Los Angeles County
Metropolitan Transportation Authority

# Appendix J
# Geology, Soils and Paleontological Resources

## LA RIVER PATH

Metro

LA RIVER PATH
Contract AE47795000

FINAL

# Geology, Soils, and Paleontological Resources Technical Report

Task 6.4.7

Prepared for:

Metro

Los Angeles County
Metropolitan Transportation Authority

Prepared by:

THE JACOBS ALTA TEAM

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## AUTHORS

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## DISCLAIMER

This Technical Report provides information in support of the Draft Environmental Impact Report for the LA River Path Project.

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## Attachments



## Tables

## Figures

# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| % | percent |
| AASHTO | American Association of State Highway and Transportation Officials |
| ACTA | Alameda Corridor Transportation Authority |
| AREMA | American Railway Engineering and Maintenance-of-Way Association |
| ARS | Acceleration Response Spectra |
| BDS | *Bridge Design Specifications* |
| bgs | below ground surface |
| BMP | best management practice |
| CalGEM | California Geologic Energy Management Division |
| Caltrans | California Department of Transportation |
| CCR | *California Code of Regulations* |
| CEQA | California Environmental Quality Act |
| CGS | California Geological Survey |
| CIDH | cast-in-drilled-hole |
| DWR | California Department of Water Resources |
| ECI | Earth Consultants International |
| EIR | Environmental Impact Report |
| EM | Engineer Manual |
| g | acceleration due to gravity |
| $H_2S$ | hydrogen sulfide |
| HDM | *Highway Design Manual* |
| LOTB | log of test borings |
| LRFD | load and resistance factor design |
| Metro | Los Angeles County Metropolitan Transportation Authority |
| $M_{max}$ | maximum moment magnitude |
| MMRP | Mitigation Monitoring and Reporting Program |
| $M_W$ | moment magnitude |
| NHMLA | Natural History Museum of Los Angeles County |
| O&M | operations and maintenance |
| OSHA | Occupational Safety and Health Administration |
| PGA | peak ground acceleration |
| PHBT | Puente Hills Blind Thrust |
| PRC | Public Resources Code |

| | |
|---|---|
| PRMP | Paleontological Resources Mitigation Plan |
| SDC | *Seismic Design Criteria* |
| SR- | State Route |
| SVP | Society of Vertebrate Paleontology |
| SWCA | SWCA Environmental Consultants |
| UCMP | University of California Museum of Paleontology |
| UEPBT | Upper Elysian Park Blind Thrust |
| Union Station | Los Angeles Union Station |
| UP | Union Pacific Railroad |
| US-101 | US Highway 101 |
| USACE | US Army Corps of Engineers |
| USGS | US Geological Survey |
| VP | vertebrate paleontology |
| WEAP | Worker Environmental Awareness Program |

# 01

# INTRODUCTION

Geology and soils along the Proposed Project study area may affect the design, construction, and use of the facility because of their potential to interact with design elements such as foundations and pavements. Potentially adverse subsurface conditions not accounted for during design and construction could pose risks to Proposed Project components, public safety, and the lead agency.

## 1.1 Methodology

### 1.1.1 Approach to Impact Analysis

#### 1.1.1.1 Geology and Soils

The geology and soils analysis is based on the review and evaluation of previously published geologic and hydrogeologic information developed within the resource study area (RSA), including available as-built log of test borings (LOTBs). The Proposed Project and its options, Option 1, and Option 2, were then evaluated based on the anticipated subsurface conditions.

The as-built LOTBs depict the subsurface conditions encountered during past geotechnical investigations for the design of the existing bridge structures across the LA River. Near these existing bridge sites, similar conditions are likely to be encountered during the Proposed Project's design and construction.

The existing geotechnical, subsurface, and seismic conditions and associated hazards in the study area, including seismic shaking and ground rupture, liquefaction/seismically induced settlement and inundation, expansive soils, ground settlement, collapsible soils, and naturally occurring oil and gas, are summarized in Section 3. Where Proposed Project components are proposed within or directly adjacent to known geologic hazard areas, the potential for impact was identified and assessed. Finally, impact analysis was conducted to analyze the impacts on the geology and soils and paleontological resources in the Proposed Project area.

#### 1.1.1.2 Paleontological Resources

The paleontological resources study examined whether previously recorded fossil localities, or fossiliferous geologic units known to contain fossils, are present within the Proposed Project. To assess the Proposed Project's paleontological sensitivity and to establish the paleontological sensitivity (potential) of each geologic unit present within and adjacent to the Proposed Project, Jacobs reviewed published geology maps, paleontological literature, and geotechnical data.

Geologic maps, geotechnical data, and available published and unpublished geological and paleontological literature covering the bedrock and surficial geology and paleontology of the Proposed Project and surrounding area were reviewed to determine what exposed and subsurface rock units are present, and to assess the potential paleontological productivity of each rock unit in respect to the Proposed Project. This research identified the geologic units, previous paleontological studies, fossil localities (such as locations where paleontological resources have been documented), and types of fossils in geologic units that may be encountered within or adjacent to the Proposed Project.

In addition, in July 2021, Jacobs requested a paleontology records (that is, a database) search by the Natural History Museum of Los Angeles County (NHMLA) Department of Paleontology staff paleontologists. The records search request was supplemented by an online fossil locality search by the Jacobs staff paleontologist, using the University of California Museum of Paleontology (UCMP) online fossil database.

After completing the tasks, each geologic unit mapped within or near the Proposed Project was assigned a paleontological potential (such as sensitivity), based on the number of previously recorded fossil sites (such as localities) it contains and the scientific importance of the fossil remains recorded. The methods are consistent with Society of Vertebrate Paleontology (SVP) (2010) criteria and guidelines for assessment and mitigation of adverse impacts to paleontological resources in areas of potential environmental effect and areas of critical environmental concern. The SVP considers significant fossils as fossils that contribute new and useful taxonomic, taphonomic, phylogenetic, paleoecologic, biochronologic, and stratigraphic data (SVP 2010).

#### 1.1.1.3 Data Sources and Standards

Primary sources of information used to prepare this Impact Analysis Report are listed here, and a complete list of references is in Chapter 3, *References*.

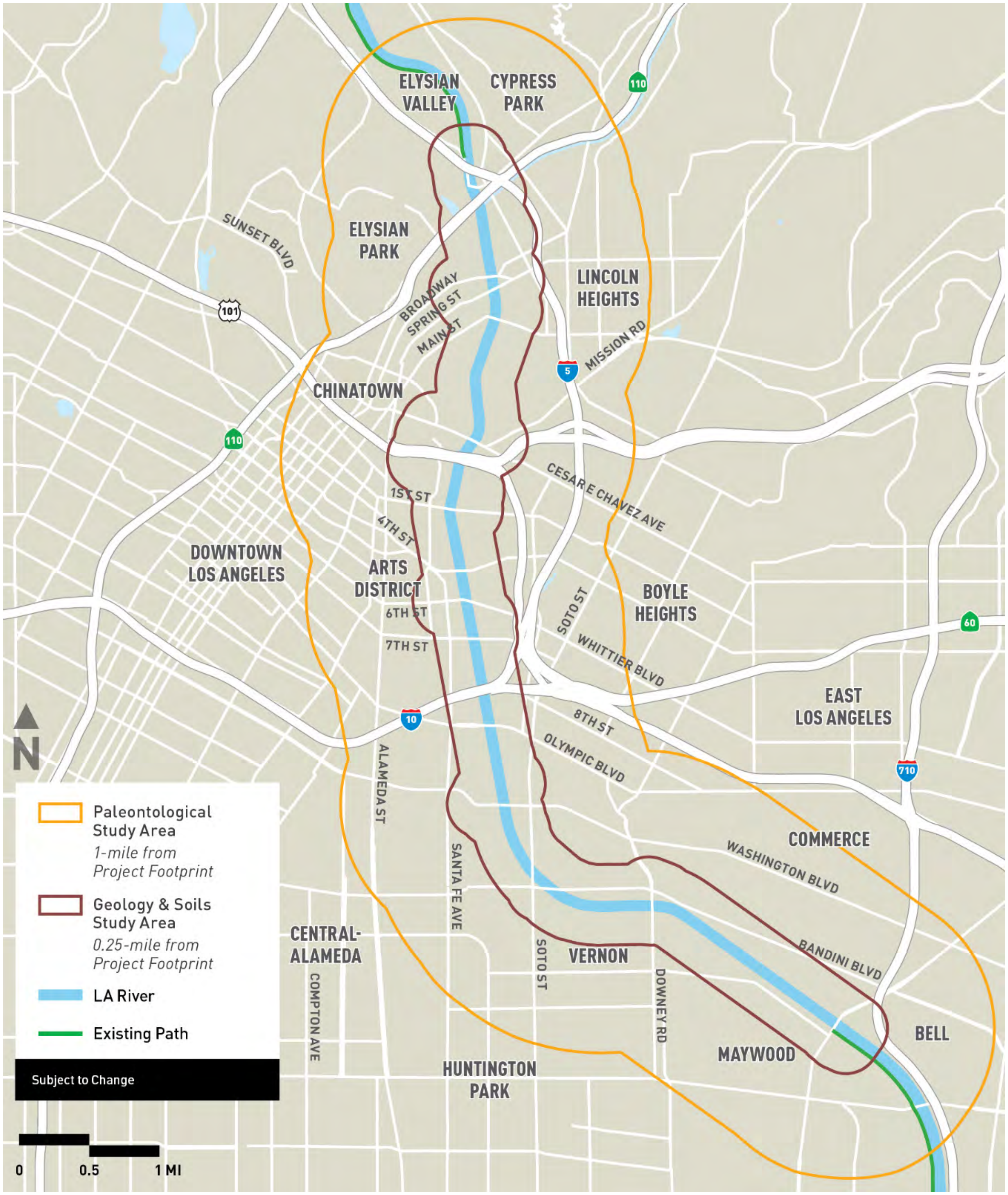
- As-built LOTBs for the bridge structures crossing the Proposed Project
- Published geologic and geologic hazard maps from the California Geological Survey (CGS) and US Geological Survey (USGS)
- Information from the following organizations:
  - California Geologic Energy Management Division (CalGEM)
  - California Department of Water Resources (DWR)
  - California Department of Transportation (Caltrans)
  - NHMLA Department of Paleontology
  - UCMP online fossil database
  - SVP guidelines, the standard against which all paleontological mitigation is oriented

#### 1.1.1.4 Determine Geology and Soils Impact Analysis Area

**Geology and Soils:** An area of 0.25-mile on each side of the Proposed Project footprint was selected as the Proposed Project geology and soils study area (Figure 1-1). The geology and soils study area width was established with the goal of capturing the area where major physical Proposed Project components such as structures and pavements would be constructed.

**Paleontological Resources:** The geologic units that occur within approximately 1 mile of the Proposed Project (also shown on Figure 1-1) were studied to assess the Proposed Project's potential impacts to known paleontological resources or rock units determined to possess a high potential to contain important paleontological resources. This distance was chosen to adequately encompass and understand the geological context of the area and to further correlate the results of the paleontological records search and literature review.

**Figure 1-1. Geology and Soils Resource Study Area Map**



# 02

# EXISTING SETTING

The geology- and soils-related existing conditions in the RSA are summarized in the following sections. Many Proposed Project components will permanently interface with these existing conditions. Therefore, these conditions may affect the Proposed Project's construction and operational impacts.

## 2.1 Regional Geology

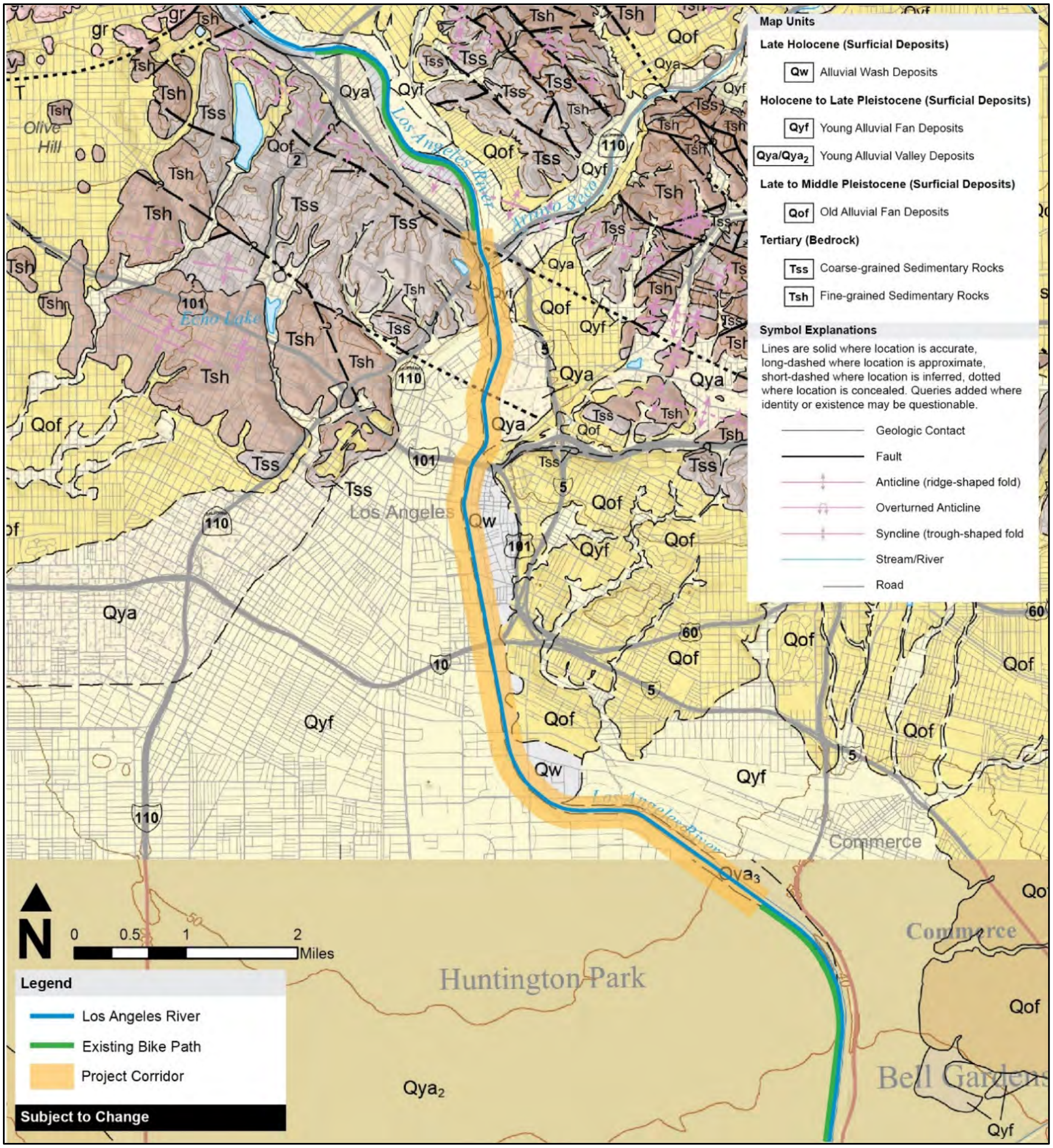
California is separated into 11 geomorphic provinces based on the distinct landforms (or geomorphology) of each province. The RSA is situated within the Los Angeles Basin portion of the Peninsular Ranges geomorphic province of California. The Peninsular Ranges province is characterized by northwest-trending mountain ranges, valleys, and faults, all of which generally parallel the trend of the San Andreas Fault system, which is located approximately 30 miles northeast of the study area. The Elysian Park-Repetto Hills and the Newport-Inglewood Fault Zone are prime examples of this northwest-trending regional structure. Near the central part of the Los Angeles Basin, nearly 30,000 feet of marine and alluvial sediments and sedimentary rocks of Quaternary and Tertiary age are present (Yerkes et al. 1965). These Quaternary aged (recent to 2 million years old) and Tertiary aged (2 to 65 million years old) units are underlain by Cretaceous age (greater than 65 million years old) crystalline bedrock. The surficial geology of the study area is shown on Figure 2-1.

## 2.2 Physiography and Topography

The study area is situated primarily on a gently sloping alluvial surface (the LA River channel and floodplain) within the Los Angeles Basin. Steeper terrain is present adjacent to the study area generally from where the LA River crosses below I-5 to where the LA River crosses below Broadway. The Elysian Hills are present in this area (on the west side of the LA River) with a local elevation high of approximately 620 feet, the LA River channel bottom in this area has an approximate elevation of 295 feet.

In the Proposed Project study area, the concrete-lined LA River drains to the south and southeast. Approximate elevations along the LA River channel bottom range from a high of 300 feet at the north end of the study area, 252 feet at Cesar E Chavez Avenue, 225 feet at Sixth Street, 176 feet at Bandini Boulevard, and 142 feet near the southern terminus of the study area at Atlantic Boulevard. The LA River channel shape within the study area is rectangular along some reaches and trapezoidal along others.

**Figure 2-1. Geologic Map**




Sources: Bedrossian et al. 2012, Saucedo et al. 2016

## 2.3 Local Geology

The following is a summary of the study area geologic units is derived from review of a combination of regional geologic maps and their associated literature (Bedrossian et al. 2012, Campbell et al. 2014, Dibblee 1989, Lamar 1970, Saucedo et al. 2016, Yerkes et al. 1977). Figure 2-1 depicts the surficial geology covering the study area. The surficial geology shown on Figure 2-1 represents the geographical extents of the various geologic units mapped at the ground surface. The extent of the units varies with depth below the ground surface and depends on several factors, such as faulting and the past and present depositional environment. Along with regional geologic information, as-built LOTBs were considered in preparation of the following geologic unit descriptions. The as-built LOTBs depict subsurface conditions encountered during past geotechnical investigations for the design of the existing bridge structures across the LA River. Near these existing bridge sites, similar subsurface conditions are likely to be encountered during the Proposed Project's design and construction. Table 2-1 summarizes of the as-built boring data presented on the LOTBs.

The geologic units underlying the study area are described in the following sections. These geologic units are linked to potential hazards described in Sections 3.6.2 and 3.7.

### 2.3.1 Artificial Fill Soil

Artificial fill soils are present locally within the study area. The depth and lateral extent of these fill soils are dependent on the original topography as well as past and current improvements in the study area. The composition of the fill soils varies depending on the source. Fill soil descriptions based on the as-built LOTBs are included in Table 2-1 in Section 2.4. Review of the LOTBs indicate that some fill soils present in the study area contain cobbles, boulders, trash, and construction debris. Because of the scale of the map and local nature of the fill soils, they are not shown on Figure 2-1.

### 2.3.2 Alluvial Soil

The alluvial materials in the study area include interbedded layers, discontinuous lenses of coarse-grained sediment (sand, gravel, cobbles, and boulders; sand and gravel with lesser amounts of fine-grained sediments), and fine-grained sediment (silt, clay, and silts and clays with lesser amounts of coarse-grained sediments). Within the study area, cobbles and boulders (3 feet in diameter and greater) are widespread, but not uniformly distributed within the alluvial soils, at depths of 0 to more than 120 feet below ground surface (bgs) (Yerkes et al. 1977). The cobble and boulder layers are generally irregularly shaped and are noncontinuous over longer distances. From a geologic perspective, the alluvial soils are considered unconsolidated because the soils lack cementation typically associated with rock formations. Alluvial soils descriptions based on the available as-built LOTBs are included in Section 4.4. Review of the LOTBs indicate that some of the alluvial soils present in the study area contain hydrocarbons and peat. In addition, hydrogen sulfide ($H_2S$) and organic odors have been encountered locally. As shown on Figure 2-1, the alluvial soils mapped in the study area include: Alluvial Wash Deposits (unit Qw); Young Alluvial Fan Deposits (unit Qyf); Young Alluvial Valley Deposits (units Qya, $Qya_2$, and $Qya_3$); and Old Alluvial Fan Deposits (unit Qof).

The contact between the alluvial materials and underlying bedrock is irregular because the alluvium has covered landscapes developed by erosion into older deposits. The approximate depth to the alluvial soil/bedrock contact varies within the study area from as shallow as 10 feet bgs in the area of State Route (SR-)110 to approximately 200 to 300 feet at the southern terminus of the study area (Lamar 1970; Yerkes et al. 1965, 1977).

### 2.3.3 Bedrock

Two sedimentary bedrock formations are present at depths that could affect the Proposed Project: the Pliocene-age Fernando Formation and the Miocene-age Puente Formation. These bedrock formations are represented by units Tss and Tsh on Figure 2-1.

The Fernando Formation generally includes soft, gray to black, vaguely bedded, claystone, and siltstone. This formation underlies the alluvial soils along the study area from near US Highway (US)-101 to the southern terminus of the study area.

Three members of the Puente Formation are mapped in the study area: the fine-to-medium-grained, well-bedded Sandstone Member; and the well-bedded Siltstone and Shale Members. The Puente Formation is mapped on both sides of the LA River (below the alluvial soils) generally from the northern terminus of the study area to US-101. The Elysian Hills are composed of Puente Formation bedrock.

The Puente and Fernando Formations contain scattered, hard concretions and thin hard layers. The degree of weathering in these rocks decreases with increasing depth from decomposed to fresh. Review of the LOTBs indicate that the bedrock encountered in the study area is generally soft, with local (hard) concretionary areas encountered.

In the study area near the surface, bedding (internal layering) within the Fernando and Puente Formation units dip to the south to southwest (Dibblee 1989, Lamar 1970).

It is likely that inactive, intra-formational faults are present within bedrock units underlying the study area. These inactive faults would have formed as a result of the Miocene and Pliocene tectonic regime (approximately 16 to 2 million years ago). Active faulting is discussed in Section 2.6.1.

## 2.4 Subsurface Geotechnical Summary

The following descriptions of the geologic units underlying the study area are based primarily on the information presented in available as-built LOTBs. The LOTBs depict the geologic units encountered during past geotechnical investigations for the design of the existing bridge structures across the LA River. Similar conditions are likely to be encountered during the design and construction of the Proposed Project components.

The geotechnical conditions summarized in Table 2-1 are obtained from the existing bridge structure plans and are based on the subsurface data presented in the associated as-built LOTBs. Information in the table is presented from north to south along the LA River channel. If a structure is not included in Table 2-1, the as-built LOTB was not available. Attachment A includes a summary of as-built boring information data presented on the LOTBs. The elevations discussed in the following sections are based on the datum indicated on the as-built LOTB or in the associated plan set.

**Table 2-1. Summary of Subsurface Data from North to South**

| Bridge Name | Bridge Number | Owner | Contract Number | Year |
|---|---|---|---|---|
| I-5 Viaduct | 53-1424 | Caltrans | 07-114884 and 07-129001 | 1957 and 1993 |

The subsurface profile includes fill, alluvial soil, and sedimentary bedrock. The fill soils generally include coarse-grained soil (very loose to dense sand with variable amounts of silt, clay, and gravel; debris was also encountered) and fine-grained soil (clay with variable amounts of silt, sand, and gravel; metal and rubber debris were also encountered). The fill soils were locally described as "dump-fill rubbish mixed with sand and gravel." The alluvial soils generally include coarse-grained soils (loose to very dense sand and gravel with variable amounts of silt, clay, and cobbles) and some fine-grained soil layers (stiff to hard silt and clay with variable amounts of sand and gravel). The sedimentary bedrock is shale. Groundwater was encountered between elevations 281 and 305 feet.

| Bridge Name | Bridge Number | Owner | Contract Number | Year |
|---|---|---|---|---|
| Riverside Drive Viaduct | 53-C2355 | City of Los Angeles | E700002F | 2010 |

The subsurface profile includes of fill, alluvial soil, and sedimentary bedrock. The fill soils generally include coarse-grained soil (sand with variable amounts of silt and gravel; plastic debris was also encountered). The alluvial soils generally consist of coarse-grained soils (loose to very dense sand and gravel with variable amounts of silt, clay, and cobbles) and few fine-grained soil layers (lean clay and silt with variable amounts of sand). The sedimentary bedrock is claystone, siltstone, shale, and sandstone. Groundwater was encountered at elevations between 286 and 295 feet.

| Bridge Name | Bridge Number | Owner | Contract Number | Year |
|---|---|---|---|---|
| Metrolink LA River–Downey Bridge | None | Southern California Regional Rail Authority | C6250 | 1993 |

The subsurface profile includes fill, alluvial soil, and sedimentary bedrock. The fill soils generally include coarse-grained soil (sand with variable amounts of silt and gravel; concrete debris was also encountered). The alluvial soils generally include coarse-grained soils (very loose to very dense sand with variable amounts of clay and gravel) with few fine-grained soil layers (lean and fat clays with variable amounts of silt, sand, and gravel). The sedimentary bedrock is sandstone. Groundwater was encountered at elevations between 286 and 295 feet.

| Bridge Name | Bridge Number | Owner | Contract Number | Year |
|---|---|---|---|---|
| North Broadway Viaduct | 53-C0545 | City of Los Angeles | 0043-0128 | 1994 |

The subsurface profile includes fill, alluvial soil, and sedimentary bedrock. The fill soils generally include coarse-grained soil (sand with variable amounts of silt, clay, gravel, and cobbles). The alluvial soils generally include coarse-grained soils (dense to very dense sand with variable amounts of silt, gravel, cobbles, and boulders). The sedimentary bedrock is sandstone, siltstone and shale. Groundwater was encountered at elevation 266 and 278 feet.

| Bridge Name | Bridge Number | Owner | Contract Number | Year |
|---|---|---|---|---|
| North Spring Street Viaduct | 53-C0859 | City of Los Angeles | Unknown | 2005 |

The subsurface profile includes fill and alluvial soil. The fill soils generally include coarse-grained soil (medium dense sand with variable amounts of silt and gravel). The alluvial soils generally include coarse-grained soils (medium dense to very dense sand and gravel with variable amounts of silt, clay, and cobbles) with few fine-grained soils (silt and clay with variable amounts of sand). Groundwater was not encountered.

| Bridge Name | Bridge Number | Owner | Contract Number | Year |
|---|---|---|---|---|
| Cesar E Chavez Avenue Viaduct | 53-C0131 | City of Los Angeles | D-30803 | 1993 |

The subsurface profile includes fill and alluvial soil. The fill soils generally include coarse-grained soil (sand with variable amounts of silt and clay; brick debris was also encountered). The alluvial soils generally include coarse-grained soils (medium dense to very dense sand with variable amounts of silt, gravel, and cobbles). Groundwater was encountered at elevation 239 feet.

| Bridge Name | Bridge Number | Owner | Contract Number | Year |
|---|---|---|---|---|
| El Monte Busway Bridge | 53-C2673 | Caltrans | 07-417804 | 1985 and 1995 |

The subsurface profile includes fill, alluvial soil, and sedimentary bedrock. The fill soils generally include coarse-grained soil (very loose to dense sand with variable amounts of silt, gravel, and cobbles; brick, tile, and other debris were also encountered) and fine-grained soil (silt with variable amounts of sand, gravel, and cobbles; concrete debris was also encountered). The fill soils were locally described as "old land fill." The alluvial soils generally include coarse-grained soils (loose to very dense sand and gravel with variable amounts of silt, clay, gravel, cobbles, and boulders). Hydrocarbons and peat were encountered, and organic, creosote, and $H_2S$ odors were reported. The sedimentary bedrock is shale and siltstone. Groundwater was encountered at elevations between 234 and 257 feet.

### Table 2-1. Summary of Subsurface Data from North to South

| Bridge Name | Bridge Number | Owner | Contract Number | Year |
|---|---|---|---|---|
| US-101 LA River Bridge | 53-0405 | Caltrans | 55-14V02 | 1952 |

The subsurface profile includes fill, alluvial soil, and sedimentary bedrock. The fill soils generally include coarse-grained soil (sand with variable amounts of brick and other debris were also encountered). The alluvial soils generally include coarse-grained soils (loose to very dense sand with silt, gravel, cobbles; in addition, oil sands and $H_2S$ odor were encountered) with few fine-grained soil layers (clay with variable amounts of sand and gravel). The sedimentary bedrock is shale. Groundwater was encountered between elevations 234 and 259 feet.

| Bridge Name | Bridge Number | Owner | Contract Number | Year |
|---|---|---|---|---|
| First Street Viaduct | 53-C1166 | City of Los Angeles | Unknown | 1992 |

The subsurface profile includes fill and alluvial soil. The fill soils generally include coarse-grained soil (sand with variable amounts of silt; brick fragments were also encountered). The alluvial soils generally include coarse-grained soils (dense to very dense sand with variable amounts of silt, gravel, and cobbles) with scarce fine-grained soil layers (firm silt with variable amounts of clay, sand, and gravel). Groundwater was not encountered.

| Bridge Name | Bridge Number | Owner | Contract Number | Year |
|---|---|---|---|---|
| Sixth Street Viaduct | 53-C2329 | City of Los Angeles | E700224F | 2015 |

The subsurface profile includes fill, alluvial soil, and sedimentary bedrock. The fill soils generally include coarse-grained soil (loose sand with variable amounts of silt, clay, and gravel; construction debris was also encountered) and fine-grained soils (clay with variable amounts of sand; construction debris was also encountered). The alluvial soils generally include coarse-grained soils (loose to very dense sand and gravel with variable amounts of silt, clay, and cobbles; hydrocarbons and organic odors were encountered) and fine-grained soils (stiff to hard silt, elastic silt, and lean and fat clay, with variable amounts of sand and gravel). The sedimentary bedrock was described as very stiff to hard clay and silty clay, as well as mudstone and claystone. Groundwater was encountered between elevations 171 and 210 feet.

| Bridge Name | Bridge Number | Owner | Contract Number | Year |
|---|---|---|---|---|
| I-10 Santa Monica Viaduct | 53-1301 | Caltrans | 58-14VC14-FI | 1956 |

The subsurface profile includes fill and alluvial soil. The fill soils generally include coarse-grained soil (loose sand with variable amounts of silt, clay, and gravel; brick, concrete, and other debris were also encountered). The alluvial soils generally include coarse-grained soils (dense to very dense sand with variable amounts of silt, clay, gravel, and cobbles; loose to very dense gravel with variable amounts of sand) with some fine-grained soil layers (slightly compacted to stiff clays and silts with variable amounts of sand). Groundwater was not encountered.

| Bridge Name | Bridge Number | Owner | Contract Number | Year |
|---|---|---|---|---|
| Olympic Boulevard Viaduct | 53-C0163 | City of Los Angeles | Unknown | 1993 |

The subsurface profile includes fill and alluvial soil. The fill soils generally include coarse-grained soil (dense sand with variable amounts of gravel; brick fragments were also encountered). The alluvial soils generally include coarse-grained soils (dense to very dense gravel and sand with variable amounts of silt and clay) with scarce fine-grained soil layers (clays and silts with variable amounts of sand). Groundwater was not encountered.

| Bridge Name | Bridge Number | Owner | Contract Number | Year |
|---|---|---|---|---|
| UP LA River Bridge | None | UP/Alameda Corridor Transportation Authority | Unknown | 1996 |

The subsurface profile includes alluvial soil (fill soils were not indicated). The alluvial soils generally include coarse-grained soils (dense to very dense sand with variable amounts of silt, clay, and gravel) with few fine-grained soil layers (very stiff to hard lean and fat clays and silts with variable amounts of sand). Groundwater was not encountered.

| Bridge Name | Bridge Number | Owner | Contract Number | Year |
|---|---|---|---|---|
| Washington Boulevard Bridge | 53-C1375 | City of Los Angeles | Unknown | 1993 |

The subsurface profile includes fill and alluvial soil. The fill soils generally include coarse-grained soil (slightly compact sand with variable amounts of silt and gravel; bricks and other debris were also encountered). The alluvial soils generally include coarse-grained soils (loose to very dense sand with variable amounts of silt, clay, and gravel), and fine-grained soil layers (very stiff to hard lean clays with variable amounts of silt and sand, and very hard silt). Groundwater was not encountered.

**Table 2-1. Summary of Subsurface Data from North to South**

<table>
<tr><th>Bridge Name</th><th>Bridge Number</th><th>Owner</th><th>Contract Number</th><th>Year</th></tr>
<tr><td>Redondo Junction Grade Separation</td><td>53-C2081</td><td>Southern California Regional Rail Authority</td><td>Unknown</td><td>1996</td></tr>
<tr><td colspan="5">The subsurface profile includes fill and alluvial soil. The fill soils generally include coarse-grained soil (sand with variable amounts silt, clay, and gravel) and fine-grained soil (clay with variable amounts of silt, sand, and gravel; concrete fragments, brick, metal, and other debris were also encountered in the fill). The alluvial soils generally include coarse-grained soils (loose to very dense sand with variable amounts of silt, gravel, cobbles, and boulders) with fine-grained soil layers (very stiff to hard lean clay with variable amounts of silt and sand and soft to very stiff silts with variable amounts of sand). Groundwater was not encountered.</td></tr>
<tr><th>Bridge Name</th><th>Bridge Number</th><th>Owner</th><th>Contract Number</th><th>Year</th></tr>
<tr><td>Soto Street Bridge</td><td>53-C0867</td><td>Los Angeles County</td><td>Unknown</td><td>1985</td></tr>
<tr><td colspan="5">The subsurface profile was not differentiated between fill and alluvial soil. The soils encountered generally include coarse-grained soils (firm to very firm sand with variable amounts of silt, clay, gravel, and cobbles). Groundwater was not encountered.</td></tr>
<tr><th>Bridge Name</th><th>Bridge Number</th><th>Owner</th><th>Contract Number</th><th>Year</th></tr>
<tr><td>Bandini Boulevard Bridge</td><td>53-C0827</td><td>City of Vernon</td><td>Unknown</td><td>1966</td></tr>
<tr><td colspan="5">The subsurface profile includes fill and alluvial soil. The fill soils generally include fine-grained soil (firm sandy clay with gravel; boulders, bricks, and wood were also encountered). The alluvial soils generally include coarse-grained soils (firm to very firm sand with variable amounts of silt, clay, and gravel) with fine-grained soil layers (medium firm to firm clays with silt and variable amounts of sand and cobbles). Groundwater was encountered at approximate elevations 129 and 131 feet.</td></tr>
<tr><th>Bridge Name</th><th>Bridge Number</th><th>Owner</th><th>Contract Number</th><th>Year</th></tr>
<tr><td>Downey Road Bridge</td><td>53-C0576</td><td>Los Angeles County</td><td>Unknown</td><td>1978</td></tr>
<tr><td colspan="5">The subsurface profile includes fill and alluvial soil. The fill soils generally include coarse-grained soils (dense sand with variable amounts of silt; boulders and wood debris were also encountered). The alluvial soils generally include coarse-grained soils (loose to dense sand with variable amounts of silt and clay) and fine-grained soil layers (silts and clays with variable amounts of sand). Groundwater was not encountered.</td></tr>
<tr><th>Bridge Name</th><th>Bridge Number</th><th>Owner</th><th>Contract Number</th><th>Year</th></tr>
<tr><td>Atlantic Boulevard Bridge</td><td>53-C0252</td><td>City of Vernon</td><td>CS-0099</td><td>2017</td></tr>
<tr><td colspan="5">Based on the as-built LOTB for the Atlantic Boulevard over the LA River. The subsurface profile includes fill and alluvial soil. The fill soils generally include coarse-grained soils (loose to medium dense sand with variable amounts of silt). The alluvial soils generally include coarse-grained soils (medium dense to dense sand with variable amounts of silt and clay) with few fine-grained soil layers (lean clays and silts with variable amounts of sand). Groundwater was encountered at an elevation of 61.5 feet.</td></tr>
</table>

Sources: ACTA 1996; Caltrans 1952, 1956, 1957, 1985, 1993, 1995; City of Los Angeles 1992, 1993a, 1993b, 1993c, 1994, 2005, 2010, 2015; City of Vernon 1966, 2017; Los Angeles County 1978, 1985; Southern California Regional Rail Authority 1993, 1996

# 2.5 Groundwater and Surface Water

The following surface and groundwater information is presented for geologic context only and is based on existing water resource information in the study area.

## 2.5.1 Surface Water

The LA River collects runoff from the San Fernando Valley and a large portion of the Los Angeles Basin. Within the study area, major tributaries to the LA River include the Arroyo Seco, which joins the LA River just south of SR-110. The portion of the study area outside the LA River channel area drains by sheet flow into the LA River or into secondary drainages, which eventually drain into the Pacific

Ocean. Flowing surface water can result in an erosion hazard to unprotected slopes and can result in scour around unprotected structural supports, such as bridge columns.

### 2.5.2 Groundwater

Historically, the highest groundwater levels within the study area generally range from 20 feet bgs at the northern terminus, 40 feet bgs between US-101 and First Street, 100 feet bgs near Fourth Street, 175 feet bgs near Seventh Street, 150 feet bgs near I-10, 60 feet bgs at Washington Boulevard, 40 feet bgs near Downey Road, and 15 feet bgs near Atlantic Boulevard (CGS 1998a, 1998b). Groundwater levels, based on a review of the as-built LOTB, are summarized in Section 3.4 and Attachment A.

At the depths that could impact Proposed Project features (generally the upper 100 feet bgs), the bedrock units within the study area generally do not have a fixed groundwater table. However, the bedrock can hold and transport groundwater in the form of seepages present within local sandstone beds as well as fault and/or fracture zones. Substantial amounts of groundwater inflows can be expected locally in alluvial deposits where situated below the groundwater table.

Groundwater can impact the Proposed Project in a variety of ways. For example, a relatively shallow groundwater table is a required element for liquefaction to occur. In addition, during construction of cast-in-drilled-hole (CIDH) piles for bridge or elevated path, the groundwater table may facilitate temporary caving conditions during drilling.

## 2.6 Faulting and Seismicity

Fault displacements result in the release of energy stored within the earth's crust. This release of energy results in seismicity (earthquakes), which can impact the stability of structures that will be included as part of the Proposed Project. The effects of an earthquake generally increase as the distance between the Proposed Project site and an active fault decrease.

Faults designated as active under the Alquist-Priolo Earthquake Fault Zoning Act have the potential for ground surface rupture during an earthquake event (CGS 2018). Such a designation indicates the fault is known to have experienced surface offsets in Holocene time (the last 12,000 years) and its location is well defined. No known active faults capable of ground rupture are mapped within the study area (CGS 1977; City of Los Angeles 2018). Nearby active faults are present and contribute to the seismic hazard potential on the Proposed Project because rupture of these faults can result in seismic shaking during an earthquake.

A potentially active fault is defined by the state as a fault that has experienced surface displacement within the Quaternary period (the last 1.6 million years) but has not been confirmed to have younger Holocene displacements (CGS 2018). No potentially active faults transect the study area.

### 2.6.1 Active Faults

There are no known active faults capable of ground rupture are mapped within the study area, and the study area is not located in an Alquist-Priolo Earthquake Fault Zone (CGS 1977) (Figure 2-2). The study area is underlain by two active blind-thrust fault systems, the Upper Elysian Park Blind-Thrust (UEPBT) Fault and Puente Hills Blind-Thrust Fault (Shaw and Suppe 1996; Shaw et al. 2002). These faults do not extend to the ground surface and are not considered capable of ground rupture during an earthquake. Because blind-thrust faults are not capable of surface rupture, they are therefore not subject to the conditions of the Alquist-Priolo Act.

Numerous other active faults are present in Southern California that also contribute to potential ground shaking hazards for the Proposed Project (Table 2-2). These faults are considered in the seismic analysis discussed in Section 2.6.2.1.

**Table 2-2. Summary of Nearby Active Faults**

| Fault Name | Moment Magnitude ($M_w$) | Closest Distance to Study Area (miles)[a] |
|---|---:|---:|
| Puente Hills–Los Angeles (Blind-Thrust Fault) | 6.5-7.7[b] | 1.62 |
| Upper Elysian Park Fault (Blind-Thrust Fault) | 6.2-6.7[c] | 0 |
| Elysian Park Fault–Lower Cfm (Blind-Thrust Fault) | 6.2-6.7[c] | 0 |
| Newport-Inglewood Fault Zone–N Los Angeles Basin Section | 6.0-7.4[d] | 6.8 |
| Raymond | 6.0-7.0[d] | 2.0 |
| Hollywood | 5.8-6.5[d] | 3.0 |
| Puente Hills–Santa Fe Springs (Blind-Thrust Fault) | 6.5-7.1[b] | 6.3 |
| Verdugo–Eagle Rock | 6.0-6.8[d] | 3.9 |
| Sierra Madre Fault Zone–Sierra Madre B | 6.0-7.0[d] | 8.3 |
| Puente Hills–Coyote Hills (Blind-Thrust Fault) | 6.5-7.1[b] | 10.0 |

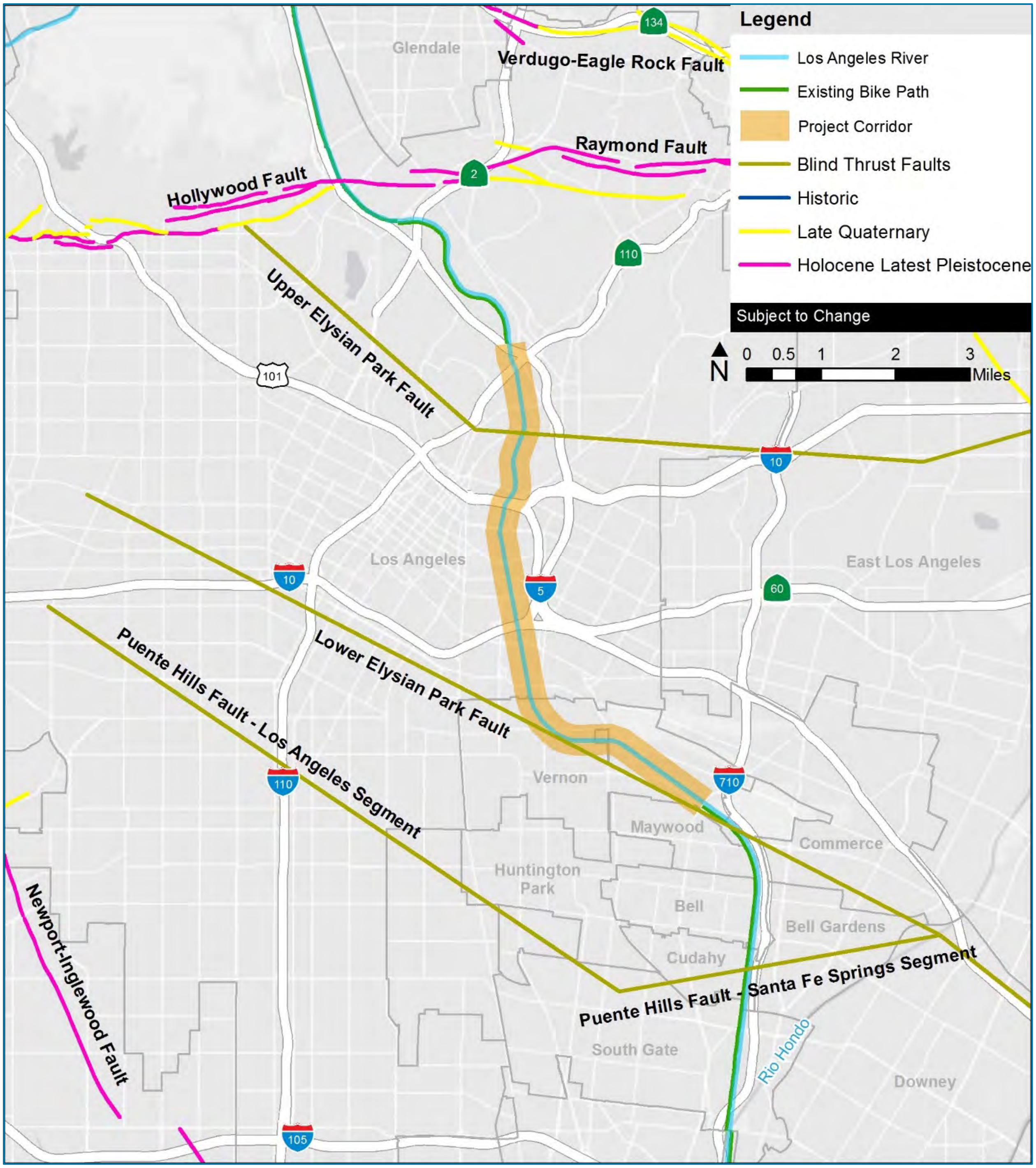
[a] Distance tabulated is approximately the closest distance from the surface projection of the fault to the study area, based on USGS and CGS 2022. The blind-thrust faults do not actually extend to the surface.

[b] Shaw et al. 2002

[c] Oskin et al. 2000

[d] Southern California Earthquake Data Center 2021

**Figure 2-2. Fault Location Map**




Source: USGS and CGS 2022

## 2.6.2 Seismic Hazards

Several geologic hazards can occur in direct relation to a seismic event (earthquake). The hazards range from seismic shaking to liquefaction to tsunamis and seiches, as discussed in the following sections. Consideration of seismic hazards during design and construction can prevent adverse impacts on Proposed Project components during operation.

### 2.6.2.1 Seismic Shaking

The study area is located within the seismically active region of Southern California and may be subject to seismic ground shaking over time. The Proposed Project bridge, retaining wall, and elevated path structures would be designed in accordance with the Caltrans SDC, and retaining walls associated with river channel will be designed in accordance with USACE requirements, accounting for seismic hazards.

Based on the available subsurface data, soils in the study area can generally be classified as competent soils or Class S1 soils. For this evaluation of the Proposed Project study area, report preparers assumed the average shear wave velocity in the upper 30 meters of soils (Vs30) to be about 886 feet per second (approximately 270 meters per second). This velocity is equivalent to the lower bound of Caltrans SDC Class S1 Soil, and is in the approximate mid-range of California Building Code Site Class D. For final design, this value would be developed using site-specific boring data and/or in situ shear wave velocity measurements.

The Caltrans Acceleration Response Spectrum (ARS) Online Tool (2021) was used to develop the Proposed Project's preliminary design ARS, with an assumed Vs30 value of 270 meters per second. The Caltrans ARS Online Tool considers the probabilistic response spectra developed for an approximate 975-year return period (or 5% probability of exceedance in 50 years) ground motions based on the 2014 edition of the USGS Hazard Maps. The response spectrum is adjusted for near fault and basin effects.

Considering that the peak ground acceleration (PGA) decreases from north to south along the Proposed Project study area, and that many of the proposed structures will be long and continuous, two design response spectra were developed for this conceptual evaluation:

- Northern spectra are representative of the study area from the northern terminus to Seventh Street. The calculated PGA is 0.69 g (g = acceleration due to gravity) for the northern spectra, based on an event with a mean magnitude of 6.8. The northern spectra are based on the location of Riverside Drive at the LA River.
- Southern spectra are representative of the study area from Seventh Street to the southern terminus. The calculated PGA is 0.65 g for the southern spectra, based on an event with a mean magnitude of 6.8. The southern spectra are based on the location of Seventh Street at the LA River.

For the final design, the PGA value will be determined on a structure-specific basis. Proposed Project structures would be designed and constructed to account for the estimated levels of PGA stipulated by the Caltrans ARS.[1] The conceptual design spectra are presented in Attachment B.

### 2.6.2.2 Other Seismic Hazards

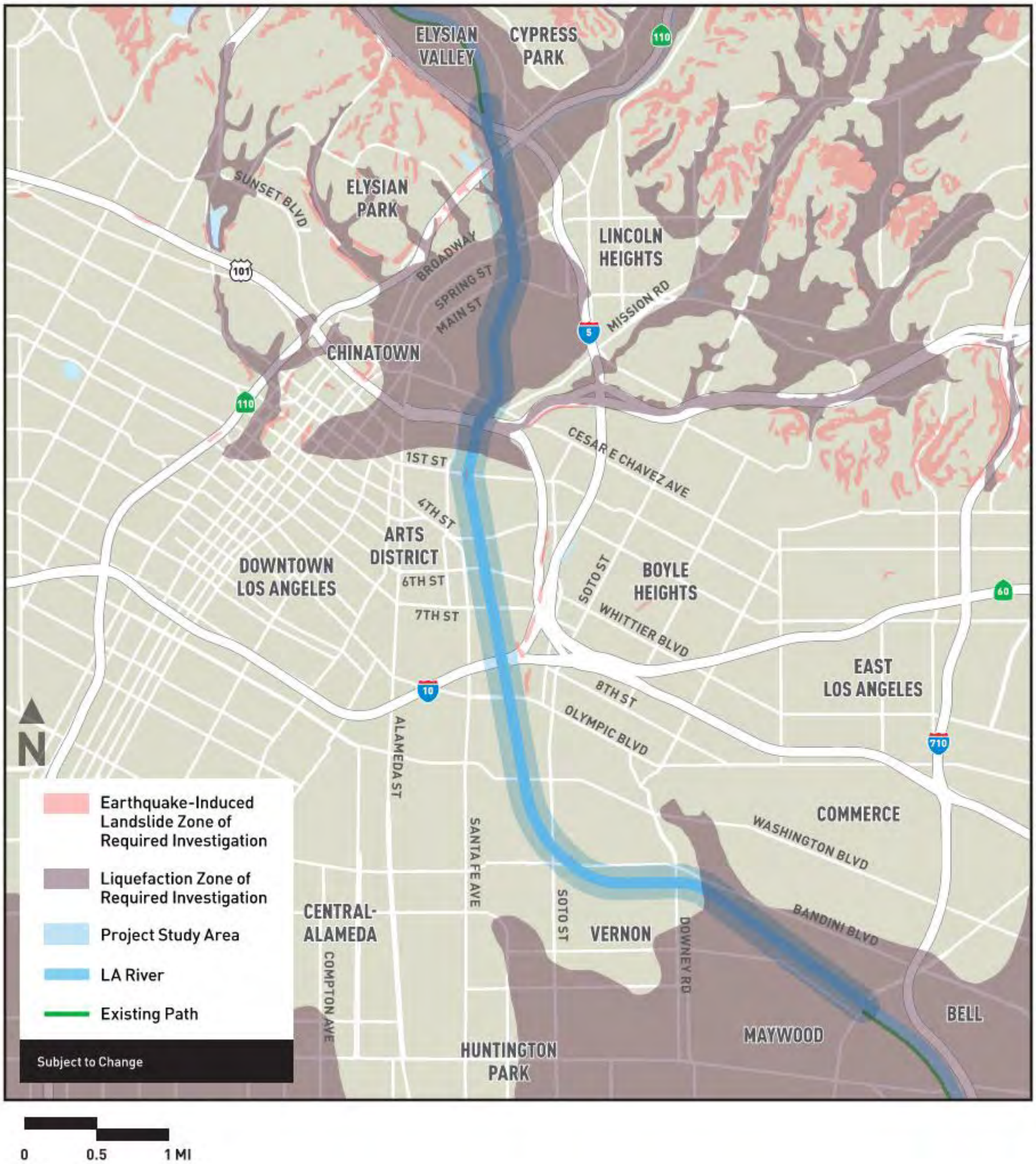
Seismic hazards (other than seismic shaking) present in the study area are discussed as follows:

- **Liquefaction:** During strong ground shaking, loose, saturated, cohesionless soils in the upper 50 to 75 feet bgs can experience a temporary loss of shear strength and ground deformations can occur, leading to liquefaction. Based on CGS Seismic Hazard Zones Official Maps covering the study

[1] In the event that a different owning agency specifies different design guidelines, the owning agency's guidelines would take precedent.

area (CGS 1999a, 1999b), the portions of the study area from its northern terminus to roughly First Street, and from near Downey Road to the Proposed Project study area's southern terminus, are located in a Zone of Required Investigation for liquefaction, as shown on Figure 2-3. The Zone of Required Investigation delineation is established around areas where existing data indicates that the potential for the hazard warrants a detailed evaluation, in accordance with the Seismic Hazards Mapping Act.

**Figure 2-3. Seismic Hazard Zones Map**




Sources: CGS 1999a, 1999b

- **Lateral spreading:** In liquefiable areas, where the ground surface is gently sloped and/or has a free face (such as a riverbank), lateral spreading may occur. Lateral spreads develop on a relatively continuous layer of liquefiable soil that is present near the ground surface. Seismic and gravitational forces can cause the soil mass to move on the liquefied soil layer.
- **Seismically induced landslides:** The potential for seismically induced landslides will depend on the steepness of the slope, strength and structure of the soil/rock, groundwater depth and extent, and level of ground shaking. Most of the study area is relatively flat, and significant slopes are not present. However, steeper terrain is present adjacent to the study area generally from where the LA River crosses below I-5 to where the LA River crosses below Broadway. An existing landslide is mapped in this area (Section 3.7.1). As shown on Figure 2-3, this area is located in a Zone of Required Investigation for earthquake-induced landslides (CGS 1999a).
- **Seismically induced settlement:** Loose, unsaturated granular soils are susceptible to seismically induced settlement. This could include the alluvial soils located above the groundwater table within the study area. These settlements can result in total and differential settlement of soils supporting structures and utilities. The magnitude of these settlements will depend on the type of structure, the characteristics of the soil below the structure, and the level of ground shaking. Within the study area, granular alluvial soils in the upper 50 to 75 feet bgs are potentially susceptible to seismically induced settlement.
- **Seismically induced inundation**: This hazard can occur when an earthquake causes catastrophic failure of a water-retaining structure (such as a reservoir, dam, or levee), and subsequent flooding occurs due to the release of water from the structure. Los Angeles County has prepared a Dam and Reservoir Inundation Routes Map, which shows that the study area is located within a potential dam inundation area (Los Angeles County 2012). The map depicts roughly two dozen reservoirs/dams, the majority of which are located near the foothills of the San Gabriel Mountains, as being potential sources of inundation.
- **Tsunamis and seiches**: Tsunamis are waves typically generated offshore or within large, open bodies of water primarily during subaqueous fault rupture or a subaqueous landslide event. Seiches are waves generated within a large, closed body of water, and are also caused by subaqueous fault rupture, landslide events, or by ground oscillations from distant earthquakes. At its closest point to the Proposed Project, the Pacific Ocean is located over 15 miles to the southwest. No closed bodies of water are within or adjacent to the study area. Based on the distance between the study area and large bodies of water, the potential impact on the Proposed Project due to a tsunami or seiche is negligible. In addition, the study area is not located within a Tsunami Inundation Area (Los Angeles County 2022).

## 2.7 Nonseismic Hazards

Potential geologic hazards that may exist within the study area under static loading conditions are discussed in the following sections. Static loading conditions are the normal conditions in which the primary load (or force) acting on a design feature or geologic unit is gravity.

### 2.7.1 Slope Stability

The stability of a slope depends on the inclination, geology and geologic structure, soil and rock strength, and ground and surface water conditions within the slope. The majority of the study area is relatively flat, and significant natural slopes are not present; however, steeper terrain is present adjacent to the study area generally from where the LA River crosses below I-5 to where the LA River crosses below North Broadway. Regional geologic maps (Dibblee 1989, Lamar 1970) indicate that a landslide is present on the west side of the LA River, south of Interstate (I-)5 and immediately west of the newly constructed Riverside Drive Viaduct. This landslide is likely a relatively shallow slump type landslide, because the feature's direction of movement (to the northeast) would be opposite the bedding plane dip direction (to the south to southwest) of the Puente Formation bedrock in this area.

### 2.7.2 Expansive Materials

Expansive soils are clay-rich soils that swell and shrink with wetting and drying. The shrink-swell capacity of expansive soils can result in differential movement below or adjacent to a structure, such as the Proposed Project at-grade path and retaining walls. Clay-rich soils exist locally within alluvial soils present in the study area. In addition, bedrock units also can exhibit expansive properties due to the clay content within the bedrock; this includes the Puente Formation Siltstone Member, and the Fernando Formation present within the study area.

### 2.7.3 Regional Subsidence

Regional subsidence results from the withdrawal of groundwater and hydrocarbons from the subsurface. As the groundwater or hydrocarbons are pumped out of the ground, the resultant voids or pores are compressed under the pressures of the soils above. Accumulation of the compression results in subsidence of the ground surface. DWR estimated the potential for future land subsidence within the study area as low because groundwater withdrawal is restricted and managed and, where performed, is compensated by reinjection of water in volumes similar to what is withdrawn (DWR 2014). Similar protocol is in place during pumping for hydrocarbons.

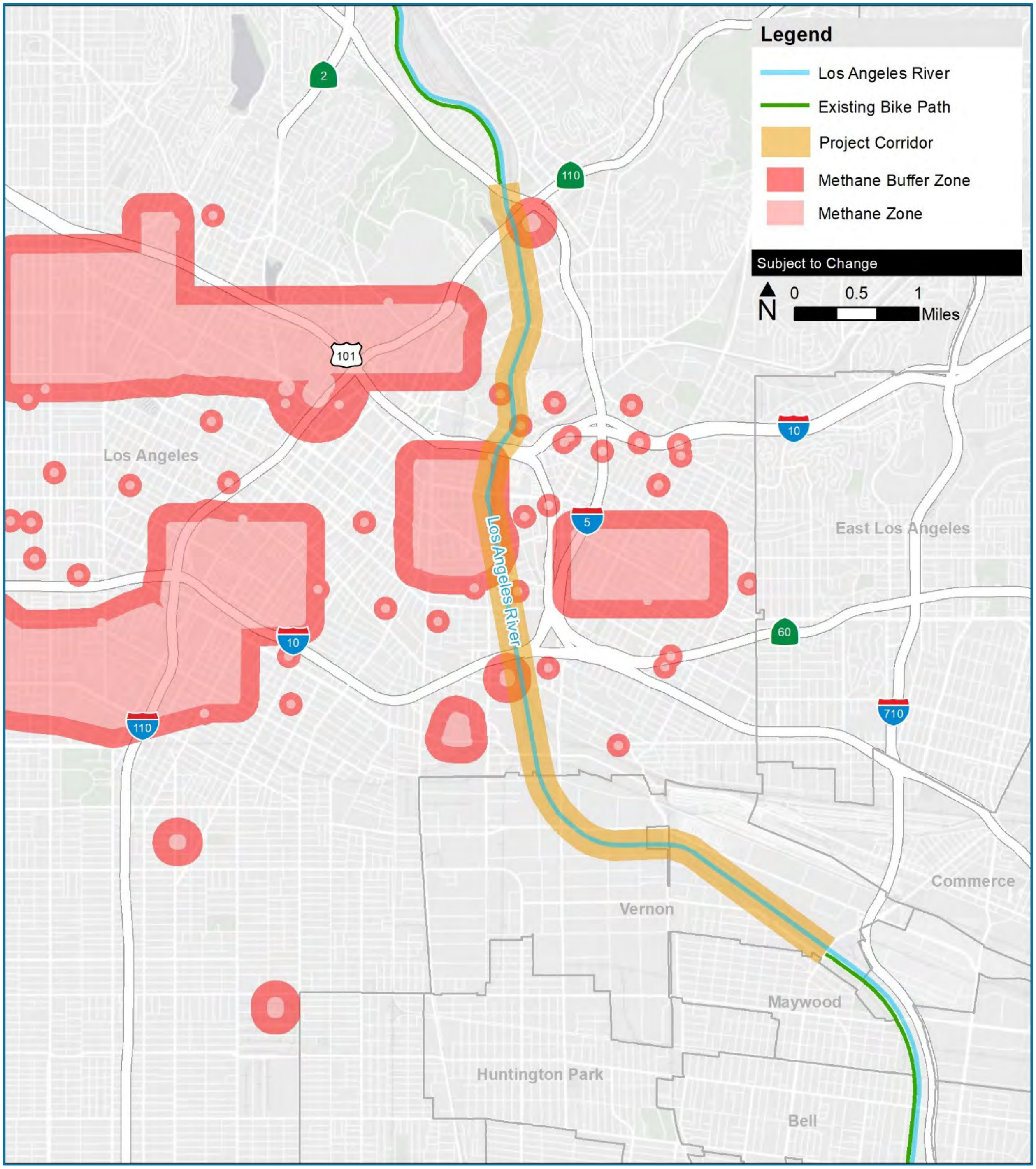
### 2.7.4 Naturally Occurring Oil and Gas

Naturally occurring oil and gas are present in portions of the study area. Union Station Oil Field is mapped immediately west of the LA River (City of Los Angeles 2016) roughly from US-101 to Sixth Street. Los Angeles City Oil Field is located immediately north of the northern terminus of the Proposed Project. Development of these areas as true oil fields is abandoned. However, numerous operational oil wells are present in these oil field areas. In addition, and based on the CalGEM's database, plugged and abandoned wells are located on the east bank of the LA River, approximately 350 feet north of Cesar E Chavez Avenue, and in the rail right-of-way, approximately 250 feet east of the LA River (CalGEM 2018). Active wells are not present within the study area (CalGEM 2018).

Methane is a naturally occurring gas associated with the decomposition of organic materials. Methane gas is common in oil and gas fields and often occurs with $H_2S$. $H_2S$ is produced by anaerobic decomposition of type of organic or inorganic mater that contains sulfur. Methane and $H_2S$ can also occur in a dissolved state in groundwater. Methane and $H_2S$ are considered hazardous gases due to their explosive properties.

As shown on Figure 2-4, numerous portions of the study area are located within a methane zone or methane buffer zone designated by the City of Los Angeles (City of Los Angeles 2004). Methane data for neighboring cities are not publicly available. These methane and methane buffer zones were established where naturally occurring methane may occur and create a hazard to life and property. Methane is combustible when mixed with air in the range of between 5 and 15% by volume. The 5% methane volume is called the lower explosive limit. The US Occupational Safety and Health Administration (OSHA) permissible exposure limit to $H_2S$ for workers is 10 parts per million.

**Figure 2-4. Methane and Methane Buffer Zones in the City of Los Angeles**




Source: City of Los Angeles 2004 (data for neighboring cities are not publicly available)

Encountering gassy conditions anywhere in the study area is possible because it is characterized by oil and gas fields and areas with known subsurface gas conditions. Considering the Proposed Project components, the primary Proposed Project hazard associated with naturally occurring oil and gas would be during construction of deep excavations, such as those required for CIDH pile type foundation systems.

### 2.7.5 Hazardous Materials

Hazardous materials (such as contaminated soil and groundwater) may be present in the study area. Hazardous materials are discussed in the *Phase I Environmental Site Assessment* (Metro 2023).

## 2.8 Mineral Resources

The study area is situated atop alluvial soils, some of which could likely be used as construction material, such as sand and gravel. However, considering the highly urbanized nature of the study area, mining of these materials is not economically viable, meaning that it would not be profitable to convert the study area to a quarry. In addition, the study area is not located on an existing or previously mined area and local ordinances, or regulations do not allow surface mining within the study area.

## 2.9 Existing Structural Foundations

This summary of the existing foundation types is based on review of the available as-built bridge foundation plans for structures that cross the LA River within the study area. A thorough evaluation of the existing foundation types will be performed as the Proposed Project proceeds. The existing structures are supported by a wide variety of foundation types that were installed over the last 110 years or so, including the following types:

- Spread footings
- Driven untreated timber piles
- Driven "H" piles
- Driven steel rail piles
- Cast-in-steel-shell concrete piles
- CIDH piles

Based on the available as-built structural plans, existing pile lengths (below the LA River channel bottom) vary from approximately 12 to more than 160 feet long, and range in diameter or width from 1 to 11 feet. A summary of the available as-built foundation information is presented in Table 2-3.

**Table 2-3. Summary of Available As-built Foundation Information**

| Structure | Bridge Name | Bridge Number | Piers, Abutments, Columns | Foundation Types | Pile Length | Material Type |
|---|---|---|---|---|---|---|
| 1 | I-5 Viaduct | 53-1424 | East Bent 17 | 24-inch CIDH (original) and 24-inch CIDH (retrofit) | 49 feet and 57 feet | Concrete |
| | | | River Pier 18 | 24-inch CIDH | 14 feet | Concrete |
| | | | West Bent 19 | 24-inch CIDH (original) and 16-inch pipe piles (retrofit) | 29 feet and 59 feet | Concrete |
| 2 | Riverside Drive Viaduct | 53-C2355 | East Abutment | Driven steel piles HP14 by 89 | 42 feet | Steel |
| | | | Bent 2 | 24-inch CIDH | 62 feet | Concrete |
| | | | Bent 3 | 96-inch and 84-inch CIDH | 73 feet | Concrete |
| | | | Bent 4 | 120-inch CIDH | 104 feet | Concrete |
| | | | Bent 5 | 96-inch CIDH | 113 feet | Concrete |
| | | | West Abutment | 24-inch CIDH | 74 feet | Concrete |
| 3 | Metrolink LA River–Downey Bridge | N/A | West Abutment | Spread footing | N/A | Concrete |
| | | | Pier | 8-foot CIDH | 49.5 feet | Concrete |
| | | | East Abutment | Spread footing | N/A | Concrete |
| 4(R) | SR-110 Bridge Right | 53-0042R | West River Pier 6 (R) | Driven timber piles | Spread footing | Timber |
| | | | East River Pier 7 (R) | N/A | 13 feet | Concrete |
| 4(L) | SR-110 Bridge Left | 53-0042L | East River Pier 2 (L) | Spread footing | N/A | Concrete |
| | | | West River Pier 3 (L) | Driven piles | 17.5 feet | Unknown |
| 5 | Metro A Line LA River Bridge | N/A | Pier 4 | 9-foot CIDH | 68 feet | Concrete |
| | | | Pier 5 | Spread footing | N/A | Concrete |
| | | | Pier 6 | Spread footing | N/A | Concrete |
| | | | Pier 7 | 7-foot CIDH | 85 feet | Concrete |
| 6 | North Broadway Viaduct | 53-C0545 | Pier 5 | Driven timber piles | 23 feet 8 inches | Timber |
| | | | Pier 6 | Driven timber piles | 23 feet 8 inches | Timber |
| | | | Pier 7 | Driven timber piles | 23 feet 8 inches | Timber |

**Table 2-3. Summary of Available As-built Foundation Information**

| Structure | Bridge Name | Bridge Number | Piers, Abutments, Columns | Foundation Types | Pile Length | Material Type |
|---|---|---|---|---|---|---|
| 7 | North Spring Street Viaduct | 53-C0859 | West Abutment | Spread footing (original) and 5-foot CIDH (widening) | 62 feet | Concrete |
| | | | Center Pier | Spread footing (original) and 5-foot CIDH (widening) | 67.5 feet | Concrete |
| | | | East Abutment | Spread footing (original) and 5-foot CIDH (widening) | 62 feet | Concrete |
| 8 | North Main Street Viaduct | 53-C1010 | West Abutment | Driven timber piles | Unknown | Timber |
| | | | West River Pier | Driven timber piles | Unknown | Timber |
| | | | East River Pier | Driven timber piles | Unknown | Timber |
| | | | East Abutment | Driven timber piles | Unknown | Timber |
| 9 | Metrolink Mission Junction Railroad Bridge North | N/A | West Abutment | Driven steel rail piles | Unknown | Steel |
| | | | Pier 1 | Driven steel rail piles | Unknown | Steel |
| | | | Pier 2 | Driven steel rail piles | Unknown | Steel |
| | | | East Abutment | Driven steel rail piles | Unknown | Steel |
| 10 | Metrolink Mission Junction Railroad Bridge South | N/A | East Abutment | Driven HP 10 by 42 piles | 28 feet | Steel |
| | | | Pier 1 | Driven HP 10 by 42 piles | 28 feet | Steel |
| | | | Pier 2 | Driven HP 10 by 42 piles | 27 feet | Steel |
| | | | West Abutment | Driven HP 10 by 42 piles | 28 feet | Steel |
| 11 | Cesar E Chavez Avenue Viaduct | 53-C0131 | Bent 1 | Spread footing | N/A | Concrete |
| | | | East Abutment | Spread footing | N/A | Concrete |
| | | | West Abutment | Spread footing | N/A | Concrete |
| | | | Bent 2 | Spread footing | N/A | Concrete |
| 12 | El Monte Busway Bridge | 53-C2673 | Bent 11 | Driven HP 14 by 89 piles | 34 feet | Steel |
| | | | Bent 12 | Driven HP 14 by 89 piles | 34 feet | Steel |
| 13 | US-101 LA River Bridge | 53-0405 | West Abutment | Spread footing | N/A | Concrete |
| | | | East Abutment | Spread footing | N/A | Concrete |

**Table 2-3. Summary of Available As-built Foundation Information**

| Structure | Bridge Name | Bridge Number | Piers, Abutments, Columns | Foundation Types | Pile Length | Material Type |
|---|---|---|---|---|---|---|
| 14 | First Street Viaduct | 53-C1166 | Bent 9 | Spread footing | N/A | Concrete |
| | | | West Arch Abutment | 12-inch driven timber piles | 12 feet | Timber |
| | | | Pier | 12-inch driven timber piles | 12 feet | Timber |
| | | | East Arch Abutment | 12-inch driven timber piles | 12 feet | Timber |
| | | | Bent 8 | Spread footing | N/A | Concrete |
| 15 | Fourth Street Viaduct | 53-C0044 | Pier 5 | Driven precast piles | 12–15 feet | Concrete |
| | | | Abutment 4 | Driven precast piles | 12–15 feet | Concrete |
| | | | Abutment 3 | Driven precast piles | 12–15 feet | Concrete |
| | | | Pier 2 | Driven precast piles | 12–15 feet | Concrete |
| 16 | Sixth Street Viaduct | 53-C2329 | Bent 5 | 10-foot CIDH | 156 feet | Concrete |
| | | | Bent 6 | 10-foot CIDH | 163 feet | Concrete |
| 17 | Seventh Street Viaduct | 53-C1321 | Bent 9 | Spread footing | Unknown | Concrete |
| | | | West River Abutment | Driven piles | Unknown | Concrete |
| | | | Pier 2 | Driven piles | Unknown | Concrete |
| | | | Pier 1 | Driven piles | Unknown | Concrete |
| | | | East River Abutment | Driven piles | Unknown | Concrete |
| | | | Bent 8 | Spread footing | Unknown | Concrete |
| 18 | I-10 Santa Monica Viaduct | 53-1301 | Bent 3 | 24-inch CIDH pile | 43 feet | Concrete |
| | | | Pier 4 | Spread footing | N/A | Concrete |
| | | | Bent 5 | 24-inch CIDH pile | 43 feet | Concrete |

**Table 2-3. Summary of Available As-built Foundation Information**

| Structure | Bridge Name | Bridge Number | Piers, Abutments, Columns | Foundation Types | Pile Length | Material Type |
|---|---|---|---|---|---|---|
| 19 | Olympic Boulevard Viaduct | 53-C0163 | Abutment 1 | Driven untreated Douglas fir piles | 8.75–20.33 feet (varies) | Timber |
| | | | Abutment 2 | Driven untreated Douglas fir piles | 20 feet | Timber |
| | | | Pier 1 | Driven untreated Douglas fir piles | 20 feet | Timber |
| | | | Pier 2 | Driven untreated Douglas fir piles | 20 feet | Timber |
| | | | Other bents | Spread footing | N/A | Concrete |
| | | | Bent 15 and 18 | Driven Class 100 piles | 144 feet | Steel |
| 20 | UP LA River Bridge | N/A | Abutment 1 | Driven steel pile and 5-foot CIDH pile | CIDH L = 61 feet | Steel/Concrete |
| | | | Pier 2 | 6-foot CIDH pile | 59 feet | Concrete |
| | | | Pier 3 | 6-foot CIDH pile | 59 feet | Concrete |
| | | | Pier 4 | Driven steel pile and 5-foot | 59 feet | Concrete |
| | | | Abutment 5 | CIDH pile | CIDH L = 61 feet | Steel/Concrete |
| 21 | Washington Boulevard Bridge | 53-C1375 | Columns A and B | Driven 16-inch concrete piles | 12–18 feet (varies) | Concrete |
| | | | Pier 1 | Driven 16-inch concrete piles | 13–16 feet (varies) | Concrete |
| | | | Pier 2 | Driven 16-inch concrete piles | 13–15.6 feet (varies) | Concrete |
| | | | Pier 3 | Driven 16-inch concrete piles | 13–13.9 feet (varies) | Concrete |
| | | | Pier 4 | Driven 16-inch concrete piles | 11–16.5 feet (varies) | Concrete |
| | | | Abutments | Driven 16-inch concrete piles16 feet | 11–16.5 feet (varies) | Concrete |
| 22 | Redondo Junction Grade Separation | 53-C2081 | Bent 12 | 11-foot CIDH pile | 72 feet | Concrete |
| | | | Bent 13 | 11-foot CIDH pile | 81 feet | Concrete |
| | | | Bent 14 | 11-foot CIDH pile | 72 feet | Concrete |
| 23 | BNSF Railway LA River Bridge | As-builts unavailable | -- | -- | -- | -- |
| 24 | 26th Street Bridge | 53-C0868 | All abutments and piers | Spread footing | N/A | Concrete |

**Table 2-3. Summary of Available As-built Foundation Information**

| Structure | Bridge Name | Bridge Number | Piers, Abutments, Columns | Foundation Types | Pile Length | Material Type |
|---|---|---|---|---|---|---|
| 25 | Soto Street Bridge | 53-C0867 | Abutment 1 | Driven HP14 by 73 piles | 44.75–46.75 feet (varies) | Steel |
| | | | Piers 3 through 7 | Driven HP14 by 73 piles | 32.5–33.4 feet (varies) | Steel |
| | | | Pier 2 R | Driven HP14 by 73 piles | 52 feet/60 feet | Steel |
| | | | Pier 2 L | Driven HP14 by 73 piles | 49.75 feet/57.75 feet | Steel |
| | | | Pier 3 R/L | Driven 16-inch by 1/2-inch pipe piles | 28.5 feet | Steel |
| | | | Pier 4 R/L | Driven 16-inch by 1/2-inch pipe piles | 32.5 feet | Steel |
| | | | Pier 5 R/L | Driven 16-inch by 1/2-inch pipe piles | 32.5 feet | Steel |
| | | | Pier 6 R/L | Driven 16-inch by 1/2-inch pipe piles | 32.5 feet | Steel |
| | | | Pier 7 R | Driven 16-inch by 1/2-inch pipe piles | 34.5 feet | Steel |
| | | | Pier 7 L | Driven 16-inch by 1/2-inch pipe piles | 28.5 feet | Steel |
| | | | Pier 8 R | Driven HP14 by 73 piles | 53.5 feet/61.5 feet | Steel |
| | | | Pier 8 L | Driven HP14 by 73 piles | 48.25 feet/56.25 feet | Steel |
| | | | Abutment 9 | Driven HP14 by 73 piles | 43.75–50.75 feet (varies) | Steel |
| 26 | Bandini Boulevard Bridge | 53-C0827 | Abutment 1 | Driven HP 12 by 53 piles | 47.43 feet | Steel |
| | | | Pier 2 | Driven HP 12 by 53 piles | 153.58 feet (varies) | Steel |
| | | | Pier 3 | Driven HP 12 by 53 piles | 154.75 feet (varies) | Steel |
| | | | Pier 4 | Driven HP 12 by 53 piles | 154.75 feet (varies) | Steel |
| | | | Pier 5 | Driven HP 12 by 53 piles | 154.33 feet (varies) | Steel |
| | | | Pier 6 | Driven HP 12 by 53 piles | 158 feet (varies) | Steel |
| | | | Pier 7 | Driven HP 12 by 53 piles | 161.25 feet (varies) | Steel |
| | | | Pier 8 | Driven HP 12 by 53 piles | 164.83 feet (varies) | Steel |
| | | | Abutment 9 | Driven HP 12 by 53 piles | 37.09 feet | Steel |

**Table 2-3. Summary of Available As-built Foundation Information**

| Structure | Bridge Name | Bridge Number | Piers, Abutments, Columns | Foundation Types | Pile Length | Material Type |
|---|---|---|---|---|---|---|
| 27 | Downey Road Bridge | 53-C0576 | Abutment 1 | 16-inch by 16-inch concrete piles (original)<br>Driven HP 12 by 53 piles (widening) | 30 feet | Steel |
| | | | Piers 2–11 | Driven HP 12 by 53 piles (widening) | 28–30 feet (varies) | Steel |
| | | | Pier 12 | 24-inch by 24-inch concrete piles (original) | 30 feet | Concrete |
| | | | Abutment 13 | 16-inch by 16-inch concrete piles (original) | 64 feet | Concrete |
| 28 | BNSF Railway Bridge at Downey Road | As-builts unavailable | -- | -- | -- | -- |
| 29 | BNSF Railway Bridge at District Boulevard | As-builts unavailable | -- | -- | -- | -- |
| 30 | Atlantic Boulevard Bridge | 53-C0252 | South Abutment | 16-inch by 16-inch driven concrete piles | 25–30.25 feet (varies) | Concrete |
| | | | Piers 1 through 6 | 16-inch by 16-inch driven concrete piles | 25–38.6 feet (varies) | Concrete |
| | | | North Abutment | 16-inch by 16-inch driven concrete piles | 25–30.25 feet (varies) | Concrete |

# 2.10 Paleontological Resources

## 2.10.1 Paleontological Potential and Sensitivity

Paleontological potential is defined as the potential for a geologic unit to produce scientifically significant fossils. This is determined by rock type, geologic history of the rock unit in preserving and producing significant fossils, and fossil localities that are recorded from that unit. Paleontological potential is derived from the fossil data collected from the entire geologic unit, not just from a specific survey. A four-tiered classification system with Classes a through d for paleontological potential, recommended by SVP (1995, 1996, 2010) and recognized in California are as follows:

- **Class a—High Potential:** Indicates rock units that have the potential for yielding abundant or significant fossils, such as significant vertebrate and invertebrate, plant or trace fossils, or microfossils, and the potential to yield important scientific data. These units range temporally from middle Holocene in age or older and are lithologically suitable for fossil preservation, such as fine-grained alluvial, fluvial, marine, and lacustrine sediments, paleosols, and volcanic (airfall and volcaniclastic). In rare instances, fossils may be present within low-grade metamorphic rocks, such as marble (limestone or dolostone variety) (SVP 2010).
- **Class b—Undetermined Potential:** Unknown or undetermined sensitivity indicates that the rock unit has not been sufficiently studied or lacks good exposures to warrant a definitive rating. This rating is treated initially as having a high sensitivity or potential. After study or monitoring, the unit may fall into one of the other categories. According to the SVP (2010), 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 subsurface data are not available, paleontological potential can sometimes be determined by strategically located excavations into subsurface stratigraphy" (SVP 2010).
- **Class c—Low Potential:** Indicates significant fossils are not likely to be found because of a random fossil distribution pattern, extreme youth of the rock unit (younger than middle Holocene), and/or the geologic history of rock formation processes, such as alteration by heat and pressure. The rock units will not likely require impact mitigation for fossil protection (SVP 2010).
- **Class d—No Potential:** Indicates significant fossils are not likely to be found because the rock unit is a high-grade metamorphic, or plutonic rock that is unsuitable for fossil preservation. These rock units do not typically require protection of impact mitigation for paleontological resources (SVP 2010). These units also include human altered or human placed sediments (fill) in ex situ context, and disturbed sediments. Fossil in ex situ context may be encountered in these deposits, yet they lack scientific integrity.

## 2.10.2 Records Search Results

Jacobs requested a museum records search from NHMLA on July 14, 2021 and received the records search results on July 22, 2021 (NHMLA 2021). NHMLA reports that fossil localities from NHMLA collections are not mapped within the Proposed Project area; however, fossils are recorded nearby within similar Pleistocene deposits, as well as the Monterey Formation and its local equivalent the Modelo Formation. The fossils are recorded from the surface (LACM VP-1880) to nearly 100 feet bgs (LAMC VP-7507). NHMLA fossil localities nearest the Proposed Project are presented in Table 2-4.

**Table 2-4. NHMLA Fossil Localities Closest to the Proposed Project**

| Locality Number | Location | Formation | Taxa | Depth; Distance |
|---|---|---|---|---|
| LACM VP-7702 | Intersection of 26th Street and Atlantic Boulevard, Bell Gardens | Unknown Formation (Pleistocene; silt) | Fish (*Gasterosteus*); Snake (*Colubridae*), Rodents (*Thomomys, Microtus*); Rabbit (*Sylvilagus*) | 30 feet bgs; 0.60 mile east of Proposed Project |
| LACM VP-3363 | West of Monterey Pass Road in Coyote Pass; East of the Long Beach Freeway and South of the North boundary of Section 32 | Unknown formation (Pleistocene; sand and silt) | Horse (*Equus*) | Unknown depth; > 1 mile east of Proposed Project |
| LACM VP-7758 | South Region Middle School 6; S. Western Avenue and 46th Street | Unknown formation (Pleistocene) | Three-spined stickleback (*Gasterosteus*); rodents (*Perognathus*, *Thomomys*, *Microtus*) | 16 feet bgs; > 1 mile west of Proposed Project |
| LACM VP-1755 | Near 12th and Hill Streets | Unknown formation (Pleistocene) | Horse (*Equus*) | 43 feet bgs; > 1 mile west of Proposed Project |
| LACM VP-2032 | Los Angeles Brickyard Mission Road and Daly Street | Unknown formation (Pleistocene; silt and clay) | Mastodon (*Mammut*) | 20–35 feet bgs; 0.70 mile east of Proposed Project |
| LACM VP-1023 | Workman and Alhambra Streets | Unknown formation (Pleistocene) | Saber-toothed cat (*Smilodon*), horse (*Equus*), deer (*Odocoileus*), turkey (*Meleagris*) | Unknown depth (storm drain excavations); 0.6 mile east of Proposed Project |
| LACM VP-7507 | Near intersection of San Fernando Road and Humbolt Street | Monterey Formation | Fish (*Thyrsocles kriegeri*) | 101.7–105 feet bgs (Humboldt Street Sewer Shaft); 0.15 mile east of Proposed Project |
| LACM VP-1880 | 3320 Seymour Street, West of Mt. Washington | Modelo Formation (orange shale) | Fish (*Osteichthyes*) | Surface; 0.4 mile east of Proposed Project |

VP = vertebrate paleontology

The results of the UCMP online fossil database search conducted by Jacobs determined that the UCMP has numerous pre-Quaternary and Quaternary age fossil specimens recorded for Los Angeles County. The fossil specimens include Miocene fossils, Eocene to Miocene microfossils, Eocene to Pliocene invertebrates, and Miocene mammal fossils. Numerous Quaternary age vertebrate, invertebrate, microfossil, insect, and plant fossils are also recorded for all of Los Angeles County. Only two UCMP fossil localities, however, are located within a 5-mile radius of the Proposed Project. The two localities consist of Miocene-age microfossils (*Foraminifera*) from bedrock units associated with the Monterey Formation (*Tss* and *Tsh*). The localities are west and east of the Proposed Project (UCMP 2021).

## 2.10.3 Overall Sensitivity of the Proposed Project and Vicinity

Table 2-5 lists the geologic units that occur within about 1 mile of the Proposed Project. This distance was chosen to adequately encompass and understand the geological context of the area and to further correlate the results of the paleontological records search and literature review. Geologic units (bedrock units) mapped and described by Dibblee (1989) and Yerkes (Yerkes et al.1997) have been added to the table to better correlate paleontological localities with similar bedrock units that were mapped, described and labeled differently by various geologists over time. The paleontological sensitivity of each geologic unit is further discussed as follows.

**Table 2-5. Geologic Units within about 1 Mile of the Proposed Project**

| Map Symbol | Geologic Unit Description | Paleontological Potential | Mapped within Proposed Project or in Immediate Vicinity of Proposed Project |
|---|---|---|---|
| Af1 | Artificial Fill—Historic and modern fill | Class d—-No Potential | Yes—extensive throughout Proposed Project-urban area. |
| QwQg[a] | Late Holocene Alluvial Wash Deposits (Qw)/Holocene alluvial clay and sand of valley areas (Qg) | Classes c to a—-Low to High Potential, Increasing with depth | Yes—within and adjacent to LA River channel. May be encountered below fill. Paleontological Potential increases with depth toward underlying Pleistocene (or older) deposits. |
| Qyf/Qya/Qya$_2$/ Qa[a]/Qay[b] | Holocene to late Pleistocene young alluvial fan deposits (Qyf)/young alluvial valley deposits (Qya, Qya$_2$)/ Holocene floodplain deposits (Qa, Qay) | Classes c to a—-Low to High Potential, Increasing with depth | Yes—adjacent to and surrounding landscape of LA River and Proposed Project area. May be encountered below fill or Qw, Qg. Paleontological Potential increases with depth toward underlying Pleistocene (or older) deposits. |
| Qo/fQoa[a]/Qt[b]/ Qoa[2] | Late to Middle Pleistocene surficial deposits-old alluvial fan deposits (Qof)/ Pleistocene Alluvium (Qoa, Qt) | Class a—-High Potential | Yes—patches present along east side of LA River and likely underlies Holocene deposits throughout Proposed Project at unknown depth. |
| Tss/Tsh/Tmss[a]/ Tmsh[a]/Tfr[a]/Tush[a]/ Tpn[b] | Tertiary Sandstone Member (Tmss) and Shale Member (Tmsh) of the Monterey Formation/(Puente Formation) (Tss, Tush, Tpn)/Tertiary fine-grained sedimentary rocks (Fernando Formation) (Tsh, Tfr) | Class a—-High Potential | Yes—within and adjacent to north end of Proposed Project between I-5 and North Broadway. Underlies Holocene and/or Pleistocene deposits at variable depth. May be encountered at surface or shallow depth in north, yet likely too deep in south to encounter for this Proposed Project. |

Notes:

[a]Dibblee 1989

[b]Yerkes 1997

Artificial fill (af) and similar previously disturbed sediments, which are typically encountered in urban area, such as the Proposed Project area and surrounding landscape, would not have fossils in stratigraphic context. Most fossils and their associated stratigraphic context would have been destroyed by the mechanical equipment used in excavation, mixing, and spreading of fill. Therefore, this anthrosediment (anthropogenic sediment-fill) and similar disturbed sediments have a Class d—No paleontological potential (Paleo Solutions 2018; SWCA Environmental Consultants [SWCA] 2003).

The Holocene alluvium and fan deposits (Qw, Qg, Qyf, Qya, Qya$_2$,Qa, and Qay) that are mapped within and adjacent to the Proposed Project are too young to contain important fossil resources and are considered Class c—Low paleontological potential. However, these deposits are likely underlain by Class a—High Potential Pleistocene rock units, such as Qof, Qoa, and Qt, as well as the Pliocene and

Miocene rock units (Tss, Tsh, Tmss, Tmsh, Tush, Tfr, and Tpn). Thus, the paleontological potential of the Holocene units is low, yet increases with depth.

The Pleistocene age terrace, fan and alluvial deposits that are mapped within and adjacent to the Proposed Project study area are well-known fossil bearing units that has nearby (NHMLA 2021) and elsewhere produced numerous fossils of birds, snakes, turtles, rabbits, birds, sloths, as well as larger wolves, saber-toothed cats, horses, bison, and mammoth, among others. Given this, the Pleistocene terrace, fan, and alluvial sediments are all considered to possess a Class a—High paleontological potential (Paleo Solutions 2018; SWCA 2003).

The Tertiary rock units of the Monterey Formation, Fernando Formation, and Puente Formation (Tss and Tsh units) are mapped at the northern portion of the Proposed Project all possess a Class a—High potential for paleontological resources that are significant and unique because the fossils, and sediments can provide important paleoclimatic, paleoecological, and paleontological data and information.

The Puente Formation is contemporaneous with the Monterey Formation and consists of mudstone, sandstone and conglomerate that was deposited in a submarine fan environment. The formation has produced an extensive collection of marine vertebrates and invertebrates and has thus been assigned a Class a—High paleontological sensitivity (SWCA 2003).

The Monterey Formation (and associated Modelo Formation) is a well-known fossil bearing unit that contains numerous fossils of marine mammals, invertebrates, fish and microfossils of diatoms, foraminifera and sponges, yet also numerous terrestrial fossils of plants, dogs, squirrels, deer and birds. Given this has been given a Class a—High paleontological potential (Paleo Solutions 2018; SWCA 2003; NHMLA 2021).

The paleontological study for the Proposed Project determined that rock units with a Class a—High paleontological potential are mapped within and adjacent to the Proposed Project, and at variable depth below the existing surface of Class c—Low potential Holocene deposits and Class d—No potential fill deposits.

# 03

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# Attachment A
# Summary of Available As-built Logs of Test Borings

## Table J-1. Summary of Available As-built Logs of Test Borings

| Boring Number | Boring Type | Station | Offset (feet) | Ground Elevation (feet) | Depth (feet) | Groundwater Elevation (feet) |
|---|---|---|---|---|---|---|
| **Bridge Name** | I-5: Elysian Viaduct | | | | | |
| **Bridge Number** | 53-1424 | | | | | |
| **Owner** | Caltrans | | | | | |
| **Contract** | 07-114884 and 07-129001 | | | | | |
| **Year** | 1957 and 1993 | | | | | |
| B.A Cone | CPT | 301+75 | 71 LT | 354.7 | 79 | NM |
| B-1 | Rotary boring | 278+34 | 60 RT | 334.1 | 85 | 292.1 |
| B-1 | CPT | 218+00 | 16 LT | 338.4 | 76 | NE |
| B-1 | CPT | 158+31 | 30 RT | 335.1 | 18 | NE |
| B-1 | Auger boring | 299+20 | 76 RT | 325.4 | 83 | 295.6 |
| B-2 | Rotary boring | 282+02 | 50 LT | 328.0 | 62 | NM |
| B-2 | CPT | 216+16 | 12 LT | 345.8 | 36 | NE |
| B-2 | CPT | 158+34 | 19 RT | 335.2 | 9 | NE |
| B-2 | Auger boring | 278+22 | 65 LT | 324.2 | 66 | 296.8 |
| B-2A | Auger boring | 278+22 | 90 LT | 326.9 | 22 | NE |
| B-3 | CPT | 280+44 | 59 RT | 328.2 | 68 | NM |
| B-3 | CPT | 205+17 | 05 LT | 339.3 | 74 | NE |
| B-3 | CPT | 158+28 | 16 LT | 336.6 | 76 | NE |
| B-3 | Auger boring | 286+97 | 59 LT | 341.0 | 89 | NM |
| B-4 | CPT | 288.47 | 39 LT | 332.5 | 78 | NM |
| B-4 | CPT | 160+86 | 06 LT | 328.9 | 84 | NE |
| B-4 | Auger boring | 282+39 | 96 RT | 327.2 | 35 | 296.5 |
| B-4 | CPT | 203+09 | 14 RT | 332.4 | 72 | NE |
| B-4A | Auger boring | 282+43 | 71 RT | 327.3 | 84 | NM |
| B-5 | Rotary boring | 279+69 | 64 LT | 329.6 | 40 | NM |
| B-5 | CPT | 220+45 | 11 LT | 330.7 | 67 | NE |
| B-5 | CPT | Unknown | Unknown | 330.2 | 34 | NE |
| B-5 | Auger boring | 292+32 | 68 RT | 334.5 | 87 | 294.4 |
| B-6 | CPT | 281+35 | 60 RT | 328.2 | 68 | NM |
| B-6 | CPT | 208+49 | 16 RT | 344.3 | 24 | NE |
| B-6 | CPT | 162+95 | 12 LT | 329.1 | 75 | NE |
| B-6 | Auger boring | 259+49 | 67 LT | 328.1 | 85 | 293.1 |
| B-7 | CPT | 280+63 | 56 LT | 328.9 | 84 | NM |
| B-7 | CPT | 251+29 | 09 LT | 345.4 | 31 | NE |
| B-7 | Rotary boring | 164+85 | 13 RT | 338 | 50 | NE |

**Table J-1. Summary of Available As-built Logs of Test Borings**

| Boring Number | Boring Type | Station | Offset (feet) | Ground Elevation (feet) | Depth (feet) | Groundwater Elevation (feet) |
|---|---|---|---|---|---|---|
| B-8 | CPT | 282+27 | 58 RT | 327.3 | 61 | NM |
| B-8 | CPT | 223+29 | 25 LT | 332 | 60 | NE |
| B-8 | Rotary boring | 166+98 | 19 RT | 340.5 | 38 | NE |
| B-9 | Rotary boring | 286+85 | 102 LT | 340.5 | 38 | NM |
| B-9 | CPT | 170+18 | 37 LT | 336.3 | 70 | NE |
| B-10 | CPT | 286+95 | 20 RT | 341.3 | 86 | NE |
| B-11 | CPT | 290+56 | 65 RT | 336.9 | 50 | 304.9 |
| B-12 | CPT | 290+29 | 126 LT | 336.3 | 70 | NM |
| B-13 | CPT | 292+00 | 67 RT | 334.3 | 75 | NM |
| B-14 | Rotary boring | 296+39 | 48 LT | 325 | 77 | NM |
| B-14A | Bucket auger boring | 296+30 | 60 RT | 324 | 42 | 288.2 |
| B-15 | CPT | 298+30 | 50 LT | 324.6 | 45 | 281.4 |
| B-16 | CPT | 301+80 | 55 RT | 325.4 | 42 | 285 |
| B-17 | CPT | 295+65 | 55 LT | 324.9 | 34 | NM |
| B-18 | CPT | 295+81 | 48 LT | 325.2 | 88 | NM |
| B-18A | Bucket auger boring | 295+67 | 62 LT | 324 | 45 | 290.2 |
| B-19 | CPT | 284+00 | 99 RT | 332.0 | 59 | NM |
| B-20 | Rotary boring | 284+63 | 108 LT | 338 | 61 | NM |
| B-21 | CPT | 300+51 | 60 LT | 324.8 | 50 | 296.8 |
| B-22 | Rotary boring | 297+29 | 7 RT | 294.7 | 50 | NM |
| B-23 | CPT | 297+74 | 55 RT | 294.9 | 51 | NM |
| B-24 | CPT | 297+17 | 44 LT | 294.5 | 37 | NM |
| B-25 | Rotary boring | 299+18 | 79 RT | 324.9 | 70 | NM |
| B-26 | CPT | 289+82 | 8 RT | 339.1 | 33 | NM |
| **Bridge Name** | Riverside Drive Viaduct | | | | | |
| **Bridge Number** | 53C2355 | | | | | |
| **Owner** | City of Los Angeles | | | | | |
| **Contract** | EF700002F | | | | | |
| **Year** | 2010 | | | | | |
| B-1 | Rotary boring | 11+78 | 9 RT | 344 | 90 | 293.5 |
| B-1 | Hollow stem auger | 7+31 | 190 RT | 332 | 214 | NE |
| B-2 | Hollow stem auger | 11+60 | 214 RT | 328.5 | 21.5 | NE |
| B-2b | Rotary/core boring | 14+14 | 106 LT | 292 | 70 | NM |
| B-3 | Rotary/core boring | 15+47 | 36 LT | 291 | 80 | NM |
| B-3 | Hollow stem auger | 18+50 | 48.5 RT | 334.6 | 50.5 | 291.6 |

**Table J-1. Summary of Available As-built Logs of Test Borings**

| Boring Number | Boring Type | Station | Offset (feet) | Ground Elevation (feet) | Depth (feet) | Groundwater Elevation (feet) |
|---|---|---|---|---|---|---|
| B-4 | Rotary/core boring | 17+27 | 2 LT | 292 | 80 | NM |
| B-4 | Hollow stem auger | 18+50 | 46.5 RT | 334.5 | 21.5 | NE |
| B-4L | Hollow stem auger | 17+33 | 13 LT | 324 | 30 | NE |
| B-5 | Rotary/core boring | 18+50 | 47 RT | 291 | 57 | NM |
| B-5L | Hollow stem auger | 18+54 | 25 RT | 324 | 18 | NE |
| B-6 | Rotary/core boring | 19+70 | 55 RT | 291 | 63 | NM |
| B-6L | Hollow stem auger | 19+71 | 34 RT | 324 | 30 | NE |
| B-7 | Rotary boring | 21+21 | 17 RT | 330 | 36.3 | 295 |
| B-8 | Rotary boring | 20+72 | 97 LT | 332 | 80.2 | 294 |
| B-9 | Rotary boring | 21+76 | 87 LT | 327 | 60.5 | 286 |
| R-1 | Rotary/core boring | 14+23 | Unknown | 236.6 | 91 | NM |
| **Bridge Name** | LAR Downey Bridge (Rail) | | | | | |
| **Bridge Number** | NA | | | | | |
| **Owner** | SCRRA | | | | | |
| **Contract** | C6250 | | | | | |
| **Year** | 1992 | | | | | |
| B-1 | Hollow stem auger | Unknown | Unknown | 330 | 40 | 295 |
| B-2 | Hollow stem auger | Unknown | Unknown | 291.5 | 25 | 292 |
| B-3 | Hollow stem auger | Unknown | Unknown | 330 | 84 | 286 |
| **Bridge Name** | North Broadway Viaduct | | | | | |
| **Bridge Number** | 53C0545 | | | | | |
| **Owner** | City of Los Angeles | | | | | |
| **Contract** | 0043-0128 | | | | | |
| **Year** | 1994 | | | | | |
| B-1 | Hollow stem auger | 9+95 | 6.7 RT | 341 | 120 | 277.5 |
| B-2 | Hollow stem auger | 0+50 | 7.5 RT | 348 | 45 | NE |
| B-3 | Hollow stem auger | 4+50 | 16.6 RT | 305 | 100 | 266 |
| **Bridge Name** | North Spring Street | | | | | |
| **Bridge Number** | 53C0859 | | | | | |
| **Owner** | City of Los Angeles | | | | | |
| **Contract** | Unknown | | | | | |
| **Year** | 2005 | | | | | |
| B-1 | Auger boring | 30+62 | 26 LT | 319 | 47.5 | NE |
| B-2 | Auger boring | 28+17 | 40 LT | 316 | 52 | NE |
| B-3 | Rotary boring | 25+46 | 65 RT | 276 | 80.5 | NE |

### Table J-1. Summary of Available As-built Logs of Test Borings

| Boring Number | Boring Type | Station | Offset (feet) | Ground Elevation (feet) | Depth (feet) | Groundwater Elevation (feet) |
|---|---|---|---|---|---|---|
| B-4 | Auger boring | 23+10 | 38 LT | 310 | 62.5 | NE |
| B-5 | Auger boring | 21+70 | 47 RT | 311 | 46 | NE |
| B-6 | Auger boring | 22+45 | 408 LT | 311 | 10 | NE |
| B-7 | Auger boring | 18+51 | 220 LT | 309 | 10.5 | NE |
| B-8 | Rotary boring | 25 +12 | 58 LT | 277 | 18.5 | NE |
| **Bridge Name** | Cezar Chavez Avenue | | | | | |
| **Bridge Number** | 53C0131 | | | | | |
| **Owner** | City of Los Angeles | | | | | |
| **Contract** | D-30803 | | | | | |
| **Year** | 1993 | | | | | |
| B-1 | Hollow stem auger | 6+20 | 10 LT | 278 | 55 | 239 |
| **Bridge Name** | Los Angeles (El Monte) Busway | | | | | |
| **Bridge Number** | 53.2673 | | | | | |
| **Owner** | Caltrans | | | | | |
| **Contract** | | | | | | |
| **Year** | 1985 and 1995 | | | | | |
| B1 | Unknown | 29+23 | 37 LT | 279.2 | 79 | 239 |
| B-1 | Rotary boring | 27+80 | 8 RT | 276.3 | 74 | 250.9 |
| B-1 | Rotary/core boring | 27+76 | 10 LT | 276.3 | 74 | 250.9 |
| B-2 | CPT | 50+71 | 16 RT | 278.5 | 42 | 255.5 |
| B-2 | Rotary/core boring | 19+00 | 44 LT | 275.7 | 35 | NM |
| B-3 | CPT | 52+42 | 18 RT | 277.8 | 48 | NM |
| B-3 | Rotary boring | 22+30 | 63 LT | 292.1 | 66 | NM |
| B-4 | Rotary boring | 52+37 | 23 LT | 279.3 | 72 | 256.9 |
| B-4 | CPT | 26+57 | 63 LT | 292.8 | 18 | NM |
| B-5 | Rotary boring | 46+63 | 27 LT | 277.9 | 71 | NM |
| B-5 | CPT | 24+96 | 34 RT | 291.5 | 18 | NM |
| B-6 | Rotary boring | 49+14 | 76 RT | 281.6 | 66 | NM |
| B-7 | CPT | 30+55 | 22 RT | 275.8 | 21 | NM |
| B-7 | Rotary boring | 27+04 | 34 RT | 292.5 | 45 | NM |
| B-8 | CPT | 30+57 | 128 LT | 277 | 24 | NM |
| B-9 | CPT | 27+69 | 129 LT | 277.2 | 19 | NM |
| B-10 | CPT | 31+37 | 393 LT | 279 | 54 | 253.1 |
| B-11 | CPT | 31+64 | 65 LT | 277.1 | 20 | NM |
| B-12 | CPT | 33+64 | 104 LT | 277.5 | 18 | NM |

**Table J-1. Summary of Available As-built Logs of Test Borings**

| Boring Number | Boring Type | Station | Offset (feet) | Ground Elevation (feet) | Depth (feet) | Groundwater Elevation (feet) |
|---|---|---|---|---|---|---|
| B-13 | CPT | 34+51 | 30 RT | 277.6 | 22 | NM |
| B-14 | Rotary boring | 32+51 | 78 RT | 277.5 | 46 | NM |
| B-15 | CPT | 35+69 | 12 LT | 276.9 | 22 | NM |
| B-16 | CPT | 35+54 | 29 RT | 278.6 | 21 | NM |
| B-17 | Rotary boring | 31+64 | 247 LT | 277.2 | 101.2 | NM |
| B-18 | Rotary boring | 37+11 | 43 LT | 278.3 | 52 | 255.3 |
| B-19 | Rotary boring | 36+31 | 60 RT | 278.9 | 37 | 246.5 |
| B-20 | Core boring | 37+45 | 48 RT | 278.6 | 22 | NM |
| B-21 | Core boring | 38+72 | 38 RT | 278.3 | 38 | NM |
| B-22 | Core boring | 41+29 | 60 RT | 277.4 | 30 | NM |
| B-23 | Core Boring | 43+37 | 66 RT | 246 | 61 | 234 |
| B-24 | Core boring | 44+24 | 75 RT | 246 | 52 | 234 |
| B-25 | Rotary boring | 47+16 | 50 RT | 279.5 | 41 | NM |
| B-26 | CPT | 53+97 | 23 LT | 279.5 | 44 | NM |
| B-27 | Auger boring | 45+66 | 13 LT | 274 | 30 | NE |
| B-28 | Auger boring | 45+84 | 47 LT | 274 | 27 | NE |
| **Bridge Name** | US 101 Viaduct | | | | | |
| **Bridge Number** | 53-0405 | | | | | |
| **Owner** | Caltrans | | | | | |
| **Contract** | 55-14V02 | | | | | |
| **Year** | 1952 | | | | | |
| B-1 | Core/rotary boring | 9+50 | 35 LT | 278.3 | 38.3 | NM |
| B-1 | CPT | Unknown | Unknown | 298.6 | 61.0 | 258.6 |
| B-2 | CPT | 3+30 | 45 LT | 278.9 | 10.4 | NE |
| B-2 | Rotary boring | Unknown | Unknown | 298.9 | 68 | NM |
| B-3 | Rotary boring | 2+80 | 42 LT | 278.8 | 37.8 | 246.5 |
| B-3 | CPT | Unknown | Unknown | 299.2 | 60 | NM |
| B-4 | Core/rotary boring | 5+80 | 37 LT | 278.6 | 20.6 | NM |
| B-4 | CPT | Unknown | Unknown | 298.9 | 62 | NM |
| B-5 | CPT | 25+15 | 20 LT | 279.7 | 53.7 | NM |
| B-6 | Core/rotary boring | 16+80 | 60 LT | 277.4 | 30.9 | NM |
| B-7 | Rotary boring | 22+70 | 20 LT | 279.5 | 40.5 | NM |
| B-7A | CPT | 22+75 | 25 LT | 279.6 | 34.1 | NM |
| B-8 | CPT | 20+80 | 40 LT | 279.3 | 30.3 | NM |
| B-8A | Rotary boring | 20+85 | 40 LT | 279.3 | 29.8 | 246.5 |

**Table J-1. Summary of Available As-built Logs of Test Borings**

| Boring Number | Boring Type | Station | Offset (feet) | Ground Elevation (feet) | Depth (feet) | Groundwater Elevation (feet) |
|---|---|---|---|---|---|---|
| B-9 | Core/rotary boring | 18+60 | 75 LT | 246.0 | 53 | 234 |
| B-10 | Core/rotary boring | 18+40 | 95 LT | 246.0 | 60 | 234 |
| B-11 | Core/CPT | 18+65 | 102 LT | 246.0 | 36 | NM |
| **Bridge Name** | First Street Viaduct | | | | | |
| **Bridge Number** | 53C1166 | | | | | |
| **Owner** | City of Los Angeles | | | | | |
| **Contract** | Unknown | | | | | |
| **Year** | 1992 | | | | | |
| Test Hole 1 | Hollow stem auger | NA | NA | 265 | 38 | NE |
| Test Hole 2 | Hollow stem auger | NA | NA | 250 | 14 | NE |
| Test Hole 2A | Hollow stem auger | NA | NA | 250 | 8 | NE |
| Test Hole 3 | Hollow stem auger | NA | NA | 265 | 31 | NE |
| Test Hole 4 | Hollow stem auger | NA | NA | 265 | 32 | NE |
| **Bridge Name** | Sixth Street Viaduct | | | | | |
| **Bridge Number** | 53C-2329 | | | | | |
| **Owner** | City of Los Angeles | | | | | |
| **Contract** | E700224F | | | | | |
| **Year** | 2015 | | | | | |
| 04-01 | Auger boring | 34+15 | 13 RT | 253.7 | 100.3 | 188.2 |
| 04-02 | Auger boring | 29+55 | 10 RT | 224.2 | 101.5 | 203.7 |
| 04-03 | Auger boring | 23+05 | 20 RT | 253.4 | 101.5 | 197.1 |
| 04-04 | Auger boring | 19+20 | 0 RT | 250.5 | 101.5 | 196.3 |
| 04-05 | Auger boring | 16+20 | 15 RT | 249.5 | 101.5 | 196.0 |
| 04-06 | Auger boring | 12+40 | 10 RT | 248.3 | 101.5 | 192.8 |
| 08-01 | Rotary boring | 11+31 | 30 RT | 254 | 40.1 | NE |
| 08-02 | Rotary boring | 12+74 | 30 RT | 260 | 50.3 | NE |
| 08-03 | Rotary boring | 14+25 | 34 LT | 252 | 100.5 | NM |
| 08-04 | Rotary boring | 15+97 | 46 RT | 250 | 45.4 | NE |
| 08-05 | Rotary boring | 17+30 | 19 LT | 251 | 126.5 | 189 |
| 08-06 | Rotary boring | 20+69 | 25 LT | 251.5 | 136.5 | NM |
| 08-07 | Rotary boring | 28+87 | 28 RT | 250 | 121 | 193.7 |
| 08-08 | Rotary boring | 33+21 | 106 RT | 250.5 | 151.5 | 189 |
| 08-09 | Rotary boring | 35+95 | 14 RT | 248.5 | 120.9 | NM |
| 08-10 | Rotary boring | 43+59 | 81 RT | 245 | 200.8 | NM |
| 08-11 | Rotary boring | 46+11 | 24 RT | 314.7 | 101.5 | NE |

### Table J-1. Summary of Available As-built Logs of Test Borings

| Boring Number | Boring Type | Station | Offset (feet) | Ground Elevation (feet) | Depth (feet) | Groundwater Elevation (feet) |
|---|---|---|---|---|---|---|
| 08-12 | Rotary boring | 47+33 | 25 RT | 315.3 | 41.5 | NE |
| A-13-001 | Auger boring | 16+41 | 40 LT | 250.6 | 151.2 | 174.6 |
| A-13-008 | Auger boring | 31+60 | 40 LT | 252.5 | 141.5 | 192.3 |
| A-13-014 | Auger boring | 40+31 | 28 LT | 249.6 | 154.2 | 188.9 |
| A-13-017 | Auger boring | 43+36 | 41 LT | 247.7 | 150.9 | 209.7 |
| A-13-018 | Auger boring | 45+87 | 23 LT | 314.8 | 151 | NM |
| A-13-019 | Auger boring | 17+98 | 14 RT | 246.4 | 101.5 | 170.9 |
| A-13-020 | Auger boring | 19+12 | 16 LT | 251.8 | 111.8 | 188.8 |
| A-13-021 | Auger boring | 21+01 | 36 LT | 251.3 | 120.9 | 187.7 |
| A-13-023 | Auger boring | 22+35 | 22 LT | 232.5 | 101.5 | 180.7 |
| R-13-002 | Rotary boring | 20+05 | 37 RT | 251.5 | 202 | 191.5 |
| R-13-003 | Rotary boring | 23+45 | 60 LT | 222.2 | 201 | 187.2 |
| R-13-004 | Rotary boring | 23+71 | 42 RT | 221.4 | 201.4 | 187.4 |
| R-13-009 | Rotary boring | 31+70 | 50 LT | 250.2 | 201.5 | 191.7 |
| R-13-010 | Rotary boring | 34+65 | 52 RT | 248.1 | 201 | 190.1 |
| R-13-012 | Rotary boring | 37+58 | 75 RT | 247.3 | 201.5 | 187.8 |
| R-13-015 | Rotary boring | 40+76 | 45 RT | 246.7 | 201.5 | 186.7 |
| R-15-005 | Rotary boring | 25+12 | 36 RT | 221.3 | 181.5 | 186.3 |
| R-15-007 | Rotary boring | 28+59 | 47 LT | 252.1 | 201 | 184.6 |
| R-15-008 | Rotary boring | 28+62 | 115 LT | 252.1 | 201.5 | 188.1 |
| **Bridge Name** | I-10 Santa Monica Viaduct | | | | | |
| **Bridge Number** | 53-1301 | | | | | |
| **Owner** | Caltrans | | | | | |
| **Contract** | 58-14VC14-FI | | | | | |
| **Year** | 1956 | | | | | |
| B-1 | Rotary boring | 882+52 | 143 LT | 236.6 | 61 | NE |
| B-1 | Rotary boring | 892+91 | 15 RT | 285.6 | 35 | NE |
| B-2 | Rotary boring | 883+97 | 70 RT | 236.9 | 35 | NE |
| B-2 | Rotary boring | 896+43 | 34 LT | 294.7 | 35 | NE |
| B-3 | Rotary boring | 884+82 | 195 LT | 237.8 | 35 | NE |
| B-3 | Sampler boring | 897+09 | 47 RT | 293.9 | 10 | NE |
| B-4 | Rotary boring | 876+95 | 50 LT | 236.8 | 42 | NE |
| B-4 | Sample boring | 901+11 | 43 RT | 286.5 | 24 | NE |
| B-5 | Rotary boring | 881+09 | 9 LT | 204.6 | 34 | NE |
| B-5 | Sampler boring | 902+73 | 9 RT | 282.2 | 26 | NE |

**Table J-1. Summary of Available As-built Logs of Test Borings**

| Boring Number | Boring Type | Station | Offset (feet) | Ground Elevation (feet) | Depth (feet) | Groundwater Elevation (feet) |
|---|---|---|---|---|---|---|
| B-6 | Rotary boring | 880+50 | 112 RT | 203.6 | 49 | NE |
| B-6 | Sampler boring | 903+39 | 46 RT | 281.0 | 19 | NE |
| B-7 | Rotary boring | 880+38 | 149 LT | 204.6 | 31 | NE |
| B-7 | Sampler boring | 902+92 | 51 RT | 283.3 | 18 | NE |
| B-8 | Rotary boring | 879+78 | 23 LT | 204.5 | 40 | NE |
| B-8 | Sampler boring | 904+04 | 01 RT | 278.2 | 18 | NE |
| B-9 | Sampler boring | 878+86 | 75 RT | 232.9 | 8 | NE |
| B-9 | Rotary boring | 899+25 | 17 RT | 291.0 | 35 | NE |
| B-10 | Sampler boring | 878+91 | 21 LT | 232.6 | 19 | NE |
| B-10 | Rotary boring | 901+91 | 46 RT | 285.1 | 31 | NE |
| B-11 | Sampler boring | 878+98 | 158 LT | 234.5 | 27 | NE |
| B-11 | Rotary boring | 903+19 | 30 RT | 281.5 | 39 | NE |
| B-12 | Rotary boring | 885+70 | 285 LT | 235.2 | 45 | NE |
| B-13 | CPT | 887+13 | 105 RT | 244.4 | 39 | NE |
| B-14 | Rotary boring | 886+10 | 130 RT | 235.8 | 71 | NE |
| B-15 | CPT | 886+81 | 80 LT | 242.7 | 43 | NE |
| B-15 | CPT | 894+42 | 10 RT | 293.9 | 32 | NE |
| B-16 | Rotary boring | 889+27 | 62 RT | 258.8 | 101 | NE |
| B-16 | CPT | 889+07 | 42 RT | 258.6 | 47 | NE |
| B-17 | Rotary boring | 886+59 | 350 LT | 284.4 | 101 | NE |
| B-17 | CPT | 890+72 | 55 LT | 284.4 | 29 | NE |
| B-18 | Rotary boring | 888+25 | 85 LT | 284.0 | 95 | NE |
| B-19 | Rotary boring | 886+86 | 61 LT | 243.8 | 45 | NE |
| B-20 | Rotary boring | 895+43 | 44 RT | 294.0 | 20 | NE |
| B-21 | CPT | 893+47 | 11 RT | 292.6 | 27 | NE |
| B-22 | CPT | 891+63 | 58 RT | 296.4 | 59 | NE |
| B-23 | CPT | 890+71 | 29 RT | 295.5 | 50 | NE |
| B-24 | CPT | 902+45 | 2 RT | 262.4 | 16 | NE |
| B-25 | CPT | 889+97 | 17 RT | 291.0 | 40 | NE |
| B-26 | CPT | 890+21 | 70 RT | 291.6 | 47 | NE |
| **Bridge Name** | Olympic Boulevard | | | | | |
| **Bridge Number** | 53C0163 | | | | | |
| **Owner** | City of Los Angeles | | | | | |
| **Contract** | Unknown | | | | | |
| **Year** | 1993 | | | | | |

**Table J-1. Summary of Available As-built Logs of Test Borings**

| Boring Number | Boring Type | Station | Offset (feet) | Ground Elevation (feet) | Depth (feet) | Groundwater Elevation (feet) |
|---|---|---|---|---|---|---|
| B-1 | Auger boring | 16+84 | 43 LT | 224.8 | 60.8 | NE |
| B-2 | Auger boring | 12+77 | 42 RT | 225.9 | 80.9 | NE |
| B-3 | Auger boring | 6+34 | 90 LT | 231.9 | 80.9 | NE |
| B-4 | Auger boring | 2+24 | 07 RT | 252.4 | 79.4 | NE |
| **Bridge Name** | LA River Bridge (Rail) | | | | | |
| **Bridge Number** | Alameda Corridor Transportation Authority | | | | | |
| **Owner** | Alameda Corridor Transportation Authority | | | | | |
| **Contract** | Unknown | | | | | |
| **Year** | 1996 | | | | | |
| B-3 | Auger boring | 327+77 | 11.5 LT | 219.2 | 102 | NE |
| B-5 | Auger boring | 330+09 | Unknown | 190.9 | 81.4 | NE |
| B-9 | Auger boring | 330+48 | Unknown | 221.5 | 86.6 | NE |
| B-10 | Rotary boring | 329+56 | Unknown | 191.6 | 61.4 | NM |
| B-11 | Rotary boring | 328+62 | Unknown | 191.6 | 96.5 | NM |
| **Bridge Name** | Washington Boulevard | | | | | |
| **Bridge Number** | 53C1375 | | | | | |
| **Owner** | City of Los Angeles | | | | | |
| **Contract** | Unknown | | | | | |
| **Year** | 1993 | | | | | |
| B-1 | Hollow stem auger | 10+60 | 0 (CL) | 221 | 76 | NE |
| B-2 | Hollow stem auger | 6+70 | 8 LT | 221 | 76.5 | NE |
| **Bridge Name** | Redondo Junction—Rail Flyover | | | | | |
| **Bridge Number** | 53C2081 | | | | | |
| **Owner** | SCRRA | | | | | |
| **Contract** | Unknown | | | | | |
| **Year** | 1996 | | | | | |
| B-1 | Auger boring | 415+32 | 26.2 LT | 214.9 | 11.2 | NE |
| B-2 | Auger boring | 413+58 | 3.3 LT | 216.5 | 11.2 | NE |
| B-3 | Auger boring | 411+74 | 60.7 LT | 216.5 | 40.0 | NE |
| B-4 | Auger boring | 410+76 | 3.3 RT | 217.4 | 51.0 | NE |
| B-5 | Auger boring | 410+54 | 60.7 LT | 218.2 | 16.1 | NE |
| B-6 | Auger boring | 408+84 | 8.2 RT | 216.5 | 16.1 | NE |
| B-7 | Auger boring | 408+26 | 49.2 LT | 219.8 | 50.9 | NE |
| B-8 | Auger boring | 406+72 | 9.8 LT | 221.5 | 81.4 | NE |
| B-9 | Auger boring | 405+08 | 8.2 RT | 221.5 | 70.9 | NE |

**Table J-1. Summary of Available As-built Logs of Test Borings**

| Boring Number | Boring Type | Station | Offset (feet) | Ground Elevation (feet) | Depth (feet) | Groundwater Elevation (feet) |
|---|---|---|---|---|---|---|
| B-10 | Auger boring | 404+42 | 31.2 LT | 221.5 | 16.1 | NE |
| B-12 | Auger boring | 403+49 | 34.4 LT | 223.1 | 50.9 | NE |
| B-13 | Auger boring | 403+37 | 1.0 LT | 224.7 | 91.5 | NE |
| B-16 | Auger boring | 402+16 | 55.8 LT | 224.7 | 90.9 | NE |
| B-17 | Auger boring | 401+54 | 4.9 RT | 224.7 | 46.6 | NE |
| B-18 | Auger boring | 398+86 | 24.6 RT | 228.0 | 70.9 | NE |
| B-19 | Auger boring | 399+29 | 29.5 LT | 224.7 | 1.0 | NE |
| B-20 | Auger boring | 396+91 | 9.8 RT | 226.4 | 74.1 | NE |
| B-22 | Auger boring | 389+92 | 34.4 LT | 221.5 | 90.9 | NE |
| B-23 | Auger boring | 387+99 | 19.7 LT | 221.5 | 71.5 | NE |
| B-24 | Auger boring | 386+87 | 3.3 LT | 221.5 | 81.0 | NE |
| B-25 | Auger boring | 385+92 | 6.6 LT | 221.5 | 50.9 | NE |
| B-26 | Auger boring | 384+94 | 1.6 LT | 228.0 | 71.5 | NE |
| B-27 | Auger boring | 382+74 | 6.6 RT | 228.0 | 70.9 | NE |
| B-28 | Auger boring | 380+92 | 37.7 LT | 229.7 | 54.1 | NE |
| B-29 | Auger boring | 379+44 | 8.2 LT | 228.3 | 81.4 | NE |
| B-30 | Auger boring | 378+11 | 32.8 LT | 229.7 | 70.9 | NE |
| B-31 | Auger boring | 376+73 | 4.9 RT | 228.3 | 41.3 | NE |
| B-32 | Auger boring | 374+34 | 16.4 RT | 231.3 | 40.0 | NE |
| B-33 | Auger boring | 372+04 | 44.3 RT | 231.6 | 4.9 | NE |
| B-34 | Auger boring | 369+42 | 39.4 RT | 231.6 | 10.5 | NE |
| **Bridge Name** | Soto Street | | | | | |
| **Bridge Number** | 53C0867 | | | | | |
| **Owner** | City of Vernon | | | | | |
| **Contract** | Unknown | | | | | |
| **Year** | 1985 | | | | | |
| B-1 | F.C. wet drilling equipment | 16+82 | 53 LT | 172.5 | 45 | NM |
| B-2 | F.C. wet drilling equipment | 14+74 | 35 RT | 173.5 | 46 | NM |
| B-3 | Hollow core auger | 18+28 | 3 RT | 205 | 69 | NE |
| B-4 | Hollow core auger | 13+20 | 14 LT | 205 | 70 | NE |
| **Bridge Name** | Bandini Boulevard | | | | | |
| **Bridge Number** | 53C0827 | | | | | |
| **Owner** | City of Vernon | | | | | |
| **Contract** | Unknown | | | | | |
| **Year** | 1966 | | | | | |

**Table J-1. Summary of Available As-built Logs of Test Borings**

| Boring Number | Boring Type | Station | Offset (feet) | Ground Elevation (feet) | Depth (feet) | Groundwater Elevation (feet) |
|---|---|---|---|---|---|---|
| B-1 | Bucket auger | 64+70 | 0 (CL) | 198 | 58 | NE |
| B-2 | Bucket auger | 66+40 | 0 (CL) | 169.6 | 50 | 128.6 |
| B-3 | Bucket auger | 68+80 | 0 (CL) | 170.8 | 45 | 130.8 |
| B-4 | Bucket auger | 70+30 | 0 (CL) | 169.8 | 45 | 130.8 |
| B-5 | Bucket auger | 72+65 | 5.5 RT | 192 | 65 | NE |
| **Bridge Name** | Downey Road | | | | | |
| **Bridge Number** | 53C0576 | | | | | |
| **Owner** | Los Angeles County | | | | | |
| **Contract** | Unknown | | | | | |
| **Year** | 1978 | | | | | |
| B-1 | Bucket auger | 33+75 | 75 RT | 187 | 77 | NE |
| B-2 | Bucket auger | 39+40 | 55 RT | 189 | 13 | NE |
| B-3 | Bucket auger | 38+00 | 50 RT | 161.7 | 50 | NE |
| **Bridge Name** | Atlantic Boulevard | | | | | |
| **Bridge Number** | 53C0252 | | | | | |
| **Owner** | City of Vernon | | | | | |
| **Contract** | CS-0099 | | | | | |
| **Year** | 2017 | | | | | |
| A-10-001 | Hollow stem auger | 20+23 | 47 LT | 164 | 61.5 | NE |
| A-10-002 | Hollow stem auger | 18+78 | 55 LT | 141.5 | 101.5 | 61.5 |
| A-10-003 | Hollow stem auger | 16+97 | 54 RT | 141.5 | 61.5 | NE |
| A-10-004 | Hollow stem auger | 15+54 | 58 LT | 164 | 101.5 | NE |
| CPT-10-001 | CPT | 20+17 | 54 RT | 162 | 100 | NE |
| CPT-10-002 | CPT | 15+15 | 65 RT | 162 | 57 | NE |

Notes:

Stationing, offset, and elevation shown in table are based on that presented on the as-built log of test boring (LOTB) sheets (converted to English units from metric units as needed).

Blvd = Boulevard
Caltrans = California Department of Transportation
CL = center line
CPT = Cone Penetration Test
I-5 = Interstate 5
LA River = Los Angeles River
LT = left
NA = not applicable
NE = not encountered
NM = not measured
RT = right
SCRRA = Southern California Regional Rail Authority

# Attachment B
# California Department of Transportation Acceleration Response Spectra

# ARS Online V3.0.2

**Using the tool:** Specify latitude and longitude in decimal degrees in the input boxes below. Alternatively, **Google Maps** can be used to find the site location. Specify the time-averaged shear-wave velocity in the upper 30m (Vs30) in the input box. After submitting the data, the USGS 2014 hazard data for a 975-year return period will be reported along with adjustment factors required by Caltrans Seismic Design Criteria (SDC) V2.0.

**Latitude:** 34.081261 **Longitude:** -118.227481 **Vs30 (m/s):** 270 Submit

*Caltrans Design Spectrum (5% damping)*

| Period(s) | $Sa_{2008}$(g) | $Sa_{2014}$(g) | $Basin_{2008}$ | $Basin_{2014}$ | Near Fault Amp | Design $Sa_{2008}$(g) | Design $Sa_{2014}$(g) |
|---|---|---|---|---|---|---|---|
| PGA | 0.72 | 0.69 | 1 | 1 | 1 | 0.72 | 0.69 |
| 0.10 | 1.19 | 1.14 | 1 | 1 | 1 | 1.19 | 1.14 |
| 0.20 | 1.51 | 1.53 | 1 | 1 | 1 | 1.51 | 1.53 |
| 0.30 | 1.56 | 1.7 | 1 | 1 | 1 | 1.56 | 1.7 |
| 0.50 | 1.44 | 1.6 | 1 | 1 | 1 | 1.44 | 1.6 |
| 0.75 | 1.2 | 1.28 | 1 | 1 | 1.1 | 1.32 | 1.41 |
| 1.0 | 0.96 | 1.04 | 1 | 1 | 1.2 | 1.16 | 1.25 |
| 2.0 | 0.47 | 0.52 | 1 | 1 | 1.2 | 0.56 | 0.63 |
| 3.0 | 0.28 | 0.32 | 1 | 1 | 1.2 | 0.34 | 0.39 |
| 4.0 | 0.2 | 0.22 | 1 | 1 | 1.2 | 0.23 | 0.26 |
| 5.0 | 0.16 | 0.16 | 1 | 1 | 1.2 | 0.19 | 0.19 |

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**Deaggregation (based on 2014 hazard)**

| | |
|---|---|
| mean magnitude (for PGA) | 6.77 |
| mean site-source distance (km, for Sa at 1s) | 12.6 |

*Option: recalculate Near Fault amplification with user specified distance*

**Site-source distance (km):** 12.6 Update

# ARS Online V3.0.2

**Using the tool:** Specify latitude and longitude in decimal degrees in the input boxes below. Alternatively, **Google Maps** can be used to find the site location. Specify the time-averaged shear-wave velocity in the upper 30m (Vs30) in the input box. After submitting the data, the USGS 2014 hazard data for a 975-year return period will be reported along with adjustment factors required by Caltrans Seismic Design Criteria (SDC) V2.0.

**Latitude:** 34.034538 **Longitude:** -118.227060 **Vs30 (m/s):** 270 Submit

*Caltrans Design Spectrum (5% damping)*

| Period(s) | $Sa_{2008}$(g) | $Sa_{2014}$(g) | $Basin_{2008}$ | $Basin_{2014}$ | Near Fault Amp | Design $Sa_{2008}$(g) | Design $Sa_{2014}$(g) |
|---|---|---|---|---|---|---|---|
| PGA | 0.64 | 0.65 | 1 | 1 | 1 | 0.64 | 0.65 |
| 0.10 | 1.08 | 1.1 | 1 | 1 | 1 | 1.08 | 1.1 |
| 0.20 | 1.37 | 1.48 | 1 | 1 | 1 | 1.37 | 1.48 |
| 0.30 | 1.4 | 1.63 | 1 | 1 | 1 | 1.4 | 1.63 |
| 0.50 | 1.25 | 1.52 | 1 | 1 | 1 | 1.25 | 1.52 |
| 0.75 | 1.04 | 1.2 | 1 | 1 | 1.1 | 1.14 | 1.32 |
| 1.0 | 0.83 | 0.98 | 1 | 1 | 1.2 | 0.99 | 1.17 |
| 2.0 | 0.41 | 0.49 | 1.03 | 1 | 1.2 | 0.5 | 0.58 |
| 3.0 | 0.25 | 0.3 | 1.03 | 1 | 1.2 | 0.31 | 0.36 |
| 4.0 | 0.17 | 0.21 | 1.03 | 1 | 1.2 | 0.22 | 0.25 |
| 5.0 | 0.14 | 0.15 | 1.03 | 1 | 1.2 | 0.18 | 0.18 |

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**Deaggregation (based on 2014 hazard)**

| | |
|---|---|
| mean magnitude (for PGA) | 6.77 |
| mean site-source distance (km, for Sa at 1s) | 14.9 |

*Option: recalculate Near Fault amplification with user specified distance*

**Site-source distance (km):** 14.9 Update