |
| USEPA | United States Environmental Protection Agency |

# Appendix A

## Emission Calculations

Option A -Traditional Design Construction
Construction Emissions Summary

| | Metric Tons $CO_2e$ |
|---|---|
| **2020** | |
| Option A - Phase I | 872 |
| | |
| **2021** | |
| Option A - Phase I | 3,488 |
| Option A - Phase II | 5,673 |
| Option A - Phase III | 2,063 |
| Maximum Annual | 11,224 |
| | |
| **2022** | |
| Option A - Phase I | 1,163 |
| Option A - Phase II | 3,782 |
| Option A - Phase III | 1,313 |
| Maximum Annual | 6,258 |
| Total | 18,354 |

**Option A - Phase 1 - Move On (Laydown, Construction Trailers, Parking Area), Grading, Site Preparation**

Phase Duration (days): 399 19 months 21 working days per month

| | | | | | | | Emissions Summary (lbs/day) | | | | | | | | | Emissions Summary (tons per phase) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Equipment Category | Equipment Type | Number | Usage Factor (hrs/day or miles/day) | Power Rating (hp) | Load Factor | Total Days/VMT | VOC | NOx | CO | PM10 | PM2.5 | CO2 | CH4 | N2O | VOC | NOX | CO | PM10 | PM2.5 | CO2 | CH4 | N2O | Total GHG Emissions (MT CO2e) |
| Off-Highway Trucks >176 and <250 | Water Truck | 2 | 8 | 230 | 0.38 | 399 | 0.85 | 7.73 | 4.29 | 0.30 | 0.28 | 1,449.50 | 0.47 | 0.21 | 0.17 | 1.54 | 0.86 | 0.06 | 0.06 | 289.18 | 0.09 | 0.04 | 275.65 |
| Off-Highway Trucks >176 and <250 | Water Pull | 2 | 8 | 185 | 0.41 | 399 | 0.74 | 6.71 | 3.72 | 0.26 | 0.24 | 1,257.95 | 0.41 | 0.18 | 0.15 | 1.34 | 0.74 | 0.05 | 0.05 | 250.96 | 0.08 | 0.04 | 239.22 |
| Graders >176 and <250 | Motor Grader | 3 | 6 | 185 | 0.41 | 399 | 1.06 | 14.08 | 4.04 | 0.45 | 0.41 | 1,430.65 | 0.46 | 0.21 | 0.21 | 2.81 | 0.81 | 0.09 | 0.08 | 285.42 | 0.09 | 0.04 | 272.06 |
| Rubber Tired Dozers > 121 and <175 | Dozer (D6) | 1 | 6 | 158 | 0.40 | 399 | 0.61 | 6.01 | 3.25 | 0.34 | 0.32 | 395.43 | 0.13 | 0.06 | 0.12 | 1.20 | 0.65 | 0.07 | 0.06 | 78.89 | 0.03 | 0.01 | 75.20 |
| Tractors/Loaders/Backhoes >176 and <250 | Loader | 2 | 6 | 190 | 0.36 | 399 | 0.41 | 4.95 | 2.16 | 0.16 | 0.15 | 851.40 | 0.28 | 0.12 | 0.08 | 0.99 | 0.43 | 0.03 | 0.03 | 169.85 | 0.05 | 0.02 | 161.91 |
| Skid Steer Loaders >51 and <120 | Skid Steer | 3 | 6 | 83 | 0.40 | 399 | 0.25 | 3.30 | 4.32 | 0.14 | 0.13 | 621.73 | 0.20 | 0.09 | 0.05 | 0.66 | 0.86 | 0.03 | 0.03 | 124.04 | 0.04 | 0.02 | 118.23 |
| Other Construction Equipment >51 and <120 | Tractor Buster | 2 | 6 | 120 | 0.42 | 399 | 0.69 | 6.36 | 4.98 | 0.47 | 0.43 | 629.63 | 0.20 | 0.09 | 0.14 | 1.27 | 0.99 | 0.09 | 0.09 | 125.61 | 0.04 | 0.02 | 119.73 |
| Other Construction Equipment >251 and <500 | Tractor Disk | 2 | 6 | 300 | 0.42 | 399 | 0.75 | 8.79 | 5.45 | 0.32 | 0.29 | 1,584.14 | 0.51 | 0.23 | 0.15 | 1.75 | 1.09 | 0.06 | 0.06 | 316.04 | 0.10 | 0.05 | 301.25 |
| Off-Highway Trucks >176 and <250 | Truck (onroad) | 10 | 4 | 238 | 0.38 | 399 | 2.19 | 20.00 | 11.09 | 0.78 | 0.72 | 3,749.80 | 1.21 | 0.54 | 0.44 | 3.99 | 2.21 | 0.16 | 0.14 | 748.08 | 0.24 | 0.11 | 713.08 |
| Generator Sets >51 and <120 | Generator (Office)(45 kW) | 1 | 24 | 60 | 0.74 | 399 | 0.86 | 7.45 | 7.94 | 0.42 | 0.42 | 1,335.08 | 0.08 | 0.03 | 0.17 | 1.49 | 1.58 | 0.08 | 0.08 | 266.35 | 0.01 | 0.01 | 244.38 |
| Generator Sets >26 and <50 | Generator (Security, IT)(30 kW) | 1 | 24 | 40 | 0.74 | 399 | 1.08 | 6.38 | 6.26 | 0.30 | 0.30 | 890.05 | 0.10 | 0.04 | 0.22 | 1.27 | 1.25 | 0.06 | 0.06 | 177.56 | 0.02 | 0.01 | 164.17 |
| Rollers >121 and <175 | Roller/Vibrator/Padder | 1 | 6 | 160 | 0.38 | 399 | 0.17 | 1.97 | 2.36 | 0.09 | 0.08 | 379.54 | 0.12 | 0.06 | 0.03 | 0.39 | 0.47 | 0.02 | 0.02 | 75.72 | 0.02 | 0.01 | 72.17 |
| Scrapers >251 and <500 | Scraper | 3 | 6 | 365 | 0.40 | 399 | 1.85 | 21.92 | 13.91 | 0.85 | 0.79 | 2,735.67 | 0.88 | 0.40 | 0.37 | 4.37 | 2.77 | 0.17 | 0.16 | 545.77 | 0.18 | 0.08 | 520.22 |
| Pumps >26 and <50 | Water Pump | 2 | 8 | 45 | 0.74 | 399 | 0.89 | 4.85 | 4.93 | 0.24 | 0.24 | 667.54 | 0.08 | 0.04 | 0.18 | 0.97 | 0.98 | 0.05 | 0.05 | 133.17 | 0.02 | 0.01 | 123.32 |
| **Total** | | **35** | **124** | | | **5,586** | **12.38** | **120.50** | **78.70** | **5.14** | **4.81** | **17,978.10** | **5.13** | **2.30** | **2.47** | **24.04** | **15.70** | **1.03** | **0.96** | **3,586.63** | **1.02** | **0.46** | **3,400.58** |

*hp based on CalEEMod default values

**On Road Construction Emissions**

| | | | | | | Emissions Summary (lbs/day) | | | | | | | | | Emissions Summary (tons per phase) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Daily Trips | Distance | Average Daily Mileage | Calculated Time - Rounded (days) | Total Mileage | VOC | NOx | CO | PM10 | PM2.5 | CO2 | CH4 | N2O | VOC | $NO_x$ | CO | PM10 | PM2.5 | CO2 | CH4 | N2O | Total GHG Emissions (MT CO2e) |
| Worker Trips | 334 | 13 | 8,684 | 399 | 3,464,916 | 0.26 | 1.34 | 14.10 | 0.89 | 0.37 | 5,743 | 0.54 | 0.71 | 0.05 | 0.27 | 2.81 | 0.18 | 0.07 | 1,145.78 | 0.11 | 0.14 | 1,182.79 |
| Gravel Delivery | - | 13 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Module Delivery | 10 | 150 | 3,000 | 81 | 242,100 | 0.58 | 28.88 | 2.38 | 0.79 | 0.38 | 9,831 | 0.03 | 0.03 | 0.02 | 1.17 | 0.10 | 0.03 | 0.02 | 396.66 | 0.00 | 0.00 | 397.01 |
| Foundation Delivery | 10 | 150 | 3,000 | 98 | 293,550 | 0.58 | 28.88 | 2.38 | 0.79 | 0.38 | 9,831 | 0.03 | 0.03 | 0.03 | 1.41 | 0.12 | 0.04 | 0.02 | 480.96 | 0.00 | 0.00 | 481.38 |
| Water Delivery Trips | 14 | 13 | 364 | 102 | 37,267 | 0.07 | 3.50 | 0.29 | 0.10 | 0.05 | 1,193 | 0.00 | 0.00 | 0.00 | 0.18 | 0.01 | 0.00 | 0.00 | 61.06 | 0.00 | 0.00 | 61.11 |
| **Total** | | | | | | **1.50** | **62.60** | **19.15** | **2.57** | **1.17** | **26,597.05** | **0.62** | **0.77** | **0.11** | **3.02** | **3.04** | **0.25** | **0.11** | **2,084.45** | **0.11** | **0.14** | **2,122.29** |

Water trucks assumed to come from Blythe at a distance of approximately 13 miles (26 miles round trip).

| | Emissions Summary (lbs/day) | | | | | | | | Emissions Summary (tons per phase) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total** | VOC | NOx | CO | PM10 | PM2.5 | CO2 | CH4 | N2O | VOC | $NO_x$ | CO | PM10 | PM2.5 | CO2 | CH4 | N2O | Total GHG Emissions (MT CO2e) |
| **Maximum Daily Emissions** | **13.88** | **183.10** | **97.84** | **7.71** | **5.98** | **44,575.14** | **5.75** | **3.07** | | | | | | | | | |
| **Maximum Annual Emissions** | | | | | | | | | **2.58** | **27.06** | **18.74** | **1.28** | **1.07** | **5,671.08** | **1.14** | **0.60** | **5,522.87** |

**Option A - Phase 2 - Construction - Solar Array Structural Components (Structural Components, Underground Work, Module Installation)**

Phase Duration (days): 399 — 19 months — 21 working days per month

| | | | | | | | Emissions Summary (lbs/day) | | | | | | | | Emissions Summary (tons per phase) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Equipment Type** | **Equipment Category** | **Number** | **Usage Factor (hrs/day or miles/day)** | **Power Rating (hp)** | **Load Factor** | **Total Days/VMT** | **VOC** | **NOx** | **CO** | **PM10** | **PM2.5** | **CO2** | **CH4** | **N2O** | **VOC** | **NOx** | **CO** | **PM10** | **PM2.5** | **CO2** | **CH4** | **N2O** | **Total GHG Emissions (MT CO2e)** |
| Off-Highway Trucks >176 and <250 | Water truck | 8 | 8 | 238 | 0.38 | 399 | 3.51 | 31.99 | 17.75 | 1.25 | 1.15 | 5,999.68 | 1.94 | 0.87 | 0.70 | 6.38 | 3.54 | 0.25 | 0.23 | 1,196.94 | 0.39 | 0.17 | 1,140.94 |
| Other Construction Equipment >16 and <25 | ATV | 40 | 4 | 24 | 0.40 | 399 | 3.63 | 17.05 | 18.30 | 1.37 | 1.26 | 1,787.85 | 0.58 | 0.26 | 0.72 | 3.40 | 3.65 | 0.27 | 0.25 | 356.68 | 0.12 | 0.05 | 339.99 |
| Air Compressors >26 and <50 | Air Compressor | 2 | 6 | 49 | 0.48 | 399 | 0.62 | 2.74 | 3.21 | 0.16 | 0.16 | 353.61 | 0.06 | 0.03 | 0.12 | 0.55 | 0.64 | 0.03 | 0.03 | 70.55 | 0.01 | 0.01 | 65.69 |
| Cranes >251 and <500 | Crane | 2 | 2 | 400 | 0.29 | 399 | 0.33 | 3.95 | 2.72 | 0.16 | 0.15 | 483.40 | 0.16 | 0.07 | 0.07 | 0.79 | 0.54 | 0.03 | 0.03 | 96.44 | 0.03 | 0.01 | 91.92 |
| Forklifts >51 and <120 | Forklift (5 K) | 10 | 4 | 67 | 0.20 | 399 | 0.54 | 4.88 | 4.44 | 0.36 | 0.33 | 557.20 | 0.18 | 0.08 | 0.11 | 0.97 | 0.89 | 0.07 | 0.07 | 111.16 | 0.04 | 0.02 | 105.96 |
| Aerial Lifts >51 and <120 | Forklift (10 K) (Aerial Lift) | 10 | 4 | 110 | 0.31 | 399 | 0.35 | 5.62 | 9.55 | 0.13 | 0.11 | 1,419.70 | 0.46 | 0.21 | 0.07 | 1.12 | 1.91 | 0.02 | 0.02 | 283.23 | 0.09 | 0.04 | 269.98 |
| Other Construction Equipment >26 and <50 | Post Machine | 14 | 6 | 49 | 0.40 | 399 | 3.89 | 18.28 | 19.62 | 1.47 | 1.35 | 1,916.35 | 0.62 | 0.28 | 0.78 | 3.65 | 3.91 | 0.29 | 0.27 | 382.31 | 0.12 | 0.06 | 364.43 |
| Skid Steer Loaders >51 and <120 | Skid Steer | 20 | 4 | 80 | 0.40 | 399 | 1.06 | 14.14 | 18.50 | 0.61 | 0.56 | 2,663.37 | 0.86 | 0.39 | 0.21 | 2.82 | 3.69 | 0.12 | 0.11 | 531.34 | 0.17 | 0.08 | 506.47 |
| Off-Highway Trucks >176 and <250 | Truck, flatbed (onroad) | 4 | 4 | 238 | 0.38 | 399 | 0.88 | 8.00 | 4.44 | 0.31 | 0.29 | 1,499.92 | 0.49 | 0.22 | 0.17 | 1.60 | 0.89 | 0.06 | 0.06 | 299.23 | 0.10 | 0.04 | 285.23 |
| Off-Highway Trucks >176 and <250 | Truck (onroad) | 30 | 4 | 238 | 0.38 | 399 | 6.57 | 59.99 | 33.28 | 2.34 | 2.15 | 11,249.39 | 3.64 | 1.63 | 1.31 | 11.97 | 6.64 | 0.47 | 0.43 | 2,244.25 | 0.73 | 0.33 | 2,139.25 |
| Generator Sets >51 and <120 | Generator (45 kW) | 1 | 24 | 60 | 0.74 | 399 | 0.86 | 7.45 | 7.94 | 0.42 | 0.42 | 1,335.08 | 0.08 | 0.03 | 0.17 | 1.49 | 1.58 | 0.08 | 0.08 | 266.35 | 0.01 | 0.01 | 244.38 |
| Excavators >51 and <120 | Backhoe/Excavator | 4 | 4 | 90 | 0.37 | 399 | 0.35 | 3.63 | 4.12 | 0.22 | 0.20 | 549.79 | 0.18 | 0.08 | 0.07 | 0.72 | 0.82 | 0.04 | 0.04 | 109.68 | 0.04 | 0.02 | 104.55 |
| Trenchers >51 and <120 | Cable Plow | 1 | 6 | 120 | 0.42 | 399 | 0.41 | 3.68 | 2.56 | 0.28 | 0.25 | 316.76 | 0.10 | 0.05 | 0.08 | 0.73 | 0.51 | 0.05 | 0.05 | 63.19 | 0.02 | 0.01 | 60.24 |
| Trenchers >26 and <50 | Cable Trencher | 1 | 6 | 42 | 0.50 | 399 | 0.25 | 1.30 | 1.34 | 0.10 | 0.09 | 146.42 | 0.05 | 0.02 | 0.05 | 0.26 | 0.27 | 0.02 | 0.02 | 29.21 | 0.01 | 0.00 | 27.84 |
| Paving Equipment >176 and <250 | Compactor | 1 | 4 | 180 | 0.43 | 399 | 0.17 | 2.20 | 0.85 | 0.08 | 0.07 | 322.27 | 0.10 | 0.05 | 0.03 | 0.44 | 0.17 | 0.02 | 0.01 | 64.29 | 0.02 | 0.01 | 61.28 |
| Rollers >176 and <250 | Roller/Vibrator/Padder | 2 | 6 | 180 | 0.38 | 399 | 0.38 | 4.98 | 2.27 | 0.16 | 0.15 | 856.58 | 0.28 | 0.12 | 0.08 | 0.99 | 0.45 | 0.03 | 0.03 | 170.89 | 0.06 | 0.02 | 162.89 |
| Trenchers >26 and <50 | Mini-Trencher | 4 | 6 | 40 | 0.50 | 399 | 0.96 | 4.95 | 5.11 | 0.38 | 0.35 | 557.78 | 0.18 | 0.08 | 0.19 | 0.99 | 1.02 | 0.08 | 0.07 | 111.28 | 0.04 | 0.02 | 106.07 |
| Rollers >51 and <120 | Sheepsfoot Roller | 3 | 6 | 95 | 0.38 | 399 | 0.56 | 5.56 | 5.06 | 0.35 | 0.33 | 678.83 | 0.22 | 0.10 | 0.11 | 1.11 | 1.01 | 0.07 | 0.07 | 135.43 | 0.04 | 0.02 | 129.09 |
| Off-Highway Trucks >251 and <500 | 5 CY Dump Truck | 1 | 4 | 480 | 0.38 | 399 | 0.40 | 3.77 | 2.27 | 0.14 | 0.13 | 763.36 | 0.25 | 0.11 | 0.08 | 0.75 | 0.45 | 0.03 | 0.03 | 152.29 | 0.05 | 0.02 | 145.16 |
| **Total** | | **158** | **112** | | | **7,581** | **25.70** | **204.16** | **163.34** | **10.27** | **9.50** | **33,457.33** | **10.41** | **4.67** | **5.13** | **40.73** | **32.59** | **2.05** | **1.89** | **6,674.74** | **2.08** | **0.93** | **6,351.37** |

**On Road Construction Emissions**

| | | | | | | Emissions Summary (lbs/day) | | | | | | | | Emissions Summary (tons per phase) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Daily Trips** | **Distance** | **Average Daily Mileage** | **Calculated Time - Rounded (days)** | **Total Mileage** | **VOC** | **NOx** | **CO** | **PM10** | **PM2.5** | **CO2** | **CH4** | **N2O** | **VOC** | **NOx** | **CO** | **PM10** | **PM2.5** | **CO2** | **CH4** | **N2O** | **Total GHG Emissions (MT CO2e)** |
| Worker Trips | 427 | 13 | 11,102 | 399 | 4,429,698 | 0.34 | 1.71 | 18.03 | 1.14 | 0.47 | 7,342 | 0.70 | 0.90 | 0.07 | 0.34 | 3.60 | 0.23 | 0.09 | 1,464.81 | 0.14 | 0.18 | 1,379.95 |
| Gravel Delivery | - | 13 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Module Delivery | 10 | 150 | 3,000 | 81 | 242,100 | 0.58 | 28.88 | 2.38 | 0.79 | 0.38 | 9,831 | 0.03 | 0.03 | 0.02 | 1.17 | 0.10 | 0.03 | 0.02 | 396.66 | 0.00 | 0.00 | 361.30 |
| Tracker Delivery | 9 | 150 | 2,700 | 207 | 560,100 | 0.52 | 25.99 | 2.14 | 0.71 | 0.34 | 8,847 | 0.03 | 0.03 | 0.05 | 2.70 | 0.22 | 0.07 | 0.04 | 917.68 | 0.00 | 0.00 | 835.88 |
| Foundation Delivery | 10 | 150 | 3,000 | 98 | 293,550 | 0.58 | 28.88 | 2.38 | 0.79 | 0.38 | 9,831 | 0.03 | 0.03 | 0.03 | 1.41 | 0.12 | 0.04 | 0.02 | 480.96 | 0.00 | 0.00 | 438.09 |
| Inverter Delivery | 2 | 150 | 600 | 36 | 21,750 | 0.12 | 5.78 | 0.48 | 0.16 | 0.08 | 1,966 | 0.01 | 0.01 | 0.00 | 0.10 | 0.01 | 0.00 | 0.00 | 35.64 | 0.00 | 0.00 | 32.46 |
| Water Delivery Trips | 14 | 13 | 364 | 102 | 37,267 | 0.07 | 3.50 | 0.29 | 0.10 | 0.05 | 1,193 | 0.00 | 0.00 | 0.00 | 0.18 | 0.01 | 0.00 | 0.00 | 61.06 | 0.00 | 0.00 | 55.62 |
| **Total** | | | | | | **2.21** | **94.74** | **25.69** | **3.69** | **1.68** | **39,009.78** | **0.80** | **1.00** | **0.18** | **5.90** | **4.05** | **0.38** | **0.17** | **3,356.80** | **0.15** | **0.19** | **3,103.29** |

Water trucks assumed to come from Blythe at a distance of approximately 13 miles (26 miles round trip).

| | Emissions Summary (lbs/day) | | | | | | | | Emissions Summary (tons per phase) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total** | **VOC** | **NOx** | **CO** | **PM10** | **PM2.5** | **CO2** | **CH4** | **N2O** | **VOC** | **NOx** | **CO** | **PM10** | **PM2.5** | **CO2** | **CH4** | **N2O** | **Total GHG Emissions (MT CO2e)** |
| **Maximum Daily Emissions** | **27.91** | **298.91** | **189.03** | **13.96** | **11.18** | **72,467.12** | **11.21** | **5.67** | | | | | | | | | |
| **Maximum Annual Emissions** | | | | | | | | | **5.31** | **46.63** | **36.64** | **2.43** | **2.06** | **10,031.54** | **2.22** | **1.12** | **9,454.67** |

**Option A - Phase 3 - Construction - Electrical (Substation, Gen-Tie, Collection System, Energy Storage, O&M Building)**

Phase Duration (days): 378 | 18 months | 21 working days per month

| Equipment Type | Equipment Category | Number | Usage Factor (hrs/day or miles/day) | Power Rating (hp) | Load Factor | Total Days/VMT | Emissions Summary (lbs/day) | | | | | | | | Emissions Summary (tons per phase) | | | | | | | | Total GHG Emissions (MT CO2e) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | VOC | NOx | CO | PM10 | PM2.5 | CO2 | CH4 | N2O | VOC | NOx | CO | PM10 | PM2.5 | CO2 | CH4 | N2O | |
| Off-Highway Trucks >176 and <250 | Water truck | 4 | 8 | 230 | 0.38 | 378 | 1.69 | 15.46 | 8.58 | 0.60 | 0.55 | 2,899.00 | 0.94 | 0.42 | 0.32 | 2.92 | 1.62 | 0.11 | 0.10 | 547.91 | 0.18 | 0.08 | 522.28 |
| Bore/Drill Rigs >176 and <250 | Auger | 5 | 4 | 238 | 0.50 | 378 | 0.75 | 9.48 | 5.60 | 0.27 | 0.25 | 2,449.48 | 0.79 | 0.36 | 0.14 | 1.79 | 1.06 | 0.05 | 0.05 | 462.95 | 0.15 | 0.07 | 441.29 |
| Excavators >51 and <120 | Backhoe/Excavator | 6 | 4 | 90 | 0.37 | 378 | 0.53 | 5.44 | 6.18 | 0.33 | 0.30 | 824.68 | 0.27 | 0.12 | 0.10 | 1.03 | 1.17 | 0.06 | 0.06 | 155.86 | 0.05 | 0.02 | 148.57 |
| Cranes >251 and <500 | Crane | 6 | 5 | 400 | 0.29 | 378 | 2.46 | 29.63 | 20.41 | 1.19 | 1.09 | 3,625.51 | 1.17 | 0.53 | 0.46 | 5.60 | 3.86 | 0.22 | 0.21 | 685.22 | 0.22 | 0.10 | 653.15 |
| Forklifts >51 and <120 | Forklift | 3 | 4 | 90 | 0.20 | 378 | 0.22 | 1.97 | 1.79 | 0.15 | 0.13 | 224.54 | 0.07 | 0.03 | 0.04 | 0.37 | 0.34 | 0.03 | 0.03 | 42.44 | 0.01 | 0.01 | 40.45 |
| Excavators >26 and <50 | Mini Excavator | 1 | 6 | 42 | 0.50 | 378 | 0.16 | 1.12 | 1.25 | 0.06 | 0.06 | 145.94 | 0.05 | 0.02 | 0.03 | 0.21 | 0.24 | 0.01 | 0.01 | 27.58 | 0.01 | 0.00 | 26.29 |
| Aerial Lifts >51 and <120 | Man/Aerial Lift | 2 | 4 | 60 | 0.31 | 378 | 0.04 | 0.61 | 1.04 | 0.01 | 0.01 | 154.88 | 0.05 | 0.02 | 0.01 | 0.12 | 0.20 | 0.00 | 0.00 | 29.27 | 0.01 | 0.00 | 27.90 |
| Tractors/Loaders/Backhoes >176 and <250 | Tractor | 1 | 6 | 190 | 0.36 | 378 | 0.20 | 2.48 | 1.08 | 0.08 | 0.07 | 425.70 | 0.14 | 0.06 | 0.04 | 0.47 | 0.20 | 0.02 | 0.01 | 80.46 | 0.03 | 0.01 | 76.69 |
| Off-Highway Trucks >176 and <250 | Truck, flatbed (onroad) | 2 | 2 | 200 | 0.38 | 378 | 0.18 | 1.68 | 0.93 | 0.07 | 0.06 | 315.11 | 0.10 | 0.05 | 0.03 | 0.32 | 0.18 | 0.01 | 0.01 | 59.56 | 0.02 | 0.01 | 56.77 |
| Off-Highway Trucks >176 and <250 | Truck (onroad) | 13 | 2 | 200 | 0.38 | 378 | 1.20 | 10.92 | 6.06 | 0.43 | 0.39 | 2,048.21 | 0.66 | 0.30 | 0.23 | 2.06 | 1.15 | 0.08 | 0.07 | 387.11 | 0.13 | 0.06 | 369.00 |
| Generator Sets >51 and <120 | Generator (45 kW) | 2 | 4 | 60 | 0.74 | 378 | 0.29 | 2.48 | 2.65 | 0.14 | 0.14 | 445.03 | 0.03 | 0.01 | 0.05 | 0.47 | 0.50 | 0.03 | 0.03 | 84.11 | 0.00 | 0.00 | 77.17 |
| Crawler Tractors >121 and <175 | Crawler Tractor | 1 | 4 | 147 | 0.29 | 126 | 0.18 | 1.83 | 1.26 | 0.10 | 0.09 | 177.07 | 0.06 | 0.03 | 0.01 | 0.12 | 0.08 | 0.01 | 0.01 | 11.16 | 0.00 | 0.00 | 10.63 |
| Tractors/Loaders/Backhoes >176 and <250 | Truck Mounted Digger | 1 | 4 | 190 | 0.42 | 126 | 0.16 | 1.93 | 0.84 | 0.06 | 0.06 | 331.10 | 0.11 | 0.05 | 0.01 | 0.12 | 0.05 | 0.00 | 0.00 | 20.86 | 0.01 | 0.00 | 19.88 |
| Other Construction Equipment >251 and <500 | Tensioner | 1 | 4 | 238 | 0.42 | 126 | 0.20 | 2.32 | 1.44 | 0.08 | 0.08 | 418.92 | 0.14 | 0.06 | 0.01 | 0.15 | 0.09 | 0.01 | 0.00 | 26.39 | 0.01 | 0.00 | 25.16 |
| Off-Highway Trucks >176 and <250 | Wire Truck | 1 | 4 | 238 | 0.38 | 126 | 0.22 | 2.00 | 1.11 | 0.08 | 0.07 | 374.98 | 0.12 | 0.05 | 0.01 | 0.13 | 0.07 | 0.00 | 0.00 | 23.62 | 0.01 | 0.00 | 22.52 |
| Graders >176 and <250 | Motor Grader | 1 | 1 | 185 | 0.41 | 126 | 0.06 | 0.78 | 0.22 | 0.02 | 0.02 | 79.48 | 0.03 | 0.01 | 0.00 | 0.05 | 0.01 | 0.00 | 0.00 | 5.01 | 0.00 | 0.00 | 4.77 |
| Scrapers >251 and <500 | Scraper | 1 | 1 | 365 | 0.40 | 126 | 0.10 | 1.22 | 0.77 | 0.05 | 0.04 | 151.98 | 0.05 | 0.02 | 0.01 | 0.08 | 0.05 | 0.00 | 0.00 | 9.57 | 0.00 | 0.00 | 9.13 |
| Trenchers >26 and <50 | Cable Trencher | 5 | 10 | 42 | 0.50 | 126 | 2.09 | 10.83 | 11.19 | 0.82 | 0.76 | 1,220.15 | 0.39 | 0.18 | 0.13 | 0.68 | 0.70 | 0.05 | 0.05 | 76.87 | 0.02 | 0.01 | 73.27 |
| **Total** | | **56** | | | | | **10.73** | **102.19** | **72.40** | **4.55** | **4.20** | **16,311.75** | **5.16** | **2.31** | **1.65** | **16.68** | **11.56** | **0.71** | **0.65** | **2,735.96** | **0.86** | **0.39** | **2,604.93** |

**On Road Construction Emissions**

| | Daily Trips | Distance | Average Daily Mileage | Calculated Time - Rounded (days) | Total Mileage | Emissions Summary (lbs/day) | | | | | | | | Emissions Summary (tons per phase) | | | | | | | | Total GHG Emissions (MT CO2e) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | VOC | NOx | CO | PM10 | PM2.5 | CO2 | CH4 | N2O | VOC | NOx | CO | PM10 | PM2.5 | CO2 | CH4 | N2O | |
| Worker Trips | 180 | 13 | 4,680 | 378 | 1,769,040 | 0.14 | 0.72 | 7.60 | 0.48 | 0.20 | 3,095 | 0.29 | 0.38 | 0.03 | 0.14 | 1.44 | 0.09 | 0.04 | 584.98 | 0.06 | 0.07 | 551.09 |
| Inverter Delivery | 2 | 150 | 600 | 36 | 21,750 | 0.12 | 5.78 | 0.48 | 0.16 | 0.08 | 1,966 | 0.01 | 0.01 | 0.00 | 0.10 | 0.01 | 0.00 | 0.00 | 35.64 | 0.00 | 0.00 | 32.46 |
| Concrete Truck Trips (Unless Batched on site) | 9 | 13 | 234 | 378 | 88,452 | 0.05 | 2.25 | 0.19 | 0.06 | 0.03 | 767 | 0.00 | 0.00 | 0.01 | 0.43 | 0.04 | 0.01 | 0.01 | 144.92 | 0.00 | 0.00 | 132.00 |
| Water Delivery Trips | 14 | 13 | 364 | 102 | 37,267 | 0.07 | 3.50 | 0.29 | 0.10 | 0.05 | 1,193 | 0.00 | 0.00 | 0.00 | 0.18 | 0.01 | 0.00 | 0.00 | 61.06 | 0.00 | 0.00 | 55.62 |
| **Total** | | | | | | **0.37** | **12.25** | **8.55** | **0.80** | **0.35** | **7,020.81** | **0.31** | **0.39** | **0.04** | **0.85** | **1.49** | **0.11** | **0.05** | **826.60** | **0.06** | **0.07** | **771.17** |

Concrete and water trucks assumed to haul material from Blythe at a distance of approximately 13 miles (26 miles round trip).

| | Emissions Summary (lbs/day) | | | | | | | | Emissions Summary (tons per phase) | | | | | | | | Total GHG Emissions (MT CO2e) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total** | VOC | NOx | CO | PM10 | PM2.5 | CO2 | CH4 | N2O | VOC | NOx | CO | PM10 | PM2.5 | CO2 | CH4 | N2O | |
| **Maximum Daily Emissions** | **11.10** | **114.45** | **80.95** | **5.34** | **4.54** | **23,332.56** | **5.46** | **2.71** | | | | | | | | | |
| **Maximum Annual Emissions** | | | | | | | | | **1.69** | **17.53** | **13.06** | **0.82** | **0.70** | **3,562.56** | **0.92** | **0.46** | **3,376.10** |

| Emission Factors - OFFROAD | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Equipment Type | Year | Low HP | High HP | TOG (g/bhp-hr) | ROG (g/bhp-hr) | CO (g/bhp-hr) | NOX (g/bhp-hr) | SO2 (g/bhp-hr) | PM10 (g/bhp-hr) | PM2.5 (g/bhp-hr) | CO2 (g/bhp-hr) | CH4 (g/bhp-hr) | Load Factor |
| Aerial Lifts | 2020 | 6 | 15 | 0.199447 | 0.1676 | 3.09942 | 2.95486 | 0.0054 | 0.0309 | 0.0284 | 525.0743 | 0.1698 | 0.31 |
| Aerial Lifts | 2020 | 16 | 25 | 0.199447 | 0.1676 | 3.09942 | 2.95486 | 0.0054 | 0.0309 | 0.0284 | 525.0743 | 0.1698 | 0.31 |
| Aerial Lifts | 2020 | 26 | 50 | 0.199447 | 0.1676 | 3.09942 | 2.95486 | 0.0054 | 0.0309 | 0.0284 | 525.0743 | 0.1698 | 0.31 |
| Aerial Lifts >51 and <120 | 2020 | 51 | 120 | 0.136778 | 0.1149 | 3.1768 | 1.86859 | 0.0049 | 0.0416 | 0.0382 | 472.1142 | 0.1527 | 0.31 |
| Aerial Lifts | 2020 | 251 | 500 | 0.081859 | 0.0688 | 0.94623 | 0.63803 | 0.0049 | 0.009 | 0.0083 | 472.0545 | 0.1527 | 0.31 |
| Aerial Lifts | 2020 | 501 | 750 | 26.846 | 0.2 | 1.013 | 1.868 | 0.005 | 0.057 | 0.057 | 568.299 | 0.018 | 0.31 |
| Air Compressors | 2020 | 6 | 15 | 1.907 | 0.731 | 3.546 | 4.542 | 0.008 | 0.227 | 0.227 | 568.299 | 0.066 | 0.48 |
| Air Compressors | 2020 | 16 | 25 | 4.009 | 0.769 | 2.473 | 4.538 | 0.007 | 0.212 | 0.212 | 568.3 | 0.069 | 0.48 |
| Air Compressors >26 and <50 | 2020 | 26 | 50 | 8.048 | 1.001 | 5.164 | 4.397 | 0.007 | 0.25 | 0.25 | 568.299 | 0.09 | 0.48 |
| Air Compressors | 2020 | 51 | 120 | 8.287 | 0.489 | 3.698 | 3.4 | 0.006 | 0.224 | 0.224 | 568.299 | 0.044 | 0.48 |
| Air Compressors | 2020 | 121 | 175 | 11.957 | 0.374 | 3.203 | 2.558 | 0.006 | 0.133 | 0.133 | 568.299 | 0.033 | 0.48 |
| Air Compressors | 2020 | 176 | 250 | 13.668 | 0.288 | 1.121 | 2.172 | 0.006 | 0.069 | 0.069 | 568.299 | 0.026 | 0.48 |
| Air Compressors | 2020 | 251 | 500 | 23.406 | 0.279 | 1.076 | 1.935 | 0.005 | 0.067 | 0.067 | 568.299 | 0.025 | 0.48 |
| Air Compressors | 2020 | 501 | 750 | 36.303 | 0.28 | 1.076 | 1.982 | 0.005 | 0.067 | 0.067 | 568.299 | 0.025 | 0.48 |
| Air Compressors | 2020 | 751 | 1000 | 53.87 | 0.306 | 1.158 | 3.828 | 0.005 | 0.093 | 0.093 | 568.3 | 0.027 | 0.48 |
| Bore/Drill Rigs | 2020 | 6 | 15 | 0.851825 | 0.7158 | 4.51013 | 4.6451 | 0.0055 | 0.2941 | 0.2706 | 535.2948 | 0.1731 | 0.5 |
| Bore/Drill Rigs | 2020 | 16 | 25 | 0.851825 | 0.7158 | 4.51013 | 4.6451 | 0.0055 | 0.2941 | 0.2706 | 535.2948 | 0.1731 | 0.5 |
| Bore/Drill Rigs | 2020 | 26 | 50 | 0.851825 | 0.7158 | 4.51013 | 4.6451 | 0.0055 | 0.2941 | 0.2706 | 535.2948 | 0.1731 | 0.5 |
| Bore/Drill Rigs | 2020 | 51 | 120 | 0.292949 | 0.2462 | 3.32347 | 3.06601 | 0.0048 | 0.1586 | 0.1459 | 463.5827 | 0.1499 | 0.5 |
| Bore/Drill Rigs >121 and <175 | 2020 | 121 | 175 | 0.207426 | 0.1743 | 2.96948 | 1.87149 | 0.0049 | 0.0822 | 0.0757 | 477.722 | 0.1545 | 0.5 |
| Bore/Drill Rigs >176 and <250 | 2020 | 176 | 250 | 0.169462 | 0.1424 | 1.06766 | 1.80732 | 0.0048 | 0.0521 | 0.0479 | 466.8342 | 0.151 | 0.5 |
| Bore/Drill Rigs | 2020 | 251 | 500 | 0.148188 | 0.1245 | 1.01263 | 1.40938 | 0.0048 | 0.0446 | 0.041 | 466.8219 | 0.151 | 0.5 |
| Bore/Drill Rigs | 2020 | 501 | 750 | 0.129293 | 0.1086 | 0.97413 | 1.23085 | 0.0049 | 0.0409 | 0.0377 | 473.6679 | 0.1532 | 0.5 |
| Bore/Drill Rigs | 2020 | 751 | 1000 | 0.158163 | 0.1329 | 0.98839 | 3.05008 | 0.0049 | 0.0612 | 0.0563 | 471.8492 | 0.1526 | 0.5 |
| Cement and Mortar Mixers | 2020 | 6 | 15 | 1.075 | 0.661 | 3.47 | 4.142 | 0.008 | 0.161 | 0.161 | 568.299 | 0.059 | 0.56 |
| Cement and Mortar Mixers | 2020 | 16 | 25 | 3.265 | 0.723 | 2.397 | 4.442 | 0.007 | 0.187 | 0.187 | 568.299 | 0.065 | 0.56 |
| Concrete/Industrial Saws | 2020 | 16 | 25 | 1.532 | 0.685 | 2.339 | 4.332 | 0.007 | 0.161 | 0.161 | 568.299 | 0.061 | 0.73 |
| Concrete/Industrial Saws >26 and <50 | 2020 | 26 | 50 | 3.271 | 0.798 | 4.552 | 4.196 | 0.007 | 0.212 | 0.212 | 568.299 | 0.072 | 0.73 |
| Concrete/Industrial Saws | 2020 | 51 | 120 | 4.042 | 0.401 | 3.535 | 3.163 | 0.006 | 0.19 | 0.19 | 568.299 | 0.036 | 0.73 |
| Concrete/Industrial Saws | 2020 | 121 | 175 | 6.669 | 0.306 | 3.072 | 2.324 | 0.006 | 0.114 | 0.114 | 568.299 | 0.027 | 0.73 |
| Cranes | 2020 | 26 | 50 | 2.47956 | 2.0835 | 7.37625 | 5.98471 | 0.0053 | 0.6237 | 0.5738 | 517.9263 | 0.1675 | 0.29 |
| Cranes | 2020 | 51 | 120 | 0.871016 | 0.7319 | 4.17141 | 6.38117 | 0.0048 | 0.4529 | 0.4167 | 469.8821 | 0.152 | 0.29 |
| Cranes | 2020 | 121 | 175 | 0.638941 | 0.5369 | 3.56232 | 5.5697 | 0.0049 | 0.2978 | 0.274 | 474.5939 | 0.1535 | 0.29 |
| Cranes >176 and <250 | 2020 | 176 | 250 | 0.45669 | 0.3837 | 1.7904 | 4.56329 | 0.0049 | 0.1881 | 0.1731 | 472.9488 | 0.153 | 0.29 |
| Cranes >251 and <500 | 2020 | 251 | 500 | 0.381547 | 0.3206 | 2.66037 | 3.86243 | 0.0049 | 0.1548 | 0.1424 | 472.5579 | 0.1528 | 0.29 |
| Cranes | 2020 | 501 | 750 | 0.287724 | 0.2418 | 1.44353 | 3.10471 | 0.0049 | 0.116 | 0.1067 | 470.4254 | 0.1521 | 0.29 |
| Cranes | 2020 | 1001 | 9999 | 0.216797 | 0.1822 | 0.99943 | 2.3614 | 0.0049 | 0.0604 | 0.0556 | 472.0545 | 0.1527 | 0.29 |
| Crawler Tractors | 2020 | 26 | 50 | 2.443056 | 2.0528 | 7.3 | 5.64276 | 0.0053 | 0.5912 | 0.5439 | 515.679 | 0.1668 | 0.43 |
| Crawler Tractors | 2020 | 51 | 120 | 0.850709 | 0.7148 | 4.04412 | 6.00933 | 0.0049 | 0.5005 | 0.4604 | 476.3284 | 0.1541 | 0.43 |
| Crawler Tractors >121 and <175 | 2020 | 121 | 175 | 0.566576 | 0.4761 | 3.33989 | 4.87226 | 0.0049 | 0.2722 | 0.2504 | 471.015 | 0.1523 | 0.43 |
| Crawler Tractors | 2020 | 176 | 250 | 0.428471 | 0.36 | 1.55491 | 4.63225 | 0.0049 | 0.1746 | 0.1606 | 472.941 | 0.153 | 0.43 |
| Crawler Tractors | 2020 | 251 | 500 | 0.358593 | 0.3013 | 2.0875 | 3.62175 | 0.0049 | 0.1409 | 0.1296 | 475.2338 | 0.1537 | 0.43 |
| Crawler Tractors | 2020 | 501 | 750 | 0.304872 | 0.2562 | 1.31018 | 3.13716 | 0.0049 | 0.1151 | 0.1059 | 473.3119 | 0.1531 | 0.43 |
| Crawler Tractors | 2020 | 751 | 1000 | 0.551035 | 0.463 | 2.02764 | 7.23682 | 0.0049 | 0.212 | 0.195 | 475.6525 | 0.1538 | 0.43 |
| Crushing/Proc. Equipment | 2020 | 26 | 50 | 2.489 | 0.947 | 5.211 | 4.347 | 0.007 | 0.233 | 0.233 | 568.299 | 0.085 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 51 | 120 | 2.348 | 0.473 | 3.722 | 3.249 | 0.006 | 0.206 | 0.206 | 568.299 | 0.042 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 121 | 175 | 3.673 | 0.367 | 3.234 | 2.392 | 0.006 | 0.124 | 0.124 | 568.299 | 0.033 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 176 | 250 | 4.222 | 0.289 | 1.125 | 2.014 | 0.006 | 0.065 | 0.065 | 568.299 | 0.026 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 251 | 500 | 6.283 | 0.281 | 1.078 | 1.799 | 0.005 | 0.063 | 0.063 | 568.299 | 0.025 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 501 | 750 | 9.884 | 0.281 | 1.077 | 1.835 | 0.005 | 0.063 | 0.063 | 568.299 | 0.025 | 0.78 |
| Crushing/Proc. Equipment | 2020 | 1001 | 9999 | 25.755 | 0.329 | 1.153 | 3.699 | 0.005 | 0.089 | 0.089 | 568.299 | 0.029 | 0.78 |
| Dumpers/Tenders | 2020 | 16 | 25 | 0.819 | 0.685 | 2.339 | 4.336 | 0.007 | 0.165 | 0.165 | 568.299 | 0.061 | 0.38 |
| Excavators | 2020 | 16 | 25 | 0.705964 | 0.5932 | 4.50032 | 4.03131 | 0.0054 | 0.2222 | 0.2044 | 525.3675 | 0.1699 | 0.38 |
| Excavators >26 and <50 | 2020 | 26 | 50 | 0.705964 | 0.5932 | 4.50032 | 4.03131 | 0.0054 | 0.2222 | 0.2044 | 525.3675 | 0.1699 | 0.38 |
| Excavators >51 and <120 | 2020 | 51 | 120 | 0.356064 | 0.2992 | 3.50495 | 3.08964 | 0.0048 | 0.1848 | 0.17 | 468.0546 | 0.1514 | 0.38 |
| Excavators | 2020 | 121 | 175 | 0.275327 | 0.2314 | 3.08597 | 2.27838 | 0.0049 | 0.1104 | 0.1015 | 472.2891 | 0.1527 | 0.38 |
| Excavators | 2020 | 176 | 250 | 0.211076 | 0.1774 | 1.11778 | 2.02738 | 0.0049 | 0.0614 | 0.0565 | 471.8828 | 0.1526 | 0.38 |
| Excavators >251 and <500 | 2020 | 251 | 500 | 0.182542 | 0.1534 | 1.1016 | 1.57199 | 0.0049 | 0.0518 | 0.0476 | 470.2956 | 0.1521 | 0.38 |
| Excavators | 2020 | 501 | 750 | 0.202011 | 0.1697 | 1.14543 | 1.79718 | 0.0048 | 0.0612 | 0.0563 | 468.8706 | 0.1516 | 0.38 |
| Forklifts | 2020 | 26 | 50 | 1.337399 | 1.1238 | 5.70563 | 4.68572 | 0.0054 | 0.3601 | 0.3313 | 525.4833 | 0.17 | 0.2 |
| Forklifts >51 and <120 | 2020 | 51 | 120 | 0.545921 | 0.4587 | 3.75954 | 4.13299 | 0.0049 | 0.3079 | 0.2833 | 471.5285 | 0.1525 | 0.2 |
| Forklifts | 2020 | 121 | 175 | 0.402357 | 0.3381 | 3.24885 | 3.3196 | 0.0049 | 0.1797 | 0.1653 | 472.1062 | 0.1527 | 0.2 |
| Forklifts | 2020 | 176 | 250 | 0.348476 | 0.2928 | 1.44178 | 3.24149 | 0.0049 | 0.1259 | 0.1158 | 473.3255 | 0.1531 | 0.2 |
| Forklifts | 2020 | 251 | 500 | 0.299035 | 0.2513 | 1.47807 | 2.43991 | 0.0049 | 0.0967 | 0.0889 | 473.6151 | 0.1532 | 0.2 |
| Generator Sets | 2020 | 6 | 15 | 1.715 | 0.646 | 3.546 | 4.516 | 0.008 | 0.212 | 0.212 | 568.299 | 0.058 | 0.74 |
| Generator Sets | 2020 | 16 | 25 | 3.307 | 0.721 | 2.473 | 4.538 | 0.007 | 0.205 | 0.205 | 568.299 | 0.065 | 0.74 |
| Generator Sets >26 and <50 | 2020 | 26 | 50 | 5.508 | 0.691 | 3.995 | 4.075 | 0.007 | 0.194 | 0.194 | 568.299 | 0.062 | 0.74 |
| Generator Sets >51 and <120 | 2020 | 51 | 120 | 7.383 | 0.364 | 3.38 | 3.173 | 0.006 | 0.179 | 0.179 | 568.299 | 0.032 | 0.74 |
| Generator Sets | 2020 | 121 | 175 | 9.884 | 0.267 | 2.93 | 2.38 | 0.006 | 0.105 | 0.105 | 568.299 | 0.024 | 0.74 |
| Generator Sets | 2020 | 176 | 250 | 10.963 | 0.198 | 1.026 | 2.016 | 0.006 | 0.057 | 0.057 | 568.299 | 0.017 | 0.74 |
| Generator Sets | 2020 | 251 | 500 | 16.528 | 0.188 | 1.005 | 1.816 | 0.005 | 0.055 | 0.055 | 568.299 | 0.017 | 0.74 |
| Generator Sets | 2020 | 501 | 750 | 27.045 | 0.191 | 1.005 | 1.858 | 0.005 | 0.056 | 0.056 | 568.299 | 0.017 | 0.74 |
| Generator Sets | 2020 | 1001 | 9999 | 66.08 | 0.242 | 1.082 | 3.608 | 0.005 | 0.079 | 0.079 | 568.3 | 0.021 | 0.74 |
| Graders | 2020 | 26 | 50 | 2.994737 | 2.5164 | 8.13394 | 5.82549 | 0.005 | 0.7086 | 0.6519 | 492.8615 | 0.1594 | 0.41 |
| Graders >51 and <120 | 2020 | 51 | 120 | 1.161574 | 0.976 | 4.56142 | 7.72513 | 0.0048 | 0.622 | 0.5722 | 469.3371 | 0.1518 | 0.41 |
| Graders >121 and <175 | 2020 | 121 | 175 | 0.674427 | 0.5667 | 3.62102 | 5.53045 | 0.0049 | 0.3085 | 0.2838 | 478.0403 | 0.1546 | 0.41 |
| Graders >176 and <250 | 2020 | 176 | 250 | 0.41877 | 0.3519 | 1.34183 | 4.67787 | 0.0049 | 0.1495 | 0.1376 | 475.3037 | 0.1537 | 0.41 |
| Graders | 2020 | 251 | 500 | 0.383198 | 0.322 | 1.5256 | 3.10731 | 0.0049 | 0.1206 | 0.111 | 471.9795 | 0.1526 | 0.41 |
| Graders | 2020 | 501 | 750 | 12.961 | 0.319 | 1.229 | 2.031 | 0.005 | 0.072 | 0.072 | 568.299 | 0.028 | 0.41 |
| Off-Highway Tractors | 2020 | 51 | 120 | 0.533073 | 0.4479 | 3.78798 | 4.18317 | 0.0049 | 0.307 | 0.2825 | 474.1481 | 0.1533 | 0.44 |
| Off-Highway Tractors | 2020 | 121 | 175 | 0.322507 | 0.271 | 3.21511 | 2.89032 | 0.0049 | 0.1402 | 0.129 | 472.9169 | 0.153 | 0.44 |
| Off-Highway Tractors | 2020 | 176 | 250 | 0.263453 | 0.2214 | 1.1813 | 2.57547 | 0.0049 | 0.0862 | 0.0793 | 470.943 | 0.1523 | 0.44 |
| Off-Highway Tractors >501 and <750 | 2020 | 501 | 750 | 0.239679 | 0.2014 | 1.13143 | 2.04663 | 0.0049 | 0.0762 | 0.0701 | 471.8151 | 0.1526 | 0.44 |
| Off-Highway Tractors | 2020 | 751 | 1000 | 0.178457 | 0.15 | 1.02156 | 2.39599 | 0.0049 | 0.063 | 0.058 | 472.0545 | 0.1527 | 0.44 |
| Off-Highway Trucks | 2020 | 121 | 175 | 0.36879 | 0.3099 | 3.3388 | 2.62769 | 0.0049 | 0.137 | 0.126 | 470.0967 | 0.152 | 0.38 |
| Off-Highway Trucks >176 and <250 | 2020 | 176 | 250 | 0.327003 | 0.2748 | 1.39106 | 2.50726 | 0.0049 | 0.0977 | 0.0899 | 470.1675 | 0.1521 | 0.38 |
| Off-Highway Trucks >251 and <500 | 2020 | 251 | 500 | 0.292906 | 0.2461 | 1.41417 | 2.34677 | 0.0049 | 0.0855 | 0.0787 | 474.5787 | 0.1535 | 0.38 |
| Off-Highway Trucks | 2020 | 501 | 750 | 0.371665 | 0.3123 | 2.02683 | 3.05816 | 0.0049 | 0.1196 | 0.11 | 472.7499 | 0.1529 | 0.38 |

| Equipment Type | Year | Low HP | High HP | TOG (g/bhp-hr) | ROG (g/bhp-hr) | CO (g/bhp-hr) | NOX (g/bhp-hr) | SO2 (g/bhp-hr) | PM10 (g/bhp-hr) | PM2.5 (g/bhp-hr) | CO2 (g/bhp-hr) | CH4 (g/bhp-hr) | Load Factor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Emission Factors - OFFROAD | | | | | | | | | | | | | |
| Off-Highway Trucks | 2020 | 751 | 1000 | 0.360605 | 0.303 | 1.37163 | 4.79365 | 0.0049 | 0.1252 | 0.1152 | 469.8892 | 0.152 | 0.38 |
| Other Construction Equipment | 2020 | 6 | 15 | 1.276029 | 1.0722 | 5.40446 | 5.03626 | 0.0054 | 0.4052 | 0.3728 | 527.9656 | 0.1708 | 0.42 |
| Other Construction Equipment >16 and <25 | 2020 | 16 | 25 | 1.276029 | 1.0722 | 5.40446 | 5.03626 | 0.0054 | 0.4052 | 0.3728 | 527.9656 | 0.1708 | 0.42 |
| Other Construction Equipment >26 and <50 | 2020 | 26 | 50 | 1.276029 | 1.0722 | 5.40446 | 5.03626 | 0.0054 | 0.4052 | 0.3728 | 527.9656 | 0.1708 | 0.42 |
| Other Construction Equipment >51 and <120 | 2020 | 51 | 120 | 0.617777 | 0.5191 | 3.73189 | 4.7712 | 0.0049 | 0.3537 | 0.3254 | 472.2162 | 0.1527 | 0.42 |
| Other Construction Equipment >121 and <175 | 2020 | 121 | 175 | 0.461441 | 0.3877 | 3.23528 | 4.11203 | 0.0049 | 0.217 | 0.1996 | 469.9837 | 0.152 | 0.42 |
| Other Construction Equipment >251 and <500 | 2020 | 251 | 500 | 0.266788 | 0.2242 | 1.6338 | 2.63672 | 0.0049 | 0.096 | 0.0883 | 475.2326 | 0.1537 | 0.42 |
| Other General Industrial Equipment | 2020 | 6 | 15 | 1.125869 | 0.946 | 5.50397 | 4.62219 | 0.0054 | 0.334 | 0.3073 | 526.1761 | 0.1702 | 0.34 |
| Other General Industrial Equipment | 2020 | 16 | 25 | 1.125869 | 0.946 | 5.50397 | 4.62219 | 0.0054 | 0.334 | 0.3073 | 526.1761 | 0.1702 | 0.34 |
| Other General Industrial Equipment | 2020 | 26 | 50 | 1.125869 | 0.946 | 5.50397 | 4.62219 | 0.0054 | 0.334 | 0.3073 | 526.1761 | 0.1702 | 0.34 |
| Other General Industrial Equipment | 2020 | 51 | 120 | 0.53075 | 0.446 | 3.77073 | 4.06079 | 0.0048 | 0.2959 | 0.2722 | 469.9998 | 0.152 | 0.34 |
| Other General Industrial Equipment | 2020 | 121 | 175 | 0.319281 | 0.2683 | 3.22922 | 2.57503 | 0.0049 | 0.135 | 0.1242 | 471.8502 | 0.1526 | 0.34 |
| Other General Industrial Equipment | 2020 | 176 | 250 | 0.281815 | 0.2368 | 1.23914 | 2.66782 | 0.0049 | 0.0902 | 0.083 | 473.2231 | 0.153 | 0.34 |
| Other General Industrial Equipment | 2020 | 251 | 500 | 0.247036 | 0.2076 | 1.34424 | 2.06187 | 0.0049 | 0.0724 | 0.0666 | 472.929 | 0.153 | 0.34 |
| Other General Industrial Equipment | 2020 | 501 | 750 | 0.207847 | 0.1746 | 1.46184 | 1.67591 | 0.0049 | 0.0622 | 0.0572 | 473.4638 | 0.1531 | 0.34 |
| Other General Industrial Equipment | 2020 | 751 | 1000 | 0.322174 | 0.2707 | 1.085 | 4.85721 | 0.0049 | 0.1186 | 0.1092 | 472.0545 | 0.1527 | 0.34 |
| Other Material Handling Equipment | 2020 | 26 | 50 | 1.481858 | 1.2452 | 6.1671 | 5.13925 | 0.0054 | 0.4392 | 0.4041 | 523.7088 | 0.1694 | 0.4 |
| Other Material Handling Equipment | 2020 | 51 | 120 | 0.36479 | 0.3065 | 3.58938 | 3.10396 | 0.0049 | 0.1823 | 0.1677 | 473.5884 | 0.1532 | 0.4 |
| Other Material Handling Equipment | 2020 | 121 | 175 | 0.299922 | 0.252 | 3.17089 | 2.36653 | 0.0049 | 0.1181 | 0.1086 | 472.2193 | 0.1527 | 0.4 |
| Other Material Handling Equipment | 2020 | 176 | 250 | 0.346024 | 0.2908 | 1.31882 | 3.59889 | 0.0049 | 0.1152 | 0.106 | 471.482 | 0.1525 | 0.4 |
| Other Material Handling Equipment | 2020 | 251 | 500 | 0.336187 | 0.2825 | 1.52346 | 3.20974 | 0.0049 | 0.1198 | 0.1102 | 470.2972 | 0.1521 | 0.4 |
| Other Material Handling Equipment | 2020 | 1001 | 9999 | 0.238473 | 0.2004 | 1.04898 | 3.61407 | 0.0049 | 0.0783 | 0.072 | 472.0545 | 0.1527 | 0.4 |
| Pavers | 2020 | 16 | 25 | 1.568718 | 1.3182 | 5.52345 | 4.76401 | 0.0054 | 0.4022 | 0.37 | 526.2098 | 0.1702 | 0.42 |
| Pavers | 2020 | 26 | 50 | 1.568718 | 1.3182 | 5.52345 | 4.76401 | 0.0054 | 0.4022 | 0.37 | 526.2098 | 0.1702 | 0.42 |
| Pavers | 2020 | 51 | 120 | 0.558949 | 0.4697 | 3.60405 | 4.42718 | 0.0048 | 0.3249 | 0.2989 | 469.8815 | 0.152 | 0.42 |
| Pavers | 2020 | 121 | 175 | 0.324615 | 0.2728 | 3.0097 | 2.91833 | 0.0049 | 0.1419 | 0.1305 | 472.7746 | 0.1529 | 0.42 |
| Pavers | 2020 | 176 | 250 | 0.209036 | 0.1756 | 1.02834 | 2.77699 | 0.0049 | 0.076 | 0.0699 | 472.8337 | 0.1529 | 0.42 |
| Pavers | 2020 | 251 | 500 | 0.195949 | 0.1647 | 0.98677 | 2.13394 | 0.0048 | 0.0772 | 0.071 | 466.2059 | 0.1508 | 0.42 |
| Paving Equipment | 2020 | 16 | 25 | 0.73951 | 0.6214 | 4.22322 | 3.9519 | 0.0054 | 0.2169 | 0.1996 | 520.1235 | 0.1682 | 0.36 |
| Paving Equipment | 2020 | 26 | 50 | 0.73951 | 0.6214 | 4.22322 | 3.9519 | 0.0054 | 0.2169 | 0.1996 | 520.1235 | 0.1682 | 0.36 |
| Paving Equipment | 2020 | 51 | 120 | 0.472907 | 0.3974 | 3.58172 | 3.78064 | 0.0049 | 0.2558 | 0.2353 | 473.3249 | 0.1531 | 0.36 |
| Paving Equipment >121 and <175 | 2020 | 121 | 175 | 0.294586 | 0.2475 | 3.02393 | 2.55498 | 0.0049 | 0.1278 | 0.1176 | 470.7359 | 0.1522 | 0.36 |
| Paving Equipment >176 and <250 | 2020 | 176 | 250 | 0.289784 | 0.2435 | 1.25215 | 3.2202 | 0.0049 | 0.1107 | 0.1018 | 472.1514 | 0.1527 | 0.36 |
| Plate Compactors | 2020 | 6 | 15 | 0.79 | 0.661 | 3.469 | 4.142 | 0.008 | 0.161 | 0.161 | 568.299 | 0.059 | 0.43 |
| Pressure Washers | 2020 | 6 | 15 | 1.78 | 0.646 | 3.546 | 4.516 | 0.008 | 0.212 | 0.212 | 568.299 | 0.058 | 0.3 |
| Pressure Washers | 2020 | 16 | 25 | 2.904 | 0.721 | 2.473 | 4.538 | 0.007 | 0.205 | 0.205 | 568.299 | 0.065 | 0.3 |
| Pressure Washers | 2020 | 26 | 50 | 4.025 | 0.499 | 3.393 | 3.917 | 0.007 | 0.161 | 0.161 | 568.299 | 0.045 | 0.3 |
| Pressure Washers | 2020 | 51 | 120 | 4.048 | 0.298 | 3.225 | 3.036 | 0.006 | 0.151 | 0.151 | 568.299 | 0.026 | 0.3 |
| Pressure Washers | 2020 | 121 | 175 | 16.638 | 0.258 | 2.907 | 2.383 | 0.006 | 0.104 | 0.104 | 568.299 | 0.023 | 0.3 |
| Pressure Washers | 2020 | 176 | 250 | 8.005 | 0.098 | 0.986 | 0.265 | 0.006 | 0.009 | 0.009 | 568.299 | 0.008 | 0.3 |
| Pumps | 2020 | 6 | 15 | 1.593 | 0.731 | 3.546 | 4.542 | 0.008 | 0.227 | 0.227 | 568.299 | 0.066 | 0.74 |
| Pumps | 2020 | 16 | 25 | 4.396 | 0.769 | 2.473 | 4.538 | 0.007 | 0.212 | 0.212 | 568.299 | 0.069 | 0.74 |
| Pumps >26 and <50 | 2020 | 26 | 50 | 7.613 | 0.755 | 4.197 | 4.128 | 0.007 | 0.206 | 0.206 | 568.299 | 0.068 | 0.74 |
| Pumps | 2020 | 51 | 120 | 8.832 | 0.386 | 3.432 | 3.219 | 0.006 | 0.189 | 0.189 | 568.299 | 0.034 | 0.74 |
| Pumps | 2020 | 121 | 175 | 11.744 | 0.285 | 2.974 | 2.418 | 0.006 | 0.111 | 0.111 | 568.299 | 0.025 | 0.74 |
| Pumps | 2020 | 176 | 250 | 12.575 | 0.212 | 1.042 | 2.05 | 0.006 | 0.06 | 0.06 | 568.299 | 0.019 | 0.74 |
| Pumps >251 and <500 | 2020 | 251 | 500 | 20.565 | 0.203 | 1.017 | 1.841 | 0.005 | 0.057 | 0.057 | 568.3 | 0.018 | 0.74 |
| Pumps | 2020 | 501 | 750 | 34.373 | 0.205 | 1.017 | 1.884 | 0.005 | 0.058 | 0.058 | 568.299 | 0.018 | 0.74 |
| Pumps | 2020 | 1001 | 9999 | 101.462 | 0.255 | 1.096 | 3.649 | 0.005 | 0.081 | 0.081 | 568.3 | 0.023 | 0.74 |
| Rollers | 2020 | 6 | 15 | 1.102095 | 0.9261 | 4.72504 | 4.53426 | 0.0054 | 0.3289 | 0.3026 | 525.8798 | 0.1701 | 0.38 |
| Rollers | 2020 | 16 | 25 | 1.102095 | 0.9261 | 4.72504 | 4.53426 | 0.0054 | 0.3289 | 0.3026 | 525.8798 | 0.1701 | 0.38 |
| Rollers | 2020 | 26 | 50 | 1.102095 | 0.9261 | 4.72504 | 4.53426 | 0.0054 | 0.3289 | 0.3026 | 525.8798 | 0.1701 | 0.38 |
| Rollers >51 and <120 | 2020 | 51 | 120 | 0.462004 | 0.3882 | 3.53135 | 3.88153 | 0.0049 | 0.2475 | 0.2277 | 473.8594 | 0.1533 | 0.38 |
| Rollers >121 and <175 | 2020 | 121 | 175 | 0.256128 | 0.2152 | 2.93333 | 2.45176 | 0.0049 | 0.1126 | 0.1036 | 471.9177 | 0.1526 | 0.38 |
| Rollers >176 and <250 | 2020 | 176 | 250 | 0.248138 | 0.2085 | 1.25343 | 2.75095 | 0.0049 | 0.0892 | 0.082 | 473.3669 | 0.1531 | 0.38 |
| Rollers | 2020 | 251 | 500 | 0.279691 | 0.235 | 2.11346 | 2.82823 | 0.005 | 0.1094 | 0.1007 | 479.3254 | 0.155 | 0.38 |
| Rough Terrain Forklifts | 2020 | 26 | 50 | 1.188595 | 0.9987 | 4.68594 | 4.4946 | 0.0054 | 0.3164 | 0.2911 | 525.6222 | 0.17 | 0.4 |
| Rough Terrain Forklifts >51 and <120 | 2020 | 51 | 120 | 0.225188 | 0.1892 | 3.25575 | 2.45218 | 0.0049 | 0.1026 | 0.0944 | 472.9842 | 0.153 | 0.4 |
| Rough Terrain Forklifts | 2020 | 121 | 175 | 0.170092 | 0.1429 | 2.84466 | 1.86888 | 0.0049 | 0.0684 | 0.0629 | 471.7152 | 0.1526 | 0.4 |
| Rough Terrain Forklifts | 2020 | 176 | 250 | 0.132727 | 0.1115 | 0.97848 | 1.60906 | 0.0049 | 0.0366 | 0.0337 | 472.5671 | 0.1528 | 0.4 |
| Rough Terrain Forklifts | 2020 | 251 | 500 | 0.105484 | 0.0886 | 0.94184 | 1.30199 | 0.0048 | 0.0281 | 0.0258 | 465.7709 | 0.1506 | 0.4 |
| Rubber Tired Dozers > 121 and <175 | 2020 | 121 | 175 | 0.864425 | 0.7264 | 3.89288 | 7.18525 | 0.0049 | 0.4107 | 0.3778 | 473.0116 | 0.153 | 0.4 |
| Rubber Tired Dozers > 176 and <250 | 2020 | 176 | 250 | 0.737248 | 0.6195 | 2.37104 | 6.50332 | 0.0049 | 0.3185 | 0.293 | 474.7928 | 0.1536 | 0.4 |
| Rubber Tired Dozers | 2020 | 251 | 500 | 0.636621 | 0.5349 | 4.41134 | 5.64089 | 0.0049 | 0.2591 | 0.2384 | 479.7569 | 0.1552 | 0.4 |
| Rubber Tired Dozers | 2020 | 501 | 750 | 0.543245 | 0.4565 | 2.60108 | 6.12255 | 0.0049 | 0.2181 | 0.2007 | 473.0562 | 0.153 | 0.4 |
| Rubber Tired Dozers | 2020 | 751 | 1000 | 7.811 | 0.522 | 2.164 | 5.306 | 0.005 | 0.16 | 0.16 | 568.299 | 0.047 | 0.4 |
| Rubber Tired Loaders | 2020 | 16 | 25 | 1.761913 | 1.4805 | 6.76793 | 5.25369 | 0.0054 | 0.4741 | 0.4362 | 524.6967 | 0.1697 | 0.36 |
| Rubber Tired Loaders | 2020 | 26 | 50 | 1.761913 | 1.4805 | 6.76793 | 5.25369 | 0.0054 | 0.4741 | 0.4362 | 524.6967 | 0.1697 | 0.36 |
| Rubber Tired Loaders | 2020 | 51 | 120 | 0.661113 | 0.5555 | 3.94839 | 4.68644 | 0.0048 | 0.367 | 0.3376 | 465.6735 | 0.1506 | 0.36 |
| Rubber Tired Loaders | 2020 | 121 | 175 | 0.450696 | 0.3787 | 3.36809 | 3.51735 | 0.0049 | 0.1936 | 0.1781 | 471.2135 | 0.1524 | 0.36 |
| Rubber Tired Loaders | 2020 | 176 | 250 | 0.345399 | 0.2902 | 1.26885 | 3.42116 | 0.0048 | 0.1136 | 0.1045 | 469.5127 | 0.1518 | 0.36 |
| Rubber Tired Loaders | 2020 | 251 | 500 | 0.343959 | 0.289 | 1.6304 | 3.01666 | 0.0048 | 0.1122 | 0.1032 | 466.7831 | 0.151 | 0.36 |
| Rubber Tired Loaders | 2020 | 501 | 750 | 0.329462 | 0.2768 | 1.39991 | 2.76722 | 0.0048 | 0.1075 | 0.0989 | 462.193 | 0.1495 | 0.36 |
| Rubber Tired Loaders | 2020 | 751 | 1000 | 0.370676 | 0.3115 | 1.20366 | 5.25309 | 0.0049 | 0.1385 | 0.1274 | 469.9352 | 0.152 | 0.36 |
| Scrapers | 2020 | 51 | 120 | 0.834143 | 0.7009 | 4.19756 | 6.6767 | 0.005 | 0.5101 | 0.4693 | 483.745 | 0.1565 | 0.48 |
| Scrapers | 2020 | 121 | 175 | 0.568453 | 0.4777 | 3.50114 | 4.86851 | 0.0049 | 0.262 | 0.241 | 478.6077 | 0.1548 | 0.48 |
| Scrapers | 2020 | 176 | 250 | 0.531032 | 0.4462 | 2.06469 | 5.089 | 0.0048 | 0.2232 | 0.2054 | 468.9883 | 0.1517 | 0.48 |
| Scrapers >251 and <500 | 2020 | 251 | 500 | 0.380326 | 0.3196 | 2.40063 | 3.78254 | 0.0049 | 0.1475 | 0.1357 | 472.1751 | 0.1527 | 0.48 |
| Scrapers | 2020 | 501 | 750 | 0.311991 | 0.2622 | 1.72502 | 3.12592 | 0.0049 | 0.1132 | 0.1042 | 471.7776 | 0.1526 | 0.48 |
| Signal Boards | 2020 | 6 | 15 | 1.04 | 0.661 | 3.469 | 4.142 | 0.008 | 0.161 | 0.161 | 568.299 | 0.059 | 0.82 |
| Signal Boards | 2020 | 26 | 50 | 7.28 | 0.788 | 4.448 | 4.132 | 0.007 | 0.206 | 0.206 | 568.299 | 0.071 | 0.82 |
| Signal Boards | 2020 | 51 | 120 | 8.081 | 0.395 | 3.504 | 3.134 | 0.006 | 0.187 | 0.187 | 568.299 | 0.035 | 0.82 |
| Signal Boards | 2020 | 121 | 175 | 11.756 | 0.298 | 3.043 | 2.309 | 0.006 | 0.11 | 0.11 | 568.299 | 0.026 | 0.82 |
| Signal Boards | 2020 | 176 | 250 | 14.813 | 0.274 | 1.281 | 2.35 | 0.007 | 0.071 | 0.071 | 686.695 | 0.024 | 0.82 |
| Skid Steer Loaders | 2020 | 16 | 25 | 0.522771 | 0.4393 | 3.76397 | 3.69113 | 0.0054 | 0.1447 | 0.1331 | 527.7577 | 0.1707 | 0.37 |
| Skid Steer Loaders | 2020 | 26 | 50 | 0.522771 | 0.4393 | 3.76397 | 3.69113 | 0.0054 | 0.1447 | 0.1331 | 527.7577 | 0.1707 | 0.37 |
| Skid Steer Loaders >51 and <120 | 2020 | 51 | 120 | 0.224183 | 0.1884 | 3.2771 | 2.5046 | 0.0049 | 0.1084 | 0.0997 | 471.9075 | 0.1526 | 0.37 |

| Equipment Type | Year | Low HP | High HP | TOG (g/bhp-hr) | ROG (g/bhp-hr) | CO (g/bhp-hr) | NOX (g/bhp-hr) | SO2 (g/bhp-hr) | PM10 (g/bhp-hr) | PM2.5 (g/bhp-hr) | CO2 (g/bhp-hr) | CH4 (g/bhp-hr) | Load Factor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Emission Factors - OFFROAD | | | | | | | | | | | | | |
| Surfacing Equipment | 2020 | 26 | 50 | 0.637406 | 0.5356 | 3.93357 | 4.23906 | 0.0055 | 0.2164 | 0.1991 | 535.5275 | 0.1732 | 0.3 |
| Surfacing Equipment | 2020 | 51 | 120 | 0.392345 | 0.3297 | 3.43932 | 3.61216 | 0.0049 | 0.2063 | 0.1898 | 473.8188 | 0.1532 | 0.3 |
| Surfacing Equipment | 2020 | 121 | 175 | 0.365927 | 0.3075 | 2.93068 | 3.67232 | 0.0048 | 0.1745 | 0.1606 | 469.2079 | 0.1518 | 0.3 |
| Surfacing Equipment | 2020 | 176 | 250 | 0.252128 | 0.2119 | 1.21774 | 3.22243 | 0.0049 | 0.0972 | 0.0894 | 476.4261 | 0.1541 | 0.3 |
| Surfacing Equipment | 2020 | 251 | 500 | 0.173203 | 0.1455 | 1.21902 | 1.83755 | 0.0049 | 0.0669 | 0.0615 | 471.6331 | 0.1525 | 0.3 |
| Surfacing Equipment | 2020 | 501 | 750 | 0.168871 | 0.1419 | 0.99569 | 2.09374 | 0.0049 | 0.0744 | 0.0684 | 469.6252 | 0.1519 | 0.3 |
| Sweepers/Scrubbers | 2020 | 6 | 15 | 1.599203 | 1.3438 | 6.1554 | 5.09515 | 0.0054 | 0.4629 | 0.4259 | 525.3284 | 0.1699 | 0.46 |
| Sweepers/Scrubbers | 2020 | 16 | 25 | 1.599203 | 1.3438 | 6.1554 | 5.09515 | 0.0054 | 0.4629 | 0.4259 | 525.3284 | 0.1699 | 0.46 |
| Sweepers/Scrubbers | 2020 | 26 | 50 | 1.599203 | 1.3438 | 6.1554 | 5.09515 | 0.0054 | 0.4629 | 0.4259 | 525.3284 | 0.1699 | 0.46 |
| Sweepers/Scrubbers | 2020 | 51 | 120 | 0.618762 | 0.5199 | 3.82752 | 4.4821 | 0.0049 | 0.3601 | 0.3313 | 474.1157 | 0.1533 | 0.46 |
| Sweepers/Scrubbers | 2020 | 121 | 175 | 0.549287 | 0.4616 | 3.35909 | 4.60809 | 0.0049 | 0.2371 | 0.2181 | 473.1221 | 0.153 | 0.46 |
| Sweepers/Scrubbers | 2020 | 176 | 250 | 0.246498 | 0.2071 | 1.13655 | 2.4856 | 0.0049 | 0.079 | 0.0727 | 470.1263 | 0.152 | 0.46 |
| Tractors/Loaders/Backhoes | 2020 | 16 | 25 | 0.987255 | 0.8296 | 5.03491 | 4.39784 | 0.0053 | 0.2878 | 0.2648 | 515.874 | 0.1668 | 0.37 |
| Tractors/Loaders/Backhoes | 2020 | 26 | 50 | 0.987255 | 0.8296 | 5.03491 | 4.39784 | 0.0053 | 0.2878 | 0.2648 | 515.874 | 0.1668 | 0.37 |
| Tractors/Loaders/Backhoes >51 and <120 | 2020 | 51 | 120 | 0.393883 | 0.331 | 3.60147 | 3.32571 | 0.0049 | 0.2103 | 0.1935 | 475.1543 | 0.1537 | 0.37 |
| Tractors/Loaders/Backhoes >121 and <175 | 2020 | 121 | 175 | 0.29217 | 0.2455 | 3.10518 | 2.41467 | 0.0048 | 0.1217 | 0.1119 | 467.5132 | 0.1512 | 0.37 |
| Tractors/Loaders/Backhoes >176 and <250 | 2020 | 176 | 250 | 0.268036 | 0.2252 | 1.19592 | 2.73794 | 0.0049 | 0.0898 | 0.0826 | 470.4998 | 0.1522 | 0.37 |
| Tractors/Loaders/Backhoes | 2020 | 251 | 500 | 0.230511 | 0.1937 | 1.35815 | 2.07976 | 0.0048 | 0.073 | 0.0672 | 468.2447 | 0.1514 | 0.37 |
| Tractors/Loaders/Backhoes | 2020 | 501 | 750 | 0.318709 | 0.2678 | 1.60984 | 3.11926 | 0.0048 | 0.1174 | 0.108 | 468.6602 | 0.1516 | 0.37 |
| Trenchers | 2020 | 6 | 15 | 1.076913 | 0.9049 | 4.8331 | 4.67651 | 0.0054 | 0.3561 | 0.3276 | 527.0962 | 0.1705 | 0.5 |
| Trenchers | 2020 | 16 | 25 | 1.076913 | 0.9049 | 4.8331 | 4.67651 | 0.0054 | 0.3561 | 0.3276 | 527.0962 | 0.1705 | 0.5 |
| Trenchers >26 and <50 | 2020 | 26 | 50 | 1.076913 | 0.9049 | 4.8331 | 4.67651 | 0.0054 | 0.3561 | 0.3276 | 527.0962 | 0.1705 | 0.5 |
| Trenchers >51 and <120 | 2020 | 51 | 120 | 0.726229 | 0.6102 | 3.83272 | 5.51952 | 0.0049 | 0.4132 | 0.3802 | 475.1265 | 0.1537 | 0.5 |
| Trenchers | 2020 | 121 | 175 | 0.500709 | 0.4207 | 3.32968 | 4.46042 | 0.0048 | 0.2281 | 0.2098 | 467.7348 | 0.1513 | 0.5 |
| Trenchers | 2020 | 176 | 250 | 0.466499 | 0.392 | 1.77405 | 4.8091 | 0.0049 | 0.1949 | 0.1793 | 473.5951 | 0.1532 | 0.5 |
| Trenchers | 2020 | 251 | 500 | 0.276702 | 0.2325 | 1.85932 | 2.775 | 0.0049 | 0.1052 | 0.0968 | 470.6367 | 0.1522 | 0.5 |
| Trenchers | 2020 | 501 | 750 | 0.083454 | 0.0701 | 0.95004 | 0.56006 | 0.0049 | 0.009 | 0.0083 | 472.6556 | 0.1529 | 0.5 |
| Welders | 2020 | 6 | 15 | 1.835 | 0.731 | 3.546 | 4.542 | 0.008 | 0.227 | 0.227 | 568.299 | 0.066 | 0.45 |
| Welders | 2020 | 16 | 25 | 3.507 | 0.769 | 2.473 | 4.538 | 0.007 | 0.212 | 0.212 | 568.299 | 0.069 | 0.45 |
| Welders >26 and <50 | 2020 | 26 | 50 | 9.83 | 0.937 | 4.84 | 4.304 | 0.007 | 0.238 | 0.238 | 568.299 | 0.084 | 0.45 |
| Welders | 2020 | 51 | 120 | 7.278 | 0.455 | 3.605 | 3.351 | 0.006 | 0.216 | 0.216 | 568.299 | 0.041 | 0.45 |
| Welders | 2020 | 121 | 175 | 13.663 | 0.344 | 3.122 | 2.523 | 0.006 | 0.127 | 0.127 | 568.299 | 0.031 | 0.45 |
| Welders | 2020 | 176 | 250 | 12.577 | 0.261 | 1.093 | 2.143 | 0.006 | 0.066 | 0.066 | 568.299 | 0.023 | 0.45 |
| Welders | 2020 | 251 | 500 | 17.094 | 0.252 | 1.055 | 1.91 | 0.005 | 0.064 | 0.064 | 568.299 | 0.022 | 0.45 |

Equipment Load Factors

| Equipment Type | HP | Load Factor |
|---|---|---|
| Aerial Lifts | 63 | 0.31 |
| Air Compressors | 78 | 0.48 |
| Bore/Drill Rigs | 206 | 0.5 |
| Cement and Mortar Mixers | 9 | 0.56 |
| Concrete/Industrial Saws | 81 | 0.73 |
| Cranes | 226 | 0.29 |
| Crawler Tractors | 208 | 0.43 |
| Crushing/Proc. Equipment | 85 | 0.78 |
| Dumpers/Tenders | 16 | 0.38 |
| Excavators | 163 | 0.38 |
| Forklifts | 89 | 0.2 |
| Generator Sets | 84 | 0.74 |
| Graders | 175 | 0.41 |
| Off-Highway Tractors | 123 | 0.44 |
| Off-Highway Trucks | 400 | 0.38 |
| Other Construction Equipment | 172 | 0.42 |
| Other General Industrial Equipment | 88 | 0.34 |
| Other Material Handling Equipment | 167 | 0.4 |
| Pavers | 126 | 0.42 |
| Paving Equipment | 131 | 0.36 |
| Plate Compactors | 8 | 0.43 |
| Pressure Washers | 13 | 0.3 |
| Pumps | 84 | 0.74 |
| Rollers | 81 | 0.38 |
| Rough Terrain Forklifts | 100 | 0.4 |
| Rubber Tired Dozers | 255 | 0.4 |
| Rubber Tired Loaders | 200 | 0.36 |
| Scrapers | 362 | 0.48 |
| Signal Boards | 6 | 0.82 |
| Skid Steer Loaders | 65 | 0.37 |
| Surfacing Equipment | 254 | 0.3 |
| Sweepers/Scrubbers | 64 | 0.46 |
| Tractors/Loaders/Backhoes | 98 | 0.37 |
| Trenchers | 81 | 0.5 |
| Welders | 46 | 0.45 |

Riverside County 2020 On-Road Emission Factors

| VEH | FUEL | MDLYR | SPEED | POP | VMT | Percent VMT | TRIPS | CO2_RUNEX | CH4 | N2O |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | (Miles/hr) | (Vehicles) | (Miles/day) | | (Trips/day) | (gms/mile) | (gms/mile) | (gms/mile) |
| LDA | GAS | Aggregate | Aggregated | 6,241,441 | 216,000,000 | 67.95% | 39386956 | 274.0485814 | | |
| LDA | DSL | Aggregate | Aggregated | 58578.66528 | 2,170,199 | 0.68% | 364867 | 253.3966805 | | |
| LDT1 | GAS | Aggregate | Aggregated | 529468.9231 | 17,839,922 | 5.61% | 3216559 | 325.2843956 | | |
| LDT1 | DSL | Aggregate | Aggregated | 653.8523923 | 17,425 | 0.01% | 3379 | 342.1599989 | | |
| LDT2 | GAS | Aggregate | Aggregated | 2196840.435 | 81,691,951 | 25.70% | 13902518 | 366.6776059 | | |
| LDT2 | DSL | Aggregate | Aggregated | 3707.582469 | 150,823 | 0.05% | 23906 | 326.8633798 | | |
| Total | | | | 9,030,690 | 317,870,319 | | 56,898,185 | | | |
| Average | | | | | | | | 300.617 | 0.028 | 0.0370 |

Source: EMFAC 2014, TCR 2018

| VEH | FUEL | MDLYR | SPEED | POP | VMT | TRIPS | CO2_RUNEX | CH4 | N2O |
|---|---|---|---|---|---|---|---|---|---|
| | | | (Miles/hr) | (Vehicles) | (Miles/day) | (Trips/day) | (gms/mile) | (gms/mile) | (gms/mile) |
| T7 tractor | DSL | Aggregate | Aggregated | 19484 | 2584405 | 0 | 1489.472848 | 0.0051 | 0.0048 |

Source: EMFAC 2014, EPA 2018

**CH4 and N2O Emission Factors - On-Road Vehicles**

| Gasoline Passenger Cars | | |
|---|---|---|
| | **CH4** | **N2O** |
| Model Years 1984-1993 | 0.0704 | 0.0647 |
| Model Year 1994 | 0.0531 | 0.056 |
| Model Year 1995 | 0.0358 | 0.0473 |
| Model Year 1996 | 0.0272 | 0.0426 |
| Model Year 1997 | 0.0268 | 0.0422 |
| Model Year 1998 | 0.0249 | 0.0393 |
| Model Year 1999 | 0.0216 | 0.0337 |
| Model Year 2000 | 0.0178 | 0.0273 |
| Model Year 2001 | 0.011 | 0.0158 |
| Model Year 2002 | 0.0107 | 0.0153 |
| Model Year 2003 | 0.0114 | 0.0135 |
| Model Year 2004 | 0.0145 | 0.0083 |
| Model Year 2005 | 0.0147 | 0.0079 |
| Model Year 2006 | 0.0161 | 0.0057 |
| Model Year 2007 | 0.017 | 0.0041 |
| Model Year 2008 | 0.0172 | 0.0038 |
| Average | 0.024388 | 0.026719 |

| Gasoline Light Trucks (Vans, Pickup Trucks, SUVs) | | |
|---|---|---|
| | **CH4** | **N2O** |
| Model Years 1987-1993 | 0.0813 | 0.1035 |
| Model Year 1994 | 0.0646 | 0.0982 |
| Model Year 1995 | 0.0517 | 0.0908 |
| Model Year 1996 | 0.0452 | 0.0871 |
| Model Year 1997 | 0.0452 | 0.0871 |
| Model Year 1998 | 0.0391 | 0.0728 |
| Model Year 1999 | 0.0321 | 0.0564 |
| Model Year 2000 | 0.0346 | 0.0621 |
| Model Year 2001 | 0.0151 | 0.0164 |
| Model Year 2002 | 0.0178 | 0.0228 |
| Model Year 2003 | 0.0155 | 0.0114 |
| Model Year 2004 | 0.0152 | 0.0132 |
| Model Year 2005 | 0.0157 | 0.0101 |
| Model Year 2006 | 0.0159 | 0.0089 |
| Model Year 2007 | 0.0161 | 0.0079 |
| Model Year 2008 | 0.0163 | 0.0066 |
| Average | 0.047206 | 0.0325875 |

| | **CH4** | **N2O** |
|---|---|---|
| Combined Average (g/mi) | 0.028488 | 0.036963 |

Source: The Climate Registry 2018 Emission Factors: Table 13.7: U.S. Default Factors for Calculating CH4 and N2O Emissions from Non-Highway Vehicles
Fuel consumption obtained from OFFROAD 2017 Web Database.

Crimson Solar

Operational Emissions Summary

| | Total Daily Emissions (pounds/day) | | | | | Total Annual Emissions (tons/year) | | | | | Total Annual Emissions (metric tons/year) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ROG | NOX | CO | PM10 | PM2.5 | ROG | NOX | CO | PM10 | PM2.5 | CO2e |
| Operations and Maintenance Vehicles | 0.1 | 3.7 | 2.4 | 77.2 | 11.7 | 0.0 | 0.1 | 0.1 | 6.3 | 1.0 | 72 |
| Electricity | | | | | | | | | | | - |
| Water | | | | | | | | | | | 26 |
| Wastewater | | | | | | | | | | | 0 |
| Gas Insulated Switchgear | | | | | | | | | | | 73 |
| Total | 0.1 | 3.7 | 2.4 | 77.2 | 11.7 | 0.0 | 0.1 | 0.1 | 6.3 | 1.0 | 171 |

| Renewable Energy Carbon Savings | | | | |
|---|---|---|---|---|
| 350 | MW Renewable Energy | 1,533,000 MWh | 355,836 MT CO2e | |
| SCE 2015 Average GHG per Unit of Electricity Provided (MT $CO_2$e/MWh) | 0.23 | | | |

Notes: Assumes 12 hrs/day, 365 days/year

Source: SCE 2015 Corporate Responsibility Report

Operational Emissions
**On-Road Vehicle Trips**

| | | | | | | Emissions Summary (lbs/day) | | | | | Emissions Summary (tons per phase) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Daily Trips | Distance | Average Daily Mileage | Calculated Time - Rounded (days) | Total Mileage | VOC | $NO_x$ | CO | PM10 | PM2.5 | VOC | $NO_x$ | CO | PM10 | PM2.5 | $CO_2$ | $CH_4$ | N2O | Total GHG Emissions (MT CO2e) |
| Worker Trips | 50 | 13 | 1,300 | 78 | 101,400 | 0.04 | 0.20 | 2.11 | 0.13 | 0.06 | 0.00 | 0.01 | 0.08 | 0.01 | 0.00 | 33.53 | 0.00 | 0.00 | 31.51 |
| Water Delivery Trips | 14 | 13 | 364 | 75 | 27,300 | 0.07 | 3.50 | 0.29 | 0.10 | 0.05 | 0.00 | 0.13 | 0.01 | 0.00 | 0.00 | 44.73 | 0.00 | 0.00 | 40.74 |
| **Total** | | | | | | **0.11** | **3.70** | **2.40** | **0.23** | **0.10** | **0.00** | **0.14** | **0.09** | **0.01** | **0.00** | **78.26** | **0.00** | **0.00** | **72.25** |

Note:
Construction equipment included with appropriate construction phase
Material deliveries are constant regardless of Option A or Option B design selection.

Crimson Solar

Water Use Estimates

| | Total Estimated Water Demand (acre-feet) | Energy Factor for Outdoor water use for Southern CA (kWh/MG) [1] | MWh | Emission Factor $CO_2$ [2] (lb/MWh) | Emission Factor $CH_4$ [2] (lb/MWh) | Emission Factor $N_2O$[2] (lb/MWh) | Total $CO_2e$ Emissions (MT $CO_2e$/yr) |
|---|---|---|---|---|---|---|---|
| Construction | | | | | | | |
| Option A | 1,000.00 | 11,110 | 3,620.20 | 702 | 0.029 | 0.01 | 1,162.75 |
| Operations | | | | | | | |
| Option A | 22.40 | 11,110 | 81.09 | 702 | 0.029 | 0.01 | 26.05 |

Notes: Water demand based on estimates in the project description.

Source:

1. Emission factor for  Southern California region from California Energy Commission Refining Estimates of Water-Related Energy Use in California (2006).

2. Emission factors: LGOP 2010 V1.1 Table G.7 California Grid Average Electricity Emission Factors (1990-2007) and 2012 E-Grid for California (2009 inventory)

Crimson Solar Energy Center

Wastewater Use Estimates

Influent Emissions

| Influent (gal/yr) | Influent BOD* (mg/L) | Influent BOD (kg/yr) | Adjusted BOD Emission Factor (kg CH4/kg BOD) | Influent Emissions (MT $CO_2$e) |
|---|---|---|---|---|
| 2,000 | 439 | 3 | 0.12 | 0.01 |

Effluent Emissions

| Effluent (gal/yr) | Effluent Nitrogen Content (mg/L) | Effluent Nitrogen Content (kg/yr) | N2O Emissions (kg/yr) | Effluent Emissions (MT $CO_2$e) |
|---|---|---|---|---|
| 2,000 | 40 | 0.30 | 0 | 0.00 |

| | |
|---|---|
| Total Emissions (MT CO2e) | 0.01 |

Note: During operation and maintenance, portable sanitary waste facilities may be installed to retain wastewater for employee use. Each facility would have a capacity of approximately 2,000 gallons.

Source: Intergovernmental Panel on Climate Change 2006. IPCC Guidelines for National Greenhouse Gas Inventories; Chapter 6: Wastewater Treatment and Discharge

EMISSION FACTORS

Methane Emissions

| EmisFact (kg CH4/kg BOD) (EF = Max CH4 * MCF) | Max CH4 Producing Capacity (kg CH4/kg BOD) | Methane Correction Factor | GWP |
|---|---|---|---|
| 0.12 | 0.6 | 0.2 | 28 |

Equation 6.2 IPCC Chapter 6

Nitrogen Emissions

| $EF_{Effluent}$ (kg N2O-N/kg N) | Molecular Weight Ratio (N2O/N2) | GWP |
|---|---|---|
| 0.005 | 1.57 | 265 |

Crimson Solar

Gas-Insulated Switchgear

| | | |
|---|---|---|
| $SF_6$ Capacity[1] | lbs | 1,344 |
| Leakage Rate[2] | %/year | 0.5% |
| Annual Leakage | lbs $SF_6$/year | 6.72 |
| GWP $SF_6$[3] | | 23,900 |
| Annual Emissions | MT $CO_2E$/year | 73.08 |

Notes:

1. Estimated based on similar projects
2. Typical upper-bound leakage rate for new devices.
   NEMA Guideline - 0.1%/year
   IEC Specification - 0.5%/year
3. Source: IPCC 2007 Second Assessment Report

# J.2 Supplemental GHG Calculations, July 2019

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **UNMITIGATED** | | pounds per day | | | | | tons per phse | | | | | MT |
| | | number | VOC | NOX | CO | PM10 | PM2.5 | VOC | NOX | CO | PM10 | PM2.5 | CO2e |
| PA | Phase 1 motor grader | 3 | 1.06 | 14.08 | 4.04 | 0.45 | 0.41 | 0.21 | 2.81 | 0.81 | 0.09 | 0.08 | 262.08 |
| Alt B | Phase 1 motor grader | 2 | 0.71 | 9.39 | 2.69 | 0.30 | 0.27 | 0.14 | 1.87 | 0.54 | 0.06 | 0.05 | 174.72 |
| | motor grader difference | | -0.35 | -4.69 | -1.35 | -0.15 | -0.14 | -0.07 | -0.94 | -0.27 | -0.03 | -0.03 | -87.36 |
| PA | Phase 1 scraper | 3 | 1.85 | 21.92 | 13.91 | 0.85 | 0.79 | 0.37 | 4.37 | 2.77 | 0.17 | 0.16 | 501.14 |
| Alt B | Phase 1 scraper | 2 | 1.23 | 14.61 | 9.27 | 0.57 | 0.53 | 0.25 | 2.91 | 1.85 | 0.11 | 0.11 | 334.09 |
| | scraper Difference | | -0.62 | -7.31 | -4.64 | -0.28 | -0.26 | -0.12 | -1.46 | -0.92 | -0.06 | -0.05 | -167.05 |
| PA | Phase 1 - Fugitive Dust | 7 | | | | 31.62 | 17.42 | | | | 6.31 | 3.48 | |
| Alt B | Phase 1 - Fugitive Dust | 5 | | | | 22.59 | 12.44 | | | | 4.51 | 2.49 | |
| | Fugitive Dust Difference | | | | | -9.03 | -4.98 | | | | -1.80 | -0.99 | |
| **Alt B** | **Phase 1 Net Difference** | | **-0.97** | **-12.00** | **-5.98** | **-9.47** | **-5.38** | -0.19 | -2.39 | -1.19 | -1.89 | -1.07 | **-254.41** |
| | ***Net Dif. Max. Annual** | | | | | | | **-0.12** | **-1.51** | **-0.75** | **-1.19** | **-0.68** | 0 |
| | 63.2 percent of Phase 1 emissions would occur in 2021, the peak year. | | | | | | | | | | | | |
| | | | pounds per day | | | | | tons per phse | | | | | MT |
| | | number | VOC | NOX | CO | PM10 | PM2.5 | VOC | NOX | CO | PM10 | PM2.5 | CO2 |
| PA | Phase 3 backhoe/excav | 6 | 0.53 | 5.44 | 6.18 | 0.33 | 0.3 | 0.1 | 1.03 | 1.17 | 0.06 | 0.06 | 143.12 |
| Alt B | Phase 3 backhoe/excav | 4 | 0.35 | 3.63 | 4.12 | 0.22 | 0.20 | 0.07 | 0.69 | 0.78 | 0.04 | 0.04 | 95.41 |
| | backhoe/excavater dif. | | -0.18 | -1.81 | -2.06 | -0.11 | -0.10 | -0.03 | -0.34 | -0.39 | -0.02 | -0.02 | -47.71 |
| PA | Phase 3 - 5 augers | 5 | 0.75 | 9.48 | 5.6 | 0.27 | 0.25 | 0.14 | 1.79 | 1.06 | 0.05 | 0.05 | 425.1 |
| Alt B | Phase 3 - 6 augers | 6 | 0.90 | 11.38 | 6.72 | 0.32 | 0.30 | 0.17 | 2.15 | 1.27 | 0.06 | 0.06 | 510.12 |
| | Auger difference | | 0.15 | 1.90 | 1.12 | 0.05 | 0.05 | 0.03 | 0.36 | 0.21 | 0.01 | 0.01 | 85.02 |
| PA | Phase 3 - 6 cranes | 6 | 2.46 | 29.63 | 20.41 | 1.19 | 1.09 | 0.46 | 5.6 | 3.86 | 0.22 | 0.21 | 629.2 |
| Alt B | Phase 3 - 7 cranes | 7 | 2.87 | 34.57 | 23.81 | 1.39 | 1.27 | 0.54 | 6.53 | 4.50 | 0.26 | 0.25 | 734.07 |
| | Crane difference | | 0.41 | 4.94 | 3.40 | 0.20 | 0.18 | 0.08 | 0.93 | 0.64 | 0.04 | 0.04 | 104.87 |
| PA | Phase 3 - Fugitive Dust | 2 | | | | 1.51 | 0.83 | | | | 0.28 | 0.16 | |
| Alt B | Phase 3 - Fugitive Dust | 0 | | | | 0.00 | 0.00 | | | | 0.00 | 0.00 | |
| | Fugitive Dust Difference | | | | | -1.51 | -0.83 | | | | -0.28 | -0.16 | |
| **Alt B** | **Phase 3 Net Difference** | | **0.38** | **5.02** | **2.46** | **-1.37** | **-0.70** | -0.01 | 0.01 | -0.18 | -0.25 | -0.14 | **37.31** |
| | ***Net Dif. Max. Annual** | | | | | | | **0.00** | **0.01** | **-0.07** | **-0.10** | **-0.05** | |
| | 38.9 percent of Phase 3 emissions would occur in 2021, the peak year. | | | | | | | | | | | | |
| | Total Fugitive Dust Net Difference for Phases 1 and 3 | | | | | -10.54 | -5.81 | | | | -2.08 | -1.15 | |
| | Total PA Emissions in MDAQMD | | 50.8 | 468.8 | 349.3 | 1311.9 | 147.7 | 5.8 | 53.1 | 41.6 | 106.8 | 13.2 | 21,827 |
| | **Total Net Difference** | | **-0.59** | **-6.98** | **-3.52** | **-10.84** | **-6.08** | -0.20 | -2.38 | -1.37 | -2.14 | -1.21 | **-217.09** |
| | **Maximum Annual Net Difference** | | | | | | | **-0.12** | **-1.51** | **-0.82** | **-1.29** | **-0.73** | **0.00** |
| | Alternative B Emissions(lbs/day) | | **50.21** | **461.82** | **345.78** | **1301.06** | **141.62** | | | | | | 21,609.91 |
| | Alternative B Emissions (tons/yr.) | | | | | | | **5.68** | **51.59** | **40.78** | **105.51** | **12.47** | |
| | Alternative B Emissions | | | | | | | | | | | | 21,609.91 |
| | Alternative B Emissions Amortized over life of the 30-year project. | | | | | | | | | | | | 720.33 |
| | Alternative C Emissions adjusted for 300 fewer acres (approximatley 88 percent (2,200 / 2,500) of Proposed Action). | | | | | | | | | | | | 19,207.76 |
| | AlternativeC Emissions Amortized over life of the 30-year project. | | | | | | | | | | | | 640.26 |
| | Alternative B Fugitive Dust | | | | | 1290.52 | 135.82 | | | | 103.43 | 11.31 | |
| | Alternative B PM Exhaust | | | | | 10.54 | 5.81 | | | | 2.08 | 1.15 | |

| | MITIGATED | | pounds per day | | | | | tons per phse | | | | | MT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | number | VOC | NOX | CO | PM10 | PM2.5 | VOC | NOX | CO | PM10 | PM2.5 | CO2e |
| PA | Phase 1 motor grader | 3 | 0.18 | 0.78 | 6.62 | 0.02 | 0.02 | 0.04 | 0.16 | 1.32 | 0 | 0 | 262.08 |
| Alt B | Phase 1 motor grader | 2 | 0.12 | 0.52 | 4.41 | 0.01 | 0.01 | 0.03 | 0.11 | 0.88 | 0.00 | 0.00 | 174.72 |
| | motor grader difference | | -0.06 | -0.26 | -2.21 | -0.01 | -0.01 | -0.01 | -0.05 | -0.44 | 0.00 | 0.00 | -87.36 |
| PA | Phase 1 scraper | 3 | 0.35 | 1.51 | 12.75 | 0.05 | 0.05 | 0.07 | 0.3 | 2.54 | 0.01 | 0.01 | 501.14 |
| Alt B | Phase 1 scraper | 2 | 0.23 | 1.01 | 8.50 | 0.03 | 0.03 | 0.05 | 0.20 | 1.69 | 0.01 | 0.01 | 334.09 |
| | scraper Difference | | -0.12 | -0.50 | -4.25 | -0.02 | -0.02 | -0.02 | -0.10 | -0.85 | 0.00 | 0.00 | -167.05 |
| PA | Phase 1 - Fugitive Dust | 7 | | | | 12.65 | 6.97 | | | | 2.52 | 1.39 | |
| Alt B | Phase 1 - Fugitive Dust | 5 | | | | 9.04 | 4.98 | | | | 1.80 | 0.99 | |
| | Fugitive Dust Difference | | | | | -3.61 | -1.99 | | | | -0.72 | -0.40 | |
| **Alt B** | **Phase 1 Net Difference** | | **-0.18** | **-0.76** | **-6.46** | **-3.64** | **-2.01** | **-0.04** | **-0.15** | **-1.29** | **-0.72** | **-0.40** | **-254.41** |
| | ***Net Dif. Max. Annual** | | | | | | | **-0.02** | **-0.10** | **-0.81** | **-0.46** | **-0.25** | |
| | 63.2 percent of Phase 1 emissions would occur in 2021, the peak year. | | | | | | | | | | | | |
| | | | pounds per day | | | | | tons per phse | | | | | MT |
| | | number | VOC | NOX | CO | PM10 | PM2.5 | VOC | NOX | CO | PM10 | PM2.5 | CO2 |
| PA | Phase 3 backhoe/excav | 6 | 0.11 | 0.46 | 6.52 | 0.01 | 0.01 | 0.02 | 0.09 | 1.23 | 0 | 0 | 143.12 |
| Alt B | Phase 3 backhoe/excav | 4 | 0.07 | 0.31 | 4.35 | 0.01 | 0.01 | 0.01 | 0.06 | 0.82 | 0.00 | 0.00 | 95.41 |
| | backhoe/excavater dif. | | -0.04 | -0.15 | -2.17 | 0.00 | 0.00 | -0.01 | -0.03 | -0.41 | 0.00 | 0.00 | -47.71 |
| PA | Phase 5 augers | 5 | 0.31 | 1.36 | 11.54 | 0.04 | 0.04 | 0.06 | 0.26 | 2.18 | 0.01 | 0.01 | 425.1 |
| Alt B | Phase 6 augers | 6 | 0.37 | 1.63 | 13.85 | 0.05 | 0.05 | 0.07 | 0.31 | 2.62 | 0.01 | 0.01 | 510.12 |
| | Auger difference | | 0.06 | 0.27 | 2.31 | 0.01 | 0.01 | 0.01 | 0.05 | 0.44 | 0.00 | 0.00 | 85.02 |
| PA | Phase 3 - 6 cranes | 6 | 0.46 | 1.99 | 16.88 | 0.06 | 0.06 | 0.09 | 0.38 | 3.19 | 0.01 | 0.01 | 629.2 |
| Alt B | Phase 3 - 7 cranes | 7 | 0.54 | 2.32 | 19.69 | 0.07 | 0.07 | 0.11 | 0.44 | 3.72 | 0.01 | 0.01 | 734.07 |
| | Crane difference | | 0.08 | 0.33 | 2.81 | 0.01 | 0.01 | 0.02 | 0.06 | 0.53 | 0.00 | 0.00 | 104.87 |
| PA | Phase 3 - Fugitive Dust | 2 | | | | 0.60 | 0.33 | | | | 0.11 | 0.06 | |
| Alt B | Phase 3 - Fugitive Dust | 0 | | | | 0.00 | 0.00 | | | | 0.00 | 0.00 | |
| | Fugitive Dust Difference | | | | | -0.60 | -0.33 | | | | -0.11 | -0.06 | |
| **Alt B** | **Phase 3 Net Difference** | | **0.10** | **0.45** | **2.95** | **-0.59** | **-0.32** | **0.02** | **0.09** | **0.56** | **-0.11** | **-0.06** | **37.31** |
| | ***Net Dif. Max. Annual** | | | | | | | **0.01** | **0.03** | **0.22** | **-0.04** | **-0.02** | |
| | 38.9 percent of Phase 3 emissions would occur in 2021, the peak year. | | | | | | | | | | | | |
| | Total Fugitive Dust Net Difference for Phases 1 and 3 | | | | | -4.21 | -2.32 | | | | -0.83 | -0.46 | |
| PA | Total PA Emissions | | 20.3 | 189 | 404.5 | 286.8 | 40.9 | 2.3 | 20.3 | 48.2 | 23.1 | 3.6 | |
| **Alt B** | **Total Net Difference** | | **-0.07** | **-0.31** | **-3.51** | **-4.22** | **-2.33** | -0.02 | -0.07 | -0.73 | -0.83 | -0.46 | -217.09 |
| | **Maximum Annual Net Difference** | | | | | | | **-0.02** | **-0.06** | **-0.60** | **-0.50** | **-0.27** | **0.00** |
| Alt B | Alternative B Emissions | | 20.23 | 188.69 | 400.99 | 282.58 | 38.57 | | | | | | |
| | Alternative B Emissions (tons/yr.) | | | | | | | **2.28** | **20.24** | **47.60** | **22.60** | **3.33** | |
| | Alternative B Fugitive Dust | | | | | 278.36 | 36.25 | | | | 21.77 | 2.87 | |
| | Alternative B PM10 Exhaust | | | | | 4.21 | 2.32 | | | | 0.83 | 0.46 | |

**Total Project Operation Emissions**

| Emissions Source | $CO_2$e metric tons |
|---|---|
| Total Operational Emissions | 171 |
| Amortized Construction over 30 Years | 728 |
| Amortized Decommissioning over 30 Years | 728 |
| Total | 1,627 |
| Carbon Savings | 355,836 |
| Total Net | 354,209 |

**Total Alternative B Operation Emissions**

| Emissions Source | $CO_2$e metric tons |
|---|---|
| Total Operational Emissions | 171 |
| Amortized Construction over 30 Years | 720 |
| Amortized Decommissioning over 30 Years | 720 |
| Total | 1,612 |
| Carbon Savings | 355,836 |
| Total Net | 354,224 |

**Total Alternative C Operation Emissions**

| Emissions Source | $CO_2$e metric tons |
|---|---|
| Total Operational Emissions | 171 |
| Amortized Construction over 30 Years | 640 |
| Amortized Decommissioning over 30 Years | 640 |
| Total | 1,452 |
| Carbon Savings | 355,836 |
| Total Net | 354,384 |

**Maximum Daily Construction Emissions Summary**

| Construction Phase/Source | Maximum Daily Emissions (lbs/day) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | $PM_{10}$ | | | $PM_{2.5}$ | | | | |
| | Exhaust | Dust | Total | Exhaust | Dust | Total | | |
| 2020 | | | | | | | | |
| Phase I | 7.71 | 210.94 | 218.65 | 5.98 | 37.55 | 43.53 | 218.65 | 43.53 |
| | | | | | | | | |
| 2021 | | | | | | | | |
| Phase I | 7.71 | 210.94 | 218.65 | 5.98 | 37.55 | 43.53 | 218.65 | 43.53 |
| Phase II | 13.98 | 241.92 | 255.9 | 11.18 | 27.79 | 38.97 | 255.88 | 38.97 |
| Phase III | 5.34 | 117.73 | 123.07 | 4.54 | 11.81 | 16.35 | 123.08 | 16.35 |
| Maximum Daily | 27.03 | 570.59 | 597.62 | 21.7 | 77.15 | 98.85 | 597.61 | 98.85 |
| | | | | | | | | |
| 2022 | | | | | | | | |
| Phase I | 7.71 | 210.94 | 218.65 | 5.98 | 37.55 | 43.53 | 218.65 | 43.53 |
| Phase II | 13.98 | 241.92 | 255.9 | 11.18 | 27.79 | 38.97 | 255.88 | 38.97 |
| Phase III | 5.34 | 117.73 | 123.07 | 4.54 | 11.81 | 16.35 | 123.08 | 16.35 |
| Maximum Daily | 27.03 | 570.59 | 597.62 | 21.7 | 77.15 | 98.85 | 597.61 | 98.85 |

**Percent of Phase by Year**

| Phase/Year | Total Days | Total Tons PM10 | Percent |
|---|---|---|---|
| Phase I | | | |
| 2020 | 63 | 6.85 | 15.79% |
| 2021 | 252 | 27.39 | 63.15% |
| 2022 | 84 | 9.13 | 21.05% |
| Total | 399 | 43.37 | |
| Phase 2 | | | |
| 2021 | 239 | 30.41 | 59.99% |
| 2022 | 160 | 20.28 | 40.01% |
| Total | 399 | 50.69 | |
| Phase 3 | | | |
| 2021 | 231 | 14.1 | 61.12% |
| 2022 | 147 | 8.97 | 38.88% |
| Total | 378 | 23.07 | |

**Total Particulate Matter Emissions Summary**

| Construction Phase/Source | Total Emissions (tons/phase) | | | | | |
|---|---|---|---|---|---|---|
| | $PM_{10}$ | | | $PM_{2.5}$ | | |
| | Exhaust | Dust | Total | Exhaust | Dust | Total |
| Phase I | 1.28 | 42.08 | 43.36 | 1.07 | 7.49 | 8.56 |
| Phase II | 2.43 | 48.26 | 50.69 | 2.06 | 5.54 | 7.6 |
| Phase III | 0.82 | 22.25 | 23.07 | 0.7 | 2.23 | 2.93 |

Source AECOM, 2019

**Maximum Annual Construction PM Emissions Summary for Fugitive Dust and Exhaust by Year**

| | | Maximum Annual Emissions (tons/year) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | $PM_{10}$ | | | $PM_{2.5}$ | | | | |
| Construction Phase/Source | Percent per Phase per year | Exhaust | Dust | Total | Exhaust | Dust | Total | | |
| 2020 | | | | | | | | | |
| Phase I | 16% | 0.20 | 6.65 | 6.85 | 0.17 | 1.18 | 1.35 | 6.85 | 1.35 |
| | | | | | | | | | |
| 2021 | | | | | | | | | |
| Phase I | 63% | 0.81 | 26.58 | 27.38 | 0.68 | 4.73 | 5.41 | 27.39 | 5.41 |
| Phase II | 60% | 1.46 | 28.95 | 30.41 | 1.24 | 3.32 | 4.56 | 30.41 | 4.56 |
| Phase III | 61% | 0.50 | 13.60 | 14.10 | 0.43 | 1.36 | 1.79 | 14.1 | 1.79 |
| Maximum Annual | | 2.77 | 69.13 | 71.89 | 2.34 | 9.42 | 11.76 | 71.9 | 11.76 |
| | | | | | | | | | |
| 2022 | | | | | | | | | |
| Phase I | 21% | 0.27 | 8.86 | 9.13 | 0.23 | 1.58 | 1.80 | 9.13 | 1.8 |
| Phase II | 40% | 0.97 | 19.31 | 20.28 | 0.82 | 2.22 | 3.04 | 20.28 | 3.04 |
| Phase III | 39% | 0.32 | 8.65 | 8.97 | 0.27 | 0.87 | 1.14 | 8.97 | 1.14 |
| Maximum Annual | | 1.56 | 36.82 | 38.38 | 1.32 | 4.66 | 5.98 | 38.38 | 5.98 |

**Mitigated Maximum Daily Construction PM Emissions Summary for Fugitive Dust and Exhaust by Year**

| | Maximum Daily Emissions (lbs/day) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | $PM_{10}$ | | | $PM_{2.5}$ | | | | |
| Construction Phase/Source | Exhaust | Dust | Total | Exhaust | Dust | Total | | |
| 2020 | | | | | | | | |
| Phase I | 2.87 | 42.46 | 45.33 | 1.46 | 9.66 | 11.12 | 45.33 | 11.12 |
| | | | | | | | | |
| 2021 | | | | | | | | |
| Phase I | 2.87 | 42.46 | 45.33 | 1.46 | 9.66 | 11.12 | 45.33 | 11.12 |
| Phase II | 5.59 | 43.16 | 48.75 | 3.47 | 4.48 | 7.95 | 48.75 | 7.95 |
| Phase III | 1.07 | 22.01 | 23.08 | 0.62 | 2.19 | 2.81 | 23.08 | 2.81 |
| Maximum Daily | 9.53 | 107.63 | 117.16 | 5.55 | 16.33 | 21.88 | 117.16 | 21.89 |
| | | | | | | | | |
| 2022 | | | | | | | | |
| Phase I | 2.87 | 42.46 | 45.33 | 1.46 | 9.66 | 11.12 | 45.33 | 11.12 |
| Phase II | 5.59 | 43.16 | 48.75 | 3.47 | 4.48 | 7.95 | 48.75 | 7.95 |
| Phase III | 1.07 | 22.01 | 23.08 | 0.62 | 2.19 | 2.81 | 23.08 | 2.81 |
| Maximum Daily | 9.53 | 107.63 | 117.16 | 5.55 | 16.33 | 21.88 | 117.16 | 21.89 |

**Total Mitigated Particulate Matter Emissions Summary**

| | Total Emissions (tons/phase) | | | | | |
|---|---|---|---|---|---|---|
| | $PM_{10}$ | | | $PM_{2.5}$ | | |
| Construction Phase/Source | Exhaust | Dust | Total | Exhaust | Dust | Total |
| Phase I | 0.31 | 8.47 | 8.78 | 0.17 | 1.93 | 2.10 |
| Phase II | 0.76 | 8.61 | 9.37 | 0.52 | 0.89 | 1.41 |
| Phase III | 0.16 | 4.16 | 4.32 | 0.09 | 0.41 | 0.50 |

Source AECOM, 2019

**Mitigated Maximum Annual Construction PM Emissions Summary for Fugitive Dust and Exhaust by Year**

| | | Maximum Annual Emissions (tons/year) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Percent | $PM_{10}$ | | | $PM_{2.5}$ | | | | |
| Construction Phase/Source | per Phase per year | Exhaust | Dust | Total | Exhaust | Dust | Total | | |
| 2020 | | | | | | | | | |
| Phase I | 16% | 0.05 | 1.34 | 1.39 | 0.03 | 0.30 | 0.33 | 1.39 | 0.33 |
| | | | | | | | | | |
| 2021 | | | | | | | | | |
| Phase I | 63% | 0.20 | 5.35 | 5.54 | 0.11 | 1.22 | 1.33 | 5.55 | 1.32 |
| Phase II | 60% | 0.46 | 5.17 | 5.62 | 0.31 | 0.53 | 0.85 | 5.62 | 0.85 |
| Phase III | 61% | 0.10 | 2.54 | 2.64 | 0.06 | 0.25 | 0.31 | 2.64 | 0.31 |
| Maximum Annual | | 0.75 | 13.06 | 13.81 | 0.47 | 2.00 | 2.48 | 13.81 | 2.48 |
| | | | | | | | | | |
| 2022 | | | | | | | | | |
| Phase I | 21% | 0.07 | 1.78 | 1.85 | 0.04 | 0.41 | 0.44 | 1.85 | 0.44 |
| Phase II | 40% | 0.30 | 3.44 | 3.75 | 0.21 | 0.36 | 0.56 | 3.75 | 0.57 |
| Phase III | 39% | 0.06 | 1.62 | 1.68 | 0.03 | 0.16 | 0.19 | 1.68 | 0.2 |
| Maximum Annual | | 0.43 | 6.85 | 7.28 | 0.28 | 0.92 | 1.20 | 7.28 | 1.21 |

## Option A - Traditional Design Construction

## GHG Emissions

### On-road Vehicle Trip Emissions - Within Mojave Desert AQMD jurisdiction

| | workdays/ phase | trips/day | miles/one-way trip[1] | Average daily mileage | No. of days/phase | mileage/ phase | Emissions Factors (gms/mile)[2] | | | Emissions (tons/phase) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2$ | $CH_4$ | $N_2O$ |
| *Phase 1* | *19 months* | | | | | | | | | | | |
| Module delivery | 399 | 10 | 228 | 4,560 | 81 | 369,360 | 1,489.47 | 0.01 | 0.00 | 606.44 | 0.00 | 0.00 |
| Foundation delivery | 399 | 10 | 228 | 4,560 | 98 | 446,880 | 1,489.47 | 0.01 | 0.00 | 733.72 | 0.00 | 0.00 |
| Water Delivery Trips | 339 | 96 | 13 | 2,492 | 102 | 254,176 | 1,489.47 | 0.01 | 0.00 | 417.32 | 0.00 | 0.00 |
| Other on-road trips (workers) | --- | | | | | | --- | | | 1,145.78 | 0.11 | 0.14 |
| Total on-road for Phase 1 | --- | | | | | | --- | | | 2,903.26 | 0.12 | 0.15 |
| *Phase 2* | *19 months* | | | | | | | | | | | |
| Module delivery | 399 | 10 | 228 | 4,560 | 81 | 369,360 | 1,489.47 | 0.01 | 0.00 | 606.44 | 0.00 | 0.00 |
| Tracker delivery | 399 | 9 | 228 | 4,104 | 207 | 849,528 | 1,489.47 | 0.01 | 0.00 | 1,394.81 | 0.00 | 0.00 |
| Foundation delivery | 399 | 10 | 228 | 4,560 | 98 | 446,880 | 1,489.47 | 0.01 | 0.00 | 733.72 | 0.00 | 0.00 |
| Inverter delivery | 399 | 2 | 228 | 912 | 36 | 32,832 | 1,489.47 | 0.01 | 0.00 | 53.91 | 0.00 | 0.00 |
| Water Delivery Trips | 339 | 192 | 13 | 4,984 | 102 | 508,326 | 1,489.47 | 0.01 | 0.00 | 834.60 | 0.00 | 0.00 |
| Other on-road trips (workers) | --- | | | | | | --- | | | 1,464.81 | 0.14 | 0.18 |
| Total on-road for Phase 2 | --- | | | | | | --- | | | 5,088.28 | 0.15 | 0.19 |
| *Phase 3* | *18 months* | | | | | | | | | | | |
| Inverter delivery | 378 | 2 | 228 | 912 | 36 | 32,832 | 1,489.47 | 0.01 | 0.00 | 53.91 | 0.00 | 0.00 |
| Water Delivery Trips | 339 | 32 | 13 | 831 | 102 | 84,734 | 1,489.47 | 0.01 | 0.00 | 139.12 | 0.00 | 0.00 |
| Other on-road trips (workers and concrete) | --- | | | | | | --- | | | 729.90 | 0.06 | 0.70 |
| Total on-road for Phase 3 | --- | | | | | | --- | | | 922.93 | 0.06 | 0.70 |

1. Estimated one-way travel distance for trucks from Port of Los Angeles to the project site for module, tracker, foundation, and inverter deliveries. Water deliveries are assumed to be from Blythe, assuming the following round trip amounts: Phase 1 – 9,776 trips; Phase 2 – 19,551 trips; and Phase 3 – 3,259 trips.
2. Exhaust emission factors for obtained from Riverside County 2020 Onroad emission factors for diesel T7 tractor (aggregated model years and speeds) from AECOM appendix.
*Shaded numbers were obtained from the AECOM GHG Report.

# TOTAL CONSTRUCTION EMISSIONS

| | Emissions (tons/phase) | | | MT/phase |
|---|---|---|---|---|
| | $CO_2$ | $CH_4$ | $N_2O$ | $CO_2e$ |
| Phase 1 - onroad emissions with trip length adjustment | 2,903.3 | 0.1 | 0.1 | 2,671.8 |
| Phase 1 - offroad emissions | 3,586.6 | 1.0 | 0.5 | 3,390.3 |
| Total revised Phase 1 emissions | 6,489.9 | 1.1 | 0.6 | 6,062.0 |
| | | | | |
| Phase 2 - onroad emissions with trip length adjustment | 5,088.3 | 0.2 | 0.2 | 4,666.0 |
| Phase 2 - offroad emissions | 6,674.7 | 2.1 | 0.9 | 6,331.7 |
| Total revised Phase 2 emissions | 11,763.0 | 2.2 | 1.1 | 10,997.7 |
| | | | | |
| Phase 3 - onroad emissions with trip length adjustment | 922.9 | 0.1 | 0.7 | 1,007.2 |
| Phase 3 - offroad emissions | 2,736.0 | 0.9 | 0.4 | 2,597.7 |
| Total revised Phase 3 emissions | 3,658.9 | 0.9 | 1.1 | 3,604.9 |
| Total Emissions | 21,911.8 | 4.3 | 2.8 | 20,664.7 |

Offroad CO2e emissions vary slightly from emissions estimated by AECOM; emissions estimated here are based on the following global warming potential (GWP) factors: 28 for CH4, and 265 for N2O.

**Total Project Construction Emissions**

| Emissions Source | $CO_2e$ metric tons |
|---|---|
| Construction Equipment and Vehicles | 20,665 |
| Water Use Indirect Emissions* | 1,163 |
| Total | 21,827 |
| Amortized over 30 Years | 728 |
| Amortized construction and decommissioning | 1,455 |

* see AECOM 2019.

| | |
|---|---|
| Operational Emission* | 171 |
| Amortized construction and decommissioning | 1,455 |
| Total | 1,626 |

* see AECOM 2019.