Appendix G-b Paleontological Existing Conditions Technical Report

Appendices

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PALEONTOLOGICAL RESOURCES TECHNICAL REPORT FOR THE CITY OF SANTA ANA GENERAL PLAN UPDATE, ORANGE COUNTY, CALIFORNIA

APRIL 2020

PREPARED FOR

PlaceWorks

PREPARED BY

SWCA Environmental Consultants

PALEONTOLOGICAL RESOURCES TECHNICAL REPORT FOR THE CITY OF SANTA ANA GENERAL PLAN UPDATE, ORANGE COUNTY, CALIFORNIA

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ABSTRACT/EXECUTIVE SUMMARY

Purpose and Scope: In support of the forthcoming City of Santa Ana General Plan update, Placeworks retained SWCA Environmental Consultants (SWCA) to summarize the existing conditions of paleontological resources within the General Plan Area. The study area corresponds with the approximately 17,472 acres (27.3 square miles [70.7 km^2]) city limits. Methods include a records search from the Natural History Museum of Los Angeles County (LACM) as well as a search of the online records of the San Diego Natural History Museum and the University of California Museum of Paleontology, and a review of geologic mapping and the scientific literature.

Dates of Investigation: The records search results were received from the LACM on March 4, 2019. Online museum records were searched on March 6, 2019. The first draft of this report was authored in March 2019, and updated as the final draft in May 2020.

Summary of Findings: The review of online museum records indicates thousands of fossil specimens have been collected from geologic formations within and in the vicinity of the City of Santa Ana. A review of the scientific literature provided context for these and other fossil discoveries. Geologic mapping shows the surficial geology of the City consists of alluvial deposits that range in age from the Holocene to early Pleistocene, with older geologic units likely present in the subsurface. Analysis of these data allowed the assignment of both Society of Vertebrate Paleontology sensitivity rankings to the geologic units present in Santa Ana. Paleontological sensitivity varies across the study area, with younger sedimentary units having low sensitivity at the surface and sensitivity increasing with the age of the sediments. Growth and development will inevitably lead to impacts on paleontological resources, but with the implementation of planning and mitigation measures, impacts to paleontological resources can be reduced to less than significant.

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1 INTRODUCTION

PlaceWorks retained SWCA Environmental Consultants (SWCA) to provide paleontological resources services in support of the City of Santa Ana General Plan Update (project) for the City of Santa Ana in Orange County, California (the City). SWCA performed a desktop analysis to assess paleontological conditions throughout the project area and reviewed relevant technical documents and agency-maintained databases on paleontological resources. The desktop research is summarized in this paleontological resources technical report (PRTR) that documents reported paleontological resources within the project area and assesses paleontological sensitivity across the City. This interim technical update to the General Plan, last updated in 1982, will ensure that all technical data and policies remain current, and will guide decisions carried out by the City. The General Plan addresses an area encompassing the 27.3 square miles (70.7 km^2) of the city.

SWCA relied upon three main sources of data to conduct this paleontological assessment: 1) geologic mapping, 2) scientific literature, and 3) museum records from the Natural History Museum of Los Angeles County (LACM), University of California Museum of Paleontology (UCMP), and the San Diego Natural History Museum (SDNHM). Data from these sources were used to assign paleontological sensitivity rankings following the guidelines of the Society of Vertebrate Paleontology (SVP 1995, 2010).

1.1 Project Description

The proposed project is a comprehensive update to the City of Santa Ana's General Plan (1982). The City's General Plan was last updated in 1982, with some updates to the City's Land Use Element, Circulation Element, Urban Design Element, and Economic Development in 1998. In March of 2014, the City Council adopted the Santa Ana Strategic Plan, identifying the need for a comprehensive update to the City's Existing General Plan. The General Plan is the City's principal policy and planning document guiding the development, conservation, and enhancement of Santa Ana. It contains a comprehensive collection of goals and policies related to the physical development of the City, and the General Plan Update is intended to result in a total of 11 elements to guide the physical development, quality of life, economic health, and sustainability of the Santa Ana community.

The City identified five areas suited for new growth and development: South Main Street, Grand Avenue/17th Street, West Santa Ana Boulevard, 55 Freeway/Dyer Road, and South Bristol Street. These five areas are located along major travel corridors, the future OC Streetcar line, and/or linked to the Downtown. In general, many areas currently designated for General Commercial and Professional Office are expanding opportunities for residential development through a proposed change to the Urban Neighborhood or District Center General Plan land use designations. Industrial Flex would be introduced where Industrial land use designations currently exist within each of the five focus areas in order to allow for cleaner industrial and commercial uses with live-work opportunities.

1.2 Project Location

The City of Santa Ana is located in the southwest portion of California, bordered by Anaheim to the north, Garden Grove to the west, Huntington Beach and Newport Beach to the southwest, and Irvine to the southeast (Figure 1). As shown in Table 1, the City is plotted in numerous Townships, Ranges, and Sections, as depicted on the U.S. Geological Survey (USGS) Anaheim, Orange, Newport Beach, and Tustin 7.5 minute quadrangles (Figure 2). Encompassing approximately 27.3 square miles (70.7 km^2), Santa Ana is the County Seat and second largest city in Orange County, and eleventh largest in California. The Santa Ana River runs northeast-southwest through the western side of the city. Interstate 5 (I-5), a major north-south route through California, passes through the northern portion of Santa Ana.

Figure 1. Project Vicinity.

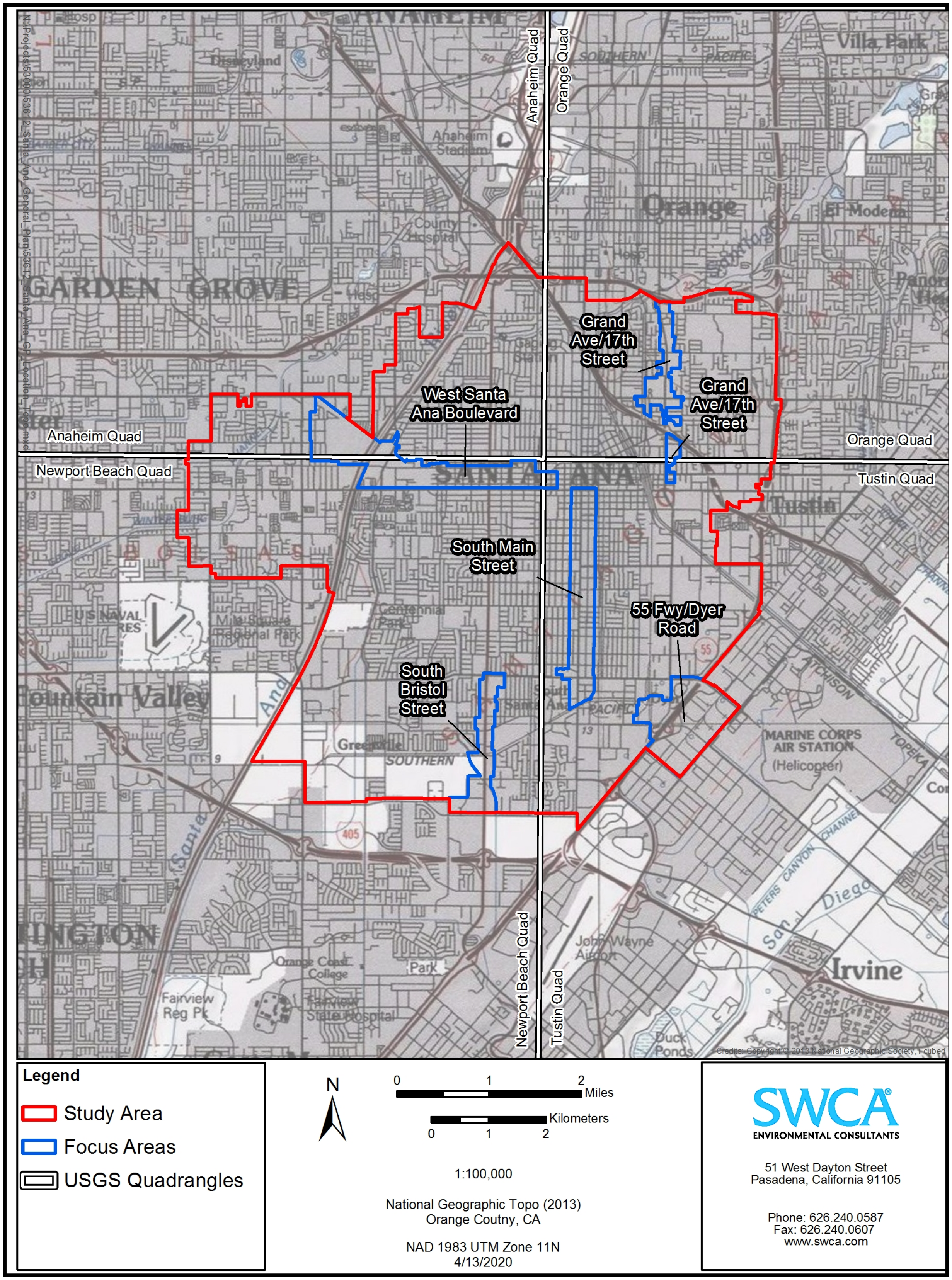

Figure 2. Project Location.

Another major interstate, Interstate 405 (I-405), is located just south of the City's limits and serves as a major north-south connector between Greater Los Angeles, Orange County, and San Diego County. Within the City, five focus areas are present: South Main Street, located in the central portion of the city along Main Street; Grand Avenue/17th Street, located in the northeastern corner of the city; West Santa Ana Boulevard, located along the Santa Ana Boulevard in the northern half of the city; 55 Freeway / Dyer Road, located in the southeastern corner of the city; and South Bristol Street, located in the southern-most part of the city along Bristol Street.

1.3 Definition and Significance of Paleontological Resources

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 un-mineralized bones and teeth, soft tissues, shells, wood, leaf impressions, footprints, burrows, and microscopic remains. Paleontological resources include not only the fossils themselves, but also the physical characteristics of the fossils' associated sedimentary matrix.

The fossil record is the only evidence that indicates life on earth has existed for more than 3.6 billion years. Fossils are considered nonrenewable resources because the organisms they represent no longer exist. Thus, once destroyed, a fossil can never be replaced (Murphey and Daitch 2007). Fossils are important scientific and educational resources and can be used to:

- study the phylogenetic relationships among 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, which forms the basis for biochronology and biostratigraphy, and 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 (Murphey and Daitch 2007).

2 REGULATORY SETTING

Paleontological resources are limited, nonrenewable resources of scientific, cultural, and educational value, and are afforded protection under federal and state laws and regulations. This study satisfies project requirements in accordance with both federal and state regulations. This analysis also complies with guidelines and significance criteria specified by the SVP (1995, 2010).

2.1 State Regulations

2.1.1 California Environmental Quality Act (CEQA)

CEQA is the principal statute governing environmental review of projects occurring in the state and is codified at Public Resources Code (PRC) Section 21000 et seq. CEQA requires lead agencies to determine if a proposed project would have a significant effect on the environment, including significant effects on paleontological resources. Guidelines for the implementation of CEQA, as amended March 29, 1999 (Title 14, Chapter 3, California Code of Regulations 15000 et seq.), define procedures, types of activities, persons, and public agencies required to comply with CEQA, and include as one of the questions to be answered in the Environmental Checklist (Section 15023, Appendix G, Section XIV, Part a) the following: "Will the proposed project directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?"

2.1.2 Public Resources Code (PRC) Section 5097.5

Requirements for paleontological resource management are included in the PRC Division 5, Chapter 1.7, Section 5097.5, and Division 20, Chapter 3, Section 30244, which states:

> No person shall knowingly and willfully excavate upon, or remove, destroy, injure or deface any historic or prehistoric ruins, burial grounds, archaeological or vertebrate paleontological site, including fossilized footprints, inscriptions made by human agency, or any other archaeological, paleontological or historical feature, situated on public lands, except with the express permission of the public agency having jurisdiction over such lands. Violation of this section is a misdemeanor.

These statutes prohibit the removal, without permission, of any paleontological site or feature from lands under the jurisdiction of the state or any city, county, district, authority, or public corporation, or any agency thereof. As a result, local agencies are required to comply with PRC 5097.5 for their own activities, including construction and maintenance, as well as for permit actions (e.g., encroachment permits) undertaken by others. PRC Section 5097.5 also establishes the removal of paleontological resources as a misdemeanor, and requires reasonable mitigation of adverse impacts to paleontological resources from developments on public (state, county, city, and district) lands.

2.2 Resource Assessment Guidelines

The loss of any identifiable fossil that could yield information important to prehistory, or that embodies the distinctive characteristics of a type of organism, environment, period of time, or geographic region, would be a significant environmental impact. Direct impacts on paleontological resources primarily concern the potential destruction of nonrenewable paleontological resources and the loss of information associated with these resources. This includes the unauthorized collection of fossil remains. If potentially fossiliferous bedrock or surficial sediments are disturbed, the disturbance could result in the destruction of paleontological resources and subsequent loss of information (a significant impact). At the project-specific level, direct impacts can be reduced to a less than significant level through the implementation of paleontological mitigation.

The CEQA threshold of significance for an impact to paleontological resources is reached when a project is determined to "directly or indirectly destroy a significant paleontological resource or unique geologic feature" (Appendix G, State CEQA Guidelines). In general, for project areas underlain by paleontologically sensitive geologic units, the greater the amount of ground disturbance, the higher the potential for significant impacts to paleontological resources. For project areas that are directly underlain by geologic units with no paleontological sensitivity, there is no potential for impacts on paleontological resources unless sensitive geologic units that underlie the non-sensitive unit are also affected.

Numerous paleontological studies have developed criteria for the assessment of significance for fossil discoveries (e.g., Eisentraut and Cooper 2002; Murphey and Daitch 2007; Scott and Springer 2003). In general, these studies assess fossils as significant if one or more of the following criteria apply:

1. The fossils provide information on the evolutionary relationships and developmental trends 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 interaction between paleobotanical and paleozoological biotas;
4. The fossils demonstrate unusual or spectacular circumstances in the history of life; 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.

2.2.1 Professional Standards

The SVP (1995, 2010) has established standard guidelines that outline professional protocols and practices for conducting paleontological resource assessments and surveys, monitoring and mitigation, data and fossil recovery, sampling procedures, and specimen preparation, identification, analysis, and curation. Most practicing professional vertebrate paleontologists adhere closely to the SVP's assessment, mitigation, and monitoring requirements as specifically provided in its standard guidelines. Most state regulatory agencies with paleontological laws, ordinances, regulations, and standards accept and use the professional standards set forth by the SVP to meet the requirements of CEQA.

As defined by the SVP (2010:11), significant paleontological resources are:

> …fossils and fossiliferous deposits, here defined as consisting of identifiable vertebrate fossils, large or small, uncommon invertebrate, plant, and trace fossils, and other data that provide taphonomic, taxonomic, phylogenetic, paleoecologic, stratigraphic, and/or biochronologic information. Paleontological resources are considered to be older than recorded human history and/or older than middle Holocene (i.e., older than about 5,000 radiocarbon years).

A geologic unit known to contain significant fossils is considered sensitive to adverse impacts if there is a high probability that earth-moving or ground-disturbing activities in that rock unit will either disturb or destroy fossil remains directly or indirectly. This definition of sensitivity differs fundamentally from the definition for archaeological resources as follows:

> It is extremely important to distinguish between archaeological and paleontological resources when discussing the paleontological potential of rock units. The boundaries of an archaeological resource site define the areal/geographic extent of an archaeological resource, which is generally independent from the rock unit on which it sits. However, paleontological sites indicate that the containing rock unit or formation is fossiliferous. Therefore, the limits of the entire rock unit, both areal and stratigraphic, define the extent of paleontological potential (SVP 2010).

Many archaeological sites contain features that are visually detectable on the surface. In contrast, fossils are often contained within surficial sediments or bedrock, and are therefore not observable or detectable unless exposed by erosion or human activity.

In summary, paleontologists cannot know either the quality or quantity of fossils prior to natural erosion or human-caused exposure. As a result, even in the absence of fossils on the surface, it is necessary to assess the sensitivity of rock units based on their known potential to produce significant fossils elsewhere within the same geologic unit (both within and outside the study area), a similar geologic unit, or based on whether the unit in question was deposited in a type of environment that is known to be favorable for fossil preservation. Monitoring by experienced paleontologists greatly increases the probability that fossils will be discovered during ground-disturbing activities and that, if these remains are significant, successful mitigation and salvage efforts may be undertaken in order to prevent adverse impacts to these resources.

2.2.1.1 SVP SENSITIVITY RANKINGS

Paleontological sensitivity is defined as the potential for a geologic unit to produce scientifically significant fossils. This is determined by rock type, past history of the geologic unit in producing significant fossils, and fossil localities recorded from that unit. Paleontological sensitivity is derived from the known fossil data collected from the entire geologic unit, not just from a specific survey. In its *Standard Procedures for the Assessment and Mitigation of Adverse Impacts to Paleontological Resources*, the SVP (2010:1–2) defines four categories of paleontological sensitivity (potential) for rock units: high, low, undetermined, and no potential:

> **High Potential.** Rock units from which vertebrate or significant invertebrate, plant, or trace fossils have been recovered are considered to have a high potential for containing additional significant paleontological resources. Rock units classified as having high potential for producing paleontological resources include, but are not limited to, sedimentary formations and some volcaniclastic formations (e.g., ashes or tephras), and some low-grade metamorphic rocks which contain significant paleontological resources anywhere within their geographical extent, and sedimentary rock units temporally or lithologically suitable for the preservation of fossils (e.g., middle Holocene and older, fine-grained fluvial sandstones, argillaceous and carbonate-rich paleosols, cross-bedded point bar sandstones, fine-grained marine sandstones, etc.). Paleontological potential consists of both a) the potential for yielding abundant or significant vertebrate fossils or for yielding a few significant fossils, large or small, vertebrate, invertebrate, plant, or trace fossils and b) the importance of recovered evidence for new and significant taxonomic, phylogenetic, paleoecologic, taphonomic, biochronologic, or stratigraphic data. Rock units which contain potentially datable organic remains older than late Holocene, including deposits associated with animal nests or middens, and rock units which may contain new vertebrate deposits, traces, or trackways are also classified as having high potential.
>
> **Low Potential.** Reports in the paleontological literature or field surveys by a qualified professional paleontologist may allow determination that some rock units have low potential for yielding significant fossils. Such rock units will be poorly represented by fossil specimens in institutional collections, or based on general scientific consensus, only preserve fossils in rare circumstances and the presence of fossils is the exception not the rule, e.g. basalt flows or Recent colluvium. Rock units with low potential typically will not require impact mitigation measures to protect fossils.
>
> **Undetermined Potential.** Rock units for which little information is available concerning their paleontological content, geologic age, and depositional environment are considered to have

undetermined potential. Further study is necessary to determine if these rock units have high or low potential to contain significant paleontological resources. A field survey by a qualified professional paleontologist to specifically determine the paleontological resource potential of these rock units is required before a paleontological resource impact mitigation program can be developed. In cases where no subsurface data are available, paleontological potential can sometimes be determined by strategically located excavations into subsurface stratigraphy.

No Potential. Some rock units have no potential to contain significant paleontological resources, for instance high-grade metamorphic rocks (such as gneisses and schists) and plutonic igneous rocks (such as granites and diorites). Rock units with no potential require no protection or impact mitigation measures relative to paleontological resources.

3 GEOLOGIC SETTING

The City of Santa Ana is located in the northwestern Peninsular Ranges Geomorphic Province, one of the largest geologic regions in western North America (Norris and Webb 1990). The Peninsular Ranges extend from the Mexican border in the south to the Transverse Ranges in the north and northeast and are bordered by the Pacific Ocean on the west and the Colorado Desert on the east. The Peninsular Ranges are a series of northwest trending mountain ranges extending approximately 149 miles (240 km) to the Mexican border, where they then continue for an additional 746 miles (1,200 km) along the Baja Peninsula (Harden 2004). The core of the Peninsular Ranges is made up of Mesozoic plutonic rocks and represents the roots of a magmatic arc formed by active subduction along the Pacific Plate boundary (Harden 2004). Two main batholiths form the core of the Peninsular Ranges. The western batholith, where the project area is located, is 140–105 million years old (Ma) and consists of mafic plutonic rocks, while the eastern batholith is 99–92 Ma and is more silica-rich granodiorites and tonalities (Kimbrough et al. 2001). These plutonic rocks intruded into the older rocks of a Paleozoic carbonate platform and early Mesozoic marine sequences, heavily metamorphosing them (Harden 2004). Above these plutonic rocks, around 130–120 Ma, the Santiago Peak Volcanics were deposited as primarily andesitic and silicic flows, and then metamorphosed by the batholith emplacement (Fife et al. 1967). Cretaceous sedimentary rocks deposited as turbidity currents overlie the plutons and volcanic rocks (Kimbrough et al. 2001). These rocks are in turn overlain by more recent sedimentary deposits leading up to the present day. These deposits were marine through the Eocene and then shifted to terrestrial volcanic and sedimentary strata by the Oligocene and lower Miocene (Powell 1993).

Locally, the project area lies within the alluvial valley of the Santa Ana River on the Perris Block. The Perris Block is an area of low topographic relief bounded by the San Jacinto and Elsinore fault zones (Morton and Miller 2006). This region is characterized by widespread alluvial fan deposits originating from the San Gabriel Mountains to the east of the project area and dating to the late Pleistocene.

4 METHODS

This PRTR is based on a desktop review of available scientific literature, geologic maps, a records search from the LACM, and a review of the online collections databases of the UCMP and the SDNHM. The purpose of this report is to assess the paleontological sensitivity of the geologic units found within the City of Santa Ana. The guidelines of the SVP (2010) were used to assign paleontological sensitivity rankings and develop recommended mitigation measures.

4.1 Project Personnel

SWCA Lead Paleontologist Alyssa Bell, Ph.D., conducted the paleontological analysis and authored this report. Geographic Information Systems (GIS) Specialist John Walls produced the figures. SWCA Principal Investigator Paleontologist Russell Shapiro, Ph.D. reviewed this report. SWCA Project Manager Alyssa Newcomb, M.S., RPA provided oversight on this project.

5 RESULTS (EXISTING CONDITIONS)

5.1 Geology and Paleontology in the City of Santa Ana

Geologic mapping by Morton and Miller (2006) indicates the surficial geology of the City of Santa Ana is composed of alluvial sediments that range in age from the Holocene to early Pleistocene. These sediments are subdivided into recognized geologic units on the basis of their age and lithology as follows (as shown on Figure 3):

Young Alluvial Fan Deposits (Qyf). These sediments date from the Holocene to the late Pleistocene (near recent times to 12,600 years ago), and consist of unconsolidated to moderately consolidated silt, sand, and gravel with slightly to moderately dissected surfaces (Morton and Miller 2006). These sediments cover the majority of the city (Figure 3). As relatively recent sediments at the surface, upper layers of this unit are not old enough to preserve fossil resources (5,000 years, as defined by the SVP [2010]). However, these sediments increase in age with depth, such that in the subsurface they may be old enough to preserve fossils similar to those described below for old alluvial fan deposits. Moreover, these units may overlie older sediments with high paleontological sensitivity. The depth at which Holocene sediments are old enough to preserve fossil resources (i.e., more than 5,000 years old) or transitions to old alluvial fan deposits is highly variable and often unknown for any specific area. One study of inland valley fossil deposits in Riverside and San Bernardino Counties identifies this transition as relatively shallow in many areas, with fossil-bearing sediments occurring as little as 5 feet (1.5 m) below the surface (Reynolds and Reynolds 1991).

Young Axial-Channel Deposits (Qya). These sediments also date from the Holocene to the late Pleistocene (near recent times to 126,000 years ago), and consist of clay, silt, and sand deposited along river channels and valleys (Morton and Miller 2006). Like the young alluvial fan deposits described above, these sediments are too young in the surficial layers to preserve fossil resources, but increase in age with depth, such that in the subsurface they may be old enough to preserve fossils similar to those described below for old alluvial fan deposits. These sediments are restricted to outcrops in the southern portion of the city (Figure 3).

Old Alluvial Fan Deposits (Qof). Old alluvial fan deposits are very similar to young alluvial fan deposits in terms of lithology and depositional setting; however, they are much older, dating to the late to middle Pleistocene (roughly 780,000–11,700 years old) (Morton and Miller 2006). As such, these sediments are of an appropriate age to preserve fossil resources. These sediments are only found at the surface in the northeastern-most portion of the city but occur extensively in this area outside the city limits. These sediments are likely present in the subsurface throughout the city at an undetermined depth that may be quite shallow in the northeastern parts of city.

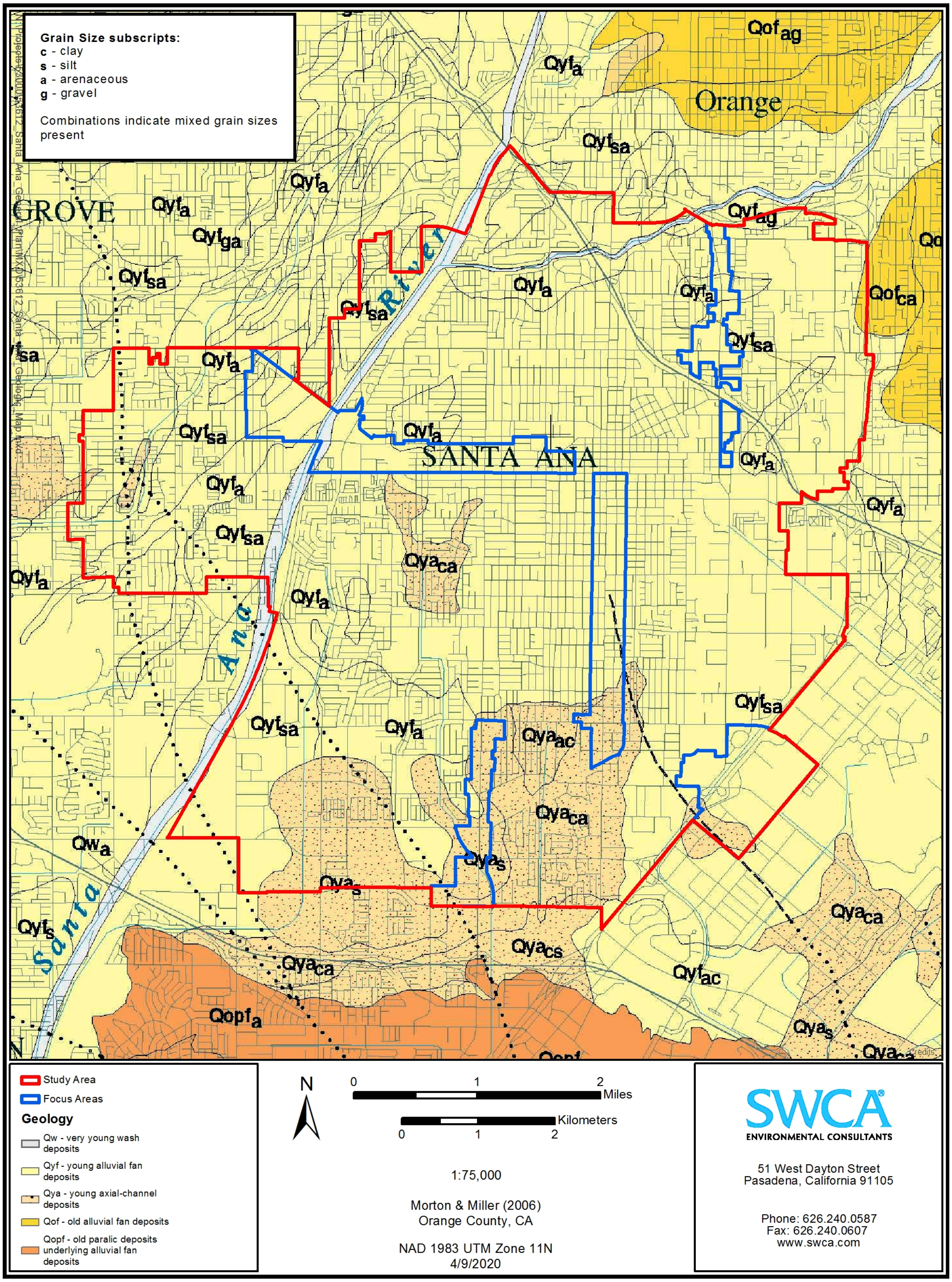

Figure 3. Geologic Map of the Project Area.

Pleistocene sediments have a rich fossil history in southern California (Hudson and Brattstrom 1977; Jefferson 1991a, 1991b; McDonald and Jefferson 2008; Miller 1941, 1971; Roth 1984; Scott 2010; Scott and Cox 2008; Springer et al. 2009). The most common Pleistocene terrestrial mammal fossils include the bones of mammoth, horse, bison, camel, and small mammals, but other taxa, including lion, cheetah, wolf, antelope, peccary, mastodon, capybara, and giant ground sloth, have been reported (Graham and Lundelius 1994), as well as birds, amphibians, and reptiles such as frogs, salamanders, snakes, and turtles (Hudson and Brattstrom 1977). In addition to illuminating the striking differences between Southern California in the Pleistocene and today, this abundant fossil record has been vital in studies of extinction (e.g., Sandom et al., 2014; Scott 2010), ecology (e.g., Connin et al. 1998), and climate change (e.g., Roy et al. 1996).

The LACM has records of 16 fossil localities within a five-mile radius of the city (Table 1). The closest fossil locality from these sediments known to the LACM is approximately 2.5 miles south of the City, where LACM 1339 produced fossil specimens of mammoth (*Mammuthus*) and camel (Camelidae) from sands approximately 15 feet below ground surface (bgs) along Adams Avenue east of the Santa Ana River (McLeod 2019). Also in this area, LACM 4219 produced specimens of sea turtle (*Chelonia*) and camel, LACM 3267 produced a specimen of a fossil elephant (Proboscidea), and LACM 6370 produced a specimen of horse (*Equus*), all from unrecorded depths (McLeod 2019). North of the city, a fossil sheep (*Ovis*) was discovered near the intersection of Lincoln Avenue and South Rio Vista Avenue at LACM 1652, approximately four miles from the project area (McLeod 2019). Just to the east of this locality, along Fletcher Avenue east of the Santa Ana River LACM 4943 produced a specimen of fossil horse at a depth of 8–10 feet bgs (McLeod 2019). Just over five miles to the west of the City, near the intersection of Warner Avenue and Bolsa Chica Street, LACM 65113 produced specimens of mammoth between six and eight feet bgs and specimens of fossil bison (*Bison*) between 14 and 20 feet bgs (McLeod 2019). To the southeast of the City, LACM has records of nine fossil localities around MacArthur Boulevard east of Upper Newport Bay that produced a rich suite of fossil vertebrates detailed by Miller (1971) and included specimens of sea otter (*Enhydra lutris*), pallid bat (*Antrozous pallidus*), shrews (*Notiosorex crawfordi* and *Sorex ornatus*), and pocket gopher (*Thomomys bottae*).

Table 1. LACM Pleistocene-aged Fossil Localities in the Vicinity of the City of Santa Ana

Locality Number	Depth	Specimens
LACM 1339	15 feet bgs	Mammoth, camel
LACM 4219	NA	Sea turtle, camel
LACM 3267	NA	elephant
LACM 6370	NA	horse
LACM 1652	NA	sheep
LACM 4943	8–10 feet bgs	horse
LACM 65113	6–20 feet bgs	Mammoth, bison
LACM multiple (9)	NA	sea otter, pallid bat, shrews, pocket gopher

The online collections databases from the UCMP (2019) and SDNHM (2019) do not provide precise locality information, but indicate that numerous specimens have been recovered from Pleistocene-aged deposits in Orange County (Table 2). The majority of these specimens are invertebrates, with vertebrates such as fish, birds, and mammals also recovered.

Table 2. Pleistocene-aged Fossils from Orange County

Museum	Specimens
UCMP (multiple)	Invertebrate fossils (4,732 specimens); Vertebrate fossils (bird: 2 specimens, fish: 29 specimens, mammals: 7 specimens)
SDNHM (multiple)	Invertebrate fossils (2,432 specimens); Vertebrate fossils (bird: 14 specimens, fish: 24 specimens, mammals: 460 specimens)

5.2 Paleontological Sensitivity Analysis

The results of the desktop analysis presented above were used to assign SVP paleontological sensitivity rankings (SVP 2010) to each geologic unit present in the City of Santa Ana (Table 3, Figure 4).

Low-to-High Sensitivity, increasing with depth. Both young alluvial fan deposits (Qyf) and young axial-channel deposits (Qya) are too young to preserve fossil resources at the surface or in the shallow subsurface (i.e., sediments younger than 5,000 years before present), but may preserve fossils at depth or overlie older units that have high paleontological sensitivity. These units are widespread across the city, making up the majority of the surficial sediments. In assessing the sensitivity and determining mitigation measures for areas mapped as these units, it is important to establish the thickness of these surficial, low-sensitivity sediments (those less than 5,000 years old that have low sensitivity). The museum records search from the LACM notes several fossil localities at depths of as little as 6–10 feet bgs, indicating the transition to high sensitivity sediments can be quite shallow in this area. Geotechnical studies specific to individual projects may also be able to help determine the depth of this change in specific locations within the city.

High Sensitivity. Old alluvial fan deposits are present at the surface in the most northeastern part of the City and are likely present in the subsurface throughout the City. The records of the LACM, UCMP, and SDNHM as well as the review of the scientific literature all indicate Pleistocene-aged sediments have a strong history of fossil preservation in this area, and therefore these sediments are assigned high paleontological sensitivity.

Table 3. Paleontological Sensitivity of Geologic Units in Santa Ana

Geologic Unit	Map Symbol	Age	Occurrence	Focus Areas	SVP Sensitivity
Young alluvial fan deposits	Qyf	Holocene – late Pleistocene	Surface, majority of city	Grand Avenue / 17th Street; 55 Freeway / Dyer Road; South Main Street; South Bristol Street; West Santa Ana Boulevard	Low-to-High, increasing with depth
Young axial-channel deposits	Qya	Holocene – late Pleistocene	Surface, southern part of city	55 Freeway / Dyer Road; South Main Street; South Bristol Street	Low-to-High, increasing with depth
Old alluvial fan deposits	Qof	Late – middle Pleistocene	Surface, northeastern-most city; Subsurface, throughout city	None	High

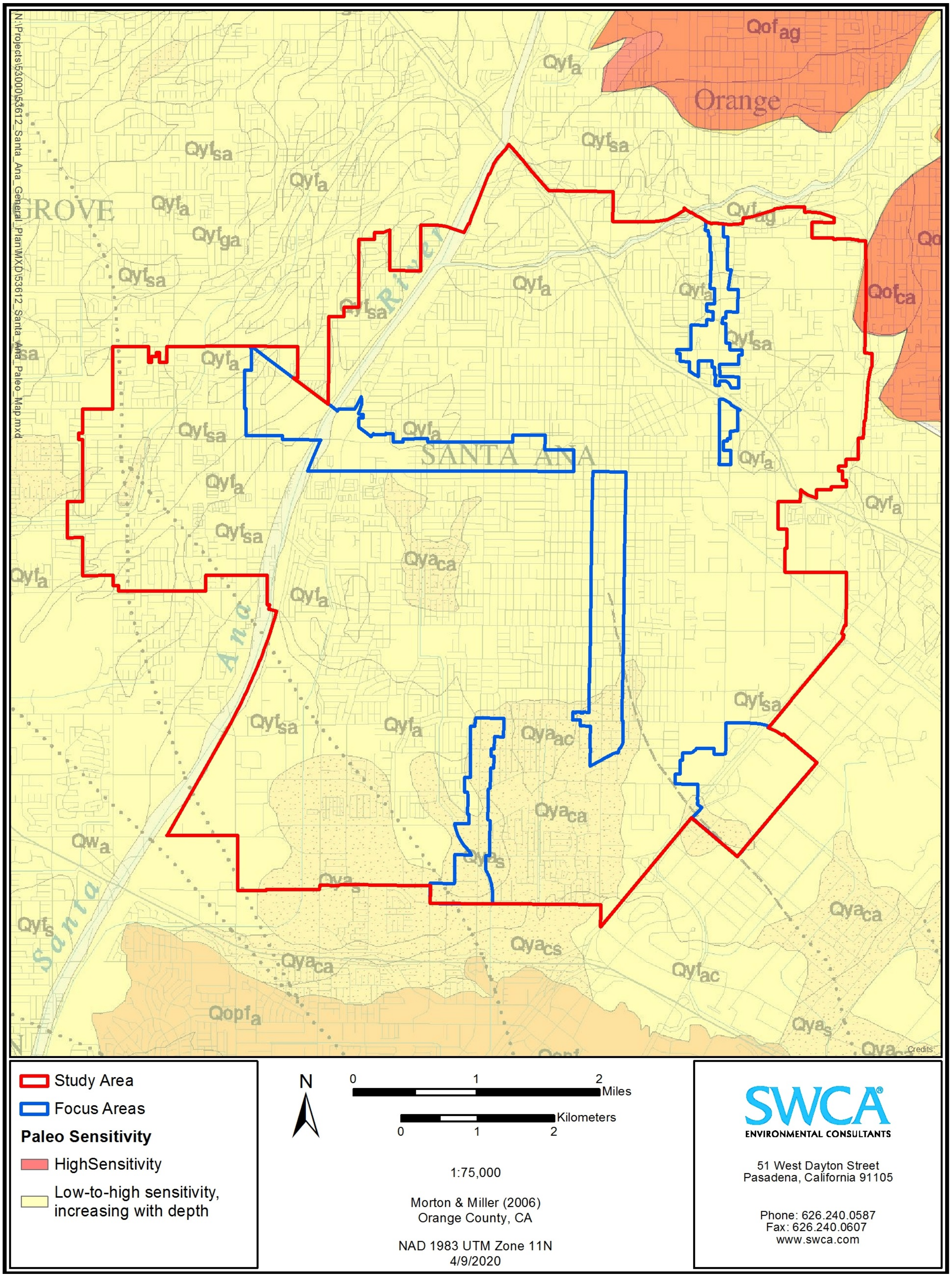

Figure 4. Paleontological Sensitivity of the Project Area.

6 POTENTIAL IMPACTS AND MITIGATION MEASURES

As discussed above, numerous federal and state regulations have been established to protect paleontological resources. If it can be demonstrated that a project will cause damage to a unique paleontological resource, mitigation measures are required (CEQA, Appendix G). Impacts to paleontological resources most commonly occur from damage or destruction during ground-disturbing activities. Fossils are most commonly buried in sediment or rock, and so are often undetectable from surface observations until excavations uncover them. This can result in damage to the fossil if measures are not taken during ground-disturbing activities to identify and protect fossils as they are encountered. The mitigation measures presented in this section are designed to reduce impacts to less than significant.

6.1 Thresholds of Significance

The General Plan provides a framework within which future development projects can be considered. The potential for future proposed projects to result in impacts associated with paleontological resources is based on the CEQA thresholds of significance outlined in Appendix G of the State CEQA Guidelines, which asks the question, "Will the proposed project directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?"

6.1.1 Impacts to Paleontological Resources

The review of the LACM records search, the UCMP and SDNHM online paleontological collections, geologic mapping, and the scientific literature presented here indicate that the General Plan Area contains areas with sediments of high paleontological sensitivity, either at the surface or in the subsurface. Future development or improvements related to changes in land use could potentially affect and cause significant adverse impacts to paleontological resources. The following measures are recommended to assist in the avoidance and mitigation of potential impacts to paleontological resources from future projects in the General Plan Area.

The guidelines of the SVP (1995, 2010) have been used to develop general recommendations for proposed projects in the City of Santa Ana. With the implementation of the following mitigation measures, construction projects in Santa Ana will be mitigated against directly or indirectly destroying unique paleontological resources or sites or unique geologic features. The intent of these recommendations is to ensure that potential adverse impacts to paleontological resources as a result of project implementation are reduced to a less-than-significant level. These mitigation measures are only general guidelines, and all projects should develop a project-specific paleontological mitigation and monitoring plan, as discussed below.

6.1.2 Paleontological Resources Mitigation Measure 1

A Qualified Paleontologist meeting the standards of the SVP (2010) will be designated to conduct all paleontological mitigation measures associated with construction activities and develop a project-specific paleontological resources monitoring and mitigation plan (PRMMP). This plan will address monitoring and mitigation measures specific to that project area and construction plan, and will take into account updated geologic mapping, geotechnical data, updated paleontological records searches, and any changes to the regulatory framework. This PRMMP should usually meet the standards of the SVP (2010). The following provisions should be made, based on the paleontological sensitivity of the geologic units impacted by specific projects:

High Sensitivity — All projects involving ground disturbances in previously undisturbed areas mapped as having high paleontological sensitivity will be monitored by a qualified paleontological monitor (SVP 2010) on a full-time basis under the supervision of the Qualified Paleontologist. This monitoring will include inspection of exposed sedimentary units during active excavations within sensitive geologic sediments. The monitor will have authority to temporarily divert activity away from exposed fossils to evaluate the significance of the find and, should the fossils be determined to be significant, professionally and efficiently recover the fossil specimens and collect associated data. Paleontological monitors will use field data forms to record pertinent location and geologic data, will measure stratigraphic sections (if applicable), and collect appropriate sediment samples from any fossil localities.

Low-to-High Sensitivity—All projects involving ground disturbance in previously undisturbed areas mapped with low-to-high paleontological sensitivity will only require monitoring if construction activity will exceed the depth of the low sensitivity surficial sediments. The underlying sediments may have high paleontological sensitivity, and therefore work in those units might require paleontological monitoring, as determined by the Qualified Paleontologist in the PRMMP. When determining the depth at which the transition to high sensitivity occurs and monitoring becomes necessary, the Qualified Paleontologist should take into account: a) the most recent local geologic mapping, b) depths at which fossils have been found in the vicinity of the project area, as revealed by the museum records search, and c) geotechnical studies of the project area, if available.

6.1.3 Paleontological Resources Mitigation Measure 2

In the event of any fossil discovery, regardless of depth or geologic formation, construction work will halt within a 50-ft. radius of the find until its significance can be determined by the Qualified Paleontologist. Significant fossils will be recovered, prepared to the point of curation, identified by qualified experts, listed in a database to facilitate analysis, and deposited in a designated paleontological curation facility, such as the LACM, in accordance with the standards of the SVP (2010). A repository will be identified, and a curatorial arrangement will be signed prior to collection of the fossils.

7 LITERATURE CITED

Connin, S., J. Betancourt, and J. Quade. 1998. Late Pleistocene C4 plant dominance and summer rainfall in the Southwestern United States from isotopic study of herbivore teeth. *Quaternary Research 50:179–193.*

Eisentraut, P. and J. Cooper. 2002. *Development of a model curation program for Orange County's archaeological and paleontological collections*. Prepared by California State University, Fullerton and submitted to the County of Orange Public Facilities and Resources Department/Harbors, Parks and Beaches (PFRD/HPB)

Fife, D. L., J. A. Minch, and P. J. Crampton. 1967. Late Jurassic age of the Santiago Peak Volcanics, California. *GSA Bulletin* 78: 299-304

Graham, R. W., and E. L. Lundelius. 1994. FAUNMAP: a database documenting the late Quaternary distributions of mammal species in the United States. *Illinois State Museum Scientific Papers* XXV(1).

Harden, D. 2004. *California Geology*, 2nd edition. Pearson Prentice Hall, 552 p.

Hudson, D., and B. Brattstrom. 1977. A small herpetofauna from the late Pleistocene of Newport Beach Mesa, Orange County, California. *Bulletin of the Southern California Academy of Sciences* 76:16–20.

Jefferson, G. T. 1991a. *A catalogue of Late Quaternary vertebrates from California: part one, nonmarine lower vertebrate and avian taxa*. Natural History Museum of Los Angeles County Technical Reports No. 5.

———. 1991b. *A catalogue of Late Quaternary vertebrates from California: part two, mammals*. Natural History Museum of Los Angeles County Technical Reports No. 7.

Kimbrough, D. L., T. E. Moore, M. Grove, R. G. Gastil A. Ortega-Rivera, and C. M. Fanning. 2001. Forearc-basin sedimentary response to rapid Late Cretaceous batholith emplacement in the Peninsular Ranges of southern and Baja California. *Geology* 29: 491-494

McDonald, H. G., and G. T. Jefferson. 2008. Distribution of Pleistocene *Nothrotheriops* (Xenartha, Nothrotheriidae) in North America; pp. 313–331 in X. Wang and L. Barnes (eds.), *Geology and Vertebrate Paleontology of Western and Southern North America*. Natural History Museum of Los Angeles County Science Series 41.

McLeod, S. 2019. Records search of the Los Angeles County Natural History Museum. Letter response to A. Bell on March 4, 2019

Miller, W. E. 1941. A new fossil bird locality. *Condor* 44:283–284.

———. 1971. *Pleistocene vertebrates of the Los Angeles Basin and vicinity: exclusive of Rancho La Brea*. Los Angeles County Museum of Natural History 10.

Morton, D. M., and F. K. Miller. 2006. Geologic map of the San Bernardino and Santa Ana 30' × 60' quadrangles, California. Scale 1:100,000. U.S. Geological Survey Open File Report 2006-1217.

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

Norris, R. M., and R. W. Webb. 1990. *Geology of California*. 2nd ed. New York: John Wiley & Sons.

Powell, R. E. 1993. Balanced palinspastic reconstruction of pre-late Cenozoic paleogeology, southern California: Geologic and kinematic constraints on evolution of the San Andreas fault system. *GSA Memoirs* 178: 1-106.

Reynolds, R. E., and R. L. Reynolds. 1991. The Pleistocene beneath our feet: near-surface Pleistocene fossils in inland southern California basins; pp. 41–43 in M. O. Woodburne, R. E. Reynolds, and D. P. Whistler (eds.), *Inland Southern California: the last 70 million years*. Redlands, CA: San Bernardino County Museum Association.

Roth, V. L. 1984. How elephants grow: heterochrony and the calibration of developmental stages in some living and fossil species. *Journal of Vertebrate Paleontology* 4:126–145.

Roy, K., J. Valentine, D. Jablonski, and S. Kidwell. 1996. Scales of climatic variability and time averaging in Pleistocene biotas: implications for ecology and evolution. *Trends in Ecology and Evolution* 11:458–463.

San Diego County Natural History Museum (SDNHM). 2019. Online search of collections database. Available at: http://www.sdnhm.org/science/paleontology/resources/collection-database/. Accessed February 12, 2018.

Sandom, C., S. Faurby, B. Sandel, and J.-C. Svenning. 2014. Global late Quaternary megafauna extinctions linked to humans, not climate change. *Proceedings of the Royal Society B* 281, 9 pp.

Scott, E. 2010. Extinctions, scenarios, and assumptions: changes in latest Pleistocene large herbivore abundance and distribution in western North America. *Quaternary International* 217:225–239.

Scott, E., and S. Cox. 2008. Late Pleistocene distribution of Bison (Mammalia; Artiodactyla) in the Mojave Desert of Southern California and Nevada; pp. 359–382 in X. Wang and L. Barnes (eds.), *Geology and Vertebrate Paleontology of Western and Southern North America*. Natural History Museum of Los Angeles County, Science Series 41.

Scott, E. and Springer, K. 2003. CEQA and fossil preservation in southern California. *The Environmental Monitor* 2003: 4-10.

Society of Vertebrate Paleontology (SVP). 1995. Assessment and mitigation of adverse impacts to nonrenewable paleontologic resources: standard guidelines. *Society of Vertebrate Paleontology News Bulletin* 163:22–27.

———. 2010. *Standard procedures for the assessment and mitigation of adverse impacts to paleontological resources*. Available at: http://vertpaleo.org/Membership/Member-Ethics/SVP_Impact_Mitigation_Guidelines.aspx. Accessed January 26, 2016.

Springer, K., E. Scott, J. Sagebiel, and L. Murray. 2009. The Diamond Valley Lake local fauna: late Pleistocene vertebrates from inland southern California; pp. 217–237 in L. Albright (ed.), *Papers on Geology, Vertebrate Paleontology, and Biostratigraphy in Honor of Michael O. Woodburne*. Museum of Northern Arizona Bulletin 65.

United States Department of the Interior (USDI). 2000. *Assessment of Fossil Management on Federal and Indian Lands*. Washington, D.C.: USDI.

University of California Museum of Paleontology (UCMP). 2019. Online search of collections database. Available at: http://ucmpdb.berkeley.edu/. Accessed February 12, 2018.

Appendix A.

Confidential - Paleontological Records from the Natural History Museum of Los Angeles County

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

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4 March 2019

SWCA Environmental Consultants
51 West Dayton Street
Pasadena, CA 91105

Attn: Alyssa Bell, Ph.D., Lead Paleontologist

re: Paleontological resources for the proposed Santa Ana General Plan Update Project, SWCA Project # 53612, in the City of Santa Ana, Orange County, project area

Dear Alyssa:

I have conducted a thorough search of our paleontology collection records for the locality and specimen data for proposed Santa Ana General Plan Update Project, SWCA Project # 53612, in the City of Santa Ana, Orange County, project area as outlined on the portions of the Anaheim, Orange, Newport Beach, and Tustin USGS topographic quadrangle maps that you sent to me via e-mail on 26 February 2019. We do not have any vertebrate fossil localities that lie directly within the proposed project area boundaries, but we do have vertebrate fossil localities nearby from sedimentary deposits similar to those that occur in the proposed project area, either at the surface or at depth.

In the entire proposed project area the surficial deposits consist of younger Quaternary Alluvium, derived as alluvial fan deposits from the Santa Ana Mountains to the east and northeast, partly via Santiago Creek that currently flows through the northern portion of the proposed project area, but especially from the Santa Ana River that currently flows through the western portion of the proposed project area. These younger Quaternary deposits typically do not contain significant vertebrate fossils, at least in the uppermost layers, but we have a vertebrate fossil locality, LACM 1652, north of the proposed project area on the western side of the Santa Ana River along Rio Vista Avenue south of Lincoln Avenue, that produced a fossil specimen of sheep, *Ovis*. Almost due east of locality LACM 1652, along Fletcher Avenue east of Glassell

Street east of the Santa Ana River, our vertebrate fossil locality from older Quaternary deposits, LACM 4943, produced a specimen of fossil horse, *Equus*, at a depth of 8-10 feet below the surface.

To the southwest of the proposed project area our closest fossil vertebrate locality from these deposits is LACM 4018, southwest of the proposed project area at the intersection of Warner Avenue and Golden West Street, that produced specimens of invertebrates, reptiles, birds, rodents, horses and deer in peat between four and eight feet below the surface, but these specimens were later determined to be of very late Holocene age. Further west along Warner Avenue, close to Bolsa Chica Street, our fossil vertebrate locality LACM 65113 from these deposits produced Pleistocene age specimens of mammoth, *Mammuthus*, between six and eight feet below the soil and specimens of fossil bison, *Bison*, between fourteen and twenty feet below the soil. A little further southwest of the proposed project area, along Ellis Avenue east of Beach Boulevard, our vertebrate fossil localities LACM 7657-7659 from the underlying Pleistocene San Pedro Sand produced fossil shark and fish specimens including soupfin shark, *Galeorhinus galeus*, skate, *Raja*, ray, *Myliobatis*, angel shark, *Squatina californica*, cusk eel, *Otophidium*, toadfish, *Porichthys notatus*, queenfish, *Seriphus politus*, sculpin, *Leptocottus*, goby, *Lepidogobius lepidus*, and sanddabs, *Citharichthys sordidus* and *Citharichthys stigmaeus*, from well cores over 100 feet below the surface.

To the south of the western portion of the proposed project area our closest older Quaternary locality is LACM 1339, east of the Santa Ana River near the top of the mesa bluffs along Adams Avenue, that produced fossil specimens of mammoth, *Mammuthus*, and camel, Camelidae, from sands approximately 15 feet below the top of the mesa that is overlain by shell bearing silts and sands. Further to the south and east, along the Newport Freeway near Santa Isabel Avenue, our locality LACM 4219 produced fossil specimens of sea turtle, *Chelonia*, and camel, Camelidae. Further south, near the intersection of 19^{th} Street and Anaheim Avenue, our older Quaternary locality LACM 3267 produced a specimen of a fossil elephant, Proboscidea. Due south farther still from the proposed project area, our locality LACM 6370, from the Hoag Hospital lower campus parcel near the intersection of Superior Avenue and the Pacific Coast Highway, produced a specimen of a fossil horse, *Equus*, in older Quaternary deposits.

To the south of the eastern portion of the proposed project area, just east of Upper Newport Bay around MacArthur Boulevard, we have several vertebrate fossil localities from older Quaternary deposits including LACM 1066, 1068-1069, 1086, 1240, 3407, 3877, 4426 and 6732. These localities, and many more closer to Upper Newport Bay, produced a rich suite of Quaternary fossil vertebrates. In his 1971 publication (Pleistocene vertebrates of the Los Angeles basin and vicinity (exclusive of Rancho La Brea). Los Angeles County Museum Science Bulletin 10:1-124) W.E. Miller documented many of these taxa from localities LACM 1066 and 3877 and figured specimens of sea otter, *Enhydra lutris*, pallid bat, *Antrozous pallidus*, shrews, *Notiosorex crawfordi* and *Sorex ornatus*, and pocket gopher, *Thomomys bottae*.

Shallow excavations in the uppermost layers of the younger Quaternary alluvial fan sediments in the proposed project site area are unlikely to uncover significant fossil vertebrate remains. Deeper excavations in the proposed project area, however, may well encounter significant vertebrate fossils in older Quaternary sediments. Any substantial excavations below the uppermost layers, therefore, should be closely monitored to quickly and professionally collect any specimens without impeding development. Also, sediment samples should be collected and processed to determine the small fossil potential in the proposed project area. Any fossils recovered during mitigation should be deposited in an accredited and permanent 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, Ph.D.
Vertebrate Paleontology

enclosure: invoice