PALEONTOLOGICAL RESOURCES ASSESSMENT REPORT
AND
PALEONTOLOGICAL RESOURCES MANAGEMENT AND MONITORING PLAN

COVE Borrow Pit PROJECT

Near the Community of Lucerne Valley
San Bernardino County, California

For Submittal to:

San Bernardino County Department of Public Works
825 East 3rd Street
San Bernardino, CA 92415

Prepared for:

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September 13, 2019

CRM TECH Contract #3449P
Approximately 124 Acres
USGS Lucerne Valley, Calif., 7.5' (1:24,000) Quadrangle
Section 3, T4N R1W, and Sections 33 and 34, T5N R1W, San Bernardino Baseline and Meridian

EXECUTIVE SUMMARY

Between March and September, 2019, at the request of the Lilburn Corporation, CRM TECH performed a paleontological resource assessment on approximately 124 acres of vacant land near the unincorporated community of Lucerne Valley, San Bernardino County, California. The subject property of the study consists of Assessor's Parcel Numbers 0451-022-04, 0452-041-64, and 0464-171-01, located on both sides of Cove Road near its intersection with Exeter Street, within Section 3 of T4N R1W and Sections 33 and 34 of T5N R1W, San Bernardino Baseline and Meridian.

The study is part of the environmental review process for the proposed Cove Borrow Pit Project, which proposes the continuation of "cut and fill" aggregate materials mining operations on the property. The County of San Bernardino, as the lead agency for the project, required the study in compliance with the California Environmental Quality Act (CEQA). The purpose of the study is to assist the County in determining whether the project would adversely affect any significant, nonrenewable paleontological resources, as required by CEQA, and to design a paleontological resources management and monitoring plan for the project.

In order to identify any paleontological resource localities that may exist in or near the project area and to assess the probability for such resources to be encountered during the project, CRM TECH initiated records searches at the appropriate repositories, conducted a literature review, and carried out a systematic field survey. The results of these research procedures indicate that the granitic rocks in the southwestern portion of the project area are very low in sensitivity for paleontological remains. The Holocene-age lacustrine deposits on the surface in the northeastern portion of the project area are also considered low in paleontological sensitivity but the Pleistocene-age lacustrine deposits at depth are high in sensitivity.

In the middle portion of the project area, where the existing quarry activities are concentrated, the Holocene-age alluvial soils at and near the ground surface are similarly considered to be low in paleontological sensitivity, but the older, finer-grained alluvial sediments underneath are highly sensitive for significant, nonrenewable paleontological resources if they are of sufficient age. Sources place the project location in an area of active erosion and deposition through an alluvial plain and into the Lucerne Dry Lake. The surface alluvium lies close to its source, namely the decomposing granitic bedrock of the Granite Mountain, and likely forms a relatively thick Holocene sedimentation. However, the exact depth of this coarse-grained, low-sensitivity Holocene sedimentation is currently unknown.

As the objective of the quarry operations is to obtain coarse-grained aggregate materials from the surface and near-surface deposit, current project plans call for a horizontal progress of excavations from the middle portion of the project area into the slopes to the southwest instead of vertical excavations into the deeper sediments. As long as the quarry activities do not extend into the older, finer-grained alluvial sediments occurring at depth in the middle portion of the project area, the project will have a low potential to impact significant, nonrenewable paleontological resources, and no monitoring will be necessary.

In order to prevent inadvertent impacts on paleontological resources, CRM TECH recommends that all ground disturbances be strictly limited to the granitic rocks in the southwestern portion of the project area and the coarse-grained Holocene alluvium on and near the surface in the middle portion, and that the finer-grained sediments underneath be avoided whenever they are exposed. If the project plans change in the future and the complete avoidance of the finer-grained sediments at depth is no longer possible, an updated paleontological resources management and monitoring plan, including some level of paleontological monitoring and/or periodic field inspection by qualified personnel, will need to be designed and implemented based on the extent of impacts anticipated in this potentially fossiliferous formation.

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INTRODUCTION

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The study is part of the environmental review process for the proposed Cove Borrow Pit Project, which proposes the continuation of "cut and fill" aggregate materials mining operations on the property. The County of San Bernardino, as the lead agency for the project, required the study in compliance with the California Environmental Quality Act (CEQA; PRC §21000, et seq.). The purpose of the study is to assist the County in determining whether the project would adversely affect any significant, nonrenewable paleontological resources, as required by CEQA, and to design a paleontological resources management and monitoring plan for the project.

In order to identify any paleontological resource localities that may exist in or near the project area and to assess the probability for such resources to be encountered during the project, CRM TECH initiated records searches at the appropriate repositories, conducted a literature review, and carried out a systematic field survey. The following report is a complete account of the methods, results, and final conclusion of this study. Personnel who participated in the study are named in the appropriate sections below, and their qualifications are provided in Appendix 1.

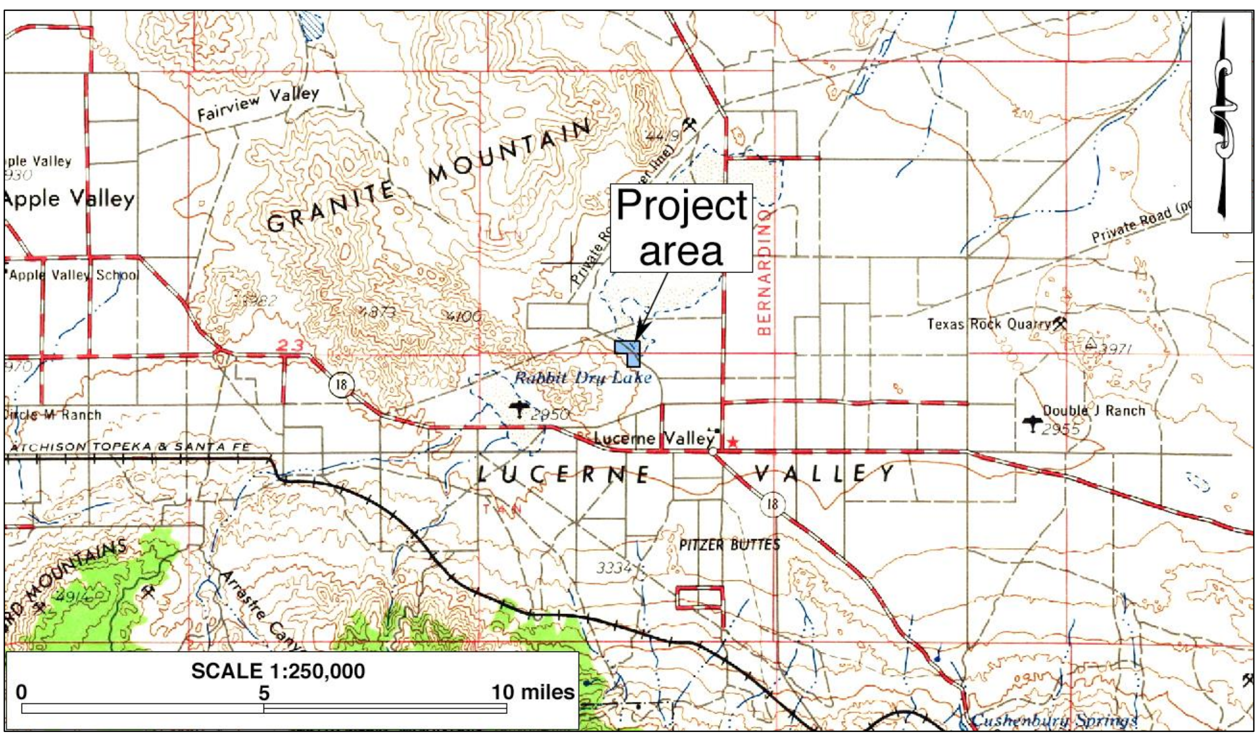

Figure 1. Project vicinity. (Based on USGS San Bernardino, Calif., 30'x60' quadrangle)

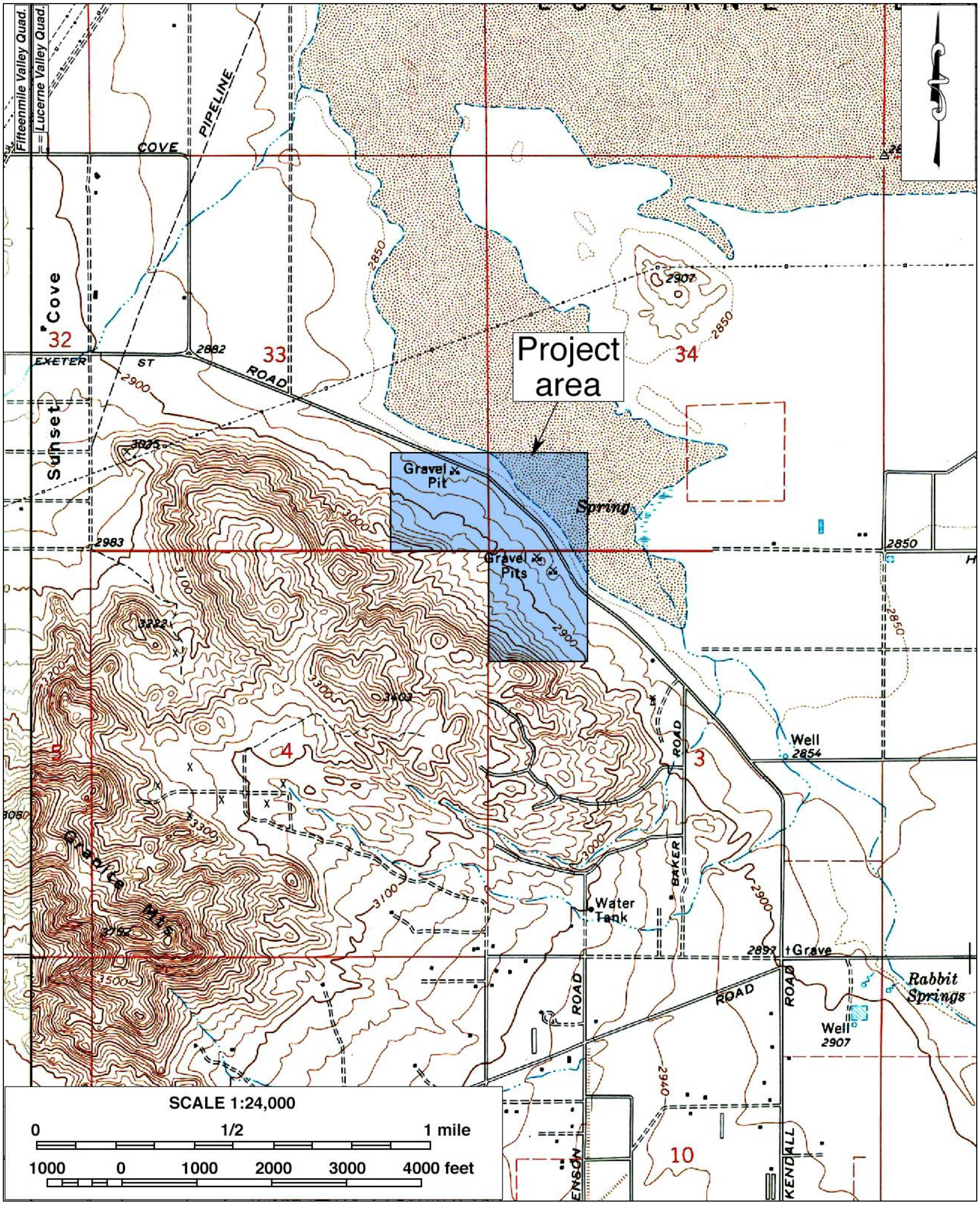

Figure 2. Project area. (Based on USGS Fifteenmile Valley and Lucerne Valley, Calif., 7.5' quadrangles)

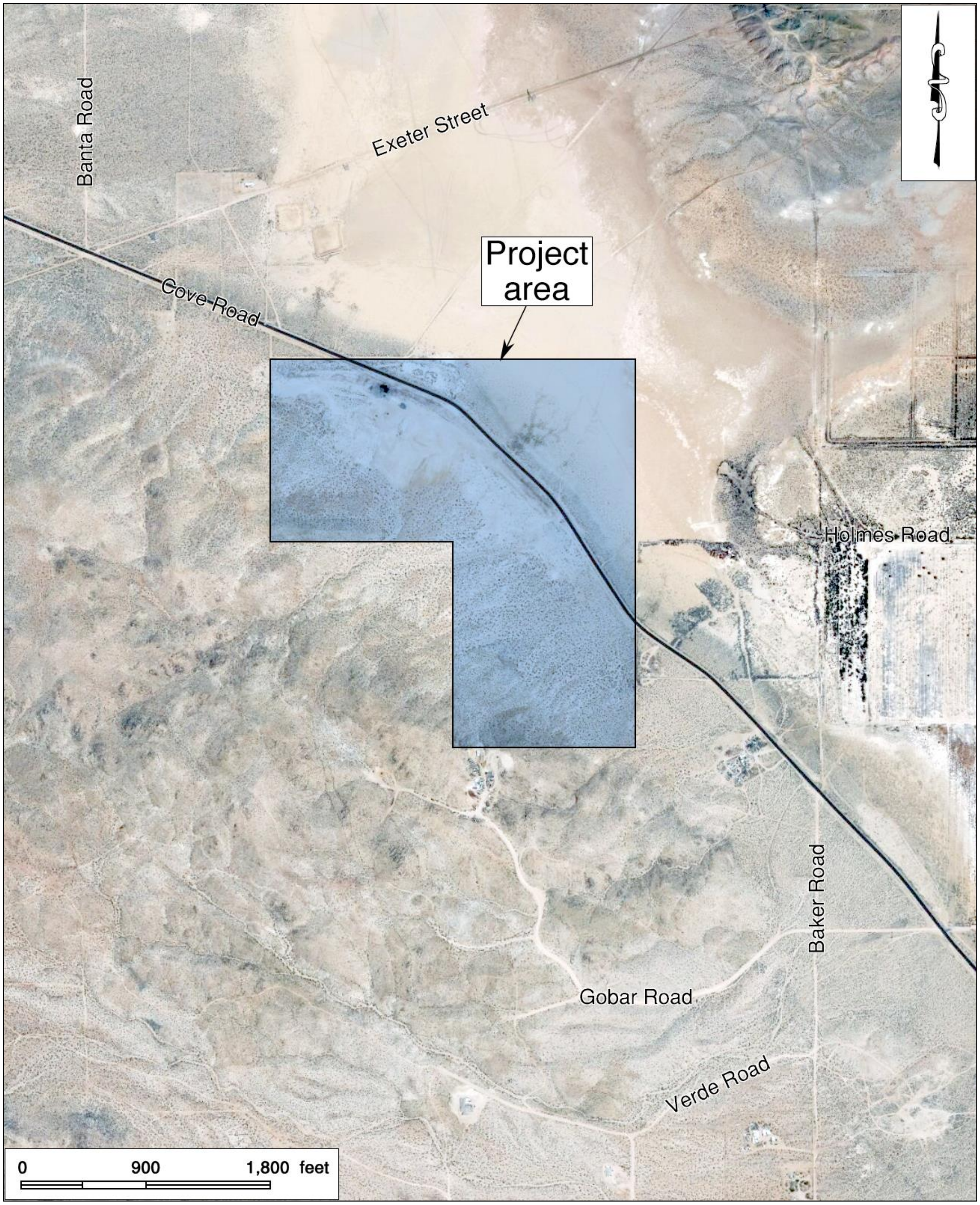

Figure 3. Aerial photograph of the project area.

PALEONTOLOGICAL RESOURCES

DEFINITION

Paleontological resources represent the remains of prehistoric life, exclusive of any human remains, and include the localities where fossils were collected as well as the sedimentary rock formations in which they were found. The defining character of fossils or fossil deposits is their geologic age, which is typically regarded as older than approximately 12,000 years, the generally accepted temporal boundary marking the end of the last late Pleistocene (circa 2.6 million to 12,000 years B.P.) glaciation and the beginning of the current Holocene epoch (circa 12,000 years B.P. to the present).

Common fossil remains include marine shells; the bones and teeth of fish, amphibians, reptiles, and mammals; leaf assemblages; and petrified wood. Fossil traces, another type of paleontological resource, include internal and external molds (impressions) and casts created by these organisms. These items can serve as important guides to the age of the rocks and sediments in which they are contained and may prove useful in determining the temporal relationships between rock deposits from one area and those from another as well as the timing of geologic events. They can also provide information regarding evolutionary relationships, development trends, and environmental conditions.

Fossil resources generally occur only in areas of sedimentary rock (e.g., sandstone, siltstone, mudstone, claystone, or shale). Because of the infrequency of fossil preservation, fossils, particularly vertebrate fossils, are considered nonrenewable paleontological resources. Occasionally fossils may be exposed at the surface through the process of natural erosion or because of human disturbances; however, they generally lay buried beneath the surficial soils. Thus, the absence of fossils on the surface does not preclude the possibility of their being present within subsurface deposits, while the presence of fossils at the surface is often a good indication that more remains may be found in the subsurface.

SIGNIFICANCE CRITERIA

According to guidelines proposed by Eric Scott and Kathleen Springer (2003) of the San Bernardino County Museum, paleontological resources can be considered to be of significant scientific interest if they meet one or more of the following criteria:

1. The fossils provide information on the evolutionary relationships and developmental trends exhibited among organisms, living or extinct;
2. The fossils provide data useful in determining the age(s) of the rock unit or sedimentary stratum, including data important in determining the depositional history of the region and the timing of geologic events therein;
3. The fossils provide data regarding the development of biological communities or the interactions between paleobotanical and paleozoological biotas;
4. The fossils demonstrate unusual or spectacular circumstances in the history of life; and/or
5. The fossils are in short supply and/or in danger of being depleted or destroyed by the elements, vandalism, or commercial exploitation, and are not found in other geographic locations.

PALEONTOLOGICAL SENSITIVITY

The fossil record is unpredictable, and the preservation of organic remains is rare, requiring a particular sequence of events involving physical and biological factors. Skeletal tissue with a high percentage of mineral matter is the most readily preserved within the fossil record; soft tissues not intimately connected with the skeletal parts, however, are the least likely to be preserved (Raup and Stanley 1978). For this reason, the fossil record contains a biased selection not only of the types of organisms preserved but also of certain parts of the organisms themselves. As a consequence, paleontologists are unable to know with certainty, the quantity of fossils or the quality of their preservation that might be present within any given geologic unit.

Sedimentary units that are paleontologically sensitive are those geologic units (mappable rock formations) with a high potential to contain significant nonrenewable paleontological resources. More specifically, these are geologic units within which vertebrate fossils or significant invertebrate fossils have been determined by previous studies to be present or are likely to be present. These units include, but are not limited to, sedimentary formations that contain significant paleontological resources anywhere within their geographical extent as well as sedimentary rock units temporally or lithologically amenable to the preservation of fossils.

A geologic formation is defined as a stratigraphic unit identified by its lithic characteristics (e.g., grain size, texture, color, and mineral content) and stratigraphic position. There is a direct relationship between fossils and the geologic formations within which they are enclosed and, with sufficient knowledge of the geology and stratigraphy of a particular area, it is possible for paleontologists to reasonably determine the formation's potential to contain significant nonrenewable vertebrate, invertebrate, marine, or plant fossil remains.

The paleontological sensitivity for a geologic formation is determined by the potential for that formation to produce significant nonrenewable fossils. This determination is based on what fossil resources the particular geologic formation has produced in the past at other nearby locations. Determinations of paleontologic sensitivity must consider not only the potential for yielding vertebrate fossils but also the potential of yielding a few significant fossils that may provide new and significant taxonomic, phylogenetic, and/or stratigraphic data.

The Society of Vertebrate Paleontology issued a set of standard guidelines intended to assist paleontologists to assess and mitigate any adverse effects/impacts to nonrenewable paleontological resources. The guidelines defined four categories of paleontological sensitivity for geologic units that might be impacted by a proposed project, as listed below (Society of Vertebrate Paleontology 2010:1-2):

- **High Potential**: Rock units from which vertebrate or significant invertebrate, plant, or trace fossils have been recovered.
- **Undetermined Potential**: Rock units for which little information is available concerning their paleontological content, geologic age, and depositional environment.
- **Low Potential**: Rock units that are poorly represented by fossil specimens in institutional collections, or based on general scientific consensus only preserve fossils in rare circumstances.
- **No Potential**: Rock units that have no potential to contain significant paleontological resources, such as high-grade metamorphic rocks and plutonic igneous rocks.

SETTING

The project area is located within the Mojave Desert geomorphic province of southeastern California (Jenkins 1980:40-41; Harms 1996:93-96; Harden 2004:127-136). Dibblee (1967) and Coombs et al. (1979) place the project area within what they call the Western Mojave Desert area. The landscape in the area features a relatively high-elevation desert with scattered, isolated mountains and numerous broad, shallow basins, some with dry lakebeds at the low points (*ibid*.). Many of these basins have pediment surfaces developed along the margins, separating them from the mountains (Coombs et al. 1979:9).

The pediment surfaces are commonly covered by desert pavement, which helps protect these areas from sheetwash and channeling (*ibid*.). These mountains and intermountain valleys tend to have a northwest-southeast trend (*ibid*.:7). The basin areas of the Western Mojave Desert are filled with sediments ranging in age from Miocene to Recent (Dibblee 1967:49-82; Meisling and Weldon 1989:110). The climate in this region is marked by extremes in temperature and aridity, with summer highs reaching well over 110ºF and winter lows dipping below freezing. Average annual precipitation is less than 10 inches.

More specifically, the project area lies approximately two miles north of the rural community of Lucerne Valley, in the northwestern portion of the desert valley bearing the same name, and at the southeastern end of Lucerne Dry Lake. It is surrounded in all directions by other parcels of open desert land in a mostly natural state (Fig. 3). Cove Road, a paved two-lane public road, runs through the project area in a generally northwest-southeast direction. A large stockpile of soil is located northeast of Cove Road, and the area along the southwestern side of the road displays signs of heavy disturbance from past quarrying activities.

Elevations in the project area range approximately from 2,855 feet to 3,140 feet above mean sea level. The southernmost and westernmost portions of the project area are characterized by a hillside landscape dotted with granitic outcrops, and the northeastern portion lies on the dry lakebed of Lucerne Lake (Fig. 4). These portions are roughly delineated by the course of Cove Road. Further to the southwest, the project area begins to slope steeply upward into the Granite Mountain.

Native soils in most of the project area consist of brownish-yellow, fine- to coarse-grained sands mixed with small to large rocks and boulders, while in wash areas the sand was light gray and coarse. The surface soils also contain a significant amount decomposing granite. Vegetation observed within the project area include yucca, foxtails, tumbleweeds, wild mustards, and other small desert shrubs, flowers, and grasses (Fig. 4).

RESEARCH DESIGN

For any scientific investigation to be able to contribute important knowledge to its field of inquiry it must contribute important information to the scientific field. This can be accomplished by building on previous work, by supporting or refuting current understandings, and by asking questions that lead in new directions and, thus, laying the groundwork for future studies. A paleontological assemblage can be analyzed and evaluated against current research questions of paleontological interest.

Figure 4. Overview of the current natural setting of the project area. (Photograph taken on March 27, 2019; view to the northeast)

A research design for paleontology is intended to guide paleontological investigations, directing paleontologists to focus on those questions that have the best potential to fill gaps in current knowledge and theory. Paleontologists then plan their field and laboratory strategies to collect scientific data that can address questions that are the subject of ongoing debate regarding paleoenvironments and lifeforms. A research design is therefore an important foundation for any such research program.

A standard set of research questions can be applied to almost any paleontological investigation. These questions include chronology, evolutionary development, evolutionary relationships and the development of biological communities, and paleoenvironments. If recovered fossils can address these issues, they could be considered to be significant fossil resources. Fossils can also be considered significant if they are in short supply and/or in danger of being depleted or destroyed by the elements, vandalism, or commercial exploitation, or are not found in other geographic locations. Some of the general, but important, paleontological research questions are presented below.

- Do the resources provide data on the evolutionary relationships and developmental trends among both living and extinct organisms, or even within a single species?

Information recovered from the resources such as the taxa that are present in the flora and faunal assemblage(s), how many individuals are present, and what species diversity is evident in the assemblage(s) can help answer this question. Also, noting the relative abundance of different species in the assemblage(s) would be important, as would determining how the observed variety of taxa relate to other assemblages found in southern California and other parts of North America.

- Do the resources provide data useful in determining the age(s) of the rock unit or sedimentary stratum in which they were found? This includes data important in determining the depositional history of the region and the timing of geologic events therein.

By observing the depositional environment of sediments and rock units in the study area, the relative age of the different strata can be determined. Also, the age of the various faunal assemblage(s) is indicative of the age of the geological strata. New techniques and technologies combined with a growing data base can be brought to bear on these questions.

- Can the resources provide data regarding the development of paleobiological communities and/or the interaction between paleobotanical and paleozoological life-forms?

Although construction-related earth-moving activities may negatively impact paleontological resources, enough data may be available to determine if fossil bones had been gradually worn down or if some catastrophic event (mechanical force) had damaged them. It is also important to note which osteological elements are most common in the assemblage(s), and whether these elements vary from species to species. The primary directional orientation of the fossils, and whether there is evidence of abrasion or weathering on some or all of the fossils recovered can provide information regarding the depositional history of the fossils. Observing if the fossils are usually complete or fragmented, or if there is evidence of carnivore, scavenger, or even human activity on the fossils, would also provide important information.

- Do the resources represent unusual or spectacular circumstances in the history of life in the area?

The number of individuals present in the sample and their age structures (i.e., number of adults, subadults, and juveniles) can provide important information regarding this question. If the sample is sufficiently large and unbiased, life tables and survivorship curves can be constructed. If the gender of the recovered resources can be determined, then the ratio of males to females can be established.

- Are the resources in short supply and/or in danger of being depleted or destroyed by the elements, vandalism, commercial exploitation, or development? Are they found in other geographic locations?

Just the fact that there may be very few remaining examples of a particular fossil increases its importance to the discipline of paleontology.

- Can the resources provide any important information regarding the paleo-environment of the area? Was the climate drastically different, or largely the same, as it is now?

Examining the ratio of moist, or even aquatic, species to dry-environment species in the assemblage can lead to a better understanding of the past environment. The same can be said regarding the ratio of presumed grassland-dwelling species to woodland- and/or forest-dwelling species. Additionally, paleobotanical data from the various fossil-bearing formations encountered may shed further light on past climate and environment.

Fossil remains that could help answer research questions regarding ancient life and environmental conditions in the Lucerne Valley area could be present on this property. If such remains are recovered, they may yield important data regarding early life-forms in the area and thus contribute to the discipline of paleontology. If the recovered data can address some of the research questions presented above, the paleontological finds would be considered significant.

METHODS AND PROCEDURES

RECORDS SEARCHES

The records search service for this study was provided by the Western Science Center (WSC) in Hemet, the Natural History Museum of Los Angeles County (NHMLAC) in Los Angeles, and the San Bernardino County Museum (SBCM) in Redlands. The records search results were used to identify known paleontological localities as well as previously completed paleontological resource studies, if any, within a one-mile radius of the project location.

LITERATURE REVIEW

In conjunction with the records searches, CRM TECH geologist Harry M. Quinn, California Professional Geologist #3477, pursued a literature review on the project vicinity. Sources consulted during the review include primarily topographic, geologic, and soil maps of the Lucerne Valley area, published geologic literature pertaining to the project location, and other materials in the CRM TECH library and Quinn's personal library, including unpublished reports produced during similar surveys in the vicinity.

FIELD SURVEY

On March 27, 2019, CRM TECH field director Daniel Ballester and paleontological surveyors Michael Robinson and Hunter O'Donnell carried out the field survey of the project area under the direction of Harry M. Quinn. The survey was completed by walking a series of parallel north-south and east-west transects spaced 15 meters (approximately 50 feet) apart. In this way, the ground surface in the entire project area was systematically examined to determine soil types, verify the geological formations, and search for indications of paleontological remains. Visibility of the native ground surface was fair (60-70 percent) to good (80-90 percent) over most of the property but was poor (0-20 percent) where pockets of dense vegetation or other ground cover, such as road pavement, were present.

RESULTS AND FINDINGS

RECORDS SEARCHES

The records search results identified no known paleontological localities within the project area or a one-mile radius (Cortez 2019; McLeod 2019; Radford 2019; see App. 2). However, the SBCM reported fossil localities of Pleistocene vertebrates located approximately a mile to the southeast, which were discovered in geological units similar to those known to occur in the northeastern portion of the project area (Cortez 2019). Additionally, the NHMLAC reported several paleontological localities in the Manix Wash and Mojave River sediments near Lake Manix, known as the Manix Formation (McLeod 2019). The Manix Formation is made up of older Quaternary alluvial deposits, similar to those that underlie much of the project area, as well as lacustrine deposits, which make up the northeastern potion of the project area.

Both the NHMLAC and the SBMC identified the surface geology in the project area as alluvium deposits situated between lacustrine deposits on the northeast and Mesozoic granitic rocks on the southeast (Cortez 2019; McLeod 2019). The WSC described the surface geology at this location as Mesozoic granitic rocks and alluvium and clay deposits of Pleistocene age (Radford 2019). All three institutions agree that the granitic rocks in the southwestern portion of the project area have low paleontological sensitivity (Cortez 2019; McLeod 2019; Radford 2019).

The WSC considered the alluvial units as highly sensitive (Radford 2019). In comparison, the SBMC and the NHMLAC considered the coarser alluvial sediments on the surface as low-sensitivity soils but the finer-grained, older alluvium at some unknown depth beneath the surface to be of high paleontological sensitivity (Cortez 2019; McLeod 2019). The WSC recommended monitoring of earth-moving activities associated with the project, while the NHMLAC reserved the monitoring recommendation for "any substantial excavations in the finer-grained sedimentary deposits" within the project area (McLeod 2019; Radford 2019).

LITERATURE REVIEW

The surface geology in the project area was mapped by Bortugno and Spittler (1986) as *Q*, *Ql*, and *JKgr*. *Q* was identified as alluvium of Holocene age, *Ql* as Lake deposits of Holocene age, and *JKgr* as Jurassic or Cretaceous granite (*ibid*.). The Holocene alluvium, or *Q*, is low in potential for containing fossil materials, but these sediments rest atop Pleistocene-aged alluvial sediments at some unknown depth that have a much higher potential (*ibid*.). Similarly, the *Ql* sediments are recent lakebed sediments and have a low potential for containing fossil materials, but they rest on Pleistocene-age lakebed sediments of higher paleontological sensitivity (*ibid*.). The *JKgr* rocks are igneous granitic rocks and have no potential for containing fossil remains (*ibid*.).

Dibblee (2008) mapped the surface geology in the project area as *Qa*, *Qc*, and *gqm* (Fig. 5), which roughly correspond to *Q*, *Ql*, and *JKgr* in Bortugno and Spittler's (1986) mapping. He described *Qa* as alluvial silt, sand, and gravel of valley areas and Holocene age, and *Qc* as "clay and silt of playa lakes and mud flats," also Holocene in age (Dibblee 2008). Located at higher elevation in the southwestern portion of the project area, *gqm* was described as "gneissoid granite and quartz monzonite, nearly white, weathers buff to gray, hard, massive, medium- to locally coarse-grained," upper Jurassic in age (*ibid*.).

Tugel and Woodruff (1986:Map Sheet 34) mapped the surface soil in the project area as mainly 139 with some 158, 104, and 156. The 139-type soils belong to the Kimberlina gravelly sandy loam, cool, 2-5 percent slopes, which is a very deep, well-drained soil on alluvial fans derived from mixed sources (*ibid*.:47). The 158-type soils belong to the Rock Outcrops-Lithic Torriorthents complex, 15-50 percent slopes (*ibid*.:59-60). This unit is 60 percent rock outcrops and 30 percent lithic

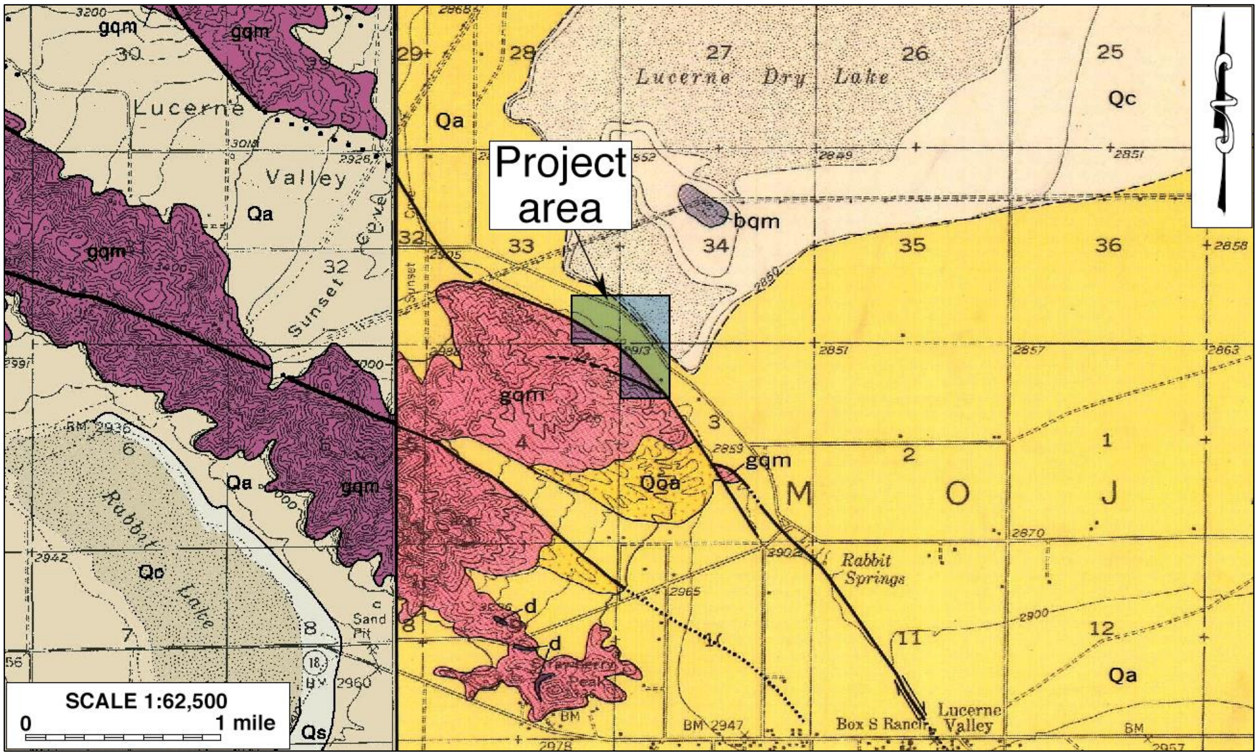

Figure 5. Geologic map of the project vicinity. (Sources: Dibblee 1964; 2008)

torriorthents, and the outcrops consist of granitic rock (*ibid*.). The 104-type soils belong to the Bousic clay, which is a very deep, moderately well-drained, nearly level soil found on basin rims (*ibid*.:20-21). It forms in fine-grained alluvium derived from mixed sources (*ibid*.). The 156-type soils belong to the Playas, dominantly clay with silty clay and loamy sands (Tugel and Woodruff 1986:20-21). These soils are strongly saline-alkali rich and commonly have a salty surface (*ibid*.). The aerial photographs on which the soils were mapped show three existing gravel pits in the project area, all of them situated on the 139-type soils (*ibid*.:Map Sheet 34).

FIELD SURVEY

The field survey encountered no surface manifestation of any fossil remains within or adjacent to the project area. The surface sediments observed during the survey match closely the distribution of geologic formation in the project area (Fig. 5), with fine-grained silty sand in the northeastern portion, coarse-grained sand mixed with rocks and gravel, all from decomposing granitic materials, in the middle portion, and granitic rocks and boulders in the southwestern portion (Fig. 6). Evidence of ongoing quarrying activities was observed in the alluvial soils along Cove Road, and it is clear that a fair amount of surface soil has been previously removed from the property. No fine-grained alluvial soil was noted in the existing cuts.

DISCUSSION

The geologic maps show the surface sediments in the northeastern portion of the project area, where no quarry activities are proposed, to be Holocene-age lacustrine deposits, which rest atop sediments

Figure 6. Surface sediments in the project area. *Left*: previously disturbed area on the alluvial fan; *right*: granitic rocks covering the hillside. (Photographs taken on March 27, 2019)

of similar origin but of Pleistocene age (Fig. 5). In the area where quarry activities are being proposed, generally to the southwest of Cove Road, the surface geology consists of granitic rocks at higher elevations in the southwest portion of the project area and Holocene-age alluvium of alluvial fan origin on the relatively level terrain in the middle portion (Fig. 5).

The granitic rocks in the Granite Mountain, being igneous in origin, have no potential to contain any fossil remains. The alluvial soils are relatively low in potential, in comparison with lacustrine or marine sediments, for the preservation of fossil materials, as animals perishing on an alluvial fan normally become food for other animals. Any bone material left behind tends to be broken and scattered on a sunny surface and is not easily preserved. Much of the deposition on an alluvial fan is by sheet wash, and this is not a good setting for the rapid burial of remains left on the surface. However, during times of flash flooding, organisms can be trapped in flowing waters and rapidly buried as the flow ceases. In these cases, the entire carcass can be preserved. Additionally, alluvial fans tend to be made up of coarse-grained materials that are not the conducive for preserving fossil remains. The sediments are generally coarser near the source and decrease in coarseness further away. In the project vicinity, the alluvial fan sediments are very close to the source.

To the northeast, the alluvial fan sediments tend to underlie and interfinger with the lakebed sediments. In these areas the potential for fossilization of both land animals, aquatic animals, and aquatic and land-based plants increases significantly. The lake would have supported aquatic life and waterfowl as well as habitat for land animals which could have become mired in the mud and therefore would have provided a better environment for fossil preservation. However, the lakebed sediments, mainly clays and silts, would not be good as aggregate materials, which is the intended purpose of the quarry operation.

PALEONTOLOGICAL RESOURCES MANAGEMENT AND MONITORING PLAN

CEQA guidelines (Title 14 CCR App. G, Sec. V(c)) require that public agencies in the State of California determine whether a proposed project would "directly or indirectly destroy a unique paleontological resource" during the environmental review process. The present study, conducted in compliance with this provision, is designed to identify any significant, non-renewable paleontological resources that may exist within or adjacent to the project area, to assess the possibility for such resources to be encountered during the project, and to formulate a paleontological resources management and monitoring plan for the protection of such resources.

Based on the research results presented above, the granitic rocks in the southwestern portion of the project area (Fig. 5) are very low in sensitivity for paleontological remains. The Holocene-age lacustrine deposits on the surface in the northeastern portion of the project area (Fig. 5) are also considered low in paleontological sensitivity but the Pleistocene-age lacustrine deposits at depth are high in sensitivity.

In the middle portion of the project area (Fig. 5), where the existing quarry activities are concentrated, the Holocene-age alluvial soils at and near the ground surface are similarly considered to be low in paleontological sensitivity, but the older, finer-grained alluvial sediments underneath are highly sensitive for significant, nonrenewable paleontological resources if they are of sufficient age. Sources place the project location in an area of active erosion and deposition through an alluvial plain and into the Lucerne Dry Lake. The surface alluvium lies close to its source, namely the decomposing granitic bedrock of the Granite Mountain, and likely forms a relatively thick Holocene sedimentation. However, the exact depth of this coarse-grained, low-sensitivity Holocene sedimentation is currently unknown.

As the objective of the quarry operations is to obtain coarse-grained aggregate materials from the surface and near-surface deposit, current project plans call for a horizontal progress of excavations from the middle portion of the project area into the slopes to the southwest instead of vertical excavations into the deeper sediments. As long as the quarry activities do not extend into the older, finer-grained alluvial sediments occurring at depth in the middle portion of the project area, the project will have a low potential to impact significant, nonrenewable paleontological resources, and no monitoring will be necessary.

In order to prevent inadvertent impacts on paleontological resources, CRM TECH recommends that all ground disturbances be strictly limited to the granitic rocks in the southwestern portion of the project area and the coarse-grained Holocene alluvium on and near the surface in the middle portion, and that the finer-grained sediments underneath be avoided whenever they are exposed. If the project plans change in the future and the complete avoidance of the finer-grained sediments at depth is no longer possible, an updated paleontological resources management and monitoring plan, including some level of paleontological monitoring and/or periodic field inspection by qualified personnel, will need to be designed and implemented in accordance with the extent of impacts anticipated in this potentially fossiliferous formation.

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APPENDIX 1

PERSONNEL QUALIFICATIONS

PROJECT GEOLOGIST/PALEONTOLOGIST
Harry M. Quinn, M.S., California Professional Geologist #3477

Education

1968 M.S., Geology, University of Southern California, Los Angeles, California.
1964 B.S, Geology, Long Beach State College, Long Beach.
1962 A.A., Los Angeles Harbor College, Wilmington, California.

- Graduate work oriented toward invertebrate paleontology; M.S. thesis completed as a stratigraphic paleontology project on the Precambrian and Lower Cambrian rocks of Eastern California.

Professional Experience

2000- Project Paleontologist, CRM TECH, Riverside/Colton, California.
1998- Project Archaeologist, CRM TECH, Riverside/Colton, California.
1992-1998 Independent Geological/Geoarchaeological/Environmental Consultant, Pinyon Pines, California.
1994-1996 Environmental Geologist, E.C E.S., Inc, Redlands, California.
1988-1992 Project Geologist/Director of Environmental Services, STE, San Bernardino, California.
1987-1988 Senior Geologist, Jirsa Environmental Services, Norco, California.
1986 Consulting Petroleum Geologist, LOCO Exploration, Inc. Aurora, Colorado.
1978-1986 Senior Exploration Geologist, Tenneco Oil E & P, Englewood, Colorado.
1965-1978 Exploration and Development Geologist, Texaco, Inc., Los Angeles, California.

Previous Work Experience in Paleontology

1969-1973 Attended Texaco company-wide seminars designed to acquaint all paleontological laboratories with the capability of one another and the procedures of mutual assistance in solving correlation and paleo-environmental reconstruction problems.
1967-1968 Attended Texaco seminars on Carboniferous coral zonation techniques and Carboniferous smaller foraminifera zonation techniques for Alaska and Nevada.
1966-1972, 1974, 1975 Conducted stratigraphic section measuring and field paleontological identification in Alaska for stratigraphic controls. Pursued more detailed fossil identification in the paleontological laboratory to establish closer stratigraphic controls, mainly with Paleozoic and Mesozoic rocks and some Tertiary rocks, including both megafossil and microfossil identification, as well as fossil plant identification.
1965 Conducted stratigraphic section measuring and field paleontological identification in Nevada for stratigraphic controls. Pursued more detailed fossil identification in the paleontological laboratory to establish closer stratigraphic controls, mainly with Paleozoic rocks and some Mesozoic and Tertiary rocks. The Tertiary work included identification of ostracods from the Humboldt and Sheep Pass Formations and vertebrate and plant remains from Miocene alluvial sediments.

Memberships

Society of Vertebrate Paleontology; American Association of Petroleum Geologists; Association of Environmental Professionals; Rocky Mountain Association of Geologists, Pacific Section; Society of Economic Paleontologists and Mineralogists; San Bernardino County Museum.

Publications in Geology

Five publications in Geology concerning an oil field study, a ground water and earthquake study, a report on the geology of the Santa Rosa Mountain area, and papers on vertebrate and invertebrate Holocene Lake Cahuilla faunas.

REPORT WRITER
Ben Kerridge, M.A.

Education

2010	M.A., Anthropology, California State University, Fullerton.
2009	Project Management Training, Project Management Institute/CH2M HILL, Santa Ana, California.
2004	B.A., Anthropology, California State University, Fullerton.

Professional Experience

2015-	Project Archaeologist/Report Writer, CRM TECH, Colton, California.
2015	Teaching Assistant, Institute for Field Research, Kephallenia, Greece.
2009-2014	Publications Delivery Manager, CH2M HILL, Santa Ana, California.
2010-	Naturalist, Newport Bay Conservancy, Newport Beach, California.
2006-2009	Technical Publishing Specialist, CH2M HILL, Santa Ana, California.
2002-2006	English Composition/College Preparation Tutor, various locations, California.

PALEONTOLOGICAL SURVEYOR/FIELD DIRECTOR
Daniel Ballester, M.S.

Education

2013	M.S., Geographic Information System (GIS), University of Redlands, California.
2007	Certificate in Geographic Information Systems (GIS), California State University, San Bernardino.
1998	B.A., Anthropology, California State University, San Bernardino.

- Cross-trained in paleontological field procedures and identifications by CRM TECH Geologist/Paleontologist Harry M. Quinn.

Professional Experience

2002-	Field Director/GIS Specialist, CRM TECH, Riverside/Colton, California.
2011-2012	GIS Specialist for Caltrans District 8 Project, Garcia and Associates, San Anselmo, California.
2009-2010	Field Crew Chief, Garcia and Associates, San Anselmo, California.
2009-2010	Field Crew, ECorp, Redlands.
1999-2002	Project Paleontologist/Archaeologist, CRM TECH, Riverside, California.
1998-1999	Field Crew, K.E.A. Environmental, San Diego, California.
1998	Field Crew, A.S.M. Affiliates, Encinitas, California.
1998	Field Crew, Archaeological Research Unit, University of California, Riverside.

APPENDIX 2

RECORDS SEARCH RESULTS

WESTERN SCIENCE CENTER

March 26, 2019

CRM TECH
Nina Gallardo
1016 E. Cooley Drive, Suite A/B
Colton, CA 92324

Dear Ms. Gallardo,

This letter presents the results of a record search conducted for the Cove Quarry Project (CRM TECH # 3449P) in Lucerne Valley, San Bernardino County, California. The project site is located on the south east intersection of Ocotillo Way and Valley Vista Avenue in Section 33 and 34, Township 5 North, Range 1 West on the Fifteen-Mile Valley USGS 7.5 minute quadrangle, and Section 3, Township 4 North, Range 1 West of the Lucerne Valley USGS 7.5 minute quadrangle.

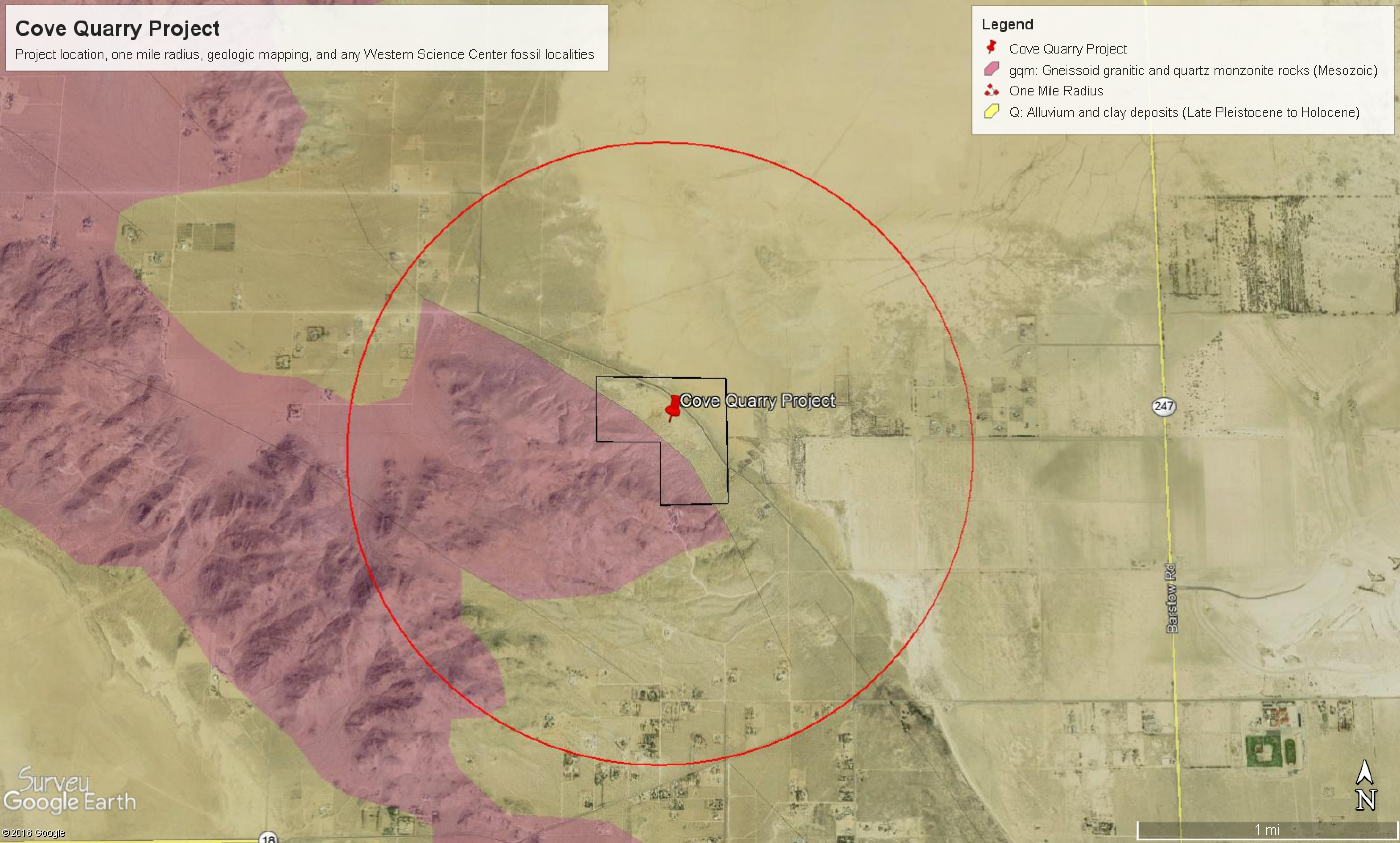
The geologic units underlying this project are mapped partially as alluvium and clay deposits dating from the Pleistocene period, and gneissoid granitic rocks from the Mesozoic epoch (Dibblee, 2008). While Mesozoic granitic units are considered to be of low paleontological sensitivity, alluvial units are considered to be of high paleontological sensitivity. The Western Science Center does not have localities within the project area or within a 1 mile radius, but does have fossil localities in similarly mapped alluvial units associated with numerous projects in Riverside County that resulted in Pleistocene fossil specimens.

Any fossils recovered from the Cove Quarry Project area would be scientifically significant. Excavation activity associated with development of the project area would impact the paleontologically sensitive Pleistocene alluvial units and it is the recommendation of the Western Science Center that a paleontological resource mitigation program be put in place to monitor, salvage, and curate any recovered fossils associated with the current study area.

If you have any questions, or would like further information about similar Pleistocene alluvial deposit projects, please feel free to contact me at dradford@westerncentermuseum.org

Sincerely,

Darla Radford
Collections Manager



Cove Quarry Project
Project location, one mile radius, geologic mapping, and any Western Science Center fossil localities
Legend
Cove Quarry Project
gqm: Gneissoid granitic and quartz monzonite rocks (Mesozoic)
One Mile Radius
Q: Alluvium and clay deposits (Late Pleistocene to Holocene)
Cove Quarry Project
247
Barstow Rd
18
Google Earth
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NATURAL HISTORY MUSEUM
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Vertebrate Paleontology Section
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3 April 2019

CRM Tech
1016 East Cooley Drive, Suite B
Colton, CA 92324

Attn: Nina Gallardo, Project Archaeologist / Native American liaison

re: Paleontological resources for the proposed Cove Quarry Project, CRM TECH # 3449P, near the Community of Lucerne, San Bernardino County, project area

Dear Nina:

I have conducted a thorough search of our paleontology collection records for the locality and specimen data for the proposed Cove Quarry Project, CRM TECH # 3449P, near the Community of Lucerne, San Bernardino County, project area as outlined on the portion of the Lucerne Valley USGS topographic quadrangle map that you sent to me via e-mail on 20 March 2019. We do not have any vertebrate fossil localities that lie directly within the proposed project boundaries, but we do have localities at some distance from deposits similar to those that occur in the proposed project area

In the elevated terrain of the Granite Mountains on the southwestern sides of the proposed project area there are exposures of plutonic igneous rocks that will not contain recognizable fossils. In the less elevated terrain around Cove Road in the central portions of the proposed project area there are surface deposits of younger Quaternary Alluvium, derived as alluvial fan deposits from the elevated terrain of the Granite Mountains adjacent to the southwest. These deposits typically do not contain significant vertebrate fossils in the uppermost layers, but older and perhaps finer-grained deposits at modest depth may well contain significant fossil vertebrate remains.

In the northeastern portion of the proposed project area there are surficial lacustrine deposits from the dry Lucerne Lake. These fine-grained deposits always have the potential to produce significant vertebrate fossil remains. We have several vertebrate fossil localities northeast of the proposed project area along the Manix Wash and Mojave River from similar deposits known as the Manix Formation. These Manix Formation localities include LACM (CIT) 540-542, LACM 1093, 3496, 4032-4039, 4054-4061, and 5746-5756. An extensive fossil fauna, primarily of birds, has been produced from these localities and a composite faunal list is provided in an appendix. Some of the specimens from these localities have also been published in the scientific literature, particularly the holotype (name-bearing specimen for a species new to science) of the extinct gull-like bird *Phoenicopterus minutus* named by Howard in 1955 (see attached appendix for a list of publications).

Excavations in the plutonic igneous rocks exposed in the very southwestern portions of the proposed project area will not encounter any recognizable fossils. Shallow excavations in the coarse alluvial fan deposits exposed in the central portions of the proposed project area are unlikely to uncover significant vertebrate fossils. Excavations anywhere in finer-grained lacustrine deposits of the dry Lucerne Lake, however, may well encounter significant vertebrate fossils. Any substantial excavations in the finer-grained sedimentary deposits in the proposed project area, therefore, should be monitored closely to quickly and professionally recover any fossil remains uncovered while not impeding development. Sediment samples should also be collected and processed to determine the small fossil potential in the proposed project area. Any fossils collected should be placed in an accredited scientific institution for the benefit of current and future generations.

This records search covers only the vertebrate paleontology records of the Natural History Museum of Los Angeles County. It is not intended to be a thorough paleontological survey of the proposed project area covering other institutional records, a literature survey, or any potential on-site survey.

Sincerely,

Samuel A. McLeod

Samuel A. McLeod, Ph.D.
Vertebrate Paleontology

enclosures: appendices, invoice

Manix Formation composite fossil fauna
based on specimens in the LACM collections

Osteichthyes			
Cypriniformes			
Cyprinidae		- minnows & carp	
Gila	*bicolar*		
Reptilia			
Chelonia			
Emydidae		- pond turtles	
Clemmys	*marmorata*		
Aves			
Accipitriformes			
Accipitridae		- eagles & haws	
Aquila	*chrysaetos*		- Published
Anseriformes			
Anatidae		- ducks & geese	
Anas	*carolinensis*		
Anas	*crecca*		- Published
Aythya	*valisineria*		- Published
Branta	*canadensis*		- Published
Oxyura	*jamaicensis*		- Published
Charadriiformes			
Laridae		- gulls & terns	
Larus	*oregonus*		- Figured
Phoenicopteridae		- extinct gull relatives	
Phoenicopterus	*copei*		- Published
Phoenicopterus	*minutus*		- HOLOTYPE
Scolopacidae		- sandpipers & avocets	
Actitis			- Published
Phalaropus	*fulicarius*		
Ciconiiformes			
Ciconiidae		- storks	
Ciconia	*maltha*		- Published
Gruiformes			
Gruidae		- cranes	
Grus			- Published
Rallidae		- coots	
Fulica	*americana*		- Published
Pelecaniformes			
Pelecanidae		- pelecans	
Pelecanus	*erythrorhynchus*		- Published
Phalacrocoracidae		- cormorants	
Phalacrocorax	*auritus*		- Published
Phalacrocorax	*macropus*		- Published
Podicipediformes			
Podicipedidae		- grebes	
Aechmophorus	*occidentalis*		- Figured

Manix Formation composite fossil fauna
based on specimens in the LACM collections [continued]

Mammalia			
Artiodactyla			
Bovidae		- cattle, sheep & goats	
Bison			
Capra			
Camelidae		- camels	
Camelops	*kansanus*		
Hemiauchenia			
Tanupolama			
Carnivora			
Felidae		- cats	
Felis	*concolor*		
Homotherium			- Figured
Ursidae		- bears	
Tremarctotherium			
Ursus			
Lagomorpha			
Leporidae		- rabbits	
Perissodactyla			
Equidae		- horses	
Equus			
Proboscidea			
Elephantidae		- mammoths	
Mammuthus			
Xenarthra			
Megatheriidae		- ground sloths	
Nothrotheriops			

Scientific Publications on Manix Formation specimens
based on specimens in the LACM collections

Emslie, Stephen D. 1992. Two New Late Blancan Avifaunas from Florida and the Extinction of Wetland Birds in the Plio-Pleistocene. Natural History Museum of Los Angeles County Science Series, 36:249-269.

Howard, Hildegarde. 1955. Fossil birds from Manix Lake. United States Geological Survey Professional Paper, 264:199-205.

Jefferson, George T. 1985. Review of the Late Pleistocene avifauna from Lake Manix, Central Mojave Desert, California. Natural History Museum of Los Angeles County Contributions in Science, 362:1-13.

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SAN BERNARDINO COUNTY

San Bernardino County Museum
Division of Earth Sciences

Crystal Cortez
Curator of Earth Sciences

email: Crystal.cortez@sbcm.sbcounty.org

28 June, 2019

CRM Tech
Attn: Michael Hogan
1016 E. Cooley Drive, Suite B
Colton, CA 92324

PALEONTOLOGY RECORDS REVIEW for proposed Cove Quarry project

Dear Michael,

The Division of Earth Sciences of the San Bernardino County Museum (SBCM) has completed a records search for the above-named project in San Bernardino County, California. The proposed Cove Quarry project is located in the City of Lucerne, as shown on the United States Geological Survey (USGS) 7.5 minute Lucerne Valley, California quadrangle (1971).

Previous geologic mapping indicates that the proposed project site has surface exposures of Quaternary alluvium of Holocene age that overlay older Pleistocene alluvium. These subsurface Pleistocene sediments have high potential to contain fossil resources.

For this review, I conducted a search of the Regional Paleontological Locality Inventory (RPLI) at the SBCM. The results of this search indicate that no recorded paleontological resource localities are present within the proposed project. The nearest fossil site at SBCM is approximately 1 mile south east, near Rabbit springs (SBCM locality number 1.107.1). This site yielded fossil material of an extinct *Equus* and *Camelidae* from Pleistocene aged lacustrine sediments.

This records search covers only the paleontological records of the San Bernardino County Museum. It is not intended to be a thorough paleontological survey of the proposed project area covering other institutional records, a literature survey, or any potential on-site survey.

Please do not hesitate to contact us with any further questions that you may have.

Sincerely,

Crystal Cortez, Curator of Earth Sciences
Division of Earth Sciences
San Bernardino County Museum