PALEONTOLOGICAL TECHNICAL STUDY

ENCHANTED HILLS PARK SKATE SPOT PROJECT, CITY OF PERRIS, RIVERSIDE COUNTY, CALIFORNIA

Prepared for: **The City of Perris**
Planning Department
101 N. D St.
Perris, CA 92570

HELIX Environmental Planning, Inc.
7578 El Cajon Boulevard
La Mesa, CA 91942

Prepared by: **Paleo Solutions, Inc.**
911 S. Primrose Ave., Unit N
Monrovia, CA 91016

Courtney Richards, M.S. – Principal Investigator
Joey Raum, B.S. – Report Author

PSI Report: CA20RiversideHEL01R

January 2, 2020

This page intentionally left blank.

Table of Contents

1.0 EXECUTIVE SUMMARY 4
2.0 INTRODUCTION 5
2.1 Project Description and Location 5
3.0 DEFINITION AND SIGNIFICANCE OF PALEONTOLOGICAL RESOURCES 8
4.0 LAWS, ORDINANCES, REGULATIONS, AND STANDARDS 9
4.1 State Regulatory Setting 9
4.1.1 California Environmental Quality Act (CEQA) 9
4.1.2 State of California Public Resource Code 9
4.2 Local Regulatory Setting 9
4.2.1 Riverside County 9
4.2.2 City of Perris 10
5.0 METHODS 10
5.1 Analysis of Existing Data 11
5.2 Criteria for Evaluating Paleontological Potential 11
6.0 ANALYSIS OF EXISTING DATA 13
6.1 Geologic Map and Literature Review 14
6.1.1 Tonalite of Val Verde Pluton (Kvt) (Cretaceous) 14
6.2 Paleontological Record Search Results 16
7.0 IMPACT TO PALEONTOLOGICAL RESOURCES 16
8.0 CONCLUSIONS AND RECOMMENDATIONS 16
REFERENCES 17
APPENDIX A 19

Figures

Figure 1. Project Location Map. 6
Figure 2. Project Overview Map. 7
Figure 3. Project Geology Map. 15

Tables

Table 1. Enchanted Hills Park Skate Spot Project Summary. 5
Table 2. Summary of Comparison between PFYC System and Riverside County Paleontological Sensitivity Rankings. 11

1.0 EXECUTIVE SUMMARY

This report presents the results of the paleontological technical study conducted by Paleo Solutions, Inc. (Paleo Solutions) in support of the Enchanted Hills Park Skate Spot Project (Project) located in the City of Perris in Riverside County, California, within the Peninsular Ranges Geomorphic Province (see Figures 1 and 2). Paleo Solutions was contracted by Helix Environmental Planning, Inc. (Helix) to conduct an analysis of existing paleontological data and to provide recommendations for mitigation based on the geological and paleontological data. This work was required by the City of Perris (the City) to meet their requirements as the lead agency under the California Environmental Quality Act (CEQA). All paleontological work was completed in compliance with CEQA, local guidelines, and best practices in mitigation paleontology (Murphey et al., 2019). The results of the paleontological technical study will be incorporated into the Project's Initial Study/Mitigated Negative Declaration (IS/MND). See Table 1 for a Project summary.

The Project consists of construction of a skate park within the existing Enchanted Hills Park located in the City of Perris. The Project area encompasses approximately 22.2 acres and is bounded by residential properties on all sides. The Project area is mapped on the USGS Peak (2003) and Steele Peak (2001) 7.5' Topographic Quadrangles and is situated entirely on lands with undetermined ownership in the Northwest-Southwest and Northeast-Southwest quarter-quarters, of Section 25, Township 4 South, Range 4 West. Geologic mapping by D.M. Morton, R.M. Alvarez, and V.M. Diep (2002) and D.M. Morton, K.R. Bovard, and R.M. Alvarez (2003) indicates that the Project area is entirely underlain by Cretaceous-age tonalite of Val Verde pluton (Kvt) (see Figure 3). Late to middle Pleistocene-age old alluvial fan deposits, arenaceous (Qofa), is also mapped within the Project vicinity, within a half mile buffer (Morton et al., 2002, 2003; see Figure 3). However, since these sediments are not located at the surface within the Project area boundaries and will also not be encountered within the Project area beneath the Cretaceous-age tonalite of Val Verde pluton (Kvt) due to the stratigraphic relationship of the two geologic units, the late to middle Pleistocene-age old alluvial fan deposits (Qofa) are not discussed in this report.

The Project area was evaluated based on an analysis of existing paleontological data. The three components of the analysis included a geologic map review, a literature search, and two institutional record searches. According to the record searches, there are no previously recorded fossil localities within the Project site; there are no localities recorded within the Project vicinity from geologic units similar to those that occur within the Project area.

Using the analysis of existing data, the geologic unit was evaluated on its potential for producing significant paleontological resources. Paleontological sensitivity assignments were developed following the Potential Fossil Yield Classification (PFYC) system (BLM, 2016) and best practices in mitigation paleontology (Murphey et al., 2019). Cretaceous-age tonalite of Val Verde pluton (Kvt) consists of plutonic rocks, which are formed at high temperatures and pressures not conducive to fossil preservation. Cretaceous-age tonalite of Val Verde pluton (Kvt), therefore, has a very low paleontological potential (PFYC 1).

Due to the very low paleontological potential (PFYC 1) of the Cretaceous-age tonalite of Val Verde pluton (Kvt) that is located throughout the entirety of the Project area, further paleontological mitigation is not recommended.

2.0 INTRODUCTION

This report presents the results of the paleontological technical study conducted by Paleo Solutions in support of the Enchanted Hills Park Skate Spot Project located in the City of Perris in Riverside County, California, within the Peninsular Ranges Geomorphic Province (Figures 1 and 2). Paleo Solutions was contracted by Helix to conduct an analysis of existing paleontological data and to provide recommendations for mitigation based on the geological and paleontological data. This work was required by the City to meet their requirements as the lead agency under CEQA. All paleontological work was completed in compliance with CEQA, local guidelines, and best practices in mitigation paleontology (Murphey et al., 2019). See Table 1 for a Project summary.

2.1 Project Description and Location

The Project consists of construction of a skate park within the existing Enchanted Hills Park located in the City of Perris. The Project area encompasses approximately 22.2 acres and is bounded by residential properties on all sides. The Project area is mapped on the USGS Peak (2003) and Steele Peak (2001) 7.5' Topographic Quadrangles and is situated entirely on lands with undetermined ownership in the Northwest-Southwest and Northeast-Southwest quarter-quarters, of Section 25, Township 4 South, Range 4 West. Geologic mapping by D.M. Morton, R.M. Alvarez, and V.M. Diep (2002) and D.M. Morton, K.R. Bovard, and R.M. Alvarez (2003) indicates that the Project area is entirely underlain by Cretaceous-age tonalite of Val Verde pluton (Kvt) (Figure 3).

Table 1. Enchanted Hills Park Skate Spot Project Summary.

<table>
<tr><td>Project Name</td><td colspan="4">Enchanted Hills Park Skate Spot Project</td></tr>
<tr><td>Project Description</td><td colspan="4">The Project consists of construction of a skate park within the existing Enchanted Hills Park. The Project area is bounded by residential properties on all sides.</td></tr>
<tr><td>Project Area</td><td colspan="4">The Project area is located in the City of Perris, Riverside County, California.</td></tr>
<tr><td rowspan="2">Location (PLSS)</td><td>Quarter-Quarter</td><td>Section</td><td>Township</td><td>Range</td></tr>
<tr><td>NWSW, NESW</td><td>Sec. 25</td><td>T4S</td><td>R4W</td></tr>
<tr><td rowspan="2">Land Owner</td><td>Surface Management Agency</td><td colspan="3">Acres</td></tr>
<tr><td>Undetermined</td><td colspan="3">22.2 acres</td></tr>
<tr><td>Topographic Map(s)</td><td colspan="4">USGS Peak (2003) and Steele Peak (2001) 7.5' Topographic Quadrangles</td></tr>
<tr><td>Geologic Map(s)</td><td colspan="4">Geologic Map of the Steele Peak 7.5' Quadrangle, Riverside County, California (Morton et al., 2002)
Preliminary Geologic Map of the Perris 7.5' Quadrangle, Riverside County, California (Morton et al., 2003)</td></tr>
<tr><td rowspan="3">Mapped Geologic Unit(s) and age(s)</td><td>Geologic Unit and Map Symbol</td><td colspan="2">Age</td><td>Paleontological Potential (PFYC)</td></tr>
<tr><td>Old alluvial fan deposits, arenaceous (Qofa)</td><td colspan="2">Late to middle Pleistocene</td><td>3 (Moderate)</td></tr>
<tr><td>Tonalite of Val Verde pluton (Kvt)</td><td colspan="2">Cretaceous</td><td>1 (Very Low)</td></tr>
<tr><td>Previously Documented Fossil Localities within the Project area</td><td colspan="4">Record searches were requested from the Natural History Museum of Los Angeles County (LACM) and the Western Science Center (WSC) located in Riverside County, California. The LACM and WSC record searches yielded no fossil localities recorded within the Project area (see Section 6.2; Appendix A).</td></tr>
<tr><td>Recommendation(s)</td><td colspan="4">Due to the very low paleontological potential (PFYC 1) of the Cretaceous-age tonalite of Val Verde pluton (Kvt) that is located throughout the entirety of the Project area, further paleontological mitigation is not recommended.</td></tr>
</table>

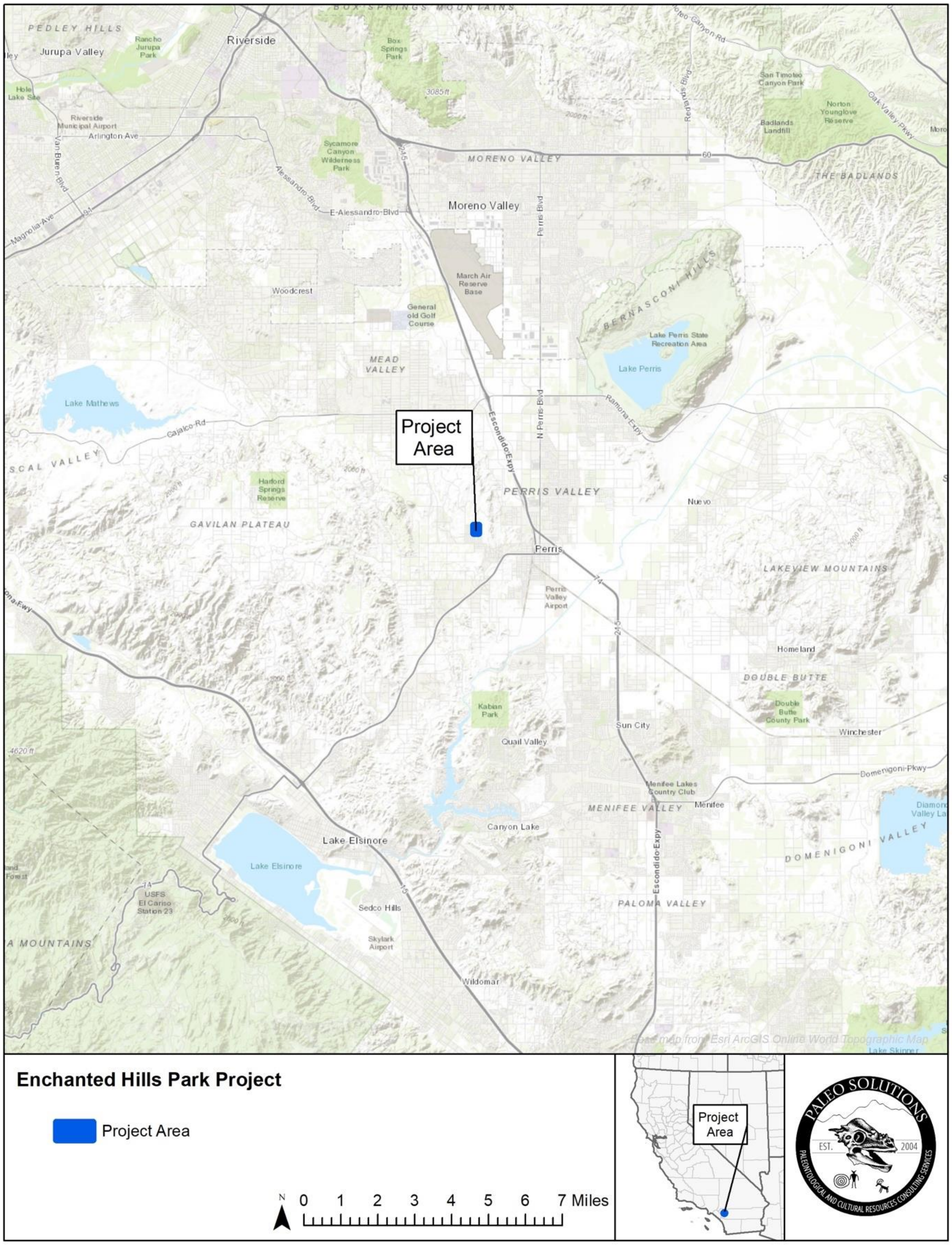

Figure 1. Project Location Map.

Figure 2. Project Overview Map.

3.0 DEFINITION AND SIGNIFICANCE OF PALEONTOLOGICAL RESOURCES

As defined by Murphey and Daitch (2007): "Paleontology is a multidisciplinary science that combines elements of geology, biology, chemistry, and physics in an effort to understand the history of life on earth. Paleontological resources, or fossils, are the remains, imprints, or traces of once-living organisms preserved in rocks and sediments. These include mineralized, partially mineralized, or unmineralized bones and teeth, soft tissues, shells, wood, leaf impressions, footprints, burrows, and microscopic remains. Paleontological resources include not only fossils themselves, but also the associated rocks or organic matter and the physical characteristics of the fossils' associated sedimentary matrix.

The fossil record is the only evidence that life on earth has existed for more than 3.6 billion years. Fossils are considered non-renewable resources because the organisms they represent no longer exist. Thus, once destroyed, a fossil can never be replaced. Fossils are important scientific and educational resources because they are used to:

- Study the phylogenetic relationships amongst extinct organisms, as well as their relationships to modern groups;
- Elucidate the taphonomic, behavioral, temporal, and diagenetic pathways responsible for fossil preservation, including the biases inherent in the fossil record;
- Reconstruct ancient environments, climate change, and paleoecological relationships;
- Provide a measure of relative geologic dating that forms the basis for biochronology and biostratigraphy, and which is an independent and corroborating line of evidence for isotopic dating;
- Study the geographic distribution of organisms and tectonic movements of land masses and ocean basins through time;
- Study patterns and processes of evolution, extinction, and speciation; and
- Identify past and potential future human-caused effects to global environments and climates."

Fossil resources vary widely in their relative abundance and distribution and not all are regarded as significant. According to the BLM Instructional Memorandum (IM) 2009-011, a "Significant Paleontological Resource" is defined as:

> "Any paleontological resource that is considered to be of scientific interest, including most vertebrate fossil remains and traces, and certain rare or unusual invertebrate and plant fossils. A significant paleontological resource is considered to be of scientific interest if it is a rare or previously unknown species, it is of high quality and well-preserved, it preserves a previously unknown anatomical or other characteristic, provides new information about the history of life on earth, or has an identified educational or recreational value. Paleontological resources that may be considered not to have scientific significance include those that lack provenience or context, lack physical integrity due to decay or natural erosion, or that are overly redundant or are otherwise not useful for research. Vertebrate fossil remains and traces include bone, scales, scutes, skin impressions, burrows, tracks, tail drag marks, vertebrate coprolites (feces), gastroliths (stomach stones), or other physical evidence of past vertebrate life or activities" (BLM, 2008)."

Vertebrate fossils, whether preserved remains or track ways, are classified as significant by most state and federal agencies and professional groups (and are specifically protected under the California Public Resources Code). In some cases, fossils of plants or invertebrate animals are also considered significant and can provide important information about ancient local environments.

The full significance of fossil specimens or fossil assemblages cannot be accurately predicted before they are collected, and in many cases, before they are prepared in the laboratory and compared with previously collected fossils. Pre-construction assessment of significance associated with an area or formation must be made based on previous finds, characteristics of the sediments, and other methods that can be used to determine paleoenvironmental and taphonomic conditions.

4.0 LAWS, ORDINANCES, REGULATIONS, AND STANDARDS

This section of the report presents the state and local regulatory requirements pertaining to paleontological resources that will apply to this Project.

4.1 State Regulatory Setting

4.1.1 California Environmental Quality Act (CEQA)

The procedures, types of activities, persons, and public agencies required to comply with CEQA are defined in the Guidelines for Implementation of CEQA (State CEQA Guidelines), as amended on March 18, 2010 (Title 14, Section 15000 et seq. of the California Code of Regulations) and further amended January 4, 2013 and again December 28, 2018. One of the questions listed in the CEQA Environmental Checklist is: "Would the project directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?" (State CEQA Guidelines Appendix G, Section VII, Part F).

4.1.2 State of California Public Resource Code

The State of California Public Resources Code (Chapter 1.7), Sections 5097 and 30244, includes additional state level requirements for the assessment and management of paleontological resources. These statutes require reasonable mitigation of adverse impacts to paleontological resources resulting from development on state lands, and define the excavation, destruction, or removal of paleontological "sites" or "features" from public lands without the express permission of the jurisdictional agency as a misdemeanor. As used in Section 5097, "state lands" refers to lands owned by, or under the jurisdiction of, the state or any state agency. "Public lands" is defined as lands owned by, or under the jurisdiction of, the state, or any city, county, district, authority, or public corporation, or any agency thereof.

4.2 Local Regulatory Setting

4.2.1 Riverside County

The Riverside County General Plan requires consideration of paleontological resources under the Multipurpose Open Space Element of the general plan (County of Riverside, 2015). The Riverside County General Plan recommendations are based on the Society of Vertebrate Paleontology (SVP) guidelines (SVP, 2010) for the mitigation of paleontological resources. The Multipurpose Open Space Element of the general plan (County of Riverside, 2015) provides the following requirements for paleontological sensitive areas within the county:

- OS 19.6 Whenever existing information indicates that a site proposed for development has high paleontological sensitivity as shown on Figure OS-8, a paleontological resource impact mitigation program (PRIMP) shall be filed with the 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 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 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.

4.2.2 City of Perris

The City of Perris General Plan (2005) has one goal, one policy, and three implementation measures relating to paleontological resources. Goal 4 requires the protection of historical, archaeological and paleontological sites. Policy IV.A requires that the City of Perris comply with state and federal regulations and ensure preservation of the significant historical, archaeological and paleontological resources within the City. The three implementation measures require that all new construction involving grading require appropriate surveys and necessary site investigations in conjunction with the earliest environmental documents prepared for a project, that in specifically delineated areas shown on the City's paleontological sensitivity map that levels of paleontological monitoring will be required, from full-time monitoring to part-time monitoring in some less-sensitive areas. Finally, the General Plan requires that the City of Perris identify and collect previous surveys of cultural resources, evaluate each resource and consider preparation of a comprehensive citywide inventory of cultural resources including both prehistoric sites and man-made resources.

5.0 METHODS

The paleontological analysis of existing data included a geologic map review, a literature search, and a review of the LACM and WSC record searches. The goal of this report is to identify the paleontological potential of the Project area and make recommendations for the mitigation of adverse impacts on paleontological resources that may occur as a result of the proposed construction. Paleontological sensitivity assignments were determined using the PFYC system (BLM, 2016) and best practices in mitigation paleontology (Murphey et al., 2019). Joey Raum, B.S., completed the background research and authored this report. Courtney Richards, M.S., performed the technical review of this report. GIS maps were prepared by Barbara Webster, M.S. Geraldine Aron, M.S., and Courtney Richards, M.S., oversaw all aspects of the Project as the Project Manager and Paleontological Principal Investigator, respectively.

Copies of this report will be submitted to be the City and Helix and will be incorporated into the Project's IS/MND. Paleo Solutions will retain an archival copy of all project information including maps and other data.

5.1 Analysis of Existing Data

Paleo Solutions reviewed geologic mapping of the Project area and half-mile buffer by D.M. Morton, R.M. Alvarez, and V.M. Diep (2002) and D.M. Morton, K.R. Bovard, and R.M. Alvarez (2003). The literature reviewed included published and unpublished scientific papers. Paleontological museum record searches were conducted at the LACM and WSC. Samuel McLeod, Ph.D., conducted the LACM search (December 13, 2019), and Darla Radford, M.S., conducted the WSC search (December 12, 2019). The results of two museum record searches are provided as Appendix A.

5.2 Criteria for Evaluating Paleontological Potential

The PFYC system was developed by the BLM (BLM, 2016). Because of its demonstrated usefulness as a resource management tool, the PFYC has been utilized for many years for projects across the country, regardless of land ownership. It is a predictive resource management tool that classifies geologic units on their likelihood to contain paleontological resources on a scale of 1 (very low potential) to 5 (very high potential). This system is intended to aid in predicting, assessing, and mitigating paleontological resources. The PFYC ranking system is summarized in Table 2, along with the Riverside County guidelines paleontological sensitivity rankings, which are included for a comparison of the two systems.

Table 2. Summary of Comparison between PFYC System and Riverside County Paleontological Sensitivity Rankings.

BLM PFYC Designation	*Riverside County Paleontological Sensitivity	Assignment Criteria Guidelines and Management Summary (PFYC system)
1 = Very Low Potential	Low Sensitivity	Geologic units are not likely to contain recognizable paleontological resources.
		Units are igneous or metamorphic, excluding air-fall and reworked volcanic ash units.
		Units are Precambrian in age.
		Management concern is usually negligible, and impact mitigation is unnecessary except in rare or isolated circumstances.
2 = Low Potential**	High B Sensitivity	Geologic units are not likely to contain paleontological resources.
		Field surveys have verified that significant paleontological resources are not present or are very rare.
		Units are generally younger than 10,000 years before present.
		Recent aeolian deposits.
		Sediments exhibit significant physical and chemical changes (i.e., diagenetic alteration) that make fossil preservation unlikely.
		Management concern is generally low, and impact mitigation is usually unnecessary except in occasional or isolated circumstances.
3 = Moderate Potential	High A Sensitivity	Sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence.
		Marine in origin with sporadic known occurrences of paleontological resources.
		Paleontological resources may occur intermittently, but these occurrences are widely scattered.
		The potential for authorized land use to impact a significant paleontological resource is known to be low-to-moderate.

BLM PFYC Designation	*Riverside County Paleontological Sensitivity	Assignment Criteria Guidelines and Management Summary (PFYC system)
		Management concerns are moderate. Management options could include record searches, pre-disturbance surveys, monitoring, mitigation, or avoidance. Opportunities may exist for hobby collecting. Surface-disturbing activities may require sufficient assessment to determine whether significant paleontological resources occur in the area of a proposed action and whether the action could affect the paleontological resources.
4 = High Potential	High A Sensitivity	Geologic units that are known to contain a high occurrence of paleontological resources.
		Significant paleontological resources have been documented but may vary in occurrence and predictability.
		Surface-disturbing activities may adversely affect paleontological resources.
		Rare or uncommon fossils, including nonvertebrate (such as soft body preservation) or unusual plant fossils, may be present.
		Illegal collecting activities may impact some areas.
		Management concern is moderate to high depending on the proposed action. A field survey by a qualified paleontologist is often needed to assess local conditions. On-site monitoring or spot-checking may be necessary during land disturbing activities. Avoidance of known paleontological resources may be necessary.
5 = Very High Potential	High A Sensitivity	Highly fossiliferous geologic units that consistently and predictably produce significant paleontological resources.
		Significant paleontological resources have been documented and occur consistently.
		Paleontological resources are highly susceptible to adverse impacts from surface disturbing activities.
		Unit is frequently the focus of illegal collecting activities.
		Management concern is high to very high. A field survey by a qualified paleontologist is almost always needed and on-site monitoring may be necessary during land use activities. Avoidance or resource preservation through controlled access, designation of areas of avoidance, or special management designations should be considered.
U = Unknown Potential	Undetermined Sensitivity	Geologic units that cannot receive an informed PFYC assignment
		Geological units may exhibit features or preservational conditions that suggest significant paleontological resources could be present, but little information about the actual paleontological resources of the unit or area is unknown.
		Geologic units represented on a map are based on lithologic character or basis of origin but have not been studied in detail.
		Scientific literature does not exist or does not reveal the nature of paleontological resources.
		Reports of paleontological resources are anecdotal or have not been verified.
		Area or geologic unit is poorly or under-studied.
		BLM staff has not yet been able to assess the nature of the geologic unit.
		Until a provisional assignment is made, geologic units with unknown potential have medium to high management concerns. Field surveys are normally necessary, especially prior to authorizing a ground-disturbing activity.

*Riverside County guidelines paleontological sensitivity rankings comparison to BLM PFYC rankings. This comparison does not denote an absolute correlation between the rankings.
**Sensitivity may increase with depth.

6.0 ANALYSIS OF EXISTING DATA

The Project area is located within the Peninsular Ranges Geomorphic Province (Harden, 2004). A geomorphic province is a geographical area of distinct landscape character, with related geophysical features, including relief, landforms, orientations of valleys and mountains, type of vegetation, and other geomorphic attributes (Harden, 2004). Attributes of the Peninsular Ranges Geomorphic Province consist of northwest-southeast-trending, fault-bounded discrete blocks, with mountain ranges, broad intervening valleys, and low-lying coast plains (Yerkes et al., 1965; Norris and Webb, 1990). Within California, the province extends approximately 125 miles from the Transverse Ranges and the Los Angeles Basin south to the Mexican border, extending southward approximately 775 miles toward to the tip of Baja California, and it is bound on the east by the right-slip San Andreas Fault Zone, the Eastern Transverse Ranges, and the Colorado Desert (Norris and Webb, 1990; Hall, 2007). Most of the geomorphic province is located offshore and includes the Santa Catalina and San Clemente islands (Hall, 2007). Topographically on the mainland, the Peninsular Ranges are steeper on the eastern slopes, where they are truncated by normal faults like the Elsinore or San Jacinto faults, and are more gradual on their western slopes toward the Pacific Ocean, similar to the topography of the Sierra Nevada (Norris and Webb, 1990; Prothero, 2017). Within the province, the highest elevations are found in the eastern-most block, with San Jacinto Peak reaching approximately 10,805 feet in elevation and various summits of the Santa Rosa Mountains averaging 6,000 feet in elevation (Norris and Webb, 1990). Westward toward the coast, elevations are less dramatic.

The pre-Phanerozoic history of the Peninsular Ranges is not represented within the province, and few locations contain rocks older than the Mesozoic (Norris and Webb, 1990), and sparse Paleozoic strata within the Peninsular Ranges is in stark contrast to the Sierra Nevada, which contains thick sections of Paleozoic rocks. The oldest pre-batholithic rocks in the Peninsular Ranges are Paleozoic in age and consist of metamorphosed remnants of a stable carbonate platform (now marble and schist) on a passive continental margin that existed along western North America at that time (Harden, 2004). Moreover, late Paleozoic limestone is present near Riverside (Norris and Webb, 1990), further supporting the presence of a shallow marine environment prior to the Mesozoic. Most of the geologic history of the Peninsular Ranges is represented by Mesozoic-age plutonic rocks and Cenozoic-age uplift, erosion, and sedimentary deposition in basins (Sylvester and O'Black Gans, 2016).

During the Triassic and Jurassic, marine sedimentary rocks composed of sandstone and shale were deposited in turbidite sequences along a submarine fan (Harden, 2004). Throughout the Jurassic and Cretaceous, the continental margin became active as the Farallon Plate, which ferried old island arcs, subducted beneath the North American Plate, creating a large pluton complex (i.e., batholith) beneath the surface that rose into the upper crust and intruded into Paleozoic and Mesozoic sedimentary and volcanic rocks (Harden, 2004; Sylvester and O'Black Gans, 2016). The large complex of batholiths resulted in the formation of the San Marcos Gabbro, Bonsall Tonalite, and Woodson Mountain Granodiorite among others in the Peninsular Ranges (Norris and Webb, 1990). Contact metamorphism from the plutons metamorphosed older sedimentary and volcanic rocks into marble, slate, schist, quartzite, gneiss, and metavolcanic rocks (Sylvester and O'Black Gans, 2016). The timing of the Peninsular Ranges Batholith is similar to that of the Sierra Nevada, ranging in age from 70 to 120 million years ago (Norris and Webb, 1990). The batholith complex originally formed south of the Mexican border but has since moved along the right-slip San Andreas Fault over the past 40 million years (Prothero, 2017). During the Late Cretaceous through the Paleogene, the Peninsular Ranges Batholith was uplifted and eroded into a broad plain, where fluvial systems transported sediments westward across the plain and onto the seafloor (Sylvester and O'Black Gans, 2016). Sedimentary rocks were deposited in a forearc basin by turbidity currents representing both deep and shallow marine and nonmarine environments, including the marine Williams, Ladd, and Rosario formations and the nonmarine Trabuco Formation, with extensive exposures in the western flank of the Santa Ana Mountains (Norris and Webb, 1990; Harden, 2004).

Throughout the Cenozoic, thick sections of sedimentary rocks were deposited in large basins, such as the Los Angeles, Imperial, and offshore basins, due to erosion (Norris and Webb, 1990). Most exposures of early Tertiary strata are restricted to the coastal margins, with a maximum thickness of approximately 4,500 feet in the Santa Ana Mountains (Norris and Webb, 1990). Most Cenozoic strata represent nonmarine depositional environments; however, approximately 600 feet of marine sediments are present near San Diego (Norris and Webb, 1990). Thick nonmarine deposits formed during the Oligocene, followed by a pause of sedimentation at the end of the Oligocene due to tectonic uplift (Norris and Webb, 1990). By the beginning of the Miocene, most of the Farallon Plate had been subducted beneath the North American Plate, and the Pacific Plate came into contact with the North American Plate (Sylvester and O'Black Gans, 2016). As the Pacific Plate slid northwest along the North American Plate, a section of forearc basin was rafted, rotated clockwise approximately 110 degrees, and carried north approximately 130 miles; while carried northward, the forearc basin was compressed and formed the Transverse Ranges located immediately north of the Peninsular Ranges (Sylvester and O'Black Gans, 2016). Additionally, movement along the San Jacinto Fault Zone, which bifurcates from the San Andreas Fault Zone in an area north of the Peninsular Ranges, occurred in the middle to late Tertiary through the Quaternary, with a right-slip and vertical motion resulting in approximately 18 miles of lateral displacement (Norris and Webb, 1990). During this time, thick accumulations of nonmarine sediments filled basins, as well as coastal and offshore areas, in the northern Peninsular Ranges during the Pliocene, with up to 7,000-foot thick sections of siltstone, sandstone, and conglomerate in the Mount Eden and San Timoteo canyons (Norris and Webb, 1990). Despite widespread volcanism elsewhere in southern California during the late Tertiary, little volcanism occurred within the Peninsular Ranges during this time (Norris and Webb, 1990). Throughout the Quaternary, fluvial and lacustrine sediments continued to fill basins within the province, with restricted volcanic and marine terrace deposits along the coast (Norris and Webb, 1990).

The Project area is situated in the Perris Block, which is a fault-bounded block comprising part of the northern Peninsular Ranges. The block lies between the Los Angeles Basin and the San Jacinto Mountains and is bounded by the San Jacinto and Elsinore-Chino Fault zones and the Cucamonga Fault (Woodford et al., 1971). During the Pliocene and Pleistocene, deep isostatic flow caused the Perris Block to oscillate vertically as the Los Angeles Basin sank and the San Jacinto Mountains rose (Woodford et al., 1971). The oscillations resulted in deposition of deep valley continental sediments as well as volcanic rocks, which were emplaced on top of the dominantly crystalline basement, and multiple erosional surfaces (Woodford et al., 1971).

6.1 Geologic Map and Literature Review

Geologic mapping by D.M. Morton, R.M. Alvarez, and V.M. Diep (2002) and D.M. Morton, K.R. Bovard, and R.M. Alvarez (2003) indicates that the Project area is entirely underlain by Cretaceous-age tonalite of Val Verde pluton (Kvt) (Figure 3). Late to middle Pleistocene-age old alluvial fan deposits, arenaceous (Qofa), is also mapped within the Project vicinity, within a half mile buffer (Morton et al., 2002, 2003; see Figure 3). However, since these sediments are not located at the surface within the Project area boundaries and will also not be encountered within the Project area beneath the Cretaceous-age tonalite of Val Verde pluton (Kvt) due to the stratigraphic relationship of the two geologic units, the late to middle Pleistocene-age old alluvial fan deposits (Qofa) are not discussed in this report.

6.1.1 Tonalite of Val Verde Pluton (Kvt) (Cretaceous)

Cretaceous-age tonalite of Val Verde pluton (Kvt) is mapped at the surface of the entire Project area (Morton et al., 2002; 2003; Figure 3). Plutonic rocks formed deep within the Earth's surface at high temperatures and high pressures and lack fossil resources. Cretaceous-age tonalite of Val Verde pluton (Kvt) is therefore considered to have very low paleontological potential (PFYC 1) using BLM (2016) guidelines.

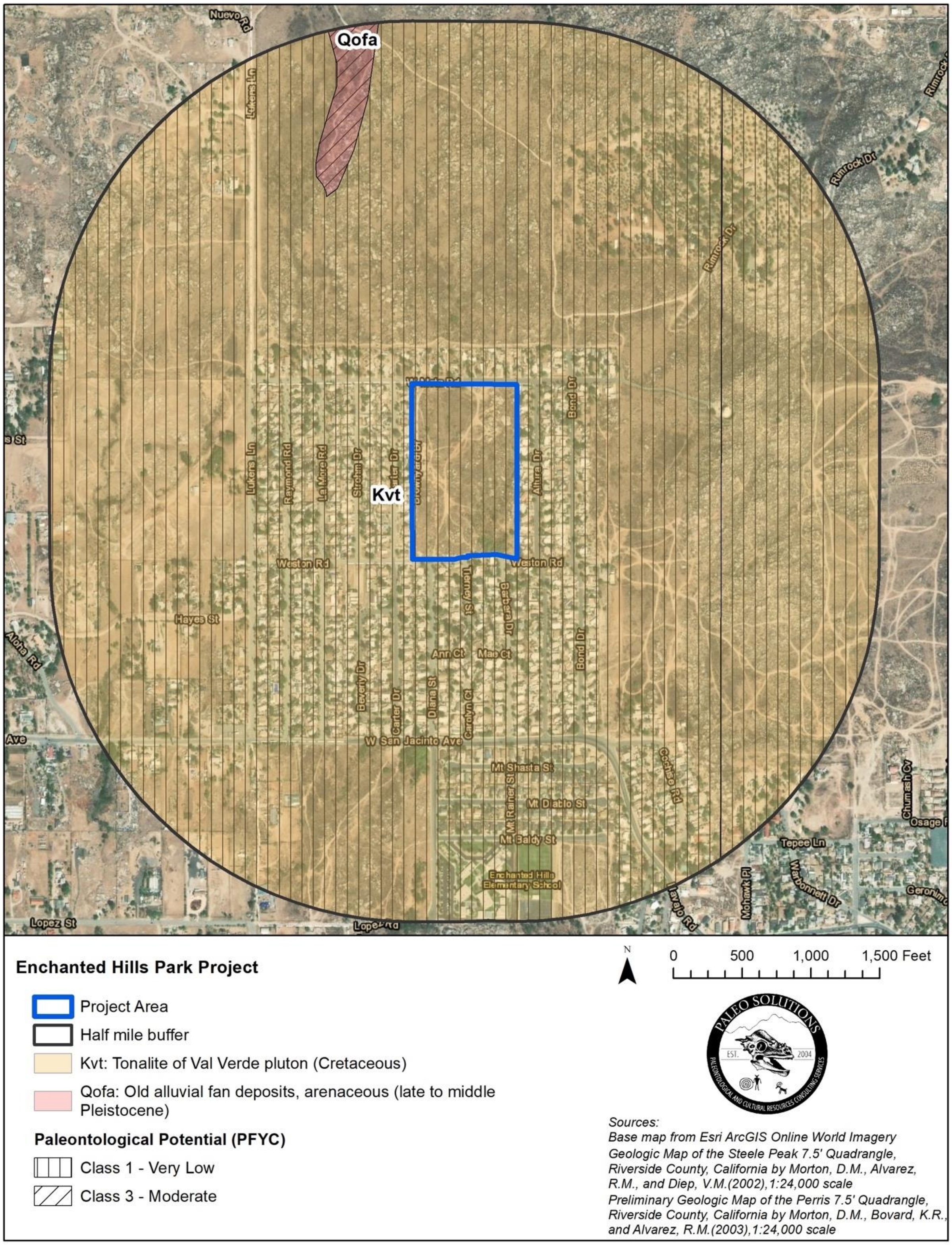

Figure 3. Project Geology Map.

6.2 Paleontological Record Search Results

Paleo Solutions requested paleontological searches of records maintained by the LACM and the WSC. The museums responded on December 13, 2019 and December 12, 2019, respectively, that no vertebrate fossil localities recorded from within the Project area (McLeod, 2019; Radford, 2019). Additionally, there are no localities recorded within the Project vicinity from geologic units similar to those that occur within the Project area.

7.0 IMPACT TO PALEONTOLOGICAL RESOURCES

Impacts on paleontological resources can generally be classified as either direct, indirect, or cumulative. Direct adverse impacts on surface or subsurface paleontological resources are the result of destruction by breakage and crushing as the result of surface disturbing actions including construction excavations. In areas that contain paleontologically sensitive geologic units, ground disturbance has the potential to adversely impact surface and subsurface paleontological resources of scientific importance. Without mitigation, these fossils and the paleontological data they could provide if properly recovered and documented, could be adversely impacted (damaged or destroyed), rendering them permanently unavailable to science and society.

Indirect impacts typically include those effects which result from the continuing implementation of management decisions and resulting activities, including normal ongoing operations of facilities constructed within a given project area. They also occur as the result of the construction of new roads and trails in areas that were previously less accessible. This increases public access and therefore increases the likelihood of the loss of paleontological resources through vandalism and unlawful collecting. Human activities that increase erosion also cause indirect impacts to surface and subsurface fossils as the result of exposure, transport, weathering, and reburial.

Cumulative impacts can result from incrementally minor but collectively significant actions taking place over a period of time. The incremental loss of paleontological resources over time as a result of construction-related surface disturbance or vandalism and unlawful collection would represent a significant cumulative adverse impact, because it would result in the destruction of non-renewable paleontological resources and the associated irretrievable loss of scientific information.

Plutonic rocks, such as the tonalite of Val Verde pluton (Kvt) of the Project area, formed deep within the Earth's surface at high temperatures and high pressures and lack fossil resources. Therefore, Project construction and operation are not anticipated to result in any direct, indirect, or cumulative impacts on paleontological resources.

8.0 CONCLUSIONS AND RECOMMENDATIONS

Due to the very low paleontological potential (PFYC 1) of the Cretaceous-age tonalite of Val Verde pluton (Kvt) that is located throughout the entirety of the Project area at both the surface and at depth, further paleontological mitigation is not recommended.

REFERENCES

Bureau of Land Management (BLM). 2008. Assessment and Mitigation of Potential Impacts to Paleontological Resources: BLM Instruction Memorandum No. 2009-011.

Bureau of Land Management (BLM). 2016. Potential Fossil Yield Classification system: BLM Instruction Memorandum No. 2016-124 (PFYC revised from USFS, 2008).

City of Perris. 2005. City of Perris General Plan, available at: http://www.cityofperris.org/city-hall/general-plan.html

Hall, C.A. 2007. Introduction to the Geology of Southern California and its Native Plants. University of California Press. Berkeley. Pp. 101-149.

Harden, D.R. 2004. California Geology, 2nd Edition: Pearson Prentice Hall. Upper Saddle River. Pp. 464-479.

McLeod, S.A. 2019. Paleontological Resources for the Proposed Enchanted Hills Park Project in the City of Perris, Riverside County, Project area. Natural History Museum of Los Angeles County. Dated December 13, 2019.

Morton, D.M., R.M. Alvarez, and V.M. Diep. 2002. Geologic Map of the Steele Peak 7.5' Quadrangle, Riverside County, California. Scale 1:24,000.

Morton, D.M., K.R. Bovard, and R.M. Alvarez. 2003. Preliminary Geologic Map of the Perris 7.5' Quadrangle, Riverside County, California. Scale 1:24,000.

Murphey, P.C., and D. Daitch. 2007. Paleontological overview of oil shale and tar sands areas in Colorado, Utah and Wyoming: U.S. Department of Energy, Argonne National Laboratory Report Prepared for the U.S. Department of Interior Bureau of Land Management, 468 p., 6 maps, scale 1:500,000.

Murphey, P.C., G.E. Knauss, L.H. Fisk, T.A. Deméré, and R.E. Reynolds. 2019. Best practices in mitigation paleontology: Proceedings of the San Diego Society of Natural History, No. 47.

Norris, R.M. and R.W. Webb. 1990. Geology of California, 2nd Edition: John Wiley and Sons, Inc. New York. Pp. 277-299.

Prothero, D.R. 2017. California's Amazing Geology: CRC Press. Boca Raton. Pp. 295-319.

Radford, D. 2019. Paleontological Records Search Results for the Enchanted Hills Park Project in the City of Perris, Riverside County, California. Western Science Center. Dated December 12, 2019.

Riverside County. 2015. Riverside County General Plan, available at: https://planning.rctlma.org/General-Plan-Zoning/General-Plan

Sylvester, A.G., and E. O'Black Gans. 2016. Roadside Geology of Southern California. Mountain Press Publishing Company. Missoula. Pp. 153-199.

Woodford, A.O., J.S. Shelton, D.O. Doehring, and R.K. Morton. 1971. Pliocene-Pleistocene history of the Perris Block, Southern California. Geological Society of America Bulletin, v. 82, 3421-3448 p.

Yerkes, R.F., T.H. McCulloh, J.E. Schoellhamer, and J.G. Vedder. 1965. Geology of the Los Angeles Basin, California: An Introduction: Professional Paper.

APPENDIX A

Museum Paleontological Record Search Results

Natural History Museum
of Los Angeles County
900 Exposition Boulevard
Los Angeles, CA 90007

tel 213.763.DINO
www.nhm.org

Vertebrate Paleontology Section
Telephone: (213) 763-3325

e-mail: smcleod@nhm.org

13 December 2019

Paleo Solutions, Inc.
911 South Primrose Avenue, Unit N
Monrovia, CA 91016

Attn: Barbara Webster, GIS Specialist & Archaeologist

re: Paleontological resources for the proposed Enchanted Hills Park Project, in the City of Perris, Riverside County, project area

Dear Barbara:

I have conducted a thorough search of our paleontology collection records for the locality and specimen data for the proposed Enchanted Hills Park Project, in the City of Perris, Riverside County, project area as outlined on the portion of the Steele Peak USGS topographic quadrangle map that you sent to me via e-mail on 9 December 2019. We do not have any fossil localities that lie directly within the proposed project area boundaries, nor do we have any fossil localities from the types of rocks that occur in the proposed project area.

Geologic mapping shows that the entire proposed project area has bedrock composed of plutonic igneous rocks that will not contain recognizable fossils. We have no vertebrate fossil localities from these types of rocks. Because the entire proposed project area has exposures and bedrock composed exclusively of igneous rocks, any excavations in the proposed project area will not encounter any recognizable fossils. No paleontological mitigation measures, therefore, are warranted or recommended.

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

enclosure: invoice

WESTERN SCIENCE CENTER

December 12, 2019

Paleo Solutions
Barbara Webster, MS
911 S. Primrose Ave., Unit N
Monrovia, CA 91016

Dear Ms. Webster,

This letter presents the results of a record search conducted for the Enchanted Hills Park Project in the city of Perris, Riverside County, California. The project site is located north of Weston Road, south of West Metz Road and east of Carter Drive, in Section 25, Township 4 South, and Range 4 West on the Steele Peak USGS 7.5 minute quadrangle.

The geologic units underlying the project area are mapped entirely as Val Verde tonalite deposits dating from the Cretaceous period (Morton, 1996). Tonalite units are considered to be of low paleontological value, and the Western Science Center does not have localities within the project area or within a 1 mile radius.

Should excavation activity associated with the development of the project area extend beyond the current project area into nearby alluvial units, paleontological resources would be possible. However, under current project parameters, and with the geologic units described, it would be unlikely for fossil material to be preserved.

If you have any questions, or would like further information, please feel free to contact me at dradford@westerncentermuseum.org

Sincerely,

Darla Radford
Collections Manager

2345 Searl Parkway ♦ Hemet, CA 92543 ♦ phone 951.791.0033 ♦ fax 951.791.0032 ♦ WesternScienceCenter.org