Plumas County

Mitigated Negative Declaration Number 678

For

Public Utility Facility

(Solar Electric Generation Facility)

Plumas County, CA

Filed: December 30, 2020

Review Period:

From: December 30, 2020 through January 28, 2021

APPROVED/CERTIFIED:

MITIGATED NEGATIVE DECLARATION

It is found, based on this Initial Study, that this project as mitigated would not have a significant impact on the environment.

An attached copy of the Initial Study documents reasons supporting the finding.

Determination by: Timothy E. Evans

Title: Associate Planner

Date: December 30, 2020

Written by: Timothy E. Evans

Title: Associate Planner

Date: December 30, 2020

Initial Study

1. **Project Title:** Plumas-Sierra Rural Electric Cooperative Special Use Permit U 12-19/20- 03 and Site Development Permit SDP 1-19/20-01

2. **Date of Initial Study Preparation:** June 2020

3. **Lead Agency Name and Address:** Plumas County Planning and Building Services
   555 Main Street
   Quincy, CA 95971

4. **Prepared By:** Timothy Evans, Associate Planner
   (530) 283-6207
   TimEvans@countyofplumas.com

5. **Project Location:** Assessor's Parcel Number 010-200-009-000; 92754 Highway 70, Vinton; unincorporated Plumas County; T23N/R16E/Section 34 & 35, MDM; Latitude: 39.798770, Longitude: -120.164000

6. **Project Sponsor:** Plumas-Sierra Rural Electric Cooperative

7. **General Plan Designation:** Industrial, Suburban Residential, and Scenic Road

8. **Zoning:** I-2 (Light Industrial), S-1 (Suburban), F (Farm Animal Combining), and SP-ScR (Special Plan Scenic Road)

9. **Project Description:** The project being proposed by Plumas-Sierra Rural Electric Cooperative for the property located at 92754 Highway 70, Vinton, which is privately owned by Mary Duncan, is a solar electric generation facility. The property is zoned I-2 (Light Industrial), S-1 (Suburban), F (Farm Animal Combining), and SP-ScR (Special Plan Scenic Road).

   Under Plumas County Code (PCC), a solar electric generation facility is considered a "public utility facility." A "public utility facility" is defined as the following by Plumas County Code Section 9-2.277 – *Public utility facility*:

   > "Public utility facility" shall mean an improvement use necessary for the provision, distribution, or conveyance to the public of utilities or a facility for the maintenance of such facilities.

   Due to the site being zoned S-1, which permits residential uses, a "public utility facility" is a use permitted subject to a special use permit (PCC 9-2.1502(b)(1)). Additionally, due to a portion of the property being zoned I-2, a site development review (site development permit) is required.

   The parcel in which the project is located is approximately 37.01 acres. The proposed project would encompass 26.8 acres of the 37.01 acre parcel. The proposed solar electric generation

facility would produce 4.625 MW_{AC} (megawatts – alternating current) and 5.694 MW_{DC} (megawatts – direct current) of power. The expected yearly power output of the facility is 12,425 MWh (megawatt-hour).

10. **Surrounding Land Uses and Setting:** The land uses surrounding the property include Agricultural Preserve (AP) and Recreation Open Space (Rec-OS) to the north, Suburban (S-1) to the west, Light Industrial (I-2) to the east, and AP to the south. The property is also bordered by State Highway 70 to the north, Union Pacific Railroad to the south, a mobile home park to the west, and a power substation and biodiesel manufacturer to the east.

11. **Relationship to Other Projects:** None

12. **Other public agencies whose approval is required**: None

13. **Have California Native American tribes traditionally and culturally affiliated with the project area requested consultation pursuant to Public Resources Code section 21080.3.1? If so, is there a plan for consultation that includes, for example, the determination of significance of impacts to tribal cultural resources, procedures regarding confidentiality, etc.?** California Native American tribes traditionally and culturally affiliated with the project area have not requested consultation pursuant to Public Resources Code section 21080.3.1.

Environmental Factors Potentially Affected: The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a "Potentially Significant Impact" and subject to mitigation as indicated by the checklist on the following pages.

☐ **Aesthetics**	☐ **Agriculture and Forestry Resources**	☐ **Air Quality**
☐ **Biological Resources**	☐ **Cultural Resources**	☐ **Energy**
☐ **Geology/Soils**	☐ **Greenhouse Gas Emissions**	☐ **Hazards and Hazardous Materials**
☐ **Hydrology/Water Quality**	☐ **Land Use/Planning**	☐ **Mineral Resources**
☐ **Noise**	☐ **Population/Housing**	☐ **Public Services**
☐ **Recreation**	☐ **Transportation**	☐ **Tribal Cultural Resources**
☐ **Utilities/Service Systems**	☐ **Wildfire**	☐ **Mandatory Findings of Significance**

DETERMINATION:

On the basis of this initial evaluation:

☒ I find that, based on the initial study and the county and state regulations that govern the project approval, there will not be a significant effect on the environment. Mitigation measures required to avoid the potentially significant impacts on the environment are included in the Initial Study. Therefore, a **MITIGATED NEGATIVE DECLARATION** will be prepared.

Timothy Evans

Timothy Evans
Associate Planner
December 30, 2020

SUMMARY OF MITIGATION MEASURES

Noise Impact 13A

To minimize the disturbance to the adjacent residential dwellings due to construction noise impacts from the proposed project, the following mitigation measure shall be required:

Mitigation Measure 13A: Project construction shall only occur between the hours of 7 a.m. and 7 p.m., Monday through Friday and 8 a.m. and 5 p.m. on weekends or on federally recognized holidays.

Plan Requirements: The mitigation measure shall be incorporated into the conditions of the Special Use Permit and Site Development Permit.

Timing: The mitigation measure shall be implemented during site preparation and project construction.

Monitoring: The Plumas County Planning and Building Services shall monitor adherence to the mitigation measure.

INITIAL STUDY AND CHECKLIST

Purpose of Initial Study:

An initial study, after a project is determined not exempt from the California Environmental Quality Act (CEQA), is to be prepared and completed according to CEQA Guidelines Section 15063 to determine if the project will have a significant effect on the environment. All phases of project planning, implementation, and operation will be considered within this Initial Study. The information, analysis, and conclusions contained in this Initial Study will be utilized to determine whether to prepare an Environmental Impact Report (EIR), Mitigated Negative Declaration, or Negative Declaration. If the Initial Study reveals that an EIR should be prepared, the information contained in the Initial Study will be used to focus the EIR on the effects determined to be potentially significant.

1. AESTHETICS.

Environmental Setting: Plumas County is located within the Sierra Nevada Mountain Range. The County consists of a variety of aesthetic characteristics; rural, natural, and historic characteristics are predominant throughout the County. The rural, natural, and historic character is due to the County's many valleys, ridgelines, varying types of vegetation, watercourses, travel routes, and historic residential neighborhoods. Scenic resources within the County include mountains, hills, geologic features and formations, rivers, streams, and natural vegetation. Historic and cultural resources also contribute to the aesthetics of the County. Historical and cultural resources are sites, structures, features, objects, and properties being of nationwide, statewide, or local significance and having architectural, engineering, scientific, economic, agricultural, educational, social, political, military, cultural, or other values. Examples of historical and cultural resources are ranch home sites, barns, historic residential neighborhoods, ceremonial and/or sacred sites, quarries, mills, and cemeteries.

The aesthetic character of the county is most often viewed from the County's roads and highways. There aren't any officially designated state or county scenic highways within Plumas County. However, the Plumas County General Plan does designate scenic roads and applies design standards to those county designated scenic roads.

State Highway 70 is designated as a Scenic Road in the Plumas County 2035 General Plan. The Scenic Road policy applies standards for development, which includes maintaining the natural vegetation within the scenic corridors.

Scenic areas throughout the County play a major role in the rural, natural character of the County. The Plumas County 2035 General Plan specifically identifies scenic areas. The scenic areas identified by the General Plan are designed to maintain the natural, rural characteristics, preserve historic lifestyles, and attract tourists. In addition, the Plumas County 2035 General Plan also sets forth requirements to protect and preserve cultural and historic resources.

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporation	Less Than Significant Impact	No Impact
Would the project:				
a) Have a substantial adverse effect on a scenic vista?	☐	☐	☐	☒
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	☐	☐	☐	☒
c) In non-urbanized areas, substantially degrade the existing visual character or quality of public views of the site and its surroundings? (Public views are those that are experienced from publicly accessible vantage point.) If the project is in an urbanized area, would the project conflict with applicable zoning and other regulations governing scenic quality?	☐	☐	☒	☐
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?	☐	☐	☒	☐

Impact Discussion: The proposed project site at 92754 Highway 70, Vinton, is located within the Sierra Valley. The Sierra Valley is comprised of a large valley surrounded by mountains providing for scenic vistas throughout the entire valley. There are scenic vistas at the project site. However, solar panels in general, and the proposed solar panels, would be mounted at heights so as to not obstruct the scenic vista. It is anticipated there would be no impact to the scenic vista.

Plumas County does not contain any designated state scenic highways, however, Plumas County does have scenic roads with design standards designated in the General Plan. The purpose of the design standards are to maintain and preserve the rural character, representative qualities of historic lifestyles, qualities that attract tourists, and to provide standards for scenic highways.

The scenic corridor for Highway 70 is 100-feet in width from the edge of the highway easement. The design standards for the portion of Highway 70 in the Sierra Valley are as follows:

1. No off-premise advertising signs.

2. Signs, on-premise only, shall not exceed 6 square feet maximum for residential uses, and 100 square feet maximum area for commercial uses. Signs will not exceed the height of any on-site building roof line. No pennants or flashing lights shall be permitted.

3. Locate transmission and utility lines where they may be concealed by vegetation or topographical features.

4. Establish building exclusion areas within 50 feet from perennial streams or irrigation ditches, measured from the top of the bank.

5. Maintain natural topographical features within public road rights-of-way where it is not a clear and present danger to public health, safety, and welfare.

6. Maintain natural vegetation within scenic corridor areas.

Additionally, within the Conservation and Open Space element of the Plumas County 2035 General Plan is policy COS 7.6.3, *Scenic Roadway Protection*, which states:

> The County shall protect the scenic quality of roadways for the enjoyment of natural and scenic resources, landmarks, or points of historic and cultural interest. The Scenic Road standards applied to the development of the property and will apply to any future development.

The proposed project conforms to the requirements set forth by the County's Scenic Road requirements and Plumas County 2035 General Plan Policy COS 7.6.3. The proposed project would not substantially damage any scenic resources and would have no impact on a state scenic highway.

Plumas County's airspace contains a number of Military Training Routes (MTR), which are defined by the Plumas County 2035 General Plan as "airspace of defined dimensions established for the conduct of military aircraft training flights." Due to the MTRs, Plumas County's 2035 General Plan contains a variety of policies related to MTRs. One of those policies is policy LU 1.4.1, *Working with the Military*, which states the following:

> Ensure early notification to the military of proposed discretionary development projects within Military Operations Areas (MOAs) and Military Training Routes (MTRs) and facilitate the exchange of project-related information pertinent to military operations within those areas.

Due to policy LU 1.1.4, the Department of Defense (DoD) was contacted and provided information regarding the proposed project for review during the project's initial 30-day review period. During the review period, the Department of Defense provided comment stating that they concluded the project would have a "negligible impact to military operations and not cause an adverse impact to the DoD mission." (Exhibit 1)

In addition to the comment received from the DoD, research was conducted in regards to guides and studies addressing the glare from ground-mounted solar photovoltaic systems. In the guide *Clean Energy Results: Questions and Answers Ground-Mounted Solar Photovoltaic Systems*

(Exhibit 2), published June 2015 by the Massachusetts Department of Energy Resources, the following is stated in regards to glare:

> "Solar panels are designed to reflect only about [two] percent of incoming light, so issues with glare from PV [photovoltaic] panels are rare."
>
> "Solar panels are designed to absorb solar energy and convert it into electricity. Most are designed with anti-reflective glass front surfaces to capture and retain as much of the solar spectrum as possible. Solar module glass has less reflectivity than water or window glass. Typical panels are designed to reflect only about [two] percent of incoming sunlight. Reflected light from solar panels will have significantly lower intensity than glare from direct sunlight."

Furthermore, the study *General Design Procedures for Airport-Based Solar Photovoltaic Systems* (Exhibit 3) by Anurag Anurag, et al., Department of Electrical and Computer Engineering, Michigan Technological University, stated that "reflection from a PV front glass surface without any antireflecting (AR) coating is less intense than that of water."

Lastly, the study *A Study of the Hazardous Glare Potential to Aviators from utility-Scale Flat-Plate Photovoltaic Systems* (Exhibit 4) concluded "the potential for glare from plat plate PV systems is comparable to that of smooth water and not expected to be a hazard to air navigation."

Although there is a potential for glare to result from the project, based on the comments from the Department of Defense and the studies on ground-mounted solar photovoltaic systems, the impact from glare would be less than significant.

It is anticipated that the project would not have a significant impact on Scenic Resources. Therefore, the project would result in a **less than significant** impact to **Aesthetic Resources**.

Mitigation Measures: No mitigation is required.

2. AGRICULTURE/FOREST RESOURCES.

Environmental Setting: Agriculture and forest resource lands comprise a major portion of Plumas County. The total acreage dedicated to agriculture and forest lands are approximately 159,200 acres and 1.4 million acres, respectively. Agriculture has been and is a significant part of the economy in Plumas County. Livestock-raising, hay production, and pasture uses comprise a majority of the agricultural land uses, with the remaining land being used for nurseries, apiary, seed, fruit, potatoes, and grains. Of the approximate 159,200 acres used for agriculture, approximately 109,658 acres are under Williamson Act contracts and Important Agriculture Areas. Agricultural areas throughout the state, and those in Plumas County, may be studied by the California Department of Conservation to determine the land classification under the Farmland Mapping and Monitoring Program. Currently, Plumas County is not mapped under the Farmland Mapping and Monitoring program, with the exception of the Sierra Valley.

Agricultural lands are the second largest land use in the county, with forest resources being the first. The 1.4 million acres of forest lands in the county are comprised of private, State, and federal lands. Of those 1.4 million acres of forest land, approximately 1.0 million acres are National Forest System lands. Timber production is the primary forest product generated on

private and public lands. Public lands include the National Forests, such as Plumas, Lassen, Toiyabe, and Tahoe.

The project site located at 92754 Highway 70, Vinton, is located on the eastern side of the Sierra Valley. The Sierra Valley is mapped under the Farmland Mapping and Monitoring Program per the 2018 mapping available from the California Resources Agency. The property in which the proposed project will be located is defined as "Grazing Land" and is not "Prime Farmland," "Unique Farmland," or "Farmland of Statewide Importance." Although the property is defined as "Grazing Land," the property is not being used for grazing. However, the property on the opposite side of Highway 70 to the north of the project site is part of a cattle ranch and has been used in the recent past for cattle grazing and may still be in use for grazing. Additionally, on the opposite side of the railroad to the south of the project site are parcels that are part of multiple ranches which may be in use for livestock grazing.

	Potentially Significant Impact	**Less Than Significant with Mitigation Incorporation**	**Less Than Significant Impact**	**No Impact**
In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Dept. of Conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state's inventory of forest land, including the Forest and Range Assessment Project and Forest Legacy Assessment project; and forest carbon measurement methodology provided in Forest Protocols adopted by the California Air Resources Board. Would the project:				

a)	Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	☐	☐	☐	☒
b)	Conflict with existing zoning for agricultural use, or a Williamson Act Contract?	☐	☐	☐	☒
c)	Conflict with existing zoning for , or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?	☐	☐	☐	☒
d)	Result in the loss of forest land or conversion of forest land to non-forest use?	☐	☐	☐	☒
e)	Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use?	☐	☐	☐	☒

Impact Discussion: The project site located at 92754 Highway 70, Vinton, is located on the eastern side of the Sierra Valley. As mentioned earlier, the Sierra Valley is mapped under the Farmland Mapping and Monitoring Program. However, per the 2018 mapping available from the California Resources Agency, the property is defined as "Grazing Land" and is not "Prime Farmland," "Unique Farmland," or "Farmland of Statewide Importance." Although the property for the proposed project is defined as "Grazing Land," the property is not used for livestock grazing. Nearby properties are/may be in use for livestock grazing, but due to their location would not be impacted by the proposed project. Therefore, the project would not involve changes in the existing environment which, due to their location or nature, could result in the conversion of Farmland to non-agricultural use.

The property is not a Williamson Act property and is not eligible for the Williamson Act due to the primary zones of the property being S-1 (Suburban Residential) and I-2 (Light Industrial).

The project would not conflict with existing zoning for agricultural use or a Williamson Act contract.

The project would not conflict with existing zoning for, or cause rezoning of, forest land as defined by Public Resources Code 12220(g).

Tree removal for construction would undergo the regulatory processes of the California Department of Forestry and Fire Protection (CAL FIRE) due to state laws governing tree removal being under the jurisdiction of CAL FIRE. However, the property does not contain any forest land. Therefore, the project would not result in the loss of forest land or conversion of forest land to non-forest use.

The project site does not contain any Farmland. Therefore, the project would not involve changes in the existing environment which, due to their location or nature, could result in the conversion of forest land to non-forest use.

Therefore, the project would result in **no impact** to **Agriculture and Forest Resources**.

Mitigation Measures: No mitigation is required.

3. AIR QUALITY.

Environmental Setting: Plumas County's topography greatly influences its climate, which results in disproportionate levels of precipitation throughout the County. More commonly known as the rain shadow effect, this condition is created by the Sierra Nevada Crest which acts as a barrier to storm systems between the western and eastern portions of the County. Consequently, while the western side of the Sierra Nevada Range receives over 90 inches of rain annually, areas east of the Sierra Crest receive only 11 inches, with the majority occurring from October to April. Throughout the year, average temperatures, as measured at Portola, can range over 80 degrees Fahrenheit (^{o}F) during the summer months to 18 ^{o}F during the winter months.

Plumas County is located within the Mountain Counties Air Basin, which is a relatively large air basin located entirely within the Sierra Nevada Mountains. The Northern Sierra Air Quality Management District (NSAQMD) regulates air quality conditions within the Mountain Counties Air Basin. Plumas County is in attainment or unclassified for all federal Ambient Air Quality Standards (AAQS). However, the U.S. Environmental Protection Agency (EPA) is considering designating the Portola Valley as being in non-attainment for $PM_{2.5}$, which consists of dust/particulate matter 2.5 microns in diameter or smaller, based on federal standards.

Plumas County is currently designated as non-attainment for $PM_{2.5}$ and PM_{10} based on state standards administered by the California Air Resources Board (CARB). Recorded trends are likely to continue because the primary causes of PM_{10}, such as road dust and wildfires, are not expected to decrease. These designations are based on annually collected data from three air quality monitoring stations located in the County. The County's largest sources of particulate matter are unpaved road dust, prescribed burning and residential fuel. Primary activities contributing to these pollutant emissions include wildfires, use of woodstoves, forestry management burns, residential open burning, vehicle traffic, and windblown dust. The varying topography of the air basin also contributes to localized air quality issues within the valley areas.

The NSAQMD has adopted various rules to control air pollution. Among the rules that would apply to the project, two of the rules are Rule 226: Dust Control and Rule 205: Nuisance. Rule 226 is meant to reduce and control fugitive dust emissions to the atmosphere due to the operation of machines and equipment. Rule 205 is meant to prohibit the discharge of air contaminants from any source to any considerable amount of the public or which cause injury or damage to business or property.

Sensitive receptors are locations where individuals are more sensitive to the adverse effects of pollutants. The sensitivity to air pollution can be caused by health problems, prolonged exposure to air pollutants, or an increased susceptibility due to factors such as age. Sensitive receptors are considered residences, day care providers, hospitals, schools, elderly housing, and convalescent facilities.

	Potentially Significant Impact	**Less Than Significant with Mitigation Incorporation**	**Less Than Significant Impact**	**No Impact**
Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations. Would the project:				
a) Conflict with or obstruct implementation of the applicable air quality plan?	☐	☐	☐	☒
b) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard?	☐	☐	☐	☒
c) Expose sensitive receptors to substantial pollutant concentrations?	☐	☐	☐	☒
d) Result in other emissions (such as those leading to odors) adversely affecting a substantial number of people?	☐	☐	☐	☒

Impact Discussion: The project would not obstruct or conflict with the implementation of any known applicable air quality plan. The only means by which the project would impact air quality is through indirect emissions as the solar electric generation facility would not emit greenhouse gases. Emissions would be indirectly affected from a minimal, temporary increase in vehicle

traffic during facility construction and maintenance. As discussed in the Greenhouse Gas Emissions section, the project would result in a less than significant impact to greenhouse gas emissions.

The dry, windy climate throughout the County during the summer months creates a potential generation of dust when soil is disturbed. Dust caused by soil disturbance during construction would potentially contribute to the levels of $PM_{2.5}$ for which Plumas County is non-attainment, based on state standards administered by the California Air Resources Board (CARB) and federal standards administered by the Environmental Protection Agency (EPA), potentially conflicting with an air quality plan.

In response to being designated non-attainment for $PM_{2.5}$, the *Portola Fine Particulate Matter ($PM_{2.5}$) Attainment Plan* (Plan) was developed by the Northern Sierra Air Quality Management District (NSAQMD). The Plan considers fugitive dust insignificant and does not establish a budget for that pollutant. Emissions due to construction would be temporary and minimal, and long-term impacts caused by vehicles used during occasional facility maintenance would also be minimal. In addition, the NSAQMD requires compliance for all public and private construction with Rule 226: *Dust Control* to minimize and control fugitive dust. The NSAQMD also requires a dust control plan for any project disturbing more than one (1) acre of natural surface area.

Plumas County is also designated non-attainment for PM_{10} by the CARB. However, the NSAQMD has not adopted an attainment plan for PM_{10}.

The operation and construction of the solar electric generation facility would not violate any air quality standard or contribute substantially to air quality violations.

Due to the construction of the facility being temporary, it is not expected to the result in a cumulatively considerable increase of any criteria pollutants. In addition, the rules adopted by the Northern Sierra Air Quality Management District would be in effect, such as Rule 226: *Dust Control*.

Pollutant concentrations would minimally and temporarily increase during the construction and occasional maintenance of the facility. The facility would not expose sensitive receptors to substantial pollutant concentrations.

Due to the nature of the solar electric generation facility, objectionable odors would not be emitted.

Therefore, the project would result in **no impact** to **Air Quality**.

Mitigation Measure: No mitigation is required.

4. BIOLOGICAL RESOURCES.

Environmental Setting: Plumas County encompasses a range of habitat types, many of which influence the water quality and quantity of the Feather River Watershed. These habitats, or vegetation communities, provide food, shelter, movement corridors, and breeding opportunities for a variety of wildlife species, many unique to the Feather River Watershed and the larger Sierra Mountain region. Conifer, including Mixed Conifer, habitat types comprise approximately 72% of

land coverage in the County and are habitats commonly found at higher elevations. Plants characteristic of this habitat include a variety of pines and firs. The common pines and firs begin to disappear as distance is increased from the higher elevation Sierra region. The greater distances from the higher elevation Sierra region gives rise to sagebrush, annual grasslands, and the freshwater emergent wetland habitat types more common at lower elevations.

Plumas County and the larger Feather River Watershed area contain aquatic habitats such as small alpine streams, natural ponds, lakes, reservoirs, and rivers. Two types of fisheries found within the County are cold water river/stream species and warm water lake/reservoir species.

Special-status species are plants or animals that are legally protected under the State and/or federal Endangered Species Acts (ESAs) or other regulations, and species that are considered by the scientific community to be sufficiently rare to qualify for such listing. The California Department of Fish and Game has documented habitat for over 90 different species of special concern in the County. These include several amphibians, such as the red-legged frog, bald eagles, osprey, several mammals, and plant/wildlife species associated with the wetland habitats.

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporation	Less Than Significant Impact	No Impact
Would the project:				
a) 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 the California Department of Fish and Game or U.S. Fish and Wildlife Service?	☐	☐	☐	☒
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, and regulations or by the California Department of Fish and Game or US Fish and Wildlife Service?	☐	☐	☐	☒
c) Have a substantial adverse effect on state or federally protected wetlands (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☐	☐	☐	☒
d) 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?				
e)	Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☒	☐	☐	☒
f)	Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?	☐	☐	☐	☒

Impact Discussion: The project is located on a parcel which is bordered by a railroad to the south, Highway 70 to the north, a mobile home park to the west, and an industrial building and electrical power substation to the east. Therefore, the surrounding project area has been developed for many years.

Furthermore, the Mitigated Negative Declaration and Initial Study (State Clearinghouse #2019079014) prepared for the project by K.S. Dunbar and Associates, Inc., which was submitted by the project applicant with the Special Use Permit and Site Development Permit application, made the point that the property surrounding the project, as well as the parcel for the proposed project, all have been subject to forms of disturbance over the years, such as cattle grazing, which has likely changed the vegetation that existed at one time providing habitats for various species.

The project would not have a substantial adverse impact, directly or indirectly, on any species, habitat, or community identified in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service.

The following Plumas County 2035 General Plan policies apply to the project:

COS

7.2.2 Species and Habitat Avoidance

The County shall require new development projects to avoid or minimize adverse impacts to threatened, rare, or endangered species and critical, sensitive habitat, as defined by appropriate local, state, and federal agencies, through proper project location and design. In the event that avoidance is not feasible, the County shall require a "no-net-loss" of these sensitive natural plant or habitat communities. Wildlife habitat will be preserved and managed in a manner that will not lead to the listing of additional species as threatened and endangered or negatively impact listed threatened or endangered species.

COS

7.2.3 Land Use Management

The County shall restrict the density and intensity of development in wildlife habitat areas to the extent needed to avoid significant interference with the habitat. These restrictions shall include, but not necessarily be limited to, maintenance of large parcel sizes, increasing building setback lines, limiting building and fencing, and designating open space corridors.

The project is not anticipated to have a substantial adverse effect on state or federally protected wetlands.

The project is not expected to interfere substantially with any migratory fish or wildlife species, wildlife migration corridors, or native wildlife nursery sites due to the location and nature of the project.

The project does not conflict with any local policies or ordinances protecting biological resources, or with any provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan due to none of those plans existing on or near the project site.

Therefore, the project would result in **no impact** to **Biological Resources**.

Mitigation Measure: No mitigation is required.

5. CULTURAL RESOURCES.

Environmental Setting: The cultural resources located throughout Plumas County can be attributed to the rich history of the county. The history of Plumas County begins from the time that the glaciers began to recede from the Sierra Nevada and Cascade Mountain ranges. Due to the glacial recession, for thousands of years, humans have been utilizing the Sierra and Cascade ranges.

The primary inhabitants of the county prior to European settlement were the Mountain Maidu. The Mountain Maidu people have lived in Plumas County from hundreds to thousands of years ago, and still live here. Other tribes, such as the Washoe and the Paiute most likely utilized the area while not settling permanently. It is likely that the Mountain Maidu people existed in small, scattered, familial groups in the valleys of Plumas County. While maintaining permanent villages in the lower elevations of the glacial valleys, during spring and fall, smaller groups traveled to the higher elevations, such as the to the ridge tops and valleys of the Sierras, setting up open brush shelters. During the winter months, villages remained occupied and relied mostly on stored and preserved food.

In the spring of 1850, gold-seeking miners poured into the region in search of the fabled "Gold" Lake. Mining camps throughout the County were quickly established. Rivers were turned from their beds, ditches were dug to bring water from distant sources to the diggings, and the land was turned upside down.

The Mountain Maidu adapted to the changing environment by living on portions of ranch properties. In some cases the Mountain Maidu adopted the name of the ranching family associated with the ranch on which they resided. European settlers brought illnesses the Maidu had never been exposed to, causing a significant decline of the Maidu population.

One of the larger groups to settle in Plumas County during the Gold Rush years were the Chinese. After the decline of the mining industry in Plumas County around the 1900s, most of the Chinese population left the area.

The North, Middle, and South forks of the Feather River were named in 1821 by Captain Luis Arguello as the Rio de las Plumas ("River of Feathers") after the Spanish explorer saw what looked

like bird feathers floating in the water. “Plumas”, the Spanish word for “feathers”, later became the name for the county. The river and its forks were the primary sites of early mining activity, with many smaller camps located on their tributaries. Over the next five decades, gold mining remained the main industry of the county.

Ranching operations in the area also began during the Gold Rush years, with several large ranches established in the valleys of Plumas County. Dairies provided milk, butter, and cheese to the gold fields and later provided dairy products to the silver mining operations in northern Nevada. Many of the Swiss and Italian families who settled and worked the local meadows and valleys have third and fourth generations living and ranching their agricultural lands in the county today.

In 1850, the famous mountain man James P. Beckwourth, discovered the lowest pass across the Sierra Nevada and the following year navigated a wagon trail for California-bound emigrants from western Nevada, through Plumas County, to the Sacramento Valley.

In March of 1854, Plumas County was formed from the eastern portion of Butte County. After a heated election, the town of Quincy was selected as the county seat. In 1864, a large part of northern Plumas County was split off to form Lassen County. Shortly after, a portion of Sierra County was annexed to Plumas County, which included the mining town of La Porte.

After the construction of the Western Pacific Railroad in 1910, the timber industry emerged as the primary economic force in the county. Before the railroad, lumber was milled for local use. The completion of the railroad gave the ability for local mills to distribute their lumber nationwide. In March, 1905, President Theodore Roosevelt established the Plumas National Forest, with boundaries roughly encompassing the branches of the Feather River.

Along with the railroad’s construction, up the Feather River Canyon came some of the earliest tourists to the county. Resorts and lodges popped up at intervals along the “Feather River Route” to accommodate fishermen, hikers, and sightseers. The last passenger train ran in 1970, and the line is now devoted to freight traffic only. In 1937, the Feather River Highway, touted as an “all weather route,” was completed through the Feather River Canyon from Oroville to Quincy, linking Plumas County year-round to the Sacramento Valley. The railroads that were once utilized as a main source of transportation in the county have left a legacy of notable bridges and other railway features throughout the county.

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporation	Less Than Significant Impact	No Impact
Would the project:				
a) Cause a substantial adverse change in the significance of a historical resource as defined in § 15064.5?	☐	☐	☐	☒
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to § 15064.5?	☐	☐	☐	☒

c) Disturb any human remains, including those interred outside of dedicated cemeteries?	☐	☐	☐	☒

Impact Discussion: The project area is not known to contain any historical, archaeological, or paleontological resources. It is anticipated that no significant impacts to historical, archaeological, or paleontological resources will result due to the construction and installation of the solar electric generation facility. However, any unanticipated cultural resources (historic or prehistoric) exposed during ground excavation or ground disturbing activities would cause construction to be terminated immediately until a qualified cultural resources specialist evaluates the resource(s). Any discovered resources that merit long-term consideration would be collected and reported in accordance with standard archaeological management requirements.

The project area is not known to contain any human remains and the disturbance of human remains is unlikely as it is unlikely that human remains are located within the proposed project area. However, in the unlikely event that project construction reveals human remains, per Health and Safety Code 7050.5, no further disturbance shall occur until the County Coroner has made a determination of origin and disposition pursuant to Public Resources Code 5097.98. The Coroner must be notified within 24 hours. If the Coroner determines that the remains are not historic, but are pre-historic, the Native American Heritage Commission (NAHC) must be contacted to determine the most likely descendent for this area. Once the most likely descendent is determined, treatment of the Native American human remains will proceed pursuant to Public Resources Code 5097.98. The Native American Heritage Commission may become involved with decisions concerning the disposition of the remains.

Therefore, there would be **no impact** to **Cultural Resources**.

Mitigation Measure: No mitigation is required.

6. ENERGY

Environmental Setting: The main source of energy production and use in Plumas County is for electricity. Depending upon the location in Plumas County, electricity may be provided by Pacific Gas & Electric (PG&E), Plumas-Sierra Rural Electric Cooperative, Liberty Utilities, or Sierra-Pacific Power.

Located within Plumas County are 13 power plants, which produce about 666 megawatts (MW) of electricity as of September 2009. The facilities include one biomass plant, one oil/gas plant, and eleven hydroelectric plants. Energy consumption in Plumas County is almost entirely electricity use because there are no natural gas service lines within the County, although some residents and businesses use propane tank services. In 2007, the total non-residential consumption was 109 megawatt-hours (MWh) and residential consumption equaled 105 MWh for a total of 214 MWhs. This is a decrease from 2006 when the total electricity consumption in the County was 224 MWhs. The lower consumption in 2007 was driven by a fall in nonresidential consumption. Therefore, in Plumas County the total supply of electricity produced in the County exceeds the demand for electricity. Potential for additional hydroelectric power generation in Plumas County may be limited because of the 30 megawatt capacity limit for “small” hydroelectric plants and the requirement that the water travel through existing man-made conduits. The County does have potential for additional solar energy production. According to the California Energy Commission staff paper California Solar Resources, the photovoltaic potential of Plumas County is estimated to be 71,626 megawatts.

A report from the Center for Economic Development indicates that Plumas County has very little potential for large scale geothermal production. Plumas County's greatest asset for renewable energy production lies in the County's forests, where bio-fuels proliferate and where vegetation management for forest fire hazard reduction has potential to create an ongoing source of fuel for power generation plants.

Other types of energy consumption in Plumas County are through the use of propane, heating oils, and other petroleum fuels. Propane and heating oils are used as a significant source of heat and are provided by companies such as Suburban Propane, High Sierra Propane, and Hunt & Sons, Inc. Other petroleum fuels include gasoline and diesel used for the operation of equipment and vehicles.

Particularly for this project, the solar array will generate electrical power. The project being proposed by Plumas-Sierra Rural Electric Cooperative (PSREC) is for the purpose of electric generation and meeting PSREC's goal of having 50% of their electrical power produced by renewable energy sources. The facility would have a maximum power output of approximately 4.62 MW_{AC} and 5.64 MW_{DC}, with a yearly power output of approximately 12,425 MWh.

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporation	Less Than Significant Impact	No Impact
Would the project:				
a) Result in potentially significant environmental impact due to wasteful, inefficient, or unnecessary consumption of energy resources, during project construction or operation?	☐	☐	☐	☒
b) Conflict with or obstruct a state or local plan for renewable energy or energy efficiency?	☐	☐	☐	☒

Impact Discussion: The proposed project entails the construction and operation of a solar electric generation facility. The construction of the facility, as well as long-term maintenance, of the facility would entail energy usage, specifically the usage of fossil fuels to power equipment/vehicles during construction and vehicles to maintain the facility. The fossil fuels used during construction and maintenance would not be wasteful, inefficient, or an unnecessary consumption of energy resources. Any consumption of fuels for the construction and maintenance of the facility would be considered negligible.

As mentioned previously, the project is a solar electric generation project to meet the renewable energy production goals of Plumas-Sierra Rural Electric Cooperative, which would not conflict with or obstruct a state or local plan for renewable energy or energy efficiency.

Therefore, there would be **no impact** to **Energy.**

Mitigation Measure: No mitigation is required.

7. GEOLOGY AND SOILS

Environmental Setting: Geologic hazards pose a potential danger to property and human safety, and are present due to the risk of naturally occurring geologic events and processes affecting human development. The Lake Almanor Fault, Butt Creek Fault Zone, Indian Valley Fault, and the Mohawk Valley Fault are four of the several faults mapped by the California Geologic Survey in Plumas County. In addition, the County is surrounded by faults; two of the closer, more active faults are the Honey Lake and Fort Sage Faults. Although the County is surrounded by and contains faults, the County is not located within a delineated Alquist-Priolo Earthquake Fault Zone. Although the faults located within and around the county have the potential to result in seismic activity causing an impact on County residents and property, seismic hazard mapping indicates a low seismic hazard potential for Plumas County.

While Plumas County contains varying soils types, the majority of the County consists of denser granular soils and bedrock at shallow depths, therefore, liquefaction potential is considered low.

The County is located in an area with varying topography and slopes. Areas with steep slopes in the County could be prone to landslides, mud slides, and avalanches. Landslides are dependent on slope, geology, rainfall, excavation, or seismic activity. Mud slides are often caused by heavy rainfall. Areas that have recently been subject to wildfire are susceptible to mudslides. Avalanches consist of a rapid flow of snow down a slope. They often reoccur in the same areas and can be triggered by varying weather patterns and human activity. The volcanic soils in the eastern portion of the Plumas National Forest and the areas along the North and Middle Forks of the Feather River are susceptible to landslides.

The rate of erosion is influenced by a myriad of variables, such as rainfall, runoff, slope gradient, vegetation, physical soil characteristics, and human activity. Human activities, such as timber harvesting, water diversion, irrigation practices, road and railroad construction, grazing, and mining have all contributed to in-stream water quality issues, such as sediment transport, that impact aquatic life and riparian vegetation. Approximately 70% of the County is considered as having a moderate potential for soil erosion, while less than 1% is considered a high potential for soil erosion. The remaining portion of the county is either considered low erosion potential or is not mapped. High erosion potential occurs at higher elevations in the County.

Expansive soils change due to the moisture content within the soil. Expansive soils shrink when dry and expand or swell when wet. The swelling and shrinking can cause damage to homes, foundations, roads, utilities, and other structures. The California Building Code and Uniform Building Code (1994) Table 18-1-B both set forth the classifications of expansive soils. The expansion index ranges from 0 to 130, with 0-20 being a very low potential expansion, 91-130 being a high expansion potential, and greater than 130 being a very high expansion potential. Highly expansive soils are undesirable for use as engineered fill or subgrade directly underneath foundations or pavement, and must be replaced with non-expansive engineered fill or require treatment to mitigate their expansion potential.

	Potentially Significant Impact	Less Than Significant with	Less Than Significant Impact	No Impact

					Mitigation Incorporation
Would the project:					
a)	Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:				
	i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.	☐	☐	☐	☒
	ii) Strong seismic ground shaking?	☐	☐	☐	☒
	iii) Seismic-related ground failure, including liquefaction?	☐	☐	☐	☒
	iv) Landslides?	☐	☐	☐	☒
b)	Result in substantial soil erosion or the loss of topsoil?	☐	☐	☐	☒
c)	Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?	☐	☐	☐	☒
d)	Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?	☐	☐	☐	☒
e)	Have soils incapable of adequately supporting the use of septic tanks or alternative	☐	☐	☐	☒

	wastewater disposal systems where sewers are not available for the disposal of wastewater?				
f)	Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☐	☐	☐	☒

Impact Discussion: The proposed project entails the construction of a solar electric generation facility which would not expose people or structures to substantial adverse effects due to earthquakes, seismic shaking, seismic-related ground failure, or landslides.

According to the Alquist-Priolo Earthquake Fault Zoning Map, the project is not located near active faults.

The project is located in an area where the probability of significant ground shaking is low, and because the project does not propose structures for human habitation that would be at risk to seismic activity, potential geologic impacts would be less than significant.

Although Plumas County is considered to have a low seismic and liquefaction hazard potential, which renders geologic impacts a less than significant risk to people and structures, the proposed project will be constructed under a building permit and will be subject to the California Building Code. Furthermore, although no buildings are proposed, any future building or improvement(s) constructed would be subject to the California Building Code. The enforcement and subjection of solar electric generation facility to the California Building Code reduces potential impacts due to liquefaction to less than significant.

The proposed project would not expose people or structures to significant risk due to landslides. There is no evidence of landslides in the project area and there are no steep slopes located in the project area. The project is not susceptible to seismically-induced landslides or mudflows due to the granular soils and bedrock at the site. No impacts resulting from landslides are anticipated.

There is a possibility that site preparation and grading would expose bare soil to the elements causing erosion and stormwater runoff. However, the proposed facility would be built under a building permit and in compliance with all applicable California building codes. Construction buffers and appropriate Best Management Practices (BMPs) would serve to address possible impacts. For example, due to the project disturbing over one acre, a Storm Water Pollution Prevention Plan (SWPPP) would be required. The SWPPP would include Best Management Practices (BMPs) to minimize erosion, sediment, and non-stormwater discharges. The BMPs would entail procedures and/or engineered controlled devices to reduce stormwater pollution from the project. Therefore, the project would not violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or ground water quality.

As previously mentioned, the proposed project will be located on a parcel that is not on a geologic unit or soil that is unstable or would become unstable as a result of the project and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse.

The project would not be located on expansive soil as defined in Table 18-1-B of the Uniform Building Code. Although it is not anticipated that the project would be located on expansive

soils, the solar electric generation facility will be installed under a building permit and required to meet all the applicable requirements of the California Building Code.

The project is a solar electric generation facility and does not require a septic system or wastewater disposal system and, therefore, would not have soils incapable of supporting the use of septic tanks or alternative wastewater disposal systems.

There are no know paleontological resource or site and there are no unique geologic features located on the property.

Therefore, the project would result in **no impact** to **Geology and Soils**.

Mitigation Measure: No mitigation is required.

8. GREENHOUSE GAS EMISSIONS.

Environmental Setting: Greenhouse gases (GHGs) are comprised of a variety of gases. Greenhouse gases are: carbon dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O), and fluorinated gases. According to the Environmental Protection Agency (EPA), the greenhouse gases emitted are approximately 81% carbon dioxide, 10% methane, 6% nitrous oxide, and 3% fluorinated gases. Greenhouse gases, along with other naturally occurring processes, have been shown to have a significant impact on the warming of the Earth. The rise in temperature is due to the greenhouse gases being similar to an adiabatic process or blanket around the Earth. Some of the solar radiation reflected from Earth's surface is absorbed by the gases causing the rate at which radiation is emitted from Earth to decrease.

Greenhouse gases are expelled from a variety of sources. The three largest sources are electricity generation, transportation, and industrial processes. The main emissions that electricity generation, transportation, and industrial processes emit are greenhouse gases, such as CO_2, through the combustion of fossil fuels. According to the EPA, CO_2 emissions, which are the largest portion of greenhouse gases, is emitted by transportation processes and contributes approximately 34% of the carbon dioxide emissions.

To combat greater increases in greenhouse gases, various forms of legislation have been implemented. Some of the major legislative changes were Executive Orders S-3-05 and B-30-15, Assembly Bill (AB) 32, and Senate Bill (SB) 32. The first major piece of legislation that set emissions reduction targets was Executive Order (EO) S-3-05 signed by Governor Arnold Schwarzenegger. EO S-3-05 established the target to reduce greenhouse gas emissions to below 2000 levels by 2010, 1990 levels by 2020, and 80% below 1990 levels by 2050. On September 27, 2006, Governor Arnold Schwarzenegger signed into law AB 32, also known as the California Global Warming Solutions Act. AB 32 gave authority to the California Air Resources Board (CARB) to implement and enforce the targets set forth in EO S-3-05. More recently, in 2015, Governor Brown signed EO B-30-15, which was an expansion of AB 32. The expansion set the goal to have a 40% reduction in greenhouse gases by 2030. On September 8, 2016, to further empower CARB to institute regulations to meet the aggressive target set by EO B-30-15, SB 32, also known as the California Global Warming Solutions Act of 2006, was signed into law. To ensure the goals of EO S-3-05 and EO B-30-15 are met, AB 32 established mandatory greenhouse gas emissions reporting, verification, and other requirements for operators of certain facilities that directly emit greenhouse gases.

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporation	Less Than Significant Impact	No Impact
Would the project:				
a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?	☐	☐	☒	☐
b) Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of greenhouse gases?	☐	☐	☐	☒

Impact Discussion: The solar electric generation facility would not directly generate greenhouse gas emissions. However, construction and operation would emit greenhouse gases. The greenhouse gases emitted during construction would be due to combustion processes from vehicles being used in the construction of the facility. In addition, the operation of the facility may require maintenance and/or monitoring, therefore, requiring a small number of site visits per year. The temporary nature of construction and the negligible traffic increase due to site maintenance and/or monitoring would contribute a negligible increase in greenhouse gases.

Plumas County is under the jurisdiction of the Northern Sierra Air Quality Management District (NSAQMD). As discussed in the Air Quality section of this Initial Study, the purpose of the district is to monitor air quality levels and set rules and regulations to limit air pollution. Implementation of the applicable rules and regulations set forth by NSAQMD would limit air pollution to below levels of significance. The proposed solar electric generation facility would not conflict with any applicable plan, policy, or regulation adopted for the purpose of reducing greenhouse gas emissions, nor does it conflict with any General Plan policy or goal designed to reduce greenhouse gas emissions.

Therefore, the project would result in a **less than significant impact** to **Greenhouse Gas Emissions**.

Mitigation Measure: No mitigation is required.

9. HAZARDS AND HAZARDOUS MATERIALS.

Environmental Setting: Throughout Plumas County, a variety of hazardous wastes may exist and can be transported in a variety of ways. Hazardous wastes can be liquids, solids, or gases. The Environmental Protection Agency (EPA) defines hazardous wastes as hazardous materials that are discarded, abandoned, or recycled. The EPA groups hazardous wastes in three categories: Listed Wastes, Characteristic Wastes, and Mixed Radiological and Hazardous Wastes. Examples of the most common types of hazardous materials that are routinely transported and used throughout the County are diesel, gasoline, oils, cleaning materials, and propane.

Transportation-related public health and safety issues have the potential to occur along the major thoroughfares of the County. The highest potential for transportation-related incidents exists along

the County's main east-west thoroughfare, State Route 70, and along State Routes 36 and 89. The majority of hazardous materials shipped through and within the County consists primarily of petroleum products, such as heating fuels, gasoline, diesel, and propane. The County's railroad corridors, both Union Pacific Railroad and Burlington Northern Santa Fe Railway, are an additional public safety concern since freight trains also carry bulk containers of hazardous materials such as petroleum.

Locally, the Plumas County Environmental Health Division (EHD) manages the County's hazardous materials management program. The EHD maintains the Hazardous Materials Business Plan and Inventory Program. The program enforces the State "right-to-know" laws passed in 1984 and requires local businesses to provide public access to information about the types and amounts of chemicals being used on their property. Businesses must plan and prepare for a chemical emergency through the preparation of a Hazardous Materials Inventory that is certified annually and an inventory of hazardous updates annually. EHD also regulates the use, storage, and treatment of hazardous wastes and above-ground storage tanks.

Wildland fires are a major hazard in Plumas County. Wind, steepness of terrain, and naturally volatile or hot-burning vegetation contribute to wildland fire hazard potential. The principal ingredients of wildland fires - fuel, topography, and weather - combine to make highly hazardous fire conditions throughout much of the county. Fire protection is categorized in three ways, Local Responsibility Areas (LRA), State Responsibility Areas (SRA), or Wildland Urban Interface Fire Areas (WUIFA). Applicable building standards serve to address potential health and safety impacts within the LRA. Wildland Urban Interface Building Standards (WUIBS) serve to address potential health and safety impacts within a SRA, Local Agency Very-High Fire Hazard Severity Zone, or WUIFA.

Located within Plumas County are three public-use airports: Nervino Airport in Beckwourth, Rogers Field Airport in Chester, and Gansner Airport in Quincy. The airports serve approximately 44,000 operations (takeoffs plus landings) annually. Potential safety issues associated with airports include aircraft accidents and noise impacts to surrounding land uses. Airport operation hazards include the development of incompatible land uses, power transmission lines, wildlife hazards, such as bird strikes, existing obstructions such as timbered hillsides, and tall structures in the vicinity of these airports. Airport safety zones are established to minimize the number of people subjected to noise and potential aircraft accidents through limitations on the type of development allowed around airports. Local Airport Land Use Compatibility Plan zoning regulations provide specific details for the established airport safety zones.

In addition to the airports, the Plumas District Hospital in Quincy, the Indian Valley Health Care District in Greenville, and the Eastern Plumas Hospital in Portola have heliports.

The closest commercial airport is Reno/Tahoe International Airport in Reno, Nevada.

	Potentially Significant Impact	**Less Than Significant with Mitigation Incorporation**	**Less Than Significant Impact**	**No Impact**

Would the project:

a)	Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☐	☒
b)	Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	☐	☐	☐	☒
c)	Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of existing or proposed school?	☐	☐	☐	☒
d)	Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	☐	☐	☐	☒
e)	For a project located within an airport land use plan or, where such a plan has not been adopted, within two (2) miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?	☐	☐	☐	☒
f)	Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	☐	☒
g)	Expose people or structures, either directly or	☐	☐	☐	☒

indirectly, to a significant risk of loss, injury, or death involving wildland fires?

Impact Discussion: Construction of the solar electric generation facility would involve the use of potentially hazardous materials. Some potential materials are: automotive and heavy equipment fuels and oils, paints, and cleaning materials. The use of these materials are temporary due to the temporary nature of construction, and the materials being utilized would be stored according to the manufacturer's specifications, as well as local, state, and federal laws and regulations. Maintenance visits would involve the use of fuel powered vehicles and/or equipment and would be used in conformance with the manufacturer's instructions and local, state, and federal laws and regulations. Due to the nature of construction and operation of the facility, the routine transport, disposal, or use of hazardous materials is not expected, nor is the facility expected to cause a reasonable foreseeable upset or accident releasing hazardous materials.

There are no schools, existing or proposed, within one-quarter mile of the proposed project site.

Plumas County has a minimal amount of sites considered to be hazardous materials sites pursuant to Government Code Section 65962.5. The site in which the solar electric generation facility is proposed is not on a site considered to be a hazardous materials site pursuant to Government Code Section 65962.5.

The closest airport to the project site is Nervino Airport in Beckwourth, California, which is approximately nine (9) miles northwest from the project site. Therefore, the project would not result in a safety hazard for people residing or working in the project area.

Due to the nature and location of the project, the project would not impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan.

The project site is located within the Sierra Valley Fire Protection District, which provides structural fire protection. The project site is designated as a State Responsibility Area for wildland fire protection and the State's requirements for building construction and vegetation management within the SRA are applicable to the project. The project would also be subject to all applicable building and electrical standards, which would help protect the public's health, safety, and welfare.

In addition, the Mitigated Negative Declaration and Initial Study (State Clearinghouse #2019079014) prepared for the project by K.S. Dunbar and Associates, Inc., which was submitted by the project applicant with the Special Use Permit and Site Development Permit application, made the point that the proposed project site is covered mostly by wild vegetation. Due to the construction of the proposed project, removing most or all of the existing vegetation on the property would be required, which would greatly reduce the fire danger of the site.

Furthermore, it is anticipated that maintenance of the property's vegetation would be required to ensure maximum efficiency of the facility. Therefore, the impact would be less than significant.

Therefore, the project would result in **no impact** to **Hazards and Hazardous Materials**.

Mitigation Measure: No mitigation is required.

10. <u>HYDROLOGY AND WATER QUALITY.</u>

Environmental Setting: Water quality may be impacted by a variety of factors; one factor is erosion of the earth's soil by natural, physical forces. Erosion is due to, and may be accelerated

by, precipitation, running water, and wind. The rate of erosion is influenced by a myriad of variables, such as rainfall, runoff, slope gradient, vegetation, physical soil characteristics, and human activity. Human activities, such as timber harvesting, water diversion, irrigation practices, road and railroad construction, grazing, and mining have all contributed to in-stream water quality issues, such as sediment transport, that impact aquatic life and riparian vegetation. Approximately 70% of the County is considered as having a moderate potential for soil erosion, while less than 1% is considered a high potential for soil erosion. The remaining portion of the county is either considered low erosion potential or is not mapped. High erosion potential occurs at higher elevations in the County.

Flooding can occur in two fashions, the first being naturally due to excessive amounts of water in flood zones and the second is due to inundation by water due to dam or levee failure. Plumas County has been mapped by the Federal Emergency Management Agency (FEMA) to determine the locations of the Special Flood Hazard Areas, such as the 100-year flood hazard area. FEMA has identified the seven areas located in, or in the vicinity of, Chester, Greenville, Crescent Mills, Taylorsville, Quincy, Vinton, and the City of Portola as being in the 100-year flood hazard area.

The second means of flooding can occur due to a partial or complete failure of a levee or dam, causing an inundation of water to flood the adjoining regions. There are approximately 28 dams with the smallest being 50 acre-feet and the largest being 1,208,000 acre feet. The dams located within Plumas County that FEMA has identified as having inundation areas are along the North and Middle Forks of the Feather River, Indian Creek between Taylorsville and Antelope Lake, Sierra Valley, and Indian Valley. The inundation areas also closely coincide with the flood zones identified by FEMA.

The property, per the FEMA flood map (source: Plumas County GIS) in Exhibit 5, is located within Zone X, an area of minimal flood hazard.

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporation	Less Than Significant Impact	No Impact
Would the project:				
a) Violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or ground water quality?	☐	☐	☐	☒
b) Substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin?	☐	☐	☐	☒
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a				

	stream or river or through the addition of impervious surfaces, in a manner which would:				
	i. Result in substantial erosion or siltation on- or off-site;	☐	☐	☐	☒
	ii. substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site;	☐	☐	☐	☒
	iii. create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff; or	☐	☐	☐	☒
	iv. impede or redirect flood flows?	☐	☐	☐	☒
d)	In flood hazard, tsunami, or seiche zones, risk release of pollutants due to project inundation?	☐	☐	☐	☒
e)	Conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan?	☐	☐	☐	☒

Impact Discussion: There is a possibility that site preparation and grading would expose bare soil to the elements causing erosion and stormwater runoff. However, the proposed facility would be built under a building permit and in compliance with all applicable California building codes. Construction buffers and appropriate Best Management Practices (BMPs) would serve to address possible impacts. For example, due to the project disturbing over one acre, a Storm Water Pollution Prevention Plan (SWPPP) would be required. The SWPPP would include Best Management

Practices (BMPs) to minimize erosion, sediment, and non-stormwater discharges. The BMPs would entail procedures and/or engineered control devices to reduce stormwater pollution from the project. Therefore, the project would not violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or ground water quality.

The facility would not deplete groundwater supplies or interfere with groundwater due to not utilizing groundwater.

The installation of the facility may entail a slight increase in on-site impermeable surfaces, resulting in a minimal increase in stormwater runoff. It is anticipated that the minimal increase in stormwater runoff and implementation of the SWPPP and BMPs would result in a less than significant impact.

There would be no impacts due to substantial flooding or erosion on or off-site as a result of the alteration of drainage on the property. The drainage of the property would only be minimially altered as the existing topography of the property is level and would only require minimal grading.

No stormwater drainage systems are planned or exist near the project site, therefore, capacities would not be exceeded.

According to the FEMA flood map (Exhibit 5; Source: Plumas County GIS), the project site is located within Zone X, an area of minimal flood hazard. The project site would not impede or redirect flood flows.

Seiche is a possibility for any body of water; a solar electric generation facility would not increase the possibility of a seiche.

Due to the location and nature of the project and the project being located in flood Zone X, pollutants are not at risk of release due to inundation of the project and the project is not anticipated to conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan.

Therefore, the project would result in **no impact** to **Hydrology and Water Quality**.

Mitigation Measure: No mitigation is required.

11. <u>LAND USE AND PLANNING.</u>

Environmental Setting: The predominate land use within Plumas County consists of open space use with a majority of land, approximately 94% of the total County area, dedicated to timberland or other managed resource uses. Consequently, many of these lands are managed for a combination of resource values, including, but not limited to recreation, mining, timber production, agriculture production, and cultural and historic resources. That leaves approximately 6% of the land area for uses such as residential, commercial, industrial, and public service.

Resources, history, and people have all had a significant role in defining Plumas County. Communities originally developed and evolved on the landscape based on proximity to the resources that provided a livelihood. The Mountain Maidu established villages in the valleys of the County where there was shelter from winter storms and access to good hunting and planting gathering sites. Upon arrival and settlement of Europeans in the mid-1800s, towns first grew up

around mining activities, then log mills and later around transportation such as stagecoach and railroad.

The land use pattern across the County today reflects this historical approach to settlement in a time before the automobile. Today many counties and cities across California and the United States are trying to institute smart growth, transient-oriented design, form-based development, and to re-focus their communities into walkable places. Plumas County has, with a few exceptions, maintained its rural character with its compact and walkable communities.

The Land Use Element of the Plumas County 2035 General Plan defines the goals, policies, and implementation measures that will facilitate appropriate growth and development. Between the years of 1981 and 2012, Plumas County encountered an approximate 13% increase in population. In recent years, between 2000 and 2010, Plumas County experienced a 4% decline in population. Although, the California Department of Finance predicts that Plumas County's population growth will be approximately 1% per decade between 2010 and 2050.

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporation	Less Than Significant Impact	No Impact
Would the project:				
a) Physically divide an established community?	☐	☐	☐	☒
b) Cause a significant environmental impact due to a conflict with any land use plan, policy, or regulation adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☐	☒

Impact Discussion: It is not common or expected to have a solar electric generation facility physically divide an established community. This project is no exception, it will not be located on a parcel that will physically divide an established community.

As has been previously established, under Plumas County Code a solar electric generation facility is considered a "public utility facility." A public utility facility is defined as the following by Plumas County Code (PCC) Sec. 9-2.277 – *Public utility facility*:

> "Public utility facility" shall mean an improvement use necessary for the provision, distribution, or conveyance to the public of utilities or a facility for the maintenance of such facilities.

Due to the site being zoned S-1, which permits residential uses, a "public utility facility" is a use permitted subject to a special use permit (PCC 9-2.1502(b)(1)). Additionally, due to the property being zoned I-2, a site development review (site development permit) is required.

The proposed use does not cause a significant environmental impact due to a conflict with any land use plan, policy, or regulation as it is a use permitted in the S-1 zoning subject to a special use permit and in the I-2 zoning subject to site development review.

Therefore, the project would result in **no impact** to **Land Use and Planning**.

Mitigation Measure: No mitigation is required.

12. MINERAL RESOURCES.

Environmental Setting: Since the 1800s, mineral resources have been a major part of the economy in Plumas County. Gold, copper, aggregate, and silver are some of the mineral resources that have been mined and exported. Although the significance of the mining industry has been declining over the past several decades, gold and copper mining speculation continues to contribute to the County's economy.

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporation	Less Than Significant Impact	No Impact
Would the project:				
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	☐	☐	☐	☒
b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan?	☐	☐	☐	☒

Impact Discussion: The proposed project is not located in an area with known mineral resources and it is not anticipated that any mineral resources will be discovered during construction.

The project would not result in the loss of availability of a locally-important mineral resources recovery site delineated on a local general plan, specific plan, or other land use plan.

Therefore, there would be **no impact** to **Mineral Resources**.

Mitigation Measure: No mitigation is required.

13. NOISE.

Environmental Setting: The dominant sources of noise in Plumas County are mobile, related to vehicle (including truck traffic), aircraft and train transportation, to a lesser extent. Common stationary sources in the county include lumber mills and aggregate mining and processing facilities. To a lesser extent, construction sites are also considered a stationary source of short-term, or temporary, noise in the County. Common noise sources within Plumas County are the main roadways, railroads, some stationary activities, and airports.

Traffic contributes to the noise within the County. The primary factors that determine roadway noise levels are traffic volumes, a percentage of heavy trucks and buses on individual roadways, average vehicle speed, and presence of natural or human-made noise attenuation features such as sound wall and landscaping. Given the predominantly rural nature of the County, roadway noise impacts are those associated with the larger regional, or Statewide, network.

The traffic volumes on County roadways are fairly low, with most roadways experiencing fewer than 3,000 vehicles per year. The 24 hour average decibel (dB) level associated with a majority of the roadways is typically between 65 dB and 70 dB.

The second contributor to noise within the County is the railroad. Plumas County has two active rail lines used by the Union Pacific Railroad (UPRR) and the Burlington Northern Santa Fe Railway (BNSF). While both lines are primarily used for freight and local shipping and receiving, a portion of the UPRR line through the Feather River Canyon is recognized as a scenic route, with occasional chartered passenger trains. Daily traffic on the UPRR and BNSF lines in the County consists of a limited number of trains per day. This volume creates minimal noise impacts in terms of frequency.

Stationary noise sources also contribute to the noise throughout the county. One of the temporary, stationary noise sources is construction. First, construction crew commutes and the transport of construction equipment and materials to construction sites would incrementally increase noise levels on access roads leading to the sites. Second, noise would be generated during excavation, grading, and erection of structures. Construction typically occurs in discrete steps, each of which has a distinctive mix of equipment and, consequently, distinctive noise characteristics. These various sequential phases would change the character of the noise generated on each site and, therefore, the noise levels surrounding these sites as construction progresses.

Three public use airports are located in the County: Nervino Airport in Beckwourth, Rogers Field Airport in Chester, and Gansner Field Airport in Quincy. Airport noise caused by aircraft depends primarily on the type of aircraft and the frequency and direction of flights, with specific noise events caused by aircraft flyovers, takeoffs, and landings. Noise from aircraft warming up early in the morning can also be a significant noise source from airports. In addition, helicopter related noise is common due to helipads being located at Rogers Field Airport, Gansner Field Airport, in Greenville, and at Plumas District Hospital.

	Potentially Significant Impact	**Less Than Significant with Mitigation Incorporation**	**Less Than Significant Impact**	**No Impact**
Would the project result in:				
a) Generation of a substantial temporary or permanent increase in ambient noise	☐	☒	☐	☐

	levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?				
b)	Generation of excessive groundborne vibration or groundborne noise levels?	☐	☐	☐	☒
c)	For a project located within an airport land use plan area or, where such a plan has not been adopted, within two (2) miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒

Impact Discussion: Noise exposure due to the project would be from the construction of the solar electric generation facility. The construction noise resulting from construction of the facility would be temporary. Although Plumas County does not have an ordinance in relation to construction noise, the Plumas County 2035 General Plan does contain policies for construction noise and discretionary projects such as a special use permit.

The policy within the Plumas County 2035 General Plan addressing impacts due to construction noise is as follows:

N

3.1.4 Construction Noise

The County shall seek to limit the potential noise impacts of construction activities on surrounding land uses. The standards outlined below shall apply to those activities associated with actual construction of a project as long as such construction occurs between the hours of 7 a.m. and 7 p.m., Monday through Friday and 8 a.m. and 5 p.m. on weekends or on federally recognized holidays. Exceptions are allowed if it can be shown that construction beyond these times is necessary to alleviate traffic congestion and safety hazards.

TABLE 3-5. MAXIMUM ALLOWABLE NOISE EXPOSURE WITHIN PLANNING AREAS – CONSTRUCTION NOISE.

Land Use Designation	Time Period	Noise Level (dB)	
		L_{eq}	L_{max}
Residential	7 am to 7 pm	55	75
	7 pm to 10 pm	50	65
	10 pm to 7 am	45	60
Commercial and Public Facilities	7 am to 7 pm		90
	7 pm to 7 am		75
Industrial	Any Time		90

Any adopted community plan area should refer to the land use designations that most closely correspond to the General Plan land use designations for similar development.

The property in which the project is proposed has a General Plan land use designation of Suburban Residential and Industrial. The property directly adjacent to the west has a General Plan land use

designation of Suburban Residential and the property directly adjacent to the east is Industrial. Table 3-5 shows times throughout the day in residential and industrial land use designations, with their maximum allowable noise exposure levels. The residential land use designation has a maximum noise level of 75 decibels (dB) for 7 a.m. to 7 p.m., 65 dB for 7 p.m. to 10 p.m., and 60 dB for 10 p.m. to 7 a.m. The industrial land use designation has a maximum noise level of 90 dB for any time of the day.

The policy in the Plumas County 2035 General Plan addressing noise impacts for discretionary projects is as follows:

N

3.1.3 Noise / Land Use Compatibility Standards

When considering a discretionary project, the County shall refer to the Noise Land Use Compatibility Standards, as shown in Figure 21 as a guide to ensure compatibility of land uses. New development of noise sensitive land uses will not be permitted in areas exposed to existing or projected levels of noise which exceed the levels specified in Figure 21 unless the project design includes effective mitigation measures to reduce exterior noise and noise levels in interior spaces to the levels specified in Figure 21.

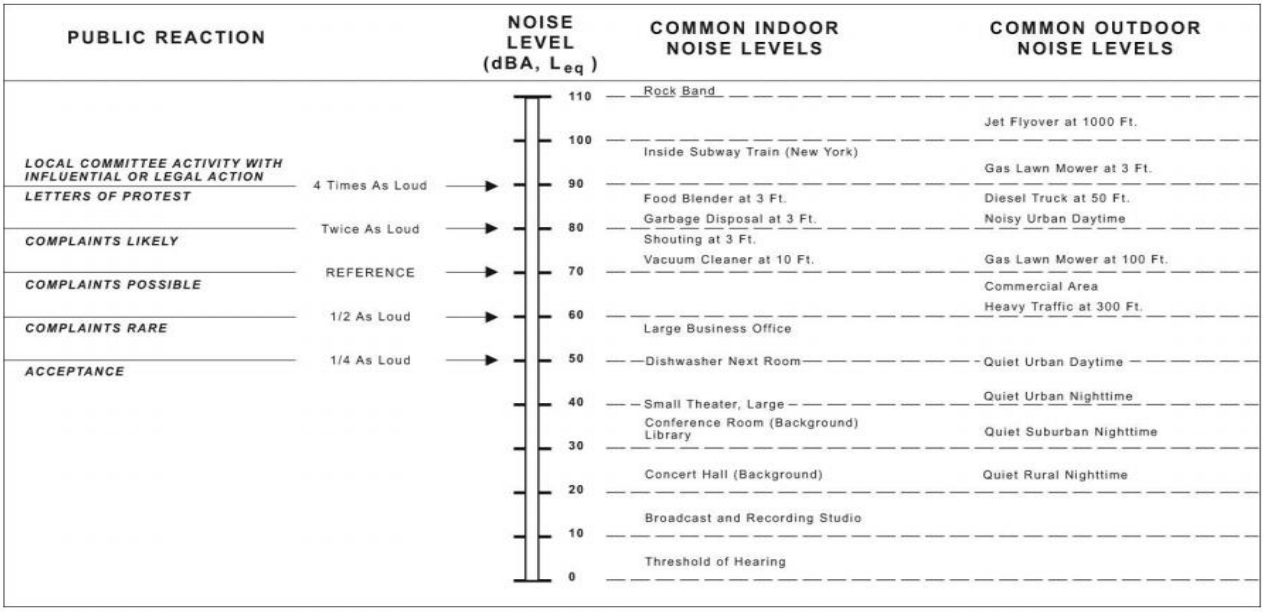

Figure 21. Selected Noise Sources and the Corresponding A-weighted Noise Levels. Source: ESA 2011.

Figure 21 from the Plumas County 2035 General Plan shows noise levels for indoor and outdoor types of scenarios/equipment. It is highly likely that project construction would entail the use of diesel powered equipment and vehicles. Figure 21 demonstrates that a diesel truck at 50 feet corresponds to under 90 dBA (A-weighted decibels).

As shown on the site plan for the project (Exhibit 6), the closest portion of the project site and construction work could occur approximately 60 feet from the property line adjacent to the neighboring mobile home park, with the nearest mobile home being approximately 150 feet from the area of the project site in which construction work would likely occur.

As mentioned previously, the property has a land use designation of Suburban Residential and Industrial, with the adjacent property to the west being designated Suburban Residential and the property to the east being designated Industrial. Comparing the values from Figure 21 and Table

3-5 demonstrates that the noise level of a diesel truck at 50 feet would not exceed that of the maximum allowed noise level for the "Industrial" land use designation in Table 3-5, but the maximum allowable construction noise level for the "Residential" land use designation for any time of the day would be exceeded. However, the impact due to noise is an impact that lessens with distance. The noise level will diminish due to sound level spreading in a geometric pattern, also known as "Geometric Spreading", and attenuating at a rate of 6 dB for each doubling of distance from the noise source. In addition, noise attenuation from ground absorption and reflective-wave canceling adds to the attenuation associated with geometric spreading.

It is anticipated that the noise level, with geometric spreading, would diminish to slightly below the maximum allowable noise level for the "Residential" land use designation for the time period of 7 a.m. to 7 p.m., which is 75 dB. However, the noise level shown in Table 3-5 for the time periods of 7 p.m. to 10 p.m. and 10 p.m. to 7 a.m. would be exceeded. Therefore, in order to mitigate noise levels to a time that does not exceed the maximum allowable for the "Residential" designation, the following mitigation is required:

> Project construction shall only occur between the hours of 7 a.m. and 7 p.m., Monday through Friday and 8 a.m. and 5 p.m. on weekends or on federally recognized holidays.

Submitted by the project applicant with the Special Use Permit and Site Development Permit applications was a Mitigated Negative Declaration and Initial Study (State Clearinghouse #2019079014) prepared by K.S. Dunbar and Associates, Inc., specifically for the proposed project. The Mitigated Negative Declaration and Initial Study prepared by K.S. Dunbar and Associates, Inc., discussed that the California Department of Transportation developed the *Transportation and Construction Vibration Guidance Manual* (Manual) to specifically address the criteria for the thresholds of vibration. Chapter 7, *Vibration Prediction and Screening Assessment for Construction Equipment*, of the Manual (Exhibit 7) provides tables listing the threshold criteria for human perception and structure damage due to vibration as well as provides specific equations to calculate the peak particle velocity (PPV) which is used to describe ground vibration.

Table 1 and Table 2 were sourced from the Manual and detail criteria for damage potential and annoyance potential criteria due to vibration.

Table 1. Guideline Vibration Damage Potential Threshold Criteria

Structure and Condition	**Maximum PPV (in/sec)**	
	Transient Sources	**Continuous/Frequent Intermittent Resources**
Extremely fragile historic buildings, ruins, ancient monuments	0.12	0.08
Fragile buildings	0.20	0.10
Historic and some old buildings	0.50	0.25
Older residential structures	0.50	0.30
New residential structures	1.00	0.50

Modern industrial/commercial buildings	2.00	0.50

Table 2. Guideline Vibration Annoyance Potential Criteria

Human Response	Maximum PPV (in/sec)	
	Transient Sources	Continuous/Frequent Intermittent Resources
Barely perceptible	0.04	0.01
Distinctly perceptible	0.25	0.04
Strongly perceptible	0.90	0.10
Severe	2.00	0.40

Table 3 was also sourced from the Manual and provides values for ground vibration for different types of equipment from a distance of 25 feet.

Table 3. Vibration Source Amplitudes for Construction Equipment

Equipment	Reference PPV at 25 ft. (in/sec)
Vibratory miller	0.210
Large Bulldozer	0.089
Caisson drilling	0.089
Loaded trucks	0.076
Jackhammer	0.035
Small bulldozer	0.003
Crack-and-seat operation	2.400

To quantify the level of ground vibration possible for the equipment that may be used to construct the solar electric generation facility, Equation 1 below, sourced from Chapter 7 of the Manual, may be used.

$$PPV_{Equipment} = PPV_{Ref}(25/D)^{n} \quad (in/sec) \qquad [1]$$

Where:

PPV_{Ref} = reference PPV at 25 ft.
D = distance from equipment to the receiver in ft.
n = 1.1 (the value related to the attenuation rate through the ground)

The closest structures to the proposed project are the dwellings located to the west, which are approximately 150 feet from the proposed project. Therefore, utilizing 150 feet for "D" in Equation 1 and the reference PPVs shown in Table 3 for the most likely types of equipment used for project construction, which would be a "large bulldozer," "loaded trucks," and "small bulldozer," the peak particle velocity may be calculated. An example calculation using Equation 1 is shown below for a "large bulldozer" from a 150 foot distance.

$$PPV_{Equipment} = PPV_{Ref}(25/D)^{n}$$

$$PPV_{Equipment} = (0.089 \text{ in/sec})(25 \text{ feet}/ 150 \text{ feet})^{1.1}$$

$$PPV_{Equipment} = 0.0124 \text{ in/sec}$$

Table 4 details a compilation of the calculated ground vibration or PPV for each equipment type from a distance of 150 feet.

Table 4. Calculated Ground Vibration (PPV)

Equipment	PPV (in/sec)
Large Bulldozer	0.0124
Loaded Trucks	0.0106
Small Bulldozer	0.0004

As mentioned earlier, the closest structures to the project would be the residences to the west. Therefore, it can be concluded from comparing the calculated values in Table 4 to the threshold criteria in Table 2 and Table 3 that any ground vibration from the temporary use of heavy equipment and trucks during construction would have no impact as the calculated ground vibration is classified as "barely perceptible" and is significantly less than the damage potential threshold criteria for residential structures.

It is not likely or anticipated that the project will generate or expose people to excessive ground borne vibration and noise levels.

The project does not conflict with any of the provisions outlined in the Plumas County 2035 General Plan or applicable standards of other agencies.

The project site is located approximately nine (9) miles from the nearest airport, which would be Beckwourth's Nervino Airport. The project is not located within an airport land use area and would not expose people residing or working in the project area to excessive noise levels

Therefore, the impact to **Noise** is considered **less than significant with mitigation incorporated** due to the distance of the project from the nearby residences, the temporary nature of construction noise, and long-term noise generated by a solar electric generation facility being minimal and negligible.

Mitigation Required: *Project construction shall only occur between the hours of 7 a.m. and 7 p.m., Monday through Friday and 8 a.m. and 5 p.m. on weekends or on federally recognized holidays.*

14. <u>POPULATION AND HOUSING.</u>

Environmental Setting: Plumas County is considered one of the most rural counties in California. The population, according to the 2010 U.S. Census, was 20,007, giving a population per square mile of 7.8. Plumas County's population is expected to grow annually by 0.7 percent through 2050, according to the California Department of Finance. The gradual increase in population would lead to a gradual expansion of home and business developments while maintaining the rural character of the County.

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporation	Less Than Significant Impact	No Impact
Would the project:				
a) Induce substantial unplanned population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	☐	☐	☐	☒
b) Displace a substantial number of existing housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒

Impact Discussion: The project entails the construction and operation of a solar electric generation facility for the production of electrical power. Due to the nature of the project, the project would not directly or indirectly cause population growth.

The project site located at 92754 Highway 70, Vinton, is a vacant parcel encompassing approximately 37.01 acres. The project would not displace any existing housing necessitating the construction of replacement housing, but will reduce the number of potential residential units on the property without impact.

Therefore, there would be **no impact** to **Population and Housing**.

Mitigation Measure: No mitigation is required.

15. PUBLIC SERVICES.

Environmental Setting: Public services are provided by a variety of service providers, including the County, special districts, and state and federal agencies. Special districts include the fire protection districts, school districts, County Service Agencies (CSAs), Community Service Districts (CSDs), and Public Utility Districts (PUDs).

This project site is located within the Sierra Valley Fire Protection District which provides structural fire protection services. Police protection is provided by the Plumas County Sheriff. The project site is located in the Eastern Plumas Health Care District, with the nearest hospital located in Portola.

Comments were received from the Sierra Valley Fire Protection District on February 28, 2020, indicating that the Sierra Valley Fire Protection District personnel would need training for the specific type of facility of a solar electric generation facility as well as additional fire-fighting equipment being helpful. (Exhibits 8 & 9)

	Potentially Significant Impact	**Less Than Significant with Mitigation Incorporation**	**Less Than Significant Impact**	**No Impact**
a) Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered government facilities, need for new or physically altered government facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:				
Fire protection?	☐	☐	☒	☐
Police protection?	☐	☐	☐	☒
Schools?	☐	☐	☐	☒
Parks?	☐	☐	☐	☒
Other public facilities?	☐	☐	☐	☒

Impact Discussion: The solar electric generation facility would not cause a physical impact to or additional demand for public services such as fire protection, police protection, schools, parks, or other public facilities. Population growth is the driving force behind an increased demand on fire protection, police protection, schools, parks, and other facilities. The proposed solar electric

generation facility would not directly or indirectly induce population growth causing an increased demand on fire protection, police protection, schooling, parks, or other public facilities.

During the 30-day review period for the Special Use Permit, comments were provided by Michael Shehorn, Board Member, Sierra Valley Fire Protection District (SVFPD) (Exhibit 8), and Vicki Anderson, Fire Chief, SVFPD (Exhibit 9). As mentioned previously, the comments indicated that the Sierra Valley Fire Protection District personnel would need training for the specific type of facility of a solar electric generation facility as well as additional fire-fighting equipment being helpful.

Planning staff provided the SVFPD comments to Plumas-Sierra Rural Electric Cooperative (PSREC) and PSREC provided a response (Exhibit 10) to the comments stating the following:

1. Plumas-Sierra will work with the contractor as needed to ensure the design and construction of the solar generating facility is consistent with current safety standards.
2. Plumas-Sierra will coordinate with the Sierra Valley Fire District to provide training materials used in our area for other Solar facilities to orient to fire safety and management around a Solar facility. The SVFD will not be responsible for accessing or managing fire in the facility.
3. Since SVFD will not be required to access the Solar facility it is not expected that any additional PPE will be required.

The response from PSREC provides clarity as to the future steps that will occur for the project. Therefore, the comments provided do not result in substantial adverse physical impacts associated with the provision of new or physically altered government facilities or the need for a new or physically altered facility.

Therefore, there would be **a less than significant impact** to **Public Services**.

Mitigation Measure: No mitigation is required.

16. <u>RECREATION.</u>

Environmental Setting: People utilize the various areas around Plumas County for recreation. Recreation areas within the County are public parks, trails, forest lands, lakes, waterways, and other open space areas.

The project is located within the Eastern Plumas Recreation District.

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporation	Less Than Significant Impact	No Impact
a) Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that	☐	☐	☐	☒

substantial physical deterioration of the facility would occur or be accelerated?				
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?	☐	☐	☐	☒

Impact Discussion: The project involves the construction and operation of a solar electric generation facility, which would not increase the use of existing park or recreational facilities.

As mentioned, due to the nature of the project being a solar electric generation facility, recreational facilities would not be part of the project nor would the project require the construction or expansion of any recreational facilities.

Therefore, there would be **no impact** to **Recreation**.

Mitigation Measure: No mitigation is required.

17. <u>TRANSPORTATION.</u>

Environmental Setting: The state highway system provides the key inter-community roadway links within Plumas County. East-west access across Plumas County is provided by State Route (SR) 36 in the northern portion of the county and by SR 70 in the central/southern portions of the county, while SR 89 provides north-south access across the county. SR 147 serves the east side of Lake Almanor, while SR 49 and SR 284 provide access south towards Loyalton and north to Frenchman Reservoir in the far east portion of the county. County roads (and city roads in Portola) also provide important access, as do Forest Service roads. In total, there are 1,823 miles of public roadway in Plumas County, including 935 miles of US Forest Service roads, 674 miles of county roadways and 182 miles of state highways.

Due to the relatively dispersed nature of development in Plumas County, traffic congestion is not an issue, with the exception of "bell times" at some school areas and some locations around Lake Almanor during the summer months. SR 70 in Quincy is the busiest highway in Plumas County, with a peak-month, typically August, Average Daily Traffic (ADT) volume of 12,200. Other relatively busy locations are on SR 36 in Chester (7,900 ADT) and SR 70 in Portola (7,800 ADT). Overall, peak month volumes on Plumas County state highways have declined by 12 percent over the last 10 years. The decline has been seen in all regions of the County. Caltrans counts of all trucks countywide have declined by 15 percent since 1992. However, the number of the largest trucks (5 axle and above) has climbed by 45 percent over this same period, particularly along State Route 70.

Public transit is also provided in the county through several deviated fixed-routes. The service carries approximately 54,000 passenger-trips annually and is available to everyone.

Plumas County does not have passenger rail service, but there are two active freight rail operations. Union Pacific Railroad operates a line connecting Roseville, CA to the west with Salt Lake City, UT to the east. Burlington Northern Santa Fe (BNSF) Railway operates track from Keddie and along Lake Almanor into Lassen County and Oregon.

While there are no commercial airports in Plumas County, there are three publicly owned airports: Gansner Field in Quincy, Rogers Field Airport in Chester, and Nervino Airport in Beckwourth. As a whole, these airports serve approximately 44,000 operations (takeoffs and landings) annually. In addition to the airports, the Plumas District Hospital in Quincy, the Indian Valley Health Care District in Greenville, and the Eastern Plumas Hospital in Portola have heliports.

While there are many hiking trails in Plumas County, bicycle and pedestrian facilities along main travel corridors and in communities are very limited.

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporation	Less Than Significant Impact	No Impact
Would the project:				
a) Conflict with a program, plan, ordinance or policy addressing the circulation system, including transit, roadway, bicycle and pedestrian facilities?	☐	☐	☐	☒
b) Conflict or be consistent with CEQA Guidelines section 15064.3, subdivision (b)?	☐	☐	☐	☒
c) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	☐	☐	☐	☒
d) Result in inadequate emergency access?	☐	☐	☐	☒

Impact Discussion: As discussed throughout this study, the project is for a solar electric generation facility. The facility is served by State Highway 70. The project would not conflict with a program, plan, ordinance or policy addressing the circulation system.

Caltrans was contacted during the 30-day review period for the project and comment was provided, with the main point being that any work done in the state highway right-of-way must meet state highway standards and will require an encroachment permit. (Exhibit 11).

Due to the nature of the project, the vehicle miles traveled related to the project would be from construction crews during project construction, which is temporary, and limited travel from facility maintenance. The vehicle miles traveled as a result of the project would be negligible and the project would not conflict with CEQA Guidelines Section 15064.3 subdivision (b).

The project does not entail the development of sharp curves or dangerous intersections and would not increase hazards due to a design feature.

The project would not result in inadequate emergency access.

Therefore, the project would result in **no impact** to **Transportation**.

Mitigation Measure: No mitigation is required.

18. TRIBAL CULTURAL RESOURCES.

Environmental Setting: The cultural resources located throughout Plumas County can be attributed to the rich history of the county. The history of Plumas County begins from the time that the glaciers began to recede from the Sierra Nevada and Cascade Mountain ranges. Due to the glacial recession, for thousands of years, humans have been utilizing the Sierra and Cascade ranges.

The primary inhabitants of the county prior to European settlement were the Mountain Maidu. The Mountain Maidu people have lived in Plumas County from hundreds to thousands of years ago, and still live here. Other tribes, such as the Washoe and the Paiute most likely utilized the area while not settling permanently. It is likely that the Mountain Maidu people existed in small, scattered, familial groups in the valleys of Plumas County. While maintaining permanent villages in the lower elevations of the glacial valleys, during spring and fall, smaller groups traveled to the higher elevations, such as to the ridge tops and valleys of the Sierras, setting up open brush shelters. During the winter months, villages remained occupied and relied mostly on stored and preserved food.

In the spring of 1850, gold-seeking miners poured into the region in search of the fabled "Gold" Lake. Mining camps throughout the County were quickly established. Rivers were turned from their beds, ditches were dug to bring water from distant sources to the diggings, and the land was turned upside down.

The Mountain Maidu adapted to the changing environment by living on portions of ranch properties. In some cases the Mountain Maidu adopted the name of the ranching family associated with the ranch on which they resided. European settlers brought illnesses the Maidu had never been exposed to, causing a significant decline of the Maidu population.

To help preserve the rich Native American history, such as that in Plumas County, on September 25, 2014, Governor Brown signed Assembly Bill No. 52 (AB 52). AB 52 went into effect on July 1, 2015, and added tribal cultural resources to the categories of cultural resources in the California Environmental Quality Act. According to AB 52, a project has an impact on the environment if it has a substantial adverse change in the significance of a tribal cultural resource. A tribal cultural resource is considered significant if it is defined in Public Resources Code Section 21074 as either

a site, feature, place, or cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is listed or eligible for listing in the California Register of Historical Resources, in a local register of historical resources, or is a resource determined to be significant pursuant to Public Resources Code Section 5024.1 subdivision (c).

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporation	Less Than Significant Impact	No Impact
a) Would the project cause a substantial adverse change in the significance of a tribal cultural resource, defined in Public Resources Code Section 21074 as either a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is:				
(i) Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources as defined in Public Resources Code Section 5020.1(k), or	☐	☐	☐	☒
(ii) A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code 5024.1. In applying the criteria set forth in subdivision (c) of Public Resources Code Section 5024.1, the lead agency shall consider the	☐	☐	☐	☒

significance of the resource to a California Native American tribe.

Impact Discussion: On July 21, 2020, Planning staff mailed the notifications as required by Assembly Bill 52 (AB 52) to the following contacts shown on the Native American Contact List provided by Nancy Gonzalez-Lopez, Cultural Resources Analyst, Native American Heritage Commission:

Glenda Nelson, Chairperson
Estom Yumeka Maidu Tribe of the Enterprise Rancheria
2133 Monte Vista Avenue
Oroville, CA, 95966
Phone: (530) 532 - 9214
Fax: (530) 532-1768
info@enterpriserancheria.org

Kyle Self, Chairperson
Greenville Rancheria of Maidu Indians
P.O. Box 279
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Only two comments were received as a result of the noticing. The first comment was received on July 27, 2020 from the Estom Yumeka Maidu Tribe of the Enterprise Rancheria (Rancheria) by phone and followed up with an email (Exhibit 12) stating the Rancheria had "no comment." The second comment was received on July 30, 2020 from the Mooretown Rancheria of Maidu Indians which stated, "the Mooretown Rancheria is not aware of any known cultural resources on this site."(Exhibit 13) The remaining tribes did not respond or request consultation.

It is not anticipated that tribal cultural resources, as defined by Public Resources Code Section 21074 and listed or eligible for listing in the California Register of Historical Resources, in a local register of historical resources as defined in Public resources Code Section 5020.1(k), or is determined to be significant pursuant to Public Resources Code Section 5024.1 subdivision (c), would be impacted as a result of the construction and installation of a solar electric generation facility. The project site is fairly level and would require minimal ground disturbance. Additionally, the solar panels will be supported by piers in the ground, which too, would require minimal ground disturbance.

However, if any construction were to occur, any unanticipated cultural resources (historic or prehistoric) exposed during ground excavation or ground disturbing activities would cause construction to be terminated immediately until a qualified cultural resources specialist evaluates the resource(s). Any discovered resource(s) that merit long-term consideration will be collected and reported in accordance with standard archaeological management requirements.

Therefore, the project would result in **no impact** to **Tribal Cultural Resources**.

Mitigation Measure: No mitigation is required.

19. <u>UTILITIES AND SERVICE SYSTEMS.</u>

Environmental Setting: Utilities that are used within Plumas County are electricity, gas, water, and sewerage. Depending upon the location in Plumas County, electricity may be provided by Pacific Gas & Electric (PG&E), Plumas-Sierra Rural Electric Cooperative, or Liberty Utilities. The two ways that water and sewer treatment is provided to people in Plumas County are individual on-site systems or through special districts, Community Service Districts (CSDs), and County Service Agencies (CSAs). Propane and heating oils are used as a significant source of heat and are provided by companies such as Suburban Propane, High Sierra Propane, and Hunt & Sons, Inc.

Curbside solid waste services are provided throughout the unincorporated areas of the County by Feather River Disposal, a subsidiary of Waste Management, with the City of Portola being served by Intermountain Disposal. Solid waste is transferred to a transfer station by two methods, one being through curbside solid waste service and the other is personally by individuals for their benefit. Solid waste from the five transfer stations located in Plumas County is transferred to Lockwood Regional Landfill in Sparks, Nevada.

	Potentially Significant Impact	**Less Than Significant with Mitigation Incorporation**	**Less Than Significant Impact**	**No Impact**

Would the project:

a) Require or result in the relocation or construction of new or expanded water, wastewater treatment or stormwater drainage, electric power, natural gas, or telecommunications facilities, the construction or relocation of which could cause significant environmental effects?	☐	☐	☐	☒
b) Have sufficient water supplies available to serve the project and reasonably foreseeable future development during normal, dry, and multiple dry years?	☐	☐	☐	☒
c) Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?	☐	☐	☐	☒
d) Generate solid waste in excess of State or local standards, or in excess of the capacity of local infrastructure, or otherwise impair the attainment of solid waste reduction goals?	☐	☐	☐	☒
e) Comply with federal, state, and local statutes and regulations related to solid waste?	☐	☐	☐	☒

Impact Discussion: Due to the nature of the project, no new utility systems will be required to be constructed to serve the proposed project. The project is a solar electric generation facility for Plumas-Sierra Rural Electric Cooperative to generate "renewable, carbon-free electricity" to supply to the local electrical grid, which has a point of connection directly adjacent to the proposed project site.

As mentioned previously, the project is a solar electric generation facility, which would not require the use of water or wastewater treatment.

Due to the nature of the project, solid waste would not be generated.

Therefore, the project would result in **no impact** to **Utilities and Service Systems**.

Mitigation Measure: No mitigation is required.

20. <u>WILDFIRE.</u>

Environmental Setting: Suppression of natural fires has allowed the forest understory to become dense, creating the potential for larger and more intense wildland fires. Wind, steepness of terrain, and naturally volatile or hot-burning vegetation contributes to wildland fire hazard potential. In reviewing fire threat mapping data provided by the California Department of Forestry and Fire Protection, it appears that a majority of the County is classified as having a "Moderate" to "High" threat of wildland fire.

More specifically, reviewing Figure 26 from the Plumas County 2035 General Plan shows the location of the proposed project as being located within the "Very High" Fire Hazard Severity Zone of the State Responsibility Area.

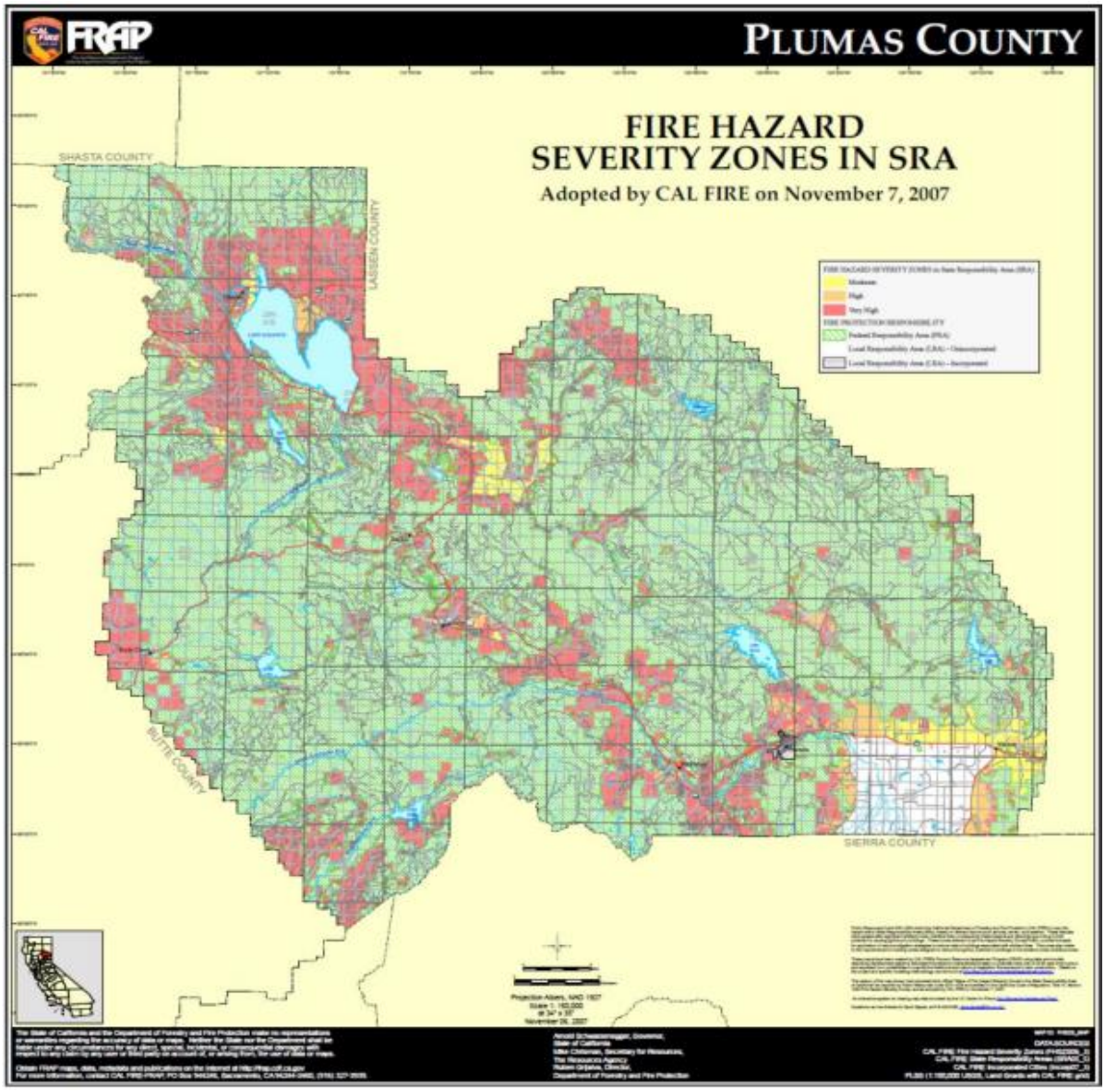


Figure 26. Fire Hazard Severity Zones in Plumas County, CA. Source: Department of Forestry

The Fire Hazard Severity Zones Map is a result of Government Code Section 51178 which requires the California Department of Forestry and Fire Protection to identify "Very High Fire Hazard Severity Zones."

The "Very High Fire Hazard Severity Zones" map is created based on the following criteria, per the "Fact Sheet: California's Fire Hazard Severity Zones" (Exhibit 14):

1. Vegetation – Fire hazard considers the potential vegetation over a 30- to 50-year time horizon. Vegetation is "fuel" to a wildfire and it changes over time.
2. Topography- Fire typically burns faster up steep slopes.
3. Weather- Fire moves faster under hot, dry, and windy conditions.
4. Crown fire potential – Under extreme conditions, fires burn to the top of trees and tall brush.

5. Ember production and movement – Fire brands are embers blown ahead of the main fire. Fire brands spread the wildfire and they get into buildings and catch the building on fire.
6. Likelihood – Chances of an area burning over a 30- to 50-year time period based on history and other factors.

Among the varying intended uses for the Fire Hazard Severity Zone maps, one is to guide building officials in the implementation and application of the wildland-urban interface standards for new construction.

Furthermore, in 2005, the Plumas County Fire Safe Council created the Plumas County Communities Wildfire Protection Plan to provide mitigations to potential threats from wildfire, such as hazardous fuel reduction, defensible space, land use, and building codes. Since 2005, the Plan was updated in 2013 and 2019.

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporation	Less Than Significant Impact	No Impact
If located in or near state responsibility areas or lands classified as very high fire hazard severity zones, would the project:				
a) Substantially impair an adopted emergency response plan or emergency evacuation plan?	☐	☐	☐	☒
b) Due to slope, prevailing winds, and other factors, exacerbate wildfire risks, and thereby expose project occupants to, pollutant concentrations from a wildfire or the uncontrolled spread of wildfire?	☐	☐	☐	☒
c) Require the installation or maintenance of associated infrastructure (such as roads, fuel breaks, emergency water sources, power lines or other utilities) that may exacerbate fire risk or that may result in temporary or	☐	☐	☐	☒

	ongoing impacts to the environment?				
d)	Expose people or structure to significant risks, including downslope or downstream flooding or landslides, as a result of runoff, post-fire slope instability, or drainage changes?	☐	☐	☐	☒

Impact Discussion: The project entails the construction of a solar electric generation facility which would be subject to all applicable building codes and standards, including the wildland-urban interface standards. The project is served by a paved, maintained state highway. Therefore, the project would not substantially impair an adopted emergency response plan or emergency evacuation plan.

Due to the nature of the project being the construction of a solar electric generation facility, removal of the project site's vegetation would be required as part of the project construction.

As previously mentioned, the Mitigated Negative Declaration and Initial Study (State Clearinghouse #2019079014) prepared for the project by K.S. Dunbar and Associates, Inc., which was submitted by the project applicant with the Special Use Permit and Site Development Permit application, made the point that removal of most of or all of the existing vegetation on the property would be required during construction, which would greatly reduce the fire danger of the site.

Additionally, the project site topography is fairly level and it is anticipated that maintenance of the property's vegetation would be required to ensure maximum efficiency of the facility. It is not anticipated that wildfire risks would be exacerbated causing the project occupants to be exposed to pollutant concentrations from a wildfire.

The purpose of the solar electric generation facility is to provide electricity to the local electric grid. Any connections made would be to the substation immediately adjacent to the project site and would be underground. Any connections made would not exacerbate fire risk or result in temporary or ongoing impacts to the environment.

The project is located on a site with level topography and the project is located in an overall area that has fairly flat and level topography. As a result, people or structures would not be exposed to significant risks, including downslope or downstream flooding, or landslides as a result of runoff, post-fire slope instability, or drainage changes.

Therefore, the project would result in **no impact** to **Wildfire**.

Mitigation Measure: No mitigation is required.

21. MANDATORY FINDINGS OF SIGNIFICANCE.

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporation	Less Than Significant Impact	No Impact
a) Does the project have the potential to substantially degrade the quality of the environment, 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, reduce the number or restrict the range of a rare or endangered plant or animal, or eliminate important examples of the major periods of California history or prehistory?	☐	☐	☐	☒
b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?	☐	☐	☐	☒
c) Does the project have environmental effects that will cause substantial adverse effects on human beings, either directly or indirectly?	☐	☐	☐	☒

Impact Discussion: The analysis from this Initial Study for the proposed project found the project would not have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, or threaten to eliminate a plant or animal in compliance with the mitigation measures set forth by the project applicant.

As discussed throughout this Initial Study, the proposed project was analyzed for cumulatively considerable impacts. This Initial Study found that the project would not have a cumulatively considerable impact when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects in compliance with the mitigation measures set forth by the project applicant.

The Initial Study found that the project would not have environmental effects that would cause substantial adverse effects on human beings, either directly or indirectly in compliance with the mitigation measures set forth by the project applicant.

In conclusion, from the project documentation submitted by the project applicant, Plumas-Sierra Rural Electric Cooperative, for the project site and proposed project, project impacts would cause no impact or a less than significant impact with all mitigation measures being incorporated.

EXHIBITS:

1. Email from Steve Chung, Encroachment Program Director, Navy Region Southwest dated March 30, 2020
2. Study titled *Clean Energy Results: Questions and Answers Ground-Mounted Solar Photovoltaic Systems*
3. Study titled *General Design Procedures for Airport-Based Solar Photovoltaic System*
4. Study titled *A Study of the Hazardous Glare Potential to Aviators from utility-Scale Flat-Plate Photovoltaic Systems*
5. FEMA flood map (Source: Plumas County GIS)
6. Project Site Plan
7. Excerpt from the California Department of Transportation's *Transportation and Construction Vibration Guidance Manual*
8. Comment letter from Michael Shehorn, Board Member, Sierra Valley Fire Protection District, dated February 23, 2020
9. Comment letter from Vicki Anderson, Fire Chief, Sierra Valley Fire Protection District, dated February 23, 2020
10. Comment letter from Plumas-Sierra Rural Electric Cooperative in response to Sierra Valley Fire Protection District comments, dated October 27, 2020
11. Email from Marcelino Gonzalez, Local Development Review & Regional Transportation Planner, California Department of Transportation, dated February 24, 2020
12. Email from Creig Marcus, Tribal Administrator, Estom Yumeka Maidu Tribe of the Enterprise Rancheria, dated July 27, 2020
13. Comment letter from Matthew Hatcher, Tribal Historic Preservation Officer, Mooretown Rancheria, dated July 27, 2020
14. California Department of Forestry and Fire Protection's *Fact Sheet: California's Fire Hazard Severity Zones*

Evans, Tim

From: Chung, Steve U CIV USN COMNAVREG SW SAN CA (USA) <steve.u.chung@navy.mil>
Sent: Monday, March 30, 2020 8:28 AM
To: Evans, Tim
Subject: RE: [Non-DoD Source] Plumas County - Special Use Permit and Site Development Permit for 4MW Solar Farm

Good Morning Tim,

We have completed our review for the proposed solar project in Plumas County. We have determined that the project will create negligible impact to military operations and not cause an adverse impact to the DoD mission. Our only request is that the proposed project utilize non-reflective panels to minimize glint/glare.

Should the proposed project be amended/revised to alter configuration or technology type, we would appreciate reviewing the revised plans so DoD may ensure compatibility with our military operations.

Thank you for the opportunity to review the proposed project.

All the Best and V/R,

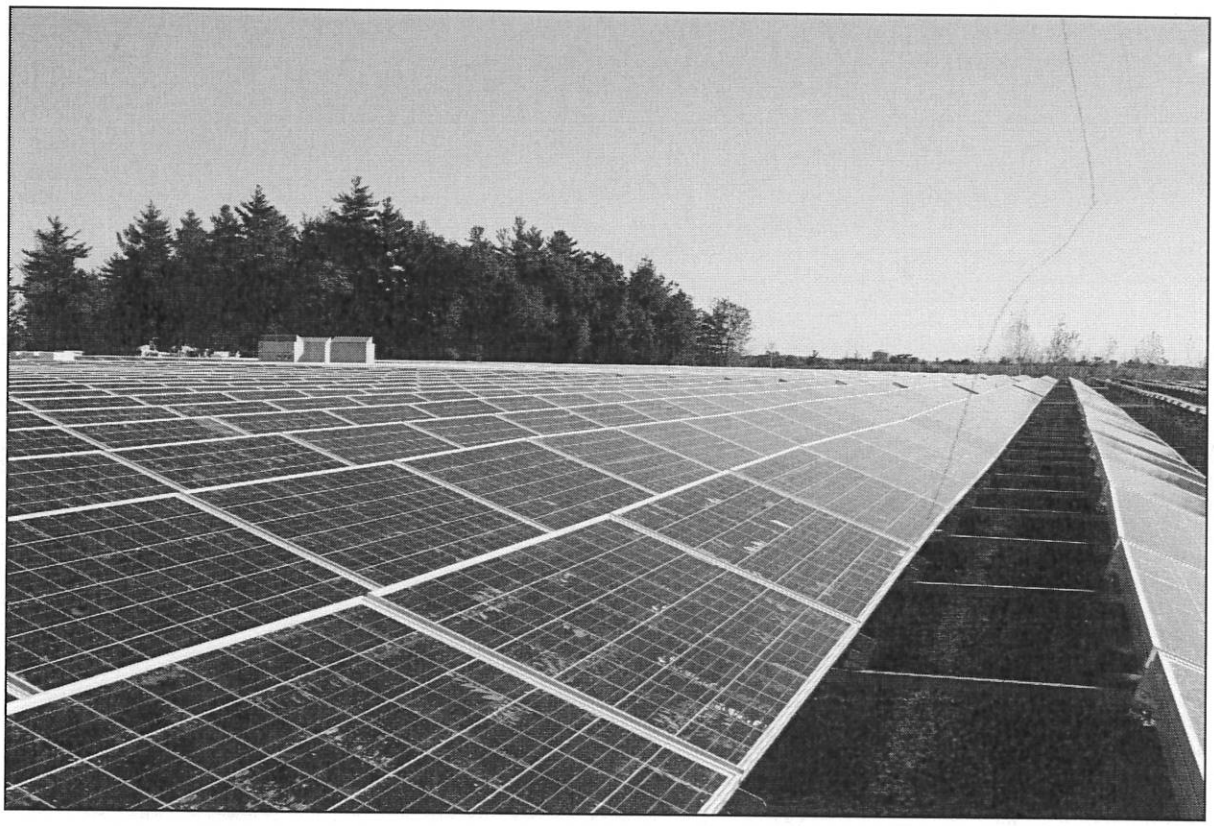
Steve Chung
NRSW Regional CPLO - Encroachment Program Director
937 N Harbor Dr, San Diego, CA 92132
Office: 619-532-4268 / Cell 619-723-5936
steve.u.chung@navy.mil (NIPR)
steve.u.chung@navy.smil.mil (SIPR)

EXHIBIT 1

CLEANENERGYRESULTS

Questions & Answers

Ground-Mounted Solar Photovoltaic Systems



Westford Solar Park, photo courtesy of EEA

June 2015

Massachusetts Department of Energy Resources
Massachusetts Department of Environmental Protection
Massachusetts Clean Energy Center

EXHIBIT 2

Table of Contents

Background

Encouraging increased use of solar photovoltaic (PV) technology, which converts sunlight directly into electricity, is a key priority for state clean energy efforts. The environmental benefits of solar PV abound. Unlike conventional fossil fuel power generation (such as coal, gas and oil), generating electricity with ground-mounted solar PV involves no moving parts, uses no water, and produces no direct emissions of climate-warming greenhouse gases.

Solar PV environmental and energy benefits, combined with strong incentives available for solar projects, have significantly increased the use of this technology recently. The Commonwealth's vibrant solar industry has a variety of ownership and financing options for Massachusetts residents and businesses looking to install solar PV systems. Purchasing a solar PV system generally involves upfront installation and equipment costs, but there are significant upfront and production-based incentives[1].

As the Massachusetts clean energy sector grows, the Baker Administration is working to ensure that solar PV and other clean energy technologies are sited in a way that is most protective of human health and the environment, and minimizes impacts on scenic, natural, and historic resources.

Purpose of Guide

This guide is intended to help local decision-makers and community members answer common questions about ground-mounted solar PV development. Ground-mounted solar PV has many proven advantages and there has been a steady growth of well received projects in the Commonwealth. However, these systems are still relatively new and unfamiliar additions to our physical landscape.

This guide focuses on questions that have been raised concerning the installation and operation of ground-mounted solar PV projects. It provides summaries and links to existing research and studies that can help understand solar PV technology in general and ground-mounted solar in particular.

Solar PV panels can and are of course also installed on buildings[2], car ports or light poles. This guide focuses on ground-mounted systems since most questions relate to this type of solar installation.

Developed through the partnership of the Massachusetts Department of Energy Resources (DOER), the Massachusetts Department of Environmental Protection (MassDEP), and the Massachusetts Clean Energy Center (MassCEC), this guide draws from existing recent literature in the United States and abroad and is not the result of new original scientific studies. The text was reviewed by the National Renewable Energy Laboratory (NREL).

As more or new information becomes available, the guide will be updated and expanded accordingly.

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[1] For a comprehensive overview, start at http://masscec.com/index.cfm/page/Solar-PV/pid/12584

[2] For an overview of the multiple options for siting PV and buildings in the same footprint, see the Solar Ready Buildings Planning Guide, NREL, 2009.

Solar PV Projects Are Sited Locally

The siting authority for solar PV projects resides at the local - not the state - level. One purpose of this guide is to inform and facilitate local efforts to expand clean energy generation in a sustainable way, and provide a consolidated source of existing research and information that addresses common questions faced by communities.

As part of the Green Communities Act of 2008, DOER and the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA) developed a model zoning by-law/ordinance called "as-of-right siting" that does not require a special permit. It is designed to help communities considering adoption of zoning for siting of large-scale solar. This model zoning by-law/ordinance provides standards for the placement, design, construction, operation, monitoring, modification and removal of new large-scale ground-mounted solar PV installations. The latest version of the model by-law was published in December 2014[3]. It provides useful information that will not be repeated extensively in this guide.

Consider Impacts of Other Possible Developments at Site

Use of land for the purpose of solar photovoltaic power generation should be compatible with most other types of land usage. However, DOER strongly discourages designating locations that require significant tree cutting because of the important water management, cooling and climate benefits trees provide. DOER encourages designating locations in industrial and commercial districts, or on vacant, disturbed land.

When assessing the impact of new ground-mounted solar arrays, communities and other stakeholders should carefully consider other types of development that might take place in a particular location if there was no solar installation. Stakeholders should bear in mind the higher or lower impacts that those alternatives might have in terms of noise, air pollution or landscape. These alternative impacts fall outside the scope of this guide, but are relevant when looking at individual projects.

[3] http://www.mass.gov/eea/docs/doer/green-communities/grant-program/model-solar-zoning.pdf

Hazardous Materials

The Question: What, if any, health risks do chemicals used to manufacture solar panels and other devices used in solar PV arrays pose if they are released into the environment?

Bottom Line: Because PV panel materials are enclosed, and don't mix with water or vaporize into the air, there is little, if any, risk of chemical releases to the environment during normal use. The most common type of PV panel is made of tempered glass, which is quite strong. They pass hail tests, and are regularly installed in Arctic and Antarctic conditions. Only in the unlikely event of a sufficiently hot fire is there a slight chance that chemicals could be released. This is unlikely because most residential fires are not hot enough to melt PV components and PV systems must conform to state and federal fire safety, electrical and building codes.

Transformers used at PV installations, that are similar to the ones used throughout the electricity distribution system in cities and towns, have the potential to release chemicals if they leak or catch fire. Transformer coolants containing halogens have some potential for toxic releases to the air if combusted. However, modern transformers typically use non-toxic coolants, such as mineral oils. Potential releases from transformers using these coolants at PV installations are not expected to present a risk to human health.

More Information: Ground-mounted PV solar arrays are typically made up of panels of silicon solar cells covered by a thin layer of protective glass, which is attached to an inert solid underlying substance (or "substrate"). While the vast majority of PV panels currently in use are made of silicon, certain types of solar cells may contain cadmium telluride (CdTe), copper indium diselenide (CIS), and gallium arsenide (GaAs).

All solar panel materials, including the chemicals noted above, are contained in a solid matrix, insoluble and non-volatile at ambient conditions, and enclosed. Therefore, releases to the ground from leaching, to the air from volatilization during use, or from panel breakage, are not a concern. Particulate emissions could only occur if the materials were ground to a fine dust, but there is no realistic scenario for this. Panels exposed to extremely high heat could emit vapors and particulates from PV panel components to the air. However, researchers have concluded that the potential for emissions derived from PV components during typical fires is limited given the relatively short-duration of most fires and the high melting point (>1000 degrees Celsius) of PV materials compared to the roof level temperatures typically observed during residential fires (800-900 degrees Celsius). In the rare instance where a solar panel might be subject to higher temperatures, the silicon and other chemicals that comprise the solar panel would likely bind to the glass that covers the PV cells and be retained there.

Release of any toxic materials from solid state inverters is also unlikely provided appropriate electrical and installation requirements are followed. For more information on public safety and fire, see the Public Safety section of this document.

We should also note that usually the rain is sufficient to keep the panels clean, so no extra cleaning in which cleaning products might be used, is necessary.

Resources:

Fthenakis, V.M., Overview of Potential Hazards in *Practical Handbook of Photovoltaics: Fundamentals and Applications, General editors T. Markvart and L. Castaner, to be published by Elsevier in 2003.*

Fthenakis, V.M. Life cycle impact analysis of cadmium in CdTe PV production. Renewable and Sustainable Energy Reviews 8, 303-334, 2004.

Fthenakis V.M., Kim H.C., Colli A., and Kirchsteiger C., Evaluation of Risks in the Life Cycle of Photovoltaics in a Comparative Context, 21st European Photovoltaic Solar Energy Conference, Dresden, Germany, 4-8 September 2006.

Moskowitz P. and Fthenakis V., Toxic materials released from photovoltaic modules during fires; health risks, Solar Cells, 29, 63-71, 1990.

Sherwani, A.F., Usmani, J.A., & Varun. Life cycle assessment of solar PV based electricity generation systems: A review. Renewable and Sustainable Energy Reviews. 14, 540-544, 2010.

Zayed, J; Philippe, S (2009-08). "Acute Oral and Inhalation Toxicities in Rats With Cadmium Telluride" (PDF). *International journal of toxicology* (International Journal of Toxicology) **28** (4): 259–65. doi:10.1177/1091581809337630. PMID 19636069. http://ijt.sagepub.com/cgi/content/short/28/4/259.

End-of-Life/Decommissioning

Question: How do I manage solar panels after they are decommissioned and no longer in use? Can they be recycled and do hazardous waste disposal requirements apply?

Bottom Line: As more solar panels are decommissioned interest in recycling the panels has increased in Europe and the U.S. Massachusetts regulations ensure proper disposal and recycling of panels if they have components that constitute solid or hazardous waste under state regulations.

More information: The average life of solar PV panels can be 20-30 years (or longer) after initial installation. PV cells typically lose about 0.5% of their energy production capacity per year. At the time of decommissioning, panels may be reused, recycled or disposed. Since widespread use of solar PV is recent in Massachusetts, only a small percentage of solar panels in use in the state have had to be replaced due to damage or reached the end of their useful lifetime. A significant increase in the amount of end-of-life PV modules is expected over the next few decades.

When solar panels are decommissioned and discarded, state rules require that panel disposal be "properly managed" pursuant to the Massachusetts hazardous waste regulations, 310 CMR 30.000. There are many different types of solar panels used in ground-mounted or roof mounted solar PV systems; some of these panels have components that may require special hazardous waste disposal or recycling. Solar module manufacturers typically provide a list of materials used in the manufacturing of their product, which may be used to determine the proper disposal requirements at the time of decommissioning. Under the hazardous waste regulations, the burden is on the generator of the panels to determine if the waste being generated (the solar panels) is hazardous or not. This determination can be made using "knowledge" (i.e. an MSDS sheet listing the materials used in manufacture of the panels) or testing (i.e. the Toxicity Characteristic Leaching Procedure – TCLP).

If a panel is tested and passes TCLP then it is regulated as a solid waste; if it fails TCLP then it is regulated as a hazardous waste.

However, if the solar panel is determined to be hazardous due solely to the presence of metal-bearing circuit boards, the panels may be conditionally exempt from the hazardous waste regulations if destined for recycling. See 310 CMR 30.202(5)(d)-(e) in the Mass. Hazardous Waste Regulations.[4]

People who lease land for solar projects are encouraged to include end-of-life panel management as part of the lease. In cases where panels are purchased, owners need to determine whether the end-of

[4] (5) The following materials are not subject to 310 CMR 30.200, or any other provision of 310 CMR 30.000:

(d) Whole used circuit boards being recycled provided they are free of mercury switches, mercury relays, nickel-cadmium batteries, or lithium batteries.

(e) Shredded circuit boards being recycled provided that they are:

1. managed in containers sufficient to prevent a release to the environment prior to recovery; and,
2. free of mercury switches, mercury relays and nickel-cadmium batteries and lithium batteries.

life panels are a solid or hazardous waste and dispose or recycle the panels appropriately. Massachusetts regulations require testing of waste before disposal.

Because of the various materials used to produce solar panels (such as metal and glass), interest in recycling of solar modules has grown. Throughout Europe, a not-for-profit association (PV Cycle) is managing a voluntary collection and recycling program for end-of-life PV modules. The American photovoltaic industry is not required by state or federal regulation to recycle its products, but several solar companies are starting to recycle on a voluntary basis. Some manufacturers are offering end-of-life recycling options and independent companies looking to recycle solar modules are growing. This allows for the recycling of the PV panels and prevents issues with the hazardous materials. Currently, the California Department of Toxic Substances Control is considering standards for the management of solar PV panels at the end of their use.

DOER's model zoning provides language on requirements for abandonment and decommissioning of solar panels for use by local officials considering local approvals for these projects.

Resources

End-of-life PV: then what? - Recycling solar PV panels
http://www.renewableenergyfocus.com/view/3005/end-of-life-pv-then-what-recycling-solar-pv-panels/

MassDEP Hazardous Waste Regulations 310 CMR 30.000
http://www.mass.gov/eea/agencies/massdep/recycle/regulations/310-cmr-30-000.html

PV Cycle, Europe: http://www.pvcycle.org/

California Department of Toxic Substances Control, Proposed Standards for the Management of Hazardous Waste Solar Modules,
http://www.dtsc.ca.gov/LawsRegsPolicies/Regs/Reg_Exempt_HW_Solar_Panels.cfm

Ambient Temperature ("Heat Island")

The Question: Does the presence of ground-mounted solar PV arrays cause higher ambient temperatures in the surrounding neighborhood (i.e., the "heat island" effect)?

Bottom Line: All available evidence indicates that there is no solar "heat island" effect caused by the functioning of solar arrays. Cutting shade trees for solar PV might increase the need for cooling if those trees were shading buildings. This is primarily a concern in town centers and residential areas (locations where large ground-mounted PV is not encouraged) and is a potential impact of any development activity that requires tree-cutting.

More Information: All available evidence indicates that there is no solar "heat island" effect caused by the functioning of solar arrays. Solar panels absorb photons from direct sunlight and convert it to electricity. This minimizes the likelihood of substantially changing temperatures at the site or the surrounding neighborhood. For an area with no PV system, solar energy impacting the ground is either reflected or absorbed. There is no research to support heat production from the solar panels themselves.

Sunpower, a private solar manufacturer, conducted a study on the impact of solar PV on the local temperature, and concluded that a solar PV array can absorb a higher percentage of heat than a forested parcel of land without an array. The study points out that while solar PV modules can reach high operating temperatures up to 120 degrees Fahrenheit, they are thin and lightweight and therefore do not store a large amount of heat. Because of this, and the fact that panels are also shown to cool to ambient air temperature shortly after the sun sets, the Sunpower study concludes that the area surrounding a large-scale solar array is unlikely to experience a net heating change from the panels.

If trees are removed that were previously shading a building, that building could get warmer in full sunshine than when the trees were shading it. The June 1, 2011 tornado that ripped through Western Massachusetts created an opportunity to empirically measure the effects of the loss of neighborhood trees on temperatures and air humidity in the streets. A report by the U.S. Department of Agriculture Forest Service concluded that daily mean morning and afternoon temperatures were typically greater in the tornado-impacted neighborhood in Springfield, Massachusetts than in the unaffected neighborhood and forest sites, but were similar at night. Residents noted increased use of air-conditioning units and an overall increase in energy costs in July and August of 2011.

Resources:

SUNPOWER, Impact of PV Systems on Local Temperature, July 2010

USDA Forest Services report: http://www.regreenspringfield.com/wp-content/uploads/2011/11/tornado%20climate%20report%203.pdf

Electric and Magnetic Fields (EMF)

The Question: What, if any, health risks do the electric and magnetic fields (EMF) from solar panels and other components of solar PV arrays pose?

Bottom Line: Electric and magnetic fields are a normal part of life in the modern world. PV arrays generate EMF in the same extremely low frequency (ELF) range as electrical appliances and wiring found in most homes and buildings. The average daily background exposure to magnetic fields is estimated to be around one mG (milligauss – the unit used to measure magnetic field strength), but can vary considerably depending on a person's exposure to EMF from household electrical devices and wiring. The lowest exposure level that has been potentially associated with a health effect is three mG. Measurements at three commercial PV arrays in Massachusetts demonstrated that their contributions to off-site EMF exposures were low (less than 0.5 mG at the site boundary), which is consistent with the drop off of EMF strength based on distance from the source.

More Information: Solar PV panels, inverters and other components that make up solar PV arrays produce extremely low frequency EMF when generating and transmitting electricity. The extremely low frequency EMF from PV arrays is the same as the EMF people are exposed to from household electrical appliances, wiring in buildings, and power transmission lines (all at the power frequency of 60 hertz). EMF produced by cell phones, radios and microwaves is at much higher frequencies (30,000 hertz and above).

Electric fields are present when a device is connected to a power source, but are shielded or blocked by common materials, resulting in low potential for exposures. On the other hand, magnetic fields, which are only generated when a device is turned on, are not easily shielded and pass through most objects, resulting in greater potential for exposure. Both types of fields are strongest at the source and their strength decreases rapidly as the distance from the source increases. For example, the magnetic field from a vacuum cleaner six inches away from the motor is 300 mG and decreases to two mG three feet away. People are exposed to EMF during normal use of electricity and exposure varies greatly over time, depending on the distance to various household appliances and the length of time they are on. The daily average background level of magnetic fields for US residents is one mG.

EMF from PV Arrays: Solar PV panels produce low levels of extremely low frequency (ELF) EMF, with measured field strengths of less than one mG three inches from the panel. Solar PV power inverters, transformers and conduits generate higher levels of ELF-EMF. The amount of ELF-EMF is proportional to the electrical capacity of the inverter and is greater when more current (electricity) is flowing through a power line.

In a study of two PV arrays (using 10-20 kW invertors) in Kerman and Davis, California, the magnetic field was highest at the inverters and transformers, but decreased rapidly to less than one mG within 50 feet of the units, well within the boundary of the PV array (Chang and Jennings 1994). This data indicates that extremely low frequency EMF field strengths at residences near systems of this size would be below the typical levels experienced by most people at home. The highest extremely low frequency EMF (up to 1,050 mG) was found next to an inverter unit at the point of entry of the electrical conduits. Even this

value is less than the extremely low frequency EMF reported for some common household devices such as an electric can opener with a maximum of 1500 mG at 6 inches.

In a recent study of three ground mounted PV arrays in Massachusetts, the above results were confirmed. The PV arrays had a capacity range of 1 to 3.5 MW. Magnetic field levels along the PV array site boundary were in the very low range of 0.2 to 0.4 mG. Magnetic fields at 3 to 7 feet from the inverters ranged from 500 to 150 mG. At a distance of 150 feet from the inverters, these fields dropped back to very low levels of 0.5 mG or less, and in many cases to much less than background levels (0.2 mG).

Potential Health Effects: Four research studies have reported an association between three to four mG EMF exposure and childhood leukemia, while 11 other studies have not. These studies are inconsistent and do not demonstrate a causal link that would trigger a World Health Organization (WHO) designation of EMF as a possible carcinogen[5]. Studies looking at other cancers in humans and animals have not found evidence of a link to residential ELF-EMF exposure.

Reference Exposure Levels: To protect the general public from health effects from short-term high level magnetic fields, the International Commission on Non-Ionizing Radiation Protection (ICNIRP, 2010) advised an exposure limit for extremely low frequency magnetic fields at 2000 mG. ICNIRP determined that the evidence on the impact of long-term exposure to low level magnetic fields was too uncertain to use to set a guideline. Guidelines for the magnetic field allowed at the edge of transmission line right-of-ways have been set at 200 mG by Florida and New York. Exposure to magnetic fields greater than 1000 mG is not recommended for people with pacemakers or defibrillators (ACGIH, 2001).

Resources:

American Conference of Government Industrial Hygienist (ACGIH). 2001. as cited in NIEHS 2002.

Chang, GJ and Jennings, C. 1994. Magnetic field survey at PG&E photovoltaic sites. PG&E R&D Report 007.5-94-6.

Electric Power Research Institute (EPRI). 2012. EMF and your health. http://my.epri.com/portal/server.pt?Abstract_id=000000000001023105.

International Commission on Non-Ionizing Radiation Protection (ICNIRP). 2010. ICNIRP Guidelines for limiting exposure to time-varying electric and magnetic fields (1 Hz – 100kHz). Health Physics 99(6):818-836.

National Cancer Institute (NCI). 2005. Magnetic Field Exposure and Cancer: Questions and Answers. U.S. Department of Health and Human Services, National Institutes of Health. Available http://www.cancer.gov/cancertopics/factsheet/Risk/magnetic-fields, accessed May 14, 2012.

[5] WHO has designated ELF-EMF as a possible carcinogen. The use of the label "possible carcinogen" indicates that there is not enough evidence to designate ELF-EMF as a "probable carcinogen "or "human carcinogen," the two indicators of higher potential for being carcinogenic in humans.

National Institute of Environmental Health Science (NIEHS) 2002. Electric and Magnetic Fields Associated with the Use of Electric Power: Questions and Answers. Available http://www.niehs.nih.gov/health/assets/docs_p_z/results_of_emf_research_emf_questions_answers_booklet.pdf, accessed May 11, 2012.

National Institute of Environmental Health Science (NIEHS) web page on EMF. Available http://www.niehs.nih.gov/health/topics/agents/emf/, accessed May 11, 2012.

Oregon Department of Transportation (Oregon DOT). Scaling public concerns of electromagnetic fields produced by solar photovoltaic arrays. Produced by Good Company for ODOT for the West Linn Solar Highway Project. Available www.oregon.gov/ODOT/HWY/OIPP/docs/emf**concerns**.pdf.

World Health Organization (WHO). 2007. Electromagnetic fields and public health: Exposure to extremely low frequency fields. Fact sheet N°322. June 2007. Available http://www.who.int/mediacentre/factsheets/fs322/en/index.html, accessed May 16, 2012. This fact sheet provides a short summary of the in-depth review documented in the WHO 2007, Environmental Health Criteria 238. Available http://www.who.int/peh-emf/publications/elf_ehc/en/index.html.

Property Values

Question: How do ground-mounted solar PV arrays adjacent to residential neighborhoods influence the property values in those neighborhoods?

Bottom Line: No research was found specific to ground-mounted solar PV and property values. Residential property value research on roof-mounted solar PV and wind turbines illustrates no evidence of devaluation of homes in the area. Municipalities that adopt zoning for solar facilities may want to consider encouraging project developers to include screening vegetation along site borders to minimize visual impacts on surrounding neighborhoods.

More Information: A review of literature nationwide shows little evidence that solar arrays influence nearby property values. An analysis focused on roof-mounted solar PV done by the U.S. Department of Energy Lawrence Berkeley National Laboratory concludes that household solar installation actually increases home property values. This research analyzes a large dataset of California homes that sold from 2000 through mid-2009 with PV installed. Across a large number of repeat sales model specifications and robustness tests, the analysis finds strong evidence that California homes with PV systems have sold for a premium over comparable homes without PV systems.

Resources:

An Analysis of the Effects of Residential Photovoltaic Energy Systems on Home Sales Prices in California
http://emp.lbl.gov/sites/all/files/lbnl-4476e.pdf

Public Safety (including fires)

Question: What public safety issues arise from people's (including children) access to areas where solar arrays are installed? Can electrical and other equipment associated with solar projects cause electrical fires?

Bottom Line: Large-scale ground-mounted arrays are typically enclosed by fencing. This prevents children and the general public from coming into contact with the installations, thus preventing unsafe situations. The National Electric Code has mandatory requirements to promote the electrical safety of solar PV arrays. Emergency personnel responding to potential emergencies at a solar PV site face the most risk, but the solar industry and firefighters provide training and education for emergency personnel to ensure that the proper safety precautions are taken.

More Information: The National Electric Code has mandatory requirements for the electrical safety of solar PV arrays. To protect against intruders, Article 690 of the National Electric Code covers the safety standards for solar PV installation and requires that conductors installed as part of solar PV be "not readily accessible". With a large-scale ground-mounted array, a fence is typically installed around the system to prevent intruders. Some communities have solar PV or signage by-laws that require identification of the system owner and 24-hour emergency contact information.

DOER's Model by-Law/ordinance requires owners of solar PV facilities to provide a copy of the project summary, electrical schematic, and site plan to the local fire chief, who can then work with the owner and local emergency services to develop an emergency response plan.

These measures can be combined with products to prevent theft of the panels. Some are very low cost options (fastener type) while there are other options that are more expensive (alarm system type) but also more effective. The biggest potential risk associated with solar PV systems is the risk of shock or electrocution for firefighters and other emergency responders who could come in contact with high voltage conductors. A 2010 study on firefighter safety and emergency response for solar PV systems by the Fire Protection Research Foundation, based in Quincy, Massachusetts, recommended steps firefighters can take when dealing with wiring and other components that may be energized. The Solar Energy Business Association of New England (SEBANE) has been working to provide training and education to first-responders to identify and avoid potential hazards when responding to a solar PV fire.

For more information about toxics/fires, see the Hazardous Materials Section.

Resources:

Moskowitz, P.D. and Fthenakis, V.M., Toxic Materials Released from Photovoltaic Modules During Fires: Health Risks, Solar Cells, 29, 63-71, 1990. 21.

Solar America Board for Codes and Standards
http://www.solarabcs.org/about/publications/reports/blindspot/pdfs/BlindSpot.pdf

Fire Fighter Safety and Emergency Response for Solar Power Systems: Final Report, May 2010. Prepared by The Fire Protection Research Foundation

National Electric Code Article 250: Grounding and Bonding, Article 300: Wiring Methods, Article 690 Solar PV Systems, Article 705 Interconnected Electric Power Production Sources

Historic Preservation

The Question: What are the appropriate standards when land with historical or archaeological significance is developed for large-scale solar PV arrays?

Bottom Line: Parties undertaking solar PV projects with state or federal agency involvement must provide the Massachusetts Historical Commission (MHC) with complete project information as early as possible in the planning stage, by mail to the MHC's office (see Resources). Parties should also contact local planning, historical or historic district commissions to learn about any required local approvals. Municipalities should also take the presence of historic resources into account when establishing zoning regulations for solar energy facilities in order to avoid or minimize impacts.

More Information: Land being evaluated for the siting of large-scale solar PV has historical or archaeological significance including properties listed in the National or State Registers of Historic Places and/or the Inventory of Historic and Archaeological Assets of the Commonwealth.

Federal and state laws require that any new construction, demolition or rehabilitation projects (including new construction of solar PV) that propose to use funding, licenses or permits from federal or state government agencies must be reviewed by the MHC so that feasible alternatives are developed and implemented to avoid or mitigate any adverse effects to historic and archaeological properties. Projects receiving federal funding, licenses or permits are reviewed by the involved federal agency in consultation with the MHC and other parties in compliance with Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. 470f) and the implementing regulations (36 CFR 800) in order to reach agreement to resolve any adverse effects. Projects receiving state funding, licenses or permits must notify the MHC in compliance with M.G.L. c. 9, ss. 26-27C and the implementing regulations 950 CMR 71. If the MHC determines that the project will have an adverse effect, the involved state agency, the project proponent, the local historical preservation agencies, and other interested parties consult to reach an agreement that outlines measures to be implemented to avoid, minimize, or mitigate adverse effects. For projects with both federal and state agency involvement, the Section 106 process is used.

Some communities have local preservation ordinances or established local historic districts that require local approval for new construction visible from a public way. Local historic district commissions have adopted design guidelines for new construction within their historic districts and historic neighborhoods. However, these guidelines must account for Chapter 40C Section 7 of the General Laws, which requires a historic district commission to consider the policy of the Commonwealth to encourage the use of solar energy systems and to protect solar access.

Resources:

Federal Agency Assisted Projects:

Section 106 review information and the federal regulations 36 CFR 800 are available at the Advisory Council on Historic Preservation (ACHP) web site: www.achp.gov. Check with the involved federal agency for how they propose to initiate the MHC notification required by 36 CFR 800.3.

State Agency Assisted Projects:

Massachusetts General Laws Chapter 9, sections 26-27C

MHC Regulations 950 CMR 71 (available from the State House Bookstore)

MHC Review & Compliance FAQs http://www.sec.state.ma.us/mhc/mhcrevcom/revcomidx.htm

MHC Project Notification Form (PNF) & Guidance for Completing the PNF and required attachments (USGS locus map, project plans, current photographs keyed to the plan). Mail or deliver the complete project information to the MHC's office: http://www.sec.state.ma.us/mhc/mhcform/formidx.htm

General Guidance about Designing Solar PV Projects on Historic Buildings and in Historic Areas: http://www.nrel.gov/docs/fy11osti/51297.pdf

Noise

Question: Do the inverters, transformers or other equipment used as part of ground-mounted solar PV create noise that will impact the surrounding neighborhood?

Bottom Line: Ground-mounted solar PV array inverters and transformers make a humming noise during daytime, when the array generates electricity. At 50 to 150 feet from the boundary of the arrays, any sound from the inverters is inaudible. Parties that are planning and designing ground-mounted solar PV should explore options to minimize noise impacts to surrounding areas. This could include conducting pre-construction sound studies, evaluating where to place transformers, and undertaking appropriate noise mitigation measures.

More Information: Most typically, the source of noise associated with ground-mounted solar PV comes from inverters and transformers. There also may be some minimal noise from switching gear associated with power substations. The crackling or hissing sound caused by high-voltage transmission lines (the "Corona Effect") is not a concern in the case of solar PV, which uses lower voltage lines.

Parties siting ground-mounted solar PV projects should consult equipment manufacturers to obtain information about sound that can be expected from electrical equipment, since this can vary. For example, according to manufacturer's information, a SatCon Powergate Plus 1 MW Commercial Solar PV Inverter has an unshielded noise rating of 65 decibels (dBA) at five feet. This is approximately the sound equivalent of having a normal conversation with someone three feet away. Another source of information is the National Electrical Manufacturers Association (NEMA) standards, which will provide maximum sound levels from various equipment arrays. From NEMA, a large dry-type transformer (2001-3333 kVA) that is forced air cooled and ventilated has an average sound level of 71 dBA, which is approximately the sound level one would expect from a vacuum cleaner at ten feet. There may be several such units on a substantially sized PV site, which would increase the sound level to some degree.

Sound impacts from electrical equipment can be modeled to the property line or nearest sensitive receptor (residence). Sound impacts can be mitigated with the use of enclosures, shielding and careful placement of the sound-generating equipment on-site. The rule of thumb for siting noise-generating equipment is that the sound impact can be reduced by half by doubling the distance to the receptor.

In some areas both in the US and Canada, sound impact analysis is required as part of the permitting process for large PV systems. For example, in the Province of Ontario, Canada, any project greater than 12 MW is required to perform a sound impact analysis (Ontario 359/09). California also requires a sound impact analysis for large PV projects. Massachusetts currently has no such requirement, but the reader should note that ground-mounted systems in Massachusetts very rarely go over 6 MW, which is half the size of the 12 MW that triggers a sound analysis in Ontario.

A recent study measured noise levels at set distances from the inverters and from the outer boundary of three ground-mounted PV arrays in Massachusetts with a capacity range of 1 to 3.5 MW. Close to the inverters (10 feet), sound levels varied from an average of 55 dBA to 65 dBA. Sound levels along the fenced boundary of the PV arrays were generally at background levels, though a faint inverter hum could be heard at some locations. Any sound from the PV array and equipment was inaudible and

sound levels were at background levels at setback distances of 50 to 150 feet from the boundary. Project developers should consult with local planning and zoning officials to determine if local noise ordinances may be applicable. Many local noise ordinances establish absolute limits on project impact noise (such as a 40 dBA nighttime limit). In these communities, a noise impact assessment may be required.

Resources:

NEMA Standards Publication No. TR=1-1993(R2000), *Transformers, Regulators and Reactors*

Noise Assessment: Borrego 1 Solar Project, MUP 3300-10-26 Prepared by Ldn Consulting, Inc, Fallbrook, CA. January 14, 2011

Ontario Regulation 359/09 Renewable Energy Approval (REA) Regulation, Ontario Ministry of the Environment, Canada http://www.ontario.ca/environment-and-energy/renewable-energy-approvals

Tech Environmental, Study of Acoustic and EMF levels from Solar Photovoltaic Projects, Prepared for the Massachusetts Clean Energy Center, December 2012, http://images.masscec.com/uploads/attachments/Create%20Basic%20page/Study_of_Acoustic_and_EMF_Levels_from_Solar_Photovoltaic_Projects.pdf

Water-Related Impacts

Question: Can chemicals that might be contained in solar PV threaten public drinking water systems? Will flooding occur in cases where trees must be removed in order to install the solar arrays? How do we ensure that wetland resources are protected?

Bottom Line: Rules are in place to ensure that ground-mounted solar arrays are installed in a ways that protect public water supplies, wetlands, and other water resource areas. All solar panels are contained in a solid matrix, are insoluble and are enclosed. Therefore, releases are not a concern.

More Information: Because trees offer multiple water management, cooling and climate benefits, clear-cutting of trees for the installation of ground-mounted solar PV is discouraged. For projects that do propose to alter trees, the Massachusetts Environmental Policy Act (MEPA) has thresholds for the proposed alteration of a certain number of acres of land, the size of electrical facilities, and other criteria that trigger state review of proposed projects. Clear cutting of trees and other aspects of proposed projects would be reviewed through an Environmental Notification Form/Environmental Impact Statement if thresholds are triggered. More information is available at:

MassDEP has determined that the installation of solar arrays can be compatible with the operation and protection of public drinking water systems. This includes the installation of solar arrays within the Zone I, which is a 400-foot protective radius around a public ground water well. Solar projects proposed on lands owned by public water systems outside the Zone I may be approved subject to standard best management practices, such as the proper labeling, storage, use, and disposal of products. MassDEP has a guidance/review process in place to ensure that the installation of ground-mounted solar PV in these areas protects public water supplies.

Installing solar arrays on undeveloped land can preserve the permeable nature of the land surface provided the project design minimizes disturbance to natural vegetative cover, avoids concentrated runoff, and precipitation is otherwise recharged into the ground to the greatest extent practicable. Storm water flow, as well as information about site-specific soils and slope, is taken into account during the design and installation of solar arrays.

MassDEP discourages installation of ground-mounted solar PV systems in wetland areas, including riverfront locations. Solar projects within wetland areas are unlikely to comply with the performance standards in the Wetlands Protection Act regulations. If a solar installation is proposed in a wetland, a riverfront area, a floodplain, or within 100 feet of certain wetlands, the project proponent must file a notice of intent (or application to work in wetland areas) with the local Conservation Commission, which administers the Wetlands Protection Act at the municipal level. Copies should also go to MassDEP. Solar installations may be sited near, but outside of wetlands, in a manner that protects the functions of wetlands and that minimizes impacts from associated activities such as access and maintenance. Ancillary structures related to construction of a solar installation or transmission of power may be permitted to cross rivers and streams using best design and management practices.

Resources:

More information about the Wetlands Protection Act requirements may be found in the implementing regulations at 310 CMR 10.00: http://www.mass.gov/eea/agencies/massdep/water/regulations/310-cmr-10-00-wetlands-protection-act-regulations.html

MassDEP Guidance for Siting Wind and Solar in Public Water Supply Land: http://www.mass.gov/eea/agencies/massdep/water/regulations/wind-and-solar-energy-project-on-public-water-supply-land.html

MassDEP Chapter 91 Guidance for Renewable Energy Projects: http://www.mass.gov/eea/agencies/massdep/water/reports/chapter-91-licensing-and-renewable-energy.html

Glare

Question: How important is reflectivity and potential visual impacts from solar projects, especially near airports?

Bottom Line: Solar panels are designed to reflect only about 2 percent of incoming light, so issues with glare from PV panels are rare. Pre-construction modeling can ensure that the placement of solar panels prevents glare.

More Information: Solar panels are designed to absorb solar energy and convert it into electricity. Most are designed with anti-reflective glass front surfaces to capture and retain as much of the solar spectrum as possible. Solar module glass has less reflectivity than water or window glass. Typical panels are designed to reflect only about 2 percent of incoming sunlight. Reflected light from solar panels will have a significantly lower intensity than glare from direct sunlight.

An analysis of a proposed 25-degree fixed-tilt flat-plate polycrystalline PV system located outside of Las Vegas, Nevada showed that the potential for hazardous glare from flat-plate PV systems is similar to that of smooth water and not expected to be a hazard to air navigation.

Many projects throughout the US and the world have been installed near airports with no impact on flight operations. United Kingdom and U.S. aircraft accident databases contain no cases of accidents in which glare caused by a solar energy facility was cited as a factor.

When siting solar PV arrays pre-construction modeling can ensure the panels are placed in a way that minimizes any potential glare to surrounding areas.

Resources:

Technical Guidance for Evaluating Selected Solar Technologies on Airports, Federal Aviation Administration, November 2010 (currently under review), http://www.faa.gov/airports/environmental/policy_guidance/media/airport_solar_guide.pdf

A Study of the Hazardous Glare Potential to Aviators from Utility-Scale Flat-Plate Photovoltaic Systems, Black & Veatch Corporation, August 2011, http://www.isrn.com/journals/re/2011/651857/

Solar Photovoltaic Energy Facilities, Assessment of Potential Impact on Aviation, Spaven Consulting, January 2011: http://www.solarchoice.net.au/blog/solar-panels-near-airports-glare-issue/

Endangered Species and Natural Heritage

Question: Who ensures that rare animal and plant species and their habitats are not displaced or destroyed during the construction of ground-mounted solar PV?

Bottom Line: Rules are in place to ensure that the installation of ground-mounted solar arrays protects state-listed rare species and animals and plants. Project proponents can check with the local Conservation Commission to determine if the footprint of the solar PV project lies within a rare species habtat.

More Information: The Massachusetts Natural Heritage and Endangered Species Program (NEHSP) was created under the Massachusetts Endangered Species Act (MESA) and is responsible for protecting rare animal and plant species and their habitats from being displaced or destroyed. Specifically, NEHSP reviews projects proposed for:

- **Priority Habitats:** These are areas known to be populated by state-listed rare species of animals or plants. Any project that could result in the alteration of more than two acres of Priority Habitat is subject to NHESP regulatory review. Projects will need to file a MESA Information Request Form, along with a project plan, a U.S. Geological Survey (USGS) topographical map of the site, and a $50 processing fee. NHESP will let project administrators know within 30 days if the filing is complete, then will determine within the next 60 days whether the project, as proposed, would result in a "take" of state-listed rare species that might require the project to redesign, scale down, or abandon its plan.
- **Estimated Habitats:** These are a sub-set of Priority Habitats that are based on the geographical range of state-listed rare wildlife – particularly animals that live in and around wetlands. If the project is proposed for one of these areas and the local Conservation Commission requires filing a Notice of Intent (NOI) under the Wetlands Protection Act, the project will need to submit copies of the NOI, project plans and a U.S. Geological Survey (USGS) topographical map to NHESP. Within 30 days of receiving this information, NHESP will send its comments to the Conservation Commission, with copies to the project administrator, project consultants, and the Department of Environmental Protection (MassDEP).

Resources:

To learn more about the NHESP review process and download a MESA Information Request Form, visit: http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/regulatory-review/mass-endangered-species-act-mesa/

For list of rare animal and plant species in Massachusetts, visit: http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/species-information-and-conservation/mesa-list/list-of-rare-species-in-massachusetts.html

energies

MDPI

Review

General Design Procedures for Airport-Based Solar Photovoltaic Systems

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Abstract: A source of large surface areas for solar photovoltaic (PV) farms that has been largely overlooked in the 13,000 United States of America (U.S.) airports. This paper hopes to enable PV deployments in most airports by providing an approach to overcome the three primary challenges identified by the Federal Aviation Administration (FAA): (1) reflectivity and glare; (2) radar interference; and (3) physical penetration of airspace. First, these challenges and precautions that must be adhered to for safe PV projects deployment at airports are reviewed and summarized. Since one of the core concerns for PV and airport symbiosis is solar panel reflectivity, and because this data is largely estimated, a controlled experiment is conducted to determine worst-case values of front panel surface reflectivity and compare them to theoretical calculations. Then a general approach to implement solar PV systems in an airport is outlined and this approach is applied to a case study airport. The available land was found to be over 570 acres, which would generate more than 39,000% of the actual annual power demand of the existing airport. The results are discussed while considering the scaling potential of airport-based PV systems throughout the U.S.

Keywords: airport; photovoltaic; solar energy; glare; Federal Aviation Administration; economics

1. Introduction

Solar photovoltaic (PV) technology is now well known as a widely accessible, sustainable, and clean source of energy that can be scaled to meet humanity's energy needs [1–3]. After years of steady growth, the PV industry is beginning to meet this potential with approximately 6000 TWh of PV electricity estimated to be generated by 2050, which is roughly 16% of the total global electricity demand [4]. This much solar PV-generated electricity will necessitate substantial surface areas dedicated to PV deployment because of the diffuse nature of solar energy. Much of this need can be met via rooftop PV or the relatively immature building-integrated PV (BIPV) market [5–10]. The remainder will need to be met by large-area solar PV farms on either land-based solar PV farms [11–14] or even water-based floating solar PV farms [15–22]. However, as the global population increases 1.15% per year [23], attractive land and even waterways will become more valuable, especially in densely populated areas. This has the adverse consequence of creating competition for limited land resources between food and energy demand [24–26], which will exacerbate the current problem of 870 million people who are chronically malnourished [27]. This means practically that all available non-food producing surface areas should be used before energy production impacts food production.

One source of large surface areas that has been largely overlooked for PV deployments and is not suitable for food production is the surface areas surrounding airports [28]. Airports have large

 EXHIBIT 3

electric load demand, and are generally located near population centers with even higher demands, and also have large unused land areas due to existing design protocols. By 2013, the total number of airports in United States of America (U.S.) was over 13,000 (paved and unpaved) [29], out of which the Federal Aviation Administration (FAA) currently includes over 4500 as public, general aviation use airports [30], which makes airports even more of a potential market for solar PV systems.

One of the factors that influences economic viability of large solar farms are the investments pertaining to acquiring and maintaining suitable land. Thus, airport property has the potential to substantially decrease the land cost as the property under airport authorities has no value for any other use. Another advantage comes in terms of maintenance, as the land under consideration is maintained by the airport authorities from any physical obstruction above ground, thus making it an ideal location for solar PV. There are 30 airports in U.S. [31] and many more across the globe that already have solar power partially supporting their load demands, including Kempegowda International Airport and Cochin International Airport in India [32], and Indianapolis International Airport [33], Tucson International Airport [34], Chattanooga Airport [35], San Francisco International Airport [36] and Denver International Airport in the U.S. [37]. However, the economically viable application of PV [38] in airports is far from saturated, as there are lingering safety concerns from reflectivity and radar interference among airport operators for installation of large-scale PV systems within their land areas [39]. In addition, there is no generalized approach to apply solar PV systems to airports.

This paper rectifies these impediments to further PV deployments at airports by reviewing existing work on PV and airports and providing a new generalized approach to overcome the three primary challenges identified by the F.A.A. [39]: (1) reflectivity and glare; (2) radar interference; and (3) physical penetration of airspace. First, these challenges and precautions that must be adhered to for safe PV projects deployment at airports are reviewed and described. Since one of the core concerns for PV and airport symbiosis is solar panel reflectivity, and because this data is largely unavailable, a controlled experiment is conducted here to determine worst-case values of front panel surface reflectivity. Then a general approach to implement solar PV systems in an airport is outlined and this approach is applied to a case study airport: Houghton County Memorial Airport (CMX) in Hancock, Michigan. The results are provided and discussed while considering the scaling potential of airport-based PV systems.

2. Background on Three Primary Road Blocks to Photovoltaic Systems at Airports

The paper reviews methods to overcome the three primary roadblocks identified by the F.A.A. to deployment of solar PV systems at airports [39]: (1) reflectivity and glare; (2) radar interference; and (3) physical penetration of airspace.

2.1. Reflectivity and Glare

Reflectivity in this context denotes the ability of the PV module surface to reflect light, which may interfere as glare with pilot or airport staff visibility. The possible impacts of PV module reflectivity may lead to either glint or glare, or both. This can cause a brief loss of vision (also called flash blindness), which is a safety concern for the pilots. Flash blindness for a period of 4–12 s (i.e., time to recovery of vision) occurs when 7–11 W/m^2 (or 650–1100 $lumens/m^2$) reaches the eye [39]. It is recommended when designing any solar installation for an airport to carefully consider the final approach of pilots and guarantee that no placed installation section will give any face glare that is straight ahead of them or within 25° of straight ahead during final approach [40]. Often the maximum solar irradiation of 1000 W/m^2 is used in calculations as an estimate of the solar energy interacting with a module when no other information is available [39]. However, this may be a poor assumption as PV modules have been optically engineered to minimize optical reflection in both conventional [41,42] and thin film PV devices [43,44]. Most PV are using anti-reflection coating (ARC) [45,46] and future PV are expected to integrate metamaterial perfect absorbers into solar modules [47,48], which would be expected to reduce reflection even further [49,50]. The exact percentage of light that is reflected from PV panels is currently best estimated using the Solar Glare Hazard Analysis Tool (SGHAT) [51].

This was a free online tool developed with U.S. tax dollars by the Sandia National Lab in the U.S. Unfortunately, it was disabled in 2016 and is currently available for licensing from Sandia only to commercial ventures. The impact of denying access to publicly funded research in this area will be discussed below. In addition, the reflectivity is not absolutely known for all PV modules. However, the vast majority of PV modules on the market contain some form of anti-reflection coating, and this loss (due to reflection) is generally considered to be only a few percent [52]. In addition, outside of very unusual circumstances, flash blindness can only occur from specular reflections.

A study and report published by Federal Aviation Administration in 2015 [40] gives further insight on how glare actually affects aircraft aviation and compares PV glare to other common sources of glare. On performing a thorough study with pilots, it was found that majority of pilots had encountered glare with durations between 1 and 10 s with longer durations being encountered for objects other than direct sunlight or solar panels. This study concluded that for most pilots, glare emanated primarily from bodies of water. One of the solutions to the glare problem is avoid angles of glare between approaching planes and solar PV modules using SGHAT as a guide and the other potential solution is to eventually achieve lower reflectivity from PV surfaces compared to typical source of glare from other real-world objects like water, buildings/glass windows, other aircraft and even snow. It should be noted that the real location considered in this paper has snow in 5 of the 12 months of the year and hence it will be safe to assume that glare off snow here will be one of the highest compared to other locations. To counter this problem, which is primarily that of an unknown, a reliable method to calculate the percentage of specular reflection off a particular PV module shall be measured and compared to a theoretical model. Experimentally determined reflection values will be addressed below.

2.2. *Radar Interference*

PV systems could cause negative impacts on radar, NAVAIDS (navigation aids) and infrared instruments called communication, navigation, and surveillance (CNS) by causing interference [39]. Interference of radar and NAVAIDS (despite passive components) occurs when objects are placed too close to a radar sail or antenna and obstruct the transmission of signals between the radar antenna and the receiver, which can be a plane or a remote monitoring location. Metal components on the PV racking may also cause reflected signals. However, due to PV systems having a low profile these risks are low. For example, most large-scale solar farms are of low height profiles like the Topaz Solar PV Farm in California, which is approximately 1.7 m (5.5 ft.) above ground at its top edge, minimize visual impact [53]. If solar PV systems do not represent any level of risk of interfering with surrounding CNS facilities, solar PV project sponsors do not need to conduct studies on their own to determine impacts on CNS facilities when siting a solar energy system at an airport [54]. Due to their low profiles, solar PV systems typically represent little risk of interfering with radar transmissions. In addition, solar modules do not emit electromagnetic waves over distances that could interfere with radar signal transmissions, and any electrical facilities that do carry concentrated current are buried beneath the ground and away from any signal transmission [39]. The one area of potential problem of interference might occur due to the use of metal parts for the racking of the modules. This has not been found it practice, but there are also already alternative materials that can be used for PV racking including plastic tension-based systems [55,56], fiber glass [57], plastic [58] and concrete [59]. These alternative material systems may be considered for airports with metal racking concerns. Lastly, solar energy not converted into electricity by the PV device is converted into heat, raising the temperature of the PV modules in operation normally to about 50 °C in full sun. Thus, impacts on infrared communications can also occur because the solar PV continue to retain heat into the first part of dusk, and the heat they release can be picked up by infrared communications in aircraft [39]. Although this risk is also low, a certain safe radial distance of 150 ft. must be maintained between communication instruments, the control tower and PV modules to avoid all mechanism of interference. It should be noted that some past solar fields have required greater setbacks up to 500 ft. [39].

2.3. Physical Penetration of Airspace and Land

No physical structure is allowed to intervene in spaces that may lead to any safety issues at airports. Hence airspace inside and around any airport is pre-defined where no physical body of any kind is allowed to stand, as shown in Figure 1 [60]. The important volumes in Figure 1 from a PV system installation perspective are in the lower right. The primary surface is a surface longitudinally centered on a runway shown in blue. Next, a horizontal plane 150 ft. above the established airport elevation is shown in dark grey. The approach surface of the aircraft area in blue and transition surface in purple along with other aerial zones concerned with flying aircraft only. All these zones are aerial (150 ft. and above the runway) and will not represent an interference hazard with any of the typical surface solar PV racking designs [61]. The only point of concern will be the restricted zones defined on the actual surface around the runway. This will be discussed in detail in Section 4.3.

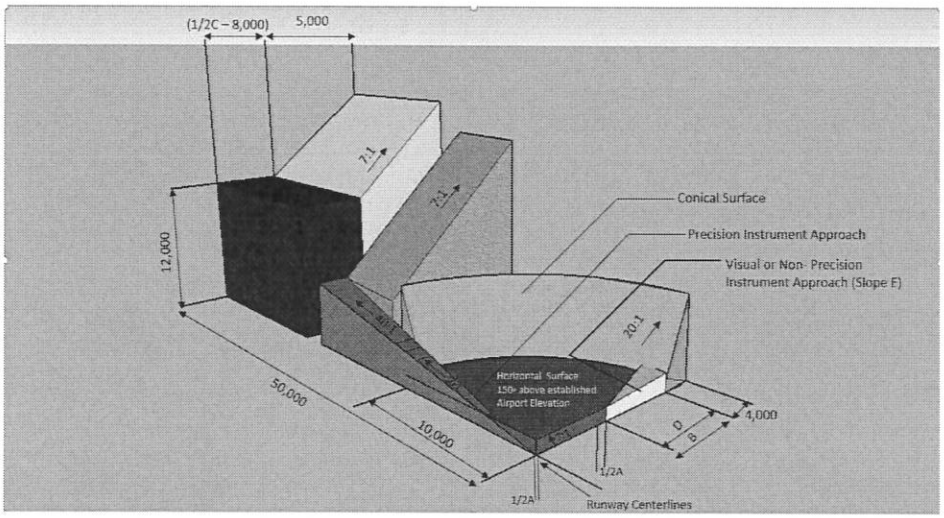

Figure 1. Defining aerial zones defined for airports, which are adapted from [60]. The lower right is the region of relevance for photovoltaics (PV) systems. The primary surface is a surface longitudinally centered on a runway shown in blue, a horizontal plane 150 ft. above the established airport elevation is shown in dark grey, and the conical surface is shown in green.

3. Experimental Determination of Reflection from a Photovoltaic Module Surface

As noted in Section 2.1, despite glare being considered one of the biggest challenges for an airport solar PV system deployment, there is little available worst-case data on how much of the incident light is due to specular reflection from a standard solar module. Experiments are conducted here to provide background data on the effect of PV array tilt angle on the amount of glared produced from the face of a module in non-glancing angle approaches. The results are also used to validate/correlate part of the data provided by the FAA for PV systems located near airports.

Experimental data was obtained using the following protocol. A small area solar simulator (PV Measurements model SASS, class-BBA) was used as a light source. A calibrated photovoltaic reference cell was used to calibrate the solar simulator to 1 sun (1000 W/m^2) using an AM 1.5 spectrum prior to performing the reflection measurements. A 255 W Sharp (model make Sharp #ND-255QCSBX) crystalline silicon-based solar module was used as a reflecting surface (solar PV panel surface). This type of module was chosen as the majority of PV modules on the market are silicon crystalline or polycrystalline silicon absorber material, and this module has standard optics (e.g., anti-reflective coating on Si but not on glass). This module is typical for large commercial applications, with maximum power (P_{max}) 250 W (under standard conditions), tolerance of P_{max} of +5%/−0%, and the temperature coefficient is −0.485%/°C. A mounted photodiode was used to measure irradiance from both the incident and reflected beam (glare) as a direct function of current generated. The photodiode sensors

deliver a current that depends on the optical power and wavelength of the incident beam. Here it is used to measure the reflected glare noted in percentage of the incident irradiation on the panel. The tilt angle was measured using an inclinometer ($\pm 0.5°$). The distances between the light source, detector and the panel surface, as well as the relative positions, were kept constant throughout the entire experiment. First, measurements were made to determine the irradiance on the panel surface for normal incidence angle (90°) and zero reflection. Then subsequent measurements were made to determine the reflected irradiance for a range of panel tilt angles from 10° to 70° (limited by setup geometries) in 10° incremental steps. Three measurements at the peak location of reflectivity were obtained and averaged for each tilt angle in order to improve the accuracy of the measured results and minimize random error.

4. General Approach to Design Solar System for Airports

4.1. Airport Type and Surface Selection

There are several variables to consider when applying a solar PV system to an airport. First, the location of airport. If the airport is located in the city, like Ronald Reagan Washington National Airport (DCA), it does not have much land available per unit size as compared to more rural airports. These cases where there is limited ground area available should first consider the installation of solar PV on rooftops of buildings and then look at any potential ground area for ground-based systems. On the other hand, if the airport is located in a rural or remote location, like Washington Dulles International Airport (IAD) or CMX in Hancock, Michigan, there is a relatively larger land area available per unit load within the airport. This situation favors a large uniform designed ground-mounted system with roof-mounted or BIPV playing a relatively minor role.

Second, the annual weather conditions for the airport is also a factor for airport PV system design. Although the location of airport is already selected for better weather conditions for airplane landing and taking off, weather still plays a major role in PV system performance. For example, the rural CMX has the largest number of delayed and canceled flights in the U.S. due primarily to weather conditions [62]. In addition, the region it is located in is the upper peninsula of Michigan, which records some of the largest snow events in the U.S. [63], and snow has an impact for annual PV output [64–68]. Thus, in such cases the adverse (snow losses [63–68]) and positive effects of weather (i.e., surface albedo [69]) effects need to be taken into consideration in simulation and designs.

Third, the energy consumption of the airport is a factor for sizing an airport-based solar PV system if solar energy is not to be exported to the grid. Based on how busy and how large the airport is the energy consumption varies for different cases and can be substantial. For example, San Francisco International Airport (SFO) reported 322,927 MWh of electricity used by itself and its tenants in Fiscal Year 2010 [36]. This is enough electricity to meet the annual electricity needs of over 48,000 California residents [36]. When considering airport PV systems the variability of the airport load itself should be modeled carefully as the variability can be substantial. For example, in a 2015 report on the Los Angeles International Airport (LAX) electric consumption was 184,416 MWh (14.51% more that its consumption in 2010), which was actually an increase in electricity consumption by approximately 32% until 2014. It was only because of the change in their policies and power management that power demand was reduced in the following year [70].

If the land area for solar PV is large enough and the airport size is relatively small, there is possibility of achieving a grid neutral airport. If more land area is available for PV solar system, then the generation capacity is enough to even feed back into the grid. However, if the land area around a busy airport is small, only partial energy demands will may be fulfilled by solar PV system.

4.2. Solar Photovoltaic System Design Parameters

There are several PV systems designing/modelling software including: proprietary (e.g., PVSyst, SolarGIS, INSEL, Solar Design Tool, etc.); free government supported methods (e.g., NREL's

System Advisor Model (SAM) [71], Solar Prospector [72], PVWatts Calculator [73] and Canada's RETScreen [74]); and open-source methods (e.g., r.sun/GRASS [75–77]) available for predicting; weather, solar flux and basic PV systems performance and modeling. This paper uses SAM for the performance and financial model designed to facilitate decision-making for the project considered. Using SAM performance predictions and cost of energy estimates can be made for grid-connected/independent power projects based on installation and operating costs and system design parameters that are specified as inputs to the model. The solar resource will affect the design along with the type of balance of systems (BOS) and racking configuration. As all airports constitute long and mandatory boundaries, non-traditional PV system designs may be the best option for the most restricted surface areas. For example, with large spacing between boundaries and airport properties (i.e., towers, roads, etc.), bi-facial solar PV could be another way to increase the overall solar power profile of any airport system. Though low on efficiency compared to conventional PV systems, bifacial PV can provide power and cost benefits by being a protection boundary as well as noise barrier to some extend apart from providing power alone [78]. Based on the sun location during different hours of the day and seasons of the year, the tilt angles of the solar modules will be determined normally to provide the largest annual output [79,80]. The optimized angle for solar modules will also need to take into account weather (e.g., snow conditions [63]).

4.3. Available Surface Area for Photovoltaic System

Based on airspace restrictions detailed in Figure 1, the FAA restricts the use of the surface areas in airports. This is detailed in Figure 2. The runway (grey), runway object free area (blue), runway protection zone (RPZ) (light green) and controlled activity (yellow) areas all prohibit PV deployment. Figure 2 shows the areas available for PV deployment in green.

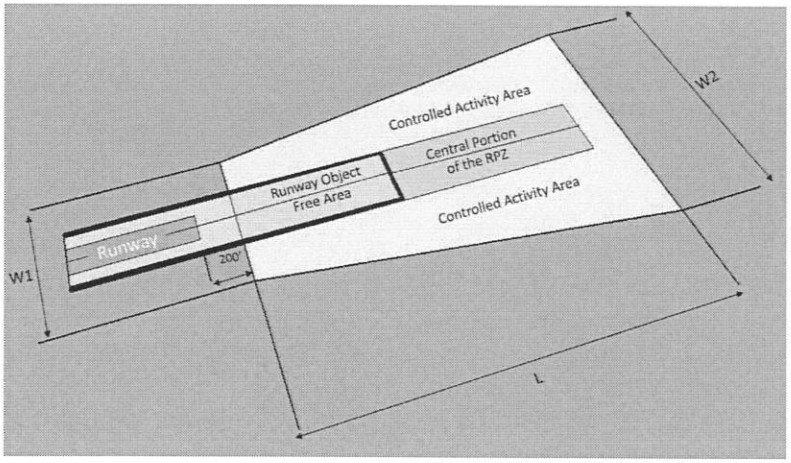

Figure 2. Surface areas with and near the end of a runway [39], which cannot be used for PV deployment. Only surface areas coated in green can be used for PV.

Using the map of the airport, the land area that is not in conflict with the restricted area and other land reserved for any other purposes should be identified as the area in which solar PV systems can possibly be deployed. For this, tools like ArcGIS can be used. By using the Area Solar Radiation Tool in the ArcGIS Spatial Analyst extension, a solar map can be generated from the georeferenced image specifying target locations, latitude and a yearly solar interval. This solar map takes into consideration the changes in the elevation (azimuth) and position of the sun, as well as any possible shading effect caused by buildings or other objects in the input raster. Such GIS software also derives raster representations of a hemispherical view shed, sun map, and sky map, which are used in the calculation of direct, diffuse, and global solar radiation [81]. A similar approach can be used for free with r.sun and GRASS [76,77,82]. Because of the direction of runways, the planes land and take off in

both direction the runways. Thus, the different locations of solar PV system panels can have different glare effects on a plane navigating around the airport. After determining the orientation and angle for a solar PV system for an airport, it is advisable to set the solar modules in the land area which is facing off the runways. Details of the approach will be presented in Section 5 for the case study airport.

In addition, land proposed for PV deployment at airports should not only be available for power production now, but also be free from any future expansion plans (e.g., proposed future runway extensions or new buildings). However, it should be noted that even if a certain section of land is proposed for use after 20 years, a PV system can be proposed for this land on lease for some time to not only make the project economically profitable, but also as a better use of the land for the time being (it is expected that solar PV technology will continue to improve [61] fast enough to compensate for the generation loss by increasing efficiency in permanent PV systems).

4.4. Airport Baseload Power to Photovoltaic Generation Potential Comparison

After determining the available land for a solar PV system, energy production potential by the solar PV system can be calculated for any time of the year. The resultant solar energy produced in calculations can be compared to the actual electric demand based on historical data and projections of the airport from an annual to daily basis, which will further help determine if the airport can be fully supported by solar power or not, and in case of excess power being generated, how much can be fed back to the grid for net metered systems.

During winter periods, energy production potential must to take into account snow losses that can be evaluated using experimental data from Heidari et al. [63] study, which used the same site as this study to perform actual snow loss calculations for solar PV systems at various tilt angles. The power for each snow-exposed module placed at airport site was determined using Equation (1), while Equation (2) was used to evaluate the power from modules without snow cover.

$$P_m = \frac{I_t(T)(P_{STC}(1 + C(T - T_{STC})))}{I_t - I_{STC}(1 + \alpha(T - T_{STC}))} \tag{1}$$

$$P_C = (G_t(1 + \beta(T_{STC} - T))) \times \frac{P_{STC}(1 + C(T - T_{STC})}{1000} \tag{2}$$

where:

α	Temperature coefficient of current, module (1/°C)
β	Temperature coefficient, pyranometer (1/°C)
C	Temperature coefficient of power, module (1/°C)
E_{loss}	Energy loss (kWh)
I_t	Short-circuit current measured at time t (A)
I_{STC}	Short-circuit current at Standard Test Conditions (STCs), (A)
$P_{C,t}$	Power that can be extracted from each virtual clean module (without snow) at time t (Watts)
$P_{m,t}$	Calculated output power of snow-exposed module (at various angles and heights) at time t (W)
G_t	Global irradiance obtained by pyranometer (at various angles) at time t (W/m^{-2})

Thus, the snow loss due to snow was calculated as the difference in energy without snow P_C versus the energy obtained from snow-covered modules P_m [63] using Equation (3).

$$E_{loss}(t) = (P_C \times t) - (P_m \times t) \tag{3}$$

5. Case Study

To clarify the methodology a case study is provided using the Houghton County Memorial Airport (CMX) in Hancock, in Michigan's Upper Peninsula (UP). The UP is situated between Lake Superior (along its northern border) and Wisconsin, Lake Michigan, and Lake Huron to the south.

It provides an extreme rural case as the UP encompasses 29% of Michigan's land area, but has only ~3% of the total population [83]. The region experiences long, cold and dark winters with some of the heaviest snowfalls in the United States, which make annual off-grid PV system design particularly challenging [84]. However, short, relatively cool summers with average-high August temperatures of only 22 °C reduce the negative temperature effects on PV performance [85]. In addition, because of the northern latitude of the UP, daylight hours are short during winter and long in the summer, which heavily skews PV production towards summer. At the same time the business case for PV systems in this region is relatively easy to make as the levelized cost of electricity (LCOE) [38] is far less than the effective rates for a consumer per kilowatt hour (kWh) which is comparable across all utilities by incorporating energy changes, service charges, state-mandated charges, and power supply cost recovery factors, which ranges up to over $0.24/kWh (more than double the U.S. average) [86].

5.1. Airport Land Zones and Photovoltaic System Sites Identification

CMX airport was chosen due to access to real time testing and data collection for the validation of the proposed methodology [87]. Furthermore, CMX is currently planning to expand its infrastructure in the near future and considering integrating PV solar power, in addition to other methods of becoming a more environmental friendly and economically viable airport by cutting purchased electricity, which is the highest in the region. Due to the availability of large vacant lands (over 200 acres, as seen in Figure 3, and the low electricity demand, it is possible to design a PV system for better than net zero and thus substantial excess generated solar electricity could be exported to the grid. Figure 3 shows the outer physical boundary (in green) with clear zones (in blue) and the runway protection zones at the ends of the runways (in pink).

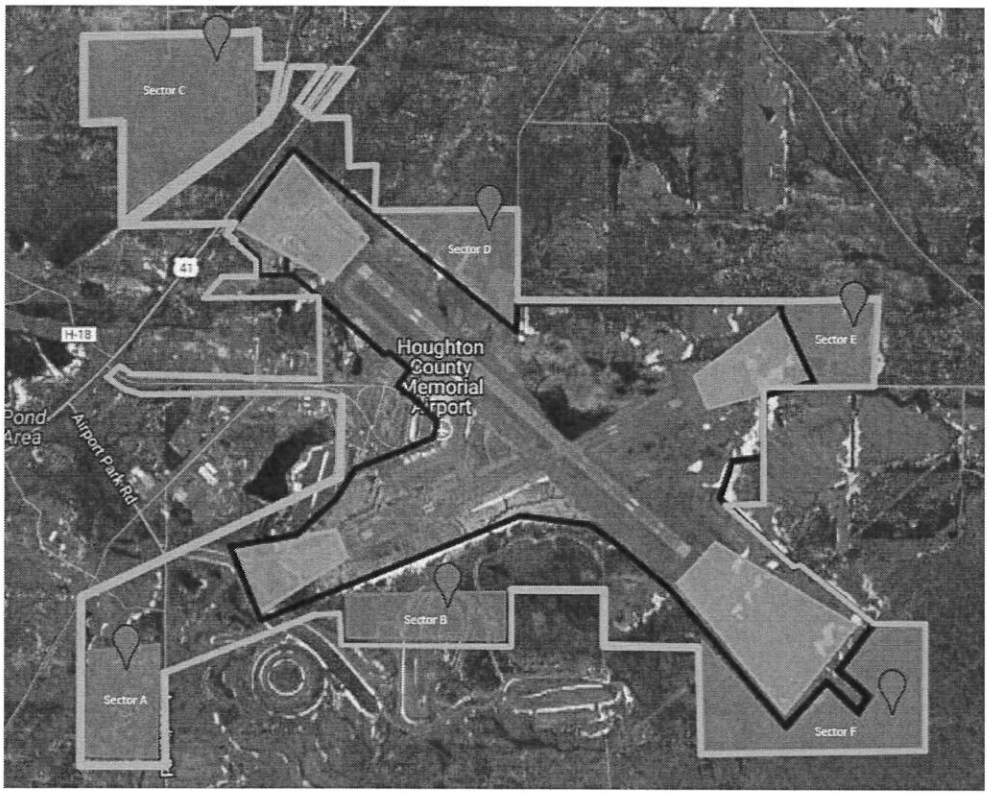

Figure 3. Ariel view of Houghton County Memorial Airport (CMX) airport, with the PV deployment zones marked. Note: The four pink trapezoid zones are the restricted areas showed in Figure 1; black lines enclosed clean area, and no objects other than necessary terminal buildings are allowed in this zone; the orange line enclosed the area which is total airport land property, and; the six red pins are suggested land/sites for the deployment of solar PV systems.

The spatial data to consider includes different building location details, boundaries of different sections across the airport, data regarding any object free zone, runways, marking of future buildings and extension work for existing runways, and boundary fencing details.

5.2. Photovoltaic System Modeling/Simulation

For simulating the PV system for the airport, System Advisor Model [71], developed by the National Renewable Energy Laboratory (NREL) is used. First, in the "Location and Resource" section of the model, actual data for CMX airport in Hancock for 2016 was used in the simulation. In the "resource data" section, SunPower SPR-445J-WHT-D (power at standard testing conditions (STC) is 445W) solar modules were selected. Suitable configurations for the sub-arrays were then made. Since the location of CMX airport is in the northern hemisphere, the azimuth is selected to be 180° so that the system faces south. Using freely available and industry accepted software (SAM), the solar flux available in Houghton County, Michigan (located in the west-central part of the UP) and class 2 TMY3 (typical meteorological year) solar data averaged from 1991 to 2005 [88], the optimal design was found to be a 30° tilt with south facing arrays receiving global horizontal of 3.41 kWh/m^2/day. Although based on [66,67], 60 degrees is optimized for minimizing snow-related losses, as it makes it easier for snow to slide off the modules, the tilt angle was set as 45. After calculation, for 80 acres of land, without snow losses the unobstructed system on SAM produces 2.33% more power for 30° tilt compared to 45°. However, after taking snow losses for both angles into consideration [66,67], power produced at 45° tile is 2.8% more than power from 30°. Thus 45° tile angle was chosen. For this study, first 80 acres (case 1) of land is evaluated out of the approximately 570.4 acres (case 2), all the blue sections in Figure 3, that is, Section A to F, of potential land available for solar PV system. For both case studies a packing factor (ratio of module area to unused area) of 0.4286 was used. The sub-PV array configuration for case 1 is shown in Table 1 below. Thus, for case 2 the solar PV farm was 2,308,000 m^2 and the total module area was 692,530 m^2.

Table 1. The sub-PV array configuration for case 1. Note: Azimuth indicates the horizontal direction of the solar array and tilt is the tilt angle of the modules with respect to the ground.

String No.	Configuration	Description	Unit of Measurement	Details
1	String Configuration	Strings in Array	No.	5619
2	Tracking & Orientation	System	-	Fixed
3	-	Tilt	Degree	45
4	-	Azimuth Angle	Degree	180
5	-	Ground Coverage Ration		0.3
6	Estimate of Land Area and Usage	Total Module Area	Meter square	97,186
7	-	Total Land Area	Acres	80

The loss settings are as follows: module mismatch is 1%; diodes and connections is 0.5%; DC (direct current) wiring is 1%; nameplate is 1%; and AC (alternating current) wiring is 1%. For the study, actual load data with each unit cost for each energy meter at the airport was acquired and the total demand and total bill payment of each month in 2015 were collected, and are shown in Table 2 [89]. In winter (November to February), the demands are high due to the heating systems loads compared to no such demand for May and June. The demand in July is slightly higher compared to June and August since there is one additional electricity demand from recreational vehicles (RVs), which consumes a little more electricity compared to other months.

Table 2. Total demand and total bill payment of each month in 2015.

Months	Total Demand (kWh)	Total Bill Payment (US$)
January	48,507.00	8612.93
February	45,590.00	8513.88
March	42,509.00	8049.09
April	35,852.00	7149.05
May	31,336.00	6568.81
June	26,641.00	5853.03
July	33,420.00	6663.00
August	29,280.00	6138.03
September	26,817.00	5871.14
October	29,894.00	6167.57
November	32,837.00	6783.91
December	39,391.00	7549.51
Total Annual Demand	422,074.00	-
Total Amount Paid	-	83,919.95

6. Results and Discussion

The reflection off a solar PV panel from most near normal angles is less than 3% and represents no risk to air traffic, as can be seen in Figure 4. Figure 4 shows the percentage of reflected light as a fraction of the total incident radiation from the surface of a PV module as a function of the incident angle, θ. This percent of reflected light is measured at the location of peak intensity as a function of the current generated by a photodiode. The results show that the reflection from solar module surface with incident radiation of 1 sun from angles of 10 to 70° varied from the range of 2.08% to 7.15% of the incident radiation. Overall, the reflections off of the PV panel surface were found to be pretty stable until the tilt reached glancing angles, from where it started to increase substantially. This is akin to the behavior of light reflecting from a still source of water such as a pond. The refractive index of still water is 1.33 [90] and the front glass of solar PV modules are made of standard soda lime glass, which has a refractive index of 1.50–1.52. It would thus be expected that for a given angle reflection from a PV front glass surface without any antireflecting (AR) coating is less intense than that of water. Now, with the current progress in solar module technology and development in anti-reflection materials such as materials with an index of refraction of 1.05 [91,92], it is safe to assume that solar PV module will have reflection off their surface dropped further with future technologies [93–96]. However, even today with the refractive index off PV with AR coating dropping below 1.33 to 1.20–1.30 [97], PV poses no (or presents tolerable/safe) hazards from reflection for airport solar PV projects. By comparing the results of the experiments described here (Figure 1) with estimates from [97], it is clear that modern PV have less intense reflectivity than still surface water. Although PV are mounted at a tilt angle with regards to the surface, the risk of flash blindness is only present for the higher angles (e.g., glancing angles). It should be noted, however, that typical AR coatings are generally optimized for overall reflectance loss, which does not necessarily minimize glancing angle reflectivity or specific polarizations. By changing the cover glass of solar PV, these glare properties can be optimized for airports. For example, glass with strong structured surfaces have proven to be most favorable as its diffusing effect is more effective than antireflective coatings, and initial tests on PV modules showed no performance loss will be induced if strong structured glass is used as a cover [98]. Minimizing this already small risk can be accomplished by selective placement and orientation for plane traffic approaches.

In addition, the use of low-tilt angle arrays would also reduce this risk. The disadvantage of such low-tilt angle arrays is the reduced energy yield per installed unit power of the PV system. However, as the cost of PV modules themselves have dropped a low-tilt angle system enables closer packing of modules (e.g., higher power per unit area) and can increase the solar electricity generated per unit area at an airport. In addition, for airports with surface water, floating solar PV farms [15–21] and

even aquavoltaics [22] would enable an increased area for PV, as well as possibly reducing water surface glare.

The most straightforward method to eliminate glare problems is with the selective placement and orientation of PV for the plane traffic approaches is best accomplished with SGHAT [99], using data from this paper and recent bidirectional reflectance distribution function work on different materials on solar installation glare [98], and following careful siting strategies [100–102]. As noted earlier, this best approach was free as the software was funded by the U.S. government and then, for reasons not known to the current licensing executives at Sandia National Laboratories, the software became available only for commercial licensing; currently the use of the software is only available from one vendor, Forge Solar, with subscription plans running from a free trialup to US$156/month [103]. If it is assumed that each airport in the U.S. would want access to the Enterprise version to enable the full optimization of PV arrays, as well as enhanced flight paths over a year of planning, the cost would be US$156/month × 12 months × 13,000 airports the cost would be over US$24.3 million. This cost could in part explain why such a small percentage of airports in the U.S. have moved to PV despite the overwhelming economic advantages seen by large-scale PV systems. This thus illustrates the need for government-funded research to ascribe to open source principles in both software [104,105], research [106] and hardware [107,108] so that the value created from publicly funded research is not locked behind paywalls, which both limits access, but also (as in this case) the deployment of superior technologies.

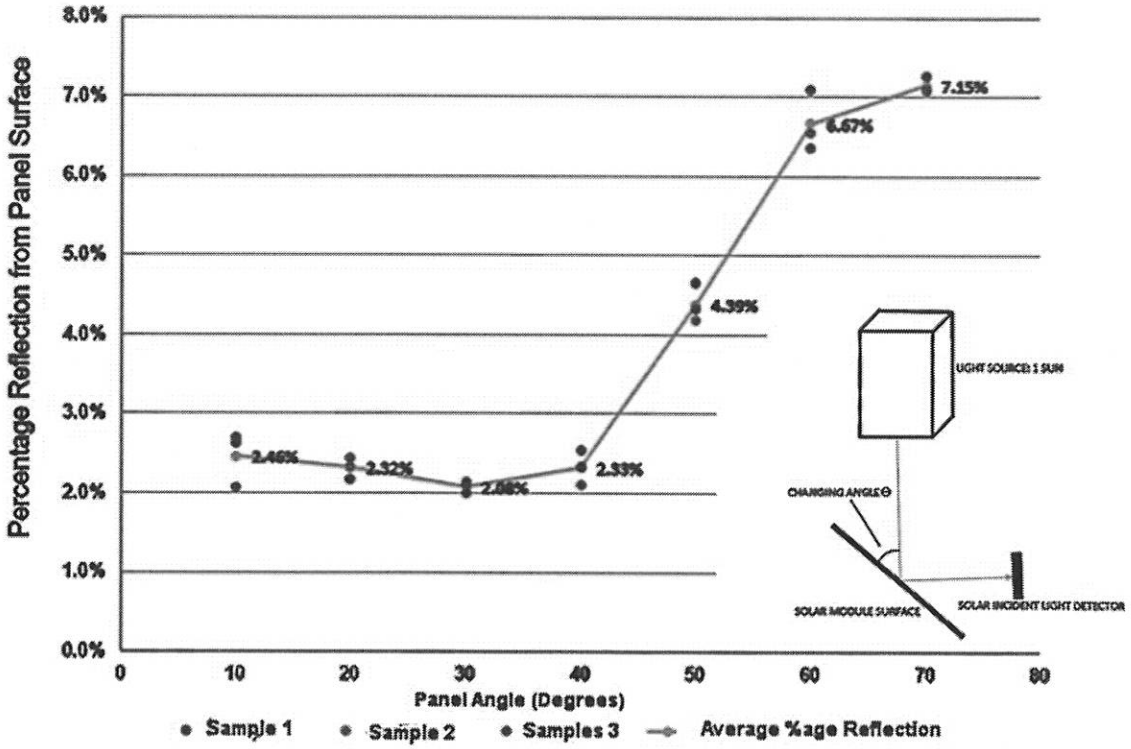

Figure 4. Percentage of reflection light from the surface of a PV module as a functional angle at the location of peak intensity. Inset: experimental setup for measurements.

Further, it is found that potential solar PV projects of substantial size do not possess a risk to aviation from an airspace penetration point of view. Under no conditions would a typical solar PV farm penetrate the approach surface for flights based on the height of PV racks (and low tilt angle racks are even shorter). To further secure the areas near to runways and control tower buildings, proper clearance can be taken from airport authorities themselves, which should result no compromise on the potential land for solar PV farm usage, as seen in Figure 3.

The CMX airport has more than 570 acres of land (all the blue sections in Figure 3, i.e., Section A to F) available and it must be kept clear of trees and vegetation by the airport authorities. Therefore, there is great potential for solar PV system since, in addition to producing solar electricity, solar PV deployment could reduce direct labor costs or shift them to a solar energy provider (e.g., if a standard power purchase agreement (PPA) is used). In the case of CMX, to be extremely conservative case 1 simulation results are first based on using only 80 acres of available land. Some of the available areas from Figure 3 are sized as zones sized for perspective. This case 1 system would have a much smaller capital investment than a full potential system of 570 acres (case 2). In addition, not only would it ensure that under no circumstances would the system interfere with the airport's existing functionality (the same as the 570 acres), but it would also enable all future expansion plans. To underscore how conservative (low estimation of available PV area) this case 2 estimate is, consider that there are existing cases where approval was given to place part of a PV farm in runway protection zones, which were excluded from the estimates here [39].

The three rectangles (sections A,B,C) highlighted on the left in Figure 3 are better for deploying solar panels compared to other three core potential array locations. The reason is the three-land area are either on the south part of airport (which have least effect glare on airplane) or far away from runways (which has least effect when plane is landing or taking off). In the case 1 simulation, 80 acres of land for deploying solar panels is assumed. In Figure 3, Section A and B is chosen for deploying solar panels.

After simulation in SAM, the monthly energy production is as shown in Figure 5. The data is the energy production before accounting for the snow losses. The next step is the need to measure the snow loss, which could be calculated using Equations (1)–(3) [63].

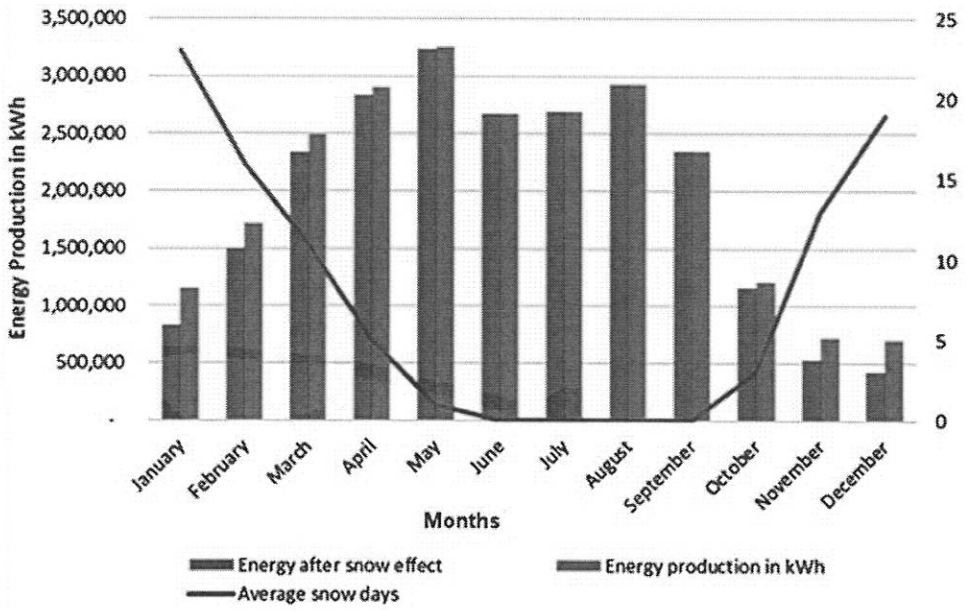

Figure 5. Monthly energy production with production with snow losses based on the configuration of solar system.

Results based on Equation (1)–(3), along with simulations studies, showed that with the increasing tilt angles from 0° to 45° for the unobstructed panels, energy loss decreased from 34% to just 5% annually. With the obstructed modules, the losses varied in the range of 29–34% of the total energy produced annually [63]. It was not surprising to find the losses for obstructed and unobstructed panels to be similar as both have the same snow covering in winters due to low or no tilt in the panels. The difference is substantial at higher tilt angles. The results showed that the optimum tilt angle for the system without snow is 30 degrees, producing 25.4 million kWh, but this angle has annual snow losses

of 10% of the annual production, giving only 22.8 million kWh. However, for a tilt angle of 45 degrees, the annual power generated by the system is 24.8 million kWh lower with no snow, which is a drop of 2.3% from what is produced from a 30° tilt. On incorporating the power loss after considering snow losses of 5.2% for a 45° tilt, the resultant annual power generated is actually 2.8% more than from a system with a 30° tilt with snow losses.

The other prominent AC and DC losses in the PV system are typical and default losses in SAM are used for selecting particular inverter types and other system components. As such, the highest loss apart from snow is DC module modeled loss, which is only 3.88%. DC inverter maximum power point tracking, MPPT clipping leads to losses of 0.0403%, while DC mismatch is 1%. DC diode and connections is 0.5%, DC wiring is 1%, DC nameplate loss is 1%, AC inverter power clipping is 0.32%, AC inverter power consumption is 0.27%, AC inverter night tare is 0.04%, AC inverter efficiency loss of 1.59% is used, and AC wiring loss is 1%. Plane of array (POA) shading and soiling is 1.54% and 1%, respectively. As the proposed system is fixed type, DC tracking loss is 0% along with AC step-up transformer and AC performance adjustment losses, which are also 0%. It is assumed that the PV system will be used in next 25 years, but for each year there will be 0.5% annual energy production loss, so the case 1 system will produce about 553 million kWh over its lifetime. This includes 23,487,128 kWh energy produced for the first year and subsequently dropping to 20,824,944 kWh by the 25th year in production.

To give a reasonable picture of monthly snow losses, 5.2% of annual loss of the total produced energy is divided with respect to average snow days in each month for one year. This method gives a fairly good representation as losses in January and December came out to be 25% and 21% alone, as shown in Figure 6. This method can be used for PV systems at airports with less detailed environmental based studies using approximations of losses for the area.

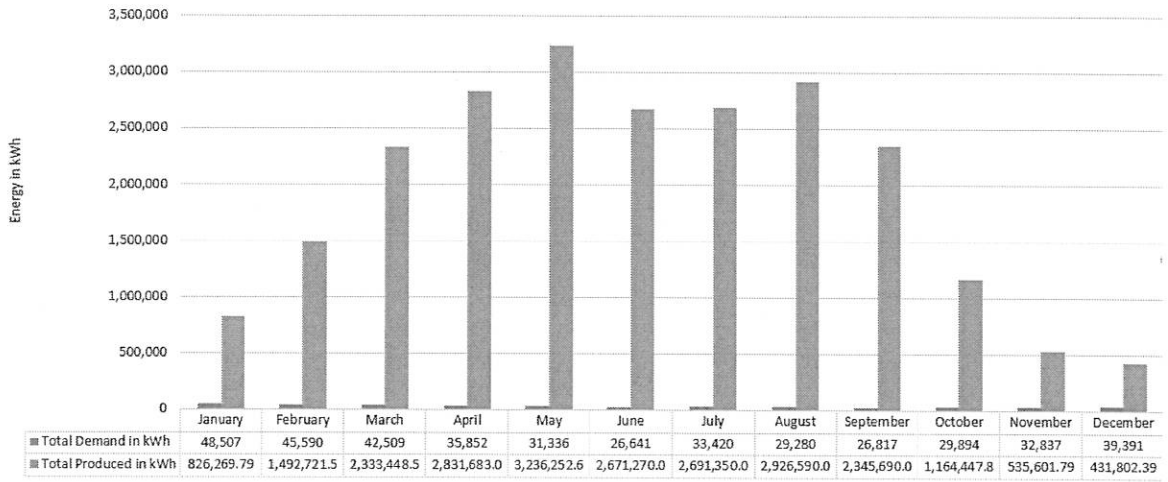

Figure 6. CMX electrical demand for each month vs. solar electrical production (after snow losses) for case study 1 [90].

The comparison between energy production and electric load is shown in Figure 6.

As shown in Figure 6, the energy produced by the relatively small solar PV system for case 1 is substantially higher than the amount of electricity load for each month. The case 1 simulated system produced 23,487,128 kWh in one year compared to the 422,074 kWh demand of the airport, which is more than 5560% of the annual demand. To explain the perspective further, if the actual available land is used which is over 570 acres (case 2), approximately 167,352,321 kWh of power can be yielded, which is more than 396 times the actual annual electrical demand of the existing airport. An important point to note here is that the supply with solar is more than the demand even during the winter days when the demand is highest for the year, and it is also the time when the panels will have maximum

losses due to snow and low solar flux. The remainder of the solar generated electricity can be fed to the grid, thus making the net metering credit high as well, along with helping to improve system power quality. An average American household consumes approximately 10,812 kWh of energy [109]. If 570 acres of land is utilized; more than 15,400 households can be benefited directly from it by having 100% of the aggregate electrical use covered by the airport PV system. This is a substantial fraction of the population as it represents roughly half of the county's (Houghton) population.

In addition to the abovementioned examples, solar PV power systems in or around an airport may in fact provide additional advantages. DeVault et al. point out that PV systems do not pose any threat to local biodiversity and, in fact, it is suggested that having solar PV arrays in an airport's vicinity may act as a repellent to birds and thus helping to improve the safety of the airspace [110].

Many of the rural domestic airports are similar to CMX, with huge areas under airport administration and less air traffic. Based on the results achieved here, similar approaches can be applied to other similar airports. This study has shown that it is technically viable to produce significant solar electricity on currently under-utilized airport surface areas. In general PV systems are found to be profitable in much of the U.S., and thus this technical potential provides a substantial business opportunity. In this particular case, residential electric rates are often over US$0.20/kWh in the CMX region. This indicates that case 2 (all safe and acceptable land at CMX) could produce over US$33 million per year in green electricity. As solar PV installations have now dropped below US$1/W costs [111] solar electricity is now widely cost competitive with other forms of electricity generation. Future work is necessary to further analyze the business and legal case for solar PV systems deployed at such airports. Finally, future work is needed to quantify the total potential area for PV system deployment in all the airports in the U.S. and the entire world in terms of PV power, solar electrical production per year, reduced greenhouse gas emissions per year and economic value.

7. Conclusions

This study showed how the technical barriers could be overcome for the large-scale deployment of solar PV in the over 13,000 airports in the U.S. Experimentally measured reflectivity from modern modules is found to agree with theory and is low enough that basic precautions can allow PV safe integration with airports. In addition, this paper summarized how radar interference and the physical penetration of airspace are not major impediments to PV applications at airports. A general approach to implementation of solar PV systems in an airport is provided. The case studies reviewed for a small rural airport show that available land area could not only provide more than 39,000% of the actual annual power demand of the existing airport, but also a significant fraction of the region's electric demand with currently dormant surface areas. Such systems can be of great socioeconomic advantage to the local community given the current costs of grid electricity and the price of PV. Based on the results achieved here, large-scale deployment of PV at airports shows enormous promise.

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Research Article

A Study of the Hazardous Glare Potential to Aviators from Utility-Scale Flat-Plate Photovoltaic Systems

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The potential flash glare a pilot could experience from a proposed 25-degree fixed-tilt flat-plate polycrystalline PV system located outside of Las Vegas, Nevada, was modeled for the purpose of hazard quantification. Hourly insolation data measured via satellite for the years 1998 to 2004 was used to perform the modeling. The theoretical glare was estimated using published ocular safety metrics which quantify the potential for a postflash glare after-image. This was then compared to the postflash glare after-image potential caused by smooth water. The results show that the potential for hazardous glare from flat-plate PV systems is similar to that of smooth water and not expected to be a hazard to air navigation.

1. Introduction

Before construction of utility scale photovoltaic (PV) power plants near airports or within known flight corridors in the United States, the Federal Aviation Administration (FAA) requires that the glare from the proposed plant not be a hazard to navigable airspace [1]. The purpose of this paper is to demonstrate that glare from flat-plate PV power plants is similar to that of water and therefore does not pose a hazard to navigable airspace.

This was done by calculating the glare potential from a theoretical flat-plate PV power plant located near Las Vegas, Nevada, and comparing that glare to the glare potential of smooth water.

To estimate potential glare from flat surfaces, a model developed which used conservative assumptions. This model is a generalization of work done by Ho et al. [1]. The model calculated glare hourly from 1998 to 2004 to find the times when the possibility for glare would be the greatest. The potential for after-image (hazardous glare) was then compared to the potential for hazardous glare from smooth water which pilots often view while on approach to land.

2. Method

A review of published literature on modeling glare was conducted. The effects of glare on humans has been quantified by Metcalf and Horn [2], Saur and Dobrash [3], Severin et al. [4], and Sliney and Freasier [5]. In other studies Brumleve [6], Chiabrando et al. [7], and Ho et al. [1] developed mathematical methods to quantify the potential danger of glare causing flash blindness. Flash blindness is defined by Ho as a "temporary disability or distraction" that can cause an after-image and is understood to be comparable to what a human experiences when viewing the flash of a camera.

Ho explains in detail various methods for modeling glare from concentrating solar systems which use mirrors and lenses to concentrate light onto a central receiver. This technology is different than flat-plate PV modules which directly convert solar energy to electricity. However, the after-image estimation method Ho outlines for concentrating solar systems is easily generalized to flat-plate PV modules. The flow diagram in Figure 1 shows the general method implemented to translate solar radiation to the after-image potential caused by energy received on an observer's retina.

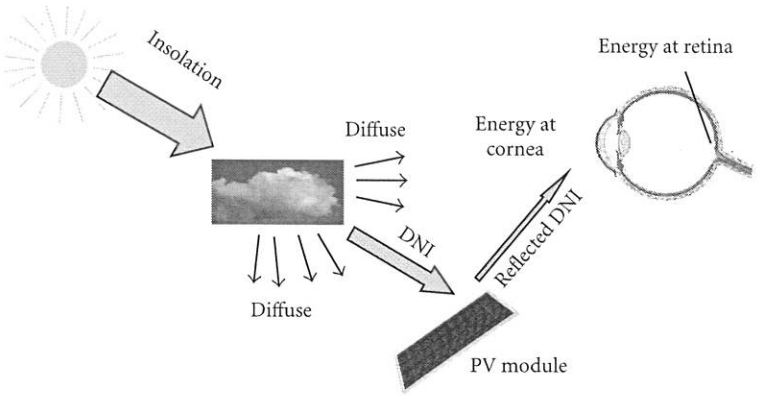

FIGURE 1: Energy flow diagram.

The subsections below provide more detail for each step of the process.

2.1. Insolation. The SUNY-Perez Satellite dataset was used for modeling glare. The National Renewable Energy Laboratory (NREL) compiled this dataset for the years 1998 to 2005 on an hourly basis for a 10×10 km nationwide grid.

Solar radiation in the visible spectrum can be broken up into two primary components, diffuse and direct. Diffuse radiation is defined as radiation that has been scattered by the atmosphere. Direct radiation, also commonly referred to as beam, is radiation which moves from the source to the observer via the shortest distance possible without scattering. For example, on a heavily overcast day when the sun is highest in the sky (solar noon), it is probable that all insolation is diffuse. On a clear day at solar noon, most of the insolation reaching earth's surface would be direct. Direct radiation is the component of solar radiation that causes visible glare from flat plate PV systems.

2.2. PV Module. The next step in the modeling process was to quantify the amount of visible radiation would be reflected off of a PV module for every hour from 1998 to 2004. The year 2005 was omitted for computational reasons. This was done by multiplying the power (Watts per square centimeter, or W/cm^2) of direct radiation with the reflectivity of the PV module at the average incidence angle for each hour evaluated.

Incidence angle is defined as the angle between the direct component of insolation and a ray perpendicular to the module. If the incidence angle is zero, the angle between the surface of the module and the direct component of radiation is 90°. The reflectance at 633 nm of a polycrystalline silicon (p-Si) PV module is a function of the incidence angle as seen below in Figure 2 developed by Parretta et al. [8]. This reflectance as a function of incidence angle was to determine how much of the direct insolation in the visible spectrum would be reflected off of the PV module and thus reach the observer.

The data shown above is for a glass encapsulated p-Si solar cell. The use of this data is a conservative assumption as the glass used to encapsulate the cell was not solar glass and no antireflective coating applied to the p-Si cell. Actual p-Si modules would likely have lower reflectance values as textured glass, and antireflective coatings are often used to reduce reflected irradiance and increase module efficiency.

The power of the reflected direct radiation was calculated hourly from 1998 to 2004 using the reflectivity in Figure 2, satellite data from NREL, and established sun position equations. The use of hourly data allows quantification of how the power of the reflected direct radiation will vary as the sun moves across the sky.

2.3. Energy at the Cornea. An assumption was made that the power of the direct radiation reflected off of the PV module was equal to the power incident on the cornea of the pilot. This is a conservative assumption as it ignores atmospheric attenuation, refraction, and further reflection. While it is likely that there will be energy diffusion or absorption due to the atmosphere, cockpit glass, or shielding, these effects were ignored during this initial estimation. Later calculations took these potential mitigation efforts into account, as can be seen in Figure 7.

2.4. Retinal Irradiance. The last step in the modeling process was to calculate retinal irradiance hourly from 1998 to 2004. Retinal irradiance can be calculated us a derivation provided by Sliney [9] from the energy incident on the cornea as

$$E_r = E_c \left(\frac{d_p}{f\omega} \right)^2 \tau, \tag{1}$$

where E_r is retinal irradiance [W/cm^2], E_c is irradiance at a plane in front of the cornea [W/cm^2], f is the focal length of the eye (~0.17 cm), d_p is the diameter of the human pupil adjusted to sunlight (~0.2 cm), ω is the subtended angle of the image (or apparent size of the image which in the case of the sun is 0.0093 radians), and τ is the transmission coefficient of the eye (~0.5). This equation assumes that the arc of a circle f is equal to its chord, which is a good approximation for small angles such as these.

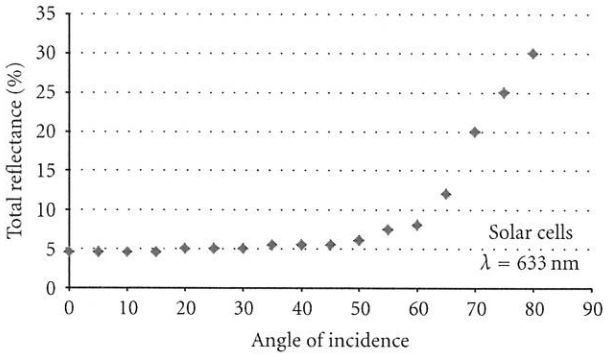

FIGURE 2: Reflectance as a Function of Incident Angle [8].

3. Ocular Safety Metrics

Next, the calculated values of retinal irradiances were compared to known ocular safety metrics. Extensive research has been done on ocular safety metrics and how to calculate the potential for after-image or retinal burns from radiation in the visible wavelengths. The threshold for retinal irradiance corresponding to the potential for retinal burns has been defined as

$$E_{r,\text{burn}} = \frac{0.118}{\omega} \quad \text{for } \omega < 0.118,$$
$$E_{r,\text{burn}} = 1 \quad \text{for } \omega \geq 0.118, \tag{2}$$

where $E_{r,\text{burn}}$ is the retinal burn threshold [W/m^2] and ω is the subtended angle of the sun or 0.0093 radians, Ho et al. [1], and Sliney and Freasier [5]. Ho also compiled data from Metcalf and Horn [2], Severin et al. [4], and Saur and Dobrash [3] to find a fit corresponding to the minimal retinal irradiances that caused after-image (glare). This is calculated by

$$E_{r,\text{flash}} = \frac{3.59 \times 10^{-5}}{\omega^{1.77}}, \tag{3}$$

where $E_{r,\text{flash}}$ is the threshold for potential after image [W/cm^2]. Ho then plotted both of these thresholds and the three regions these thresholds define (potential for retinal burn, potential for after-image, and low potential for after-image) which are illustrated in Figure 3.

The subtended source angle is a function of the size of the image viewed. For the purposes of this report, the image is a reflection of the sun which causes the subtended angle to be constant at 0.0093 radians or roughly 10 mrads.

4. Results

Retinal irradiance was calculated hourly from the years 1998 to 2004 for a fixed-tilt polycrystalline system under the assumptions illustrated in Table 1. These results were then compared to the same results from smooth water.

The assumption of a fixed-tilt system is conservative because, as seen in Figure 2, the reflected component of irradiances increases as incidence angle increases. Having the system held at a fixed tilt increases the average incident angle and therefore the average reflected irradiance.

TABLE 1: Retinal irradiance assumptions.

Module type	Polycrystalline silicon (p-Si)
Module Tilt/Azimuth	25°/0°
Atmospheric attenuation between the module and the pilot's eye?	No
Subtended angle of the sun	0.00093 radians
Diameter of the pupil in sunlight	0.2 cm
Focal length of the eye	0.0017 cm
Transmission coefficient of the eye	0.5

TABLE 2: Retinal irradiances.

	Median* [W/cm^2]	Maximum [W/cm^2]
Fixed-tilt p-Si	0.23	0.45
Smooth water	0.13	0.38
Low potential for an after-image <0.10 W/cm^2		
Potential for after-image = 0.10 to 12.7 W/cm^2		
Potential for retinal burn ≥12.7 W/cm^2		

*The median is calculated as the median of all hours with direct insolation greater than 0.

The results of the calculations are displayed in Figure 4 and Table 2. Figure 4 shows retinal irradiances for all hours in the six-year period when direct radiation was present. For example, the blue bar furthest to the left in Figure 4 represents the number of hours in the years 1998 to 2004 where retinal irradiance was between 0 and 0.02 W/cm^2 (approximately 2250 hours). The potential for an after-image corresponding to the different retinal irradiance powers are shown based on the zones defined in Figure 3. The ranges of these zones are quantified in Table 2, showing that a potential for an after-image for both PV panels and smooth water exists but is slight.

Table 2 shows that the median values of both distributions reside in the region "potential for an after-image." The histogram in Figure 4 shows that 79 to 88 percent of hourly retinal irradiances from smooth water and fixed PV modules fall in this region. However, all calculated retinal irradiances fall in the bottom 5% of the region, indicating that although

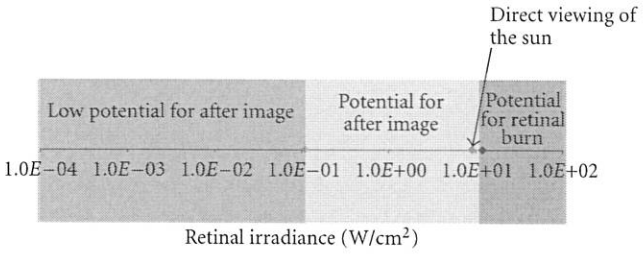

FIGURE 3: Potential impacts of retinal irradiance for a 0.15 s exposure from Ho et al. [1].

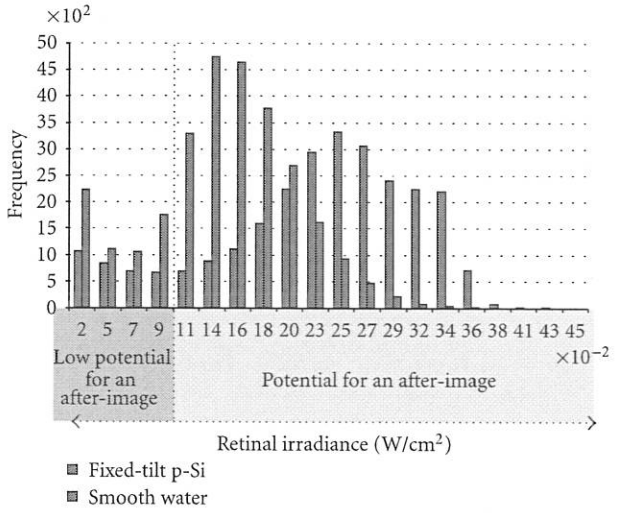

FIGURE 4: Frequency distribution of retinal irradiance 1998 to 2004.

the glare hazard exists, it is relatively low. Figure 5 illustrates this point by expanding the x-axis to the entire range of retinal irradiances that would be classified as "potential for an after-image." The major difference between this figure and the one developed by Ho in Figure 3 is the use of a linear, not logarithmic scale.

Figure 6 displays the *maximum* value of hourly glare (highest retinal irradiance) from smooth water and fixed tilt p-Si PV modules plotted onto Figure 3.

As can be seen from Figure 6, the maximum glare from a solar PV array using conservative assumptions is expected to be comparable to that of smooth water. This maximum value is in the region defined as "potential for after-image" where a potential exists, but the potential is on the low end of the range.

The nuisance of glare for pilots cannot be completely avoided. Therefore, it is typically mitigated using darkened visors, sunglasses, and glare shields. If these objects are manufactured to meet American National Standards Institute (ANSI) Standard Z80.3-2001 [10], they will reduce the intensity of retinal irradiance by roughly 70 percent. A 70 percent reduction of retinal irradiances from radiation reflected off of water and PV modules move all retinal irradiance values below 0.14 W/cm^2 as displayed below in Figure 7. Under these conditions, 92 percent of the hours over the six-year period investigated for solar PV would now be in the "low potential" zone in Las Vegas.

5. Conclusions

The potential flash glare a pilot could experience was modeled from a proposed 25-degree fixed-tilt flat-plate polycrystalline PV array installed outside of Las Vegas, Nevada. Hourly insolation data measured onsite via satellite from the years 1998 to 2004 was used to perform this modeling. These results were then compared to the potential glare from smooth water under the same assumptions. The comparison of the results showed that the potential for glare from flat plate PV systems is comparable to that of smooth water and not expected to be a hazard to air navigation.

Glare from ground-based objects can be a nuisance to pilots if proper mitigation procedures are not implemented. Portland white cement concrete (which is a common concrete for runways), snow, and structural glass all have reflectivities greater than water and flat plate PV modules as shown by Levinson and Akbari [11], Nakamura etal. [12] and Hutchins et al. [13]. Pilots viewing these objects under specific conditions may experience a distracting level of glare.

The nuisance of glare cannot be completely avoided. Therefore, it is typically mitigated using darkened visors, sunglasses, and glare shields. If these objects are manufactured to meet ANSI Standard Z80.3-2001 [10], they will reduce the intensity of retinal irradiance by roughly 70 percent. A 70-percent reduction of retinal irradiances from radiation reflected off of water and PV modules move all retinal

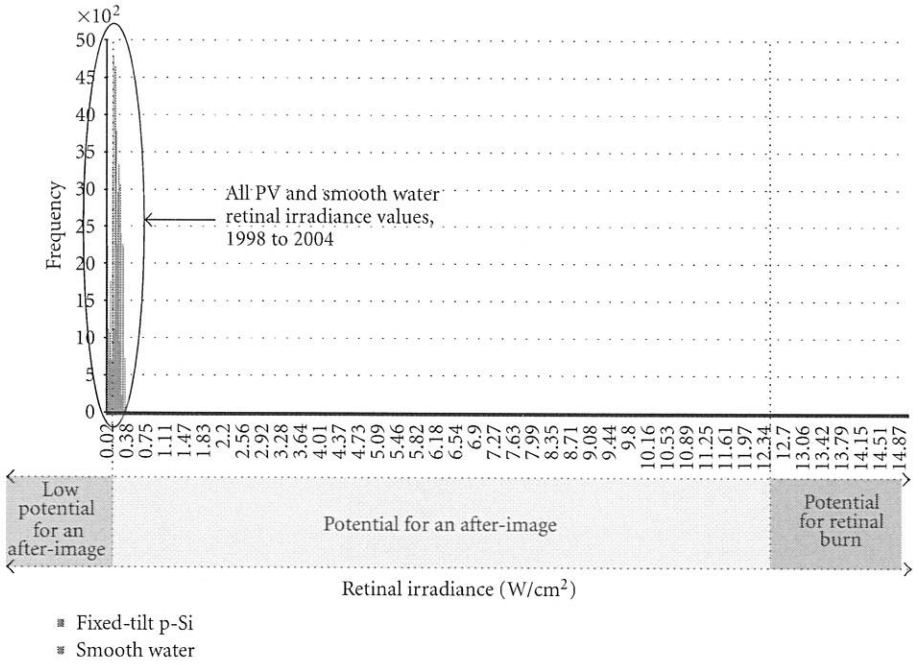

Figure 5: Linearly scaled frequency distribution of retinal irradiance.

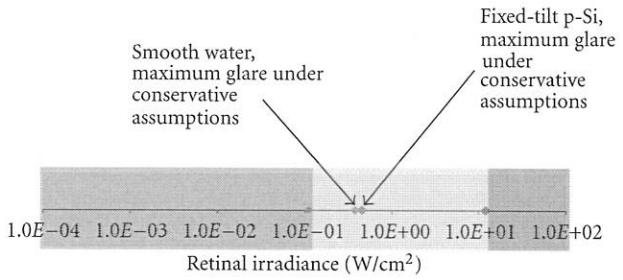

Figure 6: Calculated maximum glare at Nellis [1].

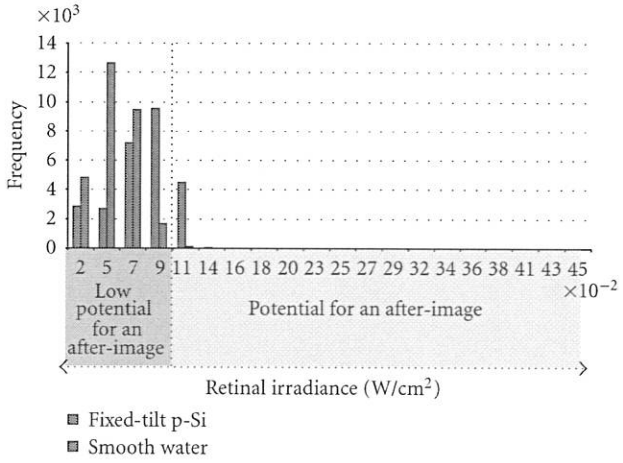

Figure 7: Frequency distribution of retinal irradiance with mitigation.

irradiance values below 0.14 W/cm^2. Under these conditions, 92 percent of the hours over the six-year period investigated for solar PV would now be in the "low potential" zone at Las Vegas.

Highlights

(i) Ocular safety metrics were used to quantify the potential for hazardous glare from a photovoltaic system hourly.

(ii) The results show that the glare hazard from smooth water and flat plate photovoltaic systems are similar.

(iii) Glare mitigation is common and significantly reduces glare hazards.

Abbreviations

ANSI: American National Standards Institute
NREL: National Renewable Energy Labs
PV: Photovoltaic
p-Si: Polycrystalline silicon.

Acknowledgments

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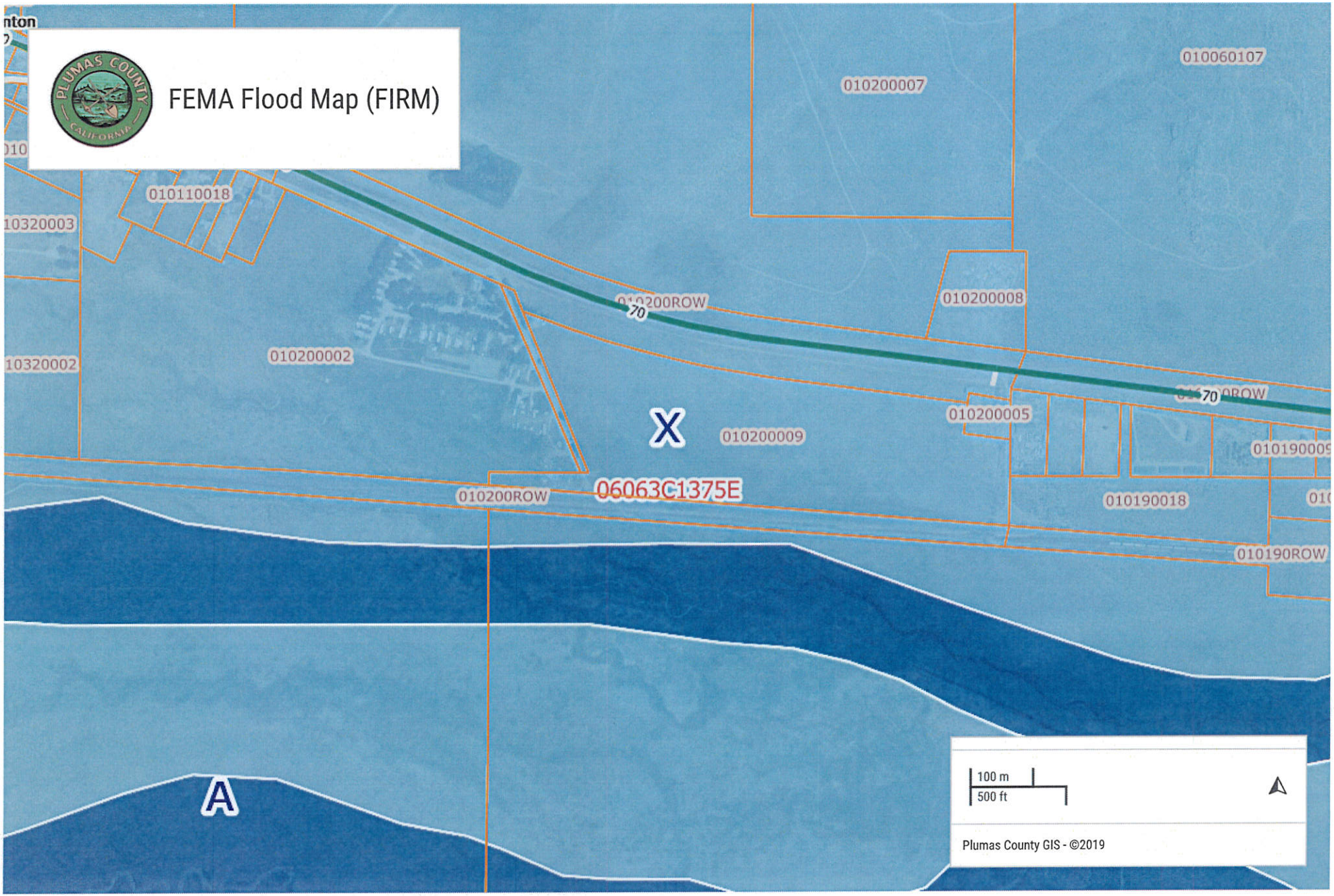
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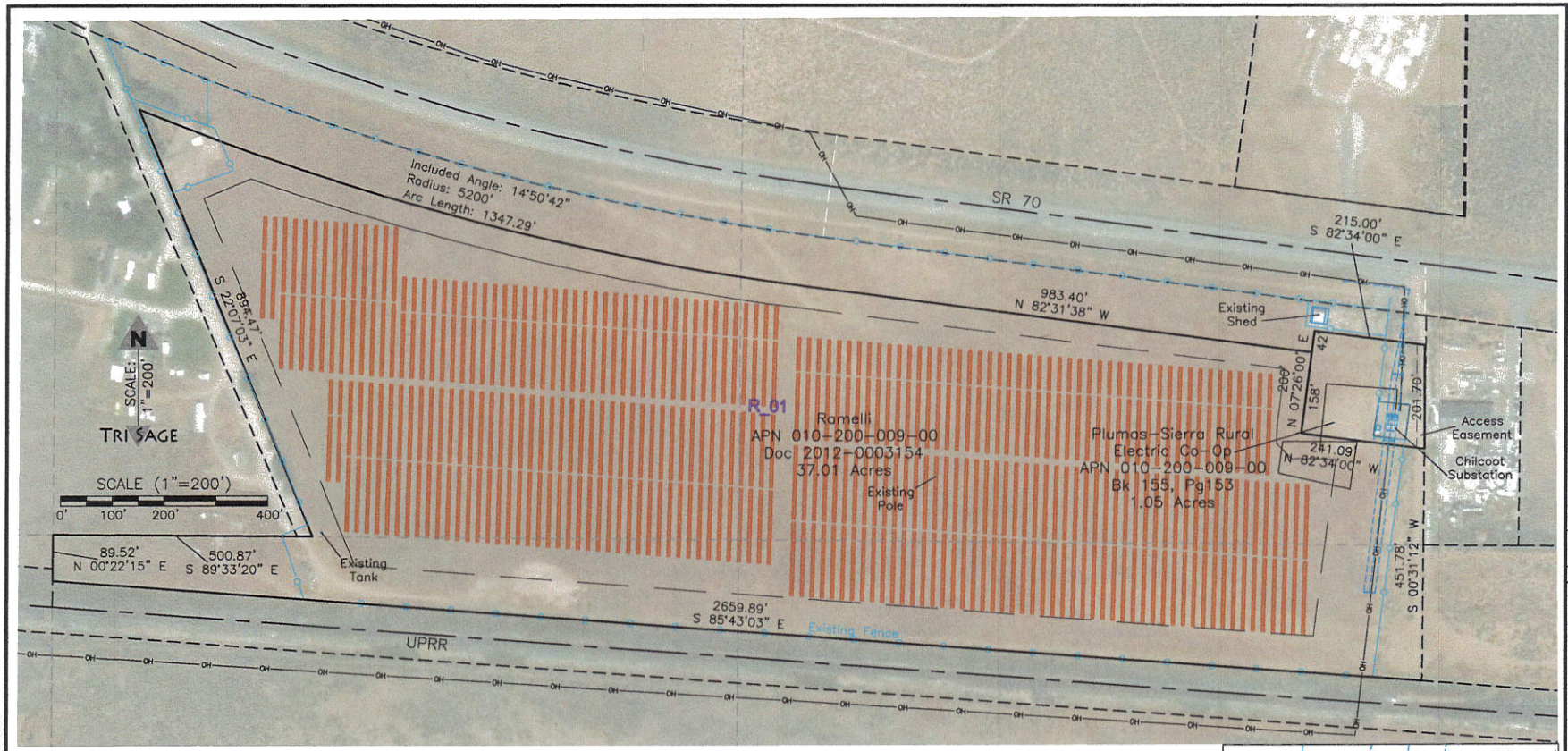

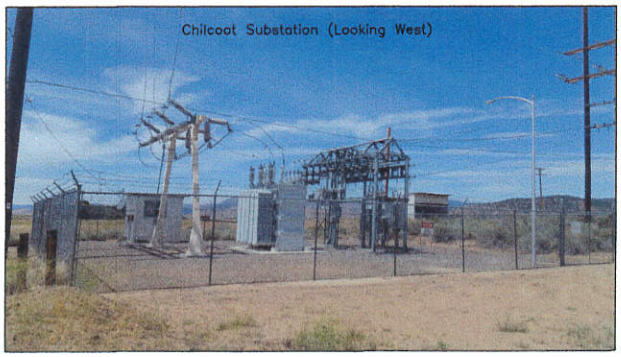

Legend

- Boundary As Surveyed 8/5/2019
- Boundary Per Record Maps*
- Facilities As Surveyed 8/5/2019
- Fence As Surveyed 8/5/2019

*Boundary based on Book 10 of Parcel Maps, Page 13; Book 10 of Record of Surveys, Page 45; and Book 9 of Record of Surveys, Page 34.

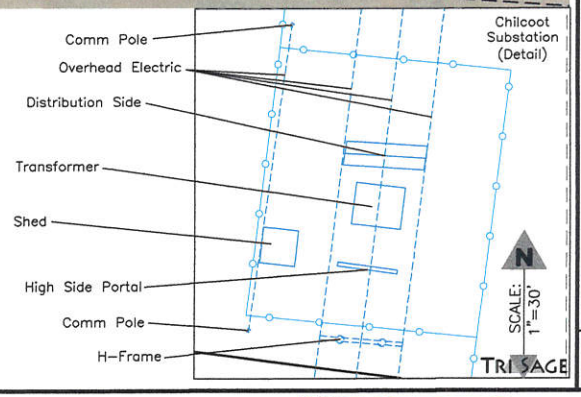

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EXHIBIT 6

Chapter 7
Vibration Prediction and Screening Assessment for Construction Equipment

To assess the potential for vibration to annoy people and damage structures, a reasonable means must be available for estimating or predicting the PPV from various sources at various distances. This section describes a simple method for predicting vibration amplitudes from construction equipment, in terms of PPV, for a variety of vibration sources and soil types. A method for evaluating vibration from blasting is provided in Chapter 8. The evaluation of potential vibration impacts on research and advanced technology production equipment is beyond the scope of this manual. Individuals with specialized expertise in the evaluation of these impacts should be contacted in cases where research and advanced technology equipment could be affected.

This assessment of effects relates to the direct effects of vibration on people and structures. For pile driving, there are few cases of direct damage to structures located farther from a pile than the length of that pile. Settlement of soil as the result of pile driving, however, has potential to damage surface and buried structures at greater distances. Assessment of effects related to vibration-related soil settlement is beyond the scope of this manual. Individuals with specialized expertise in vibration-related soil settlement should be consulted in cases where construction-induced vibration could result in soil settlement or liquefaction.

The method presented in this chapter uses reference vibration source amplitudes and the simplified Wiss propagation model (Eq. 7) described in Chapter 4. The following discussion is separated into the following equipment categories: pile drivers, hydraulic breakers, and other construction equipment. Vibration amplitudes estimated using the method presented in this chapter are expected to be *typical worst-case values* and should be viewed as guidelines only. Actual values from equipment used by a contractor may result in vibration amplitudes that exceed or are lower than the estimated values.

7.1 Pile Driving Equipment

A wide variety of impact and vibratory pile driving hammers is used for driving or extracting various types of piles. Commonly used types of pile drivers are described below.

- **Drop hammer:** The simplest form of pile driving hammer is a falling weight called a gravity or drop hammer. In this case, a weight is raised to the desired height by an attached crane hoist line and dropped directly or indirectly onto the pile. The weight can be enclosed in a steel cylinder.

- **Pneumatic hammer:** A pneumatic impact hammer, also called a compressed-air hammer, is essentially a drop hammer in which a ram/piston in a cylinder is propelled upward by compressed air. The ram strikes the pile cap at the end of a downward stroke, which may be in a free fall under gravity (single-acting) or assisted in downward stroke by pressurized air over the piston head to accelerate the ram (double-acting).

- **Diesel hammer:** Diesel impact hammers are similar to pneumatic hammers. However, whereas pneumatic hammers are one-cylinder drivers that require compressed air from an external source, diesel hammers carry their own fuel, from which they generate their power internally. The falling ram compresses the air in the cylinder, and the impact atomizes a pool of diesel fuel at the end of the cylinder. The atomized fuel ignites with the compressed air and propels the ram upward, ready for the next downward stroke. The burnt gases are scavenged from the cylinder on the upward stroke of the ram. Some diesel hammers are provided with an adjustable fuel pump that serves to regulate the jumping height, and thereby the impact energy.

- **Hydraulic hammer:** Hydraulic impact hammers are a relatively new type of hammer. They are similar to the pneumatic impact hammers, except that the ram is lifted hydraulically, using an external hydraulic source, and then is left to fall freely or is accelerated downward by pressurized gas above the piston.

- **Vibratory pile driver:** Vibratory pile drivers advance the pile by vibrating it into the ground. They are especially effective for soils that are vibratorily mobile, such as sands and silts. Vibration is created in the gear case by rotating eccentric weights powered by hydraulic motors, and sometimes by electric motors. Only vertical vibration is created in the gear case. Horizontal vibration is canceled by the paired eccentrics, which are interconnected with gears to maintain

synchronization. The vibration created in the gear case is transmitted into the pile being driven or extracted by means of a hydraulic clamp attached to the bottom of the gear case. The complete vibrator assembly is held by crane. To prevent the vibration created in the gear case from affecting the crane line, a vibration suppresser assembly is attached to the top of the gear case.

The rated energies of most pile drivers are in the range of about 20,000–300,000 foot-pounds (ft-lbs.) (Woods 1997). One very large driver, the Vulcan 6300, has a rated energy of 1,800,000 ft-lbs. Smaller drivers have rated energies as low as 300 ft-lbs. (Woods 1997.)

7.1.1 Vibration Amplitudes Produced by Impact Pile Drivers

An extensive review of the available literature (Martin 1980; Wood and Theissen 1982; Wiss 1967, 1974, 1981; Dowding 1996; Federal Transit Administration 2018; Woods 1997; Schexnayder and Ernzen 1999) and information provided by the manufacturers (Preston 2002; Morris 1991, 1996, 1997) indicates that the PPV from impact pile drivers can be estimated by the following equation:

$$PPV_{Impact\ Pile\ Driver} = PPV_{Ref}\,(25/D)^{n} \times (E_{equip}/E_{Ref})^{0.5} \quad (in/sec) \quad (Eq.\ 9)$$

Where:

PPV_{Ref} = 0.65 in/sec for a reference pile driver at 25 ft.

D = distance from pile driver to the receiver in ft.

n = 1.1 is a value related to the vibration attenuation rate through ground

E_{Ref} = 36,000 ft-lb (rated energy of reference pile driver)

E_{equip} = rated energy of impact pile driver in ft-lbs.

The above equation is based on extensive review of the actual data points at various distances, measured for a wide range of impact pile drivers. The data were measured at the ground surface outside or within various types of buildings.

Literature indicates that the value of "n" in the above equation is generally 1 to 1.5. The suggested value for n is 1.1. The use of values greater than

1.1 would likely result in overestimation of amplitudes at distances closer than 25 ft and would be slightly conservative at distances beyond 25 ft.

If vibration impacts, based on the above approach, are expected to exceed the vibration assessment criteria, vibration estimates may be refined further by using values of "n" that are based on soil type classification, ranging from Class I–IV soils as outlined in the National Cooperative Highway Research Program (NCHRP) Synthesis 253 (Woods 1997), and based on data developed by Woods and Jedele (1985). This step would require detailed information on soil conditions at the site. Table 17 describes soil materials, soil classes, values of "n" determined by Woods and Jedele (1985), and suggested values for "n" for the purposes of estimating vibration amplitude.

Table 17. Measured and Suggested "n" Values Based on Soil Class

Soil Class	Description of Soil Material	Value of "n" measured by Woods and Jedele	Suggested Value of "n"
I	Weak or soft soils: loose soils, dry or partially saturated peat and muck, mud, loose beach sand, and dune sand, recently plowed ground, soft spongy forest or jungle floor, organic soils, top soil. (shovel penetrates easily)	Data not available	1.4
II	Competent soils: most sands, sandy clays, silty clays, gravel, silts, weathered rock. (can dig with shovel)	1.5	1.3
III	Hard soils: dense compacted sand, dry consolidated clay, consolidated glacial till, some exposed rock. (cannot dig with shovel, need pick to break up)	1.1	1.1
IV	Hard, competent rock: bedrock, freshly exposed hard rock. (difficult to break with hammer)	Data not available	1.0

As indicated by Wood and Theissen (1982), the use of published attenuation relationships, based primarily on Wiss (1967) and Attewell and Farmer (1973), relating hammer energies, scaled distances, and PPVs to predict vibration levels in moderately large commercial buildings or in buried structures would probably result in overly conservative estimates. Wiss (1967, 1974, 1981) does not report data points for complete evaluation, but rather presents only generalized curves.

Research by Wood and Theissen (1982) and an evaluation of the available literature indicate that predictions based on Wiss and Attewell and Farmer are likely to be overly conservative. Therefore, it is prudent to be cautious about the upper range of values presented in FTA's *Transit Noise and Vibration Impact Assessment* guidance manual (Federal Transit Administration 2018) and the NCHRP Synthesis 218 (Schexnayder and Ernzen 1999) for the impact pile drivers, because these higher values

appear to be based on Wiss's curves. The typical values for impact pile drivers, reported in these publications, appear to be based on the actual measured data reported by Martin (1980) and form the basis for Eq. 9 above.

7.1.2 Vibration Amplitudes Produced by Vibratory Pile Drivers

Information regarding vibration amplitudes produced by vibratory pile drivers is scarce in published literature. However, Wood (1982) presents some data for vibratory pile drivers. International Construction Equipment (ICE) has also provided some data for the vibratory pile drivers (Morris 1991, 1996, 1997). ICE conducted tests in 1991 with three different vibratory pile drivers and measured vibration levels at several distances between 3 and 100 ft. Wiss (1967, 1974, 1981) also presents some data curves for vibratory pile drivers. A lack of actual data points and inconsistency in the curves presented in different publications suggests that some caution be applied in evaluating the data.

Based on review of the available literature (Wood and Theissen 1982; Wiss 1967, 1974, 1981) and information provided by ICE (Morris 1991, 1996, 1997), vibration amplitudes produced by vibratory pile drivers can be estimated by the following equation:

$$PPV_{Vibratory\ Pile\ Driver} = PPV_{Ref}\,(25/D)^{n} \quad (in/sec) \qquad (Eq.\ 10)$$

Where:

$PPV_{Ref} = 0.65$ *in/sec for a reference pile driver at 25 ft*

$D =$ *distance from pile driver to the receiver in ft.*

$n = 1.1$ *(the value related to the attenuation rate through ground)*

The suggested value for "n" is 1.1, the same value used for impact pile drivers. If desired and if soil information is available, the value of "n" may be changed to reflect soil type classification, as shown in Table 17.

Vibratory pile drivers generate the maximum vibration levels during the start-up and shut-down phases of the operation because of the various resonances that occur during vibratory pile driving (Woods 1997). Maximum vibration occurs when the vibratory pile driver is operating at the resonance frequency of the soil-pile-driver system. The frequency depends on properties of the soil strata being penetrated by the pile.

As indicated in the NCHRP Synthesis 253 (Woods 1997), vibration from vibratory pile drivers is related to the centrifugal force, which is proportional to the mass of the rotating eccentric elements, the radius of eccentricity of rotating elements, and the frequency of the rotating elements. Because of the scarcity of available data, the effect of centrifugal force on vibration from vibratory pile drivers could not be evaluated. In the absence of any reliable data, it is recommended that vibration from vibratory pile drivers be estimated by using Eq. 10 above.

Eq. 10 can be used to estimate the vibration amplitude during the resonant start-up and shut-down phases of the pile driving operation. Although there are no actual data that show the relative magnitude of vibration during the primary driving phase, away from the resonance effects, it is estimated that it could be 50% or less of the maximum levels that may occur during the start-up and shut-down phases. The maximum levels during the start-up and shut-down phases are the important values that should be evaluated when assessing potential impacts. Vibration generated during these start-up and shut-down phases is often very perceptible and is the source of most complaints from vibratory pile driving activity.

The FTA's *Transit Noise and Vibration Impact Assessment* (Federal Transit Administration 2018) and NCHRP Synthesis 218 (Schexnayder and Ernzen 1999) state that continuous operation at a fixed frequency may be more noticeable to nearby residents, even at lower vibration levels. In addition, the steady-state excitation of the ground may increase the response at the resonance frequency of building components. Response may be unacceptable in cases of fragile historical buildings or vibration-sensitive manufacturing processes. Impact pile drivers, conversely, produce high vibration levels for a short duration (0.2 second) any may have sufficient time between impacts to allow any resonant response to decay.

Wood and Theissen (1982) state that vibration levels from vibratory pile drivers may be at least as severe as those from impact pile drivers, and that the potential for damage from vibratory pile drivers may be greater than that from impact hammers because of sustained vibration levels. Vibration data provided by ICE (Morris 1991, 1996, 1997) support the fact that vibratory pile drivers generate vibration levels that are somewhat similar to those produced by impact pile drivers. The use of resonance-free vibratory pile drivers may be an exception to this inference (see "Vibration Mitigation Measures for Pile Drivers" section below).

7.1.3 Vibration Amplitudes Produced by Hydraulic Breakers

Review of available literature indicates that there is no information available about measured vibration amplitudes from hydraulic breakers used in pavement and concrete demolition projects. Hydraulic breakers (also called hoe-rams, hydraulic hammers, or mounted impact hammers) are generally rated by the amount of energy being delivered, typically in the range of 70–15,000 ft-lbs. Because the breakers are rated in a similar manner to impact pile drivers, it is reasonable to assume that the approach presented in Eq. 9 can be used for estimating vibration amplitude from hydraulic breakers. Because hydraulic breakers generally have much lower energy ratings than impact pile drivers, Eq. 9 should be adjusted for typical reference energy of only 5,000 ft-lbs. for hydraulic breakers.

Based on the above discussion, vibration produced by hydraulic breakers can be estimated by the following formula:

$$PPV_{Hydraulic\ Breaker} = PPV_{Ref}\,(25/D)^{n}\,x\,(E_{equip}/E_{Ref})^{0.5} \quad (in/sec) \quad (Eq.\ 11)$$

Where:

PPV_{Ref} = *0.24 in/sec for a reference hydraulic breaker at 25 ft.*

D = *distance from hydraulic breaker to the receiver in ft.*

n = *1.1 (the value related to the attenuation rate through ground)*

E_{Ref} = *5,000 ft-lbs. (rated energy of reference hydraulic breaker)*

E_{equip} = *rated energy of hydraulic breaker in ft-lbs.*

The suggested value for "n" is 1.1. Because vibration from the hydraulic breakers originates primarily near the ground surface, a value of "n" based on soil classification may not necessarily be applicable; however, a higher value of "n" based on site-specific soil conditions could be used for a less-conservative estimation of vibration amplitude.

7.2 Vibration Produced by Other Construction Equipment

Review of available literature indicates that there is limited information available on vibration source levels from general construction equipment. The most comprehensive list of vibration source amplitudes is provided in

the document entitled *Transit Noise and Vibration Impact Assessment* (Federal Transit Administration 2018). This document lists vibration source amplitudes at 25 ft. for various types of construction equipment. Table 18 summarizes these and other source levels.

Caltrans has conducted several studies related to ground vibration produced by crack-and-seat operations. A study conducted by Caltrans (2000) measured and evaluated ground vibration generated by crack-and-seat operations along State Route 101 near Santa Maria. A Walker Megabreaker Model 8-13000 was used. This machine drops an 8-ft-wide by 10-ft-tall steel plate weighing 13,000 lbs. approximately 4 ft. Operation of this machine produced the following results:

- At 12 m, PPV = 1.25 in/sec.
- At 27 m, PPV = 0.422 in/sec, 0.62 in/sec, and 0.412 in/sec.
- At 34 m, PPV = 0.290 in/sec.
- At 63 m, PPV = 0.083.

Another study (Ames et al. 1976) conducted in 1972 produced the following results:

- At 10 ft., PPV = 2.99 in/sec.
- At 38 ft., PPV = 0.275 in/sec.

The Santa Maria data has been used to develop a reference vibration amplitude for crack-and-seat operation. Using the measurement at 12 m as the reference distance, the data corresponds to Eq. 12 with N = 1.5. The reference amplitude at 25 ft. extrapolated from this is 2.4 in/sec and is shown in Table 18.

Table 18. Vibration Source Amplitudes for Construction Equipment

Equipment	Reference PPV at 25 ft. (in/sec)
Vibratory roller	0.210
Large bulldozer	0.089
Caisson drilling	0.089
Loaded trucks	0.076
Jackhammer	0.035
Small bulldozer	0.003
Crack-and-seat operations	2.4

Sources: Federal Transit Administration 2018 (except Hanson 2001 for vibratory rollers) and Caltrans 2000 for crack-and seat-operations.

Using these source levels, vibration from this equipment can be estimated by the following formula:

$$PPV_{Equipment} = PPV_{Ref}(25/D)^n \quad (in/sec) \qquad (Eq.\ 12)$$

Where:

PPV_{Ref} = *reference PPV at 25 ft.*

D = *distance from equipment to the receiver in ft.*

n = *1.1 (the value related to the attenuation rate through ground)*

The suggested value for "n" is 1.1. Because vibration from this equipment originates primarily near the ground surface, modifying the value of "n" based on soil classification may not necessarily be applicable; however, a higher value of "n" based on site-specific soil conditions could be used for a less-conservative estimation of vibration amplitude. FTA recommends a value of "n" of 1.5 for vibration assessment. Using a value of 1.5 is less conservative than using a value of 1.4 or less (as indicated in Table 17) because it assumes that vibration will attenuate at a greater rate.

7.3 Evaluating Potential Vibration Impacts

As shown in Chapter 6, there is limited consistency between the categorization of effects and damage thresholds; however, it is apparent that damage thresholds for continuous sources are less than those for single-event or transient sources. It is also apparent that the vibration from traffic is continuous and that vibration from a single blasting event is a single transient event; however, many types of construction activities fall between a single event and a continuous source. An impact pile driver, for example, continuously generates single transient events. As a practical matter and based on the nature of available criteria, the criteria can only be reasonably separated into two categories: continuous and transient.

To assess the damage potential from ground vibration induced by construction equipment, a synthesis of various vibration criteria presented in Chapter 6 has been developed. This synthesis of criteria essentially assumes that the threshold for continuous sources is about half of the threshold for transient sources. A vibration amplitude predicted using Eqs. 9–12 can be compared the criteria in Tables 19 and 20 to evaluate the potential for damage.

Table 19. Guideline Vibration Damage Potential Threshold Criteria

	Maximum PPV (in/sec)	
Structure and Condition	**Transient Sources**	**Continuous/Frequent Intermittent Sources**
Extremely fragile historic buildings, ruins, ancient monuments	0.12	0.08
Fragile buildings	0.2	0.1
Historic and some old buildings	0.5	0.25
Older residential structures	0.5	0.3
New residential structures	1.0	0.5
Modern industrial/commercial buildings	2.0	0.5

Note: Transient sources create a single isolated vibration event, such as blasting or drop balls. Continuous/frequent intermittent sources include impact pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers, and vibratory compaction equipment.

A similar synthesis of criteria relating to human perception has also been developed and is summarized in Table 19. A vibration amplitude predicted with Eqs. 1–4 can be compared to the criteria in Table 20 for a simple evaluation of the potential for annoyance and adverse impact. Some individuals may be annoyed at barely perceptible levels of vibration, depending on the activities in which they are participating.

Table 20. Guideline Vibration Annoyance Potential Criteria

	Maximum PPV (in/sec)	
Human Response	**Transient Sources**	**Continuous/Frequent Intermittent Sources**
Barely perceptible	0.04	0.01
Distinctly perceptible	0.25	0.04
Strongly perceptible	0.9	0.10
Severe	2.0	0.4

Note: Transient sources create a single isolated vibration event, such as blasting or drop balls. Continuous/frequent intermittent sources include impact pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers, and vibratory compaction equipment.

7.3.1 Example Calculations

Example 1: An 80,000 ft-lb. pile driver will be operated at 100 ft. from a new office building and 100 ft. from a historic building known to be

fragile. Evaluate the potential for damage to the buildings and annoyance to the building occupants. No information on the soil conditions is known.

Use Eq. 10 to estimate the PPV from the pile driving at 100 ft. In the absence of soil information, use N = 1.1.

$$PPV = 0.65\ (25/100)^{1.1}\ X\ (80{,}000/36{,}000)^{0.5} = 0.21\ in/sec$$

Table 19 suggests that an appropriate damage potential threshold for new commercial buildings is 0.5 in/sec when the source is continuous. The predicted vibration amplitude of 0.21 in/sec is well below this value, indicating low potential for structural damage to the building.

Table 19 suggests that an appropriate damage potential threshold for a fragile building is 0.1 in/sec when the source is continuous. The predicted vibration amplitude of 0.21 in/sec exceeds this value, indicating potential for structural damage to the building.

Table 20 suggests that a transient vibration amplitude 0.21 in/sec would be strongly perceptible, indicating that pile driving could lead to annoyance of building occupants.

Example 2: A vibratory roller will be operated 50 ft. from residences constructed in the 1940s. A detailed soil study is available indicating that the soil is hard competent rock. Evaluate the potential for damage to the buildings and annoyance to the building occupants.

Use Eq. 12 and data from Table 18 to estimate the vibration amplitude. Hard competent rock is in Soil Class IV. Therefore, N = 1.0 should be used.

$$PPV = 0.210\ (25/50)^{1} = 0.11\ in/sec$$

Table 19 suggests that an appropriate damage potential threshold for older residential structures is 0.3 in/sec when the source is continuous. The predicted vibration amplitude of 0.11 in/sec does not exceed this value, indicating low potential for structural damage to the building.

Table 20 suggests that a continuous vibration amplitude 0.11 in/sec would be strongly to severely perceptible, indicating that operation of the roller could lead to a high level of annoyance of residences.

Example 3: Crack-and-seat operations will be conducted on a freeway located 75 ft. from newly constructed residences and residences constructed in the 1940s. Soil conditions are known to be dense,

compacted sand. Evaluate the potential for damage to the residences and annoyance to the building occupants.

Use Eq. 12 to estimate the PPV from the pile driving at 120 ft.. Dense, compacted sand is in Soil Class IV. Therefore, N = 1.1 should be used.

$$PPV = 2.4\ (25/120)^{1.1} = 0.43\ in/sec$$

Table 19 suggests that an appropriate damage potential threshold for older residential structures is 0.3 in/sec when the source is continuous. The threshold for new residential construction is 0.5 in/sec. The predicted vibration amplitude of 0.43 in/sec is below the 0.5 in/sec threshold for new residential construction but above the threshold of 0.3 for older construction, indicating low potential for structural damage to the newer residences but potential for damage to the older structures.

Table 20 suggests that a transient vibration amplitude 0.43 in/sec would be severely perceptible, indicating that pile driving could lead to annoyance of residents.

Sierra Valley Fire Protection District

02/23/2020

To: Tim Evans Associate Planner

From: Sierra Valley Fire Protection District,

Michael Shehorn, Board Member.

Comments; The construction of Plumas Sierra Rural Electric Cooperative solar electric generation facility.

1 SVVFD personal training for this type facility.
2 Additional personal protection equipment, (IE) flash protection.
3 Wield firefighting equipment, (IE) brush truck, water tender.
4 Railroad response, (IE) derailment, chemical fire, etc. What is deeded by SVFPD?

Please review the above comments. Thank You.

Michael Shehorn SVFPD Board Member

775 721 1289 mhshehorn@gmail.com

EXHIBIT 8

Sierra Valley Fire Protection District

02-23-2020

To: Tim Evans Associate Planner

From: Sierra Valley Fire

Vicki Anderson Fire Chief

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Due to the complexity of a solar field in the location of the trailer park , bio diesel, railroad and hwy 70. We would require training for wild land fire, lighting strikes, MVC, any possible dangers. We have 1 tender and 1 brush truck. Tender would be helpful due to no fire hydrant in our district.

Thank You

Vicki Anderson Fire Chief

530-993-1111

vicki5anderson@yahoo.com

EXHIBIT 9

PLUMAS-SIERRA RURAL ELECTRIC CO-OP
PSREC

73233 State Route 70 • Portola, CA 96122
(800) 555-2207 • (530) 832-4261 • Fax (530) 832-5761
www.psrec.coop

Your Touchstone Energy® Cooperative
The power of human connections®

10/27/2020

PSREC responses to Chilcoot Solar Project EIR comments;

1. Plumas Sierra will work with the contractor as needed to ensure the design and construction of the solar generating facility is consistent with current safety standards.
2. Plumas Sierra will coordinate with the Sierra Valley Fire District to provide training materials used in our area for other Solar facilities to orient to fire safety and management around a Solar facility. The SVFD will not be responsible for accessing or managing fire in the facility.
3. Since SVFD will not be required to access the Solar facility it is not expected that any additional PPE will be required.

Evans, Tim

From: Gonzalez, Marcelino@DOT <marcelino.gonzalez@dot.ca.gov>
Sent: Monday, February 24, 2020 11:09 AM
To: Evans, Tim
Cc: Chaffin, Fred N@DOT; Battles, Michael@DOT; Maxwell, John G@DOT; Grah, Kathy M@DOT
Subject: Plu-70-92.59 Chilcoot Solar FW: PSREC Special Use Permit U 12-19/20-03 & Site Development Permit SDP 1-19/20-01
Attachments: Special Use Permit and Site Development Permit Project Information.pdf; Plu-70-92.59 Chilcoot NCPA Solar MND FILE.pdf

Here are our review comments from July, 2019.

Gonzalez, Marcelino@DOT

From: Gonzalez, Marcelino@DOT
Sent: Monday, July 29, 2019 3:10 PM
To: ksdpe67@gmail.com; state.clearinghouse@opr.ca.gov
Cc: Chaffin, Fred N@DOT; Battles, Michael@DOT; Maxwell, John G@DOT; Partlow, Karen A@DOT
Subject: Plu-70-92.59 NCPA Chilcoot Solar Project MND SCH#2019079014

Caltrans has reviewed the Mitigated Negative Declaration prepared for the Vinton-Chilcoot Solar Project site. The site is adjacent to SR 70 east of the SR 49 intersection. Access appears to be from an existing road connection leading to the site but is not specified in the project description. We are unable to determine if this project will require that work will need to be done in the state highway right-of-way. Please add to the project's construction requirements that any work done in the state highway right-of-way must meet state highway standards and will require an encroachment permit. For more information regarding encroachment permit fees or the encroachment permit process, the applicant may contact the District 2 Permits Office located at 1657 Riverside Drive in Redding. The telephone number is (530) 225-3400. Encroachment permit applications are also available from the Caltrans website at www.dot.ca.gov.

Marcelino "Marci " Gonzalez
Local Development Review
& Regional Transportation Planner
(530)225-3369

EXHIBIT 11

Evans, Tim

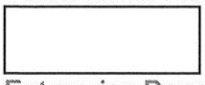
From: Creig Marcus <creigm@enterpriserancheria.org>
Sent: Monday, July 27, 2020 11:46 AM
To: Evans, Tim
Subject: Re: Contact

Your welcome and have a great day, stay healthy!

On Mon, Jul 27, 2020 at 11:42 AM Evans, Tim <TimEvans@countyofplumas.com> wrote:

> Received. Thank you for the "no comment" via phone. It will be put in the record.
>
> Have a great day.
>
> Thanks,
>
> *Tim Evans*
>
> *Associate Planner*
>
> *Plumas County Planning & Building Services*
>
> *Direct Line: (530) 283 - 6207*
>
> *Fax: (530) 283 - 6134*
>
> **From:** Creig Marcus <creigm@enterpriserancheria.org>
> **Sent:** Monday, July 27, 2020 11:43 AM
> **To:** Evans, Tim <TimEvans@countyofplumas.com>
> **Subject:** Contact
>
> Thanks Tim, have a great day.
>
> --

EXHIBIT 12

Creig Marcus
Tribal Administrator

Enterprise Rancheria
Phone: (530) 532-9214
Fax: (530) 532-1768
URL: www.enterpriserancheria.org
Toll-Free: 1-855-891-0307

--

Creig Marcus
Tribal Administrator

Enterprise Rancheria
Phone: (530) 532-9214
Fax: (530) 532-1768
URL: www.enterpriserancheria.org
Toll-Free: 1-855-891-0307

Mooretown Rancheria
#1 Alverda Drive
Oroville, CA 95966
(530) 533-3625 Office
(530) 533-3680 Fax

RECEIVED
JUL 30 2020
PC Planning+Building

July 27, 2020

Mr. Tim Evans
Associate Planner
Plumas County Planning & Building Services
555 Main Street
Quincy, CA 95971

Re: Proposed (Plumas Sierra Rural Electric Cooperative Special Use Permit U12-19/20-03) Project – Plumas Co, CA

Dear Mr. Evans:

Thank you for your letter dated, July 21, 2020, seeking information regarding the proposed Special Use Permit U12-9/20-03 project in Plumas County, California. Based on the information provided, the Mooretown Rancheria is not aware of any known cultural resources on this site. However, as the project progresses, if any new information or human remains are found, we do have a process to protect such important and sacred artifacts (especially near rivers or streams).

Please contact the following individuals if tribal cultural items or Native American human remains are found:

THPO
Mooretown Rancheria
#1Alverda Drive
Oroville, CA 95966
(530) 533-3625 Office
(530) 533-3680 Fax
E-mail: matthew.hatcher@mooretown.org

Thank you for providing us with this notice and opportunity to comment.

Sincerely,

Matthew Hatcher (THPO)

Matthew Hatcher
Tribal Historic Preservation Officer

EXHIBIT 13

"Concow - Maidu"

FACT SHEET:

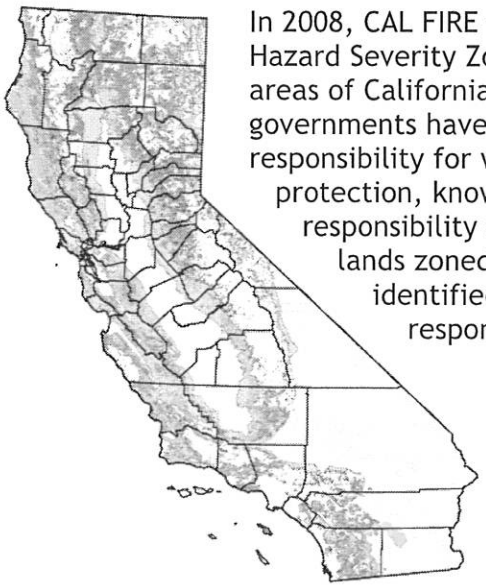
California's Fire Hazard Severity Zones

California Department of Forestry and Fire Protection
Office of the State Fire Marshal

While all of California is subject to some degree of fire hazard, there are specific features that make some areas more hazardous. The California Department of Forestry and Fire Protection (CAL FIRE) is required by law[1] to map areas of significant fire hazards based on fuels, terrain, weather, and other relevant factors.

These zones, referred to as Fire Hazard Severity Zones (FHSZ), influence how people construct buildings and protect property to reduce risk associated with wildland fires. The maps were last updated in the mid-1980s and early 1990s. They are currently being updated to incorporate improved fire science, data and mapping techniques.

The proposed Fire Hazard Severity Zone maps for lands where the state has financial responsibility for wildland fire protection, known as state responsibility area or SRA, are available for review and public comment. A series of public hearings is being conducted in 56 counties with state responsibility area lands to gather comment for consideration. After the comment period ends, the CAL FIRE Director will either modify or adopt the Fire Hazard Severity Zone maps.



In 2008, CAL FIRE will produce Fire Hazard Severity Zone maps for the areas of California where local governments have financial responsibility for wildland fire protection, known as local responsibility areas, or LRA. Only lands zoned very high are identified within local responsibility areas.

Buildings on the fringes of California's wildland areas face a greater fire hazard than those in cities and towns.

Fire Hazard Elements

Vegetation - Fire hazard considers the potential vegetation over a 30- to 50-year time horizon. Vegetation is "fuel" to a wildfire and it changes over time.

Topography - Fire typically burns faster up steep slopes.

Weather - Fire moves faster under hot, dry, and windy conditions.

Crown Fire Potential - Under extreme conditions, fires burn to the top of trees and tall brush.

Ember production and movement - Fire brands are embers blown ahead of the main fire. Fire brands spread the wildfire and they get into buildings and catch the building on fire.

Likelihood - Chances of an area burning over a 30- to 50-year time period based on history and other factors.

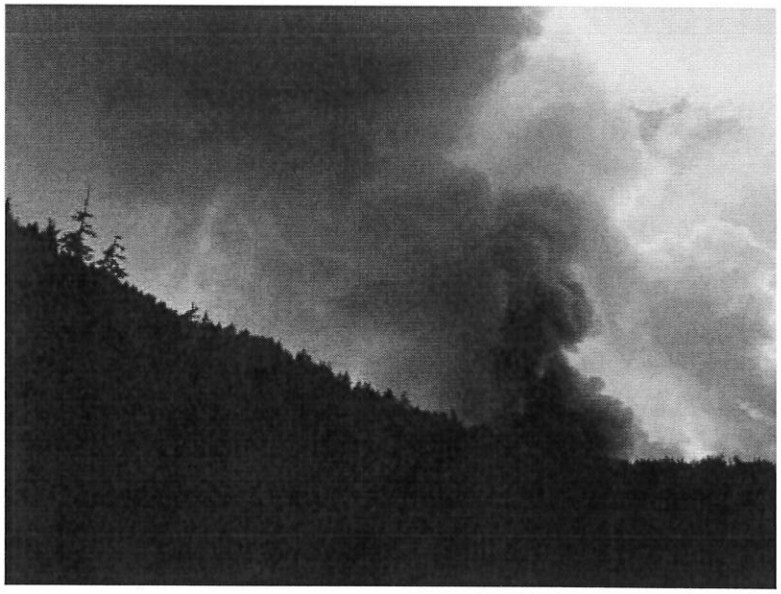
[1] (PRC 4201-4204 and Govt. Code 51175-89)

Burning embers, known as firebrands, spread fire ahead of the flame front and can ignite buildings up to a mile away from the main fire.

How are zones determined?
The Fire Hazard Severity Zone maps were developed using a science-based and field-tested computer model that assigns a hazard score based on the factors that influence fire likelihood and fire behavior. Many factors are considered such as fire history, existing and potential fuel (natural vegetation), flame length, blowing embers, terrain, and typical weather for the area. There are three hazard zones in state responsibility areas: moderate, high and very high.

Urban and wildland areas are treated differently in the model, but the model does recognize the influence of burning embers traveling into urban areas, which is a major cause of fire spread.

What is the map for?
The Fire Hazard Severity Zones identify fire hazard, not fire risk. "Hazard" is based on the physical conditions that give a likelihood that an area will burn over a 30 to 50-year period without considering modifications such as fuel reduction efforts. "Risk" is the potential damage a fire can do to the area under existing conditions, including any modifications such as defensible space, irrigation and sprinklers, and ignition resistant building construction which can reduce fire risk. Risk considers the susceptibility of what is being protected.



Fire Hazard Severity Zone maps are intended to be used for:

- Implementing wildland-urban interface building standards for new construction
- Natural hazard real estate disclosure at time of sale
- 100-foot defensible space clearance requirements around buildings
- Property development standards such as road widths, water supply and signage
- Considered in city and county general plans

How do I determine the fire hazard in my area?
Visit the CAL FIRE Website at www.fire.ca.gov. You can enter your address and easily find your Fire Hazard Severity Zone IF your property is in the state responsibility area. The statewide map and maps for each county with state responsibility area lands are also posted. For more information about Fire Hazard Severity Zones or wildland-urban interface building codes, contact your local CAL FIRE Unit.