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**RE: Supplemental Paleontological Resource Study of Off-site Improvement Areas #2 for the Menifee Valley Specific Plan Project, City of Menifee, Riverside County, California**

Dear Shaun Bowen:

At the request of Brookfield Properties, PaleoWest LLC (PaleoWest) conducted a supplemental paleontological resources study in support of the proposed Menifee Valley Specific Plan Project (Project) in the city of Menifee, Riverside County, California. The Project involves the development of a mixed-use, master-planned community consisting of residential development along with commercial and business parks, public facilities, and open space recreation. Previous paleontological resource assessments of the 590.3-acre Project site were completed by Applied EarthWorks (Æ) (2019) and PaleoWest (DeBusk 2022a). The subsequent addition of off-site improvement areas along Pinacate Road, Briggs Road, Matthews Road (Case Road), and Menifee Road (referred to herein as "Off-site Improvement Areas #1") prompted PaleoWest to complete a supplemental paleontological assessment for the proposed Project (DuBusk 2022b).

PaleoWest now understands that additional off-site improvement areas have been added to the proposed Project along Matthews Road (Case Road), McCall Boulevard, and east of McLaughlin Road. The newly added areas are herein referred to as "Off-site Improvement Areas #2" (Attachment A, Figure 1). Proposed disturbances that may take place in the Off-site Improvement Areas #2 include updates to overhead and underground utility infrastructure, additional road signage, traffic rerouting, road resurfacing and expansion, improved walkways, and road lighting; the depth of disturbance associated with these activities is currently undefined.

Because the newly added off-site improvement areas were not analyzed in the previous paleontological assessment, Brookfield Properties requested that PaleoWest conduct a supplemental study of the Off-site Improvement Area #2 for compliance with the California Environmental Quality Act (CEQA). The City of Menifee is the CEQA Lead Agency for the proposed Project. This supplemental paleontological resources study consisted of a review of geological maps and existing record search data to assess the potential impacts of the proposed additional off-site improvements on paleontological resources. Based on the findings of the analysis, mitigation recommendations are provided to reduce Project impacts to paleontological resources to a less than significant level.

This technical memorandum was written in accordance with the guidelines set forth by the Society of Vertebrate Paleontology (SVP) (2010) and draws heavily from the reports prepared by Æ (2019) and DeBusk (2022a, 2022b).

## METHODS

To assess the potential of a particular area to contain significant fossil resources at the subsurface, it is necessary to review published geologic mapping to determine the geology and stratigraphy of the area. Geologic units are considered “sensitive” for paleontological resources if they are known to contain significant fossils anywhere in their extent. Therefore, a review of pertinent local and regional museum repositories for paleontological localities within and nearby the project area is necessary to determine whether fossil localities have been previously discovered within a particular rock unit.

The paleontological resource assessment of the Off-site Improvement Areas #2 included a review of record search data previously obtained for the Project site from the Natural History Museum of Los Angeles County (NHMLAC) by Æ (2019) and the Western Science Center (WSC) by PaleoWest (DeBusk 2022a). Additionally, the results of PaleoWest’s online search of the University of California Museum of Paleontology (UCMP) for the previous assessment of Project site were also examined (DeBusk, 2022a). These record searches encompassed the Project site and vicinity, including the Off-site Improvement Areas #2.

## PALEONTOLOGICAL SENSITIVITY AND SIGNIFICANCE CRITERIA

Paleontological resources are the remains of prehistoric animal and plant life and as such, they are nonrenewable resources. Any adverse impacts to paleontological resources have the potential to be significant under CEQA guidelines and may require mitigation. This assessment follows guidelines and significance criteria specified by the *SVP Standard Procedures for the Assessment and Mitigation of Adverse Impacts to Paleontological Resources* (SVP, 2010).

### DEFINITION OF PALEONTOLOGICAL RESOURCES AND SIGNIFICANCE CRITERIA

Paleontological resources are the evidence of once-living organisms as preserved in the rock record. They include both the fossilized remains of ancient plants and animals and the traces thereof (trackways, imprints, burrows, etc.). In general, fossils are considered to be greater than 5,000 years old (older than Middle Holocene) and are typically preserved in sedimentary rocks. Although rare, fossils can also be preserved in volcanic rocks and low-grade metamorphic rocks formed under certain conditions (SVP, 2010).

Significant paleontological resources are defined as “identifiable” vertebrate fossils, uncommon invertebrate, plant, and trace fossils that provide taphonomic, taxonomic, phylogenetic, paleoecologic, stratigraphic, or biochronological data (SVP, 2010). These data are important because they are used to examine evolutionary relationships, provide insight into the

development of and interaction between biological communities, establish time scales for geologic studies, and for many other scientific purposes (SVP, 2010).

## PROFESSIONAL STANDARDS AND SVP CATEGORIES OF PALEONTOLOGICAL RESOURCE SENSITIVITY

On non-federal lands and in the absence of specific agency guidelines, most professional paleontologists in California adhere to SVP guidelines (2010). These guidelines establish detailed protocols for the assessment of the paleontological resource potential (i.e., “sensitivity”) of a project area and outline measures to follow to mitigate adverse impacts to known or unknown fossil resources during project development. To prevent project delays, SVP highly recommends that the owner or developer retain a qualified professional paleontologist in the advance planning phases of a project to conduct an assessment and to implement paleontological mitigation during construction, as necessary.

Using baseline information gathered during a paleontological resource assessment, the paleontological resource potential of the geologic unit(s) (or members thereof) underlying a project area can be assigned to one of four categories defined by SVP (2010). These categories include high, undetermined, low, and no potential. The criteria for each sensitivity classification and the corresponding mitigation recommendations are summarized in Table 1 below.

**Table 1. Paleontological Sensitivity Categories**

<b>Resource Potential*</b>	<b>Criteria</b>	<b>Mitigation Recommendations</b>
High Potential (sensitivity)	Rock units from which significant vertebrate or significant invertebrate fossils or significant suites of plant fossils have been recovered are considered to have a high potential for containing significant non-renewable fossiliferous resources. These units include but are not limited to, sedimentary formations and some volcanic formations which contain significant nonrenewable paleontological resources anywhere within their geographical extent, and sedimentary rock units temporally or lithologically suitable for the preservation of fossils. Sensitivity comprises both (a) the potential for yielding abundant or significant vertebrate fossils or for yielding a few significant fossils, large or small, vertebrate, invertebrate, or botanical and (b) the importance of recovered evidence for new and significant taxonomic, phylogenetic, ecologic, or stratigraphic data. Areas which contain potentially datable organic remains older than Recent, including deposits associated with nests or middens, and areas which may contain new vertebrate deposits, traces, or trackways are also classified as significant.	Typically, a field survey (dependent on field conditions) as well as onsite construction monitoring will be required. Any significant specimens discovered will need to be prepared, identified, and curated into a museum. A final report documenting the significance of the finds will also be required.
Low Potential (sensitivity)	Sedimentary rock units that are potentially fossiliferous, but have not yielded fossils in the past or contain common and/or widespread invertebrate fossils of well documented and understood taphonomic, phylogenetic species and habitat ecology. Reports in the paleontological literature or field surveys by a	Mitigation is not typically required.

Resource Potential*	Criteria	Mitigation Recommendations
	qualified vertebrate paleontologist may allow determination that some areas or units have low potentials for yielding significant fossils prior to the start of construction. Generally, these units will be poorly represented by specimens in institutional collections and will not require protection or salvage operations. However, as excavation for construction gets underway it is possible that significant and unanticipated paleontological resources might be encountered and require a change of classification from Low to High Potential and, thus, require monitoring and mitigation if the resources are found to be significant.	
Undetermined Potential (sensitivity)	Specific areas underlain by sedimentary rock units for which little information is available are considered to have undetermined fossiliferous potentials. Field surveys by a qualified vertebrate paleontologist to specifically determine the potentials of the rock units are required before programs of impact mitigation for such areas may be developed.	A field survey is required to further assess the unit's paleontological potential.
No Potential	Rock units of metamorphic or igneous origin are commonly classified as having no potential for containing significant paleontological resources.	No mitigation required.

\*Adapted from SVP, 2010.

## GEOLOGIC SETTING

According to published geologic mapping (Morton et al., 2003; Morton and Miller, 2006), the geologic units underlying the Off-site Improvement Areas #2 include Cretaceous (145 million years ago [Ma] to 66 Ma) granodiorite and tonalite bedrock (Kdvg), Mesozoic (252 Ma to 66 Ma) interlayered phyllite and quartzite (Mzi), Pleistocene (2.6 Ma to 11,700 years ago) Very Old Alluvial Fan Deposits (Qvof), and Pleistocene alluvial fan deposits (Qof) (Attachment A, Figure 2). A description of each of these deposits, which have been adapted from Æ (2019), is provided below.

### CRETACEOUS GRANODIORITE TO TONALITE (KDVG)

Cretaceous granodiorite and tonalite bedrock (Kdvg) is exposed in a weathered outcrop along McCall Boulevard just west of Menifee Road in the proposed Off-site Improvement Areas #2 (Attachment A, Figure 2). The composition of the intrusive igneous rock grades from medium-grained biotite–hornblende granodiorite into tonalite with moderately abundant mafic inclusions (Morton and Miller, 2006). The granitic rock belongs to the Domenigoni Valley pluton of the Peninsular Ranges Batholith. Plutonic igneous rocks do not contain fossils due to their high heat of formation deep below the surface of the earth.

## MESOZOIC INTERLAYERED PHYLLITE AND QUARTZITE (MZI)

A small exposure of Mesozoic interlayered, relatively pure quartzite and phyllite (Mzi) is mapped along McCall Boulevard in the proposed Off-site Improvement Areas #2 (Attachment A, Figure 2). Eroded out from prebatholithic rocks, the bedrock is composed of alternating layers of quartzite and phyllite-schist (Morton and Miller, 2006). The layers are thin (>3 centimeters) and are finely grained (Morton and Miller, 2006). This unit is not fossil-bearing.

## VERY OLD ALLUVIAL FAN DEPOSITS (QVOF)

According to the *Geologic Map of the Romoland 7.5-minute Quadrangle* (Morton et al., 2003), Pleistocene very old alluvial fan deposits (Qvof) are mapped at the surface of the Off-site Improvement Areas #2 along McCall Boulevard (Attachment A, Figure 2). The very old alluvial deposits were deposited during the early to middle Pleistocene. They are composed of mostly well-dissected, well-indurated, reddish-brown sand and gravel-sized alluvial fan deposits.

Pleistocene age alluvial, fluvial, and lacustrine deposits, which include Qvof, have proven to yield scientifically significant paleontological resources throughout the inland valleys of southern California. As noted by Æ (2019:13), fossils documented in the area include the following:

Just northeast of the Project area, in the vicinity of Lakeview, a diverse assemblage of fossil resources has been recovered including *Mammuthus* sp. (mammoth), *Smilodon* sp. (sabre-toothed cat), *Equus* sp. (extinct horse), *Bison* sp. cf. *B. antiquus* (bison), and numerous small mammals, reptiles, invertebrates, and plant remains (Springer et al., 2009). Southeast of the Project area, the largest known open-environment non-asphaltic late Pleistocene fossil assemblage has been documented in Diamond and Domenigoni valleys. Discovered during excavations of the Diamond Valley Lake, this locality has yielded nearly 100,000 identifiable fossils representing over 105 vertebrate, invertebrate, and plant taxa. The vertebrate taxa recovered includes reptiles such as frogs, turtles, and lizards; birds such as robins, swallows, jays, ravens, hawks, and ducks; small mammals such as rabbit, squirrel, mice, and weasels; and large mammals such as fox, bear, coyote, deer, bison, mammoths, mastodons, and ground sloths (Springer et al., 2009). The invertebrate taxa recovered includes ostracodes, snails, termites, slugs, beetles, and bivalves and the plant taxa recovered includes well preserved diatoms, pollen, and wood debris (Anderson et al., 2002). Northwest of the Project area near Lake Mathews, *Ustatochoerus* cf. *californicus* (ground dwelling herbivore) and fossilized camel remains were recovered within late Cenozoic fluvial and alluvial deposits (Woodford et al., 1971).

## OLD ALLUVIAL FAN DEPOSITS (QOF)

The Off-site Improvement Areas #2 along Case Road, east of McLaughlin Road, and at the western and eastern extent of McCall Boulevard, are all immediately underlain by middle to late Pleistocene old alluvial fan deposits (Attachment A, Figure 2). The old alluvial fan deposits (Qof) overlie the granodiorite to tonalite bedrock as a disconformity at an unknown but likely relatively shallow depth (Æ, 2019). The surficial sediments are composed of tan to reddish-

brown sandstone and siltstone that was deposited in alluvial fan and local channel environments during the Pleistocene. Pleistocene age alluvial, fluvial, and lacustrine deposits have proven to yield scientifically significant paleontological resources throughout southern California (see discussion above and in *Æ*, 2019).

## ARTIFICIAL FILL

No artificial fill is mapped within the Off-site Improvement Areas #2 by Morton et al. (2003). However, it is likely that native sediments (Kdvg, Mzi, Kvof, and Qof) are covered by artificial fill in at least some portions of the proposed off-site improvement areas along existing roads; the depth of the artificial fill in these areas is not known. Although artificial fill has the potential to contain intact fossil material, any such fossil would be removed from its original geographic and stratigraphic context (i.e., provenance); therefore, any fossils from artificial fill are typically regarded as nonsignificant.

## REVIEW OF EXISTING RECORD SEARCH DATA

The record search results from the NHMLAC and WSC indicate that there are no known fossil localities in the Off-site Improvement Areas #2. However, results of the NHMLAC record search indicate that several miles to the southwest along the western margin of Menifee Valley near the Railroad Canyon Reservoir, locality LACM 5168 has yielded fossil remains of fossil horse from similar Pleistocene alluvium. Additionally, another vertebrate fossil locality, LACM 6059, was identified in the vicinity of Lake Elsinore that yielded a specimen of fossil camel from similar Pleistocene alluvial deposits. Results of the WSC record search indicate that there have been numerous fossil localities within old alluvial sediments like those found in the Off-site Improvement Areas #2; some of these localities are associated with the Diamond Valley Lake Project located a little over a mile to the southeast (see discussion above and *Æ* 2019 and DeBusk 2022a). Finally, an online search of the UCMP database found numerous Pleistocene-age vertebrate fossil localities have been recorded in Riverside County, several of which derived from unnamed Pleistocene-age deposits.

## FINDINGS AND DISCUSSION

Based on the geological map review and museum records search results, the Off-site Improvement Areas #2 is underlain by geologic units that have low to high paleontological sensitivity in accordance with criteria set forth by SVP (2010) (see DeBusk [2022a] for full discussion of sensitivity). The old alluvial fan deposits (Qof) and the very old fan deposits (Qvof) have a high potential for paleontological resources because similar deposits in the vicinity of the Project and throughout Riverside County have proven to yield significant vertebrate fossils. The upper extent of these deposits (2–4 feet [ft] below ground surface [bgs]) has been disturbed by previous road construction and maintenance. Therefore, the old alluvial fan deposits (Qof) and very old alluvial fan deposits (Qvof) in the Off-site Improvement Areas #2 have a low to high paleontological resource potential, dependent on depth. The Cretaceous granodiorite and tonalite (Kdvg) and the Mesozoic interlayered quartzite and phyllite (Mzi) have no paleontological resource potential because of the high heat and pressure formation processes associated with these rocks.



Given the paleontological sensitivity of the Off-site Improvement Areas #2, PaleoWest recommends that the mitigation measures proposed for the Project site by Æ (2019) be applied to the Off-site Improvement Areas #2. However, the measures should be updated to include the Qvof unit, which was not considered in the previous assessments of the Project site (Æ, 2019; DeBusk, 2022a) or the Off-site Improvement Areas #1 (DeBusk, 2022b). Through the implementation of these measures, adverse impacts to paleontological resources can be reduced to a less-than-significant level per CEQA. The paleontological sensitivity of the geologic units and recommended mitigation is summarized below in Table 2. The full text of the mitigation is provided in the next section.

**Table 2. Geologic Units in the Project Area and their Paleontological Sensitivity and Recommended Mitigation**

<b>Geologic Unit*</b>	<b>Map Abbreviation</b>	<b>Age</b>	<b>Typical Fossils**</b>	<b>Paleontological Sensitivity***</b>	<b>Recommended Mitigation***</b>
Old alluvial fan deposits	Qof	Middle to Late Pleistocene	Previously worked at the surface, but Pleistocene vertebrate may be present in undisturbed deposits.	Low at the surface, high at 4 ft bgs.	Monitoring required below 4 feet bgs in previously undisturbed deposits.
Very old alluvial fan deposits	Qvof	Late Pleistocene to Middle Pleistocene			
Interlayered phyllite and quartzite	Mzi	Mesozoic	No potential for fossils.	No paleontological sensitivity.	None
Granodiorite to tonalite	Kdvg	Cretaceous			

Morton and Miller (2003)\*

DeBusk (2022a)\*\*

Applied Earthworks (2019)\*\*\*

## MANAGEMENT RECOMMENDATIONS

The mitigation measures initially proposed for the Project site by Æ (2019), have been updated and modified for the Off-site Improvement Areas #2. The full text of the updated mitigation measures is provided below.

### Worker’s Environmental Awareness Training

Prior to the start of construction, all field personnel should be briefed regarding the types of fossils that could be found in the Project area and the procedures to follow should paleontological resources be encountered. This training should be accomplished at the pre-grade kick-off meeting or morning tailboard meeting and should be conducted by the project paleontologist or their representative. Specifically, the training should provide a description of the fossil resources that may be encountered in the Project area, an outline of steps to follow if a fossil discovery is made, and contact information for the project paleontologist and on-site monitors. The training should be developed by the project paleontologist and may be conducted concurrently with other environmental training (e.g., cultural and natural resources awareness training, safety training, etc.).

## Paleontological Mitigation Monitoring

Prior to the commencement of ground-disturbing activities, a qualified professional paleontologist will be retained to prepare and implement a Paleontological Resource Impact Mitigation Program (PRIMP) for the Project. Initially, full-time monitoring is recommended for grading and excavation activities 4 ft bgs that will disturb previously undisturbed Pleistocene very old alluvium (Qvof) and old alluvium (Qof) according to criteria set forth by SVP (2010). Because of soil development and previous agricultural disturbances, monitoring will not be required in Project areas where construction activities disturb native sediments at depths less than 4 ft bgs. (Depth of disturbance for the offsite improvement areas #2 is currently undefined).

Monitoring will not be required in the Project areas underlain by geologic units with no paleontological resource potential (i.e., the granodiorite to tonalite, Kdvg, and interlayered quartzite, Mzi).

Monitoring will entail the visual inspection of excavated or graded areas and trench sidewalls. If a paleontological resource is discovered, the monitor will have the authority to temporarily divert the construction equipment around the find until it is assessed for scientific significance and collected. In areas of high sensitivity, monitoring efforts can be reduced or eliminated at the discretion of the project paleontologist if no fossil resources are encountered after 50 percent of the excavations are completed.

## Fossil Preparation, Curation, and Reporting

Upon completion of fieldwork, all significant fossils collected will be prepared in a properly equipped paleontology laboratory to a point ready for curation. Preparation will include the careful removal of the excess matrix from fossil materials and stabilizing and repairing specimens as necessary. Following laboratory work, all fossil specimens will be identified to the lowest taxonomic level, cataloged, analyzed, and delivered to the WSC for permanent curation and storage. The cost of curation is assessed by the repository and is the responsibility of the Project owner.

At the conclusion of laboratory work and museum curation, a final report will be prepared describing the results of the paleontological mitigation monitoring efforts associated with the Project. The report will include a summary of the field and laboratory methods, an overview of the Project area geology and paleontology, a list of taxa recovered (if any), an analysis of fossils recovered (if any) and their scientific significance, and recommendations. If the monitoring efforts produced fossils, then a copy of the report will also be submitted to the WSC.

It has been a pleasure working with you on this Project. If you have any questions, please do not hesitate to contact me at [jdebusk@paleowest.com](mailto:jdebusk@paleowest.com).

Sincerely,  
PALEOWEST



Jessica DeBusk, M.B.A., Regional Principal



Michaela Adler, Associate Paleontologist



## REFERENCES

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# Attachment A. Map Figures

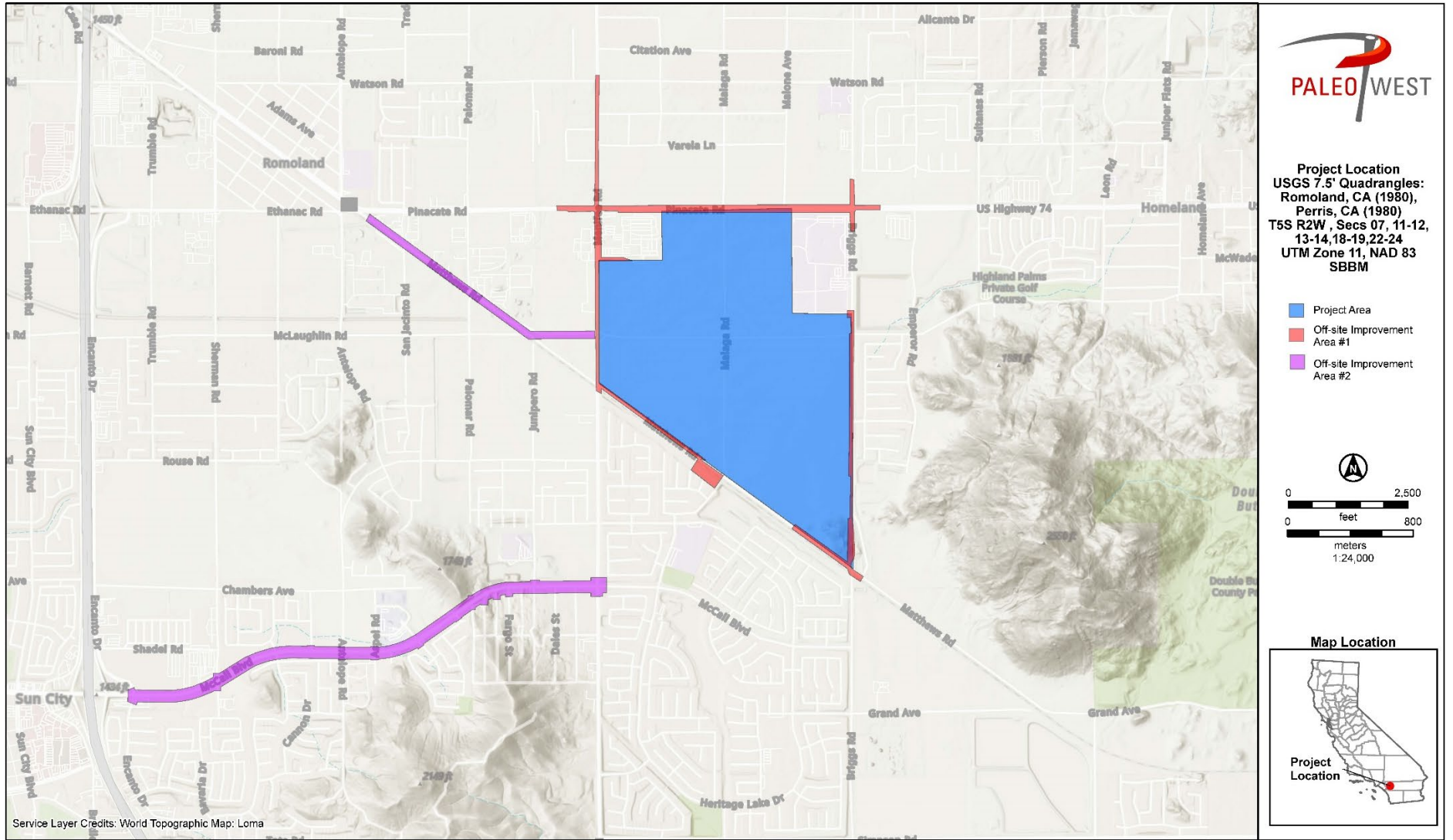


Figure 1. Project Area and Off-site Improvements Map



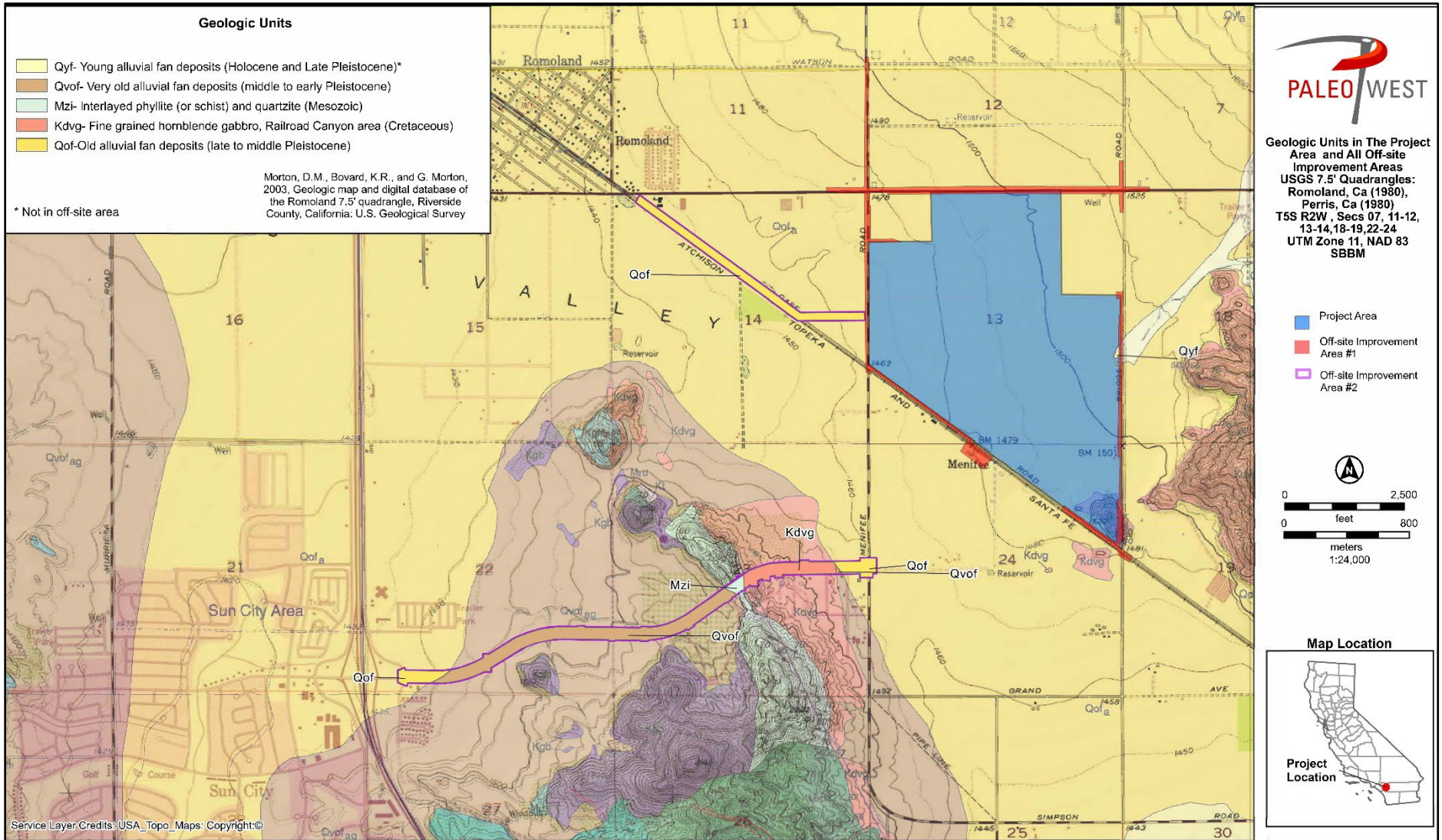


Figure 2. Geologic Units in the Project Area and Off-Site Improvement Areas