APPENDIX J

Paleontological Resource Assessment for the VENTANA Tentative Tract Map No. 37884 Project, City of Indio, Riverside County, California

March 2020

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Paleontological Resource Assessment for the VENTANA Tentative Tract Map No. 37884 Project, City of Indio, Riverside County, California

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Paleontological Resource Assessment for the VENTANA Tentative Tract Map No. 37884 Project, City of Indio, Riverside County, California

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MANAGEMENT SUMMARY

At the request of Ave 50 Indio, LLC (Ave 50), Applied EarthWorks, Inc. (Æ) completed a Paleontological Resource Assessment (PRA) for the VENTANA Tentative Tract Map No. 37884 Project (Project) in the southwest portion of the City of Indio (City) in Riverside County (County), California. This PRA is written in partial satisfaction of the California Environmental Quality Act (CEQA) and a Mitigated Negative Declaration to the Initial Study is being prepared for the City, the lead agency for CEQA compliance. The Project area encompasses 45.17 acres of vacant land, proposed for development of a 103-unit residential community. The south boundary is Avenue 50, the west boundary is the south extension of Shields Road, the east boundary is approximately 0.04-mile west of the south terminus of Croquet Court, and the north boundary is approximately 0.12-mile south of Avenue 49.

This PRA consisted of desktop studies and a field survey. The desktop studies included a review of published literature and maps as well as museum record searches. The purpose of these studies was to identify the geologic units in the Project area and to determine whether previously recorded paleontological localities occur either within the Project area or within the same geologic units elsewhere nearby. The field survey was conducted to ground-truth the results of the desktop studies. Æ utilized the results of all the desktop studies and the field survey to determine the paleontological sensitivity of the ground surface in the Project area. Æ assigned the entire Project area to High Potential, because there is a high likelihood for significant paleontological resources to be preserved both near the surface and at unknown depths.

Æ recommends the City retain a qualified professional paleontologist who meets the Society of Vertebrate Paleontology's (SVP) qualification standards (Principal Investigator, Project Paleontologist) to develop and implement a paleontological resource impact mitigation program (PRIMP) for the Project prior to the start of ground-disturbing activities. Æ makes the following recommendations to be included in the PRIMP:

- Initial period of full-time construction monitoring at all depths throughout the Project area.

- Full-time construction monitoring may be reduced to spot-check monitoring at the discretion of the Project Paleontologist, if no intact and significant paleontological resources are encountered during the initial period of construction monitoring.

Implementation of these recommendations will ensure adverse impacts to paleontological resources will be reduced to a less than significant level in accordance with CEQA.

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1
INTRODUCTION

At the request of Ave 50 Indio, LLC (Ave 50), Applied EarthWorks, Inc. (Æ) completed a Paleontological Resource Assessment (PRA) for the VENTANA Tentative Tract Map No. 37884 Project (Project) in the southwest portion of the City of Indio (City) in Riverside County (County), California (Figure 1-1). This PRA is written in partial satisfaction of the California Environmental Quality Act (CEQA) and a Mitigated Negative Declaration to the Initial Study is being prepared for the City, the lead agency for CEQA compliance.

1.1 PROJECT DESCRIPTION

The Project involves the development of a 103-unit residential community on 45.17 acres of presently vacant land, which will include a recreation center, community trail system, and associated infrastructure (Project area). The south boundary of the Project area is Avenue 50, the west boundary is the south extension of Shields road, the east boundary is approximately 0.04-mile west of the south terminus of Croquet Court, and the north boundary is approximately 0.12-mile south of Avenue 49. The Project area is mapped in the southeast quarter of Section 33 of Township 5 South, Range 7 East, as shown on the La Quinta, California 7.5-minute U.S. Geological Survey (USGS) topographic quadrangle map (Figure 1-2).

To date, the deepest depths of proposed disturbance are associated with the retention basins (i.e., ranging from 3 to 6 feet below ground surface [bgs]). However, the maximum depths of disturbance for all other proposed Project components are still yet to be decided (e.g., houses and associated infrastructure, roads, community pool, recreation center open space and retention).

1.2 PURPOSE OF INVESTIGATION

This PRA is designed to accomplish several goals: (1) identify the geologic units within the Project area and assess their paleontological resource potential; (2) determine whether the Project has the potential to adversely impact scientifically significant paleontological resources; (3) provide Project-specific management recommendations for paleontological resources, as necessary; and (4) demonstrate compliance with state laws and regulations. The following section describes the ways in which this PRA meets the stated goals.

1.3 KEY PERSONNEL

Æ's Paleontology Program Manager, Dr. Amy Ollendorf, served as the Principal Investigator for the Project. She oversaw each task required for this PRA, including quality control. Æ's Senior Paleontologist, Dr. Win McLaughlin, and Paleontology Supervisor, Chris Shi, completed the desktop research and wrote the PRA; Shi also completed the field survey. Æ GIS technician Cari Inoway produced the figures in close consultation with Shi and McLaughlin.

All of Æ's key paleontology staff responsible for this PRA meet or exceed the SVP (2010) qualification standards for Qualified Professional Paleontologist (Principal Investigator, Project Paleontologist). Ollendorf has over 35 years of environmental compliance experience across the

Figure 1-1 Project vicinity in Riverside County, California.

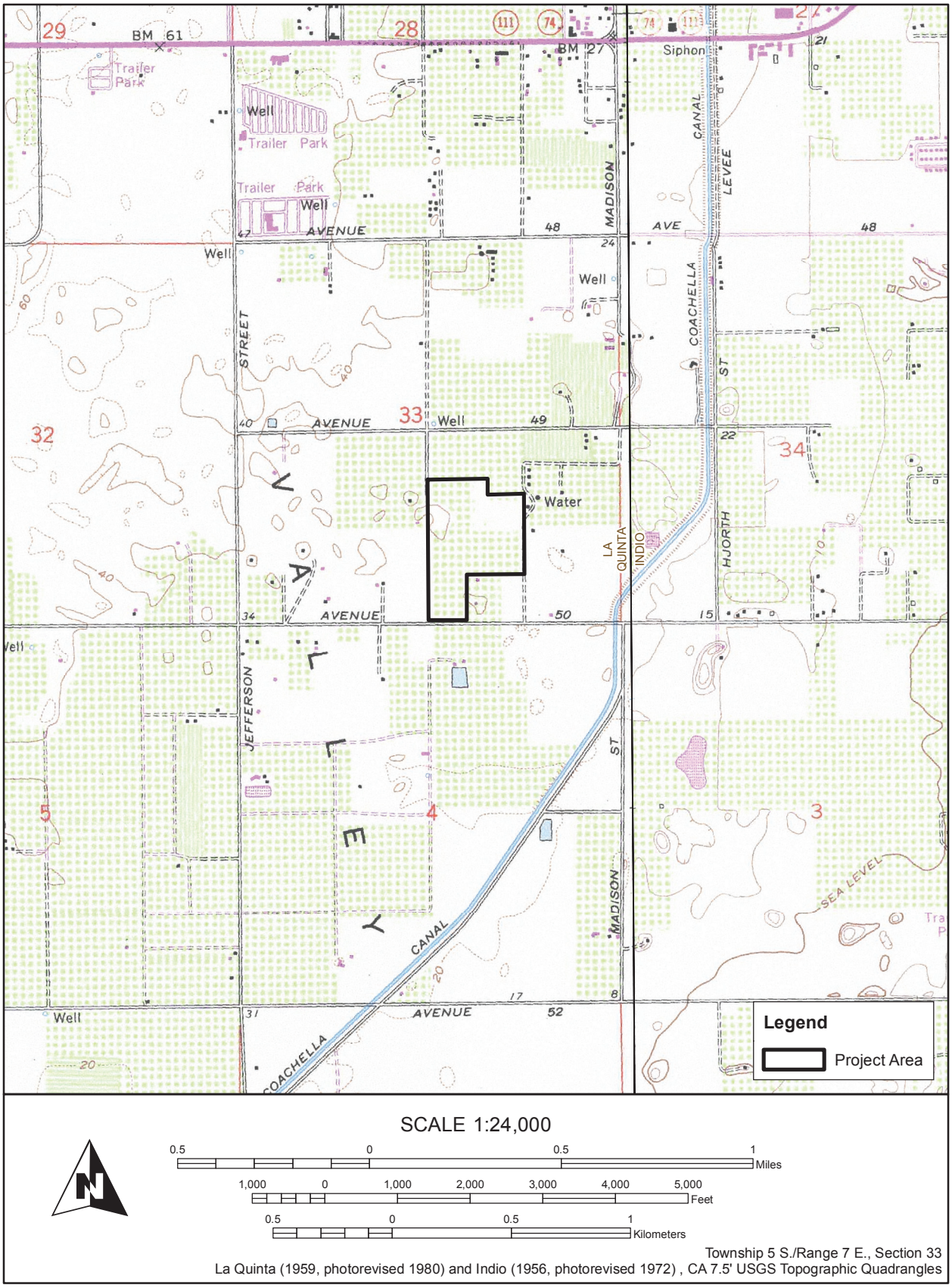

Figure 1-2 Project location map.

United States and abroad. Her project experience includes paleontology and she also completed interdisciplinary graduate degrees involving geology and a bachelor's degree in geology, all of which focused on paleontological subject matter. McLaughlin has graduate degrees in geology, which focused on the relationship between fossil vertebrates and geochronology. She also has extensive paleontological field experience in the United States and abroad, and she presently teaches college-level geology in Southern California. Shi has a graduate degree in geology with an emphasis in paleontology. He also possesses familiarity and proficiency with all aspects of paleontology, sedimentology, and stratigraphy in California. Qualifications for key personnel can be found in Appendix A.

1.4 REPORT ORGANIZATION

Chapter 1 has described the Project, defined the purpose of the investigation, and provided a description of Æ's key personnel for this PRA. Chapter 2 discusses the regulatory framework governing the Project. Chapter 3 presents the paleontological sensitivity criteria and resource guidelines used for this assessment. Chapter 4 provides the methods employed, and Chapter 5 describes the geology and paleontology of the Project area. The results of the desktop studies, field survey, and paleontological sensitivity assessment are presented in Chapter 6. Management recommendations can be found in Chapter 7, and references cited are listed in Chapter 8. Appendix A contains qualifications of key personnel.

2
REGULATORY ENVIRONMENT

Paleontological resources (i.e., fossils) are considered nonrenewable scientific resources because when they are destroyed, they cannot be replaced. As such, paleontological resources are afforded protection under various federal, state, and local laws. This Project is not subject to federal laws. Consequently, all resources are protected under only state and local laws.

2.1 STATE

California is among the states that protect significant paleontological resources. CEQA is the legal framework through which this protection is accomplished. Enacted in 1970, CEQA does not directly regulate land uses but instead requires state and local agencies within California to follow a protocol of analysis and public disclosure of environmental impacts of proposed projects and adopt all feasible measures to mitigate those impacts.

2.1.1 California Environmental Quality Act

This Project is subject to Section 15002(a)(3) of the Guidelines for Implementation of CEQA (California Code of Regulations, Title 14, Chapter 3), which states one of the basic purposes of CEQA is the intention to "prevent significant, avoidable damage to the environment by requiring changes in projects through the use of alternatives or mitigation measures when the governmental agency finds the changes to be feasible." Therefore, CEQA requires detailed studies that analyze the environmental effects of a proposed project.

If a project is determined to have a potential significant environmental effect, the act requires that alternative plans and mitigation measures be considered. Specifically, in Section VII(f) of Appendix G of the CEQA Guidelines, the Environmental Checklist Form, the question is posed, "Will the project directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?" If paleontological resources are identified as being within the proposed project area, the sponsoring agency must take those resources into consideration when evaluating project effects. The level of consideration may vary with the importance of the resource. For this Project, the City is the Lead Agency for compliance with CEQA.

2.1.2 CEQA Implementation

Guidelines for implementation of CEQA are codified in the California Code of Regulations (CCR), Title 4, Chapter 3, Sections 15000 et seq., which requires state and local public agencies to identify the environmental impacts of proposed discretionary activities or projects, determine if the impacts will be significant, and identify alternatives and mitigation measures that will substantially reduce or eliminate significant impacts to the environment. The various agencies within state government all have their own guidance documents to assist with CEQA compliance. The City of Indio is the government agency responsible for compliance with the CEQA for the Project.

2.2 LOCAL

Riverside County and the lead agency for CEQA compliance for the Project, the City, provide guidance for the identification, protection, and preservation of significant paleontological resources. The following sections describe all relevant policies, goals, and objectives.

2.2.1 Riverside County

There are four policies covering paleontological resources within the County's *General Plan*, *Multipurpose Open Space (OS) Element* (County of Riverside, 2015a:OS-51):

- **OS 19.6:** Whenever existing information indicates that a site proposed for development has high paleontological sensitivity as shown on Figure OS-8, paleontological resource impact mitigation program (PRIMP) shall be filed with the Riverside County Geologist prior to site grading. The PRIMP shall specify the steps to be taken to mitigate impacts to paleontological resources.

- **OS 19.7:** Whenever existing information indicates that a site proposed for development has low paleontological sensitivity as shown on Figure OS-8, no direct mitigation is required unless a fossil is encountered during site development. Should a fossil be encountered, the Riverside County Geologist shall be notified and a paleontologist shall be retained by the project proponent. The paleontologist shall document the extent and potential significance of the paleontological resources on the site and establish appropriate mitigation measures for further site development.

- **OS 19.8:** Whenever existing information indicates that a site proposed for development has undetermined paleontological sensitivity as shown on Figure OS-8, a report shall be filed with the Riverside County Geologist documenting the extent and potential significance of the paleontological resources on site and identifying mitigation measures for the fossil and for impacts to significant paleontological resources prior to approval of that department.

- **OS 19.9:** Whenever paleontological resources are found, the County Geologist shall direct them to a facility within Riverside County for their curation, including the Western Science Center in the City of Hemet.

The County also has a coarse-grained paleontological sensitivity map, which indicates countywide sensitivity rankings across the ground surface based on the county's system as described above (County of Riverside, 2015a:Figure OS-8, OS-55; refer to Chapter 3 for the ranking system).

2.2.2 City of Indio

In addition to County policies, guidance, and paleontological sensitivity mapping, the City's *Interim Final Draft General Plan, Conservation Element* includes "Goal CE-8: Historic, Archaeological, and Paleontological Resources" as well as two policies designed to assist with achieving the goal (City of Indio, 2019a:8–19):

- **CE-8.1 Site Plan Review.** Ensure adequate site plan review and mitigation measures are implemented for the development of sites with the potential to contain historic, archaeological, and paleontological resources.

- **CE-8.4 Monitoring.** Require monitoring on sites where grading has the potential to impact subsurface cultural and paleontological resources during excavation and construction activities.

The City also has a paleontological sensitivity map, which is based on sensitivity rankings assigned to geologic units present within the City's boundaries (City of Indio, 2019b; refer to Chapter 3 for the ranking system).

3
PALEONTOLOGICAL RESOURCE ASSESSMENT GUIDELINES

Protection of paleontological resources requires assessment of the potential for geologic units to yield significant paleontological resources that could be directly or indirectly impacted or destroyed during Project development. Successful protection also involves the formulation and implementation of appropriate management measures to mitigate impacts.

3.1 DEFINITION OF PALEONTOLOGICAL RESOURCES AND SIGNIFICANCE CRITERIA

Paleontological resources are defined by the Society of Vertebrate Paleontology (SVP, 2010) as fossils and fossiliferous deposits. Fossils are the evidence of once-living organisms as preserved in the rock record. They include both the lithified remains of ancient plants and animals and the traces thereof (trackways, imprints, burrows, etc.). In general, the SVP (2010) considers fossils to be greater than 5,000 years old (older than Middle Holocene[1]) and to typically be preserved in sedimentary rocks, although certain volcanic rocks and low-grade metamorphic rocks may be fossiliferous if formed under certain conditions.

Well-preserved and identifiable individual fossils are considered significant paleontological resources if they are a type specimen, rare, a complete specimen, or part of an important diverse fossil assemblage. Of particular importance are fossils found in situ, or undisturbed from their primary geologic context. These fossils are important because they are used to examine evolutionary relationships, provide insight on the development of and interaction between biological communities, establish time scales for geologic studies, and for many other scientific purposes, including investigation into paleoenvironments and paleoclimates (Scott and Springer, 2003; SVP, 2010). Among the various types of fossils, intact and in situ vertebrate fossils are usually assigned a greater significance than other types as they are comparatively rare. Consequently, more attention tends to be placed on the recovery of vertebrate fossils than other types.

3.2 PROFESSIONAL STANDARDS AND CLASSIFICATION OF PALEONTOLOGICAL RESOURCE SENSITIVITY

Most professional paleontologists in California adhere to guidelines set forth by the SVP (2010), unless others are available. The SVP's guidelines establish detailed protocols for the assessment of the paleontological sensitivity of a project area and outline measures to follow in order to mitigate adverse impacts to known or unknown fossil resources during project development (SVP, 2010).

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[1] Middle Holocene: extends from 8,200 to 4,200 years ago in the Holocene Epoch of the Quaternary Period, covering approximately the past 11,700 years (Cohen et al., 2020); the Quaternary Period also includes the older Pleistocene Epoch, which lasted from approximately 2.6 million years ago to approximately 11,700 years ago (Cohen et al., 2020).

Baseline information gathered during a paleontological resource assessment is used to assign the paleontological sensitivity of the geologic unit(s) (or members thereof) exposed at or distributed across the ground surface of a project area, in addition to those thought to be beneath a project area at depth. It should be noted that surface geology is not always indicative of subsurface geology or the potential for paleontological resources. For instance, an area whose surface geology is mapped as non-fossiliferous sediments may cover fossil-rich Pleistocene sediments at depth. Also, an area mapped as granite, devoid of fossils, may be covered by fossil-rich Pleistocene sediments. Thus, actual paleontological sensitivity across a project area ultimately can be determined only through a combination of desktop and field efforts.

The SVP provides a classification system to rank a geologic unit's sensitivity or potential for significant paleontological resources. The SVP scale includes High, Undetermined, Low, and No Potential. The County has developed a similar classification system for evaluating paleontological sensitivity and mitigating paleontological resources. In contrast to the SVP (2010) system, the County divides the High Potential ranking into two categories, High A and High B (County of Riverside, 2015b). High A Potential is based on the occurrence of fossils that may be present at the ground surface of the Project area, while High B Potential is based on the occurrence of fossils at or below 4 feet of depth, which may be impacted during construction activities (County of Riverside, 2015b).

Instead of the County's classification system, the City applied the SVP's system to the geologic units mapped at the ground surface within the City's boundaries (City of Indio, 2019b, 2019c). See Table 3-1 for a comparison of the SVP and Riverside County sensitivity rankings. Because the Project is within the jurisdiction of the City, this PRA utilizes SVP (2010) criteria to determine sensitivity rankings for the Project area. Detailed descriptions of the rankings along with the geologic units mapped at the ground surface within the City's limits are:

> **High Potential:** Rock units from which vertebrate or significant invertebrate, plant, or trace fossils have been recovered are considered to have a high potential for containing additional significant paleontological resources. Rock units classified as having high potential for producing paleontological resources include, but are not limited to, sedimentary formations and some volcaniclastic formations (e.g., ashes or tephras), and some low-grade metamorphic rocks which contain significant paleontological resources anywhere within their geographical extent, and sedimentary rocks temporally or lithologically suitable for the preservation of fossils (e.g., Middle Holocene and older, fine-grained fluvial sandstones, argillaceous and carbonate-rich paleosols, cross-bedded point bar sandstones, fine-grained marine sandstones, etc.). Paleontological potential consists of both (a) the potential for yielding abundant or significant vertebrate fossils or for yielding a few significant fossils, large or small, vertebrate, invertebrate, plant, or trace fossils and (b) the importance of recovered evidence for new and significant taxonomic, phylogenetic, paleoecologic, taphonomic, biochronologic, or stratigraphic data. Rock units which contain potentially datable organic remains older than Late Holocene, including deposits associated with animal nests or middens, and rock units which may contain new vertebrate deposits, traces, or trackways are also classified as having high potential. Geologic units ranked as High Potential within the City are the Mecca Formation, Palm Springs Formation, Canebrake Conglomerate, and Lake Cahuilla beds.
>
> **Undetermined Potential:** Rock units for which little information is available concerning their paleontological content, geologic age, and depositional environment are considered to have undetermined potential. Further study is necessary to determine if these rock units have high or

low potential to contain significant paleontological resources. A field survey by a qualified professional paleontologist (Project Paleontologist) to specifically determine the paleontological resource potential of these rock units is required before a Paleontological Resource Impact Mitigation Program (PRIMP) can be developed. In cases where no subsurface data are available, paleontological potential can sometimes be determined by strategically located excavations into subsurface stratigraphy. The geologic unit ranked as Undetermined Potential within the City is the Ocotillo Conglomerate.

Low Potential: Reports in the paleontological literature or field surveys by a qualified professional paleontologist may allow determination that some rock units have low potential for yielding significant fossils. Such rock units will be poorly represented by fossil specimens in institutional collections, or based on general scientific consensus only preserve fossils in rare circumstances and the presence of fossils is the exception not the rule, e.g. basalt flows or Recent colluvium. Rock units with low potential typically will not require impact mitigation measures to protect fossils. All other geologic units mapped across the City's ground surface are assigned Low Potential.

No Potential: Some rock units have no potential to contain significant paleontological resources, for instance high-grade metamorphic rocks (such as gneisses and schists) and plutonic igneous rocks (such as granites and diorites). Rock units with no potential require no protection nor impact mitigation measures relative to paleontological resources (SVP, 2010).

Table 3-1
Paleontological Sensitivity Classifications

Sensitivity/Potential		Criteria[1]	Mitigation Recommendations[2]
County of Riverside	**SVP**		
High A High B	High	Rock units from which vertebrate or significant specimens of other fossil types have been recovered are considered to have a high potential. Rock units with high potential also may include rock units that are temporally or lithologically suitable for the preservation of fossils (e.g., Middle Holocene and older, argillaceous and carbonate-rich paleosols, fine-grained marine sandstones, etc.).	Typically, a field survey, PRIMP, and onsite construction monitoring will be required. Any significant specimens discovered during monitoring will need to be prepared, identified, and curated into a museum. A final report documenting the significance of the finds will also be required.
Undetermined	Undetermined	In some cases, available literature on a particular rock unit will be scarce and a determination of whether or not it is fossiliferous or potentially fossiliferous will be difficult to make. Under these circumstances, further study is needed to determine the unit's paleontological resource potential.	A field survey is required to further assess the unit's paleontological potential. The survey may provide data for development of a Paleontological Resource Impact Mitigation Program (PRIMP) prior to construction.
Low	Low	Rocks units from which few fossils have been recovered or are generally unsuitable for preservation of fossils are considered to have a low potential. These units typically yield fossils only on rare occasions and under unusual circumstances (e.g., basalt flows, recent colluvium, etc.).	Mitigation is not typically required; however, if an unanticipated paleontological resource is encountered, a qualified professional paleontologist (Principal Investigator, Project Paleontologist) may need to evaluate the resource to consider mitigation.
N/A	No Potential	Rock units that have no potential for paleontological resources are those that are formed under or exposed to immense heat and pressure, such as high-grade metamorphic rocks and plutonic igneous rocks.	No mitigation required.

Sources: County of Riverside (2015b) and SVP (2010)
[1] Criteria based on County of Riverside (2015b) and SVP (2010)
[2] Recommendations based on SVP (2010)

4
METHODS

This PRA was completed through desktop studies and a field survey. The twofold purpose of the off- and on-site research was (1) to identify the geologic units in the Project area and immediate vicinity to determine whether previously recorded paleontological localities occur either within the Project area or within the same geologic units elsewhere nearby and (2) to determine the sensitivity of the geologic units in the Project area for their potential to yield paleontological resources.

4.1 LITERATURE REVIEW AND MUSEUM RECORDS SEARCHES

In many areas, the near-surface layers of sediments and sedimentary rocks are broken down and converted to soil (pedogenesis) through chemical and physical weathering processes (Boggs, 2012). During pedogenesis, any fossils preserved within the near-surface layers often are destroyed or rendered unrecognizable. Therefore, intact and identifiable fossils are unlikely to be found in soil. Reviews of relevant geologic maps, regional geological publications, and unpublished reports are necessary to ascertain the geology and stratigraphy of a project area to determine the potential for significant subsurface paleontological resources.

To supplement the map and literature reviews, Æ requested a search of museum collection records maintained by the Natural History Museum of Los Angeles County (NHMLAC) and the Western Science Center (WSC) in Hemet. Æ also completed online searches of two databases readily available to the public—the Paleobiology Database (PBDB) and the database maintained by the University of California Museum of Paleontology (UCMP).

4.2 FIELD SURVEY

Prior to the field survey, Æ examined recent aerial photographs of the entire Project area in Google Earth to determine likely locations of geologic outcrops and potential survey routes. Shi conducted the field reconnaissance survey for the Project on February 28, 2020. The purpose of the survey was to confirm the presence/absence of exposed fossils on the ground surface and to evaluate geologic exposures for their potential to yield subsurface fossil material. The survey consisted of a combination of close visual inspection and spot-checking to inspect the ground surface for evidence of paleontological resources while using a Global Positioning System (GPS) cellular application to navigate throughout the Project area and collect field data, if needed.

Close visual inspection was conducted for portions of the Project area where the ground surface was visible and unobscured by vegetation. This included portions that appeared undisturbed or only slightly disturbed such as a hill in the western portion of the Project area, as well as portions that were previously disturbed from agricultural tilling. Spot-checking was conducted for the remainder of the Project area where the ground surface was obscured by vegetation. Shi kept notes on the geology and sedimentology encountered and took photographs to document the survey. Observed fossils, if any, were field-documented and not collected.

5
GEOLOGY AND PALEONTOLOGY

The following section provides the regional geological context of the Project area as well as descriptions of the geologic units mapped within its boundaries and units thought to be present in the subsurface. It also includes any paleontological information reported from the units.

5.1 REGIONAL GEOLOGY

The Project area is northwest of the north end of the Salton Sea in the Coachella Valley portion of the Colorado Desert geomorphic province (California Geological Survey, 2002). A geomorphic province is a region of unique topography and geology that is distinguished from other regions based on its landforms and tectonic history (American Geological Institute, 1976). The Colorado Desert is bordered by the Transverse Ranges to the north, the Peninsular Ranges to the west, the Mojave Desert to the east, and Mexico to the south. Much of the Colorado Desert lies within the Salton Trough; a large structural depression that extends from the San Gorgonio Pass in the north to the Gulf of California in the south (Norris and Webb, 1976). The Salton Trough is a graben structure, or structurally down-dropped block, bounded by roughly parallel northwest-trending faults, including the San Andreas Fault Zone to the northeast and the San Jacinto Fault Zone to the southeast. Faults rarely follow a single trace, and instead form complex networks of roughly parallel fault zones. Both of these fault zones accommodate primarily lateral displacement, although vertical displacement is also common and allows for the rotation of the block between the fault zones.

The Salton Trough formed as a topographic depression in the Late Miocene[2] to Pliocene[3] from spreading and subsidence associated with the rift system that opened the Gulf of California, which resulted in seawater spilling into the trough when the western edge of the structure was below sea level (Alles, 2011). This event is evidenced by marine fossils and tidal rhythmite deposits, as well as geochemical indicators of salinity. Rifting initiated in the Late Miocene (Dorsey et al., 2007), evidenced from magnetostratigraphy and biostratigraphy, which date the oldest basin-filling deposits to approximately 8 million years old (Dorsey et al., 2007). While the chronology of marine intrusion is contested, undisputed marine sequences began in the Pliocene (Alles, 2011). From the Pliocene to Late Pleistocene[4], an immense volume of sediment eroded from downcutting of the Grand Canyon, resulting in the formation of a massive delta across the seaway by deposition from the ancestral Colorado River. This delta eventually separated the

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[2] Miocene Epoch: extends from approximately 23 to 5.3 million years ago in the Neogene Period, which lasted from 23 to 2.6 million years ago (Cohen et al., 2020); the Miocene can be subdivided into the Early (23-6 million years ago), Middle (16-11.6 million years ago), and Late Miocene (11.6-5.3 million years ago) (Cohen et al., 2020).
[3] Pliocene Epoch: extends from approximately 5.3 to 2.6 million years ago in the Neogene Period (Cohen et al., 2020); the Pliocene can be subdivided into the Early (5.3-3.6 million years ago) and Late Pliocene (3.6-2.6 million years ago) (Cohen et al., 2020).
[4] Pleistocene Epoch: extends from approximately 2.6 million years ago to 11,700 years ago in the Quaternary Period (Cohen et al., 2020); the Pleistocene can be subdivided into the Early (2.6-1.8 million years ago), Middle (1.8 million-129,000 years ago), and Late Pleistocene (129,000-11,700 years ago) (Cohen et al., 2020).

marine waters of the Gulf of California from the brackish and fresh waters of the Salton Trough, evidenced by the transition from marine to terrestrial fossils preserved in sedimentary strata (Dorsey et al., 2007). From the Late Pleistocene to Late Holocene[5], the trough was periodically occupied by the ancient freshwater Lake Cahuilla. This lake formed, drained, and reformed several times between approximately 10,000 to 240 years before present (B.P.) due to fluctuations in the course of the Colorado River and the subsequent diversion of the river's mouth from the Gulf of California to the Salton Trough (Deméré, n.d.; Norris, 1979). During its last high stand, Lake Cahuilla measured approximately 105-miles-long by 35-miles-wide and reached a maximum depth of 300 feet.

5.2 GEOLOGY AND PALEONTOLOGY OF THE PROJECT AREA

The regional surface geology, including the Project area, is mapped at a scale of 1:62,500 by Dibblee and Minch (2008). Neogene and Quaternary Period alluvial sediments derived from the ancestral and modern Mojave River are distributed across the entire region, above plutonic and metamorphic rocks from the Mesozoic Period[6] and Proterozoic Eon[7]. The surficial geology within the Project area is described in Section 5.2.1 below and shown in Figure 5-1, whereas the potential subsurface geology is discussed in the Section 5.2.2.

5.2.1 Holocene Alluvial Sediments (Qa)

According to Dibblee and Minch (2008), the entire ground surface in the Project area consists of unindurated, undissected Holocene-age alluvial sediments (Qa). This geologic unit is alluvial sand and clay of valley areas. Across the region, the maximum thickness of these deposits reaches 100 feet in an area south of the Project area. Various other surficial deposits are found in close association with unit Qa near the Project area: wind-laid dune sand (Qs), approximately 1 mile to the west; alluvial sand and gravel of the Whitewater River (Qg), approximately 2 miles to the north; alluvial fan gravel (Qf), approximately 4 miles to the southwest; and light gray clay of playa lakes (Qc), which form undifferentiated deposits with Qa approximately 5 miles to the west.

Holocene-age deposits, particularly those less than 5,000 years old, are unlikely to yield significant fossils, as they generally are too young for the fossilization process to occur (SVP, 2010). However, playa lake deposits (Qc) such as those of ancient Lake Cahuilla can facilitate development of sub-fossil material into fully permineralized fossiliferous material. The physical and chemical environment of dry playa lakes is particularly suitable for fossil preservation due to their arid and often alkaline conditions that promote rapid carbonate precipitation. For instance, the presence of rapidly precipitated tufa structures in these lakes is considered as an indicator that fossils may be preserved within (Medina et al., 2016). A diverse assemblage of fossils is known from Late Holocene Lake Cahuilla beds approximately 5 miles southwest of the Project area, just south of the City of La Quinta (Whistler et al., 1995). These beds can be up to 300 feet thick in the center of the Salton Trough (Norris and Webb, 1976) in which the Project area lies.

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[5] Late Holocene: extends from 4,200 years ago to the present (Cohen et al., 2020).
[6] Mesozoic Period: extends from approximately 252 to 66 million years ago (Cohen et al., 2020).
[7] Proterozoic Eon: extends from approximately 2500 to 551 million years ago (Cohen et al., 2020).

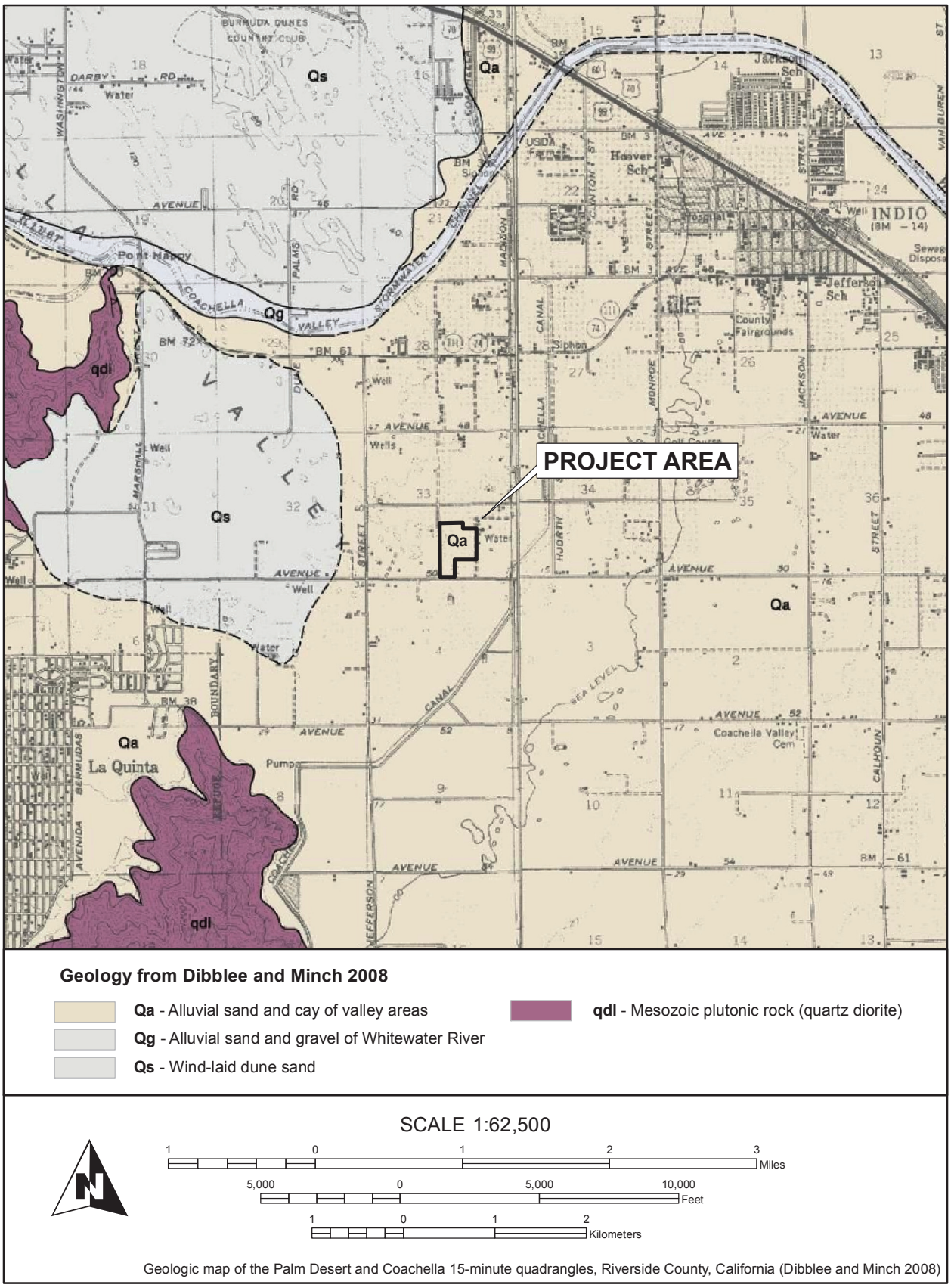

Figure 5-1 Geologic units in the Project area.

Also, similar Lake Cahuilla deposits are mixed with the alluvial deposits to form undifferentiated units mapped as Qa/Qc approximately 5 miles east of the Project area between the Whitewater River and the San Andreas Fault Zone (Dibblee and Minch, 2008).

5.2.2 Pliocene and Pleistocene Alluvial Sediments, subsurface (Qoa, QTf)

According to Dibblee and Minch (2008) and references therein, weakly indurated Pleistocene-age alluvial gravels (Qoa) are exposed at the ground surface approximately 10 miles south of the Project area. Because of the relatively close proximity of these outcrops to the Project area, the Qoa geologic unit likely also underlies the younger Holocene-aged sediments in the Project area. Approximately 7 miles to the west-southwest, the weakly lithified Pliocene- to Pleistocene-age Bautista Beds (QTf) are exposed in some scattered outcrops. This geologic unit is composed of light gray to tan alluvial sandstone, thin layers of gray claystone, and some conglomeratic fill (Dibblee and Minch, 2008). These may also occur in the subsurface, but because of the complex fault structure of the basin, the depth, angle, and exact identity of any subsurface deposits is impossible to predict. Finer-grained Pleistocene-age alluvial sediments and the Bautista Beds have yielded many significant fossils elsewhere in Riverside County (Frick, 1921; Reynolds and Reynolds, 1991).

6
RESULTS AND ANALYSIS

This chapter reports on the results of the desktop studies and field survey completed for this Project. Paleontological sensitivity rankings also are assigned to the geologic units mapped at the ground surface and likely present at unknown depths within the Project area.

6.1 LITERATURE REVIEW

Whistler et al. (1995) report the presence of many fully permineralized fossils from a Lake Cahuilla locality approximately 5 miles southwest of the Project area. This locality is recorded within the same Holocene-age surface sediments mapped in the Project area by Dibblee and Minch (2008). These fossiliferous strata are radiocarbon dated to 1,125 ± 80 and 2,545 ± 50 B.P. Fossils include various freshwater diatoms, land plants, sponges, ostracods, mollusks, fish, small terrestrial vertebrates, and traces found in excavations as shallow as 3 to 6 feet bgs. While these ages are younger than the timeframe typically required for fossils to form, the alkaline conditions of playa lakes greatly reduce the time needed to precipitate minerals into pore spaces in bone or shells for fossilization (Medina et al., 2016).

6.2 MUSEUM RECORDS SEARCHES

Many fossil localities within Pliocene and Pleistocene deposits in Riverside County are recorded in both the UCMP's online database and the PBDB. However, there are no localities from either database recorded within the Project area or a 10-mile-wide buffer zone. The PBDB does show one published fossil locality within 15 miles (to the southeast) and a second within 20 miles (also to the southeast).

The first PBDB locality, referred to as "Mesquite Oasis," is Middle Pleistocene in age and is reported from terrestrial sandstones of the Palm Springs Formation. This important locality yielded a new genus of goose, *Brantadorna downsi* (Howard, 1963). The second PBDB locality is also listed as four distinct localities in the UCMP's database. They are collectively referred to as "Travertine Rock," which is Early Pliocene in age and derived from the Latrania Sand Member of the Imperial Formation. This formation consists of near-shore marine to coastal deposits, which yielded a rich invertebrate fauna with over 35 species of Anthozoa (corals), bivalves, gastropods, and echinoderms (Powell, 2008). The Pliocene marine units also are frequently reworked into the younger Pleistocene and Holocene deposits (Cox et al., 2003).

The NHMLAC search found no vertebrate fossil localities within the Project area but did list one locality somewhat nearby from deposits similar to those mapped by Dibblee and Minch (2008) within the Project area (McLeod, 2020). This locality is LACM 1269, which is northwest of the Project area in a drainage on the northwest side of Edom Hill near Seven Palms Valley. LACM 1269 yielded a fossil specimen of the Pleistocene horse, *Equus*.

McLeod (2020) states shallow excavations within the Project area are unlikely to uncover significant vertebrate fossils, but deeper excavations that extend into older Quaternary deposits are likely to encounter them. He concludes that any substantial excavations in the Project area below the very uppermost layers should be closely monitored during construction. Additionally, sediment samples should be collected and processed to determine the potential for small-fraction fossils in the Project area.

The WSC search also did not report any fossil localities within the Project area or within a 1-mile-wide buffer zone (Radford, 2020). However, she predicts "if excavation activity disturbs deeper sediments dating to the earliest parts of the earliest parts of the Holocene or Late Pleistocene periods, the material would be scientifically significant" (Radford, 2020).

6.3 FIELD RESULTS

The topography of the Project area is generally low relief, except for a slight hill in the western portion that rises approximately 10 feet above the surrounding landscape (Figure 6-1). Most of the Project area consisted of tilled agricultural fields at the time of Æ field survey. The surficial geology is not evident in these locations due to mixing from cultivation and moderate to dense vegetation. However, native, undisturbed sediments are visible on the hill (Figure 6-2) and in an outcrop near the southeast corner of the Project area (Figure 6-3). Fine- to medium-grained sands with low to moderate proportions of silt crop out on the hill, while fine-grained sands with abundant silt and clay are present in the outcrop. Disturbed sediments within tilled portions of the Project area appear to be similar to the outcrop's sediments. Other than sparse, partially fossilized freshwater gastropod shells observed among the disturbed sediments in the central portion of the Project area (Figure 6-4), no paleontological resources were encountered in the Project area during Æ's field survey.

Figure 6-1 Project area overview from the hill in the western portion of the Project area; facing southeast.

Figure 6-2 Ground surface on top of the hill; facing southwest.

Figure 6-3 Outcrop near the southeast corner of the Project area, showing clayey and silty fine-grained sands; facing west.

Figure 6-4 **Partially mineralized gastropod shells on the ground surface, visible in the photo near top and bottom left corners, bottom right center, and below top right corner; central portion of the Project area.**

6.4 DETERMINATION OF PALEONTOLOGICAL RESOURCE POTENTIAL WITHIN THE PROJECT AREA

Using information obtained from the desktop studies and field survey, Æ determined the paleontological resource potential of the geologic units exposed at the ground surface in the Project area. Æ's paleontological sensitivity rankings follow the SVP's (2010) and County's (2015b) classification systems (Figure 6-5).

Æ notes the Holocene-age alluvial deposits (Qa), as mapped at the surface, have a low likelihood or preserving significant paleontological resources. However, Æ's observations during the survey indicate playa lake deposits also may be present in situ at the ground surface (e.g., on the hill in the western portion of the Project area or in the outcrop near the southeast corner of the Project area) or at very shallow depths as exposed by recent agricultural mixing throughout the Project area. The clayey textures of some sediments within the Project area and presence of partially mineralized freshwater gastropod shells support the interpretation of a lacustrine depositional environment.

The deposits in the Project area appear to be similar to the undifferentiated Qa/Qc unit mapped 5 miles east of the Project area (Dibblee and Minch, 2008), near the shoreline of ancient Lake Cahuilla. Additionally, the discovery of Lake Cahuilla fossils within sediments also mapped as Qa southwest of the Project area (Whistler et al., 1995) suggests at least some of the surficial alluvial sediments within the Project area may be mixed at an unknown depth with fossiliferous Lake Cahuilla beds. Furthermore, deeper excavations in the Project area may encounter older alluvial deposits of Pliocene- to Pleistocene-age (Qoa, QTf), including the Bautista Beds, which

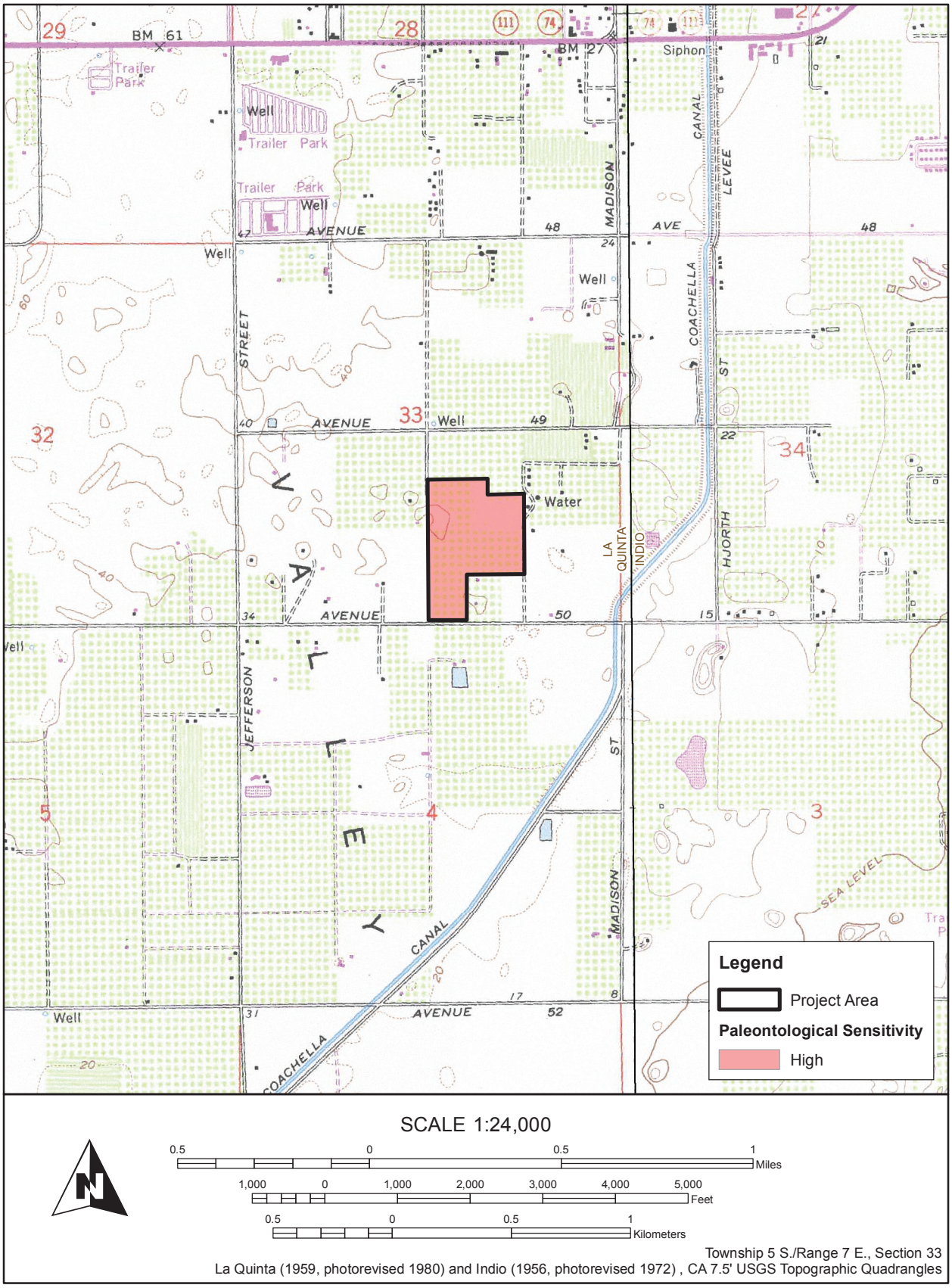

Figure 6-5 Paleontological sensitivity of the Project area.

may be present at unknown depths in the subsurface. Reports of fossils from such deposits nearby (e.g., Howard, 1963; Powell, 2008; McLeod, 2020) support this prediction. Therefore, Æ suggests the entire Project area to have High Potential for significant paleontological resources, both near the ground surface and at greater depths. Æ's evaluation is consistent with the sensitivity maps from the City of Indio (2019b) and the County of Riverside (2015a), which show the Project area as High Potential and High A, respectively.

7
RECOMMENDATIONS

Æ concludes that Project-related construction activities may impact significant paleontological resources across the entire Project area, especially at depth. Æ's desktop studies and field survey together indicate the paleontological resource potential near the ground surface and to an unknown maximum depth is High throughout the Project area. Despite being geologically young, alluvial surface sediments may be intermixed with fine-grained lacustrine sediments derived from underlying fossiliferous Lake Cahuilla beds. Additional sources of potentially significant paleontological resources are the fossiliferous Pleistocene- and Pliocene-age alluvial sediments, which likely underlie the Project area at unknown depths.

Prior to the issuance of grading permits and consistent with Policy OS-19.6 (County of Riverside, 2015a), Æ recommends a paleontological resource mitigation program (PRIMP) be prepared by a qualified professional paleontologist (Principal Investigator, Project Paleontologist), as defined by the SVP (2010). The PRIMP will specify the steps to be taken to mitigate impacts to paleontological resources. For instance, Worker's Environmental Awareness Program (WEAP) training should be prepared prior to the start of Project-related ground disturbance and presented in-person to all field personnel to describe the types of fossils that may be found and the procedures to follow if any are encountered.

A PRIMP also will indicate where construction monitoring will be required for the Project and the frequency of required monitoring (i.e., full-time, spot-checks, etc.). Based on the findings thus far, Æ recommends the following:

- Initial period of full-time construction monitoring at all depths throughout the Project area.

- Full-time monitoring may be reduced to spot-check monitoring at the discretion of the Project Paleontologist, if no intact and significant paleontological resources are encountered during the initial period of construction monitoring.

In addition to construction monitoring procedures, a PRIMP also will provide details about fossil collection, analysis, and preparation for permanent curation at an approved repository, such as the WSC. Lastly, the PRIMP describes the different reporting standards to be used—monitoring with negative findings versus monitoring resulting in fossil discoveries.

8
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APPENDIX A

Qualifications of Key Personnel

Applied EARTHWORKS Inc.

AMY L. OLLENDORF

Managing Principal/Paleontology Program Manager

Education

Postdoctoral Research Associate, 2006–2007, World Heritage Studies, University of Minnesota

Ph.D., Ancient Studies,1993, University of Minnesota

M.S., Ancient Studies, 1986, University of Minnesota

B.S., Anthropology (with honors) and Geology, 1983, Beloit College

Registrations/Certifications

- Registered Professional Archaeologist #12588
- Licensed Professional Geologist, Minnesota #30084 (6/1998-6/2018, expired)
- Certified Paleontologist and Archaeologist, Orange County (2020-present)
- Paleontology and Cultural Consultant, Riverside County (2018-present)

Professional Experience

- 2018–present, Managing Principal/ Paleontology Program Manager, Applied EarthWorks, Inc.
- 2015–2018 and 2005–2008, President and Senior Project Manager, ALO Environmental Associates LLC
- 2006–2015, Program Manager, Cultural Heritage Planning and Management, AECOM
- 2003–2005, Director, Cultural Resources Management, Peterson Environmental Consulting, Inc.

Summary of Qualifications

Dr. Ollendorf has more than 37 years of experience in cultural heritage, geoarchaeology, paleoecology, paleontology, and environmental compliance at the global, national, tribal, state, and local levels. She meets the Society of Vertebrate Paleontology qualifications standards for principal investigator and she is also Æ's principal investigator on a CA statewide Paleontological Resource Use Permit for paleontology from the US Bureau of Land Management (BLM) for 2018-2021.

Dr. Ollendorf has supervised and/or participated in archaeological, historical, architectural history, and paleontological services, tribal negotiations, and agency coordination throughout her career. She also has managed EISs and EAs. Her project experience includes work in 35 states, including Southern California, and other western states, and abroad on a wide range of client projects across many different industry sectors.

During her career, Dr. Ollendorf has written or overseen many hundreds of compliance reports in addition to having published multiple articles in peer-reviewed professional journals and presented to a wide variety of audiences, including professional peers.

Selected Project Experience

Improvements to the Avenue 50 and Jackson Street Intersection, City of Indio, Riverside County, California. Paleontology Program Manager (2019-2020). Oversaw completion of ground-surface reconnaissance field survey and provided QA/QC of paleontological technical memorandum for CEQA compliance. Paleontologically sensitive geologic units: Lake Cahuilla beds. Client: Albert A. Webb Associates for County of Riverside.

Replacement of Two Timber Railroad Avenue Bridges near the Community of Whitewater, Riverside County, California. Paleontology Program Manager and Project Manager (2019-present). Oversaw preparation and completed QA/QC of paleontological technical memorandum for replacement of the Railroad Avenue Bridge over Fornat Wash (Bridge Number 56C0099) and the Railroad Avenue Bridge over East Channel Stubbe Wash (Bridge Number 56C0101) within a 4.5-acre Project area. Paleontologically sensitive geologic units: Older Alluvial Deposits, Palm Spring Formation, and Imperial Formation. Completed for NEPA (Caltrans) and CEQA (County) compliance. Worked closely with paleontology staff (Chris Shi). Client: WSP for Caltrans District 8.

Menifee Town Center – Parcels 13, 14, and 15 Development Project, Riverside County, California. Paleontology Program Manager (2018-2020). Oversaw preparation and completed QA/QC of negative findings construction monitoring report for cultural and paleontological resources as well as PRIMP covering 13-acre project area. Paleontologically sensitive geologic units: Middle to Late Pleistocene alluvial fan deposits. Worked closely with paleontology staff (Scott Rohlf, Chris Shi, and Aimee Montenegro). Completing for CEQA compliance. Client: Kristoff Commercial Real Estate to City of Menifee.

Professional Experience (continued)

- 2000–2003, Director, Cultural Resources Management, HDR Engineering, Inc.
- 1996–2000, Director, Cultural Resources Management, Braun Intertec Corporation, Inc.
- 1994–1996, Statewide Inventory Coordinator, Minnesota State Historic Preservation Office
- 1993–1994, Staff Archaeologist, Institute for Minnesota Archaeology
- 1991–1993, Independent Contractor—Paleoecology
- 1990, Co-Director, Geoarchaeological Field School, Southern Illinois University, Edwardsville
- 1987–1990, Graduate Research Assistant, Limnological Research Center, University of Minnesota
- 1984–1987, Graduate Research Assistant, Archaeometry Laboratory, University of Minnesota
- 1983–1984, Research Assistant, Crustal Dynamics Project, Geology & Geophysics Branch, NASA Goddard Space Flight Center
- 1987, 1984, Assistant Geoarchaeologist, Tel Miqne Excavations, ASOR-Albright Institute, Jerusalem, Israel
- 1983, Summer Intern, US Bureau of Land Management, Phoenix District, Arizona
- 1983, Teaching Assistant – Evolution of the Earth, Beloit College Geology Department
- 1983, Research Assistant – Palynomorphs (Acritarchs), Beloit College Geology Department

Selected Project Experience (continued)

Pacific Gas & Electric (PG&E) Groundwater Remediation, Hinkley, San Bernardino County, California. Paleontology Program Manager and Project Manager (2018-present). Over a multi-year period, completing Release-To-Construction (RTC) project-by-project reviews for cultural and paleontological resource management. Tasks include assessing project areas for sensitivity for cultural and paleontological resources, previously surveyed areas, and recorded locations of cultural resources. Also overseeing cultural and paleontological construction monitoring on a project-by-project basis. Requires project-specific reporting, annual reporting, regular client communication, and coordination with cultural and paleontological staff. Paleontologically sensitive geologic units: Pleistocene alluvium and Middle to Late Pleistocene lacustrine deposits associated with Pluvial Harper Lake. Reports to date include Paleontological Resource Monitoring Report: Cultural Resources Constraints Reports for 14 Well Demolitions; Cultural and Paleontological Resource Findings Report: Replacement of Dry Wells (SC-MW-02M and SC-MW-03M); Paleontological Negative Findings Construction Monitoring Report: PGE-6 Freshwater Injection Pilot Test; Installation of Extraction Well 66 (EX-66); Cultural and Paleontological Resources Findings Report: Installation of monitoring Well 44S (SC-MW-44S); and 2018 Annual Report – all co-authored with Chris Shi. Completing for CEQA compliance. Client: Arcadis for PG&E.

500 MW Athos Renewable Energy Project, Riverside County, California. Paleontology Program Manager and Project Manager (2018-2019). Overseeing preparation and providing QA/QC of all paleontological resources tasks. For CEQA compliance (County), Project Area on private and state lands consisted of 3,662-acres, including a 11.1-mile-long by 200-foot-wide generation-tie transmission line corridor and access roads. Desktop study included the Project Area plus a 5-mile-wide buffer (Study Area). Paleontologically sensitive geologic units: moderately-bedded Pleistocene nonmarine alluvial gravels and sands, reddish paleosols, and Pinto Formation. Supervised completion of paleontological work plan, reconnaissance-level pedestrian field survey for paleontological resources in addition to paleontological observations of geotechnical trenching, Paleontological Identification Report (PIR), and PRIMP. For NEPA compliance, oversaw Paleontology Resource Assessment (PRA), Potential Fossil Yield Classification (PFYC), and BLM Fieldwork Authorization Request for proposed project components on BLM lands. Working closely with paleontology staff (Chris Shi and Scott Rohlf). Client: IP Athos, LLC and Aspen Environmental Group.

Sun Lakes Boulevard Realignment, City of Banning, Riverside County, California. Paleontology Program Manager (2019). Edited and approved Constraints Analysis for paleontological resources within the approximately 14-acre project area. Paleontologically sensitive geologic units: Mt. Eden and San Timoteo Formations, and Quaternary alluvial deposits. Worked closely with paleontology staff (Win McLaughlin, Chris Shi). Client: Albert A. Webb Associates, Inc.

Other Paleontological Research

Ph.D. Dissertation.
Changing Landscapes in the American Bottom (USA): An Interdisciplinary Investigation with an Emphasis on the Late-Prehistoric and Early-Historic Periods. Advisor: Herbert E. Wright, Jr.

M.S. Thesis.
A Study of Phytoliths from Philistine Levels at Tel Miqne (Ekron), Israel. Advisor: George R. Rapp, Jr.

B.S. Theses.
The High Diversity of the Mazon Creek Biota: The Result of Excellent Preservation in a Deltaic Environment. Advisor (Geology): Carl Mendelson.

The Role of Man in the Pleistocene Extinction of Large Mammals. Advisor (Anthropology): Daniel Shea.

Selected Project Experience (continued)

Western San Bernardino County Distribution System Infrastructure Protection Program (DSIPP), San Bernardino County, California. Paleontology Program Manager (2019). Oversaw completion of paleontological resource assessment for O&M activities throughout the Programmatic Footprint (74 miles of pipeline, 392 pipeline structures, and approximately 50 miles of patrol roads through 10 cities) as well as within work areas for 13 individual Capital Investment Plan (CIP) projects. Paleontologically sensitive geologic units: Early Holocene or older axial-channel deposits, alluvial fan deposits; Undetermined sensitivity: Miocene-age unnamed fault-bounded conglomerate and sandstone unit. Completed for CEQA compliance (Metropolitan Water District of Southern California). Worked closely with paleontology staff (Chris Shi). Client: Dudek.

Santa Ana River Trail – Phase 6 Through Green River Golf Course, Orange-San Bernardino County Line to City of Corona, Riverside County, California. Paleontology Program Manager (2019). Oversaw preparation and completed QA/QC of combined paleontological identification report/paleontological evaluation report (PIR/PER) for two possible Santa Ana River Trail (SART) alignments, a short segment linking SART – Phase 5 to SART – Phase 3, and a small staging area. Project included field surveys for paleontological resources. Completed for CEQA compliance (Riverside County Transportation Commission). Worked closely with paleontology staff (Chris Shi). Client: Michael Baker International.

Interstate 10 Eastbound Truck Climbing Lane Improvement Project, City of Yucaipa, San Bernardino County and City of Calimesa, Riverside County, California. Paleontology Program Manager (2019). Oversaw preparation and completed QA/QC of paleontological technical memorandum for improvements to a total of 3 miles of existing 6-lane eastbound I-10 by adding a truck-climbing lane (TCL) from the 16th Street Overcrossing Bridge to 0.2 mile east of the County Line Road Undercrossing Bridge by paving the existing median. Paleontologically sensitive geologic units: San Timoteo Formation and Pleistocene-age alluvial deposits, and possibly also pre-Pliocene Mill Creek Formation/Potato Sandstone. Completed for NEPA and CEQA compliance (Caltrans and San Bernardino County Transportation Authority). Worked closely with paleontology staff (Chris Shi). Client: HDR.

Banning Electric Utility – Ivy Distribution Substation Project, City of Banning, Riverside County, California. Paleontology Program Manager (2019). Oversaw completion and provided QA/QC of paleontological resource constraints memorandum for CEQA compliance. Paleontologically sensitive geologic units: Pleistocene alluvium. Worked closely with paleontology staff (Win McLaughlin and Chris Shi). Client: Albert A. Webb Associates for City of Banning.

Selected Publications

Ollendorf, Amy L., 1994, New Paleoecological Data Pertaining to the Late Holocene in the American Bottom, USA. *Program and Abstracts of the 13th Biennial Meeting of the American Quaternary Association,* University of Minnesota, Minneapolis, p. 236.

Ollendorf, Amy L., 1993, Review of R.R. Brooks and D. Johannes, *Phytoarchaeology,* Portland, OR: Dioscorides Press. *American Antiquity* 58(4):763-764.

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Mulholland, Susan C., Rapp, George Jr., Ollendorf, Amy L., and Regal, R., 1990, Variation in Phytolith Assemblages within a Population of Corn (cv. Mandan Yellow Flour), *Canadian Journal of Botany* 68:1638-1645.

Ollendorf, Amy L., Mulholland, Susan C., and Rapp, George Jr., 1988, Phytolith Analysis as a Means of Plant Identification: *Arundo donax* and *Phragmites communis*. *Annals of Botany* 61:209-214.

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Ollendorf, Amy L., Mulholland, Susan C., and Rapp, George Jr., 1987, A New Apparatus for the Digestion of Plants in Phytolith Analysis. *Phytolitharien Newsletter* 5(1):13-16.

Ollendorf, Amy L., 1986, Tel Miqne, Israel - Phytoliths from Philistine Levels. *Old World Archaeology Newsletter* 10(2):16.

Ollendorf, Amy L., 2000, "Pollen Analysis." Assisted Dr. Edward Cushing (Univ. of MN) by helping train health professionals during weekend seminar sponsored by Multidata Corporation. **Invited.**

Selected Presentations

Ollendorf, Amy L., 1999, "Pollen Analysis." Assisted Dr. Edward Cushing (Univ. of MN) by helping train health professionals during weekend seminar sponsored by Multidata Corporation. **Invited.**

Ollendorf, Amy L., 1997, "Sneezing, Wheezing, and the Study of Fossil Pollen: What this Allergenic Material Can Tell Us About the Past." Guest lecture at the *Annual Meeting of the Materials Information Society - Minnesota Chapter of the American Society of Metallurgists International,* Minneapolis, Minnesota. **Invited.**

Ollendorf, Amy L., 1997, "Paleoecological Research at Cahokia." Guest lecture for *Minnesota Archaeology Week and Hamline University Anthropology Club,* St. Paul, Minnesota. **Invited.**

Ollendorf, Amy L., 1994, "New Paleoecological Data Pertaining to the Late Holocene in the American Bottom, USA." *Program and Abstracts of the 13th Biennial Meeting of the American Quaternary Association*, University of Minnesota, Minneapolis, p. 236.

Ollendorf, Amy L., 1993, "Paleoecology and Culture Change in the American Bottom, USA." *58th Annual Meeting of the Society for American Archaeology,* St. Louis, Missouri.

Ollendorf, Amy L., 1993, "Recent Paleoecological Doctoral Research in the American Bottom." Guest lecture in the *Illinois State Museum Lunchtime Lecture Series,* Springfield, Illinois. **Invited.**

Ollendorf, Amy L., 1991, "The Decline of the Mississippian Occupation of Cahokia: An Interdisciplinary Investigation of Landscape Changes in the American Bottom (USA)." *24th Annual Chacmool Conference,* University of Calgary, Alberta, Canada.

Ollendorf, Amy L. and Wright, H.E. Jr., 1989, "Landscape Changes Associated with Urbanization in Temperate Europe." *1st Joint Archaeological Congress*, Baltimore, Maryland. **Invited.**

WIN N.F. MCLAUGHLIN

Senior Paleontologist

Education

Ph.D., Earth Sciences, University of Oregon 2018

M.S., Geology, University of Oregon, Eugene, 2012

B.S., Environmental Science, University of the Pacific, Stockton, 2010

Grants/Fellowships/Awards

Fullbright Research Fellowship, Kyrgyz Republic

Society of Sedimentary Geology, Student Research Grant

Evolving Earth Research Grant

AMNH Theodore Roosevelt Grant

3-Minute Thesis Award, University of Oregon

Professional Experience

- 2019–present, Senior Paleontologist, Applied EarthWorks, Inc., Pasadena, California
- 2019–present, Visiting Assistant Professor, Occidental College, Eagle Rock, California
- 2018–2019, Visiting Assistant Professor, Oberlin College, Oberlin College, Ohio
- 2016-2018, Instructor, University of Oregon, Oregon
- 2010-2018, Curator, University of Oregon Museum of Natural and Cultural History, Oregon

Summary of Qualifications

Dr. McLaughlin has more than 10 years of experience in paleontology, geoarchaeology, paleoecology, geology, and seismic hazard assessment at the global, national, state, and local levels. She meets the Society of Vertebrate Paleontology qualifications standards for principal investigator and has been an active member of good standing in SVP for ten years. She is on a current US Department of Wildlife national collection permit, and state collection permits for Oregon and Ohio. She is also current on US Bureau of Land Management (BLM) fossil vertebrate collection permits in both Oregon and Kansas for 2020.

Dr. McLaughlin has supervised and/or led paleontological, geological, and archaeological fieldwork on four continents and seven US states. She has taught geology, paleontology, and geography to hundreds of college students at three nationally accredited institutions. During her career, Dr. McLaughlin has presented over 20 first-authored scientific abstracts at international conferences and coauthored over a dozen more primarily with student lead authors. Her research is published in several scientific journals, with many more articles in preparation.

Project Experience

VENTANA Tentative Tract Map No 37784 Project, City of Indio, Riverside County, California. Senior Paleontologist (2020). Co-authored paleontological resource assessment (PRA) for CEQA compliance. Paleontologically sensitive geologic units: Pleistocene alluvium, Lake Cahuilla beds. Client: Ave 50 Indio, LLC for City of Indio.

CalTrans High Speed Rail Project, Fresno County, California. Senior Paleontologist (2020). Conducted a field audit of active excavation and fossiliferous localities for CEQA compliance. Identified fossils, prepared descriptions of fossils material. Paleontologically sensitive geologic unit: Modesto Formation. Client: TPZP and Caltrans.

Improvements to the Avenue 50 and Jackson Street Intersection, City of Indio, Riverside County, California. Senior Paleontologist (2019-2020). Conducted literature and paleontological database survey of geologic units and previously collected fossils from near the Project site. Co-authored paleontological technical memorandum for CEQA compliance. Paleontologically sensitive geologic units: Lake Cahuilla beds. Client: Albert A. Webb Associates for County of Riverside.

Ivy Substation Project, City of Banning, Riverside County, California. Senior Paleontologist (2019). Conducted literature and paleontological database survey of geologic units and previously collected fossils from near the Project site. Wrote paleontological technical memorandum for CEQA compliance. Paleontologically

Professional Experience (continued)

- 2015, English Language Instructor, American Corners, US Embassy, Bishkek, Kyrgyzstan
- 2015, SmartGirls Outreach Speaker, US Embassy, Osh, Kyrgyzstan
- 2014, Exhibit Design and Consultant, Bowerman Museum, Prineville, Oregon
- 2012, Osteological Consultant, SWCA Environmental Consultants, Oregon
- 2011, Paleontologist, John Day Fossil Beds National Monument, Oregon
- 2007-2010, Undergraduate Researcher and Lab Manager, University of the Pacific, Stockton, California

Professional Memberships

Society of Vertebrate Paleontology

Geological Society of America

American Geophysical Union

Paleontological Society

Society of Sedimentary Geologists

American Association of Naturalists

Sigma Gamma Epsilon Geological Honor Society

Society for Integrated and Comparative Biology

Fullbright Network

Project Experience (continued)

sensitive geologic units: Mt. Eden Formation, Timoteo Formation. Client: Albert A. Webb Associates for County of Riverside.

Sun Lakes Blvd Extension, City of Banning, Riverside County, California. Senior Paleontologist (2019). Conducted literature and paleontological database survey of geologic units and previously collected fossils from near the Project site. Wrote paleontological technical memorandum for CEQA compliance. Paleontologically sensitive geologic units: Mt. Eden Formation, Timoteo Formation. Client: Albert A. Webb Associates for County of Riverside.

Other Paleontological Research

Ph.D. Dissertation.
Landscape and Biotic Evolution of the Kochkor Basin, Kyrgyzstan. Advisors: Samantha Hopkins & Ray Weldon

M.S. Thesis.
Hawk Rim: A Geologic and Paleontological Description of a New Barstovian Locality in Central Oregon. Advisor: Samantha Hopkins

B.S. Thesis.
Contaminant Hydrology in the Upper Lincoln Creek Watershed of Lewis County, Washington. Advisor: Laura Rademacher

Selected Publications

McLaughlin, W.N.F., S.S.B. Hopkins, and M.D. Schmitz. 2016. A new Late Hemingfordian vertebrate fauna from Hawk Rim, Oregon, with implications for biostratigraphy and geochronology. *Journal of Vertebrate Paleontology*, 36(5):e1201095.

Barrett, P., L, Finkelman, G. Purdue, W. McLaughlin, D. Reuter, S. Hopkins. 2020. Small Carnivore Fauna of the Crooked River Mascall Formation Central Oregon. (in press) *Journal of Vertebrate Paleontology.*

Miller, S.A., P.Z. Barrett, W.N.F. McLaughlin, S.S.B. Hopkins. Identification of *Adcrocuta eximia* (Mammalia, Carnivora, HYAENIDAE) and c.f. *Paramachaerodus* (Mammalia, Carnivora, FELIDAE) dentition from the Kochkor Basin of Kyrgyzstan. (accepted, in revision) *Zoological Journal of the Linnean Society.*

McLaughlin, W., C. Boatman, E. Davis, S. Hopkins. Total dental occlusal area as a constrained feature in modern walruses (*Odobenus rosmarus*). (in review) *Journal of Mammology.*

McLaughlin, W. and S. Hopkins. Globe Trotting Rhinos: The phylobiogeographic relationships of Rhinocerotidae (Mammalia, Perissodactyla) and description of a new taxon from Kyrgyzstan. (in review) *Journal of Paleontology.*

CHRISTOPHER SHI

Associate Paleontologist

Education

Ph.D., Geology (studies), 2012-2016

M.S., Geology, University of California, Los Angeles, 2011

B.S., Biology, University of Minnesota, Minneapolis, 2006

Professional Experience

2018–present, Associate Paleontologist, Applied EarthWorks, Inc., Pasadena, California

2016–2018, Paleontological Field Technician, Applied EarthWorks, Inc., Pasadena, California

2017–2018, Lead Paleontology Monitor, Rincon Consultants, Los Angeles, California

2008–2009, Instructor, Mad Science of Minnesota, St. Paul

Other Paleontological Research

Ph.D., Geology Studies.
Proposed dissertation topic: *Establishing a link between the trend in changing seawater chemistry and the evolution of the first animals that built shells and skeletons from calcium carbonate during the Cambrian explosion*. Advisor: Bruce N. Runnegar.

M.S. Thesis.
Demonstrating the application of confocal laser scanning microscopy in the characterization of a fossil fern from the Eocene.
Advisor: J. William Schopf.

Summary of Qualifications

Mr. Shi is a paleontologist and geologist with more than 10 years of experience in paleontology, evolutionary biology, mineralogy, and sedimentary geology, and meets the Society of Vertebrate Paleontology's (SVP) standards for a qualified professional paleontologist. He has a background in plant and invertebrate taphonomy, and his master's thesis focused on the characterization of fossilized Eocene ferns using a novel three-dimensional imaging technique. Additionally, Mr. Shi spent several years working toward a Ph.D. in geology with research focused on the link between the trend in changing seawater chemistry and the evolution of the first animals to develop shells from calcium carbonate during the Cambrian explosion.

Mr. Shi completes various tasks within the Paleontology Program of Applied EarthWorks. As the Paleontology Supervisor, he coordinates and schedules paleontological monitors throughout AE's 5 offices. In the field, Mr. Shi's responsibilities include stratigraphic analyses, geological and paleontological data collection, bulk-sediment sampling, and documentation of fossil localities. In the lab, Mr. Shi's identifies, analyzes, and prepares collected fossils for permanent curation. Mr. Shi also regularly completes paleontological desktop literature and map reviews and coordinates with various paleontology curators for museum records searches; authors paleontology monitoring plans, inventory and evaluation reports, resource impact management plans, and worker environmental awareness training materials. In the past, Mr. Shi served as Æ's lead monitor on several construction monitoring projects for transportation, land development, water, and power generation projects.

Project Experience

VENTANA Tentative Tract Map No 37784 Project, City of Indio, Riverside County, California. Associate Paleontologist/Project Manager (2020). Completed ground-reconnaissance field survey and paleontological resource assessment (PRA) for CEQA compliance. Paleontologically sensitive geologic units: Pleistocene alluvium, Lake Cahuilla beds. Client: Ave 50 Indio, LLC for City of Indio.

Menifee Town Center – Parcels 13, 14, and 15 Development Project, City of Menifee, Riverside County, California. Associate Paleontologist/Project Manager (2018-2020). Completed paleontological resource impact mitigation program (PRIMP), oversaw paleontological resource monitoring for construction, and completed paleontological monitoring report for CEQA compliance. Paleontologically sensitive geologic units: Pleistocene alluvium. Client: Kristoff Commercial Real Estate for City of Menifee.

Certificates of Completion

OSHA Excavation Competent Person Seminar, March 11, 2019

OSHA 40-Hour Hazardous Waste Operations Worker (HAZWOPER) Training, January 20-23, 2020

Relevant Publications

Shi, C. S. 2013. Use of Confocal Laser Scanning Microscopy for Studies in Paleobotany: Documentation of Stem Anatomy of the Eocene Fern *Dennstaedtiopsis aerenchymata* (Dennstaedtiaceae). LAP LAMBERT Academic Publishing: 88 p.

Shi, C. S., J. W. Schopf, A. B. Kudryavtsev. 2013. Characterization of the stem anatomy of the Eocene fern *Dennstaedtiopsis aerenchymata* (Dennstaedtiaceae) by use of confocal laser scanning microscopy. American Journal of Botany, Vol. 100, No. 8: p. 1626-1640.

Zheng, J., W. Zhuang, N. Yian, G. Kou, H. Peng, C. McNally, D. Erichsen, A. Cheloha, S. Herek, C. Shi, and Y. Shi. 2004. Classification of HIV-1 mediated neuronal dendritic and synaptic damage using Multiple Criteria Linear Programming. Neuroinformatics, Vol. 2, No. 3: p. 303-326.

Project Experience (continued)

Riverside County Transportation Department 6 Timber Bridges Replacement Project, Riverside County, California. Associate Paleontologist (2020). Completed paleontological technical memoranda for NEPA and CEQA compliance. Paleontologically sensitive geologic units: Pleistocene alluvium, Palen Lake deposits, Pinto Formation. Client: WSP for RCTD and Caltrans.

Avenue 50 and Jackson Street Improvements Project, City of Indio, Riverside County, California. Associate Paleontologist (2020). Completed ground-reconnaissance field survey and paleontological technical memoranda for CEQA compliance. Paleontologically sensitive geologic units: Lake Cahuilla beds. Client: Albert A. Webb Associates for City of Indio.

Banning Electric Utility – Ivy Distribution Substation Project, City of Banning, Riverside County, California. Associate Paleontologist (2019). Reviewed paleontological resource constraints memorandum for CEQA compliance. Paleontologically sensitive geologic units: Pleistocene alluvium. Client: Albert A. Webb Associates for City of Banning.

Western San Bernardino County Distribution System Infrastructure Protection Program, San Bernardino County, California. Associate Paleontologist (2019). Completed ground-reconnaissance field survey. Completed PRA for the Programmatic Environmental Impact Report (PEIR) for CEQA compliance. Paleontologically sensitive geologic units: Pleistocene alluvium, Miocene conglomerates and sandstones, and Puente Formation. Client: Dudek for Metropolitan Water District of Southern California.

Santa Ana River Trail – Phase 6 Project, City of Corona, Orange, San Bernardino, and Riverside Counties, California. Associate Paleontologist (2019). Oversaw ground-reconnaissance field surveys. Completed combined paleontological identification report (PIR) and paleontological evaluation report (PER) for CEQA compliance. Paleontologically sensitive geologic units: Pleistocene alluvium, Puente Formation, and Topanga Group. Client: Michael Baker for Riverside County Transportation Commission and County of San Bernardino.

Sun Lakes Boulevard Realignment Project, City of Banning, Riverside County, California. Associate Paleontologist (2019). Reviewed paleontological resource constraints memorandum for CEQA compliance. Paleontologically sensitive geologic units: Pleistocene alluvium. Client: Albert A. Webb Associates for City of Banning.

Development of the Jacqueline Cochran Regional Airport, Thermal, Riverside County, California. Associate Paleontologist (2019). Completed paleontological technical memorandum for CEQA and federal compliance. Paleontologically sensitive geologic units: Lake Cahuilla beds. Client: Mead & Hunt for Riverside County Economic Development Agency Aviation Division.