Administrative Draft

Pipes Canyon Subdivision

Initial Study/Mitigated Negative Declaration

APPENDICES

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Air Quality Impact Study

TTM 20612

Air Quality Impact Study

County of San Bernardino, CA

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GLOSSARY OF TERMS

AQMP	Air Quality Management Plan
CAAQS	California Ambient Air Quality Standards
CARB	California Air Resources Board
CEQA	California Environmental Quality Act
CFCs	Chlorofluorocarbons
CH_4	Methane
CNG	Compressed natural gas
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
DPM	Diesel particulate matter
GHG	Greenhouse gas
HFCs	Hydrofluorocarbons
MDAB	Mojave Desert Air Basin
MDAQMD	Mojave Desert Air Quality Management District
$MTCO_2e$	Metric tons of carbon dioxide equivalent
$MMTCO_2e$	Million metric tons of carbon dioxide equivalent
NAAQS	National Ambient Air Quality Standards
NOx	Nitrogen Oxides
NO_2	Nitrogen dioxide
N_2O	Nitrous oxide
O_3	Ozone
PFCs	Perfluorocarbons
PM	Particle matter
PM10	Particles that are less than 10 micrometers in diameter
PM2.5	Particles that are less than 2.5 micrometers in diameter
PMI	Point of maximum impact
PPM	Parts per million
PPB	Parts per billion
RTIP	Regional Transportation Improvement Plan
RTP	Regional Transportation Plan
SF_6	Sulfur hexafluoride
SIP	State Implementation Plan
SOx	Sulfur Oxides
SRA	Source/Receptor Area
TAC	Toxic air contaminants
VOC	Volatile organic compounds
WRCC	Western Regional Climate Center

1.0 Introduction

1.1 Purpose of Analysis and Study Objectives

This air quality analysis was prepared to evaluate whether the estimated criteria pollutants emissions generated from the project would cause a significant impact to the air resources in the project area. This assessment was conducted within the context of the California Environmental Quality Act (CEQA, California Public Resources Code Sections 21000, et seq.). The assessment is consistent with the methodology and emission factors endorsed by Mojave Desert Air Quality Management District (MDAQMD), California Air Resource Board (CARB), and the United States Environmental Protection Agency (US EPA).

1.2 Project Summary

1.2.1 Site Location

The Project site is located in an unincorporated area of San Bernardino County, CA (APNs: 0594-351-32, 32). See Exhibit A for the location. Land uses and the closest existing sensitive receptors surrounding the site include single-family residential uses to the north, east, south, and west.

1.2.2 Project Description

The project site is approximately 123 acres and is currently designated by the County's General Plan as Rural Living single family homes (RL-5), with a minimum lot size of five acres, as well as Resource Conservation (RC). The project proposes to divide the property into 13 lots. Twelve lots will be developed as five-acre residential parcels for single-family homes, consistent with the Rural Living RL-5 zoning. The remaining lot, within the Resource Conservation (RC) zoning area, will maintain its current designation to protect the site's natural resources and environmental features. The proposed project site plan is in Exhibit B.

Table 1: Land Use Summary

Land Use	Unit Amount	Size Metric
Single Family housing	12.00	Dwelling Units

1.2.3 Sensitive Receptors

Sensitive receptors are considered land uses or other types of population groups that are more sensitive to air pollution than others due to their exposure. Sensitive population groups include children, the elderly, the acutely and chronically ill, and those with cardio-respiratory diseases. For CEQA purposes, a sensitive receptor would be a location where a sensitive individual could remain for 24-hours or longer, such as residencies, hospitals, and schools (etc.).

The closest existing sensitive receptors (to the site area) are the residential land uses located 80 feet to the west, as shown in Exhibit A.

1.3 Executive Summary of Findings and Mitigation Measures

The following is a summary of the analysis results:

Construction-Source Emissions
Project construction-source emissions would not exceed applicable regional thresholds of significance established by the MDAQMD.

As discussed herein, the project will comply with all applicable MDAQMD construction-source emission reduction rules and guidelines. Project construction source emissions would not cause or substantively contribute to violation of the California Ambient Air Quality Standards (CAAQS) or National Ambient Air Quality Standards (NAAQS).

Established requirements, including MDAQMD Rules 402 and 403.2, addressing construction equipment operations, and construction material use, storage, and disposal requirements act to minimize odor impacts that may result from construction activities. Moreover, construction-source odor emissions would be temporary, short-term, and intermittent in nature and would not result in persistent impacts that would affect substantial numbers of people. Potential construction-source odor impacts are therefore considered less-than-significant.

Operational-Source Emissions
The project's emissions meet MDAQMD regional thresholds and will not result in a significant cumulative impact. The project does not propose any such uses or activities that would result in potentially significant operational-source odor impacts. Potential operational-source odor impacts are therefore considered less than significant.

Mitigation Measures

A. Construction Measures
The project applicant shall ensure that all applicable MDAQMD Rules and Regulations are complied with during construction.

No construction measures are required.

B. Operational Measures
No operational measures are required.

Exhibit A
Location Map

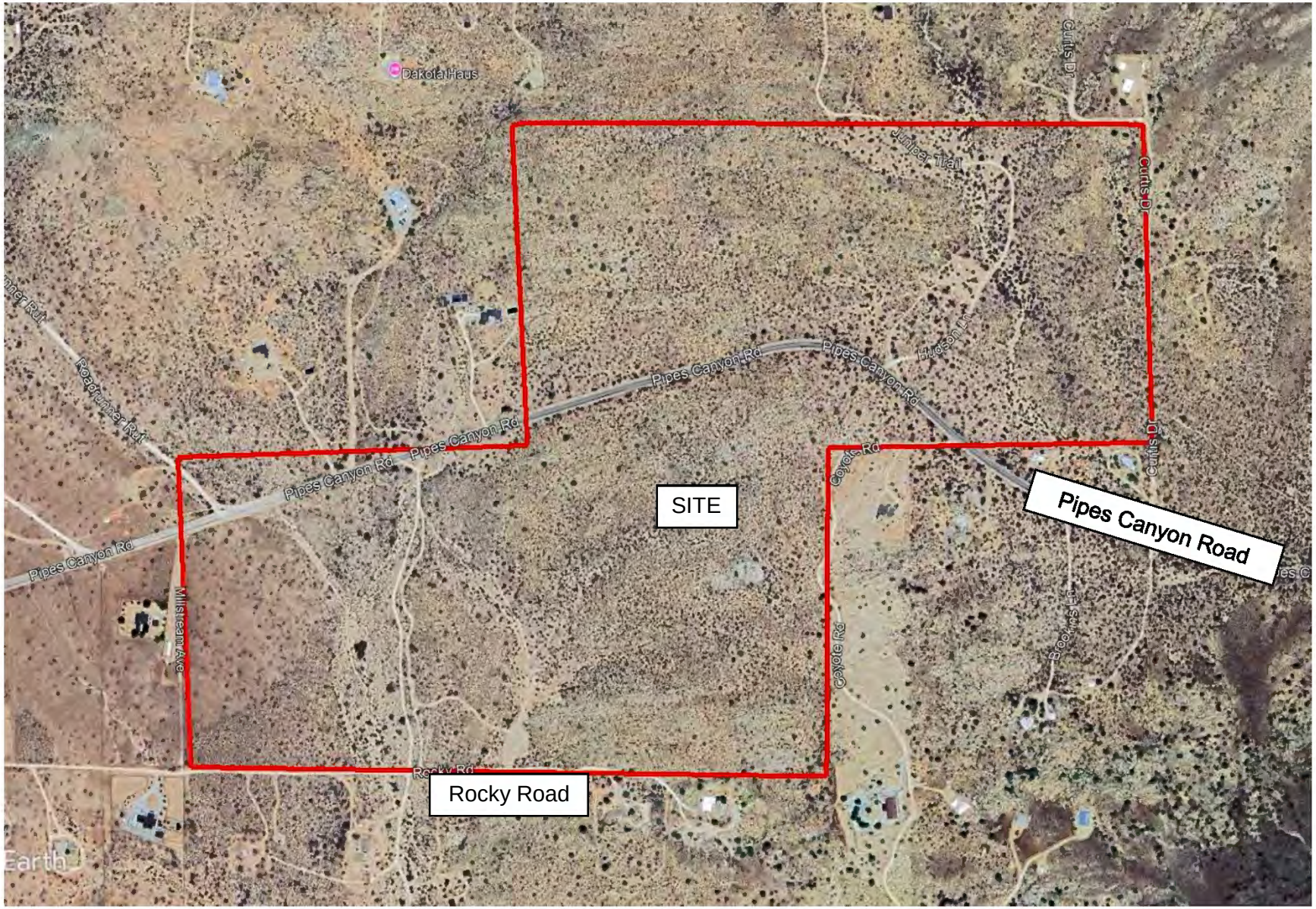
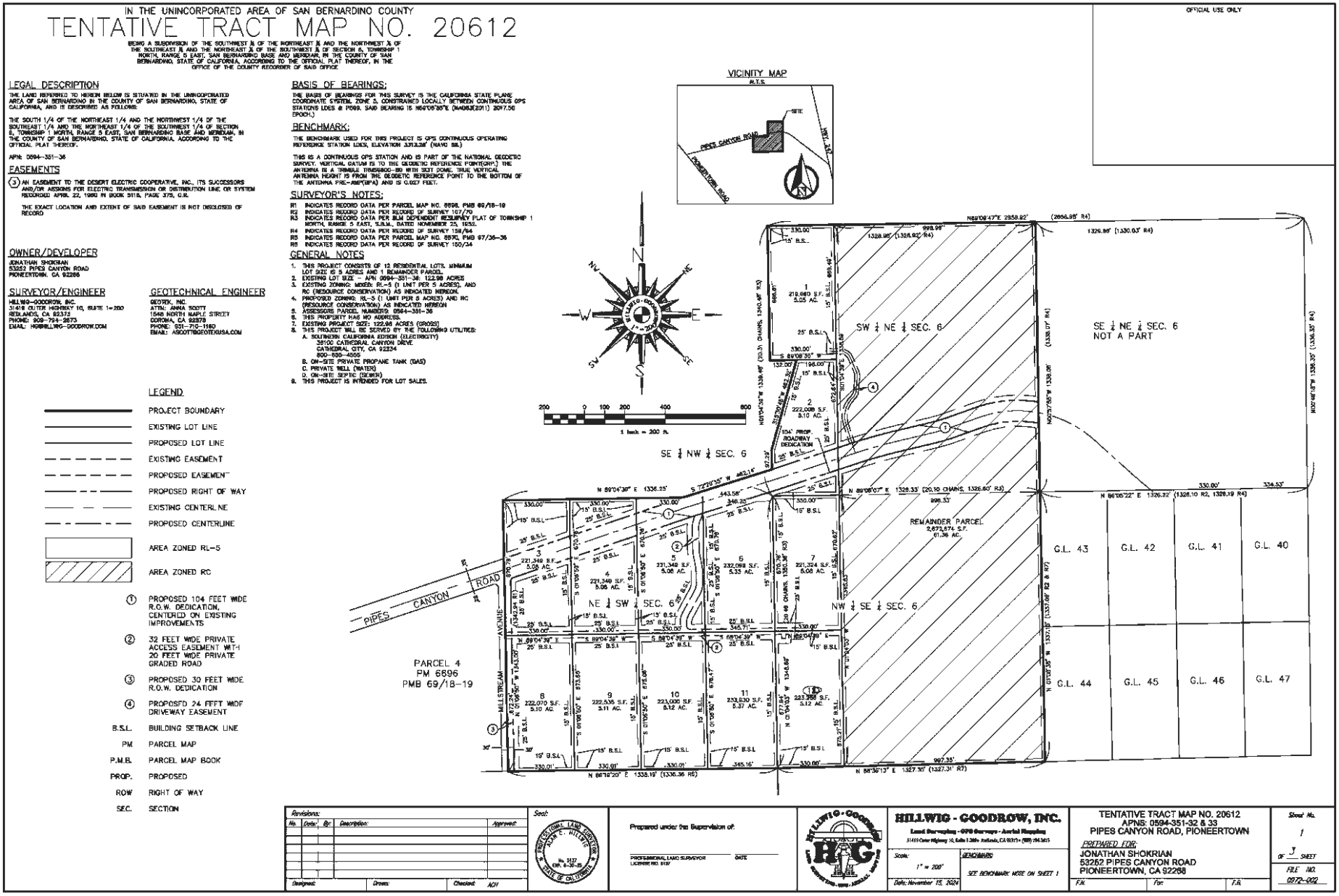


Exhibit B

Site Plan



2.0 Regulatory Framework and Background

2.1 Air Quality Regulatory Setting

Air pollutants are regulated at the national, state, and air basin level; each agency has a different level of regulatory responsibility. The United States Environmental Protection Agency (EPA) regulates at the national level. The California Air Resources Board (ARB) regulates at the state level. The Mojave Desert Air Quality Management District (MDAQMD) regulates at the air basin level.

2.1.1 National and State

The EPA is responsible for global, international, and interstate air pollution issues and policies. The EPA sets national vehicle and stationary source emission standards, oversees approval of all State Implementation Plans, provides research and guidance for air pollution programs, and sets National Air Quality Standards, also known as federal standards. There are six common air pollutants, called criteria pollutants, which were identified from the provisions of the Clean Air Act of 1970.

- Ozone
- Nitrogen Dioxide
- Lead
- Particulate Matter (PM10 and PM2.5)
- Carbon Monoxide
- Particulate Matter
- Sulfur Dioxide

The federal standards were set to protect public health, including that of sensitive individuals; thus, the standards continue to change as more medical research is available regarding the health effects of the criteria pollutants. Primary federal standards are the levels of air quality necessary, with an adequate margin of safety, to project the public health.

A State Implementation Plan is a document prepared by each state describing existing air quality conditions and measures that will be followed to attain and maintain federal standards. The State Implementation Plan for the State of California is administered by the ARB, which has overall responsibility for statewide air quality maintenance and air pollution prevention. California's State Implementation Plan incorporates individual federal attainment plans for regional air districts—air district prepares their federal attainment plan, which sent to ARB to be approved and incorporated into the California State Implementation Plan. Federal attainment plans include the technical foundation for understanding air quality (e.g., emission inventories and air quality monitoring), control measures and strategies, and enforcement mechanisms. See http://www.arb.ca.gov/research/aaqs/aaqs.htm for additional information on criteria pollutants and air quality standards.

The federal and state ambient air quality standards are summarized in Table 2 and can also be found at http://www.arb.ca.gov/research/aaqs/aaqs2.pdf.

Table 2: Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards[1]		National Standards[2]		
		Concentrations[3]	Method[4]	Primary[3,5]	Secondary[3,6]	Method[7]
Ozone (O3)	1-Hour	0.09 ppm	Ultraviolet Photometry	- -	Same as Primary Standard	Ultraviolet Photometry
	8-Hour	0.070 ppm		0.070 ppm (147 µg/m³)		
Respirable Particulate Matter (PM10)[8]	24-Hour	50 µg/m³	Gravimetric or Beta Attenuation	150 µ/m³	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	20 µg/m³		- -		
Fine Particulate Matter (PM2.5)[8]	24-Hour	- -	- -	35 µg/m³	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	12 µg/m³	Gravimetric or Beta Attenuation	12 µg/m³	15 µg/m³	
Carbon Monoxide (CO)	1-Hour	20 ppm (23 µg/m³)	Non-Dispersive Infrared Photometry (NDIR)	35 ppm (40 µg/m³)	- -	Non-Dispersive Infrared Photometry (NDIR)
	8-Hour	9.0 ppm (10 µg/m³)		9 ppm (10 µg/m³)	- -	
	8-Hour (Lake Tahoe)	6 ppm (7 µg/m³)		- -	- -	
Nitrogen Dioxide (NO_2)[9]	1-Hour	0.18 ppm (339 µg/m³)	Gas Phase Chemiluminescence	100 ppb (188 µg/m³)	- -	Gas Phase Chemiluminescence
	Annual Arithmetic Mean	0.030 ppm (357 µg/m³)		0.053 ppm (100 µg/m³)	Same as Primary Standard	
Sulfur Dioxide (SO_2)[10]	1-Hour	0.25 ppm (655 µg/m³)	Ultraviolet Fluorescence	75 ppb (196 µg/m³)	- -	Ultraviolet Fluorescence; Spectrophotometry (Pararosaniline Method)
	3-Hour	- -		- -	0.5 ppm (1300 mg/m³)	
	24-Hour	0.04 ppm (105 µg/m³)		0.14 ppm (for certain areas)[10]	- -	
	Annual Arithmetic Mean	- -		0.130ppm (for certain areas)[10]	- -	
Lead[11,12]	30 Day Average	1.5 µg/m³	Atomic Absorption	- -		
	Calendar Qrtr	- -		1.5 µg/m³ (for certain areas)[12]	Same as Primary Standard	High Volume Sampler and Atomic Absorption
	Rolling 3-Month Average	- -		0.15 µg/m³		
Visibility Reducing Particles[13]	8-Hour	See footnote 13	Beta Attenuation and Transmittance through Filter Tape	No National Standards		
Sulfates	24-Hour	25 µg/m³	Ion Chromatography			
Hydrogen Sulfide	1-Hour	0.03 ppm (42 µg/m³)	Ultraviolet Fluorescence			
Vinyl Chloride[11]	24-Hour	0.01 ppm (26 µg/m³)	Gas Chromatography			

Notes:

1. California standards for ozone, carbon monoxide (except 8-hour Lake Tahoe), sulfur dioxide (1 and 24 hour), nitrogen dioxide, and particulate matter (PM10, PM2.5, and visibility reducing particles), are values that are not to be exceeded. All others are not to be equaled or exceeded. California ambient air quality standards are listed in the Table of Standards in Section 70200 of Title 17 of the California Code of Regulations.

2. National standards (other than ozone, particulate matter, and those based on annual arithmetic mean) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest 8-hour concentration measured at each site in a year, averaged over three years, is equal to or less than the standard. For PM10, the 24 hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration above 150 µg/m³ is equal to or less than one. For PM2.5, the 24 hour standard is attained when 98 percent of the daily concentrations, averaged over three years, are equal to or less than the standard. Contact the U.S. EPA for further clarification and current national policies.

3. Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 torr. Most measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 torr; ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

4. Any equivalent measurement method which can be shown to the satisfaction of the ARB to give equivalent results at or near the level of the air quality standard may be used.

5. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health.

6. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

7. Reference method as described by the U.S. EPA. An “equivalent method” of measurement may be used but must have a “consistent relationship to the reference method” and must be approved by the U.S. EPA.

8. On December 14, 2012, the national annual PM2.5 primary standard was lowered from 15 µg/m^3 to 12.0 µg/m^3. The existing national 24-hour PM2.5 standards (primary and secondary) were retained at 35 µg/m^3, as was the annual secondary standard of 15 µg/m^3. The existing 24-hour PM10 standards (primary and secondary) of 150 µg/m^3 also were retained. The form of the annual primary and secondary standards is the annual mean, averaged over 3 years.

9. To attain the 1-hour national standard, the 3-year average of the annual 98th percentile of the 1-hour daily maximum concentrations at each site must not exceed 100 ppb. Note that the national 1-hour standard is in units of parts per billion (ppb). California standards are in units of parts per million (ppm). To directly compare the national 1-hour standard to the California standards the units can be converted from ppb to ppm. In this case, the national standard of 100 ppb is identical to 0.100 ppm.

10. On June 2, 2010, a new 1-hour SO2 standard was established and the existing 24-hour and annual primary standards were revoked. To attain the 1-hour national standard, the 3-year average of the annual 99th percentile of the 1-hour daily maximum concentrations at each site must not exceed 75 ppb. The 1971 SO2 national standards (24-hour and annual) remain in effect until one year after an area is designated for the 2010 standard, except that in areas designated nonattainment for the 1971 standards, the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standards are approved.

    Note that the 1-hour national standard is in units of parts per billion (ppb). California standards are in units of parts per million (ppm). To directly compare the 1-hour national standard to the California standard the units can be converted to ppm. In this case, the national standard of 75 ppb is identical to 0.075 ppm.

11. The ARB has identified lead and vinyl chloride as 'toxic air contaminants' with no threshold level of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.

12. The national standard for lead was revised on October 15, 2008 to a rolling 3-month average. The 1978 lead standard (1.5 µg/m^3 as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978 standard, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

13. In 1989, the ARB converted both the general statewide 10-mile visibility standard and the Lake Tahoe 30-mile visibility standard to instrumental equivalents, which are "extinction of 0.23 per kilometer" and "extinction of 0.07 per kilometer" for the statewide and Lake Tahoe Air Basin standards, respectively.

Several pollutants listed in Table 2 are not addressed in this analysis. Analysis of lead is not included in this report because the project is not anticipated to emit lead. Visibility-reducing particles are not explicitly addressed in this analysis because particulate matter is addressed. The project is not expected to generate or be exposed to vinyl chloride because proposed project uses do not utilize the chemical processes that create this pollutant and there are no such uses in the project vicinity. The proposed project is not expected to cause exposure to hydrogen sulfide because it would not generate hydrogen sulfide in any substantial quantity.

2.1.2 Mojave Desert Air Quality Management District

The 1976 Lewis Air Quality Management Act established the MDAQMD and other air districts throughout the State. The federal CAA Amendments of 1977 required that each state adopt an implementation plan outlining pollution control measures to attain the federal standards in nonattainment areas of the state.

The ARB is responsible for incorporating air quality management plans for local air basins into a State Implementation Plan (SIP) for EPA approval. Significant authority for air quality control within them has been given to local air districts that regulate stationary source emissions and develop local nonattainment plans.

California is divided geographically into air basins for the purpose of managing the air resources of the State on a regional basis. An air basin generally has similar meteorological and geographic conditions throughout. The State is currently divided into 15 air basins. The proposed project site is located within

the Mojave Desert Air Basin (MDAB). The MDAQMD includes the desert portion of the San Bernardino County. The MDAQMD is responsible for controlling emissions primarily from stationary sources within the MDAQMD and also maintains air quality monitoring stations to document historical and current levels of air quality within the District. The MDAQMD is also responsible for developing, updating, and implementing the Ozone Attainment Plan (MDAQMD 2004) which establishes a plan to implement, maintain, and enforce a program of emission control measures to attain and maintain the federal ozone air quality standards. Attainment plans prepared by the various air pollution control districts throughout the state are used to develop the SIP for the State of California. The proposed project is located within the MDAQMD and, thus, is subject to the rules and regulations of the MDAQMD.

The MDAQMD and SCAG are responsible for formulating and implementing the air quality attainment plan (AQAP) for the Basin. Regional AQAPs were adopted in 1991, 1994, and 1997. The following SIP and AQAP are the currently approved plans for the Basin region:

- 1997 SIP for O_3, PM10, and NO_2
- 1995 Mojave Desert Planning Area Federal PM10 Attainment Plan; no formal action by the EPA

The MDAQMD completed the MDAQMD 2004 Ozone Attainment Plan (State and federal) in April 2004, which has been approved by the EPA.

The MDAQMD is downwind of the Los Angeles basin and the San Joaquin Valley. Prevailing winds transport ozone and ozone precursors from both regions into and through the MDAB during the summer ozone season. These transport couplings have been officially recognized by the CARB. Local MDAQMD emissions contribute to exceedances of both the NAAQS and CAAQS for ozone, but photochemical ozone modeling conducted by the MDAQMD and CARB indicates that the MDAB would be in attainment of both standards without the influence of this transported air pollution from upwind regions. Therefore, emissions reductions in the upwind area are critical to the attainment demonstration.

The following includes, but is not limited to, the MDAQMD rules that are applicable to the proposed project:

Rule 201 (Permit to Construct) requires written authorization to build, erect, install, alter, or replace any equipment, the use of which may cause the issuance of air contaminants or the use of which may eliminate, reduce, or control the issuance of air contaminants. With respect to the proposed project, this rule would apply to any stationary equipment that is not otherwise exempt from this rule as an insignificant source of air pollutants (see Rule 219).

Rule 203 (Permit to Operate) requires written authorization to operate any equipment, the use of which may cause the issuance of air pollutants, or the use of which may reduce or control the issuance of air contaminants. With respect to the proposed project, this rule would apply to any stationary equipment that is not otherwise exempt from this rule as an insignificant source of air pollutants (see Rule 219).

Rule 219 (Equipment Not Requiring A Written Permit Pursuant to Regulation II) specifies stationary sources that the MDAQMD considers to be insignificant sources of air pollutants that are exempt from

Rules 201 and 202. With respect to the proposed project, the following sources would be exempt from permit requirements:

- Comfort air conditioning or ventilating systems which are not designed or used to remove air contaminants generated by, or released from, specific equipment units;
- Space heaters;
- Equipment used exclusively for steam cleaning;

Rule 402 (Nuisance). This rule specifies that a person may not discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance, or annoyance to any considerable number of persons or to the public, or which endanger the comfort, repose, health, or safety of any such persons or the public, or which cause, or have a natural tendency to cause, injury or damage to business or property.

Rule 403.2 (Fugitive Dust Control for the Mojave Desert Planning Area). This rule requires owners or operators of a construction or demolition fugitive dust source to implement the fugitive dust control measures listed in Rule 403.2. These measures include periodic watering for short-term stabilization of disturbed surface area to minimize visible dust emissions, stabilization of graded surfaces if no development is planned within 30 days, reducing non-essential earth moving activity under high wind conditions, and more.

Rule 1113 (Architectural Coatings). This rule requires manufacturers, distributors, and end-users of architectural and industrial maintenance coatings to reduce VOC emissions from the use of these coatings, primarily by placing limits on the VOC content of various coating categories.

Rule 1160 (Internal Combustion Engines). This rule establishes limits for VOC, NOx, and CO emissions associated with stationary internal combustion engines. However, the provisions of the rule do not apply to the following engines:

- All internal combustion engines rated at less than 500 brake horsepower;
- All internal combustion engines operated less than 100 hours within any continuous four consecutive calendar quarter period; and
- Emergency internal combustion engines.

Regulation XIII (New Source Review). For new and modified stationary sources subject to permitting requirements (see Rule 201), this series of rules prescribes the use of Best Available Control Technology and the provision of emission offsets (i.e., mitigation) for equipment whose emissions exceed specified thresholds. The applicability of these requirements would be determined upon submittal of an application for permit to construct under Rule 201.

2.1.3 County of San Bernardino

County of San Bernardino General Plan

Local jurisdictions, such as the County of San Bernardino, have the authority and responsibility to reduce air pollution through its police power and decision-making authority. Specifically, the County is responsible for the assessment and mitigation of air emissions resulting from its land use decisions. The County is also responsible for the implementation of transportation control measures as outlined in the 2016 AQMP and MDAQMD Attainment Plans. Examples of such measures include bus turnouts, energy-efficient streetlights, and synchronized traffic signals. In accordance with CEQA requirements and the CEQA review process, the County assesses the air quality impacts of new development projects, requires mitigation of potentially significant air quality impacts by conditioning discretionary permits, and monitors and enforces implementation of such mitigation.

In accordance with the CEQA requirements, the County does not, however, have the expertise to develop plans, programs, procedures, and methodologies to ensure that air quality within the County and region will meet federal and state standards. Instead, the County relies on the expertise of the SCAQMD and MDAQMD and utilizes the SCAQMD CEQA Handbook and MDAQMD California Environmental Quality Act (CEQA) And Federal Conformity Guidelines (depending on the location/jurisdiction of the project) as guidance documents for the environmental review of plans and development proposals within its jurisdiction.

The County of San Bernardino General Plan contains the following air quality-related goals and policies that are applicable to the proposed project:

Goal CO 4 The County will ensure good air quality for its residents, businesses, and visitors to reduce impacts on human health and the economy.

CO 4.1 Because developments can add to the wind hazard (due to increased dust, the removal of wind breaks, and other factors), the County will require either as mitigation measures in the appropriate environmental analysis required by the County for the development proposal or as conditions of approval if no environmental document is required, that developments in areas identified as susceptible to wind hazards to address site-specific analysis of:

a. Grading restrictions and/or controls on the basis of soil types, topography or season.
b. Landscaping methods, plant varieties, and scheduling to maximize successful revegetation.
c. Dust-control measures during grading, heavy truck travel, and other dust generating activities.

CO 4.4 Because congestion resulting from growth is expected to result in a significant increase in the air quality degradation, the County may manage growth by insuring the timely provision of infrastructure to serve projnew development.

Programs

1. Consistent with the land use designations in the Land Use Policy Map (see the Land Use Element) that will improve growth management at a sub-regional level in relation to major activity centers, review new development to encourage new intensified development around transit nodes and along transit corridors.

2. Locate and design new development in a manner that will minimize direct and indirect emission of air contaminants through such means as:

    a. Promoting mixed-use development to reduce the length and frequency of vehicle trips;
    b. Providing for increased intensity of development along existing and proposed transit corridors; and
    c. Providing for the location of ancillary employee services (including but not limited to child care, restaurants, banking facilities, convenience markets) at major employment centers for the purpose of reducing midday vehicle trips.
    d. The County shall comply, to the extent feasible, with the recommendations on siting new sensitive land uses, as recommended in California Air Resources Board's Air Quality and Land Use Handbook: A Community Health Perspective, which includes the following:

        Notable siting recommendations include avoiding siting new sensitive land uses within:

        - 500 feet of a freeway, urban roads with 100,000 vehicles/day, or rural roads with 50,000 vehicles/day;
        - 1,000 feet of a distribution center (that accommodates more than 100 trucks per day, more than 40 trucks with operating transport refrigeration units per day, or where transport refrigeration units exceed 300 hours per week);
        - 1,000 feet of a chrome plater;
        - 300 feet of any dry cleaning operation; and 300 feet of a large gas station (defined as a facility with a through put of 3.6 million gallons per year or greater); a 50 foot separation is recommended for typical gas dispensing facilities.

3. Incorporate phasing policies and requirements in the General Plan and development plans to achieve timely provision of infrastructure (particularly transportation facilities) to serve development through:

a. Tying growth to Level of Service (LOS) standards; and
b. Using phasing areas to manage growth.

County of San Bernardino Development Code

83.01.040 - Air Quality.

(a) **Equipment permit and Inspection Requirements.** Required permits shall be obtained from either the Mojave Air Pollution Management District or the South Coast Air Quality Management District depending on the location of the subject property and equipment for equipment that may cause air pollution. Before the equipment may be constructed, plans and specifications shall be submitted to the appropriate District for approval.

(b) **Permits from Air Quality Management Districts.** Permits shall be obtained from either the Mojave Air Pollution Management District or the South Coast Air Quality Management District depending on the location of the subject property and equipment. If requested by the Director, uses, activities, or processes that require Air Quality Management District approval to operate shall file a copy of the permit with the Department within 30 days of its approval.

(c) **Diesel Exhaust Emissions Control Measures.** The following emissions control measures shall apply to all discretionary land use projects approved by the County on or after January 15, 2009:

1. **On-Road Diesel Vehicles.** On-road diesel vehicles are regulated by the State of California Air Resources Board.

2. **Off-Road Diesel Vehicle/Equipment Operations.** All business establishments and contractors that use off-road diesel vehicle/equipment as part of their normal business operations shall adhere to the following measures during their operations in order to reduce diesel particulate matter emissions from diesel fueled engines:

    a. Off-road vehicles/equipment shall not be left idling on site for periods in excess of five minutes. The idling limit does not apply to:

        i. Idling when queuing,
        ii. Idling to verify that the vehicle is in safe operating condition,
        iii. Idling for testing, servicing, repairing, or diagnostic purposes,
        iv. Idling necessary to accomplish work for which the vehicle was designed (such as operating a crane),
        v. Idling required to bring the machine system to operating temperature, and
        vi. Idling necessary to ensure safe operation of the vehicle

b. Use reformulated ultra-low sulfur diesel fuel in equipment and use equipment certified by the U.S. Environmental Protection Agency (EPA) or that pre-dates EPA regulations.
c. Maintain engines in good working order to reduce emissions.
d. Signs shall be posted requiring vehicle drivers to turn off engines when parked.
e. Any requirements or standards subsequently adopted by the South Coast Air Quality Management District, the Mojave Air Quality Management District, or the California Air Resources Board.
f. Provide temporary traffic control during all phases of construction.
g. Onsite electrical power connections shall be provided for electric construction tools to eliminate the need for diesel-powered electric generators, where feasible.
h. Maintain construction equipment engines in good working order to reduce emissions. The developer shall have each contractor certify that all construction equipment is properly serviced and maintained in good operating condition.
i. Contractors shall use ultra-low sulfur diesel fuel for stationary construction equipment as required by Air Quality Management District (AQMD) Rules 431.1 and 431.2 to reduce the release of undesirable emissions.
j. Substitute electric and gasoline-powered equipment for diesel-powered equipment, where feasible.

3.0 Setting

3.1 Existing Physical Setting

The project site is located in Joshua Tree in the County of San Bernardino, which is part of the Mojave Desert Air Basin (MDAB) that includes the desert portion of San Bernardino County and the far eastern end of Riverside County

3.1.1 Local Climate and Meteorology

The MDAB is an assemblage of mountain ranges interspersed with long broad valleys that often contain dry lakes. Many of the lower mountains which dot the vast terrain rise from 1,000 to 4,000 feet above the valley floor. Prevailing winds in the MDAB are out of the west and southwest. These prevailing winds are due to the proximity of the MDAB to coastal and central regions and the blocking nature of the Sierra Nevada Mountains to the north; air masses pushed onshore in southern California by differential heating are channeled through the MDAB. The MDAB is separated from the southern California coastal and central California valley regions by mountains (highest elevation approximately 10,000 feet), whose passes form the main channels for these air masses. The Antelope Valley is bordered in the northwest by the Tehachapi Mountains, separated from the Sierra Nevada's in the north by the Tehachapi Pass (3,800-foot elevation). The Antelope Valley is bordered in the south by the San Gabriel Mountains, bisected by Soledad Canyon (3,300 feet). The Mojave Desert is bordered in the southwest by the San Bernardino Mountains, separated from the San Gabriel's by the Cajon Pass (4,200 feet). A lesser channel lies between the San Bernardino Mountains and the Little San Bernardino Mountains (the Morongo Valley).

The Palo Verde Valley portion of the Mojave Desert lies in the low desert, at the eastern end of a series of valleys (notably the Coachella Valley) whose primary channel is the San Gorgonio Pass (2,300 feet) between the San Bernardino and San Jacinto Mountains.

During the summer the MDAB is generally influenced by a Pacific Subtropical High cell that sits off the coast, inhibiting cloud formation and encouraging daytime solar heating. The MDAB is rarely influenced by cold air masses moving south from Canada and Alaska, as these frontal systems are weak and diffuse by the time the reach the desert. Most desert moisture arrives from infrequent warm, moist and unstable air masses from the south. The MDAB averages between three and seven inches of precipitation per year (from 16 to 30 days with at least 0.01 inches of precipitation). The MDAB is classified as a dry-hot desert climate (BWh), with portions classified as dry-very hot desert (BWhh), to indicate at least three months have maximum average temperatures over 100.4° F.

The temperature and precipitation levels for Joshua Tree, the closest monitoring station to the project site, are in Table 3. Table 3 shows that July is typically the warmest month and December is typically the coolest month. Rainfall in the project area varies considerably in both time and space. Almost all the annual rainfall comes from the fringes of mid-latitude storms from late November to early April, with summers being almost completely dry.

Table 3: Meteorological Summary

Month	Temperature (˚F)		Average Precipitation (inches)
	Average High	Average Low	
January	62.2	37.9	0.62
February	61.5	37.5	0.48
March	69.8	41.0	0.39
April	76.4	46.0	0.13
May	86.0	53.4	0.17
June	93.9	60.0	0.01
July	101.1	70.8	0.33
August	100.4	70.1	0.50
September	95.8	65.8	0.33
October	81.2	53.4	0.33
November	69.1	43.0	0.61
December	58.2	35.8	0.79
Annual Average	**79.6**	**51.2**	**4.7**

Notes:
[1] Source : https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca4405

3.1.2 Local Air Quality

The MDAQMD maintains an air-monitoring network that measures levels of several air pollutants throughout the air basin. Since not all air monitoring stations measure all of the tracked pollutants, the data from the following two monitoring stations, listed in the order of proximity to the project site have been used. The nearest air monitoring stations to the project site with available data is the Palm Springs – Fire Station monitoring station (Palm Springs Station) located approximately 20 miles southwest of the project site at 590 Racquet Club Ave, Palm Springs. Table 4 presents the monitored pollutant levels within the vicinity. However, it should be noted that due to the air monitoring station distance from the project site, recorded air pollution levels at the air monitoring station reflect with varying degrees of accuracy, local air quality conditions at the project site.

<Table 4, next page>

Table 4: Local Area Air Quality Levels

Pollutant (Standard)[2]	Year		
	2020	2021	2022
Ozone:			
Maximum 1-Hour Concentration (ppm)	0.119	0.110	0.106
Days > CAAQS (0.09 ppm)	**9**	**10**	**7**
Maximum 8-Hour Concentration (ppm)	0.094	0.092	0.089
Days > NAAQS (0.07 ppm)	**49**	**35**	**39**
Days > CAAQS (0.070 ppm)	**53**	**38**	**43**
Carbon Monoxide:			
Maximum 8-Hour Concentration (ppm)	*	*	*
Days > NAAQS (9 ppm)	0	0	0
Nitrogen Dioxide:			
Maximum 1-Hour Concentration (ppm)	0.047	0.036	0.038
Days > NAAQS (0.25 ppm)	0	0	0
Inhalable Particulates (PM10):			
Maximum 24-Hour Concentration (µg/m^3)	129.8	35.2	159.5
Days > NAAQS (150 µg /m^3)	**0**	**0**	**1**
Days > CAAQS (50 µg /m^3)	**0**	**0**	**3**
Annual Average (ug/m^3)	23.2	18.4	21.1
Annual > NAAQS (50 µg /m^3)	No	No	No
Annual > CAAQS (20 µg /m^3)	**Yes**	No	**Yes**
Ultra-Fine Particulates (PM2.5):			
Maximum 24-Hour Concentration (µg /m^3)	23.9	13.5	31.2
Days > NAAQS (35 µg /m^3)	0	0	0
Annual Average (µg /m^3)	6.4	6.1	6.3
Annual > NAAQS (15 µg /m3)	No	No	No
Annual > CAAQS (12 µg /m^3)	No	No	No

[1.] Source: obtained from https://www.arb.ca.gov/adam/topfour/topfour1.php
[2] CAAQS = California Ambient Air Quality Standard; NAAQS = National Ambient Air Quality Standard; ppm = parts per million; µg/m^3 = micrograms/cubic meter
[3] No data available.

The monitoring data presented in Table 4 shows that ozone and particulate matter (PM10) are the air pollutants of primary concern in the project area, which are detailed below.

Ozone

During the 2020 to 2022 monitoring period, the State 1-hour concentration standard for ozone were exceeded between 7 and 10 days each year at the Palm Springs Station. The State 8-hour ozone standard has been exceeded between 38 and 53 days each year over the past three years at the Palm Springs Station. The Federal 8-hour ozone standard has been exceeded between 35 and 49 days each year of the past three years at the Palm Springs Station.

Carbon Monoxide

CO is another important pollutant that is due mainly to motor vehicles. The Palm Springs Station did not record an exceedance of the state or federal 8-hour CO standards for the last three years.

Nitrogen Dioxide
The Palm Springs Station did not record an exceedance of the State or Federal NO_2 standards for the last three years.

Particulate Matter
During the 2020 to 2022 monitoring period, the State 24-hour concentration standard for PM10 was exceeded for three days in 2022 at the Palm Springs Station. Over the same time period the Federal 24-hour standards for PM10 have been exceeded for one day in 2022 at the Palm Springs Station.

The Federal 24-hour standard for PM2.5 has not been exceeded over the last three years at the Palm Springs Station.

According to the EPA, some people are much more sensitive than others to breathing fine particles (PM10 and PM2.5). People with influenza, chronic respiratory and cardiovascular diseases, and the elderly may suffer worsening illness and premature death due to breathing these fine particles. People with bronchitis can expect aggravated symptoms from breathing in fine particles. Children may experience decline in lung function due to breathing in PM10 and PM2.5. Other groups considered sensitive are smokers and people who cannot breathe well through their noses. Exercising athletes are also considered sensitive, because many breathe through their mouths during exercise.

3.1.3 Attainment Status

The EPA and the ARB designate air basins where ambient air quality standards are exceeded as "nonattainment" areas. If standards are met, the area is designated as an "attainment" area. If there is inadequate or inconclusive data to make a definitive attainment designation, they are considered "unclassified." National nonattainment areas are further designated as marginal, moderate, serious, severe, or extreme as a function of deviation from standards. Each standard has a different definition, or 'form' of what constitutes attainment, based on specific air quality statistics. For example, the Federal 8-hour CO standard is not to be exceeded more than once per year; therefore, an area is in attainment of the CO standard if no more than one 8-hour ambient air monitoring values exceeds the threshold per year. In contrast, the federal annual $PM_{2.5}$ standard is met if the three-year average of the annual average $PM_{2.5}$ concentration is less than or equal to the standard. Table 5 lists the attainment status for the criteria pollutants in the basin.

As indicated below in Table 5, the MDAB has been designated by the EPA as a non-attainment area for ozone (O3) and suspended particulates (PM10). Currently, the Basin is in attainment with the ambient air quality standards for carbon monoxide (CO), lead, sulfur dioxide (SO2), nitrogen dioxide (NO2) and particulate matter (PM2.5).

<Table 5, next page>

Table 5: Attainment Status of MDAQMD[1] Portion of Mojave Desert Air Basin[2]

Pollutant	Federal Designation	State Designation
1-Hour Ozone	--	Nonattainment
8-Hour Ozone	Nonattainment	Nonattainment
CO	Unclassified/Attainment	Attainment
PM10	Nonattainment	Nonattainment
PM2.5	Unclassified/Attainment	Nonattainment
Lead	Unclassified/Attainment	Attainment
SO2	Unclassified/Attainment	Attainment
NO2	Unclassified/Attainment	Attainment

Notes:

[1] MDAQMD = Mojave Desert Air Quality Management District

[2] Source: California Air Resources Board (2019) (https://ww2.arb.ca.gov/resources/documents/maps-state-and-federal-area-designations) and MDAQMD (https://www.mdaqmd.ca.gov/air-quality/mdaqmd-attaiment-status). Covers the portion of the Mojave Desert Air Basin controlled managed by the MDAQMD.

4.0 Modeling Parameters and Assumptions

4.1 Construction

Emissions are estimated using the CalEEMod (Version 2022.1.1.29) software, which is a statewide land use emissions computer model designed to provide a uniform platform for government agencies, land use planners, and environmental professionals to quantify potential criteria pollutant and GHG emissions from a variety of land use projects. CalEEMod was developed in collaboration with the air districts of California. Regional data (e.g., emission factors, trip lengths, meteorology, source inventory, etc.) have been provided by the various California air districts to account for local requirements and conditions. The model is considered to be an accurate and comprehensive tool for quantifying air quality and GHG impacts from land use projects throughout California. The CalEEMod model output for the proposed project can be found in Appendix A.

The CalEEMod program uses the EMFAC2021 computer program to calculate the emission rates specific for the MDAQMD portion of San Bernardino County for construction-related employee vehicle trips and the OFFROAD2017 computer program to calculate emission rates for heavy truck operations. EMFAC2021 and OFFROAD2017 are computer programs generated by CARB that calculates composite emission rates for vehicles. Emission rates are reported by the program in grams per trip and grams per mile or grams per running hour. Using CalEEMod, the peak daily air pollutant emissions were calculated and presented below. These emissions represent the highest level of emissions for each of the construction phases in terms of air pollutant emissions. The CalEEMod model output for the proposed project can be found in Appendix A and the EMFAC2021 output can be found in Appendix B.

The analysis assesses the emissions associated with the construction of the proposed project as indicated in Table 1. Per the site plan, the overall area to be disturbed during construction of the proposed project was estimated to be approximately 60 acres. Construction is estimated to occur over approximately 18 months, per default construction estimates from CalEEMod, beginning in mid 2025. The phases of the construction activities which have been analyzed below are: 1) site preparation, 2) grading, 3) building, 4) paving, and 5) architectural coating. The entire site was modeled to be graded for a conservative analysis. For details on construction modeling and construction equipment for each phase, please see Appendix A.

4.2 Operations

Operational or long-term emissions occur over the life of the Project. Both mobile and area sources generate operational emissions. Area source emissions arise from consumer product usage, heaters that consume natural gas, gasoline-powered landscape equipment, and architectural coatings (painting). Mobile source emissions from motor vehicles are the largest single long-term source of air pollutants from the operation of the Project. Small amounts of emissions would also occur from area sources such as the consumption of natural gas for heating, hearths, from landscaping emissions, and consumer product usage. The operational emissions were estimated using the latest version of CalEEMod. The CalEEMod model output for the proposed project can be found in Appendix A.

Mobile Sources

Mobile sources include emissions from the additional vehicle miles generated from the proposed project. The project will generate approximately 113 trips per day per the trip generation assessment from IEG (2025). The program then applies the emission factors for each trip which is provided by the EMFAC2021 model (Appendix B) to determine the vehicular traffic pollutant emissions. The CalEEMod default trip lengths were used in this analysis. Please see CalEEMod output comments sections in Appendix A for details.

Area Sources

Area sources include emissions from consumer products, landscape equipment and architectural coatings. Landscape maintenance includes fuel combustion emissions from equipment such as lawn mowers, rototillers, shredders/grinders, blowers, trimmers, chain saws, and hedge trimmers, as well as air compressors, generators, and pumps. As specifics were not known about the landscaping equipment fleet, CalEEMod defaults were used to estimate emissions from landscaping equipment.

Per MDAQMD Rule 1113 as amended on April 23, 2012, the architectural coatings that would be applied after January 1, 2013 will be limited to an average of 150 grams per liter or less.

Energy Usage

2022.1.1.29 CalEEMod defaults were utilized.

5.0 Thresholds of Significance

5.1 Air Quality Thresholds of Significance

5.1.1 CEQA Guidelines for Air Quality

The CEQA Guidelines define a significant effect on the environment as "a substantial, or potentially substantial, adverse change in the environment." To determine if a project would have a significant impact on air quality, the type, level, and impact of emissions generated by the project must be evaluated.

The following air quality significance thresholds are contained in Appendix G of the CEQA Guidelines. A significant impact would occur if the project would:

- Conflict with or obstruct implementation of the applicable air quality plan;
- Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is nonattainment under an applicable national or state ambient air quality standard;
- Expose sensitive receptors to substantial pollutant concentrations; or
- Result in other emissions (such as those leading to odors) adversely affecting a substantial number of people.

The CEQA Guidelines Section 15064.7 provides the significance criteria established by the applicable air quality management district or air pollution control district, when available, may be relied upon to make determinations of significance. The potential air quality impacts of the project are, therefore, evaluated according to thresholds developed by MDAQMD in their CEQA Guidelines.

5.1.2 Regional Significance Thresholds

According to the MDAQMD, a project is non-conforming if it conflicts with or delays implementation of any applicable attainment or maintenance plan. A project is conforming if it complies with all applicable MDAQMD rules and regulations, complies with all proposed control measures that are not yet adopted from the applicable plan(s), and it is consistent with the growth forecasts in the applicable plan(s) (or is directly included in the applicable plan).

Violation of Air Quality Standards or Substantial Contribution to Air Quality Violations. The MDAQMD currently recommends that projects with construction-related and/or operational emissions that exceed any of the following emissions thresholds should be considered significant:

- 25 tons per year or 137 pounds per day pounds per day of VOC
- 25 tons per year or 137 pounds per day of NOx
- 100 tons per year or 548 pounds per day of CO
- 25 tons per year or 137 pounds per day of Sox
- 15 tons per year or 82 pounds per day of PM10
- 12 tons per year or 65 pounds per day of PM2.5

For the purposes to this air quality impact analysis, a regional air quality impact would be considered significant if emissions exceed the MDAQMD significance thresholds identified above.

6.0 Air Quality Emissions Impact

6.1 Construction Air Quality Emissions Impact

The latest version of CalEEMod was used to estimate the onsite and offsite construction emissions. The emissions incorporate Rule 403.2, as discussed in Section 2.1.2. Rule 403.2 (fugitive dust) is not considered a mitigation measure as the project by default is required to incorporate this rule during construction.

6.1.1 Project Construction Emissions

The construction emissions for the project would not exceed MDAQMD's daily emissions thresholds as demonstrated in Table 6 and therefore would be considered less than significant.

Table 6: Project Significance - Construction Emissions (pounds/day)

Construction Year	Pollutant Emissions (pounds/day)					
	VOC	NOx	CO	SO_2	PM10	PM2.5
2025	3.41	32.50	31.60	0.08	9.26	5.25
2026	7.47	18.10	25.20	0.04	1.04	0.74
2027	7.39	17.50	25.10	0.04	0.97	0.68
Maximum Daily Emissions	**7.47**	**32.50**	**31.60**	**0.08**	**9.26**	**5.25**
MDAQMD Thresholds	**137**	**137**	**548**	**137**	**82**	**65**
Exceeds Thresholds	No	No	No	No	No	No

Notes:
[1] Source: CalEEMod Version 2022.1.1.29. See Appendix A for full output.
[2] On-site emissions from equipment operated on-site that is not operated on public roads. On-site grading PM-10 and PM-2.5 emissions show mitigated values for fugitive dust for compliance with MDAQMD Rule 403.
[3] Off-site emissions from equipment operated on public roads.
[4] Construction, architectural coatings and paving phases may overlap.

6.1.3 Odors

Potential sources that may emit odors during construction activities include equipment usage and the application of materials such as concrete. The objectionable odors that may be produced during the construction process are of short-term in nature and the odor emissions are expected cease upon construction completion and the drying or hardening of the odor producing materials. Diesel exhaust and VOCs would be emitted during construction of the project, which are objectionable to some; however, emissions would disperse rapidly from the project site and therefore should not reach an objectionable level at the nearest sensitive receptors, the residences located 80 feet to the west. Due to the short-term nature and limited amounts of odor producing materials being utilized, no significant impact related to odors would occur during construction of the proposed project.

6.1.4 Construction-Related Toxic Air Contaminant Impact

The greatest potential for toxic air contaminant emissions would be related to diesel particulate emissions associated with heavy equipment operations during construction of the proposed project. The Office of Environmental Health Hazard Assessment (OEHHA) has issued the Air Toxic Hot Spots Program

Risk Assessment Guidelines and Guidance Manual for the Preparation of Health Risk Assessments, February 2015 to provide a description of the algorithms, recommended exposure variates, cancer and noncancer health values, and the air modeling protocols needed to perform a health risk assessment (HRA) under the Air Toxics Hot Spots Information and Assessment Act of 1987. Hazard identification includes identifying all substances that are evaluated for cancer risk and/or non-cancer acute, 8-hour, and chronic health impacts. In addition, identifying any multi-pathway substances that present a cancer risk or chronic non-cancer hazard via non-inhalation routes of exposure.

OEHHA recommends a 30-year period when analyzing health risk from toxic air contaminants. Given the relatively limited number of heavy-duty construction equipment, 18-month construction schedule, the nearest sensitive receptors over 80 feet from the property line, and the overall construction area of 60 acres, the proposed project would not result in a long-term substantial source of toxic air containment emissions and corresponding individual cancer risk. Furthermore, construction-based particulate matter (PM) emissions (including diesel exhaust emissions) do not exceed any regional thresholds. Therefore, no significant short-term toxic air contaminant impacts would occur during construction of the proposed project.

6.2 Operational Air Quality Emissions Impact

6.2.1 Regional Operational Emissions

The operations-related criteria air quality impacts created by the proposed project have been analyzed through the use of CalEEMod model. See Appendix A for the full CalEEMod model output. The operating emissions were based on year 2026, which is a conservative estimate of the opening year for the project.

Table 7 provides the project's unmitigated operational emissions. Table 7 shows that the project does not exceed the MDAQMD regional emissions thresholds. Therefore, operational emissions are considered to be less than significant.

Table 7: Project Significance - Operational Emissions (tons/year)

Activity	Pollutant Emissions (tons/year)[1]					
	VOC	**NOx**	**CO**	**SO2**	**PM10**	**PM2.5**
Area Sources[2]	0.84	0.01	0.88	0.00	0.11	0.11
Energy Usage[3]	0.00	0.02	0.01	0.00	0.00	0.00
Mobile Sources[4]	0.09	0.11	0.77	0.00	0.18	0.05
Total Emissions	**0.93**	**0.14**	**1.66**	**0.00**	**0.29**	**0.16**
MDAQMD Annual Thresholds	**25**	**25**	**100**	**25**	**15**	**12**
Exceeds Threshold?	No	No	No	No	No	No

Notes:
[1] Source: CalEEMod Version 2022.1.1.29. See full output in Appendix A.
[2] Area sources consist of emissions from consumer products, architectural coatings, and landscaping equipment.
[3] Energy usage consists of emissions from on-site natural gas usage.
[4] Mobile sources consist of emissions from vehicles and road dust.
[5] Stationary sources consist of emissions from onsite generator.

6.2.2 Operations-Related Toxic Air Contaminant Impacts

MDAQMD recommends avoiding siting new sensitive land uses such as residences, schools, daycare centers, playgrounds, or medical facilities within 1,000 feet of a major transportation project (50,000 or more vehicles per day).

As the proposed project involves the construction of single-family residences, the project would be considered a sensitive receptor. The project would be over 14,000 feet (2.65 miles) from the nearest major road, State Route 247.

Furthermore, the project is only anticipated to generate approximately 113 daily vehicle trips per CalEEMod default estimates for the project (Appendix A). Therefore, as the proposed project does not generate more than 50,000 vehicles per day, a project-specific health risk assessment is not required or warranted. Impacts to nearby sensitive receptors such as existing residences located 80 feet west of the project site are considered to be less than significant.

6.2.3 Operations-Related Odor Impacts

Potential sources that may emit odors during the on-going operations of the proposed project would include odor emissions from vehicular emissions and trash storage areas. As the project is a single-family residential development, which do not typically involve generation of significant odors, no significant impact related to odors would occur during the on-going operations of the proposed project.

6.3 Cumulative Regional Air Quality Impacts

Cumulative projects include local development as well as general growth within the project area. However, as with most development, the greatest source of emissions is from mobile sources, which travel well out of the local area. Therefore, from an air quality standpoint, the cumulative analysis would extend beyond any local projects and when wind patterns are considered, would cover an even larger area. Accordingly, the cumulative analysis for the project's air quality must be generic by nature.

The project area is out of attainment for both ozone and particulate matter. Construction and operation of cumulative projects will further degrade the air quality of the Mojave Desert Air Basin. The greatest cumulative impact on the quality of regional air cell will be the incremental addition of pollutants mainly from increased traffic from residential, commercial, and industrial development and the use of heavy equipment and trucks associated with the construction of these projects. Air quality will be temporarily degraded during construction activities that occur separately or simultaneously. However, in accordance with the MDAQMD methodology, projects that do not exceed the MDAQMD criteria or can be mitigated to less than criteria levels are not considered significant and do not significantly add to the overall cumulative impact.

Project operations would generate emissions of NOx, ROG, CO, SO_2, PM10, and PM2.5, which would not exceed the MDAQMD regional thresholds and would not be expected to result in ground level concentrations that exceed the NAAQS or CAAQS. Therefore, operation of the project would not result in a cumulatively considerable net increase for non-attainment of criteria pollutants or ozone precursors. As a result, the project would result in a less than significant cumulative impact for operational emissions.

6.4 Air Quality Compliance

The California Environmental Quality Act (CEQA) requires a discussion of any inconsistencies between a proposed project and applicable General Plans and Regional Plans (CEQA Guidelines Section 15125). According to the MDAQMD, a project is non-conforming if it conflicts with or delays implementation of any applicable attainment or maintenance plan.

A project is conforming if it complies with all applicable District rules and regulations, complies with all proposed control measures that are not yet adopted from the applicable plan(s), and is consistent with the growth forecasts in the applicable plan(s) (or is directly included in the applicable plan). Conformity with growth forecasts can be established by demonstrating that the project is consistent with the land use plan that was used to generate the growth forecast. An example of a non-conforming project would be one that significantly increases the gross number of dwelling units, increases the number of trips, and/or increases the overall vehicle miles traveled in an affected area (relative to the applicable land use plan). The "one map approach" is employed by the County of San Bernardino, as it permits the use of a single map showing both General Plan land use designations and zoning classifications. The one-map approach assures that there will always be land use consistency between the County's General Plan and its Zoning Code.

Per the County, the current land use designation is Rural Living (RL-5). As the project is a single-family residential development and meets the requirements of a 5-acre minimum lot size, no change in existing zoning or General Plan Land Use designations is necessary in order to implement the proposed Project. As shown by the results of this air analysis in tables 6 and 7, the project's emissions do not exceed any MDAQMD thresholds during either short-term construction or long-term operation of the project. Therefore, as the project is consistent with the General Plan Land Use designation, the proposed project is not anticipated to exceed the Attainment Plan assumptions for the project site.

Based on the above, the proposed project would not conflict with implementation of the MDAQMD Attainment Plans, impacts are considered to be less than significant.

7.0 References

The following references were used in the preparing this analysis.

California Air Pollution Control Officers Association
2009 Health Risk Assessments for Proposed Land Use Projects

California Air Resources Board
2008 Resolution 08-43

2008 ARB Recommended Interim Risk Management Policy for Inhalation-Based Residential Cancer Risk – Frequently Asked Questions

2008 Climate Change Scoping Plan, a framework for change.

2011 Supplement to the AB 32 Scoping Plan Functional Equivalent Document

2013 Revised Emission Factors for Gasoline Marketing Operations at California Gasoline Dispensing Facilities

2014 First Update to the Climate Change Scoping Plan, Building on the Framework Pursuant to AB32, the California Global Warming Solutions Act of 2006. May.

2017 California's 2017 Climate Change Scoping Plan. November.

2020 Historical Air Quality, Top 4 Summary

Governor's Office of Planning and Research
2008 CEQA and Climate: Addressing Climate Change Through California Environmental Quality Act (CEQA) Review

2009 CEQA Guideline Sections to be Added or Amended

Mojave Desert Air Quality Management District (MDAQMD)
2016 California Environmental Quality Act (CEQA) And Federal Conformity Guidelines. August

Office of Environmental Health Hazard Assessment
2015 Air Toxics Hot Spots Program Risk Assessment Guidelines

Appendix A:

CalEEMod Emissions Output

Pipes Canyon Detailed Report

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5.8. Construction Electricity Consumption and Emissions Factors

5.9. Operational Mobile Sources

5.9.1. Unmitigated

5.10. Operational Area Sources

5.10.1. Hearths

5.10.1.1. Unmitigated

5.10.2. Architectural Coatings

5.10.3. Landscape Equipment

5.11. Operational Energy Consumption

5.11.1. Unmitigated

5.12. Operational Water and Wastewater Consumption

5.12.1. Unmitigated

5.13. Operational Waste Generation

5.13.1. Unmitigated

5.14. Operational Refrigeration and Air Conditioning Equipment

5.14.1. Unmitigated

5.15. Operational Off-Road Equipment

5.15.1. Unmitigated

5.16. Stationary Sources

5.16.1. Emergency Generators and Fire Pumps

5.16.2. Process Boilers

5.17. User Defined

5.18. Vegetation

5.18.1. Land Use Change

5.18.1.1. Unmitigated

5.18.1. Biomass Cover Type

5.18.1.1. Unmitigated

5.18.2. Sequestration

5.18.2.1. Unmitigated

6. Climate Risk Detailed Report

6.1. Climate Risk Summary

6.2. Initial Climate Risk Scores

6.3. Adjusted Climate Risk Scores

6.4. Climate Risk Reduction Measures

7. Health and Equity Details

7.1. CalEnviroScreen 4.0 Scores

7.2. Healthy Places Index Scores

7.3. Overall Health & Equity Scores

7.4. Health & Equity Measures

7.5. Evaluation Scorecard

7.6. Health & Equity Custom Measures

8. User Changes to Default Data

1. Basic Project Information

1.1. Basic Project Information

Data Field	Value
Project Name	Pipes Canyon
Construction Start Date	5/1/2025
Operational Year	2026
Lead Agency	—
Land Use Scale	Project/site
Analysis Level for Defaults	County
Windspeed (m/s)	3.60
Precipitation (days)	3.00
Location	34.19973025916252, -116.50090993485765
County	San Bernardino-Mojave Desert
City	Unincorporated
Air District	Mojave Desert AQMD
Air Basin	Mojave Desert
TAZ	5144
EDFZ	10
Electric Utility	Southern California Edison
Gas Utility	Southern California Gas
App Version	2022.1.1.29

1.2. Land Use Types

Land Use Subtype	Size	Unit	Lot Acreage	Building Area (sq ft)	Landscape Area (sq ft)	Special Landscape Area (sq ft)	Population	Description
Single Family Housing	12.0	Dwelling Unit	60.0	23,400	140,554	—	40.0	—

1.3. User-Selected Emission Reduction Measures by Emissions Sector

No measures selected

2. Emissions Summary

2.1. Construction Emissions Compared Against Thresholds

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Un/Mit.	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	3.41	32.5	31.6	0.08	1.37	7.89	9.26	1.26	3.99	5.25	—	9,327	9,327	0.28	0.45	6.31	9,476
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	7.47	18.1	25.2	0.04	0.72	0.32	1.04	0.67	0.08	0.74	—	4,493	4,493	0.17	0.07	0.04	4,518
Average Daily (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	1.17	7.58	10.2	0.02	0.29	0.71	0.98	0.27	0.29	0.54	—	1,903	1,903	0.07	0.05	0.31	1,911
Annual (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	0.21	1.38	1.86	< 0.005	0.05	0.13	0.18	0.05	0.05	0.10	—	315	315	0.01	0.01	0.05	316

2.2. Construction Emissions by Year, Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2025	3.41	32.5	31.6	0.08	1.37	7.89	9.26	1.26	3.99	5.25	—	9,327	9,327	0.28	0.45	6.31	9,476

2026	1.09	9.91	13.3	0.02	0.38	0.07	0.45	0.35	0.02	0.37	—	2,499	2,499	0.10	0.03	0.31	2,510
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2025	1.15	10.5	13.3	0.02	0.43	0.07	0.50	0.40	0.02	0.41	—	2,494	2,494	0.10	0.03	0.01	2,505
2026	7.47	18.1	25.2	0.04	0.72	0.32	1.04	0.67	0.08	0.74	—	4,493	4,493	0.17	0.07	0.04	4,518
2027	7.39	17.5	25.1	0.04	0.66	0.32	0.97	0.60	0.08	0.68	—	4,485	4,485	0.17	0.07	0.03	4,510
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2025	0.70	6.63	7.02	0.01	0.27	0.71	0.98	0.25	0.29	0.54	—	1,655	1,655	0.06	0.05	0.31	1,672
2026	1.17	7.58	10.2	0.02	0.29	0.06	0.36	0.27	0.02	0.28	—	1,903	1,903	0.07	0.02	0.13	1,911
2027	0.09	0.21	0.30	< 0.005	0.01	< 0.005	0.01	0.01	< 0.005	0.01	—	52.7	52.7	< 0.005	< 0.005	0.01	53.0
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2025	0.13	1.21	1.28	< 0.005	0.05	0.13	0.18	0.05	0.05	0.10	—	274	274	0.01	0.01	0.05	277
2026	0.21	1.38	1.86	< 0.005	0.05	0.01	0.06	0.05	< 0.005	0.05	—	315	315	0.01	< 0.005	0.02	316
2027	0.02	0.04	0.05	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	8.73	8.73	< 0.005	< 0.005	< 0.005	8.78

2.4. Operations Emissions Compared Against Thresholds

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Un/Mit.	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	19.2	0.97	25.9	0.04	2.75	1.01	3.77	2.75	0.26	3.01	275	1,644	1,919	0.79	0.08	4.37	1,967
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	19.1	1.01	24.0	0.04	2.75	1.01	3.77	2.75	0.26	3.01	275	1,534	1,810	0.79	0.08	0.28	1,854
Average Daily (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Unmit.	5.14	0.77	9.08	0.02	0.63	0.99	1.62	0.63	0.25	0.88	67.5	1,427	1,494	0.79	0.06	1.94	1,534
Annual (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	0.94	0.14	1.66	< 0.005	0.12	0.18	0.30	0.12	0.05	0.16	11.2	236	247	0.13	0.01	0.32	254

2.5. Operations Emissions by Sector, Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Sector	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mobile	0.58	0.55	5.17	0.01	0.01	1.01	1.02	0.01	0.26	0.27	—	1,222	1,222	0.04	0.05	4.20	1,242
Area	18.7	0.32	20.6	0.03	2.74	—	2.74	2.74	—	2.74	268	141	409	< 0.005	0.02	—	416
Energy	0.01	0.09	0.04	< 0.005	0.01	—	0.01	0.01	—	0.01	—	253	253	0.02	< 0.005	—	254
Water	—	—	—	—	—	—	—	—	—	—	0.96	27.7	28.7	0.10	< 0.005	—	31.9
Waste	—	—	—	—	—	—	—	—	—	—	6.29	0.00	6.29	0.63	0.00	—	22.0
Refrig.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.17	0.17
Total	19.2	0.97	25.9	0.04	2.75	1.01	3.77	2.75	0.26	3.01	275	1,644	1,919	0.79	0.08	4.37	1,967
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mobile	0.51	0.60	3.98	0.01	0.01	1.01	1.02	0.01	0.26	0.27	—	1,114	1,114	0.04	0.05	0.11	1,131
Area	18.6	0.31	20.0	0.03	2.74	—	2.74	2.74	—	2.74	268	139	407	< 0.005	0.02	—	414
Energy	0.01	0.09	0.04	< 0.005	0.01	—	0.01	0.01	—	0.01	—	253	253	0.02	< 0.005	—	254
Water	—	—	—	—	—	—	—	—	—	—	0.96	27.7	28.7	0.10	< 0.005	—	31.9
Waste	—	—	—	—	—	—	—	—	—	—	6.29	0.00	6.29	0.63	0.00	—	22.0
Refrig.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.17	0.17
Total	19.1	1.01	24.0	0.04	2.75	1.01	3.77	2.75	0.26	3.01	275	1,534	1,810	0.79	0.08	0.28	1,854
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Mobile	0.50	0.60	4.22	0.01	0.01	0.99	1.00	0.01	0.25	0.26	—	1,113	1,113	0.04	0.05	1.77	1,132
Area	4.63	0.07	4.82	0.01	0.61	—	0.61	0.61	—	0.61	60.2	32.1	92.3	< 0.005	0.01	—	94.0
Energy	0.01	0.09	0.04	< 0.005	0.01	—	0.01	0.01	—	0.01	—	253	253	0.02	< 0.005	—	254
Water	—	—	—	—	—	—	—	—	—	—	0.96	27.7	28.7	0.10	< 0.005	—	31.9
Waste	—	—	—	—	—	—	—	—	—	—	6.29	0.00	6.29	0.63	0.00	—	22.0
Refrig.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.17	0.17
Total	5.14	0.77	9.08	0.02	0.63	0.99	1.62	0.63	0.25	0.88	67.5	1,427	1,494	0.79	0.06	1.94	1,534
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mobile	0.09	0.11	0.77	< 0.005	< 0.005	0.18	0.18	< 0.005	0.05	0.05	—	184	184	0.01	0.01	0.29	187
Area	0.84	0.01	0.88	< 0.005	0.11	—	0.11	0.11	—	0.11	9.97	5.32	15.3	< 0.005	< 0.005	—	15.6
Energy	< 0.005	0.02	0.01	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	42.0	42.0	< 0.005	< 0.005	—	42.1
Water	—	—	—	—	—	—	—	—	—	—	0.16	4.58	4.74	0.02	< 0.005	—	5.28
Waste	—	—	—	—	—	—	—	—	—	—	1.04	0.00	1.04	0.10	0.00	—	3.65
Refrig.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.03	0.03
Total	0.94	0.14	1.66	< 0.005	0.12	0.18	0.30	0.12	0.05	0.16	11.2	236	247	0.13	0.01	0.32	254

3. Construction Emissions Details

3.1. Site Preparation (2025) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	3.31	31.6	30.2	0.05	1.37	—	1.37	1.26	—	1.26	—	5,295	5,295	0.21	0.04	—	5,314

Dust From Material Movement	—	—	—	—	—	7.67	7.67	—	3.94	3.94	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.11	1.04	0.99	< 0.005	0.04	—	0.04	0.04	—	0.04	—	174	174	0.01	< 0.005	—	175
Dust From Material Movement	—	—	—	—	—	0.25	0.25	—	0.13	0.13	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.02	0.19	0.18	< 0.005	0.01	—	0.01	0.01	—	0.01	—	28.8	28.8	< 0.005	< 0.005	—	28.9
Dust From Material Movement	—	—	—	—	—	0.05	0.05	—	0.02	0.02	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.10	0.08	1.45	0.00	0.00	0.23	0.23	0.00	0.05	0.05	—	255	255	0.01	0.01	0.93	259
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.04	0.00	0.00	0.01	0.01	0.00	< 0.005	< 0.005	—	7.65	7.65	< 0.005	< 0.005	0.01	7.76
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.01	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	1.27	1.27	< 0.005	< 0.005	< 0.005	1.28
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.3. Grading (2025) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	3.20	29.7	28.3	0.06	1.23	—	1.23	1.14	—	1.14	—	6,599	6,599	0.27	0.05	—	6,622
Dust From Material Movement	—	—	—	—	—	3.60	3.60	—	1.43	1.43	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Off-Road Equipment	0.31	2.85	2.71	0.01	0.12	—	0.12	0.11	—	0.11	—	633	633	0.03	0.01	—	635
Dust From Material Movement	—	—	—	—	—	0.35	0.35	—	0.14	0.14	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.06	0.52	0.50	< 0.005	0.02	—	0.02	0.02	—	0.02	—	105	105	< 0.005	< 0.005	—	105
Dust From Material Movement	—	—	—	—	—	0.06	0.06	—	0.02	0.02	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.11	0.10	1.66	0.00	0.00	0.26	0.26	0.00	0.06	0.06	—	292	292	0.01	0.01	1.07	296
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.05	2.72	0.60	0.02	0.05	0.65	0.69	0.05	0.17	0.21	—	2,437	2,437	< 0.005	0.39	5.25	2,558
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01	0.01	0.12	0.00	0.00	0.03	0.03	0.00	0.01	0.01	—	25.5	25.5	< 0.005	< 0.005	0.04	25.9
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	0.28	0.06	< 0.005	< 0.005	0.06	0.07	< 0.005	0.02	0.02	—	234	234	< 0.005	0.04	0.22	245
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.02	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	4.22	4.22	< 0.005	< 0.005	0.01	4.28

Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	0.05	0.01	< 0.005	< 0.005	0.01	0.01	< 0.005	< 0.005	< 0.005	—	38.7	38.7	< 0.005	0.01	0.04	40.6

3.5. Building Construction (2025) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.13	10.4	13.0	0.02	0.43	—	0.43	0.40	—	0.40	—	2,398	2,398	0.10	0.02	—	2,406
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.13	10.4	13.0	0.02	0.43	—	0.43	0.40	—	0.40	—	2,398	2,398	0.10	0.02	—	2,406
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.26	2.43	3.04	0.01	0.10	—	0.10	0.09	—	0.09	—	558	558	0.02	< 0.005	—	560
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.05	0.44	0.55	< 0.005	0.02	—	0.02	0.02	—	0.02	—	92.4	92.4	< 0.005	< 0.005	—	92.8
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02	0.02	0.36	0.00	0.00	0.06	0.06	0.00	0.01	0.01	—	63.0	63.0	< 0.005	< 0.005	0.23	63.9
Vendor	< 0.005	0.04	0.02	< 0.005	< 0.005	0.01	0.01	< 0.005	< 0.005	< 0.005	—	40.9	40.9	< 0.005	0.01	0.11	42.6
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02	0.02	0.24	0.00	0.00	0.06	0.06	0.00	0.01	0.01	—	55.8	55.8	< 0.005	< 0.005	0.01	56.5
Vendor	< 0.005	0.04	0.02	< 0.005	< 0.005	0.01	0.01	< 0.005	< 0.005	< 0.005	—	40.9	40.9	< 0.005	0.01	< 0.005	42.5
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	0.01	0.06	0.00	0.00	0.01	0.01	0.00	< 0.005	< 0.005	—	13.4	13.4	< 0.005	< 0.005	0.02	13.6
Vendor	< 0.005	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	9.52	9.52	< 0.005	< 0.005	0.01	9.91
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.01	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	2.21	2.21	< 0.005	< 0.005	< 0.005	2.25
Vendor	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	1.58	1.58	< 0.005	< 0.005	< 0.005	1.64
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.7. Building Construction (2026) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.07	9.85	13.0	0.02	0.38	—	0.38	0.35	—	0.35	—	2,397	2,397	0.10	0.02	—	2,405

Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.07	9.85	13.0	0.02	0.38	—	0.38	0.35	—	0.35	—	2,397	2,397	0.10	0.02	—	2,405
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.77	7.04	9.26	0.02	0.27	—	0.27	0.25	—	0.25	—	1,712	1,712	0.07	0.01	—	1,718
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.14	1.28	1.69	< 0.005	0.05	—	0.05	0.05	—	0.05	—	283	283	0.01	< 0.005	—	284
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02	0.02	0.33	0.00	0.00	0.06	0.06	0.00	0.01	0.01	—	61.8	61.8	< 0.005	< 0.005	0.21	62.7
Vendor	< 0.005	0.04	0.02	< 0.005	< 0.005	0.01	0.01	< 0.005	< 0.005	< 0.005	—	40.1	40.1	< 0.005	0.01	0.10	41.8
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02	0.02	0.22	0.00	0.00	0.06	0.06	0.00	0.01	0.01	—	54.7	54.7	< 0.005	< 0.005	0.01	55.4
Vendor	< 0.005	0.04	0.02	< 0.005	< 0.005	0.01	0.01	< 0.005	< 0.005	< 0.005	—	40.1	40.1	< 0.005	0.01	< 0.005	41.7
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01	0.02	0.18	0.00	0.00	0.04	0.04	0.00	0.01	0.01	—	40.2	40.2	< 0.005	< 0.005	0.06	40.8
Vendor	< 0.005	0.03	0.01	< 0.005	< 0.005	0.01	0.01	< 0.005	< 0.005	< 0.005	—	28.6	28.6	< 0.005	< 0.005	0.03	29.8
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.03	0.00	0.00	0.01	0.01	0.00	< 0.005	< 0.005	—	6.66	6.66	< 0.005	< 0.005	0.01	6.75
Vendor	< 0.005	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	4.74	4.74	< 0.005	< 0.005	0.01	4.94
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.9. Building Construction (2027) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.03	9.39	12.9	0.02	0.34	—	0.34	0.31	—	0.31	—	2,397	2,397	0.10	0.02	—	2,405
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01	0.11	0.15	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	28.1	28.1	< 0.005	< 0.005	—	28.2
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Off-Road Equipment	< 0.005	0.02	0.03	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	4.66	4.66	< 0.005	< 0.005	—	4.68
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02	0.02	0.21	0.00	0.00	0.06	0.06	0.00	0.01	0.01	—	53.8	53.8	< 0.005	< 0.005	< 0.005	54.4
Vendor	< 0.005	0.04	0.02	< 0.005	< 0.005	0.01	0.01	< 0.005	< 0.005	< 0.005	—	39.2	39.2	< 0.005	0.01	< 0.005	40.8
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	0.65	0.65	< 0.005	< 0.005	< 0.005	0.66
Vendor	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	0.46	0.46	< 0.005	< 0.005	< 0.005	0.48
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	0.11	0.11	< 0.005	< 0.005	< 0.005	0.11
Vendor	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	0.08	0.08	< 0.005	< 0.005	< 0.005	0.08
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.11. Paving (2026) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.76	7.12	9.94	0.01	0.32	—	0.32	0.29	—	0.29	—	1,511	1,511	0.06	0.01	—	1,516
Paving	0.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.05	0.43	0.60	< 0.005	0.02	—	0.02	0.02	—	0.02	—	91.6	91.6	< 0.005	< 0.005	—	92.0
Paving	0.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01	0.08	0.11	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	15.2	15.2	< 0.005	< 0.005	—	15.2
Paving	0.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.06	0.07	0.77	0.00	0.00	0.20	0.20	0.00	0.05	0.05	—	190	190	< 0.005	0.01	0.02	192
Vendor	0.01	0.17	0.07	< 0.005	< 0.005	0.04	0.05	< 0.005	0.01	0.01	—	156	156	< 0.005	0.02	0.01	163
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.05	0.00	0.00	0.01	0.01	0.00	< 0.005	< 0.005	—	11.9	11.9	< 0.005	< 0.005	0.02	12.0

Vendor	< 0.005	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	9.48	9.48	< 0.005	< 0.005	0.01	9.87
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.01	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	1.96	1.96	< 0.005	< 0.005	< 0.005	1.99
Vendor	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	1.57	1.57	< 0.005	< 0.005	< 0.005	1.63
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.13. Paving (2027) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.74	6.94	9.95	0.01	0.30	—	0.30	0.27	—	0.27	—	1,511	1,511	0.06	0.01	—	1,516
Paving	0.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01	0.08	0.12	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	17.7	17.7	< 0.005	< 0.005	—	17.8
Paving	0.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	< 0.005	0.01	0.02	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	2.94	2.94	< 0.005	< 0.005	—	2.95

Paving	0.00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.06	0.07	0.72	0.00	0.00	0.20	0.20	0.00	0.05	0.05	—	187	187	< 0.005	0.01	0.02	189
Vendor	< 0.005	0.16	0.07	< 0.005	< 0.005	0.04	0.05	< 0.005	0.01	0.01	—	153	153	< 0.005	0.02	0.01	159
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.01	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	2.26	2.26	< 0.005	< 0.005	< 0.005	2.29
Vendor	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	1.79	1.79	< 0.005	< 0.005	< 0.005	1.87
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	0.37	0.37	< 0.005	< 0.005	< 0.005	0.38
Vendor	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	0.30	0.30	< 0.005	< 0.005	< 0.005	0.31
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.15. Architectural Coating (2026) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.12	0.86	1.13	< 0.005	0.02	—	0.02	0.02	—	0.02	—	134	134	0.01	< 0.005	—	134
Architectural Coatings	5.42	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01	0.05	0.07	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	8.10	8.10	< 0.005	< 0.005	—	8.13
Architectural Coatings	0.33	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	< 0.005	0.01	0.01	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	1.34	1.34	< 0.005	< 0.005	—	1.35
Architectural Coatings	0.06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.04	0.00	0.00	0.01	0.01	0.00	< 0.005	< 0.005	—	10.9	10.9	< 0.005	< 0.005	< 0.005	11.1

Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	0.68	0.68	< 0.005	< 0.005	< 0.005	0.69
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	0.11	0.11	< 0.005	< 0.005	< 0.005	0.11
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.17. Architectural Coating (2027) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.11	0.83	1.13	< 0.005	0.02	—	0.02	0.02	—	0.02	—	134	134	0.01	< 0.005	—	134
Architectural Coatings	5.42	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Off-Road Equipment	< 0.005	0.01	0.01	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	1.57	1.57	< 0.005	< 0.005	—	1.57
Architectural Coatings	0.06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	0.26	0.26	< 0.005	< 0.005	—	0.26
Architectural Coatings	0.01	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	0.04	0.00	0.00	0.01	0.01	0.00	< 0.005	< 0.005	—	10.8	10.8	< 0.005	< 0.005	< 0.005	10.9
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	0.13	0.13	< 0.005	< 0.005	< 0.005	0.13
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	0.02	0.02	< 0.005	< 0.005	< 0.005	0.02
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

4. Operations Emissions Details

4.1. Mobile Emissions by Land Use

4.1.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Single Family Housing	0.58	0.55	5.17	0.01	0.01	1.01	1.02	0.01	0.26	0.27	—	1,222	1,222	0.04	0.05	4.20	1,242
Total	0.58	0.55	5.17	0.01	0.01	1.01	1.02	0.01	0.26	0.27	—	1,222	1,222	0.04	0.05	4.20	1,242
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Single Family Housing	0.51	0.60	3.98	0.01	0.01	1.01	1.02	0.01	0.26	0.27	—	1,114	1,114	0.04	0.05	0.11	1,131
Total	0.51	0.60	3.98	0.01	0.01	1.01	1.02	0.01	0.26	0.27	—	1,114	1,114	0.04	0.05	0.11	1,131
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Single Family Housing	0.09	0.11	0.77	< 0.005	< 0.005	0.18	0.18	< 0.005	0.05	0.05	—	184	184	0.01	0.01	0.29	187
Total	0.09	0.11	0.77	< 0.005	< 0.005	0.18	0.18	< 0.005	0.05	0.05	—	184	184	0.01	0.01	0.29	187

4.2. Energy

4.2.1. Electricity Emissions By Land Use - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Single Family Housing	—	—	—	—	—	—	—	—	—	—	—	133	133	0.01	< 0.005	—	134
Total	—	—	—	—	—	—	—	—	—	—	—	133	133	0.01	< 0.005	—	134
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Single Family Housing	—	—	—	—	—	—	—	—	—	—	—	133	133	0.01	< 0.005	—	134
Total	—	—	—	—	—	—	—	—	—	—	—	133	133	0.01	< 0.005	—	134
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Single Family Housing	—	—	—	—	—	—	—	—	—	—	—	22.0	22.0	< 0.005	< 0.005	—	22.1
Total	—	—	—	—	—	—	—	—	—	—	—	22.0	22.0	< 0.005	< 0.005	—	22.1

4.2.3. Natural Gas Emissions By Land Use - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Single Family Housing	0.01	0.09	0.04	< 0.005	0.01	—	0.01	0.01	—	0.01	—	120	120	0.01	< 0.005	—	121

Total	0.01	0.09	0.04	< 0.005	0.01	—	0.01	0.01	—	0.01	—	120	120	0.01	< 0.005	—	121
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Single Family Housing	0.01	0.09	0.04	< 0.005	0.01	—	0.01	0.01	—	0.01	—	120	120	0.01	< 0.005	—	121
Total	0.01	0.09	0.04	< 0.005	0.01	—	0.01	0.01	—	0.01	—	120	120	0.01	< 0.005	—	121
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Single Family Housing	< 0.005	0.02	0.01	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	19.9	19.9	< 0.005	< 0.005	—	20.0
Total	< 0.005	0.02	0.01	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	19.9	19.9	< 0.005	< 0.005	—	20.0

4.3. Area Emissions by Source

4.3.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Source	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Hearths	18.1	0.31	20.0	0.03	2.74	—	2.74	2.74	—	2.74	268	139	407	< 0.005	0.02	—	414
Consumer Products	0.50	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Architectural Coatings	0.04	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Landscape Equipment	0.06	0.01	0.68	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	1.82	1.82	< 0.005	< 0.005	—	1.83
Total	18.7	0.32	20.6	0.03	2.74	—	2.74	2.74	—	2.74	268	141	409	< 0.005	0.02	—	416

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Hearths	18.1	0.31	20.0	0.03	2.74	—	2.74	2.74	—	2.74	268	139	407	< 0.005	0.02	—	414
Consumer Products	0.50	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Architectural Coatings	0.04	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	18.6	0.31	20.0	0.03	2.74	—	2.74	2.74	—	2.74	268	139	407	< 0.005	0.02	—	414
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Hearths	0.74	0.01	0.82	< 0.005	0.11	—	0.11	0.11	—	0.11	9.97	5.17	15.1	< 0.005	< 0.005	—	15.4
Consumer Products	0.09	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Architectural Coatings	0.01	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Landscape Equipment	0.01	< 0.005	0.06	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	0.15	0.15	< 0.005	< 0.005	—	0.15
Total	0.84	0.01	0.88	< 0.005	0.11	—	0.11	0.11	—	0.11	9.97	5.32	15.3	< 0.005	< 0.005	—	15.6

4.4. Water Emissions by Land Use

4.4.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Single Family Housing	—	—	—	—	—	—	—	—	—	—	0.96	27.7	28.7	0.10	< 0.005	—	31.9
Total	—	—	—	—	—	—	—	—	—	—	0.96	27.7	28.7	0.10	< 0.005	—	31.9
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Single Family Housing	—	—	—	—	—	—	—	—	—	—	0.96	27.7	28.7	0.10	< 0.005	—	31.9
Total	—	—	—	—	—	—	—	—	—	—	0.96	27.7	28.7	0.10	< 0.005	—	31.9
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Single Family Housing	—	—	—	—	—	—	—	—	—	—	0.16	4.58	4.74	0.02	< 0.005	—	5.28
Total	—	—	—	—	—	—	—	—	—	—	0.16	4.58	4.74	0.02	< 0.005	—	5.28

4.5. Waste Emissions by Land Use

4.5.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Single Family Housing	—	—	—	—	—	—	—	—	—	—	6.29	0.00	6.29	0.63	0.00	—	22.0
Total	—	—	—	—	—	—	—	—	—	—	6.29	0.00	6.29	0.63	0.00	—	22.0
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Single Family Housing	—	—	—	—	—	—	—	—	—	—	6.29	0.00	6.29	0.63	0.00	—	22.0
Total	—	—	—	—	—	—	—	—	—	—	6.29	0.00	6.29	0.63	0.00	—	22.0
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Single Family Housing	—	—	—	—	—	—	—	—	—	—	1.04	0.00	1.04	0.10	0.00	—	3.65
Total	—	—	—	—	—	—	—	—	—	—	1.04	0.00	1.04	0.10	0.00	—	3.65

4.6. Refrigerant Emissions by Land Use

4.6.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Single Family Housing	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.17	0.17
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.17	0.17
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Single Family Housing	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.17	0.17
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.17	0.17
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Single Family Housing	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.03	0.03

Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.03	0.03

4.7. Offroad Emissions By Equipment Type

4.7.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Equipment Type	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.8. Stationary Emissions By Equipment Type

4.8.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Equipment Type	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.9. User Defined Emissions By Equipment Type

4.9.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Equipment Type	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10. Soil Carbon Accumulation By Vegetation Type

4.10.1. Soil Carbon Accumulation By Vegetation Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Vegetation	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e

Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.2. Above and Belowground Carbon Accumulation by Land Use Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.3. Avoided and Sequestered Emissions by Species - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Species	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

5. Activity Data

5.1. Construction Schedule

Phase Name	Phase Type	Start Date	End Date	Days Per Week	Work Days per Phase	Phase Description
Site Preparation	Site Preparation	7/1/2025	7/16/2025	5.00	12.0	—
Grading	Grading	7/17/2025	9/3/2025	5.00	35.0	—
Building Construction	Building Construction	9/4/2025	1/6/2027	5.00	350	—
Paving	Paving	12/1/2026	1/6/2027	5.00	27.0	—
Architectural Coating	Architectural Coating	12/1/2026	1/6/2027	5.00	27.0	—

5.2. Off-Road Equipment

5.2.1. Unmitigated

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Site Preparation	Rubber Tired Dozers	Diesel	Average	3.00	8.00	367	0.40
Site Preparation	Tractors/Loaders/Backhoes	Diesel	Average	4.00	8.00	84.0	0.37
Grading	Excavators	Diesel	Average	2.00	8.00	36.0	0.38
Grading	Graders	Diesel	Average	1.00	8.00	148	0.41
Grading	Rubber Tired Dozers	Diesel	Average	1.00	8.00	367	0.40
Grading	Scrapers	Diesel	Average	2.00	8.00	423	0.48
Grading	Tractors/Loaders/Backhoes	Diesel	Average	2.00	8.00	84.0	0.37
Building Construction	Cranes	Diesel	Average	1.00	7.00	367	0.29
Building Construction	Forklifts	Diesel	Average	3.00	8.00	82.0	0.20
Building Construction	Generator Sets	Diesel	Average	1.00	8.00	14.0	0.74
Building Construction	Tractors/Loaders/Backhoes	Diesel	Average	3.00	7.00	84.0	0.37
Building Construction	Welders	Diesel	Average	1.00	8.00	46.0	0.45

Paving	Pavers	Diesel	Average	2.00	8.00	81.0	0.42
Paving	Paving Equipment	Diesel	Average	2.00	8.00	89.0	0.36
Paving	Rollers	Diesel	Average	2.00	8.00	36.0	0.38
Architectural Coating	Air Compressors	Diesel	Average	1.00	6.00	37.0	0.48

5.3. Construction Vehicles

5.3.1. Unmitigated

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Site Preparation	—	—	—	—
Site Preparation	Worker	17.5	18.5	LDA,LDT1,LDT2
Site Preparation	Vendor	—	10.2	HHDT,MHDT
Site Preparation	Hauling	0.00	20.0	HHDT
Site Preparation	Onsite truck	—	—	HHDT
Grading	—	—	—	—
Grading	Worker	20.0	18.5	LDA,LDT1,LDT2
Grading	Vendor	—	10.2	HHDT,MHDT
Grading	Hauling	35.7	20.0	HHDT
Grading	Onsite truck	—	—	HHDT
Building Construction	—	—	—	—
Building Construction	Worker	4.32	18.5	LDA,LDT1,LDT2
Building Construction	Vendor	1.28	10.2	HHDT,MHDT
Building Construction	Hauling	0.00	20.0	HHDT
Building Construction	Onsite truck	—	—	HHDT
Paving	—	—	—	—
Paving	Worker	15.0	18.5	LDA,LDT1,LDT2
Paving	Vendor	5.00	10.2	HHDT,MHDT
Paving	Hauling	0.00	20.0	HHDT

Paving	Onsite truck	—	—	HHDT
Architectural Coating	—	—	—	—
Architectural Coating	Worker	0.86	18.5	LDA,LDT1,LDT2
Architectural Coating	Vendor	—	10.2	HHDT,MHDT
Architectural Coating	Hauling	0.00	20.0	HHDT
Architectural Coating	Onsite truck	—	—	HHDT

5.4. Vehicles

5.4.1. Construction Vehicle Control Strategies

Non-applicable. No control strategies activated by user.

5.5. Architectural Coatings

Phase Name	Residential Interior Area Coated (sq ft)	Residential Exterior Area Coated (sq ft)	Non-Residential Interior Area Coated (sq ft)	Non-Residential Exterior Area Coated (sq ft)	Parking Area Coated (sq ft)
Architectural Coating	47,385	15,795	0.00	0.00	—

5.6. Dust Mitigation

5.6.1. Construction Earthmoving Activities

Phase Name	Material Imported (cy)	Material Exported (cy)	Acres Graded (acres)	Material Demolished (sq. ft.)	Acres Paved (acres)
Site Preparation	—	—	18.0	0.00	—
Grading	—	10,000	105	0.00	—
Paving	0.00	0.00	0.00	0.00	0.13

5.6.2. Construction Earthmoving Control Strategies

Control Strategies Applied	Frequency (per day)	PM10 Reduction	PM2.5 Reduction
Water Exposed Area	2	61%	61%

5.7. Construction Paving

Land Use	Area Paved (acres)	% Asphalt
Single Family Housing	0.13	0%

5.8. Construction Electricity Consumption and Emissions Factors

kWh per Year and Emission Factor (lb/MWh)

Year	kWh per Year	CO2	CH4	N2O
2025	0.00	532	0.03	< 0.005
2026	0.00	532	0.03	< 0.005
2027	0.00	532	0.03	< 0.005

5.9. Operational Mobile Sources

5.9.1. Unmitigated

Land Use Type	Trips/Weekday	Trips/Saturday	Trips/Sunday	Trips/Year	VMT/Weekday	VMT/Saturday	VMT/Sunday	VMT/Year
Single Family Housing	113	114	103	40,853	1,422	1,437	1,288	512,790

5.10. Operational Area Sources

5.10.1. Hearths

5.10.1.1. Unmitigated

Hearth Type	Unmitigated (number)
Single Family Housing	—
Wood Fireplaces	4
Gas Fireplaces	7
Propane Fireplaces	0

Electric Fireplaces	0
No Fireplaces	1

5.10.2. Architectural Coatings

Residential Interior Area Coated (sq ft)	Residential Exterior Area Coated (sq ft)	Non-Residential Interior Area Coated (sq ft)	Non-Residential Exterior Area Coated (sq ft)	Parking Area Coated (sq ft)
47385	15,795	0.00	0.00	—

5.10.3. Landscape Equipment

Season	Unit	Value
Snow Days	day/yr	0.00
Summer Days	day/yr	180

5.11. Operational Energy Consumption

5.11.1. Unmitigated

Electricity (kWh/yr) and CO2 and CH4 and N2O and Natural Gas (kBTU/yr)

Land Use	Electricity (kWh/yr)	CO2	CH4	N2O	Natural Gas (kBTU/yr)
Single Family Housing	91,315	532	0.0330	0.0040	375,477

5.12. Operational Water and Wastewater Consumption

5.12.1. Unmitigated

Land Use	Indoor Water (gal/year)	Outdoor Water (gal/year)
Single Family Housing	500,174	3,803,140

5.13. Operational Waste Generation

5.13.1. Unmitigated

Land Use	Waste (ton/year)	Cogeneration (kWh/year)
Single Family Housing	11.7	—

5.14. Operational Refrigeration and Air Conditioning Equipment

5.14.1. Unmitigated

Land Use Type	Equipment Type	Refrigerant	GWP	Quantity (kg)	Operations Leak Rate	Service Leak Rate	Times Serviced
Single Family Housing	Average room A/C & Other residential A/C and heat pumps	R-410A	2,088	< 0.005	2.50	2.50	10.0
Single Family Housing	Household refrigerators and/or freezers	R-134a	1,430	0.12	0.60	0.00	1.00

5.15. Operational Off-Road Equipment

5.15.1. Unmitigated

Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor

5.16. Stationary Sources

5.16.1. Emergency Generators and Fire Pumps

Equipment Type	Fuel Type	Number per Day	Hours per Day	Hours per Year	Horsepower	Load Factor

5.16.2. Process Boilers

Equipment Type	Fuel Type	Number	Boiler Rating (MMBtu/hr)	Daily Heat Input (MMBtu/day)	Annual Heat Input (MMBtu/yr)

5.17. User Defined

Equipment Type	Fuel Type

5.18. Vegetation

5.18.1. Land Use Change

5.18.1.1. Unmitigated

Vegetation Land Use Type	Vegetation Soil Type	Initial Acres	Final Acres

5.18.1. Biomass Cover Type

5.18.1.1. Unmitigated

Biomass Cover Type	Initial Acres	Final Acres

5.18.2. Sequestration

5.18.2.1. Unmitigated

Tree Type	Number	Electricity Saved (kWh/year)	Natural Gas Saved (btu/year)

6. Climate Risk Detailed Report

6.1. Climate Risk Summary

Cal-Adapt midcentury 2040–2059 average projections for four hazards are reported below for your project location. These are under Representation Concentration Pathway (RCP) 8.5 which assumes GHG emissions will continue to rise strongly through 2050 and then plateau around 2100.

Climate Hazard	Result for Project Location	Unit
Temperature and Extreme Heat	36.3	annual days of extreme heat
Extreme Precipitation	1.05	annual days with precipitation above 20 mm

Sea Level Rise	—	meters of inundation depth
Wildfire	4.25	annual hectares burned

Temperature and Extreme Heat data are for grid cell in which your project are located. The projection is based on the 98th historical percentile of daily maximum/minimum temperatures from observed historical data (32 climate model ensemble from Cal-Adapt, 2040–2059 average under RCP 8.5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Extreme Precipitation data are for the grid cell in which your project are located. The threshold of 20 mm is equivalent to about ¾ an inch of rain, which would be light to moderate rainfall if received over a full day or heavy rain if received over a period of 2 to 4 hours. Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Sea Level Rise data are for the grid cell in which your project are located. The projections are from Radke et al. (2017), as reported in Cal-Adapt (Radke et al., 2017, CEC-500-2017-008), and consider inundation location and depth for the San Francisco Bay, the Sacramento-San Joaquin River Delta and California coast resulting different increments of sea level rise coupled with extreme storm events. Users may select from four scenarios to view the range in potential inundation depth for the grid cell. The four scenarios are: No rise, 0.5 meter, 1.0 meter, 1.41 meters
Wildfire data are for the grid cell in which your project are located. The projections are from UC Davis, as reported in Cal-Adapt (2040–2059 average under RCP 8.5), and consider historical data of climate, vegetation, population density, and large (> 400 ha) fire history. Users may select from four model simulations to view the range in potential wildfire probabilities for the grid cell. The four simulations make different assumptions about expected rainfall and temperature are: Warmer/drier (HadGEM2-ES), Cooler/wetter (CNRM-CM5), Average conditions (CanESM2), Range of different rainfall and temperature possibilities (MIROC5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.

6.2. Initial Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	5	0	0	N/A
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	N/A	N/A	N/A	N/A
Wildfire	N/A	N/A	N/A	N/A
Flooding	N/A	N/A	N/A	N/A
Drought	0	0	0	N/A
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.
The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.
The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores do not include implementation of climate risk reduction measures.

6.3. Adjusted Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	5	1	1	4

Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	N/A	N/A	N/A	N/A
Wildfire	N/A	N/A	N/A	N/A
Flooding	N/A	N/A	N/A	N/A
Drought	1	1	1	2
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.
The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.
The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores include implementation of climate risk reduction measures.

6.4. Climate Risk Reduction Measures

7. Health and Equity Details

7.1. CalEnviroScreen 4.0 Scores

The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Exposure Indicators	—
AQ-Ozone	91.1
AQ-PM	1.49
AQ-DPM	0.29
Drinking Water	78.4
Lead Risk Housing	38.6
Pesticides	23.1
Toxic Releases	10.8
Traffic	3.86
Effect Indicators	—

CleanUp Sites	81.4
Groundwater	23.4
Haz Waste Facilities/Generators	22.0
Impaired Water Bodies	0.00
Solid Waste	91.4
Sensitive Population	—
Asthma	41.5
Cardio-vascular	73.7
Low Birth Weights	81.3
Socioeconomic Factor Indicators	—
Education	62.9
Housing	63.3
Linguistic	16.4
Poverty	87.2
Unemployment	98.8

7.2. Healthy Places Index Scores

The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Economic	—
Above Poverty	24.47067881
Employed	1.591171564
Median HI	11.67714616
Education	—
Bachelor's or higher	35.41639933
High school enrollment	100
Preschool enrollment	1.873476197
Transportation	—

Auto Access	70.20402926
Active commuting	1.039394328
Social	—
2-parent households	21.05735917
Voting	77.86475042
Neighborhood	—
Alcohol availability	97.0101373
Park access	36.95624278
Retail density	0.166816374
Supermarket access	18.3498011
Tree canopy	0.564609265
Housing	—
Homeownership	83.48517901
Housing habitability	15.12896189
Low-inc homeowner severe housing cost burden	11.09970486
Low-inc renter severe housing cost burden	7.737713332
Uncrowded housing	53.4838958
Health Outcomes	—
Insured adults	21.36532786
Arthritis	0.0
Asthma ER Admissions	68.8
High Blood Pressure	0.0
Cancer (excluding skin)	0.0
Asthma	0.0
Coronary Heart Disease	0.0
Chronic Obstructive Pulmonary Disease	0.0
Diagnosed Diabetes	0.0
Life Expectancy at Birth	19.8

Cognitively Disabled	9.0
Physically Disabled	1.7
Heart Attack ER Admissions	39.4
Mental Health Not Good	0.0
Chronic Kidney Disease	0.0
Obesity	0.0
Pedestrian Injuries	96.7
Physical Health Not Good	0.0
Stroke	0.0
Health Risk Behaviors	—
Binge Drinking	0.0
Current Smoker	0.0
No Leisure Time for Physical Activity	0.0
Climate Change Exposures	—
Wildfire Risk	15.6
SLR Inundation Area	0.0
Children	89.4
Elderly	6.5
English Speaking	85.0
Foreign-born	4.1
Outdoor Workers	12.7
Climate Change Adaptive Capacity	—
Impervious Surface Cover	98.7
Traffic Density	2.2
Traffic Access	23.0
Other Indices	—
Hardship	69.9
Other Decision Support	—

2016 Voting	86.8

7.3. Overall Health & Equity Scores

Metric	Result for Project Census Tract
CalEnviroScreen 4.0 Score for Project Location (a)	57.0
Healthy Places Index Score for Project Location (b)	10.0
Project Located in a Designated Disadvantaged Community (Senate Bill 535)	No
Project Located in a Low-Income Community (Assembly Bill 1550)	Yes
Project Located in a Community Air Protection Program Community (Assembly Bill 617)	No

a: The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.
b: The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

7.4. Health & Equity Measures

No Health & Equity Measures selected.

7.5. Evaluation Scorecard

Health & Equity Evaluation Scorecard not completed.

7.6. Health & Equity Custom Measures

No Health & Equity Custom Measures created.

8. User Changes to Default Data

Screen	Justification
Land Use	Per project description, 12 5-acre single-family lots
Construction: Construction Phases	No demolition required
Operations: Hearths	No woodstoves

Appendix B.1

Biological Resource Assessment

Biological Resources Assessment

Pipes Canyon Project, Pioneertown, San Bernardino County, California

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Executive Summary

Introduction: This report includes the findings of a Biological Resources Assessment (BRA) conducted by South Environmental where a development has been proposed (project site) near Pioneertown in unincorporated San Bernardino County, California.

Proposed Development: The project applicant seeks approval to subdivide the property into 13 individual lots. Of these, 12 lots will be developed as five-acre residential parcels, intended for single-family homes, and will be offered for sale. These residential lots will be designed to provide ample space for rural residential living, consistent with the existing zoning designation of Rural Living RL-5. The remaining lot, situated within the RC zoning area, will retain its current Resource Conservation designation, preserving the site's natural resources and environmental features.

Proposed developments on the project site include driveways, Millstream Avenue, Private Street 'A', Private Street 'B', and 12 single family home lots. There are no current structures proposed but a development footprint that would be used for future single-family home developments are proposed. The total proposed development footprint is approximately 5.84-acres. Tentative Tract Map No. 20612 is attached within Appendix D.

Plant Communities/Habitat/Sensitive Natural Communities: There are two land cover types and two plant communities in the study area and the project site.

Community or Cover Type	Acres on Study Area	Acres on Project Site	Acres Permanently Impacted by Project	Global / State Rank
Desert Almond Scrub	11.32	3.77	0.55	G4/S4
Developed	22.24	1.07	0.44	N/A
Joshua Tree Woodland	217.03	114.02	4.48	G4/S3.2
Maintained Dirt Path or Road	10.35	4.12	0.37	N/A
Total	**260.94**	**122.98**	**5.84**	**-**

The project would permanently remove 0.55-acres of Desert Almond Scrub and 4.48-acres of Joshua Tree Woodland. Joshua Tree Woodland is considered a sensitive natural community by CDFW based on the state rarity ranking of 3.2. The Desert Almond Scrub and Joshua Tree Woodland communities have the potential to support special-status species in addition to western Joshua tree. Impacts to sensitive natural communities and habitat for special-status species would be considered significant according to CEQA.

The project design includes a 60-acres remainder parcel that will be conserved into perpetuity to mitigate for the loss of 5.03-acres of habitat capable of supporting special-status species on the project site. South Environmental recommends a 1:1 habitat conservation ratio for the Desert Almond Scrub (0.55-acre) and a 3:1 conservation ratio for the Joshua Tree Woodland (13.44-acres), which would be a total of 13.99-acres. The remainder parcel has high quality native habitats that are undisturbed and have a significant density of rock outcroppings when compared to the project impact areas, which provides protection to these significant habitat features. In addition, the large lots and large size of the remainder parcel ensures that sufficient habitat remains to provide a highly permeable landscape for wildlife movement. The proposed project impacts to habitat for special-status species and sensitive natural communities would be considered less than significant according to CEQA because the project proposes to conserve 60-acres of Joshua Tree Woodlands on the remainder parcel, which far exceeds the recommended conservation of 13.99-acres.

Nesting Birds and Raptors: The proposed development would require potential removal of trees, shrubs, and herbaceous plants in the landscaping that could provide potential nesting habitat for birds and raptors protected by the MBTA, MBPA, and the Fish and Game Code, including special-status birds such as Bendire's and Le Conte's thrashers. If present at the time of vegetation removal, active nests, eggs, or young could be destroyed or otherwise disturbed to a point at which the young do not survive, which would be a violation of the MBTA, MBPA, and the Fish and Game Code. In addition, indirect impacts from noise or vibration has the potential to disturb an active bird nest that may occur in adjacent landscaping to the point of failure if the nest is within immediate proximity to project activities, and this would also be a violation of the MBTA and Fish and Game Code. To avoid impacts to active bird or raptor nests, eggs, or young, preconstruction nesting bird surveys and monitoring is required per the MBTA and Fish and Game Code as described in **Mitigation Measure BIO-1.**

Special-Status Plants: Western Joshua tree occurs throughout the project site and impact areas; and there are 13 other special-status plants that have a moderate to high potential to occur within areas that would be impacted by the proposed development, however, the results of a focused rare plant survey (South Environmental 2025b) found that these species do not occur on the site. In addition to western Joshua tree there were banana yucca, Mohave yucca, and Wiggin's cholla found during the survey that are protected by the County of San Bernardino Desert Native Plant Protection Act.

Western Joshua tree is a is a candidate for listing under the California Endangered Species Act and is protected by the Western Joshua Tree Conservation Act. In 2025 South Environmental completed an inventory of the western Joshua Trees was completed within the proposed development footprint and within a 100-feet buffer. A total of 548 Joshua trees were identified in the survey area.

Size Class (height)	# of Joshua Trees	Live	Dead	Mature	Fruits/Flowers	Within 15m of project	Removals
Class A <1m	254	253	1	0	0	173	28
Class B 1m-5m	282	275	7	163	136	127	28
Class C >5m	12	12	0	12	12	5	2
Total	**548**	**540**	**8**	**175**	**148**	**305**	**58**

Of the 548 Joshua trees surveyed 254 were Class A, 282 Class B, and 12 Class C. A total of 8 Joshua trees were dead (1 Class A and 7 Class B) and 175 were mature. Of the mature trees, 148 had fruits or flowers. There are 305 Joshua trees within 15-meters of the proposed project footprint and 58 of those would be removed by the project because they are within the footprint. Removals include 28 Class A, 28 Class B, and 2 Class C. Overall the population of Joshua trees within the survey area is healthy, with very few dead trees and a mix of size classes and observations of fruits and flowers indicate that the Joshua trees are regenerating naturally on the site. The number of removals proposed by the project is 10% of the number surveyed, however, there are numerous other Joshua trees surrounding the survey area that are contiguous plant communities with that found on the site, and the relative number of removals to those in the region is very small.

Due to the proposed removal of 58 Joshua trees for the project, it will require a permit from the California Department of Fish and Wildlife (CDFW) prior to removing the trees as described in **Mitigation Measure BIO-2**.

South Environmental recommends **Mitigation Measure BIO-3** to ensure avoidance of western Joshua trees during construction.

Special-Status Wildlife: A total of 7 special-status animals have a moderate or high potential to occur on the site and be impacted by the project: Crotch bumble bee, pallid San Diego pocket mouse, desert tortoise, coast horned lizard, American badger, Bendire's thrasher, and Le Conte's thrasher. These species have the potential to occur within the Desert Almond Scrub and Joshua Tree Woodland on the project site and study area.

Crotch's Bumble Bee

There is suitable habitat within the Desert Almond Scrub and Joshua Tree Woodland and presence of food plant genera, *Eriogonum* sp. and *Phacelia* sp., on the project site that could serve as a host plant habitat for Crotch's bumble bee. There are also rock outcrops onsite that could serve as suitable nesting locations. If present during the proposed development, construction activities have the potential to impact this species by destroying their nests that are made in tufts of grass, dead trees, rock piles, or underground. No nests or colonies were observed during the survey, however, they could establish a colony prior to the start of work. Considering the 60-acres

remainder parcel will be conserved, potential habitat areas would be maintained in the region and the impacts to habitat would be less than significant according to CEQA. However, impacts to nests or individual bees would be considered significant and would require a take permit. **Mitigation Measure BIO-4** includes preconstruction surveys and avoidance of nests/colonies to reduce the potential direct impact to Crotch's bumble bee to a level that is less than significant according to CEQA.

Desert Tortoise

Desert tortoises have the potential to occur on the project site due to suitable habitat within both the Desert Almond Scrub and Joshua Tree Woodland. If this species is present within the development area during construction activities, they could be crushed and killed or injured. Impacts to desert tortoise, active burrows, or nests would require a take permit. To determine the presence/absence of desert tortoise prior to construction on the project site a focused survey per the USFWS Survey Protocol for Mojave Desert Tortoise (USFWS 2019) is included in **Mitigation Measure BIO-5**.

Coast Horned Lizard

Coast horned lizard has the potential to occur on the project site due to suitable habitat within both the Desert Almond Scrub and Joshua Tree Woodland. Loss of potential habitat for these species is considered less than significant because the project includes 60-acres of conserved Joshua tree woodlands that would compensate for the loss in the project footprint. However, if coast horned lizard is present within the development area during construction activities they could be crushed and killed or injured. To avoid direct impacts to individual reptiles, the salvage program described below is proposed as mitigation for these impacts in **Mitigation Measure BIO-6**.

Pallid San Diego Pocket Mouse

Pallid San Diego pocket mouse has the potential to occur on the project site due to suitable habitat within both the Desert Almond Scrub and the Joshua Tree Woodland. Pallid San Diego pocket mouse does not have a federal or state listing but is listed on the CDFW's Special Animals List with a global rarity ranking of G5T3T4 and a state rarity ranking of S3S4 indicating that there is uncertainty about the status and the species is not yet confirmed to be rare, threatened, or endangered. The project proposes to conserve 60-acres of potential habitat on the project site which would compensate for any habitat loss from the development. Because the species is not known to be at risk and potential habitat loss would be mitigated, the project potential impacts would be considered less than significant according to CEQA.

American Badger

America Badger has the potential to occur on the project site due to suitable habitat within both the Desert Almond Scrub and the Joshua Tree Woodland. The proposed project is within and adjacent to habitat that is suitable for America badger during foraging, burrowing, or movement events. The project proposes to conserve 60-acres of potential habitat on the project site which would compensate for any habitat loss from the development. However, active badger nests should be avoided by the project. American badger's use fossorial nests that can be identified during the focused survey described in **Mitigation Measure BIO-7** to avoid potential impacts to American badgers during construction of the project.

Bendire's Thrasher and Le Conte's Thrasher

Bendire's thrasher and Le Conte's thrasher are CDFW Species of Special Concern that have the potential to nest and forage on the project site. To avoid direct and indirect impacts to these birds, Mitigation Measure BIO-2 regarding nesting bird surveys is recommended. If the measure is followed, no impacts would occur to nests or thrasher and the impact to special-status birds would be less than significant according to CEQA.

Water Resources: One jurisdictional feature, Drainage #1, occurs in the study area that would be permanently impacted by the project. A total of 0.01-acre/50 linear feet of permanent impacts to RWQCB jurisdiction is anticipated for the project within Drainage #1 and a total of 0.02-acre/50 linear feet of permanent impacts to CDFW jurisdiction is anticipated for the project. These impacts would require permitting with CDFW and RWQCB prior to beginning construction of the project as described in **Mitigation Measure BIO-8**.

Protected Trees: The study area contains mature honey mesquite (living and dead), species of the family Agavaceae (banana yucca, Mojave yucca), and western Joshua trees, which are all regulated trees that require permits before removal under the San Bernardino County Code of Ordinances. These species will be included in the rare plant surveys described in Mitigation Measure BIO-2 and impacts to these species will be quantified. **Mitigation Measure BIO-9** includes permitting for any impacts to these species.

Wildlife Movement Corridors and Habitat Linkages: The project site is within a potential wildlife movement area that is contiguous with large expanses of protected native habitats within the Little San Bernardino Mountains. There are a few patches of land that are partially developed surrounding the project site, but areas to the north and east of the parcel contain large expanses of land owned by The Wildlands Conservancy, the Mojave Desert Land Trust, and the Bureau of Land Management. Onsite Desert Almond Scrub and Joshua Tree Woodland habitats are contiguous with high-quality habitats in these directions as it moves away from developments. Surrounding developments are minimal and the large lot size ensures that the areas are

permeable to wildlife movement. The proposed grading, landscaping, and building footprints are within potential movement areas and would impact 0.55-acres of Desert Almond Scrub and 4.48-acres of Joshua Tree Woodland. These developments would be placed on large lots with most of the lots remaining undeveloped and allowing for movement. In addition, the remainder parcel will be conserved and provide a large area for unhindered wildlife movement through the project site. Because there would remain a large area for wildlife movement in the remainder parcel and within the undeveloped areas of the large-lots, the potential impacts to wildlife movement from development would be less than significant according to CEQA.

Cumulative Impacts: The project is proposed in a very low density, rural area and conforms to the large lot size and large conservation area adjacent to the developments. Due to the low impact of the project and the relatively large areas of conserved and protected habitat on the site and in the region, the potential cumulative impacts would be less than significant according to CEQA as the ecological functions and integrity of the site will be maintained with the implementation of the Mitigation Measures described in this report.

1. Introduction

This report includes the findings of a Biological Resources Assessment (BRA) conducted by South Environmental for the Pipes Canyon Project (project site) near Pioneertown in unincorporated San Bernardino County, California. The purpose of this report is to identify and characterize biological resources that occur on the project site and a surrounding 500-foot buffer (study area), quantify and assess potential impacts to protected biological resources, and propose measures to reduce impacts to a less than significant level. The scope of this report includes a description of the proposed development, methods used to assess the biological resources, the environmental setting including technical characterizations and maps of vegetation communities, an assessment of the potential for special-status plants and animals to occur on the study area, a description of the regulatory setting, an analysis of the potential for the project to impact biological resources according to the thresholds of the California Environmental Quality Act (CEQA), and detailed recommendations for avoiding or mitigating impacts. Representative photographs of the study area are in Appendix A.

1.1 Project Description

1.1.1 Location and Setting

The project site includes Assessor Identification Number [AIN] 0594-351-36 and is on the Rimrock USGS 7.5-minute quad in Section 06 of Township 01 North and Range 5 East of the San Bernardino Principal Meridian. The entire parcel for the project site is 122.98-acres in size and is in an unincorporated area along Pipes Canyon Road between Gamma Gulch Road and Hudson Lane approximately 2.50-miles north of Pioneertown, 2.60-miles west of Highway 247, and 6.80-miles north of Highway 62. More broadly, the site is within the Morongo Basin region of the High Desert in San Bernardino County, California (attached Figure 1 and Figure 2). The project site is currently designated by the County's General Plan as Rural Living single family homes (RL-5), with a minimum lot size of five acres, as well as Resource Conservation (RC).

The project site is divided into a northern section and southern section by Pipes Canyon Road and bordered by Cielito Trail/ Rocky Road to the south, Millstream Avenue to the west, and Coyote Road to the east, as well as unmarked open borders. The project site is currently undeveloped with an unmarked road that cuts through the southern section and connects Pipes Canyon Road to Rocky Road. The surrounding area is also relatively undeveloped with a few residential developments and dirt roads throughout the study area.

Figure 1. Regional Location

Figure 2. Project Vicinity

1.1.2 Proposed Development

The project applicant seeks approval to subdivide the property into 13 individual lots. Of these, 12 lots will be developed as five-acre residential parcels, intended for single-family homes, and will be offered for sale. These residential lots will be designed to provide ample space for rural residential living, consistent with the existing zoning designation of Rural Living RL-5. The remaining lot, situated within the RC zoning area, will retain its current Resource Conservation designation, preserving the site's natural resources and environmental features.

As shown in Figure 3 and the Site Plan in Appendix D, proposed developments on the project site include driveways, Millstream Avenue, Private Street 'A', Private Street 'B', and 12 single family home lots. There are no current structures proposed but a development footprint that would be used for future single-family home developments are proposed. The total proposed development footprint is approximately 5.84-acres. Tentative Tract Map No. 20612 is attached within Appendix D.

1.2 Methodology

This biological resource assessment is based on information compiled through a reconnaissance survey and a literature review involving an assessment of appropriate reference materials and literature regarding the biological resources of the region.

1.2.1 Literature Review

The assessment of the project began with a review of literature relating to the natural resources — flora, fauna, and water resources — that are possibly within the study area and project site. The following were consulted:

Flora and Fauna

- The California Department of Fish and Wildlife (CDFW) California Natural Diversity Database (CNDDB) was reviewed to identify special-status plants and animals that have previously recorded in the United States Geological Survey (USGS) Rimrock 7.5" quad in which the proposed development footprint is located, and the eight surrounding USGS 7.5" quads: Yucca Valley North, Yucca Valley South, Morongo Valley, Catclaw Flat, Onyx Peak, Rattlesnake Canyon, Bighorn Canyon, and Landers (CDFW 2025a).
- CDFW California Wildlife Habitat Relationships (CWHR) life history accounts and range maps (CDFW 2025b)
- United States Fish and Wildlife Service (USFWS) Environmental Conservation Online System (ECOS) Information for Planning and Consultation (IPaC) (USFWS 2025a)

Figure 3. Proposed Development

- USFWS Designated and Proposed Critical Habitat GIS data (USFWS 2025b)
- California Native Plant Society (CNPS) online Inventory of Rare and Endangered Plants of California (CNPS 2025a)
- Western Joshua Tree Survey for the Pipes Canyon Project (South Environmental 2025a)

Water Resources

- National Hydrography Dataset (USGS 2025a)
- National Wetlands Inventory (USFWS 2025c)
- California Protected Areas Database (CPAD 2025)
- Jurisdictional Delineation Report for the Pipes Canyon Project (South Environmental 2025b)

Soil Resources

- US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soils Database (USDA 2025)

1.2.2 Field Reconnaissance

South Environmental biologist Dana Briggs, Lucas South, and Meagan Stebbings conducted a field reconnaissance on December 19-20, 2024, to record plants and animals observed on the site, characterize and map plant communities, and assess the potential for special-status species to occur. The findings described in the reports are cited in the Literature Review, and results are referenced throughout the analysis in this report.

2. Environmental Setting

2.1 Topography and Climate

The project site is within the Little San Bernardino Mountains of the Transverse Ranges in southern California. Due to being within the High Desert of the Mojave, the region is arid with desert plains, rocky outcrops, and rugged hills with landmarks such as Bowden Flat to the west, Flat Top to the northeast, Black Lava Butte to the north, and Gamma Gulch to the northwest. Relative to the surrounding area, the project site is relatively flat with some rocky outcrops, washes, and hills. Localized high elevations occur on hilltops and localized low elevations occur within valleys. The highest elevation for the project site is approximately 4,160 ft. (1,268 m.) above mean sea level (amsl) near the northern border. The lowest elevation for the project site is approximately 4,088 ft. (1,246 m.) amsl near the southwestern corner (USGS 2025). The climate in the region is hot and dry, with average summer high temperatures in the mid-90s and average winter lows in the low 40s. Average yearly rainfall is approximately 18-inches, and the wettest months are December – March. There is almost no precipitation between June-September.

2.2 Soils and Surface Geology

There is no digital data for soils at the study area from the Online Web Soil Survey Mapper (USDA/NRCS 2025), but the soils observed during the site survey were a mix of well-drained cobbly loam, rocky loam, gravelly loam, coarse sandy loam, and rock outcrops. Finer soils were found near the alluvial washes, while coarser soils were found near rocky outcrops and hills. There are rocky outcrops in the study area that can provide unique habitat for desert flora and fauna.

The surface geology geologic unit for both the project site and study area contains older alluvium surficial sediments of sedimentary and volcanic rocks from the Pleistocene Epoch (USGS 2025b). There is a very high percentage of rock outcroppings on the survey area that included areas of large boulders.

2.3 Plants

A total of 44 plant species were identified on the project site and study area. The habit of the species consisted of trees, shrubs, succulents, perennial herbs, and annual herbs. A list of the species observed, and their California Rare Plant Rank (CRPR) is presented below in Table 1 (CNPS 2025a). Species listed with an asterisk are considered invasive by the California Invasive Plant Council (Cal-IPC 2025).

Table 1. List of Plant Species Observed at the Project Site and Study Area

Common name	Scientific name	On project site	CRPR	Federal/ State
Common burrobrush	*Ambrosia salsola*	Yes	NR	--
*Sweet vernal grass	*Anthoxanthum odoratum*	Yes	NR	--
Four-wing saltbush	*Atriplex canescens*	Yes	NR	--
*Great brome	*Bromus diandrus*	Yes	NR	--
*Japanese chess	*Bromus japonicus*	Yes	NR	--
*Compact brome	*Bromus madritensis*	Yes	NR	--
Red brome	*Bromus rubens*	Yes	NR	--
*Cheatgrass	*Bromus tectorum*	Yes	NR	--
Desert mariposa lily	*Calochortus kennedyi*	Yes	NR	--
Desert willow	*Chilopsis linearis*	Yes	NR	--
Blackbrush	*Coleogyne ramosissima*	Yes	NR	--
String of buttons	*Crassula perforata*	Yes	NR	--
silver cholla	*Cylindropuntia echinocarpa*	Yes	NR	--
Strawberry hedgehog cactus	*Echinocereus engelmannii*	Yes	NR	--
Nevada ephedra	*Ephedra nevadensis*	Yes	NR	--
Desert woolly star	*Eriastrum eremicum*	Yes	NR	--
Turpentine bush	*Ericameria laricfolia*	Yes	NR	--
Desert rabbitbrush	*Ericameria paniculata*	Yes	NR	--
California buckwheat	*Eriogonum fasciculatum*	Yes	NR	--
Desert trumpet	*Eriogonum inflatum*	Yes	NR	--
Spotted buckwheat	*Eriogonum maculatum*	Yes	NR	--
Little desert trumpet	*Eriogonum trichopes*	Yes	NR	--
Broom snakeweed	*Gutierrezia sarothrae*	Yes	NR	--
California juniper	*Juniperus californica*	Yes	NR	--
Utah juniper	*Juniperus osteosperma*	Yes	NR	--
Prairie junegrass	*Koeleria macrantha*	Yes	NR	--
Creosote bush	*Larrea tridentata*	Yes	NR	--
Rough menodora	*Menodora scabra*	Yes	NR	--
Beavertail cactus	*Opuntia basilaris*	Yes	NR	--
Desert needlegrass	*Pappostipa speciosa*	Yes	NR	--
Branching phacelia	*Phacelia ramosissima*	Yes	NR	--
Desert mistletoe	*Phoradendron californicum*	Yes	NR	--
Honey mesquite	*Prosopis glandulosa*	Yes	NR	--
Desert almond	*Prunus fasciculata*	Yes	NR	--
Desert apricot	*Prunus fremontii*	Yes	NR	--
Bitterbush	*Purshia tridentata*	Yes	NR	--
Chia	*Salvia columbariae*	Yes	NR	--
*Kelch-grass	*Schismus barbatus*	Yes	NR	--
tumble mustard	*Sisymbrium altissimum*	Yes	NR	--
Mojave aster	*Xylorhiza tortifolia*	Yes	NR	--
Banana yucca	*Yucca baccata*	Yes	NR	--

Common name	Scientific name	On project site	CRPR	Federal/ State
Joshua tree	*Yucca brevifolia*	Yes	NR	Candidate State
Mojave yucca	*Yucca schidigera*	Yes	NR	--
**=invasive species; NR=Not Ranked*				

2.4 Plant Communities and Land Cover

There are two land cover types and two plant communities in the study area and the project site. Each is shown in Figure 4 below and the acres of each is summarized in Table 2 below.

Table 2. Summary of Plant Communities on the Study Area and Project Site

Community or Cover Type	Acres on Study Area	Acres on Project Site	Acres Permanently Impacted by Project	Global / State Rank
Desert Almond Scrub	11.32	3.77	0.55	G4/S4
Developed	22.24	1.07	0.44	N/A
Joshua Tree Woodland	217.03	114.02	4.48	G4/S3.2
Maintained Dirt Path or Road	10.35	4.12	0.37	N/A
Total	**260.94**	**122.98**	**5.84**	-

- **Desert Almond Scrub** (*Prunus fasciculata* Shrubland Alliance) (CNPS 2025b) occurred on 11.32-acres of the study area and 3.77-acres of the project site. It has a global/state rarity ranking of G4/S4, which is not considered a sensitive community. The community was defined by the dominance of desert almond (*Prunus fasciculata*) in the shrub layer and a subdominance of antelope bitterbrush (*Purshia tridentata*). The herbaceous layer contained similar grass species observed in the other adjacent plant communities, and California juniper (*Juniperus californica*) at low density at the edges. Other shrub species observed here included common burrobrush and Nevada ephedra, as well as herbaceous species observed in the abovementioned adjacent plant communities. A total of 0.55-acres of Desert Almond Scrub would be permanently impacted by the proposed development.

- **Developed** land cover occurred on 22.24-acres of the study area and 1.07-acres of the project site. Developed land does not have a community sensitivity rating. The developments included single-family houses, ranching infrastructure, ranching equipment, and driveways. Among others, common plants observed in the developed areas included California buckwheat, blackbrush, spotted buckwheat, desert rabbitbrush, kelch-grass, Jill Hill mustard, and brome grasses. A total of 0.44-acres of developed land cover would be permanently impacted by the proposed development.

Figure 4. Plant Communities and Land Cover

- **Joshua Tree Woodland** (*Yucca brevifolia* Woodland Alliance) (CNPS 2025b) occurred on 216.98-acres of the study area and 114.02-acres of the project site. It has a global/state rarity ranking of G4/S3.2, which is considered a sensitive community in California. It is dominated by Joshua trees that form a canopy that is open to intermittent over an open shrub canopy containing other species such as common burrobrush, blackbrush, Nevada ephedra, California buckwheat, creosote bush, banana yucca, and Mojave yucca, as well as occasional trees including California juniper and Utah juniper. The herbaceous layer is also open to intermittent with perennial grasses and seasonal annuals observed such as desert needlegrass, prairie junegrass, chia, Kelch-grass, and brome grasses. A total of 4.48-acres of Joshua Tree Woodland would by permanently impacted by the proposed development.

- **Maintained Dirt Path or Road** land cover occurred on 10.40-acres of the study area and 4.12-acres of the project site. Maintained dirt paths or roads do not have a community sensitivity rating. A total of 0.37-acres of maintained dirt paths or roads would be permanently impacted by the proposed development

2.5 Wildlife

Six common desert wildlife species were observed in the project site and study area during the site visit and are shown in Table 3 below. Although few wildlife were observed during the site visit, most desert species are not active midday, and therefore many more species are expected to occupy the site.

Table 3. Summary of Wildlife Observed on iNaturalist within the Study Area

Common name	Scientific name	Taxa	Status
Black-throated sparrow	*Amphispiza bilineata*	Birds	None
Common raven	*Corvus corax*	Birds	None
Ladder-backed woodpecker	*Dryobates scalaris*	Birds	None
House finch	*Haemorhous mexicanus*	Birds	None
California towhee	*Melozone crissalis*	Birds	None
Desert cottontail	*Sylvilagus audubonii*	Mammals	None

2.6 Special-Status Species

The literature analysis of the CNDDB, CNPS, and IPAC databases for special-status species with the potential to inhabit the project site resulted in 79 special-status species, including 42 plants and 37 animals. The list includes rare, threatened, endangered species at a federal and state level. In the case of plants, it also includes California Rare Plant Rank (CRPR) species with a classification of 1-4.

2.6.1 Special-Status Plants

During the field reconnaissance, western Joshua tree was observed throughout the site. Western Joshua tree is a Candidate species for listing under the CESA and is protected by the Western Joshua Tree Conservation Act. The 42 special-status plant species that CNDDB, CNPS, and IPAC identify as occurring in the region of the project and an assessment of their likelihood to inhabit the project site are presented in Appendix B. The native plant communities (Joshua Tree Woodland and Desert Almond Scrub) on the study area have some disturbance from non-native herbaceous plants (brome grasses, tumble mustard, Kelch-grass, etc.), but they still have the capacity to support a comparable amount of native herbaceous plants (desert needle grass, chia, desert woollystar, etc.). The large percentage of native herbaceous and shrub cover increases the potential for special-status plants to occur in either community. The survey took place outside of the blooming season for most annual plants; which typically bloom between March and August. As a result, the potential to observe a special-status plant species was limited and none were observed other than western Joshua tree, which is perennial and conspicuous. Based on the analyses in Appendix B, 14 special-status plants have the potential to occur in the study area or were observed during the survey due to the presence of suitable Joshua Tree Woodland and suitable Desert Almond Scrub, which are discussed below:

1. **San Bernardino milk-vetch** (*Astragalus bernardinus*) is a perennial herb with a CRPR of 1B.2. This species occurs in Joshua tree woodland and pinyon and juniper woodland with granitic or carbonate substrates between 290-2,290 m. There are nine CNDDB records within the region of the project, including a record from 1992 that overlaps the western end of the site and another record from 1993 that is 1.67-miles to the south. San Bernardino milk-vetch has a **high** potential to occur in the study area because it contains Joshua tree woodland with juniper shrubs and granitic substrates, and the species has a historical record (1992) recorded to the CNDDB within the western study area.

2. **Triple-ribbed milk-vetch** (*Astragalus tricarinatus*) is a perennial herb with a CRPR of 1B.2 and is ranked Endangered at the federal level. This species is found in Joshua tree woodland and Sonoran desert scrub between 455-1,585 m. with hot, rocky slopes in canyons and along edges of boulder-strewn desert washes with *Larrea* and *Encelia* present. There are 29 CNDDB records within the region of the project and the record nearest the project site is from 2019 and located 10.00-miles to the south. Triple-ribbed milk-vetch has a **moderate** potential to occur in the study area because it contains Joshua tree woodland and desert scrub with rocky slopes and desert washes with *Larrea* present.

3. **Fremont barberry** (*Berberis fremontii*) is a perennial evergreen shrub with a CRPR of 2B.3. It occurs in Joshua tree woodland and pinyon and juniper woodland with rocky, sometimes granitic microhabitats at an elevation of 1,140-1,7700 m. There is one CNDDB record within the region of the project from 2003 and located 4.46-miles to the south. Fremont barberry

has a **moderate** potential to occur in the study area because it contains Joshua tree woodland with juniper shrubs present, as well as rocky, granitic microhabitats in the southeastern study area.

4. **Pinyon rockcress** (*Boechera dispar*) is a perennial herb with a CRPR of 2B.3. This species is found in Joshua tree woodland, pinyon and juniper woodland, and Mojavean desert scrub with granitic, gravelly slopes and mesas between 1,005-2,805 m. Pinyon rockcress is often under desert shrubs that support it as it grows. There are 35 CNDDB records within the region of the project and the record nearest the project site is from 1989 and located 1.13-miles to the west. Pinyon rockcress has a **high** potential to occur in the study area because it contains Joshua tree woodland, juniper shrubs, and desert scrub with granitic, gravelly slopes.

5. **Shockley's rockcress** (*Boechera shockleyi*) is a perennial herb with a CRPR of 2B.2. This species is found in pinyon and juniper woodland on ridges, rocky outcrops, and openings on limestone or quartzite at an elevational range of 875-2,515 m. There are 11 CNDDB records within the region of the project and the record nearest the project site is from 1989 and located 0.85-miles to the southwest. Shockley's rockcress has a **high** potential to occur in the study area because it contains juniper shrubs with rocky outcrops and openings on quartzite.

6. **White-bracted spineflower** (*Chorizanthe xanti* var. *leucotheca*) is an annual herb with a CRPR of 1B.2. This flower can be found in Mojavean desert scrub, pinyon and juniper woodland, and coastal scrub (alluvial fans) in sandy or gravelly microhabitats between 365-1,830 m. There are 12 CNDDB records within the region of the project and the record nearest the project site is from 1971 and located 8.80-miles to the south. White-bracted spineflower has a **moderate** potential to occur in the study area because it contains desert scrub and juniper shrubs with sandy and gravelly substrate.

7. **San Bernardino Mountains dudleya** (*Dudleya abramsii* ssp. *affinis*) is a perennial herb with a CRPR of 1B.2. This dudleya is found within pebble (pavement) plain, upper montane coniferous forest, and pinyon and juniper woodland between 1,200-2,425 m. with outcrops, granite, or quartzite, and rarely limestone microhabitats. There are 10 CNDDB records within the region of the project and the record nearest the project site is from 2001 and located 8.09-miles to the west. San Bernardino Mountains dudleya has a **moderate** potential to occur in the study area because it contains desert scrub with juniper shrubs and rocky granite outcrops.

8. **Parish's daisy** (*Erigeron parishii*) is a perennial herb with a CRPR of 1B.1 and is ranked Threatened at the federal level. Parish's daisy can be found in Mojavean desert scrub and pinyon and juniper woodland between 1,050-2,245 m., often on microhabitats including

carbonate, limestone mountain slopes, areas near drainages, and sometimes on granite. There are 23 CNDDB records within the region of the project and the record nearest the project site is from 1988 and located 3.93-miles to the southeast. Parish's daisy has a **low** potential to occur in the study area because it contains desert scrub with juniper shrubs and granite substrate, which is less likely to host this species compared to carbonate, limestone mountains slopes, and areas near drainages.

9. **Pioneertown linanthus** (*Linanthus bernardinus*) is an annual herb with a CRPR of 1B.2. This species is found in Joshua tree woodland and pinyon and juniper woodland at an elevation between 1,120-1,345 m. There are 10 CNDDB records within the region of the project and the record nearest the project site is from 2011 and located 2.86-miles to the south. Pioneertown linanthus has a **high** potential to occur in the study area because it contains Joshua tree woodland with juniper shrubs.

10. **Little San Bernardino Mtns. linanthus** (*Linanthus maculatus* ssp. *maculatus*) is an annual herb with a CRPR of 1B.2. This species occurs within desert dunes, Sonoran desert scrub, Mojavean desert scrub, and Joshua tree woodland with a sandy microhabitat comprised of light-colored quartz sand between 135-1,220 m., often in a wash or bajada. There are 20 CNDDB records within the region of the project and the record nearest the project site is from 2015 and is located 3.33-miles to the northeast. Little San Bernardino Mtns. Linanthus has a **moderate** potential to occur in the study area because it contains desert scrub and Joshua tree woodland with some sandy microhabitats within the washes.

11. **Robison's monardella** (*Monardella robisonii*) is a perennial rhizomatous herb with a CRPR of 1B.3. It is found in pinyon and juniper woodland with rocky desert slopes and granitic boulders at an elevation between 610-1,615 m. There are 6 CNDDB records within the region of the project and the record nearest the project site is from 2013 and is located 1.09-miles to the northeast. Robinson's monardella has a **moderate** potential to occur in the study area because it contains juniper shrubs with rocky granitic outcrops.

12. **Latimer's woodland-gilia** (*Saltugilia latimeri*) is an annual herb with a CRPR of 1B.2. This species is found in chaparral, Mojavean desert scrub, pinyon and juniper woodland with rocky or sandy substrate, and sometimes in washes or limestone at an elevational range of 120-2,200 m. There are 28 CNDDB records within the region of the project and the record nearest the project site is from 2015 and is located 1.16-miles to the north. Latimer's woodland-gilia has a **moderate** potential to occur in the study area because it contains desert scrub with juniper shrubs and rocky/ sandy substrate with washes.

13. **Southern jewelflower** (*Streptanthus campestris*) is a perennial herb with a CRPR of 1B.3. This species is found in chaparral, lower montane coniferous forest, and pinyon and juniper woodland with open, rocky areas between 605-2,590 m. There is one CNDDB record within

the region of the project from year 1941 located along the central intersection of the parcel along Pipes Canyon Rd. Southern jewelflower has a **high** potential to occur in the study area because there are patches of juniper with open, rocky areas near the southeastern side of the study area and there is a historical record (1941) of this species recorded to the CNDDB within the study area, specifically along Pipes Canyon Rd.

14. **Western Joshua tree** (*Yucca brevifolia)* is a monocot that is a candidate for a CRPR. It also has the following statuses: Candidate species for listing under the California Endangered Species Act (CESA) and is protected by the Western Joshua Tree Conservation Act. The species has a general habitat that includes Joshua tree woodland, montane chaparral, pinyon and juniper woodland, and Sonoran and Mojavean desert scrub. It has been recorded at elevations between 750-2,200 meters (2,461-7,218 feet). The study area contains intact Joshua Tree Woodland with numerous Western Joshua trees **present** throughout the project site and surrounding 100-ft buffer zone. Their locations and data for each individual are documented in the corresponding Joshua Tree Survey (South Environmental 2025).

2.6.2 Special-Status Wildlife

The 37 special-status animal species that CNDDB, CNPS, and IPAC identify as occurring in the region of the project and an assessment of their likelihood to inhabit the project site are presented in Appendix B. No special-status animal species were observed during the survey. Based on the analysis in Appendix B, 7 of the special-status animals have the potential to occur on the project site due to the presence of suitable habitat, which are discussed below:

1. **Crotch's Bumble Bee** (*Bombus crotchii)* is an insect that is an International Union for the Conservation of Nature endangered species and a Candidate Endangered species at the state level. The species has a general habitat that spans from coastal California east to the Sierra-Cascade crest and south into Mexico. The species has a microhabitat defined by food plant genera that includes Antirrhinum, Phacelia, Clarkia, Dendromecon, Eschscholzia, and Eriogonum. There are two CNDDB records within the region of the project and the record nearest the project site is from 1958 and located 9.87-miles to the south. The species has a **moderate** potential to occur in the study area because it contains intact desert scrub and Joshua tree woodland with *Phacelia* and *Eriogonum* plant food genera.
2. **Pallid San Diego pocket mouse** (*Chaetodipus fallax pallidus*) is a mammal that does not have a federal or state listing, but is listed on the CDFW's Special Animals List with a global rarity ranking of G5T3T4 and a state rarity ranking of S3S4 indicating that there is uncertainty about the status and the species is not yet confirmed to be rare, threatened, or endangered. This species occurs in desert border areas of San Diego, Riverside, San Bernardino, and Los Angeles counties in desert wash, desert scrub, desert succulent scrub, pinyon-juniper, sandy, herbaceous microhabitats usually associated with rocks or coarse gravel. There are nine

CNDDB records within the region of the project and the record nearest the project site is from 2002 and located 3.34-miles to the south. Pallid San Diego pocket mouse has a **moderate** potential to occur in the study area because it contains desert wash, desert scrub, with sandy, herbaceous microhabitats with coarse gravel.

3. **Desert tortoise** (*Gopherus agassizii*) is a reptile that is ranked as Threatened at both the federal and state level. This species is most common in desert scrub, desert wash, and Joshua tree habitats, but occurs in almost every desert habitat. There are six CNDDB records within the region of the project and the record nearest the project site is from 1988 and located 3.59-miles to the south. Desert tortoise has a **moderate** potential to occur in the study area because it contains intact desert scrub, desert wash, and Joshua tree habitats.

4. **Coast horned lizard** (*Phrynosoma blainvillii*) is a reptile that is a CDFW Species of Special Concern. This lizard frequents a wide variety of habitats, most commonly in lowlands along sandy washes with scattered low bushes for cover, open areas for sunning, patches of loose soil for burial, and an abundant supply of ants and other insects. There is one CNDDB record within the region of the project and the record nearest the project site is from 1949 and is located 1.74-miles to the south. This species has a **high** potential to occur in the study area because it contains intact desert scrub with an intermediate shrub canopy and loose soils.

5. **American badger** (*Taxidea taxus*) is a mammal that is a CDFW Species of Special Concern. This species is most abundant in drier open stages of most shrub, forest, and herbaceous habitats with friable soils. American badger needs sufficient food from burrowing rodents and open, uncultivated ground. There is one CNDDB record within the region of the project from 1949 that is located 3.96-miles to the southwest. This species has a **moderate** potential to occur in the study area because it contains dry open stage shrub habitat with friable soils, uncultivated ground, and evidence of burrowing rodents.

6. **Bendire's thrasher** (*Toxostoma bendirei*) is a migratory bird that is a CDFW Species of Special Concern and USFWS Bird of Conservation Concern. This species is a local spring and summer resident in flat areas of desert succulent shrub and Joshua tree habitats in the Mojave Desert. This bird nests in chollas, yucca, palo verde, thorny shrub, or small trees usually 0.5 to 20 feet above the ground. There are two CNDDB records within the region of the project and the record nearest the project site is from 1991 and located 9.14-miles to the north. Bendire's thrasher has a **moderate** potential to occur in the study area during the spring and summer because it contains desert shrub and Joshua tree habitats with cholla, yucca, and small trees for nesting.

7. **Le Conte's thrasher** (*Toxostoma lecontei*) is a bird that is a CDFW Species of Special Concern and USFWS Bird of Conservation Concern. This species is primarily found in open desert

wash, desert scrub, alkali desert scrub, and desert succulent shrub habitats. Le Conte's thrasher commonly nests in dense, spiny shrub or densely branched cactus in desert wash habitat 2 to 8 feet above the ground. There are eight CNDDB records within the region of the project and the record nearest the project site is from 1991 and is located 3.61-miles to the east. This species has a **high** potential to occur in the study area because it contains desert wash, desert scrub, and dense spiny shrubs.

2.7 Sensitive Natural Communities

CDFW 2018 *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Sensitive Natural Communities* defines sensitive natural communities as those that are "of limited distribution statewide or within a county or region and are often vulnerable to environmental effects of projects." CDFW considers a natural community sensitive if it has a Global or State rarity rank of 1-3, which includes communities that are vulnerable (G3/S3), imperiled (G2/S2), and critically imperiled (G1/S1). CDFW uses the alliances and groups described in the California Natural Community List (CDFW 2025c) and the California Natural Communities List from A Manual of California Vegetation Online (CNPS 2025b) to characterize California's natural communities. The current global and state rarity rank for natural communities of California are listed in these resources.

Developed areas and maintained dirt paths and roads do not qualify for CDFW rankings and are not considered sensitive plant communities. The Desert Almond Scrub in the study area has a Global rarity rank of G5 and a State rarity rank of S5; therefore, it is not considered a sensitive natural community by the CDFW. The Joshua Tree Woodland in the study area has a Global rarity rank of G4 and a State rarity rank of S3.2, which is considered a sensitive natural community in California by the CDFW.

2.8 Protected Trees

The study area is within an unincorporated region of San Bernardino county. According to San Bernardino County Code of Ordinances (San Bernardino County 2025), regulated trees require a Tree or Plant Removal Permit. Regulated trees include desert native plants, mountain forest and valley trees (not applicable for site), and riparian trees (not applicable for site). Regulated desert native plants with stems at least two inches in diameter or at least six feet in height include the following:

- *Dalea spinosa* (smoketree)
- All species of the genus *Prosopis* (mesquites).
- All species of the family Agavaceae (century plants, nolinas, yuccas).
- Creosote Rings, ten feet or greater in diameter
- All Joshua trees (*Yucca brevifolia*)

Any part of any of the following species, whether living or dead:

- *Olneya tesota* (desert ironwood)
- All species of the genus *Prosopis* (mesquites).
- All species of the genus *Cercidium* (palos verdes)

The study area contains mature honey mesquite (living and dead), species of the family Agavaceae (banana yucca, Mojave yucca), and western Joshua trees, which are all regulated trees that require permits before removal under the San Bernardino County Code of Ordinances.

2.9 Hydrology Features

According to the Jurisdictional Delineation prepared for the project (South Environmental 2025a), the project site is located within the Southern Mojave watershed (HUC8) and within the Chaparrosa Wash-Pipes Wash sub-watershed (HUC12). As shown in Figure 5 and Figure 6, one unnamed drainage (Drainage #1) is in the study area. Drainage #1 is *not relatively permanent*; therefore, it is likely a waters of the state (WSC) under the jurisdiction of the California Regional Water Quality Control Board (RWQCB) and a streambed under the jurisdiction of the CDFW.

Table 4 below summarizes the acres and linear feet jurisdictional features within the study area.

Table 4. Summary of Jurisdictional Features in the Study Area

Feature	Linear Feet	Non-Wetland Waters of the State (RWQCB) acres	Streambed and Riparian (CDFW) acres
Drainage #1	1,298	0.54	0.82
Total	1,298	0.54	0.82

2.10 Wildlife Movement Areas

The assessment of the potential for wildlife movement to and from the project site consisted of consulting the following resources:

- United States Fish and Wildlife Service (USFWS) Environmental Conservation Online System (ECOS) Information for Planning and Consultation (IPaC) (USFWS 2025a)
- USFWS Designated and Proposed Critical Habitat GIS data online (USFWS 2025b)
- GreenInfo Network, Park Information online (2025)
- California Protected Areas Database Map online (CPAD 2025)

Figure 5. Overview of Jurisdictional Delineation

Figure 6. Drainage #1 Impacts

Aerial photographs were used to assess the level of connectivity of habitat to the site. The foremost considerations were whether there was a direct connection of high-quality habitat to the site — without interference from development — and whether the connecting habitat is linked to large habitat tracts.

During the South Environmental field visit, the study area was assessed for its potential use as a wildlife corridor or habitat linkage. The level of disturbance of the study area is by way of development that includes roads, house and ranching structures, fences, and lighting. The study area was assessed for the presence of a corridor of linkage of habitat that connects the study area to adjacent and higher-quality habitat.

The Joshua Tree Woodland and Desert Almond Scrub on the study area extend in all directions beyond the study area boundary between the developed areas. Outside of the study area, there are several expansive parcels of open access, protected and conserved native desert habitat that indirectly connect with the project site, including 26,784 acres to the south within Pioneertown Mountains Preserve owned by the Wildlands Conservancy, 11,859 acres to the east owned by the Mojave Desert Land Trust, and over five million acres to the north and other smaller surrounding areas owned by the Bureau of Land Management (CPAD 2025). As a result, the Desert Almond Scrub and Joshua Tree Woodland on the study area both have connectivity to open space areas within the Little San Bernardino Mountains. The open spaces within the Little San Bernardino Mountains contain Desert Almond Scrub, Joshua Tree Woodland, and other native desert habitats with higher quality habitat values; they have higher proportions of native vegetation when compared to the study area because there is less disturbance from development and human presence. Due to being adjacent to higher-quality habitat within the Little San Bernardino Mountains, the study area and project site are within potential wildlife movement areas for wildlife species, including special-status species wildlife, that have potential to occur in the vicinity of the study area.

3. Impacts Analysis

For the purposes of this report, impacts to protected biological resources are analyzed within the context of the regulatory setting. Below is an overview of the federal, state, and local regulations pertaining to protected biological resources in the study area, and an analysis of impacts to those resources that may occur as a result of the proposed development follows.

3.1 Regulatory Setting

3.1.1 Federal Regulations

Endangered Species Act

The Federal Endangered Species Act (FESA) of 1973 defines an endangered species as "any species which is in danger of extinction throughout all or a significant portion of its range." A threatened species is defined as "any species which is likely to become an Endangered species within the foreseeable future throughout all or a significant portion of its range." Under provisions of Section 9(a)(1)(B) of the FESA, unless properly permitted, it is unlawful to "take" any listed species. "Take" is defined in Section 3(18) of FESA: "...harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." Further, the USFWS, through regulation, has interpreted the terms "harm" and "harass" to include certain types of habitat modification as forms of "take." These interpretations, however, are generally considered and applied on a case-by-case basis and often vary from species to species. In a case where a property owner seeks permission from a federal agency for an action which could affect a federally listed plant or animal species, the property owner and agency are required to consult with USFWS pursuant to Section 7 of the FESA if there is a federal nexus, or pursuant to Section 10 of the FESA. Section 9(a)(2)(b) of the FESA addresses the protections afforded to listed plants.

Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) protects individuals as well as any part, nest, or eggs of any bird listed as migratory. In practice, federal permits issued for activities that potentially impact migratory birds typically have conditions that require pre-disturbance surveys for nesting birds. In the event nesting is observed, a buffer area with a specified radius must be established, within which no disturbance or intrusion is allowed until the young have fledged and left the nest, or it has been determined that the nest has failed. If not otherwise specified in the permit, the size of the buffer area varies with species and local circumstances (e.g., presence of busy roads, intervening topography, etc.), and is based on the professional judgment of a monitoring biologist. A list of migratory bird species protected under the MBTA is published by USFWS.

3.1.2 California Regulations

California Environmental Quality Act (CEQA)

The California Environmental Quality Act (CEQA) is a statute that requires state and local agencies to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible. CEQA applies to certain activities of state and local public agencies. A public agency must comply with CEQA when it undertakes an activity defined by CEQA as a "project." A project is an activity undertaken by a public agency or a private activity which must receive some discretionary approval (meaning that the agency has the authority to deny the requested permit or approval) from a government agency which may cause either a direct physical change in the environment or a reasonably foreseeable indirect change in the environment.

An Initial Study (IS) is prepared when a proposed action is determined to be a "project" under CEQA. The IS is a checklist that asks specific questions about the project's level of environmental impacts in many categories, including biological resources. The checklist includes a series of questions to determine the projects level of potential impacts in each of the categories. The CEQA Checklist includes the following questions regarding biological resources:

- *Would the project:*
    - *Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service?*
    - *Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Game or US Fish and Wildlife Service?*
    - *Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?*
    - *Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?*
    - *Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance*
    - *Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?*

Potential level of impact choices includes: No Impacts, Less Than Significant Impact, Less Than Significant with Mitigation Incorporated, and Potentially Significant Impact. For projects that have no impact or less than significant impact a Negative Declaration is prepared, for those with Less

Than Significant with Mitigation Incorporated prepare a Mitigated Negative Declaration, and for those with a Potentially Significant Impact prepare an Environmental Impact Report (EIR).

California Endangered Species Act

The California ESA mirrors the main tenets of the U.S. ESA with a few exceptions and is legislated through the Fish and Game Code, chapter 1.5, sections 2050-2115.5. One major difference is that under the California ESA, a species can be a "candidate" species for listing, a category that does not exist under the U.S. ESA. Similar to the U.S. ESA, Section 2080 of the Code prohibits the "import into this state, export out of this state, or take, possess, purchase, or sell within this state, any species, or any part or product thereof, that the commission determines to be an endangered species or a threatened species." The idea of "take" in terms of listed species is defined in Section 2086 of Code as "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill." In contrast to the U.S. ESA, the Code does not include the idea of "harass" or "harm" in the definition of take. The U.S. ESA uses Habitat Conservation Plans (HCPs) whereas the California ESA uses "Natural Community Conservation Planning (NCCP). Central tents of an NCCPS are to "promote coordination, effectively address cumulative impact concerns, and promote conservation of un-fragmented habitat areas, promote multispecies and multi-habitat management". Importantly, if a species is listed both under the U.S. ESA and the California ESA, a "consistency determination" can be requested to the California Department of Fish and Wildlife requesting that the federal "take" complies with the California "take" regulations which would effectively avoid further deliberations for the take under the California ESA.

Porter-Cologne Water Quality Control Act

The Porter-Cologne Act requires the adoption of water quality control plans (basin plans) that give direction to managing water pollution in California. The basin plans get adopted and administered by the Regional Water Quality Control Board (RWQCB). The plans incorporate the beneficial uses of the waters of the State and then provide objectives that should be met to maintain and protect these uses. Along with the Regional Water Boards, the State Water Resources Board can issue and enforce permits containing waste discharge requirements to maintain clean surface water and groundwater. Each basin plan identifies the specific beneficial uses of water in their region for the past, present, and future. These basin plans also all have objectives for which the plan clearly states steps that are being taken or will be taken to meet the objectives. These objectives are created for the purpose of keeping the water clean and safe to use beneficially. The Regional Board has the authority to give out permits for the purpose of waste disposal or waste assimilation.

State of California Fish and Game Code Section 1600

Fish and Game Code Section 1602 outlines the Lake and Streambed Alteration Agreement (LSAA) permitting process, and states:

- An entity shall not substantially divert or obstruct the natural flow of, or substantially change or use any material from the bed, channel, or bank of, any river, stream, or lake, or deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake

Fish and Game Code Section 1602 requires any entity (defined as any person, State or local governmental agency, or public utility) to notify the CDFW before beginning any activity that will do one or more of the following:

- substantially divert or obstruct the natural flow of and river, stream, or lake, or
- substantially change or use any material from the bed, channel, or bank of, any river, stream, or lake, or
- deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake.

A permit, known as a Lake or Streambed Alteration Agreement, from CDFW is required to conduct any of the activities described above.

Western Joshua Tree Conservation Act

The Western Joshua Tree Conservation Act is the current legislation in the State of California for use in protection of the Joshua tree and was passed on 2023. Foremost, the legislation prohibits the importation, export, take, possession, purchase, or sale of any western Joshua tree in California unless authorized by CDFW. The Act currently supersedes the California Endangered Species Act (ESA) and authorizes CDFW to issue permits for the "take" of one or more western Joshua trees if the permittee meets specific conditions. Permittees have the opportunity to relocate a Joshua tree in areas impacted by development or pay a fee in lieu of conducting mitigation activities. The legislation also grants the CDFW the authority to issue permits for the removal of dead western Joshua trees and trimming of live western Joshua trees.

The legislation allow for agreements to be made between the CDFW and any county or city which limit the authority to permit the taking of a Joshua tree associated with developing single-family residences, multifamily residences, accessory structures, and public works projects. A similar agreement between the CDFW and a county or city can also be authorized to limit the authority to permit the removal of dead and trimming of live Joshua trees.

With this legislation, in-lieu fees collected will be deposited into the "Joshua Tree Conservation Fund" for appropriation to CDFW strictly with the goal of acquiring, conserving, and managing Joshua tree conservation lands and carrying out other project to conserve the species.

Additionally, the act mandates the CDFW with development and implementation of a Joshua tree conservation plan in collaboration with governmental agencies, California Native American Tribes, and the public. A draft of the plan must be presented by December 31, 2024, at a public meeting of the Fish and Game Commission for its review and approval. Finally, CDFW must produce annual reports assessing the conservation status of the western Joshua tree (State of California, 2023).

In cases of private development the following is a summary of important conservation measures under the Western Joshua Tree Conservation Act:

The Western Joshua Tree Conservation Act stipulates several measures to assist with the assessment of impacts to and mitigation for western Joshua tree in areas proposed for development. Permittees may mitigate loss or damage to trees by relocating them or by paying specified fees in lieu of conducting mitigation. Under the act, all in-lieu fees collected will be deposited into the Western Joshua Tree Conservation Fund for the purposes of acquiring, conserving, and managing western Joshua tree conservation lands and completing other activities to conserve the western Joshua tree.

State of California Fish and Game Code Section 3500

Section 3503.5 of the California Fish and Game Code states that it is "unlawful to take, possess, or destroy any birds in the order Falconiformes or Strigiformes (birds of prey) or to take, possess, or destroy the nest or eggs of any such bird except as otherwise provided by this code or any regulation adopted pursuant thereto." Activities that result in the abandonment of an active bird of prey nest may also be considered in violation of this code. In addition, California Fish and Game Code, Section 3511 prohibits the taking of any bird listed as fully protected, and California Fish and Game Code, Section 3515 states that is it unlawful to take any non-game migratory bird protected under the MBTA.

California Migratory Bird Protection Act

The California Migratory Bird Protect Act (MBPA) was enacted in September 2019 to reinforce the MBTA at the state level. The Act states:

- "It is unlawful to take or possess any migratory nongame bird as designated in the federal Migratory Bird Treaty Act (16 U.S.C. Sec. 703 et seq.) before January 1, 2017, any additional migratory nongame bird that may be designated in that federal act after that date, or any part of a migratory nongame bird described in this section, except as provided by rules and regulations adopted by the United States Secretary of the Interior under that federal act before January 1, 2017, or subsequent rules or regulations adopted pursuant to that federal act, unless those rules or regulations are inconsistent with this code." This section is inactive on January 20, 2025 and the following language below will be adopted.

- "It is unlawful to take or possess any migratory nongame bird as designated in the federal Migratory Bird Treaty Act (16 U.S.C. Sec. 703 et seq.), or any part of a migratory nongame bird described in this section, except as provided by rules and regulations adopted by the United States Secretary of the Interior under that federal act." This section is operative starting on January 20, 2025.

California Desert Native Plants Act

The purpose of the CDNPA is to protect certain species of California desert native plants from unlawful harvesting on both public and privately owned lands. The CDNPA only applies within the boundaries of Imperial, Inyo, Kern, Los Angeles, Mono, Riverside, San Bernardino, and San Diego Counties. Within these counties, the CDNPA prohibits the harvest, transport, sale, or possession of specific native desert plants under many circumstances unless a person has a valid permit or wood receipt, and the required tags and seals. The appropriate permits, tags and seals must be obtained from the sheriff or commissioner of the county where collecting will occur, and the county will charge a fee

3.1.3 Local Regulations

San Bernardino County Joshua Tree Community Plan

The San Bernardino County Joshua Tree Community Plan was passed in San Bernardino County in 2007. The Plan stipulates that an effort will be made to retain native vegetation including Joshua trees as part of a new development project. Protection of Joshua trees and other important native vegetation for new development includes requiring a landscape plan; consideration of other siting areas without protected plants; encouragement of on-site relocation of Joshua tree or "adoption" off-site if on-site relocation is not possible; bearing of the cost of Joshua tree relocation by the developer; and, retention and transplantation practices must follow best nursery practices (San Bernardino County, 2007).

Joshua Tree Community Action Plan

The Joshua Tree Community Action Plan was adopted in 2016 and provides overarching goals to protect desert habitat in the area including Joshua tree woodland. There are two overarching "action statements" in the Plan that apply to conservation of Joshua trees: 1) Partner with organizations such as Mojave Desert Land Trust to conserve natural desert habitats and wildlife corridors and to protect native plants and animals, and 2) Promote respect for local ecosystems and be stewards of the environment. While the Plan does not contain detailed specific actions related to these goals, it does embody the spirit and general intent of Joshua tree conservation in the area (San Bernardino County, 2016).

3.2 Project Impacts

3.2.1 Impacts to Plant Communities and Sensitive Natural Communities

As shown in Figure 4 and summarized in Table 2, the project would permanently remove 0.55-acres of Desert Almond Scrub and 4.48-acres of Joshua Tree Woodland. Joshua Tree Woodland is considered a sensitive natural community by CDFW based on the state rarity ranking of 3.2. The Desert Almond Scrub and Joshua Tree Woodland communities have the potential to support special-status species in addition to western Joshua tree. Impacts to sensitive natural communities and habitat for special-status species would be considered significant according to CEQA.

The project design includes a 60-acres remainder parcel that will be conserved into perpetuity to mitigate for the loss of 5.03-acres of habitat capable of supporting special-status species on the project site. South Environmental recommends a 1:1 habitat conservation ratio for the Desert Almond Scrub (0.55-acre) and a 3:1 conservation ratio for the Joshua Tree Woodland (13.44-acres), which would be a total of 13.99-acres. The remainder parcel has high quality native habitats that are undisturbed and have a significant density of rock outcroppings when compared to the project impact areas, which provides protection to these significant habitat features. In addition, the large lots and large size of the remainder parcel ensures that sufficient habitat remains to provide a highly permeable landscape for wildlife movement. The proposed project impacts to habitat for special-status species and sensitive natural communities would be considered less than significant according to CEQA because the project proposes to conserve 60-acres of Joshua Tree Woodlands on the remainder parcel, which far exceeds the recommended conservation of 13.99-acres.

3.2.2 Impacts to Nesting Birds and Raptors

The proposed development would require potential removal of trees, shrubs, and herbaceous plants in the landscaping that could provide potential nesting habitat for birds and raptors protected by the MBTA, MBPA, and the Fish and Game Code, including special-status birds such as Bendire's and Le Conte's thrashers. If present at the time of vegetation removal, active nests, eggs, or young could be destroyed or otherwise disturbed to a point at which the young do not survive, which would be a violation of the MBTA, MBPA, and the Fish and Game Code. In addition, indirect impacts from noise or vibration has the potential to disturb an active bird nest that may occur in adjacent landscaping to the point of failure if the nest is within immediate proximity to project activities, and this would also be a violation of the MBTA and Fish and Game Code. To avoid impacts to active bird or raptor nests, eggs, or young, preconstruction nesting bird surveys and monitoring is required per the MBTA and Fish and Game Code as described in Mitigation Measure BIO-1.

Mitigation Measure BIO-1 - Preconstruction Nesting Bird and Raptor Survey

- If possible, ground disturbing activities and vegetation removal should be timed to occur between September 1 – January 31, which is outside the bird and raptor nesting season.

- If ground disturbing activities or vegetation removal (including tree trimming) are scheduled between February 1 – August 31, which is the bird nesting season, a preconstruction survey for nesting birds should be conducted within 72 hours prior to construction activities. The survey should be conducted by a qualified biologist with prior experience conducting nesting bird surveys for construction projects. The study area should include the affected area and suitable habitat within a 500-foot buffer, or a buffer size determined by the qualified biologist based on level of proposed disturbance and access. If no active nests are found, no additional measures are required.

- If active nests are found the biologist will map the location and document the species and nesting stage. A no-work buffer will be established around the active nest as determined by the qualified biologist and based on the species' sensitivity to disturbance and the type and duration of the disturbance. No construction activities shall occur within the no-work buffer until the biologist has determined the nest is no longer active.

3.2.3 Impacts to Special-Status Plants

Western Joshua tree occurs throughout the project site and impact areas; and there are 13 other special-status plants that have a moderate to high potential to occur within areas that would be impacted by the proposed development, however, the results of a focused rare plant survey (South Environmental 2025b) found that these species do not occur on the site. In addition to western Joshua tree there were banana yucca, Mohave yucca, and Wiggin's cholla found during the survey that are protected by the County of San Bernardino Desert Native Plant Protection Act.

Western Joshua Tree

Western Joshua tree is a is a candidate for listing under the California Endangered Species Act and is protected by the Western Joshua Tree Conservation Act. In 2025 South Environmental completed an inventory of the western Joshua Trees was completed within the proposed development footprint and within a 100-feet buffer. A total of 548 Joshua trees were identified in the survey area and Table 5 below summarizes the results of the survey and the tree locations are shown in Figure 7. More details of the survey can be found in the 2025 Joshua Tree Inventory Report.

Figure 7. Joshua Tree Inventory

Table 5. Summary of Western Joshua Tree Inventory

Size Class (height)	# of Joshua Trees	Live	Dead	Mature	Fruits/Flowers	Within 15m of project	Removals
Class A <1m	254	253	1	0	0	173	28
Class B 1m-5m	282	275	7	163	136	127	28
Class C >5m	12	12	0	12	12	5	2
Total	**548**	**540**	**8**	**175**	**148**	**305**	**58**

Of the 548 Joshua trees surveyed 254 were Class A, 282 Class B, and 12 Class C. A total of 8 Joshua trees were dead (1 Class A and 7 Class B) and 175 were mature. Of the mature trees, 148 had fruits or flowers. There are 305 Joshua trees within 15-meters of the proposed project footprint and 58 of those would be removed by the project because they are within the footprint. Removals include 28 Class A, 28 Class B, and 2 Class C. Overall the population of Joshua trees within the survey area is healthy, with very few dead trees and a mix of size classes and observations of fruits and flowers indicate that the Joshua trees are regenerating naturally on the site. The number of removals proposed by the project is 10% of the number surveyed, however, there are numerous other Joshua trees surrounding the survey area that are contiguous plant communities with that found on the site, and the relative number of removals to those in the region is very small.

Due to the proposed removal of 58 Joshua trees for the project, it will require a permit from the California Department of Fish and Wildlife (CDFW) prior to removing the trees as described in Mitigation Measure BIO-2.

Mitigation Measure BIO-2 – Western Joshua Tree Permitting and Mitigation Fees

- To obtain the permit the applicant must complete a permit application and submit the application and Joshua tree inventory to the CDFW Region 6 Office via the online permitting system. This permit will require coordination with both the County of San Bernardino and CDFW to determine the number of Joshua trees that the agencies would require for transplanting to areas outside of the development.

- There is an in-lieu fee program that allows for a fee-based mitigation for removal of Joshua trees. The 2025 Western Joshua Tree Conservation Act Incidental Take Permit annual mitigation fees for the proposed removal of 58 Joshua trees within the reduced fee area is a total of $12,010.50 as follows:

    - 28 Class A trees x $152.75 = $4,277.00

    - 28 Class B trees x $203.50 = $5,698.00

- 2 Class C trees x $1,017.75 = $2,035.50

South Environmental recommends Mitigation Measure BIO-3 to ensure avoidance of western Joshua trees during construction.

Mitigation Measure BIO-3 – Western Joshua Tree Avoidance During Construction

- South Environmental recommends installing temporary protective fencing between the project work space and each Joshua tree during construction of the project. The fencing would be high-visibility fencing placed at a minimum 15-meter buffer zone prior to start of construction (or at the distance that is permitted for trees closer to the site). No work or project activities shall occur within the fenced area and all work shall occur outside of the proposed Joshua tree buffers. Fencing would help prevent compaction and/or contamination of soil and root zone.

- During construction, heavy equipment and vehicles shall be operated in accordance with standard Best Management Practices (BMPs). For example, all equipment used in the workspace shall be properly maintained such that no leaks of oil, fuel, or residues will take place. Provisions shall be in place to remediate any accidental spills. Implementation of the BMPs will help minimize the potential for impact to Joshua trees both within and outside the Joshua tree buffer zones.

3.2.4 Impacts to Special-Status Wildlife

A total of 7 special-status animals have a moderate or high potential to occur on the site and be impacted by the project: Crotch bumble bee, pallid San Diego pocket mouse, desert tortoise, coast horned lizard, American badger, Bendire's thrasher, and Le Conte's thrasher. These species have the potential to occur within the Desert Almond Scrub and Joshua Tree Woodland habitats on the project site and study area.

Crotch's Bumble Bee

There is suitable habitat within the Desert Almond Scrub and Joshua Tree Woodland and presence of food plant genera, *Eriogonum* sp. and *Phacelia* sp., on the project site that could serve as a host plant habitat for Crotch's bumble bee. There are also rock outcrops onsite that could serve as suitable nesting locations. If present during the proposed development, construction activities have the potential to impact this species by destroying their nests that are made in tufts of grass, dead trees, rock piles, or underground. No nests or colonies were observed during the survey, however, they could establish a colony prior to the start of work. Considering the 60-acres remainder parcel will be conserved, potential habitat areas would be maintained in the region and the impacts to habitat would be less than significant according to CEQA. However, impacts to nests or individual bees would be considered significant and would require a take permit. Mitigation Measure BIO-4

includes preconstruction surveys and avoidance of nests/colonies to reduce the potential direct impact to Crotch's bumble bee to a level that is less than significant according to CEQA.

Mitigation Measure BIO-4 – Crotch's Bumble Bee Survey, Nest Avoidance, and Habitat Restoration or Replacement

- Due to suitable habitat within both the Desert Almond Scrub and Joshua Tree Woodland and a high potential for food plant genera *Eriogonum* sp. and *Phacelia* sp., within one year prior to grading and/or vegetation removal, a qualified biologist familiar with the species behavior and life history should conduct focused preactivity surveys in all project areas with potential foraging, nesting, and/or overwintering habitat and within a 100-feet buffer area.
- Surveys should be performed by a biologist who has completed a bumble bee training course, workshop, or curriculum approved by CDFW or has the appropriate handling permits.
- Focused surveys shall be conducted within the same calendar year prior to the start of vegetation- or ground-disturbing activities. Surveys shall be conducted using CDFW-approved survey protocols. No fewer than three surveys should be conducted, the first of which should include a habitat assessment of foraging, nesting, and overwintering habitats. Pre-project surveys should be conducted during peak flight period from April through August at least 2 weeks apart. Surveys should occur when weather conditions are favorable for detection when temperatures are above 60 degrees Fahrenheit and not during wet conditions. Sunny days with low wind speeds (less than 10 miles per hour) are optimal. Partially cloudy days or overcast conditions are permissible if a person' s shadow is visible. Surveys should be conducted at least two hours after sunrise and three hours before sunset. Survey results shall be recorded using the current CDFW-approved survey form.
- Survey results, including negative findings, should be submitted to the County and CDFW prior to implementing project-related ground-disturbing activities and/or vegetation removal where there may be impacts to Crotch's bumble bee. At minimum, a survey report should provide the following:
    - A description and map of the survey area, focusing on areas that could provide suitable habitat for Crotch's bumble bee;
    - Field survey conditions that should include name(s) of qualified entomologist(s) and brief qualifications, date and time of survey, survey duration, general weather conditions, survey goals, and species searched;
    - Map(s) showing the location of nests/colonies; and,
    - A description of physical (e.g., soil, moisture, slope) and biological (e.g., plant composition) conditions where each nest/colony is found. A sufficient description of biological conditions, primarily impacted habitat, should include native plant composition (e.g., density, cover, and abundance) within impacted habitat (e.g., species list separated by vegetation class; density, cover, and abundance of each species).

- If Crotch's bumble bee is detected, the CDFW and County shall be notified within 48-hours and the biologist shall establish an appropriate no-work buffer around the occupied area as approved by the County and CDFW. The no-work buffer may be removed and activities may resume after October 15.
- If Crotch's bumble bee cannot be avoided by the project, take authorization through a Memorandum of Understanding (MOU) pursuant to Fish and Game Code section 2081(a) must be obtained prior to impacts.

Desert Tortoise

Desert tortoises have the potential to occur on the project site due to suitable habitat within both the Desert Almond Scrub and Joshua Tree Woodland. If this species is present within the development area during construction activities they could be crushed and killed or injured. Impacts to desert tortoise, active burrows, or nests would require a take permit. To determine the presence/absence of desert tortoise on the project site prior to construction a focused survey per the USFWS Survey Protocol for Mojave Desert Tortoise (USFWS 2019) is included in Mitigation Measure BIO-5.

Mitigation Measure BIO-5 – Desert Tortoise Preconstruction Survey

- A preconstruction presence/absence survey for desert tortoise will be conducted on the project site according to the U.S. Fish and Wildlife Service (USFWS) 2019 Preparing for any action that may occur within the range of the Mojave desert tortoise (*Gopherus agassizii*) guidelines for small project surveys. The survey will be conducted by an experienced desert tortoise biologist and will include 10-meter belt transects conducted throughout the proposed impact areas and a 500-foot buffer to achieve 100% visual coverage of the site (approximately 130-acres). The survey would be timed to occur within 30-days of the start of construction.
- Locations of live tortoises and their sign (burrows, scat, and carcasses) will be recorded during the survey using a GPS and the burrows and sign will be scored to understand recent activities of desert tortoise if any. The survey will include incidental observations for other sensitive burrowing animals: western burrowing owl (*Athene cunicularia hypugaea*), desert kit fox (*Vulpes macrotis*), and American badger (*Taxidea taxus*).
- A detailed desert tortoise survey report will be prepared that describes the project, methods and results of the survey, and an assessment of potential impacts to desert tortoise from the project.
- If desert tortoise or active burrows are identified on the project site and cannot be avoided by the project a take permit from the USFWS and the CDFW would be required prior to start of the project.

Coast Horned Lizard

Coast horned lizard have the potential to occur on the project site due to suitable habitat within both the Desert Almond Scrub and Joshua Tree Woodland. Loss of potential habitat for these species is considered less than significant because the project includes 60-acres of conserved Joshua tree woodlands that would compensate for the loss in the project footprint. However, if coast horned lizard is present within the development area during construction activities they could be crushed and killed or injured. To avoid direct impacts to individual reptiles, the salvage program described below is proposed as mitigation for these impacts in Mitigation Measure BIO-6.

Mitigation Measure BIO-6 - Special Status Reptile Survey and Protection and/or Relocation

- A qualified biologist should conduct daily reptile biological monitoring during any activities involving vegetation clearing or modification of natural habitat. Positive detections of special-status reptiles and suitable habitat at the detection location should be mapped and photographed.
- Initial removal of vegetation shall occur using hand tools only and then can be graded. During the vegetation removal, a qualified biologist shall be onsite to recover any individuals that may be excavated with native vegetation. Individual lizards will be captured (if possible) and removed from the impact area and will be released into a predetermined area outside of construction and fuel modification in the immediate vicinity. The salvage program will continue until all special-status reptiles have been removed from the area.

Pallid San Diego Pocket Mouse

Pallid San Diego pocket mouse has the potential to occur on the project site due to suitable habitat within both the Desert Almond Scrub and the Joshua Tree Woodland. Pallid San Diego pocket mouse does not have a federal or state listing, but is listed on the CDFW's Special Animals List with a global rarity ranking of G5T3T4 and a state rarity ranking of S3S4 indicating that there is uncertainty about the status and the species is not yet confirmed to be rare, threatened, or endangered. The project proposes to conserve 60-acres of potential habitat on the project site which would compensate for any habitat loss from the development. Because the species is not known to be at risk and potential habitat loss would be mitigated, the project potential impacts would be considered less than significant according to CEQA.

American Badger

America Badger has the potential to occur on the project site due to suitable habitat within both the Desert Almond Scrub and the Joshua Tree Woodland. The proposed project is within and adjacent to habitat that is suitable for America badger during foraging, burrowing, or movement events. The project proposes to conserve 60-acres of potential habitat on the project site which would compensate for any habitat loss from the development. However, active badger nests should

be avoided by the project. American badger's use fossorial nests that can be identified during the focused survey described in Mitigation Measure BIO-7 to avoid potential impacts to American badgers.

Mitigation Measure BIO-7 – American Badger

- No more than 30 days prior to the beginning of ground disturbance and/or construction activities for all Phases of the Project, a qualified biologist(s) shall conduct surveys to determine if potential American badger burrows are present in the Project area. Surveys shall encompass both the Project site and a buffer distance adequate to determine the potential for direct or indirect impacts. Surveys shall attain 100% visual coverage and be conducted using 10-m transects (or reduced based on topography and vegetation), to determine the presence or absence of individuals, dens, and sign.
- If American badger burrows are located, the County and Project proponent shall have a qualified biologist(s) monitor the burrows using observation and tracking material and/or trail cameras over a three (3) day period to determine the status of the burrow.
- If non-natal active dens can be avoided and buffered from Project activities, the biologist shall flag a minimum 100-foot disturbance-free buffer zone. A minimum 500-foot disturbance-free buffer shall be placed around the natal den and maintained until juvenile independence is determined by the biologist.
- The biologist has the authority to halt or stop work if individuals exhibit signs of disturbance. Established buffers shall remain until the biologist determines the young have dispersed or the den is no longer active, or until Project activities cease.
- If American badger is proposed to be relocated from an active den or an active den will be impacted, an exclusion plan, including compensatory mitigation, shall be prepared for CDFW review and approval that will be performed outside of breeding season and after juvenile dispersal.

Bendire's Thrasher and Le Conte's Thrasher

Bendire's thrasher and Le Conte's thrasher are CDFW Species of Special Concern that have the potential to nest and forage on the project site. To avoid direct and indirect impacts to these birds, Mitigation Measure BIO-2 regarding nesting bird surveys is recommended. If the measure is followed, no impacts would occur to nests or thrasher and the impact to special-status birds would be less than significant according to CEQA.

3.2.5 Impacts to Water Resources

One jurisdictional feature, Drainage #1, occurs in the study area that would be permanently impacted by the project.

Permanent Impacts to RWQCB and CDFW jurisdictional areas are shown in Figure 6. Permanent impacts are also summarized in Table 6. Permanent impacts to jurisdictional features for the project would be from the proposed Private Street 'A'.

Temporary Impacts would not occur from the project as temporary staging and construction equipment will occur outside of Drainage #1 and at a distance greater than 50-feet.

Table 6. Summary of Permanent Impacts to Jurisdictional Features

Feature	Linear Feet	Non-Wetland Waters of the State acres	CDFW Streambed acres
Permanent Impacts to Drainage #1	50	0.01	0.02
Total	50	0.01	0.02

A total of 0.01-acre/50 linear feet of permanent impacts to RWQCB jurisdiction is anticipated for the project within Drainage #1 and a total of 0.02-acre/50 linear feet of permanent impacts to CDFW jurisdiction is anticipated for the project. These impacts would require permitting with CDFW and RWQCB prior to beginning construction of the project as described in Mitigation Measure BIO-8.

Mitigation Measure BIO-8 – Permitting for Impacts to Water Resources

- The project is within Region 7, Colorado River RWQCB and a *Application: Discharges of Dredged or Fill Material to Waters of the State* should be completed and sent to the RWQCB.
- Due to impacts to streambeds the project will require a Lake and Streambed Alteration Agreement with the CDFW per Section 1600 of the Fish and Game Code. The project should complete an online application with the CDFW for these impacts.

3.2.6 Impacts to Protected Trees

The study area contains mature honey mesquite (living and dead), species of the family Agavaceae (banana yucca, Mojave yucca), and western Joshua trees, which are all regulated trees that require permits before removal under the San Bernardino County Code of Ordinances. These species will be included in the rare plant surveys described in Mitigation Measure BIO-2 and impacts to these species will be quantified. Mitigation Measure BIO-9 includes permitting for any impacts to these species.

Mitigation Measure BIO-9 – Permitting for Impacts to Protected Trees

- Prior to initiation of ground-disturbing activities, the applicant shall obtain a Protected Tree Removal Permit from the County for any plant or tree subject to County Code Chapter 88.01, Plant Protection and Management. Protected species on the Project site include, but are not limited to: mature honey mesquite, species of the family Agavaceae, and western Joshua trees. A qualified arborist shall prepare a tree inventory identifying the location, species, size, and protection status of all trees that may be impacted by the project. The permit application and tree inventory shall be submitted to the County for review and approval. All protected trees approved for removal shall be compensated through on-site replacement plantings or payment of in-lieu fees in accordance with County requirements. Tree removal shall occur only under the supervision of a qualified arborist. Evidence of permit issuance and compliance shall be provided to the County prior to issuance of grading permits.

3.2.7 Impacts to Wildlife Movement Corridors and Habitat Linkages

The project site is within a potential wildlife movement area that is contiguous with large expanses of protected native habitats within the Little San Bernardino Mountains. There are a few patches of land that are partially developed surrounding the project site, but areas to the north and east of the parcel contain large expanses of land owned by The Wildlands Conservancy, the Mojave Desert Land Trust, and the Bureau of Land Management. Onsite Desert Almond Scrub and Joshua Tree Woodland habitats are contiguous with high-quality habitats in these directions as it moves away from developments. Surrounding developments are minimal and the large lot size ensures that the areas are permeable to wildlife movement. The proposed grading, landscaping, and building footprints are within potential movement areas and would impact 0.55-acres of Desert Almond Scrub and 4.48-acres of Joshua Tree Woodland. These developments would be placed on large lots with most of the lots remaining undeveloped and allowing for movement. In addition, the remainder parcel will be conserved and provide a large area for unhindered wildlife movement through the project site. Because there would remain a large area for wildlife movement in the remainder parcel and within the undeveloped areas of the large-lots, the potential impacts to wildlife movement from development would be less than significant according to CEQA.

3.2.8 Cumulative Impacts

The project is proposed in a very low density, rural area and conforms to the large lot size and large conservation area adjacent to the developments. Due to the low impact of the project and the relatively large areas of conserved and protected habitat on the site and in the region, the potential cumulative impacts would be less than significant according to CEQA as the ecological functions and integrity of the site will be maintained with the implementation of the Mitigation Measures described in this report.

4. Bibliography

California Department of Fish and Wildlife (CDFW). 2025a. California Natural Diversity Database (available by subscription) and Rarefind. CDFW: Sacramento, California. Portal Online Access: https://wildlife.ca.gov/Data/CNDDB/Maps-and-Data

California Invasive Plant Council (Cal-IPC). 2025. Plants A to Z. Accessed online: https://www.cal-ipc.org/plants/profiles/

County of San Bernardino. 2008. § 23.0301 Duty to Abate Fire Hazards or Hazardous Trees. Accessed online: https://lus.sbcounty.gov/fire-hazard-abatement-home/protect-your-home/

County of San Bernardino. 2025. Tree and Plant Removal- Planning. Accessed online: https://wp.sbcounty.gov/ezop/permits/tree-and-plant-removal/#:~:text=No%20person%2C%20except%20as%20provided,)%20(i)%20(8)%5D

CDFW. 2025b. California Wildlife Habitat Relationships life history accounts and range maps. Accessed online: https://wildlife.ca.gov/Data/CWHR/Life-History-and-Range

CDFW. 2025c. California Natural Community List. Accessed online: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=153609&inline

California Native Plant Society (CNPS). 2025a. Inventory of Rare and Endangered Plants of California. California Native Plant Society. Available online (http://cnps.web.aplus.net/cgi-bin/inv/inventory.cgi).

CNPS. 2025b. A Manual of California Vegetation Online - California Natural Communities List. Accessed online: http://vegetation.cnps.org/

CPAD. 2025. California Protected Areas Database Map. Available online: https://www.calands.org/

iNaturalist. 2025. Observation Search for the project site. Available online: https://www.inaturalist.org/observations?nelat=34.54807741613168&nelng=-118.24154813535156&swlat=34.499310936628554&swlng=-118.29642507768554&iconic_taxa=Aves,Reptilia,Mammalia

US Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS). 2025. Online Web Soil Survey Mapper (https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm).

United State Geological Service (USGS). 2025a. National Hydrography Dataset (NHD) The National Map Viewer. Accessed online: https://viewer.nationalmap.gov/services/

USGS. 2025b. The National Geologic Map Database, Map View. Available online (http://ngmdb.usgs.gov/maps/mapview/). U.S. Department of the Interior. Washington, DC.

USGS. 2025c. California Geologic Map Data. Available online (http://mrdata.usgs.gov/geology/state/ state.php?state=CA). U.S. Department of the Interior. Washington, DC.

United States Fish and Wildlife Service (USFWS). 2025a. Environmental Conservation Online System (ECOS) Information for Planning and Consultation (IPaC). Accessed online: https://ecos.fws.gov/ipac/

USFWS. 2025b. Critical Habitat GIS Data. Available for download online: (https://catalog.data.gov/dataset/fws-critical-habitat-for-threatened-and-endangered-species-dataset).

USFWS. 2025c. National Wetlands Inventory Online Wetlands Mapper. Accessed online: https://www.fws.gov/wetlands/data/mapper.html

Appendix A

Photograph Log

Appendix B

Special-Status Species Analysis

Special-Status Species

Special-status species are those plants and animals that, because of their recognized rarity or vulnerability to various causes of habitat loss or population decline, are recognized by federal, state, or other agencies as under threat from human-associated developments. Some of these species receive specific protection that is defined by federal or state endangered species legislation. Others have been designated as special-status based on adopted policies and expertise of state resource agencies or organizations with acknowledged expertise, or policies adopted by local governmental agencies such as counties, cities, and special districts to meet local conservation objectives. Special-status species include:

- Plants or wildlife listed or proposed for listing as threatened or endangered, or are candidates for possible future listing as threatened or endangered, under the federal Endangered Species Act or the California Endangered Species Act;
- Plants or wildlife that meet the definitions of rare or endangered under CEQA Guidelines Section 15380.
- Plants or wildlife covered under an adopted NCCP/HCP;
- Plants considered by the California Native Plant Society (CNPS) to be rare, threatened, or endangered (List 1A, 1B and 2 plants) in California;
- Plants listed by the CNPS as plants in which there is limited information about distribution (List 3);
- Plants listed as rare under the California Native Plant Protection Act (Fish and Game Code 1900 et seq.);
- Wildlife designated by CDFW as species of special concern;
- Wildlife "fully protected" in California (California Fish and Game Code Sections 3511, 4700, and 5050); and
- Wildlife protected by the Migratory Bird Treaty Act (MTBA).

Federally-Protected Status

All references to Federally-protected species in this BRA include the most current published status or candidate category to which each species has been assigned by USFWS. For purposes of this assessment the following acronyms are used for Federal status species, as applicable:

FE Federally-listed as Endangered
FT Federally-listed as Threatened
FPE Federally proposed for listing as Endangered
FPT Federally proposed for listing as Threatened
FPD Federally proposed for delisting
FC Federal candidate species (former C1 species)

State-Protected Status

For the purposes of this BRA, the following acronyms are used for State status species, as applicable:

SE State-listed as Endangered
ST State-listed as Threatened
SR State-listed as Rare
SCE State candidate for listing as Endangered
SCT State candidate for listing as Threatened
SFP State Fully Protected
SSC California Species of Special Concern

California Rare Plant Rank

The CNPS is a private plant conservation organization dedicated to the monitoring and protection of special-status species in California. CNPS has compiled an inventory comprised of the information focusing on geographic distribution and qualitative characterization of Rare, Threatened, or Endangered vascular plant species of California (CNPS 2018). The list serves as the candidate list for listing as Threatened and Endangered by CDFW. CNPS has developed six categories of rarity known as the California Rare Plant Rank (CRPR), of which Ranks 1A, 1B, 2A, and 2B are particularly considered sensitive:

Rank 1A Presumed extinct in California.
Rank 1B Plants Rare, Threatened, or Endangered in California and elsewhere.
Rank 2A Presumed extinct in California, but more common elsewhere.
Rank 2B Plants Rare, Threatened, or Endangered in California, but more common elsewhere.
Rank 3 Plants about which we need more information – a review list.
Rank 4 Plants of limited distribution – a watch list.

The CNPS recently added "threat ranks" which parallel the ranks used by the CNDDB. These ranks are added as a decimal code after the CNPS List (e.g., Rank 1B.1). The threat codes are as follows:

.1 Seriously threatened in California (over 80% of occurrences threatened/high degree and immediacy of threat);
.2 Moderately threatened in California (20-80% occurrences threatened);
.3 Not very threatened in California (<20% of occurrences threatened or no current threats known).

Potential to Occur Assessment

Special-status species that **present** or are **likely** (high or medium potential) to occur within the parcel are a based on one or more of the following:

- the direct observation of the species within the parcel during any field surveys;
- a record reported in the CNDDB, CNPS, or IPAC; and
- the parcel is within known distribution of a species and contains appropriate habitat.

Special-status species that are **unlikely** (low potential) to occur are based on one of the following:

- the parcel has the general habitat types but lacks necessary habitat elements such as suitable microhabitat or soils; or
- the parcel is outside the known elevation range or distribution of the species, and has otherwise suitable habitats;

Special-status species that have no potential to occur on the parcel are labeled as **none** due to the absence of suitable habitat.

Special-Status Animals

Scientific Name	Common Name	Taxonomic Group	Federal Listing	State Listing	Other Status	General Habitat	Microhabitat	Potential to Occur on Study Area
Accipiter cooperii	Cooper's hawk	Birds	None	None	CDFW_WL-Watch List | IUCN_LC-Least Concern	Woodland, chiefly of open, interrupted or marginal type.	Nest sites mainly in riparian growths of deciduous trees, as in canyon bottoms on river flood-plains; also, live oaks.	**None.** Study area lacks riparian growths of deciduous tree for nesting.
Anniella stebbinsi	Southern California legless lizard	Reptiles	None	None	CDFW_SSC-Species of Special Concern | USFS_S-Sensitive	Generally south of the Transverse Range, extending to northwestern Baja California. Occurs in sandy or loose loamy soils under sparse vegetation. Disjunct populations in the Tehachapi and Piute Mountains in Kern County.	Variety of habitats; generally in moist, loose soil. They prefer soils with a high moisture content.	**None.** Study area lack soils with a high moisture content.
Antrozous pallidus	pallid bat	Mammals	None	None	BLM_S-Sensitive | CDFW_SSC-Species of Special Concern | IUCN_LC-Least Concern | USFS_S-Sensitive	Deserts, grasslands, shrublands, woodlands and forests. Most common in open, dry habitats with rocky areas for roosting.	Roosts must protect bats from high temperatures. Very sensitive to disturbance of roosting sites.	**None.** Study area lacks suitable roosting sites that protect bats from high temperatures, such as caves or mines.
Aquila chrysaetos	golden eagle	Birds	None	None	BLM_S-Sensitive | CDF_S-Sensitive | CDFW_FP-Fully Protected | CDFW_WL-Watch List | IUCN_LC-Least Concern	Rolling foothills, mountain areas, sage-juniper flats, and desert.	Cliff-walled canyons provide nesting habitat in most parts of range; also, large trees in open areas.	**None.** Study area lack cliff-walled canyons to provide nesting habitat.
Asio otus	long-eared owl	Birds	None	None	CDFW_SSC-Species of Special Concern | IUCN_LC-Least Concern | USFWS_BCC-Birds of Conservation Concern	Riparian bottomlands grown to tall willows and cottonwoods; also, belts of live oak paralleling stream courses.	Require adjacent open land, productive of mice and the presence of old nests of crows, hawks, or magpies for breeding.	**None.** Study area lacks riparian bottomlands with tall willows or cottonwoods.
Bombus crotchii	Crotch's bumble bee	Insects	None	Candidate Endangered	IUCN_EN-Endangered	Coastal California east to the Sierra-Cascade	Food plant genera include Antirrhinum,	**Moderate.** Study area contains *Phacelia* and *Eriogonum* food

Scientific Name	Common Name	Taxonomic Group	Federal Listing	State Listing	Other Status	General Habitat	Microhabitat	Potential to Occur on Study Area
						crest and south into Mexico.	Phacelia, Clarkia, Dendromecon, Eschscholzia, and Eriogonum.	plant genera within intact desert scrub/ woodland habitat.
Callospermophilus lateralis bernardinus	San Bernardino golden-mantled ground squirrel	Mammals	None	None		Openings and open stages of mixed conifer, pine, pinyon-juniper, montane riaprain, aspen, and alpine meadow, and chaparral		**None.** Study area lacks required montane forest habitat and is outside of known locality within San Bernardino mountains.
Chaetodipus fallax pallidus	pallid San Diego pocket mouse	Mammals	None	None		Desert border areas of San Diego, Riverside, San Bernardino, and Los Angeles counties in desert wash, desert scrub, desert succulent scrub, pinyon-juniper, etc.	Sandy, herbaceous areas, usually in association with rocks or coarse gravel.	**Moderate.** Study area contains desert wash/ desert scrub habitat with sandy, herbaceous areas with rocks and coarse gravel.
Charina umbratica	southern rubber boa	Reptiles	None	Threatened	IUCN_VU-Vulnerable | USFS_S-Sensitive	Found in a variety of montane forest habitats. Previously considered morphologically intermediate, recent (2022) genomic analysis clarifies individuals from Mt Pinos, Tehachapi Mts, and southern Sierra Nevada are southern rubber boa.	Found in vicinity of streams or wet meadows; requires loose, moist soil for burrowing; seeks cover in rotting logs, rock outcrops, and under surface litter.	**None.** Study area lacks montane forest habitat with moist microhabitat.
Corynorhinus townsendii	Townsend's big-eared bat	Mammals	None	None	BLM_S-Sensitive | CDFW_SSC-Species of Special Concern | IUCN_LC-Least Concern | USFS_S-Sensitive	Throughout California in a wide variety of habitats. Most common in mesic sites.	Roosts in the open, hanging from walls and ceilings. Roosting sites limiting. Extremely sensitive to human disturbance.	**None.** Study area lacks a mesic site.
Crotalus ruber	red-diamond rattlesnake	Reptiles	None	None	CDFW_SSC-Species of Special Concern | IUCN_LC-Least Concern | USFS_S-Sensitive	Chaparral, woodland, grassland, and desert areas from coastal San Diego County to the	Occurs in rocky areas and dense vegetation. Needs rodent burrows, cracks in rocks or surface cover objects.	**Low.** Study area contains desert woodland/ scrub with rocky areas and dense vegetation with rodent burrows present but it is outside the typical range for this species.

Scientific Name	Common Name	Taxonomic Group	Federal Listing	State Listing	Other Status	General Habitat	Microhabitat	Potential to Occur on Study Area
						eastern slopes of the mountains.		
Eremarionta morongoana	Morongo (=Colorado) desertsnail	Mollusks	None	None	IUCN_NT-Near Threatened	Found in the eastern San Bernardino Mountains, the Little San Bernardino Mountains, and Mecca Hills along the the edge of the Coachella Valley and southern Mojave Desert.	Occur in rockslides with deep talus surrounded by desert scrub, or under beds of fallen palm fronds where tumbled rocks are present at palm oases.	**None.** Study area lacks rockslide area with deep talus or palm oasis habitat.
Falco mexicanus	prairie falcon	Birds	None	None	CDFW_WL-Watch List | IUCN_LC-Least Concern	Inhabits dry, open terrain, either level or hilly.	Breeding sites located on cliffs. Forages far afield, even to marshlands and ocean shores.	**None.** Study area lacks cliffs for breeding and nearby water for foraging.
Gopherus agassizii	desert tortoise	Reptiles	Threatened	Threatened	IUCN_CR-Critically Endangered	Most common in desert scrub, desert wash, and Joshua tree habitats; occurs in almost every desert habitat.	Require friable soil for burrow and nest construction. Creosote bush habitat with large annual wildflower blooms preferred.	**Moderate.** Study area contains desert scrub, desert wash, and Joshua tree habitats with friable soil, creosote bush habitat, and wildflowers.
Icteria virens	yellow-breasted chat	Birds	None	None	CDFW_SSC-Species of Special Concern | IUCN_LC-Least Concern	Summer resident; inhabits riparian thickets of willow and other brushy tangles near watercourses.	Nests in low, dense riparian, consisting of willow, blackberry, wild grape; forages and nests within 10 ft of ground.	**None.** Study area lacks permanent riparian habitat with dense thickets.
Lasiurus xanthinus	western yellow bat	Mammals	None	None	CDFW_SSC-Species of Special Concern | IUCN_LC-Least Concern	Found in valley foothill riparian, desert riparian, desert wash, and palm oasis habitats.	Roosts in trees, particularly palms. Forages over water and among trees.	**None.** Study area lacks riparian habitat for foraging and palms for roosting.
Myiarchus tyrannulus	brown-crested flycatcher	Birds	None	None	CDFW_WL-Watch List | IUCN_LC-Least Concern	Inhabits desert riparian areas along the Colorado River, as well as other desert oases and riparian areas NW to Victorville.	Requires riparian thickets, trees, snags, and shrubs for foraging perches, nesting cavities, and cover.	**None.** Study area lacks riparian habitat for foraging and nesting.
Myotis ciliolabrum	western small-footed myotis	Mammals	None	None	BLM_S-Sensitive | IUCN_LC-Least Concern	Wide range of habitats mostly arid wooded and brushy uplands near water. Seeks cover in caves,	Prefers open stands in forests and woodlands. Requires drinking water. Feeds on a wide variety of small flying insects.	**None.** Study area lacks permanent water source and caves for cover.

Scientific Name	Common Name	Taxonomic Group	Federal Listing	State Listing	Other Status	General Habitat	Microhabitat	Potential to Occur on Study Area
						buildings, mines, and crevices.		
Myotis evotis	long-eared myotis	Mammals	None	None	BLM_S-Sensitive | IUCN_LC-Least Concern	Found in all brush, woodland and forest habitats from sea level to about 9000 ft. Prefers coniferous woodlands and forests.	Nursery colonies in buildings, crevices, spaces under bark, and snags. Caves used primarily as night roosts.	**None.** Study area lacks coniferous forest and suitable roosting locations.
Myotis thysanodes	fringed myotis	Mammals	None	None	BLM_S-Sensitive | IUCN_LC-Least Concern | USFS_S-Sensitive	In a wide variety of habitats, optimal habitats are pinyon-juniper, valley foothill hardwood and hardwood-conifer.	Uses caves, mines, buildings or crevices for maternity colonies and roosts.	**None.** Study area lacks pinyon-juniper or hardwood-conifer habitat and suitable roosting locations.
Myotis volans	long-legged myotis	Mammals	None	None	IUCN_LC-Least Concern	Most common in woodland and forest habitats above 4000 ft. Trees are important day roosts; caves and mines are night roosts.	Nursery colonies usually under bark or in hollow trees, but occasionally in crevices or buildings.	**None.** Study area lacks caves or mines for roosts.
Neotoma lepida intermedia	San Diego desert woodrat	Mammals	None	None	CDFW_SSC-Species of Special Concern	Coastal scrub of Southern California from San Diego County to San Luis Obispo County.	Moderate to dense canopies preferred. They are particularly abundant in rock outcrops, rocky cliffs, and slopes.	**None.** Study area lacks coastal scrub habitat.
Ovis canadensis nelsoni	desert bighorn sheep	Mammals	None	None	BLM_S-Sensitive | CDFW_FP-Fully Protected | USFS_S-Sensitive	Widely distributed from the White Mtns in Mono Co. to the Chocolate Mts in Imperial Co.	Open, rocky, steep areas with available water and herbaceous forage.	**None.** Study area lacks steep open rocky areas with available water.
Paranomada californica	California cuckoo bee	Insects	None	None			Known only from two locations in San Bernardino County; the type locality near Yucca Valley, and a 1971 collection from 9.5 miles NW of Pioneertown, on Burns Canyon Rd (CNDDB 2006).	**Low.** Study area contains intact desert scrub and is between the two historical records approximately 8 miles away in opposite directions.
Parnopes borregoensis	Borrego parnopes cuckoo wasp	Insects	None	None		Known from San Diego, San Bernardino, and Inyo counties.	Desert dry washes and core habitats for desert tortoises.	**Moderate.** Study area contains desert dry washes and suitable habitat for tortoises.

Scientific Name	Common Name	Taxonomic Group	Federal Listing	State Listing	Other Status	General Habitat	Microhabitat	Potential to Occur on Study Area
Perognathus longimembris bangsi	Palm Springs pocket mouse	Mammals	None	None	BLM_S-Sensitive | CDFW_SSC-Species of Special Concern	Desert riparian, desert scrub, desert wash and sagebrush habitats. Most common in creosote-dominated desert scrub.	Rarely found on rocky sites. Occurs in all canopy coverage classes.	**Low.** Study area contains desert scrub, desert wash, and creosote-dominated scrub habitat but is outside the typical range for this species.
Phrynosoma blainvillii	coast horned lizard	Reptiles	None	None	BLM_S-Sensitive | CDFW_SSC-Species of Special Concern | IUCN_LC-Least Concern	Frequents a wide variety of habitats, most common in lowlands along sandy washes with scattered low bushes.	Open areas for sunning, bushes for cover, patches of loose soil for burial, and abundant supply of ants and other insects.	**Moderate.** Study area contains intact desert scrub with sandy washes, scattered low bushes, open areas for sunning, and loose soil.
Piranga rubra	summer tanager	Birds	None	None	CDFW_SSC-Species of Special Concern | IUCN_LC-Least Concern	Summer resident of desert riparian along lower Colorado River, and locally elsewhere in California deserts.	Requires cottonwood-willow riparian for nesting and foraging; prefers older, dense stands along streams.	**None.** Study area lacks permanent riparian area with dense stands of willow for nesting and foraging.
Pyrocephalus rubinus	vermilion flycatcher	Birds	None	None	CDFW_SSC-Species of Special Concern | IUCN_LC-Least Concern	During nesting, inhabits desert riparian adjacent to irrigated fields, irrigation ditches, pastures, and other open, mesic areas.	Nest in cottonwood, willow, mesquite, and other large desert riparian trees.	**None.** Study area lacks desert riparian habitat with trees adjacent to irrigated fields or other open mesic areas.
Setophaga petechia	yellow warbler	Birds	None	None	CDFW_SSC-Species of Special Concern | IUCN_LC-Least Concern	Riparian plant associations in close proximity to water. Also nests in montane shrubbery in open conifer forests in Cascades and Sierra Nevada.	Frequently found nesting and foraging in willow shrubs and thickets, and in other riparian plants including cottonwoods, sycamores, ash, and alders.	**None.** Study area lacks riparian plants near water source with thickets.
Siphateles bicolor mohavensis	Mohave tui chub	Fish	Endangered	Endangered	AFS_EN-Endangered | CDFW_FP-Fully Protected	Endemic to the Mojave River basin, adapted to alkaline, mineralized waters.	Needs deep pools, ponds, or slough-like areas. Needs vegetation for spawning.	**None.** Study area lacks permanent deep pools or ponds connected to Mojave River basin.
Taxidea taxus	American badger	Mammals	None	None	CDFW_SSC-Species of Special Concern | IUCN_LC-Least Concern	Most abundant in drier open stages of most shrub, forest, and herbaceous habitats, with friable soils.	Needs sufficient food, friable soils and open, uncultivated ground. Preys on burrowing rodents. Digs burrows.	**Moderate.** Study area contains dry open stage shrub habitat with friable soil, and uncultivated ground.

Scientific Name	Common Name	Taxonomic Group	Federal Listing	State Listing	Other Status	General Habitat	Microhabitat	Potential to Occur on Study Area
Texella deserticola	Whitewater Canyon harvestman	Arachnids	None	None		Known only from the type locality, Whitewater Canyon, Riverside County.	The only specimen known was collected from under a rock in a mesic southern chaparral community along a canyon slope.	**None.** Outside of known locality and site is not mesic.
Toxostoma bendirei	Bendire's thrasher	Birds	None	None	BLM_S-Sensitive | CDFW_SSC-Species of Special Concern | IUCN_VU-Vulnerable | USFWS_BCC-Birds of Conservation Concern	Migratory; local spring/summer resident in flat areas of desert succulent shrub/Joshua tree habitats in Mojave Desert.	Nests in cholla, yucca, palo verde, thorny shrub, or small tree, usually 0.5 to 20 feet above ground.	**Moderate.** Study area contains desert shrub/ Joshua tree habitats with cholla, yucca, and small trees for nesting.
Toxostoma lecontei	Le Conte's thrasher	Birds	None	None	BLM_S-Sensitive | CDFW_SSC-Species of Special Concern | IUCN_LC-Least Concern | USFWS_BCC-Birds of Conservation Concern	Desert resident; primarily of open desert wash, desert scrub, alkali desert scrub, and desert succulent scrub habitats.	Commonly nests in a dense, spiny shrub or densely branched cactus in desert wash habitat, usually 2-8 feet above ground.	**Moderate.** Study area contains desert wash, desert scrub, and dense spiny shrubs.
Uma inornata	Coachella Valley fringe-toed lizard	Reptiles	Threatened	Endangered	IUCN_EN-Endangered	Limited to sandy areas in the Coachella Valley, Riverside County.	Requires fine, loose, windblown sand (for burrowing), interspersed with hardpan and widely-spaced desert shrubs.	**None.** Study area is outside of known locality and lacks windblown sand areas.
Vireo bellii pusillus	least Bell's vireo	Birds	Endangered	Endangered		Summer resident of Southern California in low riparian in vicinity of water or in dry river bottoms; below 2000 ft.	Nests placed along margins of bushes or on twigs projecting into pathways, usually willow, Baccharis, mesquite.	**None.** Study area lacks nearby water with intact thickets of willow, Baccharis, or mesquite.

Special-Status Plants

Scientific Name	Common Name	Taxonomic Group	CRPR	Federal Listing	State Listing	Other Status	General Habitat	Microhabitat	Potential to Occur on Study area
Acanthoscyphus parishii var. cienegensis	Cienega Seca oxytheca	Dicots	1B.3	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | USFS_S-Sensitive	Upper montane coniferous forest, pinyon and juniper woodland, Joshua tree woodland.	Dry gravelly banks and granitic sand. 1920-2560 m.	**None.** Study area is outside of elevation range.
Acanthoscyphus parishii var. goodmaniana	Cushenbury oxytheca	Dicots	1B.1	Endangered	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Pinyon and juniper woodland.	On limestone talus and rocky slopes. 1400-2350 m.	**None.** Study area lacks limestone talus or rocky slope microhabitat.
Astragalus albens	Cushenbury milk-vetch	Dicots	1B.1	Endangered	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Joshua tree woodland, Mojavean desert scrub, pinyon and juniper woodland.	Sandy or stony flats, rocky hillsides, canyon washes, and fans, on carbonate or mixed granitic-calcareous debris. 1185-1950 m.	**Low.** Study area contains Joshua tree woodland, desert scrub, and juniper shrubs with sandy flats, rocky hillsides, and fans but is outside the known range of the species.
Astragalus bernardinus	San Bernardino milk-vetch	Dicots	1B.2	None	None	BLM_S-Sensitive | SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | USFS_S-Sensitive	Joshua tree woodland, pinyon and juniper woodland.	Granitic or carbonate substrates. 290-2290 m.	**High.** Study area contains Joshua tree woodland and juniper shrubs with granitic substrates, and species has historical record within study area.
Astragalus lentiginosus var. coachellae	Coachella Valley milk-vetch	Dicots	1B.2	Endangered	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | SB_USDA-US Dept of Agriculture	Sonoran desert scrub, desert dunes.	Sandy flats, washes, outwash fans, sometimes on dunes. 35-695 m.	**None.** Study area is outside of elevation range.

Scientific Name	Common Name	Taxonomic Group	CRPR	Federal Listing	State Listing	Other Status	General Habitat	Microhabitat	Potential to Occur on Study area
Astragalus lentiginosus var. sierrae	Big Bear Valley milk-vetch	Dicots	1B.2	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | USFS_S-Sensitive	Mojavean desert scrub, meadows and seeps, pinyon and juniper woodland, upper montane coniferous forest.	Stony meadows and open pinewoods; sandy and gravelly soils in a variety of habitats. 1710-3230 m.	**None.** Study area is outside of elevation range.
Astragalus leucolobus	Big Bear Valley woollypod	Dicots	1B.2	None	None	BLM_S-Sensitive | IUCN_VU-Vulnerable | SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Lower montane coniferous forest, pebble plain, pinyon and juniper woodland, upper montane coniferous forest.	Dry pine woods, gravelly knolls among sagebrush, or stony lake shores in the pine belt. 1460-2895 m.	**None.** Study area is outside of elevation range and not within the pine belt.
Astragalus tricarinatus	triple-ribbed milk-vetch	Dicots	1B.2	Endangered	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Joshua tree woodland, Sonoran desert scrub.	Hot, rocky slopes in canyons and along edge of boulder-strewn desert washes, with Larrea and Encelia. 455-1585 m.	**Moderate.** Study area contains Joshua tree woodland and desert scrub with rocky slopes and desert washes with *Larrea*.
Berberis fremontii	Fremont barberry	Dicots	2B.3	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Pinyon and juniper woodland, Joshua tree woodland.	Rocky, sometimes granitic. 1140-1770 m.	**Moderate.** Study area contains juniper shrubs and Joshua tree woodland with rocky, granitic microhabitats.
Boechera dispar	pinyon rockcress	Dicots	2B.3	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Joshua tree woodland, pinyon and juniper woodland, Mojavean desert scrub.	Granitic, gravelly slopes and mesas. Often under desert shrubs which support it as it grows. 1005-2805 m.	**Moderate.** Study area contains Joshua tree woodland, juniper shrubs, and desert scrub with granitic, gravelly slopes.
Boechera lincolnensis	Lincoln rockcress	Dicots	2B.3	None	None	BLM_S-Sensitive	Chenopod scrub, Mojavean desert scrub.	On limestone. 880-2410 m.	**None.** Study area contains desert scrub but

Scientific Name	Common Name	Taxonomic Group	CRPR	Federal Listing	State Listing	Other Status	General Habitat	Microhabitat	Potential to Occur on Study area
									lacks limestone microhabitat.
Boechera parishii	Parish's rockcress	Dicots	1B.2	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | USFS_S-Sensitive	Pebble plain, pinyon and juniper woodland, upper montane coniferous forest.	Generally found on pebble plains on clay soil with quartzite cobbles; sometimes on limestone. 1825-2805 m.	**None.** Study area is outside of known elevation range.
Boechera shockleyi	Shockley's rockcress	Dicots	2B.2	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | USFS_S-Sensitive	Pinyon and juniper woodland.	On ridges, rocky outcrops and openings on limestone or quartzite. 875-2515 m.	**Moderate.** Study area contains juniper shrubs with rocky outcrops and openings on quartzite.
Botrychium crenulatum	scalloped moonwort	Ferns	2B.2	None	None	USFS_S-Sensitive	Bogs and fens, meadows and seeps, upper montane coniferous forest, lower montane coniferous forest, marshes and swamps.	Moist meadows, freshwater marsh, and near creeks. 1185-3110 m.	**None.** Study area lacks bogs or mesic habitat.
Calochortus palmeri var. palmeri	Palmer's mariposa-lily	Monocots	1B.2	None	None	BLM_S-Sensitive | SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | SB_SBBG-Santa Barbara Botanic Garden | USFS_S-Sensitive	Meadows and seeps, chaparral, lower montane coniferous forest.	Vernally moist places in yellow-pine forest, chaparral. 195-2530 m.	**None.** Study area lacks meadows or vernally moist pine forest.
Carex occidentalis	western sedge	Monocots	2B.3	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Lower montane coniferous forest, meadows and seeps.	1645-2320 m.	**None.** Study area is outside of elevation range.
Castilleja cinerea	ash-gray paintbrush	Dicots	1B.2	Threatened	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Pebble plains, upper montane coniferous forest, Mojavean desert scrub, meadows and seeps, pinyon	Endemic to the San Bernardino Mountains, in clay openings; often in meadow edges. 725-2860 m.	**None.** Study area lacks meadow edge microhabitat with clay openings.

Scientific Name	Common Name	Taxonomic Group	CRPR	Federal Listing	State Listing	Other Status	General Habitat	Microhabitat	Potential to Occur on Study area
							and juniper woodland.		
Chorizanthe xanti var. leucotheca	white-bracted spineflower	Dicots	1B.2	None	None	BLM_S-Sensitive | SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | SB_USDA-US Dept of Agriculture | USFS_S-Sensitive	Mojavean desert scrub, pinyon and juniper woodland, coastal scrub (alluvial fans).	Sandy or gravelly places. 365-1830 m.	**Moderate.** Study area contains desert scrub and juniper shrubs with sandy or gravelly microhabitats.
Cymopterus multinervatus	purple-nerve cymopterus	Dicots	2B.2	None	None		Mojavean desert scrub, pinyon and juniper woodland.	Sandy or gravelly places. 765-2195 m.	**Low.** Study area contains desert scrub and juniper shrubs with sandy or gravelly microhabitats but is outside the known range for this species.
Dudleya abramsii ssp. affinis	San Bernardino Mountains dudleya	Dicots	1B.2	None	None	BLM_S-Sensitive | SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | USFS_S-Sensitive	Pebble (pavement) plain, upper montane coniferous forest, pinyon and juniper woodland.	Outcrops, granite or quartzite, rarely limestone. 1200-2425 m.	**Moderate.** Study area contains juniper shrubs with rocky granite outcrops.
Eremogone ursina	Big Bear Valley sandwort	Dicots	1B.2	Threatened	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Pebble plain, pinyon and juniper woodland, meadows and seeps.	Mesic, rocky sites. 1795-2895 m.	**None.** Study area is outside of elevation range and lacks mesic microhabitat.
Eriastrum harwoodii	Harwood's eriastrum	Dicots	1B.2	None	None	BLM_S-Sensitive | SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | SB_USDA-US Dept of Agriculture	Desert dunes.	Sandy soils. 15-1100m.	**None.** Stud area lacks desert dunes.
Erigeron parishii	Parish's daisy	Dicots	1B.1	Threatened	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Mojavean desert scrub, pinyon and juniper woodland.	Often on carbonate; limestone mountain slopes; often associated with	**Low.** Study area contains desert scrub and juniper shrubs

Scientific Name	Common Name	Taxonomic Group	CRPR	Federal Listing	State Listing	Other Status	General Habitat	Microhabitat	Potential to Occur on Study area
								drainages. Sometimes on granite. 1050-2245 m.	with granite substrate.
Eriogonum kennedyi var. austromontanum	southern mountain buckwheat	Dicots	1B.2	Threatened	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Pebble (pavement) plain, lower montane coniferous forest.	Usually found in pebble plain habitats. 1765-3020 m.	**None.** Study area is outside of elevation range.
Eriogonum microthecum var. johnstonii	Johnston's buckwheat	Dicots	1B.3	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | USFS_S-Sensitive	Subalpine coniferous forest, upper montane coniferous forest.	Slopes and ridges on granite or limestone. 1795-2865 m.	**None.** Study area is outside of elevation range.
Eriogonum ovalifolium var. vineum	Cushenbury buckwheat	Dicots	1B.1	Endangered	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Mojavean desert scrub, pinyon and juniper woodland, Joshua tree woodland.	Limestone mountain slopes. Dry, usually rocky places. 1430-2440 m.	**None.** Study area is outside of elevation range.
Gilia leptantha ssp. leptantha	San Bernardino gilia	Dicots	1B.3	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | USFS_S-Sensitive	Lower montane coniferous forest.	Sandy or gravelly sites. 1520-2595 m.	**None.** Study area is outside of elevation range.
Heuchera parishii	Parish's alumroot	Dicots	1B.3	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | USFS_S-Sensitive	Lower montane coniferous forest, subalpine coniferous forest, upper montane coniferous forest, alpine boulder and rock field.	Rocky places. Sometimes on carbonate. 1340-3505 m.	**None.** Study area is outside of elevation range.
Ivesia argyrocoma var. argyrocoma	silver-haired ivesia	Dicots	1B.2	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | USFS_S-Sensitive	Meadows and seeps, pebble plains, upper montane coniferous forest.	In pebble plains and meadows with other rare plants. 1490-2960 m.	**None.** Study area is outside of elevation range and lacks meadows.
Lilium parryi	lemon lily	Monocots	1B.2	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | SB_CRES-San Diego Zoo CRES Native Gene Seed	Lower montane coniferous forest, meadows and seeps, riparian forest, upper	Wet, mountainous terrain; generally in forested areas; on shady edges of streams, in open	**None.** Study area is outside of elevation range and not mesic mountain habitat.

Scientific Name	Common Name	Taxonomic Group	CRPR	Federal Listing	State Listing	Other Status	General Habitat	Microhabitat	Potential to Occur on Study area
						Bank | USFS_S-Sensitive	montane coniferous forest.	boggy meadows and seeps. 625-2930 m.	
Linanthus bernardinus	Pioneertown linanthus	Dicots	1B.2	None	None	BLM_S-Sensitive | SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Joshua tree woodland, pinyon and juniper woodland.	1120-1345 m.	**Moderate.** Study area contains Joshua tree woodland and juniper shrubs.
Linanthus killipii	Baldwin Lake linanthus	Dicots	1B.2	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | USFS_S-Sensitive	Alkaline meadows, pebble plain, pinyon and juniper woodland, Joshua tree woodland.	Usually on pebble plains with other rare species. 1645-2645 m.	**None.** Study area is outside of elevation range.
Linanthus maculatus ssp. maculatus	Little San Bernardino Mtns. linanthus	Dicots	1B.2	None	None	BLM_S-Sensitive | SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Desert dunes, Sonoran desert scrub, Mojavean desert scrub, Joshua tree woodland.	Sandy places. Usually in light-colored quartz sand; often in wash or bajada. 135-1220 m.	**Moderate.** Study area contains desert scrub and Joshua tree woodland with some sandy microhabitats within washes.
Monardella robisonii	Robison's monardella	Dicots	1B.3	None	None	BLM_S-Sensitive | SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Pinyon and juniper woodland.	Rocky desert slopes, often among granitic boulders. 610-1615 m.	**Moderate.** Study area contains juniper shrubs with rocky granitic outcrops.
Phlox dolichantha	Big Bear Valley phlox	Dicots	1B.2	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | USFS_S-Sensitive	Pebble plains, upper montane coniferous forest.	Sloping hillsides, in shade under pines and Quercus kelloggii, with heavy pine litter; also in openings. 1980-2805 m.	**None.** Study area is outside of elevation range.
Physaria kingii ssp. bernardina	San Bernardino Mountains bladderpod	Dicots	1B.1	Endangered	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Pinyon and juniper woodland, lower montane coniferous forest, subalpine coniferous forest.	Dry sandy to rocky carbonate soils. 1980-2590 m.	**None.** Study area is outside of elevation range.

Scientific Name	Common Name	Taxonomic Group	CRPR	Federal Listing	State Listing	Other Status	General Habitat	Microhabitat	Potential to Occur on Study area
Poa atropurpurea	San Bernardino blue grass	Monocots	1B.2	Endangered	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Meadows and seeps.	Mesic meadows of open pine forests and grassy slopes, loamy alluvial to sandy loam soil. 1255-2655 m.	**None.** Study area lacks meadows and seeps habitat.
Pyrrocoma uniflora var. gossypina	Bear Valley pyrrocoma	Dicots	1B.2	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | USFS_S-Sensitive	Pebble plain, meadows and seeps.	Meadows, meadow edges, and along streams in or near pebble plain habitat. 2040-2280 m.	**None.** Study area is outside of elevation range and lacks meadows.
Saltugilia latimeri	Latimer's woodland-gilia	Dicots	1B.2	None	None	BLM_S-Sensitive | SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | SB_USDA-US Dept of Agriculture | USFS_S-Sensitive	Chaparral, Mojavean desert scrub, pinyon and juniper woodland.	Rocky or sandy substrate; sometimes in washes, sometimes limestone. 120-2200 m.	**Moderate.** Study area contains desert scrub and juniper shrubs with rocky or sandy substrate with washes.
Streptanthus campestris	southern jewelflower	Dicots	1B.3	None	None	BLM_S-Sensitive | SB_CRES-San Diego Zoo CRES Native Gene Seed Bank | USFS_S-Sensitive	Chaparral, lower montane coniferous forest, pinyon and juniper woodland.	Open, rocky areas. 605-2590 m.	**High.** Study area contains juniper shrubs with open, rocky areas, and has a historical record adjacent to study area.
Taraxacum californicum	California dandelion	Dicots	1B.1	Endangered	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Meadows and seeps.	Mesic meadows, usually free of taller vegetation. 1620-2590 m.	**None.** Study area is outside of elevation range and lacks meadows.
Yucca brevifolia	Western Joshua tree	Monocots	CBR	None	Candidate Threatened	Western Joshua Tree Conservation Act (WJTCA); International Union for the Conservation of Nature least concern	Mojavean desert scrub, pinyon and juniper woodland, Joshua tree woodland	Hot, dry sites on flats, mesas, bajadas, and gentle slopes in the Mojave Desert	**Present.** This species was observed throughout the study area and project site and create a Joshua Tree Woodland.

Appendix C

Biologist Qualifications

Appendix D

Site Plan

Appendix B.2

Jurisdictional Delineation

2061 N Los Robles Ave., #205 Pasadena, California 91104 / www.southenvironmental.com

February 6, 2025

Rich Malacoff, AICP
Principal Planner
The Altum Group
44-600 Village Court, Suite 100
Palm Desert, CA 92260
Email: rich.malacoff@thealtumgroup.com

RE: Jurisdictional Delineation for the Pipes Canyon Project in San Bernardino County, California

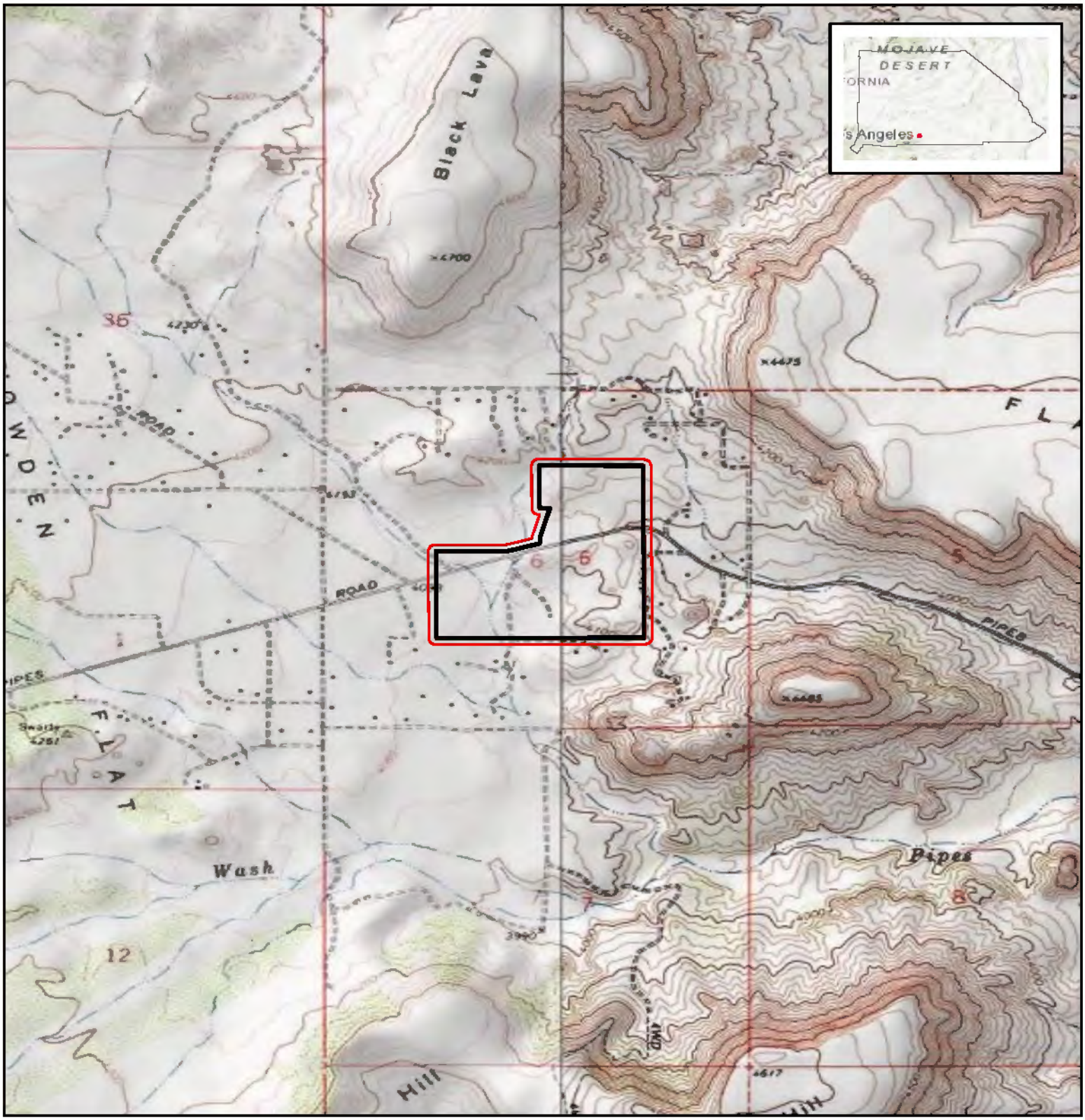
Dear Mr. Malacoff,

This letter includes results of a Jurisdictional Delineation for the Pipes Canyon Project in San Bernardino County, California. The scope of this letter report includes a description of the project, regulatory setting, a description of methodology, results of the survey, a delineation of the jurisdictional resources on the study area, and an assessment of the impacts to those resources.

Project Description

Location

The proposed project is located at Assessor Parcel Number (APN) 0594-351-36, situated on the north and south sides of Pipes Canyon Road in Pioneertown, California which is an unincorporated area of San Bernardino County. The site encompasses a total area of 122.98 acres and is currently designated by the County's General Plan as Rural Living single family homes (RL-5), with a minimum lot size of five acres, as well as Resource Conservation (RC). The project site is on the Rimrock USGS 7.5-minute quad in Section 06 of Township 01 North and Range 5 East of the San Bernardino Principal Meridian. The parcel is along Pipes Canyon Road between Gamma Gulch Road and Hudson Lane approximately 2.50-miles north of Pioneertown, 2.60-miles west of Highway 247, and 6.80-miles north of Highway 62. More broadly, the site is within the Morongo Basin region of the High Desert in San Bernardino County, California (Figure 1 and Figure 2).



Source: ESRI USA Topo Maps and World Topo Map 2025

Pipes Canyon Project

Figure 1. Regional Location

Project Site

Study Area (100-Foot Buffer)



0 1,000 2,000 Feet

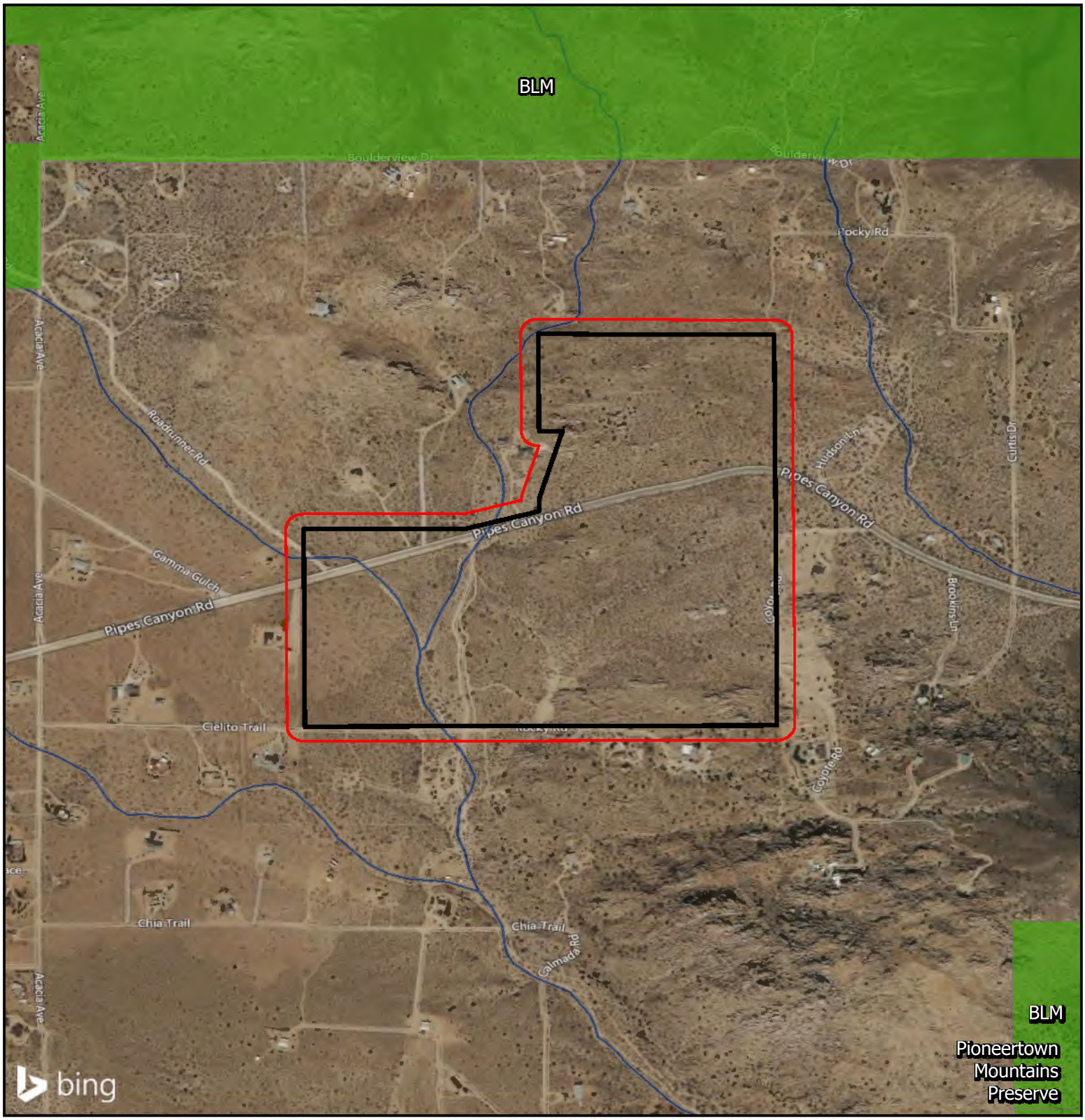
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Project Site is within unincorporated, California, in San Bernardino County on the USGS Rimrock and Yucca Valley North 7.5-minute quadrangle maps in Section 06 of Township 01 North and Range 05 East

Center Coordinate (Decimal Degrees):
Latitude: 34.1998731N Longitude: -118.5009697W

SOUTH ENVIRONMENTAL



Source: BING Aerial Map 2025

Pipes Canyon Project

Figure 2. Project Vicinity

- Project Site
- Study Area (100-Foot Buffer)
- California Protected Area Database (CPAD)
- USFWS - National Wetlands Inventory (NWI)

0 500 1,000 Feet

Scale: 1:11,000

N

SOUTH ENVIRONMENTAL

The project site is divided into a northern section and southern section by Pipes Canyon Road and bordered by Cielito Trail/ Rocky Road to the south, Millstream Avenue to the west, and Coyote Road to the east, as well as unmarked open borders. The project site is currently undeveloped with an unmarked dirt road that cuts through the southern section and connects Pipes Canyon Road to Rocky Road. The surrounding area is also relatively undeveloped with a few residential developments and dirt roads throughout the study area.

Proposed Development

The project applicant seeks approval to subdivide the property into 13 individual lots. Of these, 12 lots will be developed as five-acre residential parcels, intended for single-family homes, and will be offered for sale. These residential lots will be designed to provide ample space for rural residential living, consistent with the existing zoning designation of Rural Living RL-5. The remaining lot, situated within the RC zoning area, will retain its current Resource Conservation designation, preserving the site's natural resources and environmental features. Tentative Tract Map No. 20612 is attached within Appendix C.

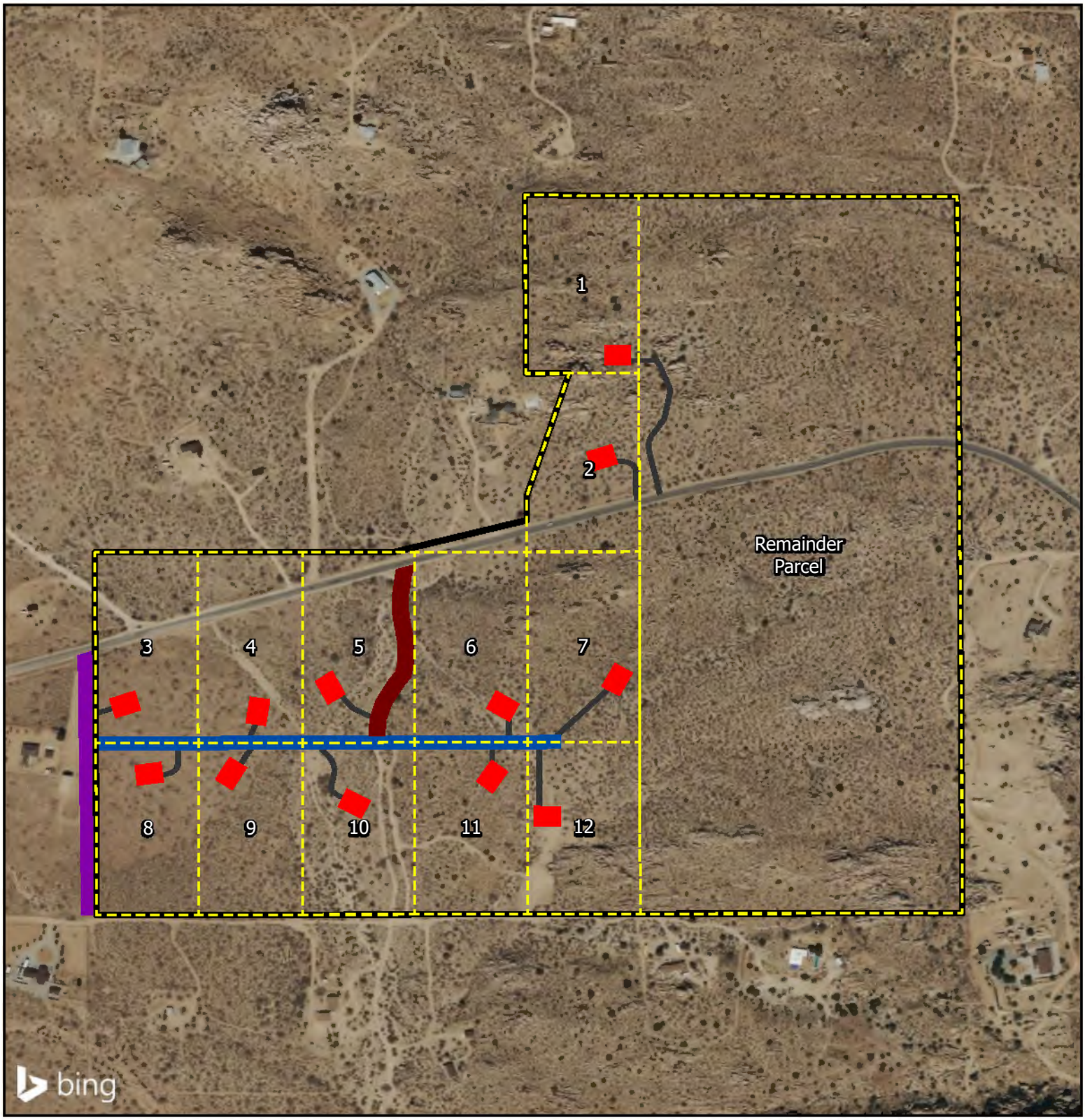
As shown in Figure 3, Proposed developments on the project site include driveways, Millstream Avenue, Private Street 'A', Private Street 'B', and 12 single family home lots. There are no current structures proposed but a development footprint that would be used for future single-family home developments are proposed. The total proposed development footprint is approximately 5.84-acres.

Regulatory Setting

Federal Regulations

Clean Water Act Sections 404 and 401

Section 404 of the Clean Water Act (CWA) establishes a program to regulate the discharge of dredged and fill material into waters of the United States (U.S.), including wetlands. Activities in waters of the U.S. or wetlands regulated under this program include fill as a result of projects such as development, water resource projects (such as dams and levees), infrastructure development and mining projects. Section 404 requires a permit before dredged or fill material may be discharged into waters of the U.S.



Source: BING Aerial Map 2025

Pipes Canyon Project

Figure 3. Proposed Development

0 300 600 Feet

Scale: 1:6,000

N

- Project Site
- Proposed Single Family House Lot
- Driveway
- Millstream Avenue
- Private Street 'A'
- Private Street 'B'
- Single-Family Home Development Pad

SOUTH ENVIRONMENTAL

Section 401 of the CWA requires that any person applying for a federal permit or license which may result in a discharge of pollutants into waters of the United States (such as a Clean Water Act Permit under Section 404), must obtain a state water quality certification stating that the activity complies with all applicable water quality standards, limitations, and restrictions. No license or permit may be issued by a federal agency until certification required by section 401 has been Granted or waived.

California Regulations

Porter-Cologne Water Quality Control Act

The Porter-Cologne Act requires the adoption of water quality control plans (basin plans) that give direction to managing water pollution in California. The basin plans get adopted and administered by the Regional Water Quality Control Board (RWQCB). The plans incorporate the beneficial uses of the waters of the State and then provide objectives that should be met to maintain and protect these uses. Along with the Regional Water Boards, the State Water Resources Board can issue and enforce permits containing waste discharge requirements to maintain clean surface water and groundwater. Each basin plan identifies the specific beneficial uses of water in their region for the past, present, and future. These basin plans also all have objectives for which the plan clearly states steps that are being taken or will be taken to meet the objectives. These objectives are created for the purpose of keeping the water clean and safe to use beneficially. The Regional Board has the authority to give out permits for the purpose of waste disposal or waste assimilation.

Waters of the State (WSC) 401 Water Quality Certification

The RWQCB regulates activities pursuant to Section 401(a)(1) of the CWA. Section 401 of the CWA specifies that certification from the State is required for any applicant requesting a federal license or permit including a Section 404 permit. The RWQCB' s delegated authority over Section 401 requires a Water Quality Certification consistent with the USACE of Engineers definition of waters of the US.

The State Wetland Definition and Procedures for Discharges of Dredged or Fill Material to Waters of the State was adopted in April 2020 and put into effect statewide on May 28, 2020 (State Water Resources Control Board [SWRCB] 2020a). The Water Boards define wetlands as follows:

"An area is wetland if, under normal circumstances, (1) the area has continuous or recurrent saturation of the upper substrate caused by groundwater, or shallow surface water, or both; (2)

the duration of such saturation is sufficient to cause anaerobic conditions in the upper substrate; and (3) the area' s vegetation is dominated by hydrophytes or the area lacks vegetation."

The Water Code defines Waters of the State of California (WSC) broadly to include "any surface water or groundwater, including saline waters, within the boundaries of the state." In the 2020 state wetland definition, the State did not define non-wetland WSC, rather they are relying on regional characterizations of jurisdiction was delegated to the Regional Boards.

The following wetlands are WSC based on the 2020 Procedures:

1. Natural wetlands;
2. Wetlands created by modification of a surface water of the state; and
3. Artificial wetlands that meet any of the following criteria:
    a. Approved by an agency as compensatory mitigation for impacts to other WSC, except where the approving agency explicitly identifies the mitigation as being of limited duration;
    b. Specifically identified in a water quality control plan as a wetland or other water of the state;
    c. Resulted from historic human activity, is not subject to ongoing operation and maintenance, and has become a relatively permanent part of the natural landscape; or
    d. Greater than or equal to one acre in size, unless the artificial wetland was constructed, and is currently used and maintained, primarily for one or more of the following purposes (i.e., the following artificial wetlands are not WSC unless they also satisfy the criteria set forth in 2, 3a, or 3b):
        i. Industrial or municipal wastewater treatment or disposal;
        ii. Settling of sediment;
        iii. Detention, retention, infiltration, or treatment of stormwater runoff and other pollutants or runoff subject to regulation under a municipal, construction, or industrial stormwater permitting program,
        iv. Treatment of surface waters;
        v. Agricultural crop irrigation or stock watering;
        vi. Fire suppression;
        vii. Industrial processing or cooling;
        viii. Active surface mining – even if the site is managed for interim wetlands functions and values;
        ix. Log storage;
        x. Treatment, storage, or distribution of recycled water;

xi. Maximizing groundwater recharge (this does not include wetlands that have incidental groundwater recharge benefits); or
xii. Fields flooded for rice growing.

All artificial wetlands that are less than 1 acre in size and do not satisfy the criteria set forth in 2, 3.a, 3.b, or 3.c are not WSC.

State of California Fish and Game Code Section 1600

Fish and Game Code Section 1602 outlines the Lake and Streambed Alteration Agreement (LSAA) permitting process, and states:

- An entity shall not substantially divert or obstruct the natural flow of, or substantially change or use any material from the bed, channel, or bank of, any river, stream, or lake, or deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake

Fish and Game Code Section 1602 requires any entity (defined as any person, State or local governmental agency, or public utility) to notify the CDFW before beginning any activity that will do one or more of the following:

- substantially divert or obstruct the natural flow of and river, stream, or lake, or
- substantially change or use any material from the bed, channel, or bank of, any river, stream, or lake, or
- deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake.

A permit, known as a Lake or Streambed Alteration Agreement, from CDFW is required to conduct any of the activities described above.

Methodology

As shown in Figure 2, the study area for the project includes the entire project site and a 100-foot buffer around the entire project site. This jurisdictional delineation is based on information compiled through a field survey and a review of appropriate reference materials and literature regarding the resources of the region. The literature review for the jurisdictional delineation was conducted by South Environmental senior biologist James McNutt. The field survey for the

jurisdictional delineation was conducted by South Environmental principal biologist Matthew South. The sources and literature referenced in this assessment are provided in the Bibliography.

Literature Review

The assessment of the jurisdictional features began with a review of literature relating to the topography, soils, and hydrology that are known to occur on and in the vicinity of the project site, and include the following sources:

- United States Geologic Service (USGS) Rimrock 7.5" and Yucca Valley North 7.5" quad topographic maps,
- US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soils Database (USDA 2025)
- National Hydrography Dataset (USGS 2025a)
- National Wetlands Inventory (USFWS 2025)
- National Watershed Boundary Dataset (USGS 2025b)
- Historic aerial photographs (historicaerials.com),
- Federal Emergency Management Agency (FEMA) flood GIS database (FEMA 2025)

Jurisdictional Delineation

A delineation of waters of the U.S. and "waters of the state" was conducted on December 18, 2024, throughout the study area and included the area within the bed and banks of any jurisdictional features and any possible associated riparian areas. The limits of jurisdictional features were recorded in the field using ArcGIS Field Maps mobile application. A Trimble R1 GPS Receiver was used to ensure that the accuracy of the measurements was less than 18-inches of error.

Waters of the U.S.

Guidance documents released by the U.S. Army Corps of Engineers (USACE) following the US Supreme Court's 2023 Sackett Decision define waters of the U.S. as any of the following:

- Traditional Navigable Waters (TNWs),
- wetlands adjacent to TNWs,
- tributaries of TNWs (relatively permanent, standing or continuously flowing bodies of water)

- wetlands directly adjacent to tributaries of TNWs and with a continuous surface connection to TNWs or tributaries to TNWs.

Wetlands

The delineator used methods described in the USACE 1987 *Wetland Delineation Manual* and the *Regional Supplement to the Corps of Engineers Wetlands Delineation Manual: Arid West Region (Version 2.0)* (USACE 2008) to determine the presence or absence of wetlands. During the site survey the following three wetland indicators were evaluated:

1. Dominance of hydrophytic wetland vegetation,
2. Presence of hydric soils, and
3. Periods of surface flooding or ponding water (visible surface water or saturated soils).

The USACE Arid West 2016 *Regional Wetland Plant List* was used to determine the wetland indicator status of plants that were observed in the Review Area, and changes in vegetation, soils, or hydrologic features are used to identify boundaries of wetlands, when present. Completed *Wetland Determination Data Form – Arid West Region* worksheets were completed for the project and are included in Appendix B.

Non-Wetland Waters

Non-wetland waters of the US are waters that lack wetland vegetation or hydric soils and have a clearly defined Ordinary High-Water Mark (OHWM), which indicates periods of surface flow. The OHWM was delineated using the methods in two USACE guidance documents: *A Field Guide to the Identification of the Ordinary High-Water Mark (OHWM) in the Arid West Region of the Western United States* (Lichvar and McColley 2008) and *Updated Datasheet for the Identification of the Ordinary High Water Mark (OHWM) in the Arid West Region of the Western United States* (USACE 2010). A completed Datasheet for Identification of the OHWM is found in Appendix B.

Waters of the State

Colorado River Regional Water Quality Control Board

South Environmental assumes all waters of the US are also considered waters of the state and are under the jurisdiction of the Colorado River Regional Water Quality Control Board (RWQCB). The limits of wetlands, or the OHWM for non-wetland waters delineated in the project footprint will also be considered the limits of waters of the state under the jurisdiction of the RWQCB.

California Department of Fish and Wildlife (CDFW)

Waters of the state that are under the jurisdiction of the California Department of Fish and Wildlife (CDFW) are delineated at the top of the bank of a stream and extend to riparian habitats or vegetation associated with watercourses. Riparian vegetation is that which depends on surface or groundwater associated with the stream to exist and other vegetation that is either more dense or vigorous than the surrounding communities will also be considered under the jurisdiction of the CDFW.

Results

Topography and Climate

The project site is within the Little San Bernardino Mountains of the Transverse Ranges in southern California. Due to being within the High Desert of the Mojave, the region is arid with desert plains, rocky outcrops, and rugged hills with landmarks such as Bowden Flat to the west, Flat Top to the northeast, Black Lava Butte to the north, and Gamma Gulch to the northwest. Relative to the surrounding area, the project site is relatively flat with many rocky outcrops and undulating hills. Localized high elevations occur on hilltops and localized low elevations occur within valleys. The highest elevation for the project site is approximately 4,160 ft. (1,268 m.) above mean sea level (amsl) near the northern border. The lowest elevation for the project site is approximately 4,088 ft. (1,246 m.) amsl near the southwestern corner (USGS 2025). The climate in the region is hot and dry, with average summer high temperatures in the mid-90s and average winter lows in the low 40s. Average yearly rainfall is approximately 18-inches, and the wettest months are December – March. There is almost no precipitation between June-September.

Rainfall prior to the survey date was very low with only 0.08-inches of rainfall in the month of September 2024 and none in October – December 2024 (Weather Underground 2024). This is considerably below average rainfall.

Soils and Surface Geology

There is no digital data for soils at the study area from the Online Web Soil Survey Mapper (USDA/NRCS 2025), but the soils observed during the site survey were a mix of well-drained cobbly loam, rocky loam, gravelly loam, coarse sandy loam, and rock outcrops. Finer soils were found near the alluvial washes, while coarser soils were found near rocky outcrops and hills.

The surface geology geologic unit for both the project site and study area contains older alluvium surficial sediments of sedimentary and volcanic rocks from the Pleistocene Epoch (USGS 2025b). There is a very high percentage of rock outcroppings on the survey area that included areas of large boulders.

Plant Communities

There are two land cover types and two plant communities in the study area and the project site. Each is shown in Figure 4 below and the acres of each is summarized in Table 1 below.

Table 1. Summary of Plant Communities on the Study Area

Community or Cover Type	Acres on Study Area	Acres on Project Site	Global (G)/State (S) Rarity Ranking
Desert Almond Scrub	4.29	3.77	G4/S4
Developed	4.61	1.07	Not Ranked
Joshua Tree Woodland	132.65	114.02	
Maintained Dirt Path or Road	5.59	4.12	
Total	**147.14**	**122.98**	

- **Joshua Tree Woodland** (*Yucca brevifolia* Woodland Alliance) (CNPS 2025b) occurred on 132.60-acres of the study area and 114.02-acres of the project site and is the dominant plant community/cover type in the study area. It has a global/state rarity ranking of G4/S3.2, which is considered a sensitive natural community in California. It is dominated by western Joshua tree (*Yucca brevifolia*) that form a canopy that is open to intermittent over an open shrub canopy containing other species such as desert almond (*Prunus fasciculata*), antelope bitterbrush (*Purshia tridentata*), blackbrush (*Coleogyne ramosissima*), Nevada ephedra (*Ephedra nevadensis*), California buckwheat (*Eriogonum fasciculatum*), creosote bush (*Larrea tridentata*), and Mojave yucca (*Yucca schidigera*), as well as occasional trees including California juniper (*Juniperus californica*) and Utah juniper (*Juniperus osteosperma*). The herbaceous layer is also open to intermittent with perennial grasses and seasonal annuals observed such as desert needlegrass (*Stipa speciosa*), chia sage (*Salvia columbariae*), kelch-grass (*Schismus barbatus*), and brome grasses.



Source: BING Aerial Map 2025

Pipes Canyon Project

Figure 4. Plant Communities and Land Cover

0 375 750 Feet

Scale: 1:7,500

N

- Project Site
- Study Area (500-Foot Buffer)
- Desert Almond Scrub
- Developed
- Joshua Tree Woodland
- Maintained Dirt Path or Road

SOUTH ENVIRONMENTAL

- **Desert Almond Scrub** (*Prunus fasciculata* Shrubland Alliance) (CNPS 2025b) occurred on 4.29-acres of the study area and 3.77-acres of the project site. It has a global/state rarity ranking of G4/S4, which is not considered a sensitive community. The community was defined by the dominance of desert almond (*Prunus fasciculata*) in the shrub layer and a subdominance of antelope bitterbrush (*Purshia tridentata*). The herbaceous layer contained similar grass species observed in the other adjacent plant communities, and California juniper (*Juniperus californica*) at low density at the edges. Other shrub species observed here included common burrobrush and Nevada ephedra, as well as herbaceous species observed in the abovementioned adjacent plant communities.

- **Developed** land cover occurred on 4.61-acres of the study area and 1.07-acres of the project site. Developed land does not have a community sensitivity rating. The developments included single-family houses, ranching infrastructure, ranching equipment, and driveways. Among others, common plants observed in the developed areas included California buckwheat, blackbrush, spotted buckwheat, desert rabbitbrush, kelch-grass, Jill Hill mustard, and brome grasses.

- **Maintained Dirt Path or Road** land cover occurred on 5.64-acres of the study area and 4.12-acres of the project site. Maintained dirt paths or roads do not have a community sensitivity rating.

Jurisdictional Features

The results of this jurisdictional delineation are based on the best professional judgement of the qualified delineator, using the most up-to-date regulations, written policy, and guidance from regulatory agencies. However, all conclusions regarding potential jurisdiction in this report should be considered preliminary and at the final discretion of the regulatory agencies.

The project site is located within the Southern Mojave watershed (HUC8) and within the Chaparrosa Wash-Pipes Wash sub-watershed (HUC12). As shown in Figure 5 and Figure 6, one unnamed drainage (Drainage #1) is in the study area. Drainage #1 is *not relatively permanent*; therefore, it is likely a WSC under the jurisdiction of the RWQCB and CDFW.



Source: BING Aerial Map 2025

Pipes Canyon Project

Figure 5. Jurisdictional Delineation Overview

0 287.5 575 Feet

Scale: 1:5,725

N

- Project Site
- Study Area (100-Foot Buffer)
- RWQCB Jurisdiction
- CDFW Jurisdiction

SOUTH ENVIRONMENTAL



Source: BING Aerial Map 2025

Pipes Canyon Project

Figure 6. Drainage #1

- Photo Point
- OHWM Form
- Project Site
- Study Area (100-Foot Buffer)
- RWQCB Jurisdiction
- CDFW Jurisdiction

0 95 190 Feet

Scale: 1:1,917

N

SOUTH ENVIRONMENTAL

Table 2 below summarizes the acres and linear feet jurisdictional features within the study area.

Table 2. Summary of Jurisdictional Features in the Study Area

Feature	Linear Feet	Non-Wetland Waters of the State (RWQCB) acres	Streambed and Riparian (CDFW) acres
Drainage #1	1,298	0.54	0.82
Total	1,298	0.54	0.82

Drainage #1

Drainage #1 is an unnamed drainage with a single low-flow, natural dirt-bottom channel that begins at Pipes Canyon Road and flows south through the study area for approximately 1,300-feet and continues south of the study area. Drainage #1 varies in width, with an average of approximately 15-feet wide, 80-feet wide at the southern end of the survey area where it is widest, and approximately 10-feet wide at the narrowest point in the northern end.

The OHWM of Drainage #1 was evident due to a change in average sediment texture, a change in vegetation cover, and erosion. Drainage #1 contained all upland vegetation; therefore, a soil pit was not dug and a USACE Wetland Determination Form was not completed because the area is a non-wetland due to lack of hydrophytic vegetation. There were signs of flow such as drainage pattern, sediment deposits, and drift deposits. Drainage #1 was determined to be a non-wetland water of the state area under the jurisdiction of RWQCB. The CDFW jurisdiction was a larger area that includes all areas between the top of the banks.

Non-Wetland Waters of the State (RWQCB)

There was a total of 0.54-acre/1,298 linear feet of non-wetland waters of the state within Drainage #1 in the study area.

CDFW Streambed

There was a total of 0.82-acre/1,298 linear feet of CDFW streambed within Drainage #1 in the study area.

Impacts Analysis

Permanent Impacts to RWQCB and CDFW jurisdictional areas are shown in Figure 7. Permanent impacts are also summarized in Table 3. Permanent impacts to jurisdictional features for the project would be from the proposed Private Street 'A'.

Temporary Impacts would not occur from the project as temporary staging and construction equipment will occur outside of Drainage #1 and at a distance greater than 50-feet.

Table 3. Summary of Permanent Impacts to Jurisdictional Features

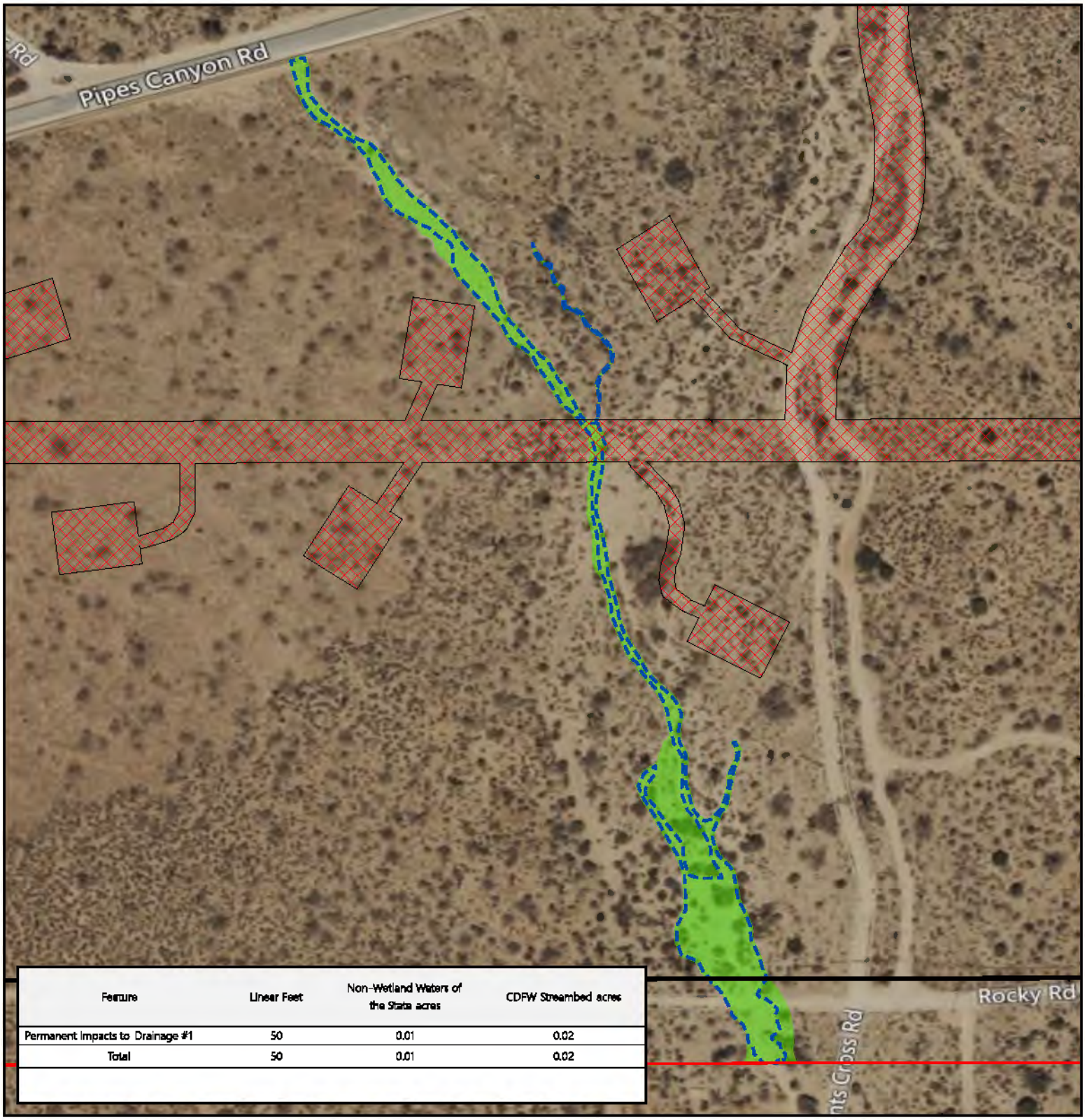
Feature	Linear Feet	Non-Wetland Waters of the State acres	CDFW Streambed acres
Permanent Impacts to Drainage #1	50	0.01	0.02
Total	50	0.01	0.02

Permanent Impacts to Non-Wetland Waters of the State (RWQCB)

Approximately 0.01-acre/50 linear feet of permanent impacts to RWQCB jurisdiction is anticipated for the project where Private Street A crosses Drainage #1.

Permanent Impacts to CDFW Lake, Streambed, and Riparian

Approximately 0.02-acre/50 linear feet of permanent impacts to CDFW jurisdiction is anticipated for the project where Private Street A crosses Drainage #1.



Feature	Linear Feet	Non-Wetland Waters of the State acres	CDFW Streambed acres
Permanent Impacts to Drainage #1	50	0.01	0.02
Total	50	0.01	0.02

Source: BING Aerial Map 2025

Pipes Canyon Project

Figure 7. Impacts to Drainage #1

0 95 190 Feet

Scale: 1:1,917

N

- Project Site
- Study Area (100-Foot Buffer)
- Proposed Development Footprint
- RWQCB Jurisdiction
- CDFW Jurisdiction

SOUTH ENVIRONMENTAL

Conclusions

One jurisdictional feature, Drainage #1, occurs in the study area that would be permanently impacted by the project. A total of 0.01-acre/50 linear feet of permanent impacts to RWQCB jurisdiction is anticipated for the project within Drainage #1 and a total of 0.02-acre/50 linear feet of permanent impacts to CDFW jurisdiction is anticipated for the project. These impacts would be the result of constructing a private road over Drainage #1 and are permanent. Downstream flow would not be disrupted and flow would continue either under or over the road without being hindered. These impacts would require permitting with CDFW and RWQCB prior to beginning construction of the project.

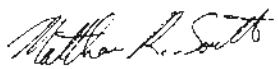
- The project is within Region 7, Colorado River RWQCB and a *Application: Discharges of Dredged or Fill Material to Waters of the State* should be completed and sent to the RWQCB.

- Due to impacts to streambeds the project will require a Lake and Streambed Alteration Agreement with the CDFW per Section 1600 of the Fish and Game Code. The project should complete an online application with the CDFW for these impacts.

This report presents South Environmental's best effort at determining the jurisdictional boundaries using the most up-to-date regulations, written policy, and guidance from regulatory agencies as well as best professional judgement and best available information at the time of the analysis. However, as with any jurisdictional delineation, the final determination of jurisdiction rests with the regulatory agencies' staff.

If you have any questions regarding the information in this report, please contact Matthew South by mobile phone: 303.818-3632 or by email: msouth@southenvironmental.com.

Sincerely,



Matthew R. South
Principal Biologist

List of Attachments

1. **Attachment A**. Photograph Exhibit
2. **Attachment B**. Arid West Ephemeral and Intermittent Streams OHWM Datasheet
3. **Attachment C**. Tentative Tract Map No. 20612

Bibliography

CNPS._2025. A Manual of California Vegetation Online. Accessed online: https://vegetation.cnps.org/search?

Sawyer, J.O, Todd Keeler-Wolf, and Julie M. Evens. 2009. A Manual of California Vegetation, 2nd Edition.

State Water Resources Control Board (SWRCB). 2020. State Wetland Definition and Procedures for Discharges of Dredged or Fill Material to Waters of the State; Adopted April 2, 2020. https://www.waterboards.ca.gov/water_issues/programs/cwa401/wrapp.html#official documents.

U.S. Army Corps of Engineers (USACE). 2008a. Arid West Supplement to the 1987 Wetlands Delineation Manual.

USACE. 2008b. A Field Guide to the Identification of the Ordinary High Water Mark (OHWM) in the Arid West Region of the Western United States. August.

USACE. 2010. Updated Datasheet for the Identification of the Ordinary High Water Mark (OHWM) in the Arid West Region of the Western United States. July.

USACE. 1987. *Corps of Engineers Wetlands Delineation Manual*. Wetlands Research Program Technical Report Y-87-1. Department of the Army, Vicksburg, VA. U.S. Army Waterways Experiment Station. Hickman. J.C. [ed.].

US Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS). 2025. Online Web Soil Survey Mapper (https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm).

United State Geological Service (USGS). 2025. National Hydrography Dataset (NHD) The National Map Viewer. Accessed online: https://viewer.nationalmap.gov/services/

United State Fish and Wildlife Service (USFWS). 2025. National Wetlands Inventory Online Wetlands Mapper. Accessed online: https://www.fws.gov/wetlands/data/mapper.html

Attachment A

Photograph Exhibit



Photo 1. View from Pipes Canyon Road within Drainage #1, facing southeast.



Photo 2. View from within Drainage #1 approximately 150 feet southeast of photo #1, facing southeast.



Photo 3. View from within Drainage #1 approximately 200 feet southeast of photo #2, facing southeast.



Photo 4. View from within Drainage #1 approximately 190 feet southeast of photo #3, facing southeast.



Photo 5. View from within Drainage #1 approximately 190 feet southeast of photo #3, facing northwest.



Photo 6. View from within Drainage #1 approximately 75 feet southeast of photo #4 and #5, facing northwest.



Photo 7. View from within Drainage #1 approximately 115 feet southeast of photo #6, facing northwest.



Photo 8. View from within Drainage #1 approximately 115 feet southeast of photo #6, facing southeast.



Photo 9. View from within Drainage #1 approximately 140 feet southeast of photo #7 and #8, facing northwest.



Photo 10. View from within Drainage #1 approximately 140 feet southeast of photo #7 and #8, facing south.



Photo 11. View from within Drainage #1 approximately 135 feet southeast of photo #9 and #10, facing northwest.



Photo 12. View from within Drainage #1 approximately 120 feet southeast of photo #11, facing southeast.



Photo 13. View from within Drainage #1 approximately 120 feet southeast of photo #11, facing northwest.

Attachment B

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Arid West Ephemeral and Intermittent Streams OHWM Datasheet

Project: Pipes Canyon Project
Project Number:
Stream: Unnamed Drainage #1
Investigator(s): Matthew South

Date:
Town: Unincorporated
Photo begin file#: 1

Time:
State: CA
Photo end file#: 13

Y [X] / N [ ] Do normal circumstances exist on the site?

Y [ ] / N [X] Is the site significantly disturbed?

Location Details:
Within OHWM of Unnamed Drainage #1

Projection: WGS 1984 **Datum:** 4063
Coordinates: 34.1984416N, -116.5038557W

Potential anthropogenic influences on the channel system:

Trash and/or debris within upstream flow from Pipe Canyon Road

Brief site description:

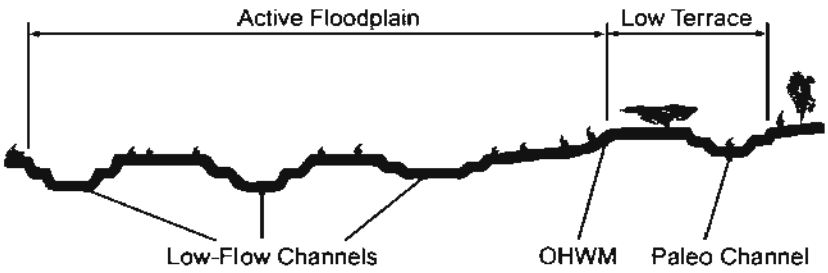
California Juniper Woodland

Checklist of resources (if available):

- [X] Aerial photography
  Dates:
- [X] Topographic maps
- [X] Geologic maps
- [X] Vegetation maps
- [ ] Soils maps
- [ ] Rainfall/precipitation maps
- [ ] Existing delineation(s) for site
- [X] Global positioning system (GPS)
- [ ] Other studies

- [ ] Stream gage data
  Gage number:
  Period of record:
- [ ] History of recent effective discharges
- [ ] Results of flood frequency analysis
- [ ] Most recent shift-adjusted rating
- [ ] Gage heights for 2-, 5-, 10-, and 25-year events and the most recent event exceeding a 5-year event

Hydrogeomorphic Floodplain Units

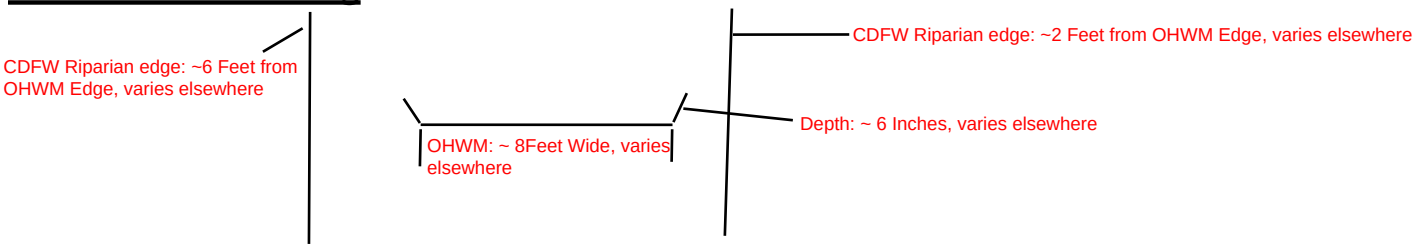


Procedure for identifying and characterizing the floodplain units to assist in identifying the OHWM:

1. Walk the channel and floodplain within the study area to get an impression of the geomorphology and vegetation present at the site.
2. Select a representative cross section across the channel. Draw the cross section and label the floodplain units.
3. Determine a point on the cross section that is characteristic of one of the hydrogeomorphic floodplain units.
   a) Record the floodplain unit and GPS position.
   b) Describe the sediment texture (using the Wentworth class size) and the vegetation characteristics of the floodplain unit.
   c) Identify any indicators present at the location.
4. Repeat for other points in different hydrogeomorphic floodplain units across the cross section.
5. Identify the OHWM and record the indicators. Record the OHWM position via:
   - [X] Mapping on aerial photograph
   - [X] Digitized on computer
   - [X] GPS
   - [ ] Other:

Project ID: **Cross section ID:** **Date:** **Time:**

Cross section drawing:



OHWM

GPS point: 34.1984416N, -116.5038557W

Indicators:

- [X] Change in average sediment texture
- [ ] Change in vegetation species
- [X] Change in vegetation cover
- [ ] Break in bank slope
- [X] Other: Erosion
- [ ] Other: _____

Comments:

The OHWM was evident based on a change in average sediment texture, a change in vegetation cover, and erosion.

Floodplain unit:

[X] Low-Flow Channel [X] Active Floodplain [ ] Low Terrace

GPS point: 34.1984416N, -116.5038557W

Characteristics of the floodplain unit:

Average sediment texture: fg-mg

Total veg cover: 40 % Tree: _____% Shrub: 30 % Herb: 10 %

Community successional stage:

- [ ] NA
- [ ] Early (herbaceous & seedlings)
- [X] Mid (herbaceous, shrubs, saplings)
- [ ] Late (herbaceous, shrubs, mature trees)

Indicators:

- [ ] Mudcracks
- [X] Ripples
- [X] Drift and/or debris
- [ ] Presence of bed and bank
- [ ] Benches
- [X] Soil development
- [X] Surface relief
- [ ] Other: _____
- [ ] Other: _____
- [ ] Other: _____

Comments:

The floodplain unit was evident due to ripples, drift and/or debris, soil development, and surface relief.

Attachment C

Tentative Tract Map No. 20612

IN THE UNINCORPORATED AREA OF SAN BERNARDINO COUNTY

TENTATIVE TRACT MAP NO. 20612

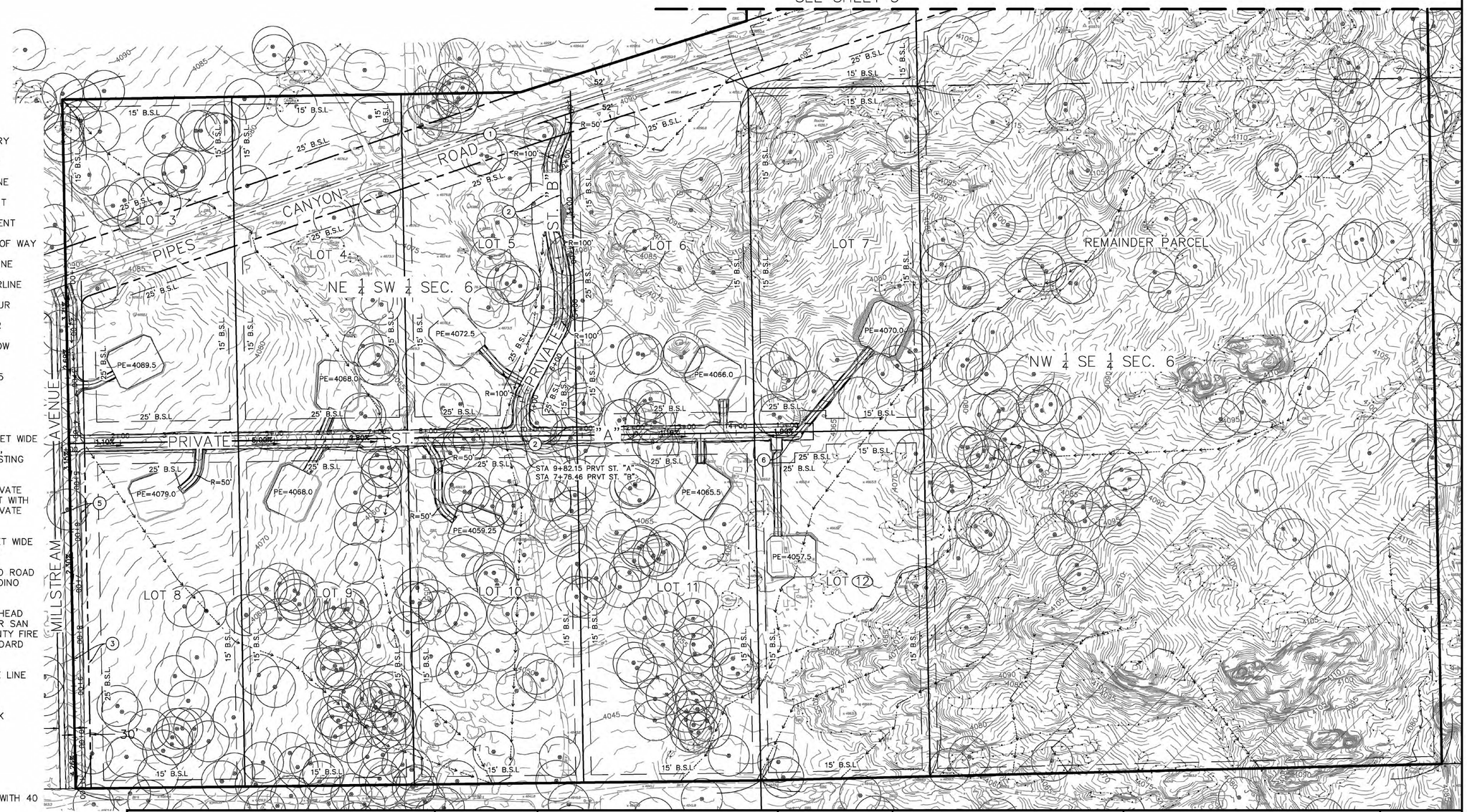
BEING A SUBDIVISION OF THE SOUTHWEST ¼ OF THE NORTHEAST ¼ AND THE NORTHWEST ¼ OF THE SOUTHEAST ¼ AND THE NORTHEAST ¼ OF THE SOUTHWEST ¼ OF SECTION 6, TOWNSHIP 1 NORTH, RANGE 5 EAST, SAN BERNARDINO BASE AND MERIDIAN, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF, IN THE OFFICE OF THE COUNTY RECORDER OF SAID OFFICE

OFFICIAL USE ONLY

NOTES:

- ALL GRADED SLOPES SHOWN HEREON ARE 2:1
- BUILDING PADS SHOWN ARE 80' BY 95'
- DRIVEWAYS SHOWN ARE 12' WIDE
- BUILDING PADS AND DRIVEWAYS ARE SHOWN TO INDICATE FEASIBILITYMENT AND ARE NOT INTENDED TO BE A PART OF IMPROVEMENTS PERFORMED AS A PART OF THIS TRACT MAP.

SEE SHEET 3



LEGEND

	PROJECT BOUNDARY
	EXISTING LOT LINE
	PROPOSED LOT LINE
	EXISTING EASEMENT
	PROPOSED EASEMENT
	PROPOSED RIGHT OF WAY
	EXISTING CENTERLINE
	PROPOSED CENTERLINE
	PROPOSED CONTOUR
	EXISTING CONTOUR
	WATERCOURSE FLOW
	AREA ZONED RL-5
	AREA ZONED RC
①	PROPOSED 104 FEET WIDE R.O.W. DEDICATION, CENTERED ON EXISTING IMPROVEMENTS
②	32 FEET WIDE PRIVATE ACCESS EASEMENT WITH 20 FEET WIDE PRIVATE GRADED ROAD
③	PROPOSED 30 FEET WIDE R.O.W. DEDICATION
⑤	PROPOSED GRADED ROAD PER SAN BERNARDINO COUNTY STD 114
⑥	MODIFIED HAMMERHEAD TURN AROUND PER SAN BERNARDINO COUNTY FIRE PREVENTION STANDARD DIAGRAM A-1.12
B.S.L.	BUILDING SETBACK LINE
PM	PARCEL MAP
P.M.B.	PARCEL MAP BOOK
PROP.	PROPOSED
ROW	RIGHT OF WAY
SEC.	SECTION
◎	REGULATED TREE WITH 40 FT. RADIUS

100 0 50 100 200 400

1 inch = 100 ft.

Revisions:

No.	Date:	By:	Description:	Approved:

Designed: | Drawn: | Checked: ACH

Seal: PROFESSIONAL LAND SURVEYOR ALAN C. HILLWIG No. 5137 EXP. 6-30-25 STATE OF CALIFORNIA

Prepared under the Supervision of:

PROFESSIONAL LAND SURVEYOR LICENSE NO. 5137 — DATE

HILLWIG - GOODROW, INC.
Land Surveying - GPS Surveys - Aerial Mapping
31419 Outer Highway 10, Suite 1-200● Redlands, CA 92373 ● (909) 794-2673

Scale: 1" = 100'

BENCHMARK: SEE BENCHMARK NOTE ON SHEET 1

Date: November 15, 2024

TENTATIVE TRACT MAP NO. 20612
ACCESS AND PAD FEASABILITY EXHIBIT
PIPES CANYON ROAD, PIONEERTOWN

PREPARED FOR:
JONATHAN SHOKRIAN
53252 PIPES CANYON ROAD
PIONEERTOWN, CA 92268

F.N. | For: | F.B.

Sheet No. 2 OF 3 SHEET

FILE NO. 0972-002

IN THE UNINCORPORATED AREA OF SAN BERNARDINO COUNTY

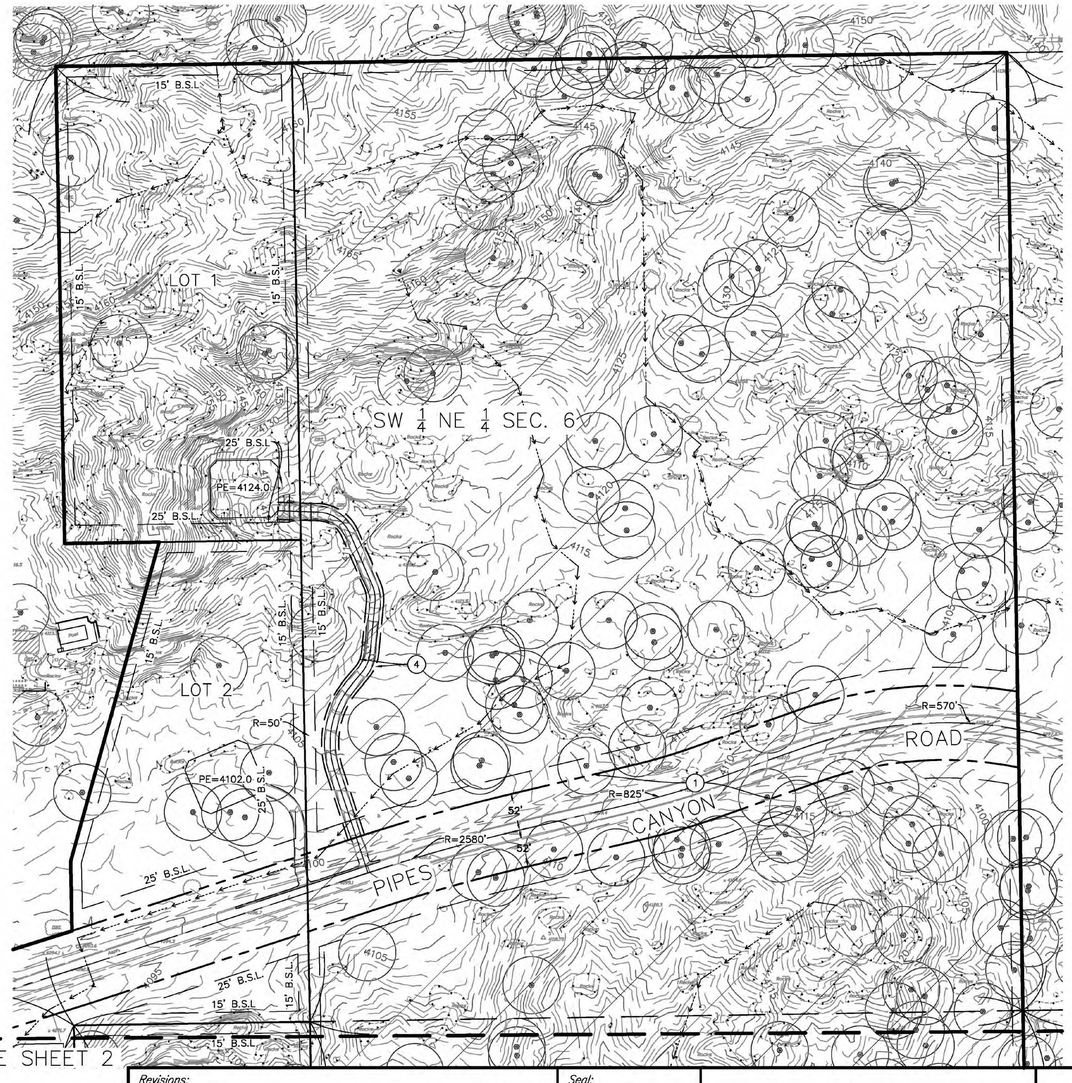
TENTATIVE TRACT MAP NO. 20612

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- EXISTING CENTERLINE
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- (4) PROPOSED 24 FEET WIDE DRIVEWAY EASEMENT
- B.S.L. BUILDING SETBACK LINE
- PM PARCEL MAP
- P.M.B. PARCEL MAP BOOK
- PROP. PROPOSED
- ROW RIGHT OF WAY
- SEC. SECTION
- REGULATED TREE WITH 40 FT. RADIUS

150 0 75 150 300 600

1 inch = 150 ft.

Revisions:

No.	Date:	By:	Description:	Approved:

Designed: | Drawn: | Checked: ACH

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PREPARED FOR:
JONATHAN SHOKRIAN
53252 PIPES CANYON ROAD
PIONEERTOWN, CA 92268

Sheet No. 3 OF 3 SHEET

FILE NO. 0972-002

IN THE UNINCORPORATED AREA OF SAN BERNARDINO COUNTY

TENTATIVE TRACT MAP NO. 20612

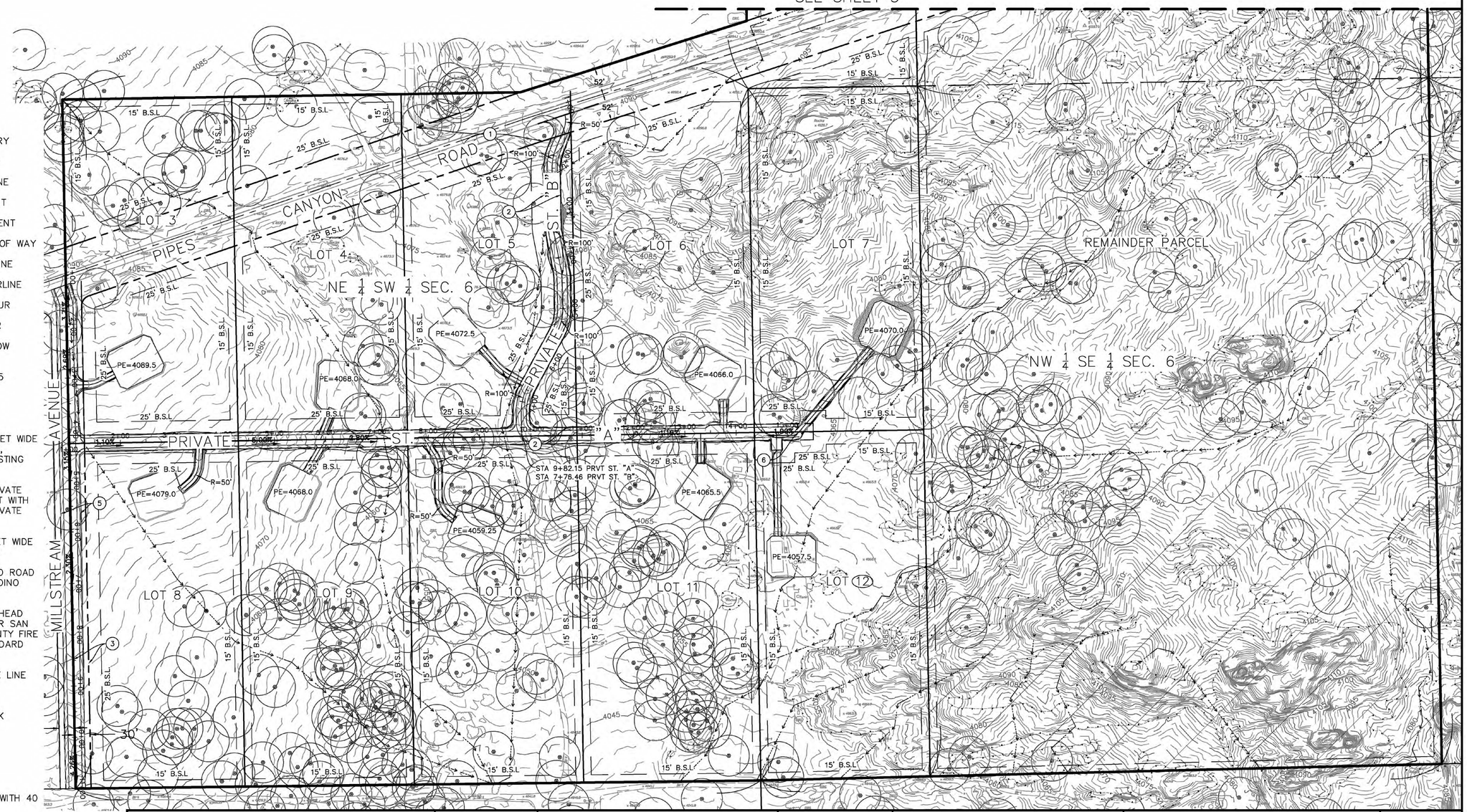
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SEE SHEET 3



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	AREA ZONED RL-5
	AREA ZONED RC
①	PROPOSED 104 FEET WIDE R.O.W. DEDICATION, CENTERED ON EXISTING IMPROVEMENTS
②	32 FEET WIDE PRIVATE ACCESS EASEMENT WITH 20 FEET WIDE PRIVATE GRADED ROAD
③	PROPOSED 30 FEET WIDE R.O.W. DEDICATION
⑤	PROPOSED GRADED ROAD PER SAN BERNARDINO COUNTY STD 114
⑥	MODIFIED HAMMERHEAD TURN AROUND PER SAN BERNARDINO COUNTY FIRE PREVENTION STANDARD DIAGRAM A-1.12
B.S.L.	BUILDING SETBACK LINE
PM	PARCEL MAP
P.M.B.	PARCEL MAP BOOK
PROP.	PROPOSED
ROW	RIGHT OF WAY
SEC.	SECTION
◎	REGULATED TREE WITH 40 FT. RADIUS

100 0 50 100 200 400

1 inch = 100 ft.

Revisions:

No.	Date:	By:	Description:	Approved:

Designed: | Drawn: | Checked: ACH

Seal: PROFESSIONAL LAND SURVEYOR ALAN C. HILLWIG No. 5137 EXP. 6-30-25 STATE OF CALIFORNIA

Prepared under the Supervision of:

PROFESSIONAL LAND SURVEYOR LICENSE NO. 5137 — DATE

HILLWIG - GOODROW, INC.
Land Surveying - GPS Surveys - Aerial Mapping
31419 Outer Highway 10, Suite 1-200● Redlands, CA 92373 ● (909) 794-2673

Scale: 1" = 100'

BENCHMARK: SEE BENCHMARK NOTE ON SHEET 1

Date: November 15, 2024

TENTATIVE TRACT MAP NO. 20612
ACCESS AND PAD FEASABILITY EXHIBIT
PIPES CANYON ROAD, PIONEERTOWN

PREPARED FOR:
JONATHAN SHOKRIAN
53252 PIPES CANYON ROAD
PIONEERTOWN, CA 92268

F.N. | For: | F.B.

Sheet No. 2 OF 3 SHEET

FILE NO. 0972-002

IN THE UNINCORPORATED AREA OF SAN BERNARDINO COUNTY

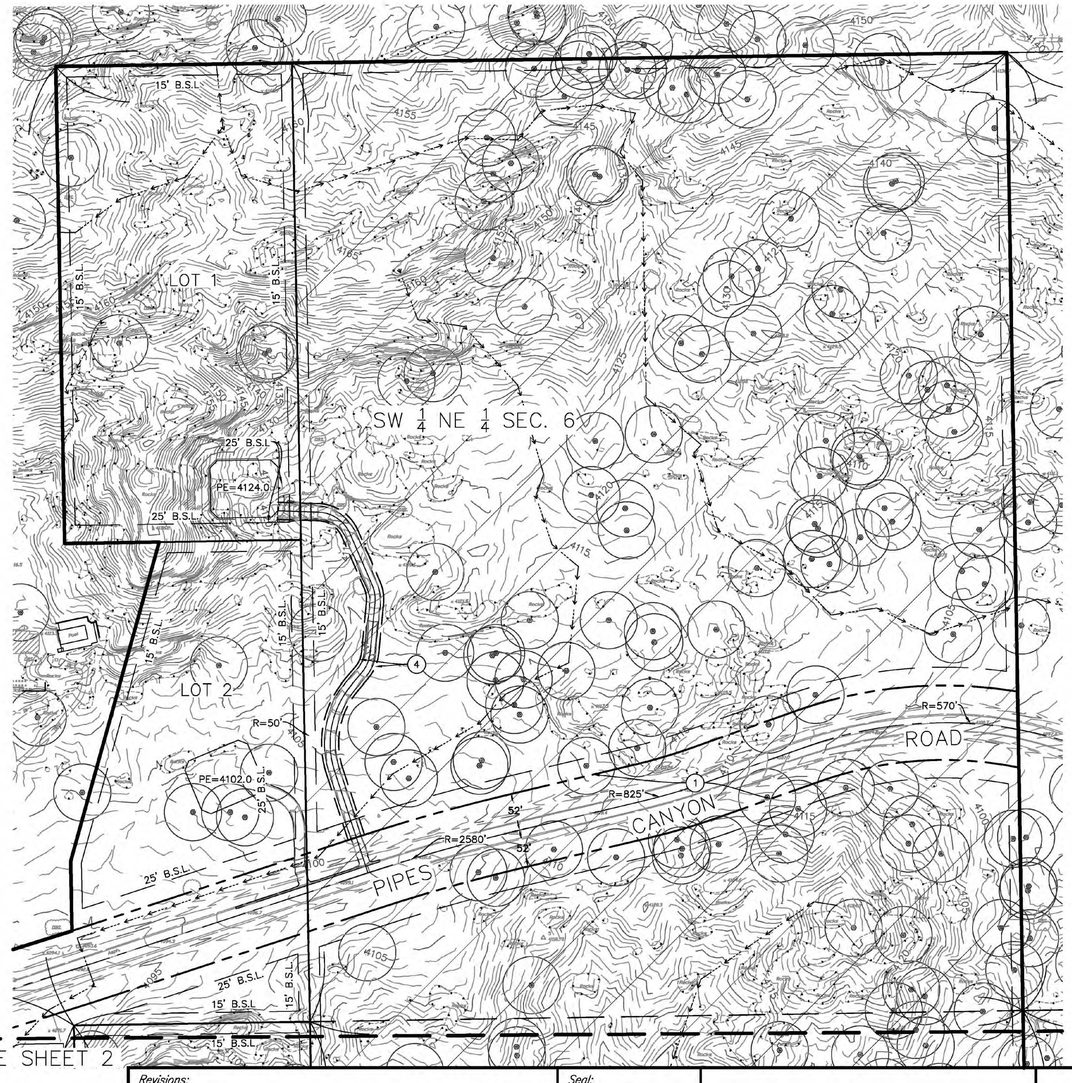
TENTATIVE TRACT MAP NO. 20612

BEING A SUBDIVISION OF THE SOUTHWEST ¼ OF THE NORTHEAST ¼ AND THE NORTHWEST ¼ OF THE SOUTHEAST ¼ AND THE NORTHEAST ¼ OF THE SOUTHWEST ¼ OF SECTION 6, TOWNSHIP 1 NORTH, RANGE 5 EAST, SAN BERNARDINO BASE AND MERIDIAN, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF, IN THE OFFICE OF THE COUNTY RECORDER OF SAID OFFICE

OFFICIAL USE ONLY

NOTES:

- ALL GRADED SLOPES SHOWN HEREON ARE 2:1
- BUILDING PADS SHOWN ARE 80' BY 95'
- DRIVEWAYS SHOWN ARE 12' WIDE
- BUILDING PADS AND DRIVEWAYS ARE SHOWN TO INDICATE FEASIBILITYMENT AND ARE NOT INTENDED TO BE A PART OF IMPROVEMENTS PERFORMED AS A PART OF THIS TRACT MAP.



LEGEND

- PROJECT BOUNDARY
- EXISTING LOT LINE
- PROPOSED LOT LINE
- EXISTING EASEMENT
- PROPOSED EASEMENT
- PROPOSED RIGHT OF WAY
- EXISTING CENTERLINE
- PROPOSED CENTERLINE
- PROPOSED CONTOUR
- EXISTING CONTOUR
- WATERCOURSE FLOW
- AREA ZONED RL-5
- AREA ZONED RC
- (1) PROPOSED 104 FEET WIDE R.O.W. DEDICATION, CENTERED ON EXISTING IMPROVEMENTS
- (4) PROPOSED 24 FEET WIDE DRIVEWAY EASEMENT
- B.S.L. BUILDING SETBACK LINE
- PM PARCEL MAP
- P.M.B. PARCEL MAP BOOK
- PROP. PROPOSED
- ROW RIGHT OF WAY
- SEC. SECTION
- REGULATED TREE WITH 40 FT. RADIUS

150 0 75 150 300 600

1 inch = 150 ft.

Revisions:

No.	Date:	By:	Description:	Approved:

Designed: | Drawn: | Checked: ACH

Seal: PROFESSIONAL LAND SURVEYOR ALAN C. HILLWIG No. 5137 EXP. 6-30-25 STATE OF CALIFORNIA

Prepared under the Supervision of:

PROFESSIONAL LAND SURVEYOR LICENSE NO. 5137 — DATE

HILLWIG - GOODROW, INC.
Land Surveying - GPS Surveys - Aerial Mapping
31419 Outer Highway 10, Suite 1-200• Redlands, CA 92373 • (909) 794-2673

Scale: 1" = 100' | BENCHMARK: SEE BENCHMARK NOTE ON SHEET 1

Date: November 15, 2024 | F.N. | For: | F.B.

TENTATIVE TRACT MAP NO. 20612
ACCESS AND PAD FEASABILITY EXHIBIT
PIPES CANYON ROAD, PIONEERTOWN

PREPARED FOR:
JONATHAN SHOKRIAN
53252 PIPES CANYON ROAD
PIONEERTOWN, CA 92268

Sheet No. 3 OF 3 SHEET

FILE NO. 0972-002

Appendix B.3

Special Status Plant Survey Report

July 21, 2025

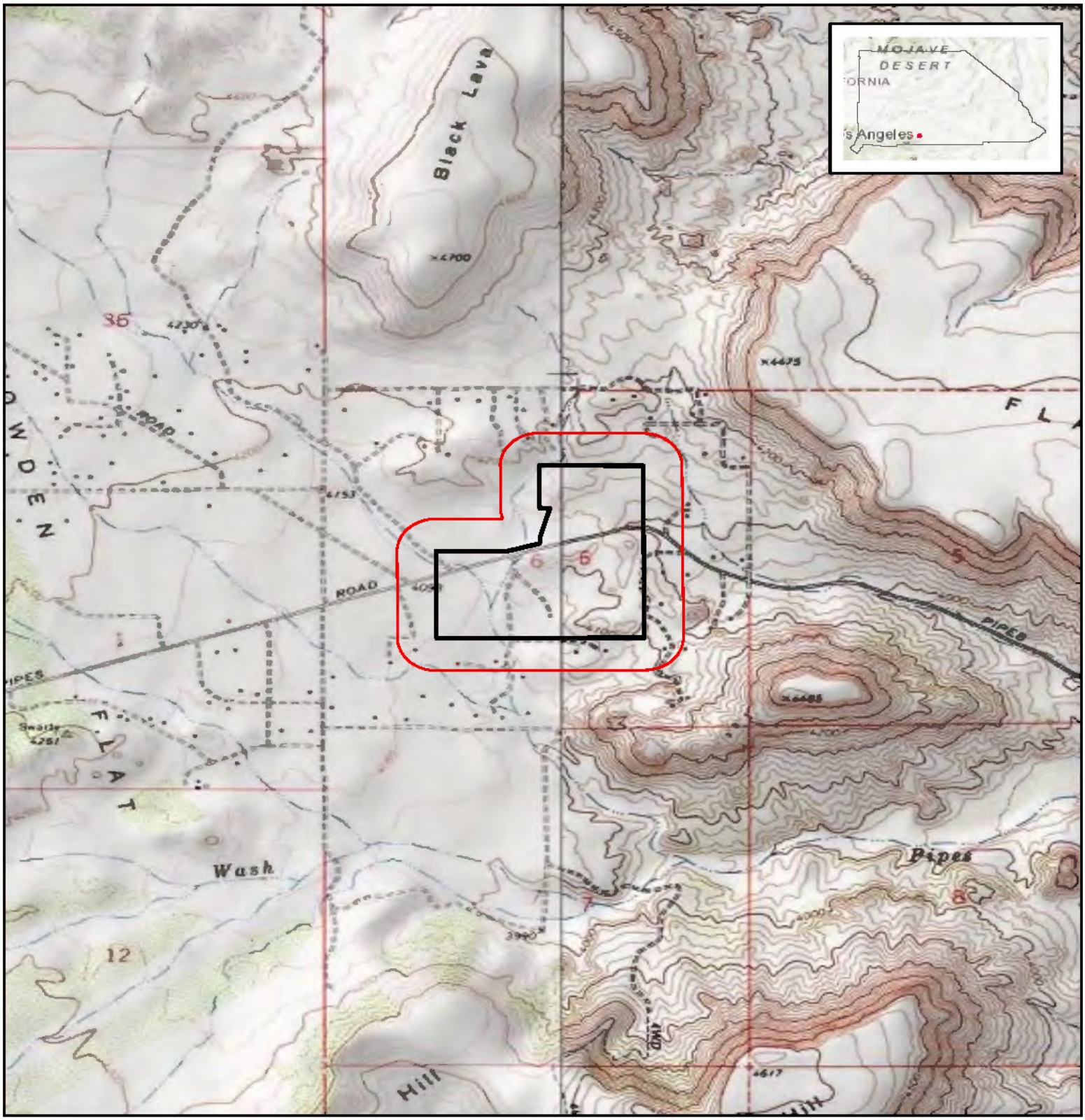
Rich Malacoff, AICP
Principal Planner
The Altum Group
44-600 Village Court, Suite 100
Palm Desert, CA 92260
Email: rich.malacoff@thealtumgroup.com

RE: Rare, Threatened, and Endangered ("Special-Status") Plant Survey for the Pipes Canyon Project (Tentative Tract Map No. 20612), near the community of Pioneertown, San Bernardino County, California

Dear Rich:

This letter includes the results of a special-status plant survey for the Pipes Canyon Project near the community of Pioneertown in unincorporated San Bernardino County, California (project) (attached Figure 1 and Figure 2). The main goal of the survey was to identify rare, threatened, and endangered ("special-status") plant species on the project site. The scope of this letter report includes a description of the project, regulatory setting, a description of methodology, results of the survey, and an assessment of the impacts to those resources.

The survey was conducted by South Environmental biologists Matthew South, Dana Briggs, Meagan Stebbings, and Lucas South from April 8, April 9, May 28, and May 29 of 2025. The survey was conducted based on federal and national criteria of government agencies including those of the U.S. Fish and Wildlife and California Department of Fish and Wildlife that evaluate the conservation status of plants in the region and their geographical natural occurrence. When applicable, standard survey methods supported by state and federal agencies were followed. The survey involved plant observation along a series of transects during which plants were identified and recorded. Plants that could not be identified in the field were photographed and identified with botanical literature. A complete list of all species recorded on the site and a brief description of the plant community including dominant species and important are included in the report.



Source: ESRI USA Topo Maps and World Topo Map 2025

Pipes Canyon Project

Figure 1. Regional Location

Project Site

Study Area (500-Foot Buffer)

Project Site is within unincorporated, California, in San Bernardino County on the USGS Rimrock and Yucca Valley North 7.5-minute quadrangle maps in Section 06 of Township 01 North and Range 05 East

Center Coordinate (Decimal Degrees):
Latitude: 34.1998731N Longitude: -118.5009697W

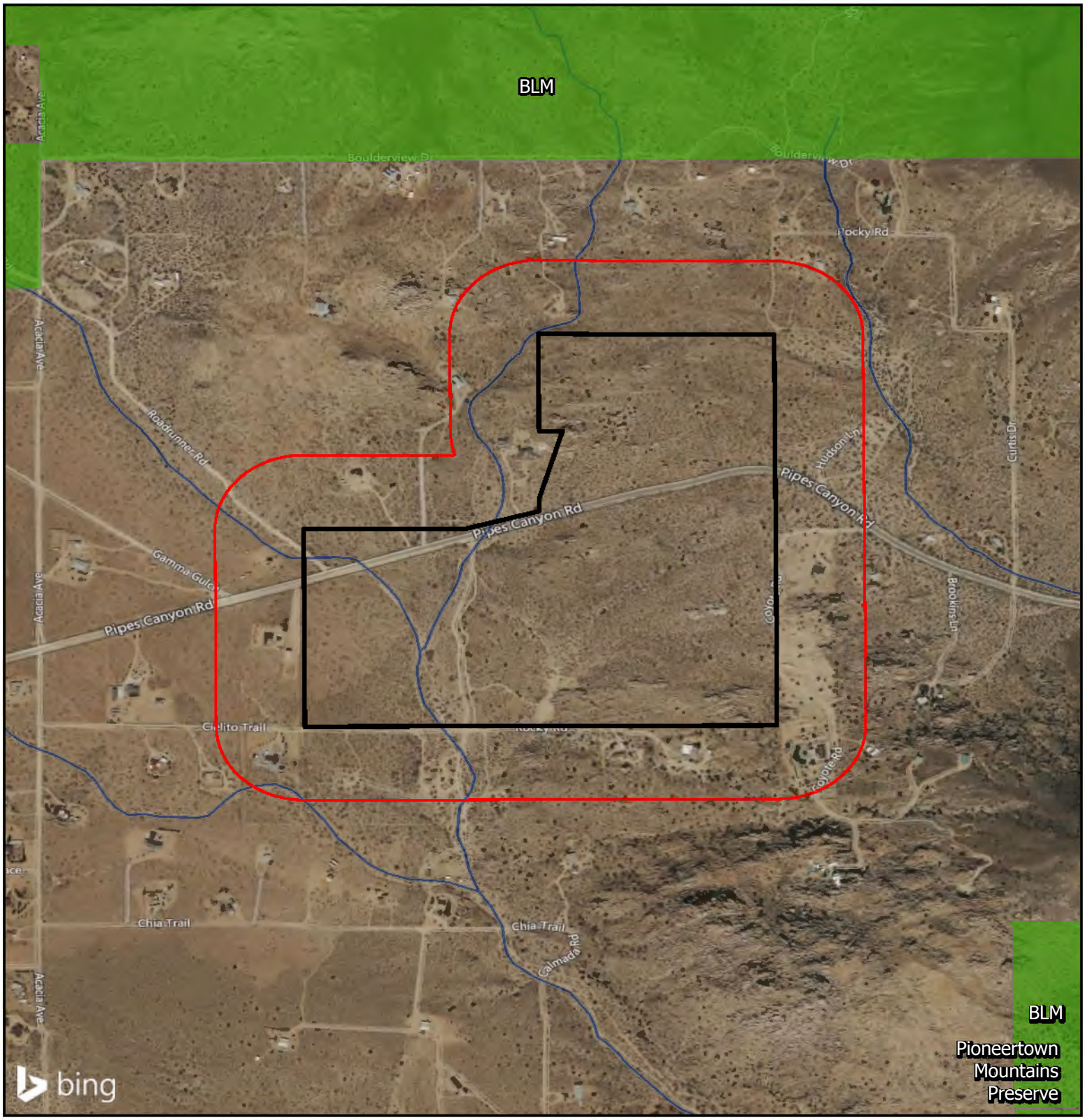


0 1,000 2,000 Feet

Scale: 1:25,000

N

SOUTH ENVIRONMENTAL



Source: BING Aerial Map 2025

Pipes Canyon Project

Figure 2. Project Vicinity

- Project Site
- Study Area (500-Foot Buffer)
- California Protected Area Database (CPAD)
- USFWS - National Wetlands Inventory (NWI)

0 500 1,000 Feet

Scale: 1:11,000

N

SOUTH ENVIRONMENTAL

Proposed Development

The proposed project applicant seeks approval to subdivide the property into 13 individual lots. Of these, 12 lots will be developed as five-acre residential parcels, intended for single-family homes, and will be offered for sale. These residential lots will be designed to provide ample space for rural residential living, consistent with the existing zoning designation of Rural Living RL-5. The remaining lot, situated within the RC zoning area, will retain its current Resource Conservation designation, preserving the site's natural resources and environmental features. Tentative Tract Map No. 20612 is attached within Appendix C.

Proposed developments on the project site include driveways, Millstream Avenue, Private Street 'A', Private Street 'B', and 12 single family home lots. There are no current structures proposed but a development footprint that would be used for future single-family home developments are proposed. The total proposed development footprint is approximately 5.84-acres.

Project Site Description

The proposed project is located at Assessor Parcel Number (APN) 0594-351-36, situated on the north and south sides of Pipes Canyon Road in Pioneertown, California which is an unincorporated area of San Bernardino County. The site encompasses a total area of 122.98 acres and is currently designated by the County's General Plan as Rural Living single family homes (RL-5), with a minimum lot size of five acres, as well as Resource Conservation (RC). The project site is on the Rimrock USGS 7.5-minute quad in Section 06 of Township 01 North and Range 5 East of the San Bernardino Principal Meridian. The parcel is along Pipes Canyon Road between Gamma Gulch Road and Hudson Lane approximately 2.50-miles north of Pioneertown, 2.60-miles west of Highway 247, and 6.80-miles north of Highway 62. More broadly, the site is within the Morongo Basin region of the High Desert in San Bernardino County, California.

The project site is divided into a northern section and southern section by Pipes Canyon Road and bordered by Cielito Trail/ Rocky Road to the south, Millstream Avenue to the west, and Coyote Road to the east, as well as unmarked open borders. The project site is currently undeveloped with an unmarked dirt road that cuts through the southern section and connects Pipes Canyon Road to Rocky Road. The surrounding area is also relatively undeveloped with a few residential developments and dirt roads throughout the study area. Photographs of the survey area are in the attached Photograph Exhibit.

Topography and Rainfall

Relative to the surrounding area, the project site is relatively flat with some rocky outcrops, washes, and hills. Localized high elevations occur on hilltops and localized low elevations occur within valleys. The highest elevation for the project site is approximately 4,160 ft. (1,268 m.) above mean sea level (amsl) near the northern border. The lowest elevation for the project site is approximately 4,088 ft. (1,246 m.) amsl near the southwestern corner (USGS 2025). The climate in the region is hot and dry, with average summer high temperatures in the mid-90s and average winter lows in the low 40s. Average yearly rainfall is approximately 18-inches, and the wettest months are December – March. There is almost no precipitation between June-September.

Soils

No soils information if available for this location of San Bernardino County (USDA/NRCS 2022). However, the soils observed during the survey were sandy, friable, and suitable for burrowing species.

Plant Communities

A Joshua Tree Woodland (*Yucca brevifolia* Woodland) as described by the Manual of California Vegetation Online (CNPS 2025a) occurs on 114.02-acres of the project site, which is a majority of the area. This desert woodland community contains Joshua trees that form an open to intermittent canopy over a shrub or grass layer that is open to intermittent with perennial grasses and seasonal annuals. This community is defined by an even distribution of Joshua tree at ≥ 1% cover and *Juniperus* and/or *Pinus* spp. < 1% absolute cover in the tree canopy (Thomas et al. 2004). According to the CNPS, the community is found on "gentle alluvial fans, ridges, gentle to moderate slopes." in areas with soils that are "coarse sands, very fine silts, gravel, or sandy loams Many sites have bimodal soils with both coarse sands and fine silts." It is found at an elevation of 750-1800 m. above sea level amsl (CNPS 2025a). The community is classified by the CDFW with a global/state ranking of G4/S3.2, which is considered a sensitive natural community in the state because communities with a classification of 3 or less at either the state or global level are a sensitive natural community. Additionally, the Joshua tree is a Candidate species for listing under the California Endangered Species Act (CESA) and is protected by the Western Joshua Tree Conservation Act (CNPS 2025b).

Desert Almond Scrub (*Prunus fasciculata* Shrubland Alliance) (CNPS 2025a) occurred on 3.77-acres of the project site, primarily in the southeastern and south-central regions of the survey area. The community was defined by the dominance of desert almond (*Prunus fasciculata*) in the shrub layer and a sub-dominance of antelope bitterbrush (*Purshia tridentata*). According to the CNPS, the community is found on "Arroyos, canyons, washes, and on disturbed upland sites, especially on

calcareous, volcanic, and granitic substrates" in areas with soils that are "alluvial or colluvial origin." It is found at an elevation of 15-1880 m. above sea level amsl (CNPS 2025a). The herbaceous layer contained similar grass species observed in the other adjacent plant communities, and California juniper (*Juniperus californica*) at low density at the edges. Other shrub species observed here included common burrobrush and Nevada ephedra, as well as herbaceous species observed in the abovementioned adjacent plant communities. The community has a global/state rank of G4/S4, and therefore is not considered a sensitive natural community.

There are also developed (1.07-acres) and maintained dirt path/ road (4.12-acres) on the project site that do not have community sensitivity ratings. The developments included single-family houses, ranching infrastructure, ranching equipment, roadways, and driveways. Among others, common plants observed in the developed areas included California buckwheat, blackbrush, spotted buckwheat, desert rabbitbrush, kelch-grass, Jill Hill mustard, and brome grasses.

Methodology

Literature Review

The California Native Plant Society (CNPS) and the California Department of Fish and Wildlife (CDFW) are the primary authorities in the State of California for recording and tracking endangered, threatened, and rare plants (i.e., special-status) in the state. The CNPS "Inventory of Rare Plants" online (CNPS 2025) and the CDFW California Natural Diversity Database (CNDDB) online (CDFW 2025a) are query tools that identify rare, endangered, and threatened plants and their occurrence based on the U.S. Geological Survey (USGS) 7.5-minute topographic quadrangles for the state. Basic information is provided for each special-status plant species including conservation status, local areas of occurrence, macro and micro habitat, elevation range, and blooming period. Plants considered by the CNPS and CDFW to be rare, threatened, and endangered species are based on specific criteria of state and federal legislation and are summarized in **Appendix B**. The geographic location of occurrences of special-status plants can also be queried directly through the Biogeographic Information and Observation System (BIOS) online (CDFW 2025b).

For the survey, both databases were queried for special-status plants that have previously been recorded in the Rimrock 7.5" quad in which the proposed development footprint is located, and the eight surrounding USGS 7.5" quads: Yucca Valley North, Yucca Valley South, Morongo Valley, Catclaw Flat, Onyx Peak, Rattlesnake Canyon, Bighorn Canyon, and Landers. Following the online queries, the rare, threatened, and endangered species identified in each query were combined into a comprehensive list for the region. These species were considered as potential special-status species to occur on the survey site. Next, an additional assessment was conducted to determine their potential to occur on the survey area based on specific habitat and micro-habitat

requirements for the species and their occurrences in the area in relation to the survey area. Based on this assessment, the special-status species were designated a "none", "low", "medium", or "high" potential to occur on the project site (**Appendix B**).

Field Survey

The survey of the western survey area was conducted on April 8-9, 2025, by South Environmental biologists Matthew South, Dana Briggs, Meagan Stebbings, and Lucas South. The surveys in April were conducted by biologists Dana Briggs, Meagan Stebbings, Lucas South, and Matthew South, and the surveys in June were conducted by Dana Briggs and Lucas South. The surveys were conducted under the following weather conditions:

- April 8, 2025. 70-76°F, calm winds (2 mph), sunny
- April 9, 2025. 72-79°F, calm winds (2 mph), sunny
- May 28, 2025. 75-84°F, light winds (5 mph), sunny
- May 29, 2025. 72-86°F, calm winds (2 mph), sunny

Complete 100% coverage of the entire survey area was surveyed using 10-meter belt transect oriented north-south.

Surveys were conducted according to the CDFW March 20, 2018 *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Sensitive Natural Communities*, the CNPS *Botanical Survey Guidelines* (revised June 2, 2001), and the USFWS July 2002 *General Rare Plant Survey Guidelines*. The field portion of the survey consisted of two days of botanical exploration in mid-Spring (April 8-9, 2025) at the site. During the survey botanists traversing the survey area on foot in north-south belt transects with each surveyor separated by approximately 10-meters. During this time all plant species encountered were either identified at the time or a sample was collected in the form of photographs and the species were identified with literature resources.

The survey followed the standard botanical protocol for special-status species survey of identifying all plant species encountered. Although the goal was to identify all plant species, field surveyors placed a special emphasis on discovery of the special-status species identified in the literature search with the potential to occur on the site. Species identification in the lab and to a lesser degree the field involved using digital photos and comparing them with taxonomically-related species from the area and using the botanical keys, diagrams, and descriptions in *The Jepson Desert Manual* (Baldwin et al. 2002) and *The Jepson Manual of Vascular Plants of California* (Baldwin et al. 2012).

Results

Literature Review

The querying of the CNPS and CDFW online databases for rare, threatened, and endangered plant species in the region resulted in the identification of 42 special-status plant species with the potential to occur in the region. Using the online BIOS, two special-status plant species have historical records within the survey area: southern jewelflower (*Streptanthus campestris*) and San Bernardino milk-vetch (*Astragalus bernardinus*) (CDFW 2025b). Further analysis of the potential for these species to occur at the site based on habitat and recorded occurrences within the immediate area identified 13 of the 42 species with a moderate or high potential to occur: San Bernardino milk-vetch (*Astragalus bernardinus*), triple-ribbed milk-vetch (*Astragalus tricarinatus*), Fremont barberry (*Berberis fremontii*), pinyon rockcress (*Boechera dispar*), Shockley' s rockcress (*Boechera shockleyi*), white-bracted spineflower (*Chorizanthe xanti* var. *leucotheca*), San Bernardino Mountains dudleya (*Dudleya abramsii* ssp. *affinis*), Pioneertown linanthus, Little San Bernardino Mountains linanthus (*Linanthus bernardinus*), Robinson' s monardella (*Monardella robisonii*), Latimer' s woodland-gilia (*Saltugilia latimeri*), southern jewelflower (*Streptanthus campestris*), and western Joshua tree (*Yucca brevifolia*).

A brief discussion of the conservation status and potential to exist on the survey site of the above listed species follows:

- **San Bernardino milk-vetch** (*Astragalus bernardinus*) is a perennial herb with a CRPR of 1B.2. This species blooms from April-June and occurs in Joshua tree woodland and pinyon and juniper woodland with granitic or carbonate substrates between 290-2,290 m. There are nine CNDDB records within the region of the project, including a record from 1992 that overlaps the western end of the site and another record from 1993 that is 1.67-miles to the south. San Bernardino milk-vetch has a **high** potential to occur in the study area because it contains Joshua tree woodland with juniper shrubs and granitic substrates, and the species has a historical record (1992) recorded to the CNDDB within the western study area.
- **Triple-ribbed milk-vetch** (*Astragalus tricarinatus*) is a perennial herb with a CRPR of 1B.2 and is ranked Endangered at the federal level. This species blooms from February-May and is found in Joshua tree woodland and Sonoran desert scrub between 455-1,585 m. with hot, rocky slopes in canyons and along edges of boulder-strewn desert washes with *Larrea spp.* and *Encelia spp.* present. There are 29 CNDDB records within the region of the project and the record nearest the project site is from 2019 and located 10.00-miles to the south. Triple-ribbed milk-vetch has a **moderate** potential to occur in the study area because it contains Joshua tree woodland and desert scrub with rocky slopes and desert washes with *Larrea* present.

- **Fremont barberry** (*Berberis fremontii*) is a perennial evergreen shrub with a CRPR of 2B.3. It blooms from March-May and occurs in Joshua tree woodland and pinyon and juniper woodland with rocky, sometimes granitic microhabitats at an elevation of 1,140-1,7700 m. There is one CNDDB record within the region of the project from 2003 and located 4.46-miles to the south. Fremont barberry has a **moderate** potential to occur in the study area because it contains Joshua tree woodland with juniper shrubs present, as well as rocky, granitic microhabitats in the southeastern study area.
- **Pinyon rockcress** (*Boechera dispar*) is a perennial herb with a CRPR of 2B.3. This species blooms from March-June and is found in Joshua tree woodland, pinyon and juniper woodland, and Mojavean desert scrub with granitic, gravelly slopes and mesas between 1,005-2,805 m. Pinyon rockcress is often under desert shrubs that support it as it grows. There are 35 CNDDB records within the region of the project and the record nearest the project site is from 1989 and located 1.13-miles to the west. Pinyon rockcress has a **high** potential to occur in the study area because it contains Joshua tree woodland, juniper shrubs, and desert scrub with granitic, gravelly slopes.
- **Shockley's rockcress** (*Boechera shockleyi*) is a perennial herb with a CRPR of 2B.2. This species blooms from May-June and is found in pinyon and juniper woodland on ridges, rocky outcrops, and openings on limestone or quartzite at an elevational range of 875-2,515 m. There are 11 CNDDB records within the region of the project and the record nearest the project site is from 1989 and located 0.85-miles to the southwest. Shockley' s rockcress has a **high** potential to occur in the study area because it contains juniper shrubs with rocky outcrops and openings on quartzite.
- **White-bracted spineflower** (*Chorizanthe xanti* var. *leucotheca*) is an annual herb with a CRPR of 1B.2. This species blooms from April-June and can be found in Mojavean desert scrub, pinyon and juniper woodland, and coastal scrub (alluvial fans) in sandy or gravelly microhabitats between 365-1,830 m. There are 12 CNDDB records within the region of the project and the record nearest the project site is from 1971 and located 8.80-miles to the south. White-bracted spineflower has a **moderate** potential to occur in the study area because it contains desert scrub and juniper shrubs with sandy and gravelly substrate.
- **San Bernardino Mountains dudleya** (*Dudleya abramsii* ssp. *affinis*) is a perennial herb with a CRPR of 1B.2. This dudleya blooms from April-June and is found within pebble (pavement) plain, upper montane coniferous forest, and pinyon and juniper woodland between 1,200-2,425 m. with outcrops, granite, or quartzite, and rarely limestone microhabitats. There are 10 CNDDB records within the region of the project and the record nearest the project site is from 2001 and located 8.09-miles to the west. San Bernardino Mountains dudleya has a **moderate** potential to occur in the study area because it contains desert scrub with juniper shrubs and rocky granite outcrops.
- **Pioneertown linanthus** (*Linanthus bernardinus*) is an annual herb with a CRPR of 1B.2. This species blooms from March-May and is found in Joshua tree woodland and pinyon and juniper woodland at an elevation between 1,120-1,345 m. There are 10 CNDDB

records within the region of the project and the record nearest the project site is from 2011 and located 2.86-miles to the south. Pioneertown linanthus has a **high** potential to occur in the study area because it contains Joshua tree woodland with juniper shrubs.

- **Little San Bernardino Mtns. linanthus** (*Linanthus maculatus* ssp. *maculatus*) is an annual herb with a CRPR of 1B.2. This species blooms from March-May and occurs within desert dunes, Sonoran desert scrub, Mojavean desert scrub, and Joshua tree woodland with a sandy microhabitat comprised of light-colored quartz sand between 135-1,220 m., often in a wash or bajada. There are 20 CNDDB records within the region of the project and the record nearest the project site is from 2015 and is located 3.33-miles to the northeast. Little San Bernardino Mtns. Linanthus has a **moderate** potential to occur in the study area because it contains desert scrub and Joshua tree woodland with some sandy microhabitats within the washes.
- **Robison's monardella** (*Monardella robisonii*) is a perennial rhizomatous herb with a CRPR of 1B.3. It blooms from April-September and is found in pinyon and juniper woodland with rocky desert slopes and granitic boulders at an elevation between 610-1,615 m. There are 6 CNDDB records within the region of the project and the record nearest the project site is from 2013 and is located 1.09-miles to the northeast. Robinson' s monardella has a **moderate** potential to occur in the study area because it contains juniper shrubs with rocky granitic outcrops.
- **Latimer's woodland-gilia** (*Saltugilia latimeri*) is an annual herb with a CRPR of 1B.2. This species blooms from March-June and is found in chaparral, Mojavean desert scrub, pinyon and juniper woodland with rocky or sandy substrate, and sometimes in washes or limestone at an elevational range of 120-2,200 m. There are 28 CNDDB records within the region of the project and the record nearest the project site is from 2015 and is located 1.16-miles to the north. Latimer' s woodland-gilia has a **moderate** potential to occur in the study area because it contains desert scrub with juniper shrubs and rocky/ sandy substrate with washes.
- **Southern jewelflower** (*Streptanthus campestris*) is a perennial herb with a CRPR of 1B.3. This species blooms from May-July and is found in chaparral, lower montane coniferous forest, and pinyon and juniper woodland with open, rocky areas between 605-2,590 m. There is one CNDDB record within the region of the project from year 1941 located along the central intersection of the parcel along Pipes Canyon Rd. Southern jewelflower has a **high** potential to occur in the study area because there are patches of juniper with open, rocky areas near the southeastern side of the study area and there is a historical record (1941) of this species recorded to the CNDDB within the study area, specifically along Pipes Canyon Rd.
- **Western Joshua tree** (*Yucca brevifolia*) is a monocot that is a candidate for a CRPR. It also has the following statuses: Candidate species for listing under the California Endangered Species Act (CESA) and is protected by the Western Joshua Tree Conservation Act. The species has a general habitat that includes Joshua tree woodland, montane chaparral,

pinyon and juniper woodland, and Sonoran and Mojavean desert scrub. It has been recorded at elevations between 750-2,200 meters (2,461-7,218 feet). The study area contains intact Joshua Tree Woodland with numerous Western Joshua trees **present** throughout the project site and surrounding 100-ft buffer zone. Their locations and data for each individual are documented in the corresponding Joshua Tree Survey (South Environmental 2025).

County of San Bernardino Desert Native Plant Protection

According to the California Desert Native Plants Act (CDNPA), certain species of California desert native plants are protected from harvesting on both public and privately owned lands within the County of San Bernardino (County of San Bernardino 2025). The CDNPA prohibits the harvest, transport, sale, or possession of specific native desert plants under many circumstances unless a person has a valid permit or wood receipt, and the required tags and seals. The appropriate permits, tags and seals must be obtained from the sheriff or commissioner of the county where collecting will occur, and the county will charge a fee.

The following regulated desert native plants shall not be removed except under a compliant Tree or Plant Removal Permit:

1. The following desert native plants with stems two inches or greater in diameter or six feet or greater in height:
    a. *Dalea spinosa* (smoketree).
    b. All species of the genus *Prosopis* (mesquites).
2. All species of the family Agavaceae (century plants, nolinas, yuccas).
3. Creosote (*Larrea*) Rings, ten feet or greater in diameter.
4. All Joshua trees (*Yucca brevifolia*).
5. Any part of any of the following species, whether living or dead:
    a. *Olneya tesota* (desert ironwood).
    b. All species of the genus *Prosopis* (mesquites).
    c. All species of the genus *Cercidium* (palos verdes).

Survey Results

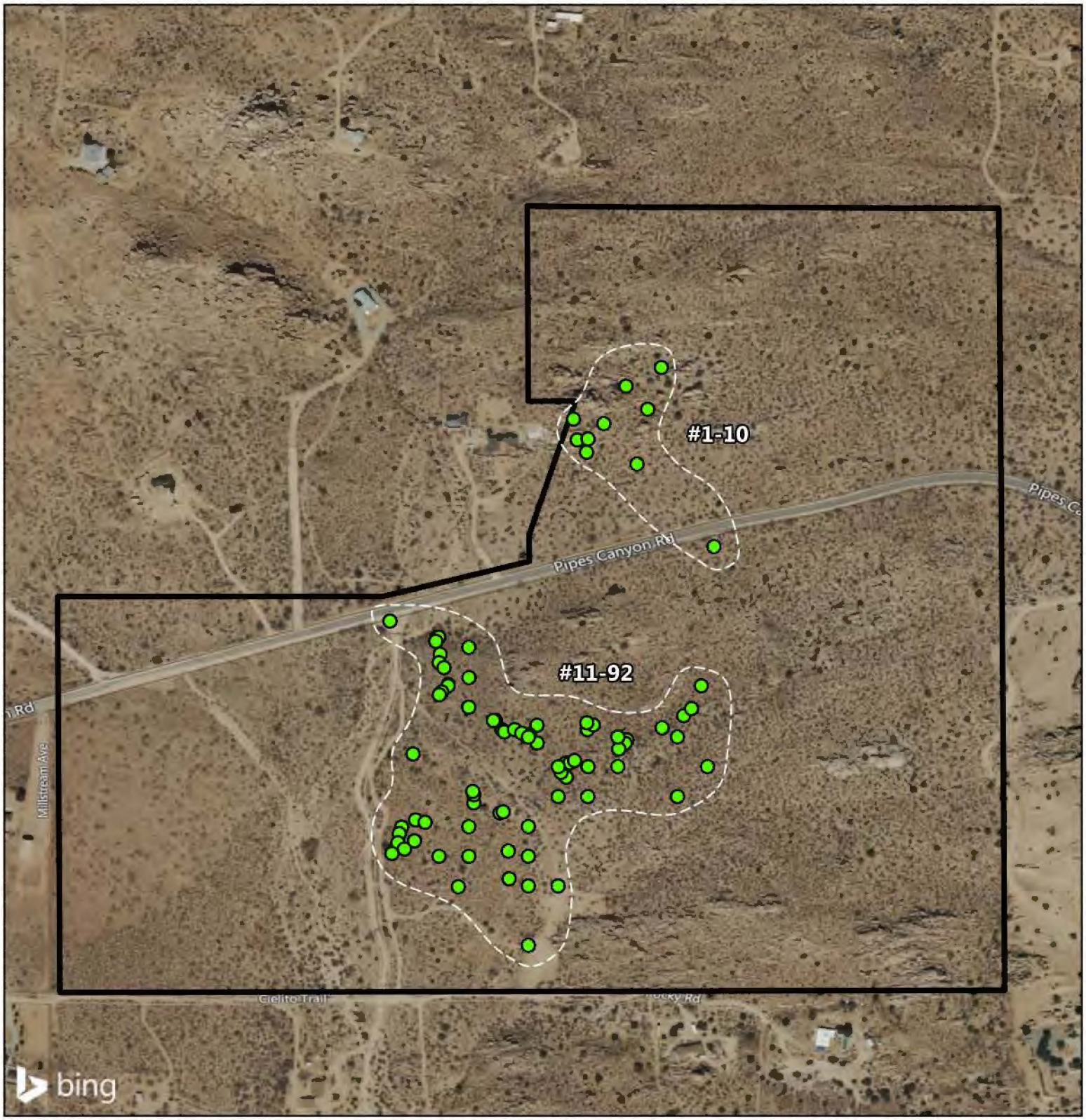
A total of 64 vascular plant species, most of which are species native to California, were identified. Species identified on the site during the survey period are listed in Table 1 and photos of the survey area and of specific common plants are in **Attachment A**. Most of the species were annual herbs and shrubs with only a few perennial herbs and trees. Plants marked with an asterisk are considered invasive species according to the California Invasive Plant Council (Cal-IPC 2025). Numerous Joshua tree (*Yucca brevifolia*) were observed on the site, which is a Candidate State species and CDNPA protected species. These trees are documented in the corresponding Joshua

Tree Report (South Environmental 2025). Two additional CDNPA species in the Agavaceae family, banana yucca (*Yucca baccata*) and Mojave yucca (*Yucca schidigera*), were also observed throughout the site (458 individuals in total, Figure 3). A total of 40 individual Wiggin's cholla (*Opuntia wigginsii*), which has a CRPR of 3.3, were also observed during the survey. No other special-status species identified through the literature search and listed in Attachment B were observed during the survey.

Table 1. List of plant species at the Pipes Canyon Project Site

Common name	Scientific name	CRPR	Federal/ State	CDNPA Species	Native/ Non-Native
Common burrobrush	*Ambrosia salsola*	NR	--	No	Native
*Sweet vernal grass	*Anthoxanthum odoratum*	NR	--	No	Non-native
Bristly fiddleneck	*Amsinckia tessellata*	NR	--	No	Native
Leafy goosefoot	*Blitum virgatum*	NR	--	No	Non-native
*Compact brome	*Bromus madritensis*	NR	--	No	Non-native
*Red brome	*Bromus rubens*	NR	--	No	Non-native
*Cheatgrass	*Bromus tectorum*	NR	--	No	Non-native
Mojave suncup	*Camissonia campestris*	NR	--	No	Native
Sandy soil suncup	*Camissonia strigulosa*	NR	--	No	Native
Desert willow	*Chilopsis linearis*	NR	--	No	Native
Northwestern Indian paintbrush	*Castilleja angustifolia* var. *dubia*	NR	--	No	Native
*Crimson fountain grass	*Cenchrus setaceus*	NR	--	No	Non-native
Panamint cryptantha	*Cryptantha angustifolia*	NR	--	No	Native
Sticky monkeyflower	*Diplacus aurantiacus*	NR	--	No	Native
Desert monkeyflower	*Diplacus bigelovii*	NR	--	No	Native
Dwarf purple monkeyflower	*Diplacus nanus*	NR	--	No	Native
lancleaf liveforever	*Dudleya lanceolata*	NR	--	No	Native
Strawberry hedgehog cactus	*Echinocereus engelmannii*	NR	--	No	Native
Squirreltail	*Elymus elymoides*	NR	--	No	Native
Nevada ephedra	*Ephedra nevadensis*	NR	--	No	Native
Desert woolystar	*Eriastrum eremicum*	NR	--	No	Native
Cliff goldenbush	*Ericameria cuneata*	NR	--	No	Native
Turpentine bush	*Ericameria laricfolia*	NR	--	No	Native
Desert rabbitbrush	*Ericameria paniculata*	NR	--	No	Native
Leafy fleabane	*Erigeron foliosus*	NR	--	No	Native
California buckwheat	*Eriogonum fasciculatum*	NR	--	No	Native
Desert trumpet	*Eriogonum inflatum*	NR	--	No	Native
Little desert trumpet	*Eriogonum trichopes*	NR	--	No	Native
Wright's buckwheat	*Eriogonum wrightii*	NR	--	No	Native
Wallace's wooly daisy	*Eriophyllum wallacei*	NR	--	No	Native
Pygmy poppy	*Eschscholzia minutiflora*	NR	--	No	Native
Rattlesnake weed	*Euphorbia albomarginata*	NR	--	No	Native

Broom snakeweed	*Gutierrezia sarothrae*	NR	--	No	Native
California juniper	*Juniperus californica*	NR	--	No	Native
Utah juniper	*Juniperus osteosperma*	NR	--	No	Native
Tumbleweed	*Kali tragus subsp. tragus*	NR	--	No	Native
Winterfat	*Krascheninnikovia ceratoides* subsp. *lanata*	NR	--	No	Native
Creosote bush	*Larrea tridentata*	NR	--	No	Native
Mojave desert parsley	*Lomatium mohavense*	NR	--	No	Native
Bajada lupine	*Lupinus concinnus*	NR	--	No	Native
Yellow sweet clover	*Melilotus officinalis*	NR	--	No	Native
whitestem blazing star	*Mentzelia albicaulis*	NR	--	No	Native
Desert wishbone	*Mirabilis laevis*	NR	--	No	Native
purple mat	*Nama demissa*	NR	--	No	Native
California evening primrose	*Oenothera californica*	NR	--	No	Native
Beavertail cactus	*Opuntia basilaris*	NR	--	No	Native
Wiggin's cholla/ silver cholla	*Opuntia wigginsii* (*Cylindropuntia echinocarpa*)	3.3	--	No	Native
Desert needlegrass	*Pappostipa speciosa*	NR	--	No	Native
Branching phacelia	*Phacelia ramosissima*	NR	--	No	Native
Lacy phacelia	*Phacelia tanacetifolia*	NR	--	No	Native
Desert mistletoe	*Phoradendron californicum*	NR	--	No	Native
Common purslane	*Portulaca oleracea*	NR	--	No	Native
Desert almond	*Prunus fasciculata*	NR	--	No	Native
Desert apricot	*Prunus fremontii*	NR	--	No	Native
Antelope bitterbush	*Purshia tridentata*	NR	--	No	Native
Chia	*Salvia columbariae*	NR	--	No	Native
*Kelch-grass	*Schismus barbatus*	NR	--	No	Native
California figwort	*Scrophularia californica*	NR	--	No	Native
Catclaw acacia	*Senegalia greggii*	NR	--	No	Native
Desert globe mallow	*Sphaeralcea ambigua*	NR	--	No	Native
Mojave aster	*Xylorhiza tortifolia*	NR	--	No	Native
Banana yucca	*Yucca baccata*	NR	--	Yes	Native
Joshua tree	*Yucca brevifolia*	NR	Candidate State	Yes	Native
Mojave yucca	*Yucca schidigera*	NR	--	Yes	Native
**=invasive species; NR= Not Ranked*					



Source: BING Aerial Map 2025

Pipes Canyon Project

Figure 3. Observed CDNPA Species in the Agavaceae Family

0 275 550 Feet

Scale: 1:5,500

N

Project Site

Banana yucca *(Yucca baccata)* and Mojave yucca *(Yucca schidigera)*

SOUTH ENVIRONMENTAL

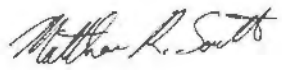
As mentioned in the Plant Communities section above, *Joshua Tree Woodland* occurs on a majority of the project site. Because this plant community has a global/state rarity ranking of G4/S3.2, it is considered a sensitive community by the CDFW. Impacts to sensitive natural communities and habitat for special-status species would be considered significant according to CEQA.

Conclusion

A literature review initially identified 13 special-status plant species with a moderate or high potential to occur in the region based on macro and micro habitat characteristics and occurrences in the immediate area. A field survey conducted over four days in April and May of 2025 resulted in the identification of 64 plant species made up primarily of shrubs and annual herbs. Based on the dominance of plants observed, the plant community on the area was assessed as predominantly *Joshua Tree Woodland* (G4/S3.2), which is considered a sensitive natural community by the CDFW. There were also smaller areas of *Desert Almond Scrub*, which is not a sensitive natural community, as well as Developed and Maintained Dirt Paths or Roads. A total of four special-status plant species were observed during the survey, which includes Wiggin's cholla (CRPR 3.3), Joshua tree (Candidate State, CDNPA Species), banana yucca (CDNPA Species), and Mojave yucca (CDNPA Species). In sum, the botanical survey indicated the presence of a protected natural community and four special-status species.

If you have any questions regarding the information in this report, please contact Matthew South by email: msouth@southenvironmental.com or by mobile phone: 303-818-3632.

Sincerely,



Matthew R. South
Principal Biologist

List of Attachments

1. **Attachment A**. Photograph Exhibit
2. **Attachment B**. Special-Status Species Analysis

Bibliography

Baldwin, B.G., Boyd, S., Ertter, B.J., Patterson, R.W., Rosatti, T.J., and Wilken, D.H. 2002. The Jepson Desert Manual. University of California Press, Berkeley and Los Angeles, California.

Baldwin, B.G., Goldman, D.H., Keil, D.J., Patterson, R., Rosatti, T.J., Wilken, D.H. 2012. The Jepson Manual Vascular Plants of California (2nd edition), University of California Press, Berkeley and Los Angeles, California.

California Invasive Plant Council (Cal-IPC). 2025. Plants A to Z. Accessed online: https://www.cal-ipc.org/plants/profiles/

California Department of Fish and Wildlife (CDFW). 2025a. California Natural Diversity Database (CNDDB) (available by subscription) and Rarefind. Sacramento, California. Accessed online: https://wildlife.ca.gov/Data/CNDDB

CDFW. 2025b. Biogeographic Information Observation System (BIOS) online. Sacramento, California. Accessed online: https://wildlife.ca.gov/Data/BIOS

California Native Plant Society (CNPS). 2025a. A Manual of California Vegetation Online. Accessed online: http://vegetation.cnps.org/

CNPS. 2025b. Inventory of Rare and Endangered Plants of California. California Native Plant Society. Accessed online: http://cnps.web.aplus.net/cgi-bin/inv/inventory.cgi

County of San Bernardino. 2025. § 88.01.060 Desert Native Plant Protection. Accessed online: https://codelibrary.amlegal.com/codes/sanbernardino/latest/sanberncty_ca/0-0-0-175924

National Oceanic and Atmospheric Administration (NOAA). 2025. National Centers for Environmental Information (NCEI) online. Accessed online: https://www.ncei.noaa.gov/

Thomas, K., Keeler-Wolf, T., Franklin, J., Stine, P. 2004. Mojave Desert Ecosystem Program: Central Mojave Vegetation Database. *Environmental Science*.

United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS). 2025. Online Web Soil Survey Mapper. Available online: https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

United States Geological Survey (USGS). 2025. Topographical Maps Online. Available online: https://apps.nationalmap.gov/downloader/#/

Attachment A:

Photograph Exhibit

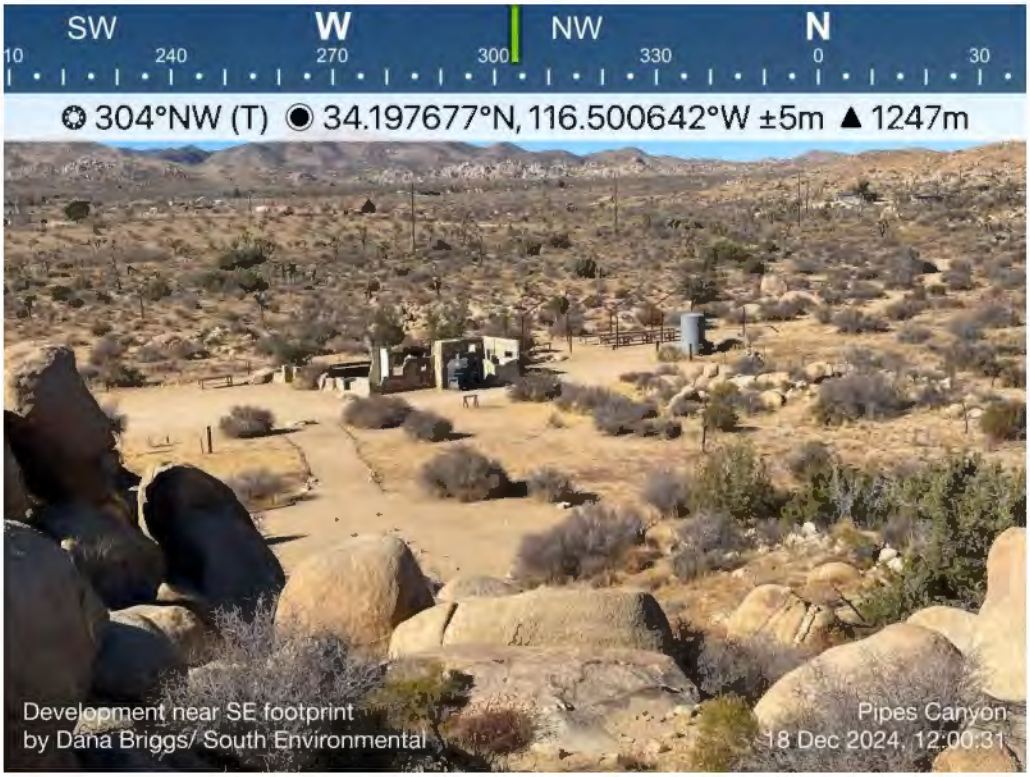


Image 1.) Depicts central region of project site that contains some developed areas and dirt paths surrounded by undeveloped desert habitat including Joshua Tree (*Yucca brevifolia*) Woodland and Desert Almond Scrub.



Image 2.) View of western region of project site that contains Joshua Tree Woodland with some disturbance from dirt paths/ roads.

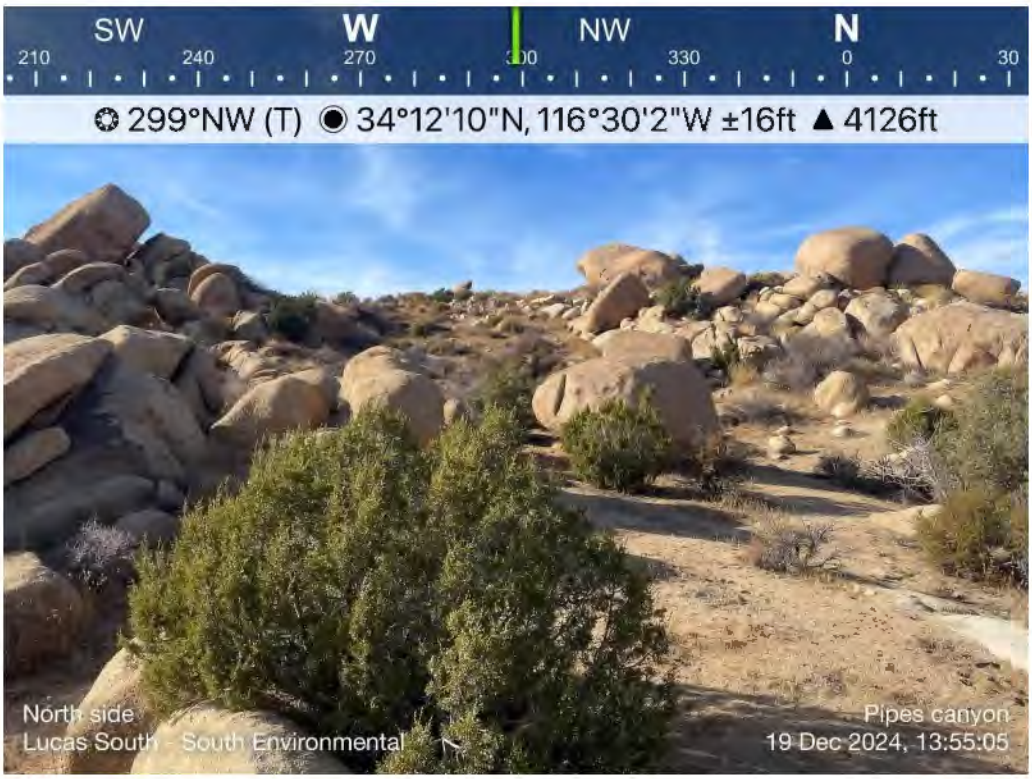


Image 3.) Depicts rocky outcrops found in project site to the north of Pipes Canyon Road that create unique microhabitats.

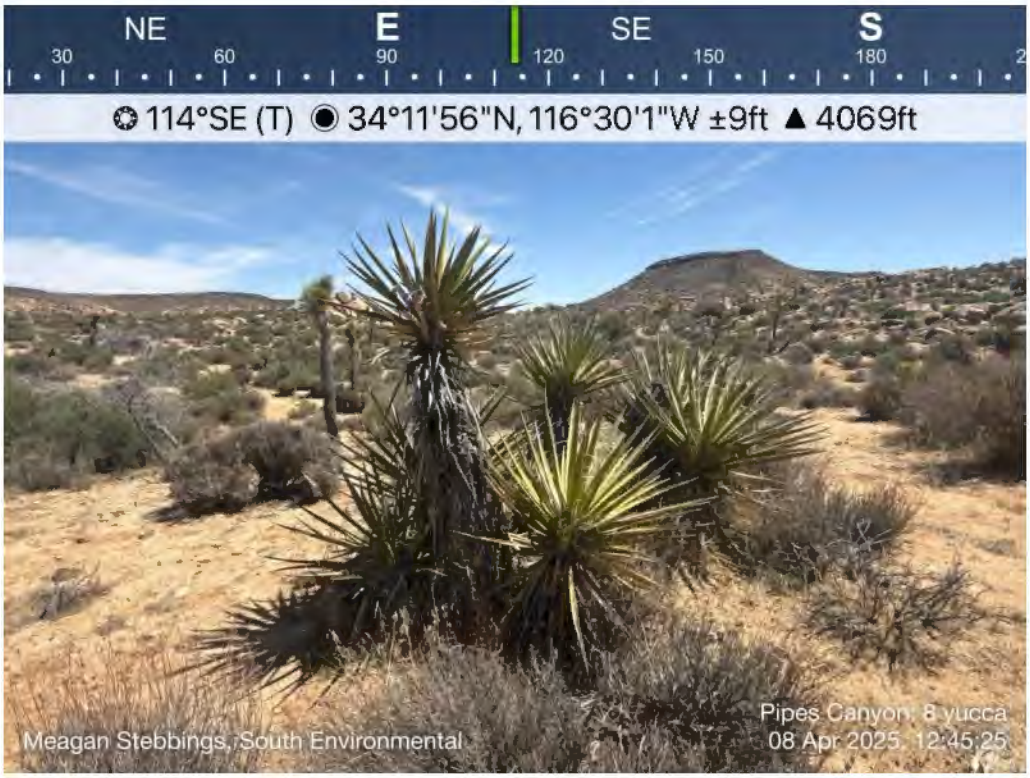


Image 4.) Depicts one cluster of numerous Mojave yucca (*Yucca schidigera*) within Joshua Tree Woodland habitat.



Image 5.) Depicts several Mojave yucca and Joshua trees within intact Joshua Tree Woodland.



Image 6.) Depicts one of numerous Wiggin's cholla (*Opuntia wigginsii/ Cylindropuntia echinocarpa*) observed throughout the project site.



Image 7.) Depicts understory that contain annual grasses and perennial herbs such as *Bromus spp.* and Eriogonum *spp*.



Image 8.) Depicts desert monkeyflower (*Diplacus bigelovii*), which was found flowering in the gravelly understory throughout the project site.



Image 9.) Depicts sticky monkeyflower (*Diplacus aurantiacus*) found growing in the northern rocky outcrop, which provides a unique microhabitat for plants not found elsewhere on site.

Appendix B:
Special-Status Species Analysis

Special-Status Species Analysis

Special-status plant species are those plants that, because of their recognized rarity or vulnerability to various causes of habitat loss or population decline, are recognized by federal, state, or other agencies as under threat from human-associated developments. Some of these species receive specific protection that is defined by federal or state endangered species legislation. Others have been designated as special-status based on adopted policies and expertise of state resource agencies or organizations with acknowledged expertise, or policies adopted by local governmental agencies such as counties, cities, and special districts to meet local conservation objectives. Special-status species include:

- Plants or wildlife listed or proposed for listing as threatened or endangered, or are candidates for possible future listing as threatened or endangered, under the federal Endangered Species Act or the California Endangered Species Act;

- Plants or wildlife that meet the definitions of rare or endangered under CEQA Guidelines Section 15380.

- Plants or wildlife covered under an adopted NCCP/HCP;

- Plants considered by the California Native Plant Society (CNPS) to be rare, threatened, or endangered (List 1A, 1B and 2 plants) in California;

- Plants listed by the CNPS as plants in which there is limited information about distribution (List 3);

- Plants listed as rare under the California Native Plant Protection Act (Fish and Game Code 1900 et seq.);

Federally-Protected Status

All references to Federally-protected species in this BRA include the most current published status or candidate category to which each species has been assigned by USFWS. For purposes of this assessment the following acronyms are used for Federal status species, as applicable:

FE Federally-listed as Endangered
FT Federally-listed as Threatened
FPE Federally proposed for listing as Endangered
FPT Federally proposed for listing as Threatened
FPD Federally proposed for delisting
FC Federal candidate species (former C1 species)

State-Protected Status

For the purposes of this BRA, the following acronyms are used for State status species, as applicable:

SE State-listed as Endangered
ST State-listed as Threatened
SR State-listed as Rare
SCE State candidate for listing as Endangered
SCT State candidate for listing as Threatened
SFP State Fully Protected
SSC California Species of Special Concern

California Rare Plant Rank

The CNPS is a private plant conservation organization dedicated to the monitoring and protection of special-status species in California. CNPS has compiled an inventory comprised of the information focusing on geographic distribution and qualitative characterization of Rare, Threatened, or Endangered vascular plant species of California (CNPS 2018). The list serves as the candidate list for listing as Threatened and Endangered by CDFW. CNPS has developed six categories of rarity known as the California Rare Plant Rank (CRPR), of which Ranks 1A, 1B, 2A, and 2B are particularly considered sensitive:

Rank 1A Presumed extinct in California.
Rank 1B Plants Rare, Threatened, or Endangered in California and elsewhere.
Rank 2A Presumed extinct in California, but more common elsewhere.
Rank 2B Plants Rare, Threatened, or Endangered in California, but more common elsewhere.
Rank 3 Plants about which we need more information – a review list.
Rank 4 Plants of limited distribution – a watch list.

The CNPS recently added "threat ranks" which parallel the ranks used by the CNDDB. These ranks are added as a decimal code after the CNPS List (e.g., Rank 1B.1). The threat codes are as follows:

.1 Seriously threatened in California (over 80% of occurrences threatened/high degree and immediacy of threat);
.2 Moderately threatened in California (20-80% occurrences threatened);
.3 Not very threatened in California (<20% of occurrences threatened or no current threats known).

Potential to Occur Assessment

Special-status species that are **present** or are **high** or **medium** potential to occur within the parcel are a based on one or more of the following:

- the direct observation of the species within the parcel during any field survey;
- a record reported in the CNDDB; and
- the parcel is within known distribution of a species and contains appropriate habitat.
- present means the species is known to occur, high potential indicates the habitat is ideal and near known occurrences of the species, and medium indicates that the habitat may be less than ideal due to some lacking element but still usable by the species and within the known range.

Special-status species that are **low** potential) to occur are based on one of the following:

- the parcel has the general habitat types but lacks necessary habitat elements such as suitable microhabitat or soils; or
- the parcel is outside the known elevation range or distribution of the species, and has otherwise suitable habitats;

Special-status species that have no potential to occur on the parcel are labeled as **none** due to the absence of suitable habitat.

Special-status species with a potential to occur on the survey area are listed below.

Scientific Name	Common Name	Taxonomic Group	CRPR	Federal Listing	State Listing	Other Status	General Habitat	Microhabitat	Potential to Occur on Study area
Acanthoscyphus parishii var. cienegensis	Cienega Seca oxytheca	Dicots	1B.3	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | USFS_S-Sensitive	Upper montane coniferous forest, pinyon and juniper woodland, Joshua tree woodland.	Dry gravelly banks and granitic sand. 1920-2560 m.	**None.** Study area is outside of elevation range.
Acanthoscyphus parishii var. goodmaniana	Cushenbury oxytheca	Dicots	1B.1	Endangered	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Pinyon and juniper woodland.	On limestone talus and rocky slopes. 1400-2350 m.	**None.** Study area lacks limestone talus or rocky slope microhabitat.
Astragalus albens	Cushenbury milk-vetch	Dicots	1B.1	Endangered	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Joshua tree woodland, Mojavean desert scrub, pinyon and juniper woodland.	Sandy or stony flats, rocky hillsides, canyon washes, and fans, on carbonate or mixed granitic-calcareous debris. 1185-1950 m.	**Low.** Study area contains Joshua tree woodland, desert scrub, and juniper shrubs with sandy flats, rocky hillsides, and fans but is outside the known range of the species.
Astragalus bernardinus	San Bernardino milk-vetch	Dicots	1B.2	None	None	BLM_S-Sensitive | SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | USFS_S-Sensitive	Joshua tree woodland, pinyon and juniper woodland.	Granitic or carbonate substrates. 290-2290 m.	**High.** Study area contains Joshua tree woodland and juniper shrubs with granitic substrates, and species has historical record within study area.

Scientific Name	Common Name	Taxonomic Group	CRPR	Federal Listing	State Listing	Other Status	General Habitat	Microhabitat	Potential to Occur on Study area
Astragalus lentiginosus var. coachellae	Coachella Valley milk-vetch	Dicots	1B.2	Endangered	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | SB_USDA-US Dept of Agriculture	Sonoran desert scrub, desert dunes.	Sandy flats, washes, outwash fans, sometimes on dunes. 35-695 m.	**None.** Study area is outside of elevation range.
Astragalus lentiginosus var. sierrae	Big Bear Valley milk-vetch	Dicots	1B.2	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | USFS_S-Sensitive	Mojavean desert scrub, meadows and seeps, pinyon and juniper woodland, upper montane coniferous forest.	Stony meadows and open pinewoods; sandy and gravelly soils in a variety of habitats. 1710-3230 m.	**None.** Study area is outside of elevation range.
Astragalus leucolobus	Big Bear Valley woollypod	Dicots	1B.2	None	None	BLM_S-Sensitive | IUCN_VU-Vulnerable | SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Lower montane coniferous forest, pebble plain, pinyon and juniper woodland, upper montane coniferous forest.	Dry pine woods, gravelly knolls among sagebrush, or stony lake shores in the pine belt. 1460-2895 m.	**None.** Study area is outside of elevation range and not within the pine belt.
Astragalus tricarinatus	triple-ribbed milk-vetch	Dicots	1B.2	Endangered	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Joshua tree woodland, Sonoran desert scrub.	Hot, rocky slopes in canyons and along edge of boulder-strewn desert washes, with Larrea and Encelia. 455-1585 m.	**Moderate.** Study area contains Joshua tree woodland and desert scrub with rocky slopes and desert washes with *Larrea*.
Berberis fremontii	Fremont barberry	Dicots	2B.3	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Pinyon and juniper woodland, Joshua tree woodland.	Rocky, sometimes granitic. 1140-1770 m.	**Moderate.** Study area contains juniper shrubs and Joshua tree woodland with rocky, granitic microhabitats.

Scientific Name	Common Name	Taxonomic Group	CRPR	Federal Listing	State Listing	Other Status	General Habitat	Microhabitat	Potential to Occur on Study area
Boechera dispar	pinyon rockcress	Dicots	2B.3	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Joshua tree woodland, pinyon and juniper woodland, Mojavean desert scrub.	Granitic, gravelly slopes and mesas. Often under desert shrubs which support it as it grows. 1005-2805 m.	**Moderate.** Study area contains Joshua tree woodland, juniper shrubs, and desert scrub with granitic, gravelly slopes.
Boechera lincolnensis	Lincoln rockcress	Dicots	2B.3	None	None	BLM_S-Sensitive	Chenopod scrub, Mojavean desert scrub.	On limestone. 880-2410 m.	**None.** Study area contains desert scrub but lacks limestone microhabitat.
Boechera parishii	Parish's rockcress	Dicots	1B.2	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | USFS_S-Sensitive	Pebble plain, pinyon and juniper woodland, upper montane coniferous forest.	Generally found on pebble plains on clay soil with quartzite cobbles; sometimes on limestone. 1825-2805 m.	**None.** Study area is outside of known elevation range.
Boechera shockleyi	Shockley's rockcress	Dicots	2B.2	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | USFS_S-Sensitive	Pinyon and juniper woodland.	On ridges, rocky outcrops and openings on limestone or quartzite. 875-2515 m.	**Moderate.** Study area contains juniper shrubs with rocky outcrops and openings on quartzite.
Botrychium crenulatum	scalloped moonwort	Ferns	2B.2	None	None	USFS_S-Sensitive	Bogs and fens, meadows and seeps, upper montane coniferous forest, lower montane coniferous forest, marshes and swamps.	Moist meadows, freshwater marsh, and near creeks. 1185-3110 m.	**None.** Study area lacks bogs or mesic habitat.
Calochortus palmeri var. palmeri	Palmer's mariposa-lily	Monocots	1B.2	None	None	BLM_S-Sensitive | SB_CalBG/RSABG-California/Rancho Santa Ana Botanic	Meadows and seeps, chaparral, lower montane	Vernally moist places in yellow-pine forest,	**None.** Study area lacks meadows or

Scientific Name	Common Name	Taxonomic Group	CRPR	Federal Listing	State Listing	Other Status	General Habitat	Microhabitat	Potential to Occur on Study area
						Garden | SB_SBBG-Santa Barbara Botanic Garden | USFS_S-Sensitive	coniferous forest.	chaparral. 195-2530 m.	vernally moist pine forest.
Carex occidentalis	western sedge	Monocots	2B.3	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Lower montane coniferous forest, meadows and seeps.	1645-2320 m.	**None.** Study area is outside of elevation range.
Castilleja cinerea	ash-gray paintbrush	Dicots	1B.2	Threatened	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Pebble plains, upper montane coniferous forest, Mojavean desert scrub, meadows and seeps, pinyon and juniper woodland.	Endemic to the San Bernardino Mountains, in clay openings; often in meadow edges. 725-2860 m.	**None.** Study area lacks meadow edge microhabitat with clay openings.
Chorizanthe xanti var. leucotheca	white-bracted spineflower	Dicots	1B.2	None	None	BLM_S-Sensitive | SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | SB_USDA-US Dept of Agriculture | USFS_S-Sensitive	Mojavean desert scrub, pinyon and juniper woodland, coastal scrub (alluvial fans).	Sandy or gravelly places. 365-1830 m.	**Moderate.** Study area contains desert scrub and juniper shrubs with sandy or gravelly microhabitats.
Cymopterus multinervatus	purple-nerve cymopterus	Dicots	2B.2	None	None		Mojavean desert scrub, pinyon and juniper woodland.	Sandy or gravelly places. 765-2195 m.	**Low.** Study area contains desert scrub and juniper shrubs with sandy or gravelly microhabitats but is outside the known range for this species.
Dudleya abramsii ssp. affinis	San Bernardino Mountains dudleya	Dicots	1B.2	None	None	BLM_S-Sensitive | SB_CalBG/RSABG-California/Rancho Santa Ana Botanic	Pebble (pavement) plain, upper montane	Outcrops, granite or quartzite, rarely limestone. 1200-2425 m.	**Moderate.** Study area contains juniper shrubs with

Scientific Name	Common Name	Taxonomic Group	CRPR	Federal Listing	State Listing	Other Status	General Habitat	Microhabitat	Potential to Occur on Study area
						Garden | USFS_S-Sensitive	coniferous forest, pinyon and juniper woodland.		rocky granite outcrops.
Eremogone ursina	Big Bear Valley sandwort	Dicots	1B.2	Threatened	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Pebble plain, pinyon and juniper woodland, meadows and seeps.	Mesic, rocky sites. 1795-2895 m.	**None.** Study area is outside of elevation range and lacks mesic microhabitat.
Eriastrum harwoodii	Harwood's eriastrum	Dicots	1B.2	None	None	BLM_S-Sensitive | SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | SB_USDA-US Dept of Agriculture	Desert dunes.	Sandy soils. 15-1100m.	**None.** Stud area lacks desert dunes.
Erigeron parishii	Parish's daisy	Dicots	1B.1	Threatened	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Mojavean desert scrub, pinyon and juniper woodland.	Often on carbonate; limestone mountain slopes; often associated with drainages. Sometimes on granite. 1050-2245 m.	**Low.** Study area contains desert scrub and juniper shrubs with granite substrate.
Eriogonum kennedyi var. austromontanum	southern mountain buckwheat	Dicots	1B.2	Threatened	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Pebble (pavement) plain, lower montane coniferous forest.	Usually found in pebble plain habitats. 1765-3020 m.	**None.** Study area is outside of elevation range.
Eriogonum microthecum var. johnstonii	Johnston's buckwheat	Dicots	1B.3	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | USFS_S-Sensitive	Subalpine coniferous forest, upper montane coniferous forest.	Slopes and ridges on granite or limestone. 1795-2865 m.	**None.** Study area is outside of elevation range.
Eriogonum ovalifolium var. vineum	Cushenbury buckwheat	Dicots	1B.1	Endangered	None	SB_CalBG/RSABG-California/Rancho	Mojavean desert scrub, pinyon and	Limestone mountain slopes. Dry, usually rocky	**None.** Study area is outside

Scientific Name	Common Name	Taxonomic Group	CRPR	Federal Listing	State Listing	Other Status	General Habitat	Microhabitat	Potential to Occur on Study area
						Santa Ana Botanic Garden	juniper woodland, Joshua tree woodland.	places. 1430-2440 m.	of elevation range.
Gilia leptantha ssp. leptantha	San Bernardino gilia	Dicots	1B.3	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | USFS_S-Sensitive	Lower montane coniferous forest.	Sandy or gravelly sites. 1520-2595 m.	**None.** Study area is outside of elevation range.
Heuchera parishii	Parish's alumroot	Dicots	1B.3	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | USFS_S-Sensitive	Lower montane coniferous forest, subalpine coniferous forest, upper montane coniferous forest, alpine boulder and rock field.	Rocky places. Sometimes on carbonate. 1340-3505 m.	**None.** Study area is outside of elevation range.
Ivesia argyrocoma var. argyrocoma	silver-haired ivesia	Dicots	1B.2	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | USFS_S-Sensitive	Meadows and seeps, pebble plains, upper montane coniferous forest.	In pebble plains and meadows with other rare plants. 1490-2960 m.	**None.** Study area is outside of elevation range and lacks meadows.
Lilium parryi	lemon lily	Monocots	1B.2	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | SB_CRES-San Diego Zoo CRES Native Gene Seed Bank | USFS_S-Sensitive	Lower montane coniferous forest, meadows and seeps, riparian forest, upper montane coniferous forest.	Wet, mountainous terrain; generally in forested areas; on shady edges of streams, in open boggy meadows and seeps. 625-2930 m.	**None.** Study area is outside of elevation range and not mesic mountain habitat.
Linanthus bernardinus	Pioneertown linanthus	Dicots	1B.2	None	None	BLM_S-Sensitive | SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Joshua tree woodland, pinyon and juniper woodland.	1120-1345 m.	**Moderate.** Study area contains Joshua tree woodland and juniper shrubs.

Scientific Name	Common Name	Taxonomic Group	CRPR	Federal Listing	State Listing	Other Status	General Habitat	Microhabitat	Potential to Occur on Study area
Linanthus killipii	Baldwin Lake linanthus	Dicots	1B.2	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | USFS_S-Sensitive	Alkaline meadows, pebble plain, pinyon and juniper woodland, Joshua tree woodland.	Usually on pebble plains with other rare species. 1645-2645 m.	**None.** Study area is outside of elevation range.
Linanthus maculatus ssp. maculatus	Little San Bernardino Mtns. linanthus	Dicots	1B.2	None	None	BLM_S-Sensitive | SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Desert dunes, Sonoran desert scrub, Mojavean desert scrub, Joshua tree woodland.	Sandy places. Usually in light-colored quartz sand; often in wash or bajada. 135-1220 m.	**Moderate.** Study area contains desert scrub and Joshua tree woodland with some sandy microhabitats within washes.
Monardella robisonii	Robison's monardella	Dicots	1B.3	None	None	BLM_S-Sensitive | SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Pinyon and juniper woodland.	Rocky desert slopes, often among granitic boulders. 610-1615 m.	**Moderate.** Study area contains juniper shrubs with rocky granitic outcrops.
Phlox dolichantha	Big Bear Valley phlox	Dicots	1B.2	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | USFS_S-Sensitive	Pebble plains, upper montane coniferous forest.	Sloping hillsides, in shade under pines and Quercus kelloggii, with heavy pine litter; also in openings. 1980-2805 m.	**None.** Study area is outside of elevation range.
Physaria kingii ssp. bernardina	San Bernardino Mountains bladderpod	Dicots	1B.1	Endangered	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Pinyon and juniper woodland, lower montane coniferous forest, subalpine coniferous forest.	Dry sandy to rocky carbonate soils. 1980-2590 m.	**None.** Study area is outside of elevation range.

Scientific Name	Common Name	Taxonomic Group	CRPR	Federal Listing	State Listing	Other Status	General Habitat	Microhabitat	Potential to Occur on Study area
Poa atropurpurea	San Bernardino blue grass	Monocots	1B.2	Endangered	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Meadows and seeps.	Mesic meadows of open pine forests and grassy slopes, loamy alluvial to sandy loam soil. 1255-2655 m.	**None.** Study area lacks meadows and seeps habitat.
Pyrrocoma uniflora var. gossypina	Bear Valley pyrrocoma	Dicots	1B.2	None	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | USFS_S-Sensitive	Pebble plain, meadows and seeps.	Meadows, meadow edges, and along streams in or near pebble plain habitat. 2040-2280 m.	**None.** Study area is outside of elevation range and lacks meadows.
Saltugilia latimeri	Latimer's woodland-gilia	Dicots	1B.2	None	None	BLM_S-Sensitive | SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden | SB_USDA-US Dept of Agriculture | USFS_S-Sensitive	Chaparral, Mojavean desert scrub, pinyon and juniper woodland.	Rocky or sandy substrate; sometimes in washes, sometimes limestone. 120-2200 m.	**Moderate.** Study area contains desert scrub and juniper shrubs with rocky or sandy substrate with washes.
Streptanthus campestris	southern jewelflower	Dicots	1B.3	None	None	BLM_S-Sensitive | SB_CRES-San Diego Zoo CRES Native Gene Seed Bank | USFS_S-Sensitive	Chaparral, lower montane coniferous forest, pinyon and juniper woodland.	Open, rocky areas. 605-2590 m.	**High.** Study area contains juniper shrubs with open, rocky areas, and has a historical record adjacent to study area.
Taraxacum californicum	California dandelion	Dicots	1B.1	Endangered	None	SB_CalBG/RSABG-California/Rancho Santa Ana Botanic Garden	Meadows and seeps.	Mesic meadows, usually free of taller vegetation. 1620-2590 m.	**None.** Study area is outside of elevation range and lacks meadows.
Yucca brevifolia	Western Joshua tree	Monocots	CBR	None	Candidate Threatened	Western Joshua Tree Conservation Act (WJTCA); International Union for the Conservation of Nature least concern	Mojavean desert scrub, pinyon and juniper woodland, Joshua tree woodland	Hot, dry sites on flats, mesas, bajadas, and gentle slopes in the Mojave Desert	**Present.** This species was observed throughout the study area and project site and create a Joshua Tree Woodland.

Appendix B.4

Western Joshua Tree Inventory

Western Joshua Tree Inventory

Pipes Canyon Project

March 2025

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Appendix A: Joshua Tree Data Matrix
Appendix B: Photograph Exhibit
Appendix C: Site Plan

1.Introduction

This report includes results of a western Joshua tree (*Yucca brevifolia)* inventory conducted by South Environmental for the Pipes Canyon Project (Tentative Tract Map No. 20612) located near the community of Pioneertown, San Bernardino County, California. There is a proposal to develop the parcel to create 12 single-family residential lots with a minimum five-acre lot size and one remainder parcel on 122.98 acres (Assessor Parcel Number 0594-351-36) located on both the north and south sides of Pipes Canyon Road. The purpose of this report is to inventory western Joshua trees on the site and potential impacts to them from proposed development. The scope of this report includes a description of the survey area; methods used to survey the trees involving assessment of structure, health, and mapping; the results of the survey including photographs of each tree; a description of the laws and regulations pursuant to Joshua tree protection; and the potential development impacts to and mitigation for Joshua trees on the site.

1.1 Project Location and Setting

The project site is in San Bernardino County approximately 6.5 miles north of 29 Palms Highway (California State Route 62) to the north of the Town of Yucca Valley. The project is within the U.S. Geological Survey (USGS) Rimrock North 7.5 Minute Topographical Quadrangle, and within Section 06 of Township 01 North (01N) and Range 05 East (05E). The site is set within a rural area adjacent to the north of Pipes Canyon Road. The site is mostly undeveloped with an outdoor pergola and cooking area in the southeastern area of the parcel that is used as an events space. The plant community is Joshua Tree Woodland dominated by western Joshua tree in the canopy and Joshua tree and desert shrubs in the sub-canopy. The soil is sandy and the overall vegetative cover on the site is sparse (15-30%). The areas adjacent to the site are undeveloped Joshua tree woodland with an occasional tiny home or larger single-family residence. The survey area is split by Pipes Canyon Road going east to west, its bordered by Millstream Avenue on the east side, and Roadrunner Road goes through the project site in the northwest corner.

1.2 Proposed Development

The project applicant seeks approval to subdivide the property into 13 individual lots. Of these, 12 lots will be developed as five-acre residential parcels, intended for single-family homes, and will be offered for sale. These residential lots will be designed to provide ample space for rural residential living, consistent with the existing zoning designation of Rural Living RL-5. The remaining lot, situated within the RC zoning area, will retain its current Resource Conservation designation, preserving the site's natural resources and environmental features.

2.Methodology

2.1 Field Survey

South Environmental biologists Lucas South and Meagan Stebbings conducted a survey of each western Joshua tree on the proposed housing pads and within a 100-foot buffer zone on December 18 and 19, 2024 and on January 14, 2025. Data were collected on each tree's height, canopy width, structure, and condition (health). The surveys were conducted in accordance with California Fish and Game Code section 1927.3, subdivision (a)(1). During the survey, each observed Joshua tree was given a unique identification number, and its location was recorded using a hand-held Geode GPS unit with an accuracy of at least 36-inches. The biologist evaluated the structure and general health of each tree, and a digital photograph was taken of each tree. The following highlights the parameters used in the structural and health evaluation of the trees.

2.1.1 Structural Evaluation

An evaluation of the physical structure of each tree included the following:

- **Height of main stem** was measured using a visual estimation
- **Canopy spread** was measured using a visual estimation by estimating the distance across the entire canopy of the tree (main stem and rhizome stems) where that distance was greatest,
- **Structure/Architecture** included describing in general structure of each tree
- **Structural Height Rating** – each Joshua tree were classified by their height by 3 groups:
    - <1m tall (Class A)
    - >1-<5m tall (Class B)
    - Greater than or equal to 5m tall (Class C)

2.1.2 Condition/Health Assessment

Condition/Health Rating – each Joshua tree received a single number health rating based on its similarity to an archetypal Joshua tree in excellent condition:

- 5 – Maximum health: has flowers or regrowth
- 4 – Healthy: Overall good health
- 3 – Fair health: Trees that had bad (dead or dying) branches, but overall structure was okay
- 2 – Poor health: no new foliage, leaf yellowing, expected to the dying soon

- 1 – Dead: all foliage dead or dying (yellow or brown)

Each tree was assessed for it's **maturity**, and those trees with at least one branch were considered mature, while those without branching were immature.

Flowers and/or **fruits** were noted for each tree.

2.2 Regulatory Setting

2.2.1 State Regulations

California Endangered Species Act (ESA)

In 2022, the CDFW developed a status review report for western Joshua tree assessing whether listing the species as endangered or threatened under the California Endangered Species Act would be warranted. And in 2023, the Western Joshua Tree Conservation Act was passed, which acted to postpone a further analysis of the species under the California ESA until at least 2033 when the CDFW is mandated with preparation of an updated status review of the species, unless the Fish and Game Commission directs CDFW to complete the update sooner. In the interim period, protection of the species in California, including take of the species, is pursuant to the Western Joshua Tree Conservation Act.

Western Joshua Tree Conservation Act

The Western Joshua Tree Conservation Act is the current legislation in the State of California for use in protection of the Joshua tree and was passed on 2023. Foremost, the legislation prohibits the importation, export, take, possession, purchase, or sale of any western Joshua tree in California unless authorized by CDFW. The Act currently supersedes the California Endangered Species Act (ESA) and authorizes CDFW to issue permits for the "take" of one or more western Joshua trees if the permittee meets specific conditions. Permittees have the opportunity to relocate a Joshua tree in areas impacted by development or pay a fee in lieu of conducting mitigation activities. The legislation also grants the CDFW the authority to issue permits for the removal of dead western Joshua trees and trimming of live western Joshua trees.

The legislation allow for agreements to be made between the CDFW and any county or city which limit the authority to permit the taking of a Joshua tree associated with developing single-family residences, multifamily residences, accessory structures, and public works projects. A similar agreement between the CDFW and a county or city can also be authorized to limit the authority to permit the removal of dead and trimming of live Joshua trees.

With this legislation, in-lieu fees collected will be deposited into the "Joshua Tree Conservation Fund" for appropriation to CDFW strictly with the goal of acquiring, conserving, and managing Joshua tree conservation lands and carrying out other project to conserve the species.

Additionally, the act mandates the CDFW with development and implementation of a Joshua tree conservation plan in collaboration with governmental agencies, California Native American Tribes, and the public. A draft of the plan must be presented by December 31, 2024, at a public meeting of the Fish and Game Commission for its review and approval. Finally, CDFW must produce annual reports assessing the conservation status of the western Joshua tree (State of California, 2023).

In cases of private development the following is a summary of important conservation measures under the Western Joshua Tree Conservation Act:

The Western Joshua Tree Conservation Act stipulates several measures to assist with the assessment of impacts to and mitigation for western Joshua tree in areas proposed for development. Permittees may mitigate loss or damage to trees by relocating them or by paying specified fees in lieu of conducting mitigation. Under the act, all in-lieu fees collected will be deposited into the Western Joshua Tree Conservation Fund for the purposes of acquiring, conserving, and managing western Joshua tree conservation lands and completing other activities to conserve the western Joshua tree.

2.2.2 Local Regulations

San Bernardino County Joshua Tree Community Plan

The San Bernardino County Joshua Tree Community Plan was passed in San Bernardino County in 2007. The Plan stipulates that an effort will be made to retain native vegetation including Joshua trees as part of a new development project. Protection of Joshua trees and other important native vegetation for new development includes requiring a landscape plan; consideration of other siting areas without protected plants; encouragement of on-site relocation of Joshua tree or "adoption" off-site if on-site relocation is not possible; bearing of the cost of Joshua tree relocation by the developer; and, retention and transplantation practices must follow best nursery practices (San Bernardino County, 2007).

Joshua Tree Community Action Plan

The Joshua Tree Community Action Plan was adopted in 2016 and provides overarching goals to protect desert habitat in the area including Joshua tree woodland. There are two overarching "action statements" in the Plan that apply to conservation of Joshua trees: 1) Partner with organizations such as Mojave Desert Land Trust to conserve natural desert habitats and wildlife

corridors and to protect native plants and animals, and 2) Promote respect for local ecosystems and be stewards of the environment. While the Plan does not contain detailed specific actions related to these goals, it does embody the spirit and general intent of Joshua tree conservation in the area (San Bernardino County, 2016).

3.Results

South Environmental surveyed a total of 548 Joshua trees in the survey area, including 542 Joshua trees found on the property that are labeled as "LXXX" and 6 Joshua trees found on inaccessible private property labeled as "PXXX". Trees on private property were mapped and assessed at a distance, with an estimated location. The findings include the latitude and longitude, size class, health, maturity, flowers/fruits, impacts, if is within 15-meters of the development, tree heights, canopy width, and structure are detailed in the data matrix in Appendix A. Table 1 below summarizes the results of the survey and the tree locations are shown in Figure 1. Photographs of the trees are in Appendix B.

Table 1. Summary of Western Joshua Tree Inventory

Size Class (height)	# of Joshua Trees	Live	Dead	Mature	Fruits/Flowers	Within 15m of project	Removals
Class A <1m	254	253	1	0	0	173	28
Class B 1m-5m	282	275	7	163	136	127	28
Class C >5m	12	12	0	12	12	5	2
Total	**548**	**540**	**8**	**175**	**148**	**305**	**58**

Of the 548 Joshua trees surveyed 254 were Class A, 282 Class B, and 12 Class C. A total of 8 Joshua trees were dead (1 Class A and 7 Class B) and 175 were mature. Of the mature trees, 148 had fruits or flowers. There are 305 Joshua trees within 15-meters of the proposed project footprint and 58 of those would be removed by the project because they are within the footprint. Removals include 28 Class A, 28 Class B, and 2 Class C. Overall the population of Joshua trees within the survey area is healthy, with very few dead trees and a mix of size classes and observations of fruits and flowers indicate that the Joshua trees are regenerating naturally on the site. The number of removals proposed by the project is 10% of the number surveyed, however, there are numerous other Joshua trees surrounding the survey area that are contiguous plant communities with that found on the site, and the relative number of removals to those in the region is very small.



Source: BING Aerial Map 2025

Pipes Canyon Project

Figure 1. Overview JT Inventory

- Western Joshua Tree
- Joshua Tree Survey Area
- Proposed Development Footprint
- Proposed Single Family House Lot
- Project Site



0 230 460 Feet

Scale: 1:4,584

N

Project Site is within unincorporated, California, in San Bernardino County on the USGS Rimrock and Yucca Valley North 7.5-minute quadrangle maps in Section 06 of Township 01 North and Range 05 East

Center Coordinate (Decimal Degrees):
Latitude: 34.1998731N Longitude: -118.5009697W

SOUTH ENVIRONMENTAL



Source: BING Aerial Map 2025

Pipes Canyon Project

Figure 1A. JT Inventory Lots 1 and 2

0 70 140 Feet

N

Scale: 1:1,400

- Western Joshua Tree
- Joshua Tree Survey Area
- Proposed Development Footprint
- Proposed Single Family House Lot
- Project Site

SOUTH ENVIRONMENTAL



Source: BING Aerial Map 2025

Pipes Canyon Project

Figure 1B. JT Inventory Lot 3

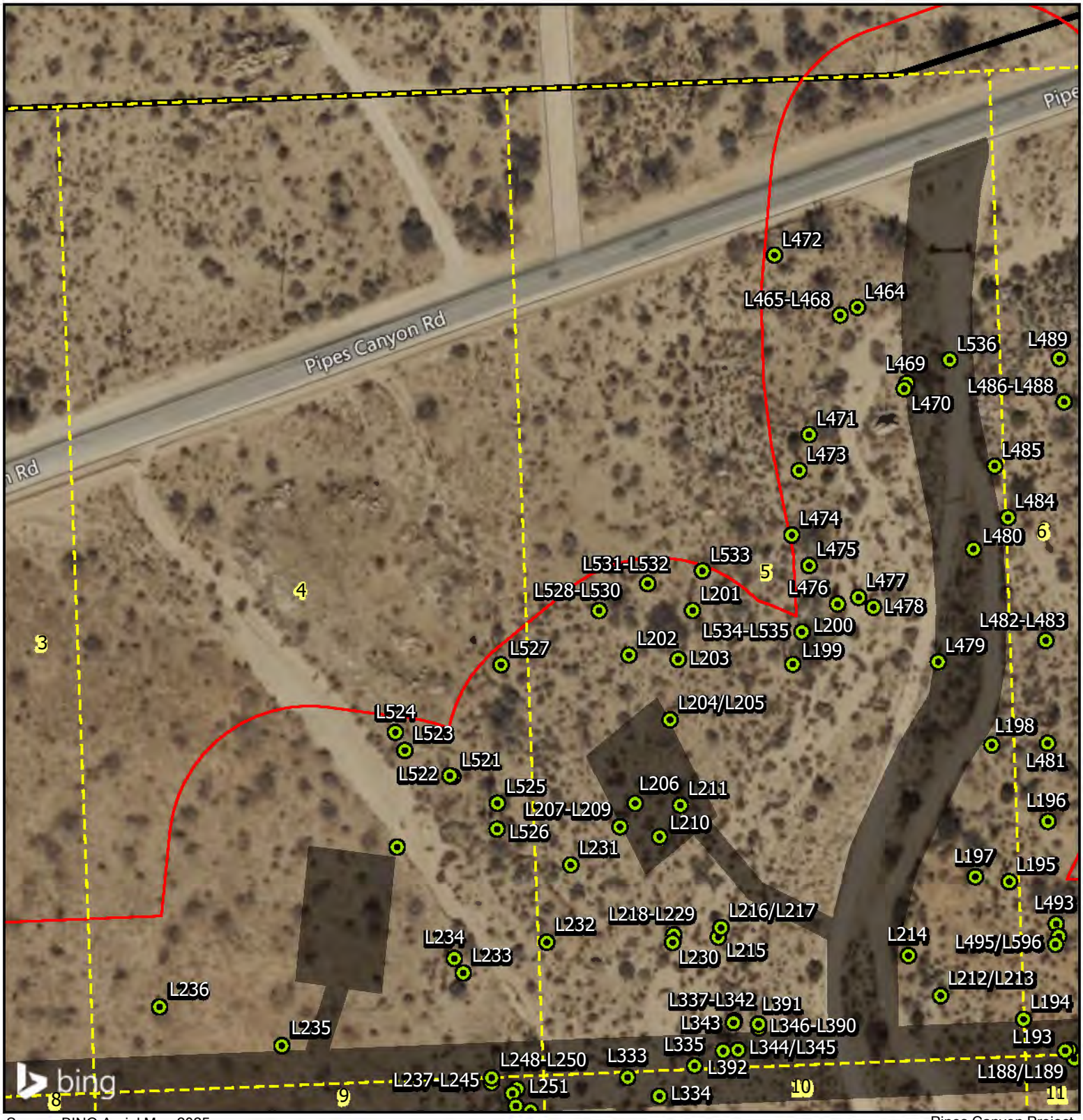
- Western Joshua Tree
- Joshua Tree Survey Area
- Proposed Development Footprint
- Proposed Single Family House Lot
- Project Site

0 55 110 Feet

Scale: 1:1,152

N

SOUTH ENVIRONMENTAL



Source: BING Aerial Map 2025

Pipes Canyon Project

Figure 1C. JT Inventory Lots 4 and 5

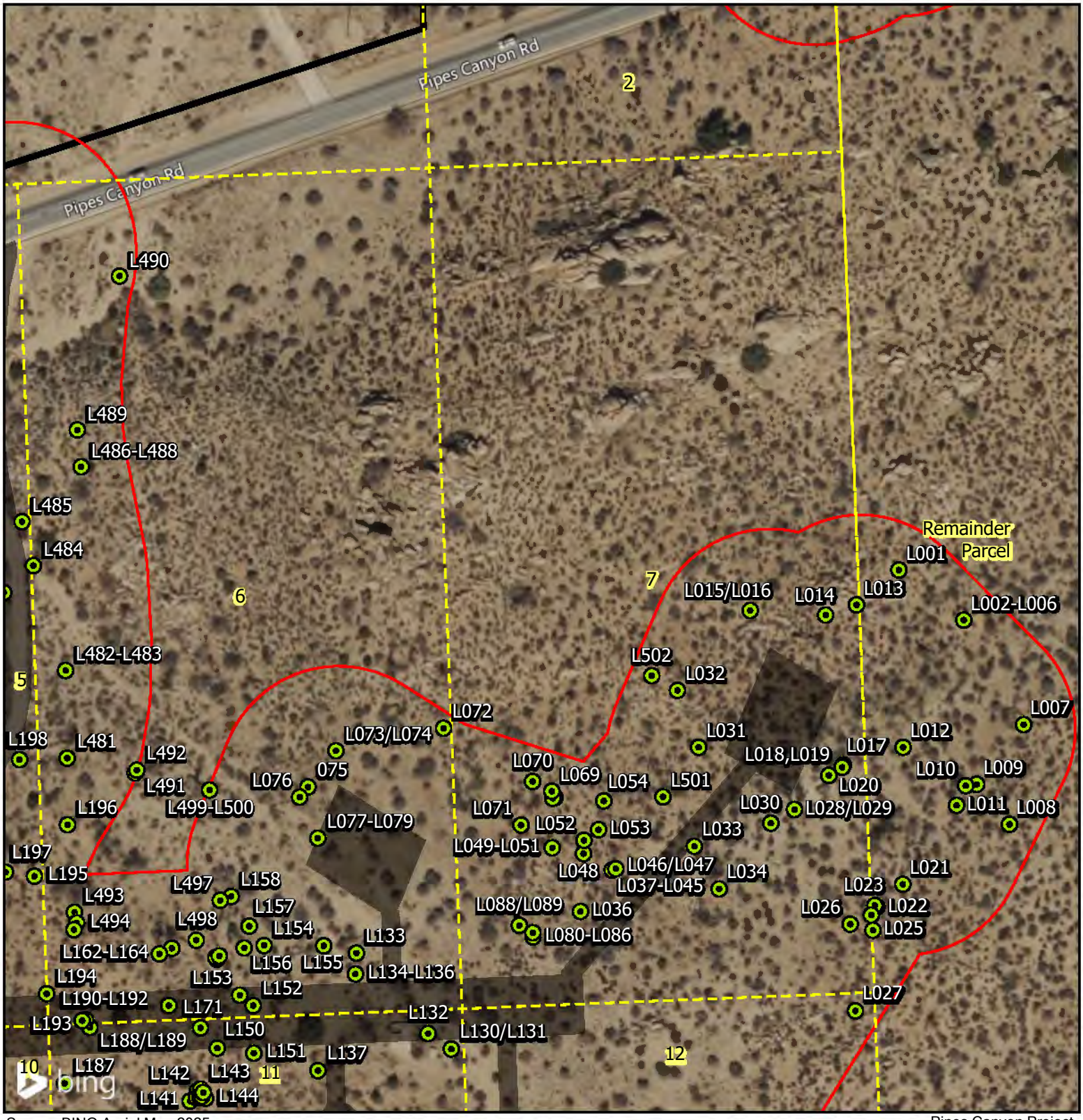
0 55 110 Feet

Scale: 1:1,152

N

- Western Joshua Tree
- Joshua Tree Survey Area
- Proposed Development Footprint
- Proposed Single Family House Lot
- Project Site

SOUTH ENVIRONMENTAL



Source: BING Aerial Map 2025

Pipes Canyon Project

Figure 1D. JT Inventory Lots 6 and 7

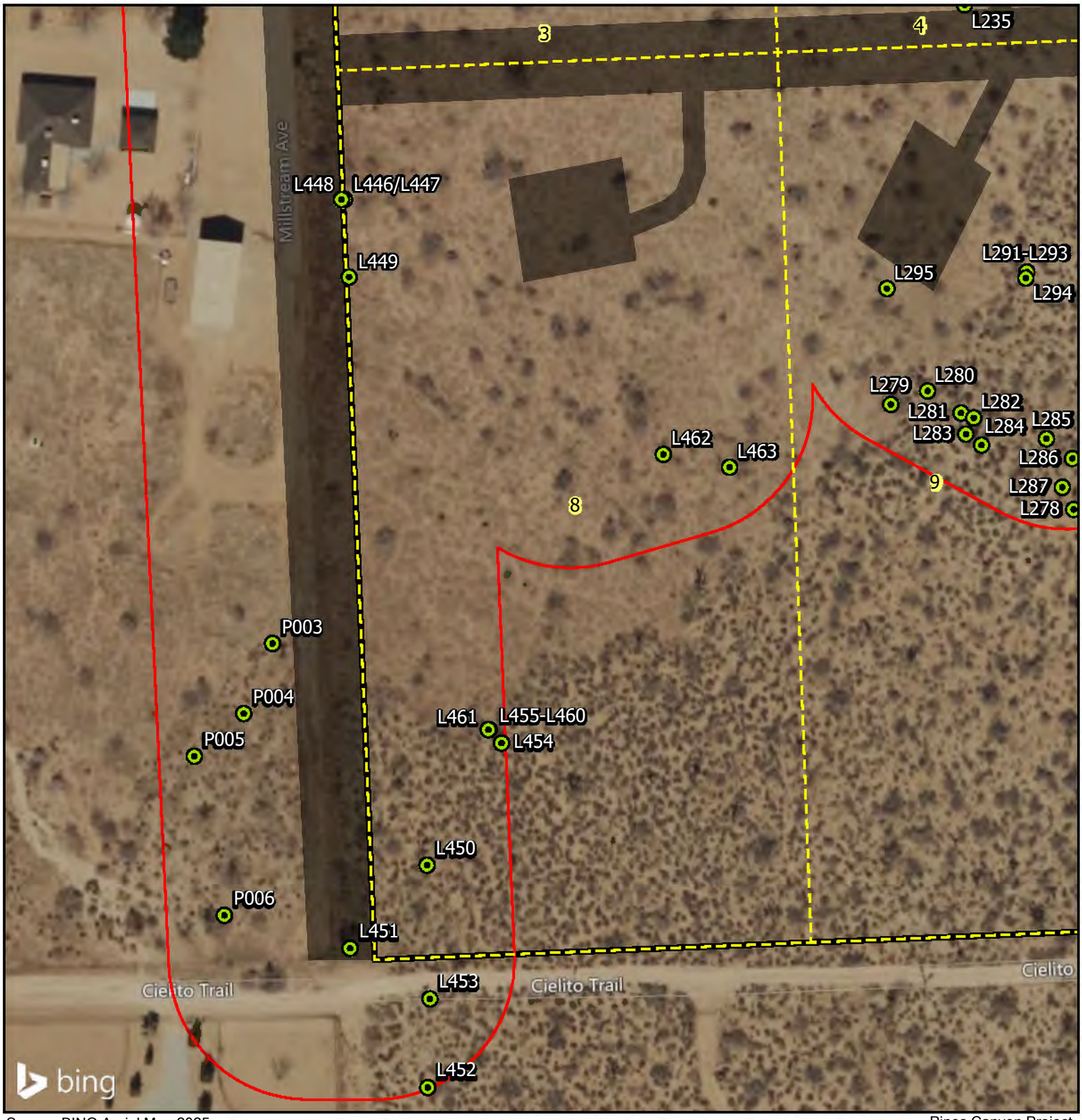
0 65 130 Feet

Scale: 1:1,350

N

- Western Joshua Tree
- Joshua Tree Survey Area
- Proposed Development Footprint
- Proposed Single Family House Lot
- Project Site

SOUTH ENVIRONMENTAL



Source: BING Aerial Map 2025

Pipes Canyon Project

Figure 1E. JT Inventory Lot 8

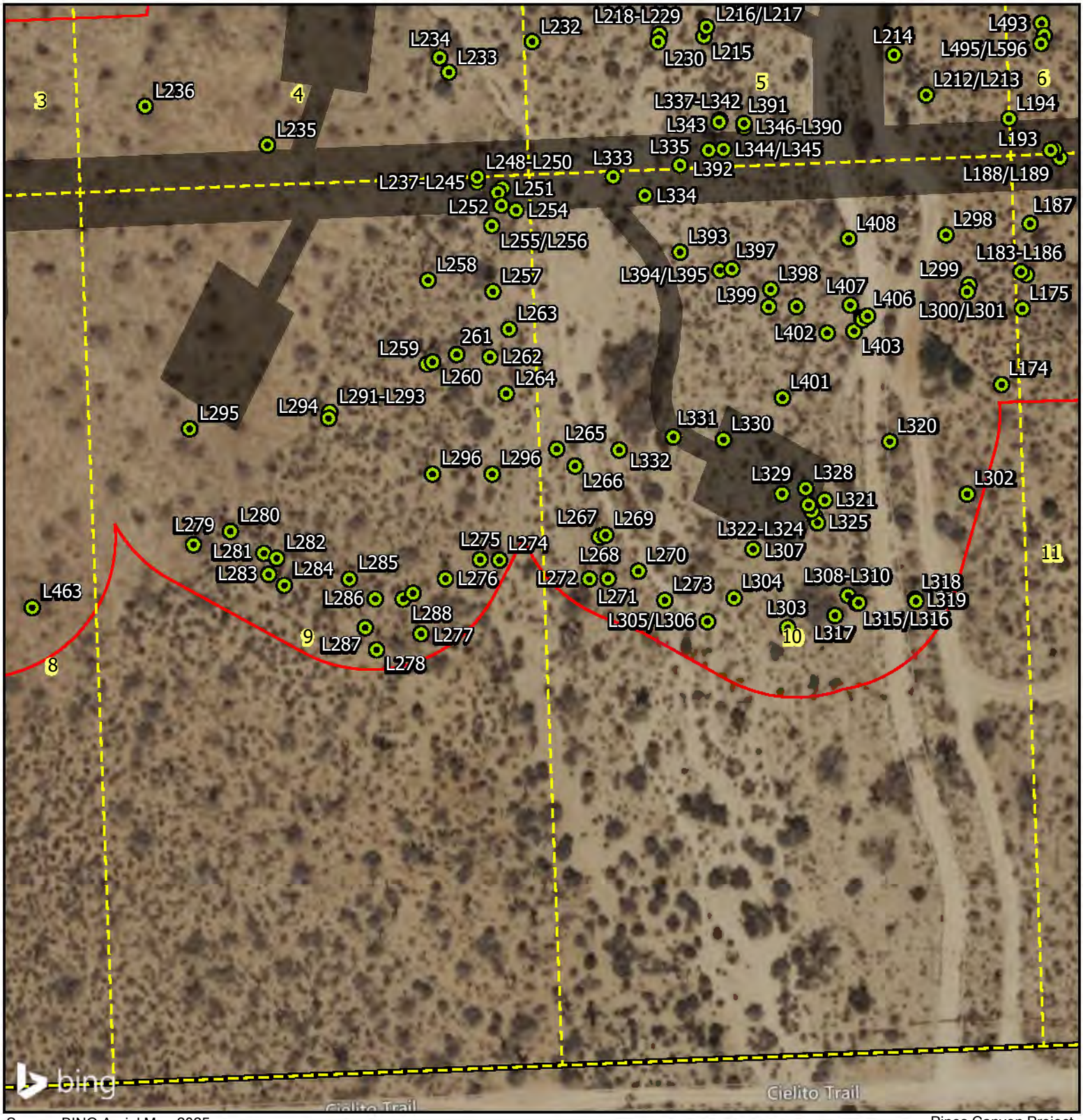
- Western Joshua Tree
- Joshua Tree Survey Area
- Proposed Development Footprint
- Proposed Single Family House Lot
- Project Site

0 55 110 Feet

Scale: 1:1,152

N

SOUTH ENVIRONMENTAL



Source: BING Aerial Map 2025

Pipes Canyon Project

Figure 1F. JT Inventory Lots 9 and 10

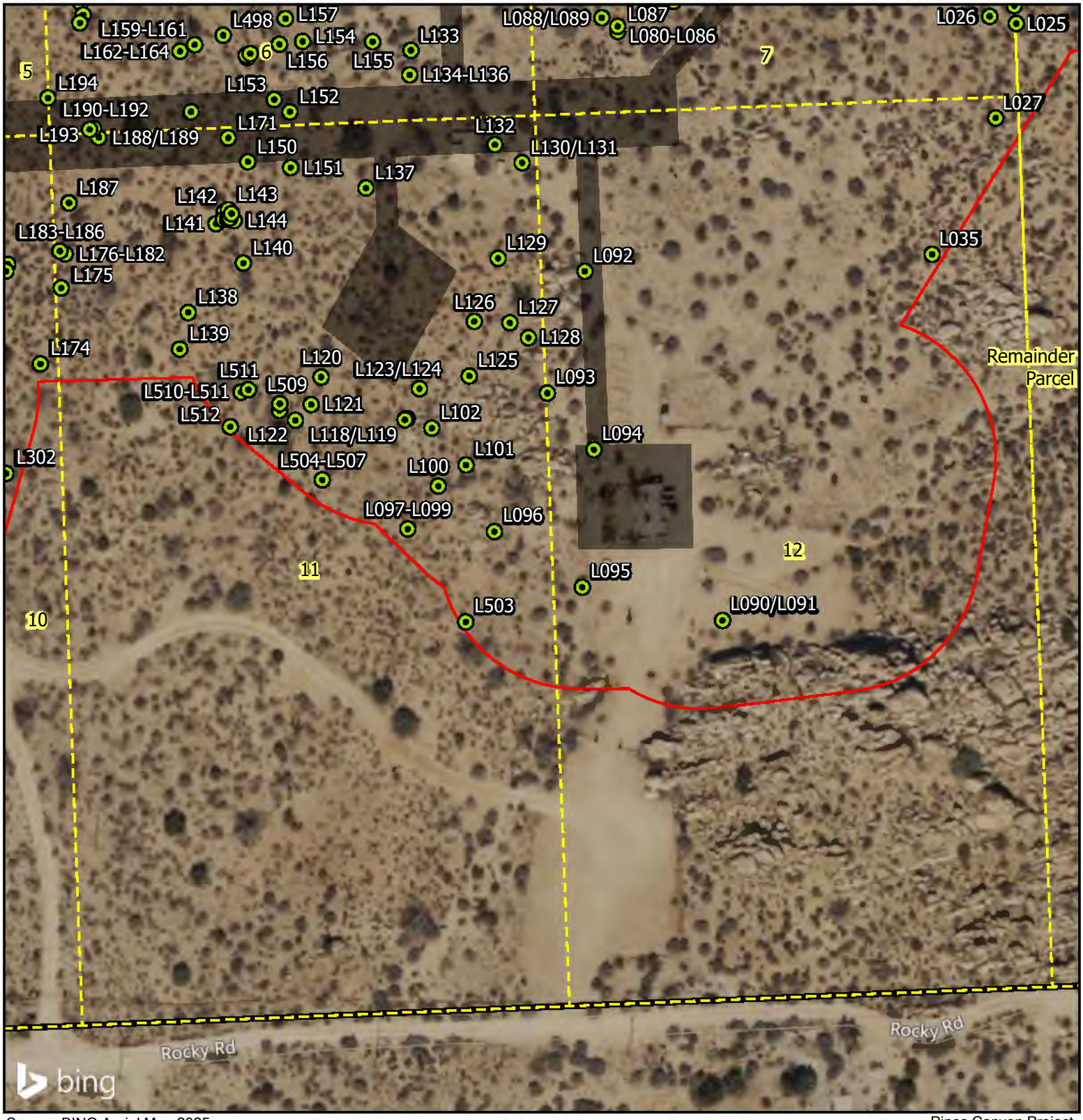
0 55 110 Feet

Scale: 1:1,152

N

- Western Joshua Tree
- Joshua Tree Survey Area
- Proposed Development Footprint
- Proposed Single Family House Lot
- Project Site

SOUTH ENVIRONMENTAL



Source: BING Aerial Map 2025

Pipes Canyon Project

Figure 1G. JT Inventory Lots 11 and 12

- Western Joshua Tree
- Joshua Tree Survey Area
- Proposed Development Footprint
- Proposed Single Family House Lot
- Project Site

0 55 110 Feet

Scale: 1:1,152

N

SOUTH ENVIRONMENTAL

4.Recommendations and Conclusions

4.1 Permitting and Mitigation Fees

Due to the proposed removal of 58 Joshua trees for the project, it will require a permit from the California Department of Fish and Wildlife (CDFW) prior to removing the trees. To obtain the permit the applicant must complete a permit application and submit the application and Joshua tree inventory to the CDFW Region 6 Office via the online permitting system. This permit will require coordination with both the County of San Bernardino and CDFW to determine the number of Joshua trees that the agencies would require for transplanting to areas outside of the development. However, there is an in-lieu fee program that allows for a fee-based mitigation for removal of Joshua trees. The 2025 Western Joshua Tree Conservation Act Incidental Take Permit annual mitigation fees for the proposed removal of 58 Joshua trees within the reduced fee area is a total of $12,010.50 as follows:

- 28 Class A trees x $152.75 = $4,277.00
- 28 Class B trees x $203.50 = $5,698.00
- 2 Class C trees x $1,017.75 = $2,035.50

4.1.1 Joshua Tree Avoidance During Construction

- South Environmental recommends installing temporary protective fencing between the project work space and each Joshua tree during construction of the project. The fencing would be high-visibility fencing placed at a minimum 15-meter buffer zone prior to start of construction (or at the distance that is permitted for trees closer to the site). No work or project activities shall occur within the fenced area and all work shall occur outside of the proposed Joshua tree buffers. Fencing would help prevent compaction and/or contamination of soil and root zone.

- During construction, heavy equipment and vehicles shall be operated in accordance with standard Best Management Practices (BMPs). For example, all equipment used in the workspace shall be properly maintained such that no leaks of oil, fuel, or residues will take place. Provisions shall be in place to remediate any accidental spills. Implementation of the BMPs will help minimize the potential for impact to Joshua trees both within and outside the Joshua tree buffer zones.

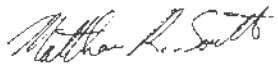
- Night work should be avoided to ensure no disturbance of pollinators or photoperiods for the remaining Joshua trees.

4.2 Conclusion

A total of 548 Joshua trees were identified by South Environmental within the project survey area. A total of 58 Joshua trees are proposed for removal by the project, which would require a permit from CFDW. In-lieu fees for the loss of the 58 trees would be as much as $12,010.50, but overall mitigation would be determined by CDFW and San Bernardino County and could include relocation of some or all of the trees that are proposed for removal. The project would need to obtain the permit prior to removal of the trees and prior to start of construction of the project. Additional mitigation is recommended by South Environmental including installation of protected fencing around the remaining Joshua Trees during construction, BMPs to avoid damaging trees or root zones, and limiting construction to daytime hours.

If you have any questions regarding the information in this report, please contact Matthew South by email: msouth@southenvironmental.com or by mobile phone: 303-818-3632.

Sincerely,



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Principal Biologist

References

Bowns, J.E. 1973. An Auto-ecological Study of Blackbrush (*Coleogyne ramosissima* torr.) in southwestern Utah, All Graduate Theses and Dissertations, 1442, Utah State University, Logan Utah.

County of San Bernardino. 2007. San Bernardino County Joshua Tree Community Plan, San Bernardino, California.

Rundel, P.W. Personal communication, August 13-18, 2021. University of California, Los Angeles, California.

State of California. Western Joshua Tree Conservation Act, Senate Bill 122, Chapter 11.5 added to Division 2 of the Fish and Game Code.

Appendix A: Joshua Tree Data Matrix

Pipes Canyon Joshua Tree Inventory

Tree ID	Latitude	Longitude	Size Class	Health	Mature (Y/N)	Flowers/ Fruit (Y/N)	Impact	Within 15m of Tree	Canopy	Structure
L001	34.19979477	-116.5003967	1-5m	3	Y	N			5ft	Upright
L002	34.1996727	-116.5002213	<1m	4	N	N			<1ft	Upright
L003	34.1996727	-116.5002213	<1m	5	N	N			<1ft	Upright
L004	34.1996727	-116.5002213	1-5m	4	N	N			<1ft	Upright
L005	34.1996727	-116.5002213	1-5m	4	Y	Y			7ft	Upright
L006	34.1996727	-116.5002213	1-5m	4	Y	Y			6ft	Upright
L007	34.19942856	-116.5000687	1-5m	4	Y	Y			4ft	Upright
L008	34.19919968	-116.5001221	1-5m	5	Y	Y			3ft	Upright
L009	34.19929504	-116.500206	<1m	1	N	N			<1ft	Upright
L010	34.19929504	-116.5002365	>5m	3	Y	Y			20ft	Upright but limbs are fragile
L011	34.19924927	-116.500267	1-5m	5	Y	Y			6ft	Upright
L012	34.1993866	-116.5004044	1-5m	5	N	N			1ft	Upright
L013	34.19971848	-116.5005188	<1m	5	N	N			<1ft	Upright
L014	34.1996994	-116.5006104	1-5m	4	N	N		Y	1ft	Upright
L015	34.19971466	-116.5008163	1-5m	1	N	N		Y	<1ft	On ground
L016	34.19971466	-116.5008163	1-5m	1	N	N		Y	<1ft	On ground
L017	34.19935226	-116.5005722	<1m	5	N	N		Y	<1ft	Upright
L018	34.19934464	-116.5005798	<1m	4	N	N		Y	<1ft	Upright
L019	34.19934464	-116.5005798	1-5m	5	Y	Y		Y	9ft	Upright
L020	34.19932938	-116.5006104	1-5m	5	Y	Y		Y	13ft	Upright
L021	34.19906998	-116.5004196	<1m	4	N	N			<1ft	Upright
L022	34.19902039	-116.5004959	<1m	4	N	N			<1ft	Upright
L023	34.1990242	-116.5005035	1-5m	5	Y	N			7ft	Upright
L024	34.19900513	-116.5005112	1-5m	5	Y	N			2ft	Upright
L025	34.19896698	-116.5005112	1-5m	4	N	N			1ft	Upright
L026	34.19898605	-116.5005722	<1m	4	N	N			<1ft	Upright
L027	34.19878387	-116.5005646	1-5m	5	Y	Y			7ft	Upright
L028	34.19925308	-116.5007095	1-5m	4	Y	Y		Y	6ft	Upright
L029	34.19925308	-116.5007095	1-5m	4	Y	Y		Y	12ft	Upright
L030	34.19922256	-116.5007782	1-5m	5	Y	Y		Y	8ft	Upright
L031	34.19940567	-116.5009689	1-5m	4	N	N		Y	1ft	Upright
L032	34.19953537	-116.5010223	1-5m	4	Y	N			3ft	Upright
L033	34.19917679	-116.5009918	1-5m	4	N	N		Y	2ft	Upright
L034	34.19907761	-116.5009308	1-5m	5	Y	Y		Y	15ft	Upright
L035	34.19852066	-116.5007248	1-5m	4	N	N			1ft	Upright
L036	34.19903564	-116.5013123	<1m	4	N	N		Y	<1ft	Upright
L037	34.19913101	-116.5012207	<1m	4	N	N		Y	<1ft	Upright
L038	34.19913101	-116.5012207	<1m	4	N	N		Y	<1ft	Upright
L039	34.19913101	-116.5012207	<1m	4	N	N		Y	<1ft	Upright
L040	34.19913101	-116.5012207	<1m	4	N	N		Y	<1ft	Upright
L041	34.19913101	-116.5012207	<1m	4	N	N		Y	<1ft	Upright
L042	34.19913101	-116.5012207	<1m	4	N	N		Y	<1ft	Upright
L043	34.19913101	-116.5012207	<1m	4	N	N		Y	<1ft	Upright
L044	34.19913101	-116.5012207	<1m	4	N	N		Y	<1ft	Upright
L045	34.19913101	-116.5012207	<1m	4	N	N		Y	<1ft	Upright
L046	34.19913101	-116.5012131	1-5m	4	N	N		Y	1ft	Upright
L047	34.19913101	-116.5012131	1-5m	5	Y	N		Y	3ft	Upright
L048	34.19916916	-116.5013046	1-5m	5	Y	N			3ft	Upright
L049	34.19918442	-116.5013885	<1m	4	N	N			<1ft	Upright
L050	34.19918442	-116.5013885	<1m	4	N	N			<1ft	Upright

Pipes Canyon Joshua Tree Inventory

Tree ID	Latitude	Longitude	Size Class	Health	Mature (Y/N)	Flowers/ Fruit (Y/N)	Impact	Within 15m of Tree	Canopy	Structure
L051	34.19918442	-116.5013885	1-5m	5	Y	Y			4ft	Upright
L052	34.19919968	-116.501297	1-5m	4	N	N			1ft	Upright
L053	34.19922256	-116.5012589	1-5m	4	N	N			<1ft	Upright
L054	34.19928741	-116.501236	<1m	4	N	N			<1ft	Upright
L055	34.19930267	-116.5013733	1-5m	4	N	N			1ft	Upright
L056	34.19929886	-116.5013809	<1m	4	N	N			<1ft	Upright
L057	34.19929886	-116.5013809	<1m	4	N	N			<1ft	Upright
L058	34.19929886	-116.5013809	<1m	4	N	N			<1ft	Upright
L059	34.19929886	-116.5013809	<1m	4	N	N			<1ft	Upright
L060	34.19929886	-116.5013809	<1m	4	N	N			<1ft	Upright
L061	34.19929886	-116.5013809	<1m	4	N	N			<1ft	Upright
L062	34.19929886	-116.5013809	<1m	4	N	N			<1ft	Upright
L063	34.19929886	-116.5013809	<1m	4	N	N			<1ft	Upright
L064	34.19929886	-116.5013809	<1m	4	N	N			<1ft	Upright
L065	34.19929886	-116.5013809	<1m	4	N	N			<1ft	Upright
L066	34.19929886	-116.5013809	<1m	4	N	N			<1ft	Upright
L067	34.19929886	-116.5013809	<1m	4	N	N			<1ft	Upright
L068	34.19929886	-116.5013809	<1m	4	N	N			<1ft	Upright
L069	34.19931412	-116.5013809	1-5m	5	Y	Y			3ft	Upright
L070	34.19934082	-116.5014343	1-5m	4	N	N			1ft	Upright
L071	34.19924164	-116.5014725	1-5m	4	Y	N			2ft	Upright
L072	34.19947052	-116.5016785	1-5m	5	Y	N			2ft	Upright
L073	34.19942856	-116.501976	<1m	4	N	N		Y	<1ft	Upright
L074	34.19942856	-116.501976	1-5m	5	N	N		Y	2ft	Upright
L075	34.19934464	-116.5020599	1-5m	5	Y	N		Y	5ft	Upright
L076	34.19932175	-116.5020828	1-5m	5	Y	Y		Y	5ft	Upright
L077	34.19922638	-116.502037	<1m	4	N	N	Remove	Y	<1ft	Upright
L078	34.19922638	-116.502037	<1m	4	N	N	Remove	Y	<1ft	Upright
L079	34.19922638	-116.502037	1-5m	5	N	N	Remove	Y	1ft	Upright
L080	34.19898224	-116.5014496	<1m	4	N	N		Y	<1ft	Upright
L081	34.19898224	-116.5014496	<1m	4	N	N		Y	<1ft	Upright
L082	34.19898224	-116.5014496	<1m	4	N	N		Y	<1ft	Upright
L083	34.19898224	-116.5014496	<1m	4	N	N		Y	<1ft	Upright
L084	34.19898224	-116.5014496	<1m	4	N	N		Y	<1ft	Upright
L085	34.19898224	-116.5014496	<1m	4	N	N		Y	<1ft	Upright
L086	34.19898224	-116.5014496	<1m	4	N	N		Y	<1ft	Upright
L087	34.19899368	-116.5014496	1-5m	5	N	N		Y	1ft	Upright
L088	34.19900894	-116.5014877	<1m	4	N	N		Y	<1ft	Upright
L089	34.19900894	-116.5014877	1-5m	5	Y	N		Y	3ft	Upright
L090	34.19781876	-116.5012512	<1m	4	N	N			<1ft	Upright
L091	34.19781876	-116.5012512	1-5m	4	N	N			3ft	Upright
L092	34.19851303	-116.5015488	1-5m	4	N	N	Remove	Y	1ft	Upright
L093	34.19827652	-116.5016479	1-5m	4	N	N		Y	1ft	Upright
L094	34.19816208	-116.5015411	1-5m	4	N	N	Remove	Y	2ft	Upright
L095	34.19789505	-116.5015793	1-5m	4	N	N		Y	1ft	Upright
L096	34.19800949	-116.5017853	<1m	4	N	N			<1ft	Upright
L097	34.19802094	-116.5019913	<1m	4	N	N			<1ft	Upright
L098	34.19802094	-116.5019913	<1m	4	N	N			<1ft	Upright
L099	34.19802094	-116.5019913	1-5m	5	Y	N			6ft	Upright
L100	34.19810486	-116.501915	1-5m	4	Y	Y			6ft	Upright
L101	34.19814301	-116.5018463	<1m	4	N	N			<1ft	Upright
L102	34.19821548	-116.5019226	<1m	4	N	N		Y	<1ft	Upright

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Tree ID	Latitude	Longitude	Size Class	Health	Mature (Y/N)	Flowers/ Fruit (Y/N)	Impact	Within 15m of Tree	Canopy	Structure
L103	34.19823837	-116.5019836	<1m	4	N	N		Y	<1ft	Upright
L104	34.19823837	-116.5019836	<1m	4	N	N		Y	<1ft	Upright
L105	34.19823837	-116.5019836	<1m	4	N	N		Y	<1ft	Upright
L106	34.19823837	-116.5019836	<1m	4	N	N		Y	<1ft	Upright
L107	34.19823837	-116.5019836	<1m	4	N	N		Y	<1ft	Upright
L108	34.19823837	-116.5019836	<1m	4	N	N		Y	<1ft	Upright
L109	34.19823837	-116.5019836	<1m	4	N	N		Y	<1ft	Upright
L110	34.19823837	-116.5019836	<1m	4	N	N		Y	<1ft	Upright
L111	34.19823837	-116.5019836	<1m	4	N	N		Y	<1ft	Upright
L112	34.19823837	-116.5019836	<1m	4	N	N		Y	<1ft	Upright
L113	34.19823837	-116.5019836	<1m	4	N	N		Y	<1ft	Upright
L114	34.19823837	-116.5019836	<1m	4	N	N		Y	<1ft	Upright
L115	34.19823837	-116.5019836	<1m	4	N	N		Y	<1ft	Upright
L116	34.19823837	-116.5019836	<1m	4	N	N		Y	<1ft	Upright
L117	34.19823837	-116.5019836	<1m	4	N	N		Y	<1ft	Upright
L118	34.19823456	-116.5019836	1-5m	5	N	N		Y	1ft	Upright
L119	34.19823456	-116.5019836	1-5m	1	Y	N		Y	3ft	Upright but not intact
L120	34.19832611	-116.502182	1-5m	4	Y	N		Y	2ft	Upright
L121	34.19827271	-116.5022049	1-5m	4	Y	Y		Y	3ft	Upright
L122	34.19824219	-116.502243	1-5m	5	Y	Y		Y	8ft	Upright
L123	34.19829559	-116.5019455	1-5m	3	N	N		Y	1ft	Upright
L124	34.19829559	-116.5019455	1-5m	3	Y	N		Y	4ft	Upright
L125	34.19831848	-116.5018311	<1m	4	N	N		Y	<1ft	Upright
L126	34.19842529	-116.5018158	1-5m	5	Y	Y		Y	4ft	Upright
L127	34.19841766	-116.5017319	1-5m	4	N	N			1ft	Upright
L128	34.19838715	-116.5016861	1-5m	4	N	N		Y	1ft	Upright
L129	34.19854736	-116.5017548	1-5m	5	N	N		Y	2ft	Upright
L130	34.19873047	-116.5016861	1-5m	4	N	N		Y	1ft	Upright
L131	34.19873047	-116.5016861	1-5m	4	N	N		Y	1ft	Upright
L132	34.19876862	-116.5017471	1-5m	4	N	N	Remove	Y	1ft	Upright
L133	34.19895935	-116.5019379	1-5m	4	N	N		Y	1ft	Upright
L134	34.19891357	-116.5019455	<1m	4	N	N		Y	<1ft	Upright
L135	34.19891357	-116.5019455	<1m	4	N	N		Y	<1ft	Upright
L136	34.19891357	-116.5019455	1-5m	5	Y	N		Y	3ft	Upright
L137	34.19869232	-116.5020599	1-5m	4	N	N		Y	1ft	Upright
L138	34.19846344	-116.5024872	1-5m	5	Y	N			5ft	Upright
L139	34.19839096	-116.5025101	1-5m	5	Y	Y			2ft	Upright
L140	34.19855499	-116.5023575	>5m	5	Y	Y			12ft	Upright
L141	34.1986351	-116.5024185	1-5m	5	Y	Y		Y	4ft	Upright
L142	34.19865799	-116.5023956	<1m	4	N	N		Y	<1ft	Upright
L143	34.1986618	-116.502388	<1m	4	N	N		Y	<1ft	Upright
L144	34.19863892	-116.5023727	<1m	5	N	N		Y	<1ft	Upright
L145	34.19864273	-116.5023804	1-5m	4	N	N		Y	2ft	Upright
L146	34.19864273	-116.5023956	1-5m	5	N	Y		Y	3ft	Upright
L147	34.19864273	-116.502388	1-5m	5	N	N		Y	3ft	Upright
L148	34.19864273	-116.5023804	1-5m	5	Y	Y		Y	4ft	Upright
L149	34.19865417	-116.5023804	1-5m	1	N	N		Y	4ft	On the ground
L150	34.19875336	-116.5023346	<1m	4	N	N	Remove	Y	<1ft	Upright
L151	34.1987381	-116.5022354	1-5m	5	N	Y		Y	2ft	Upright
L152	34.19884872	-116.5022278	1-5m	5	Y	Y	Remove	Y	10ft	Upright

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Tree ID	Latitude	Longitude	Size Class	Health	Mature (Y/N)	Flowers/ Fruit (Y/N)	Impact	Within 15m of Tree	Canopy	Structure
L153	34.19887161	-116.5022659	1-5m	5	Y	Y	Remove	Y	3ft	Upright
L154	34.19898605	-116.5021973	<1m	4	N	N		Y	<1ft	Upright
L155	34.19897842	-116.5020294	<1m	4	N	N		Y	<1ft	Upright
L156	34.19898224	-116.5022507	1-5m	5	N	Y		Y	2ft	Upright
L157	34.19903183	-116.5022354	1-5m	5	Y	Y			5ft	Upright
L158	34.19910049	-116.5022812	1-5m	5	Y	N			3ft	Upright
L159	34.19898605	-116.502449	<1m	4	N	N		Y	<1ft	Upright
L160	34.19898605	-116.502449	1-5m	4	N	N		Y	1ft	Upright
L161	34.19898605	-116.502449	1-5m	5	Y	Y		Y	10ft	Upright
L162	34.19897461	-116.5024872	<1m	4	N	N		Y	<1ft	Upright
L163	34.19897461	-116.5024872	<1m	4	N	N		Y	<1ft	Upright
L164	34.19897461	-116.5024872	1-5m	5	Y	Y		Y	8ft	Upright
L165	34.19895935	-116.502327	<1m	4	N	N		Y	<1ft	Upright
L166	34.19895935	-116.502327	<1m	4	N	N		Y	<1ft	Upright
L167	34.19895935	-116.502327	<1m	4	N	N		Y	<1ft	Upright
L168	34.19896317	-116.502327	<1m	5	N	N		Y	<1ft	Upright
L169	34.19896698	-116.5023193	1-5m	4	N	N		Y	1ft	Upright
L170	34.19896698	-116.5023193	1-5m	5	Y	N		Y	4ft	Upright
L171	34.19880295	-116.5023804	1-5m	5	Y	Y	Remove	Y	3ft	Upright
L172	34.19885635	-116.5024643	<1m	4	N	N	Remove	Y	<1ft	Upright
L173	34.19885635	-116.5024643	1-5m	5	Y	Y	Remove	Y	3ft	Upright
L174	34.19837189	-116.5028381	1-5m	5	Y	Y			6ft	Upright
L175	34.19852066	-116.5027847	1-5m	5	Y	Y			7ft	Upright
L176	34.19858551	-116.5027771	<1m	5	N	N			1ft	Upright
L177	34.19858551	-116.5027771	<1m	4	N	N			1ft	Upright
L178	34.19858551	-116.5027771	<1m	4	N	N			1ft	Upright
L179	34.19858551	-116.5027771	<1m	4	N	N			1ft	Upright
L180	34.19858551	-116.5027771	<1m	4	N	N			1ft	Upright
L181	34.19858551	-116.5027771	<1m	4	N	N			1ft	Upright
L182	34.19858551	-116.5027771	<1m	4	N	N			1ft	Upright
L183	34.19859314	-116.5027847	1-5m	4	N	N			1ft	Upright
L184	34.19859314	-116.5027847	1-5m	5	N	N			2ft	Upright
L185	34.19859314	-116.5027847	1-5m	5	Y	Y			8ft	Fragile/bent
L186	34.19859314	-116.5027847	1-5m	5	Y	Y			12ft	Upright
L187	34.19868469	-116.5027618	1-5m	5	Y	Y		Y	4ft	Upright
L188	34.19881058	-116.5026855	<1m	4	N	N	Remove	Y	<1ft	Upright
L189	34.19881058	-116.5026855	<1m	4	N	N	Remove	Y	<1ft	Upright
L190	34.19882965	-116.5026932	<1m	4	N	N	Remove	Y	<1ft	Upright
L191	34.19882965	-116.5026932	<1m	4	N	N	Remove	Y	<1ft	Upright
L192	34.19882965	-116.5026932	<1m	4	N	N	Remove	Y	1ft	Upright
L193	34.19882965	-116.5027084	1-5m	5	Y	Y	Remove	Y	8ft	Upright
L194	34.1988945	-116.5028	1-5m	5	Y	Y		Y	4ft	Upright
L195	34.19916534	-116.5028229	1-5m	5	Y	Y			10ft	Upright
L196	34.19927979	-116.5027237	1-5m	5	Y	Y			5ft	Upright
L197	34.19917679	-116.5028992	1-5m	4	N	N		Y	1ft	Upright
L198	34.19943237	-116.5028534	1-5m	4	N	N		Y	1ft	Upright
L199	34.19960785	-116.5033112	1-5m	5	Y	Y			10ft	Upright but some limbs have fallen off
L200	34.19966888	-116.5032883	1-5m	5	Y	Y			3ft	Upright

Pipes Canyon Joshua Tree Inventory

Tree ID	Latitude	Longitude	Size Class	Health	Mature (Y/N)	Flowers/ Fruit (Y/N)	Impact	Within 15m of Tree	Canopy	Structure
L201	34.19971848	-116.5035477	1-5m	4	Y	N			4ft	Upright
L202	34.19963455	-116.5037003	1-5m	4	N	N		Y	1ft	Upright
L203	34.19962311	-116.5035858	<1m	4	N	N		Y	<1ft	Upright
L204	34.19950485	-116.5036087	1-5m	1	N	N		Y	6ft	Upright
L205	34.19950485	-116.5036087	1-5m	1	N	N		Y	10ft	Upright
L206	34.19934464	-116.5037003	<1m	4	N	N	Remove	Y	<1ft	Upright
L207	34.19929886	-116.5037384	1-5m	4	N	N		Y	1ft	Upright
L208	34.19929886	-116.5037384	1-5m	4	N	N		Y	1ft	Upright
L209	34.19929886	-116.5037384	1-5m	5	Y	Y		Y	5ft	Upright
L210	34.19927597	-116.5036469	1-5m	4	N	N	Remove	Y	1ft	Upright
L211	34.19933701	-116.5035934	<1m	4	N	N	Remove	Y	<1ft	Upright
L212	34.19894409	-116.5029907	<1m	4	N	N		Y	<1ft	Upright
L213	34.19894409	-116.5029907	1-5m	5	Y	Y		Y	6ft	Upright
L214	34.19902802	-116.503067	<1m	4	N	N		Y	<1ft	Upright
L215	34.19907761	-116.5035172	<1m	4	N	N		Y	<1ft	Upright
L216	34.19909286	-116.5035095	1-5m	5	Y	Y		Y	6ft	Upright
L217	34.19909286	-116.5035095	1-5m	5	Y	Y		Y	6ft	Upright
L218	34.19908524	-116.5036163	<1m	4	N	N		Y	<1ft	Upright
L219	34.19908524	-116.5036163	<1m	4	N	N		Y	<1ft	Upright
L220	34.19908524	-116.5036163	<1m	4	N	N		Y	<1ft	Upright
L221	34.19908524	-116.5036163	<1m	4	N	N		Y	<1ft	Upright
L222	34.19908524	-116.5036163	<1m	4	N	N		Y	<1ft	Upright
L223	34.19908524	-116.5036163	<1m	4	N	N		Y	<1ft	Upright
L224	34.19908524	-116.5036163	<1m	4	N	N		Y	<1ft	Upright
L225	34.19908524	-116.5036163	<1m	4	N	N		Y	<1ft	Upright
L226	34.19908524	-116.5036163	<1m	4	N	N		Y	<1ft	Upright
L227	34.19908524	-116.5036163	<1m	4	N	N		Y	<1ft	Upright
L228	34.19908524	-116.5036163	<1m	4	N	N		Y	<1ft	Upright
L229	34.19908524	-116.5036163	<1m	4	N	N		Y	<1ft	Upright
L230	34.19906998	-116.503624	>5m	5	Y	Y			12ft	Upright
L231	34.19923019	-116.5038528	1-5m	4	N	N		Y	2ft	Upright
L232	34.19907761	-116.5039215	1-5m	1	N	N			12ft	On ground
L233	34.1990242	-116.5041199	1-5m	5	Y	Y			4ft	Upright
L234	34.19905472	-116.5041428	1-5m	5	Y	Y			12ft	Upright
L235	34.1988945	-116.5045547	<1m	4	N	N		Y	3ft	The base tree they are coming off of is dead & 1-5m
L236	34.19897842	-116.504837	1-5m	3	Y	Y		Y	4ft	Leaning over
L237	34.19880676	-116.5040588	<1m	4	N	N	Remove	Y	1ft	Upright
L238	34.19880676	-116.5040588	<1m	4	N	N	Remove	Y	1ft	Upright
L239	34.19880676	-116.5040588	<1m	4	N	N	Remove	Y	1ft	Upright
L240	34.19880676	-116.5040588	<1m	4	N	N	Remove	Y	1ft	Upright
L241	34.19880676	-116.5040588	<1m	4	N	N	Remove	Y	1ft	Upright
L242	34.19880676	-116.5040588	<1m	4	N	N	Remove	Y	1ft	Upright
L243	34.19880676	-116.5040588	<1m	4	N	N	Remove	Y	1ft	Upright
L244	34.19880676	-116.5040588	<1m	4	N	N	Remove	Y	1ft	Upright
L245	34.19880676	-116.5040588	<1m	4	N	N	Remove	Y	1ft	Upright
L248	34.19881821	-116.5040588	1-5m	4	N	N	Remove	Y	1ft	Upright

Pipes Canyon Joshua Tree Inventory

Tree ID	Latitude	Longitude	Size Class	Health	Mature (Y/N)	Flowers/ Fruit (Y/N)	Impact	Within 15m of Tree	Canopy	Structure
L249	34.19881821	-116.5040588	1-5m	5	N	Y	Remove	Y	2ft	Upright
L250	34.19881821	-116.5040588	>5m	5	Y	Y	Remove	Y	8ft	Upright
L251	34.1987915	-116.5040054	<1m	4	N	N	Remove	Y	<1ft	Upright
L252	34.19878387	-116.5040131	1-5m	5	Y	Y	Remove	Y	6ft	Upright
L253	34.19876099	-116.5040054	1-5m	5	Y	Y	Remove	Y	20ft	Upright
L254	34.19874954	-116.5039749	1-5m	5	Y	N	Remove	Y	4ft	Upright
L255	34.19871902	-116.5040283	1-5m	3	Y	N		Y	4ft	Leaning over
L256	34.19871902	-116.5040283	1-5m	2	N	N		Y	5ft	Upright w/some limb loss
L257	34.19858932	-116.5040359	1-5m	5	Y	Y			15ft	Upright
L258	34.19861603	-116.5041885	1-5m	2	Y	Y		Y	10ft	Upright, some limbs loss and trunk damage
L259	34.198452	-116.5041962	1-5m	3	Y	Y			6ft	Main trunk damaged w/down limbs & has young/healthy undergrowth
L260	34.19845581	-116.5041809	1-5m	3	Y	Y			6ft	Limb damage
L261	34.19847107	-116.5041275	<1m	4	N	N			<1ft	Upright
L262	34.19846344	-116.5040436	1-5m	5	Y	Y			8ft	Upright
L263	34.19851685	-116.5039978	1-5m	4	N	N			1ft	Upright
L264	34.19839096	-116.5040131	1-5m	4	N	N			1ft	Upright
L265	34.19827652	-116.5038986	1-5m	4	N	N			1ft	Upright
L266	34.19824219	-116.5038528	1-5m	4	N	N			1ft	Upright
L267	34.19810486	-116.5037918	1-5m	5	Y	Y			8ft	Upright
L268	34.19810104	-116.5038071	<1m	4	N	N			<1ft	Upright
L269	34.19810486	-116.5037918	1-5m	4	N	N			1ft	Upright
L270	34.19803238	-116.5037155	1-5m	5	Y	Y			6ft	Upright
L271	34.19802094	-116.5037842	1-5m	4	N	N			8ft	Upright w/ fallen taller tree in the middle
L272	34.19802094	-116.50383	1-5m	5	Y	Y			6ft	Upright
L273	34.19797134	-116.5036545	1-5m	4	N	N			1ft	Upright
L274	34.1980629	-116.5040436	1-5m	4	N	N			1ft	Upright
L275	34.19806671	-116.5040894	1-5m	5	N	N			1ft	Upright
L276	34.19803238	-116.5041733	1-5m	4	Y	Y			8ft	Upright but trunk damage
L277	34.19792557	-116.5042343	1-5m	5	Y	Y			3ft	Upright
L278	34.19789505	-116.5043411	1-5m	5	Y	Y			5ft	Upright
L279	34.1981163	-116.5047607	1-5m	5	Y	Y			6ft	Upright

Pipes Canyon Joshua Tree Inventory

Tree ID	Latitude	Longitude	Size Class	Health	Mature (Y/N)	Flowers/ Fruit (Y/N)	Impact	Within 15m of Tree	Canopy	Structure
L280	34.19813919	-116.5046768	1-5m	5	Y	Y			5ft	Upright
L281	34.19809341	-116.5046005	>5m	5	Y	Y			12ft	Upright
L282	34.19808197	-116.50457	1-5m	5	Y	Y			4ft	Upright
L283	34.19805145	-116.5045853	>5m	5	Y	Y			12ft	Upright
L284	34.19802856	-116.5045547	>5m	5	Y	Y			20ft	Upright
L285	34.19803619	-116.5044022	1-5m	5	Y	Y			10ft	Upright
L286	34.19799805	-116.5043411	1-5m	5	Y	Y			4ft	Upright
L287	34.19794083	-116.504364	1-5m	5	N	Y			2ft	Upright
L288	34.19799423	-116.5042725	1-5m	5	Y	Y			4ft	Upright
L289	34.19800568	-116.5042496	1-5m	4	N	N			1ft	Upright
L290	34.19800568	-116.5042496	1-5m	5	Y	Y			4ft	Upright
L291	34.19836426	-116.5044327	<1m	4	N	N			<1ft	Upright
L292	34.19836426	-116.5044327	<1m	4	N	N			<1ft	Upright
L293	34.19836426	-116.5044327	<1m	4	N	N			<1ft	Upright
L294	34.19835281	-116.5044327	1-5m	5	N	N			2ft	Upright
L295	34.19834518	-116.5047607	<1m	4	N	N		Y	<1ft	Upright
L296	34.19823837	-116.5041962	1-5m	5	Y	Y			5ft	Upright
L297	34.19823456	-116.5040512	1-5m	4	N	N			<1ft	Upright
L298	34.19866943	-116.5029602	1-5m	5	Y	Y		Y	5ft	Upright
L299	34.19857025	-116.5029068	<1m	4	N	N			<1ft	Upright
L300	34.19855499	-116.5029144	1-5m	4	N	N			1ft	Upright
L301	34.19855499	-116.5029144	1-5m	5	Y	Y			5ft	Upright
L302	34.19815826	-116.5029297	<1m	4	N	N			<1ft	Next to fallen mature trees
L303	34.19791031	-116.5033646	1-5m	4	N	N			1ft	Upright
L304	34.19797134	-116.5034943	1-5m	4	Y	Y		Y	4ft	Upright
L305	34.19792938	-116.5035553	1-5m	5	N	N			1ft	Upright
L306	34.19792938	-116.5035553	1-5m	4	Y	N			3ft	Upright
L307	34.19806671	-116.5034409	<1m	4	N	N		Y	<1ft	Upright
L308	34.19796753	-116.5032196	<1m	4	N	N		Y	<1ft	Upright
L309	34.19796753	-116.5032196	1-5m	2	N	N		Y	8ft	On ground but not completely dead
L310	34.19796753	-116.5032196	1-5m	5	Y	N		Y	6ft	Upright
L311	34.19795227	-116.5032043	<1m	4	N	N			<1ft	Upright
L312	34.19795227	-116.5032043	<1m	4	N	N			<1ft	Upright
L313	34.19795227	-116.5032043	<1m	4	N	N			<1ft	Upright
L314	34.19795227	-116.5032043	<1m	4	N	N			<1ft	Upright
L315	34.19795227	-116.5031967	1-5m	4	N	N			1ft	Upright
L316	34.19795227	-116.5031967	1-5m	5	Y	Y			6ft	Upright
L317	34.19792938	-116.5032578	1-5m	5	Y	N			10ft	Upright and next to a dead tree
L318	34.19795609	-116.503067	<1m	4	N	N			<1ft	Upright
L319	34.19795227	-116.5030594	1-5m	5	Y	Y			12ft	Upright

Pipes Canyon Joshua Tree Inventory

Tree ID	Latitude	Longitude	Size Class	Health	Mature (Y/N)	Flowers/ Fruit (Y/N)	Impact	Within 15m of Tree	Canopy	Structure
L320	34.19826889	-116.5031128	1-5m	2	Y	N		Y	6ft	Trunk folded over at a 90 degree ang;e, most of it on the ground
L321	34.19815826	-116.5032654	1-5m	4	N	N		Y	1ft	Upright
L322	34.19812775	-116.5032959	<1m	4	N	N		Y	<1ft	Upright
L323	34.19812775	-116.5032959	<1m	4	N	N		Y	<1ft	Upright
L324	34.19812775	-116.5032959	<1m	4	N	N		Y	<1ft	Upright
L325	34.19811249	-116.5032883	1-5m	5	Y	Y		Y	8ft	Upright
L326	34.19813919	-116.5033035	1-5m	5	Y	Y	Remove	Y	8ft	Upright
L327	34.19815063	-116.5033112	<1m	4	N	N	Remove	Y	<1m	Upright
L328	34.19818115	-116.5033112	1-5m	5	Y	Y	Remove	Y	5ft	Upright
L329	34.19817352	-116.5033722	1-5m	5	Y	Y	Remove	Y	10ft	Upright
L330	34.19828415	-116.5035019	1-5m	4	N	N	Remove	Y	2ft	Upright
L331	34.19829178	-116.503624	<1m	4	N	N	Remove	Y	<1m	Upright
L332	34.19827271	-116.5037537	<1m	4	N	N		Y	<1ft	Upright
L333	34.19880676	-116.5037384	1-5m	5	Y	Y	Remove	Y	3ft	Upright
L334	34.19876862	-116.5036697	<1m	4	N	N	Remove	Y	<1ft	Upright
L335	34.19882584	-116.5035782	1-5m	5	N	Y	Remove	Y	2ft	Upright
L336	34.19890976	-116.5034866	<1m	4	N	N			<1ft	Upright
L337	34.19890976	-116.5034866	<1m	4	N	N		Y	<1ft	Upright
L338	34.19890976	-116.5034866	<1m	4	N	N		Y	<1ft	Upright
L339	34.19890976	-116.5034866	<1m	4	N	N		Y	<1ft	Upright
L340	34.19890976	-116.5034866	<1m	4	N	N		Y	<1ft	Upright
L341	34.19890976	-116.5034866	<1m	4	N	N		Y	<1ft	Upright
L342	34.19890976	-116.5034866	<1m	4	N	N		Y	<1ft	Upright
L343	34.19890594	-116.5034866	1-5m	5	Y	Y		Y	10ft	Upright
L344	34.19885254	-116.503479	<1m	4	N	N	Remove	Y	<1ft	Upright
L345	34.19885254	-116.503479	<1m	4	N	N	Remove	Y	<1ft	Upright
L346	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L347	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L348	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L349	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L350	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L351	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L352	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L353	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L354	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L355	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L356	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L357	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L358	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L359	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L360	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L361	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L362	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L363	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L364	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L365	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright

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Tree ID	Latitude	Longitude	Size Class	Health	Mature (Y/N)	Flowers/ Fruit (Y/N)	Impact	Within 15m of Tree	Canopy	Structure
L366	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L367	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L368	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L369	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L370	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L371	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L372	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L373	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L374	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L375	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L376	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L377	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L378	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L379	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L380	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L381	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L382	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L383	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L384	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L385	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L386	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L387	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L388	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L389	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L390	34.1988945	-116.5034256	<1m	4	N	N		Y	<1ft	Upright
L391	34.19890213	-116.5034256	>5m	5	Y	Y		Y	20ft	Upright
L392	34.19885254	-116.5035095	>5m	5	Y	Y	Remove	Y	15ft	Upright
L393	34.19865417	-116.5035858	1-5m	5	N	N		Y	1ft	Upright
L394	34.19861603	-116.5034943	<1m	4	N	N		Y	<1ft	Upright
L395	34.19861603	-116.5034943	<1m	4	N	N		Y	<1ft	Upright
L396	34.19861603	-116.5034943	1-5m	5	Y	Y		Y	10ft	Upright
L397	34.19861984	-116.5034714	1-5m	5	Y	Y		Y	5ft	Upright
L398	34.19857407	-116.5033798	<1m	4	N	N			<1ft	Upright
L399	34.19853973	-116.5033875	1-5m	5	Y	Y			8ft	Upright
L400	34.19853973	-116.5033188	1-5m	5	Y	Y			5ft	Upright
L401	34.19836044	-116.5033569	1-5m	4	N	N		Y	1ft	Upright
L402	34.19848633	-116.5032501	1-5m	3	N	N			2ft	Upright
L403	34.19848633	-116.5031891	1-5m	4	N	N			1ft	Upright
L404	34.19851303	-116.5031662	<1m	4	N	N			<1ft	Upright
L405	34.19850922	-116.5031662	1-5m	5	Y	Y			12ft	Upright
L406	34.19851685	-116.5031509	1-5m	2	N	N			8ft	On ground but not completely dead
L407	34.19853973	-116.5031891	1-5m	5	Y	Y			12ft	Upright
L408	34.19866943	-116.5031891	1-5m	5	Y	Y		Y	8ft	Upright
L409	34.20190811	-116.5002823	1-5m	4	N	N		Y	1 ft	Upright
L410	34.20188141	-116.500206	1-5m	3	N	N			1ft	Upright, but dried out spines

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Tree ID	Latitude	Longitude	Size Class	Health	Mature (Y/N)	Flowers/ Fruit (Y/N)	Impact	Within 15m of Tree	Canopy	Structure
L411	34.20247269	-116.4999084	1-5m	4	Y	Y			3ft	Upright, flowering but dried out and broken spines
L412	34.20261002	-116.5006943	1-5m	4	N	N		Y	<1 ft	Upright
L413	34.20260239	-116.5006866	<1m	4	N	N		Y	<1ft	Upright
L414	34.20265961	-116.5004883	<1m	4	N	N		Y	<1ft	Upright
L415	34.20323181	-116.5010147	<1m	4	N	N			<1ft	Upright
L416	34.20323181	-116.5010147	1-5m	4	N	N			1ft	Upright
L417	34.20322418	-116.5009995	1-5m	4	Y	N			4ft	Upright
L418	34.20325089	-116.5009918	1-5m	4	N	N			2ft	Curved, but stable
L419	34.20333099	-116.5006866	1-5m	5	Y	N			5ft	Upright
L420	34.2029686	-116.5000687	1-5m	4	N	N			1ft	Upright
L421	34.20214844	-116.4996796	1-5m	4	N	N			1ft	Upright
L422	34.20214844	-116.4996796	1-5m	4	N	N			1ft	Upright
L423	34.20214844	-116.4996796	1-5m	5	Y	Y			6ft	Upright
L424	34.20214844	-116.4996796	1-5m	4	N	N			1ft	Upright
L425	34.2021637	-116.4996567	1-5m	4	Y	Y			2ft	Upright
L426	34.2021637	-116.4996567	1-5m	5	Y	Y			15ft	Upright
L427	34.20216751	-116.4996567	1-5m	4	N	N			2ft	Upright
L428	34.20216751	-116.4996567	1-5m	5	Y	Y			8ft	Upright
L429	34.20206451	-116.4995346	1-5m	4	Y	N			4ft	Upright, flowering but dried out spines
L430	34.20205688	-116.499649	1-5m	5	Y	Y			10ft	Upright
L431	34.20172501	-116.4997406	1-5m	4	Y	N			5ft	Upright
L432	34.20175171	-116.5001373	1-5m	3	N	N			2ft	Upright but top falling off and is dried out
L433	34.20168686	-116.5000687	1-5m	4	N	N			1ft	Upright
L434	34.19898987	-116.5056	<1m	4	N	N		Y	2ft	Upright
L435	34.1995163	-116.506073	1-5m	5	Y	Y	Remove	Y	4ft	Upright
L436	34.19973373	-116.5058289	1-5m	5	Y	Y			10ft	Upright
L437	34.19972229	-116.5058289	1-5m	5	Y	Y			5ft	Upright
L438	34.19996262	-116.5061111	1-5m	5	Y	Y			5ft	Upright
L439	34.19979858	-116.5062866	<1m	5	N	N		Y	2ft	Upright
L440	34.19979858	-116.5063171	1-5m	4	Y	Y		Y	6ft	Upright with fragile limbs
L441	34.19981003	-116.5065002	<1m	4	N	N			1ft	Upright
L442	34.19981003	-116.5065002	<1m	4	N	N			1ft	Upright
L443	34.19981003	-116.5065002	<1m	4	N	N			1ft	Upright
L444	34.19987488	-116.5064468	<1m	4	N	N			<1ft	Upright
L445	34.19987488	-116.5064468	<1m	4	N	N			<1ft	Upright
L446	34.19855881	-116.5060349	<1m	4	N	N		Y	<1ft	Upright
L447	34.19855881	-116.5060349	<1m	4	N	N		Y	<1ft	Upright

Pipes Canyon Joshua Tree Inventory

Tree ID	Latitude	Longitude	Size Class	Health	Mature (Y/N)	Flowers/ Fruit (Y/N)	Impact	Within 15m of Tree	Canopy	Structure
L448	34.19855881	-116.5060425	1-5m	4	N	N	Remove	Y	5ft	Upright and next to a dead tree
L449	34.19840622	-116.5060349	<1m	4	N	N		Y	<1ft	Upright
L450	34.19724274	-116.5058975	>5m	5	Y	N		Y	12ft	Upright
L451	34.19708633	-116.5060883	<1m	4	N	N	Remove	Y	1ft	Upright
L452	34.19680786	-116.5059204	1-5m	5	N	Y			3ft	Upright
L453	34.19698334	-116.5059052	1-5m	5	Y	Y		Y	6ft	Upright
L454	34.19747925	-116.5057144	1-5m	5	Y	Y			4ft	Upright
L455	34.19750595	-116.5057449	<1m	4	N	N			<1ft	Upright
L456	34.19750595	-116.5057449	<1m	4	N	N			<1ft	Upright
L457	34.19750595	-116.5057449	<1m	4	N	N			<1ft	Upright
L458	34.19750595	-116.5057449	<1m	4	N	N			<1ft	Upright
L459	34.19750595	-116.5057449	<1m	4	N	N			<1ft	Upright
L460	34.19750595	-116.5057449	<1m	4	N	N			<1ft	Upright
L461	34.19750595	-116.5057449	1-5m	5	Y	Y			3ft	Upright
L462	34.19803238	-116.5053024	1-5m	5	N	N			4ft	Upright
L463	34.19800568	-116.5051498	1-5m	5	Y	Y			3ft	Upright
L464	34.20030212	-116.5031281	1-5m	4	N	N		Y	1ft	Upright
L465	34.20028687	-116.5031738	<1m	4	N	N		Y	<1ft	Upright
L466	34.20028687	-116.5031738	<1m	4	N	N		Y	<1ft	Upright
L467	34.20028687	-116.5031738	<1m	4	N	N		Y	<1ft	Upright
L468	34.20028687	-116.5031738	1-5m	4	N	N		Y	1ft	Upright
L469	34.20014954	-116.5030212	1-5m	4	N	N	Remove	Y	1ft	Upright, but some spines falling off
L470	34.20013809	-116.5030289	<1m	4	N	N		Y	<1ft	Upright
L471	34.20005417	-116.5032578	1-5m	5	N	N			2ft	Upright
L472	34.20040894	-116.5033188	1-5m	4	Y	N			3ft	Upright
L473	34.1999855	-116.5032806	1-5m	5	Y	Y			6ft	Upright
L474	34.19985962	-116.5033035	1-5m	5	Y	Y			4ft	Upright
L475	34.19979858	-116.5032654	1-5m	5	Y	Y			7ft	Upright
L476	34.19972229	-116.5032043	1-5m	5	Y	Y			8ft	Upright
L477	34.19973373	-116.5031509	1-5m	5	Y	Y			5ft	Upright
L478	34.19971085	-116.5031204	1-5m	4	Y	Y		Y	4ft	Upright
L479	34.19960022	-116.5029678	1-5m	5	Y	Y	Remove	Y	15ft	Upright
L480	34.19981766	-116.5028763	1-5m	4	N	N	Remove	Y	1ft	Upright
L481	34.19943237	-116.5027237	>5m	5	Y	Y		Y	25ft	Upright
L482	34.19963455	-116.5027161	1-5m	4	N	N		Y	1ft	Upright
L483	34.19963455	-116.5027161	1-5m	4	Y	Y		Y	5ft	Upright
L484	34.19987869	-116.5027924	1-5m	5	Y	Y		Y	5ft	Upright
L485	34.19998169	-116.5028229	1-5m	4	N	N		Y	10ft	Upright
L486	34.20009995	-116.502655	<1m	4	N	N			1ft	Upright
L487	34.20009995	-116.502655	1-5m	4	N	N			<1ft	Upright
L488	34.20009995	-116.502655	1-5m	4	Y	N			1ft	Upright
L489	34.20018768	-116.502655	<1m	4	N	N			4ft	Upright
L490	34.20053864	-116.5025253	1-5m	4	N	N			<1ft	Upright
L491	34.19939423	-116.502533	<1m	4	N	N			1ft	Upright
L492	34.19939804	-116.5025253	<1m	4	N	N			<1ft	Upright
L493	34.19907761	-116.5027161	1-5m	5	Y	Y			3ft	Upright
L494	34.19905472	-116.5027084	1-5m	4	N	N			1ft	Upright

Pipes Canyon Joshua Tree Inventory

Tree ID	Latitude	Longitude	Size Class	Health	Mature (Y/N)	Flowers/ Fruit (Y/N)	Impact	Within 15m of Tree	Canopy	Structure
L495	34.19903946	-116.5027161	<1m	4	N	N			<1ft	Upright
L496	34.19903946	-116.5027161	1-5m	5	Y	Y			6ft	Upright
L497	34.19909286	-116.5023117	1-5m	5	Y	Y			5ft	Upright
L498	34.19900513	-116.5023804	1-5m	4	Y	N		Y	2ft	Upright
L499	34.19934845	-116.502327	1-5m	5	Y	Y			8ft	Upright
L500	34.19934845	-116.502327	1-5m	5	Y	Y			5ft	Upright
L501	34.19929504	-116.5010757	1-5m	5	Y	Y		Y	3ft	Upright
L502	34.19957352	-116.501091	<1m	4	N	N			<1ft	Upright
L503	34.19783401	-116.5018616	1-5m	4	N	N			1ft	Upright
L504	34.19812393	-116.5021896	<1m	4	N	N			<1ft	Upright
L505	34.19812393	-116.5021896	<1m	4	N	N			<1ft	Upright
L506	34.19812393	-116.5021896	<1m	4	N	N			<1ft	Upright
L507	34.19812393	-116.5021896	1-5m	4	N	N			1ft	Upright
L508	34.19826126	-116.5022812	1-5m	5	Y	Y			3ft	Upright
L509	34.19827652	-116.5022812	<1m	4	N	N			<1ft	Upright
L510	34.19830322	-116.5023727	<1m	4	N	N			1ft	Upright
L510.5	34.19830322	-116.5023727	1-5m	5	Y	Y			4ft	Upright
L511	34.19830704	-116.5023499	1-5m	5	Y	Y			6ft	Upright
L512	34.19823456	-116.5023956	1-5m	3	Y	Y			6ft	Dyring with branches falling but still producing flowers
L513	34.1999054	-116.5058823	1-5m	4	N	N			1ft	Upright
L514	34.1999054	-116.5058823	1-5m	4	N	N			1ft	Upright
L515	34.1999054	-116.5058823	1-5m	4	N	N			1ft	Upright
L516	34.1999054	-116.5058823	1-5m	4	N	N			1ft	Upright
L517	34.19927597	-116.5042648	<1m	4	N	N		Y	<1ft	Upright
L518	34.19927597	-116.5042648	<1m	4	N	N		Y	<1ft	Upright
L519	34.19927597	-116.5042648	<1m	4	N	N		Y	<1ft	Upright
L520	34.19927597	-116.5042648	<1m	4	N	N		Y	2ft	Upright
L521	34.19940948	-116.5041275	<1m	4	N	N			<1ft	Upright
L522	34.1994133	-116.5041351	1-5m	5	Y	Y			8ft	Upright
L523	34.19946671	-116.5042419	<1m	4	N	N			<1ft	Upright
L524	34.19950104	-116.5042572	1-5m	4	N	N			4ft	Upright
L525	34.19935608	-116.5040207	>5m	5	Y	Y			10ft	Upright
L526	34.19930267	-116.5040283	1-5m	5	Y	Y			20ft	Upright
L527	34.19962692	-116.5040054	1-5m	4	Y	Y			12ft	Limbs are dropping
L528	34.1997261	-116.5037689	>1m	4	N	N			<1ft	Upright
L529	34.1997261	-116.5037689	<1m	4	N	N			<1ft	Upright
L530	34.1997261	-116.5037689	1-5m	4	N	N			1ft	Upright
L531	34.1997757	-116.5036469	<1m	4	N	N			<1ft	Upright
L532	34.1997757	-116.5036469	1-5m	4	N	N			1ft	Upright
L533	34.19979477	-116.5035172	<1m	4	N	N			1ft	Upright
L534	34.19966888	-116.5032883	<1m	4	N	N			<1ft	Upright
L535	34.19966888	-116.5032883	<1m	3	N	N			<1ft	Upright
L536	34.2001915	-116.5029144	<1m	4	N	N	Remove	Y	<1ft	Upright
L537	34.20114899	-116.5004959	1-5m	4	N	N			1ft	Upright
L538	34.20171356	-116.5007095	1-5m	5	Y	Y		Y	2ft	Upright
L539	34.20174408	-116.5009613	1-5m	4	N	N	Remove	Y	1ft	Upright

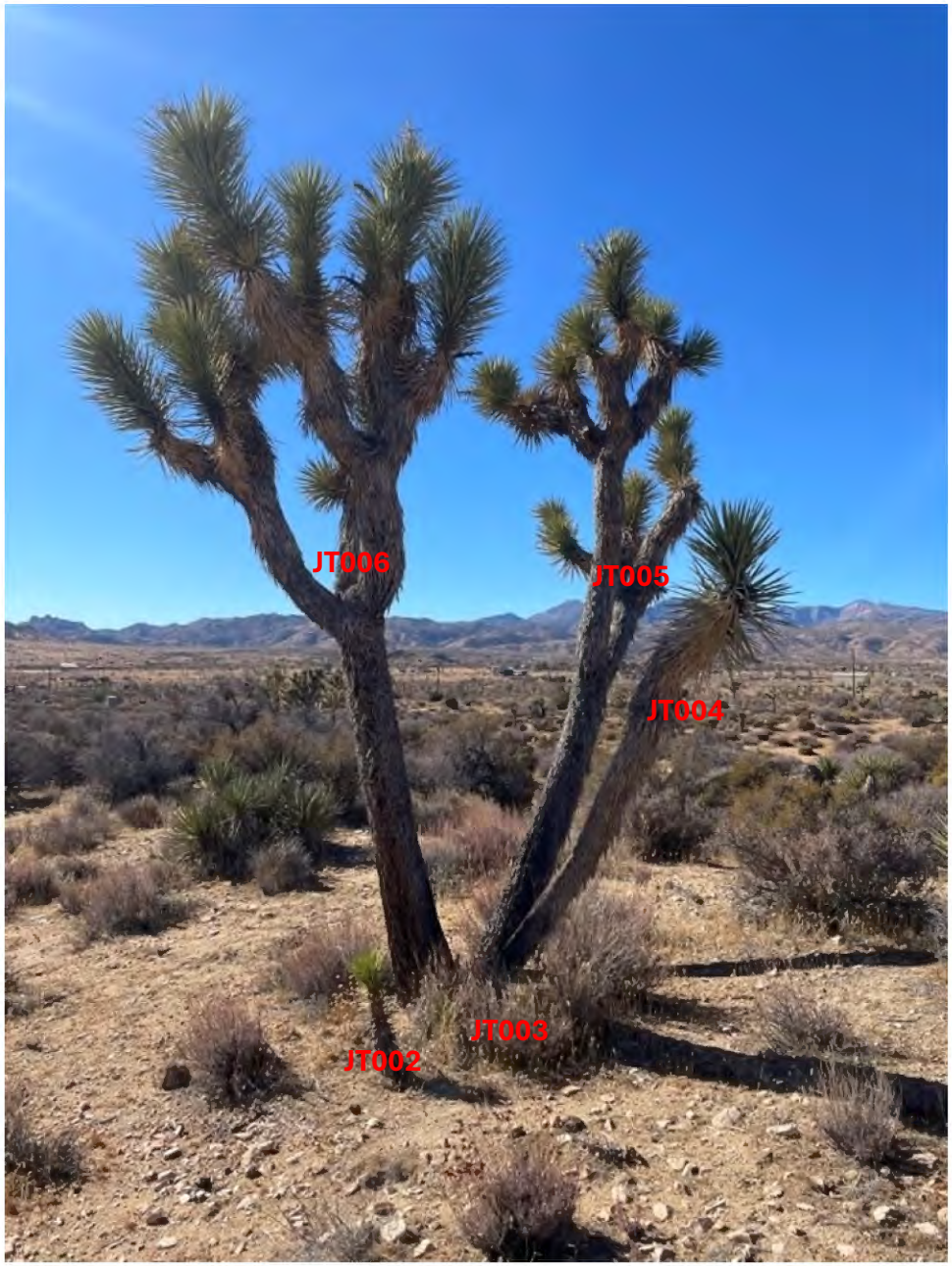
Pipes Canyon Joshua Tree Inventory

Tree ID	Latitude	Longitude	Size Class	Health	Mature (Y/N)	Flowers/ Fruit (Y/N)	Impact	Within 15m of Tree	Canopy	Structure
L540	34.20163727	-116.5011444	1-5m	4	N	N		Y	1ft	Upright
L541	34.20156097	-116.5010681	1-5m	5	Y	Y		Y	2ft	Upright
L542	34.20156479	-116.500885	1-5m	4	Y	Y		Y	4ft	Upright but recent limb breakage
L543	34.20154953	-116.500824	1-5m	4	N	N		Y	2ft	Upright
P001	34.19952774	-116.506279	<1m	4	N	N		Y	<1ft	Upright
P002	34.19906616	-116.5061646	1-5m	5	Y	Y	Remove	Y	8ft	Upright
P003	34.19769287	-116.5062485	1-5m	5	Y	N		Y	4ft	Upright
P004	34.19755554	-116.5063171	1-5m	5	Y	Y		Y	4ft	Upright
P005	34.19747543	-116.5064392	1-5m	5	Y	Y			5ft	Upright
P006	34.19716263	-116.5063858	1-5m	5	Y	N			5ft	Upright

Appendix B: Photograph Exhibit



Joshua Tree 001



Joshua Trees 002-006



Joshua Tree 007



Joshua Tree 008



Joshua Tree 009



Joshua Tree 010



Joshua Tree 012



Joshua Tree 013



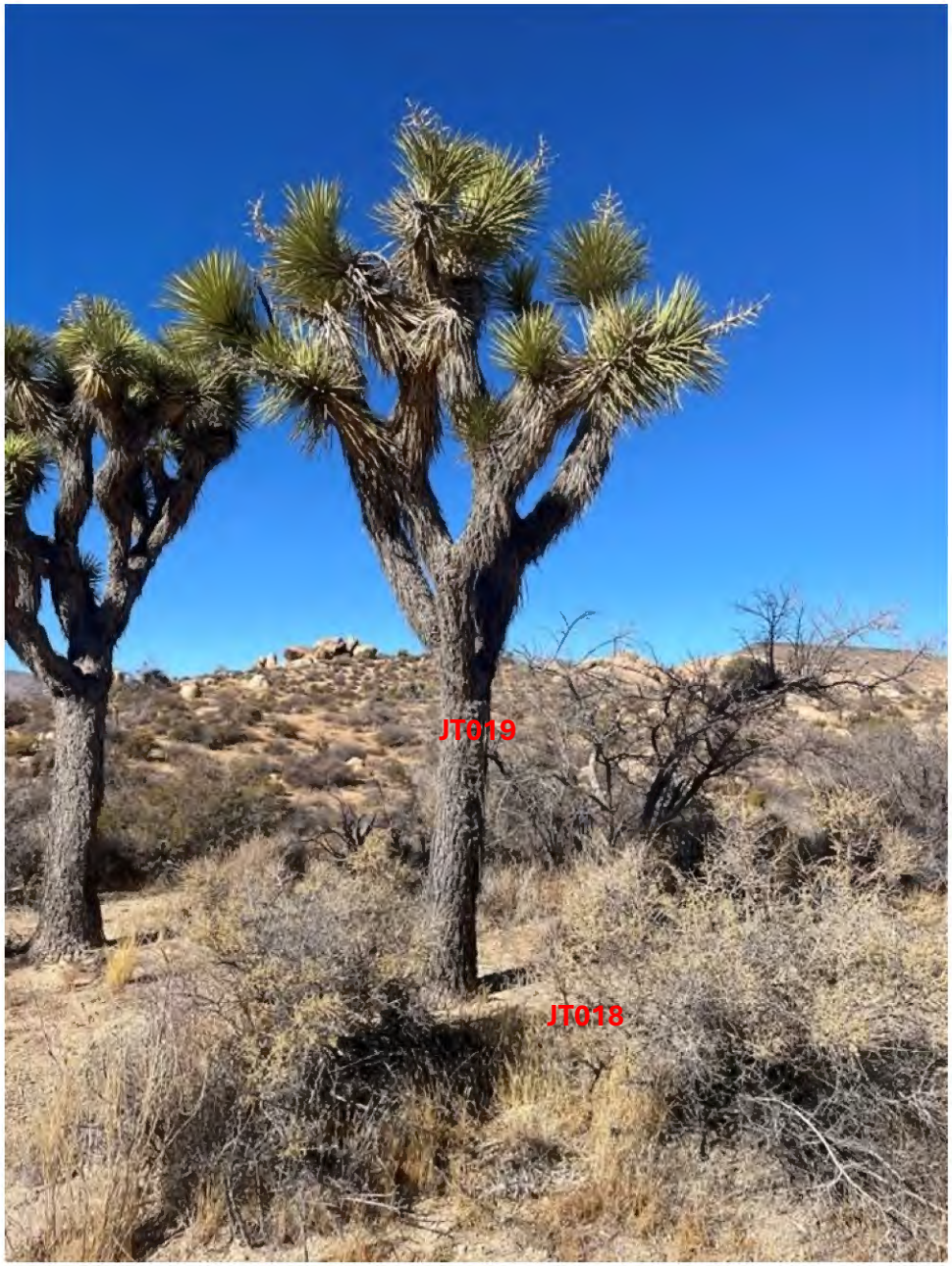
Joshua Tree 014



Joshua Trees 015-016



Joshua Tree 017



Joshua Trees 018-019



Joshua Tree 020



Joshua Tree 021



Joshua Tree 022



Joshua Tree 023



Joshua Tree 024



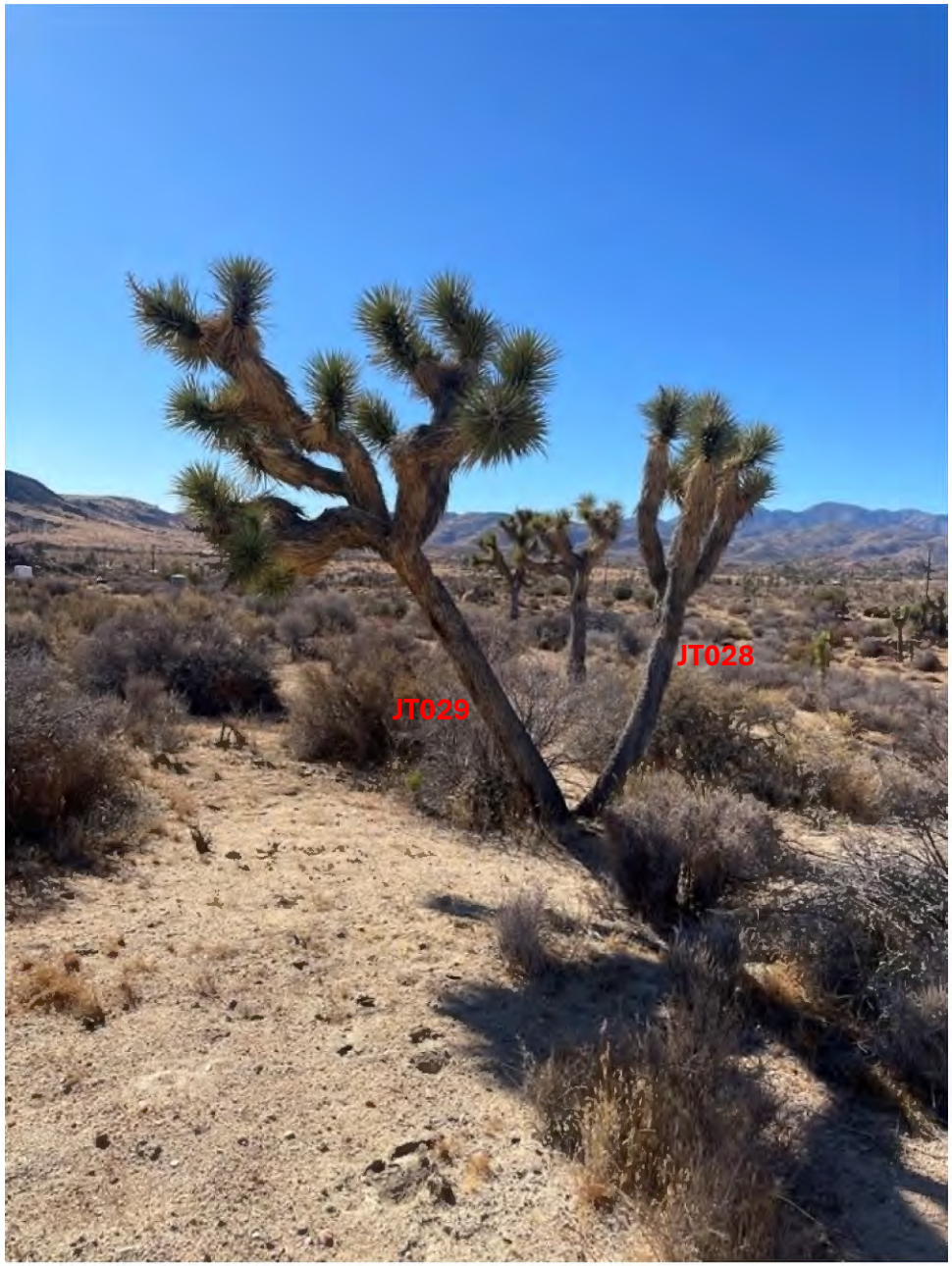
Joshua Tree 025



Joshua Trees 026



Joshua Trees 027



Joshua Trees 028-029



Joshua Tree 030



Joshua Tree 031



Joshua Tree 032



Joshua Tree 033



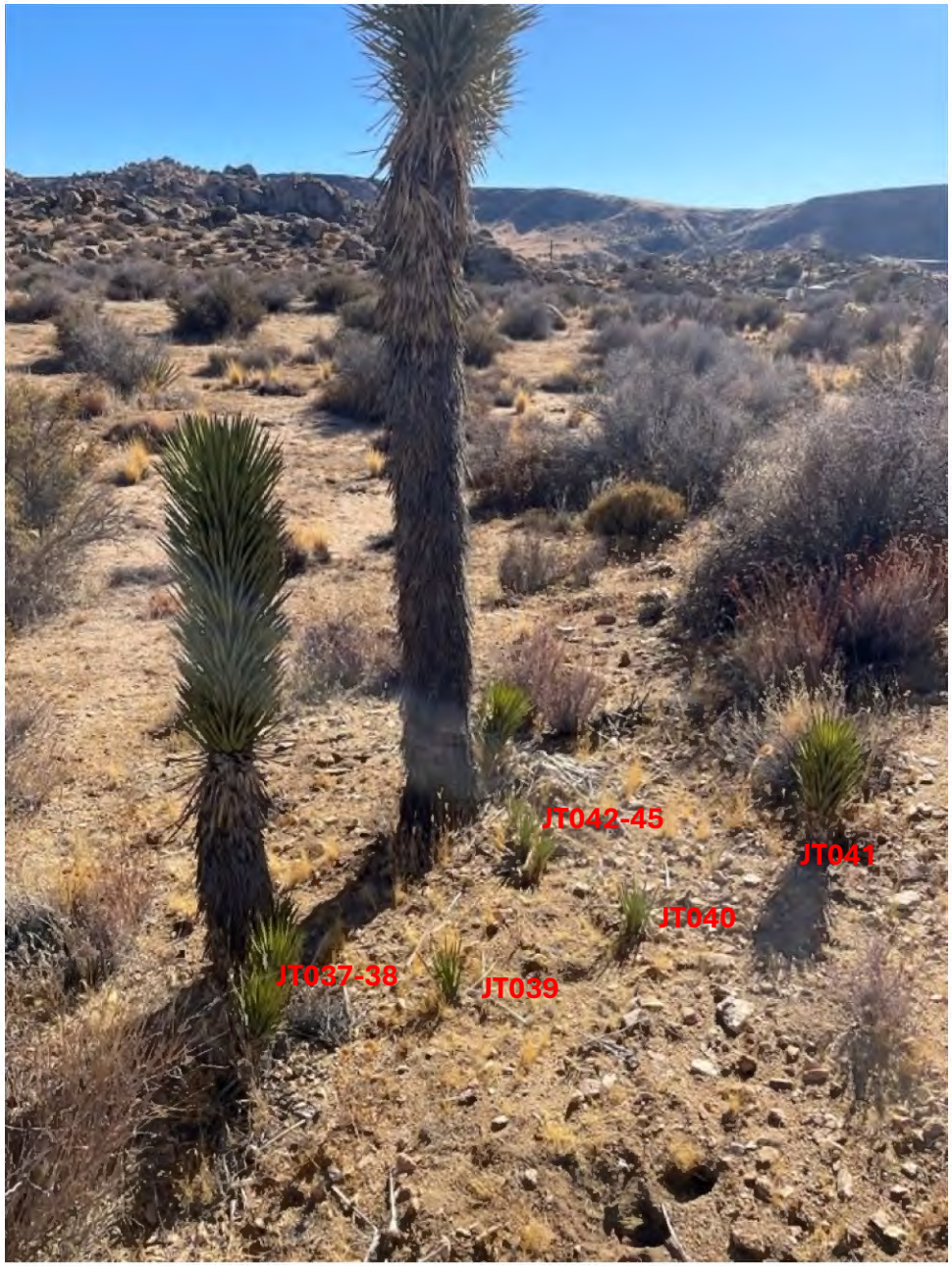
Joshua Tree 034



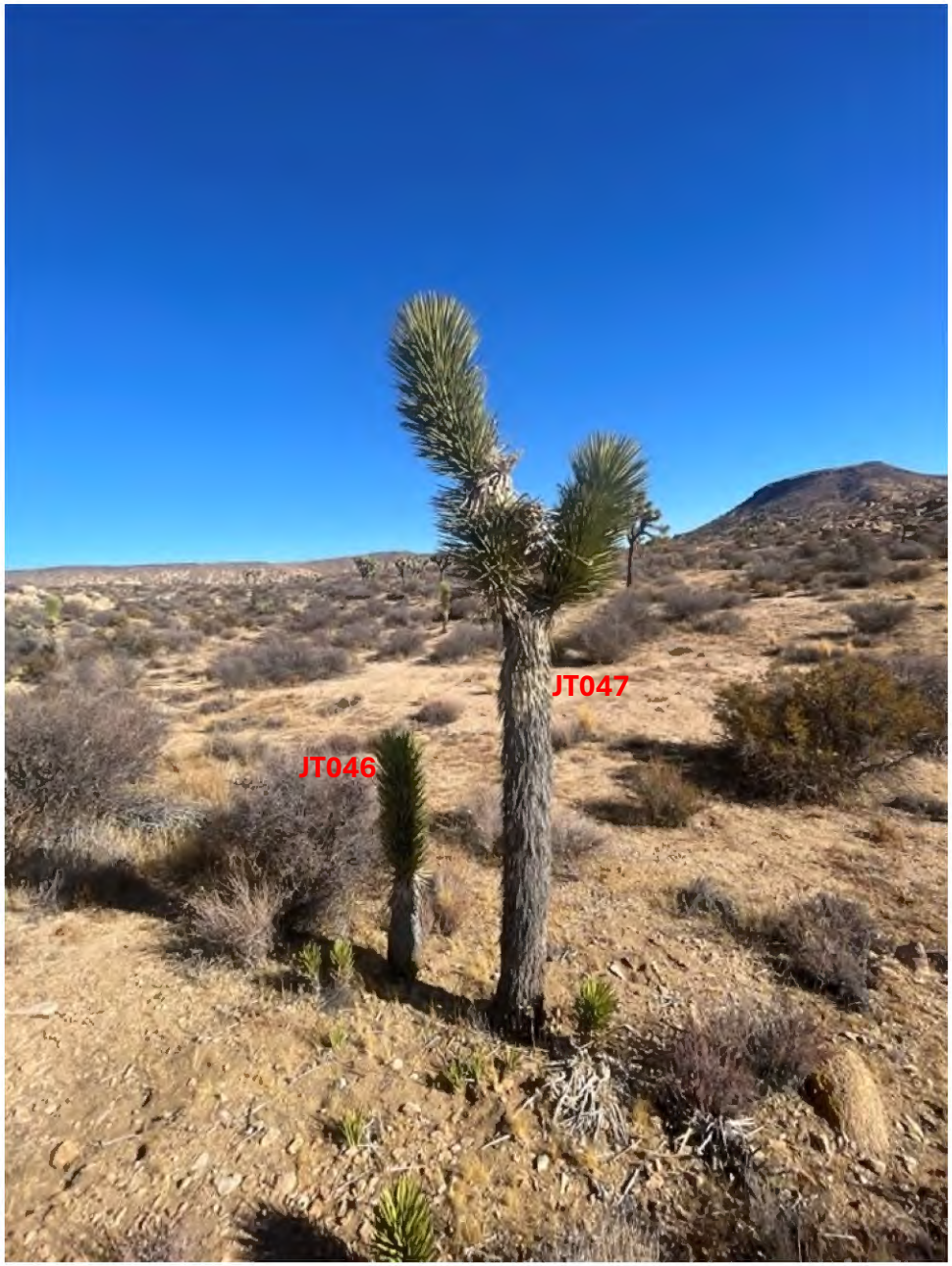
Joshua Tree 035



Joshua Tree 036



Joshua Trees 037-045



Joshua Trees 046-047



Joshua Tree 048



Joshua Tree 049-051



Joshua Tree 052



Joshua Tree 053



Joshua Tree 054



Joshua Tree 055



Joshua Tree 056-068



Joshua Tree 069



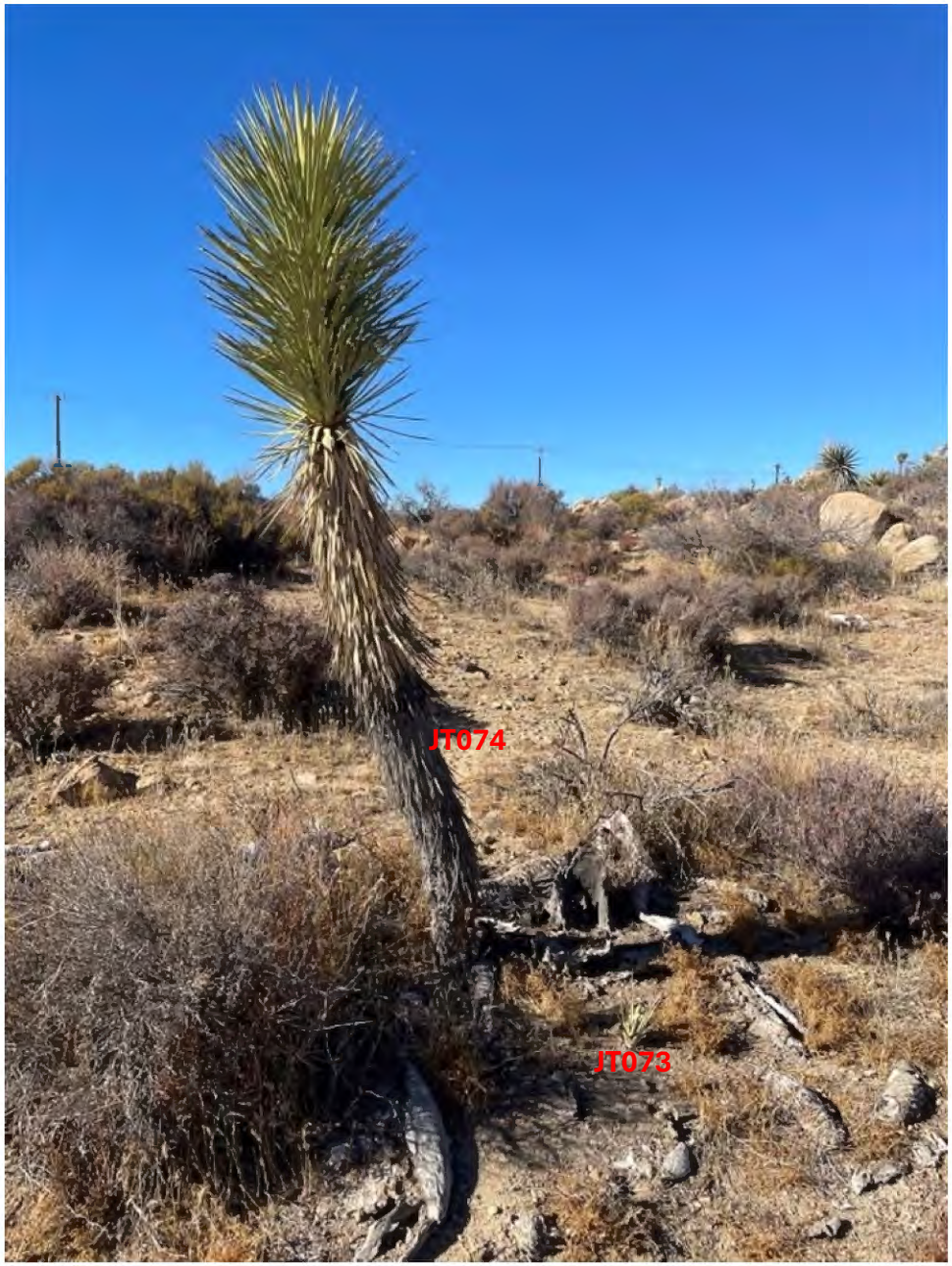
Joshua Tree 070



Joshua Tree 071



Joshua Tree 072



Joshua Trees 073-074



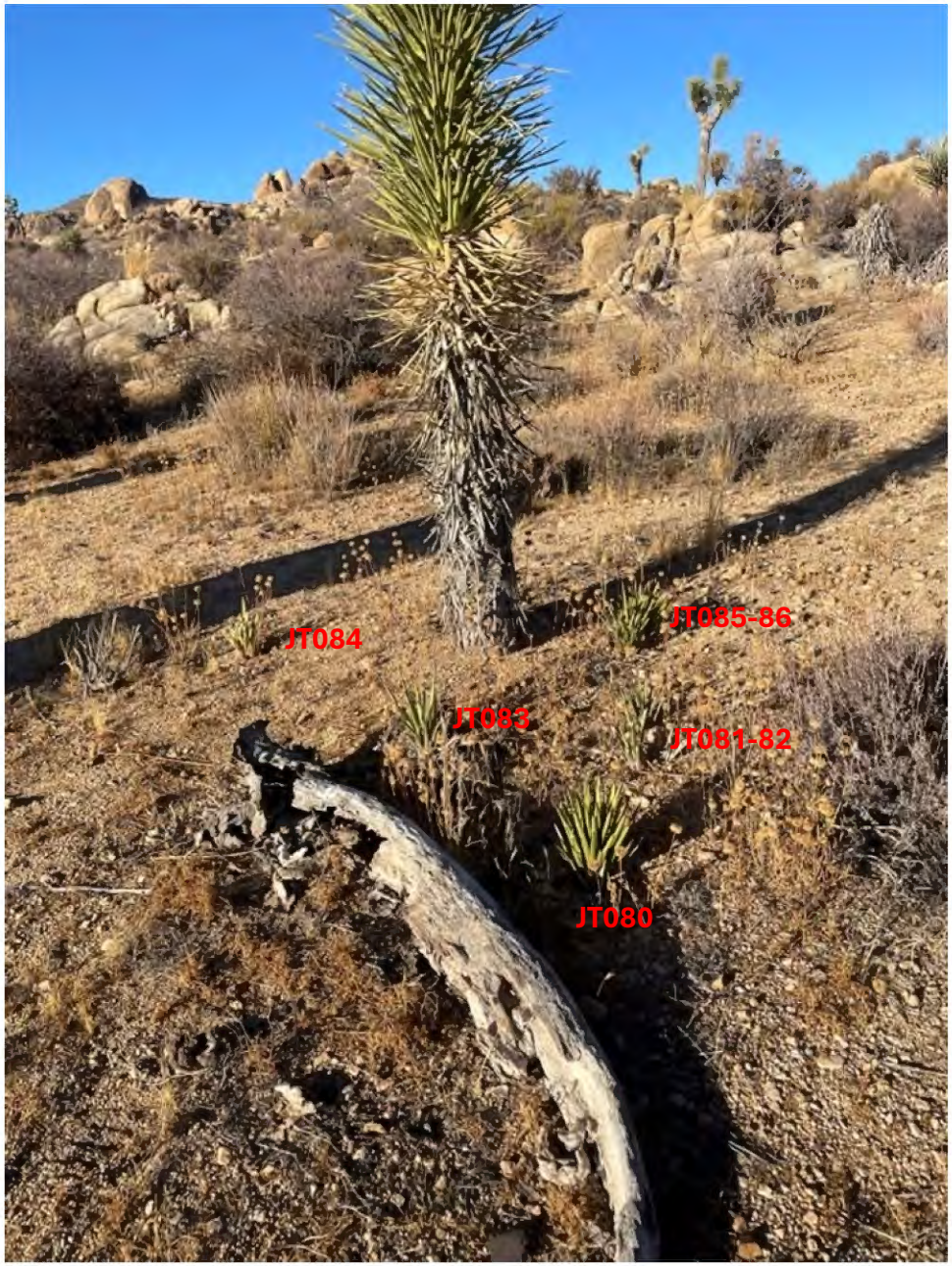
Joshua Tree 075



Joshua Tree 076



Joshua Trees 077-079



Joshua Trees 080-086



Joshua Tree 087



Joshua Trees 088-089



Joshua Trees 090-091



Joshua Tree 092



Joshua Tree 093



Joshua Tree 094



Joshua Tree 095



Joshua Tree 096



Joshua Trees 097-099



Joshua Tree 100



Joshua Tree 101



Joshua Tree 102



Joshua Trees 103-117



Joshua Trees 118-119



Joshua Tree 120



Joshua Tree 121



Joshua Tree 122



Joshua Trees 123-124



Joshua Tree 125



Joshua Tree 126



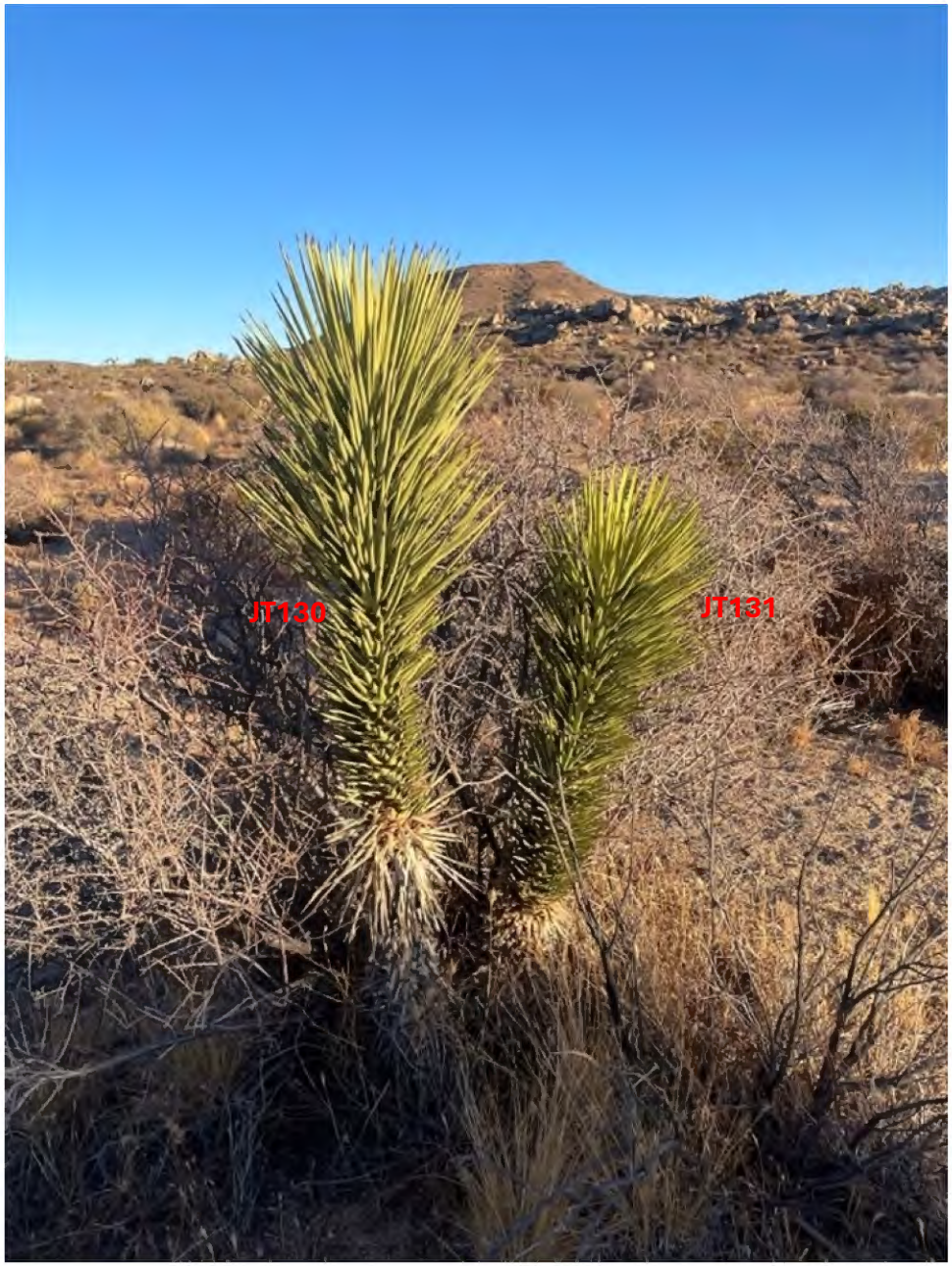
Joshua Tree 127



Joshua Tree 128



Joshua Tree 129



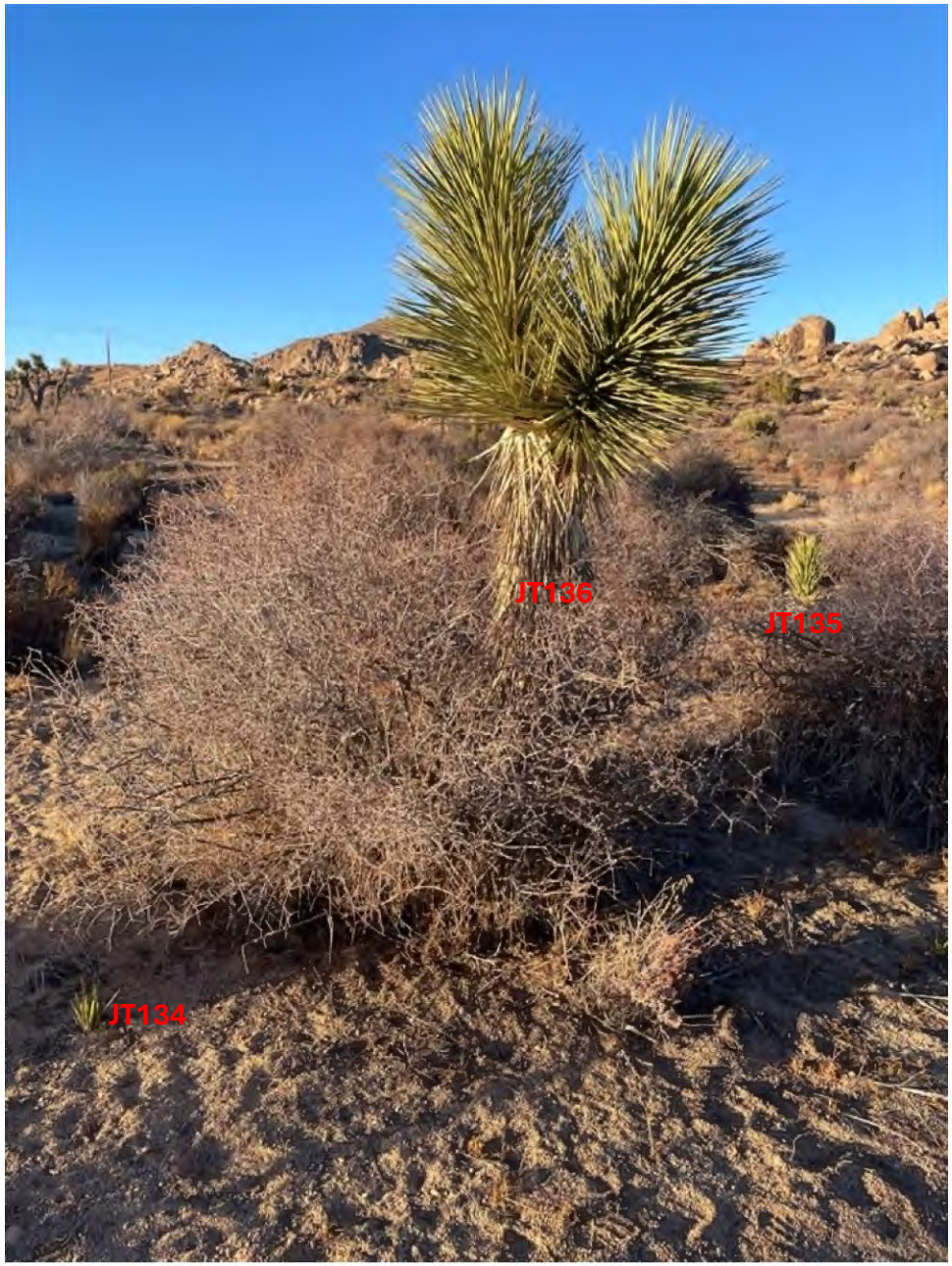
Joshua Trees 130-131



Joshua Tree 132



Joshua Tree 133



Joshua Trees 134-136



Joshua Tree 137



Joshua Tree 138



Joshua Tree 139



Joshua Tree 140



Joshua Tree 141



Joshua Tree 142



Joshua Tree 143



Joshua Tree 144



Joshua Tree 145



Joshua Tree 146



Joshua Tree 147



Joshua Tree 148



Joshua Tree 149



Joshua Tree 150



Joshua Tree 151



Joshua Tree 152



Joshua Tree 153



Joshua Tree 154



Joshua Tree 155



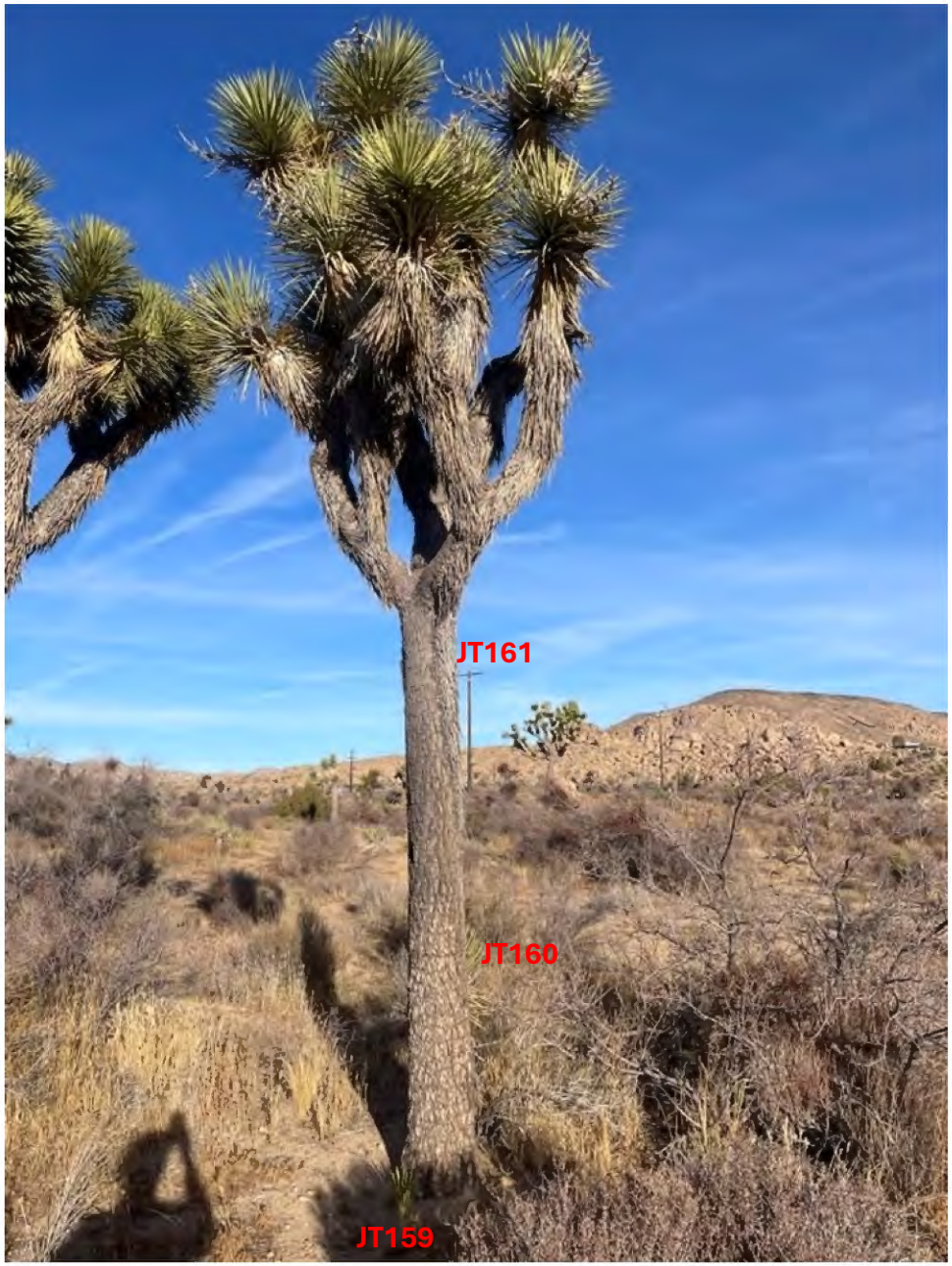
Joshua Tree 156



Joshua Tree 157



Joshua Tree 158



Joshua Tree 159-161



Joshua Trees 162-163



Joshua Tree 164



Joshua Trees 165-167



Joshua Tree 168



Joshua Trees 169-170



Joshua Tree 171



Joshua Tree 172



Joshua Tree 173



Joshua Tree 174



Joshua Tree 175



Joshua Trees 176-182



Joshua Trees 183-186



Joshua Tree 187



Joshua Trees 188-189



Joshua Trees 190-192



Joshua Tree 193



Joshua Tree 194



Joshua Tree 195



Joshua Tree 196



Joshua Tree 197



Joshua Tree 198



Joshua Tree 199



Joshua Tree 200



Joshua Tree 201



Joshua Tree 202



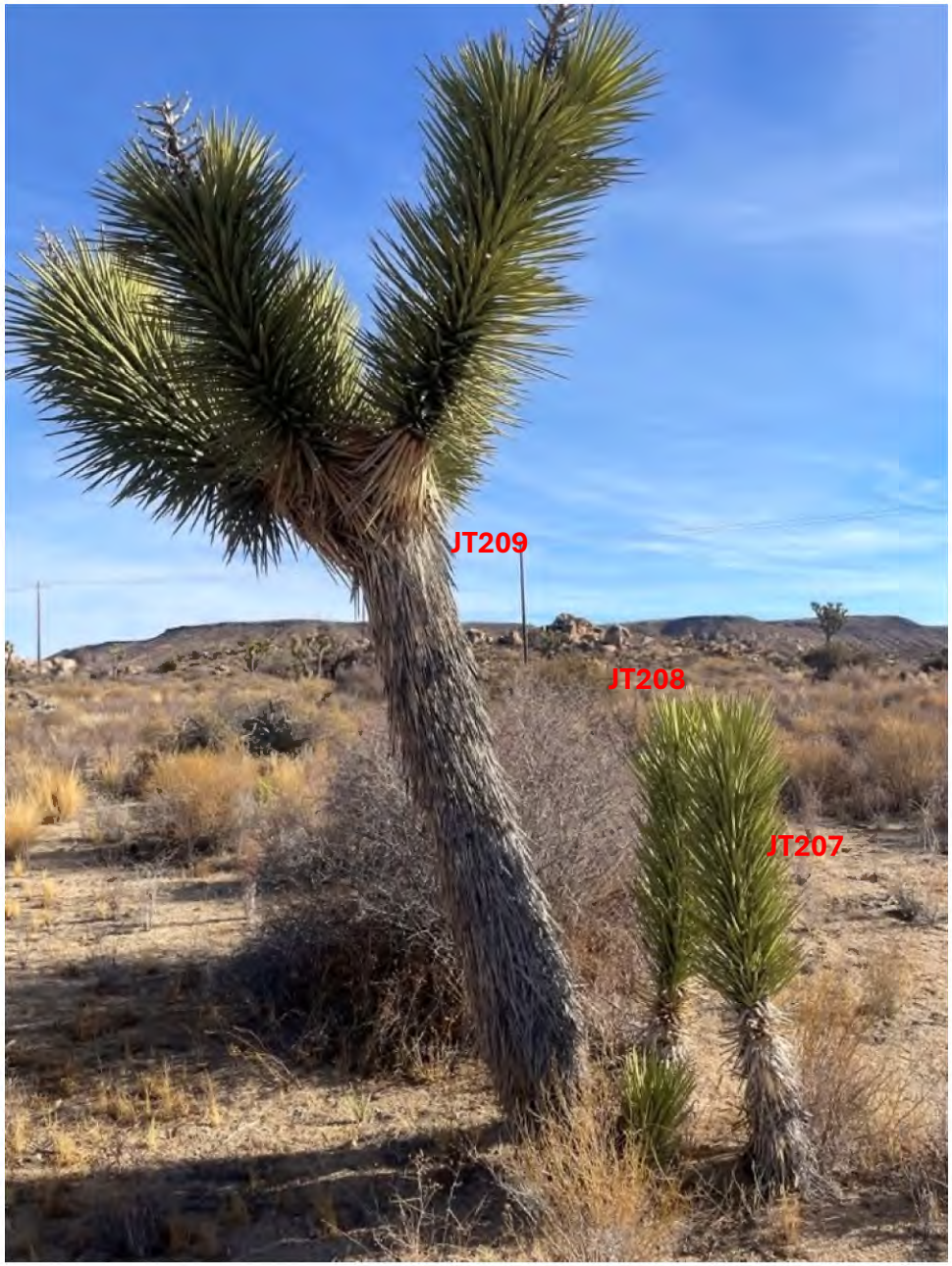
Joshua Tree 203



Joshua Trees 204-205



Joshua Tree 206



Joshua Trees 207-209



Joshua Tree 210



Joshua Tree 211



Joshua Tree 212



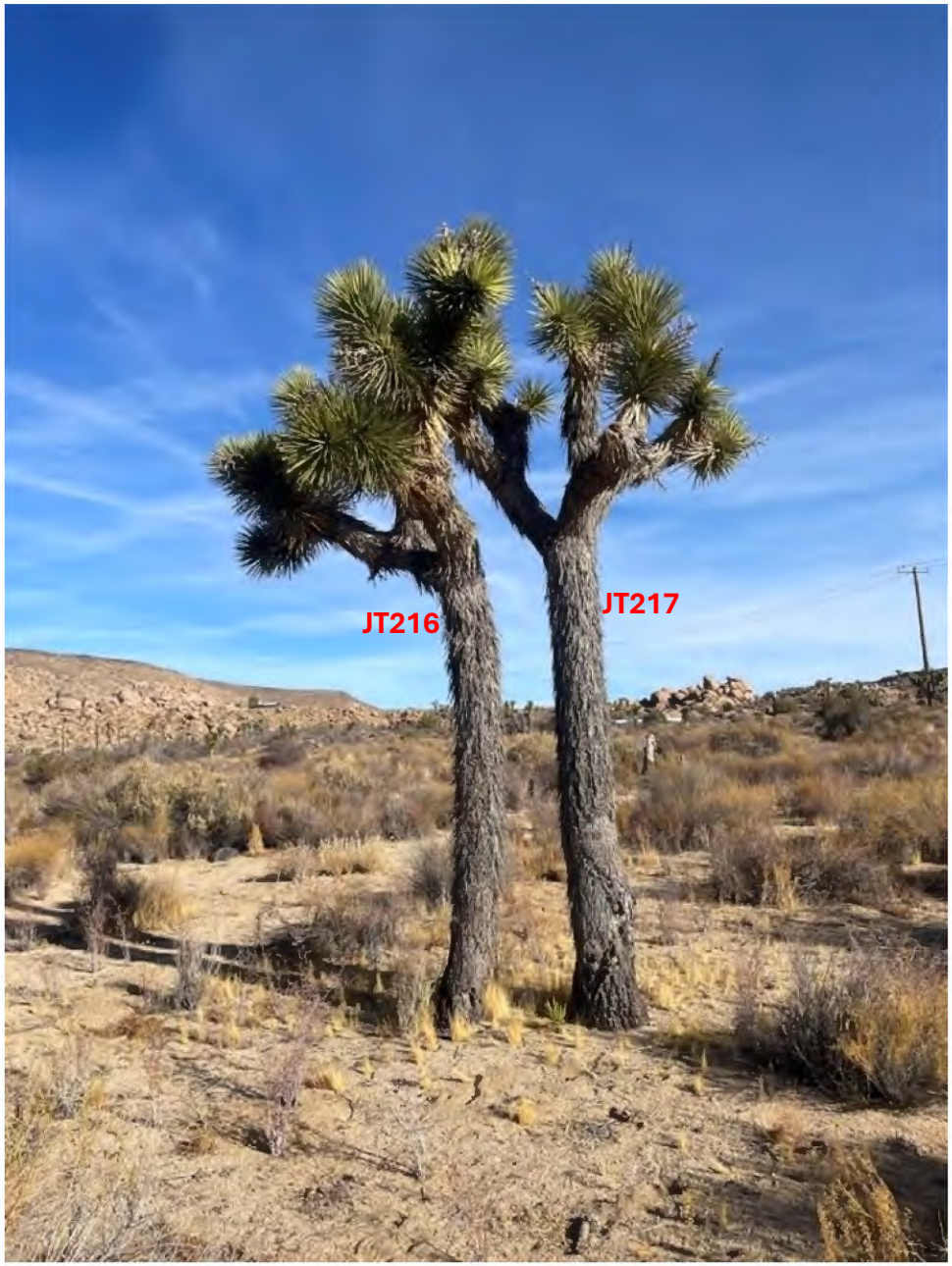
Joshua Tree 213



Joshua Tree 214



Joshua Tree 215



Joshua Trees 216-217



Joshua Trees 218-229



Joshua Tree 230



Joshua Tree 231



Joshua Tree 232



Joshua Tree 233



Joshua Tree 234



Joshua Tree 235



Joshua Tree 236



Joshua Trees 237-245



Joshua Trees 248-250



Joshua Tree 251



Joshua Tree 252



Joshua Tree 253



Joshua Tree 254



Joshua Tree 255



Joshua Tree 256



Joshua Tree 257



Joshua Tree 258



Joshua Tree 259



Joshua Tree 260



Joshua Tree 261



Joshua Tree 262



Joshua Tree 263



Joshua Tree 264



Joshua Tree 265



Joshua Tree 266



Joshua Tree 267



Joshua Tree 268



Joshua Tree 269



Joshua Tree 270



Joshua Tree 271



Joshua Tree 272



Joshua Tree 273



Joshua Tree 274



Joshua Tree 275



Joshua Tree 276



Joshua Tree 277



Joshua Tree 278



Joshua Tree 279



Joshua Tree 280



Joshua Tree 281



Joshua Tree 282



Joshua Tree 283



Joshua Tree 284



Joshua Tree 285



Joshua Tree 286



Joshua Tree 287



Joshua Tree 288



Joshua Trees 289-290



Joshua Trees 291-293



Joshua Tree 294



Joshua Tree 295



Joshua Tree 296



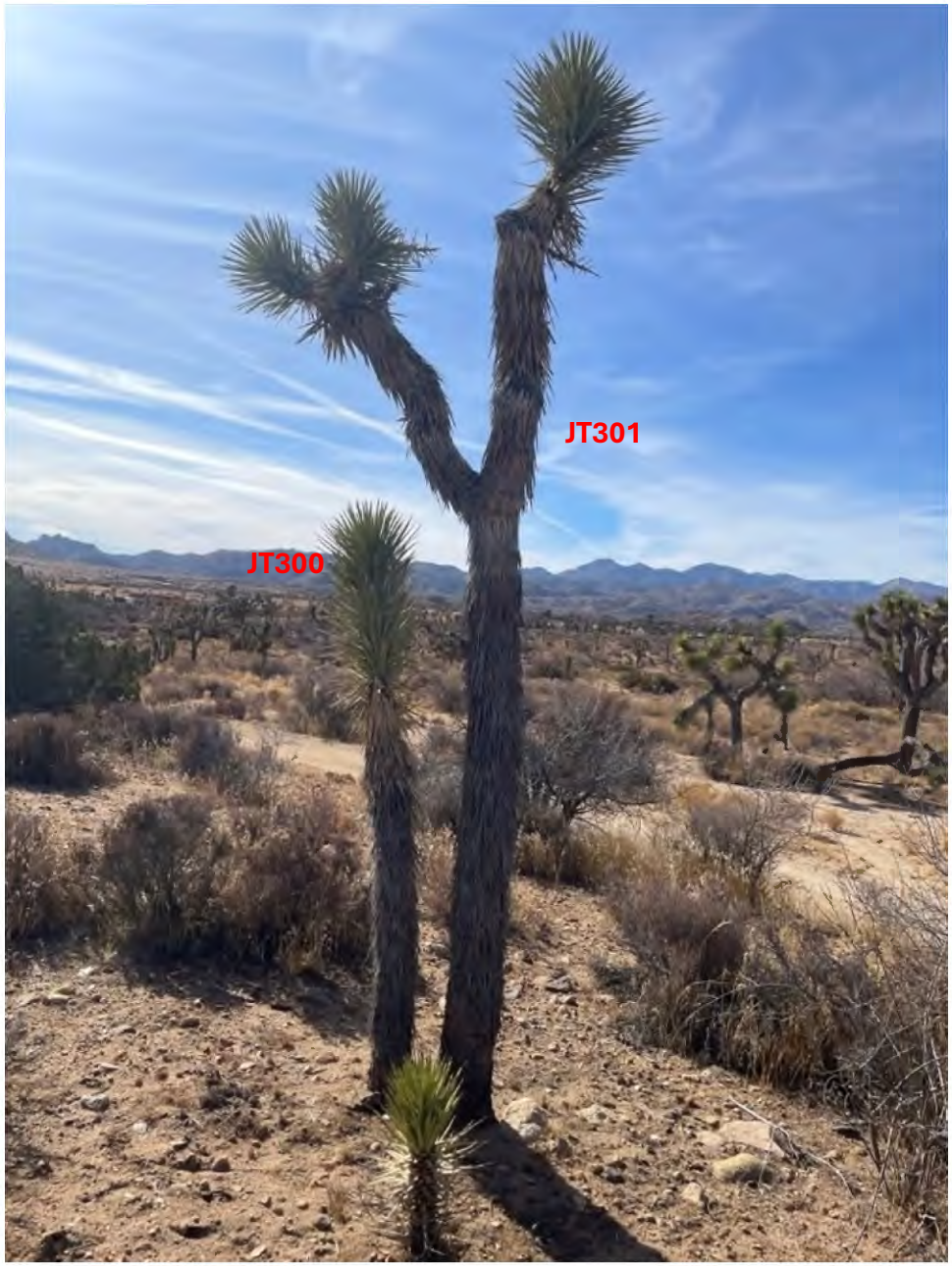
Joshua Tree 297



Joshua Tree 298



Joshua Tree 299



Joshua Trees 300-301



Joshua Tree 302



Joshua Tree 303



Joshua Tree 304



Joshua Trees 305-306



Joshua Tree 307



Joshua Tree 308



Joshua Trees 309-310



Joshua Tree 311



Joshua Trees 312-314



Joshua Trees 315-316



Joshua Tree 317



Joshua Tree 318



Joshua Tree 319



Joshua Tree 320



Joshua Tree 321



Joshua Tree 322



Joshua Tree 323



Joshua Tree 324



Joshua Tree 325



Joshua Tree 326



Joshua Tree 327



Joshua Tree 328



Joshua Tree 329



Joshua Tree 330



Joshua Tree 331



Joshua Tree 332



Joshua Tree 333



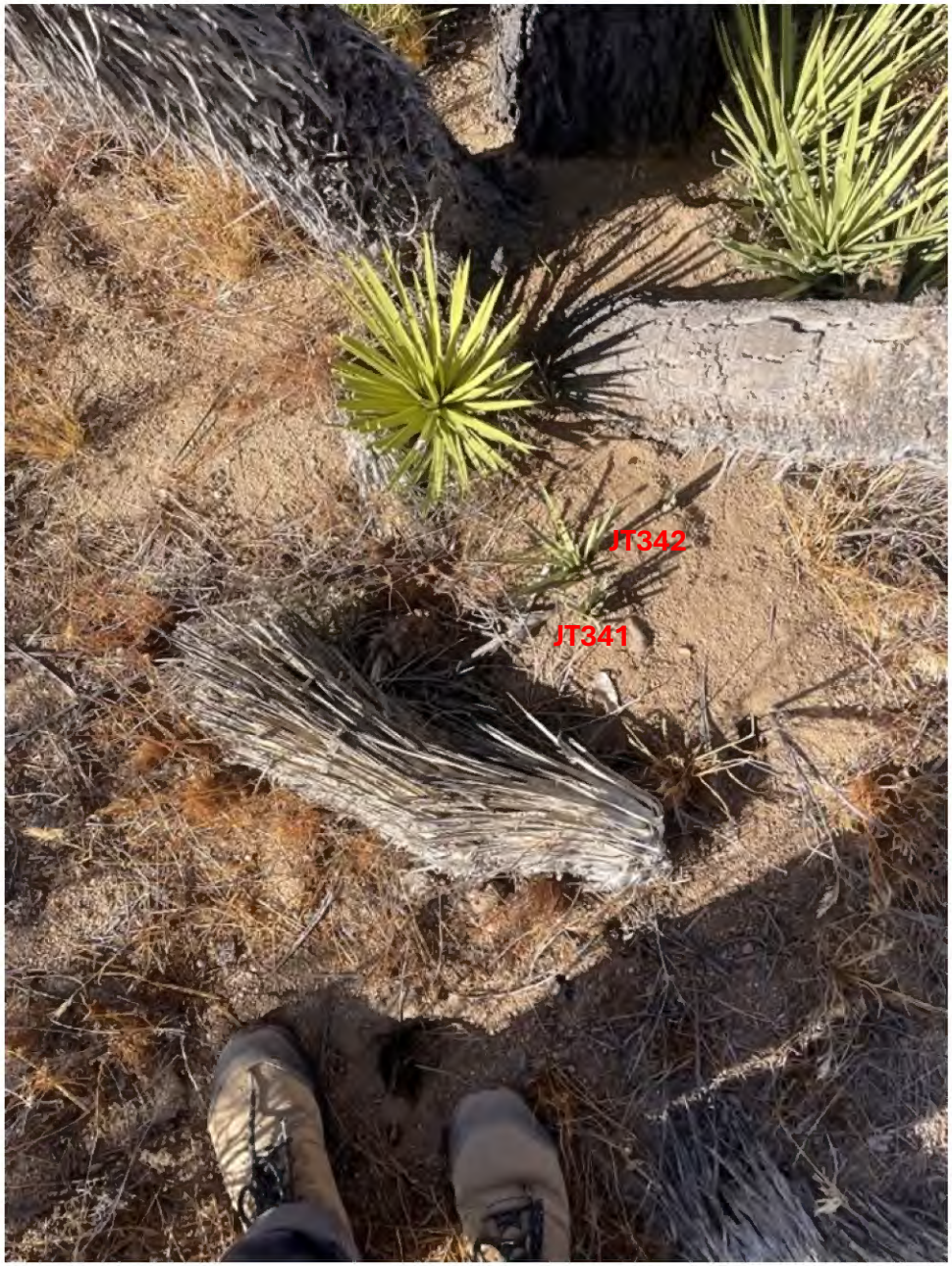
Joshua Tree 334



Joshua Tree 335



Joshua Trees 336-340



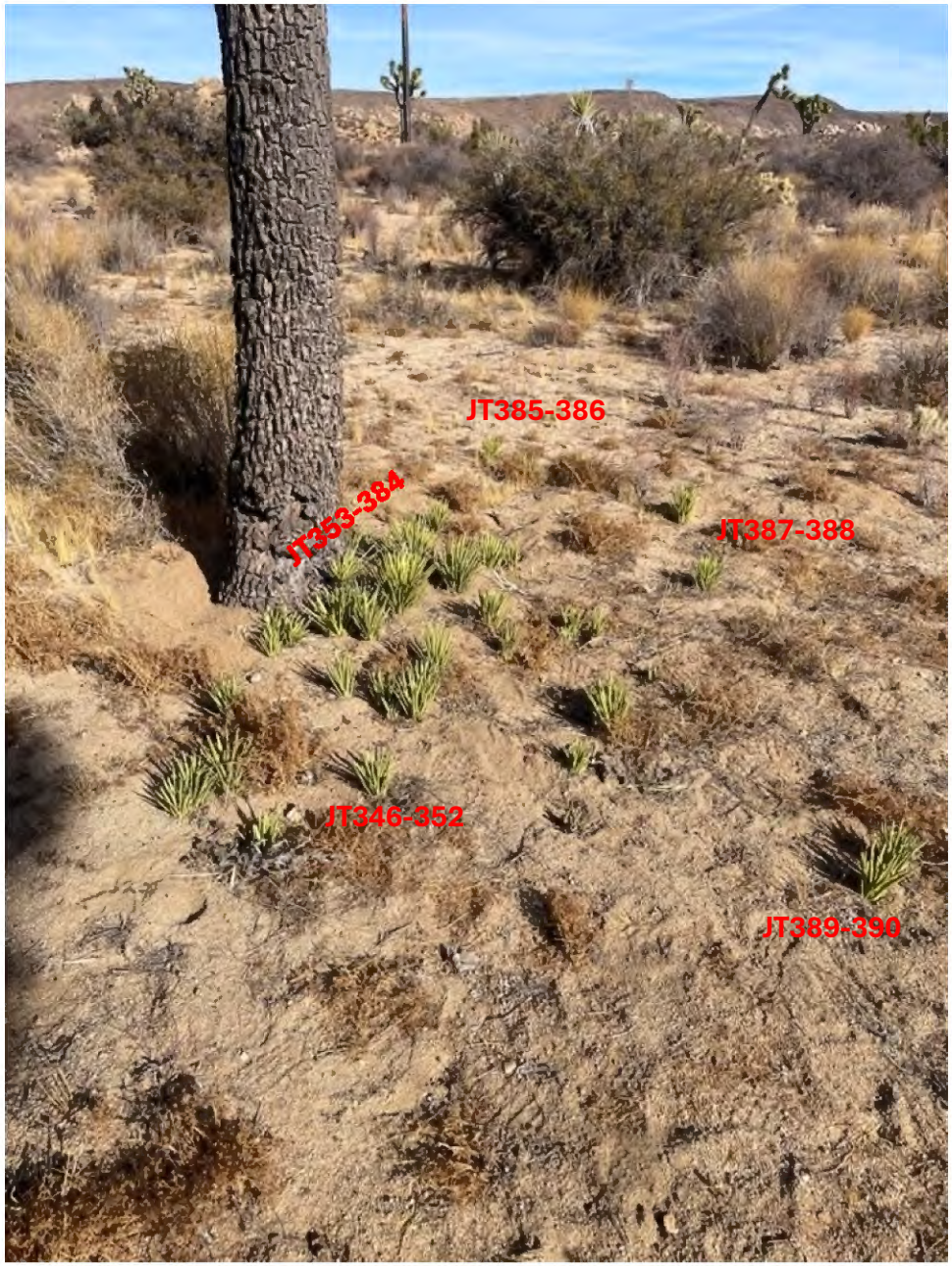
Joshua Trees 341-342



Joshua Tree 343



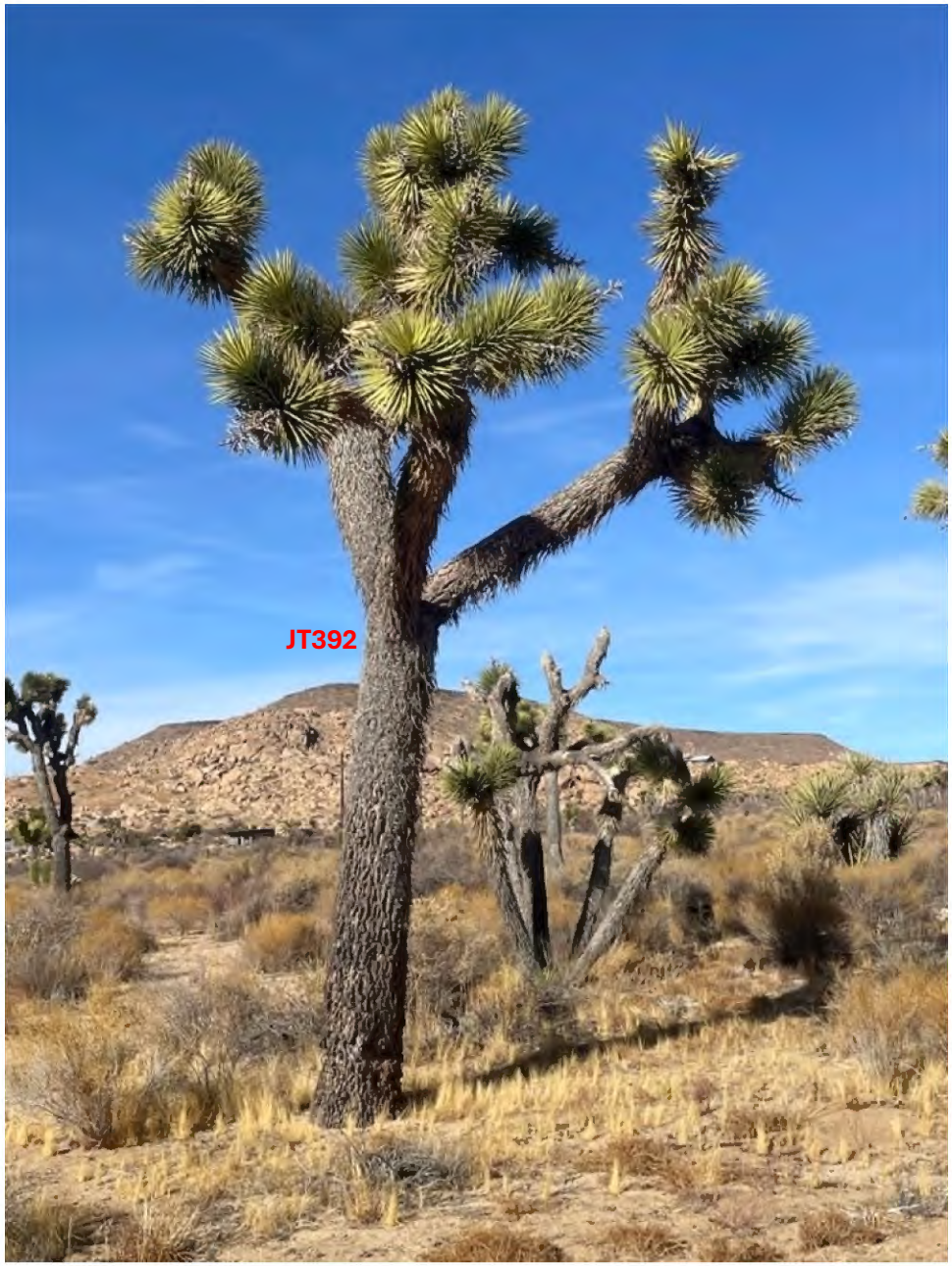
Joshua Tree 344-345



Joshua Tree 346-390



Joshua Tree 391



Joshua Tree 392



Joshua Tree 393



Joshua Trees 394-395



Joshua Tree 396



Joshua Tree 397



Joshua Tree 398



Joshua Tree 399



Joshua Tree 400



Joshua Tree 401



Joshua Tree 402



Joshua Tree 403



Joshua Tree 404



Joshua Tree 405



Joshua Tree 406



Joshua Tree 407



Joshua Tree 408



Joshua Tree 409



Joshua Tree 410



Joshua Tree 411



Joshua Tree 412



Joshua Tree 413



Joshua Tree 414



Joshua Trees 415-416



Joshua Tree 417



Joshua Tree 418



Joshua Tree 419



Joshua Tree 420



Joshua Trees 421-423



Joshua Trees 424-426



Joshua Trees 427-428



Joshua Tree 429



Joshua Tree 430



Joshua Tree 431



Joshua Tree 432



Joshua Tree 433



Joshua Tree 434



Joshua Tree 435



Joshua Tree 436



Joshua Tree 437



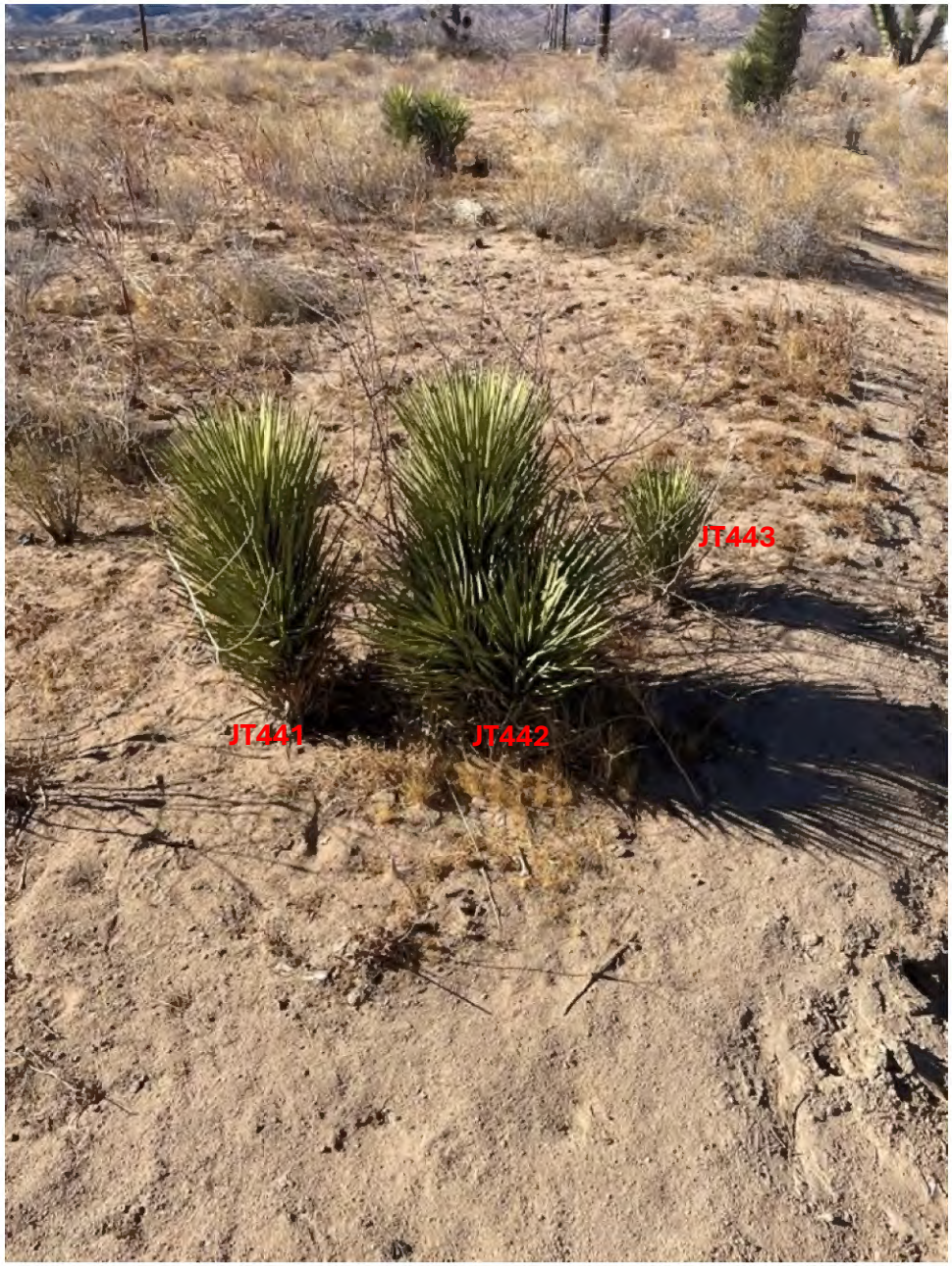
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Joshua Tree 439



Joshua Tree 440



Joshua Trees 441-443



Joshua Trees 444-445



Joshua Trees 446-447



Joshua Tree 448



Joshua Tree 449



Joshua Tree 450



Joshua Tree 451



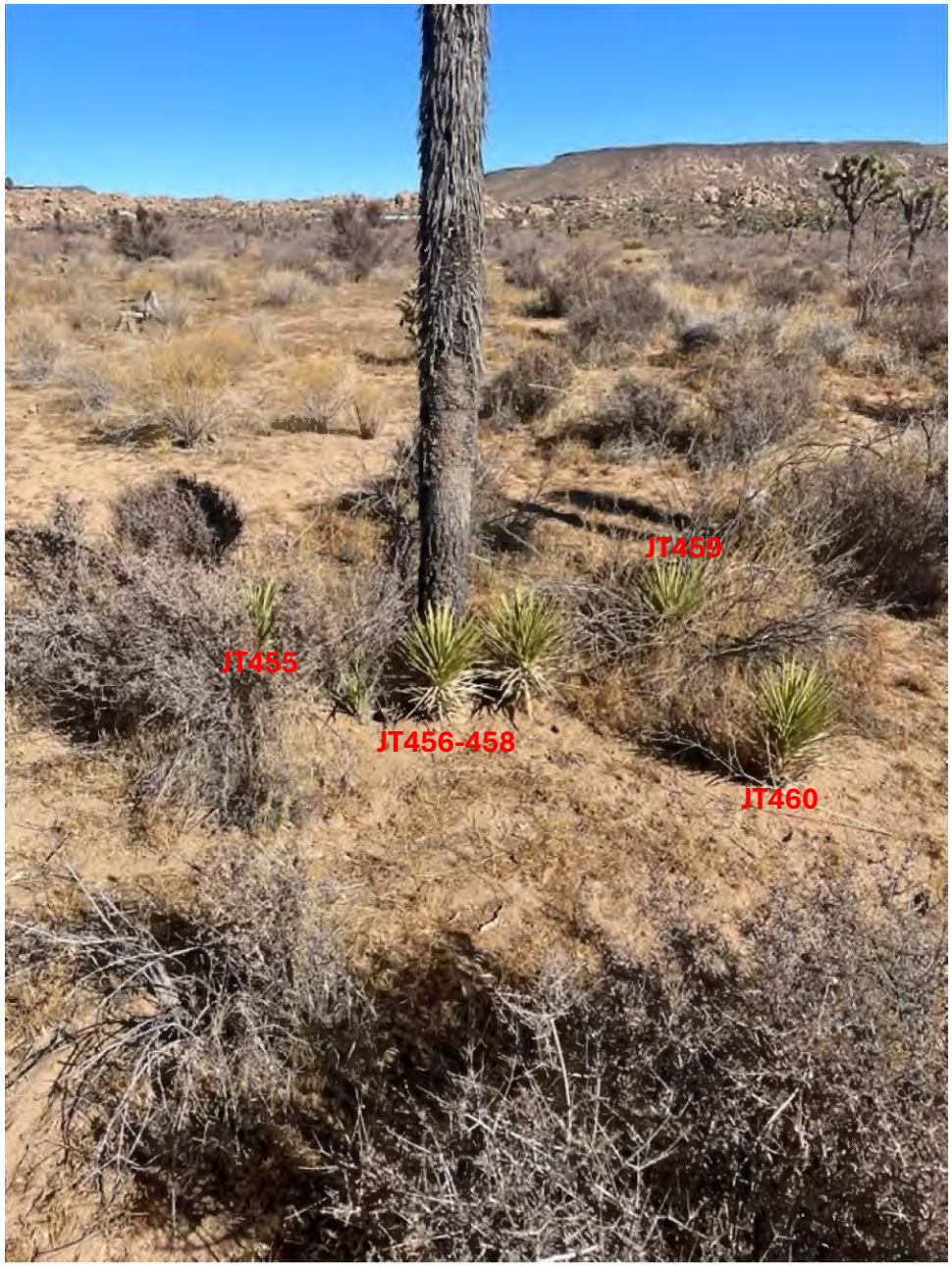
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Joshua Tree 453



Joshua Tree 454



Joshua Tree 455-460



Joshua Tree 462



Joshua Tree 463



Joshua Tree 464



Joshua Tree 465-467



Joshua Tree 468



Joshua Tree 469



Joshua Tree 470



Joshua Tree 471



Joshua Tree 472



Joshua Tree 473



Joshua Tree 474



Joshua Tree 475



Joshua Tree 476



Joshua Tree 477



Joshua Tree 478



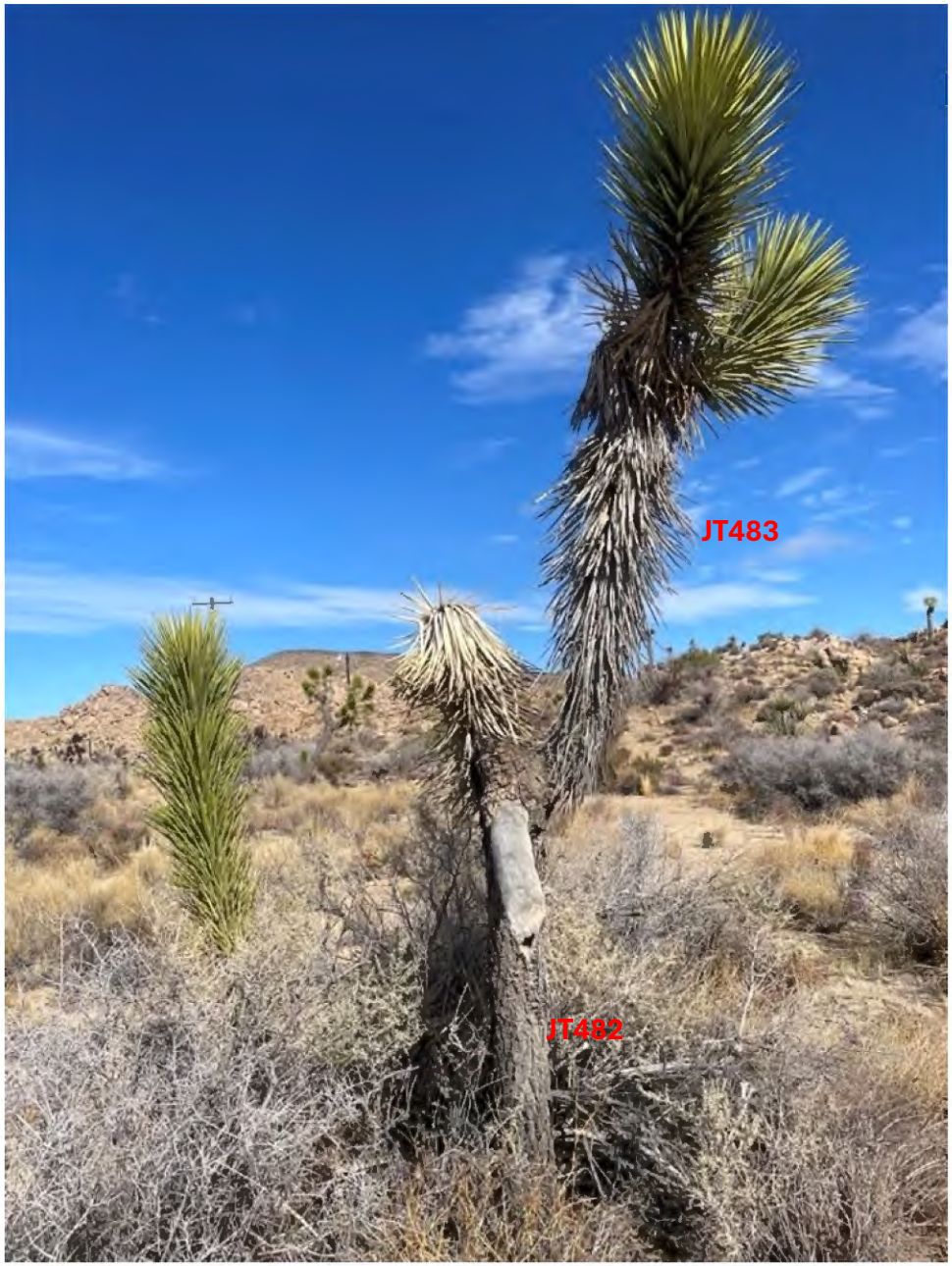
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Joshua Tree 480



Joshua Tree 481



Joshua Tree 482-483



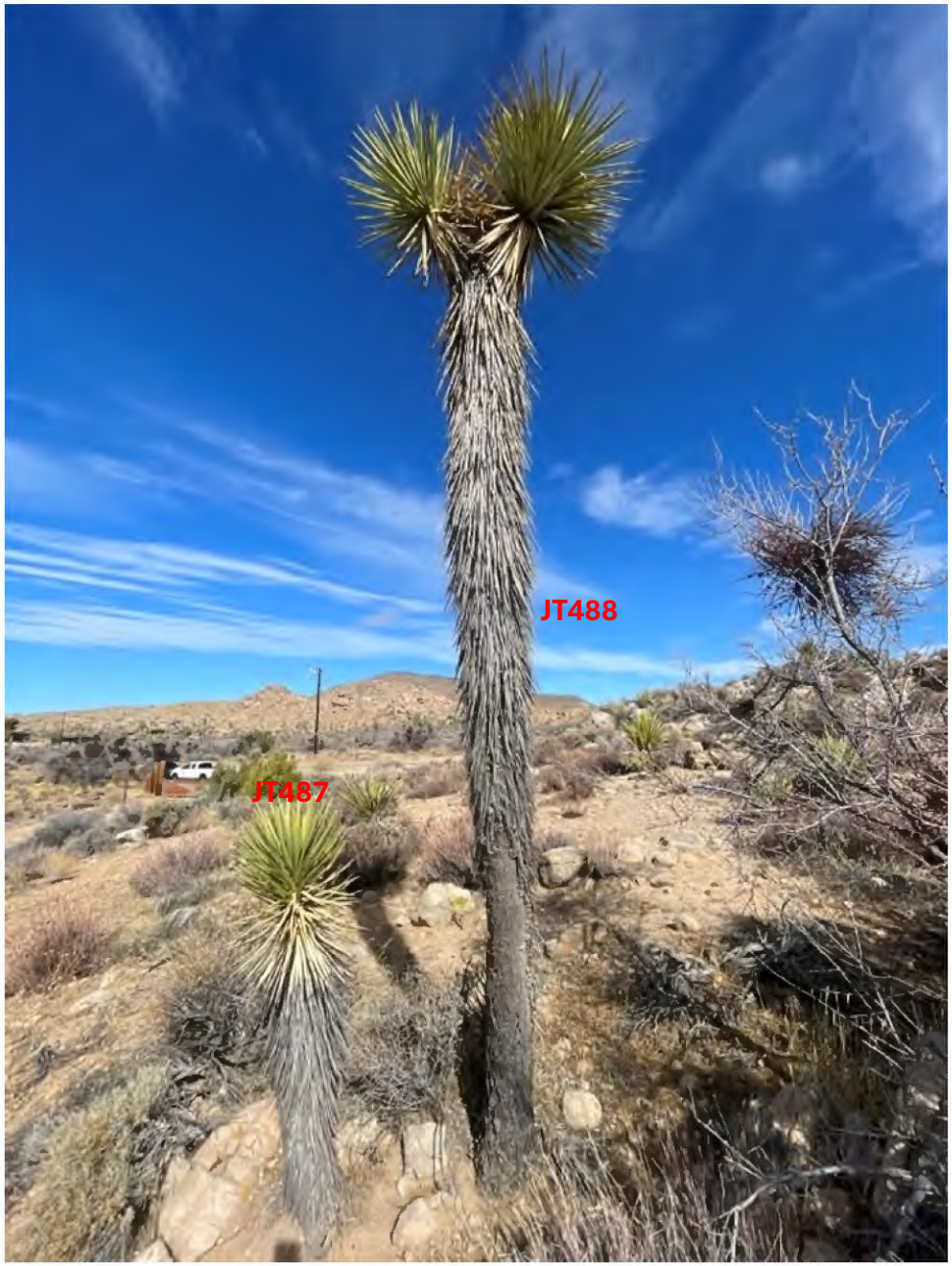
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Joshua Tree 485



Joshua Tree 486



Joshua Trees 487-488



Joshua Tree 489



Joshua Tree 490



Joshua Tree 491



Joshua Tree 492



Joshua Tree 493



Joshua Tree 494



Joshua Tree 495-496



Joshua Tree 497



Joshua Tree 498



Joshua Tree 499



Joshua Tree 500



Joshua Tree 501



Joshua Tree 502



Joshua Tree 503



Joshua Tree 504-505



Joshua Tree 506



Joshua Tree 507



Joshua Tree 508



Joshua Tree 509



Joshua Tree 510



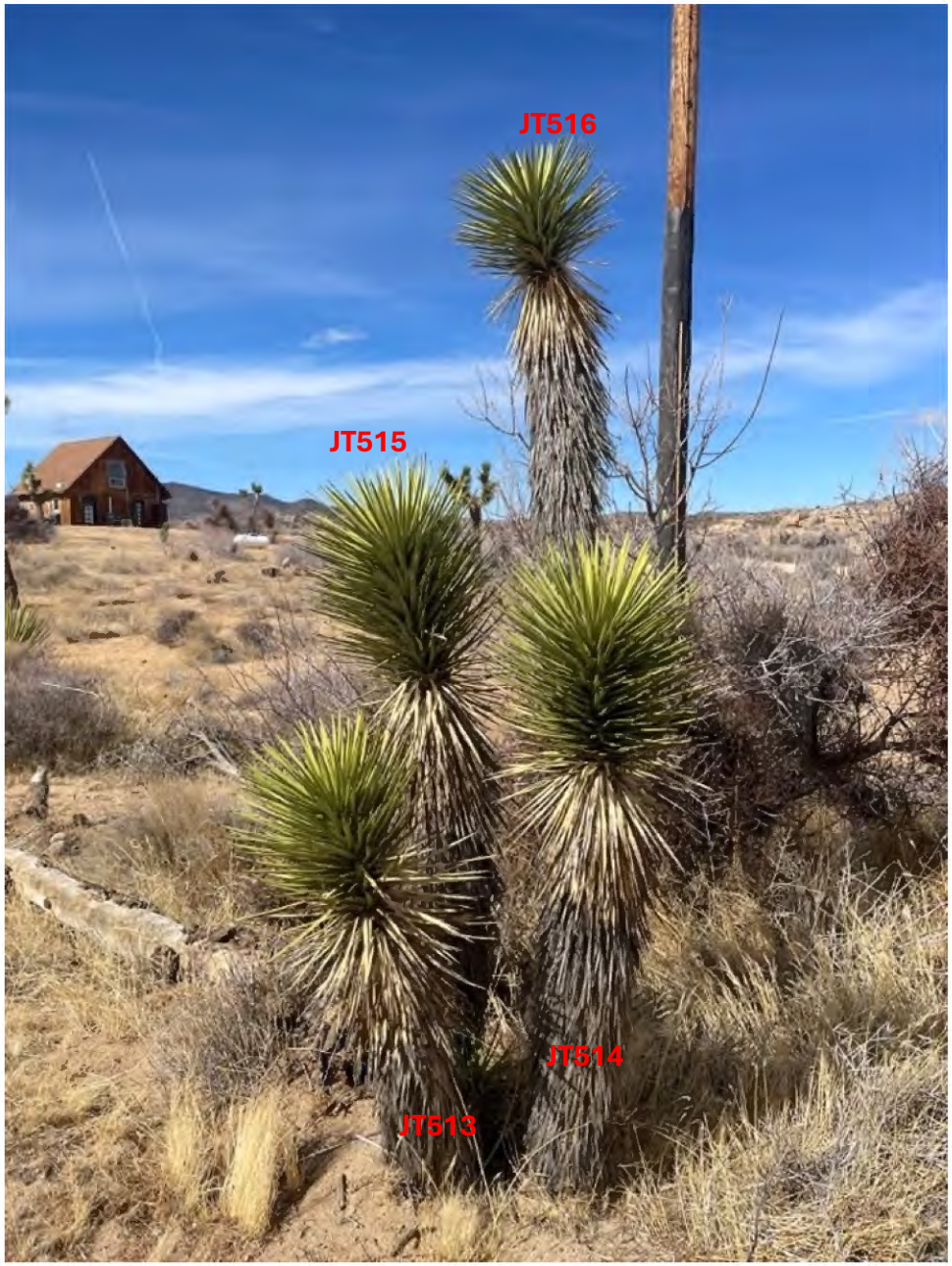
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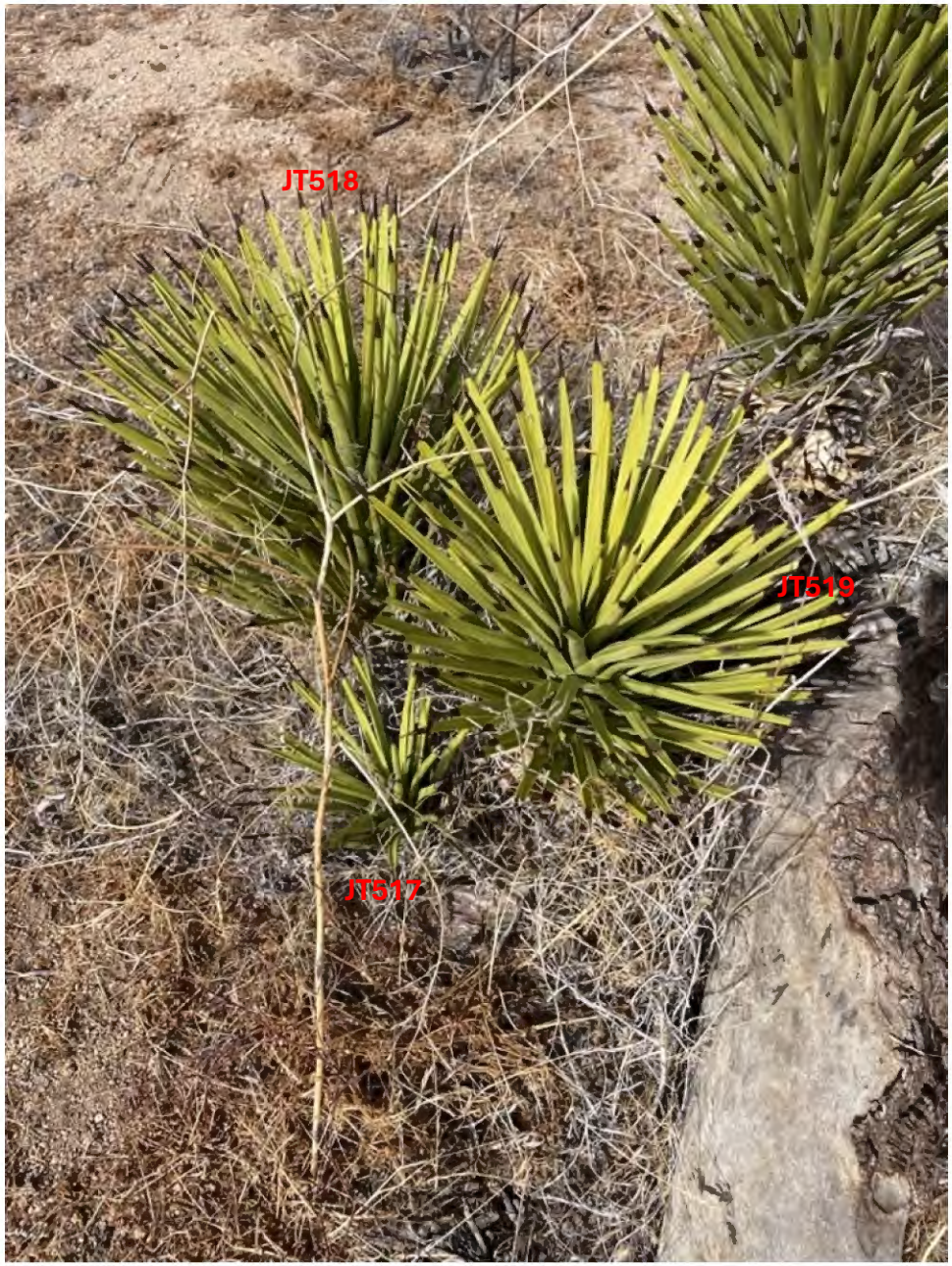
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Joshua Tree 512



Joshua Tree 513-516



Joshua Trees 517-519



Joshua Tree 520



Joshua Tree 521



Joshua Tree 522



Joshua Tree 523



Joshua Tree 524



Joshua Tree 525



Joshua Tree 526



Joshua Tree 527



Joshua Trees 528-529



Joshua Tree 530



Joshua Tree 531



Joshua Tree 532



Joshua Tree 533



Joshua Tree 534



Joshua Tree 535



Joshua Tree 536



Joshua Tree 537



Joshua Tree 538



Joshua Tree 539



Joshua Tree 540



Joshua Tree 541



Joshua Tree 542



Joshua Tree 543



*Joshua trees labeled as "PXXX" were on private property and not accessible, **P001**



P002



P003



P004



P005



P006

Appendix C: Site Plan

IN THE UNINCORPORATED AREA OF SAN BERNARDINO COUNTY

TENTATIVE TRACT MAP NO. 20612

BEING A SUBDIVISION OF THE SOUTHWEST ¼ OF THE NORTHEAST ¼ AND THE NORTHWEST ¼ OF THE SOUTHEAST ¼ AND THE NORTHEAST ¼ OF THE SOUTHWEST ¼ OF SECTION 6, TOWNSHIP 1 NORTH, RANGE 5 EAST, SAN BERNARDINO BASE AND MERIDIAN, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF, IN THE OFFICE OF THE COUNTY RECORDER OF SAID OFFICE

OFFICIAL USE ONLY

LEGAL DESCRIPTION

THE LAND REFERRED TO HEREIN BELOW IS SITUATED IN THE UNINCOPORATED AREA OF SAN BERNARDINO IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, AND IS DESCRIBED AS FOLLOWS:

THE SOUTH 1/4 OF THE NORTHEAST 1/4 AND THE NORTHWEST 1/4 OF THE SOUTHEAST 1/4 AND THE NORTHEAST 1/4 OF THE SOUTHWEST 1/4 OF SECTION 6, TOWNSHIP 1 NORTH, RANGE 5 EAST, SAN BERNARDINO BASE AND MERIDIAN, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF.

APN: 0594-351-36

EASEMENTS

(3) AN EASEMENT TO THE DESERT ELECTRIC COOPERATIVE, INC., ITS SUCCESSORS AND/OR ASSIGNS FOR ELECTRIC TRANSMISSION OR DISTRIBUTION LINE OR SYSTEM RECORDED APRIL 22, 1960 IN BOOK 5118, PAGE 375, O.R.

THE EXACT LOCATION AND EXTENT OF SAID EASEMENT IS NOT DISCLOSED OF RECORD

OWNER/DEVELOPER

JONATHAN SHOKRIAN
53252 PIPES CANYON ROAD
PIONEERTOWN, CA 92268

SURVEYOR/ENGINEER

HILLWIG-GOODROW, INC.
31419 OUTER HIGHWAY 10, SUITE 1-200
REDLANDS, CA 92373
PHONE: 909-794-2673
EMAIL: HG@HILLWIG-GOODROW.COM

GEOTECHNICAL ENGINEER

GEOTEK, INC.
ATTN: ANNA SCOTT
1548 NORTH MAPLE STREET
CORONA, CA 92878
PHONE: 951-710-1160
EMAIL: ASCOTT@GEOTEKUSA.COM

BASIS OF BEARINGS:

THE BASIS OF BEARINGS FOR THIS SURVEY IS THE CALIFORNIA STATE PLANE COORDINATE SYSTEM, ZONE 5, CONSTRAINED LOCALLY BETWEEN CONTINUOUS GPS STATIONS LDES & P599. SAID BEARING IS N59°08'35"E (NAD83(2011) 2017.50 EPOCH.)

BENCHMARK:

THE BENCHMARK USED FOR THIS PROJECT IS GPS CONTINUOUS OPERATING REFERENCE STATION LDES, ELEVATION 3313.28' (NAVD 88.)

THIS IS A CONTINUOUS GPS STATION AND IS PART OF THE NATIONAL GEODETIC SURVEY. VERTICAL DATUM IS TO THE GEODETIC REFERENCE POINT(GRP.) THE ANTENNA IS A TRIMBLE TRM59800-80 WITH SCIT DOME. TRUE VERTICAL ANTENNA HEIGHT IS FROM THE GEODETIC REFERENCE POINT TO THE BOTTOM OF THE ANTENNA PRE-AMP(BPA) AND IS 0.027 FEET.

SURVEYOR'S NOTES:

R1 INDICATES RECORD DATA PER PARCEL MAP NO. 6696, PMB 69/18-19
R2 INDICATES RECORD DATA PER RECORD OF SURVEY 107/70
R3 INDICATES RECORD DATA PER BLM DEPENDENT RESURVEY PLAT OF TOWNSHIP 1 NORTH, RANGE 5 EAST, S.B.M., DATED NOVEMBER 25, 1952.
R4 INDICATES RECORD DATA PER RECORD OF SURVEY 159/94
R5 INDICATES RECORD DATA PER PARCEL MAP NO. 8570, PMB 97/35-36
R6 INDICATES RECORD DATA PER RECORD OF SURVEY 150/34

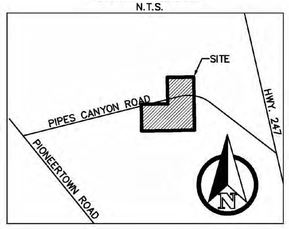
GENERAL NOTES

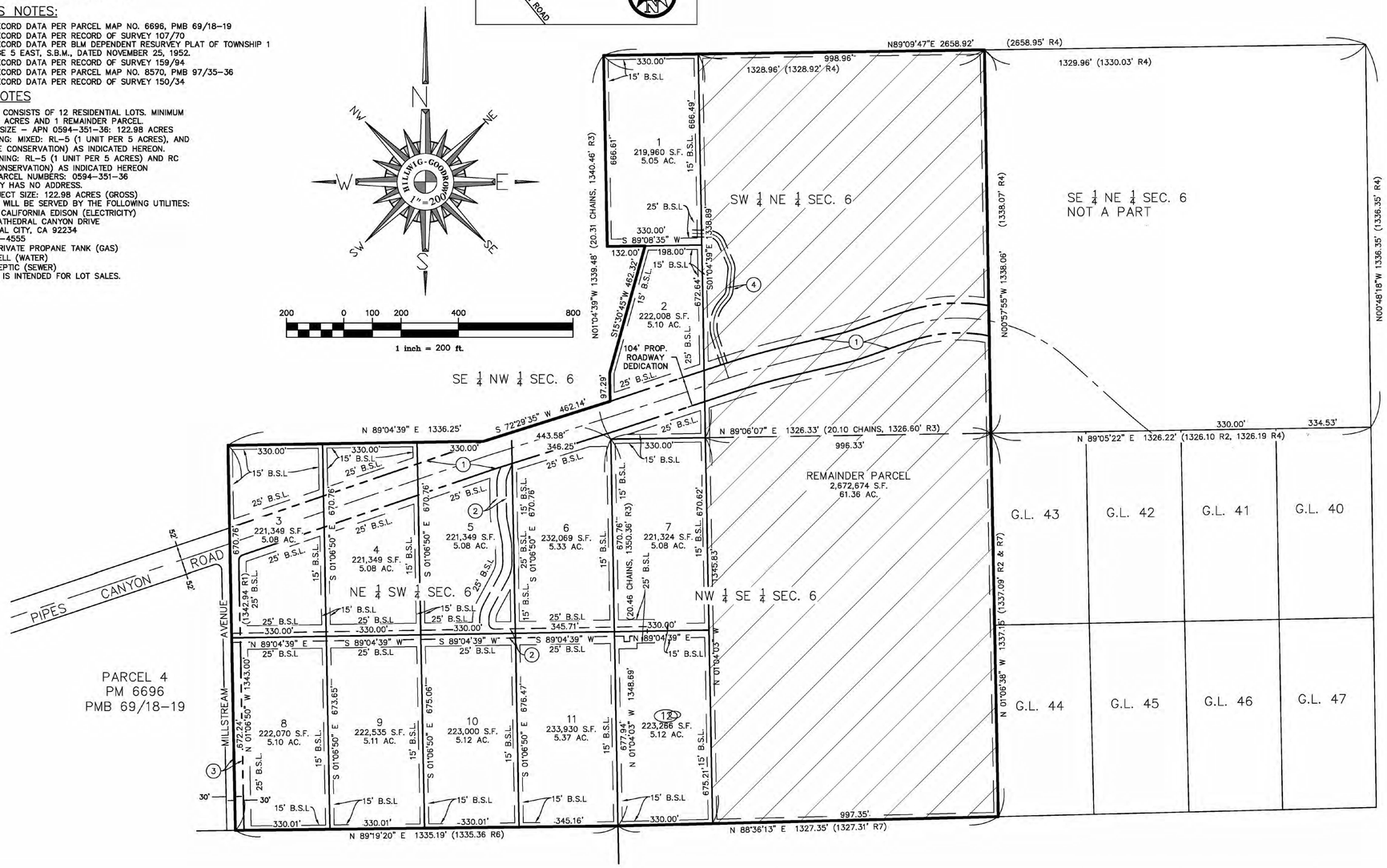
1. THIS PROJECT CONSISTS OF 12 RESIDENTIAL LOTS. MINIMUM LOT SIZE IS 5 ACRES AND 1 REMAINDER PARCEL.
2. EXISTING LOT SIZE - APN 0594-351-36: 122.98 ACRES
3. EXISTING ZONING: MIXED: RL-5 (1 UNIT PER 5 ACRES), AND RC (RESOURCE CONSERVATION) AS INDICATED HEREON.
4. PROPOSED ZONING: RL-5 (1 UNIT PER 5 ACRES) AND RC (RESOURCE CONSERVATION) AS INDICATED HEREON
5. ASSESSORS PARCEL NUMBERS: 0594-351-36
6. THIS PROPERTY HAS NO ADDRESS.
7. EXISTING PROJECT SIZE: 122.98 ACRES (GROSS)
8. THIS PROJECT WILL BE SERVED BY THE FOLLOWING UTILITIES:
   A. SOUTHERN CALIFORNIA EDISON (ELECTRICITY)
      36100 CATHEDRAL CANYON DRIVE
      CATHEDRAL CITY, CA 92234
      800-655-4555
   B. ON-SITE PRIVATE PROPANE TANK (GAS)
   C. PRIVATE WELL (WATER)
   D. ON-SITE SEPTIC (SEWER)
9. THIS PROJECT IS INTENDED FOR LOT SALES.

LEGEND

- PROJECT BOUNDARY
- EXISTING LOT LINE
- PROPOSED LOT LINE
- EXISTING EASEMENT
- PROPOSED EASEMENT
- PROPOSED RIGHT OF WAY
- EXISTING CENTERLINE
- PROPOSED CENTERLINE
- AREA ZONED RL-5
- AREA ZONED RC
- (1) PROPOSED 104 FEET WIDE R.O.W. DEDICATION, CENTERED ON EXISTING IMPROVEMENTS
- (2) 32 FEET WIDE PRIVATE ACCESS EASEMENT WITH 20 FEET WIDE PRIVATE GRADED ROAD
- (3) PROPOSED 30 FEET WIDE R.O.W. DEDICATION
- (4) PROPOSED 24 FEET WIDE DRIVEWAY EASEMENT
- B.S.L. BUILDING SETBACK LINE
- PM PARCEL MAP
- P.M.B. PARCEL MAP BOOK
- PROP. PROPOSED
- ROW RIGHT OF WAY
- SEC. SECTION

VICINITY MAP
N.T.S.





Revisions:				
No.	Date:	By:	Description:	Approved:

Designed: | Drawn: | Checked: ACH

Seal: PROFESSIONAL LAND SURVEYOR ALAN C. HILLWIG No. 5137 EXP. 6-30-25 STATE OF CALIFORNIA

Prepared under the Supervision of:

PROFESSIONAL LAND SURVEYOR
LICENSE NO. 5137

DATE

HILLWIG - GOODROW, INC.
Land Surveying - GPS Surveys - Aerial Mapping
31419 Outer Highway 10, Suite 1-200• Redlands, CA 92373 • (909) 794-2673

Scale: 1" = 200'
Date: November 15, 2024
BENCHMARK: SEE BENCHMARK NOTE ON SHEET 1

TENTATIVE TRACT MAP NO. 20612
APNS: 0594-351-32 & 33
PIPES CANYON ROAD, PIONEERTOWN

PREPARED FOR:
JONATHAN SHOKRIAN
53252 PIPES CANYON ROAD
PIONEERTOWN, CA 92268

F.N. | For: | F.B.

Sheet No. 1 OF 3 SHEET
FILE NO. 0972-002

IN THE UNINCORPORATED AREA OF SAN BERNARDINO COUNTY

TENTATIVE TRACT MAP NO. 20612

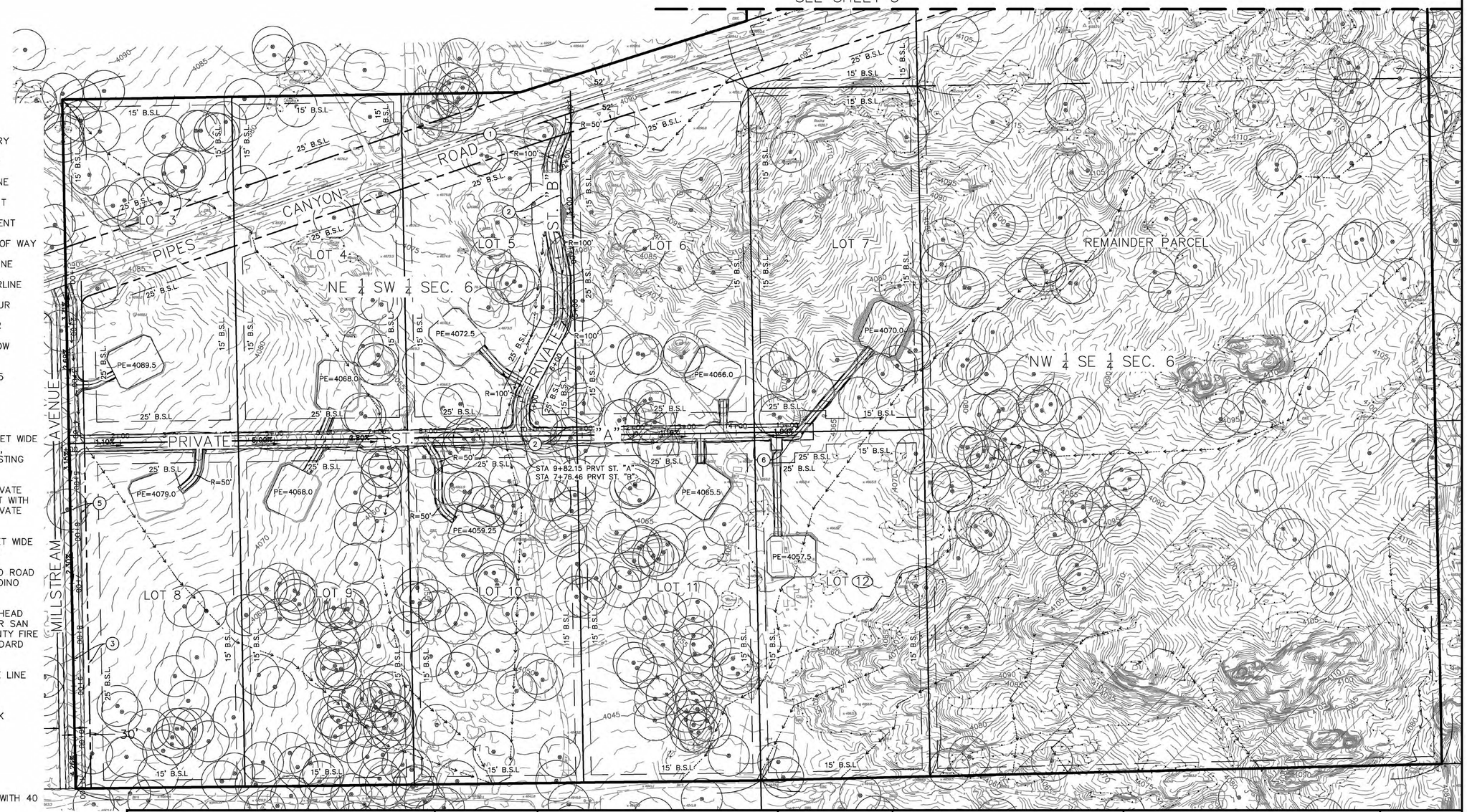
BEING A SUBDIVISION OF THE SOUTHWEST ¼ OF THE NORTHEAST ¼ AND THE NORTHWEST ¼ OF THE SOUTHEAST ¼ AND THE NORTHEAST ¼ OF THE SOUTHWEST ¼ OF SECTION 6, TOWNSHIP 1 NORTH, RANGE 5 EAST, SAN BERNARDINO BASE AND MERIDIAN, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF, IN THE OFFICE OF THE COUNTY RECORDER OF SAID OFFICE

OFFICIAL USE ONLY

NOTES:

- ALL GRADED SLOPES SHOWN HEREON ARE 2:1
- BUILDING PADS SHOWN ARE 80' BY 95'
- DRIVEWAYS SHOWN ARE 12' WIDE
- BUILDING PADS AND DRIVEWAYS ARE SHOWN TO INDICATE FEASIBILITYMENT AND ARE NOT INTENDED TO BE A PART OF IMPROVEMENTS PERFORMED AS A PART OF THIS TRACT MAP.

SEE SHEET 3



LEGEND

	PROJECT BOUNDARY
	EXISTING LOT LINE
	PROPOSED LOT LINE
	EXISTING EASEMENT
	PROPOSED EASEMENT
	PROPOSED RIGHT OF WAY
	EXISTING CENTERLINE
	PROPOSED CENTERLINE
	PROPOSED CONTOUR
	EXISTING CONTOUR
	WATERCOURSE FLOW
	AREA ZONED RL-5
	AREA ZONED RC
①	PROPOSED 104 FEET WIDE R.O.W. DEDICATION, CENTERED ON EXISTING IMPROVEMENTS
②	32 FEET WIDE PRIVATE ACCESS EASEMENT WITH 20 FEET WIDE PRIVATE GRADED ROAD
③	PROPOSED 30 FEET WIDE R.O.W. DEDICATION
⑤	PROPOSED GRADED ROAD PER SAN BERNARDINO COUNTY STD 114
⑥	MODIFIED HAMMERHEAD TURN AROUND PER SAN BERNARDINO COUNTY FIRE PREVENTION STANDARD DIAGRAM A-1.12
B.S.L.	BUILDING SETBACK LINE
PM	PARCEL MAP
P.M.B.	PARCEL MAP BOOK
PROP.	PROPOSED
ROW	RIGHT OF WAY
SEC.	SECTION
◎	REGULATED TREE WITH 40 FT. RADIUS

100 0 50 100 200 400

1 inch = 100 ft.

Revisions:

No.	Date:	By:	Description:	Approved:

Designed: | Drawn: | Checked: ACH

Seal: PROFESSIONAL LAND SURVEYOR ALAN C. HILLWIG No. 5137 EXP. 6-30-25 STATE OF CALIFORNIA

Prepared under the Supervision of:

PROFESSIONAL LAND SURVEYOR LICENSE NO. 5137 — DATE

HILLWIG - GOODROW, INC.
Land Surveying - GPS Surveys - Aerial Mapping
31419 Outer Highway 10, Suite 1-200● Redlands, CA 92373 ● (909) 794-2673

Scale: 1" = 100'

BENCHMARK: SEE BENCHMARK NOTE ON SHEET 1

Date: November 15, 2024

TENTATIVE TRACT MAP NO. 20612
ACCESS AND PAD FEASABILITY EXHIBIT
PIPES CANYON ROAD, PIONEERTOWN

PREPARED FOR:
JONATHAN SHOKRIAN
53252 PIPES CANYON ROAD
PIONEERTOWN, CA 92268

F.N. | For: | F.B.

Sheet No. 2 OF 3 SHEET

FILE NO. 0972-002

IN THE UNINCORPORATED AREA OF SAN BERNARDINO COUNTY

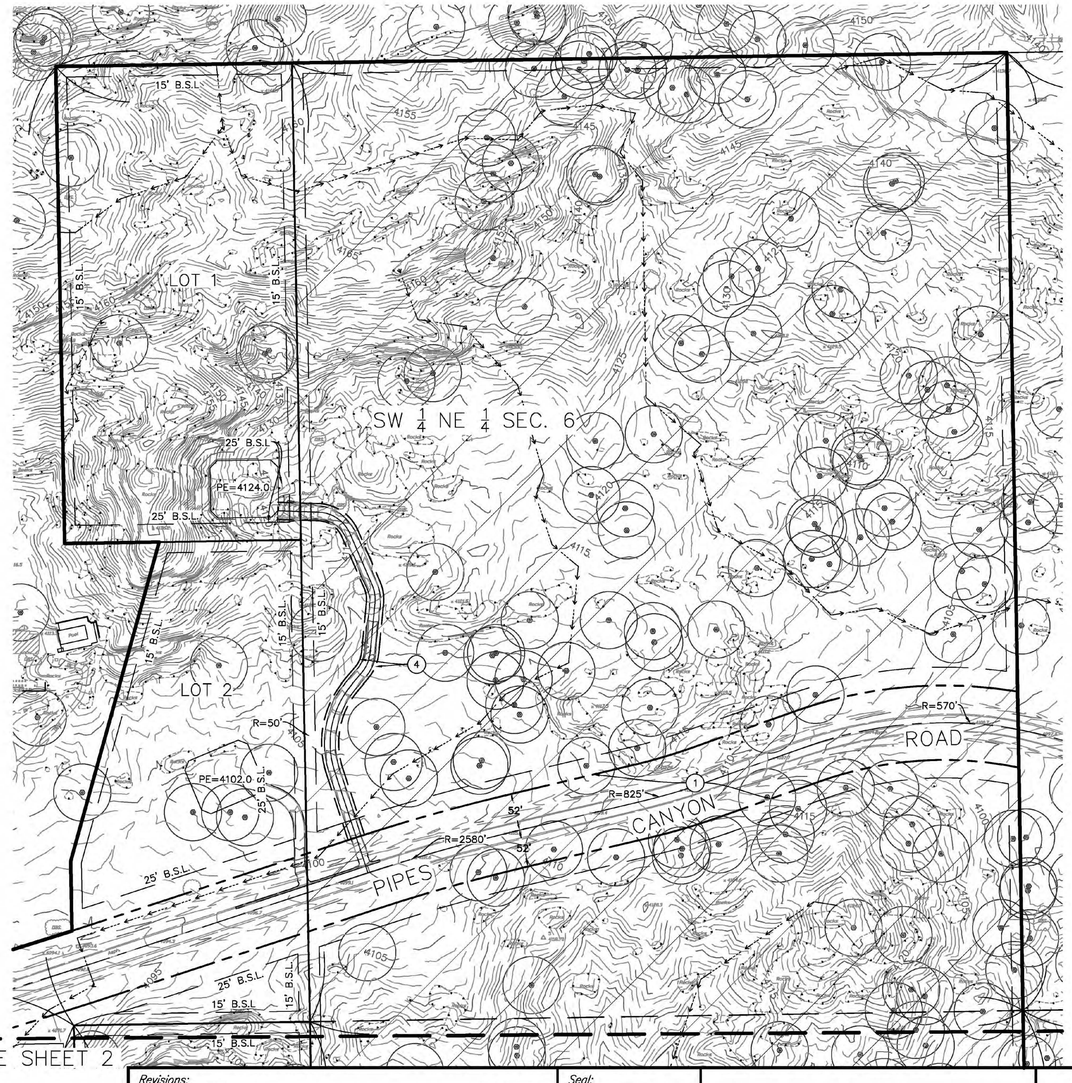
TENTATIVE TRACT MAP NO. 20612

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- BUILDING PADS AND DRIVEWAYS ARE SHOWN TO INDICATE FEASIBILITYMENT AND ARE NOT INTENDED TO BE A PART OF IMPROVEMENTS PERFORMED AS A PART OF THIS TRACT MAP.



LEGEND

- PROJECT BOUNDARY
- EXISTING LOT LINE
- PROPOSED LOT LINE
- EXISTING EASEMENT
- PROPOSED EASEMENT
- PROPOSED RIGHT OF WAY
- EXISTING CENTERLINE
- PROPOSED CENTERLINE
- PROPOSED CONTOUR
- EXISTING CONTOUR
- WATERCOURSE FLOW
- AREA ZONED RL-5
- AREA ZONED RC
- (1) PROPOSED 104 FEET WIDE R.O.W. DEDICATION, CENTERED ON EXISTING IMPROVEMENTS
- (4) PROPOSED 24 FEET WIDE DRIVEWAY EASEMENT
- B.S.L. BUILDING SETBACK LINE
- PM PARCEL MAP
- P.M.B. PARCEL MAP BOOK
- PROP. PROPOSED
- ROW RIGHT OF WAY
- SEC. SECTION
- REGULATED TREE WITH 40 FT. RADIUS

150 0 75 150 300 600

1 inch = 150 ft.

Revisions:

No.	Date:	By:	Description:	Approved:

Designed: | Drawn: | Checked: ACH

Seal: PROFESSIONAL LAND SURVEYOR ALAN C. HILLWIG No. 5137 EXP. 6-30-25 STATE OF CALIFORNIA

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Scale: 1" = 100' | BENCHMARK: SEE BENCHMARK NOTE ON SHEET 1

Date: November 15, 2024 | F.N. | For: | F.B.

TENTATIVE TRACT MAP NO. 20612
ACCESS AND PAD FEASABILITY EXHIBIT
PIPES CANYON ROAD, PIONEERTOWN

PREPARED FOR:
JONATHAN SHOKRIAN
53252 PIPES CANYON ROAD
PIONEERTOWN, CA 92268

Sheet No. 3 OF 3 SHEET

FILE NO. 0972-002

Appendix C

Phase I Cultural Resource Report

Phase I Cultural Resources Report

Pipes Canyon Project, Pioneertown, San Bernardino County, California

Prepared For:
Rich Malacoff, Principal Planner
The Altum Group
44-600 Village Court, Suite 100
Palm Desert, California 92260

Prepared By:

South Environmental LLC
2061 N. Los Robles Avenue., Ste. 205
Pasadena, California 91104

Authors: Samantha Jovanovic, MA, MS, Kevin Hunt, BA, and Samantha Murray, MA, RPA

March 2025

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Executive Summary

South Environmental was retained to prepare a cultural resources report for the Pipes Canyon Project (project), located near the unincorporated community of Pioneertown in San Bernardino County, California. This analysis includes the results of a California Historical Resources Information Center (CHRIS) records search of the project site and a one-half-mile radius from the South Central Coastal Information Center (SCCIC); a California Native American Heritage Commission (NAHC) Sacred Lands File search and informational scoping letters to local tribes; an intensive-level pedestrian survey of the project site by qualified archaeologists; and a California Register of Historical Resources (CRHR) eligibility evaluation of a historic age resource.

This report was prepared in conformance with California Environmental Quality Act (CEQA) Guidelines § 15064.5 for historical resources, the *San Bernardino County Policy Plan* (2024), and the *San Bernardino County Overview* guidelines for cultural and historical resources (2007).

No archaeological resources were identified within the project site as a result of the SCCIC records search, or Native American scoping. However, one historic-age resource (SE-Pipes-01) was identified and recorded during the pedestrian survey, evaluated for CRHR eligibility, and is recommended not eligible for CRHR eligibility. Therefore, SE-Pipes-01 is not a historical resource under CEQA.

Due to the geomorphologic nature of the project site, and its proximity to known Native American sites, the project site possesses moderate to low sensitivity for buried archaeological resources, and therefore, no cultural resources mitigation measures are recommended.

Because it is always possible to encounter resources and human remains during project-related ground disturbance, implementation of the standard regulatory requirements for inadvertent discoveries (Section 8.2) will ensure that any cultural resources or human remains identified during construction are handled appropriately such that impacts to archaeological resources and human remains are less than significant.

1 Introduction

South Environmental was retained to prepare a cultural resources report for the Pipes Canyon Project (project), located near the unincorporated community of Pioneertown in San Bernardino County, California. This analysis includes the results of a California Historical Resources Information Center (CHRIS) records search of the project site and a one-half-mile radius from the South Central Coastal Information Center (SCCIC); a California Native American Heritage Commission (NAHC) Sacred Lands File search and informational scoping letters to local tribes; an intensive-level pedestrian survey of the project site by qualified archaeologists; and recordation and evaluation of one historic-age resource identified during the survey.

This report was prepared in conformance with California Environmental Quality Act (CEQA) Guidelines § 15064.5 for historical resources, the *San Bernardino County Policy Plan* (2024), and the *San Bernardino County Overview* guidelines for cultural and historical resources (2007) by South Environmental Archaeologist Samantha Jovanovic, MA, MS, Principal Archaeologist Kevin Hunt, BA, and Cultural Resources Director and Archaeological Principal Investigator Samantha Murray, MA, Registered Professional Archaeologist (RPA), who meets the Secretary of the Interior's Professional Qualification Standards for Prehistoric and Historic Archaeology (see resumes provided in Appendix D).

1.1 Project Location

The project site is located on the north and south sides of Pipes Canyon Road at its northern apex, approximately halfway between Pioneertown Road and State Route 247 (Old Woman Springs Road) north of the unincorporated community of Pioneertown in San Bernardino County, California. The project site comprises the following Assessor's Parcel Number (APNs): 0594-351-36. The project site is located on the United States Geological Survey (USGS) *Rimrock*, *California* and *Yucca Valley*, *California* 7.5-minute Quadrangle Maps in Section 06 of Township 01 North and Range 05 East, San Bernardino Base Meridian Figures 1 and 2).

1.2 Project Description

The project site encompasses a total area of approximately 122.98 acres and is currently designated by the County's General Plan as Rural Living single family homes (RL-5), with a minimum lot size of five acres, as well as Resource Conservation (RC).

The project applicant seeks approval to subdivide the property into 13 individual lots. Of these, 12 lots will be developed as five-acre residential parcels, intended for single-family homes, and will be offered for sale. These residential lots will be designed to provide ample space for rural residential living, consistent with the existing zoning designation of Rural Living RL-5. The remaining lot, situated within

the RC zoning area, will retain its current Resource Conservation designation, preserving the site's natural resources and environmental features.

Figure 1. Project Location

Figure 2. Project Site Detail

2 Regulatory Framework

2.1.1 State

California Register of Historical Resources

In California, the term "historical resource" includes but is not limited to "any object, building, structure, site, area, place, record, or manuscript which is historically or archaeologically significant, or is significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political, military, or cultural annals of California" (California Public Resources Code Section 5020.1(j)). In 1992, the California legislature established the CRHR "to be used by state and local agencies, private groups, and citizens to identify the state's historical resources and to indicate what properties are to be protected, to the extent prudent and feasible, from substantial adverse change" (California Public Resources Code Section 5024.1(a)). The criteria for listing resources on the CRHR were expressly developed to be in accordance with previously established criteria developed for listing in the National Register of Historic Places (NRHP), enumerated below. According to California Public Resources Code Section 5024.1(c)(1–4), a resource is considered historically significant if it (i) retains "substantial integrity," and (ii) meets at least one of the following criteria:

(1) Is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage.

(2) Is associated with the lives of persons important in our past.

(3) Embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possesses high artistic values.

(4) Has yielded, or may be likely to yield, information important in prehistory or history.

In order to understand the historic importance of a resource, sufficient time must have passed to obtain a scholarly perspective on the events or individuals associated with the resource. A resource less than 50 years old may be considered for listing in the CRHR if it can be demonstrated that sufficient time has passed to understand its historical importance (see 14 CCR 4852(d)(2)).

The CRHR protects cultural resources by requiring evaluations of the significance of prehistoric and historic resources. The criteria for the CRHR are nearly identical to those for the NRHP, and properties listed or formally designated as eligible for listing in the NRHP are automatically listed in the CRHR, as are the state landmarks and points of interest. The CRHR also includes properties designated under local ordinances or identified through local historical resource surveys.

California Environmental Quality Act

As described below, the following CEQA statutes and CEQA Guidelines are of relevance to the analysis of archaeological, historic, and tribal cultural resources:

- California Public Resources Code Section 21083.2(g) defines "unique archaeological resource."
- California Public Resources Code Section 21084.1 and CEQA Guidelines Section 15064.5(a) define "historical resources." In addition, CEQA Guidelines Section 15064.5(b) defines the phrase "substantial adverse change in the significance of an historical resource." It also defines the circumstances when a project would materially impair the significance of an historical resource.
- California Public Resources Code Section 21074(a) defines "tribal cultural resources."
- California Public Resources Code Section 5097.98 and CEQA Guidelines Section 15064.5(e) set forth standards and steps to be employed following the accidental discovery of human remains in any location other than a dedicated ceremony.
- California Public Resources Code Sections 21083.2(b)-(c) and CEQA Guidelines Section 15126.4 provide information regarding the mitigation framework for archaeological and historic resources, including examples of preservation-in-place mitigation measures; preservation-in-place is the preferred manner of mitigating impacts to significant archaeological sites because it maintains the relationship between artifacts and the archaeological context and may also help avoid conflict with religious or cultural values of groups associated with the archaeological site(s).

More specifically, under CEQA, a project may have a significant effect on the environment if it may cause "a substantial adverse change in the significance of an historical resource" (California Public Resources Code Section 21084.1; CEQA Guidelines Section 15064.5(b).) If a site is either listed or eligible for listing in the CRHR, or if it is included in a local register of historic resources or identified as significant in a historical resources survey (meeting the requirements of California Public Resources Code Section 5024.1(q)), it is a "historical resource" and is presumed to be historically or culturally significant for purposes of CEQA (California Public Resources Code Section 21084.1; CEQA Guidelines Section 15064.5(a)). The lead agency is not precluded from determining that a resource is a historical resource even if it does not fall within this presumption (California Public Resources Code Section 21084.1; CEQA Guidelines Section 15064.5(a)).

A "substantial adverse change in the significance of an historical resource" reflecting a significant effect under CEQA means "physical demolition, destruction, relocation, or alteration of the resource or its immediate surroundings such that the significance of an historical resource would be materially impaired" (CEQA Guidelines Section 15064.5(b)(1); California Public Resources Code Section 5020.1(q)). In turn, CEQA Guidelines section 15064.5(b)(2) states the significance of a historical resource is materially impaired when a project:

1. Demolishes or materially alters in an adverse manner those physical characteristics of an historical resource that convey its historical significance and that justify its inclusion in, or eligibility for, inclusion in the California Register of Historical Resources; or
2. Demolishes or materially alters in an adverse manner those physical characteristics that account for its inclusion in a local register of historical resources pursuant to section 5020.1(k) of the Public Resources Code or its identification in an historical resources survey meeting the requirements of section 5024.1(g) of the Public Resources Code, unless the public agency reviewing the effects of the project establishes by a preponderance of evidence that the resource is not historically or culturally significant; or
3. Demolishes or materially alters in an adverse manner those physical characteristics of a historical resource that convey its historical significance and that justify its eligibility for inclusion in the California Register of Historical Resources as determined by a lead agency for purposes of CEQA.

Pursuant to these sections, the CEQA inquiry begins with evaluating whether a project site contains any "historical resources," then evaluates whether that project will cause a substantial adverse change in the significance of a historical resource such that the resource's historical significance is materially impaired.

If it can be demonstrated that a project will cause damage to a unique archaeological resource, the lead agency may require reasonable efforts be made to permit any or all of these resources to be preserved in place or left in an undisturbed state. To the extent that they cannot be left undisturbed, mitigation measures are required (California PRC Section 21083.2[a], [b], and [c]).

California PRC Section 21083.2(g) defines a unique archaeological resource as an archaeological artifact, object, or site about which it can be clearly demonstrated that without merely adding to the current body of knowledge, there is a high probability that it meets any of the following criteria:

1. Contains information needed to answer important scientific research questions and that there is a demonstrable public interest in that information.
2. Has a special and particular quality such as being the oldest of its type or the best available example of its type.
3. Is directly associated with a scientifically recognized important prehistoric or historic event or person.

Impacts to non-unique archaeological resources are generally not considered a significant environmental impact (California PRC section 21083.2(a); CEQA Guidelines Section 15064.5(c)(4)). However, if a non-unique archaeological resource qualifies as tribal cultural resource (California PRC Section 21074(c), 21083.2(h)), further consideration of significant impacts is required. CEQA Guidelines Section 15064.5 assigns special importance to human remains and specifies procedures to be used

when Native American remains are discovered. These procedures are detailed in California PRC Section 5097.98.

2.1.2 Local

San Bernardino County Municipal Code Chapter 82.12: Cultural Resources Preservation (CP) Overlay

§ 82.12.010 Purpose.

The Cultural Resources Preservation (CP) Overlay established by §§ 82.01.020 (Land Use Plan and Land Use Zoning Districts) and 82.01.030 (Overlays) is intended to provide for the identification and preservation of important archaeological and historical resources. This is necessary because:

(a) Many of the resources are unique and non-renewable; and
(b) The preservation of cultural resources provides a greater knowledge of County history, thus promoting County identity and conserving historic and scientific amenities for the benefit of future generations.

(Ord. 4011, passed - -2007)

§ 82.12.020 Location Requirements.

The CP Overlay may be applied to areas where archaeological and historic sites that warrant preservation are known or are likely to be present. Specific identification of known cultural resources is indicated by listing in one or more of the following inventories:

(a) California Archaeological Inventory;
(b) California Historic Resources Inventory;
(c) California Historical Landmarks;
(d) California Points of Historic Interest; and/or
(e) National Register of Historic Places.

(Ord. 4011, passed - -2007)

San Bernardino County Cultural Resource Element Policies

The following is taken directly from the Cultural Resource Element of the San Bernardino County Policy Plan of 2022 (San Bernardino County 2022).

GOAL CR-1 Tribal Cultural Resources

Tribal cultural resources that are preserved and celebrated out of respect for Native American beliefs and traditions

Policy CR-1.1 Tribal notification and coordination. We notify and coordinate with tribal representatives in accordance with state and federal laws to strengthen our working relationship with area tribes, avoid inadvertent discoveries of Native American archaeological sites and burials, assist with the treatment and disposition of inadvertent discoveries, and explore options of avoidance of cultural resources early in the planning process.

Policy CR-1.2 Tribal planning. We will collaborate with local tribes on countywide planning efforts and, as permitted or required, planning efforts initiated by local tribes.

Policy CR-1.3 Mitigation and avoidance. We consult with local tribes to establish appropriate project-specific mitigation measures and resource-specific treatment of potential cultural resources. We require project applicants to design projects to avoid known tribal cultural resources, whenever possible. If avoidance is not possible, we require appropriate mitigation to minimize project impacts on tribal cultural resources.

Policy CR-1.4 Resource monitoring. We encourage active participation by local tribes as monitors in surveys, testing, excavation, and grading phases of development projects with potential impacts on tribal resources.

GOAL CR-2 Historic and Paleontological Resources

Historic resources (buildings, structures, or archaeological resources) and paleontological resources that are protected and preserved for their cultural importance to local communities as well as their research and educational potential.

Policy CR-2.1 National and state historic resources. We encourage the preservation of archaeological sites and structures of state or national significance in accordance with the Secretary of Interior's standards.

Policy CR-2.2 Local historic resources. We encourage property owners to maintain the historic integrity of resources on their property by (listed in order of preference): preservation, adaptive reuse, or memorialization.

Policy CR-2.3 Paleontological and archaeological resources. We strive to protect paleontological and archaeological resources from loss or destruction by requiring that new development include appropriate mitigation to preserve the quality and integrity of these resources. We require new development to avoid paleontological and archeological resources whenever possible. If avoidance is not possible, we require the salvage and preservation of paleontological and archeological resources.

Policy CR-2.4 Partnerships. We encourage partnerships to champion and financially support the preservation and restoration of historic sites, structures, and districts.

Policy CR-2.5 Public awareness and education. We increase public awareness and conduct education efforts about the unique historic, natural, tribal, and cultural resources in San Bernardino County through the County Museum and in collaboration with other entities.

3 Environmental Setting

The project site is located on the north and south sides of Pipes Canyon Road at its northern apex, approximately halfway between Pioneertown Road and State Route 247 (Old Woman Springs Road) north of the unincorporated community of Pioneertown within the Morongo Basin in the southern portion of the Mojave Desert. The Morongo Basin is an endorheic basin that drains eastwardly towards the Colorado River. The basin region is predominantly hot and dry, with rough terrain.

The study area has a desert climate with hot summers and mild winters. Average annual rainfall is 6.25 inches with the wettest months being December through March, and during summer monsoons in July. December through February also occasionally experiences light snow dusting of less than one inch (Kauffman 2021, National Oceanic and Atmospheric Administration 2021).

The project site is composed of Mesozoic granitic rocks found in the Mojave Desert, Death Valley area, and the Sierra Nevada and Transverse Mountain Ranges. The unit is composed of granodiorite, tonalite, gabbro, and quartz monzonite ranging from the Lopingian Epoch (259.51 million years ago, late Permian Era) to late Pliocene in age (2.58 million years ago) (Horton et al 2017). The topsoil comprises alluvium from the surrounding granitic rocks as well as the basalt mesas that surround the area.

The topography of the project site and surrounding area is variable with small rolling hills and a braided wash on the western half and large granitic boulder outcrops on the eastern half. The overall project has a slope of approximately 5-10 degrees with the lowest point at 4,050 feet above mean sea level (amsl) at the southern end and the highest point at 4,210 feet amsl at the northern end, resulting in an elevation change of approximately 160 feet across the site.

4 Cultural Setting

4.1 Prehistoric Context

For approximately a century, archaeologists have developed chronological sequences to explain prehistoric cultural changes within all or portions of southern California (c.f., Campbell and Campbell 1935; Jones and Klar 2007; Moratto 2004). Sutton et al. (2007) devised an updated Mojave Desert culture history dividing it into four temporal periods: Pleistocene, Early Holocene, Middle Holocene, and Late Holocene (Table 1).

Table 1. Mojave Desert Chronology

Period	Cultural Complex	Approximate Dates
Pleistocene	Pre-Clovis	Pre-10,000 cal B.C.
	Paleo-Indian	10,000-8000 cal B.C.
Early Holocene	Lake Mojave	8000-6000 cal B.C.
	Pinto	
Middle Holocene		7000-3000 cal B.C.
Late Holocene	Gypsum	2000 cal B.C.-cal A.D. 200
	Rose Spring	cal A.D. 200-1100
	Late Prehistoric	cal A.D. 1100-Contact

4.1.1 Pleistocene Period (ca. 10,000 to 8000 B.C.)

The climate of the Mojave during the Pleistocene Period was cool and wet (Sutton et al. 2007: 231). It is possible that pre-Clovis occupation occurred in the Mojave Desert; however, such claims remain controversial and inadequately substantiated. Sites with reliable early dates have yet to be found.

The Clovis Complex is the earliest and only Paleo-Indian cultural complex widely accepted in the Mojave Desert (Sutton et al. 2007:233-234). This complex is generally defined by large lanceolate-shaped bifaces with fluting, prepared to thin and flatten the base of the artifact for hafting. Other tools associated with the Clovis Complex include large side scrapers, blades derived from prepared cores, and a mixture of expedient flaked tools (Justice 2002:73). Paleo-Indian populations associated with fluted point technology consisted of small, mobile groups who hunted and gathered near permanent sources of water such as pluvial lakes. The tools associated with these populations are most commonly found in the drainage basins of the pluvial lakes (Sutton et al. 2007: 234).

Fluted points have traditionally been interpreted as tools used for hunting Pleistocene megafauna because of their clear association with megafauna remains in the Great Plains and Southwest, but most fluted points found in California have lacked corroborating Pleistocene radiocarbon dates (Arnold et

al., 2004). One exception was found during excavations at China Lake in the early 1970s, where fluted points associated with burned, extinct megafaunal material were uncovered (Davis 1975). As Davis and Panlaqui (1978:31) noted, the sites at China Lake demonstrate that Paleo-Indians exploited many available resources, not just megafauna.

4.1.2 Early Holocene (8000 to 6000 B.C.)

The onset of the early Holocene was marked by warmer temperatures, reduced precipitation, and the eventual desiccation of the Pleistocene pluvial lakes. These changes are believed to have caused an irregular distribution of resources available to the early Holocene inhabitants (Sutton et al. 2007:237). The shallow lakes and marshes of the Mojave Desert during this period were biologically very productive but surrounded by desert vegetation typical of later time periods, initially dominated by white bursage and later creosote bush (Grayson 1993:199-200).

The Lake Mojave Complex is the only clear complex in the region during this time and reflects an increasingly diversified subsistence strategy that was necessary for successful adaptation to climatic changes. The Lake Mojave Complex is identified primarily by heavy, stemmed projectile points of the Great Basin Stemmed series such as Lake Mojave and Silver Lake. Other tools include bifaces, steep-edged unifaces, crescents, the occasional cobble-core tool, and, infrequently, ground stone implements (Justice 2002:91). Settlement organization components include extensive residential accumulations, workshops, and small camps containing handfuls of tools (Sutton et al. 2007: 237).

While earlier research presumed a dependence on lacustrine subsistence strategies, recent studies have found Lake Mojave Complex sites in other contexts (e.g., Basgall 2005; Basgall and Jurich 2006; Giambastiani and Berg 2008:14). Sutton et al. (2007:237) stated that the Lake Mojave assemblages included tools that are "consistent with long-term curation and transport." The presence of exotic lithic materials and marine shell beads in Lake Mojave Complex assemblages further supports the assertion that Early Holocene inhabitants were highly mobile and possibly traded with groups over long distances.

4.1.3 Middle Holocene (7000 to 3000 B.C.)

The Middle Holocene climate was generally more arid than periods before and after but experienced multiple oscillations between wetter and drier conditions throughout its 4,000 years. The desiccation of the lakes and marshes of the Pleistocene and Early Holocene required the region's inhabitants to rely on streams and springs for water, resulting in lower occupational densities (Aikens 1978; Basgall 2000; Cleland and Spaulding 1992; Sutton 1996; Warren 1984). Average temperatures and aridity increased, peaking between 6000 and 5000 B.C. Settlement patterns adapted, including a shift to upland settings where sources of water still existed and changes in tool assemblage content and diversity marked the emergence of the Pinto Complex (Sutton 1996).

The Pinto Complex was defined by Campbell and Campbell (1935) based on their work at the Pinto Basin site but has a wider distribution throughout the Mojave Desert than previous complexes. During the latter part of the Early Holocene, archaeological data indicate that the Pinto Complex overlaps the Lake Mojave Complex (Sutton et al. 2007:237). The Pinto Complex reflects shifts in subsistence patterns and adaptation to the shriveling of the Pleistocene lakes, including a greater emphasis on the exploitation of plants, with the continued pursuit of artiodactyls and smaller game. The broad distribution of this complex implies a high degree of residential mobility.

The hallmarks of the Pinto Complex tool assemblage include concave base and bifurcate base projectile points with strong basal ears and more gradual shoulders (Justice 2002:126; Zyniecki 2003:12). Other diagnostic artifacts of this complex include domed and keeled scrapers, large and small leaf-shaped bifaces, core/cobble tools, large metates and milling slabs, and shaped and unshaped handstones.

Near the end of the middle Holocene the climate became increasingly hotter and arid. There are very few sites dating during this time, between 3,000 and 2,000 B.C., suggesting that populations were low, and some areas possibly abandoned during this hot period (Sutton et al. 2007:241).

4.1.4 Late Holocene (2000 B.C. to 1700s)

The climate of the prehistoric Late Holocene was similar to modern conditions: cooler and wetter than the Middle Holocene, but not as cool and moist as the Early Holocene. The climate remained highly variable with periods that included the Mojave lakes filling to levels of earlier high stands contrasted with at least two major droughts, circa A.D. 892 to 1112, and circa A.D. 1209 to 1350 (Stine 1994). A cooler and wetter period occurred between 600 and 150 years ago (Cleland and Spaulding 1992:4). These climatic changes at the onset of the Late Holocene once again resulted in modified subsistence strategies and correlating tool kits of three progressive cultural complexes: Gypsum Complex, Rose Spring Complex, and Late Prehistoric Complex.

Dart-point sized projectile points including notched or eared (Elko), concave base (Humboldt), and small-stemmed (Gypsum) types characterized the projectile points of the Gypsum Complex. In addition to these diagnostic points, Gypsum Complex sites included leaf-shaped points, rectangular-based knives, flake scrapers, drills, and occasionally, large scraper planes, choppers, and hammerstones (Warren 1984:416). Manos and milling stones were common, but the mortar and pestle were also introduced during this period. Other artifacts found at Gypsum Complex sites include split-twig animal figurines, *Olivella* shell beads, and *Haliotis* beads and ornaments, which are indicative of trade with people of the southern California coast and southern Great Basin. The inhabitants of the Mojave Desert exported high quality locally available cryptocrystalline tool stone such as obsidian, chalcedony, and chert in exchange for exotic materials.

By A.D. 200, a slightly cooler climate appears to have provided for an increased population, based on a higher frequency of archeological sites. The Rose Spring Complex was present from approximately

A.D. 200 to 1100, with regional temporal variations known as the Saratoga Springs, Haiwee, or Amargosa periods (Sutton 1996; Sutton et al. 2007:236). The smaller Rose Spring projectile points replaced the dart-size points of previous complexes and heralded the introduction of the bow and arrow (Yohe 1998). The bow and arrow provided its user with a way to rapidly fire multiple projectiles during hunting or warfare and from a position of relative security compared to the atl-atl or spear. This technological innovation appears to correspond with the onset of the Numic expansion westward to the coast, which some researchers believe started from southeastern California (Bettinger and Baumhoff 1982; Grayson 1993). Bedrock milling features supplement portable milling stones in villages and ancillary sites within the California deserts.

The Late Prehistoric period (circa A.D. 1100–1769) corresponds to the introduction of ceramic artifacts in the Mojave Desert region as well as replacement of Rose Spring projectile points with even smaller Desert Side-notched points and Cottonwood series points. The mortar and pestle are also used, and evidence of food storage facilities becomes increasingly common. In the central Mojave Desert, the Mojave River became a primary focus of occupation, and trade networks increased along the Mojave River and over the San Gabriel Mountains (Sutton 1996). During the beginning of the Late Prehistoric period, the Colorado River intermittently flowed westward into the Salton Trough, forming Lake Cahuilla. This freshwater lake, rich in fish and other resources, occupied more than 2,000 acres before its final recession after A.D. 1500.

Archeological evidence left by highly mobile hunter-gatherers in the Mojave Desert during the Late Prehistoric period is typified by sparse scatters of flaked stone, ground stone, ceramic artifacts, and features such as hearths, rock rings, and trails.

4.2 Ethnographic Context

4.2.1 Serrano

The Serrano people, a Takic-speaking group within the Uto-Aztecan language family, traditionally inhabited the San Bernardino Mountains, the Mojave Desert, and adjacent highlands in Southern California. Their territory spanned areas near the Mojave River and extended from the San Bernardino Mountains to the desert floor near modern-day Twentynine Palms (Bean and Smith 1978:570; Kroeber 1925:617; Sutton et. al 2007:229). This summary synthesizes key aspects of their culture, including their social organization, subsistence practices, linguistic characteristics, and interactions with neighboring groups, with a particular focus on the region near present-day Pioneertown.

The term "Serrano," meaning "mountaineer" or "highlander," was used by Spanish colonists (Bean and Smith 1978:570). The Serrano language is part of the Takic branch of Uto-Aztecan and shares affinities with languages such as Kitanemuk, Gabrielino, and Cahuilla (Bright 1975; Hill 1967). The Mojave River marked the boundary between the Takic-speaking Serrano and Numic-speaking Paiutes and Shoshones to the north (Sutton et al. 2007:243). Serrano territory encompassed diverse ecological zones, from Joshua tree-dominated desert environments to piñon pine and juniper woodlands at

higher elevations. This environment supported resources critical to their subsistence, such as acorns, piñon nuts, mesquite pods, yucca roots, and small game (Bean and Smith 1978:572; Sutton et al. 2007:231).

The Serrano were primarily hunter-gatherers who adapted their mobility patterns to exploit various ecological niches. Acorns and piñon nuts were staples in mountainous regions, while desert groups relied on cactus fruits, mesquite, and yucca (Bean and Smith 1978:571). They hunted game such as deer, rabbits, and quail using bows and arrows, snares, and traps (Bean and Smith 1978:573; Sutton et al. 2007:237). Environmental variability, particularly during the Holocene, required seasonal mobility. The Middle Holocene (ca. 6000–3000 cal B.C.) saw warmer, drier conditions, encouraging smaller, more dispersed settlements, while wetter Late Holocene conditions facilitated larger villages near water (Sutton et al. 2007:231–232).

Serrano villages were typically located near permanent or seasonal water sources. Their dwellings were dome-shaped structures made from willow frames and tule thatch, with communal buildings used for ceremonial purposes (Bean and Smith 1978). Granaries stored acorns and other resources to ensure food security during lean seasons (Bean and Smith 1978:571). The Serrano social organization was centered on patrilineal clans associated with two exogamous moieties: *Tukutam* (Wildcat) and *Wahi'iam* (Coyote). Leadership was hereditary, with chiefs (*kika'*) serving as political and ceremonial leaders, and assistant chiefs (*paxa'*) managing logistical and sacred duties (Kroeber 1925:620; Bean and Smith 1978:572).

The Serrano practiced shamanic traditions, with shamans serving as healers and spiritual leaders. Rituals sometimes involved the use of hallucinogenic plants by the shaman such as *Datura wrightii* to facilitate visions and trances (Bean and Smith 1978:572). Ceremonial life was deeply integrated into their social structure, with life cycle rituals marking significant transitions in Serrano society. Birth ceremonies included a period of seclusion for mother and child, while adolescence was celebrated with gender-specific rites. Death rituals involved cremation, and possessions of the deceased were burned in elaborate ceremonies that included the creation and destruction of effigies, singing, and dancing (Bean and Smith 1978).

Archaeological evidence indicates that the Serrano's ancestors were part of broader cultural traditions in the Mojave Desert. Early Holocene groups such as those associated with the Lake Mojave Complex relied on forager-like strategies, while later adaptations, such as the Pinto Complex, show an increased reliance on plant processing and more localized settlement patterns (Sutton et al. 2007:237–239). The emergence of intensive plant exploitation during the Middle Holocene coincided with broader climatic shifts that encouraged resource predictability (Sutton et al. 2007:238).

During the Late Prehistoric period, climatic events such as the Medieval Climatic Anomaly (ca. A.D. 800–1350) prompted shifts in settlement and subsistence patterns, including the aggregation of populations into compact villages to mitigate resource stress (Sutton et al. 2007:232). Trade networks

expanded during this time, as evidenced by the distribution of marine shell beads and other trade items across the region (Sutton et al. 2007:244).

In 1808, Francisco Palomares, a Spanish missionary, documented his interactions with the Serrano. His diary offers valuable insights into early colonial encounters, noting both resistance and adaptation as the Serrano were assimilated into Spanish missionary and colonial systems (Palomares 1808:232–242). Spanish colonization intensified in 1819 with the establishment of an Asistencia (sub-mission) near Redlands. Over the following decades, the Serrano were forcibly displaced to missions such as San Gabriel, altering their traditional way of life. This disruption included the introduction of new religious practices, agricultural techniques, and colonial trade networks, which undermined the Serrano's traditional social organization.

4.3 Historic Context

Post-European contact history for the state of California is generally divided into three periods: the Spanish Period (1769–1822), Mexican Period (1822–1848), and American Period (1848–present).

4.3.1 Spanish Period (1769–1822)

In 1542, searching for the legendary Northwest Passage, Spanish explorer Juan Rodríquez Cabríllo stopped at present-day San Diego Bay. Cabríllo also explored the shorelines of present-day Santa Catalina Island, San Pedro, and Santa Monica Bays. Much of the present California and Oregon coastline was mapped and recorded in the subsequent half-century by Spanish naval officer Sebastián Vizcaíno. Spain laid claim to California based on the surveys conducted by Cabríllo and Vizcaíno (Bancroft 1885:96–99; Gumprecht 2001:35).

The 1769 overland expedition by Captain Gaspar de Portolá marks the start of California's Historic period. With a band of 64 soldiers, missionaries, Baja (lower) California Native Americans, and Mexican civilians, Portolá established the fortified military outpost of Presidio of San Diego as the first Spanish settlement in Alta California. In July of 1769, while Portolá was exploring southern California, Franciscan Friar Junípero Serra founded Mission San Diego de Alcalá at Presidio Hill, the first of the 21 missions that would be established in Alta California by the Spanish and the Franciscan Order between 1769 and 1823.

In a race against England and Russia to claim as much of the Americas as possible, Spain started colonizing Alta California in the late 18th century. Spain's goal was to establish self-sustaining colonies; they did this with a three-pronged approach that focused on religion, commerce, and military (Kimbro and Costello 2009:13). The Missions presided over religious and agricultural affairs; the pueblos provided residences and commercial base for trade; and the presidios housed soldiers that kept regional peace and provided military defense against attack (Kimbro and Costello 2009:13).

4.3.2 Mexican Period (1822–1848)

Following a tumultuous period of rebellion and warfare, New Spain (comprising Mexico and the California territory) achieved independence from Spain in 1821. A pivotal moment in this transition occurred in 1822, when the Mexican legislative body in California, in a significant departure from the past, abolished the isolationist policies that had safeguarded the Spanish trade monopoly. This bold move opened California's ports to foreign merchants, heralding a new era of trade and commerce (Dallas 1955:14).

Extensive land grants were established in the interior during the Mexican Period to increase the population inland from the more settled coastal areas where the Spanish had first concentrated their colonization efforts. The secularization of the missions following Mexico's independence from Spain resulted in the division of mission lands and the establishment of numerous ranchos. During the supremacy of the ranchos (1834–1848), landowners primarily focused on the cattle industry, devoting large tracts to grazing. Subsequently, cattle hides became the primary southern California export, providing a commodity to trade for goods from the east and other areas in the United States and Mexico. The number of non-indigenous inhabitants increased during this period due to the influx of explorers, trappers, and ranchers associated with the land grants. The rising California population contributed to the overall rise in instances of disease as well as the introduction of new diseases foreign to the Native American population, against which they had no associated immunities.

4.3.3 American Period (1848–Present)

The Mexican–American War ended with the Treaty of Guadalupe Hidalgo in 1848, ushering California into its American Period. California officially became a state along with Utah and New Mexico with the Compromise of 1850, which also designated Utah and New Mexico (with present-day Arizona) as U.S. Territories.

The early American period is marked by the discovery of gold at Sutter’s Mill in 1848, resulting in a gold rush that saw a massive influx of settlers from other parts of the United States and around the world, greatly impacting California’s native population. In 1869, the transcontinental railroad was completed linking California with the rest of the United States. The Gold Rush and the establishment of the railroad played major roles in the development of California into a national and worldwide leader in agricultural and industrial production (Burgess and Burgess 2006). With an influx of people seeking gold, cattle were no longer desired mainly for their hides but also as a source of meat and other goods. During the 1850s cattle boom, rancho vaqueros drove large herds from southern to northern California to feed the region’s burgeoning mining and commercial boom. The cattle boom ended in southern California as neighboring states and territories drove herds to northern California at reduced prices. Operation of the massive ranchos became increasingly difficult, and droughts severely reduced their productivity (Cleland 2005:102–103).

4.3.1 San Bernardino County

In 1772 Pedro Fages, Spanish Military Commander of California, led the first Europeans into the San Bernardino region (County of San Bernardino n.d.). Francisco Garces, a Spanish missionary priest, followed in 1774. Franciscan missionary Francisco Dumatz entered the valley on May 20, 1810, the feast day of St. Bernardine of Siena. Dumatz therefore called the valley "San Bernardino," which was subsequently applied to the adjacent mountain range, and later the city and county (County of San Bernardino n.d.). There was no mission established in San Bernardino County but the San Bernardino de Sena Estancia (also known as the San Bernardino Rancho) was established in 1819 near Redlands for grazing cattle owned by the Mission San Gabriel Arcángel.

San Bernardino County was created from parts of Los Angeles, San Diego and Mariposa Counties on April 26, 1853. In 1854 the City of San Bernardino was incorporated as the county seat (County of San Bernardino n.d.). Although portions of San Bernardino and San Diego counties were used to create Riverside County in 1893, San Bernardino County remains the largest county in California and in the contiguous United States. Wagon roads and railroads constructed across the Mojave Desert from the 1840s through the 1870s connected San Bernardino County with coastal California with the rest of the country.

Citrus production began in San Bernardino County by the late 1850s. By 1882 San Bernardino County was exporting oranges and lemons grown as far away as Denver (County of San Bernardino n.d.). As transportation access opened by 1887 San Bernardino experienced "a building and buying flurry almost as intense as that of Pasadena (Dumke 1970 [1944]:120)."

In the twentieth century development of the automobile and resultant construction of permanent roadways along the desert trails and wagon roads, better conveyance and storage of water, and farming contributed to San Bernardino County's rise. The Pacific Electric Railway connected San Bernardino with Los Angeles on February 8, 1911. The Great Depression brought migrants from Oklahoma and Arkansas to work the area farms. San Bernardino Army Airfield (later called Norton Air Force Base and today San Bernardino International Airport) was established during World War II and the post-war boom economy contributed to the region's growth.

Early Homesteading in Pipes Canyon Area

The Homestead Act of 1862, signed by President Abraham Lincoln, was designed to promote westward expansion by granting land to settlers willing to cultivate and inhabit it (National Park Service 2023). The Act entitled individuals who were the head of their household, over 21 years old, or a military veteran "to enter one-quarter section [160 acres] or a less quantity of unappropriated public lands" (National Archives, Homestead Act 1862). Once the land was claimed, the claimant earned it after five years and was given the land free and clear, or they could file a preemption claim within six months of habitation if they paid a fee of "one dollar and twenty-five cents" per acre (National Archives, Homestead Act 1862). If applicants chose not to file a preemption claim, they were required to live on

the land for a minimum of five years and "improve" it. The Act explicitly stated that any eligible claimant "shall, after the expiration of five years from the date of entry ⋯ be entitled to a patent" provided they had "erected a dwelling house thereon and made other improvements" (National Archives, Homestead Act 1862, Section 2).

Homesteading in the Morongo Basin was significantly challenging. Located in San Bernardino County, the Basin is characterized by its rugged desert environment, unpredictable water sources, and extreme temperatures. Despite the promise of "one hundred and sixty acres of the unappropriated public lands" to settlers (National Archives, Homestead Act 1862, Section 1), many found it nearly impossible to fulfill the Act's requirement to "improve and cultivate" the land (National Archives, Homestead Act 1862, Section 2) due to a lack of water and viable soil.

Many early homesteaders in the Morongo Basin settled in areas such as Joshua Tree, Twentynine Palms, and Wonder Valley, attempting dry farming and livestock grazing—however, the strict cultivation requirements and environmental hardships led to high failure rates (Stringfellow 2025). Unlike regions with ample rainfall, this desert landscape did not lend itself easily to traditional homesteading practices. Due to the geological composition of the region, pioneers turned to prospecting for gold and other minerals. One example in the Pipes Canyon area is the Swedish prospector, John Olsen. The remnants of his homestead dwelling lie deep in Pipes Canyon, west of the project site, which hikers can visit along the Sawtooth Loop Trail in the Pioneertown Mountain Preserve (The Wildland Conservancy 2025).

Recognizing the impracticality of large-scale homesteading in the desert, the federal government passed the Small Tract Act of 1938, also known as the Izac Five-Acre Tract Law, which allowed U.S. citizens to lease or purchase small parcels of public land not exceeding five acres, for purposes such as residential, recreational, health, or business use (Desert USA 2025, Stringfellow 2025). This legislation aimed to allow for the acquisition of smaller tracts of land. This legislation was responsible for the explosion of "jackrabbit homesteads"—small cabins dotting the desert landscape (Stringfellow 2025). These structures, many of which still stand today, reflect a mid-20th-century adaptation of homesteading ideals in response to the environmental constraints of the region (Stringfellow 2025).

4.3.2 Community of Pioneertown

Despite appearing from the 1870s, Pioneertown was built in the mid-1940s. Hollywood actors who portrayed cowboys in the popular Western movies of the day got together to construct a working movie set inspired by the Old West. At the time, sets were erected and demolished with each movie. However, the actors that built Pioneertown wanted to build something more permanent that could be used for multiple films and be a functional town with a grocery store, bowling alley, and other necessities that could serve the cast, crew, and their families while working on a movie (Visit Pioneertown 2024).

Dick Curtis is credited with proposing the idea of a "Living, Breathing Movie Set" in 1946 (Visit Pioneertown 2024). Curtis recruited 16 additional members to contribute to establishing the town. These included Roy Rogers, Dale Evans, Russell Hayden, Frank McDonald, Terry Frost, Tommy Carr, Bud Abbott, and The Sons of the Pioneers (A western singing group that Roy Rogers led). Each member contributed 500 dollars (approximately $8,100 in 2025 money) (Visit Pioneertown 2024) and was incorporated as the Pioneertown Corporation. Originally going to be called "Rogersville" after Roy Rogers, a member of The Sons of the Pioneers, Tim Spenser, wrote a song entitled "Out in Pioneertown" to promote the build, and the catchy tune ended up being the inspiration for the town name (Visit Pioneertown 2024).

Construction started in September 1946 with a grocery store, motel, saloon, restaurant, beauty shop, bowling alley, post office, and other establishments built within the first few years. Mane Street—a nod to a cowboy's primary mode of transportation—was a compacted dirt road lined with approximately 25 buildings with a 1870s to 1880s Western architectural style. This style features wood-clad structures, wood boardwalks, porches, parapets, and hitching posts (Friends of Pioneertown 2020).

There were long-term plans for a larger, permanent residential community, lake, golf course, shopping center, and airport, but none came to fruition for two reasons. Firstly, in 1948, when Curtis stepped down as president, the corporation decided to focus on investments in the entertainment industry. Secondly, the availability of safe drinking water could not support an expanded community (Visit Pioneertown 2024).

Over 50 movies and television shows have been filmed along Pioneertown's Mane Street. In 2017, The Friends of Pioneertown, a non-profit organization, was formed to gather information about the community and apply for listing on the National Register of Historic Places (NRHP) and California Register of Historic Resources (CRHR). In June 2020, Pioneertown Mane Street Historic District was added to the NRHP (Friends of Pioneertown 2020).

Over the decades, the area around the desert town has attracted people looking for some quiet and connection the nature away from the bustle of Los Angeles. Starting in the 1960s, designers, musicians, and artists purchased large swaths of land and built private complexes. Most recently, a boom in short-term rentals has driven exponential real estate price increases. Tourism to nearby Joshua Tree National Park has also experienced record highs. In 1990 Joshua Tree surpassed one million visitors, twenty years later, the annual number of visitors had only grown about 400,000. However, visitation surpassed two million in 2015, and three million in 2021 (Joshua Tree National Park 2023). Increased visitation of the area has brought tourist money and jobs to the area; however, it has also had negative impacts on the natural environment and visitor experience due to overcrowding and staff struggling to keep up with tourist demands.

5 Background Research

5.1 CHRIS Records Search

On December 17, 2024, South Environmental archaeologist Samantha Jovanovic, MS, conducted a cultural resources records search of the project site and a half-mile search radius at the South Central Coastal Information Center (SCCIC), which houses cultural resources records for San Bernardino County. This included their collections of mapped prehistoric and historic archaeological resources and historic built-environment resources, State of California Department of Parks and Recreation Series 523 forms (DPR forms), technical reports, archival resources, and ethnographic references. Additional consulted sources include historical maps of the study area, the NRHP, the CRHR, the lists of California State Historical Landmarks, California Points of Historical Interest, and the Archaeological Determinations of Eligibility list. The summary of the records search results is presented in Appendix A.

5.1.1 Previously Conducted Cultural Resource Studies

The SCCIC records search results indicate that no previously conducted cultural resource studies were conducted within one-half mile of the project site..

5.1.2 Previously Recorded Cultural Resources

The SCCIC records search results indicate that one previously recorded historic-age resource, Pipe Canyon Road (P-3624261), intersects the project site. Three (3) additional previously recorded cultural resources were identified within the one-half mile records search area. Two are historic-age resources, and one is archaeological. A list of all previously recorded resources identified within the records search radius is provided in Table 2.

Table 2. Previously Recorded Cultural Resources Within 0.5-Mile of the Project Site

Primary Number	Trinomial	Resource Age/Description	Resource Eligibility	Recorded by and Year	Proximity to Project Site
P-36-024241	CA-SBR-15426H	Historic: segment of Pipes Canyon Road	6Z: not eligible for NR, CR, and local lists	2017 (Applied Earthworks)	**WITHIN**
P-36-031400	CA-SBR-31400H	Historic site: building foundation, refuse scatter	Recommended not eligible for CRHR	2017 (K. Moslak and P. Moloney, Applied Earthworks)	Outside (Approx. 0.10 mi east)

Table 2. Previously Recorded Cultural Resources Within 0.5-Mile of the Project Site

Primary Number	Trinomial	Resource Age/Description	Resource Eligibility	Recorded by and Year	Proximity to Project Site
P-36-031401	CA-SBR-31401/H	Historic site: refuse scatter	Recommended not eligible for CRHR	2017 (K. Moslak and P. Moloney, Applied Earthworks)	Outside (Approx. 0.10 mi east)
N/A	Unknown (unclear if trinomials are still valid)	Unprocessed district or grouping of sites into a single resource. Components include prehistoric habitation sites, petroglyphs, pictographs, bedrock milling features, ceramic sherds, and lithic tools	Unknown	1979 (Jeff Dickman and Bob Helman)	Outside (Approx. 0.50 mi north)

36-024241 / CA-SBR-15426H

A segment of Pipes Canyon Road within the current project site was recorded by Applied Earthworks in 2017 and was recommended not eligible. The segment is described as an asphalt-paved two-lane highway road with double yellow lines running down the middle, single white lines on either side denoting the outer edge of the lane and flanked by dirt shoulders. Separate, smaller segments of Pipes Canyon Road located further east of the project site, were recorded by Kremkau in 2011 but were not evaluated.

5.2 Native American Scoping

A NAHC Sacred Lands File search was requested by South Environmental on December 10, 2024. The NAHC responded to the request on December 27, 2024, and reported negative results. The NAHC recommended contacting the Native American tribes listed in Table 3, for additional information or knowledge they may have regarding the presence of cultural resources that may be impacted by the proposed project. On December 30, 2024, South Environmental sent letters to each contact provided by the NAHC.

As detailed in Table 3, three tribal contacts have responded to the outreach letters to date. The Agua Caliente Band of Cahuilla Indians and Quechan Tribe of the Fort Yuma Reservation defer to tribes in closer proximity to the project site. The San Manuel Band of Mission Indians stated that the area is sensitive due to the presence of a culturally significant geological formation in the area (see Table 3 below). All Native American outreach completed by South Environmental is documented in Appendix B.

Table 3. Summary of Native American Outreach

Native American Tribal Contact	Method of Notification/Date	Response Received
Agua Caliente Band of Cahuilla Indians Lacy Padilla, Director of Historic Preservation/THPO Cultural Affiliation: Cahuilla	Letter sent via email on December 30, 2024 and January 9, 2025.	Responded via email on January 9, 2025: "A records check of the Tribal Historic Preservation Office's cultural registry revealed that this project is not located within the Tribe's Traditional Use Area. Therefore, we defer to the other tribes in the area."
Morongo Band of Mission Indians Robert Martin, Chairperson Cultural Affiliation: Cahuilla Serrano	Letter sent via email on December 30, 2024 and January 9, 2025.	No response to date.
Morongo Band of Mission Indians Ann Brierty, THPO Cultural Affiliation: Cahuilla Serrano	Letter sent via email on December 30, 2024 and January 9, 2025.	No response to date.
Quechan Tribe of the Fort Yuma Reservation Manfred Scott, Acting Chairman - Kw'ts'an Cultural Committee Cultural Affiliation: Quechan	Letter sent via email on December 30, 2024.	Jill McCormick responded on December 30, 2024, on behalf of the Quechan Tribe of the Fort Yuma Reservation. See response below.
Quechan Tribe of the Fort Yuma Reservation Jill McCormick, Historic Preservation Officer Cultural Affiliation: Quechan	Letter sent via email on December 30, 2024.	Responded via email on behalf of the Quechan Tribe of the Fort Yuma Reservation on December 30: "The Historic Preservation Office does not wish to comment on this project. We defer to the local Tribes and support their determinations on this matter."
Quechan Tribe of the Fort Yuma Reservation Jordan Joaquin, President, Quechan Tribal Council Cultural Affiliation: Quechan	Letter sent via email on December 30, 2024.	Jill McCormick responded on December 30, 2024, on behalf of the Quechan Tribe of the Fort Yuma Reservation. See response above.
San Manuel Band of Mission Indians Alexandra McCleary, Senior Manager of Cultural Resources Management Cultural Affiliation: Serrano	Letter sent via email on December 30, 2024 and January 9, 2025.	Responded on January 10, 2025 via email: "Based on our current knowledge, the proposed project site is considered culturally sensitive due to its proximity to a known place consisting of a geologic feature that is culturally significant to the Tribe. As the area is of concern, the Tribe will wish to engage in government-to-government consultation pursuant to AB 52 with the Lead Agency for the project."
Serrano Nation of Mission Indians Mark Cochrane, Co-Chairperson Cultural Affiliation: Serrano	Letter sent via email on December 30, 2024 and January 9, 2025.	No response to date.

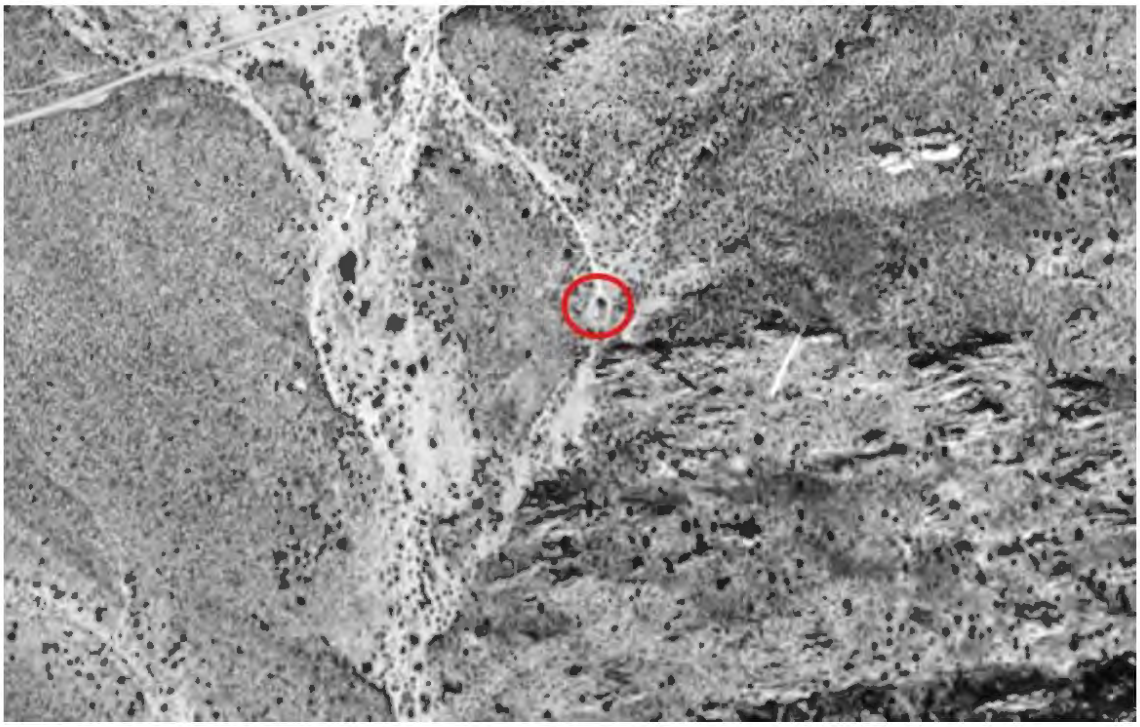
Table 3. Summary of Native American Outreach

Native American Tribal Contact	Method of Notification/Date	Response Received
Serrano Nation of Mission Indians Wayne Walker, Co-Chairperson Cultural Affiliation: Serrano	Letter sent via email on December 30, 2024 and January 9, 2025.	No response to date.
Twenty-Nine Palms Band of Mission Indians Nicolas Garza, Cultural Resources Specialist Cultural Affiliation: Chemehuevi	Letter sent via email on December 30, 2024 and January 9, 2025.	No response to date.
Twenty-Nine Palms Band of Mission Indians Christopher Nicosia, Cultural Resources Manager/THPO Manager Cultural Affiliation: Chemehuevi	Letter sent via email on December 30, 2024 and January 9, 2025.	No response to date.
Twenty-Nine Palms Band of Mission Indians Sarah O'Brien, Tribal Archivist Cultural Affiliation: Chemehuevi	Letter sent via email on December 30, 2024 and January 9, 2025.	No response to date.

5.3 Review of Historical Aerial Photographs

A review of historical aerial photographs was conducted to better understand the history of the project site and any past disturbances. Aerial photographs were available from the following years: 1970, 1983, 1989, 1994, 2005, 2009, 2010, 2012, 2014, 2016, 2018, 2020, and 2022 (National Environmental Title Research [NETR] 2024); and 1952 and 1989 (University of California, Santa Barbara [UCSB] Frame Finder 2025). The earliest available aerial photograph of the subject property is from 1952 via UCSB Frame Finder (2025).

Historic aerial photographs indicate that in 1952 Pipes Canyon Road is present along with the dirt roads of Hudson Lane and Juniper Trail just east of project site. The unnamed road that runs southwards from Pipes Canyon Road to Rocky Road in the middle of the project site appears to be a large, braided water drainage wash area. There is a small building towards the southern end of this road (Photograph 1), west of the boulder outcroppings, the remains of which encountered as part of this study (see Section X). By 1970, there was very little development of the area around Pipes Canyon Road aside from adjacent roads of Hudson Lane, Juniper Trail, and Coyote Road east of the project site, and the unnamed dirt roads leading southwards from Pipes Canyon Road to Rocky Road in the middle of the project site. By 1989, the residences directly west of the project site and north of Pipes Canyon Road are present. Very little changes from 1989 to the present.



Photograph 1. 1952 historical aerial photograph showing building (SE-Pipes-01) identified within project site. Earliest aerial photograph available (UCSB Frame Finder 2025).

5.4 Review of Historical Maps

A review of historical maps was conducted to better understand the history of the project site and any past disturbances (Exhibits 1 and 2). Sanborn Fire Insurance maps (available through the Library of Congress) and survey maps through the General Land Office were consulted. The 1903 GLO map for Yucca Valley (Exhibit 1) shows a road in the approximate alignment of Pipes Canyon Road that is labeled, "Road from Warren's Well to..." This map is the first depiction of the road. The 1950-1951 survey map (Exhibit 2) depicts an unlabeled Pipes Canyon Road similar to its current alignment and a symbol for a mine to the northeast of the project site.



Exhibit 1. GLO 1903 map for Yucca Valley (General Land Office Records 1903).

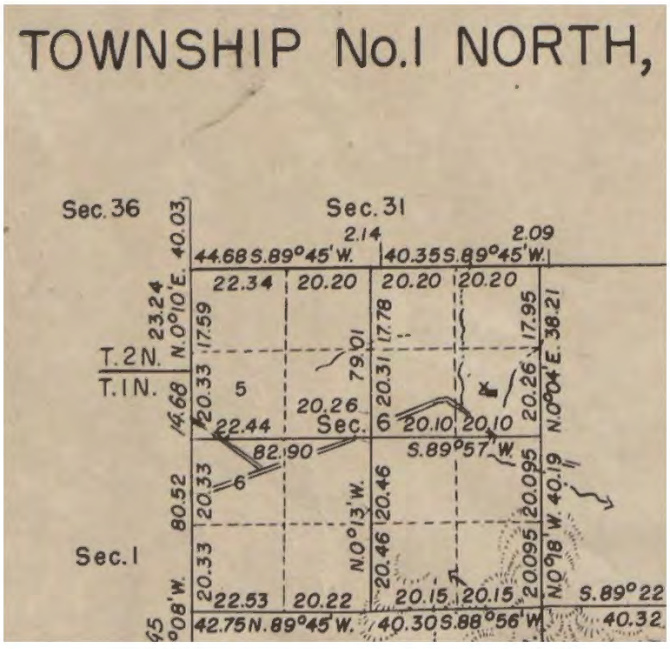


Exhibit 2. 1950-1951 survey map (General Land Office Records 1952).

5.5 Historical Newspaper Search

South Environmental reviewed historical newspapers covering the Yucca Valley region to better understand the development of the project site and surrounding area. Information from newspapers was used in the development of the historic context and historical significance evaluation sections of this report.

6 Cultural Resources Survey

6.1 Methods

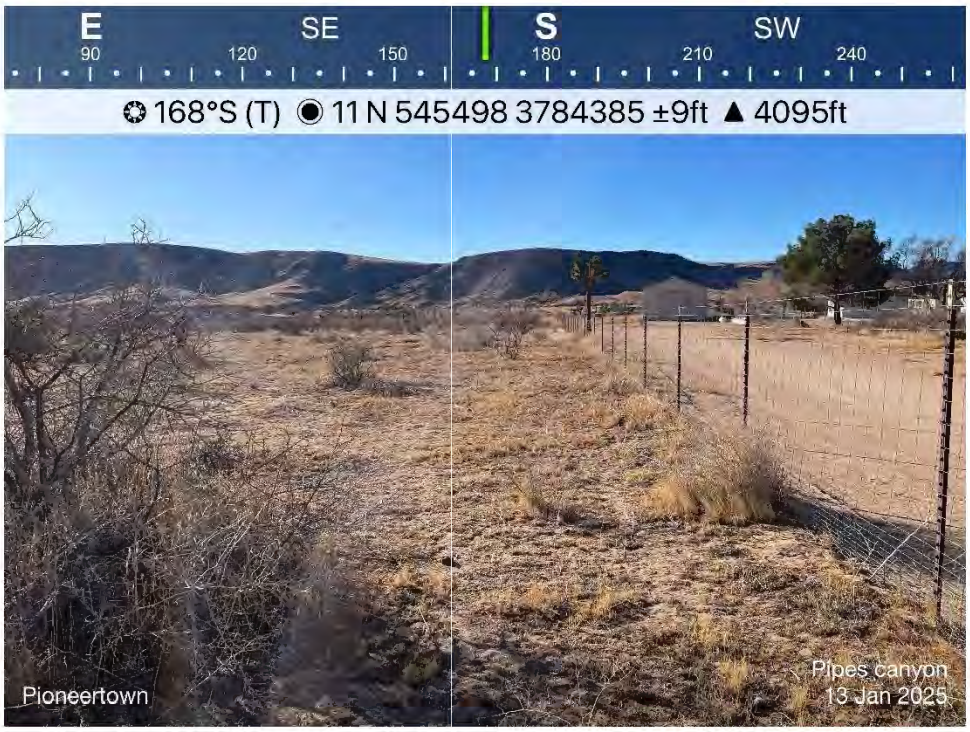
On January 13 and 14, 2025, South Environmental cultural resources specialists Samantha Jovanovic, MS, and Lindsey Bavetta, MA, conducted an intensive-level survey of the project site for cultural resources. Fieldwork included taking notes and photographs using an iPhone 12 camera with Solocator photography application.

Most of the project site is undeveloped, natural desert (e.g., Photographs 2, 7-15). The only development includes a gate on to the southern portion of the project site (Photographs 3-4), a dirt road with a parking lot at the end (Photograph 5), and the remains of a building (Photograph 6; see discussion in Section 6.2.1). A large portion of the eastern half of the project site is composed of large granite boulder outcrops.

The entire project site was surveyed using transects spaced approximately 15 meters apart throughout the site and examined for the presence of prehistoric artifacts (e.g., flaked stone tools, tool-making debris, stone milling tools), historical artifacts (e.g., metal, glass, ceramics), sediment discolorations that might indicate the presence of a cultural midden, depressions, and other features that might indicate the former presence of structures or buildings (e.g., post holes, foundations).



Photograph 2. View east from northwest corner, south of Pipes Canyon Road.



Photograph 3. View south from northwest corner, south of Pipes Canyon Road.



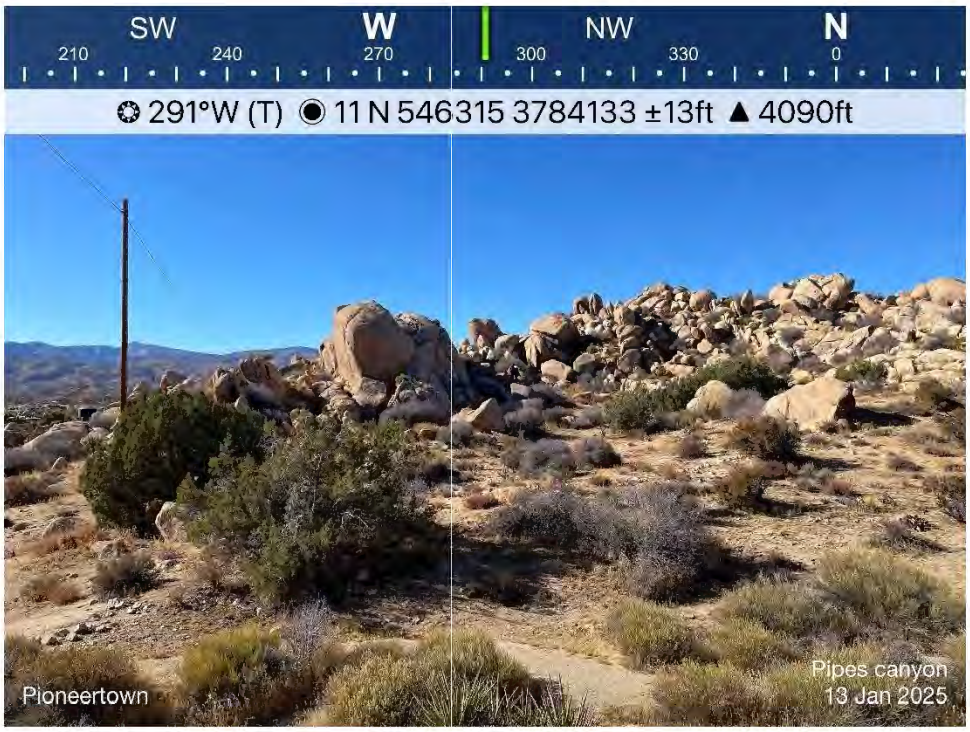
Photograph 4. View north from northwest corner, south of Pipes Canyon Road. Pipes Canyon Road in view.



Photograph 5. Dirt road bisecting southern part of project site. View north.



Photograph 6. Event space with trailer toilets in southern end of project site. View north.



Photograph 7. View west from southeastern corner of project site.



Photograph 8. View north from southeastern corner of project site.



Photograph 9. View from southeast corner of northern portion of project site. View west.



Photograph 10. View from northeast corner of project site looking south.



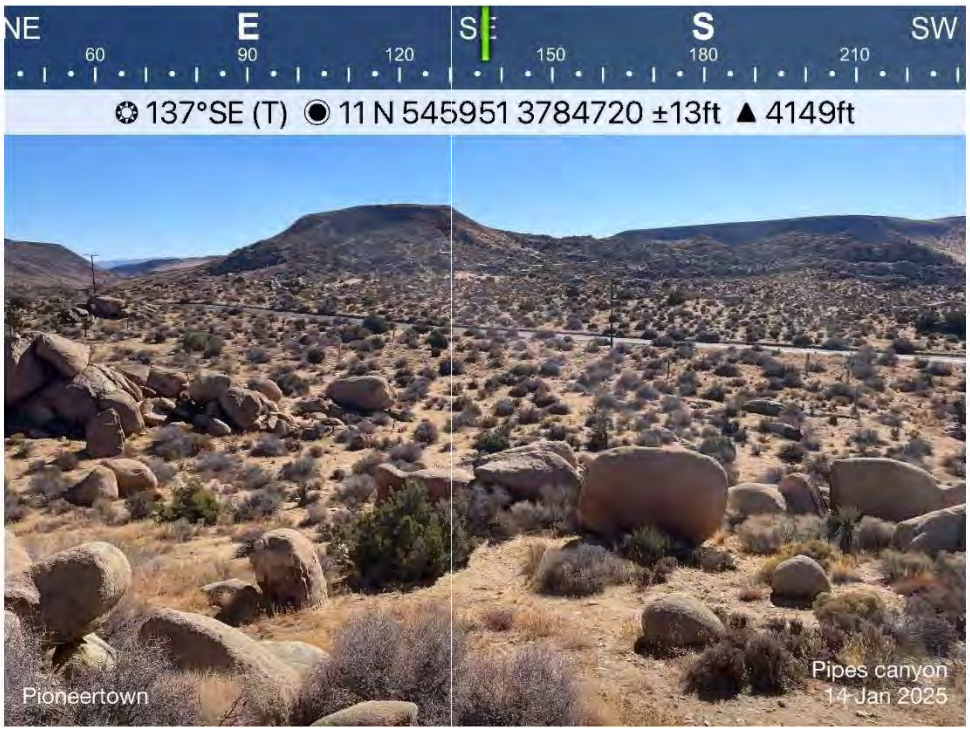
Photograph 11. View from northeast corner of project site looking west.



Photograph 12. Wash full of rounded basalt rocks. View from northwestern corner of project site, north of Pipes Canyon Road. View east.



Photograph 13. Overview of project site from northern portion. Pipes Canyon Road in view. View south.



Photograph 14. Overview of project site from northern portion. Pipes Canyon Road in view. View southeast.





Photograph 15. Overview of project site from northern portion. View east.

6.2 Results

One historic-age resource was identified at the southern end of the project site (described below in Section 6.2.1). However, no prehistoric archaeological resources were identified within the project site as a result of the intensive-level survey. Overall, the project site remains largely undeveloped, with only a dirt road and a small event space located in the southern portion.

This project site is situated within a desert ecological system characterized by decomposed granitic sand and significant granitic boulder outcrops. The primary types of rock present include granite, quartz, and basalt. The landforms within the area consist of gradual hills, a braided wash, and exposed boulder formations. The western half of the site is predominantly flat, featuring small rolling hills and a north-south braided wash system. In contrast, the eastern section displays more uneven topography, with prominent granitic boulder outcrops and varied terrain.

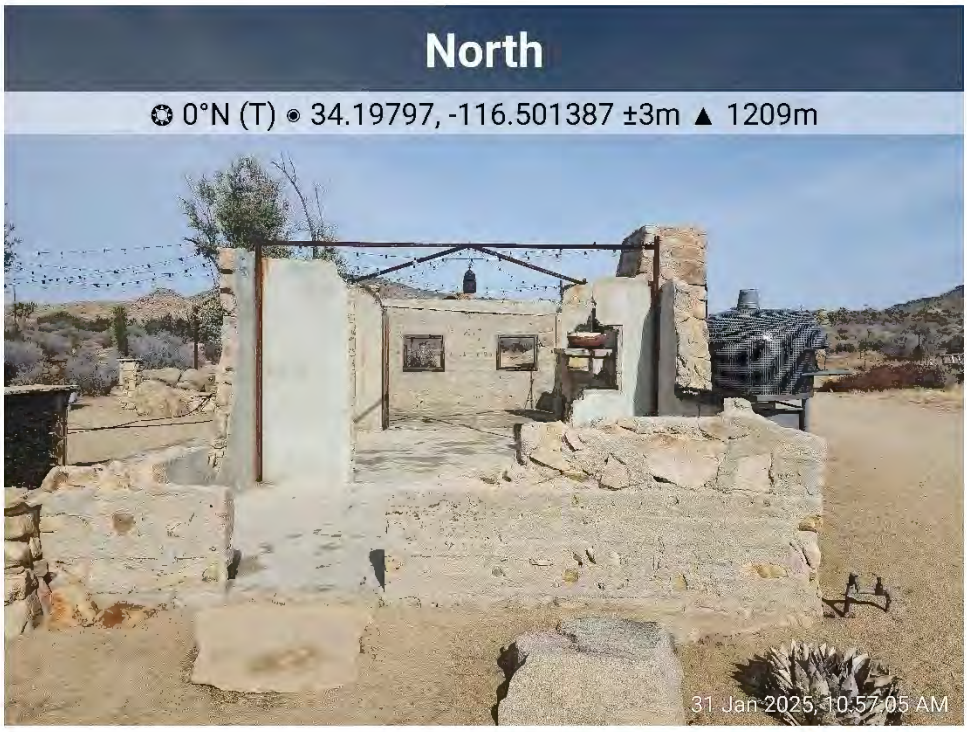
The average elevation of the site is 4,100 feet amsl, with the lowest point at 4,050 feet amsl in the southern area and the highest point at 4,210 feet amsl in the northern section, resulting in an elevation change of approximately 160 feet across the site. The vegetation present includes Joshua trees, cholla, beavertail cactus, creosote, and a variety of other desert scrub brush and grasses.

6.2.1 SE-Pipes-01

The subject property consists of the remains of a one-story residence constructed between c. 1926-1928 and converted to a private event venue in the early 2000s. The property is located on a large, undeveloped parcel in a rural setting. The property is rectangular in plan and consists of a poured concrete foundation with board-formed concrete and stone walls, stone fireplace, partial stone chimney, and wood-framed windows with no glass. The south elevation wall is entirely missing, as are more than half of the east and west walls. The property also contains numerous recently added features from when it was converted to a private event space (circa early 2000s), including a patio bar made from empty wine bottles, stone, concrete, and old window frames; stacked stone wall benches with poured concrete footers; decorative metal framing used to hang string lights; decomposed granite courtyard and pathways; a portable toilet trailer; a dining area with long tables and chairs north of the property; and a ceremony area east of the property. A pizza oven has also been added to the eastern side of the property (Photographs 16-22).



Photograph 16. Event space with toilet trailer at the southern end of project site. View north.



Photograph 17. Southern elevation with view of metal framing within ruined structure.



Photograph 18. Eastern elevation with view of chimney and modern pizza oven.



Photograph 19. Northern elevation with a view of modern masonry additions to the west and garden hose in the lower right quarter of photograph. View south.



Photograph 20. Western elevation with view of fireplace, cement pads, metal framing and lights.



Photograph 21. Detail image of fireplace and chimney. View east.



Photograph 22. Recently built high table composed of bottles, local granite, and imported sandstone. Electrical plug at corner of table.

7 Property Significance Evaluation

The following presents a historical significance evaluation for the ruins of a c. 1926-1928 residence (SE-Pipes-01) identified during the cultural resources survey. The complete resource record is provided in Appendix C.

7.1 Property Development History

To encourage westward expansion, President Abraham Lincoln signed the Homestead Act of 1862, which granted 160 acres of land to U.S. citizens or future citizens who agreed to build a dwelling and live on the land for at least five years. (National Archives 2021). The subject property was part of a Homestead Act land grant of 160 acres to William J. Hudson on October 30, 1928 (Patent number 1020329).

Hudson and his wife Camilla moved to the Hi-Desert area in 1925 from Arizona in search of a parcel to homestead. In 1927, the General Land Office issued Hudson a patent on 160 acres of Section 30 near the present-day Yucca Valley Airport (Patent number 041058). A 1981 newspaper article describes how the family relocated to the Pipes Canyon area and eventually became the founders of the first school in Pipes Canyon, located approximately five miles from what would be known as Pioneertown (The Desert Trail 1981):

> A family that was to be instrumental in opening this mountain school was that of William J. Hudson, a Redlands lawyer who had sought a desert place for his health. He and his wife Camilla with their three children in November 1925, bought a relinquishment in Sec. 20 near Warren Well (now at the airport)...The next summer, one of the Swede settlers, Carl Ahlswede, suggested they move up to his place in Pipes Canyon as he was leaving, and they would find it cooler in the mountains. To reach it they had to go around by Victorville road, and up Pipes Canyon. The Hudsons found the cabin was larger 16x20, but it was roofless, and without windows or doors. That first summer they lived in the open air structure. This later served as the Pipes school (The Desert Trail 1981).

Neighbor Fred Pierce, who lived with his daughter Emma, her husband Walter Gehrest, and their three children, wanted a school to be built for the children of Pipes Canyon but was informed that at least eight students were needed in order to open one. The arrival of the Hudson family with two of their children being school age, made the quota. The first County school teacher for the new Pipes Canyon school lived alternately with both the Hudson and Gehrest families, however, she was gone within two months after finding the rugged mountain life to be too much (The Desert Trail 1981). “When the Hudsons decided to make their home in Pipes, they filed on a quarter-section, and Bill Hudson built their home with help of friends coming out from Redlands on weekends from August 1926 to August 1927.” (The Desert Trail 1981).

In the early 1940s, the Hudsons moved to Tucson to be closer to their children while they attended the University of Arizona but returned to the desert after they graduated. William Hudson died in Palm Springs in 1946 after a long battle with illness and disability that began following his service in the U.S. Army during World War I. In the years following his death, Camilla remained active in the community, serving as a charter member of the Hi-Desert Nature Museum Association (Hi-Desert Star 1982).

It is still unclear if the Hudson family was directly responsible for construction of the subject property, and although William Hudson owned the land, there is no evidence that he or his family ever resided at the subject property. However, a previously recorded site identified on the 1928 Hudson land grant (P-36-031400, recorded by Moslak and Moloney 2017), reveals ruins of similar vernacular stone and concrete buildings that are assumed to have been built c. 1926-1928 when the Hudson family officially decided to make Pipes Canyon their home.

Around 2001, Paul Goff and Tony Angelotti from Santa Monica came across "a small, abandoned stone house" while hiking in Pipes Canyon. Over the next year or so when revisiting the property, they noticed that the roof had collapsed and the western wall containing the front door and a window were gone. The two men purchased the property in 2004 and allowed neighbors to collect wood from the collapsed roof. They soon decided to develop the property into a private, outdoor dinner party/event space known as the Ruin (Photograph 23):

> We always thought the ruin, as it stood, would be an incredible place to have a dinner party. Dinner in the Ruin — that was our goal. We imagined entertaining in front of the majestic stone fireplace as the sun went down and the stars appeared in an evening sky. Among the discovered treasures are the hand and footprints of a small child pressed into the cement floor in front of the fireplace. Magical.



The high desert moon, with assists from string lights and the photographer's shutter speed and aperture setting, captures the glow of Paul Goff and Tony Angelotti's recent summer solstice party at the Ruin. (Gina Ferazzi / Los Angeles Times)

Photograph 23. Subject property functioning as an event space (Goff/LA Times 2013).

The olive trees surrounding the property were salvaged from an orchard in the town of Lindsay and are said to be 75 years old (Goff 2013). Goff and Angelotti also purchased another Pipes Canyon property in the late 1990s/early 2000s that came to be known as the Olive Adobe. This house also incorporated Olive trees throughout the property and was used as a lodging and event space (LA Times 2011).

While the article quotes Goff as saying: "We later learned that a gold miner lived in it about a hundred years ago" (Goff 2013), this could not be confirmed. However, this is likely in reference to the Swedish miners living in Pipes Canyon who worked at a nearby onyx mine and encouraged Willam J. Hudson and his family to relocate to the area (Hi-Desert Star 1976; The Desert Trail 1981), but this also could not be confirmed.

7.2 Application of CRHR Designation Criteria

The following presents an evaluation of the subject property (SE-Pipes-01) in consideration of CRHR designation criteria.

CRHR Criterion 1. Is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage.

The subject property was constructed c. 1926-1928 as an early vernacular homestead. At this time, the land on which the subject property is located was owned by William J. Hudson, an early settler of the Pipes Canyon area who is credited with playing an instrumental role in establishing the first school in Pipes Canyon. Prior to Hudson's ownership, it was likely owned by a Swedish mining family living in Pipes Canyon although this could not be confirmed. Despite the fact the subject property has potential associations with early settlement patterns in Pipes Canyon, the property is currently in a state of ruin that has been significantly altered in recent years as part of the property's conversion to a private event space. Therefore, it can no longer convey its historical associations as an early homestead in the region and the subject property is recommended not eligible under CRHR Criterion 1.

CRHR Criterion 2. Is associated with the lives of persons important in our past.

The subject property is on land that was owned by an early Pipes Canyon settler, William J. Hudson. However, the land grant included 160 acres and contains the remains of other similarly constructed structures (i.e., P-36-031400) that may have also served as the Hudson's' place of residence. It is still unclear if the Hudson family was directly responsible for construction of the subject property, and although William Hudson owned the land, there is no evidence that he or his family ever resided at the subject property. Further, the subject property suffers from a lack of physical integrity after falling into ruin and being converted to a new use. Therefore, the subject property is recommended not eligible under CRHR Criterion 2.

CRHR Criterion 3. Embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possesses high artistic values.

The subject property is currently in a state of ruin, however, based on the remaining architectural features, it appears to have been an example of early, vernacular stone architecture that was likely common in the region and utilized locally available materials. However, the property has lost too much physical integrity to convey its original design, materials, or workmanship. It is unknown who designed or built the property. For these reasons, the subject property is recommended not eligible under CRHR Criterion 3.

CRHR Criterion 4. Has yielded, or may be likely to yield, information important in prehistory or history.

The subject property is not significant as a source, or likely source, of important historical information nor does it appear likely to yield important information about historic construction methods, materials or technologies. While in ruins, it appears to have utilized vernacular materials and construction techniques. Therefore, the property is not recommended eligible under CRHR Criterion 4.

7.2.1 Integrity

Location: The subject property retains integrity of location. The property is sited in its original location and remains in its original orientation.

Design: The subject property lacks integrity of design. Alterations include the removal of the roof, windows, doors, some walls, and incorporation of newly constructed elements for the property's more recent use as a private event space.

Setting: The subject property has integrity of setting. The building is still situated within an undeveloped, rural setting.

Materials: The subject property lacks the integrity of materials. The roof, windows, doors, and some walls have been removed. New materials have also been introduced to the property as part of its conversion into a private event space, including a bottle bar, decorative walls, and steps composed of imported materials.

Workmanship: The subject property lacks integrity of workmanship. Very little remains of the original property's design and materials, and the building has been altered to such an extent that the original workmanship is no longer discernible.

Feeling: The subject property lacks integrity of feeling as it no longer feels like a residence from the 1920s. Its conversion to a private event space introduced new elements that no longer allow it to convey its period of construction.

Association: The subject property is associated with early settlement patterns in Pipes Canyon and is located on land owned by one of the earliest settlers in the area, William J. Hudson. However, there is no clear evidence that Hudson built or lived in the subject property and the property lacks physical integrity from its period of significance such it can longer convey these historical associations.

For all of the reasons provided above, the subject property is recommended not eligible for designation in the CRHR.

8 Findings and Recommendations

8.1 Summary of Findings

No archaeological or historical resources were identified within the project site as a result of the SCCIC records search, Native American scoping, intensive-level survey, or historic significance evaluation of the single historic period resource (SE-Pipes-01) identified within the project site.

SE-Pipes-01 consists of the ruins of a former residence that was recently converted for use as a private event space. The resource was recorded and evaluated on DPR forms (Appendix C) in consideration of CRHR designation criteria and integrity requirements. While likely associated with early settlement of the Pipes Canyon area, the property lacks verifiable historical associations and integrity to its period of construction (c. 1926-1928) such that it is unable to convey any clear associations. Therefore, the property is recommended not eligible for the CRHR.

The geomorphology of the project site suggests that there could be subsurface prehistoric deposits. While the project site is underlain by Mesozoic-aged granite, eliminating the possibility of deeply buried sites, there is a significant amount of alluvium from the weathering of these granitic rocks and the nearby basalt mesas. A braided wash runs through the middle of the project site in a north-south orientation, likely prone to flooding during heavy rains. Driven by wind, water, and gravity, materials from upslope are deposited downslope into the project site. In general, fluvial environments have been favored as areas of human habitation throughout history due to their abundant resources (Waters 1992:115). To this end, a habitation site or district has been documented approximately 0.5 to one mile directly north and upslope of the project site in the shadow of the mesa (Dickman and Helman 1979). Lastly, the Native American scoping identified that there are known culturally significant geological features in the area.

This information, combined with the region's geomorphology, suggests a low to moderate possibility of secondary deposition of prehistoric resources buried within the project site. Implementation of the standard recommendations in Section 8.2 for inadvertent discoveries will ensure that any cultural resources or human remains identified during construction are handled appropriately so that impacts on archaeological resources and human remains are less than significant. No mitigation measures are required.

8.2 Recommendations

The following standard measures shall be implemented in the event of an unanticipated discovery of cultural resources or human remains during project construction.

8.2.1 Unanticipated Discovery of Cultural Resources

Should archaeological resources (sites, features, or artifacts) be exposed during construction activities for the proposed project, all construction work occurring within 100 feet of the find shall be halted until a qualified archaeologist, meeting the Secretary of the Interior's Professional Qualification Standards, can evaluate the significance of the find. Depending on the significance of the find, the archaeologist may simply record the find and allow work to continue. In the event that an identified cultural resource is of Native American origin, the qualified archaeologist will consult with the project applicant and the County of San Bernardino to implement Native American consultation procedures. If the discovery proves significant under CEQA, additional work such as preparation of an archaeological treatment plan, testing, monitoring, or data recovery may be warranted.

8.2.2 Unanticipated Discovery of Human Remains

In accordance with Section 7050.5 of the California Health and Safety Code, if human remains are found, the County Coroner shall be notified within 24 hours of the discovery. No further excavation or disturbance of the site or any nearby area reasonably suspected to overlie adjacent remains shall occur until the County Coroner has determined, within two working days of notification of the discovery, the appropriate treatment and disposition of the human remains. If the remains are determined to be Native American, the Coroner shall notify the NAHC in Sacramento within 24 hours. In accordance with California Public Resources Code, Section 5097.98, the NAHC must immediately notify those persons it believes to be the Most Likely Descendant (MLD) from the deceased Native American. The MLD shall complete their inspection within 48 hours of being granted access to the site. The MLD would then determine, in consultation with the property owner, the disposition of the human remains.

9 References

Aikens, C. Melvin. 1978. Archaeology of the Great Basin. *Annual Review of Anthropology* 7:71–87.

Arnold, Jeanne E. Michael R. Walsh, and Sandra E. Hollimon. 2004. The Archaeology of California. *Journal of Archaeological Research* Vol. 12, No. 1.

Bancroft, Hubert Howe. 1885. *History of California, Volume III: 1825-1840*. A.L. Bancroft & Co., San Francisco.

Basgall, Mark E. 2000. The Structure of Archaeological Landscapes in the North-Central Mojave Desert. In *Archaeological Passages: A Volume in Honor of Claude Nelson Warren*, edited by J. S. Schneider, R. M. Yohe II, and J. K. Gardner, pp. 123-138. Western Center for Archaeology and Paleontology, Publications in Archaeology, Hemet, California.

Basgall, Mark E. 2005. Archeological Assessment of Two Early Holocene Sites in the Noble Pass Training Area, Marine Corps Air Ground Combat Center, Twentynine Palms, California. Report submitted to NREA, MAGTFC, MCAGCC, Twentynine Palms, California.

Basgall, Mark E., and Denise M. Jurich. 2006. Archeological Investigations at Nine Prehistoric Sites in the Emerson Lake Training Area, Marine Corps Air Ground Combat Center, Twentynine Palms, California. Report submitted to NREA, MAGTFTC, MCAGCC, Twentynine Palms, California.

Basgall, Mark E., and Stephen A. Overly. 2004. Prehistoric Archaeology of the Rosamund Lake Basin, Phase II Cultural Resource Evaluations at 41 Sites in Management Region 2, Edwards Air Force Base, California. Report on File, Environmental Management Office, Conservation Branch, Edwards Air Force Base, California.

Bean, Lowell J., and Charles R. Smith. 1978. Serrano. In *California*, edited by Robert F. Heizer, pp. 570–574. Handbook of North American Indians, Vol. 8, William G. Sturtevant, general editor, Smithsonian Institution, Washington, D.C.

Bettinger, R. L., and M. A. Baumhoff. 1982. The Numic Spread: Great Basin Cultures in Competition. *American Antiquity* 47:485-503.

Bright, William. 1975. The Indigenous Languages of California. *Pacific Linguistics Monographs*, Vol. 12. Australian National University, Canberra.

Burgess, M. W and Burgess, M. (editors). 2006. *California Ranchos, Second Edition.* Wildside Press. Originally published 1988, Shumway, Burgess M. *California Ranchos*.

Campbell, E. W. C., and W. H. Campbell. 1935. The Pinto Basin Site: An Ancient Aboriginal Camping Ground in the California Desert. *Southwest Museum Papers* No. 9, Los Angeles.

Cleland, J. H., and W.G. Spaulding. 1992. An Alternative Perspective on Mojave Desert Prehistory. *Society for California Archaeology Newsletter* 26(6):1–6.

Cleland, Robert Glass. *2005. The Cattle on a Thousand Hills: Southern California, 1850-80.* Second ed., sixth printing. The Huntington Library, San Marino, California.

Dallas, S. F. 1955. The Hide and Tallow Trade in Alta California 1822–1848. Ph.D. dissertation, Indiana University, Bloomington

Davis, Emma Lou. 1975. The "exposed archaeology" of China Lake, California. *American Antiquity* 40(1):39-53.

Davis, Emma Lou and Carol Panlaqui. 1978. Stone Tools, The Action Units. In *The Ancient Californians Rancholabrean Hunters of the Mojave Lakes Country,* edited by Emma Lou Davis, pp. 30-75. Natural History Museum of Los Angeles County Science Series 29, Los Angeles.

The Desert Trail. 1981. "A childs eye view of life in Pioneer schooling days." *Hi-Desert Star.* October 8, 1981, pg.8. Accessed online: https://www.newspapers.com/image/1040656783/

Desert USA. N.d The Jackrabbit Homesteads. *Desert USA*. https://www.desertusa.com/dusablog/the-jackrabbit-homesteads/, accessed March 14, 2025.

Dickman, Jeff and Bob Helman. 1979. Primary record SBR-4113 through SBR-4117. On file at the South Central Coastal Information Center.

Dumke, Glenn S. 1970 [1944]. *The Boom of the Eighties in Southern California.* Fifth printing, 1970. Huntington Library Publications, San Marino, California.

Friends of Pioneertown. 2020. National Register of Historic Places Registration Form. National Park Service. Electronic Document: https://pioneertown1946.org/wp-content/uploads/2022/02/National-Register-Historic-District.pdf, accessed January 7, 2025.

General Land Office Records. 1903. Township No.1 North, Range No.5 East of San Bernardino Base Meridian. Bureau of Land Management. United States Department of the Interior. Electronic database: https://glorecords.blm.gov/search/default.aspx?searchTabIndex=0&searchByTypeIndex=1, access January 16, 2025.

General Land Office Records. 1927. Land Grant to William J. Hudson, Patent Number 041058. Record of Patents. Bureau of Land Management. United States Department of the Interior.

General Land Office Records. 1928. Land Grant to William J. Hudson, Patent Number 102329. Record of Patents. Bureau of Land Management. United States Department of the Interior.

General Land Office Records. 1952. Township No.1 North, Range No.5 East of San Bernardino Base Meridian. Bureau of Land Management. United States Department of the Interior. Electronic database: https://glorecords.blm.gov/details/survey/default.aspx?dm_id=282680&sid=fqtuohm0.0ps#surveyDetailsTabIndex=0, access January 16, 2025.

General Land Office Records. 2019. Land Status Records for Township 1 North Range 5 East of the San Bernardino Meridian, California, 1853 to 2019. Bureau of Land Management. United States Department of the Interior.

Giambastiani, M. A., and A. Berg. 2008. Archeological Excavations at Nine Prehistoric Sites in the Emerson Lake Basin, Marine Air Ground Task Force Training Command, Marine Corps Air Ground Combat Center, Twentynine Palms, California. Report submitted to NREA, MAGTFTC, MCAGCC, Twentynine Palms, California.

Glennan, William. 1971. *A Glimpse at the Prehistory of the Antelope Valley: Archaeological Investigations at the Sweetersite (KER-302)*. Kern-Antelope Historical Society, Ridgecrest, CA.

Glennan, William. 1987. Concave-Based Lanceolate Fluted Projectile Points from California. In *Prehistory of the Antelope Valley, California: An Overview*, edited by R. W. Robinson. Antelope Valley Archaeological Society Occasional Paper 1, Lancaster, CA.

Grayson, D. K. 1993. *The Desert's Past: A Natural Prehistory of the Great Basin*. Smithsonian Institution Press, Washington, D.C.

Goff, Paul. 2013. "Ruins of stone house in Pioneertown made into dinner-party magic." Los Angeles Times. July 12, 2013. Accessed online: https://www.latimes.com/home/la-lh-the-ruin-joshua-tree-party-house-20130712-story.html

Gumprecht, Blake. 2001. *The Los Angeles River: Its Life, Death, and Possible Rebirth*. The Johns Hopkins University Press, Baltimore, Maryland.

Hi-Desert Star. 1976. "Resident recalls bygone desert days." Hi-Desert Star. July 14, 1982, pg.20. Accessed online: https://www.newspapers.com/image/625879361/

Hi-Desert Star. 1982. "Swedish Tender of Goats." Hi-Desert Star. May 26, 1976, pg.38. Accessed online: https://www.newspapers.com/image/626116742/

Hill, Jane H. 1967. Comparative Takic Grammar. *University of California Publications in Linguistics*. University of California Press, Berkeley.

Horton, J.D., San Juan, C.A., and Stoeser, D.B. 2017. The State Geologic Map Compilation (SGMC) geodatabase of the conterminous United States (ver. 1.1, August 2017): U.S. Geological Survey Data Series 1052, 46 p., https://doi.org/10.3133/ds1052.

Jones, Terry L., and Kathryn A. Klar. 2007. *California Prehistory: Colonization, Culture, and Complexity*. AltaMira Press, New York.

Joshua Tree National Park. 2023. Park Statistics. National Park Service. https://www.nps.gov/jotr/learn/management/statistics.htm, accessed January 7, 2025.

Justice, Noel D. 2002. *Stone Age Spear and Arrow Points: of California and the Great Basin*. Indiana University Press, Bloomington.

Kauffman, Eric. 2021. Climate and Topography. In *Atlas of the Biodiversity of California*, California Department of Fish and Wildlife. pp. 12-15. United States of America.

Kimbro, Enda E. and Julia G. Costello. 2009. *The California Missions: History, Art, and Preservation*. Getty Publications, Los Angeles.

Kroeber, Alfred J. 1925. *Handbook of the Indians of California*. Bureau of American Ethnology Bulletin 78. Dover Publications, Inc., New York.

Los Angeles Times. 2011. "For Pipes Canyon remodelers, a high desert holiday." Los Angeles Times. December 10, 2011. Accessed online: https://www.latimes.com/archives/blogs/la-at-home/story/2011-12-10/for-pipes-canyon-remodelers-a-high-desert-holiday.

Moslak, K. and P. Moloney. 2017. Primary Record 36-031400/CA-SBR-31400H. Applied EarthWorks. On file at the South Central Coastal Information Center.

Meares, Hadley. 2021. "We're Getting Out of L.A. and Going to Joshua Tree": Why the Desert Area Is Booming. *The Hollywood Reporter*. Electronic Document: https://www.hollywoodreporter.com/lifestyle/style/were-getting-out-of-l-a-and-going-to-joshua-tree-why-the-desert-area-is-booming-4133595/, accessed January 7, 2025.

Moratto, Michael J. 2004. *California Archaeology*. Coyote Press, Salinas, California.

National Oceanic and Atmospheric Administration [NOAA]. 2021. U.S. Climate Normals Quick Access. https://www.ncei.noaa.gov/access/us-climate-normals/#dataset=normals-monthly&timeframe=30&location=CA&station=USC00049888, accessed January 7, 2025.

National Park Service. 2023. Homesteaders - Joshua Tree National Park. U.S. National Park Service. https://www.nps.gov/jotr/learn/historyculture/homesteaders.htm, accessed March 14, 2025.

Nationwide Environmental Title Research LLC [NETR]. 2024. Historic Aerial Photographs of project site and surrounding area. https://www.historicaerials.com/viewer, accessed January 7, 2025.

Palomares, Francisco. 1808. Diary of Francisco Palomares. *Provincial State Papers, Missions and Colonization*, Vol 1, pp. 232-242. California State Archives, Sacramento.

San Bernardino, County of. 2007. Cultural Resources Preservation (CP) Overlay. San Bernardino County Overview. Chapter 82.12. Online document: https://codelibrary.amlegal.com/codes/sanbernardino/latest/sanberncty_ca/0-0-0-168285, accessed January 7, 2025.

San Bernardino, County of. 2022. Cultural Resource Element. County Policy Plan. Pp. 41-42. https://countywideplan.sbcounty.gov/wp-content/uploads/sites/125/2021/01/CWP_PolicyPlan_HardCopy_MainText_Tables_2022_Sept_Adopted.pdf?x23421, accessed December 30, 2024.

San Bernardino, County of. n.d. County History. https://main.sbcounty.gov/sbcounty-history/, accessed January 16, 2025.

Stine, S. 1994. Extreme and Persistent Drought in California and Patagonia during Medieval Times. *Nature* 369 (6481):546–549.

Stringfellow, Kim. N.d. Jackrabbit Homestead website. https://jackrabbithomestead.com/, accessed March 14, 2025.

Sutton, Mark Q. 1996. The Current Status of Archaeological Research in the Mojave Desert. *Journal of California and Great Basin Anthropology* 18(2):221–257.

Sutton, Mark Q., Mark E. Basgall, Jill K. Gardner, and Mark W. Allen. 2007. Advances in Understanding Mojave Desert Prehistory. In *California Prehistory: Colonization, Culture, and Complexity*, edited by T. L. Jones and K. A. Klar, pp. 229–245. AltaMira Press, New York.

Sutton, Mark Q. and David D. Earle. 2017. *The Desert Serrano of the Mojave River*. Pacific Coast Archaeological Society Quarterly 53(2-3).

University of California, Santa Barbara [UCSB]. 2024. Historic Aerial Photographs of project site and surrounding area. Map & Imagery Laboratory [MIL] UCSB Library. http://mil.library.ucsb.edu/ap_indexes/FrameFinder, accessed January 7, 2025.

Visit Pioneertown. 2024. The Story of Pioneertown. *Visit Pioneertown*. https://visitpioneertown.com/the-story, accessed January 7, 2025.

Warren, Claude N. 1984. The Desert Region. In *California Archaeology*, edited by M. J. Moratto, pp. 339–430. Academic Press, Orlando, Florida.

Waters, Michael R. 1992. *Principals of Geoarchaeology: A North American Perspective*. University of Arizona Press, Tucson.

Wildlands Conservancy, The. n.d. Pioneertown Mountains Preserve. https://wildlandsconservancy.org/preserves/pioneertownmountains, accessed March 14, 2025.

Yohe, Robert M. 1998. The Introduction of the Bow and Arrow and Lithic Resource Use at Rose Spring (CA-INY-372). *Journal of California and Great Basin Anthropology* 20:26-52.

Zyniecki, M. 2003. Cultural Resources Inventory of 1,730 Acres in the Emerson Lake Training Area, Marine Air Ground Task Force Training Command, Marine Corps Air Ground Combat Center, Twentynine Palms. Report submitted to NREA, MAGTFTC, MCAGCC, Twentynine Palms, California.

Appendix A:
Records Search Summary

Appendix B:
Native American Scoping

Appendix C:
Department of Park and Recreation Form 523 Primary Record

Appendix D:
Resumes for Qualified Staff

Appendix D

Feasibility Report for On-Site Wastewater Treatment Systems (OWTS)

GeoTek, Inc.
1548 North Maple Street, Corona, California 92878
(951) 710-1160 Office (951) 710-1167 Fax www.geotekusa.com

April 5, 2023
Project No. 3508-CR

Hillwig-Goodrow, Inc.
31419 Outer Highway 10, Suite 1200
Redlands, California 92373

Attention: Mr. Alan Hillwig

Subject: **Feasibility Report for On-Site Wastewater Treatment Systems (OWTS)**
Tentative Tract Map No. 20612
Single-Family Residential Development – 32 Lots
Assessor's Parcel Numbers (APNs) 059-435-132 and -133
Yucca Valley area of San Bernardino County, California

References: See Page 5

Dear Mr. Hillwig,

Introduction

In accordance with your request, GeoTek, Inc. (GeoTek) has prepared this Feasibility Report for On-Site Wastewater Treatment Systems (OWTS) for the subject proposed development. General review and review comments provided in this report are based on review of the referenced *"Tentative Tract Map No. 20612"* prepared by Hillwig-Goodrow, Inc., dated February 13, 2023; review of published local geologic maps; and GeoTek's experience in the site vicinity; and with this type of project.

Site Description

The site parcels are approximately 160 acres in size and are located approximately ½-mile east of the intersection of Acacia Avenue and Gamma Gulch Road, in the Yucca Valley area of San Bernardino County, California. The parcels can be considered as having gradually to moderately sloping terrain with bedrock outcrops visible throughout the site. The site is currently vacant land.

Proposed Development

It is GeoTek's understanding that the property will be developed with thirty-two (32) single-family residential structures and associated improvements. GeoTek has assumed that the structures will be supported by conventional shallow spread footings with a conventional slab-on-grade floor. Sewage disposal is anticipated via on-site wastewater treatment systems and are anticipated to include a septic tank and leach lines for each residential structure. Based on the referenced tentative tract map it is GeoTek's understanding that private water wells are being proposed for each lot.

Site Geologic Conditions

The subject property is situated in the Transverse Ranges geomorphic province. The Transverse Ranges are a group of predominately east-west trending mountain ranges of southern California. The Transverse Ranges begin at the southern end of the California Coast Ranges (west of Point Conception) and extend approximately 500 kilometers eastward into the Mojave and Colorado Deserts. These mountain ranges lie within Santa Barbara, Ventura, Los Angeles, San Bernardino, Riverside and Kern counties.

The geology and topography of the ranges express three distinct segments that have contrasting elevations, rock types and vegetation. The western segment extends to the San Gabriel Mountains and San Gabriel fault. The central segment includes mountains that range eastward to the San Andreas fault. The eastern segment extends from the San Andreas fault eastward to the Colorado Desert. The central and eastern segments (near the San Andreas fault) have the highest elevations. Sedimentary basins within the Transverse Range Geomorphic Province include the Ventura, Soledad and Ridge Basins, and the San Fernando Valley.

The province is characterized by major mountain ranges with intervening alluviated, broadly synclinal valleys and narrow stream canyons. The province subdivides into several individual ranges and geologic features. The major subdivisions of interest are the Santa Ynez Mountains, Central Ventura County Mountains, Santa Monica Mountains, Ventura/Soledad Basin, Ridge Basin, San Gabriel Mountains, Los Angeles Basin, San Bernardino Mountains, and the Eastern Boundary Ranges.

More specific to the subject property, the site is located in an area geologically mapped by others to be mostly underlain by older alluvium (Qoa) and Quartz monzonite type bedrock (Qm) (Dibblee, T.W., 1967). The site is not located within an "Alquist-Priolo" Earthquake Fault Zone or a state-identified liquefaction zone. The County of San Bernardino has

designated a portion of the site (older alluvium) as "susceptible for liquefaction", not in a fault zone and not in a fault line.

Site Geotechnical Engineering Conditions

Shallow bedrock is anticipated to be encountered within the typical depths to be explored for a standard Percolation Evaluation conducted in the project area (10± feet below existing site grades). Based upon review of the California Water Data Library and GeoTracker databases, current groundwater levels at the site are at least 50 feet below the ground surface. Groundwater is not anticipated to be a design factor for this project. Due to the great depth to groundwater and underlying geologic materials, liquefaction is not considered to be a hazard at the site.

Based upon previous experience with projects in the vicinity of the project site, the site soils are anticipated to consist of interbedded layers of silty sands and sandy silts (SM and ML soil types based upon the Unified Soil Classification System).

Based upon previous experience with projects in the vicinity of the project site, the site soils are considered to have "favorable" conditions in regard to the soil classification and percolation rates in accordance with San Bernardino County guidelines.

Conclusions and Recommendations

Based on review of the provided information, it is GeoTek's opinion there is sufficient area on the subject lots to support OWTS and private wells and that these can be built meeting all set-back requirements by the County of San Bernardino Environmental Health Department.

Based on the site's geology, it is GeoTek's opinion that some, if not the majority of the subject lots will not meet San Bernardino's County minimum required vertical separation of five (5) feet between the bottom of the dispersion systems and any impermeable materials (i.e., bedrock). Therefore, it is anticipated that advanced treatment units will be required for some of the lots.

It is recommended that the percolation study begins with the excavation of exploratory borings to depths of approximately ten (10) feet below existing grades in the area of the proposed leach fields to determine if an advance treatment unit is required. Prior to conducting the field investigation, GeoTek will need the proposed improvement plans showing the location of the proposed single-family structures and private wells.

GeoTek does not design on-site wastewater advance treatment units. A company specialized in on-site wastewater advance treatment units can be recommended if desired.

Limitations

GeoTek's findings are based on site conditions observed and the stated sources. Thus, GeoTek's comments are professional opinions that are limited to the extent of the available data. These opinions have been derived in accordance with current San Bernardino County Environmental Health Department standards and no warranty is expressed or implied.

Respectfully submitted,
GeoTek, Inc.



Edward H. LaMont
CEG 1892, Exp. 07/31/24
Principal Geologist

Anna M. Scott
Project Geologist



Diego S. Alvarez
PE C 93449, Exp. 06/30/24
Project Engineer

Distribution: (1) Addressee via email

G:\Projects\3501 to 3550\3508CR Hillwig-Goodrow Inc Tentative Tract Map 20612 Yucca Valley DD\3508-CR Feasibility Report for On-Site Sewage Disposal Systems Tentative Tract Map 20612, Yucca Valley.doc

REFERENCES

Dibblee, T.W., 1967, "Geologic Map of the Joshua Tree Quadrangle, San Bernardino and Riverside Counties, California," Miscellaneous Geologic Investigations Map I-526, Scale 1:62,500.

Hillwig-Goodrow, Inc., 2023, Tentative Tract Map No. 20612, APNs: 0594-351-32 & 33, Pipes Canyon Road, Pioneertown, 1 Sheet, dated February 13.

San Bernardino County Land Use Plan, General Plan, Geologic Hazard Overlay, Newberry Springs/Big Bear Lake, Rimrock, EIFI C, Scale 1:115,200.

San Bernardino County Public Health Division of Environmental Health Services, 2017, "Local Agency Management Program (LAMP) for Onsite Wastewater Treatment Systems," dated May.

_____, 2019, "Percolation Testing and Reporting Standards for Onsite Wastewater Treatment Systems," dated September.

Appendix E.1

Preliminary Drainage Report

PRELIMINARY DRAINAGE REPORT

TTM 20612
DRNSY-????????
UNINCORPORATED, SAN BERNARDINO COUNTY, CALIFORNIA

Prepared For:

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Printed:
April 29, 2025

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Drainage Study

December 14, 2023
Updated:
April 28, 2025

Introduction

The following study and calculations were prepared to analyze the pre and post improvement conditions for the land making up the watershed of TTM 20612. Located on a portion of land being a subdivision of the South ½ of the Northeast ¼ and the Northwest ¼ of the Southeast ¼ of Section 6, Township 1 North, Range 5 East, San Bernardino base and meridian, in an unincorporated area, in the county of San Bernardino, State of California. This study was performed for a 100-year, 1-Hour storm event.

Site Background

The site is ONE parcels, totaling 122.98-acres of undeveloped land comprised of desert scrub in an area of varied natural terrain, comprised of desert washes, and hills of moderate gradient. The total tributary drainage area is comprised of 122.98-acres.

The site has existing roadway improvements along the alignment of Pipes Canyon Road, a water carrying road, that bisects the project about its approximate north south-midline. There are existing desert trails that meander about the private land and terminate at various points.

All of the runoff from the project site is tributary to the Pipes Wash Watershed.

The parcel making up this project, identified as APN:0549-351-33, is split zoned. A western portion being zoned RL-5 and the remainder zoned RC. The existing zoning is per San Bernardino County land use districts, zoning overlay; a layer publicly available through the county website,
https://sbcounty.maps.arcgis.com/apps/MapSeries/index.html?appid=f5a50c44766b4c36a3ae014497aa430d

The site is proposed to be divided to provide: 12 residential lots of 5 acres each and a remainder parcel of approximately 60 acres. The remainder parcel is that portion lying within the RC zoned portion of the subject parcel As a portion of the division, shared, private, graded access roads are proposed to provide legal means of egress to all lots not directly served by public rights of way. There is no inclusion of additional impermeable surfaces in the proposed division. The intention of the division is for lot sales. Any increase in runoff due to the construction of impermeable surfaces is to be addressed on a lot-by-lot basis at the time of permitting by the developing party.

The soil types for this site are Hydrologic Type C, per the San Bernardino County Hydrology Manual, sheet C-24, Figure C-11. (Appendix “B”)

The site is located in FEMA Flood Zone “D” per attached FEMA maps 06071C8100H, and 06071C8105H effective 08/28/2008 (Appendix “C”). It is noted that neither of these flood maps were printed, thus the firmette shows no base map information.

Study Methods

Point Rainfall data for this study was sourced from NOAA Atlas 14, Volume 6, Version 2 for the applicable location (Appendix “D”), accessed (October 25, 2023).

The results contained in this study were obtained by utilization of the San Bernardino Rational Hydrology Program provided by CIVILDESIGN Engineering Software. Rational Method calculations are provided in (Appendix “E”).

The effects of proposed improvements are minimal proposed post-development condition.
In an effort to provide clarity in comparison of the Pre to Post development conditions the individual watersheds of both conditions terminate in identically located and numbered nodes on the respective maps included as (Appendix “A”).

Pre-Development Drainage Conditions

The area included in this study contains 14 watersheds that converge into 14 distinct points of concentration. Under existing conditions, Rational Method calculations, performed as previously stated indicate peak flows as summarized by watershed, indicating subarea designations and Terminal Concentration Node as depicted on the Pre-Development Drainage Study Map included as a portion of (Appendix “A”), in Table 1.

TABLE 1: PRE-DEVELOPMENT SUMMARY							
WATERSHED ID	SUBAREA ID	SUBAREA AREA (acre)	WATERSHED AREA (acre)	TERMINAL CONCEN. NODE	NODE DESCRIPTION	Tc (min.)	Q_{100} (cfs)
1	1	0.795	0.795	10	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	6.38	6.21
2	2	1.506	1.506	20	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	8.05	9.99
3	3	0.309	0.309	30	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	4.60	3.04
4	4.0	4.525	17.116	40	FLOW ON EXISTING WATER CARRYING ROADWAY IMPROVEMENTS	22.40	54.50
	4.1	12.591					
5	5.0	0.635	0.635	50	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	8.45	4.07
6	6.0	6.430	51.048	60	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	21.91	150.05
	6.1	25.374					
	6.2	6.142					
	6.3	13.102					
7	7.0	4.453	41.437	70	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	18.48	148.74
	7.1	18.012					
	7.2	7.520					
	7.3	6.292					
	7.4	5.160					
8	8	1.938	1.938	80	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	9.59	11.36
9	9	0.884	0.884	90	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	9.09	5.38
10	10	1.358	1.358	100	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	8.77	8.48
11	11	0.634	0.634	110	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	7.37	4.48
12	12	1.885	1.885	120	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	8.49	12.05
13	13	1.011	1.011	130	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	8.23	6.60
14	14	2.413	2.413	140	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	11.35	12.56

Post Development Drainage Conditions

The area included in this study contains 14 watersheds that converge into 14 distinct points of concentration. Under proposed Post-Development conditions, Rational Method calculations, performed as previously stated indicate peak flows as summarized by watershed, indicating subarea designations and Terminal Concentration Node as depicted on the Post-Development Drainage Study Map included as a portion of (Appendix “A”), in Table 2.

TABLE 2: POST-DEVELOPMENT SUMMARY							
WATERSHED ID	SUBAREA ID	SUBAREA AREA (acre)	WATERSHED AREA (acre)	TERMINAL CONCEN. NODE	NODE DESCRIPTION	Tc (min.)	Q_{100} (cfs)
1	1	0.795	0.795	10	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	6.38	6.21
2	2	1.506	1.506	20	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	8.05	9.99
3	3	0.309	0.309	30	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	4.60	3.04
4	4.0	4.525	17.116	40	FLOW ON EXISTING WATER CARRYING ROADWAY	22.71	54.50
	4.1	12.591					
5	5.0	0.635	0.635	50	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	8.45	4.07
6	6.0	6.430	51.048	60	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	21.90	149.92
	6.1	25.374					
	6.2	6.142					
	6.3	13.102					
7	7.0	4.453	41.437	70	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	19.38	148.74
	7.1	18.012					
	7.2	7.520					
	7.3	6.292					
	7.4	5.160					
8	8	1.938	1.938	80	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	9.59	11.36
9	9	0.884	0.884	90	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	9.09	5.38
10	10	1.358	1.358	100	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	8.77	8.48
11	11	0.634	0.634	110	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	7.37	4.48
12	12	1.885	1.885	120	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	8.49	12.05
13	13	1.011	1.011	130	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	8.23	6.60
14	14	2.413	2.413	140	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	11.35	12.56

The improvements proposed for the site will retain as much of the natural topography as is practicable. The improvements proposed as a portion of this division are limited to grading of the necessary graded access roads and include no proposed addition of impermeable surface. The result being no increase in the peak flow rate at each Terminal Concentration Node as depicted on the Post-Development Drainage Study Map included as a portion of (Appendix “A”). Due to the reshaping of a portion of the flow channel in subarea 6.1, there is a resultant reduction in peak discharge from watershed 6. This reduction is approximately 1 percent and is considered insignificant for the purpose of comparison in this study.

The necessary graded roads have been located and designed such that they provide as minimal impact to existing natural flow paths as is practicable. The only measurable impact that these alignments and profiles have generated is the previously mentioned reduced peak flow from watershed 6.

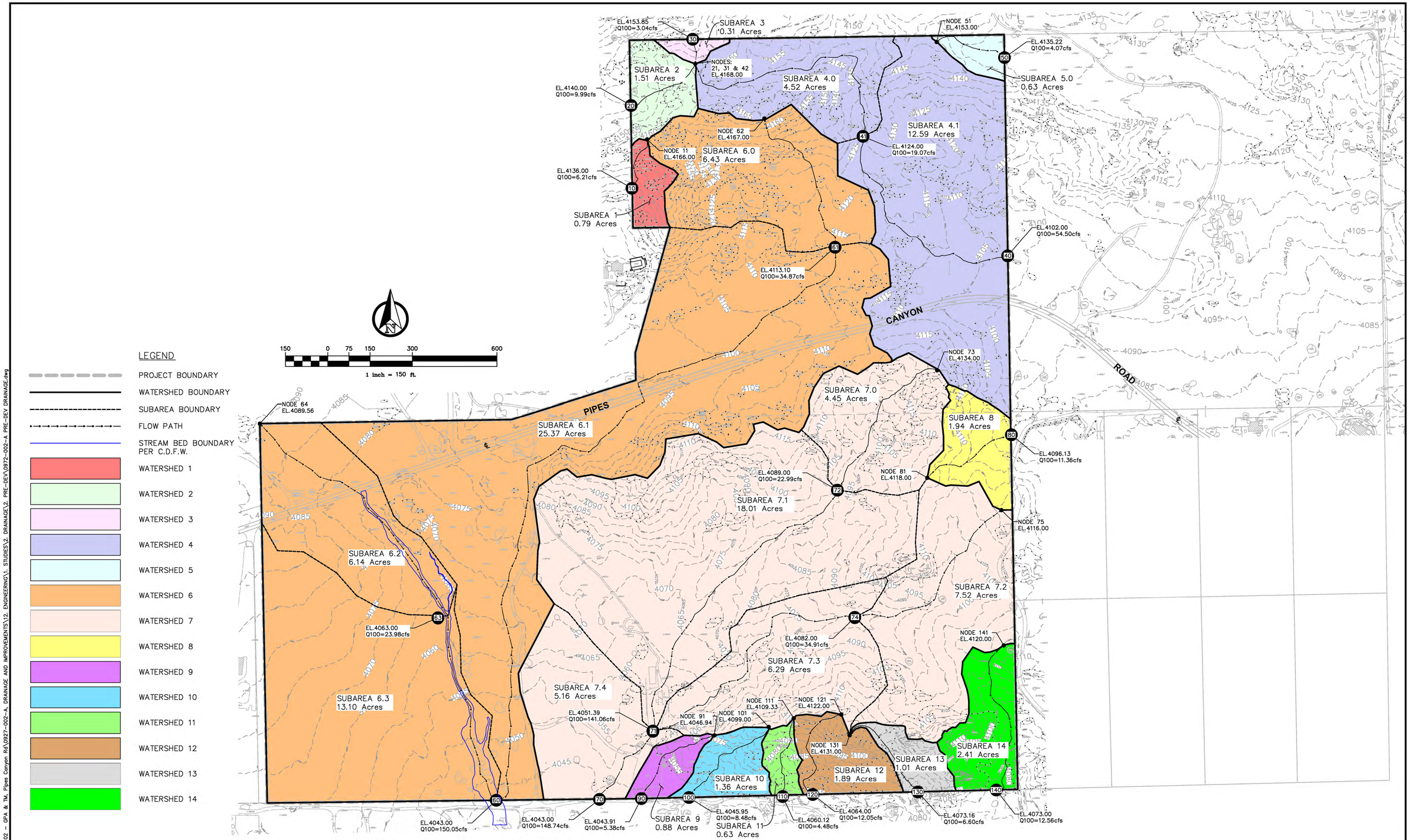
Conclusion

The proposed improvements will not result in an increased volume of storm water discharges indicated in the comparison shown as Table 3.

TABLE 3: VALUE COMPARISON						
WATERSHED ID	TERMINAL CONCEN. NODE	DEVELOPED CONDITION	Q_{100} (cfs)	PRE TO POST ΔQ_{100}	AREA (acre)	PRE TO POST ΔAREA
1	10	PRE	6.21	0.00	0.795	0.000
		POST	6.21		0.795	
2	20	PRE	9.99	0.00	17.116	0.000
		POST	9.99		17.116	
3	30	PRE	3.04	0.00	0.309	0.000
		POST	3.04		0.309	
4	40	PRE	54.50	0.00	17.116	0.000
		POST	54.50		17.116	
5	50	PRE	4.07	0.00	0.635	0.000
		POST	4.07		0.635	
6	60	PRE	150.05	-0.13	51.048	0.000
		POST	149.92		51.048	
7	70	PRE	148.74	0.00	51.048	0.000
		POST	148.74		51.048	
8	80	PRE	11.36	0.00	1.938	0.000
		POST	11.36		1.938	
9	90	PRE	5.38	0.00	0.884	0.000
		POST	5.38		0.884	
10	100	PRE	8.48	0.00	1.358	0.000
		POST	8.48		1.358	
11	110	PRE	4.48	0.00	0.634	0.000
		POST	4.48		0.634	
12	120	PRE	12.05	0.00	1.885	0.000
		POST	12.05		1.885	
13	130	PRE	6.60	0.00	1.011	0.000
		POST	6.60		1.011	
14	140	PRE	12.56	0.00	2.413	0.000
		POST	12.56		2.413	

Based on the calculations performed as a part of this study, considering the proposed improvements, onsite flows can be conveyed to a suitable point of disposal and the proposed improvements will not adversely impact offsite property.

APPENDIX “A”



J:\Clients\Shokrian, Jonathan\972-02 - GPA & TM, Pipes Canyon Rd\0927-002-A, DRAINAGE AND IMPROVEMENTS\2. ENGINEERING\1- STUDIES\2. DRAINAGE\2. PRE-DEV DRAINAGE\2. PRE-DEV\0972-002-A PRE-DEV DRAINAGE.dwg

An Original Map Product Contains An Embossed Seal In This Area

Revisions:

No.	Date:	By:	Description:	Approved:

Designed: | Drawn: | Checked: ACH

Seal: REGISTERED PROFESSIONAL ENGINEER BRAD A. HILLWIG C 95927 CIVIL STATE OF CALIFORNIA

Prepared under the Supervision of:

REGISTERED PROFESSIONAL ENGINEER LICENSE NO. C 95927 DATE

HILLWIG - GOODROW, INC.
Land Surveying - GPS Surveys - Aerial Mapping
31407 Outer Highway 10 ▲ Redlands, CA 92373 ▲ (909) 794-2673

Scale: 1"=150'

BENCHMARK: GPS C.O.R.S. LDES, ELEV. 3313.28 (NAVD 88) A PART OF THE NATIONAL GEODETIC SURVEY.

Date: APRIL 2025

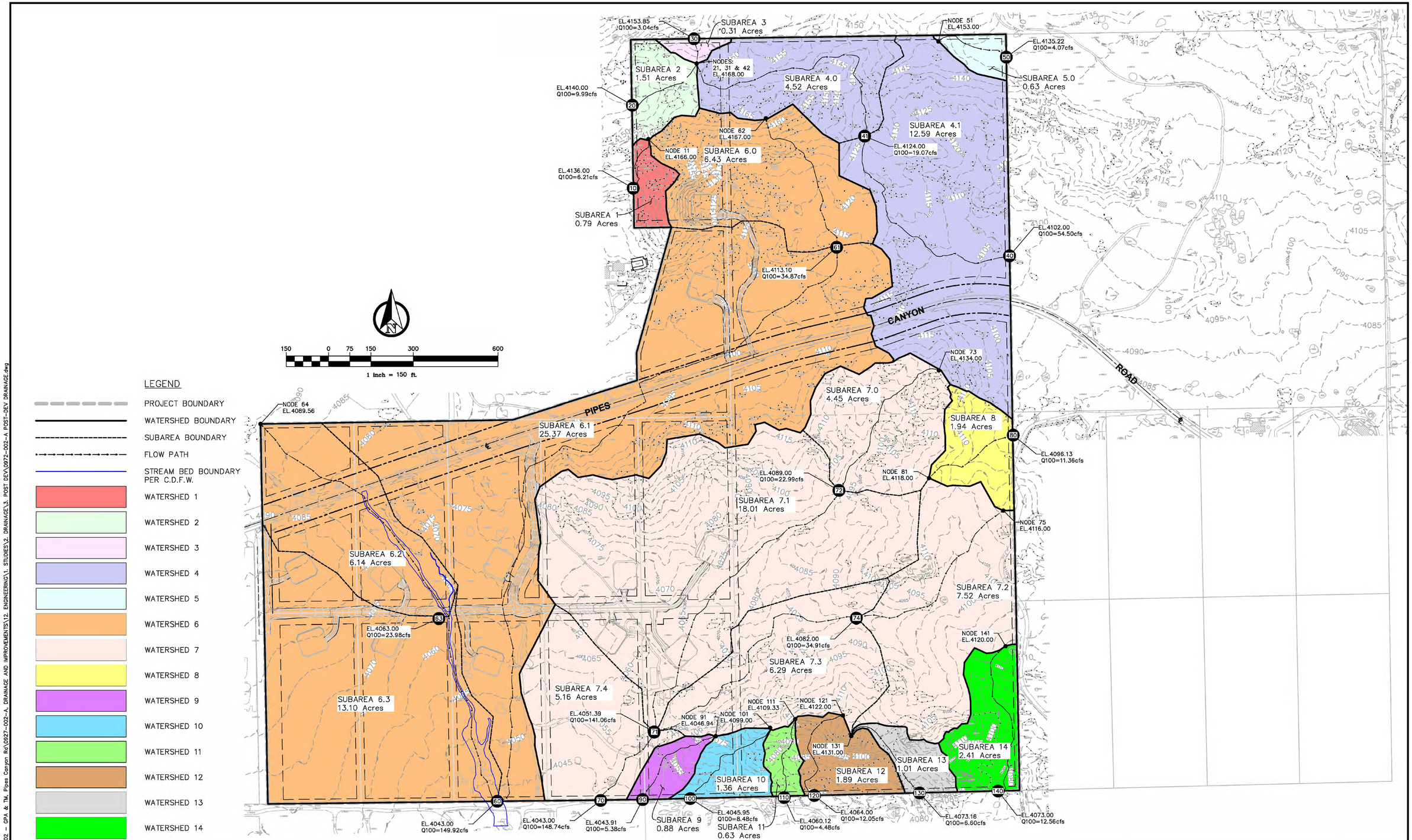
PRE-DEVELOPMENT HYDROLOGY
TTM 20612

PREPARED FOR:
JONATHAN SHOKRIAN
319 S. ROBERTSON BLVD.
BEVERLY HILLS, CA 90211

F.N. | For: | F.B.

Sheet No. 1 OF 1 SHEET

FILE NO. 0927-002-A



J:\Clients\Shokrian, Jonathan\972-02 - GPA & TM, Pipes Canyon Rd\0927-002-A, DRAINAGE AND IMPROVEMENTS\2. ENGINEERING\1. STUDIES\2. DRAINAGE\3. POST DEV\0972-002-A POST-DEV DRAINAGE.dwg

An Original Map Product Contains An Embossed Seal In This Area

Revisions:

No.	Date:	By:	Description:	Approved:

Designed: | Drawn: | Checked: ACH

Seal: REGISTERED PROFESSIONAL ENGINEER — DAVID A. HILLWIG — C 95927 — CIVIL — STATE OF CALIFORNIA

Prepared under the Supervision of:

REGISTERED PROFESSIONAL ENGINEER LICENSE NO. C 95927 — DATE

HILLWIG - GOODROW, INC.

Land Surveying - GPS Surveys - Aerial Mapping

31407 Outer Highway 10• Redlands, CA 92373• (909) 794-2673

Scale: 1"=150'

Date: APRIL 2025

BENCHMARK:
GPS C.O.R.S. LDES, ELEV. 3313.28 (NAVD 88)
A PART OF THE NATIONAL GEODETIC SURVEY.

POST-DEVELOPMENT HYDROLOGY
TTM 20612

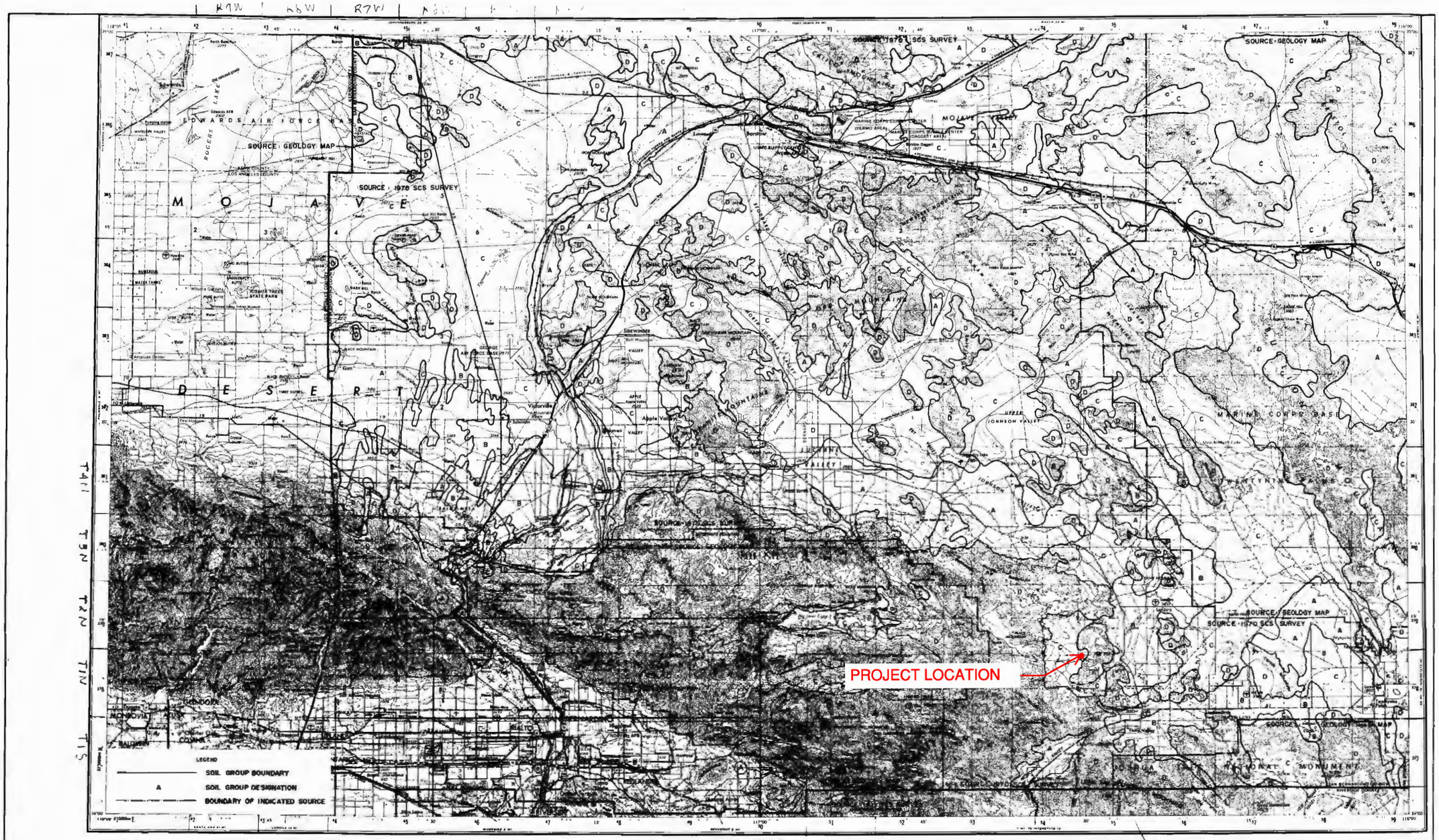
PREPARED FOR:
JONATHAN SHOKRIAN
319 S. ROBERTSON BLVD.
BEVERLY HILLS, CA 90211

F.N. | For: | F.B.

Sheet No. 1 OF 1 SHEET

FILE NO. 0927-002-A

APPENDIX “B”



INDEX MAP

Scale 1:250,000

CONTOUR INTERVAL 200 FEET
WITH SUPPLEMENTARY CONTOURS AT 100 FOOT INTERVALS
TRANSVERSE MERCATOR PROJECTION

BASE MAP REPRODUCED FROM U.S.G.S. "SAN BERNARDINO" TOPOGRAPHIC MAP

SCALE REDUCED BY 1/2

LOCATION DIAGRAM

SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

HYDROLOGIC SOILS GROUP MAP FOR SOUTHCENTRAL AREA

APPENDIX “C”

National Flood Hazard Layer FIRMette



Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

- **SPECIAL FLOOD HAZARD AREAS**
  - Without Base Flood Elevation (BFE) *Zone A, V, A99*
  - With BFE or Depth *Zone AE, AO, AH, VE, AR*
  - Regulatory Floodway
- **OTHER AREAS OF FLOOD HAZARD**
  - 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
  - Future Conditions 1% Annual Chance Flood Hazard *Zone X*
  - Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
  - Area with Flood Risk due to Levee *Zone D*
- **OTHER AREAS**
  - NO SCREEN Area of Minimal Flood Hazard *Zone X*
  - Effective LOMRs
  - Area of Undetermined Flood Hazard *Zone D*
- **GENERAL STRUCTURES**
  - Channel, Culvert, or Storm Sewer
  - Levee, Dike, or Floodwall
- **OTHER FEATURES**
  - 20.2 Cross Sections with 1% Annual Chance
  - 17.5 Water Surface Elevation
  - Coastal Transect
  - Base Flood Elevation Line (BFE)
  - Limit of Study
  - Jurisdiction Boundary
  - Coastal Transect Baseline
  - Profile Baseline
  - Hydrographic Feature
- **MAP PANELS**
  - Digital Data Available
  - No Digital Data Available
  - Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 12/13/2023 at 5:39 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

APPENDIX “D”

NOAA Atlas 14, Volume 6, Version 2
Location name: Yucca Valley, California, USA*
Latitude: 34.2014°, Longitude: -116.4977°
Elevation: 4109 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.114 (0.094-0.139)	0.162 (0.134-0.198)	0.228 (0.188-0.280)	0.284 (0.232-0.351)	0.364 (0.288-0.465)	0.428 (0.332-0.559)	0.497 (0.376-0.664)	0.571 (0.420-0.784)	0.676 (0.477-0.968)	0.764 (0.521-1.13)
10-min	0.164 (0.135-0.200)	0.233 (0.192-0.284)	0.327 (0.269-0.401)	0.407 (0.333-0.503)	0.522 (0.413-0.666)	0.614 (0.476-0.801)	0.712 (0.538-0.951)	0.818 (0.602-1.12)	0.969 (0.684-1.39)	1.10 (0.747-1.62)
15-min	0.198 (0.164-0.241)	0.281 (0.232-0.344)	0.395 (0.326-0.485)	0.492 (0.403-0.609)	0.631 (0.499-0.806)	0.743 (0.575-0.968)	0.861 (0.651-1.15)	0.989 (0.727-1.36)	1.17 (0.827-1.68)	1.32 (0.903-1.96)
30-min	0.299 (0.247-0.365)	0.425 (0.351-0.519)	0.597 (0.492-0.732)	0.744 (0.608-0.919)	0.953 (0.753-1.22)	1.12 (0.869-1.46)	1.30 (0.983-1.74)	1.49 (1.10-2.05)	1.77 (1.25-2.53)	2.00 (1.36-2.96)
60-min	0.418 (0.346-0.511)	0.595 (0.492-0.727)	0.837 (0.689-1.02)	1.04 (0.852-1.29)	1.33 (1.06-1.70)	1.57 (1.22-2.05)	1.82 (1.38-2.43)	2.09 (1.54-2.87)	2.48 (1.75-3.55)	2.80 (1.91-4.15)
2-hr	0.556 (0.460-0.679)	0.781 (0.645-0.955)	1.10 (0.902-1.34)	1.36 (1.12-1.69)	1.76 (1.39-2.24)	2.08 (1.61-2.71)	2.42 (1.83-3.24)	2.80 (2.06-3.84)	3.34 (2.36-4.78)	3.79 (2.58-5.61)
3-hr	0.657 (0.544-0.802)	0.919 (0.759-1.12)	1.29 (1.06-1.58)	1.61 (1.31-1.99)	2.08 (1.64-2.65)	2.46 (1.91-3.21)	2.88 (2.18-3.84)	3.33 (2.45-4.58)	4.00 (2.82-5.72)	4.55 (3.10-6.74)
6-hr	0.869 (0.719-1.06)	1.22 (1.00-1.49)	1.70 (1.40-2.09)	2.13 (1.74-2.63)	2.74 (2.17-3.51)	3.26 (2.52-4.25)	3.81 (2.88-5.09)	4.41 (3.24-6.06)	5.29 (3.73-7.57)	6.02 (4.10-8.91)
12-hr	1.12 (0.928-1.37)	1.58 (1.30-1.92)	2.20 (1.82-2.70)	2.74 (2.24-3.39)	3.52 (2.78-4.50)	4.15 (3.22-5.41)	4.82 (3.65-6.45)	5.55 (4.08-7.63)	6.60 (4.66-9.44)	7.45 (5.08-11.0)
24-hr	1.45 (1.29-1.67)	2.06 (1.82-2.38)	2.90 (2.56-3.35)	3.61 (3.16-4.21)	4.63 (3.92-5.57)	5.45 (4.52-6.70)	6.32 (5.12-7.95)	7.25 (5.72-9.38)	8.58 (6.50-11.6)	9.66 (7.07-13.5)
2-day	1.68 (1.49-1.93)	2.44 (2.16-2.81)	3.50 (3.09-4.05)	4.42 (3.87-5.15)	5.76 (4.88-6.94)	6.86 (5.70-8.43)	8.05 (6.53-10.1)	9.34 (7.37-12.1)	11.2 (8.50-15.1)	12.8 (9.36-17.8)
3-day	1.84 (1.63-2.12)	2.70 (2.39-3.12)	3.94 (3.48-4.56)	5.04 (4.41-5.87)	6.65 (5.64-8.01)	8.01 (6.65-9.84)	9.49 (7.70-11.9)	11.1 (8.79-14.4)	13.6 (10.3-18.3)	15.6 (11.4-21.8)
4-day	1.91 (1.69-2.20)	2.84 (2.51-3.27)	4.17 (3.68-4.82)	5.35 (4.69-6.24)	7.13 (6.04-8.58)	8.63 (7.16-10.6)	10.3 (8.33-12.9)	12.1 (9.56-15.7)	14.9 (11.3-20.0)	17.2 (12.6-24.0)
7-day	2.13 (1.89-2.46)	3.19 (2.82-3.67)	4.72 (4.16-5.46)	6.09 (5.33-7.10)	8.16 (6.91-9.82)	9.91 (8.23-12.2)	11.9 (9.62-14.9)	14.0 (11.1-18.2)	17.3 (13.1-23.3)	20.1 (14.8-28.1)
10-day	2.28 (2.02-2.62)	3.42 (3.03-3.94)	5.09 (4.49-5.88)	6.58 (5.76-7.67)	8.83 (7.49-10.6)	10.8 (8.93-13.2)	12.9 (10.4-16.2)	15.3 (12.1-19.8)	18.9 (14.3-25.5)	22.0 (16.1-30.6)
20-day	2.42 (2.15-2.79)	3.71 (3.29-4.28)	5.59 (4.94-6.46)	7.27 (6.37-8.48)	9.81 (8.32-11.8)	12.0 (9.94-14.7)	14.4 (11.7-18.1)	17.1 (13.5-22.1)	21.1 (16.0-28.5)	24.6 (18.0-34.3)
30-day	2.68 (2.38-3.09)	4.15 (3.68-4.79)	6.29 (5.55-7.27)	8.19 (7.18-9.55)	11.1 (9.38-13.3)	13.5 (11.2-16.6)	16.2 (13.1-20.4)	19.2 (15.2-24.9)	23.8 (18.0-32.0)	27.6 (20.2-38.5)
45-day	3.05 (2.71-3.52)	4.75 (4.20-5.48)	7.20 (6.36-8.32)	9.38 (8.22-10.9)	12.7 (10.7-15.2)	15.4 (12.8-19.0)	18.5 (15.0-23.2)	21.9 (17.3-28.3)	26.9 (20.4-36.3)	31.3 (22.9-43.6)
60-day	3.41 (3.02-3.92)	5.30 (4.69-6.10)	8.02 (7.08-9.27)	10.4 (9.13-12.2)	14.0 (11.9-16.9)	17.1 (14.2-21.0)	20.4 (16.5-25.6)	24.1 (19.0-31.1)	29.5 (22.4-39.8)	34.2 (25.0-47.6)

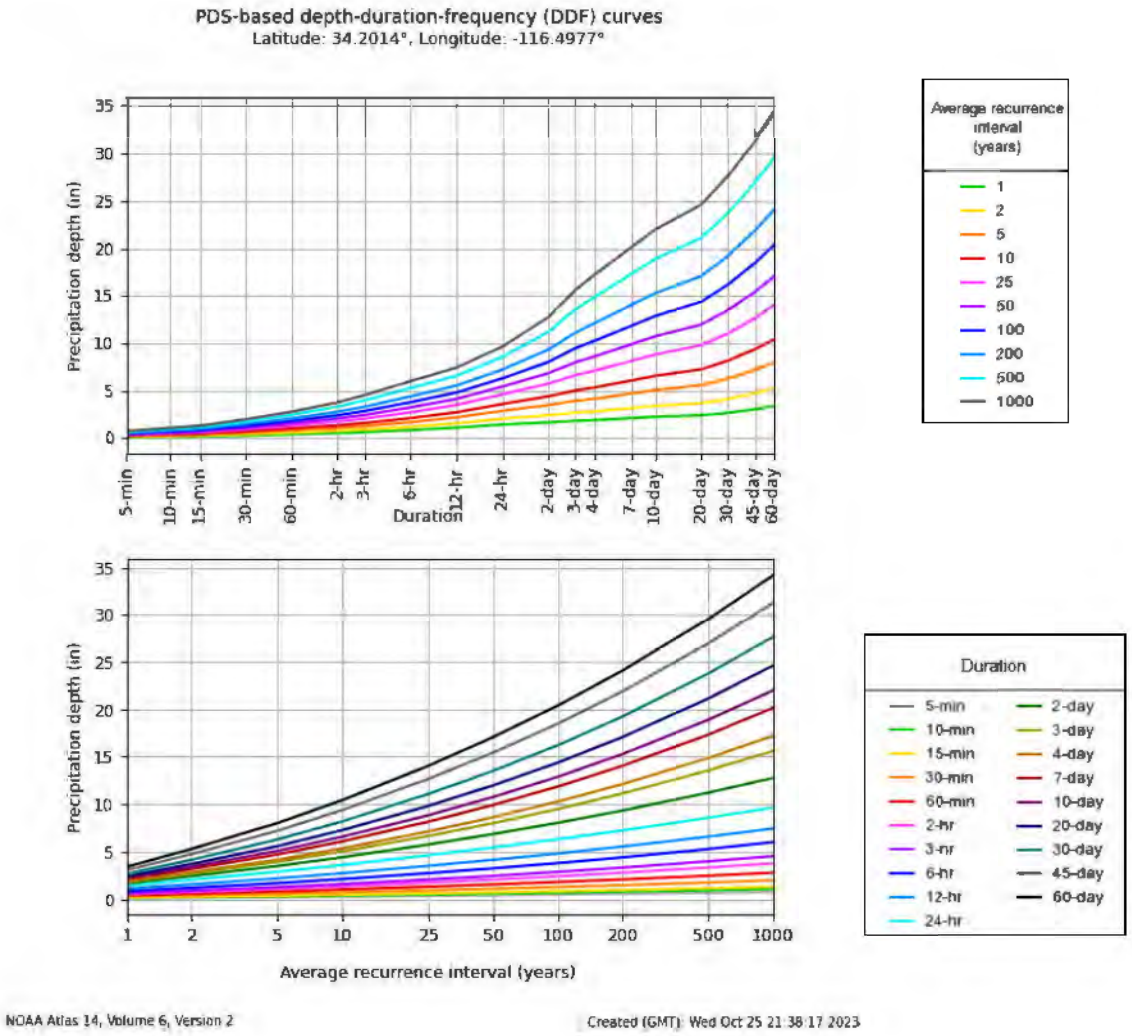
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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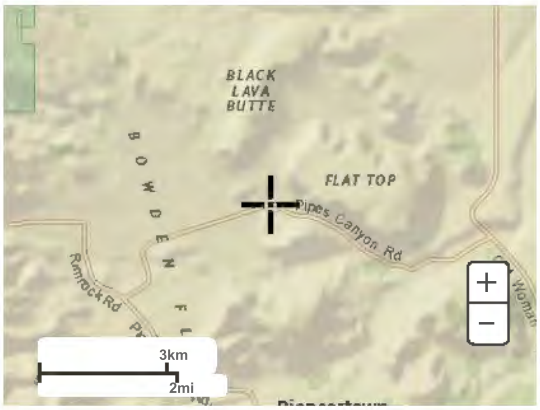
PF graphical



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Maps & aerials

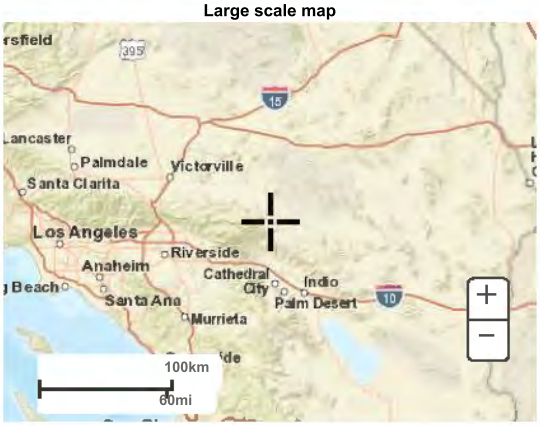
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

APPENDIX “E”

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 10/26/23

0972-002-A
PRE-DEV
WATERSHED 1
TERMINAL NODE 10

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 11.000 to Point/Station 10.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 199.690(Ft.)
Top (of initial area) elevation = 4166.000(Ft.)
Bottom (of initial area) elevation = 4136.000(Ft.)
Difference in elevation = 30.000(Ft.)
Slope = 0.15023 s(%)= 15.02
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 6.382 min.

Rainfall intensity = 8.736(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.894
Subarea runoff = 6.211(CFS)
Total initial stream area = 0.795(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 0.80 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 10/26/23

0972-002-A
PRE-DEV
WATERSHED 2
TERMINAL NODE 20

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 21.000 to Point/Station 20.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 287.310(Ft.)
Top (of initial area) elevation = 4168.000(Ft.)
Bottom (of initial area) elevation = 4140.000(Ft.)
Difference in elevation = 28.000(Ft.)
Slope = 0.09746 s(%)= 9.75
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.049 min.

Rainfall intensity = 7.426(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff = 9.990(CFS)
Total initial stream area = 1.506(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 1.51 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 10/26/23

0972-002-A
PRE-DEV
WATERSHED 3
TERMINAL NODE 30

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 31.000 to Point/Station 30.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 90.180(Ft.)
Top (of initial area) elevation = 4168.000(Ft.)
Bottom (of initial area) elevation = 4153.850(Ft.)
Difference in elevation = 14.150(Ft.)
Slope = 0.15691 s(%)= 15.69
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 4.603 min.

Rainfall intensity = 10.981(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.895
Subarea runoff = 3.038(CFS)
Total initial stream area = 0.309(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 0.31 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/21/25

0972-002-A
PRE-DEV
WATERSHED 4
TERMINAL NODE 40

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++
Process from Point/Station 42.000 to Point/Station 41.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 973.350(Ft.)
Top (of initial area) elevation = 4168.000(Ft.)
Bottom (of initial area) elevation = 4124.000(Ft.)
Difference in elevation = 44.000(Ft.)
Slope = 0.04520 s(%)= 4.52
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 15.291 min.

```
Rainfall intensity =      4.739(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.889
Subarea runoff =     19.074(CFS)
Total initial stream area =        4.525(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.055(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       41.000 to Point/Station       40.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.385(Ft.), Average velocity =   1.892(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              1.48
        2             35.97              0.64
        3             41.17              0.48
        4             48.87              0.34
        5             65.15              0.16
        6             83.95              0.03
        7             98.22              0.00
        8            119.00              0.20
        9            136.69              0.73
        10            154.50              1.06
        11            162.11              1.48
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     36.834(CFS)
  '     '        flow top width =     78.768(Ft.)
  '     '    velocity=    1.892(Ft/s)
  '     '        area =     19.468(Sq.Ft)
  '     '        Froude number =     0.671

Upstream point elevation =  4124.000(Ft.)
Downstream point elevation =  4102.000(Ft.)
Flow length =   841.900(Ft.)
Travel time  =    7.42 min.
Time of concentration =   22.71 min.
Depth of flow =   0.385(Ft.)
Average velocity =   1.892(Ft/s)
Total irregular channel flow =    36.834(CFS)
Irregular channel normal depth above invert elev. =   0.385(Ft.)
Average velocity of channel(s) =   1.892(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
```

Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Rainfall intensity = 3.593(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.886
Subarea runoff = 35.422(CFS) for 12.591(Ac.)
Total runoff = 54.496(CFS)
Effective area this stream = 17.12(Ac.)
Total Study Area (Main Stream No. 1) = 17.12(Ac.)
Area averaged Fm value = 0.055(In/Hr)
Depth of flow = 0.457(Ft.), Average velocity = 2.145(Ft/s)
End of computations, Total Study Area = 17.12 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/21/25

0972-002-A
PRE-DEV
WATERSHED 5
TERMINAL NODE 50

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 51.000 to Point/Station 50.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 267.580(Ft.)
Top (of initial area) elevation = 4153.000(Ft.)
Bottom (of initial area) elevation = 4135.220(Ft.)
Difference in elevation = 17.780(Ft.)
Slope = 0.06645 s(%)= 6.64
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.446 min.

Rainfall intensity = 7.180(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff = 4.072(CFS)
Total initial stream area = 0.635(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 0.64 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/21/25

0972-002-A
PRE-DEV
WATERSHED 6
TERMINAL NODE 60

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 62.000 to Point/Station 61.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 575.040(Ft.)
Top (of initial area) elevation = 4167.000(Ft.)
Bottom (of initial area) elevation = 4113.100(Ft.)
Difference in elevation = 53.900(Ft.)
Slope = 0.09373 s(%)= 9.37
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 10.707 min.

```
Rainfall intensity =      6.082(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.892
Subarea runoff =     34.873(CFS)
Total initial stream area =        6.430(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.055(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       61.000 to Point/Station       60.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.000(Ft.), Average velocity =   2.951(Ft/s)
!!Warning: Water is above left or right bank elevations
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              1.00
        2              3.59              0.00
        3             12.22              0.00
        4             14.68              0.71
        5             15.74              0.95
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     44.139(CFS)
  '     '        flow top width =     15.740(Ft.)
  '     '    velocity=    3.618(Ft/s)
  '     '        area =     12.198(Sq.Ft)
  '     '        Froude number =     0.724

Information entered for subchannel number 2 :
Point number      'X' coordinate     'Y' coordinate
        1             21.53              0.95
        2             26.99              0.74
        3             29.79              0.59
        4             32.34              0.53
        5             34.35              0.48
        6             34.75              0.47
        7             37.93              0.42
        8             49.57              1.00
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     19.185(CFS)
  '     '        flow top width =     28.040(Ft.)
  '     '    velocity=    2.071(Ft/s)
  '     '        area =      9.263(Sq.Ft)
  '     '        Froude number =     0.635
```

```
Upstream point elevation =  4113.100(Ft.)
Downstream point elevation =  4043.000(Ft.)
Flow length =  2724.980(Ft.)
Travel time  =   15.39 min.
Time of concentration =   26.10 min.
Depth of flow =   1.000(Ft.)
Average velocity =   2.951(Ft/s)
Total irregular channel flow =    63.324(CFS)
Irregular channel normal depth above invert elev. =   1.000(Ft.)
Average velocity of channel(s) =   2.951(Ft/s)
!!Warning: Water is above left or right bank elevations
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
Rainfall intensity =      3.259(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.885
Subarea runoff =     56.837(CFS) for   25.374(Ac.)
Total runoff =     91.711(CFS)
Effective area this stream =       31.80(Ac.)
Total Study Area (Main Stream No. 1) =       31.80(Ac.)
Area averaged Fm value =    0.055(In/Hr)
Depth of flow =   1.122(Ft.), Average velocity =   3.422(Ft/s)
!!Warning: Water is above left or right bank elevations


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       61.000 to Point/Station       60.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     31.804(Ac.)
Runoff from this stream =     91.711(CFS)
Time of concentration =   26.10 min.
Rainfall intensity =     3.259(In/Hr)
Area averaged loss rate (Fm) =    0.0554(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       64.000 to Point/Station       63.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
UNDEVELOPED (poor cover) subarea
```

```
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
Initial subarea data:
Initial area flow distance =   985.000(Ft.)
Top (of initial area) elevation =  4089.560(Ft.)
Bottom (of initial area) elevation =  4063.000(Ft.)
Difference in elevation =    26.560(Ft.)
Slope =    0.02696  s(%)=       2.70
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   17.036 min.
Rainfall intensity =      4.394(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.889
Subarea runoff =     23.980(CFS)
Total initial stream area =        6.142(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.055(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       63.000 to Point/Station       60.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.648(Ft.), Average velocity =   2.377(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              0.87
        2              1.31              0.86
        3              9.19              0.73
        4             20.93              0.00
        5             22.50              0.01
        6             31.81              0.29
        7             41.56              0.32
        8             48.15              0.70
        9             51.28              0.74
        10             93.48              0.75
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     33.546(CFS)
  '     '        flow top width =     36.735(Ft.)
  '     '    velocity=    2.523(Ft/s)
  '     '        area =     13.295(Sq.Ft)
  '     '        Froude number =     0.739
```

```
Information entered for subchannel number 2 :
Point number      'X' coordinate     'Y' coordinate
        1             95.44              0.67
        2             99.55              0.64
        3            103.90              0.33
        4            108.70              0.10
        5            112.09              0.38
        6            120.22              0.74
        7            150.25              0.87
Manning's 'N' friction factor =   0.050
-----------------------------------------------------------------
Sub-Channel flow  =      9.909(CFS)
  '     '        flow top width =     19.667(Ft.)
  '     '    velocity=    1.988(Ft/s)
  '     '        area =      4.983(Sq.Ft)
  '     '        Froude number =     0.696

Upstream point elevation =  4063.000(Ft.)
Downstream point elevation =  4043.000(Ft.)
Flow length =   694.570(Ft.)
Travel time  =    4.87 min.
Time of concentration =   21.91 min.
Depth of flow =   0.648(Ft.)
Average velocity =   2.377(Ft/s)
Total irregular channel flow =    43.455(CFS)
Irregular channel normal depth above invert elev. =   0.648(Ft.)
Average velocity of channel(s) =   2.377(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
Rainfall intensity =      3.685(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.886
Subarea runoff =     38.876(CFS) for   13.102(Ac.)
Total runoff =     62.856(CFS)
Effective area this stream =       19.24(Ac.)
Total Study Area (Main Stream No. 1) =       51.05(Ac.)
Area averaged Fm value =    0.055(In/Hr)
Depth of flow =   0.807(Ft.), Average velocity =   1.979(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       63.000 to Point/Station       60.000
```

**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 19.244(Ac.)
Runoff from this stream = 62.856(CFS)
Time of concentration = 21.91 min.
Rainfall intensity = 3.685(In/Hr)
Area averaged loss rate (Fm) = 0.0554(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

Stream No.	Flow rate (CFS)	Area (Ac.)	TC (min)	Fm (In/Hr)	Rainfall Intensity (In/Hr)
1	91.71	31.804	26.10	0.055	3.259
2	62.86	19.244	21.91	0.055	3.685

Qmax(1) =
1.000 * 1.000 * 91.711) +
0.883 * 1.000 * 62.856) + = 147.203
Qmax(2) =
1.133 * 0.839 * 91.711) +
1.000 * 1.000 * 62.856) + = 150.046

Total of 2 streams to confluence:
Flow rates before confluence point:
91.711 62.856
Maximum flow rates at confluence using above data:
147.203 150.046
Area of streams before confluence:
31.804 19.244
Effective area values after confluence:
51.048 45.938
Results of confluence:
Total flow rate = 150.046(CFS)
Time of concentration = 21.905 min.
Effective stream area after confluence = 45.938(Ac.)
Study area average Pervious fraction(Ap) = 1.000
Study area average soil loss rate(Fm) = 0.055(In/Hr)
Study area total (this main stream) = 51.05(Ac.)
End of computations, Total Study Area = 51.05 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/21/25

0972-002-A
PRE-DEV
WATERSHED 7
TERMINAL NODE 70

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 73.000 to Point/Station 72.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 608.240(Ft.)
Top (of initial area) elevation = 4134.000(Ft.)
Bottom (of initial area) elevation = 4089.000(Ft.)
Difference in elevation = 45.000(Ft.)
Slope = 0.07398 s(%)= 7.40
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 11.481 min.

```
Rainfall intensity =      5.792(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.891
Subarea runoff =     22.989(CFS)
Total initial stream area =        4.453(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.055(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       72.000 to Point/Station       71.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.947(Ft.), Average velocity =   3.893(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              6.00
        2             59.15              0.00
        3             65.72              0.00
        4             68.34              0.24
        5            103.54              5.38
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     56.536(CFS)
  '     '        flow top width =     23.369(Ft.)
  '     '    velocity=    3.893(Ft/s)
  '     '        area =     14.522(Sq.Ft)
  '     '        Froude number =     0.870

Upstream point elevation =  4089.000(Ft.)
Downstream point elevation =  4051.390(Ft.)
Flow length =  1155.080(Ft.)
Travel time  =    4.94 min.
Time of concentration =   16.43 min.
Depth of flow =   0.947(Ft.)
Average velocity =   3.893(Ft/s)
Total irregular channel flow =    56.536(CFS)
Irregular channel normal depth above invert elev. =   0.947(Ft.)
Average velocity of channel(s) =   3.893(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
```

```
Rainfall intensity =      4.507(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.889
Subarea runoff =     67.021(CFS) for   18.012(Ac.)
Total runoff =     90.010(CFS)
Effective area this stream =       22.47(Ac.)
Total Study Area (Main Stream No. 1) =       22.47(Ac.)
Area averaged Fm value =    0.055(In/Hr)
Depth of flow =   1.180(Ft.), Average velocity =   4.408(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       72.000 to Point/Station       71.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     22.465(Ac.)
Runoff from this stream =     90.010(CFS)
Time of concentration =   16.43 min.
Rainfall intensity =     4.507(In/Hr)
Area averaged loss rate (Fm) =    0.0554(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       75.000 to Point/Station       74.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
Initial subarea data:
Initial area flow distance =   711.640(Ft.)
Top (of initial area) elevation =  4116.000(Ft.)
Bottom (of initial area) elevation =  4082.000(Ft.)
Difference in elevation =    34.000(Ft.)
Slope =    0.04778  s(%)=       4.78
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   13.342 min.
Rainfall intensity =      5.213(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.890
Subarea runoff =     34.910(CFS)
Total initial stream area =        7.520(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.055(In/Hr)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       74.000 to Point/Station       71.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.740(Ft.), Average velocity =   3.623(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              6.00
        2             15.61              3.00
        3             26.84              2.00
        4             41.74              1.31
        5             49.42              1.00
        6             52.18              0.99
        7             59.26              0.00
        8             70.75              0.00
        9             78.67              1.37
        10           104.16               3.47
        11           123.65               6.00
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     43.614(CFS)
  '     '        flow top width =     21.057(Ft.)
  '     '    velocity=    3.623(Ft/s)
  '     '        area =     12.039(Sq.Ft)
  '     '        Froude number =     0.844

Upstream point elevation =  4082.000(Ft.)
Downstream point elevation =  4051.390(Ft.)
Flow length =   970.470(Ft.)
Travel time  =    4.46 min.
Time of concentration =   17.81 min.
Depth of flow =   0.740(Ft.)
Average velocity =   3.623(Ft/s)
Total irregular channel flow =    43.614(CFS)
Irregular channel normal depth above invert elev. =   0.740(Ft.)
Average velocity of channel(s) =   3.623(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
```

```
Rainfall intensity =      4.260(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.888
Subarea runoff =     17.352(CFS) for    6.292(Ac.)
Total runoff =     52.262(CFS)
Effective area this stream =       13.81(Ac.)
Total Study Area (Main Stream No. 1) =       36.28(Ac.)
Area averaged Fm value =    0.055(In/Hr)
Depth of flow =   0.815(Ft.), Average velocity =   3.824(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       74.000 to Point/Station       71.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =     13.812(Ac.)
Runoff from this stream =     52.262(CFS)
Time of concentration =   17.81 min.
Rainfall intensity =     4.260(In/Hr)
Area averaged loss rate (Fm) =    0.0554(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

Stream Flow rate    Area    TC     Fm       Rainfall Intensity
 No.    (CFS)   (Ac.)       (min) (In/Hr)     (In/Hr)


1     90.01    22.465     16.43    0.055      4.507
2     52.26    13.812     17.81    0.055      4.260
Qmax(1) =
           1.000 *    1.000 *    90.010) +
           1.059 *    0.922 *    52.262) + =     141.058
Qmax(2) =
           0.944 *    1.000 *    90.010) +
           1.000 *    1.000 *    52.262) + =     137.265

Total of 2 streams to confluence:
Flow rates before confluence point:
      90.010      52.262
Maximum flow rates at confluence using above data:
      141.058      137.265
Area of streams before confluence:
       22.465       13.812
Effective area values after confluence:
       35.206       36.277
Results of confluence:
Total flow rate =    141.058(CFS)
Time of concentration =    16.426 min.
Effective stream area after confluence =     35.206(Ac.)
```

```
Study area average Pervious fraction(Ap) =  1.000
Study area average soil loss rate(Fm) =    0.055(In/Hr)
Study area total (this main stream) =      36.28(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       71.000 to Point/Station       70.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.684(Ft.), Average velocity =   2.624(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              3.04
        2              6.61              2.07
        3             17.26              1.07
        4             30.67              0.28
        5             38.50              0.07
        6             47.98              0.00
        7             66.71              0.07
        8            102.00              0.61
        9            112.77              0.64
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     96.309(CFS)
  '     '        flow top width =     88.965(Ft.)
  '     '    velocity=    2.639(Ft/s)
  '     '        area =     36.491(Sq.Ft)
  '     '        Froude number =     0.726

Information entered for subchannel number 2 :
Point number      'X' coordinate     'Y' coordinate
        1            135.02              0.36
        2            160.04              0.24
        3            165.94              0.07
        4            169.49              0.07
        5            189.76              1.07
        6            199.09              1.89
        7            212.67              4.72
        8            214.46              5.07
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     48.620(CFS)
  '     '        flow top width =     46.924(Ft.)
  '     '    velocity=    2.593(Ft/s)
  '     '        area =     18.749(Sq.Ft)
  '     '        Froude number =     0.723
```

```
Upstream point elevation =  4051.390(Ft.)
Downstream point elevation =  4043.000(Ft.)
Flow length =   324.070(Ft.)
Travel time  =    2.06 min.
Time of concentration =   18.48 min.
Depth of flow =   0.684(Ft.)
Average velocity =   2.624(Ft/s)
Total irregular channel flow =   144.929(CFS)
Irregular channel normal depth above invert elev. =   0.684(Ft.)
Average velocity of channel(s) =   2.624(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
Rainfall intensity =      4.150(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.888
Subarea runoff =      7.684(CFS) for    5.160(Ac.)
Total runoff =    148.743(CFS)
Effective area this stream =       40.37(Ac.)
Total Study Area (Main Stream No. 1) =       41.44(Ac.)
Area averaged Fm value =    0.055(In/Hr)
Depth of flow =   0.691(Ft.), Average velocity =   2.649(Ft/s)
End of computations, Total Study Area =           41.44 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  86.0
```

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/21/25

0972-002-A
PRE-DEV
WATERSHED 8
TERMINAL NODE 80

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 81.000 to Point/Station 80.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 354.280(Ft.)
Top (of initial area) elevation = 4118.000(Ft.)
Bottom (of initial area) elevation = 4096.130(Ft.)
Difference in elevation = 21.870(Ft.)
Slope = 0.06173 s(%)= 6.17
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 9.590 min.

Rainfall intensity = 6.569(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.892
Subarea runoff = 11.362(CFS)
Total initial stream area = 1.938(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 1.94 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

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Rational Hydrology Study Date: 04/21/25

0972-002-A
PRE-DEV
WATERSHED 9
TERMINAL NODE 90

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 91.000 to Point/Station 90.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 371.680(Ft.)
Top (of initial area) elevation = 4076.940(Ft.)
Bottom (of initial area) elevation = 4043.910(Ft.)
Difference in elevation = 33.030(Ft.)
Slope = 0.08887 s(%)= 8.89
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 9.088 min.

Rainfall intensity = 6.821(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff = 5.383(CFS)
Total initial stream area = 0.884(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 0.88 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/21/25

0972-002-A
PRE-DEV
WATERSHED 10
TERMINAL NODE 100

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 101.000 to Point/Station 100.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 410.110(Ft.)
Top (of initial area) elevation = 4099.000(Ft.)
Bottom (of initial area) elevation = 4045.950(Ft.)
Difference in elevation = 53.050(Ft.)
Slope = 0.12936 s(%)= 12.94
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.769 min.

Rainfall intensity = 6.994(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff = 8.480(CFS)
Total initial stream area = 1.358(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 1.36 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/21/25

0972-002-A
PRE-DEV
WATERSHED 11
TERMINAL NODE 110

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 111.000 to Point/Station 110.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 299.260(Ft.)
Top (of initial area) elevation = 4109.330(Ft.)
Bottom (of initial area) elevation = 4060.120(Ft.)
Difference in elevation = 49.210(Ft.)
Slope = 0.16444 s(%)= 16.44
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 7.368 min.

Rainfall intensity = 7.900(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.894
Subarea runoff = 4.476(CFS)
Total initial stream area = 0.634(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 0.63 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/21/25

0972-002-A
PRE-DEV
WATERSHED 12
TERMINAL NODE 120

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 121.000 to Point/Station 120.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 400.140(Ft.)
Top (of initial area) elevation = 4122.000(Ft.)
Bottom (of initial area) elevation = 4064.000(Ft.)
Difference in elevation = 58.000(Ft.)
Slope = 0.14495 s(%)= 14.49
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.488 min.

Rainfall intensity = 7.155(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff = 12.045(CFS)
Total initial stream area = 1.885(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 1.89 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/21/25

0972-002-A
PRE-DEV
WATERSHED 13
TERMINAL NODE 130

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 131.000 to Point/Station 130.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 379.460(Ft.)
Top (of initial area) elevation = 4131.000(Ft.)
Bottom (of initial area) elevation = 4073.160(Ft.)
Difference in elevation = 57.840(Ft.)
Slope = 0.15243 s(%)= 15.24
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.226 min.

Rainfall intensity = 7.314(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff = 6.604(CFS)
Total initial stream area = 1.011(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 1.01 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

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0972-002-A
PRE-DEV
WATERSHED 14
TERMINAL NODE 140

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 141.000 to Point/Station 140.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 605.350(Ft.)
Top (of initial area) elevation = 4120.000(Ft.)
Bottom (of initial area) elevation = 4073.000(Ft.)
Difference in elevation = 47.000(Ft.)
Slope = 0.07764 s(%)= 7.76
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 11.349 min.

Rainfall intensity = 5.839(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.891
Subarea runoff = 12.560(CFS)
Total initial stream area = 2.413(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 2.41 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

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Rational Hydrology Study Date: 12/12/23

0972-002-A
POST-DEV
WATERSHED 1
TERMINAL NODE 10

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 11.000 to Point/Station 10.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 199.690(Ft.)
Top (of initial area) elevation = 4166.000(Ft.)
Bottom (of initial area) elevation = 4136.000(Ft.)
Difference in elevation = 30.000(Ft.)
Slope = 0.15023 s(%)= 15.02
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 6.382 min.

Rainfall intensity = 8.736(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.894
Subarea runoff = 6.211(CFS)
Total initial stream area = 0.795(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 0.80 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

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Rational Hydrology Study Date: 12/12/23

0972-002-A
POST-DEV
WATERSHED 2
TERMINAL NODE 20

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 21.000 to Point/Station 20.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 287.310(Ft.)
Top (of initial area) elevation = 4168.000(Ft.)
Bottom (of initial area) elevation = 4140.000(Ft.)
Difference in elevation = 28.000(Ft.)
Slope = 0.09746 s(%)= 9.75
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.049 min.

Rainfall intensity = 7.426(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff = 9.990(CFS)
Total initial stream area = 1.506(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 1.51 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

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0972-002-A
POST-DEV
WATERSHED 3
TERMINAL NODE 30

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 31.000 to Point/Station 0.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 90.180(Ft.)
Top (of initial area) elevation = 4168.000(Ft.)
Bottom (of initial area) elevation = 4153.850(Ft.)
Difference in elevation = 14.150(Ft.)
Slope = 0.15691 s(%)= 15.69
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 4.603 min.

Rainfall intensity = 10.981(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.895
Subarea runoff = 3.038(CFS)
Total initial stream area = 0.309(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 0.31 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

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0972-002
POST-DEV
SUBAREA 4
TERMINAL NODE 40

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 42.000 to Point/Station 41.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 973.350(Ft.)
Top (of initial area) elevation = 4168.000(Ft.)
Bottom (of initial area) elevation = 4124.000(Ft.)
Difference in elevation = 44.000(Ft.)
Slope = 0.04520 s(%)= 4.52
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 15.291 min.

```
Rainfall intensity =      4.739(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.889
Subarea runoff =     19.074(CFS)
Total initial stream area =        4.525(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.055(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       41.000 to Point/Station       40.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.385(Ft.), Average velocity =   1.892(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              1.48
        2             35.97              0.64
        3             41.17              0.48
        4             48.87              0.34
        5             65.15              0.16
        6             83.95              0.03
        7             98.22              0.00
        8            119.00              0.20
        9            136.69              0.73
        10            154.50              1.06
        11            162.11              1.48
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     36.834(CFS)
  '     '        flow top width =     78.768(Ft.)
  '     '    velocity=    1.892(Ft/s)
  '     '        area =     19.468(Sq.Ft)
  '     '        Froude number =     0.671

Upstream point elevation =  4124.000(Ft.)
Downstream point elevation =  4102.000(Ft.)
Flow length =   841.900(Ft.)
Travel time  =    7.42 min.
Time of concentration =   22.71 min.
Depth of flow =   0.385(Ft.)
Average velocity =   1.892(Ft/s)
Total irregular channel flow =    36.834(CFS)
Irregular channel normal depth above invert elev. =   0.385(Ft.)
Average velocity of channel(s) =   1.892(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
```

Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Rainfall intensity = 3.593(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.886
Subarea runoff = 35.422(CFS) for 12.591(Ac.)
Total runoff = 54.496(CFS)
Effective area this stream = 17.12(Ac.)
Total Study Area (Main Stream No. 1) = 17.12(Ac.)
Area averaged Fm value = 0.055(In/Hr)
Depth of flow = 0.457(Ft.), Average velocity = 2.145(Ft/s)
End of computations, Total Study Area = 17.12 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

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0972-002-A
POST-DEV
WATERSHED 5
TERMINAL NODE 50

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 51.000 to Point/Station 50.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 267.580(Ft.)
Top (of initial area) elevation = 4153.000(Ft.)
Bottom (of initial area) elevation = 4135.220(Ft.)
Difference in elevation = 17.780(Ft.)
Slope = 0.06645 s(%)= 6.64
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.446 min.

Rainfall intensity = 7.180(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff = 4.072(CFS)
Total initial stream area = 0.635(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 0.64 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

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0972-002-A
POST-DEV
WATERSHED 6
TERMINAL NODE 60

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 62.000 to Point/Station 61.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 575.040(Ft.)
Top (of initial area) elevation = 4167.000(Ft.)
Bottom (of initial area) elevation = 4113.100(Ft.)
Difference in elevation = 53.900(Ft.)
Slope = 0.09373 s(%)= 9.37
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 10.707 min.

```
Rainfall intensity =      6.082(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.892
Subarea runoff =     34.873(CFS)
Total initial stream area =        6.430(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.055(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       61.000 to Point/Station       60.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.000(Ft.), Average velocity =   2.948(Ft/s)
!!Warning: Water is above left or right bank elevations
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              1.00
        2              3.59              0.00
        3             12.22              0.00
        4             14.68              0.71
        5             15.74              0.95
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     44.103(CFS)
  '     '        flow top width =     15.740(Ft.)
  '     '    velocity=    3.615(Ft/s)
  '     '        area =     12.199(Sq.Ft)
  '     '        Froude number =     0.724

Information entered for subchannel number 2 :
Point number      'X' coordinate     'Y' coordinate
        1             21.53              0.95
        2             26.99              0.74
        3             29.79              0.59
        4             32.34              0.53
        5             34.35              0.48
        6             34.75              0.47
        7             37.93              0.42
        8             49.57              1.00
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     19.171(CFS)
  '     '        flow top width =     28.040(Ft.)
  '     '    velocity=    2.069(Ft/s)
  '     '        area =      9.264(Sq.Ft)
  '     '        Froude number =     0.634
```

```
Upstream point elevation =  4113.100(Ft.)
Downstream point elevation =  4043.000(Ft.)
Flow length =  2729.810(Ft.)
Travel time  =   15.43 min.
Time of concentration =   26.14 min.
Depth of flow =   1.000(Ft.)
Average velocity =   2.948(Ft/s)
Total irregular channel flow =    63.274(CFS)
Irregular channel normal depth above invert elev. =   1.000(Ft.)
Average velocity of channel(s) =   2.948(Ft/s)
!!Warning: Water is above left or right bank elevations
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
Rainfall intensity =      3.256(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.885
Subarea runoff =     56.737(CFS) for   25.374(Ac.)
Total runoff =     91.610(CFS)
Effective area this stream =       31.80(Ac.)
Total Study Area (Main Stream No. 1) =       31.80(Ac.)
Area averaged Fm value =    0.055(In/Hr)
Depth of flow =   1.122(Ft.), Average velocity =   3.418(Ft/s)
!!Warning: Water is above left or right bank elevations


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       61.000 to Point/Station       60.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     31.804(Ac.)
Runoff from this stream =     91.610(CFS)
Time of concentration =   26.14 min.
Rainfall intensity =     3.256(In/Hr)
Area averaged loss rate (Fm) =    0.0554(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       64.000 to Point/Station       63.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
UNDEVELOPED (poor cover) subarea
```

```
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
Initial subarea data:
Initial area flow distance =   985.320(Ft.)
Top (of initial area) elevation =  4089.560(Ft.)
Bottom (of initial area) elevation =  4063.000(Ft.)
Difference in elevation =    26.560(Ft.)
Slope =    0.02696  s(%)=       2.70
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   17.040 min.
Rainfall intensity =      4.393(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.889
Subarea runoff =     23.977(CFS)
Total initial stream area =        6.142(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.055(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       63.000 to Point/Station       60.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.646(Ft.), Average velocity =   2.383(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              0.87
        2              1.31              0.86
        3              9.19              0.73
        4             20.93              0.00
        5             22.50              0.00
        6             31.81              0.29
        7             41.56              0.32
        8             48.15              0.70
        9             51.28              0.74
        10             93.48              0.75
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     33.566(CFS)
  '     '        flow top width =     36.679(Ft.)
  '     '    velocity=    2.526(Ft/s)
  '     '        area =     13.287(Sq.Ft)
  '     '        Froude number =     0.740
```

```
Information entered for subchannel number 2 :
Point number      'X' coordinate     'Y' coordinate
        1             95.44              0.67
        2             99.55              0.64
        3            103.90              0.33
        4            108.70              0.10
        5            112.09              0.38
        6            120.22              0.74
        7            150.25              0.87
Manning's 'N' friction factor =   0.050
-----------------------------------------------------------------
Sub-Channel flow  =      9.896(CFS)
  '     '        flow top width =     19.397(Ft.)
  '     '    velocity=    1.999(Ft/s)
  '     '        area =      4.950(Sq.Ft)
  '     '        Froude number =     0.697

Upstream point elevation =  4063.000(Ft.)
Downstream point elevation =  4043.000(Ft.)
Flow length =   694.570(Ft.)
Travel time  =    4.86 min.
Time of concentration =   21.90 min.
Depth of flow =   0.646(Ft.)
Average velocity =   2.383(Ft/s)
Total irregular channel flow =    43.461(CFS)
Irregular channel normal depth above invert elev. =   0.646(Ft.)
Average velocity of channel(s) =   2.383(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
Rainfall intensity =      3.686(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.886
Subarea runoff =     38.896(CFS) for   13.102(Ac.)
Total runoff =     62.873(CFS)
Effective area this stream =       19.24(Ac.)
Total Study Area (Main Stream No. 1) =       51.05(Ac.)
Area averaged Fm value =    0.055(In/Hr)
Depth of flow =   0.806(Ft.), Average velocity =   1.980(Ft/s)


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Process from Point/Station       63.000 to Point/Station       60.000
```

**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 19.244(Ac.)
Runoff from this stream = 62.873(CFS)
Time of concentration = 21.90 min.
Rainfall intensity = 3.686(In/Hr)
Area averaged loss rate (Fm) = 0.0554(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

Stream No.	Flow rate (CFS)	Area (Ac.)	TC (min)	Fm (In/Hr)	Rainfall Intensity (In/Hr)
1	91.61	31.804	26.14	0.055	3.256
2	62.87	19.244	21.90	0.055	3.686

Qmax(1) =
1.000 * 1.000 * 91.610) +
0.882 * 1.000 * 62.873) + = 147.042
Qmax(2) =
1.134 * 0.838 * 91.610) +
1.000 * 1.000 * 62.873) + = 149.919

Total of 2 streams to confluence:
Flow rates before confluence point:
91.610 62.873
Maximum flow rates at confluence using above data:
147.042 149.919
Area of streams before confluence:
31.804 19.244
Effective area values after confluence:
51.048 45.887
Results of confluence:
Total flow rate = 149.919(CFS)
Time of concentration = 21.897 min.
Effective stream area after confluence = 45.887(Ac.)
Study area average Pervious fraction(Ap) = 1.000
Study area average soil loss rate(Fm) = 0.055(In/Hr)
Study area total (this main stream) = 51.05(Ac.)
End of computations, Total Study Area = 51.05 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

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Rational Hydrology Study Date: 04/24/25

0972-002-A
POST-DEV
WATERSHED 7
TERMINAL NODE 70

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.280(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.280 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 73.000 to Point/Station 72.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 608.240(Ft.)
Top (of initial area) elevation = 4134.000(Ft.)
Bottom (of initial area) elevation = 4089.000(Ft.)
Difference in elevation = 45.000(Ft.)
Slope = 0.07398 s(%)= 7.40
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 11.481 min.

```
Rainfall intensity =      5.792(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.891
Subarea runoff =     22.989(CFS)
Total initial stream area =        4.453(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.055(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       72.000 to Point/Station       71.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.947(Ft.), Average velocity =   3.893(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              6.00
        2             59.15              0.00
        3             65.72              0.00
        4             68.34              0.24
        5            103.54              5.38
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     56.536(CFS)
  '     '        flow top width =     23.369(Ft.)
  '     '    velocity=    3.893(Ft/s)
  '     '        area =     14.522(Sq.Ft)
  '     '        Froude number =     0.870

Upstream point elevation =  4089.000(Ft.)
Downstream point elevation =  4051.390(Ft.)
Flow length =  1155.080(Ft.)
Travel time  =    4.94 min.
Time of concentration =   16.43 min.
Depth of flow =   0.947(Ft.)
Average velocity =   3.893(Ft/s)
Total irregular channel flow =    56.536(CFS)
Irregular channel normal depth above invert elev. =   0.947(Ft.)
Average velocity of channel(s) =   3.893(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
```

```
Rainfall intensity =      4.507(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.889
Subarea runoff =     67.021(CFS) for   18.012(Ac.)
Total runoff =     90.010(CFS)
Effective area this stream =       22.47(Ac.)
Total Study Area (Main Stream No. 1) =       22.47(Ac.)
Area averaged Fm value =    0.055(In/Hr)
Depth of flow =   1.180(Ft.), Average velocity =   4.408(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       72.000 to Point/Station       71.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     22.465(Ac.)
Runoff from this stream =     90.010(CFS)
Time of concentration =   16.43 min.
Rainfall intensity =     4.507(In/Hr)
Area averaged loss rate (Fm) =    0.0554(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       75.000 to Point/Station       74.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
Initial subarea data:
Initial area flow distance =   711.640(Ft.)
Top (of initial area) elevation =  4116.000(Ft.)
Bottom (of initial area) elevation =  4082.000(Ft.)
Difference in elevation =    34.000(Ft.)
Slope =    0.04778  s(%)=       4.78
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   13.342 min.
Rainfall intensity =      5.213(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.890
Subarea runoff =     34.910(CFS)
Total initial stream area =        7.520(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.055(In/Hr)
```

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Process from Point/Station       74.000 to Point/Station       71.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.740(Ft.), Average velocity =   3.623(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              6.00
        2             15.61              3.00
        3             26.84              2.00
        4             41.74              1.31
        5             49.42              1.00
        6             52.18              0.99
        7             59.26              0.00
        8             70.75              0.00
        9             78.67              1.37
        10           104.16               3.47
        11           123.65               6.00
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     43.614(CFS)
  '     '        flow top width =     21.057(Ft.)
  '     '    velocity=    3.623(Ft/s)
  '     '        area =     12.039(Sq.Ft)
  '     '        Froude number =     0.844

Upstream point elevation =  4082.000(Ft.)
Downstream point elevation =  4051.390(Ft.)
Flow length =   970.470(Ft.)
Travel time  =    4.46 min.
Time of concentration =   17.81 min.
Depth of flow =   0.740(Ft.)
Average velocity =   3.623(Ft/s)
Total irregular channel flow =    43.614(CFS)
Irregular channel normal depth above invert elev. =   0.740(Ft.)
Average velocity of channel(s) =   3.623(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
```

```
Rainfall intensity =      4.260(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.888
Subarea runoff =     17.352(CFS) for    6.292(Ac.)
Total runoff =     52.262(CFS)
Effective area this stream =       13.81(Ac.)
Total Study Area (Main Stream No. 1) =       36.28(Ac.)
Area averaged Fm value =    0.055(In/Hr)
Depth of flow =   0.815(Ft.), Average velocity =   3.824(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       74.000 to Point/Station       71.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =     13.812(Ac.)
Runoff from this stream =     52.262(CFS)
Time of concentration =   17.81 min.
Rainfall intensity =     4.260(In/Hr)
Area averaged loss rate (Fm) =    0.0554(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

Stream Flow rate    Area    TC     Fm       Rainfall Intensity
 No.    (CFS)   (Ac.)       (min) (In/Hr)     (In/Hr)


1     90.01    22.465     16.43    0.055      4.507
2     52.26    13.812     17.81    0.055      4.260
Qmax(1) =
           1.000 *    1.000 *    90.010) +
           1.059 *    0.922 *    52.262) + =     141.058
Qmax(2) =
           0.944 *    1.000 *    90.010) +
           1.000 *    1.000 *    52.262) + =     137.265

Total of 2 streams to confluence:
Flow rates before confluence point:
      90.010      52.262
Maximum flow rates at confluence using above data:
      141.058      137.265
Area of streams before confluence:
       22.465       13.812
Effective area values after confluence:
       35.206       36.277
Results of confluence:
Total flow rate =    141.058(CFS)
Time of concentration =    16.426 min.
Effective stream area after confluence =     35.206(Ac.)
```

```
Study area average Pervious fraction(Ap) =  1.000
Study area average soil loss rate(Fm) =    0.055(In/Hr)
Study area total (this main stream) =      36.28(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       71.000 to Point/Station       70.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.684(Ft.), Average velocity =   2.624(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              3.04
        2              6.61              2.07
        3             17.26              1.07
        4             30.67              0.28
        5             38.50              0.07
        6             47.98              0.00
        7             66.71              0.07
        8            102.00              0.61
        9            112.77              0.64
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     96.309(CFS)
  '     '        flow top width =     88.965(Ft.)
  '     '    velocity=    2.639(Ft/s)
  '     '        area =     36.491(Sq.Ft)
  '     '        Froude number =     0.726

Information entered for subchannel number 2 :
Point number      'X' coordinate     'Y' coordinate
        1            135.02              0.36
        2            160.04              0.24
        3            165.94              0.07
        4            169.49              0.07
        5            189.76              1.07
        6            199.09              1.89
        7            212.67              4.72
        8            214.46              5.07
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     48.620(CFS)
  '     '        flow top width =     46.924(Ft.)
  '     '    velocity=    2.593(Ft/s)
  '     '        area =     18.749(Sq.Ft)
  '     '        Froude number =     0.723
```

```
Upstream point elevation =  4051.390(Ft.)
Downstream point elevation =  4043.000(Ft.)
Flow length =   324.070(Ft.)
Travel time  =    2.06 min.
Time of concentration =   18.48 min.
Depth of flow =   0.684(Ft.)
Average velocity =   2.624(Ft/s)
Total irregular channel flow =   144.929(CFS)
Irregular channel normal depth above invert elev. =   0.684(Ft.)
Average velocity of channel(s) =   2.624(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
Rainfall intensity =      4.150(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.888
Subarea runoff =      7.684(CFS) for    5.160(Ac.)
Total runoff =    148.743(CFS)
Effective area this stream =       40.37(Ac.)
Total Study Area (Main Stream No. 1) =       41.44(Ac.)
Area averaged Fm value =    0.055(In/Hr)
Depth of flow =   0.691(Ft.), Average velocity =   2.649(Ft/s)
End of computations, Total Study Area =           41.44 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  86.0
```

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/24/25

0972-002-A
POST-DEV
WATERSHED 8
TERMINAL NODE 80

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 81.000 to Point/Station 80.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 354.280(Ft.)
Top (of initial area) elevation = 4118.000(Ft.)
Bottom (of initial area) elevation = 4096.130(Ft.)
Difference in elevation = 21.870(Ft.)
Slope = 0.06173 s(%)= 6.17
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 9.590 min.

Rainfall intensity = 6.569(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.892
Subarea runoff = 11.362(CFS)
Total initial stream area = 1.938(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 1.94 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

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Rational Hydrology Study Date: 04/24/25

0972-002-A
POST-DEV
WATERSHED 9
TERMINAL NODE 90

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 91.000 to Point/Station 90.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 371.680(Ft.)
Top (of initial area) elevation = 4076.940(Ft.)
Bottom (of initial area) elevation = 4043.910(Ft.)
Difference in elevation = 33.030(Ft.)
Slope = 0.08887 s(%)= 8.89
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 9.088 min.

Rainfall intensity = 6.821(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff = 5.383(CFS)
Total initial stream area = 0.884(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 0.88 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/24/25

0972-002-A
POST-DEV
WATERSHED 10
TERMINAL NODE 100

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 101.000 to Point/Station 100.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 410.000(Ft.)
Top (of initial area) elevation = 4099.000(Ft.)
Bottom (of initial area) elevation = 4045.950(Ft.)
Difference in elevation = 53.050(Ft.)
Slope = 0.12939 s(%)= 12.94
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.768 min.

Rainfall intensity = 6.994(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff = 8.480(CFS)
Total initial stream area = 1.358(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 1.36 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

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Rational Hydrology Study Date: 04/24/25

0972-002-A
POST-DEV
WATERSHED 11
TERMINAL NODE 110

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 111.000 to Point/Station 110.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 299.260(Ft.)
Top (of initial area) elevation = 4109.330(Ft.)
Bottom (of initial area) elevation = 4060.120(Ft.)
Difference in elevation = 49.210(Ft.)
Slope = 0.16444 s(%)= 16.44
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 7.368 min.

Rainfall intensity = 7.900(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.894
Subarea runoff = 4.476(CFS)
Total initial stream area = 0.634(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 0.63 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/24/25

0972-002-A
POST-DEV
WATERSHED 12
TERMINAL NODE 120

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 121.000 to Point/Station 120.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 400.140(Ft.)
Top (of initial area) elevation = 4122.000(Ft.)
Bottom (of initial area) elevation = 4064.000(Ft.)
Difference in elevation = 58.000(Ft.)
Slope = 0.14495 s(%)= 14.49
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.488 min.

Rainfall intensity = 7.155(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff = 12.045(CFS)
Total initial stream area = 1.885(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 1.89 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/24/25

0972-002-A
POST-DEV
WATERSHED 13
TERMINAL NODE 130

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 131.000 to Point/Station 130.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 379.460(Ft.)
Top (of initial area) elevation = 4131.000(Ft.)
Bottom (of initial area) elevation = 4073.160(Ft.)
Difference in elevation = 57.840(Ft.)
Slope = 0.15243 s(%)= 15.24
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.226 min.

Rainfall intensity = 7.314(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff = 6.604(CFS)
Total initial stream area = 1.011(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 1.01 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/24/25

0972-002-A
POST-DEV
WATERSHED 14
TERMINAL NODE 140

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 141.000 to Point/Station 140.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 605.350(Ft.)
Top (of initial area) elevation = 4120.000(Ft.)
Bottom (of initial area) elevation = 4073.000(Ft.)
Difference in elevation = 47.000(Ft.)
Slope = 0.07764 s(%)= 7.76
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 11.349 min.

Rainfall intensity = 5.839(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.891
Subarea runoff = 12.560(CFS)
Total initial stream area = 2.413(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 2.41 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

Appendix E.2

Water Quality Management Plan

PRELIMINARY WATER QUALITY MANAGEMENT PLAN

(PWQMP)

Tentative Tract 20612

Pipes Canyon Road

In Pioneertown, in San Bernardino County

Prepared for:
Jonathan Shokrian
53252 Pipes Canyon Road
Pioneertown, CA 92286

Prepared By:
Everest Environmental, Inc
6297 East Avenue
Rancho Cucamonga, CA 91739

EVEREST ENVIRONMENTAL

Water Quality Management Plan

For:

Tentative Tract Map 20612

PIPES CANYON ROAD

IN PIONEERTOWN, IN SAN BERNARDINO COUNTY

Prepared for:

Jonathan Shokrian

53252 Pipes Canyon Road

Pioneertown, CA 92286

Prepared by:

Everest Environmental, Inc.

6297 East Avenue

Rancho Cucamonga, CA 91739

(909) 957-4239

Submittal Date: 08/11/2025

Revision Date: N/A

Approval Date:_____

Project Owner's Certification

This Water Quality Management Plan (WQMP) has been prepared for Johnathan Shokrian by Everest Environmental, Inc. The WQMP is intended to comply with the requirements of the County of San Bernardino and the NPDES Areawide Stormwater Program requiring the preparation of a WQMP. The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with San Bernardino County's Municipal Storm Water Management Program and the intent of the NPDES Permit for San Bernardino County and the incorporated cities of San Bernardino County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors in interest and the city/county shall be notified of the transfer. The new owner will be informed of its responsibility under this WQMP. A copy of the approved WQMP shall be available on the subject site in perpetuity.

"I certify under a penalty of law that the provisions (implementation, operation, maintenance, and funding) of the WQMP have been accepted and that the plan will be transferred to future successors."

.

Project Data			
Permit/Application Number(s):	PENDING	Grading Permit Number(s):	Pending
Tract/Parcel Map Number(s):	20612	Building Permit Number(s):	Pending
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			0594-351-32 & 33

Owner's Signature			
Owner Name: Johnathan Shokrian			
Title	Owner		
Company	None		
Address	53252 Pipes Canyon Road, Pioneertown, CA 92268		
Email			
Telephone #			
Signature		Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):	Pending	Grading Permit Number(s):	Pending
Tract/Parcel Map Number(s):	20612	Building Permit Number(s):	n/a
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			0594-351-32 & 33

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan were prepared under my oversight and meet the requirements of Regional Water Quality Control Board Order No. R8-2010-0036."

Engineer: Brad Hillwig		PE Stamp Below
Title	RCE	
Company	Hillwig-Goodrow, Inc.	
Address	31419 Outer Highway 10, Suite 1-200	
Email	Brad@hillwig-goodrow.com	
Telephone #	(909)794-2673	
Signature		
Date		

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Section 1 Discretionary Permit(s)

Form 1-1 Project Information

Project Name	Tentative Tract Map 20612 – 12 Lot Subdivision				
Project Owner Contact Name:	Johnathan Shokrian				
Mailing Address:	53252 Pipes Canyon Road, Pioneertown, CA 92268	E-mail Address:	jonathan@meundies.com	Telephone:	310-497-9581
Permit/Application Number(s):	Pending		Tract/Parcel Map Number(s):	20612	
Additional Information/ Comments:	The proposed project is a residential development consisting of twelve (12), 5-acre, single family lots for individual sale. Proposed Tentative Tract 20612 discharges to Pipes Wash. The project site consists of 61.56 acres.				
Description of Project:	This project proposes to create twelve (12) SFR's on undeveloped property. This site is located on Pipes Canyon Road, in Pioneertown, in San Bernardino County. The project site area is bordered by open desert with sparse residences on all sides. The developer intends to create 12 lots, each with a 7,410sf building pad. Each lot is will contain a maximum of 40% impervious surfaces, or 2,964sf. All lots and building pads will be accessed via an open graded, gravel road. Each of the twelve lots will create a Drainage Management Area, with each lot containing an infiltration trench designed to retain and infiltrate the Design Capture Volume (DCV), 300cf, plus the difference in runoff volumes for a 100yr event in compliance with hydromodification controls as discussed/calculated in Appendix E. This site incorporates on-site LID BMPs, to infiltrate the DCV and Hydromodification Flows. Proposed LID BMPs include on-site retention/infiltration basins to intercept full Design Capture Volume from the proposed "on-lot" development. See Attachment in Appendix E for measured Infiltration rates.				
Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.	None				

Section 2 Project Description

2.1 Project Information

This section of the WQMP should provide the information listed below. The information provided for Conceptual/ Preliminary WQMP should give sufficient detail to identify the major proposed site design and LID BMPs and other anticipated water quality features that impact site planning. Final Project WQMP must specifically identify all BMP incorporated into the final site design and provide other detailed information as described herein.

The purpose of this information is to help determine the applicable development category, pollutants of concern, watershed description, and long term maintenance responsibilities for the project, and any applicable water quality credits. This information will be used in conjunction with the information in Section 3, Site Description, to establish the performance criteria and to select the LID BMP or other BMP for the project or other alternative programs that the project will participate in, which are described in Section 4.

Form 2.1-1 Description of Proposed Project

1 Development Category (Select all that apply):

☐ Significant re-development involving the addition or replacement of 5,000 ft² or more of impervious surface on an already developed site	☒ New development involving the creation of 10,000 ft² or more of impervious surface collectively over entire site	☐ Automotive repair shops with standard industrial classification (SIC) codes 5013, 5014, 5541, 7532- 7534, 7536-7539	☐ Restaurants (with SIC code 5812) where the land area of development is 5,000 ft² or more
☐ Hillside developments of 5,000 ft² or more which are located on areas with known erosive soil conditions or where the natural slope is 25 percent or more	☐ Developments of 2,500 ft² of impervious surface or more adjacent to (within 200 ft) or discharging directly into environmentally sensitive areas or waterbodies listed on the CWA Section 303(d) list of impaired waters.	☐ Parking lots of 5,000 ft² or more exposed to storm water	☐ Retail gasoline outlets that are either 5,000 ft² or more, or have a projected average daily traffic of 100 or more vehicles per day

☐ Non-Priority / Non-Category Project *May require source control LID BMPs and other LIP requirements. Please consult with local jurisdiction on specific requirements*.

2 Project Area (ft2):	2,681,858	**3** Number of Dwelling Units:	12	**4** SIC Code:	n/a

5 Is Project going to be phased? Yes ☐ No ☒ *If yes, ensure that the WQMP evaluates each phase as a distinct DA, requiring LID BMPs to address runoff at time of completion.*

6 Does Project include roads? Yes ☐ No ☒ *If yes, ensure that applicable requirements for transportation projects are addressed (see Appendix A of TGD for WQMP)*

2.2 Property Ownership/Management

Describe the ownership/management of all portions of the project and site. State whether any infrastructure will transfer to public agencies (City, County, Caltrans, etc.) after project completion. State if a homeowners or property owners association will be formed and be responsible for the long-term maintenance of project stormwater facilities. Describe any lot-level stormwater features that will be the responsibility of individual property owners.

Form 2.2-1 Property Ownership/Management

Describe property ownership/management responsible for long-term maintenance of WQMP stormwater facilities:

Long term long-term maintenance of WQMP stormwater facilities will be the responsibility of the Lot/Home owner. Owner/Developers will construct and verify each BMP as required through individual plan check processes. Each individual Lot Owner will be required to enter into a Maintenance Covenant with the County of San Bernardino and perform the inspection and maintenance responsibilities as outlined herein.

2.3 Potential Stormwater Pollutants

Determine and describe expected stormwater pollutants of concern based on land uses and site activities (refer to Table 3-3 in the TGD for WQMP).

Form 2.3-1 Pollutants of Concern

Pollutant	Please check: E=Expected, N=Not Expected		Additional Information and Comments
Pathogens (Bacterial / Virus)	E ☒	N ☐	
Nutrients - Phosphorous	E ☒	N ☐	
Nutrients - Nitrogen	E ☒	N ☐	
Noxious Aquatic Plants	E ☐	N ☒	
Sediment	E ☒	N ☐	
Metals	E ☐	N ☒	
Oil and Grease	E ☒	N ☐	
Trash/Debris	E ☒	N ☐	
Pesticides / Herbicides	E ☒	N ☐	
Organic Compounds	E ☐	N ☒	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	

2.4 Water Quality Credits

A water quality credit program is applicable for certain types of development projects if it is not feasible to meet the requirements for on-site LID. Proponents for eligible projects, as described below, can apply for water quality credits that would reduce project obligations for selecting and sizing other treatment BMP or participating in other alternative compliance programs. Refer to Section 6.2 in the TGD for WQMP to determine if water quality credits are applicable for the project.

Form 2.4-1 Water Quality Credits

1 Project Types that Qualify for Water Quality Credits: *Select all that apply*			
☐ Redevelopment projects that reduce the overall impervious footprint of the project site. [Credit = % impervious reduced]	Higher density development projects ☐ Vertical density [20%] ☐ 7 units/ acre [5%]	☐ Mixed use development, (combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that demonstrate environmental benefits not realized through single use projects) [20%]	☐ Brownfield redevelopment (redevelop real property complicated by presence or potential of hazardous contaminants) [25%]
☐ Redevelopment projects in established historic district, historic preservation area, or similar significant core city center areas [10%]	☐ Transit-oriented developments (mixed use residential or commercial area designed to maximize access to public transportation) [20%]	☐ In-fill projects (conversion of empty lots & other underused spaces < 5 acres, substantially surrounded by urban land uses, into more beneficially used spaces, such as residential or commercial areas) [10%]	☐ Live-Work developments (variety of developments designed to support residential and vocational needs) [20%]
2 Total Credit % 10 *(Total all credit percentages up to a maximum allowable credit of 50 percent)*			
Description of Water Quality Credit Eligibility (if applicable)	This project does not qualify for any Water Quality Credits since it can feasibly install LID BMPs		

Section 3 Site and Watershed Description

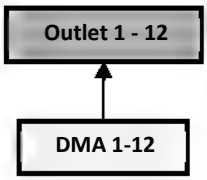
Describe the project site conditions that will facilitate the selection of BMP through an analysis of the physical conditions and limitations of the site and its receiving waters. Identify distinct drainage areas (DA) that collect flow from a portion of the site and describe how runoff from each DA (and sub-watershed DMAs) is conveyed to the site outlet(s). Refer to Section 3.2 in the TGD for WQMP. The form below is provided as an example. Then complete Forms 3.2 and 3.3 for each DA on the project site. ***If the project has more than one drainage area for stormwater management, then complete additional versions of these forms for each DA / outlet.***

Form 3-1 Site Location and Hydrologic Features

Site coordinates *take GPS measurement at approximate center of site*	Latitude 34.199932	Longitude -116.501068	Thomas Bros Map page

1 San Bernardino County climatic region: ☐ Valley ☐ Mountain

2 Does the site have more than one drainage area (DA): Yes☐ No☐ *If no, proceed to Form 3-2. If yes, then use this form to show a conceptual schematic describing DMAs and hydrologic feature connecting DMAs to the site outlet(s). An example is provided below that can be modified for proposed project or a drawing clearly showing DMA and flow routing may be attached*



Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA
DMA 1-12	Each Lot (1-12) will contain an infiltration basin capable of retaining and infiltrating the DCV and Hydromodification Volumes. Any flows in excess will flow out to the Desert via existing, natural drainageways.

Form 3-2 Existing Hydrologic Characteristics for Drainage Area

For Drainage Areas, provide the following characteristics	DA1			
1 DMA drainage area (ft^2)	2,681,858			
2 Existing site impervious area (ft^2)	0			
3 Antecedent moisture condition *For desert areas, use* *http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	n/a			
4 Hydrologic soil group *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	A-C			
5 Longest flowpath length (ft)	3000			
6 Longest flowpath slope (ft/ft)	.04			
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	SPARSE VEGETATION			
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*	POOR			

Form 3-3 Watershed Description for Drainage Area

Receiving waters *Refer to Watershed Mapping Tool - http://permitrack.sbcounty.gov/wap/ See 'Drainage Facilities" link at this website*	PINION CREEK, PIPES CANYON WASH
Applicable TMDLs *Refer to Local Implementation Plan*	NONE
303(d) listed impairments *Refer to Local Implementation Plan and Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/ and State Water Resources Control Board website – http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/index.shtml*	NONE
Environmentally Sensitive Areas (ESA) *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	NONE
Unlined Downstream Water Bodies *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	Pipes Canyon Wash
Hydrologic Conditions of Concern	☒ Yes *Complete Hydrologic Conditions of Concern (HCOC) Assessment. Include Forms 4.2-2 through Form 4.2-5 and Hydromodification BMP Form 4.3-10 in submittal* ☐ No
Watershed–based BMP included in a RWQCB approved WAP	☐ Yes *Attach verification of regional BMP evaluation criteria in WAP* • *More Effective than On-site LID* • *Remaining Capacity for Project DCV* • *Upstream of any Water of the US* • *Operational at Project Completion* • *Long-Term Maintenance Plan* ☒ No

Section 4 Best Management Practices (BMP)

4.1 Source Control BMP

4.1.1 Pollution Prevention

Non-structural and structural source control BMP are required to be incorporated into all new development and significant redevelopment projects. Form 4.1-1 and 4.1-2 are used to describe specific source control BMPs used in the WQMP or to explain why a certain BMP is not applicable. Table 7-3 of the TGD for WQMP provides a list of applicable source control BMP for projects with specific types of potential pollutant sources or activities. The source control BMP in this table must be implemented for projects with these specific types of potential pollutant sources or activities.

The preparers of this WQMP have reviewed the source control BMP requirements for new development and significant redevelopment projects. The preparers have also reviewed the specific BMP required for project as specified in Forms 4.1-1 and 4.1-2. All applicable non-structural and structural source control BMP shall be implemented in the project.

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N1	Education of Property Owners, Tenants and Occupants on Stormwater BMPs	☒	☐	Education for Owners, Tenants, and Occupants will be supplied in order to educate end users of potential pollutants and options to control those pollutants at the source. By providing education materials, owners/leasers will be informed of the restriction of activity that can potentially cause of contribute to pollutants discharged from the site to Waters of the U.S. The Developer is responsible to provide appropriate Stormwater BMP Educational Materials in Section 6.4, to first time homebuyers.
N2	Activity Restrictions	☒	☐	Through property owner/leasee, employee and Contractor training information development, all concerned parties, including the individual homeowners, will be informed of the restriction of activity that can potentially cause or contribute to pollutants discharged from the site to Waters of the U.S. CC&R's shall also include verbiage that in effect limits the activities that may commence on the property. Restrictions include : No discharging of specified wastes via hosing, or direct discharging to gutters, catch basins and storm drains. Never pour grease, oil, cleaning solutions, or waste grease down a catch basin, storm drain. Use a recycler or liquid disposal company
N3	Landscape Management BMPs	☒	☐	This BMP has been utilized during the planning stages of the project by instituting a plan to include landscape. Follow federal, state, San Bernardino County guidelines governing the use, storage, and disposal of fertilizers and pesticides. Use pesticides only if there is an actual pest problem. Do not use pesticides if rain is expected. Collect lawn and planter clippings, pruning waste and tree trimmings. Do not place them in gutters. Do not blow or rake leaves, etc. into the street. Landscaping and irrigation systems have been designed with several concerns in mind. Foremost, planted vegetation will be drought tolerant and require light irrigation. Furthermore, irrigation systems have been designed and will be maintained in proper order to ensure that over irrigation and subsequent excessive non-stormwater discharge does not occur. Maintenance to said

Form 4.1-1 Non-Structural Source Control BMPs

				irrigation systems will be the responsibility of the Owner's association and inspected on a monthly basis. The Developer will initially verify that the landscaping and irrigation contractor correctly installs, per efficient irrigation plans, and all irrigation equipment functions properly and the Property Owner shall maintain common area landscaping/ irrigation, in perpetuity.
N4	BMP Maintenance	☒	☐	All BMPs will be maintained in proper working order per written procedures in Form 5-1
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	Significant onsite storage of hazardous materials is not anticipated and shall be prohibited.
N6	Local Water Quality Ordinances	☒	☐	Compliance with the San Bernardino's Stormwater Quality Ordinance through BMP implementation, shall be required of all homeowners, renters & contractors.
N7	Spill Contingency Plan	☐	☒	Significant onsite storage of hazardous materials is not expected and shall be prohibited.
N8	Underground Storage Tank Compliance	☐	☒	Not a project feature
N9	Hazardous Materials Disclosure Compliance	☐	☒	Onsite storage of significant quantities of hazardous waste not anticipated

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N10	Uniform Fire Code Implementation	☐	☒	Compliance with uniform fire code will be implemented
N11	Litter/Debris Control Program	☒	☐	The Property Owner will coordinate regular trash and litter collection. Onsite litter collection shall be performed monthly, and weekly during the defined rainy season (generally Oct. 1 – May 1). Residents shall keep waste in containers with lids closed to keep out rainwater, never placing liquid waste or leaky garbage bags into trash receptacles
N12	Employee Training	☐	☒	No employee's proposed
N13	Housekeeping of Loading Docks	☐	☒	Not a project feature
N14	Catch Basin Inspection Program	☐	☒	Not a project feature
N15	Vacuum Sweeping of Private Streets and Parking Lots	☐	☒	No paved streets or parking lots proposed
N16	Other Non-structural Measures for Public Agency Projects	☐	☒	Not required
N17	Comply with all other applicable NPDES permits	☒	☐	The Developer shall comply with all requirements of the CGP by filing an NOI & SWPPP with the State Water Board, obtaining a WDID# and implement all required BMPs, during the entire period of project construction.

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S1	Provide storm drain system stencilling and signage (CASQA New Development BMP Handbook SD-13)	☐	☒	This is not a project feature
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☒	Outdoor material storage shall be prohibited.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☐	☒	This is not a project feature
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control (Statewide Model Landscape Ordinance; CASQA New Development BMP Handbook SD-12)	☒	☐	Landscaping and irrigation systems have been designed with several concerns in mind. Foremost, planted vegetation will be drought tolerant and require light irrigation. Furthermore, irrigation systems have been designed and will be maintained in proper order to ensure that over irrigation and subsequent non-stormwater discharge does not occur. Maintenance to said irrigation systems will be the responsibility of the Property Owner and inspected on a monthly basis.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☐	☒	Not utilized
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☐	☒	No slopes evident
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☐	☒	Not a project feature
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☐	☒	Not a project feature
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	Onsite vehicle washing, and associated vehicle wash racks, are not an anticipated project feature.

S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	Not a project feature

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S11	Equipment wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	Not a project feature
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	Not a project feature
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	Not a project element
S14	Wash water control for food preparation areas	☐	☒	This is a residential development and all commercial preparation activities shall be prohibited.
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	Not a project feature

4.1.2 Preventative LID Site Design Practices

Site design practices associated with new LID requirements in the MS4 Permit should be considered in the earliest phases of a project. Preventative site design practices can result in smaller DCV for LID BMP and hydromodification control BMP by reducing runoff generation. Describe site design and drainage plan including:

- A narrative of site design practices utilized or rationale for not using practices
- A narrative of how site plan incorporates preventive site design practices
- Include an attached Site Plan layout which shows how preventative site design practices are included in WQMP

Refer to Section 5.2 of the TGD for WQMP for more details.

Form 4.1-3 Preventative LID Site Design Practices Checklist

Site Design Practices *If yes, explain how preventative site design practice is addressed in project site plan. If no, other LID BMPs must be selected to meet targets*
Minimize impervious areas: Yes ☒ No ☐ Explanation: Pervious areas have been maximized, at or around 60%, over each building pad.
Maximize natural infiltration capacity: Yes ☒ No ☐ Explanation: By maximizing the natural areas, infiltration capacity is maintained over much of the site.
Preserve existing drainage patterns and time of concentration: Yes ☒ No ☐ Explanation: Historic drainage patterns and channels have been preserved.
Disconnect impervious areas: Yes ☒ No ☐ Explanation: All impervious areas are primarily disconnected since all flows enter one of several infiltration basin areas, designed to capture and contain flows in excess of the DCV.
Protect existing vegetation and sensitive areas: Yes ☒ No ☐ Explanation: The site will only include improvements over the pad and gravel access drives, approximately 9,000sf of the 5 acres allotted for each lot. Some sparse vegetation and features will remain.
Re-vegetate disturbed areas: Yes ☒ No ☐ Explanation: ALL disturbed areas that remain after construction of project features will be re-vegetated to pre-construction condition.
Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐ Explanation: The construction process shall limit the use of heavy equipment in the proposed retention/infiltration area locations and all infiltration basins shall be excavated only to the minimum depth necessary, to prevent backfill & re-compaction of base soil.
Utilize vegetated drainage swales in place of underground piping or imperviously lined swales: Yes ☒ No ☐ Explanation: No underground piping or imperviously lined drainage ways are proposed.
Stake off areas that will be used for landscaping to minimize compaction during construction : Yes ☒ No ☐ Explanation: Via staking, the construction process shall limit the use of heavy equipment in the proposed retention/infiltration basin locations in order to maintain infiltration rates/capacities.

4.2 Project Performance Criteria

The purpose of this section of the Project WQMP is to establish targets for post-development hydrology based on performance criteria specified in the MS4 Permit. These targets include runoff volume for water quality control (referred to as LID design capture volume), and runoff volume, time of concentration, and peak runoff for protection of any downstream waterbody segments with a HCOC. ***If the project has more than one outlet for stormwater runoff, then complete additional versions of these forms for each DA / outlet.***

Methods applied in the following forms include:

- For LID BMP Design Capture Volume (DCV), the San Bernardino County Stormwater Program requires use of the P_6 method (MS4 Permit Section XI.D.6a.ii) – Form 4.2-1
- For HCOC pre- and post-development hydrologic calculation, the San Bernardino County Stormwater Program requires the use of the Rational Method (San Bernardino County Hydrology Manual Section D). Forms 4.2-2 through Form 4.2-5 calculate hydrologic variables including runoff volume, time of concentration, and peak runoff from the project site pre- and post-development using the Hydrology Manual Rational Method approach. For projects greater than 640 acres (1.0 mi^2), the Rational Method and these forms should not be used. For such projects, the Unit Hydrograph Method (San Bernardino County Hydrology Manual Section E) shall be applied for hydrologic calculations for HCOC performance criteria.

Refer to Section 4 in the TGD for WQMP for detailed guidance and instructions.

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA LOT 1-12 TYP.)

1 Project area DA (ft^2): 7,410	**2** Imperviousness after applying preventative site design practices (Imp%): 0.40	**3** Runoff Coefficient (Rc): 0.280 *$R_c = 0.858(Imp\%)^{\wedge 3}-0.78(Imp\%)^{\wedge 2}+0.774(Imp\%)+0.04$*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.595 *http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html*		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.881 *P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)*		
6 Drawdown Rate *Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.*		24-hrs ☐ 48-hrs ☒
7 Compute design capture volume, DCV (ft^3): 300 *DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)* *Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2*		

Form 4.2-2 Summary of HCOC Assessment (DA 1)

Does project have the potential to cause or contribute to an HCOC in a downstream channel: Yes ☐ No ☒

Go to: *http://permitrack.sbcounty.gov/wap/*

If "Yes", then complete HCOC assessment of site hydrology for 2yr storm event using Forms 4.2-3 through 4.2-5 and insert results below

(Forms 4.2-3 through 4.2-5 may be replaced by computer software analysis based on the San Bernardino County Hydrology Manual)

If "No," then proceed to Section 4.3 Project Conformance Analysis

Condition	Runoff Volume (ft^3)	Time of Concentration (min)	Peak Runoff (cfs)
Pre-developed	**1** N/A *Form 4.2-3 Item 12*	**2** N/A *Form 4.2-4 Item 13*	**3** N/A *Form 4.2-5 Item 10*
Post-developed	**4** N/A *Form 4.2-3 Item 13*	**5** N/A *Form 4.2-4 Item 14*	**6** N/A *Form 4.2-5 Item 14*
Difference	**7** N/A *Item 4 – Item 1*	**8** N/A *Item 2 – Item 5*	**9** N/A *Item 6 – Item 3*
Difference (as % of pre-developed)	**10** N/A *Item 7 / Item 1*	**11** N/A *Item 8 / Item 2*	**12** N/A *Item 9 / Item 3*

Form 4.2-3 HCOC Assessment for Runoff Volume (DA 1)

Weighted Curve Number Determination for: Pre-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1a Land Cover type	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2a Hydrologic Soil Group (HSG)								
3a DMA Area, ft^2 *sum of areas of DMA should equal area of DA*								
4a Curve Number (CN) *use Items 1 and 2 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*								
Weighted Curve Number Determination for: Post-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1b Land Cover type								
2b Hydrologic Soil Group (HSG)								
3b DMA Area, ft^2 *sum of areas of DMA should equal area of DA*								
4b Curve Number (CN) *use Items 5 and 6 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*								

5 Pre-Developed area-weighted CN:	**7** Pre-developed soil storage capacity, S (in): *S = (1000 / Item 5) - 10*	**9** Initial abstraction, I_a (in): *I_a = 0.2 * Item 7*
6 Post-Developed area-weighted CN:	**8** Post-developed soil storage capacity, S (in): *S = (1000 / Item 6) - 10*	**10** Initial abstraction, I_a (in): *I_a = 0.2 * Item 8*

11 Precipitation for 2 yr, 24 hr storm (in):
Go to: http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

12 Pre-developed Volume (ft^3):
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 9)^2 / ((Item 11 – Item 9 + Item 7)*

13 Post-developed Volume (ft^3):
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 10)^2 / ((Item 11 – Item 10 + Item 8)*

14 Volume Reduction needed to meet HCOC Requirement, (ft^3): N/A
*V_{HCOC} = (Item 13 * 0.95) – Item 12*

Form 4.2-4 HCOC Assessment for Time of Concentration (DA 1)

Compute time of concentration for pre and post developed conditions for each DA *(For projects using the Hydrology Manual complete the form below)*

Variables	Pre-developed DA1 *Use additional forms if there are more than 4 DMA*				Post-developed DA1 *Use additional forms if there are more than 4 DMA*			
	DMA A	DMA B	DMA C	DMA D	DMA A	DMA B	DMA C	DMA D
1 Length of flowpath (ft) *Use Form 3-2 Item 5 for pre-developed condition*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2 Change in elevation (ft)								
3 Slope (ft/ft), S_o *= Item 2 / Item 1*								
4 Land cover								
5 Initial DMA Time of Concentration (min) *Appendix C-1 of the TGD for WQMP*								
6 Length of conveyance from DMA outlet to project site outlet (ft) *May be zero if DMA outlet is at project site outlet*								
7 Cross-sectional area of channel (ft^2)								
8 Wetted perimeter of channel (ft)								
9 Manning's roughness of channel (n)								
10 Channel flow velocity (ft/sec) V_{fps} *= (1.49 / Item 9) * (Item 7/Item 8)^0.67 * (Item 3)^0.5*								
11 Travel time to outlet (min) T_t *= Item 6 / (Item 10 * 60)*								
12 Total time of concentration (min) T_c *= Item 5 + Item 11*								
13 Pre-developed time of concentration (min): *Minimum of Item 12 pre-developed DMA*								
14 Post-developed time of concentration (min): *Minimum of Item 12 post-developed DMA*								
15 Additional time of concentration needed to meet HCOC requirement (min): $T_{C\text{-}HCOC}$ *= (Item 13 * 0.95) – Item 14*								

Form 4.2-5 HCOC Assessment for Peak Runoff (DA 1)

Variables		Pre-developed DA to Project Outlet (*Use additional forms if more than 3 DMA)*			Post-developed DA to Project Outlet (*Use additional forms if more than 3 DMA)*		
		DMA A	DMA B	DMA C	DMA A	DMA B	DMA C
1 Rainfall Intensity for storm duration equal to time of concentration *I_{peak} = 10^(LOG Form 4.2-1 Item 4 - 0.6 LOG Form 4.2-4 Item 5 /60)*		N/A	N/A	N/A	N/A	N/A	N/A
2 Drainage Area of each DMA (Acres) *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
3 Ratio of pervious area to total area *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
4 Pervious area infiltration rate (in/hr) *Use pervious area CN and antecedent moisture condition with Appendix C-3 of the TGD for WQMP*							
5 Maximum loss rate (in/hr) *F_m = Item 3 * Item 4* *Use area-weighted F_m from DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
6 Peak Flow from DMA (cfs) *Q_p =Item 2 * 0.9 * (Item 1 - Item 5)*							
7 Time of concentration adjustment factor for other DMA to site discharge point *Form 4.2-4 Item 12 DMA / Other DMA upstream of site discharge point (If ratio is greater than 1.0, then use maximum value of 1.0)*	DMA A	*n/a*			*n/a*		
	DMA B		*n/a*			*n/a*	
	DMA C			*n/a*			*n/a*

8 Pre-developed Q_p at T_c for DMA A: *Q_p = Item 6_{DMAA} + [Item 6_{DMAB} * (Item 1_{DMAA} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAA/2}$] + [Item 6_{DMAC} * (Item 1_{DMAA} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAA/3}$]*	**9** Pre-developed Q_p at T_c for DMA B: *Q_p = Item 6_{DMAB} + [Item 6_{DMAA} * (Item 1_{DMAB} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAB/1}$] + [Item 6_{DMAC} * (Item 1_{DMAB} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAB/3}$]*	**10** Pre-developed Q_p at T_c for DMA C: *Q_p = Item 6_{DMAC} + [Item 6_{DMAA} * (Item 1_{DMAC} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAC/1}$] + [Item 6_{DMAB} * (Item 1_{DMAC} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAC/2}$]*
10 Peak runoff from pre-developed condition confluence analysis (cfs): *Maximum of Item 8, 9, and 10 (including additional forms as needed)*		
11 Post-developed Q_p at T_c for DMA A: *Same as Item 8 for post-developed values*	**12** Post-developed Q_p at T_c for DMA B: *Same as Item 9 for post-developed values*	**13** Post-developed Q_p at T_c for DMA C: *Same as Item 10 for post-developed values*
14 Peak runoff from post-developed condition confluence analysis (cfs): *Maximum of Item 11, 12, and 13 (including additional forms as needed)*		
15 Peak runoff reduction needed to meet HCOC Requirement (cfs): N/A *$Q_{p\text{-}HCOC}$ = (Item 14 * 0.95) – Item 10*		

4.3 Project Conformance Analysis

Complete the following forms for each project site DA to document that the proposed LID BMPs conform to the project DCV developed to meet performance criteria specified in the MS4 Permit (WQMP Template Section 4.2). For the LID DCV, the forms are ordered according to hierarchy of BMP selection as required by the MS4 Permit (see Section 5.3.1 in the TGD for WQMP). The forms compute the following for on-site LID BMP:

- Site Design and Hydrologic Source Controls (Form 4.3-2)
- Retention and Infiltration (Form 4.3-3)
- Harvested and Use (Form 4.3-4) or
- Biotreatment (Form 4.3-5).

At the end of each form, additional fields facilitate the determination of the extent of mitigation provided by the specific BMP category, allowing for use of the next category of BMP in the hierarchy, if necessary.

The first step in the analysis, using Section 5.3.2.1 of the TGD for WQMP, is to complete Forms 4.3-1 and 4.3-3) to determine if retention and infiltration BMPs are infeasible for the project. For each feasibility criterion in Form 4.3-1, if the answer is "Yes," provide all study findings that includes relevant calculations, maps, data sources, etc. used to make the determination of infeasibility.

Next, complete Forms 4.3-2 and 4.3-4 to determine the feasibility of applicable HSC and harvest and use BMPs, and, if their implementation is feasible, the extent of mitigation of the DCV.

If no site constraints exist that would limit the type of BMP to be implemented in a DA, evaluate the use of combinations of LID BMPs, including all applicable HSC BMPs to maximize on-site retention of the DCV. If no combination of BMP can mitigate the entire DCV, implement the single BMP type, or combination of BMP types, that maximizes on-site retention of the DCV within the minimum effective area.

If the combination of LID HSC, retention and infiltration, and harvest and use BMPs are unable to mitigate the entire DCV, then biotreatment BMPs may be implemented by the project proponent. If biotreatment BMPs are used, then they must be sized to provide sufficient capacity for effective treatment of the remainder of the volume-based performance criteria that cannot be achieved with LID BMPs (TGD for WQMP Section 5.4.4.2). **Under no circumstances shall any portion of the DCV be released from the site without effective mitigation and/or treatment**.

Form 4.3-1 Infiltration BMP Feasibility (DMA A & DMA B)

Feasibility Criterion – Complete evaluation for each DA on the Project Site

[1] Would infiltration BMP pose significant risk for groundwater related concerns? Yes ☐ No ☒
Refer to Section 5.3.2.1 of the TGD for WQMP

If Yes, Provide basis: (attach)

[2] Would installation of infiltration BMP significantly increase the risk of geotechnical hazards? Yes ☐ No ☒
(Yes, if the answer to any of the following questions is yes, as established by a geotechnical expert):

- The location is less than 50 feet away from slopes steeper than 15 percent
- The location is less than eight feet from building foundations or an alternative setback.
- A study certified by a geotechnical professional or an available watershed study determines that stormwater infiltration would result in significantly increased risks of geotechnical hazards.

If Yes, Provide basis: (attach) According to the Geotechnical Engineer, Infiltration is not advisable. See attached.

[3] Would infiltration of runoff on a Project site violate downstream water rights? Yes ☐ No ☒

If Yes, Provide basis: (attach)

[4] Is proposed infiltration facility located on hydrologic soil group (HSG) D soils or does the site geotechnical investigation indicate presence of soil characteristics, which support categorization as D soils? Yes ☐ No ☒

If Yes, Provide basis: (attach)

[5] Is the design infiltration rate, after accounting for safety factor of 2.0, below proposed facility less than 0.3 in/hr (accounting for soil amendments)? Yes ☐ No ☒

If Yes, Provide basis: (attach)

[6] Would on-site infiltration or reduction of runoff over pre-developed conditions be partially or fully inconsistent with watershed management strategies as defined in the WAP, or impair beneficial uses? Yes ☐ No ☒
See Section 3.5 of the TGD for WQMP and WAP

If Yes, Provide basis: (attach)

[7] Any answer from Item 1 through Item 3 is "Yes": Yes ☐ No ☒
If yes, infiltration of any volume is not feasible onsite. Proceed to Form 4.3-4, Harvest and Use BMP. If no, then proceed to Item 8 below.

[8] Any answer from Item 4 through Item 6 is "Yes": Yes ☐ No ☒
If yes, infiltration is permissible but is not required to be considered. Proceed to Form 4.3-2, Hydrologic Source Control BMP.
If no, then proceed to Item 9, below.

[9] All answers to Item 1 through Item 6 are "No":
Infiltration of the full DCV is potentially feasible, LID infiltration BMP must be designed to infiltrate the full DCV to the MEP.
Proceed to Form 4.3-2, Hydrologic Source Control BMP.

4.3.1 Site Design Hydrologic Source Control BMP

Section XI.E. of the Permit emphasizes the use of LID preventative measures; and the use of LID HSC BMPs reduces the portion of the DCV that must be addressed in downstream BMPs. Therefore, all applicable HSC shall be provided except where they are mutually exclusive with each other, or with other BMPs. Mutual exclusivity may result from overlapping BMP footprints such that either would be potentially feasible by itself, but both could not be implemented. Please note that while there are no numeric standards regarding the use of HSC, if a project cannot feasibly meet BMP sizing requirements or cannot fully address HCOCs, feasibility of all applicable HSC must be part of demonstrating that the BMP system has been designed to retain the maximum feasible portion of the DCV. Complete Form 4.3-2 to identify and calculate estimated retention volume from implementing site design HSC BMP. Refer to Section 5.4.1 in the TGD for more detailed guidance.

Form 4.3-2 Site Design Hydrologic Source Control BMPs (DA 1)

1 Implementation of Impervious Area Dispersion BMP (i.e. routing runoff from impervious to pervious areas), excluding impervious areas planned for routing to on-lot infiltration BMP: Yes ☐ No ☒ *If yes, complete Items 2-5; If no, proceed to Item 6*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Total impervious area draining to pervious area (ft^2)	N/A		
3 Ratio of pervious area receiving runoff to impervious area			
4 Retention volume achieved from impervious area dispersion (ft^3) *V = Item2 * Item 3 * (0.5/12), assuming retention of 0.5 inches of runoff*			
5 Sum of retention volume achieved from impervious area dispersion (ft^3): $V_{retention}$ *=Sum of Item 4 for all BMPs*			
6 Implementation of Localized On-lot Infiltration BMPs (e.g. on-lot rain gardens): Yes ☐ No ☒ *If yes, complete Items 7-13 for aggregate of all on-lot infiltration BMP in each DA; If no, proceed to Item 14*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
7 Ponding surface area (ft^2)			
8 Ponding depth (ft)			
9 Surface area of amended soil/gravel (ft^2)			
10 Average depth of amended soil/gravel (ft)			
11 Average porosity of amended soil/gravel			
12 Retention volume achieved from on-lot infiltration (ft^3) $V_{retention}$ *= (Item 7 *Item 8) + (Item 9 * Item 10 * Item 11)*			
13 Runoff volume retention from on-lot infiltration (ft^3): $V_{retention}$ *=Sum of Item 12 for all BMPs*			

Form 4.3-2 Site Design Hydrologic Source Control BMPs (DA 1)

Form 4.3-2 cont. Site Design Hydrologic Source Control BMPs (DA 1)

14 Implementation of evapotranspiration BMP (green, brown, or blue roofs): Yes ☐ No ☒ *If yes, complete Items 15-20. If no, proceed to Item 21*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
15 Rooftop area planned for ET BMP (ft^2)			
16 Average wet season ET demand (in/day) *Use local values, typical ~ 0.1*			
17 Daily ET demand (ft^3/day) *Item 15 * (Item 16 / 12)*			
18 Drawdown time (hrs) *Copy Item 6 in Form 4.2-1*			
19 Retention Volume (ft^3) $V_{retention}$ *= Item 17 * (Item 18 / 24)*			
20 Runoff volume retention from evapotranspiration BMPs (ft^3):	$V_{retention}$ *=Sum of Item 19 for all BMPs*		
21 Implementation of Street Trees: Yes ☐ No ☒ *If yes, complete Items 22-25. If no, proceed to Item 26*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
22 Number of Street Trees			
23 Average canopy cover over impervious area (ft^2)			
24 Runoff volume retention from street trees (ft^3) $V_{retention}$ *= Item 22 * Item 23 * (0.05/12) assume runoff retention of 0.05 inches*			
25 Runoff volume retention from street tree BMPs (ft^3):	$V_{retention}$ *= Sum of Item 24 for all BMPs*		
26 Implementation of residential rain barrel/cisterns: Yes ☐ No ☒ *If yes, complete Items 27-29; If no, proceed to Item 30*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
27 Number of rain barrels/cisterns			
28 Runoff volume retention from rain barrels/cisterns (ft^3) $V_{retention}$ *= Item 27 * 3*			
29 Runoff volume retention from residential rain barrels/Cisterns (ft3):	$V_{retention}$ *=Sum of Item 28 for all BMPs*		
30 Total Retention Volume from Site Design Hydrologic Source Control BMPs:	*Sum of Items 5, 13, 20, 25 and 29*		

4.3.2 Infiltration BMPs

Use Form 4.3-3 to compute on-site retention of runoff from proposed retention and infiltration BMPs. Volume retention estimates are sensitive to the percolation rate used, which determines the amount of runoff that can be infiltrated within the specified drawdown time. The infiltration safety factor reduces field measured percolation to account for potential inaccuracy associated with field measurements, declining BMP performance over time, and compaction during construction. Appendix D of the TGD for WQMP provides guidance on estimating an appropriate safety factor to use in Form 4.3-3.

If site constraints limit the use of BMPs to a single type and implementation of retention and infiltration BMPs mitigate no more than 40% of the DCV, then they are considered infeasible and the Project Proponent may evaluate the effectiveness of BMPs lower in the LID hierarchy of use (Section 5.5.1 of the TGD for WQMP)

If implementation of infiltrations BMPs is feasible as determined using Form 4.3-1, then LID infiltration BMPs shall be implemented to the MEP (section 4.1 of the TGD for WQMP).

Form 4.3-3 Infiltration LID BMP - including underground BMPs

1 Remaining LID DCV not met by site design HSC BMP (ft^3): Per Lot (300cf each) 3,600cf *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30*			
BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs*	DMA 1-12 BMP Type Infiltration Basin		
2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix D of the TGD for WQMP for minimum requirements for assessment methods*	4.0"		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	2.0		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	2"		
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48		
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	12'		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	1'		
8 Infiltrating surface area, SA_{BMP} (ft^2) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	600		
9 Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	0		
10 Amended soil porosity	0		
11 Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	0		
12 Gravel porosity	0		
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3		
14 Above Ground Retention Volume (ft3) Vretention = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]	900CF PER EACH LOTS 1-12		
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*			
16 Total Retention Volume from LID Infiltration BMPs: 900cf * 12 lots = 10,800cf *(Sum of Items 14 and 15 for all infiltration BMP*			
17 Fraction of DCV achieved with infiltration BMP: 100% *Retention% = Item 16 / Form 4.2-1 Item 7*			
18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? Yes ☒ No ☐ *If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.*			

4.3.3 Harvest and Use BMP

Harvest and use BMP may be considered if the full LID DCV cannot be met by maximizing infiltration BMPs. Use Form 4.3-4 to compute on-site retention of runoff from proposed harvest and use BMPs.

Volume retention estimates for harvest and use BMPs are sensitive to the on-site demand for captured stormwater. Since irrigation water demand is low in the wet season, when most rainfall events occur in San Bernardino County, the volume of water that can be used within a specified drawdown period is relatively low. The bottom portion of Form 4.3-4 facilitates the necessary computations to show infeasibility if a minimum incremental benefit of 40 percent of the LID DCV would not be achievable with MEP implementation of on-site harvest and use of stormwater (Section 5.5.4 of the TGD for WQMP).

Form 4.3-4 Harvest and Use BMPs (DA 1)

1 Remaining LID DCV not met by site design HSC or infiltration BMP (ft^3): 0

V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30 – Form 4.3-3 Item 16

BMP Type(s) *Compute runoff volume retention from proposed harvest and use BMP (Select BMPs from Table 5-4 of the TGD for WQMP) - Use additional forms for more BMPs*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Describe cistern or runoff detention facility	N/A		
3 Storage volume for proposed detention type (ft^3) *Volume of cistern*			
4 Landscaped area planned for use of harvested stormwater (ft^2)			
5 Average wet season daily irrigation demand (in/day) Use local values, typical ~ 0.1 in/day			
6 Daily water demand (ft^3/day) *Item 4 * (Item 5 / 12)*			
7 Drawdown time (hrs) *Copy Item 6 from Form 4.2-1*			

8 Retention Volume (ft^3)

*$V_{retention}$ = Minimum of (Item 3) or (Item 6 * (Item 7 / 24))*

9 Total Retention Volume (ft^3) from Harvest and Use BMP: N/A *Sum of Item 8 for all harvest and use BMP included in plan*

10 Is the full DCV retained with a combination of LID HSC, retention and infiltration, and harvest & use BMPs? Yes ☐ No ☐

If yes, demonstrate conformance using Form 4.3-10. If no, then re-evaluate combinations of all LID BMP and optimize their implementation such that the maximum portion of the DCV is retained on-site (using a single BMP type or combination of BMP types). If the full DCV cannot be mitigated after this optimization process, proceed to Section 4.3.4.

4.3.4 Biotreatment BMP

Biotreatment BMPs may be considered if the full LID DCV cannot be met by maximizing retention and infiltration, and harvest and use BMPs. A key consideration when using biotreatment BMP is the effectiveness of the proposed BMP in addressing the pollutants of concern for the project (see Table 5-5 of the TGD for WQMP).

Use Form 4.3-5 to summarize the potential for volume based and/or flow based biotreatment options to biotreat the remaining unmet LID DCV w. Biotreatment computations are included as follows:

- Use Form 4.3-6 to compute biotreatment in small volume based biotreatment BMP (e.g. bioretention w/underdrains);
- Use Form 4.3-7 to compute biotreatment in large volume based biotreatment BMP (e.g. constructed wetlands);
- Use Form 4.3-8 to compute sizing criteria for flow-based biotreatment BMP (e.g. bioswales)

Form 4.3-5 Selection and Evaluation of Biotreatment BMP (DA 1)

1 Remaining LID DCV not met by site design HSC, infiltration, or harvest and use BMP for potential biotreatment (ft^3): 0 *Form 4.2-1 Item 7 - Form 4.3-2 Item 30 – Form 4.3-3 Item 16- Form 4.3-4 Item 9*	List pollutants of concern *Copy from Form 2.3-1.* n/a	
2 Biotreatment BMP Selected *(Select biotreatment BMP(s) necessary to ensure all pollutants of concern are addressed through Unit Operations and Processes, described in Table 5-5 of the TGD for WQMP)*	Volume-based biotreatment *Use Forms 4.3-6 and 4.3-7 to compute treated volume*	Flow-based biotreatment *Use Form 4.3-8 to compute treated volume*
	☐ Bioretention with underdrain ☐ Planter box with underdrain ☐ Constructed wetlands ☐ Wet extended detention ☐ Dry extended detention	☐ Vegetated swale ☐ Vegetated filter strip ☐ Proprietary biotreatment
3 Volume biotreated in volume based biotreatment BMP (ft^3): *Form 4.3-6 Item 15 + Form 4.3-7 Item 13*	**4** Compute remaining LID DCV with implementation of volume based biotreatment BMP (ft^3): *Item 1 – Item 3*	**5** Remaining fraction of LID DCV for sizing flow based biotreatment BMP: *Item 4 / Item 1*
6 Flow-based biotreatment BMP capacity provided (cfs): *Use Figure 5-2 of the TGD for WQMP to determine flow capacity required to provide biotreatment of remaining percentage of unmet LID DCV (Item 5), for the project's precipitation zone (Form 3-1 Item 1)*		
7 Metrics for MEP determination: • Provided a WQMP with the portion of site area used for suite of LID BMP equal to minimum thresholds in Table 5-7 of the TGD for WQMP for the proposed category of development: ☐ *If maximized on-site retention BMPs is feasible for partial capture, then LID BMP implementation must be optimized to retain and infiltrate the maximum portion of the DCV possible within the prescribed minimum effective area. The remaining portion of the DCV shall then be mitigated using biotreatment BMP.*		

Form 4.3-6 Volume Based Biotreatment (DA 1) – Bioretention and Planter Boxes with Underdrains

Biotreatment BMP Type *(Bioretention w/underdrain, planter box w/underdrain, other comparable BMP)*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type
1 Pollutants addressed with BMP *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP*	N/A		
2 Amended soil infiltration rate *Typical ~ 5.0*			
3 Amended soil infiltration safety factor *Typical ~ 2.0*			
4 Amended soil design percolation rate (in/hr) P_{design} *= Item 2 / Item 3*			
5 Ponded water drawdown time (hr) *Copy Item 6 from Form 4.2-1*			
6 Maximum ponding depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
7 Ponding Depth (ft) d_{BMP} *= Minimum of (1/12 * Item 4 * Item 5) or Item 6*			
8 Amended soil surface area (ft^2)			
9 Amended soil depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
10 Amended soil porosity, *n*			
11 Gravel depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
12 Gravel porosity, *n*			
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*			
14 Biotreated Volume (ft^3) $V_{biotreated}$ *= Item 8 * [(Item 7/2) + (Item 9 * Item 10) +(Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*			
15 Total biotreated volume from bioretention and/or planter box with underdrains BMP: See Next *Sum of Item 14 for all volume-based BMPs included in this form*			

Form 4.3-7 Volume Based Biotreatment (DA 1) – Constructed Wetlands and Extended Detention

Biotreatment BMP Type *Constructed wetlands, extended wet detention, extended dry detention, or other comparable proprietary BMP. If BMP includes multiple modules (e.g. forebay and main basin), provide separate estimates for storage and pollutants treated in each module.*	DA DMA BMP Type		DA DMA BMP Type *(Use additional forms for more BMPs)*	
	Forebay	Basin	Forebay	Basin
1 Pollutants addressed with BMP forebay and basin *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP*	N/A			
2 Bottom width (ft)				
3 Bottom length (ft)				
4 Bottom area (ft^2) A_{bottom} = *Item 2 * Item 3*				
5 Side slope (ft/ft)				
6 Depth of storage (ft)				
7 Water surface area (ft^2) $A_{surface}$ =*(Item 2 + (2 * Item 5 * Item 6)) * (Item 3 + (2 * Item 5 * Item 6))*				
8 Storage volume (ft^3) *For BMP with a forebay, ensure fraction of total storage is within ranges specified in BMP specific fact sheets, see Table 5-6 of the TGD for WQMP for reference to BMP design details* V =*Item 6 / 3 * [Item 4 + Item 7 + (Item 4 * Item 7)^0.5]*				
9 Drawdown Time (hrs) *Copy Item 6 from Form 2.1*				
10 Outflow rate (cfs) Q_{BMP} = *(Item* $8_{forebay}$ + *Item* 8_{basin}*) / (Item 9 * 3600)*				
11 Duration of design storm event (hrs)				
12 Biotreated Volume (ft^3) $V_{biotreated}$ = *(Item* $8_{forebay}$ + *Item* 8_{basin}*) +(Item 10 * Item 11 * 3600)*				
13 Total biotreated volume from constructed wetlands, extended dry detention, or extended wet detention : *(Sum of Item 12 for all BMP included in plan)*				

Form 4.3-8 Flow Based Biotreatment (DA 1)

Biotreatment BMP Type *Vegetated swale, vegetated filter strip, or other comparable proprietary BMP*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
1 Pollutants addressed with BMP *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in TGD Table 5-5*	N/A		
2 Flow depth for water quality treatment (ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
3 Bed slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
4 Manning's roughness coefficient			
5 Bottom width (ft) b_w = *(Form 4.3-5 Item 6 * Item 4) / (1.49 * Item 2^1.67 * Item 3^0.5)*			
6 Side Slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
7 Cross sectional area (ft^2) *A = (Item 5 * Item 2) + (Item 6 * Item 2^2)*			
8 Water quality flow velocity (ft/sec) *V = Form 4.3-5 Item 6 / Item 7*			
9 Hydraulic residence time (min) *Pollutant specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
10 Length of flow based BMP (ft) *L = Item 8 * Item 9 * 60*			
11 Water surface area at water quality flow depth (ft^2) SA_{top} = *(Item 5 + (2 * Item 2 * Item 6)) * Item 10*			

4.3.5 Conformance Summary

Complete Form 4.3-9 to demonstrate how on-site LID DCV is met with proposed site design hydrologic source control, infiltration, harvest and use, and/or biotreatment BMP. The bottom line of the form is used to describe the basis for infeasibility determination for on-site LID BMP to achieve full LID DCV, and provides methods for computing remaining volume to be addressed in an alternative compliance plan. If the project has more than one outlet, then complete additional versions of this form for each outlet.

Form 4.3-9 Conformance Summary and Alternative Compliance Volume Estimate (DA 1)

1 Total LID DCV for the Project DA-A-H (LOTS 1-8) (ft^3): 300cf Each Lot (3,600cf overall) *Copy Item 7 in Form 4.2-1*

2 On-site retention with site design hydrologic source control LID BMP (ft^3): 0

3 On-site retention with LID infiltration BMP (ft^3): 900cf Each Lot (10,800cf)

4 On-site retention with LID harvest and use BMP (ft^3): 0 *Copy Item 9 in Form 4.3-4*

5 On-site biotreatment with volume based biotreatment BMP (ft^3): 0 *Copy Item 3 in Form 4.3-5*

6 Flow capacity provided by flow based biotreatment BMP (cfs): 0 *Copy Item 6 in Form 4.3-5*

7 LID BMP performance criteria are achieved if answer to any of the following is "Yes":

- Full retention of LID DCV with site design HSC, infiltration, or harvest and use BMP: Yes ☒ No ☐
  If yes, sum of Items 2, 3, and 4 is greater than Item 1
- Combination of on-site retention BMPs for a portion of the LID DCV and volume-based biotreatment BMP that address all pollutants of concern for the remaining LID DCV: Yes ☐ No ☒
  If yes, a) sum of Items 2, 3, 4, and 5 is greater than Item 1, and Items 2, 3 and 4 are maximized; or b) Item 6 is greater than Form 4.3--5 Item 6 and Items 2, 3 and 4 are maximized
- On-site retention and infiltration is determined to be infeasible and biotreatment BMP provide biotreatment for all pollutants of concern for full LID DCV: Yes ☐ No ☒
  If yes, Form 4.3-1 Items 7 and 8 were both checked yes

8 If the LID DCV is not achieved by any of these means, then the project may be allowed to develop an alternative compliance plan. Check box that describes the scenario which caused the need for alternative compliance:

- Combination of HSC, retention and infiltration, harvest and use, and biotreatment BMPs provide less than full LID DCV capture: ☐
  Checked yes for Form 4.3-5 Item 7, Item 6 is zero, and sum of Items 2, 3, 4, and 5 is less than Item 1. If so, apply water quality credits and calculate volume for alternative compliance, V_{alt} *= (Item 1 – Item 2 – Item 3 – Item 4 – Item 5) * (100 - Form 2.4-1 Item 2)%*
- An approved Watershed Action Plan (WAP) demonstrates that water quality and hydrologic impacts of urbanization are more effective when managed in at an off-site facility: ☐
  Attach appropriate WAP section, including technical documentation, showing effectiveness comparisons for the project site and regional watershed

4.3.6 Hydromodification Control BMP

Use Form 4.3-10 to compute the remaining runoff volume retention, after LID BMP are implemented, needed to address HCOC, and the increase in time of concentration and decrease in peak runoff necessary to meet targets for protection of waterbodies with a potential HCOC. Describe hydromodification control BMP that address HCOC, which may include off-site BMP and/or in-stream controls. Section 5.6 of the TGD for WQMP provides additional details on selection and evaluation of hydromodification control BMP.

Form 4.3-10 Hydromodification Control BMPs (DA 1)

1 Volume reduction needed for HCOC performance criteria (ft^3): N/A *(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1*	**2** On-site retention with site design hydrologic source control, infiltration, and harvest and use LID BMP (ft^3): 0 *Sum of Form 4.3-9 Items 2, 3, and 4 Evaluate option to increase implementation of on-site retention in Forms 4.3-2, 4.3-3, and 4.3-4 in excess of LID DCV toward achieving HCOC volume reduction*
3 Remaining volume for HCOC volume capture (ft^3): 0 *Item 1 – Item 2*	**4** Volume capture provided by incorporating additional on-site or off-site retention BMPs (ft^3): 0 *Existing downstream BMP may be used to demonstrate additional volume capture (if so, attach to this WQMP a hydrologic analysis showing how the additional volume would be retained during a 2-yr storm event for the regional watershed)*

5 If Item 4 is less than Item 3, incorporate in-stream controls on downstream waterbody segment to prevent impacts due to hydromodification ☐ *Attach in-stream control BMP selection and evaluation to this WQMP*

6 Is Form 4.2-2 Item 11 less than or equal to 5%: Yes ☐ No ☐

If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:

- Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site or off-site retention BMP ☐
  BMP upstream of a waterbody segment with a potential HCOC may be used to demonstrate increased time of concentration through hydrograph attenuation (if so, show that the hydraulic residence time provided in BMP for a 2-year storm event is equal or greater than the addition time of concentration requirement in Form 4.2-4 Item 15)
- Increase time of concentration by preserving pre-developed flow path and/or increase travel time by reducing slope and increasing cross-sectional area and roughness for proposed on-site conveyance facilities ☐
- Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California ☐

7 Form 4.2-2 Item 12 less than or equal to 5%: Yes ☐ No ☐

If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:

- Demonstrate reduction in peak runoff achieved by proposed LID site design, LID BMPs, and additional on-site or off-site retention BMPs ☐
  BMPs upstream of a waterbody segment with a potential HCOC may be used to demonstrate additional peak runoff reduction through hydrograph attenuation (if so, attach to this WQMP, a hydrograph analysis showing how the peak runoff would be reduced during a 2-yr storm event)
- Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California ☐

4.4 Alternative Compliance Plan (if applicable)

Describe an alternative compliance plan (if applicable) for projects not fully able to infiltrate, harvest and use, or biotreat the DCV via on-site LID practices. A project proponent must develop an alternative compliance plan to address the remainder of the LID DCV. Depending on project type some projects may qualify for water quality credits that can be applied to reduce the DCV that must be treated prior to development of an alternative compliance plan (see Form 2.4-1, Water Quality Credits). Form 4.3-9 Item 8 includes instructions on how to apply water quality credits when computing the DCV that must be met through alternative compliance. Alternative compliance plans may include one or more of the following elements:

- On-site structural treatment control BMP - All treatment control BMP should be located as close to possible to the pollutant sources and should not be located within receiving waters;
- Off-site structural treatment control BMP - Pollutant removal should occur prior to discharge of runoff to receiving waters;
- Urban runoff fund or In-lieu program, if available

Depending upon the proposed alternative compliance plan, approval by the executive officer may or may not be required (see Section 6 of the TGD for WQMP).

Section 5 Inspection and Maintenance Responsibility for Post Construction BMP

All BMP included as part of the project WQMP are required to be maintained through regular scheduled inspection and maintenance (refer to Section 8, Post Construction BMP Requirements, in the TGD for WQMP). Fully complete Form 5-1 summarizing all BMP included in the WQMP. Attach additional forms as needed. The WQMP shall also include a detailed Operation and Maintenance Plan for all BMP and may require a Maintenance Agreement (consult the jurisdiction's LIP). If a Maintenance Agreement is required, it must also be attached to the WQMP.

Form 5-1 BMP Inspection and Maintenance (use additional forms as necessary)

BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
N3. Common Area Landscape Management	Property Owners	This BMP has been utilized during the planning stages of the project by instituting a plan to include landscape. Follow federal, state, San Bernardino County guidelines governing the use, storage, and disposal of fertilizers and pesticides. Use pesticides only if there is an actual pest problem. Do not use pesticides if rain is expected. Collect lawn and planter clippings, pruning waste and tree trimmings. Do not place them in gutters. Do not blow or rake leaves, etc. into the street. Landscaping and irrigation systems have been designed with several concerns in mind. Foremost, planted vegetation will be drought tolerant and require light irrigation. Furthermore, irrigation systems have been designed and will be maintained in proper order to ensure that over irrigation and subsequent excessive non-stormwater discharge does not occur. Maintenance to said irrigation systems will be the responsibility of the Owner's association and inspected on a monthly basis. The Developer will initially verify that the landscaping and irrigation contractor correctly installs, per efficient irrigation plans, and all irrigation equipment functions properly and the Property Owners shall maintain area landscaping/ irrigation, in perpetuity.	Quarterly as seasonal changes

N11. Common Area Litter Control Program	Property Owners	The Property Owners will coordinate regular trash and litter collection. Common area litter collection shall be performed monthly, and weekly during the defined rainy season (generally Oct. 1 – May 1). Residents shall keep waste in containers with lids closed to keep out rainwater, never placing liquid waste or leaky garbage bags into trash receptacles	Weekly
S4 Efficient Irrigation Systems	Property Owners	Landscaping and irrigation systems have been designed with several concerns in mind. Foremost, planted vegetation will be drought tolerant and require light irrigation. Furthermore, irrigation systems have been designed and will be maintained in proper order to ensure that over irrigation and subsequent non- stormwater discharge does not occur. Maintenance to said irrigation systems will be the responsibility of the Owner's association and inspected on a monthly basis.	Maintenance will be completed at least once monthly as part of the Common Area Landscape Management
Infiltration Basin	Property Owners	Infiltration Basin inspection/maintenance shall be conducted to ensure that the basin is are free from litter and debris. Inspection and maintenance shall include inspection 72 hours after the conclusion of a ¾" rain event to confirm that the trench has proper drawdown.	See Maintenance Manual in Appendix B

Section 6 WQMP Attachments

6.1. See Appendices A-E

6.2 Electronic Data Submittal

Minimum requirements include submittal of PDF exhibits in addition to hard copies. Format must not require specialized software to open. If the local jurisdiction requires specialized electronic document formats (as described in their local Local Implementation Plan), this section will describe the contents (e.g., layering, nomenclature, geo-referencing, etc.) of these documents so that they may be interpreted efficiently and accurately.

6.3 Post Construction

Attach all O&M Plans and Maintenance Agreements for BMP to the WQMP.

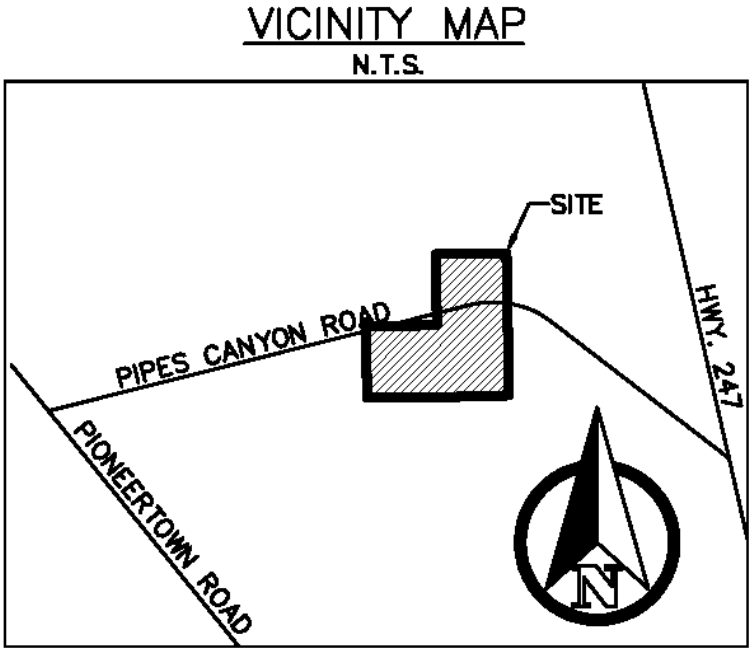
Appendix A

AGREEMENTS – CC&RS, COVENANT AND AGREEMENTS AND/OR OTHER MECHANISMS FOR ENSURING ONGOING OPERATION, MAINTENANCE, FUNDING AND TRANSFER OF REQUIREMENTS FOR THIS PROJECT-SPECIFIC WQMP

At the time of WQMP Preparation, no CC&Rs have been developed for the property.

Appendix B

VICINITY MAP AND SITE PLAN



IN THE UNINCORPORATED AREA OF SAN BERNARDINO COUNTY

TENTATIVE TRACT MAP NO. 20612

BEING A SUBDIVISION OF THE SOUTHWEST ¼ OF THE NORTHEAST ¼ AND THE NORTHWEST ¼ OF THE SOUTHEAST ¼ AND THE NORTHEAST ¼ OF THE SOUTHWEST ¼ OF SECTION 6, TOWNSHIP 1 NORTH, RANGE 5 EAST, SAN BERNARDINO BASE AND MERIDIAN, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF, IN THE OFFICE OF THE COUNTY RECORDER OF SAID OFFICE

OFFICIAL USE ONLY

LEGAL DESCRIPTION

THE LAND REFERRED TO HEREIN BELOW IS SITUATED IN THE UNINCOPORATED AREA OF SAN BERNARDINO IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, AND IS DESCRIBED AS FOLLOWS:

THE SOUTH 1/4 OF THE NORTHEAST 1/4 AND THE NORTHWEST 1/4 OF THE SOUTHEAST 1/4 AND THE NORTHEAST 1/4 OF THE SOUTHWEST 1/4 OF SECTION 6, TOWNSHIP 1 NORTH, RANGE 5 EAST, SAN BERNARDINO BASE AND MERIDIAN, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF.

APN: 0594-351-36

EASEMENTS

(3) AN EASEMENT TO THE DESERT ELECTRIC COOPERATIVE, INC., ITS SUCCESSORS AND/OR ASSIGNS FOR ELECTRIC TRANSMISSION OR DISTRIBUTION LINE OR SYSTEM RECORDED APRIL 22, 1960 IN BOOK 5118, PAGE 375, O.R.

THE EXACT LOCATION AND EXTENT OF SAID EASEMENT IS NOT DISCLOSED OF RECORD

OWNER/DEVELOPER

JONATHAN SHOKRIAN
53252 PIPES CANYON ROAD
PIONEERTOWN, CA 92268

SURVEYOR/ENGINEER

HILLWIG-GOODROW, INC.
31419 OUTER HIGHWAY 10, SUITE 1-200
REDLANDS, CA 92373
PHONE: 909-794-2673
EMAIL: HG@HILLWIG-GOODROW.COM

GEOTECHNICAL ENGINEER

GEOTEK, INC.
ATTN: ANNA SCOTT
1548 NORTH MAPLE STREET
CORONA, CA 92878
PHONE: 951-710-1160
EMAIL: ASCOTT@GEOTEKUSA.COM

BASIS OF BEARINGS:

THE BASIS OF BEARINGS FOR THIS SURVEY IS THE CALIFORNIA STATE PLANE COORDINATE SYSTEM, ZONE 5, CONSTRAINED LOCALLY BETWEEN CONTINUOUS GPS STATIONS LDES & P599. SAID BEARING IS N59°08'35"E (NAD83(2011) 2017.50 EPOCH.)

BENCHMARK:

THE BENCHMARK USED FOR THIS PROJECT IS GPS CONTINUOUS OPERATING REFERENCE STATION LDES, ELEVATION 3313.28' (NAVD 88.)

THIS IS A CONTINUOUS GPS STATION AND IS PART OF THE NATIONAL GEODETIC SURVEY. VERTICAL DATUM IS TO THE GEODETIC REFERENCE POINT(GRP.) THE ANTENNA IS A TRIMBLE TRM59800-80 WITH SCIT DOME. TRUE VERTICAL ANTENNA HEIGHT IS FROM THE GEODETIC REFERENCE POINT TO THE BOTTOM OF THE ANTENNA PRE-AMP(BPA) AND IS 0.027 FEET.

SURVEYOR'S NOTES:

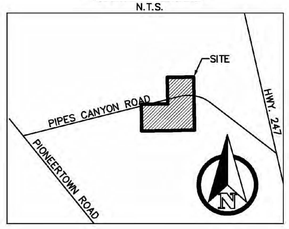
R1 INDICATES RECORD DATA PER PARCEL MAP NO. 6696, PMB 69/18-19
R2 INDICATES RECORD DATA PER RECORD OF SURVEY 107/70
R3 INDICATES RECORD DATA PER BLM DEPENDENT RESURVEY PLAT OF TOWNSHIP 1 NORTH, RANGE 5 EAST, S.B.M., DATED NOVEMBER 25, 1952.
R4 INDICATES RECORD DATA PER RECORD OF SURVEY 159/94
R5 INDICATES RECORD DATA PER PARCEL MAP NO. 8570, PMB 97/35-36
R6 INDICATES RECORD DATA PER RECORD OF SURVEY 150/34

GENERAL NOTES

1. THIS PROJECT CONSISTS OF 12 RESIDENTIAL LOTS. MINIMUM LOT SIZE IS 5 ACRES AND 1 REMAINDER PARCEL.
2. EXISTING LOT SIZE - APN 0594-351-36: 122.98 ACRES
3. EXISTING ZONING: MIXED: RL-5 (1 UNIT PER 5 ACRES), AND RC (RESOURCE CONSERVATION) AS INDICATED HEREON.
4. PROPOSED ZONING: RL-5 (1 UNIT PER 5 ACRES) AND RC (RESOURCE CONSERVATION) AS INDICATED HEREON
5. ASSESSORS PARCEL NUMBERS: 0594-351-36
6. THIS PROPERTY HAS NO ADDRESS.
7. EXISTING PROJECT SIZE: 122.98 ACRES (GROSS)
8. THIS PROJECT WILL BE SERVED BY THE FOLLOWING UTILITIES:
   A. SOUTHERN CALIFORNIA EDISON (ELECTRICITY)
      36100 CATHEDRAL CANYON DRIVE
      CATHEDRAL CITY, CA 92234
      800-655-4555
   B. ON-SITE PRIVATE PROPANE TANK (GAS)
   C. PRIVATE WELL (WATER)
   D. ON-SITE SEPTIC (SEWER)
9. THIS PROJECT IS INTENDED FOR LOT SALES.

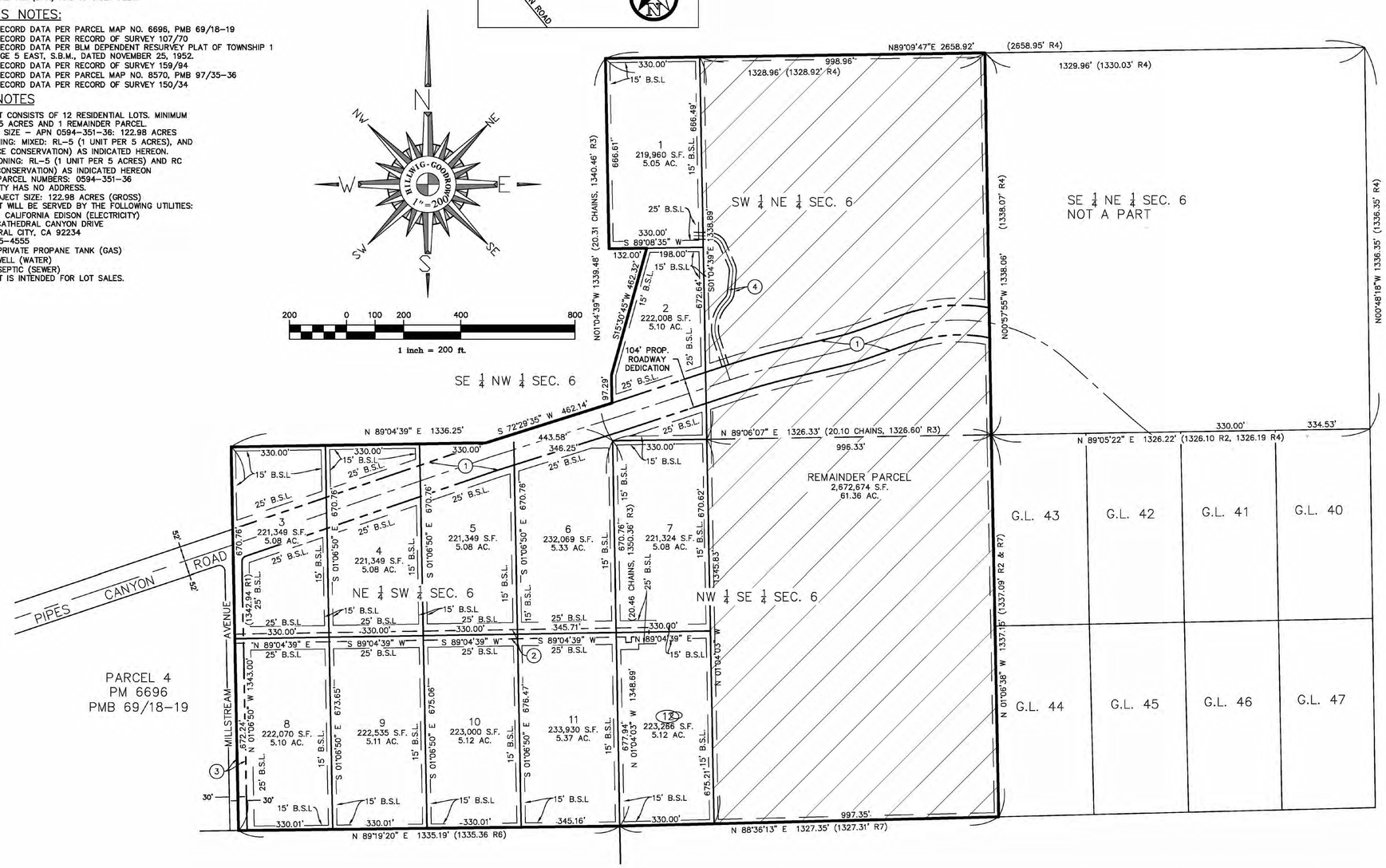
VICINITY MAP

N.T.S.



LEGEND

- PROJECT BOUNDARY
- EXISTING LOT LINE
- PROPOSED LOT LINE
- EXISTING EASEMENT
- PROPOSED EASEMENT
- PROPOSED RIGHT OF WAY
- EXISTING CENTERLINE
- PROPOSED CENTERLINE
- AREA ZONED RL-5
- AREA ZONED RC
- (1) PROPOSED 104 FEET WIDE R.O.W. DEDICATION, CENTERED ON EXISTING IMPROVEMENTS
- (2) 32 FEET WIDE PRIVATE ACCESS EASEMENT WITH 20 FEET WIDE PRIVATE GRADED ROAD
- (3) PROPOSED 30 FEET WIDE R.O.W. DEDICATION
- (4) PROPOSED 24 FEET WIDE DRIVEWAY EASEMENT
- B.S.L. BUILDING SETBACK LINE
- PM PARCEL MAP
- P.M.B. PARCEL MAP BOOK
- PROP. PROPOSED
- ROW RIGHT OF WAY
- SEC. SECTION



Revisions:				
No.	Date:	By:	Description:	Approved:

Designed: | Drawn: | Checked: ACH

Seal: PROFESSIONAL LAND SURVEYOR ALAN C. HILLWIG No. 5137 EXP. 6-30-25 STATE OF CALIFORNIA

Prepared under the Supervision of:

PROFESSIONAL LAND SURVEYOR
LICENSE NO. 5137

DATE

HILLWIG - GOODROW, INC.
Land Surveying - GPS Surveys - Aerial Mapping
31419 Outer Highway 10, Suite 1-200• Redlands, CA 92373 • (909) 794-2673

Scale: 1" = 200'
Date: September 13, 2024
BENCHMARK: SEE BENCHMARK NOTE ON SHEET 1

TENTATIVE TRACT MAP NO. 20612
APNS: 0594-351-32 & 33
PIPES CANYON ROAD, PIONEERTOWN

PREPARED FOR:
JONATHAN SHOKRIAN
53252 PIPES CANYON ROAD
PIONEERTOWN, CA 92268

F.N. | For: | F.B.

Sheet No. 1 OF 3 SHEET
FILE NO. 0972-002

IN THE UNINCORPORATED AREA OF SAN BERNARDINO COUNTY

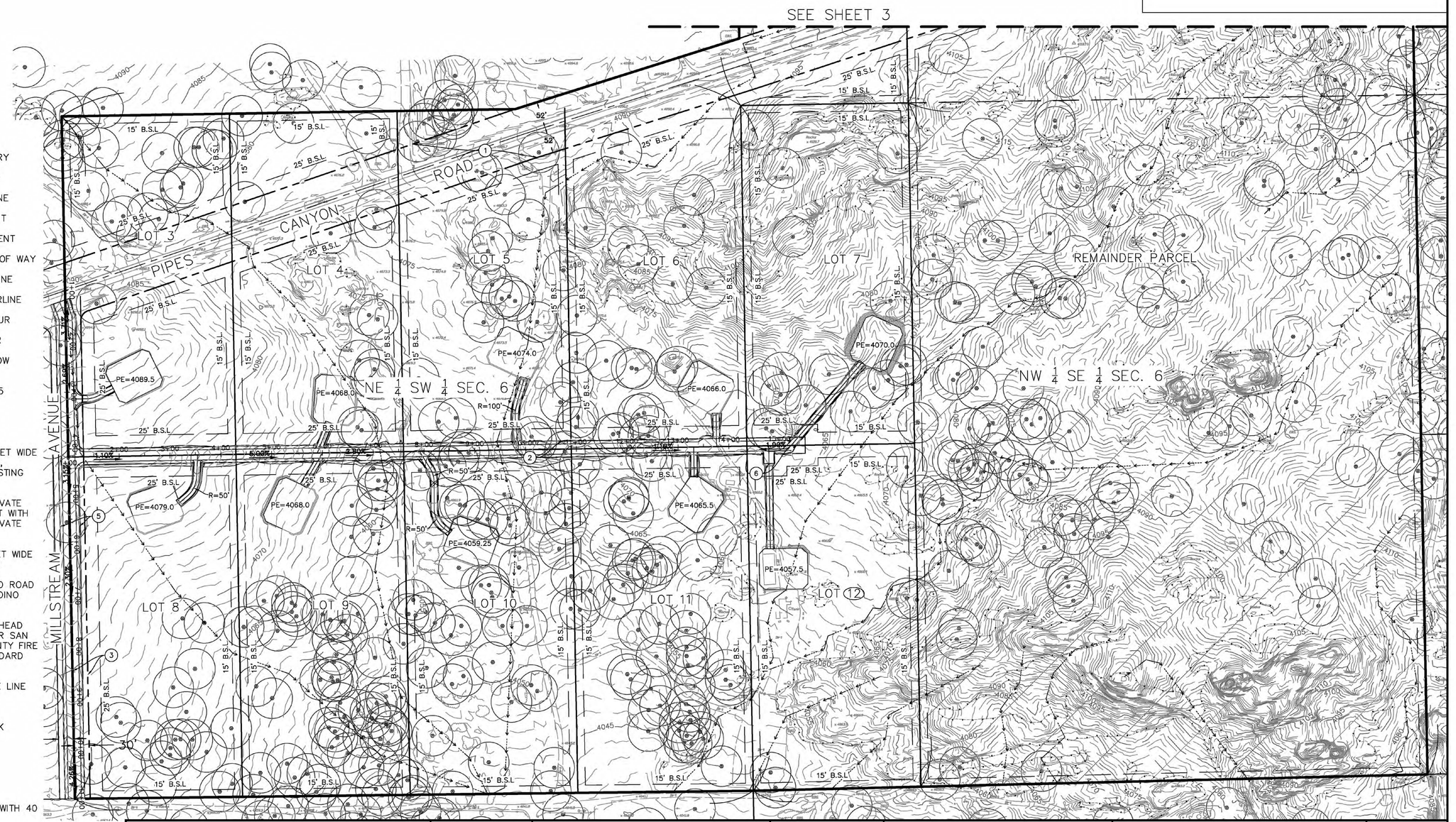
TENTATIVE TRACT MAP NO. 20612

BEING A SUBDIVISION OF THE SOUTHWEST ¼ OF THE NORTHEAST ¼ AND THE NORTHWEST ¼ OF THE SOUTHEAST ¼ AND THE NORTHEAST ¼ OF THE SOUTHWEST ¼ OF SECTION 6, TOWNSHIP 1 NORTH, RANGE 5 EAST, SAN BERNARDINO BASE AND MERIDIAN, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF, IN THE OFFICE OF THE COUNTY RECORDER OF SAID OFFICE

OFFICIAL USE ONLY

NOTES:

- ALL GRADED SLOPES SHOWN HEREON ARE 2:1
- BUILDING PADS SHOWN ARE 80' BY 95'
- DRIVEWAYS SHOWN ARE 12' WIDE
- BUILDING PADS AND DRIVEWAYS ARE SHOWN TO INDICATE FEASIBILITYMENT AND ARE NOT INTENDED TO BE A PART OF IMPROVEMENTS PERFORMED AS A PART OF THIS TRACT MAP.



LEGEND

———	PROJECT BOUNDARY
———	EXISTING LOT LINE
———	PROPOSED LOT LINE
— — —	EXISTING EASEMENT
— — —	PROPOSED EASEMENT
— — —	PROPOSED RIGHT OF WAY
———	EXISTING CENTERLINE
———	PROPOSED CENTERLINE
———	PROPOSED CONTOUR
———	EXISTING CONTOUR
> ---→ ---→ ---	WATERCOURSE FLOW
	AREA ZONED RL-5
	AREA ZONED RC
①	PROPOSED 104 FEET WIDE R.O.W. DEDICATION, CENTERED ON EXISTING IMPROVEMENTS
②	32 FEET WIDE PRIVATE ACCESS EASEMENT WITH 20 FEET WIDE PRIVATE GRADED ROAD
③	PROPOSED 30 FEET WIDE R.O.W. DEDICATION
⑤	PROPOSED GRADED ROAD PER SAN BERNARDINO COUNTY STD 114
⑥	MODIFIED HAMMERHEAD TURN AROUND PER SAN BERNARDINO COUNTY FIRE PREVENTION STANDARD DIAGRAM A-1.12
B.S.L.	BUILDING SETBACK LINE
PM	PARCEL MAP
P.M.B.	PARCEL MAP BOOK
PROP.	PROPOSED
ROW	RIGHT OF WAY
SEC.	SECTION
◎	REGULATED TREE WITH 40 FT. RADIUS

100 0 50 100 200 400

1 inch = 100 ft.

Revisions:

No.	Date:	By:	Description:	Approved:

Designed: | Drawn: | Checked: ACH

Seal: PROFESSIONAL LAND SURVEYOR ALAN C. HILLWIG No. 5137 EXP. 6-30-25 STATE OF CALIFORNIA

Prepared under the Supervision of:

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LICENSE NO. 5137

DATE

HILLWIG - GOODROW, INC.
Land Surveying - GPS Surveys - Aerial Mapping
31419 Outer Highway 10, Suite 1-200● Redlands, CA 92373 ● (909) 794-2673

Scale: 1" = 100'

BENCHMARK: SEE BENCHMARK NOTE ON SHEET 1

Date: September 13, 2024

TENTATIVE TRACT MAP NO. 20612
ACCESS AND PAD FEASABILITY EXHIBIT
PIPES CANYON ROAD, PIONEERTOWN

PREPARED FOR:
JONATHAN SHOKRIAN
53252 PIPES CANYON ROAD
PIONEERTOWN, CA 92268

F.N. | For: | F.B.

Sheet No. 2 OF 3 SHEET

FILE NO. 0972-002

IN THE UNINCORPORATED AREA OF SAN BERNARDINO COUNTY

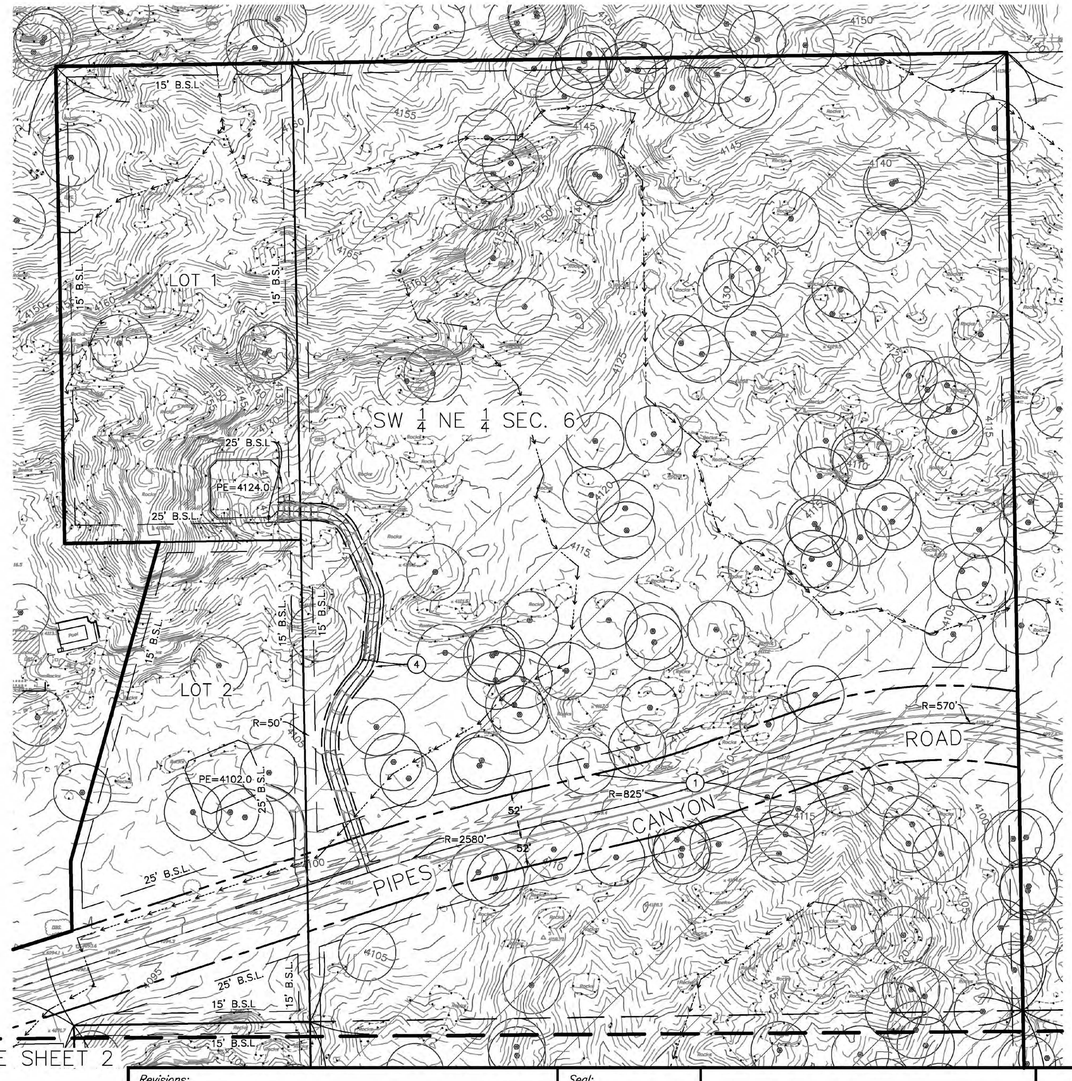
TENTATIVE TRACT MAP NO. 20612

BEING A SUBDIVISION OF THE SOUTHWEST ¼ OF THE NORTHEAST ¼ AND THE NORTHWEST ¼ OF THE SOUTHEAST ¼ AND THE NORTHEAST ¼ OF THE SOUTHWEST ¼ OF SECTION 6, TOWNSHIP 1 NORTH, RANGE 5 EAST, SAN BERNARDINO BASE AND MERIDIAN, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF, IN THE OFFICE OF THE COUNTY RECORDER OF SAID OFFICE

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LEGEND

	PROJECT BOUNDARY
	EXISTING LOT LINE
	PROPOSED LOT LINE
	EXISTING EASEMENT
	PROPOSED EASEMENT
	PROPOSED RIGHT OF WAY
	EXISTING CENTERLINE
	PROPOSED CENTERLINE
	PROPOSED CONTOUR
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B.S.L.	BUILDING SETBACK LINE
PM	PARCEL MAP
P.M.B.	PARCEL MAP BOOK
PROP.	PROPOSED
ROW	RIGHT OF WAY
SEC.	SECTION
	REGULATED TREE WITH 40 FT. RADIUS

150 0 75 150 300 600

1 inch = 150 ft.

Revisions:

No.	Date:	By:	Description:	Approved:

Designed: | Drawn: | Checked: ACH

Seal: PROFESSIONAL LAND SURVEYOR ALAN C. HILLWIG No. 5137 EXP. 6-30-25 STATE OF CALIFORNIA

Prepared under the Supervision of:

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HILLWIG - GOODROW, INC.

Land Surveying - GPS Surveys - Aerial Mapping

31419 Outer Highway 10, Suite 1-200• Redlands, CA 92373 • (909) 794-2673

Scale: 1" = 100' | BENCHMARK: SEE BENCHMARK NOTE ON SHEET 1

Date: September 13, 2024

F.N. | For: | F.B.

TENTATIVE TRACT MAP NO. 20612
ACCESS AND PAD FEASABILITY EXHIBIT
PIPES CANYON ROAD, PIONEERTOWN

PREPARED FOR:
JONATHAN SHOKRIAN
53252 PIPES CANYON ROAD
PIONEERTOWN, CA 92268

Sheet No. 3 OF 3 SHEET

FILE NO. 0972-002

Appendix C

POLLUTANTS OF CONCERN DEFINITIONS

Pollutants of Concern

- *Bacteria and Viruses* – Bacteria and Viruses are ubiquitous microorganisms that thrive under certain environmental conditions. Their proliferation is typically cause by the transport of animal or human fecal wastes from the watershed. Water, containing excessive bacteria and viruses, can alter the aquatic habitat and create a harmful environment for humans and aquatic life. Also, the decomposition of excess organic waste causes increased growth of undesirable organisms in the water.

- *Metals* – The primary source of metal pollution in stormwater is typically commercially available metals and metal products. Metals of concern include cadmium, chromium, copper, lead, mercury, and zinc. Lead and chromium have been used as corrosion inhibitors in primer coatings and cooling tower systems. Metals are also raw material components in non-metal products such as fuels, adhesives, paints, and other coatings. At low concentrations naturally occurring in soil, metals may not be toxic. However, at higher concentrations, certain metals can be toxic to aquatic life. Humans can be impacted from contaminated groundwater resources, and bioaccumulation of metals in fish and shellfish. Environmental concerns, regarding the potential for release of metals to the environment, have already led to restricted metal usage in certain applications (OC 2003).

- *Nutrients* – Nutrients are inorganic substances, such as nitrogen and phosphorus. Excessive discharge of nutrients to water bodies and streams causes eutrophication, where aquatic plants and algae growth can lead to excessive decay of organic matter in the water body, loss of oxygen in the water, release of toxins in sediment, and the eventual death of aquatic organisms. Primary sources of nutrients in urban runoff are fertilizers and eroded soils.

- *Pesticides* -- Pesticides (including herbicides) are chemical compounds commonly used to control nuisance growth or prevalence of organisms. Relatively low levels of the active component of pesticides can result in conditions of aquatic toxicity. Excessive or improper application of a pesticide may result in runoff containing toxic levels of its active ingredient (OC 2003).

- *Organic Compounds* – Organic compounds are carbon-based. Commercially available or naturally occurring organic compounds are found in pesticides, solvents, and hydrocarbons. Organic compounds can, at certain concentrations, indirectly or directly constitute a hazard to life or health. When rinsing off objects, toxic levels of solvents and cleaning compounds can be discharged to storm drains. Dirt, grease, and grime retained in the cleaning fluid or rinse water may also adsorb levels of organic compounds that are harmful or hazardous to aquatic life (OC 2003).

- *Sediments* – Sediments are solid materials that are eroded from the land surface. Sediments can increase turbidity, clog fish gills, reduce spawning habitat, lower young aquatic organisms survival rates, smother bottom dwelling organisms, and suppress aquatic vegetation growth.

- *Trash and Debris* – Trash (such as paper, plastic, polystyrene packing foam, and aluminum materials) and biodegradable organic matter (such as leaves, grass cuttings, and food waste) are

general waste products on the landscape. The presence of trash and debris may have a significant impact on the recreational value of a water body and aquatic habitat. Trash impacts water quality by increasing biochemical oxygen demand.

- *Oxygen-Demanding Substances* – This category includes biodegradable organic material as well as chemicals that react with dissolved oxygen in water to form other compounds. Proteins, carbohydrates, and fats are examples of biodegradable organic compounds. Compounds such as ammonia and hydrogen sulfide are examples of oxygen-demanding compounds. The oxygen demand of a substance can lead to depletion of dissolved oxygen in a water body and possibly the development of septic conditions. A reduction of dissolved oxygen is detrimental to aquatic life and can generate hazardous compounds such as hydrogen sulfides.

- *Oil and Grease* – Oil and grease in water bodies decreases the aesthetic value of the water body, as well as the water quality. Primary sources of oil and grease are petroleum hydrocarbon products, motor products from leaking vehicles, esters, oils, fats, waxes, and high molecular-weight fatty acids.

Appendix D

EDUCATIONAL MATERIALS AND BMP DETAILS

Building & Grounds Maintenance SC-41



Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	☑
Oil and Grease	☑
Organics	☑
Oxygen Demanding	☑

Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers and pesticides, suspended solids, heavy metals, and abnormal pH. Utilizing the following protocols will prevent or reduce the discharge of pollutants to stormwater from building and grounds maintenance activities by washing and cleaning up with as little water as possible, following good landscape management practices, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the stormwater collection system.

Approach

Pollution Prevention

- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Encourage proper lawn management and landscaping, including use of native vegetation.
- Encourage use of Integrated Pest Management techniques for pest control.
- Encourage proper onsite recycling of yard trimmings.
- Recycle residual paints, solvents, lumber, and other material as much as possible.

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Suggested Protocols

Pressure Washing of Buildings, Rooftops, and Other Large Objects

- In situations where soaps or detergents are used and the surrounding area is paved, pressure washers must use a waste water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.
- If soaps or detergents are not used, and the surrounding area is paved, wash water runoff does not have to be collected but must be screened. Pressure washers must use filter fabric or some other type of screen on the gronnd and/or in he catch basin to trap the particles in wash water runoff.
- If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement. Ensure that this practice does not kill grass.

Landscaping Activities

- Do not apply any chemicals (insecticide, herbicide, or fertilizer) directly to surface waters, unless the application is approved and permitted by the state.
- Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage, or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures on exposed soils.
- Check irrigation schedules so pesticides will not be washed away and to minimize non-stormwater discharge.

Building Repair, Remodeling, and Construction

- Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.
- Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.
- Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.
- Clean paint brushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.

- Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. The containment device(s) must be in place at the beginning of the work day, and accumulated dirty runoff and solids must be collected and disposed of before removing the containment device(s) at the end of the work day.
- If you need to de-water an excavation site, you may need to filter the water before discharging to a catch basin or off-site. In which case you should direct the water through hay bales and filter fabric or use other sediment filters or traps.
- Store toxic material under cover with secondary containment during precipitation events and when not in use. A cover would include tarps or other temporary cover material.

Mowing, Trimming, and Planting

- Dispose of leaves, sticks, or other collected vegetation as garbage, by composting or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures when soils are exposed.
- Place temporarily stockpiled material away from watercourses and drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Consider an alternative approach when bailing out muddy water; do not put it in the storm drain, pour over landscaped areas.
- Use hand or mechanical weeding where practical.

Fertilizer and Pesticide Management

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.
- Follow manufacturers' recommendations and label directions. Pesticides must never be applied if precipitation is occuring or predicted. Do not apply insecticides within 100 feet of surface waters such as lakes, ponds, wetlands, and streams.
- Use less toxic pesticides that will do the job, whenever possible. Avoid use of copper-based pesticides if possible.
- Do not use pesticides if rain is expected.
- Do not mix or prepare pesticides for application near storm drains.
- Use the minimum amount needed for the job.
- Calibrate fertilizer distributors to avoid excessive application.
- Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.

- Apply pesticides only when wind speeds are low.
- Work fertilizers into the soil rather than dumping or broadcasting them onto the surface.
- Irrigate slowly to prevent runoff and then only as much as is needed.
- Clean pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Dispose of empty pesticide containers according to the instructions on the container label.
- Use up the pesticides. Rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Implement storage requirements for pesticide products with guidance from the local fire department and County Agricultural Commissioner. Provide secondary containment for pesticides.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering, and repair leaks in the irrigation system as soon as they are observed.

Training

- Educate and train employees on use of pesticides and in pesticide application techniques to prevent pollution.
- Train employees and contractors in proper techniques for spill containment and cleanup.
- Be sure the frequency of training takes into account the complexity of the operations and the nature of the staff.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup
- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- Alternative pest/weed controls may not be available, suitable, or effective in many cases.

Requirements

Costs

- Overall costs should be low in comparison to other BMPs.

Maintenance

- Sweep paved areas regularly to collect loose particles, and wipe up spills with rags and other absorbent material immediately, do not hose down the area to a storm drain.

Supplemental Information

Further Detail of the BMP

Fire Sprinkler Line Flushing

Building fire sprinkler line flushing may be a source of non-stormwater runoff pollution. The water entering the system is usually potable water though in some areas it may be non-potable reclaimed wastewater. There are subsequent factors that may drastically reduce the quality of the water in such systems. Black iron pipe is usually used since it is cheaper than potable piping but it is subject to rusting and results in lower quality water. Initially the black iron pipe has an oil coating to protect it from rusting between manufacture and installation; this will contaminate the water from the first flush but not from subsequent flushes. Nitrates, poly-phosphates and other corrosion inhibitors, as well as fire suppressants and antifreeze may be added to the sprinkler water system. Water generally remains in the sprinkler system a long time, typically a year, between flushes and may accumulate iron, manganese, lead, copper, nickel and zinc. The water generally becomes anoxic and contains living and dead bacteria and breakdown products from chlorination. This may result in a significant BOD problem and the water often smells. Consequently dispose fire sprinkler line flush water into the sanitary sewer. Do not allow discharge to storm drain or infiltration due to potential high levels of pollutants in fire sprinkler line water.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

King County - ftp://dnr.metrokc.gov/wlr/dss/spcm/Chapter%203.PDF

Orange County Stormwater Program
http://www.ocwatersheds.com/StormWater/swp_introduction.asp

Mobile Cleaners Pilot Program: Final Report. 1997. Bay Area Stormwater Management Agencies Association (BASSMA) http://www.basmaa.org/

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA) http://www.basmaa.org/

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP) -
http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf

Landscape Maintenance SC-73



Objectives

- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	
Bacteria	
Oil and Grease	
Organics	
Oxygen Demanding	☑

Description

Landscape maintenance activities include vegetation removal; herbicide and insecticide application; fertilizer application; watering; and other gardening and lawn care practices. Vegetation control typically involves a combination of chemical (herbicide) application and mechanical methods. All of these maintenance practices have the potential to contribute pollutants to the storm drain system. The major objectives of this BMP are to minimize the discharge of pesticides, herbicides and fertilizers to the storm drain system and receiving waters; prevent the disposal of landscape waste into the storm drain system by collecting and properly disposing of clippings and cuttings, and educating employees and the public.

Approach

Pollution Prevention

- Implement an integrated pest management (IPM) program. IPM is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools.
- Choose low water using flowers, trees, shrubs, and groundcover.
- Consider alternative landscaping techniques such as naturescaping and xeriscaping.
- Conduct appropriate maintenance (i.e. properly timed fertilizing, weeding, pest control, and pruning) to help preserve the landscapes water efficiency.

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CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Consider grass cycling (grass cycling is the natural recycling of grass by leaving the clippings on the lawn when mowing. Grass clippings decompose quickly and release valuable nutrients back into the lawn).

Suggested Protocols

Mowing, Trimming, and Weeding

- Whenever possible use mechanical methods of vegetation removal (e.g mowing with tractor-type or push mowers, hand cutting with gas or electric powered weed trimmers) rather than applying herbicides. Use hand weeding where practical.
- Avoid loosening the soil when conducting mechanical or manual weed control, this could lead to erosion. Use mulch or other erosion control measures when soils are exposed.
- Performing mowing at optimal times. Mowing should not be performed if significant rain events are predicted.
- Mulching mowers may be recommended for certain flat areas. Other techniques may be employed to minimize mowing such as selective vegetative planting using low maintenance grasses and shrubs.
- Collect lawn and garden clippings, pruning waste, tree trimmings, and weeds. Chip if necessary, and compost or dispose of at a landfill (see waste management section of this fact sheet).
- Place temporarily stockpiled material away from watercourses, and berm or cover stockpiles to prevent material releases to storm drains.

Planting

- Determine existing native vegetation features (location, species, size, function, importance) and consider the feasibility of protecting them. Consider elements such as their effect on drainage and erosion, hardiness, maintenance requirements, and possible conflicts between preserving vegetation and the resulting maintenance needs.
- Retain and/or plant selected native vegetation whose features are determined to be beneficial, where feasible. Native vegetation usually requires less maintenance (e.g., irrigation, fertilizer) than planting new vegetation.
- Consider using low water use groundcovers when planting or replanting.

Waste Management

- Compost leaves, sticks, or other collected vegetation or dispose of at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Place temporarily stockpiled material away from watercourses and storm drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Reduce the use of high nitrogen fertilizers that produce excess growth requiring more frequent mowing or trimming.

- Avoid landscape wastes in and around storm drain inlets by either using bagging equipment or by manually picking up the material.

Irrigation

- Where practical, use automatic timers to minimize runoff.
- Use popup sprinkler heads in areas with a lot of activity or where there is a chance the pipes may be broken. Consider the use of mechanisms that reduce water flow to sprinkler heads if broken.
- Ensure that there is no runoff from the landscaped area(s) if re-claimed water is used for irrigation.
- If bailing of muddy water is required (e.g. when repairing a water line leak), do not put it in the storm drain; pour over landscaped areas.
- Irrigate slowly or pulse irrigate to prevent runoff and then only irrigate as much as is needed.
- Apply water at rates that do not exceed the infiltration rate of the soil.

Fertilizer and Pesticide Management

- Utilize a comprehensive management system that incorporates integrated pest management (IPM) techniques. There are many methods and types of IPM, including the following:
  - Mulching can be used to prevent weeds where turf is absent, fencing installed to keep rodents out, and netting used to keep birds and insects away from leaves and fruit.
  - Visible insects can be removed by hand (with gloves or tweezers) and placed in soapy water or vegetable oil. Alternatively, insects can be sprayed off the plant with water or in some cases vacuumed off of larger plants.
  - Store-bought traps, such as species-specific, pheromone-based traps or colored sticky cards, can be used.
  - Slugs can be trapped in small cups filled with beer that are set in the ground so the slugs can get in easily.
  - In cases where microscopic parasites, such as bacteria and fungi, are causing damage to plants, the affected plant material can be removed and disposed of (pruning equipment should be disinfected with bleach to prevent spreading the disease organism).
  - Small mammals and birds can be excluded using fences, netting, tree trunk guards.
  - Beneficial organisms, such as bats, birds, green lacewings, ladybugs, praying mantis, ground beetles, parasitic nematodes, trichogramma wasps, seed head weevils, and spiders that prey on detrimental pest species can be promoted.
- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.

- Use pesticides only if there is an actual pest problem (not on a regular preventative schedule).
- Do not use pesticides if rain is expected. Apply pesticides only when wind speeds are low (less than 5 mph).
- Do not mix or prepare pesticides for application near storm drains.
- Prepare the minimum amount of pesticide needed for the job and use the lowest rate that will effectively control the pest.
- Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Calibrate fertilizer and pesticide application equipment to avoid excessive application.
- Periodically test soils for determining proper fertilizer use.
- Sweep pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Purchase only the amount of pesticide that you can reasonably use in a given time period (month or year depending on the product).
- Triple rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Dispose of empty pesticide containers according to the instructions on the container label.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering, and repair leaks in the irrigation system as soon as they are observed.
- Inspect pesticide/fertilizer equipment and transportation vehicles daily.

Training

- Educate and train employees on use of pesticides and in pesticide application techniques to prevent pollution. Pesticide application must be under the supervision of a California qualified pesticide applicator.
- Train/encourage municipal maintenance crews to use IPM techniqnes for managing pnblic green areas.
- Annually train employees within departments responsible for pesticide application on the appropriate portions of the agency's IPM Policy, SOPs, and BMPs, and the latest IPM techniques.

- Employees who are not authorized and trained to apply pesticides should be periodically (at least annually) informed that they cannot use over-the-counter pesticides in or around the workplace.
- Use a training log or similar method to document training.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup
- Have spill cleanup materials readily available and in a know in location
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- The Federal Pesticide, Fungicide, and Rodenticide Act and California Title 3, Division 6, Pesticides and Pest Control Operations place strict controls over pesticide application and handling and specify training, annual refresher, and testing requirements. The regulations generally cover: a list of approved pesticides and selected uses, updated regularly; general application information; equipment use and maintenance procedures; and record keeping. The California Department of Pesticide Regulations and the County Agricultural Commission coordinate and maintain the licensing and certification programs. All public agency employees who apply pesticides and herbicides in "agricultural use" areas such as parks, golf courses, rights-of-way and recreation areas should be properly certified in accordance with state regulations. Contracts for landscape maintenance should include similar requirements.
- All employees who handle pesticides should be familiar with the most recent material safety data sheet (MSDS) files.
- Municipalities do not have the authority to regulate the use of pesticides by school districts, however the California Healthy Schools Act of 2000 (AB 2260) has imposed requirements on California school districts regarding pesticide use in schools. Posting of notification prior to the application of pesticides is now required, and IPM is stated as the preferred approach to pest management in schools.

Requirements

Costs

Additional training of municipal employees will be required to address IPM techniques and BMPs. IPM methods will likely increase labor cost for pest control which may be offset by lower chemical costs.

Maintenance

Not applicable

Supplemental Information

Further Detail of the BMP

Waste Management

Composting is one of the better disposal alternatives if locally available. Most municipalities either have or are planning yard waste composting facilities as a means of reducing the amount of waste going to the landfill. Lawn clippings from municipal maintenance programs as well as private sources would probably be compatible with most composting facilities

Contractors and Other Pestieide Users

Municipal agencies should develop and implement a process to ensure that any contractor employed to conduct pest control and pesticide application on municipal property engages in pest control methods consistent with the IPM Policy adopted by the agency. Specifically, municipalities should require contractors to follow the agency's IPM policy, SOPs, and BMPs; provide evidence to the agency of having received training on current IPM techniques when feasible; provide documentation of pesticide use on agency property to the agency in a timely manner.

References and Resources

King County Stormwater Pollution Control Manual. Best Management Practices for Businesses. 1995. King County Surface Water Management. July. On-line: http://dnr.metrokc.gov/wlr/dss/spcm.htm

Los Angeles County Stormwater Quality Model Programs. Public Agency Activities http://ladpw.org/wmd/npdes/model_links.cfm

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July. 1998.

Orange County Stormwater Program http://www.ocwatersheds.com/StormWater/swp_introduction.asp

Santa Clara Valley Urban Runoff Pollution Prevention Program. 1997 Urban Runoff Management Plan. September 1997, updated October 2000.

United States Environmental Protection Agency (USEPA). 2002. Pollntion Prevention/Good Housekeeping for Municipal Operations Landscaping and Lawn Care. Office of Water. Office of Wastewater Management. On-line: http://www.epa.gov/npdes/menuofbmps/poll_8.htm

Infiltration Basin TC-11



Design Considerations

- Soil for Infiltration
- Slope
- Aesthetics

Targeted Constituents

☑	Sediment	■
☑	Nutrients	■
☑	Trash	■
☑	Metals	■
☑	Bacteria	■
☑	Oil and Grease	■
☑	Organics	■

Legend ***(Removal Effectiveness)***

- ● Low
- ■ High
- ▲ Medium

Description

An infiltration basin is a shallow impoundment that is designed to infiltrate stormwater. Infiltration basins use the natural filtering ability of the soil to remove pollutants in stormwater runoff. Infiltration facilities store runoff until it gradually exfiltrates through the soil and eventually into the water table. This practice has high pollutant removal efficiency and can also help recharge groundwater, thus helping to maintain low flows in stream systems. Infiltration basins can be challenging to apply on many sites, however, because of soils requirements. In addition, some studies have shown relatively high failure rates compared with other management practices.

California Experience

Infiltration basins have a long history of use in California, especially in the Central Valley. Basins located in Fresno were among those initially evaluated in the National Urban Runoff Program and were found to be effective at reducing the volume of runoff, while posing little long-term threat to groundwater quality (EPA, 1983; Schroeder, 1995). Proper siting of these devices is crucial as underscored by the experience of Caltrans in siting two basins in Southern California. The basin with marginal separation from groundwater and soil permeability failed immediately and could never be rehabilitated.

Advantages

- Provides 100% reduction in the load discharged to surface waters.
- The principal benefit of infiltration basins is the approximation of pre-development hydrology during which a

significant portion of the average annual rainfall runoff is infiltrated and evaporated rather than flushed directly to creeks.

- If the water quality volume is adequately sized, infiltration basins can be useful for providing control of channel forming (erosion) and high frequency (generally less than the 2-year) flood events.

Limitations

- May not be appropriate for industrial sites or locations where spills may occur.
- Infiltration basins require a minimum soil infiltration rate of 0.5 inches/hour, not appropriate at sites with Hydrologic Soil Types C and D.
- If infiltration rates exceed 2.4 inches/hour, then the runoff should be fully treated prior to infiltration to protect groundwater quality.
- Not suitable on fill sites or steep slopes.
- Risk of groundwater contamination in very coarse soils.
- Upstream drainage area must be completely stabilized before construction.
- Difficult to restore functioning of infiltration basins once clogged.

Design and Sizing Guidelines

- Water quality volume determined by local requirements or sized so that 85% of the annual runoff volume is captured.
- Basin sized so that the entire water quality volume is infiltrated within 48 hours.
- Vegetation establishment on the basin floor may help reduce the clogging rate.

Construction/Inspection Considerations

- Before construction begins, stabilize the entire area draining to the facility. If impossible, place a diversion berm around the perimeter of the infiltration site to prevent sediment entrance during construction or remove the top 2 inches of soil after the site is stabililized. Stabilize the entire contributing drainage area, including the side slopes, before allowing any runoff to enter once construction is complete.
- Place excavated material such that it can not be washed back into the basin if a storm occurs during construction of the facility.
- Build the basin without driving heavy equipment over the infiltration surface. Any equipment driven on the surface should have extra-wide ("low pressure") tires. Prior to any construction, rope off the infiltration area to stop entrance by unwanted equipment.
- After final grading, till the infiltration surface deeply.
- Use appropriate erosion control seed mix for the specific project and location.

Performance

As water migrates through porous soil and rock, pollutant attenuation mechanisms include precipitation, sorption, physical filtration, and bacterial degradation. If functioning properly, this approach is presumed to have high removal efficiencies for particulate pollutants and moderate removal of soluble pollutants. Actual pollutant removal in the subsurface would be expected to vary depending upon site-specific soil types. This technology eliminates discharge to surface waters except for the very largest storms; consequently, complete removal of all stormwater constituents can be assumed.

There remain some concerns about the potential for groundwater contamination despite the findings of the NURP and Nightingale (1975; 1987a,b,c; 1989). For instance, a report by Pitt et al. (1994) highlighted the potential for groundwater contamination from intentional and unintentional stormwater infiltration. That report recommends that infiltration facilities not be sited in areas where high concentrations are present or where there is a potential for spills of toxic material. Conversely, Schroeder (1995) reported that there was no evidence of groundwater impacts from an infiltration basin serving a large industrial catchment in Fresno, CA.

Siting Criteria

The key element in siting infiltration basins is identifying sites with appropriate soil and hydrogeologic properties, which is critical for long term performance. In one study conducted in Prince George's County, Maryland (Galli, 1992), all of the infiltration basins investigated clogged within 2 years. It is believed that these failures were for the most part due to allowing infiltration at sites with rates of less than 0.5 in/hr, basing siting on soil type rather than field infiltration tests, and poor construction practices that resulted in soil compaction of the basin invert.

A study of 23 infiltration basins in the Pacific Northwest showed better long-term performance in an area with highly permeable soils (Hilding, 1996). In this study, few of the infiltration basins had failed after 10 years. Consequently, the following guidelines for identifying appropriate soil and subsurface conditions should be rigorously adhered to.

- Determine soil type (consider RCS soil type 'A, B or C' only) from mapping and consult USDA soil survey tables to review other parameters such as the amount of silt and clay, presence of a restrictive layer or seasonal high water table, and estimated permeability. The soil should not have more than 30% clay or more than 40% of clay and silt combined. Eliminate sites that are clearly unsuitable for infiltration.

- Groundwater separation should be at least 3 m from the basin invert to the measured ground water elevation. There is concern at the state and regional levels of the impact on groundwater quality from infiltrated runoff, especially when the separation between groundwater and the surface is small.

- Location away from buildings, slopes and highway pavement (greater than 6 m) and wells and bridge structures (greater than 30 m). Sites constructed of fill, having a base flow or with a slope greater than 15% should not be considered.

- Ensure that adequate head is available to operate flow splitter structures (to allow the basin to be offline) without ponding in the splitter structure or creating backwater upstream of the splitter.

- Base flow should not be present in the tributary watershed.

Secondary Screening Based on Site Geotechnical Investigation

- At least three in-hole conductivity tests shall be performed using USBR 7300-89 or Bouwer-Rice procedures (the latter if groundwater is encountered within the boring), two tests at different locations within the proposed basin and the third down gradient by no more than approximately 10 m. The tests shall measure permeability in the side slopes and the bed within a depth of 3 m of the invert.

- The minimum acceptable hydraulic conductivity as measured in any of the three required test holes is 13 mm/hr. If any test hole shows less than the minimum value, the site should be disqualified from further consideration.

- Exclude from consideration sites constructed in fill or partially in fill unless no silts or clays are present in the soil boring. Fill tends to be compacted, with clays in a dispersed rather than flocculated state, greatly reducing permeability.

- The geotechnical investigation should be such that a good understanding is gained as to how the stormwater runoff will move in the soil (horizontally or vertically) and if there are any geological conditions that could inhibit the movement of water.

Additional Design Guidelines

(1) Basin Sizing - The required water quality volume is determined by local regulations or sufficient to capture 85% of the annual runoff.

(2) Provide pretreatment if sediment loading is a maintenance concern for the basin.

(3) Include energy dissipation in the inlet design for the basins. Avoid designs that include a permanent pool to reduce opportunity for standing water and associated vector problems.

(4) Basin invert area should be determined by the equation:

$$A = \frac{WQV}{kt}$$

where A = Basin invert area (m^2)

WQV = water quality volume (m^3)

k = 0.5 times the lowest field-measured hydraulic conductivity (m/hr)

t = drawdown time (48 hr)

(5) The use of vertical piping, either for distribution or infiltration enhancement shall not be allowed to avoid device classification as a Class V injection well per 40 CFR146.5(e)(4).

Maintenance

Regular maintenance is critical to the successful operation of infiltration basins. Recommended operation and maintenance guidelines include:

- Inspections and maintenance to ensure that water infiltrates into the subsurface completely (recommended infiltration rate of 72 hours or less) and that vegetation is carefully managed to prevent creating mosquito and other vector habitats.
- Observe drain time for the design storm after completion or modification of the facility to confirm that the desired drain time has been obtained.
- Schedule semiannual inspections for beginning and end of the wet season to identify potential problems such as erosion of the basin side slopes and invert, standing water, trash and debris, and sediment accumulation.
- Remove accumulated trash and debris in the basin at the start and end of the wet season.
- Inspect for standing water at the end of the wet season.
- Trim vegetation at the beginning and end of the wet season to prevent establishment of woody vegetation and for aesthetic and vector reasons.
- Remove accumulated sediment and regrade when the accumulated sediment volume exceeds 10% of the basin.
- If erosion is occurring within the basin, revegetate immediately and stabilize with an erosion control mulch or mat until vegetation cover is established.
- To avoid reversing soil development, scarification or other disturbance should only be performed when there are actual signs of clogging, rather than on a routine basis. Always remove deposited sediments before scarification, and use a hand-guided rotary tiller, if possible, or a disc harrow pulled by a very light tractor.

Cost

Infiltration basins are relatively cost-effective practices because little infrastructure is needed when constructing them. One study estimated the total construction cost at about $2 per ft (adjusted for inflation) of storage for a 0.25-acre basin (SWRPC, 1991). As with other BMPs, these published cost estimates may deviate greatly from what might be incurred at a specific site. For instance, Caltrans spent about $18/ft^3 for the two infiltration basins constructed in southern California, each of which had a water quality volume of about 0.34 ac.-ft. Much of the higher cost can be attributed to changes in the storm drain system necessary to route the runoff to the basin locations.

Infiltration basins typically consume about 2 to 3% of the site draining to them, which is relatively small. Additional space may be required for buffer, landscaping, access road, and fencing. Maintenance costs are estimated at 5 to 10% of construction costs.

One cost concern associated with infiltration practices is the maintenance burden and longevity. If improperly maintained, infiltration basins have a high failure rate. Thus, it may be necessary to replace the basin with a different technology after a relatively short period of time.

References and Sources of Additional Information

Caltrans, 2002, BMP Retrofit Pilot Program Proposed Final Report, Rpt. CTSW-RT-01-050, California Dept. of Transportation, Sacramento, CA.

Galli, J. 1992. *Analysis of Urban BMP Performance and Longevity in Prince George's County, Maryland.* Metropolitan Washington Council of Governments, Washington, DC.

Hilding, K. 1996. Longevity of infiltration basins assessed in Puget Sound. *Watershed Protection Techniques* 1(3):124–125.

Maryland Department of the Environment (MDE). 2000. *Maryland Stormwater Design Manual.* http://www.mde.state.md.us/environment/wma/stormwatermanual. Accessed May 22, 2002.

Metzger, M. E., D. F. Messer, C. L. Beitia, C. M. Myers, and V. L. Kramer. 2002. The Dark Side Of Stormwater Runoff Management: Disease Vectors Associated With Structural BMPs. Stormwater 3(2): 24-39.

Nightingale, H.I., 1975, "Lead, Zinc, and Copper in Soils of Urban Storm-Runoff Retention Basins," American Water Works Assoc. Journal. Vol. 67, p. 443-446.

Nightingale, H.I., 1987a, "Water Quality beneath Urban Runoff Water Management Basins," Water Resources Bulletin, Vol. 23, p. 197-205.

Nightingale, H.I., 1987b, "Accumulation of As, Ni, Cu, and Pb in Retention and Recharge Basin Soils from Urban Runoff," Water Resources Bulletin, Vol. 23, p. 663-672.

Nightingale, H.I., 1987c, "Organic Pollutants in Soils of Retention/Recharge Basins Receiving Urban Runoff Water," Soil Science Vol. 148, pp. 39-45.

Nightingale, H.I., Harrison, D., and Salo, J.E., 1985, "An Evaluation Technique for Ground-water Quality Beneath Urban Runoff Retention and Percolation Basins," Ground Water Monitoring Review, Vol. 5, No. 1, pp. 43-50.

Oberts, G. 1994. Performance of Stormwater Ponds and Wetlands in Winter. *Watershed Protection Techniques* 1(2): 64–68.

Pitt, R., et al. 1994, *Potential Groundwater Contamination from Intentional and Nonintentional Stormwater Infiltration*, EPA/600/R-94/051, Risk Reduction Engineering Laboratory, U.S. EPA, Cincinnati, OH.

Schueler, T. 1987. *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs.* Metropolitan Washington Council of Governments, Washington, DC.

Schroeder, R.A., 1995, *Potential For Chemical Transport Beneath a Storm-Runoff Recharge (Retention) Basin for an Industrial Catchment in Fresno, CA*, USGS Water-Resource Investigations Report 93-4140.

Southeastern Wisconsin Regional Planning Commission (SWRPC). 1991. *Costs of Urban Nonpoint Source Water Pollution Control Measures*. Southeastern Wisconsin Regional Planning Commission, Waukesha, WI.

U.S. EPA, 1983, *Results of the Nationwide Urban Runoff Program: Volume 1 – Final Report*, WH-554, Water Planning Division, Washington, DC.

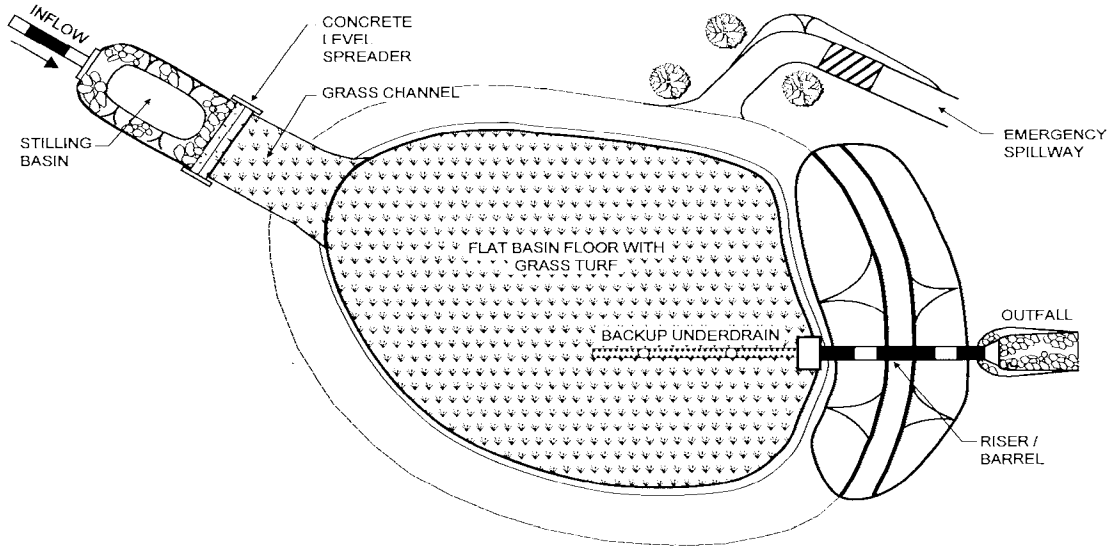
Watershed Management Institute (WMI). 1997. *Operation, Maintenance, and Management of Stormwater Management Systems*. Prepared for U.S. Environmental Protection Agency Office of Water, Washington, DC.

Information Resources

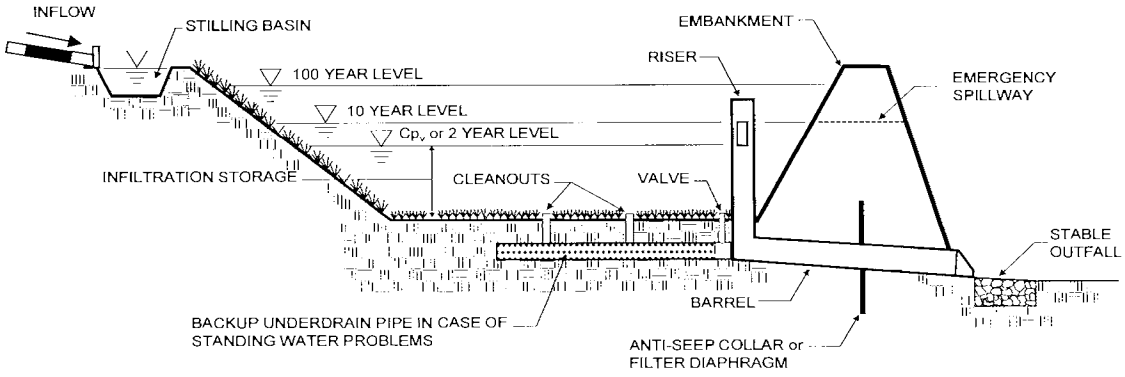
Center for Watershed Protection (CWP). 1997. *Stormwater BMP Design Supplement for Cold Climates*. Prepared for U.S. Environmental Protection Agency Office of Wetlands, Oceans and Watersheds. Washington, DC.

Ferguson, B.K., 1994. *Stormwater Infiltration*. CRC Press, Ann Arbor, MI.

USEPA. 1993. *Guidance to Specify Management Measures for Sources of Nonpoint Pollution in Coastal Waters*. EPA-840-B-92-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC.



PLAN VIEW



PROFILE

Stormwater Pollution Prevention

Best Management Practices for Homeowner's Associations, Property Managers and Property Owners

Your Guide To Maintaining Water Friendly Standards In Your Community

sbcountystormwater.org

Big Bear · Chino · Chino Hills · Colton · Fontana · Grand Terrace · Highland · Loma Linda · Montclair · Ontario · Rancho Cucamonga
Redlands · Rialto · San Bernardino · San Bernardino County · San Bernardino County Flood Control District · Upland · Yucaipa

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COMMERCIAL TRASH ENCLOSURES

FOLLOW THESE **REQUIREMENTS** TO **KEEP OUR WATERWAYS CLEAN**

Trash enclosures, such as those found in commercial and apartment complexes, typically contain materials that are intended to find their way to a landfill or a recycling facility. **These materials are NOT meant to go into our local lakes and rivers.**

PROTECT WATER QUALITY BY FOLLOWING THESE SIMPLE STEPS

PUT TRASH INSIDE



Place trash inside the bin (preferably in sealed bags)

CLOSE THE LID



Prevent rain from entering the bin in order to avoid leakage of polluted water runoff

KEEP TOXICS OUT



- Paint
- Grease, fats and used oils
- Batteries, electronics and fluorescent lights

SOME ADDITIONAL GUIDELINES, INCLUDE

SWEEP FREQUENTLY
Sweep trash enclosure areas frequently, instead of hosing them down, to prevent polluted water from flowing into the streets and storm drains.

FIX LEAKS
Address trash bin leaks immediately by using dry clean up methods and report to your waste hauler to receive a replacement.

CONSTRUCT ROOF
Construct a solid cover roof over the existing trash enclosure structure to prevent rainwater from coming into contact with trash and garbage. Check with your local City/County for Building Codes.

In San Bernardino County, stormwater pollution is caused by food waste, landscape waste, chemicals and other debris that are washed into storm drains and end up in our waterways - untreated! You can be part of the solution by maintaining a water-friendly trash enclosure.

THANK YOU FOR HELPING TO KEEP SAN BERNARDINO COUNTY CLEAN AND HEALTHY!

In the event of a spill or discharge to a storm drain or waterway, contact San Bernadino County Stormwater immediately: (877) WASTE18 | sbcountystormwater.org/report

sbcountystormwater.org

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CESQG PROGRAM

Conditionally Exempt Small Quantity Generator

WHAT IS A CESQG?

Businesses that generate 27 gallons or 220 lbs. of hazardous waste, or 2.2 lbs. of extremely hazardous waste per month are called "Conditionally Exempt Small Quantity Generators," or CESQGs. San Bernardino County Household Hazardous Program provides waste management services to CESQG businesses. The most common CESQGs in San Bernardino County are painters, print shops, auto shops, builders, agricultural operators and property managers, but there are many others. When you call, be ready to describe the types and amounts of waste your business generates in a typical month. If you generate hazardous waste on a regular basis, you must:

- Register with San Bernardino County Fire Department (909) 386-8401 as a hazardous waste generator.
- To obtain an EPA ID# and application form from the State visit www.dtsc.ca.gov.
- Manage hazardous waste in accordance with all applicable local, state and federal laws and regulations.

HOW DO I GET SERVICE?

To arrange an appointment for the CESQG Program, call 1-800-OILY CAT or 909-382-5401. Be ready to describe the type and amount of hazardous waste your business is ready to dispose of, and the types and size(s) of containers that the waste is in.

Waste Type and Cost

There is a small handling fee involved in the collection of hazardous waste from your business. Disposal costs depend on the type of waste.

Aerosols	$1.29/lb.
Automobile motor oil	$.73/gal.
Anti-freeze	$1.57/gal.
Contaminated oil	$4.48/gal.
Car batteries	$.62/ea.
Corrosive liquids, solids	$2.80/lb.
Flammable solids, liquids	$1.57/lb.
Latex Paint	$.73/lb.
Mercury	$10.08/lb.
NiCad/Alkaline Batteries	$2.13/lb.
Oil Base Paints	$1.00/lb.
Oil Filters	$.56/ea.
Oxidizers	$9.63/lb.
PCB Ballasts	$5.94/lb.
Pesticides (most)	$2.91/lb.
Photofixer, developer	$4.31/gal.
Television & Monitors	$11.20/ea.
Additional Handling	$138.00/hr.

Rates subject to change without notice

WE CANNOT ACCEPT

- Radioactives
- Water reactives
- Explosives
- Compressed gas cylinders
- Medical or biohazardous waste
- Asbestos
- Remediation wastes

HAZARDOUS WASTE

WHY IS THE FIRE DEPARTMENT COLLECTING HAZARDOUS WASTE?

Small Quantity Generators often have difficulty disposing of small quantities of hazardous waste. Hazardous waste companies usually have a minimum amount of waste that they will pick up, or charge a minimum fee for service. Typically, the minimum fee exceeds the cost of disposal for the hazardous waste. This leaves the small quantity generator in a difficult situation. Some respond by storing hazardous waste until it becomes economical for the hazardous waste transporter to pick it up, putting the business out of compliance by exceeding regulatory accumulation time limits. Other businesses simply store their hazardous wastes indefinitely, creating an unsafe work environment and exceeding accumulation time limits. Yet other businesses attempt to illegally dispose of their waste at household hazardous waste collection facilities. These facilities are not legally permitted to accept commercial wastes, nor are prepared to provide legal documentation for commercial hazardous waste disposal. In answer to the problems identified above, the San Bernardino County Fire Department Household Hazardous Program instituted the Conditionally Exempt Small Quantity Generator Program.

PAYMENT FOR SERVICES

The CESQG Program will prepare an invoice for your business at the time of service. You can pay at the time of service with cash or a check, or you can mail your payment to the Fire Department within 30 days. Please note that we do not accept credit card payments. The preferred method of payment is to handle payment at time of service. Additional charges may apply for accounts not paid within 30 days.

ARE THERE ANY OTHER WAYS THAT I CAN SAVE MONEY ON HAZARDOUS WASTE DISPOSAL?

Yes! First, start by reducing the amount of waste that you produce by changing processes or process chemicals, at your business. Next, examine if there is a way that you can recycle your waste back into your processes. Network with similar businesses or trade associations for waste minimization and pollution prevention solutions.

WHAT IF YOUR BUSINESS DOES NOT QUALIFY?

Call the San Bernardino County Fire Department Field Services Division for assistance with hazardous waste management at 909-386-8401. If you reduce the amount of waste you generate each month to 27 gallons or less, you may qualify in the future.

WHAT HAPPENS TO YOUR HAZARDOUS WASTE?

Hazardous waste collected by the CESQG Program is transported to a state permitted processing facility in San Bernardino. The waste is further processed at this point and packaged for off-site recycling (oil filters, oil, latex paint, antifreeze, and batteries) or destructive incineration (pesticides, corrosives, flammables, oil based paint).

San Bernardino County Fire Department
CESQG Program
2824 East "W" Street
San Bernardino, CA 92415-0799
Phone: 909-382-5401
Fax: 909-382-5413
www.sbcfire.org/hazmat/hhw.asp
Email: jschwab@sbcfire.org

WHEN WORKING OUTDOORS USE THE 3Cs

CUANDO TRABAJE AL AIRE LIBRE UTILICE LAS 3Cs

CONTROL | CONTROL



Locate the nearest storm drain and ensure nothing can enter or be discharged into it.

Ubique el desagüe de aguas pluviales más cercano y asegúrese de que nada pueda ingresar a éste ni descargarse en él.

CONTAIN | CONTENER



Isolate your area to prevent material from potentially flowing or being blown away.

Aísle su área para evitar que el material pueda discurrirse o ser llevado por el viento.

CAPTURE | CAPTURAR



Sweep up debris and place it in the trash. Clean up spills with an absorbent material (e.g. kitty litter) or vacuum with a Wet-Vac and dispose of properly.

Recoja los restos y colóquelos en la basura. Limpie los derrames con un material absorbente (como la arena para gatos) o aspírelos con una Wet-Vac (aspiradora de humedad) y deséchelos correctamente.

COMMERCIAL LANDSCAPE

Yard waste, sediments, and toxic lawn/garden chemicals used in commercial landscape maintenance often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates local waterways, making them unsafe for people and wildlife. Following these best management practices will prevent pollution, comply with regulations and protect public health.

Recycle Yard Waste
Recycle leaves, grass clippings and other yard waste. Do not blow, sweep, rake or hose yard waste into the street. Try grasscycling - the natural recycling of grass by leaving clippings on the lawn when mowing. Grass clippings willquickly decompose, returning valuable nutrients to the soil. Further information can be obtained at www.calrecycle.ca.gov/organics.

Use Fertilizers, Herbicides and Pesticides Safely
Fertilizers, herbicides and pesticides are often carried into the storm drain system by sprinkler runoff. Use of natural, non-toxic alternatives to the traditional fertilizers, herbicides and pesticides is highly recommended. If you must use chemical fertilizers, herbicides, or pesticides:

- Spot apply pesticides and herbicides, rather than blanketing entire areas.
- Avoid applying near curbs and driveways, and never apply before a rain.
- Apply fertilizers as needed, when plants can best use it, and when the potential for it being carried away by runoff is low.

Recycle Hazardous Waste
Pesticides, fertilizers, herbicides and motor oil contaminate landfills and should be disposed of through a Hazardous Waste Facility, which accepts these types of materials. For information on proper disposal call, (909) 386-8401.

Use Water Wisely
Conserve water and prevent runoff by controlling the amount of water and direction of sprinklers. Sprinklers should be on long enough to allow water to soak into the ground but not so long as to cause runoff. Periodically inspect, fix leaks and realign sprinkler heads. Plant native vegetation to reduce the need of water, fertilizers, herbicides, and pesticides.

Prevent Erosion
Erosion washes sediments, debris and toxic runoff into the storm drain system, polluting waterways.

- Prevent erosion and sediment runoff by using ground cover, berms and vegetation down-slope to capture runoff.
- Avoid excavation or grading during wet weather.

Store Materials Safely
Keep landscaping materials and debris away from the street, gutter and storm drains. On-site stockpiles of materials must be covered with plastic sheeting and surrounded with sand bags to protect from rain, wind and runoff.

SIDEWALK, PLAZA, ENTRY MONUMENT & FOUNTAIN MAINTENANCE

Pollutants on sidewalks and other pedestrian traffic areas and plazas are typically due to littering and vehicle use. Fountain water containing chlorine and copperbased algaecides is toxic to aquatic life. Proper inspection, cleaning, and repair of pedestrian areas and HOA owned surfaces and structures can reduce pollutant runoff from these areas. Maintaining these areas may involve one or more of the following activities:

1. **Surface Cleaning**
2. **Graffiti Cleaning**
3. **Sidewalk Repair**
4. **Controlling Litter**
5. **Fountain Maintenance**

POLLUTION PREVENTION:

Pollution prevention measures have been considered and incorporated in the model procedures. Implementation of these measures may be more effective and reduce or eliminate the need to implement other more complicated or costly procedures. Possible pollution prevention measures for sidewalk, plaza, and fountain maintenance and cleaning include:

- Use dry cleaning methods whenever practical for surface cleaning activities.
- Use the least toxic materials available (e.g. water based paints, gels or sprays for graffiti removal).
- Once per year, educate HOA staff and tenants on pollution prevention measures.

MODEL PROCEDURES:

1. Surface Cleaning

Discharges of wash water to the storm water drainage system from cleaning or hosing of impervious surfaces is prohibited.

Sidewalks, Plazas

✓ Use dry methods (e.g. sweeping, backpack blowers, vacuuming) whenever practical to clean sidewalks and plazas rather than hosing, pressure washing, or steam cleaning. DO NOT sweep or blow material into curb; use devices that contain the materials.

✓ If water must be used, block storm drain inlets and contain runoff. Discharge wash water to landscaping or contain and dispose of properly.

SIDEWALK, PLAZA, ENTRY MONUMENT & FOUNTAIN MAINTENANCE

Parking Areas, Driveways, Drive-thru

✓ Parking facilities should be swept/vacuumed on a regular basis. Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.

✓ If water must be used, block storm drain inlets and contain runoff. Discharge wash water to landscaping or contain and dispose of properly.

✓ Sweep all parking lots at least once before the onset of the wet season.

✓ Use absorbents to pick up oil; then dry sweep.

✓ Appropriately dispose of spilled materials and absorbents.

OPTIONAL:

- Consider increasing sweeping frequency based on factors such as traffic volume, land use, field observations of sediment and trash accumulation, proximity to water courses, etc.

Building Surfaces, Decks, etc., without loose paint

✓ Use high-pressure water, no soap.

✓ If water must be used, block storm drain inlets and contain runoff. Discharge wash water to landscaping or contain and dispose of properly.

Unpainted Building Surfaces, Wood Decks, etc.

✓ If water must be used, block storm drain inlets and contain runoff. Discharge wash water to landscaping or contain and dispose of properly.

✓ Use biodegradable cleaning agents to remove deposits.

✓ Make sure pH is between 6.5 and 8.5 THEN discharge to landscaping (if cold water without a cleaning agent) otherwise dispose of properly.

2. Graffiti Cleaning

Graffiti Removal

✓ Avoid graffiti abatement activities during rain events.

✓ When graffiti is removed by painting over, implement the procedures under Painting and Paint Removal in the Roads, Streets, and Highway Operation and Maintenance procedure sheet.

✓ Protect nearby storm drain inlets prior to removing graffiti from walls, signs, sidewalks, or other structures needing graffiti abatement. Clean up afterwards by sweeping or vacuuming thoroughly, and/or by using absorbent and properly disposing of the absorbent.

SIDEWALK, PLAZA, ENTRY MONUMENT & FOUNTAIN MAINTENANCE

✓ Note that care should be taken when disposing of waste since it may need to be disposed of as hazardous waste.

OPTIONAL:

• Consider using a waterless and non-toxic chemical cleaning method for graffiti removal (e.g. gels or spray compounds).

3. Sidewalk Repair

Surface Removal and Repair

✓ Schedule surface removal activities for dry weather if possible.

✓ Avoid creating excess dust when breaking asphalt or concrete.

✓ Take measures to protect nearby storm drain inlets prior to breaking up asphalt or concrete (e.g. place hay bales or sand bags around inlets). Clean afterwards by sweeping up material.

✓ Designate an area for clean up and proper disposal of excess materials.

✓ Remove and recycle as much of the broken pavement as possible.

✓ When making saw cuts in pavement, use as little water as possible. Cover each storm drain inlet with filter fabric during the sawing operation and contain the slurry by placing straw bales, sandbags, or gravel dams around the inlets. After the liquid drains shovel or vacuum the slurry, remove from site and dispose of properly.

✓ Always dry sweep first to clean up tracked dirt. Use a street sweeper or vacuum truck. Do not dump vacuumed liquid in storm drains. Once dry sweeping is complete, the area may be hosed down if needed. Discharge wash water to landscaping, pump to the sanitary sewer if permitted to do so or contain and dispose of properly.

Concrete Installation and Repair

✓ Avoid mixing excess amounts of fresh concrete or cement mortar on-site. Only mix what is needed for the job.

✓ Wash concrete trucks off-site or in designated areas on-site, such that there is no discharge of concrete wash water into storm drain inlets, open ditches, streets, or other storm water conveyance structures. (See Concrete Waste Management BMP WM – 8)

SIDEWALK, PLAZA, ENTRY MONUMENT & FOUNTAIN MAINTENANCE

- ✓ Store dry and wet concrete materials under cover, protected from rainfall and runoff and away from drainage areas. After job is complete remove temporary stockpiles (asphalt materials, sand, etc.) and other materials as soon as possible.
- ✓ Return leftover materials to the transit mixer. Dispose of small amounts of excess concrete, grout, and mortar in the trash.
- ✓ When washing concrete to remove fine particles and expose the aggregate, contain the wash water for proper disposal.
- ✓ Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stock pile, or dispose in the trash.
- ✓ Protect applications of fresh concrete from rainfall and runoff until the material has hardened.

4. Litter Control

- ✓ Enforce anti-litter laws.
- ✓ Provide litter receptacles in busy, high pedestrian traffic areas of the community, at recreational facilities, and at community events.
- ✓ Cover litter receptacles and clean out frequently to prevent leaking/spillage or overflow.

OPTIONAL:

- Post "No Littering" signs.

5. Fountain Maintenance

- ✓ Do not use copper-based algaecides. Control algae with chlorine or other alternatives, such as sodium bromide.
- ✓ Allow chlorine to dissipate for a few days and then recycle/reuse water by draining it gradually onto a landscaped area. Water must be tested prior to discharge to ensure that chlorine is not present (concentration must be less than 0.1 ppm).
- ✓ Contact local agency for approval to drain into sewer or storm drain.
- ✓ Avoid mixing excess amounts of fresh concrete or cement mortar on-site. Only mix what is needed for the job.

EQUIPMENT MAINTENANCE & REPAIR

Vehicle or equipment maintenance has the potential to be a significant source of stormwater pollution. Engine repair and service (parts cleaning, spilled fuel, oil, etc.), replacement of fluids, and outdoor equipment storage and parking (dripping engines) can all contaminate stormwater. Conducting the following activities in a controlled manner will reduce the potential for stormwater contamination:

1. **General Maintenance and Repair**
2. **Vehicle and Machine Repair**
3. **Waste Handling/Disposal**

Related vehicle maintenance activities are covered under the following program headings in this manual: "Vehicle and Equipment Cleaning", "Vehicle and Equipment Storage", and "Vehicle Fueling".

POLLUTION PREVENTION:

Pollution prevention measures have been considered and incorporated in the model procedures. Implementation of these measures may be more effective and reduce or eliminate the need to implement other more complicated or costly procedures. Possible pollution prevention measures for equipment maintenance and repair include:

- Review maintenance activities to verify that they minimize the amount of pollutants discharged to receiving waters. Keep accurate maintenance logs to evaluate materials removed and improvements made.
- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Minimize use of solvents. Clean parts without using solvents whenever possible. Recycle used motor oil, diesel oil, and other vehicle fluids and parts whenever possible.
- Once per year, educate HOA staff and tenants on pollution prevention measures.

EQUIPMENT MAINTENANCE & REPAIR

MODEL PROCEDURES:

1. General Maintenance and Repair

General Guidelines

➔ *Note: Permission must be obtained for any discharge of wash water to the sanitary sewer from the local sewering agency.*

- ✓ Review maintenance activities to verify that they minimize the amount of pollutants discharged to receiving waters. Keep accurate maintenance logs to evaluate materials removed and improvements made.
- ✓ Regularly inspect vehicles and equipment for leaks.
- ✓ Move activity indoors or cover repair area with a permanent roof if feasible.
- ✓ Minimize contact of stormwater with outside operations through berming the local sewering and drainage routing.
- ✓ Place curbs around the immediate boundaries of the process equipment.
- ✓ Clean yard storm drain inlets regularly and stencil them.

Good Housekeeping

- ✓ Avoid hosing down work areas. If work areas are washed and if discharge to the sanitary sewer is allowed, treat water with an appropriate treatment device (e.g. clarifier) before discharging. If discharge to the sanitary sewer is not permitted, pump water to a tank and dispose of properly.
- ✓ Collect leaking or dripping fluids in drip pans or container. Fluids are easier to recycle or dispose of properly if kept separate.
- ✓ Keep a drip pan under the vehicle while you unclip hoses, unscrew filters, any discharge of or remove other parts. Place a drip pan under any vehicle that might leak while you work on it to keep splatters or drips off the shop floor.
- ✓ Educate employees on proper handling and disposal of engine fluids.
- ✓ Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.
- ✓ Do not pour liquid waste to floor drains, sinks, outdoor storm drain inlets, or other storm drains or sewer connections.
- ✓ Post signs at sinks and stencil outdoor storm drain inlets.

2. Vehicle Repair

General Guidelines

- ✓ Perform vehicle fluid removal or changing inside of a building or in a contained covered area, where feasible, to prevent the run-on of stormwater and the runoff of spills.
- ✓ Regularly inspect vehicles and equipment for leaks, and repair as needed.

- ✓ Use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- ✓ Immediately drain all fluids from wrecked vehicles. Ensure that the drain pan or drip pan is large enough to contain drained fluids (e.g. larger pans are needed to contain antifreeze, which may gush from some vehicles).
- ✓ Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.
- ✓ Recycle used motor oil, diesel oil, and other vehicle fluids and parts whenever possible.
- ✓ Oil filters disposed of in trash cans or dumpsters can leak oil. Place the oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters.
- ✓ Store cracked batteries in a non-leaking secondary container and dispose of properly at recycling facilities or at County hazardous waste disposal site.

Vehicle Leak and Spill Control

- ✓ Use absorbent materials on small spills. Remove the absorbent materials promptly and dispose of properly.
- ✓ Place a stockpile of spill cleanup materials where it will be readily accessible.
- ✓ Sweep floor using dry absorbent material.

3. Machine Repair

- ✓ Keep equipment clean; don't allow excessive build-up of oil or grease.
- ✓ Minimize use of solvents.
- ✓ Use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- ✓ Perform major equipment repairs at the corporation yard, when practical.
- ✓ Following good housekeeping measures in Vehicle Repair section.

4. Waste Handling/Disposal

Waste Reduction

- ✓ Prevent spills and drips of solvents and cleansers to the shop floor.
- ✓ Do liquid cleaning at a centralized station so the solvents and residues stay in one area. Recycle liquid cleaners when feasible.

✓ Locate drip pans, drain boards, and drying racks to direct drips back into a solvent sink or fluid holding tank for reuse.

OPTIONAL:

- If possible, eliminate or reduce the amount of hazardous materials and waste by substituting non-hazardous or less hazardous material:

  -Use non-caustic detergents instead of caustic cleaning for parts cleaning.

  -Use a water-based cleaning service and have tank cleaned. Use detergent-based or water-based cleaning systems in place of organic solvent degreasers.

  -Replace chlorinated organic solvents with non-chlorinated solvents. Non-chlorinated solvents like kerosene or mineral spirits are less toxic and less expensive to dispose of properly. Check list of active ingredients to see whether it contains chlorinated solvents.

  -Choose cleaning agents that can be recycled.

Recycling

OPTIONAL:

- Separate wastes for easier recycling. Keep hazardous and non-hazardous wastes separate, do not mix used oil and solvents, and keep chlorinated solvents separate from non-chlorinated solvents.

- Label and track the recycling of waste material (e.g. used oil, spent solvents, batteries).

- Purchase recycled products to support the market for recycled materials.

LIMITATIONS:

Space and time limitations may preclude all work being conducted indoors. It may not be possible to contain and clean up spills from vehicles/equipment brought on-site after working hours. Dry floor cleaning methods may not be sufficient for some spills – see spill prevention and control procedures sheet. Identification of engine leaks may require some use of solvents.

POOL MAINTENANCE

Pool chemicals and filter solids, when discharged to the City streets, gutters or storm drans, DO NOT GET TREATED before reaching the Santa Ana River. Chlorine, acid cleaning chemicals and metal-based algaecides used in pools can kill beneficial organisms in the food chain and pollute our drinking water.

When emptying your swimming pool, spa or fountain, please use one of the following best management practices to prevent water pollution:

- Reuse the water as landscape irrigation
- Empty the water into the sewer between midnight and 6:00 am
- Remove solids and floating debris and dispose of in the trash, de-chlorinate the water to a chlorine residual = 0, wait 24 hours, then discharge the water to the street or storm drain
- Try not to use metal-based algaecides (i.e. copper sulfate) in your pool or spa. If you have, empty your pool or spa into the sewer. *Prior to discharging pool water into the sanitary sewer system, contact your local agency.*
- If the pool contains algae and mosquito larvae, discharge the water to the sewer

When acid cleaning or other chemical cleaning:

- Neutralize the pool water to pH of 6.5 to 8.5, then discharge to the sewer

For swimming pool and spa filter backwash:

- Dispose of solids into trash bag, then wash filter into a landscape area
- Settle, dispose of solids in trash and discharge water to the sewer, never to the storm drain

For Residents

The following is a preview of the information we have available to residents. For more fact sheets, visit ***sbcountystormwater.org***

Household Hazardous Waste Center Locations

TOO TOXIC TO TRASH

Dispose of your **HOUSEHOLD HAZARDOUS WASTE** (HHW) at a **FREE** HHW Center near you. Examples of items collected: pesticides, fertilizers, paints, cleaners, antifreeze, batteries, motor oil, oil filters, and electronic waste.

SERVICE AREA	LOCATION	DAYS OPEN	HOURS
Big Bear Lake	42040 Garstin Dr. (cross: Big Bear Blvd.)	Saturdays	9 a.m. - 2 p.m.
Chino	5050 Schaefer Ave. (cross: 4th St.)	2nd & 4th Sat.	8 a.m. - 1 p.m.
Fontana (Fontana residents only)	16454 Orange Way (cross: Cypress Ave.) Note: Provide a trash bill and a driver's license as proof of residency.	Saturdays	8 a.m. - 12 p.m.
Ontario	1430 S. Cucamonga Ave. (cross: Belmont St.)	Fri. & Sat.	9 a.m. - 2 p.m.
Rancho Cucamonga	12158 Baseline Rd. (cross: Rochester Ave.)	1st & 3rd Sat.	8 a.m. - 12 p.m.
Redlands	500 Kansas St. (cross: Park Ave.)	Saturdays	9:30 a.m. - 12:30 p.m.
Rialto	246 Willow Ave. (cross: Rialto Ave.)	2nd & 4th Fri. & Sat.	8 a.m. - 12 p.m.
San Bernardino	2824 East 'W' St., 302 (cross: Victoria Ave.)	Mon. – Fri.	9 a.m. - 4 p.m.
Upland (does not accept E-Waste)	1370 N. Benson Ave. (cross: 14th St.)	Saturdays	9 a.m. - 2 p.m.

sbcounty.gov/stormwater or (800) CLEANUP

Artwork Courtesy of the City of Los Angeles Stormwater Program. Printed on recycled paper.



WE DID IT OURSELVES AND WE DID IT RIGHT

When painting your home, protect your family and community.

- **PAINTS** that are water-based are less toxic and should be used whenever possible.
- **BRUSHES** with water-based paint should be washed in the sink. Those with oil-based paint should be cleaned with paint thinner.
- **SAFELY** dispose of unwanted paint and paint thinner. The County of San Bernardino offers 9 HHW Centers that accept paint and other household hazardous waste from residents FREE of charge. For a list of acceptable materials, location information, and hours of operation call 1-800-OILY CAT.

VEHICLE MAINTENANCE

Oil, grease, anti-freeze and other toxic automotive fluids often make their way into the San Bernardino County storm drain system, and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution and protect public health.

Cleaning Auto Parts
Scrape parts with a wire brush or use a bake oven rather than liquid cleaners. Arrange drip pans, drying racks and drain boards so that fluids are directed back into the parts washer or the fluid holding tank. Do not wash parts or equipment in a sink, parking lot, driveway or street.

Storing Hazardous Waste
Keep your liquid waste segregated. Many fluids can be recycled via hazardous waste disposal companies if they are not mixed. Store all materials under cover with spill containment or inside to prevent contamination of rainwater runoff.

Preventing Leaks and Spills
Conduct all vehicle maintenance inside of a garage. Place drip pans underneath vehicle to capture fluids. Use absorbent materials instead of water to clean work areas.

Cleaning Spills
Use dry methods for spill cleanup (sweeping, absorbent materials). To report accidental spills into the street or storm drain call (877) WASTE18 or 911.

Proper Disposal of Hazardous Waste
Dispose of household hazardous waste by taking it to your nearest household hazardous waste center. For more information, call 1-800-OILY CAT or check out sbcountystormwater.org/Disposal.html

PET WASTE DISPOSAL

FREE

DOGGIE WASTE BAGS

Remember to pick up after your pet every time to keep San Bernardino County clean and healthy!



In the event of a spill or discharge to a storm drain or waterway, contact San Bernadino County Stormwater immediately: (877) WASTE18 | sbcountystormwater.org/report

sbcountystormwater.org

Big Bear • Chino • Chino Hills • Colton • Fontana • Grand Terrace • Highland • Loma Linda • Montclair • Ontario • Rancho Cucamongo
Redlands • Rialto • San Bernadino • San Bernadino County • San Bernadino County Flood Control District • Upland • Yucaipa

» Get In Touch With Us Online!

» **Website**
sbcountystormwater.org

» **eUpdates**
sbcountystormwater.org/newsletter

» **Facebook**
facebook.com/sbcountystormwater

» **YouTube**
youtube.com/sbcountystormwater

» **Report Pollution Violations**
sbcountystormwater.org/report

» **Email**
info@sbcountystormwater.org

Appendix E

DRAINAGE STUDY & PERCOLATION REPORT

PRELIMINARY DRAINAGE REPORT

TTM 20612
DRNSY-????????
UNINCORPORATED, SAN BERNARDINO COUNTY, CALIFORNIA

Prepared For:

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Printed:
April 29, 2025

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Drainage Study

December 14, 2023
Updated:
April 28, 2025

Introduction

The following study and calculations were prepared to analyze the pre and post improvement conditions for the land making up the watershed of TTM 20612. Located on a portion of land being a subdivision of the South ½ of the Northeast ¼ and the Northwest ¼ of the Southeast ¼ of Section 6, Township 1 North, Range 5 East, San Bernardino base and meridian, in an unincorporated area, in the county of San Bernardino, State of California. This study was performed for a 100-year, 1-Hour storm event.

Site Background

The site is ONE parcels, totaling 122.98-acres of undeveloped land comprised of desert scrub in an area of varied natural terrain, comprised of desert washes, and hills of moderate gradient. The total tributary drainage area is comprised of 122.98-acres.

The site has existing roadway improvements along the alignment of Pipes Canyon Road, a water carrying road, that bisects the project about its approximate north south-midline. There are existing desert trails that meander about the private land and terminate at various points.

All of the runoff from the project site is tributary to the Pipes Wash Watershed.

The parcel making up this project, identified as APN:0549-351-33, is split zoned. A western portion being zoned RL-5 and the remainder zoned RC. The existing zoning is per San Bernardino County land use districts, zoning overlay; a layer publicly available through the county website,
https://sbcounty.maps.arcgis.com/apps/MapSeries/index.html?appid=f5a50c44766b4c36a3ae014497aa430d

The site is proposed to be divided to provide: 12 residential lots of 5 acres each and a remainder parcel of approximately 60 acres. The remainder parcel is that portion lying within the RC zoned portion of the subject parcel As a portion of the division, shared, private, graded access roads are proposed to provide legal means of egress to all lots not directly served by public rights of way. There is no inclusion of additional impermeable surfaces in the proposed division. The intention of the division is for lot sales. Any increase in runoff due to the construction of impermeable surfaces is to be addressed on a lot-by-lot basis at the time of permitting by the developing party.

The soil types for this site are Hydrologic Type C, per the San Bernardino County Hydrology Manual, sheet C-24, Figure C-11. (Appendix “B”)

The site is located in FEMA Flood Zone “D” per attached FEMA maps 06071C8100H, and 06071C8105H effective 08/28/2008 (Appendix “C”). It is noted that neither of these flood maps were printed, thus the firmette shows no base map information.

Study Methods

Point Rainfall data for this study was sourced from NOAA Atlas 14, Volume 6, Version 2 for the applicable location (Appendix “D”), accessed (October 25, 2023).

The results contained in this study were obtained by utilization of the San Bernardino Rational Hydrology Program provided by CIVILDESIGN Engineering Software. Rational Method calculations are provided in (Appendix “E”).

The effects of proposed improvements are minimal proposed post-development condition.
In an effort to provide clarity in comparison of the Pre to Post development conditions the individual watersheds of both conditions terminate in identically located and numbered nodes on the respective maps included as (Appendix “A”).

Pre-Development Drainage Conditions

The area included in this study contains 14 watersheds that converge into 14 distinct points of concentration. Under existing conditions, Rational Method calculations, performed as previously stated indicate peak flows as summarized by watershed, indicating subarea designations and Terminal Concentration Node as depicted on the Pre-Development Drainage Study Map included as a portion of (Appendix “A”), in Table 1.

TABLE 1: PRE-DEVELOPMENT SUMMARY							
WATERSHED ID	SUBAREA ID	SUBAREA AREA (acre)	WATERSHED AREA (acre)	TERMINAL CONCEN. NODE	NODE DESCRIPTION	Tc (min.)	Q_{100} (cfs)
1	1	0.795	0.795	10	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	6.38	6.21
2	2	1.506	1.506	20	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	8.05	9.99
3	3	0.309	0.309	30	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	4.60	3.04
4	4.0	4.525	17.116	40	FLOW ON EXISTING WATER CARRYING ROADWAY IMPROVEMENTS	22.40	54.50
	4.1	12.591					
5	5.0	0.635	0.635	50	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	8.45	4.07
6	6.0	6.430	51.048	60	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	21.91	150.05
	6.1	25.374					
	6.2	6.142					
	6.3	13.102					
7	7.0	4.453	41.437	70	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	18.48	148.74
	7.1	18.012					
	7.2	7.520					
	7.3	6.292					
	7.4	5.160					
8	8	1.938	1.938	80	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	9.59	11.36
9	9	0.884	0.884	90	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	9.09	5.38
10	10	1.358	1.358	100	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	8.77	8.48
11	11	0.634	0.634	110	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	7.37	4.48
12	12	1.885	1.885	120	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	8.49	12.05
13	13	1.011	1.011	130	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	8.23	6.60
14	14	2.413	2.413	140	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	11.35	12.56

Post Development Drainage Conditions

The area included in this study contains 14 watersheds that converge into 14 distinct points of concentration. Under proposed Post-Development conditions, Rational Method calculations, performed as previously stated indicate peak flows as summarized by watershed, indicating subarea designations and Terminal Concentration Node as depicted on the Post-Development Drainage Study Map included as a portion of (Appendix “A”), in Table 2.

TABLE 2: POST-DEVELOPMENT SUMMARY							
WATERSHED ID	SUBAREA ID	SUBAREA AREA (acre)	WATERSHED AREA (acre)	TERMINAL CONCEN. NODE	NODE DESCRIPTION	Tc (min.)	Q_{100} (cfs)
1	1	0.795	0.795	10	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	6.38	6.21
2	2	1.506	1.506	20	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	8.05	9.99
3	3	0.309	0.309	30	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	4.60	3.04
4	4.0	4.525	17.116	40	FLOW ON EXISTING WATER CARRYING ROADWAY	22.71	54.50
	4.1	12.591					
5	5.0	0.635	0.635	50	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	8.45	4.07
6	6.0	6.430	51.048	60	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	21.90	149.92
	6.1	25.374					
	6.2	6.142					
	6.3	13.102					
7	7.0	4.453	41.437	70	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	19.38	148.74
	7.1	18.012					
	7.2	7.520					
	7.3	6.292					
	7.4	5.160					
8	8	1.938	1.938	80	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	9.59	11.36
9	9	0.884	0.884	90	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	9.09	5.38
10	10	1.358	1.358	100	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	8.77	8.48
11	11	0.634	0.634	110	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	7.37	4.48
12	12	1.885	1.885	120	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	8.49	12.05
13	13	1.011	1.011	130	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	8.23	6.60
14	14	2.413	2.413	140	NATURAL CHANNEL DISCHARGED ONTO ADJACENT PARCEL	11.35	12.56

The improvements proposed for the site will retain as much of the natural topography as is practicable. The improvements proposed as a portion of this division are limited to grading of the necessary graded access roads and include no proposed addition of impermeable surface. The result being no increase in the peak flow rate at each Terminal Concentration Node as depicted on the Post-Development Drainage Study Map included as a portion of (Appendix “A”). Due to the reshaping of a portion of the flow channel in subarea 6.1, there is a resultant reduction in peak discharge from watershed 6. This reduction is approximately 1 percent and is considered insignificant for the purpose of comparison in this study.

The necessary graded roads have been located and designed such that they provide as minimal impact to existing natural flow paths as is practicable. The only measurable impact that these alignments and profiles have generated is the previously mentioned reduced peak flow from watershed 6.

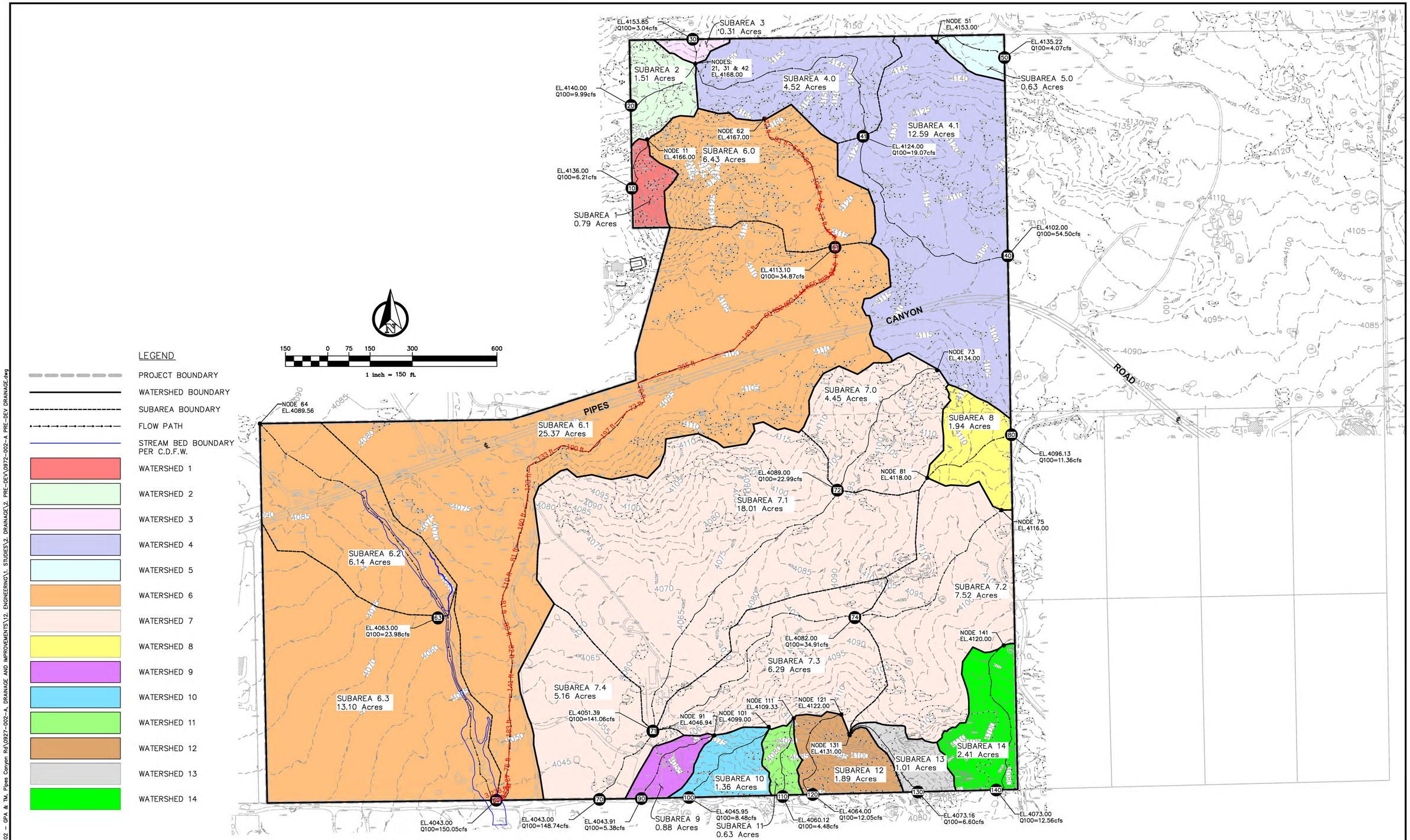
Conclusion

The proposed improvements will not result in an increased volume of storm water discharges indicated in the comparison shown as Table 3.

TABLE 3: VALUE COMPARISON						
WATERSHED ID	TERMINAL CONCEN. NODE	DEVELOPED CONDITION	Q_{100} (cfs)	PRE TO POST ΔQ_{100}	AREA (acre)	PRE TO POST ΔAREA
1	10	PRE	6.21	0.00	0.795	0.000
		POST	6.21		0.795	
2	20	PRE	9.99	0.00	17.116	0.000
		POST	9.99		17.116	
3	30	PRE	3.04	0.00	0.309	0.000
		POST	3.04		0.309	
4	40	PRE	54.50	0.00	17.116	0.000
		POST	54.50		17.116	
5	50	PRE	4.07	0.00	0.635	0.000
		POST	4.07		0.635	
6	60	PRE	150.05	-0.13	51.048	0.000
		POST	149.92		51.048	
7	70	PRE	148.74	0.00	51.048	0.000
		POST	148.74		51.048	
8	80	PRE	11.36	0.00	1.938	0.000
		POST	11.36		1.938	
9	90	PRE	5.38	0.00	0.884	0.000
		POST	5.38		0.884	
10	100	PRE	8.48	0.00	1.358	0.000
		POST	8.48		1.358	
11	110	PRE	4.48	0.00	0.634	0.000
		POST	4.48		0.634	
12	120	PRE	12.05	0.00	1.885	0.000
		POST	12.05		1.885	
13	130	PRE	6.60	0.00	1.011	0.000
		POST	6.60		1.011	
14	140	PRE	12.56	0.00	2.413	0.000
		POST	12.56		2.413	

Based on the calculations performed as a part of this study, considering the proposed improvements, onsite flows can be conveyed to a suitable point of disposal and the proposed improvements will not adversely impact offsite property.

APPENDIX “A”



J:\Clients\Shokrian, Jonathan\972-02 - GPA & TM, Pipes Canyon Rd\0927-002-A, DRAINAGE AND IMPROVEMENTS\2. ENGINEERING\1- STUDIES\2. DRAINAGE\2. PRE-DEV DRAINAGE\2. PRE-DEV DRAINAGE.dwg

An Original Map Product Contains An Embossed Seal In This Area

Revisions:

No.	Date:	By:	Description:	Approved:

Designed: | Drawn: | Checked: ACH

Seal: REGISTERED PROFESSIONAL ENGINEER BRAD A. HILLWIG C 95927 CIVIL STATE OF CALIFORNIA

Prepared under the Supervision of:

REGISTERED PROFESSIONAL ENGINEER LICENSE NO. C 95927 DATE

HILLWIG - GOODROW, INC.
Land Surveying - GPS Surveys - Aerial Mapping
31407 Outer Highway 10 ● Redlands, CA 92373 ● (909) 794-2673

Scale: 1"=150'

Date: APRIL 2025

BENCHMARK: GPS C.O.R.S. LDES, ELEV. 3313.28 (NAVD 88) A PART OF THE NATIONAL GEODETIC SURVEY.

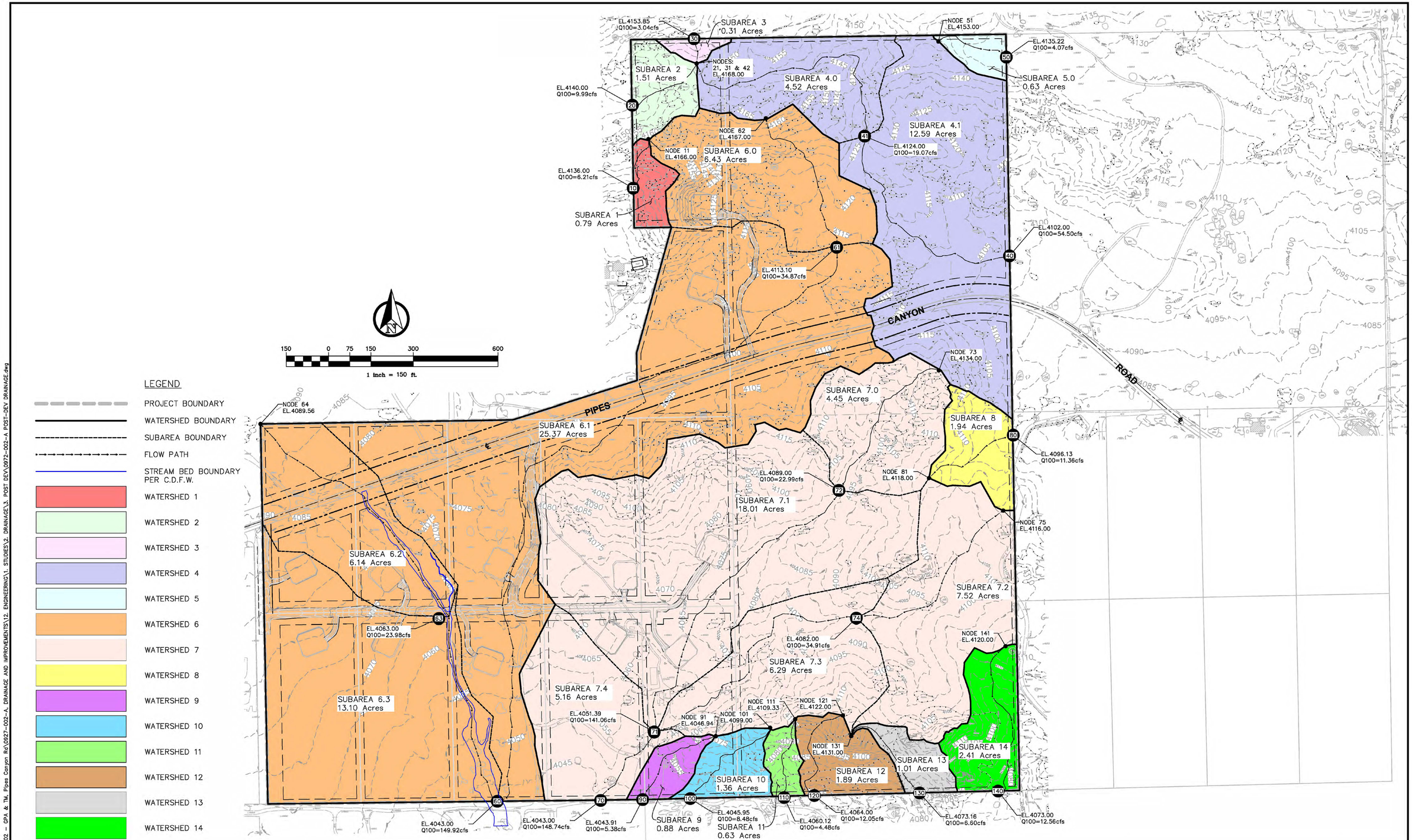
PRE-DEVELOPMENT HYDROLOGY
TTM 20612

PREPARED FOR:
JONATHAN SHOKRIAN
319 S. ROBERTSON BLVD.
BEVERLY HILLS, CA 90211

F.N. | For: | F.B.

Sheet No. 1 OF 1 SHEET

FILE NO. 0927-002-A



J:\Clients\Shokrian, Jonathan\972-02 - GPA & TM, Pipes Canyon Rd\0927-002-A, DRAINAGE AND IMPROVEMENTS\2. ENGINEERING\1. STUDIES\2. DRAINAGE\3. POST DEV\0972-002-A POST-DEV DRAINAGE.dwg

An Original Map Product Contains An Embossed Seal In This Area

Revisions:

No.	Date:	By:	Description:	Approved:

Designed: | Drawn: | Checked: ACH

Seal: REGISTERED PROFESSIONAL ENGINEER — DAVID A. HILLWIG — C 95927 — CIVIL — STATE OF CALIFORNIA

Prepared under the Supervision of:

REGISTERED PROFESSIONAL ENGINEER LICENSE NO. C 95927 — DATE

HILLWIG - GOODROW, INC.

Land Surveying - GPS Surveys - Aerial Mapping

31407 Outer Highway 10• Redlands, CA 92373• (909) 794-2673

Scale: 1"=150'

Date: APRIL 2025

BENCHMARK:
GPS C.O.R.S. LDES, ELEV. 3313.28 (NAVD 88)
A PART OF THE NATIONAL GEODETIC SURVEY.

POST-DEVELOPMENT HYDROLOGY
TTM 20612

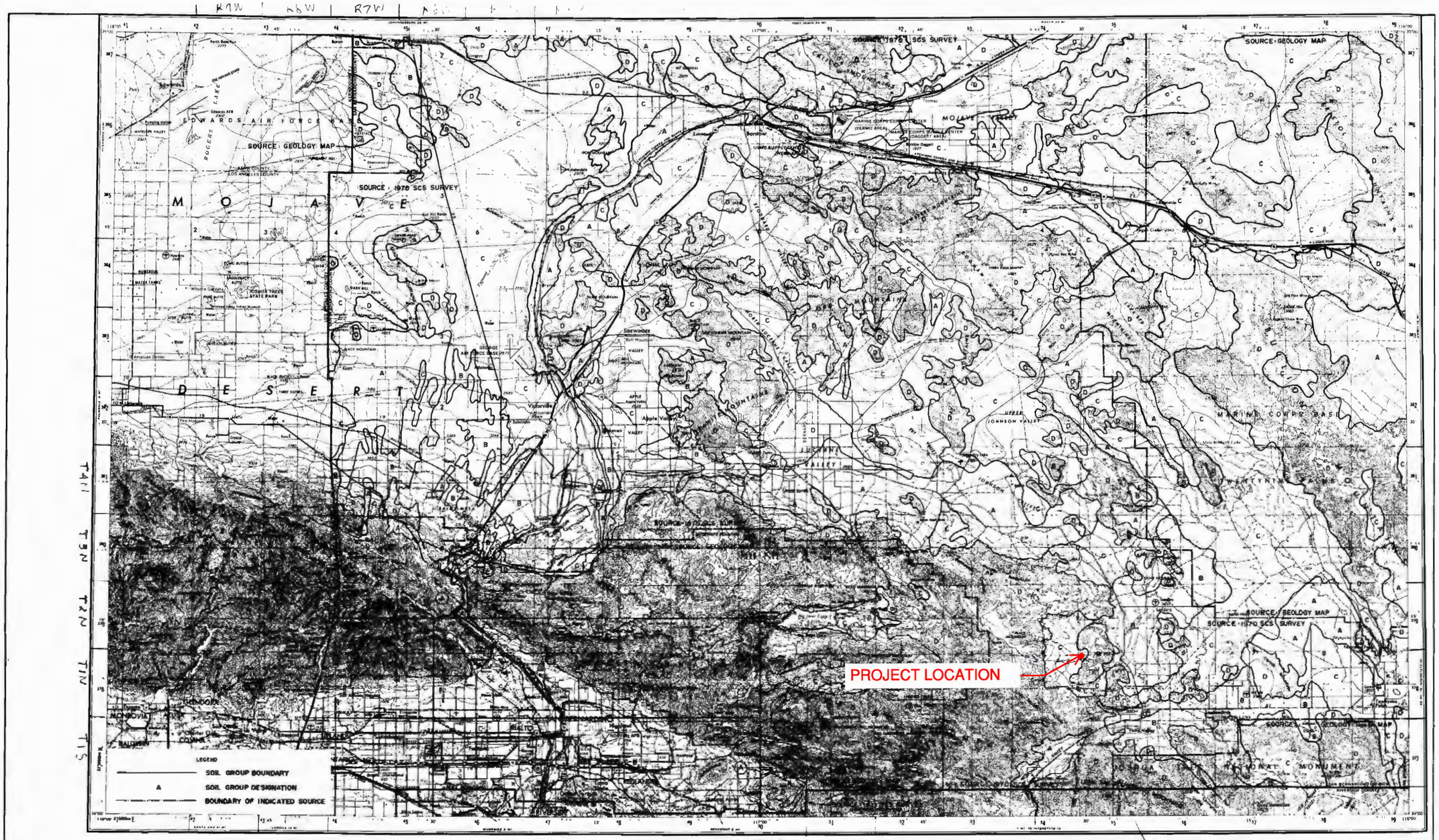
PREPARED FOR:
JONATHAN SHOKRIAN
319 S. ROBERTSON BLVD.
BEVERLY HILLS, CA 90211

F.N. | For: | F.B.

Sheet No. 1 OF 1 SHEET

FILE NO. 0927-002-A

APPENDIX “B”



INDEX MAP

Scale 1:250,000

CONTOUR INTERVAL 200 FEET
WITH SUPPLEMENTARY CONTOURS AT 100 FOOT INTERVALS
TRANSVERSE MERCATOR PROJECTION

BASE MAP REPRODUCED FROM U.S.G.S. "SAN BERNARDINO" TOPOGRAPHIC MAP

SCALE REDUCED BY 1/2

LOCATION DIAGRAM

SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

HYDROLOGIC SOILS GROUP MAP FOR SOUTHCENTRAL AREA

APPENDIX “C”

National Flood Hazard Layer FIRMette



Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

- **SPECIAL FLOOD HAZARD AREAS**
  - Without Base Flood Elevation (BFE) *Zone A, V, A99*
  - With BFE or Depth *Zone AE, AO, AH, VE, AR*
  - Regulatory Floodway
- **OTHER AREAS OF FLOOD HAZARD**
  - 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
  - Future Conditions 1% Annual Chance Flood Hazard *Zone X*
  - Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
  - Area with Flood Risk due to Levee *Zone D*
- **OTHER AREAS**
  - NO SCREEN Area of Minimal Flood Hazard *Zone X*
  - Effective LOMRs
  - Area of Undetermined Flood Hazard *Zone D*
- **GENERAL STRUCTURES**
  - Channel, Culvert, or Storm Sewer
  - Levee, Dike, or Floodwall
- **OTHER FEATURES**
  - 20.2 Cross Sections with 1% Annual Chance
  - 17.5 Water Surface Elevation
  - Coastal Transect
  - Base Flood Elevation Line (BFE)
  - Limit of Study
  - Jurisdiction Boundary
  - Coastal Transect Baseline
  - Profile Baseline
  - Hydrographic Feature
- **MAP PANELS**
  - Digital Data Available
  - No Digital Data Available
  - Unmapped

N

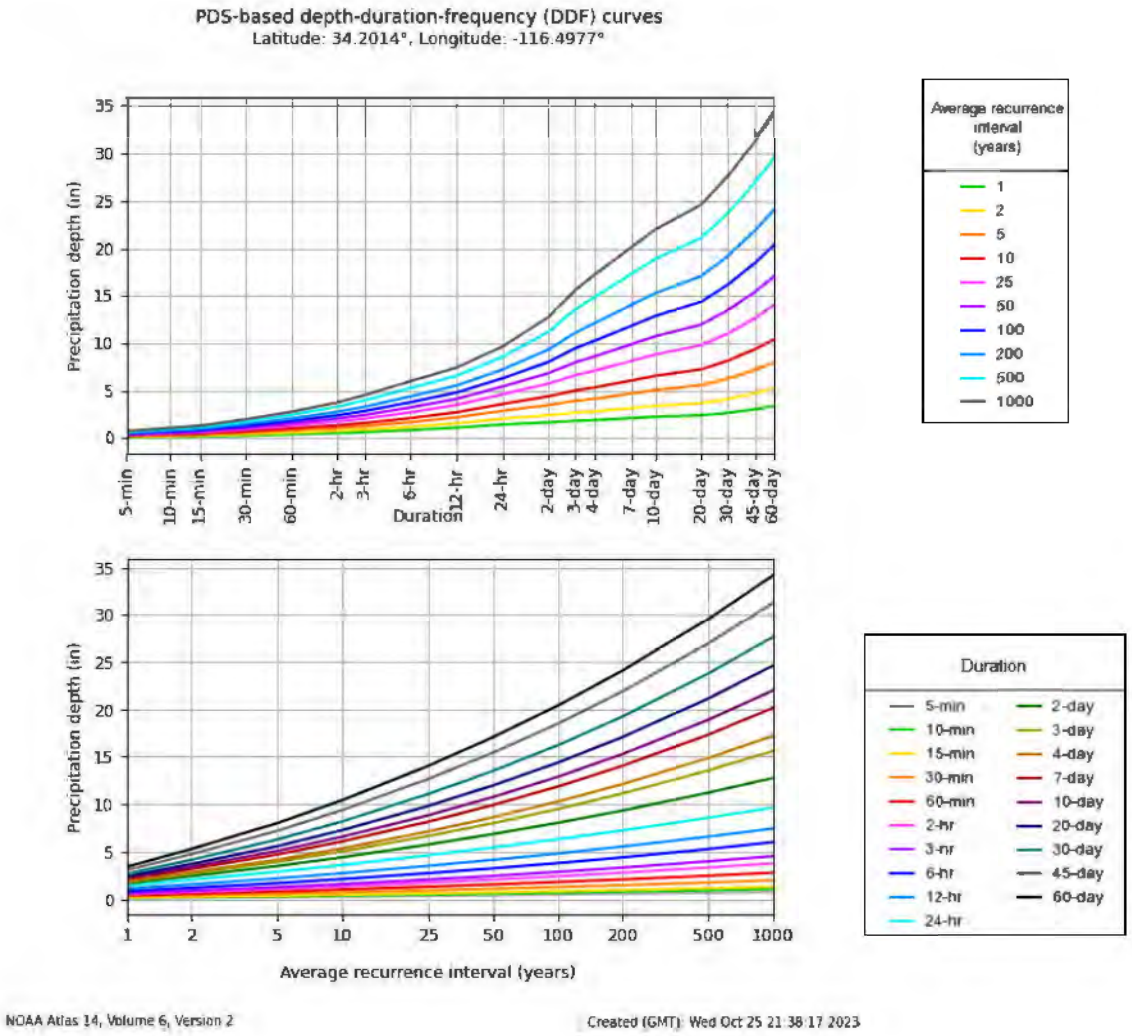
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 12/13/2023 at 5:39 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

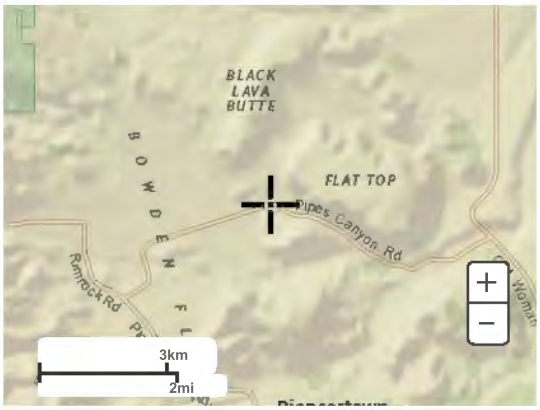
APPENDIX “D”



Back to Top

Maps & aerials

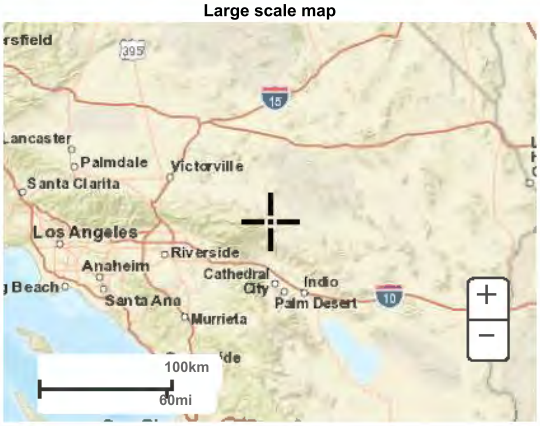
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial



Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

APPENDIX “E”

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 10/26/23

0972-002-A
PRE-DEV
WATERSHED 1
TERMINAL NODE 10

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 11.000 to Point/Station 10.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 199.690(Ft.)
Top (of initial area) elevation = 4166.000(Ft.)
Bottom (of initial area) elevation = 4136.000(Ft.)
Difference in elevation = 30.000(Ft.)
Slope = 0.15023 s(%)= 15.02
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 6.382 min.

Rainfall intensity = 8.736(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.894
Subarea runoff = 6.211(CFS)
Total initial stream area = 0.795(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 0.80 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 10/26/23

0972-002-A
PRE-DEV
WATERSHED 2
TERMINAL NODE 20

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 21.000 to Point/Station 20.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 287.310(Ft.)
Top (of initial area) elevation = 4168.000(Ft.)
Bottom (of initial area) elevation = 4140.000(Ft.)
Difference in elevation = 28.000(Ft.)
Slope = 0.09746 s(%)= 9.75
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.049 min.

Rainfall intensity = 7.426(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff = 9.990(CFS)
Total initial stream area = 1.506(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 1.51 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 10/26/23

0972-002-A
PRE-DEV
WATERSHED 3
TERMINAL NODE 30

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 31.000 to Point/Station 30.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 90.180(Ft.)
Top (of initial area) elevation = 4168.000(Ft.)
Bottom (of initial area) elevation = 4153.850(Ft.)
Difference in elevation = 14.150(Ft.)
Slope = 0.15691 s(%)= 15.69
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 4.603 min.

Rainfall intensity = 10.981(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.895
Subarea runoff = 3.038(CFS)
Total initial stream area = 0.309(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 0.31 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/21/25

0972-002-A
PRE-DEV
WATERSHED 4
TERMINAL NODE 40

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++
Process from Point/Station 42.000 to Point/Station 41.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 973.350(Ft.)
Top (of initial area) elevation = 4168.000(Ft.)
Bottom (of initial area) elevation = 4124.000(Ft.)
Difference in elevation = 44.000(Ft.)
Slope = 0.04520 s(%)= 4.52
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 15.291 min.

```
Rainfall intensity =      4.739(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.889
Subarea runoff =     19.074(CFS)
Total initial stream area =        4.525(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.055(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       41.000 to Point/Station       40.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.385(Ft.), Average velocity =   1.892(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              1.48
        2             35.97              0.64
        3             41.17              0.48
        4             48.87              0.34
        5             65.15              0.16
        6             83.95              0.03
        7             98.22              0.00
        8            119.00              0.20
        9            136.69              0.73
        10            154.50              1.06
        11            162.11              1.48
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     36.834(CFS)
  '     '        flow top width =     78.768(Ft.)
  '     '    velocity=    1.892(Ft/s)
  '     '        area =     19.468(Sq.Ft)
  '     '        Froude number =     0.671

Upstream point elevation =  4124.000(Ft.)
Downstream point elevation =  4102.000(Ft.)
Flow length =   841.900(Ft.)
Travel time  =    7.42 min.
Time of concentration =   22.71 min.
Depth of flow =   0.385(Ft.)
Average velocity =   1.892(Ft/s)
Total irregular channel flow =    36.834(CFS)
Irregular channel normal depth above invert elev. =   0.385(Ft.)
Average velocity of channel(s) =   1.892(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
```

Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Rainfall intensity = 3.593(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.886
Subarea runoff = 35.422(CFS) for 12.591(Ac.)
Total runoff = 54.496(CFS)
Effective area this stream = 17.12(Ac.)
Total Study Area (Main Stream No. 1) = 17.12(Ac.)
Area averaged Fm value = 0.055(In/Hr)
Depth of flow = 0.457(Ft.), Average velocity = 2.145(Ft/s)
End of computations, Total Study Area = 17.12 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/21/25

0972-002-A
PRE-DEV
WATERSHED 5
TERMINAL NODE 50

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 51.000 to Point/Station 50.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 267.580(Ft.)
Top (of initial area) elevation = 4153.000(Ft.)
Bottom (of initial area) elevation = 4135.220(Ft.)
Difference in elevation = 17.780(Ft.)
Slope = 0.06645 s(%)= 6.64
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.446 min.

Rainfall intensity = 7.180(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff = 4.072(CFS)
Total initial stream area = 0.635(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 0.64 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/21/25

0972-002-A
PRE-DEV
WATERSHED 6
TERMINAL NODE 60

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 62.000 to Point/Station 61.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 575.040(Ft.)
Top (of initial area) elevation = 4167.000(Ft.)
Bottom (of initial area) elevation = 4113.100(Ft.)
Difference in elevation = 53.900(Ft.)
Slope = 0.09373 s(%)= 9.37
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 10.707 min.

```
Rainfall intensity =      6.082(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.892
Subarea runoff =     34.873(CFS)
Total initial stream area =        6.430(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.055(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       61.000 to Point/Station       60.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.000(Ft.), Average velocity =   2.951(Ft/s)
!!Warning: Water is above left or right bank elevations
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              1.00
        2              3.59              0.00
        3             12.22              0.00
        4             14.68              0.71
        5             15.74              0.95
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     44.139(CFS)
  '     '        flow top width =     15.740(Ft.)
  '     '    velocity=    3.618(Ft/s)
  '     '        area =     12.198(Sq.Ft)
  '     '        Froude number =     0.724

Information entered for subchannel number 2 :
Point number      'X' coordinate     'Y' coordinate
        1             21.53              0.95
        2             26.99              0.74
        3             29.79              0.59
        4             32.34              0.53
        5             34.35              0.48
        6             34.75              0.47
        7             37.93              0.42
        8             49.57              1.00
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     19.185(CFS)
  '     '        flow top width =     28.040(Ft.)
  '     '    velocity=    2.071(Ft/s)
  '     '        area =      9.263(Sq.Ft)
  '     '        Froude number =     0.635
```

```
Upstream point elevation =  4113.100(Ft.)
Downstream point elevation =  4043.000(Ft.)
Flow length =  2724.980(Ft.)
Travel time  =   15.39 min.
Time of concentration =   26.10 min.
Depth of flow =   1.000(Ft.)
Average velocity =   2.951(Ft/s)
Total irregular channel flow =    63.324(CFS)
Irregular channel normal depth above invert elev. =   1.000(Ft.)
Average velocity of channel(s) =   2.951(Ft/s)
!!Warning: Water is above left or right bank elevations
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
Rainfall intensity =      3.259(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.885
Subarea runoff =     56.837(CFS) for   25.374(Ac.)
Total runoff =     91.711(CFS)
Effective area this stream =       31.80(Ac.)
Total Study Area (Main Stream No. 1) =       31.80(Ac.)
Area averaged Fm value =    0.055(In/Hr)
Depth of flow =   1.122(Ft.), Average velocity =   3.422(Ft/s)
!!Warning: Water is above left or right bank elevations


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       61.000 to Point/Station       60.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     31.804(Ac.)
Runoff from this stream =     91.711(CFS)
Time of concentration =   26.10 min.
Rainfall intensity =     3.259(In/Hr)
Area averaged loss rate (Fm) =    0.0554(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       64.000 to Point/Station       63.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
UNDEVELOPED (poor cover) subarea
```

```
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
Initial subarea data:
Initial area flow distance =   985.000(Ft.)
Top (of initial area) elevation =  4089.560(Ft.)
Bottom (of initial area) elevation =  4063.000(Ft.)
Difference in elevation =    26.560(Ft.)
Slope =    0.02696  s(%)=       2.70
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   17.036 min.
Rainfall intensity =      4.394(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.889
Subarea runoff =     23.980(CFS)
Total initial stream area =        6.142(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.055(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       63.000 to Point/Station       60.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.648(Ft.), Average velocity =   2.377(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              0.87
        2              1.31              0.86
        3              9.19              0.73
        4             20.93              0.00
        5             22.50              0.01
        6             31.81              0.29
        7             41.56              0.32
        8             48.15              0.70
        9             51.28              0.74
        10             93.48              0.75
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     33.546(CFS)
  '     '        flow top width =     36.735(Ft.)
  '     '    velocity=    2.523(Ft/s)
  '     '        area =     13.295(Sq.Ft)
  '     '        Froude number =     0.739
```

```
Information entered for subchannel number 2 :
Point number      'X' coordinate     'Y' coordinate
        1             95.44              0.67
        2             99.55              0.64
        3            103.90              0.33
        4            108.70              0.10
        5            112.09              0.38
        6            120.22              0.74
        7            150.25              0.87
Manning's 'N' friction factor =   0.050
-----------------------------------------------------------------
Sub-Channel flow  =      9.909(CFS)
  '     '        flow top width =     19.667(Ft.)
  '     '    velocity=    1.988(Ft/s)
  '     '        area =      4.983(Sq.Ft)
  '     '        Froude number =     0.696

Upstream point elevation =  4063.000(Ft.)
Downstream point elevation =  4043.000(Ft.)
Flow length =   694.570(Ft.)
Travel time  =    4.87 min.
Time of concentration =   21.91 min.
Depth of flow =   0.648(Ft.)
Average velocity =   2.377(Ft/s)
Total irregular channel flow =    43.455(CFS)
Irregular channel normal depth above invert elev. =   0.648(Ft.)
Average velocity of channel(s) =   2.377(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
Rainfall intensity =      3.685(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.886
Subarea runoff =     38.876(CFS) for   13.102(Ac.)
Total runoff =     62.856(CFS)
Effective area this stream =       19.24(Ac.)
Total Study Area (Main Stream No. 1) =       51.05(Ac.)
Area averaged Fm value =    0.055(In/Hr)
Depth of flow =   0.807(Ft.), Average velocity =   1.979(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       63.000 to Point/Station       60.000
```

**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 19.244(Ac.)
Runoff from this stream = 62.856(CFS)
Time of concentration = 21.91 min.
Rainfall intensity = 3.685(In/Hr)
Area averaged loss rate (Fm) = 0.0554(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

Stream No.	Flow rate (CFS)	Area (Ac.)	TC (min)	Fm (In/Hr)	Rainfall Intensity (In/Hr)
1	91.71	31.804	26.10	0.055	3.259
2	62.86	19.244	21.91	0.055	3.685

Qmax(1) =
1.000 * 1.000 * 91.711) +
0.883 * 1.000 * 62.856) + = 147.203
Qmax(2) =
1.133 * 0.839 * 91.711) +
1.000 * 1.000 * 62.856) + = 150.046

Total of 2 streams to confluence:
Flow rates before confluence point:
91.711 62.856
Maximum flow rates at confluence using above data:
147.203 150.046
Area of streams before confluence:
31.804 19.244
Effective area values after confluence:
51.048 45.938
Results of confluence:
Total flow rate = 150.046(CFS)
Time of concentration = 21.905 min.
Effective stream area after confluence = 45.938(Ac.)
Study area average Pervious fraction(Ap) = 1.000
Study area average soil loss rate(Fm) = 0.055(In/Hr)
Study area total (this main stream) = 51.05(Ac.)
End of computations, Total Study Area = 51.05 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/21/25

0972-002-A
PRE-DEV
WATERSHED 7
TERMINAL NODE 70

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 73.000 to Point/Station 72.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 608.240(Ft.)
Top (of initial area) elevation = 4134.000(Ft.)
Bottom (of initial area) elevation = 4089.000(Ft.)
Difference in elevation = 45.000(Ft.)
Slope = 0.07398 s(%)= 7.40
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 11.481 min.

```
Rainfall intensity =      5.792(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.891
Subarea runoff =     22.989(CFS)
Total initial stream area =        4.453(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.055(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       72.000 to Point/Station       71.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.947(Ft.), Average velocity =   3.893(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              6.00
        2             59.15              0.00
        3             65.72              0.00
        4             68.34              0.24
        5            103.54              5.38
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     56.536(CFS)
  '     '        flow top width =     23.369(Ft.)
  '     '    velocity=    3.893(Ft/s)
  '     '        area =     14.522(Sq.Ft)
  '     '        Froude number =     0.870

Upstream point elevation =  4089.000(Ft.)
Downstream point elevation =  4051.390(Ft.)
Flow length =  1155.080(Ft.)
Travel time  =    4.94 min.
Time of concentration =   16.43 min.
Depth of flow =   0.947(Ft.)
Average velocity =   3.893(Ft/s)
Total irregular channel flow =    56.536(CFS)
Irregular channel normal depth above invert elev. =   0.947(Ft.)
Average velocity of channel(s) =   3.893(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
```

```
Rainfall intensity =      4.507(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.889
Subarea runoff =     67.021(CFS) for   18.012(Ac.)
Total runoff =     90.010(CFS)
Effective area this stream =       22.47(Ac.)
Total Study Area (Main Stream No. 1) =       22.47(Ac.)
Area averaged Fm value =    0.055(In/Hr)
Depth of flow =   1.180(Ft.), Average velocity =   4.408(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       72.000 to Point/Station       71.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     22.465(Ac.)
Runoff from this stream =     90.010(CFS)
Time of concentration =   16.43 min.
Rainfall intensity =     4.507(In/Hr)
Area averaged loss rate (Fm) =    0.0554(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       75.000 to Point/Station       74.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
Initial subarea data:
Initial area flow distance =   711.640(Ft.)
Top (of initial area) elevation =  4116.000(Ft.)
Bottom (of initial area) elevation =  4082.000(Ft.)
Difference in elevation =    34.000(Ft.)
Slope =    0.04778  s(%)=       4.78
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   13.342 min.
Rainfall intensity =      5.213(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.890
Subarea runoff =     34.910(CFS)
Total initial stream area =        7.520(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.055(In/Hr)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       74.000 to Point/Station       71.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.740(Ft.), Average velocity =   3.623(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              6.00
        2             15.61              3.00
        3             26.84              2.00
        4             41.74              1.31
        5             49.42              1.00
        6             52.18              0.99
        7             59.26              0.00
        8             70.75              0.00
        9             78.67              1.37
        10           104.16               3.47
        11           123.65               6.00
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     43.614(CFS)
  '     '        flow top width =     21.057(Ft.)
  '     '    velocity=    3.623(Ft/s)
  '     '        area =     12.039(Sq.Ft)
  '     '        Froude number =     0.844

Upstream point elevation =  4082.000(Ft.)
Downstream point elevation =  4051.390(Ft.)
Flow length =   970.470(Ft.)
Travel time  =    4.46 min.
Time of concentration =   17.81 min.
Depth of flow =   0.740(Ft.)
Average velocity =   3.623(Ft/s)
Total irregular channel flow =    43.614(CFS)
Irregular channel normal depth above invert elev. =   0.740(Ft.)
Average velocity of channel(s) =   3.623(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
```

```
Rainfall intensity =      4.260(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.888
Subarea runoff =     17.352(CFS) for    6.292(Ac.)
Total runoff =     52.262(CFS)
Effective area this stream =       13.81(Ac.)
Total Study Area (Main Stream No. 1) =       36.28(Ac.)
Area averaged Fm value =    0.055(In/Hr)
Depth of flow =   0.815(Ft.), Average velocity =   3.824(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       74.000 to Point/Station       71.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =     13.812(Ac.)
Runoff from this stream =     52.262(CFS)
Time of concentration =   17.81 min.
Rainfall intensity =     4.260(In/Hr)
Area averaged loss rate (Fm) =    0.0554(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

Stream Flow rate    Area    TC     Fm       Rainfall Intensity
 No.    (CFS)   (Ac.)       (min) (In/Hr)     (In/Hr)


1     90.01    22.465     16.43    0.055      4.507
2     52.26    13.812     17.81    0.055      4.260
Qmax(1) =
           1.000 *    1.000 *    90.010) +
           1.059 *    0.922 *    52.262) + =     141.058
Qmax(2) =
           0.944 *    1.000 *    90.010) +
           1.000 *    1.000 *    52.262) + =     137.265

Total of 2 streams to confluence:
Flow rates before confluence point:
      90.010      52.262
Maximum flow rates at confluence using above data:
      141.058      137.265
Area of streams before confluence:
       22.465       13.812
Effective area values after confluence:
       35.206       36.277
Results of confluence:
Total flow rate =    141.058(CFS)
Time of concentration =    16.426 min.
Effective stream area after confluence =     35.206(Ac.)
```

```
Study area average Pervious fraction(Ap) =  1.000
Study area average soil loss rate(Fm) =    0.055(In/Hr)
Study area total (this main stream) =      36.28(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       71.000 to Point/Station       70.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.684(Ft.), Average velocity =   2.624(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              3.04
        2              6.61              2.07
        3             17.26              1.07
        4             30.67              0.28
        5             38.50              0.07
        6             47.98              0.00
        7             66.71              0.07
        8            102.00              0.61
        9            112.77              0.64
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     96.309(CFS)
  '     '        flow top width =     88.965(Ft.)
  '     '    velocity=    2.639(Ft/s)
  '     '        area =     36.491(Sq.Ft)
  '     '        Froude number =     0.726

Information entered for subchannel number 2 :
Point number      'X' coordinate     'Y' coordinate
        1            135.02              0.36
        2            160.04              0.24
        3            165.94              0.07
        4            169.49              0.07
        5            189.76              1.07
        6            199.09              1.89
        7            212.67              4.72
        8            214.46              5.07
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     48.620(CFS)
  '     '        flow top width =     46.924(Ft.)
  '     '    velocity=    2.593(Ft/s)
  '     '        area =     18.749(Sq.Ft)
  '     '        Froude number =     0.723
```

```
Upstream point elevation =  4051.390(Ft.)
Downstream point elevation =  4043.000(Ft.)
Flow length =   324.070(Ft.)
Travel time  =    2.06 min.
Time of concentration =   18.48 min.
Depth of flow =   0.684(Ft.)
Average velocity =   2.624(Ft/s)
Total irregular channel flow =   144.929(CFS)
Irregular channel normal depth above invert elev. =   0.684(Ft.)
Average velocity of channel(s) =   2.624(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
Rainfall intensity =      4.150(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.888
Subarea runoff =      7.684(CFS) for    5.160(Ac.)
Total runoff =    148.743(CFS)
Effective area this stream =       40.37(Ac.)
Total Study Area (Main Stream No. 1) =       41.44(Ac.)
Area averaged Fm value =    0.055(In/Hr)
Depth of flow =   0.691(Ft.), Average velocity =   2.649(Ft/s)
End of computations, Total Study Area =           41.44 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  86.0
```

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/21/25

0972-002-A
PRE-DEV
WATERSHED 8
TERMINAL NODE 80

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 81.000 to Point/Station 80.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 354.280(Ft.)
Top (of initial area) elevation = 4118.000(Ft.)
Bottom (of initial area) elevation = 4096.130(Ft.)
Difference in elevation = 21.870(Ft.)
Slope = 0.06173 s(%)= 6.17
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 9.590 min.

Rainfall intensity = 6.569(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.892
Subarea runoff = 11.362(CFS)
Total initial stream area = 1.938(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 1.94 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/21/25

0972-002-A
PRE-DEV
WATERSHED 9
TERMINAL NODE 90

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

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Process from Point/Station 91.000 to Point/Station 90.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 371.680(Ft.)
Top (of initial area) elevation = 4076.940(Ft.)
Bottom (of initial area) elevation = 4043.910(Ft.)
Difference in elevation = 33.030(Ft.)
Slope = 0.08887 s(%)= 8.89
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 9.088 min.

Rainfall intensity = 6.821(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff = 5.383(CFS)
Total initial stream area = 0.884(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 0.88 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/21/25

0972-002-A
PRE-DEV
WATERSHED 10
TERMINAL NODE 100

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 101.000 to Point/Station 100.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 410.110(Ft.)
Top (of initial area) elevation = 4099.000(Ft.)
Bottom (of initial area) elevation = 4045.950(Ft.)
Difference in elevation = 53.050(Ft.)
Slope = 0.12936 s(%)= 12.94
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.769 min.

Rainfall intensity = 6.994(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff = 8.480(CFS)
Total initial stream area = 1.358(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 1.36 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/21/25

0972-002-A
PRE-DEV
WATERSHED 11
TERMINAL NODE 110

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 111.000 to Point/Station 110.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 299.260(Ft.)
Top (of initial area) elevation = 4109.330(Ft.)
Bottom (of initial area) elevation = 4060.120(Ft.)
Difference in elevation = 49.210(Ft.)
Slope = 0.16444 s(%)= 16.44
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 7.368 min.

Rainfall intensity = 7.900(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.894
Subarea runoff = 4.476(CFS)
Total initial stream area = 0.634(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 0.63 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/21/25

0972-002-A
PRE-DEV
WATERSHED 12
TERMINAL NODE 120

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 121.000 to Point/Station 120.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 400.140(Ft.)
Top (of initial area) elevation = 4122.000(Ft.)
Bottom (of initial area) elevation = 4064.000(Ft.)
Difference in elevation = 58.000(Ft.)
Slope = 0.14495 s(%)= 14.49
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.488 min.

Rainfall intensity = 7.155(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff = 12.045(CFS)
Total initial stream area = 1.885(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 1.89 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/21/25

0972-002-A
PRE-DEV
WATERSHED 13
TERMINAL NODE 130

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 131.000 to Point/Station 130.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 379.460(Ft.)
Top (of initial area) elevation = 4131.000(Ft.)
Bottom (of initial area) elevation = 4073.160(Ft.)
Difference in elevation = 57.840(Ft.)
Slope = 0.15243 s(%)= 15.24
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.226 min.

Rainfall intensity = 7.314(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff = 6.604(CFS)
Total initial stream area = 1.011(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 1.01 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/21/25

0972-002-A
PRE-DEV
WATERSHED 14
TERMINAL NODE 140

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 141.000 to Point/Station 140.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 605.350(Ft.)
Top (of initial area) elevation = 4120.000(Ft.)
Bottom (of initial area) elevation = 4073.000(Ft.)
Difference in elevation = 47.000(Ft.)
Slope = 0.07764 s(%)= 7.76
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 11.349 min.

Rainfall intensity = 5.839(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.891
Subarea runoff = 12.560(CFS)
Total initial stream area = 2.413(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 2.41 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 12/12/23

0972-002-A
POST-DEV
WATERSHED 1
TERMINAL NODE 10

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 11.000 to Point/Station 10.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 199.690(Ft.)
Top (of initial area) elevation = 4166.000(Ft.)
Bottom (of initial area) elevation = 4136.000(Ft.)
Difference in elevation = 30.000(Ft.)
Slope = 0.15023 s(%)= 15.02
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 6.382 min.

Rainfall intensity = 8.736(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.894
Subarea runoff = 6.211(CFS)
Total initial stream area = 0.795(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 0.80 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 12/12/23

0972-002-A
POST-DEV
WATERSHED 2
TERMINAL NODE 20

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 21.000 to Point/Station 20.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 287.310(Ft.)
Top (of initial area) elevation = 4168.000(Ft.)
Bottom (of initial area) elevation = 4140.000(Ft.)
Difference in elevation = 28.000(Ft.)
Slope = 0.09746 s(%)= 9.75
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.049 min.

Rainfall intensity = 7.426(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff = 9.990(CFS)
Total initial stream area = 1.506(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 1.51 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 12/13/23

0972-002-A
POST-DEV
WATERSHED 3
TERMINAL NODE 30

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 31.000 to Point/Station 0.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 90.180(Ft.)
Top (of initial area) elevation = 4168.000(Ft.)
Bottom (of initial area) elevation = 4153.850(Ft.)
Difference in elevation = 14.150(Ft.)
Slope = 0.15691 s(%)= 15.69
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 4.603 min.

Rainfall intensity = 10.981(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.895
Subarea runoff = 3.038(CFS)
Total initial stream area = 0.309(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 0.31 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/24/25

0972-002
POST-DEV
SUBAREA 4
TERMINAL NODE 40

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 42.000 to Point/Station 41.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 973.350(Ft.)
Top (of initial area) elevation = 4168.000(Ft.)
Bottom (of initial area) elevation = 4124.000(Ft.)
Difference in elevation = 44.000(Ft.)
Slope = 0.04520 s(%)= 4.52
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 15.291 min.

```
Rainfall intensity =      4.739(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.889
Subarea runoff =     19.074(CFS)
Total initial stream area =        4.525(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.055(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       41.000 to Point/Station       40.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.385(Ft.), Average velocity =   1.892(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              1.48
        2             35.97              0.64
        3             41.17              0.48
        4             48.87              0.34
        5             65.15              0.16
        6             83.95              0.03
        7             98.22              0.00
        8            119.00              0.20
        9            136.69              0.73
        10            154.50              1.06
        11            162.11              1.48
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     36.834(CFS)
  '     '        flow top width =     78.768(Ft.)
  '     '    velocity=    1.892(Ft/s)
  '     '        area =     19.468(Sq.Ft)
  '     '        Froude number =     0.671

Upstream point elevation =  4124.000(Ft.)
Downstream point elevation =  4102.000(Ft.)
Flow length =   841.900(Ft.)
Travel time  =    7.42 min.
Time of concentration =   22.71 min.
Depth of flow =   0.385(Ft.)
Average velocity =   1.892(Ft/s)
Total irregular channel flow =    36.834(CFS)
Irregular channel normal depth above invert elev. =   0.385(Ft.)
Average velocity of channel(s) =   1.892(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
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Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Rainfall intensity = 3.593(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.886
Subarea runoff = 35.422(CFS) for 12.591(Ac.)
Total runoff = 54.496(CFS)
Effective area this stream = 17.12(Ac.)
Total Study Area (Main Stream No. 1) = 17.12(Ac.)
Area averaged Fm value = 0.055(In/Hr)
Depth of flow = 0.457(Ft.), Average velocity = 2.145(Ft/s)
End of computations, Total Study Area = 17.12 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/24/25

0972-002-A
POST-DEV
WATERSHED 5
TERMINAL NODE 50

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 51.000 to Point/Station 50.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 267.580(Ft.)
Top (of initial area) elevation = 4153.000(Ft.)
Bottom (of initial area) elevation = 4135.220(Ft.)
Difference in elevation = 17.780(Ft.)
Slope = 0.06645 s(%)= 6.64
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.446 min.

Rainfall intensity = 7.180(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff = 4.072(CFS)
Total initial stream area = 0.635(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 0.64 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/24/25

0972-002-A
POST-DEV
WATERSHED 6
TERMINAL NODE 60

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 62.000 to Point/Station 61.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 575.040(Ft.)
Top (of initial area) elevation = 4167.000(Ft.)
Bottom (of initial area) elevation = 4113.100(Ft.)
Difference in elevation = 53.900(Ft.)
Slope = 0.09373 s(%)= 9.37
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 10.707 min.

```
Rainfall intensity =      6.082(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.892
Subarea runoff =     34.873(CFS)
Total initial stream area =        6.430(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.055(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       61.000 to Point/Station       60.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   1.000(Ft.), Average velocity =   2.948(Ft/s)
!!Warning: Water is above left or right bank elevations
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              1.00
        2              3.59              0.00
        3             12.22              0.00
        4             14.68              0.71
        5             15.74              0.95
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     44.103(CFS)
  '     '        flow top width =     15.740(Ft.)
  '     '    velocity=    3.615(Ft/s)
  '     '        area =     12.199(Sq.Ft)
  '     '        Froude number =     0.724

Information entered for subchannel number 2 :
Point number      'X' coordinate     'Y' coordinate
        1             21.53              0.95
        2             26.99              0.74
        3             29.79              0.59
        4             32.34              0.53
        5             34.35              0.48
        6             34.75              0.47
        7             37.93              0.42
        8             49.57              1.00
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     19.171(CFS)
  '     '        flow top width =     28.040(Ft.)
  '     '    velocity=    2.069(Ft/s)
  '     '        area =      9.264(Sq.Ft)
  '     '        Froude number =     0.634
```

```
Upstream point elevation =  4113.100(Ft.)
Downstream point elevation =  4043.000(Ft.)
Flow length =  2729.810(Ft.)
Travel time  =   15.43 min.
Time of concentration =   26.14 min.
Depth of flow =   1.000(Ft.)
Average velocity =   2.948(Ft/s)
Total irregular channel flow =    63.274(CFS)
Irregular channel normal depth above invert elev. =   1.000(Ft.)
Average velocity of channel(s) =   2.948(Ft/s)
!!Warning: Water is above left or right bank elevations
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
Rainfall intensity =      3.256(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.885
Subarea runoff =     56.737(CFS) for   25.374(Ac.)
Total runoff =     91.610(CFS)
Effective area this stream =       31.80(Ac.)
Total Study Area (Main Stream No. 1) =       31.80(Ac.)
Area averaged Fm value =    0.055(In/Hr)
Depth of flow =   1.122(Ft.), Average velocity =   3.418(Ft/s)
!!Warning: Water is above left or right bank elevations


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       61.000 to Point/Station       60.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     31.804(Ac.)
Runoff from this stream =     91.610(CFS)
Time of concentration =   26.14 min.
Rainfall intensity =     3.256(In/Hr)
Area averaged loss rate (Fm) =    0.0554(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       64.000 to Point/Station       63.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
UNDEVELOPED (poor cover) subarea
```

```
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
Initial subarea data:
Initial area flow distance =   985.320(Ft.)
Top (of initial area) elevation =  4089.560(Ft.)
Bottom (of initial area) elevation =  4063.000(Ft.)
Difference in elevation =    26.560(Ft.)
Slope =    0.02696  s(%)=       2.70
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   17.040 min.
Rainfall intensity =      4.393(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.889
Subarea runoff =     23.977(CFS)
Total initial stream area =        6.142(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.055(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       63.000 to Point/Station       60.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.646(Ft.), Average velocity =   2.383(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              0.87
        2              1.31              0.86
        3              9.19              0.73
        4             20.93              0.00
        5             22.50              0.00
        6             31.81              0.29
        7             41.56              0.32
        8             48.15              0.70
        9             51.28              0.74
        10             93.48              0.75
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     33.566(CFS)
  '     '        flow top width =     36.679(Ft.)
  '     '    velocity=    2.526(Ft/s)
  '     '        area =     13.287(Sq.Ft)
  '     '        Froude number =     0.740
```

```
Information entered for subchannel number 2 :
Point number      'X' coordinate     'Y' coordinate
        1             95.44              0.67
        2             99.55              0.64
        3            103.90              0.33
        4            108.70              0.10
        5            112.09              0.38
        6            120.22              0.74
        7            150.25              0.87
Manning's 'N' friction factor =   0.050
-----------------------------------------------------------------
Sub-Channel flow  =      9.896(CFS)
  '     '        flow top width =     19.397(Ft.)
  '     '    velocity=    1.999(Ft/s)
  '     '        area =      4.950(Sq.Ft)
  '     '        Froude number =     0.697

Upstream point elevation =  4063.000(Ft.)
Downstream point elevation =  4043.000(Ft.)
Flow length =   694.570(Ft.)
Travel time  =    4.86 min.
Time of concentration =   21.90 min.
Depth of flow =   0.646(Ft.)
Average velocity =   2.383(Ft/s)
Total irregular channel flow =    43.461(CFS)
Irregular channel normal depth above invert elev. =   0.646(Ft.)
Average velocity of channel(s) =   2.383(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
Rainfall intensity =      3.686(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.886
Subarea runoff =     38.896(CFS) for   13.102(Ac.)
Total runoff =     62.873(CFS)
Effective area this stream =       19.24(Ac.)
Total Study Area (Main Stream No. 1) =       51.05(Ac.)
Area averaged Fm value =    0.055(In/Hr)
Depth of flow =   0.806(Ft.), Average velocity =   1.980(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       63.000 to Point/Station       60.000
```

**** CONFLUENCE OF MINOR STREAMS ****

Along Main Stream number: 1 in normal stream number 2
Stream flow area = 19.244(Ac.)
Runoff from this stream = 62.873(CFS)
Time of concentration = 21.90 min.
Rainfall intensity = 3.686(In/Hr)
Area averaged loss rate (Fm) = 0.0554(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

Stream No.	Flow rate (CFS)	Area (Ac.)	TC (min)	Fm (In/Hr)	Rainfall Intensity (In/Hr)
1	91.61	31.804	26.14	0.055	3.256
2	62.87	19.244	21.90	0.055	3.686

Qmax(1) =
1.000 * 1.000 * 91.610) +
0.882 * 1.000 * 62.873) + = 147.042
Qmax(2) =
1.134 * 0.838 * 91.610) +
1.000 * 1.000 * 62.873) + = 149.919

Total of 2 streams to confluence:
Flow rates before confluence point:
91.610 62.873
Maximum flow rates at confluence using above data:
147.042 149.919
Area of streams before confluence:
31.804 19.244
Effective area values after confluence:
51.048 45.887
Results of confluence:
Total flow rate = 149.919(CFS)
Time of concentration = 21.897 min.
Effective stream area after confluence = 45.887(Ac.)
Study area average Pervious fraction(Ap) = 1.000
Study area average soil loss rate(Fm) = 0.055(In/Hr)
Study area total (this main stream) = 51.05(Ac.)
End of computations, Total Study Area = 51.05 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 04/24/25

0972-002-A
POST-DEV
WATERSHED 7
TERMINAL NODE 70

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.280(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.280 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 73.000 to Point/Station 72.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 608.240(Ft.)
Top (of initial area) elevation = 4134.000(Ft.)
Bottom (of initial area) elevation = 4089.000(Ft.)
Difference in elevation = 45.000(Ft.)
Slope = 0.07398 s(%)= 7.40
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 11.481 min.

```
Rainfall intensity =      5.792(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.891
Subarea runoff =     22.989(CFS)
Total initial stream area =        4.453(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.055(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       72.000 to Point/Station       71.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.947(Ft.), Average velocity =   3.893(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              6.00
        2             59.15              0.00
        3             65.72              0.00
        4             68.34              0.24
        5            103.54              5.38
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     56.536(CFS)
  '     '        flow top width =     23.369(Ft.)
  '     '    velocity=    3.893(Ft/s)
  '     '        area =     14.522(Sq.Ft)
  '     '        Froude number =     0.870

Upstream point elevation =  4089.000(Ft.)
Downstream point elevation =  4051.390(Ft.)
Flow length =  1155.080(Ft.)
Travel time  =    4.94 min.
Time of concentration =   16.43 min.
Depth of flow =   0.947(Ft.)
Average velocity =   3.893(Ft/s)
Total irregular channel flow =    56.536(CFS)
Irregular channel normal depth above invert elev. =   0.947(Ft.)
Average velocity of channel(s) =   3.893(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
```

```
Rainfall intensity =      4.507(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.889
Subarea runoff =     67.021(CFS) for   18.012(Ac.)
Total runoff =     90.010(CFS)
Effective area this stream =       22.47(Ac.)
Total Study Area (Main Stream No. 1) =       22.47(Ac.)
Area averaged Fm value =    0.055(In/Hr)
Depth of flow =   1.180(Ft.), Average velocity =   4.408(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       72.000 to Point/Station       71.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     22.465(Ac.)
Runoff from this stream =     90.010(CFS)
Time of concentration =   16.43 min.
Rainfall intensity =     4.507(In/Hr)
Area averaged loss rate (Fm) =    0.0554(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       75.000 to Point/Station       74.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
Initial subarea data:
Initial area flow distance =   711.640(Ft.)
Top (of initial area) elevation =  4116.000(Ft.)
Bottom (of initial area) elevation =  4082.000(Ft.)
Difference in elevation =    34.000(Ft.)
Slope =    0.04778  s(%)=       4.78
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   13.342 min.
Rainfall intensity =      5.213(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.890
Subarea runoff =     34.910(CFS)
Total initial stream area =        7.520(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.055(In/Hr)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       74.000 to Point/Station       71.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.740(Ft.), Average velocity =   3.623(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              6.00
        2             15.61              3.00
        3             26.84              2.00
        4             41.74              1.31
        5             49.42              1.00
        6             52.18              0.99
        7             59.26              0.00
        8             70.75              0.00
        9             78.67              1.37
        10           104.16               3.47
        11           123.65               6.00
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     43.614(CFS)
  '     '        flow top width =     21.057(Ft.)
  '     '    velocity=    3.623(Ft/s)
  '     '        area =     12.039(Sq.Ft)
  '     '        Froude number =     0.844

Upstream point elevation =  4082.000(Ft.)
Downstream point elevation =  4051.390(Ft.)
Flow length =   970.470(Ft.)
Travel time  =    4.46 min.
Time of concentration =   17.81 min.
Depth of flow =   0.740(Ft.)
Average velocity =   3.623(Ft/s)
Total irregular channel flow =    43.614(CFS)
Irregular channel normal depth above invert elev. =   0.740(Ft.)
Average velocity of channel(s) =   3.623(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
```

```
Rainfall intensity =      4.260(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.888
Subarea runoff =     17.352(CFS) for    6.292(Ac.)
Total runoff =     52.262(CFS)
Effective area this stream =       13.81(Ac.)
Total Study Area (Main Stream No. 1) =       36.28(Ac.)
Area averaged Fm value =    0.055(In/Hr)
Depth of flow =   0.815(Ft.), Average velocity =   3.824(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       74.000 to Point/Station       71.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =     13.812(Ac.)
Runoff from this stream =     52.262(CFS)
Time of concentration =   17.81 min.
Rainfall intensity =     4.260(In/Hr)
Area averaged loss rate (Fm) =    0.0554(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

Stream Flow rate    Area    TC     Fm       Rainfall Intensity
 No.    (CFS)   (Ac.)       (min) (In/Hr)     (In/Hr)


1     90.01    22.465     16.43    0.055      4.507
2     52.26    13.812     17.81    0.055      4.260
Qmax(1) =
           1.000 *    1.000 *    90.010) +
           1.059 *    0.922 *    52.262) + =     141.058
Qmax(2) =
           0.944 *    1.000 *    90.010) +
           1.000 *    1.000 *    52.262) + =     137.265

Total of 2 streams to confluence:
Flow rates before confluence point:
      90.010      52.262
Maximum flow rates at confluence using above data:
      141.058      137.265
Area of streams before confluence:
       22.465       13.812
Effective area values after confluence:
       35.206       36.277
Results of confluence:
Total flow rate =    141.058(CFS)
Time of concentration =    16.426 min.
Effective stream area after confluence =     35.206(Ac.)
```

```
Study area average Pervious fraction(Ap) =  1.000
Study area average soil loss rate(Fm) =    0.055(In/Hr)
Study area total (this main stream) =      36.28(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       71.000 to Point/Station       70.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.684(Ft.), Average velocity =   2.624(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              3.04
        2              6.61              2.07
        3             17.26              1.07
        4             30.67              0.28
        5             38.50              0.07
        6             47.98              0.00
        7             66.71              0.07
        8            102.00              0.61
        9            112.77              0.64
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     96.309(CFS)
  '     '        flow top width =     88.965(Ft.)
  '     '    velocity=    2.639(Ft/s)
  '     '        area =     36.491(Sq.Ft)
  '     '        Froude number =     0.726

Information entered for subchannel number 2 :
Point number      'X' coordinate     'Y' coordinate
        1            135.02              0.36
        2            160.04              0.24
        3            165.94              0.07
        4            169.49              0.07
        5            189.76              1.07
        6            199.09              1.89
        7            212.67              4.72
        8            214.46              5.07
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =     48.620(CFS)
  '     '        flow top width =     46.924(Ft.)
  '     '    velocity=    2.593(Ft/s)
  '     '        area =     18.749(Sq.Ft)
  '     '        Froude number =     0.723
```

```
Upstream point elevation =  4051.390(Ft.)
Downstream point elevation =  4043.000(Ft.)
Flow length =   324.070(Ft.)
Travel time  =    2.06 min.
Time of concentration =   18.48 min.
Depth of flow =   0.684(Ft.)
Average velocity =   2.624(Ft/s)
Total irregular channel flow =   144.929(CFS)
Irregular channel normal depth above invert elev. =   0.684(Ft.)
Average velocity of channel(s) =   2.624(Ft/s)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.055(In/Hr)
Rainfall intensity =      4.150(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.888
Subarea runoff =      7.684(CFS) for    5.160(Ac.)
Total runoff =    148.743(CFS)
Effective area this stream =       40.37(Ac.)
Total Study Area (Main Stream No. 1) =       41.44(Ac.)
Area averaged Fm value =    0.055(In/Hr)
Depth of flow =   0.691(Ft.), Average velocity =   2.649(Ft/s)
End of computations, Total Study Area =           41.44 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  86.0
```

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0972-002-A
POST-DEV
WATERSHED 8
TERMINAL NODE 80

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 81.000 to Point/Station 80.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 354.280(Ft.)
Top (of initial area) elevation = 4118.000(Ft.)
Bottom (of initial area) elevation = 4096.130(Ft.)
Difference in elevation = 21.870(Ft.)
Slope = 0.06173 s(%)= 6.17
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 9.590 min.

Rainfall intensity = 6.569(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.892
Subarea runoff = 11.362(CFS)
Total initial stream area = 1.938(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 1.94 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

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0972-002-A
POST-DEV
WATERSHED 9
TERMINAL NODE 90

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 91.000 to Point/Station 90.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 371.680(Ft.)
Top (of initial area) elevation = 4076.940(Ft.)
Bottom (of initial area) elevation = 4043.910(Ft.)
Difference in elevation = 33.030(Ft.)
Slope = 0.08887 s(%)= 8.89
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 9.088 min.

Rainfall intensity = 6.821(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff = 5.383(CFS)
Total initial stream area = 0.884(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 0.88 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

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0972-002-A
POST-DEV
WATERSHED 10
TERMINAL NODE 100

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 101.000 to Point/Station 100.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 410.000(Ft.)
Top (of initial area) elevation = 4099.000(Ft.)
Bottom (of initial area) elevation = 4045.950(Ft.)
Difference in elevation = 53.050(Ft.)
Slope = 0.12939 s(%)= 12.94
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.768 min.

Rainfall intensity = 6.994(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff = 8.480(CFS)
Total initial stream area = 1.358(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 1.36 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

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0972-002-A
POST-DEV
WATERSHED 11
TERMINAL NODE 110

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 111.000 to Point/Station 110.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 299.260(Ft.)
Top (of initial area) elevation = 4109.330(Ft.)
Bottom (of initial area) elevation = 4060.120(Ft.)
Difference in elevation = 49.210(Ft.)
Slope = 0.16444 s(%)= 16.44
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 7.368 min.

Rainfall intensity = 7.900(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.894
Subarea runoff = 4.476(CFS)
Total initial stream area = 0.634(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 0.63 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

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0972-002-A
POST-DEV
WATERSHED 12
TERMINAL NODE 120

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 121.000 to Point/Station 120.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 400.140(Ft.)
Top (of initial area) elevation = 4122.000(Ft.)
Bottom (of initial area) elevation = 4064.000(Ft.)
Difference in elevation = 58.000(Ft.)
Slope = 0.14495 s(%)= 14.49
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.488 min.

Rainfall intensity = 7.155(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff = 12.045(CFS)
Total initial stream area = 1.885(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 1.89 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

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0972-002-A
POST-DEV
WATERSHED 13
TERMINAL NODE 130

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 131.000 to Point/Station 130.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 379.460(Ft.)
Top (of initial area) elevation = 4131.000(Ft.)
Bottom (of initial area) elevation = 4073.160(Ft.)
Difference in elevation = 57.840(Ft.)
Slope = 0.15243 s(%)= 15.24
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 8.226 min.

Rainfall intensity = 7.314(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff = 6.604(CFS)
Total initial stream area = 1.011(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 1.01 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

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0972-002-A
POST-DEV
WATERSHED 14
TERMINAL NODE 140

Program License Serial Number 6560

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
10 Year storm 1 hour rainfall = 1.040(In.)
100 Year storm 1 hour rainfall = 1.820(In.)
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.820 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 3

++

Process from Point/Station 141.000 to Point/Station 140.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Adjusted SCS curve number for AMC 3 = 97.20
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.055(In/Hr)
Initial subarea data:
Initial area flow distance = 605.350(Ft.)
Top (of initial area) elevation = 4120.000(Ft.)
Bottom (of initial area) elevation = 4073.000(Ft.)
Difference in elevation = 47.000(Ft.)
Slope = 0.07764 s(%)= 7.76
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 11.349 min.

Rainfall intensity = 5.839(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.891
Subarea runoff = 12.560(CFS)
Total initial stream area = 2.413(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.055(In/Hr)
End of computations, Total Study Area = 2.41 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 86.0

Jonathan Shokrian
319 South Robertson Boulevard
Beverly Hills, California 90211

Feasibility-Level Geotechnical Engineering Report
Proposed Subdivision Project
Pipes Canyon Road
APN 0594-351-36
Pioneertown, San Bernardino County, California

July 21, 2025

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File No.: 307129-001
Doc. No.: 25-07-703

July 21, 2025

File No.: 307129-001
Doc No.: 25-07-703

Mr. Jonathan Shokrian
319 South Robertson Boulevard
Beverly Hills, California 90211

Attention: Mr. Jonathan Shokrian

Subject: Feasibility-Level Geotechnical Engineering Report

Project: **Proposed Subdivision Project**
Pipes Canyon Road
APN 0594-351-36
Pioneertown, San Bernardino County, California

Earth Systems Pacific (Earth Systems) is pleased to present this feasibility-level geotechnical engineering report prepared for the proposed subdivision project located at Pipes Canyon Road, Pioneertown, San Bernardino County, California. This report presents our findings and recommendations for site grading and foundation design, incorporating the information provided to our office. On a feasibility level, the site is suitable for the proposed development, provided the recommendations in this report are followed in initial design. This report should stand as a whole, and no part of the report should be excerpted or used to the exclusion of any other part.

This report completes our scope of services in accordance with our proposal BER-25-2-001, dated February 24, 2025, and authorized March 21, 2025. Unless requested in writing, the client is responsible for distributing this report to the appropriate governing agency or other members of the design team. Once the project progresses to location and design of actual homesites, a design-level geotechnical report will need to be completed.

We appreciate the opportunity to provide our professional services. Please contact our office if there are any questions or comments concerning this report or its recommendations.

Respectfully submitted,
EARTH SYSTEMS PACIFIC



Rocio Carrillo, PE
Project Engineer
CE 75721



Kevin L. Paul, PE, GE
Principal Engineer
CE 70084, GE 2930



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EG 1174

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Feasibility-Level Geotechnical Engineering Report
Proposed Subdivision Project
Pipes Canyon Road
APN 0594-351-36
Pioneertown, San Bernardino County, California

Section 1
INTRODUCTION

1.1 Project Description

This feasibility-level geotechnical engineering report has been prepared for the new proposed subdivision project located at Pipes Canyon Road (APN 0594-351-36), Pioneertown, San Bernardino County, California, see Plate 1 (Site Vicinity Map).

We understand that the proposed site improvements will consist of subdividing the existing 122.98 acre parcel into twelve (12) individual parcels (approximately 5 acres each) with a "remainder parcel". The subdivision will be for individual lot sales to allow for custom builds. No formal house plans or grading plans were available. Building sites depicted for preliminary development purposes are for feasibility tract approval and are not necessarily where actual building sites may be constructed. The project has access to municipal power, but will require on-site septic systems for wastewater treatment for each lot. In addition, appurtenant site work is assumed to include underground utilities, landscaping, driveway approaches, and access drives.

We have assumed the structures will be one to two-story in height made of masonry, concrete, wood-framed or metal construction founded on shallow permanent foundations, and that there will be no below grade basement levels. We have assumed the anticipated loads will be less than approximately 50 kips for isolated spread footings and 3 kip/lineal foot for continuous footings. As the basis for the foundation recommendations, all loading is assumed to be dead plus actual live load.

No preliminary design loading was provided by the structural engineer. If actual structural loading exceeds these assumed values, we will need to re-evaluate the given recommendations.

1.2 Site Description

The approximate 123-acre project is located adjacent to Pipes Canyon Road approximately 0.27 miles east of Acacia Avenue, and about 0.27 miles north of Chia Trail in the Pioneer Town area of San Bernardino County, California (see Plate 1). The property is described as Assessor Parcel Number APN 0594-351-36. Coordinates near the center of the property are 34.20072°N/116.50162°W.

The proposed 12-lot residential subdivision is located in the western 2/3 of the property, with a remainder (open-space) lot forming the eastern 1/3 of the property (see Figure 1). Access to the site is primarily via the paved Pipes Canyon Road that trends diagonally from southwest to northeast across the property. One moderately maintained dirt road trends north to south

through the western 1/3 for the site, with another dirt road along a portion of the south boundary.



Figure 1- Project Limits

Existing improvements include Pipes Canyon Road, several poorly to moderately maintained dirt roads, and an abandoned residence and associated improvements (within the proposed Lot 12 boundary). Vegetation consists of typical high desert-desert vegetation with abundant Joshua trees, junipers, creosote, and native weeds and grasses. Bold granitic outcrops are common in the eastern half of the property.

1.3 Purpose and Scope of Services

The purpose of our services was to evaluate the site soil and geologic conditions at our exploration locations and to provide professional opinions and recommendations from a geologic and geotechnical point of view, regarding the proposed tentative tract feasibility. We understand that the proposed site improvements will be developed in general under the regulation of the current California Building Code (2022). **Depending on the specific actual building sites selected by future builders, additional site specific geotechnical evaluations and reporting will be necessary to review the specific geologic/geotechnical constraints for those future sites, as well as develop percolation reports for onsite septic wastewater disposal**.

The scope of services included:

Task 1 - Literature and Photograph Reviews

We began our services by reviewing select geologic and geotechnical literature pertaining to the

project. This included a review of various hazard, fault, and geologic maps prepared by the California Geological Survey, the U.S. Geological Survey, the County of San Bernardino and other governmental agencies as they relate to the project area. Historical aerial photographs were reviewed using the Google Earth Pro website and Historical Aerials website.

Task 2 – Utility Clearance, USA Dig Alert

Each of our proposed field exploration locations was located and marked in the field and cleared with known utility lines as identified by Underground Service Alert (USA), "Dig Alert". Our exploration locations were located in the field by consumer grade Global Positioning System (GPS) accurate to ± 15 feet in conjunction with pacing based upon the control provided or sighting from landmarks identified on the project topographic map.

Task 3 – Field Exploration

Earth Systems' project engineer and engineering geologist performed a site reconnaissance on March 27, 2025 to locate and mark exploration borings and percolation test locations and document the general geologic conditions. We evaluated the general subsurface conditions at the site by drilling twelve small diameter borings, from approximately 6 feet to 21½ feet in depth. Plate 2 shows the approximate locations of the borings.

Task 4 – Percolation Testing for Onsite Wastewater Treatment System (Leach Fields)

Twelve test holes were drilled to maximum depths of approximately 5 feet below the existing ground surface for the proposed feasibility percolation testing (one test per parcel). These holes were drilled on June 5 and 6, 2025 with the same drill rig as the exploration borings. Plate 2 shows the approximate locations of the tests. The tests were run in general conformance with the standards of the County of San Bernardino.

Task 5 – Percolation Testing for Basin Infiltration

Twelve test holes were drilled to maximum depths of approximately 5 feet below the existing ground surface for the proposed feasibility infiltration testing, as approved by the client. These holes were drilled on June 5 and 6, 2025 with the same drill rig as the exploration borings. Plate 2 shows the approximate location of the tests. The tests were run in general conformance with the standards of the County of San Bernardino.

Task 6 - Laboratory Testing

Laboratory tests were performed on selected samples to evaluate the physical characteristics of the materials encountered during our field exploration. Laboratory testing included moisture content, dry unit weight, maximum dry density/optimum moisture content, sieve analysis, consolidation/collapse potential, Expansion Index, and direct shear. The testing was performed in general accordance with American Society for Testing and Materials (ASTM) or appropriate test procedures. Selected samples were tested for a preliminary screening level of corrosion potential (pH, electrical resistivity, water-soluble sulfates and water-soluble chlorides). Earth Systems does not practice corrosion engineering; however, these test results may be used by a qualified engineer in designing an appropriate corrosion plan for the project.

Task 7 – Analysis and Report

Earth Systems analyzed the field data obtained, performed engineering analyses, and provided recommended feasibility-level design parameters for earthwork and foundations for the structures as described within. Our report includes:

- A description of the proposed project including a site plan showing the approximate boring locations;
- A description of the surface and subsurface site conditions including groundwater conditions, as encountered in our field exploration;
- A description of the site geologic setting and possible associated geology-related hazards, including liquefaction, subsidence, and seismic settlement analysis;
- A discussion of regional geology and site seismicity;
- A description of local and regional active faults, their distances from the site, and the potential for future earthquakes;
- A discussion of other geologic hazards such as ground shaking, landslides, flooding, and tsunamis;
- A General Procedure seismic analysis including recommendations for geotechnical seismic design coefficients in accordance with the 2022 CBC.
- A discussion of site conditions, including the geotechnical suitability of the site for the general type of construction proposed;
- Recommendations for imported fill (if required) for use in compacted fills;
- Recommendations for feasibility foundation design including parameters for shallow foundations and subgrade preparation;
- Anticipated total and differential settlements for the assumed foundation system;
- Preliminary recommendations for the mitigation of liquefaction (if applicable);
- Recommendations for lateral load resistance (earth pressures and drainage) for below grade structures including drainage requirements and seismic earth pressures;
- Recommendations for site preparation, earthwork, and fill compaction specifications;
- Discussion of anticipated excavation conditions;
- Recommendations for underground utility trench backfill;
- Recommendations for stability of temporary trench excavations;
- Recommendations for slabs-on-grade, including recommendations for reducing the potential for moisture transmission through interior slabs;
- Recommendations for collapsible or expansive soils (if applicable);
- Recommendations for fire lanes and pavements;
- A discussion of the corrosion potential of the near-surface soils encountered during our field exploration; and

- An appendix, which includes a summary of the field exploration (computer generated boring logs) and laboratory testing program (computer generated plots).

Not Contained in This Report: Although available through Earth Systems, the current geotechnical scope of our services does not include:

- An environmental Phase 1 assessment.
- An investigation for the presence or absence of wetlands, hazardous or toxic materials in the soil, surface water, groundwater, or air on, below, or adjacent to the subject property.

Section 2
METHODS OF EXPLORATION AND TESTING

2.1 Field Exploration

The geotechnical subsurface exploration program included advancing twelve exploratory borings. The borings were drilled to depths ranging from approximately 6 to 21½ feet below existing grades using a limited access track rig equipped with 8-inch hollow-stem augers provided by Calpac Drilling of Calimesa, California. The borings were advanced to observe soil profiles and obtain samples for laboratory testing. The approximate boring locations are shown on Plate 2, in Appendix A. The locations shown are approximate, established by consumer grade Global Positioning System (GPS) accurate to ± 15 feet in conjunction with pacing based upon the control provided.

Staff from Earth Systems maintained a log of the subsurface conditions encountered and obtained samples for logging, classification and laboratory testing. Subsurface conditions encountered in the borings were categorized and logged in general accordance with the Unified Soil Classification System (USCS) and ASTM D 2487 and 2488 (current edition). Our typical sampling interval within the borings was approximately every 2½ or 5 feet to the full depth explored; however, sampling intervals were adjusted depending on the materials encountered onsite. Current samples were obtained within the test borings using a Modified California (MC) ring sampler (ASTM D 3550 with those similar to ASTM D 1586) and a Standard Penetration (SPT) sampler. The MC sampler has an approximate 3-inch outside diameter and 2.4-inch inside diameter, while the SPT sampler has an outside diameter of approximate 2 inches and an inside diameter of approximately 1.4 inches. The samplers were mounted on a drill rod and driven using a rig-mounted 140-pound automatic hammer falling for a height of 30 inches. The number of blows necessary to drive the samplers within the borings was recorded.

Design parameters provided by Earth Systems in this report have considered an estimated 78% hammer efficiency based on data provided by the drilling subcontractor, past report information, and limits per SP117A. The N-values (blow count) using the California sampler can be roughly correlated to SPT N-values using a conversion factor that may vary from about 0.5 to 0.7. In general, a conversion factor of approximately 0.63 from a study at the Port of Los Angeles (Zueger and McNeilan, 1998 per SP 117A) is considered satisfactory. A value of 0.63 was applied in our calculations for this project.

Bulk samples of the soil materials were obtained from the drill auger cuttings, representing a mixture of soils encountered at the depths noted. The depth to groundwater, if any, was measured in the boreholes. Following drilling, sampling, and logging, the borings were backfilled with the cuttings and tamped upon completion. Our field exploration was provided under the direction of a State of California Registered Geotechnical Engineer from our firm.

The logs of the borings represent our interpretation of the contents of the field data and the results of laboratory testing performed on the samples obtained during the subsurface exploration. The final logs are included in Appendix A of this report. The stratification lines represent the approximate boundaries between soil types, although the transitions may be gradual. In reviewing the logs and legend, the reader should recognize the legend is intended as

a guideline only, and there are a number of conditions that may influence the soil characteristics observed during drilling. These include, but are not limited to cementation, variations in soil moisture, presence of groundwater, and other factors.

The boring logs present field blow counts per 6 inches of driven embedment (or portion thereof) for a total driven depth attempted of 18 inches. Where gravel was observed in sufficient quantity, blows were recorded in 1-inch increments summed, and erroneous blows on rock discarded, as needed. The blow counts on the logs are uncorrected (i.e. not corrected for overburden, sampling, etc.). Consequently, the user must correct the blow counts per standard methodology if they are to be used for design and exercise judgment in interpreting soil characteristics, possibly resulting in soil descriptions that vary somewhat from the legend.

2.2 Laboratory Testing

Samples were reviewed along with field logs to select those that would be analyzed further. Those selected for laboratory testing include, but were not limited to, soils that would be exposed and those deemed to be within the influence of the proposed structures. Test results are presented in graphic and tabular form in Appendix B of this report. Testing was performed in general accordance with American Society for Testing and Materials (ASTM) or other appropriate test procedure. Selected samples were also tested for a screening level of corrosion potential (pH, electrical resistivity, water-soluble sulfates, and water-soluble chlorides). Earth Systems does not practice corrosion engineering; however, these test results may be used by a qualified corrosion engineer in designing an appropriate corrosion control plan for the project.

Our testing program consisted of the following:

- Density and Moisture Content of select samples of the site soils (ASTM D 2937 & 2216).
- Maximum Dry Density/Optimum Moisture Content tests to evaluate the moisture-density relationship of typical soils encountered (ASTM D 1557).
- Particle Size Analysis to classify and evaluate soil composition. The gradation characteristics of selected samples were made by sieve analysis procedures (ASTM D 6913 and D1140).
- Consolidation and Collapse Potential to evaluate the compressibility and hydroconsolidation (collapse) potential of the soil upon wetting (ASTM D 5333).
- Direct Shear to evaluate the relative frictional strength of the surficial slope soils. Specimens were in a saturated condition prior to and during testing and were sheared under normal loads ranging from 1.0 to 4.0 kips per square foot (ASTM D 3080).
- Expansion Index tests to evaluate the expansive nature of the soil. The samples were surcharged under 144 pounds per square foot at moisture contents of near 50% saturation. Samples were then submerged in water for 24 hours and the amount of expansion was recorded with a dial indicator (ASTM D 4829).
- Screening Level Chemical Analyses (Soluble Sulfates and Chlorides (ASTM D 4327), pH (APHA 2320-B), and Electrical Resistivity/Conductivity (ASTM G 187) to evaluate the potential for adverse effects of the soil on concrete and steel.

Section 3
DISCUSSION

3.1 Soil and Rock Conditions

The field exploration indicates that site soils consist predominantly of sand with varying amounts of silt and gravel and silty sand (Unified Soils Classification System symbols of SP, SP-SM, and SM) and weathered granitic bedrock to the maximum depth of exploration of 21½ feet below the ground surface. Exposed bedrock outcrops and rock encountered in the boring logs consists of moderately weathered and moderately hard to hard intrusive igneous rock (granodiorite/quartz monzonite) common referred to as "granitic rock". Decomposed granite and hard rock were observed at depths varying between 2½ to 10 feet below the ground surface and estimated to be greater than 20 feet bgs at borings B-3, B-8, and B-9. Refusal was encountered in eight (8) of the twelve (12) borings. See also Plates 5a and 5b for mapping.

The soils were observed to be dry. Site soils are classified as OSHA Class C, but decomposed rock may be classified as Class B. The boring logs provided in Appendix A include more detailed descriptions of the soils encountered.

General observations per lot are as follows:

Lot #	Soil Type	Debris Flow	Flooding	Rockfall	Rolling Boulders	Joshua Trees	Slope Instability
1	Qa/Rock		Minor	Yes	Yes	Yes	Outcrops
2	Qa/Rock					Yes	
3	Qoa						
4	Qt/Rock	Yes	Yes				
5	Qa		Yes			Yes	
6	Qa/Rock		Yes			Yes	
7	Qa/Rock	Yes	Yes			Yes	
8	Qoa					Yes	
9	Qoa					Yes	
10	Qa		Yes			Yes	
11	Qa/Rock					Yes	
12	Qa/Rock					Yes	

Qa = younger alluvial soil Rock = bedrock

Qt = terrace deposit Qoa = older alluvial soil

3.2 Groundwater

No free groundwater was encountered during our field exploration to the maximum depth of exploration of 21½ feet; however, due to bedrock conditions, perched water/high moisture conditions could occur at the soil/bedrock interface. Soil discoloration or mottling, suggestive of perched groundwater was not observed at the borings.

Nearby State monitoring wells were researched for their recent and historic well readings. The following is a summary of our findings for the well closest to the site.

- Well No. 01N04E01B001S located approximately 1.0 mile to the northwest of the site. The surface elevation of the well is approximately 4,171 feet and groundwater elevation reading as measured from 1971 was 4,095 feet.

Based on the above data, groundwater is not anticipated to be encountered during construction and is expected to be deeper than 50 feet at the site such that liquefaction is not a concern. Fluctuations of the groundwater level, and localized zones of increased soil moisture content may be anticipated during and following the rainy season or from irrigation.

3.3 Collapse and Consolidation Potential

Collapsible soil deposits generally exist in regions of moisture deficiency. Collapsible soils are generally defined as soils that have potential to suddenly decrease in volume upon increase in moisture content even without an increase in external loads. Soils susceptible to collapse include loess, weakly cemented sands and silts where the cementing agent is soluble (e.g. soluble gypsum, halite), valley alluvial deposits within semi-arid to arid climate, and certain granite residual soils above the groundwater table. In arid climatic regions, granular soils may have a potential to collapse upon wetting. Collapse (hydro-consolidation) may occur when the soils are lubricated or the soluble cements (carbonates) in the soil matrix dissolve, causing the soil to densify from its loose configuration from deposition.

The degree of collapse of a soil can be defined by the Collapse Potential [CP] value, which is expressed as a percent of collapse of the total sample using the Collapse Potential Test (ASTM Standard Test Method D 5333). Based on the Naval Facilities Engineering Command (NAVFAC) Design Manual 7.1, the severity of collapse potential is commonly evaluated by the following Table 3, Collapse Potential Values.

Table 1
Collapse Potential Values

Collapse Potential Value	Severity of Problem
0-1%	No Problem
1-5%	Moderate Problem
5-10%	Trouble
10-20%	Severe Trouble
> 20%	Very Severe Trouble

Table 3 can be combined with other factors such as the probability of ground wetting to occur on-site and the extent or depth of potential collapsible soil zone to evaluate the potential hazard by collapsible soil at a specific site. A hazard ranking system associated with collapsible soil as developed by Hunt (1984) is presented in Table 4, Collapsible Soil Hazard Ranking System.

Table 2
Collapsible Soil Hazard Ranking System

Degree of Hazard	Definition of Hazard
No Hazard	No hazard exists where the potential collapse magnitudes are non-existent under any condition of ground wetting.
Low Hazard	Low hazards exist where the potential collapse magnitudes are small and tolerable, or the probability of significant ground wetting is low.
Moderate Hazard	Moderate hazards exist where the potential collapse magnitudes are undesirable, or the probability of substantial ground wetting is low, or the occurrence of the collapsible unit is limited.
High Hazard	High hazard exists where potential collapse magnitudes are undesirably high and the probability of occurrence is high.

The results of collapse potential tests performed on five selected individual ring samples from depths ranging from 2.5 to 10 feet below the ground surface indicated a collapse potential ranging from 0.3 to 1.0 percent. Typically, the initial 1% is estimated to be from sampler disturbance as demonstrated by Table 1. Based on the above criteria and our field and laboratory findings, and assuming the grading is accomplished according to Section 5.1 of this report, we estimate the collapse potential is very low. Based on that, collapse settlement is estimated to be negligible.

3.4 Expansive Soils

Expansive soils are characterized by their ability to undergo significant volume change (shrink or swell) due to variations in moisture content. Changes in soil moisture content can result from rainfall, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors, and may cause unacceptable settlement or heave of structures, concrete slabs supported-on-grade, or pavements supported over these materials. Depending on the extent and location below finished subgrade, expansive soils can have a detrimental effect on structures. Based on our visual observations, laboratory testing, and past reporting, the Expansion Index of the onsite soils is “very low” as defined by ASTM D 4829 and the 2022 California Building Code. Samples of building pad soils should be tested during grading to confirm or modify these findings.

3.5 Corrosivity

Two samples of the near-surface soils within the site were currently tested for potential corrosion of concrete and ferrous metals. Soils were tested as blended (composite) samples. The tests were conducted in general accordance with the ASTM Standard Test Methods to evaluate pH, resistivity, and water-soluble sulfate and chloride content. The test results are presented in Appendix B. These tests should be considered as only an indicator of corrosivity for the samples tested. Other earth materials found on site may be more, less, or of a similar corrosive nature.

Water-soluble sulfates in soil can react adversely with concrete. ACI 318 provides the relationship between corrosivity to concrete and sulfate concentration, presented in the table below:

Table 3

Water-Soluble Sulfate in Soil (ppm)	Corrosivity to Concrete
0-1,000	Negligible
1,000 – 2,000	Moderate
2,000 – 20,000	Severe
Over 20,000	Very Severe

In general, the lower the pH (the more acidic the environment), the higher the soil corrosivity will be with respect to ferrous structures and utilities. As soil pH increases above 7 (the neutral value), the soil is increasingly more alkaline and less corrosive to buried steel structures, due to protective surface films, which form on steel in high pH environments. A pH between 5 and 8.5 is generally considered relatively passive from a corrosion standpoint. High chloride levels tend to reduce soil resistivity and break down otherwise protective surface deposits, which can result in corrosion of buried steel or reinforced concrete structures. Soil resistivity is a measure of how easily electrical current flows through soils and is the most influential factor. Based on the findings of studies presented in ASTM STP 1013 titled "Effects of Soil Characteristics on Corrosion" (ASTM, 1989), the approximate relationship between soil resistivity and soil corrosivity was developed as shown in Table 4.

Table 4

Soil Resistivity (Ohm-cm)	Corrosivity to Ferrous Metals
0 to 900	Very Severely Corrosive
900 to 2,300	Severely Corrosive
2,300 to 5,000	Moderately Corrosive
5,000 to 10,000	Mildly Corrosive
10,000 to >100,000	Very Mildly Corrosive

Test results show pH values of 7.7 to 8.1, chloride contents of 3 to 4 ppm, sulfate contents of 9 ppm and minimum resistivity's of 7,600 to 8,000 Ohm-cm. Although Earth Systems does not practice corrosion engineering, the corrosion values from the soils tested are normally considered as being mildly corrosive to buried metals and as possessing a "negligible" sulfate exposure to sulfate attack for concrete as defined in American Concrete Institute (ACI, 2011) 318, Section 4.3. The results of current chemical testing have been provided in Appendix B. The above values can potentially change based on several factors, such as importing soil from another job site and the quality of construction water used during grading and subsequent landscape irrigation.

3.6 Stormwater Percolation Testing

As indicated in Section 1.3 of this report, twelve test holes were drilled using the same drill rig as the exploration borings. Test holes were drilled on June 5 and 6, 2025 and reached depths of approximately 5 feet below the ground surface. The test locations represent the soils at the

assumed bottom of the proposed infiltration system. The percolation boring locations are shown on the Boring Location Map (Plate 2), in Appendix A.

The presence of gravel and PVC pipe (inserted in the boring) were accounted for in the percolation test results. The borings were pre-saturated with potable water prior to testing. Test results were taken with a water surface at approximate depths between 3 and 5 feet below existing grade at the test locations, respectively (see Table 5).

Test procedures followed the procedures for deep boring percolation testing according to the County of San Bernardino Technical Guidance Documents for Water Quality Management Plans, (Effective Date: September 19, 2013) for Santa Ana Region. The soils encountered at the test location and the percolation rate as well as empirically correlated infiltration rates are presented in Table 5.

Table 5
Infiltration Rate Results

Test	Soil Condition	USCS Soil Description in Test Zone	Test Zone Below Existing Surface (feet)	Percolation Rate (min/in)	Porchet Empirical Infiltration Rate* (in/hr)
P-1	(Native)	Sand with Silt (SP-SM)	3 to 5	5.2	0.6 in/hr
P-2	(Native)	Sand with Silt (SP-SM)	3 to 5	1.8	1.7 in/hr
P-3	(Native)	Sand (SP)	3 to 5	1.0	4.7 in/hr
P-4	(Native)	Sand (SP)	3 to 5	0.8	6.3 in/hr
P-5	(Native)	Gravelly Sand (SP)	3 to 5	0.2	36 in/hr
P-6	(Native)	Sand (SP)	3 to 5	1.0	5.4 in/hr
P-7	(Native)	Sand (SP)	3 to 5	1.4	3.3 in/hr
P-8	(Native)	Sand with Silt (SP-SM)	3 to 5	1.8	1.9 in/hr
P-9	(Native)	Sand with Silt (SP-SM)	3 to 5	1.5	2.4 in/hr
P-10	(Native)	Gravelly Sand (SP)	3 to 5	0.1	103 in/hr
P-11	(Native)	Sand (SP)	3 to 5	1.3	3.4 in/hr
P-12	(Native)	Sand (SP)	3 to 5	0.6	9.6 in/hr

*Field Values, No factor of safety applied. Typical factors of safety range from 3 to 12 depending on the type of system which will be designed using the field values and depending on the level of pre-treatment and influent which will be discharged into the infiltration trenches.

3.7 Percolation Testing for Onsite Wastewater Treatment System (Leach Fields)

As indicated in Section 1.3 of this report, twelve test holes were drilled using the same drill rig as the exploration borings. Percolation tests were performed at the test locations shown on Plate 2 and reached depths of approximately 5 feet below the ground surface to evaluate feasibility percolation for leach lines. The percolation tests were performed in substantial conformance to the County percolation test method for single lots. Tests were made at potential leach field areas, see Plate 2, in order to evaluate the general percolation rate at those areas where a potential leach field maybe feasible. Once actual leach field areas are known, final percolation testing as well as exploratory borings per County criteria will be required.

All percolation holes were approximately 8 inches in diameter. Two-inches of gravel was placed in the bottom of the holes after loose soils were removed and a section of perforated 3-inch diameter pipe was placed in each hole to guide the water to the bottom of the test hole to minimize sidewall disturbance and caving. All depths were measured from the top of the ¾ inch gravel. A total of twelve percolation tests were performed, see test location map in Appendix A.

Standard Percolation Test Procedure for Leach lines:

a) Each hole was presoaked with clean water per the San Bernardino Guidelines (San Bernardino, 2019) after drilling and on the day of testing.
b) All shallow percolation tests, number P-13 through P-24, had 10-inch water fill above the gravel and dropped away within 10 minutes of filling. Given the sandy, coarse texture and water drop, testing followed immediately after the presoaking (San Bernardino, page 15).

The percolation tests were performed on June 5, 6, and 9, 2025 and consisted of refilling each hole to 6 inches above the gravel level and measuring the drop in water level at typically 10-minute intervals for 1 hour. Because the gravel was added, the drop of 1 to 3 inches was recorded at the end (San Bernardino, page 15 “Rapid Readings”). After each reading the water level was readjusted by adding water to the same (similar) start level. Raw percolation rates are provided in Table 6 and were not corrected since they were within the diameter size suggested in the San Bernardino guidelines. Since gravel was used between the cylinder and native side walls, we calculated a gravel correction factor of 0.5. Holes did not cave. The following is a table of the results of the shallow percolation tests performed on the referenced site.

Table 6
Percolation Rate Results

Test	Soil Condition	USCS Soil Description in Test Zone	Test Zone Below Existing Surface (feet)	Percolation Rate (min/in)*
P-13	(Native)	Sand (SP)	3 to 5	1.0
P-14	(Native)	Sand (SP)	3 to 5	1.0
P-15	(Native)	Sand (SP)	3 to 5	0.7
P-16	(Native)	Sand (SP)	3 to 5	0.5
P-17	(Native)	Sand (SP)	3 to 5	0.2
P-18	(Native)	Sand with Silt (SP-SM)	3 to 5	3.1
P-19	(Native)	Sand (SP)	3 to 5	1.4
P-20	(Native)	Sand with Silt (SP-SM)	3 to 5	2.7
P-21	(Native)	Sand (SP)	3 to 5	0.8
P-22	(Native)	Gravelly Sand (SP)	3 to 5	0.1
P-23	(Native)	Sand (SP)	3 to 5	1.4
P-24	(Native)	Sand (SP)	3 to 5	0.8

*mpi: minutes per inch

3.8 Geologic Setting

Regional Geology: The site lies near the margin of the north-central portion of Transverse Ranges geomorphic province and the southerly margin of the Mojave Desert geomorphic province. This region consists of interspersed mountain ranges and intervening valleys oriented in an east-west direction across southern California. Multiple mountain ranges exist near the project area, including the San Bernardino and Little San Bernardino Mountains. Geomorphic/geopraphic areas in the project vicinity include Pipes Canyon, Little Morongo Valley, and several volcanic highlands north, east, and southerly of the project site. Major regional faults include the San Andreas, Landers, Johnson Valley, and Pinto Mountain fault zones.

Local Geology: The project site is located in the Pioneertown area (Plate 3), which is characterized by the northeastern foothills of the Little San Bernardino Mountains, and volcanic highlands of the Mojave Desert. The project is located near the intersection of Bowden Flat and Pipes Canyon Wash where Pre-Tertiary igneous rocks predominate. Granitic rocks are exposed within the site with Holocene alluvium and interspersed stream channel deposits adjacent to the

bedrock outcrops, with older alluvial fan deposits in the western portion of the site. No Holocene-active faults have been mapped through or in the immediate vicinity of the site.

The Johnson Valley fault, a fault zone within the Eastern California shear zone, ruptured during the 1992 Landers earthquake event and is located about 3 miles east of the site, within Johnson Valley. The predominate San Andreas fault is located about 14 miles southwest of the property. The Pinto Mountain fault is located about 6 miles southeast of the project. The site is not located within a currently delineated Alquist-Priolo Earthquake Fault Zone.

3.9 Geologic Hazards

Geologic hazards that may affect the region include seismic hazards (ground shaking, surface fault rupture, soil liquefaction, and other secondary earthquake-related hazards), slope instability, flooding, debris flows, rock falls, ground subsidence, and erosion. A discussion follows on the specific hazards to this site.

3.10 Primary Seismic Hazards

Seismic Sources: Several active faults or seismic zones lie within 62 miles (100 kilometers) of the project site as shown on Table 1 in Appendix A. The primary seismic hazard to the site is strong ground shaking from earthquakes along regional faults, including the Pinto Mountain, faults associated with the Eastern California shear zone, and San Andreas faults. The Maximum Magnitude Earthquake (M_{max}) listed is from published geologic information available for each fault (Cao et al., CGS, 2003). The M_{max} corresponds to the maximum earthquake believed to be tectonically possible.

Surface Fault Rupture: The project site does not lie within a currently delineated State of California, *Alquist-Priolo* Earthquake Fault Zone (CGS 2018). Well-delineated fault lines cross through this region as shown on California Geological Survey (CGS) maps (Jennings, 2010). However, based on our geologic review, no currently mapped faults, lineaments, or other fault related geologic features exist at the property. Therefore, active fault rupture is unlikely to occur at the project site. While fault rupture would most likely occur along previously established fault traces, future fault rupture could occur at other locations.

Historic Seismicity: The project site is located in seismically active southern California where approximately 34 earthquakes of magnitude 5.5 or greater have occurred within 60 miles of the site since 1880. Six historic seismic events (5.9 M or greater) have significantly affected the Pioneertown area in the last 100 years. They are as follows:

- *Desert Hot Springs Earthquake* – On December 4, 1948, a magnitude 6.5 M_L (6.0M_W) earthquake occurred east of Desert Hot Springs. This event was strongly felt in the project area.
- *North Palm Springs Earthquake* – A magnitude 5.9 M_L (6.2M_W) earthquake occurred on July 8, 1986 in the Painted Hills, causing minor surface creep of the Banning segment of the San Andreas fault.

- *Joshua Tree Earthquake* – On April 22, 1992, a magnitude 6.1 M_L (6.1M_W) earthquake occurred in the mountains east of Desert Hot Springs, approximately 20 miles from the the project site.
- *Landers and Big Bear Earthquakes* – Early on June 28, 1992, a magnitude 7.5 M_S (7.3M_W) earthquake occurred near Landers, the largest seismic event in Southern California for 40 years. Surface rupture occurred south of the town of Yucca Valley and extended some 43 miles toward Barstow. Associated surface fault rupture along the Eureka Peak fault occurred about 3 miles west of the project site. About three hours later, a magnitude 6.6 M_S (6.4M_W) earthquake occurred near Big Bear Lake. The epicenter of the Landers event was located approximately 4 miles from the site.
- *Hector Mine Earthquake* – On October 16, 1999, a magnitude 7.1M_W earthquake occurred on the Lavic Lake and Bullion Mountain faults north of Twentynine Palms.

States Geological Survey [USGS] presented new earthquake forecasts for California (USGS UCERF3). We have used these maps in our evaluation of the seismic risk at the site. The recent Working Group of California Earthquake Probabilities (WGCEP, 2014) estimated a 31 percent conditional probability that a magnitude 6.7 or greater earthquake may occur in 30 years (2014 as base year) along the nearby Coachella segments of the San Andreas fault. For the nearby Pinto Mountain fault, the 30-year probability is about 5 percent, and for the Landers associated faults 3%.

The primary seismic risk at the site is a potential earthquake along regional faults, including the Pinto Mountain and San Andreas faults. Geologists believe that the San Andreas fault has characteristic earthquakes that result from rupture of each fault segment. The estimated characteristic earthquake is magnitude 7.7 for the Southern Segment of the fault (USGS, 2002). This segment has the longest elapsed time since rupture of any part of the San Andreas fault. The last rupture occurred about 1690 AD, based on dating by the USGS near Indio (WGCEP, 1995). This segment has also ruptured on about 1020, 1300, and 1450 AD, with an average recurrence interval of about 220 years. The San Andreas fault may rupture in multiple segments, producing a higher magnitude earthquake. Recent paleoseismic studies suggest that the San Bernardino Mountain Segment to the north and the Coachella Segment may have ruptured together in 1450 and 1690 AD (WGCEP, 1995). The Pinto Mountain fault is characterized by the State as a “B” fault and is therefore considered to have a less probable risk of rupture than the nearby segments of the San Andreas fault. However, though less probable to rupture, the Pinto Mountain fault has a significant potential to produce strong ground motion.

3.11 Secondary Hazards

Secondary seismic hazards related to ground shaking include soil liquefaction, ground subsidence, tsunamis, and seiches. The site is far inland, so the hazard from tsunamis is non-existent. At the present time, no large water storage reservoirs are located in the immediate vicinity of the site. Therefore, hazards from seiches are considered negligible at this time. Other hazards include flooding, debris flows, rockfalls, and slope instability. Currently, existing on-site slopes are of minimal height and angle, thus the potential for on-site slope instability is considered low. However, adjacent to the bold bedrock ridges and outcrops, rockfall/rolling boulder hazards do exist.

Ground Subsidence: The potential for seismically induced ground subsidence is considered to be low at the site due to the presence of shallow or exposed bedrock. Dry sands tend to settle and densify when subjected to strong earthquake shaking. The amount of subsidence is dependent on relative density of the soil, ground motion, and earthquake duration. Uncompacted fill areas may be susceptible to seismically induced settlement. Based on Tokimatsu and Seed methodology, we estimate that less than 0.1 inch of total ground subsidence may occur in the shallow on-site soil profiles.

Soil Liquefaction and Lateral Spreading: Liquefaction is the loss of soil strength from sudden shock (usually earthquake shaking), causing the soil to become a fluid mass. In general, for the effects of liquefaction to be manifested at the surface, groundwater levels must be within 50 feet of the ground surface and the soils within the saturated zone must also be susceptible to liquefaction. The potential for liquefaction to occur at this site is considered low because the current and historic high groundwater at the site are deeper than 50 feet below the ground surface and bedrock is shallow. Setbacks are also recommended for structural areas from any leach fields to minimize any impact from water mounding. Due to the deep groundwater and low potential for liquefaction the potential for lateral spreading is considered very low.

Dry Seismic Settlement: The amount of dry seismic settlement is dependent on relative density of the soil, ground motion, and earthquake duration. In accordance with current CGS policy (Earth Systems discussion with Jennifer Thornburg, CGS May 2014), we used a site peak ground acceleration of ⅔ PGA_M and an earthquake magnitude of 7.9 to evaluate dry seismic settlement potential. The design peak ground acceleration value (0.87g) was obtained from the USGS online application (www.seismicmaps.org).

For coarse grained soils, we have used the data obtained from boring B-3, B-8, and B-9 that had the deepest excavation without experiencing refusal due to bedrock.

Typical guidance (SP117A) suggests the limiting depth profile should reach 50 feet below the ground surface. However, bedrock outcrops were observed at the site and explorations indicated that excavation refusal occurred at depths between 2.5 to 10 feet at most of the locations of the proposed structures. The deepest excavation reached a depth of 21½ feet below the ground surface. Therefore, 21½ feet was used to estimate the greatest dry seismic settlement that occurred at borings B-3, B-8, and B-9.

Based upon methods presented by Tokimatsu and Seed (1987), the potential for seismically induced dry settlement of soils having the deepest soil column height was estimated for borings B-3, B-8, and B-9. Estimated settlement was 0.1, 0.1, and 0 inches respectively for borings B-3, B-8, and B-9. Per SP117A, differential seismic settlement may be estimated to be the difference between zero and 0.1 inches. The estimate is based on the grading recommendations found in Section 5.1 of this report.

Fissuring and Ground Subsidence: The potential for ground subsidence do to groundwater removal is considered to be low at the site due to shallow bedrock

3.11.1 Other Hazards

Slope Stability**:** Most of the delineated/assumed building sites are relative flat. Some site grading is anticipated with cuts and fills estimated to be less than 10 feet high. Therefore, potential hazards from on-site slope instability or landslides are considered low. Rockfall hazard exists within the limits of Lots 1, 2, 6, 7 and 12 adjacent to the bold granitic outcrops, especially during earthquake events.

Flooding: Earth Systems searched a FEMA online service (https://msc.fema.gov/portal/search). Using project coordinates (Latitude = 34.20072°, Longitude = -116.50162°) we note the project lies in Zone D.: "Areas with Flood Risk due to Leve and Areas of Undetermined Flood Hazard.", (Area No. 06071C8100H, Effective 8/28/2008) see Figure 2 below. The project site is in an area where sheet flooding and erosion do occur. Appropriate project design by the civil engineer, construction, and maintenance can minimize the site sheet flooding and erosion potential.

Adjacent to and within defined drainage courses and re-entrant drainage courses, seasonal flooding and debris flows can occur.

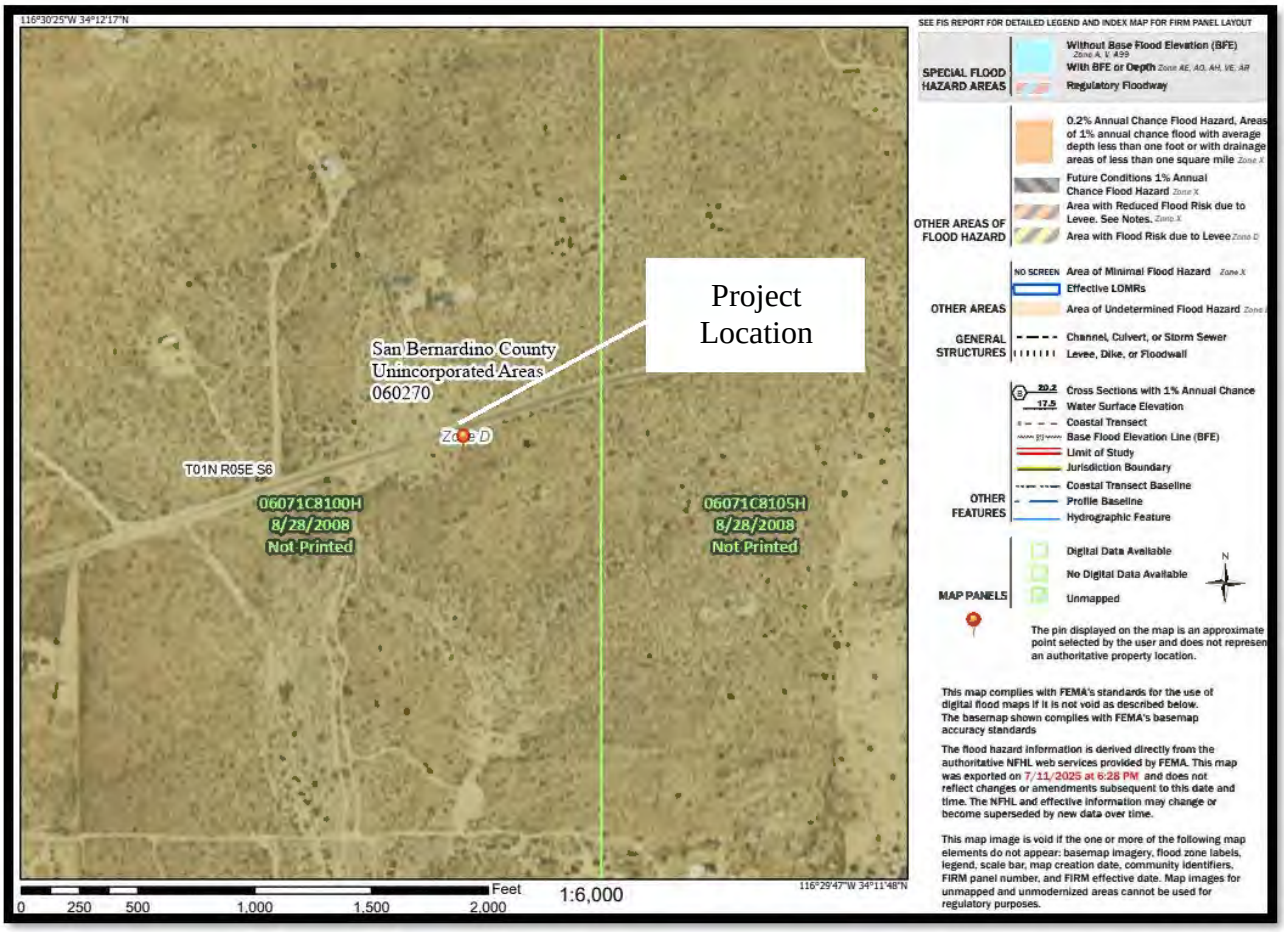


Figure 2 Flood Map per FEMA Website

Section 4
CONCLUSIONS

The following is a summary of our conclusions and professional opinions based on the data obtained from a review of selected technical literature and the site evaluation.

General:

From a geotechnical perspective, the site is suitable for the proposed developments, provided the recommendations in this report are followed in the design and construction of this project.

- The primary geologic hazard is moderate to severe ground shaking from earthquakes originating on regional southern California faults. A major earthquake originating on the nearby segments of the San Andreas fault, Pinto Mountain fault, faults associated with the Eastern California shear zone, and other regional faults would be the critical seismic events that may affect the site within the design life. Engineered design and earthquake-resistant construction increase safety and allow development within seismic areas.

- The underlying geologic condition for seismic design is Site Class C and D, see Appendix A. The lot is about 14 miles from a Type A seismic source as defined by the California Geological Survey. A qualified professional should design any permanent structure constructed on the site. The **minimum** seismic design should comply with the 2022 edition of the California Building Code.

- The potential for seismic settlement hazards are considered low for this project. The site is not within an area of significant documented areal subsidence. Nil settlement potentials exist for the on-site bedrock.

- The soils are susceptible to wind and water erosion. Preventative measures to reduce seasonal flooding and erosion should be incorporated into site grading plans. Dust control should also be implemented during construction. Site grading should be in strict compliance with the requirements of the South Coast Air Quality Management District (SCAQMD).

- Other geologic hazards, including landslides, are considered low potential on this site.

- Based on current conditions, groundwater is not anticipated to be encountered during construction; however, landscaped or watered areas may encounter moist to wet soils in the upper shallow profile.

- Based on our laboratory testing and experience with the project, the Expansion Index of the onsite soil is “very low” as defined by ASTM D 4829. Samples of pad soils should be evaluated to confirm or modify these findings.

- Laboratory testing of two samples showed potentially “mild” corrosivity to buried metallic elements and “negligible” for sulfate exposure to concrete. See Section 3.5 for further information. Site soils should be reviewed by an engineer competent in corrosion evaluation and protection for all elements embedded or founded upon site soils.

- Precise Grading and Foundation Plans have not been reviewed for geotechnical conformance. This report is valid only if Earth Systems reviews the precise grading and foundation plans for geotechnical conformance. Depth and limits of over-excavation are dependent upon the actual building location and should be defined during the plan review process. Design-level geotechnical and percolation reports will be required for future development as this report is for feasibility only.

Section 5
RECOMMENDATIONS

5.1 Site Development

Site Development and Grading

A representative of Earth Systems should observe site clearing, grading, and the bottoms of excavations before placing fill. Local variations in soil conditions may warrant increasing or decreasing the depth of recompaction and over-excavation. Proper geotechnical observation and testing during construction is imperative to allow the geotechnical engineer the opportunity to verify assumptions made during the design process, to verify that our geotechnical recommendations have been properly interpreted and implemented during construction and is required by the 2022 California Building Code. Preventative measures to reduce seasonal flooding and erosion should be incorporated into site grading plans. Dust control should also be implemented during construction. Site grading should be in strict compliance with the requirements of the South Coast Air Quality Management District [SCAQMD].

Observation of fill placement by the Geotechnical Engineer of Record should be in conformance with Section 17 of the 2022 California Building Code. California Building Code requires full time observation by the geotechnical consultant during site grading and pile/pier placement. Therefore, we recommend that Earth Systems be retained during the construction of the proposed improvements to provide testing and observe compliance with the design concepts and geotechnical recommendations, and to allow design changes in the event that subsurface conditions or methods of construction differ from those assumed while completing this study. Additionally, the California Building Code requires the testing agency to be employed by the project owner or representative (i.e. architect) to avoid a conflict of interest if employed by the contractor. Unless noted otherwise, grading should be performed in general accordance with Appendix J of the 2022 CBC.

Special Considerations for Specific Geologic Conditions: For future building sites adjacent to bold bedrock outcrops or where cutting into the bedrock is considered, site-specific geotechnical and geologic studies are recommended to address slope stability of cut faces, natural slopes, and rockfall hazards.

Where future building sites are located within, adjacent to, or at the mouth of drainages or re-entrant drainages, debris flow analysis is recommended.

Where future building sites are proposed for exposed bedrock areas, rippability studies are recommended to address rock hardness and constraints with respect to grading with conventional equipment and generation of over-size rock unsuitable for incorporation into typical engineered fill.

For all lot conditions, geotechnical review of grading and foundation plans for each building site and access roads is recommended.

FOR GENERAL REMEDIAL GRADING AND FOUNDATION DESIGN OF TYPICAL BUILDING SITES AS SHOWN ON THE TENTATIVE TRACT MAP, THE FOLLOWING PRELIMINARY RECOMMENDATIONS ARE PROVIDED.

Clearing and Grubbing: At the start of site grading, existing vegetation, trees (including the entire root system), large roots, overly wet and/or soft soil, undocumented fill, pavements, foundations, construction debris, deleterious material, trash, and abandoned underground utilities should be removed from the proposed building areas. Organic growth should be stripped off the surface and removed from the construction area. Areas disturbed during demolition and clearing should be properly backfilled and compacted as described below.

Undocumented fill, and buried utilities may be located in the vicinity of the planned structures and within other areas of the project site. All buried structures which are removed should have the resultant excavation backfilled with soil compacted as engineered fill described herein or with a minimum 2-sack cement sand slurry approved by the project geotechnical engineer. The demolition operations (removal of foundations, subsurface items, utilities, drywells) should be documented by the demolition contractor for future use. Abandoned utilities should be removed entirely, or pressure-filled with concrete or grout and be capped. Abandoned buried utilities structures, or foundations should not extend under building limits, and should be entirely removed.

After stripping and grubbing operations, areas to receive fill or over excavation should be stripped of loose or soft earth materials until a firm subgrade is exposed, as evaluated by the geotechnical engineer or geologist (or their representative).

Grading:

As foundation types are not known at this time, two options are presented:

1) Foundation on typical shallow foundations with a slab-on-grade floor. This foundation and slab system rely in part on the resistive nature of the existing soils placed as engineered fill for support of the residence.

2) Pile or pier (helical) or shallow foundations supported entirely on bedrock with a structural slab, which does not rely on soil support, but is supported by the foundation system. For Option 2, no building pad remedial grading is required for structure support because the foundation components (helical piers, piles, etc) are extended to bedrock and the slab is supported by the superstructure.

For Option 1, the grading should be performed as below and all soils shall be over-excavated to bedrock.

1) Remedial Grading Building Pad (Over-Excavation and Recompaction): Subsequent to stripping and grubbing operations, areas requiring grading should be stripped of loose or soft earth materials (this also includes all undocumented fill) until a uniform, firm bedrock subgrade is exposed, as evaluated by the geotechnical engineer or geologist. Because of the relatively non-uniform and unequal depths of soil over shallow bedrock of the site soils, especially after stripping, we recommend recompaction of soils in the building areas (including any foundation areas for column supported walkways, canopies, pool shells, etc.). Prior to the placement of fill or subsequent to cut, the existing surface soils within the building pad and foundation areas should be over-excavated to a competent surface of firm bedrock

across the entire pad as determined by the geotechnical engineer or his representative with direct field observations. The over-excavation depth across the building pad will be determined at the time of remedial grading.

To minimize the potential differential settlement of foundations, the minimum depth of excavation across the pad shall be ⅓ the total depth of the deepest excavation under the foundation. For example: If the deepest excavation on one side of the home's foundation is 9 feet under the foundation and on the shallowest side of the home's foundation bedrock located 2 feet below the foundation, then the shallow bedrock must be excavated an additional one (1) foot to make it 3 feet of engineered fill under the foundation—this is the ⅓ criteria. Note in the above example, bedrock term above is defined as "competent material" and this shall be designated by the geotechnical or geologist during grading. Competent material shall also be defined as "excavation refusal on bedrock using a Case 580E backhoe or direct equivalent". No placement of fill shall be permitted unless the geotechnical engineer of record or his representative has approved the competent material. Transitions between the deep over-excavation to the shallow over-excavation shall be benched (5-foot minimum width) to create level benches for fill support and transition the differential fill thicknesses across the building pad, see Figure 5.

For preliminary planning purposes, the extent of the remedial grading should extend a minimum of 5 feet beyond the limits of the structure and associated improvements. This can be adjusted at the time of grading by potholing the building pad area to verify the depth of remedial grading across the building pad prior to remedial grading. In general, the limits of remedial grading beyond the limits of the structure should equal the depth of the remedial grading adjacent to specific exterior points of the structure (5 feet minimum).

The undisturbed bedrock bottom of the exposed over-excavation should be approved by the project geologist or his representative to verify the presence of firm bedrock. If this criterion is not met, additional over-excavation may be required.

The approved bottom of the sub-excavation should then be scarified 12 inches, moisture conditioned to near optimum moisture content, and recompacted to at least 90% relative compaction (ASTM D 1557). Compaction should be verified by testing. Fill placed upon slopes should be benched into the existing slope a minimum of two feet for every one vertical foot of rise or as directed by the geotechnical engineer.

Over-excavations should extend to a depth where the project geotechnical engineer or his representative has deemed the exposed bedrock as being suitable for receiving compacted fill. The materials exposed at the bottom of excavations should be observed by a geotechnical engineer or geologist from our office prior to the placement of any compacted fill soils. Additional removals may be required as a result of observation and/or testing of the exposed subgrade subsequent to the required over-excavation.

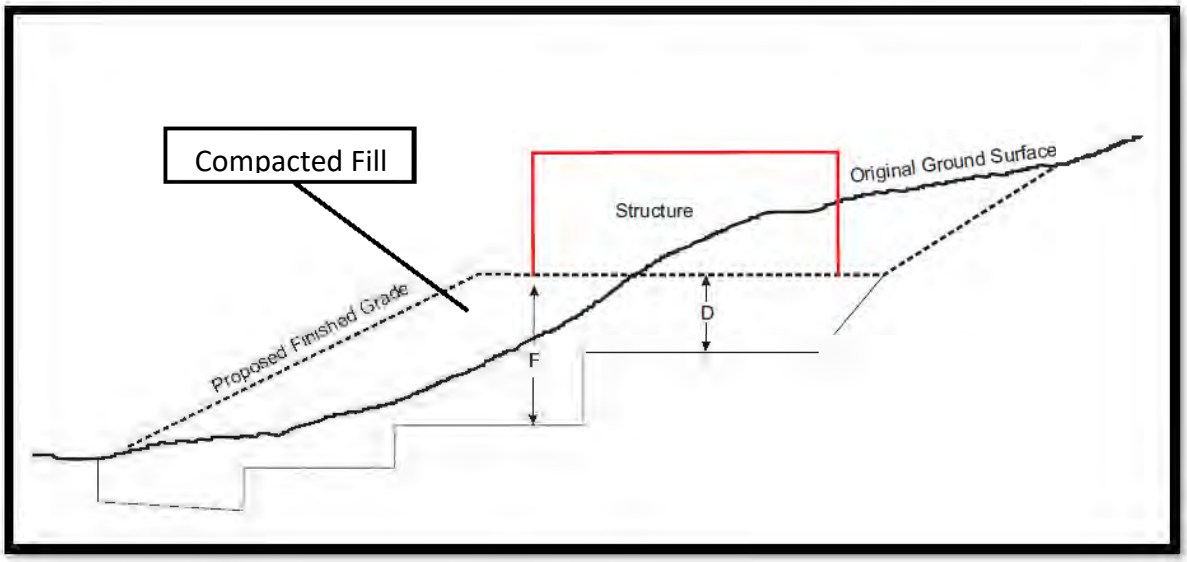


Figure 3
F equals deepest depth to bedrock in pad area;
D equals minimum depth of soil engineered fill (1/3 of F).

Helical Pier or Pile Geotechnical Parameters: Where the structure is planned currently, refusal depths vary from 2 to more than 12 feet below the ground surface, see Figure 3, Table 2, and the trench logs in the appendix. For the soil profile densities with no earth work performed, trench log T-3 provides the estimated soil profile showing approximate densities of the soil profile.

At locations where over-excavation is not desired, helical piles or piles drilled to bedrock and socketed into bedrock a minimum of 1 foot may be used. Minimum socketed embedment and depth needed into bedrock shall be determined by the structural engineer and/or pier/pile manufacturer based on the loads necessary to resist (lateral, uplift, and downward). The helical piers/piles shall be constructed with structural slab, grade beams, and footings per the structural engineer. For lateral loading resistance, see subsection "Minor Deep Foundations" and "Foundation" section of this report.

Auxiliary Structures Subgrade Preparation: Auxiliary structures such as garden, fence wall, or retaining walls should have the foundation subgrade prepared similar to the conditioning and building pad recommendations given above.

Pavement and Hardscape Subgrade Preparation: For pavement and hardscape that are not attached to building structures and are allowed to float freely, the standard of care for design can be the minimum over excavation depth of 2 feet shown below but with the expectation of continuous maintenance being performed due to possible settlement of native soils.

In pavement and hardscape areas, the subgrade should be over-excavated, moisture conditioned, and compacted to at least 95% relative compaction (ASTM D 1557) at near optimum moisture content such that pavement (and vehicular Portland cement concrete) is supported by at least two feet of engineered fill. The exposed subgrades should be moisture conditioned to at least optimum moisture for a minimum of two feet below existing or finished grade and then proof rolled prior to placement of fill to observe if undocumented fill, soft, or loose zones are

present. Any undocumented fill, loose. or soft zones should be over-excavated until a stable subgrade is established. Compaction should be verified by testing.

Engineered Fill Soils and Backfill: The native soil are suitable for use as engineered fill and utility trench backfill, provided they are free of significant organic material, oversize rock (6 inches or greater) or deleterious matter. Fill should be predominately soil classified as silty sand (SM) or poorly graded sand with silt (SP-SM). The native soil and undocumented fill (and any import) should be placed in maximum 8-inch lifts (loose) and each lift compacted to at least 90% relative compaction (ASTM D 1557) near its optimum moisture content (typically +/-2 percent of optimum). prior to the placement of subsequent lifts (unless noted otherwise). Moisture conditioning is required to allow adequate compaction. Vibratory compaction is recommended. Within pavement areas, the upper 24 inches of subgrade should be compacted to at least 95% relative compaction (ASTM D 1557) (98% in paver areas). Compaction should be verified by testing. Rocks larger than 6 inches in greatest dimension should be removed from fill or backfill material. The amount of rock shall not exceed the requirements of ASTM D1557 or per the Geotechnical Engineer of Record's observation and judgement.

Imported fill soils (if needed) should be very low expansion potential granular soils meeting the USCS classifications of SM, SP-SM, or SW-SM with a maximum rock size of 3 inches and 5 to 35% passing the No. 200 sieve (unless otherwise approved by the geotechnical engineer). The geotechnical engineer should evaluate the import fill soils before hauling to the site. However, because of the potential variations within the borrow source, import soil will not be prequalified by Earth Systems. Gap graded gravel should not be used as backfill.

A program of compaction testing, including frequency and method of test, should be developed by the project geotechnical engineer at the time of grading. Acceptable methods of test may include Nuclear methods such as those outlined in ASTM D 6938 (Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods). Alternative methods may include methods outlined in ASTM D 1556 (Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method) or correlation probing with a hand probe.

Sand-Cement Slurry Backfill (Controlled Low Strength Material, CLSM): Where approved by the geotechnical engineer for use, sand-cement "slurry" as backfill (controlled low strength material (CLSM)), shall comply with the provisions of this report for the following:

1. Specifications for the preparation of the site prior to placement of the CLSM.
    - Remove any spoils, uncertified fill, loose material, debris and standing water from the existing excavations to a firm subgrade as approved by the geotechnical engineer or his representative.
    - A representative of Earth Systems should observe bottoms of excavations before placing CLSM.
    - CLSM shall not be placed on a sloping surface with a gradient steeper than 5:1 (H:V).

Specifications for the CLSM:

2. CLSM shall be ready-mixed by an ACI approved batch plant. Use 2-sack sand-cement CLSM complying with Caltrans Standard Specification (2015) Section 19-3.02F Controlled Low-Strength Material. CLSM should have a low or non-shrinkage potential. CLSM must have a 28-day compressive strength of at least 120 psi; however, it is cautioned that increased strength may not be excavatable. Placement of CLSM After Item 1 above is Completed.
    - Place CLSM to the bottom of the foundation area or, in maximum 3-foot lifts (the minimum placement of CLSM should be 12 inches thickness), and allow the CLSM to cure at least for 24 hours or initial set, whichever is longer before placing a subsequent lift. Vibration and rodding of the entire lift should be accomplished during placement. Repeat as needed until the CLSM is at the bottom of the footing.
3. Laboratory or field test method(s) to be used to determine the compressive strength or bearing capacity of the CLSM.
    - Sample CLSM and fabricate test cylinder in accordance with ASTM D4832. Test for density in accordance with ASTM D6023 if there is concern about an as-delivered mix. Test for compressive strength at 28 days in accordance with ASTM D4832.
4. Test methods for determining the acceptance of the CLSM in the field.
    - ASTM D4832-16, Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
    - ASTM D6023-07, Density (Unit Weight), Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low-Strength Material (CLSM), where there is concern.
    - Number and frequency of field tests required to determine compliance with item 5: Fabricate one set of 5 cylinders and test for density for each 50 cubic yards or fraction thereof or as directed by the geotechnical engineer (GE) of record or the GE's representative.

Shrinkage and Bulking: The shrinkage factor for earthwork is expected to range from -2 to 31 percent for the upper excavated or scarified site soils. Negative shrinkage is bulking. This estimate is based on compactive effort to achieve an average relative compaction of about 92 percent. Shrinkage is highly dependent on and may vary with contractor methods for compaction. Losses from site clearing, oversize rock removal, and removal of existing site improvements may significantly affect earthwork quantity calculations and should be considered.

Limiting over-excavation is dependent on lowest elevation of utilities (including the required bedding layer) within the building area, finding native material elevation, and adequate density of the native material.

5.2 Excavations and Shoring

Excavations should be made in accordance with Cal/OSHA requirements. Using the Cal/OSHA standards and general soil information obtained from the field exploration, classification of the

near surface on-site soils will likely be characterized as Type C. Actual classification of site-specific soil type per Cal/OSHA specifications as they pertain to trench safety should be based on real-time observations and determinations of exposed soils by the contractors *Competent Person* (as defined by OSHA) during grading and trenching operations.

Our site exploration and knowledge of the general area indicates there is a high potential for caving and sloughing of site soil excavations (over excavation areas, utilities, footings, etc.) due to dry conditions. Excavations in bedrock may expose jointed or fractured rock where sluffing and rock popouts can occur off of trench walls. Hard cobble, core stones, and boulders are likely present. Where excavations in soils over 4 feet deep are planned, lateral bracing or appropriate cut slopes of 1.5:1 (horizontal/vertical) should be provided. No surcharge loads from stockpiled soils or construction materials should be allowed within a horizontal distance measured from the top of the excavation slope and equal to the depth of the excavation.

Excavations which parallel structures, pavements, or other flatwork, should be planned so that they do not extend into a plane having a downward slope of 1:1 (horizontal: vertical) from the bottom edge of the footings, pavements, or flatwork. Shoring or other excavation techniques may be required where these recommendations cannot be satisfied due to space limitations or foundation layout. Where over-excavation will be performed adjacent to existing structures, ABC slot cutting techniques (5-foot maximum width, minimum 5-foot lateral extent) may be used as pre-approved by the project geotechnical engineer. No oversize material shall be allowed to be located within a 45-degree plane protruding from the bottom of the cut.

Surcharge Load and Excavation Restrictions: No fill or other surcharge loads shall be placed adjacent to any building or structure unless such building or structure is capable of withstanding the additional loads caused by the fill or the surcharge. Existing footings or foundations that will be affected by any excavation shall be underpinned or otherwise protected against settlement and shall be protected against detrimental lateral or vertical movement, or both.

Exception: Minor grading for landscaping purposes shall be permitted where performed with walk-behind equipment, where the grade is not increased more than 1 foot from original design grade or where approved by the building official.

Where excavations will reduce support from any foundation, a registered design professional shall prepare an assessment for the structure as determined from examination of the structure, the review of available design documents and, if necessary, excavation of test pits. The registered design professional shall determine the requirements for underpinning and protection and prepare site-specific plans, details and sequence of work for submission. Such support shall be provided by underpinning, sheeting and bracing, or by other means acceptable to the building official.

Shoring: Shoring may be required where soil conditions, space, or other restrictions do not allow a sloped excavation or slot cutting is not an option. A braced or cantilevered shoring system may be used. Trench boxes should not be placed below or within the pipe zone elevation as their removal may loosen compacted backfill. Positive trench shoring may be required (jacks and plates).

A temporary cantilevered shoring system should be designed to resist an active earth pressure equivalent to a fluid weighing as shown in the table below. Braced or restrained excavations above the groundwater table should be designed to resist a uniform horizontal equivalent soil pressure as presented in the table below. Cuts in bedrock should be evaluated on a case-by-case basis.

Table 7
Temporary Cantilevered and Braced Shoring System Parameters

Equivalent Fluid Pressure pounds per cubic foot (pcf)	
Cantilevered	**Braced**
42	63

The values provided above assume a level ground surface adjacent to the top of the shoring and do not include a factor of safety. Fifty percent of an areal surcharge placed adjacent to the shoring may be assumed to act as an additional uniform horizontal pressure against the shoring. Special cases such as combinations of slopes and shoring or other surcharge loads may require an increase in the design values recommended above. These conditions should be evaluated by the project geotechnical or shoring engineer on a case-by-case basis. Retaining walls subjected to traffic loads should include a uniform surcharge load equivalent to at least 250 psf for auto or delivery truck (2 axle) traffic kept at least 3 feet from the back of the wall. Retaining walls with closer traffic or heavier traffic loads should be designed for a 400 psf surcharge load. Retaining walls should be designed with a minimum factor of safety of 1.5.

The wall pressures above the groundwater do not include hydrostatic pressures; it is assumed that drainage will be provided. If drainage is not provided, shoring extending below the groundwater level should be evaluated on a case-by-case basis.

Cantilevered shoring must extend to a sufficient depth below the excavation bottom to provide the required lateral resistance. We recommend required embedment depths be determined using methods for evaluating sheet pile walls and based on the principles of force and moment equilibrium. For this method, the allowable passive pressure against shoring, which extends below the level of excavation, may be assumed to be equivalent to a fluid weighing 300 pcf. Additionally, we recommend a factor of safety of at least 1.2 be applied to the calculated embedment depth and that passive pressure be limited to 2,000 psf.

The contractor should be responsible for the structural design and safety of all temporary shoring systems. The contractor should carefully review the boring logs in this report, and perform their own assessment of potential construction difficulties, and methods should be selected accordingly. Shoring should be sealed to prevent the piping of soil material and potential soil loss conditions which can cause settlement. The method of excavation and support is ultimately left to the contractor. We recommend that existing structures be monitored for both vertical and horizontal movement.

The contractor should carefully review the boring logs in this report, and perform their own assessment of potential construction difficulties, and methods should be selected accordingly. The method of excavation and support is ultimately left to the contractor. A representative from

our firm should be present during grading operations to monitor site conditions, substantiate proper use of materials, and evaluate compaction operations.

5.3 Utility Trenches and Backfill

Backfill of utilities within roads or public rights-of-way should be placed in conformance with the requirements of the governing agency (water district, public works department, etc.). Utility trench backfill within private property should be placed in conformance with the provisions of this report. Backfill operations should be observed and tested to monitor compliance with these recommendations.

For compaction testing of pipeline subgrades, where excavations require trench entry, the contractor should make allowance and provide proper shoring or stabilize the excavation in accordance with CalOSHA for safe entry by the testing lab and workers. Hard bedrock will likely be encountered in utility trench excavations.

Trench Width and Vertical Loads on Pipelines: Vertical loads to the pipeline are highly dependent upon the geometry of the trench. In general, the narrower the trench is at the top of the pipe/conduit with respect to the diameter of the conduit, the less vertical load is applied to the conduit. This is because as the trench backfill and bedding compress or consolidate over time, the weight of the soil mass is partially offset by the frictional resistance along the trench sidewalls. In addition, the type of bedding supporting the pipeline affects the bearing strength of the pipe. This is accounted by a load factor that is multiplied to the design strength of the pipe. The pipe manufacturer recommendations for trench installation and maximum width should be followed to reduce the potential for overloading the pipe due to excess backfill load.

Pipe Subgrade and Bedding: Pipeline subgrade should be compacted to a minimum of 90% relative compaction (ASTM D 1557) or to a firm condition as evaluated by the geotechnical engineer or his representative for a depth of 6 inches below any bedding. Bedding material should consist of sand 100 percent passing a No. 4 sieve and less than 5 percent fines (passing a No. 200 sieve), and a sand equivalent of 30 or more or as approved by the project inspector and geotechnical engineer and be a minimum of 6 inches in thickness. The unprocessed native soils are not typical of that used for bedding, and import will be required if needed. Bedding is recommended due to the rocky nature of soils exposed in trenches and the non-uniform and potentially abrasive pipe support.

Pipe-Zone, Trench–Zone, Trench Backfill and Compaction: Backfill of utilities should be placed in conformance with the requirements of the specifications. Backfill of utilities within roads or public rights-of-way should be placed in conformance with the requirements of the governing agency (water district, public works department, etc.).

Pipe zone backfill material (the pipe area from the bedding to 12 inches above the top of pipe) may consist of native soils with a ¾" maximum particle size or import sand (as described above for bedding) as dictated by the pipe designer or manufacturer. The pipe zone backfill material should be placed in maximum 8-inch lifts (loose) and compacted near its optimum moisture content prior to the placement of subsequent lifts. Pipe zone backfill should be compacted to a minimum of 90% relative compaction (ASTM D 1557) or to a firm condition as evaluated by the

geotechnical engineer or his representative. Compaction should be assured in the pipe haunches.

The native soil may be suitable for use as trench zone and street zone (and manholes) backfill (from the top of pipe zone up to finished subgrade), if approved suitable by the pipe manufacturer, provided it is free of significant organic or deleterious matter and oversize materials. Rocky soils, if encountered may not be suitable to support pipe haunches, there by requiring a sandy import, as above for bedding. Trench-zone backfill should contain no particles larger than 3 inches in greatest dimension. The final backfill material should be placed in maximum 8-inch lifts (loose) and compacted to at least 90% relative compaction (ASTM D 1557) near its optimum moisture content for the trench zone and 95% for the street zone (upper 12 inches) where below pavement. Compaction should be verified by testing.

Backfill materials should be brought up at substantially the same rate on both sides of the pipe or conduit. Reduction of the lift thickness may be necessary to achieve the above recommended compaction. Care should be taken to not overstress the piping during compaction operations. Mechanical compaction is recommended. Ponding or jetting is not recommended.

Alternatively, if the utility cannot accommodate the increased stress, or if compaction is difficult, we recommend the pipe be encased by at least 1 foot of 1-sack cement-sand slurry (at least 1 foot as measured from the top of pipe) or 2 sack in structural/pavement areas. Backfill operations should be observed and tested to monitor compliance with these recommendations.

In general, coarse-grained sand and/or gap graded gravel (i.e. ¾-inch rock or pea-gravel, etc.) should not be used for pipe or trench zone backfill due to the potential for soil migration into the relatively large void spaces present in this type of material and water seepage along trenches backfilled with coarse-grained sand and/or gravel. Water seepage or soil migration will cause settlement of the overlying soils. Gap graded backfill should be wrapped in filter fabric such as Mirafi 140N.

Compaction should be verified by testing. Backfill operations should be observed and tested to monitor compliance with these recommendations. Trench backfill compacted per these requirements can be expected to settle 0.1 to 0.3 percent of the trench depth. This can cause an elevation difference between backfilled trenches and the surrounding soil or pavement. Increased relative compaction can reduce settlement if the potentials presented are not acceptable. The geotechnical engineer should be consulted on a case-by-case basis to provide further recommendations to reduce the settlement potential.

STRUCTURES

5.4 Shallow Foundation Recommendations

In our professional opinion, foundations for new structures (as presented within) can be supported on shallow foundations bearing in properly prepared and compacted soils placed as recommended in Section 5.1 or entirely on bedrock. The following recommendations are based on “very low” expansion category soils in the upper 5 feet of subgrade. Soils which are found to

be more expansive than a "very low" Expansion Index should be relocated to non-improvement locations or per specific recommendations of the geotechnical engineer.

Footing design of widths, depths, and reinforcing are the responsibility of the Structural Engineer, considering the structural loading and the geotechnical parameters given in this report. A minimum footing depth of 12 inches (wall footings) (15 inches for 2 story structures) and 18 inches (column footings and three-story structures) below lowest adjacent grade should be maintained (lowest grade within 3 feet laterally as measured from the foundation bottom). Earth Systems should be retained to observe foundation excavations before placement of reinforcing steel or concrete. Loose soil or construction debris should be removed from footing excavations before placement of concrete. *All footing excavations should be probed for uniformity. Soft or loose zones should be excavated and recompacted to finish foundation bottom subgrade. The bottom of all foundations should be compacted and tested to confirm a minimum of 90% relative compaction (ASTM D 1557).*

Slope Setback for Foundations: Earth Systems recommends a minimum setback distance of 5 feet for the tops of slopes and 25 feet from any leach bed edge. The 2022 California Building Code provides setback distances for foundations along slopes. Setback distances are measured differently for foundations located at the top of the slope and those located at the bottom of the slope. For foundations located at the top of the slope, the measurement is taken horizontally from the outside face of the foundation footing to the face of the slope. For foundations located below the slope, the horizontal distance is measured from the face of the structure to the bottom of the slope. For pools and slopes steeper than 1(H):1(V), please contact Earth System for these setbacks with submittal of detailed information using plan form.

Shallow Foundations based on Grading per Section 5.1 Option 1 of this report: Allowable soil bearing pressures are given below for foundations bearing on recompacted soils as described in Section 5.1 or entirely on bedrock. Allowable bearing pressures are net (weight of footing and soil surcharge may be neglected).

- Continuous wall foundations, 12-inch minimum to 36-inch maximum width and 12 inches minimum to 30-inch maximum embedment depth:

  1,500 psf for dead plus design live loads

- Isolated pad foundations, 2 x 2-foot minimum, 5 x 5-foot maximum in plan dimension and 18 inches minimum to 30-inch maximum embedment depth:

  2,000 psf for dead plus design live loads

Shallow Foundations or Piers/Piles Founded in Bedrock (minimum of 1 foot socketing), Option 2 of Section 5.1.

- Foundations/Pile/Piers with minimum 4-foot embedment:

  4,000 psf for dead plus design live load which may be increased 500 psf for each additional foot of embedment to a maximum of 8,000 psf.

A one-third (⅓) increase in the allowable bearing pressure may be used when calculating resistance to wind or seismic loads if the structural engineer determines they are allowed per

California Building Code. The allowable bearing values indicated are based on the anticipated maximum loads stated in Section 1.1 of this report. If the anticipated loads exceed these values, the geotechnical engineer must reevaluate the allowable bearing values and the grading requirements.

Any maximum foundation sizes are based on settlement due to Dead + Live loads. Transient loads such as earthquake or wind loads are not subject to the stated size limitations; however, the allowable bearing pressure (including ⅓ increase) should be followed considering the relevant foundation sizes given above. Earth Systems recommends the structural engineer provide actual Dead, Live, and Transient Loads for analysis of allowed bearing stresses. Factors for Live Load related to sustained and transient loading should also be provided by the Structural Engineer.

The spacing between large spread footings should be evaluated by the geotechnical engineer during the plan review stage to confirm or modify the settlement estimates and bearing capacity due to large footings and the influences from adjacent footings. These settlements are based on exploration data obtained during our exploration. A preliminary analysis suggests spacing the footings (adjacent edge to adjacent edge) a lateral distance from one another of the width of the largest footing from any adjacent footing, such that influence effects are minor.

An average modulus of subgrade reaction, k, of 200 (new foundations) pounds per cubic inch (pci) can be used to design lightly loaded footings and slabs founded upon compacted fill. Other foundations such as mat slabs, will require the use of differing modulus of subgrade reaction values than used for lightly loaded slabs.

Stepped foundations should be designed in accordance with the 2022 CBC. The CBC 2022 and ACI Section 4.3, Table 4.3.1 should be followed for recommended cement type, water cement ratio, and compressive strength. Seismic Design Category for compressive strength determination is ‘D’.

Minimum Foundation Reinforcement: Minimum reinforcement should be provided by the structural engineer to accommodate the settlement potentials presented within.

Estimated Settlements for New Foundations Caused by Static Loading and Collapse Soils: Estimated total static load settlement is less than 1 inch, and seismic settlement is remediated for a combined settlement of 1 inch. These estimates are based on footings founded on firm soils as described in Section 5.1 of this report. The total estimated differential settlement for the combined static and remediated collapse settlement is estimated to less than 1 inch. As such, considering differential settlement applied over a typical foundation distance of 40 feet, we recommend the structural engineer design for the standard angular distortion of 1:480 for the differential condition.

Earthquake Performance Statement: Depending upon the extent of structural and geotechnical design of exterior flatwork, walls, utilities, roadways, and other similar site improvements, some damage due to seismic events will occur. Note that all of southern California in general is in earthquake country. Site developments in southern California are typically not designed to mitigate anticipated seismic events without some damage. In fact, the Building Code is intended to provide Life-Safety performance, not complete damage-free design. In other words, some

damage from earthquakes in the form of structural damage, settlement, cracking, and disruption of utilities can occur. It is not the current standard of care for site designers to fully mitigate all anticipated earthquake induced hazards.

According to literature from Robert W. Day, doors and windows may stick at distortion angles between 1:240 and 1:175. In this situation, a human being could be put in a life-threatening situation. Therefore, Earth Systems recommends (for shallow foundation design) the maximum distortion angle using all the settlement conditions including seismic settlements be 1:240. The estimated angular distortions for this project are better than this threshold.

Minor Depth Foundations (less than 15 foot embedment as described within): Although no specific elements were identified by the architect, for structural components, or similar may be supported on cast-in-place piles (pier), helical piers, or direct embed in drilled holes filled with concrete which are entirely supported on bedrock, and the design be based on parameters presented in the subsequent sections of this report. Piers will be very hard to drill in the rocky and dry soil (caving) soils. Construction employing poles or posts may utilize design methods presented in Section 1806 and 1807 and values of the CBC for Silty Sand (SM) material class of Table 1806.2 for lateral resistance and the allowable bearing pressures presented earlier. For designs utilizing allowable frictional resistance, Earth Systems recommends the use of Section 1810.3.3.1.4 and .5 of the CBC. Side friction and end bearing should not be considered to act concurrently for design except for drill (screwed) insertion of helical piers. For piles with an axial or lateral load, these design methods apply for piles spaced at least 3 pile diameters center to center for axial loads and 6 pile diameters for lateral load where the load is in the same direction as adjacent piers and their stress envelope overlaps. Piles spaced closer than these limits could have soil strength reduction and should be evaluated on a case-by-case basis by geotechnical engineer.

For piers founded in areas with native soil at the surface, an additional 3 feet should be added to the calculated pile embedment due to the potential effects of long-term surficial disturbance and erosion. For lateral evaluation, it should be considered that the upper 3 feet is unsupported. Additionally, where piers are constructed adjacent to the tops of slopes, there should be a minimum distance between the top of the slope and the closest edge of the pier of H/3, where ‘H’ is the height of the slope, otherwise a lateral resistance reduction must be applied. For piers founded closer than a distance H/3 to the crest or within the slope area itself, the calculated lateral resistance of the soil should be reduced by 30%. The above recommendations have considered slopes no steeper than 2:1 (horizontal:vertical). Steeper slopes will require additional analysis and may change the recommendations presented.

For estimated refusal depths, please see Figure 3 and Table 2 and trench logs in Appendix A. Drilled piers should have a minimum 3 inches of clearance between the embedded post and the soil side wall to allow for adequate placement and flow of concrete.

Drill holes may end up oversize. Casing or other means may be required in a drilled hole. Any "slough" or loose soils at the bottom of the shaft must be removed or tamped prior to setting rebar cages and placing concrete. Extreme care must be exercised to carefully position reinforcing steel cages and place concrete without disturbing the sidewalls of the drilled shafts. We recommend centralizers be used to positively locate rebar cages within the pier shaft. It is

recommended that pier excavations that have not received concrete, not be left open and concrete should be placed immediately. Caving is a very high concern.

Normally, drilled pier excavations are made without the use of water. If necessary, water may be used to facilitate removal of cuttings unless it aggravates caving problems. Samples during our geotechnical exploration were unrecoverable due to dry and cohesionless soils. Added water that may accumulate at the bottom of the hole should be removed from the drilled hole prior to placing the concrete. Sidewalls which have softened from the addition of water should be cleaned of the soft/loose material. Each excavation should be completed in a continuous operation and the concrete should be placed without undue delay. The contractor should use appropriate means to clean the bottom of the excavation so that no loose material is present at the base of the pier. We do not recommend over-drilling beyond specified pier tip elevations to eliminate the need for bottom cleaning in order to account for slough or loose materials at the excavation bottom. To reduce the potential for caving and sidewall sloughing which may contaminate concrete during placement, and segregation, concrete should be placed by tremie methods and not directly chute-dumped into the hole.

Where casing is used with drilled holes and cannot be withdrawn, the skin friction capacity is theoretically reduced, as are passive resistance and stiffness. The amount of reduction is subject to assessment by the geotechnical consultant. The use of casing with drilled holes should be approved prior to use by the geotechnical engineer.

If casing is required, it should be withdrawn as the concrete is being placed, maintaining a 3-foot minimum head of concrete within the casing. This is to prevent reduction in the diameter of the drilled shaft due to earth pressure on the fresh concrete and to prevent extraneous material from falling in from the sides and mixing with the concrete. Concrete placement should continue in this manner until suitable concrete extends to the top of the excavation or forms. The upper eight feet of the pier should be consolidated by vibratory means.

Pier capacity is greatly dependent on the soil conditions at the location of the pier and upon contractor means and methods of placement. It is recommended that drilling operations and concrete placement be performed in the continuous presence of the geotechnical consultant or his representative to confirm that suitable materials for pier support are penetrated, that the dimensions of the installed piers meet the design dimensions, and that the installation has been performed as specified by the 2022 California Building Code. Observation during drilling is required by the 2022 California Building Code on a full-time basis by the geotechnical engineer or his representative. If subsurface conditions noted during drilled pier installation are significantly different than those encountered in our borings, it may be necessary to adjust the overall length of the pier.

Prior to the placement of steel, and again prior to and during the placement of concrete, the excavation must be examined by the geotechnical consultant before proceeding with construction. The contractor should provide all aid and assistance required by the geotechnical and geologic consultants for field monitoring of the drilled pier operations.

Piers are accepted or rejected based on visual observation and testing during construction. The contractor should not allow nor cause any of this work to be permanently enclosed or covered

up until it has been observed, tested, and accepted by the geotechnical engineer and all legally constituted authorities having jurisdiction.

Pier Foundation Grading and Testing: If the design uses pile foundations, the GER recommends the use of end bearing only unless noted otherwise. The contractor shall prove that the bottom of the pier foundation is clean before placement of the concrete. The contractor shall also make safe the bottom of the pier footing to allow access to test the bottom of the pier foundation prior to placement of concrete—this may require contractor to provide shoring for safe access. Other options of obtaining samples at the bottom of the pier foundation to determine adequate compaction may be provide at the expense of the contractor but must be approved the GER.

5.5 Slope Construction

Site soils are highly susceptible to erosion. Compacted fill slopes protected against erosion (per approved methods such as significant planting, facing, or erosion blankets, etc.) should be constructed at 3:1 (horizontal: vertical) or flatter inclinations. Unprotected slopes or steeper slopes with exposed native soils or compacted fill at the surface should be expected to require repair after heavy nuisance or storm runoff occurs due to significant erosion. Slope recommendations may change pending a more in-depth geotechnical evaluation once design plans are developed. Slopes used as nuisance or storm drainage channel slopes should be no steeper than 3:1 and protected with heavy 12” minimum rip-rap or designed by the civil engineer to resist the anticipated flows. Positive lot drainage should be designed, constructed, and maintained to prevent flow of water off the pad over the descending fill slope. Berms, lined swales, and other means should be utilized to divert runoff away from the slope face.

Compacted fill should be placed at near optimum moisture content and compacted to a minimum 90 percent of the maximum dry unit weight, as measured in relation to ASTM D 1557 test procedures. The exposed face of any cut or fill slope (upper 12 inches) should have a minimum relative compaction of 90 percent, as measured in relation to ASTM D 1557 test procedures and be compacted at near optimum moisture content. Due to the erodible site soils, slope faces should be protected with facing or densely spaced vegetation to reduce the erosion potential.

Surficial Slope Failures: Site soils are highly susceptible to erosion from wind and water sources. All slopes will be exposed to weathering, resulting in decomposition of surficial earth materials, thus potentially reducing shear strength properties of the surficial soils. In addition, these slopes become increasingly susceptible to rodent burrowing. As these slopes deteriorate, they can be expected to become susceptible to surficial instability such as soil slumps, erosion, soil creep, and debris flows. Development areas immediately adjacent to ascending or descending slopes should address future surficial sloughing of soil material and erosion. Such measures may include debris fences, slope facing, catchment areas or walls, diversion ditches or berms, soil planting, velocity reducers or other techniques to contain soil material away from developed areas and reduce erosion. Additionally, foundations should be set back at least 5 feet from the edge of slope or as per the 2022 CBC, whichever is greater.

Operation and maintenance inspections should be done after a significant rainfall event and on a time-based criterion (annually or less) to evaluate distress such as erosion, slope condition, rodent infestation burrows, etc. Inspections should be recorded, and photographs taken to

document current conditions. The repair procedure should outline a plan for fixing and maintaining surficial slope failures, erosional areas, gullies, animal burrows, etc. Repair methods could consist of excavating and infilling with compacted soil erosional features, track walking the slope faces with heavy equipment, as determined by the type and size of repair. These repairs should be performed in a prompt manner after their occurrence. Slope inclinations should be maintained, and a maintenance program should include identifying areas where slopes begin to steepen. Where future maintenance is not possible, slopes should be faced to reduce the erosion and degradation potential.

Slope faces are erodible even if compacted and will gradually erode and move down slope presenting maintenance issues and debris deposited in drainage devices and flatwork areas. The minimum material necessary to support landscaping should be specified by the landscape consultant (typically less than 6 inches).

5.6 Slabs-on-Grade

Subgrade: Concrete slabs-on-grade and flatwork should be supported by compacted and moisture conditioned soil placed in accordance with Section 5.1 of this report.

Vapor Retarder: In areas of moisture-sensitive floor coverings, coatings, adhesives, underlayment, goods or equipment stored in direct contact with the top of the slab, bare slabs, humidity-controlled environments, or climate-controlled cooled environments, an appropriate vapor retarder that maintains a permeance of 0.01 perms or less after ASTM E1745's mandatory conditioning tests should be installed to reduce moisture transmission from the subgrade soil to the slab. For these areas, a vapor retarder (Stego wrap 15-mil thickness or equal) should underlie the floor slabs. If a Class A vapor retarder (ASTM E 1745) is specified, the retarder can be placed directly on non-expansive soil and be covered with a minimum 2 inches of clean sand.

Clean sand is defined as well or poorly-graded sand (ASTM D 2488) of which less than 5 percent passes the No. 200 sieve and all the material passes a No. 4 sieve. The site soils do not fulfill the criteria to be considered clean sand. Alternatively, the slab designer may consider the use of other vapor retarder systems that are recommended by the American Concrete Institute.

Low-slump concrete should be used to help reduce the potential for concrete shrinkage. The effectiveness of the membrane is dependent upon its quality, the method of overlapping, its protection during construction, the successful sealing of the membrane around utility lines, and sealing the membrane at perimeter terminations and of all penetrations. Capillary breaks, if any, beneath slabs should consist of a minimum of at least four inches of permeable base material (Caltrans) with the following specified gradation.

Table 8
Capillary Break

Sieve Size	Percent Passing
1 inch	100
¾ Inch	90-100
3/8 Inch	40-100
#4	25-40
#8	18-33
#30	5-15
#50	0-7
#200	0-3

Where vapor retarders are placed directly on a gravel capillary break, they should be a minimum of 15 mil thickness.

Where concrete is placed directly on the vapor retarder "plastic", proper curing techniques are essential to minimizing the potential of slab edge curl and shrinkage cracking. The edges of slabs can curl upward because of differential shrinkage when the top of the slab dries to lower moisture content than the bottom of the slab. Curling and cracking are caused by the difference in drying shrinkage between the top and bottom of the slab. Curling and cracking can be exacerbated by hot weather, or dry condition concrete placement, even with proper curing techniques.

The following minimum slab recommendations are intended to address geotechnical concerns such as potential variations of the subgrade and are not to be construed as superseding any structural design. A design engineer should be retained to provide building specific systems to handle subgrade moisture to ensure compliance with SB800 with regards to moisture and moisture vapor.

Slab Thickness and Reinforcement: Slabs on grade should be a minimum of 5 inches in actual thickness (4 inches for flatwork) and be reinforced with at least #3 bars at 18 inches on center both ways. Reinforcing bars should extend at least 40 bar diameters into the footings and slabs. Concrete slabs-on-grade and flatwork should be supported by compacted and moisture conditioned soil placed in accordance with this report.

Slab thickness and reinforcement of slabs-on-grade are contingent on the recommendations of the structural engineer or architect and the expansion index of the supporting soil. Based upon our findings, a modulus of subgrade reaction of approximately 200 pounds per cubic inch can be used in concrete lightly loaded (not mat) slab design for the expected compacted subgrade. Mat slab design will require differing modulus values. ACI Section 4.3, Table 4.3.1 should be followed for recommended cement type, water cement ratio, and compressive strength.

If heavily loaded flatwork is proposed (RV drive areas, heavy racking, etc.), the actual thickness should be designed by the structural engineer utilizing techniques of the American Concrete

Institute (ACI) and may be greater than 5 inches in thickness. Concrete floor slabs may either be monolithically placed with the foundations or doweled (No. 4 bar embedded at least 40 bar diameters) after footing placement. The thickness and reinforcing given are not intended to supersede any structural requirements provided by the structural engineer. The project architect or concrete inspector should continually observe all reinforcing steel in slabs during placement of concrete to check for proper location within the slab. The minimum concrete rebar cover should be as per the project architect or structural engineer.

Slab-On-Grade Control Joints: Control joints should be provided in all regular concrete slabs-on-grade at a maximum spacing of 36 times the slab thickness on-center, each way as recommended by American Concrete Institute [ACI] guidelines (sidewalks every 4 to 6 feet). All joints should form approximately square patterns to reduce the potential for randomly oriented shrinkage cracks. Control joints in the slabs should be tooled at the time of the concrete placement or saw cut (¼ of slab depth) as soon as practical but not more than 8 hours from concrete placement.

Construction (cold) joints should consist of thickened butt joints with ¾-inch dowels at 18 inches on center (12 inches at doorways) mid-slab embedded per ACI or a thickened keyed-joint to resist vertical deflection at the joint. All control joints in exterior flatwork should be sealed to reduce the potential of moisture or foreign material intrusion. These procedures will reduce the potential for randomly oriented cracks and lifting but may not prevent them from occurring.

Curing and Quality Control: The contractor should take precautions to reduce the potential of curling and cracking of slabs in this arid desert region using proper batching, placement, and curing methods. Curing and cracking is highly affected by temperature, wind, and humidity.

Quality control procedures should be used, including trial batch mix designs, batch plant inspection, and on-site special inspection and testing. Curing should be in accordance with ACI recommendations contained in ACI 211, 304, 305, 308, 309, and 318. Additionally, the concrete should be vibrated during placement. Concrete should be wet cured for at least 7 days with burlap or plastic and not allowed to dry out to minimize surface cracking.

5.7 Retaining Walls and Lateral Earth Pressures

Walls which are restrained at the top such as retaining wall returns, below-grade walls and walls tied to floor slabs should be designed with “at rest” earth pressures. Retaining walls, free to tilt at the top, may be designed for “active” earth pressures.

The following list presents lateral earth pressures for use in wall design. The values are given as equivalent fluid pressures ***without*** surcharge loads or hydrostatic pressure. Clay soils are not suitable for wall backfill as they are not free draining.

- Conventional cantilever retaining walls can be backfilled with compacted on-site engineered fill soils verified to be “very low” in expansion potential. Provided the wall is backfilled at a 1:1 projection upward from the heels of the wall footings with non-expansive engineered fill, an active pressure of 42 pcf of equivalent fluid weight for well-drained, level backfill may be used. Similarly, an active pressure of 52 pcf of equivalent fluid weight may be used for well-drained backfill sloping at 2H:1V (horizontal to vertical).

For the restrained level backfill condition, a pressure of 63 pcf of equivalent fluid weight should be used.

- In addition to the active or at rest soil pressure, where not excepted by code, the proposed wall structures should be designed to include forces from dynamic (seismic) earth pressure. Dynamic pressures are additive to active and at-rest earth pressure and should be considered as 57 pcf for flexible walls, and 73 pcf for rigid walls using engineered fill as backfill. Seismic pressures are based on PGA_M of 0.87 g, Friction Soil Angle of 31^o, and a total density of 125 pcf.
- Walls retaining bedrock should be evaluated on a case-by-case basis.
- Retaining wall foundations should be placed upon compacted fill or bedrock described in Section 5.1.
- A back-drain or an equivalent system of backfill drainage should be incorporated into the wall design, whereby the collected water is conveyed to an approved point of discharge. Design should be in accordance with the 2022 California Building Code. Drain rock should be wrapped in filter fabric such as Mirafi 140N as a minimum and should have a volume of 1 cubic foot per foot of length. Backfill immediately behind the retaining structure should be a free-draining granular material. Waterproofing should be according to the designer's specifications. Water should not be allowed to pond or infiltrate near the top of the wall. To accomplish this, the final backfill grade should divert water away from retaining walls.
- Compaction on the retained side of the wall within a horizontal distance equal to one wall height (to a maximum of 6 feet) should be performed by hand-operated or other lightweight compaction equipment (90% compaction relative to ASTM D 1557 at near optimum moisture content). This is intended to reduce potential locked-in lateral pressures caused by compaction with heavy grading equipment or dislodging modular block type walls.
- The above recommended values do not include compaction or truck-induced wall pressures. Care must be taken during the compaction operation not to overstress the wall. Heavy construction equipment should be maintained a distance of at least 3 feet away from the walls while the backfill soils are placed. Upward sloping backfill or surcharge loads from nearby footings can create larger lateral pressures. Should any walls be considered for retaining sloped backfill or placed next to foundations, our office should be contacted for recommended design parameters. Surcharge loads should be considered if they exist within a zone between the face of the wall and a plane projected 45 degrees upward from the base of the wall. The increase in lateral earth pressure should be taken as 50% of the surcharge load within this zone. Retaining walls subjected to traffic loads should include a minimum uniform surcharge load equivalent of 250 psf for auto and 400 psf for truck traffic kept back at least 3 feet from the wall back edge. Retaining walls should be designed with a minimum factor of safety of 1.5.

Frictional and Lateral Coefficients:

- Resistance to lateral loads (including those due to wind or seismic forces) may be provided by frictional resistance between the bottom of concrete foundations and the underlying soil, and by ½ of the passive soil pressure against the foundations if used together due to different rates of mobilization. An allowable coefficient of friction of 0.35 may be used between cast-in-place concrete foundations and slabs and the underlying soil or bedrock. An allowable coefficient of friction of 0.30 may be used between pre-cast or formed concrete foundations and slabs and the underlying soil or bedrock.
- Allowable passive pressure may be taken as equivalent to the pressure exerted by a fluid weighing 300 pounds per cubic foot (pcf). Vertical uplift resistance may consider a soil unit weight of 105 pounds per cubic foot. The upper 1 foot of soil should not be considered when calculating passive pressure unless confined by overlying asphalt concrete pavement or Portland cement concrete slab. The soils pressures presented have considered onsite fill soils. Testing or observation should be performed during grading by the soils engineer or his representative to confirm or revise the presented values.
- Passive resistance for thrust blocks bearing against firm natural soil or properly compacted backfill can be calculated using an equivalent fluid pressure of 300 pcf. The maximum passive resistance should not exceed 2,000 psf.
- Construction employing poles or posts (i.e. lamp posts) may utilize design methods presented in Section 1807.3 of the CBC for Silty Sand soils (SM) material class.
- The passive resistance of the subsurface soils will diminish or be non-existent if trench sidewalls slough, cave, or are over-widened during or following excavations. If this condition is encountered, our firm should be notified to review the condition and provide remedial recommendations, if warranted.

5.8 Seismic Design Criteria (2022 California Building Code)

This site is subject to strong ground shaking due to potential fault movements along regional faults including the San Andreas and Pinto Mountain fault zones. Engineered design and earthquake-resistant construction increase safety and allow development of seismic areas. The minimum seismic design should comply with the 2022 edition of the California Building Code and ASCE 7-16 (Supplement 3).

However, this site was found not to have liquefiable soil. Based on our site class estimator and the shallow site weathered bedrock, the site is classified as Site Class C. Note, Exception 11.4.8 in ASCE 7-16 is not required for Site Class C and a Site-Specific Ground Motion Analysis is not required.

General Procedure for seismic parameters is presented below considering a Site Class C. Values were obtained from a web site (https://seismicmaps.org/) using a coordinate location of Latitude 34.0748°N and Longitude 116.3314°W. The structural design engineer should use the most conservative results based of the specific building design and spectral response. A seismic evaluation should be performed for Site Class for each final homesite due to varying conditions of each site.

Table 9
2022 CBC (ASCE 7-16) Seismic Parameters

Site Class:	C
Risk Category:	II
Seismic Design Category	D
Maximum Considered Earthquake [MCE] Ground Motion	
Short Period Spectral Response S_s:	1.788 g
1 second Spectral Response, S_1:	0.6 g
Code Design Earthquake Ground Motion	
F_a	1.2
F_v	1.4
F_{PGA}	1.2
S_{MS}	2.145 g
S_{M1}	0.84 g
Short Period Spectral Response, S_{DS}	1.43 g
1 second spectral response, SD1	0.56 g
Peak Ground Acceleration (PGA_M) Eq 11.8-1	0.869 g

The intent of the CBC lateral force requirements is to provide a structural design that will resist collapse to provide reasonable life safety from a major earthquake but may experience some structural and nonstructural damage. A fundamental tenet of seismic design is that inelastic yielding is allowed to adapt to the seismic demand on the structure. In other words, *damage is allowed*. The CBC lateral force requirements should be considered a *minimum* design. The owner and the designer may evaluate the level of risk and performance that is acceptable. Performance-based criteria could be set in the design. The design engineer should exercise special care so that all components of the design are fully met with attention to providing a continuous load path. An adequate quality assurance and control program is urged during project construction to verify that the design plans and good construction practices are followed. This is especially important for sites lying close to the major seismic sources.

Spectral accelerations may exceed one g. Actual acceleration may be more or less than estimated. Vertical accelerations are typically ⅓ to ⅔ of the horizontal accelerations, but can equal or exceed the horizontal accelerations, depending upon the local site effects and amplification.

Earthquake Performance Statement: Depending upon the extent of structural and geotechnical design of exterior flatwork, walls, utilities, roadways, and other similar site improvements, some damage due to seismic events will occur. We recommend a standard statement for purchasers of the property and within title reports that seismic induced damage may occur. Note that all of southern California in general is in earthquake country. Site developments in southern California

are typically not designed to mitigate anticipated seismic events without some damage. In fact, the Building Code is intended to provide Life-Safety performance, not complete damage-free design. In other words, some damage from earthquakes in the form of structural damage, rock fall, settlement, cracking, and disruption of utilities is expected and that repair after an earthquake event will likely be required. It is not the current standard of care for site developers to fully mitigate all anticipated earthquake induced hazards. It is incumbent on the developer to advise the end-users of the project of the anticipated hazards in the form of disclosure statements during the initial and subsequent purchase processes.

According to literature from Robert W. Day, doors and windows may stick at distortion angles between 1:240 and 1:175. In this situation, a human being could be put in a life-threatening situation. Therefore, Earth Systems recommends the maximum distortion angle using all the settlement conditions including seismic settlements be 1:240. For all settlement conditions excluding seismic settlement, the structure's maximum distortion angle should be the typical County required 1:480.

5.9 Surface and Subsurface Site Drainage and Maintenance

Positive drainage should be maintained away from the structure foundations (5 percent for 10 feet minimum) to prevent ponding, water intrusion, and subsequent saturation of the foundation soils. Gutters and downspouts in conjunction with a 2 percent (%) hardscape grade sloped away from structures draining to area drains can be considered as a means to convey water away from foundations if increased fall is not provided. A minimum 2% fall is required by the 2022 CBC. There is an exception where less than 2 % grade is allowable if the area is for a door landing or ramp per ADA regulations:

- Water control and conveyance is a critical aspect of project design. It is highly recommended that landscape irrigation or other sources of water be collected and conducted to an approved drainage device. Landscaping grades should be lowered and sloped such that water drains to appropriate collection and disposal areas. All runoff water should be controlled, collected, and drained into proper drain outlets. Control methods may include curbing, ribbon gutters, 'V' ditches, or other suitable containment and redirection devices.

- Site drainage should be devised such that runoff should be directed away from the tops of all graded slopes. Water should not freely flow over slopes. Diversion and conveyance structures which can accommodate water and eroded soil should be constructed at the tops and toes of all slopes. Lined swales or berms at the top and bottom of slopes are recommended.

- Applied irrigation to maintain landscaping should be controlled to the minimum volume and frequency necessary to sustain plant material. Excess and frequent watering could lead to saturated areas and standing water which can cause slab and foundation distress. The irrigation system designer should consider these conditions in their design and control irrigation accordingly.

- In no instance should water be allowed to flow or pond against structures, slabs or foundations or flow over unprotected slope faces. Adequate provisions should be employed

to control and limit moisture changes in the subgrade beneath foundations or structures to reduce the potential for soil saturation and intrusion. Landscape borders should not act as traps for water within landscape areas. Potential sources of water such as piping, drains, over-spray broken sprinklers, etc., should be frequently examined. Any such leakage, over-spray, or plugging should be immediately repaired.

- Landscape areas should be cut off from slab or foundation areas by subsurface barriers which extend at least 2 feet below the top of slab grade.

- The drainage pattern should be established at the time of final grading and maintained throughout the life of the project. Additionally, drainage structures should be maintained (including the de-clogging of piping) throughout their design life. Structural performance is dependent on many drainage-related factors such as landscaping, irrigation, lateral drainage patterns and other improvements. Cleanout should be provided in drainage piping.

- Maintenance of drainage systems and infiltration structures can be the most critical element in determining the success of a design. They must be protected and maintained from sediment-laden water both during and after construction to prevent clogging of the surficial soils any filter medium. The potential for clogging can be reduced by pre-treating structure inflow through the installation of maintainable forebays, biofilters, or sedimentation chambers. In addition, sediment, leaves, and debris must be removed from inlets and traps on a regular basis. Since these and other factors (such as varying soil conditions) may affect the rate of water infiltration, it is imperative to apply a conservative factor of safety [FOS] to the unfactored Basic Percolation/Infiltration Rates to provide a reliable basis for design. In order to account not only for the unknown factors above but also for changes of conditions during the use of the structures such as potential clogging effects due to washing in of soil fines, a FOS between 3 and 10 should be applied to lower design infiltration rates as per Riverside County BMP Manual (2014) requirements.

- The factor of safety should be selected by the project drainage engineer and may be dependent on agency guidelines and the presence of filters and sedimentation structures. If these measures are provided, the factor of safety can be reduced.

- We recommend drywells or infiltrating structure be located at least 25 feet from structure foundations, slopes, or settlement sensitive features.

- Water should not be allowed to pond within 10 feet of building foundations. The civil engineer producing the grading plan is notified that a gap made of clean sand is typically found between the vapor barrier and bottom of slabs or foundations. If water intrusion into this gap is possible the civil engineer shall either provide for no ponding or an impervious material to prevent water intrusion into the sand gap.

When grades of 5 percent for 10 feet away from foundations are not possible, the CBC allows for alternative drainage systems (Section 1804.3). Earth Systems experience has found that alternative methods may include impervious surface material (such as concrete and asphalt),

area drains, and horizontal moisture barriers. Please contact Earth Systems for additional information or if the project has difficulty making grades.

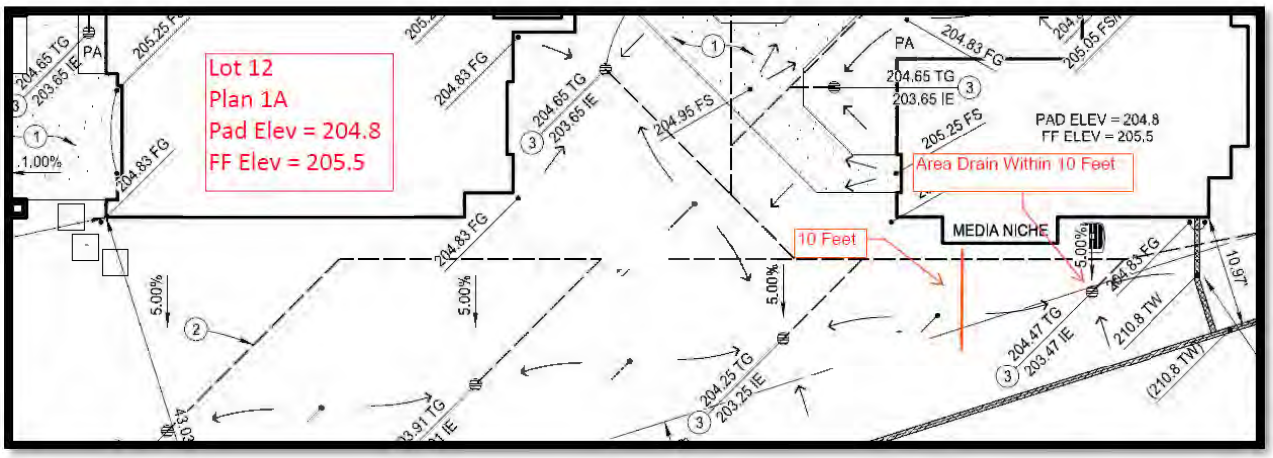


Figure 4 Example Area Drains Used Within 10 Feet of Foundations

5.10 Pavements

Pavement structural sections for associated drive areas including recommendations for standard asphalt concrete, and Portland cement concrete are provided below and are based upon on-site soils as described in Section 5.1. Soils differing from those described will require differing pavement sections. The appropriate pavement section depends primarily on the shear strength of the subgrade soil exposed after grading in the near finished subgrade elevation and the anticipated traffic over the useful life of the pavement. R-value testing or observation of subgrade soils should be performed of near finished subgrade elevation soils to verify and/or modify the preliminary pavement sections presented within this report.

Pavement Area Preparation: In street, drive, and parking areas, the exposed subgrade should be overexcavated as recommended in Section 5.1, moisture conditioned, and compacted. Compaction should be verified by testing. Aggregate base should be compacted to a minimum 95% relative compaction (ASTM D 1557).

Automobile Traffic and Parking Areas: Pavement sections presented in the following table for automobile type traffic areas and are based on a tested R-value, observed soil types likely present after grading, and current Caltrans design procedures. Traffic Indices (TI) of 5 and 7 were used to facilitate the design of asphalt concrete pavements for parking and main drives, including fire lanes. The fire lane calculation assumed a conservative traffic flow of one fire truck per day entering and exiting the site on the same path (20 year life cycle), and a maximum loading of an 88,000 lb Tandem Axle apparatus (approximate 24,000 lb front axle load and two 32,000 lb rear axles loads) which is based upon the *Emergency Vehicle Size and Weight Regulation Guideline*, dated November 22, 2011, prepared by the Fire Apparatus Manufacturers' Association.

Based on the above stated traffic pattern and apparatus loads, a Traffic Index of 4.6 is calculated for fire lanes. For comparison, a 40-year fire lane life cycle analysis results in a Traffic Index of 5. The TI's assumed below should be reviewed by the project Civil Engineer to evaluate the

suitability for this project. All design should be based upon an appropriately selected Traffic Index. Changes in the traffic indices will affect the corresponding pavement section.

Table 10
Preliminary Flexible Pavement Section Recommendations
On-site/Interior Automobile Drive Areas

R-Value of Subgrade Soils – (50 assumed) – Design Method – CALTRANS

Traffic Index (Assumed)*	Pavement Use	Flexible Pavements**	
		Asphaltic Concrete Thickness (inches)	Aggregate Base Thickness (inches)
5	Parking Areas & Fire Lanes***	3	4
7	Main Drive Areas	4	4.5

*The presented Traffic Indices should be confirmed by the project civil engineer. Changes to the Traffic Index will result in a differing pavement section required.

**Pavement Sections were calculated using Caltrans Methods.

***Where fire lanes will be a part of a main drive, the Main Drive Area pavement section should be used.

Conventional, rigid pavements, i.e. Portland cement concrete (PCC) pavements, are recommended in areas of typical residential driveways.

The pavement section below is based upon the American Concrete Institute (ACI) *Guide for Construction of Concrete Parking Lots, ACI 330R*, and the assumptions outlined below.

Table 11
Preliminary Portland Cement Concrete Pavement Sections

Area	Minimum Pavement PCC Thickness (inches)*	Minimum 28 Day Flexural Strength (psi)	Concrete Compressive Strength (psi)
Residence Driveway	5.0	500	3,250

*PCC may be placed on a compacted subgrade of engineered fill.

Should the actual traffic category vary from those assumed and listed above, these sections should be modified. All above recommended preliminary pavement sections are contingent on the following recommendations being implemented during construction:

- Pavement should be placed upon compacted fill processed as described in Section 5.1.

- Subsequent to utility installation, the entire pavement (including PCC) final subgrade should be scarified 8 inches, moisture conditioned to near optimum moisture content, and compacted to a minimum 95% relative compaction immediately prior (within a few days) to the placement and compaction of aggregate base to re-establish proper moisture content and compaction in site soils. Subgrade soils should be surface watered prior to the placement of aggregate base.
- Subgrade soils and aggregate base should be in a stable, non-pumping condition at the time of placement and compaction. Exposed subgrades should be proof-rolled to verify the absence of soft or unstable zones.
- Aggregate base materials should be compacted at near optimum moisture content to at least 95 percent relative compaction (ASTM D 1557) and should conform to Caltrans Class II criteria. Standard Specifications for Public Works Construction "Greenbook" standards (Crushed Aggregate Base class) may be used in lieu of Caltrans. Compaction efforts should include rubber tire proof-rolling of the aggregate base with heavy compaction-specific equipment (i.e. fully loaded water trucks).
- All concrete curbs separating pavement from landscaped areas should extend at least 6 inches into the subgrade soils to reduce the potential for movement of moisture into the aggregate base layer (this reduces the risk of pavement failures due to subsurface water originating from landscaped areas).
- Asphaltic concrete should be ½-in. or ¾-in. grading and compacted to a minimum of 95% of the 75-blow Marshall density (ASTM D 1559) or equivalent.
- Portland cement concrete pavements should be constructed with transverse joints at maximum spacing of 12 feet. A thickened edge should be used where possible and, as a minimum, where concrete pavements abut asphalt pavements. The thickened edge should be 1.2 times the thickness of the pavement (6 inches for a 5-inch thick pavement) and should taper back to the PCC thickness over a horizontal distance on the order of 3 feet.
- All longitudinal or transverse control joints should be constructed by hand forming or placing pre-molded filler such as "zip strips." Expansion joints should be used to isolate fixed objects abutting or within the pavement area.

  The expansion joint should extend the full depth of the PCC pavement. Joints should run continuously and extend through integral curbs and thickened edges. We recommend that joint layout be adjusted to coincide with the corners of objects and structures. In addition, the following is recommended for concrete pavements:

  1. Slope pavement at least ½ percent to provide drainage;
  2. Provide rough surface texture for traction;
  3. Cure PCC concrete with curing compound or keep continuously moist for a minimum of seven days;

4. Keep all traffic off concrete until PCC compressive strength exceeds 2,000 pounds per square inch (truck traffic should be limited until the concrete meets the design strength (3,250 psi); and
5. Consideration should be given to having PCC construction joints keyed or using slip dowels on 24-inch centers to strengthen control and construction joints. Dowels placed within dowel baskets should be incorporated into the concrete at each saw-cut control joint (i.e. dowel baskets and dowels are set in place prior to placement of concrete).

- Portland cement concrete placement and curing should, at a minimum, be in accordance with the American Concrete Institute [ACI] recommendations contained in ACI 211, 304, 305, 308, 309, and 318.
- Within the structural pavement section areas, positive drainage (both surface and subsurface) should be provided. In no instance should water be allowed to pond on the pavement. Roadway performance depends greatly on how well runoff water drains from the site. This drainage should be maintained both during construction and over the entire life of the project.
- Proper methods, such as hot-sealing or caulking, should be employed to limit water infiltration into the pavement base course and/or subgrade at construction/expansion joints and/or between existing and reconstructed asphalt concrete sections (if any). Water infiltration could lead to premature pavement failure.
- To reduce the potential for detrimental settlement, excess soil material, and/or fill material removed during any footing or utility trench excavation, should not be spread or placed over compacted finished grade soils unless subsequently compacted to at least 90% of the maximum dry unit weight, as evaluated by ASTM D 1557 test procedure, at near optimum moisture content, or 95% if placed under areas designated for pavement.
- Where new roadways will be installed against existing roadways, the repaired asphalt concrete pavement section should be designed and constructed to have at least the pavement and aggregate base section as the original pavement section thickness (for both AC and base) or upon the newly calculated pavement sections presented within, whichever is greater.
- Pavement designs assume that heavy construction traffic will not be allowed on the base cap or finished pavement sections.

Soil Access Roads: Based on our local knowledge of the project area, the ability of access roads on the site to support construction traffic and passenger vehicles will be dependent on soil moisture contents and compaction level. Light construction traffic and passenger vehicles should be able to traverse most portions of the site, either on or off roads, during the dry months of the year if the compaction recommendations provided below are followed. Surficial soils are expected to be silty in nature and may provide poor support under loading if they become saturated or overly wet or dry out and become loose. Rainfall events at the site are expected to last less than a few hours and have a low intensity. Compacted native soils may be used in these

areas; however, during or after a rainfall event, watering for dust control, other application of water, or general use, there may be some significant limitations on use in wet conditions and there may be increased roadway maintenance costs due to rutting and general soil disturbance. Assuming owners will be actively maintaining the roads, the option of compacted native soils use for roadways is a valid means of reducing construction costs in exchange for higher maintenance costs and reduced passability in wet or very dry conditions. Soil access roads are not considered "All Weather".

In improved access road areas, the subgrade should be scarified, moisture conditioned, and compacted to at least 95% relative compaction (ASTM D 1557) for a depth of at least one foot below subgrade. Fill compacted to a minimum 95% compaction relative to ASTM D 1557 should be placed to finished grade where required. Weak subgrade areas can be identified by proof rolling with heavy, rubber-tired equipment, such as a loaded water truck. Periodic moisture conditioning and rolling with heavy equipment will be required to maintain the compaction of the subgrade.

The site soils have a fine grained component of their composition. As such, native soil roadways may be subject to disturbed fine particulate matter (PM_{10}) which can create airborne dust if the roadways are not maintained. Daily moisture conditioning during construction will be necessary due to the warm desert climate. Traffic speed should be restricted to 10 mph to reduce the potential for "wash boarding" and further restricted to 5 mph at turns to avoid rutting. Compaction should be verified by testing.

Aggregate Roads: Where it is desired to have roads with increased passability in wet conditions, have a greater ability to handle heavy loads, or have reduced maintenance costs, Class 2 aggregate base or open graded gravel (3/4 inch or larger rock size) may be used on top of compacted native soils (95% relative compaction (ASTM D 1557)). Sections for access roads (light vehicles) and roads subject to a design level 100,000 pound fire truck (40,000 pound axle load) are provided. R-Value testing was estimated to evaluate pavement support characteristics (CTM 301).

We have based aggregate section design on TM 5-822-12, Technical Manual, Design of Aggregate Surfaced Roads and Airfields, Department of the Army, September 1990. For roads, considering a Group 3 condition (passenger vehicles, pickups, and three, four and five axle trucks) and a Category III (Traffic containing as much as 15 percent trucks, but not more than 1 percent of the total traffic composed of trucks having three or more axles (Group 3 trucks), Road Class of G (less than 70 vehicles per day) and a corresponding Design Index of 1, the minimum calculated aggregate thickness is 3.25 inches; however, 4 inches is the minimum allowed section per TM 5-822-12. Based upon TM 5-822-12, the minimum compacted subgrade beneath the aggregate section should be 6 inches (interpolated for the semi-cohesiveness of the very silty sand soils). Compaction should be at least 95% relative to ASTM D 1557.

For evaluation of the necessary aggregate section for fire access roads to support a 100,000 pound fire truck (HS20, 40,000 pound single axle load), we considered a CBR of the aggregate fill of 80, 100 psi tire pressure, maximum rut depth of 3 inches, two visits to the site each year for the fire truck, and considering the road is maintained at least on a yearly basis. We utilized the Spectrpave4 PRO software (Tensar International Corporation) for calculation. Based upon these

input parameters, the required minimum aggregate section thickness is 6 inches. Based upon TM 5-822-12, the minimum compacted subgrade beneath the aggregate section should be 8 inches (interpolated for the semi-cohesiveness of the very silty sand soils and the additional load for Design Index 2). Compaction should be at least 95% relative to ASTM D 1557. Aggregate sections are summarized in the Table below.

Table 12
Preliminary Aggregate/Compacted Subgrade Section Recommendations

CBR Value Subgrade Soils – 10 (assumed)

Pavement Use	Aggregate Roadway	
	Aggregate Thickness (inches)	Compacted Subgrade Thickness (inches)
Light Vehicles	4	6
Fire Lanes, Heavy Truck Access	6	8

Aggregate base should be compacted to a minimum 95% relative compaction (ASTM D 1557). To maintain roadway integrity and reduce the potential for roadway surface failure due to water infiltration and ponding, it is suggested that roadways be constructed with a minimum 4%-crown. It should be noted that the site lies within an area of moderate to high potential for wind erosion. The site soils have a fine grained component of their composition. As such, native soil roadways may be subject to disturbed fine particulate matter (PM_{10}) which can create airborne dust if the roadways are not maintained. Daily moisture conditioning during construction will be necessary due to the warm desert climate. Traffic speed should be restricted to 10 mph to reduce the potential for “wash boarding” and further restricted to 5 mph at turns to avoid rutting.

Section 6
LIMITATIONS AND ADDITIONAL SERVICES

6.1 Uniformity of Conditions and Limitations

Our findings and recommendations in this report are based on selected points of field exploration, laboratory testing, and our understanding of the proposed project. Furthermore, our findings and recommendations assume that soil conditions do not vary significantly from those found at specific exploratory locations. Variations in soil or groundwater conditions could exist between and beyond the exploration points. The nature and extent of these variations may not become evident until construction. Variations in soil or groundwater may require additional studies, consultation, and possible revisions to our recommendations.

The planning and construction process is an integral design component with respect to the geotechnical aspects of this project. Because geotechnical engineering is an inexact science due to the variability of natural processes and because we sample only a small portion of the soil and material affecting the performance of the proposed structure, unanticipated or changed conditions can be disclosed during demolition and construction. Proper geotechnical observation and testing during construction is imperative to allow the geotechnical engineer the opportunity to verify assumptions made during the design process and to verify that our geotechnical recommendations have been properly interpreted and implemented during construction. Therefore, we recommend that Earth Systems be retained during the construction of the proposed improvements to observe compliance with the design concepts and geotechnical recommendations, and to allow design changes in the event that subsurface conditions or methods of construction differ from those assumed while completing this investigation. If we are not accorded the privilege of performing this review, we can assume no responsibility for misinterpretation or the applicability of our recommendations. The above services can be provided in accordance with our current Fee Schedule.

Our evaluation of subsurface conditions at the site has considered subgrade soil and groundwater conditions present at the time of our study. The influence(s) of post-construction changes to these conditions such as introduction or removal of water into or from the subsurface will likely influence future performance of the proposed project. It should be recognized that definition and evaluation of subsurface conditions are difficult. Judgments leading to conclusions and recommendations are generally made with incomplete knowledge of the subsurface conditions due to the limitation of data from field studies. The availability and broadening of knowledge and professional standards applicable to engineering services are continually evolving. As such, our services are intended to provide the Client with a source of professional advice, opinions and recommendations based on the information available as applicable to the project location and scope. If the scope of the proposed construction changes from that described in this report, the conclusions and recommendations contained in this report are not considered valid unless the changes are reviewed, and the conclusions of this report are modified or approved in writing by Earth Systems.

Findings of this report are valid as of the issued date of the report. However, changes in conditions of a property can occur with passage of time, whether they are from natural processes or works of man, on this or adjoining properties. In addition, changes in applicable standards

occur, whether they result from legislation or broadening of knowledge. Accordingly, findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of one year.

This report is issued with the understanding that the owner or the owner's representative has the responsibility to bring the information and recommendations contained herein to the attention of the architect and engineers for the project so that they are incorporated into the plans and specifications for the project. The owner or the owner's representative also has the responsibility to verify that the general contractor and all subcontractors follow such recommendations. It is further understood that the owner or the owner's representative is responsible for submittal of this report to the appropriate governing agencies.

Earth Systems has striven to provide our services in accordance with generally accepted geotechnical engineering practices in this locality at this time. No warranty or guarantee, express or implied, is made. This report was prepared for the exclusive use of the Client and the Client's authorized agents.

Earth Systems should be provided the opportunity for a general review of final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications. If Earth Systems is not accorded the privilege of making this recommended review, we can assume no responsibility for misinterpretation or the applicability of our recommendations. The owner or the owner's representative has the responsibility to provide the final plans requiring review to Earth Systems' attention so that we may perform our review.

Any party other than the client who wishes to use this report shall notify Earth Systems of such intended use. Based on the intended use of the report, Earth Systems may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Earth Systems from any liability resulting from the use of this report by any unauthorized party.

In addition, if there are any changes in the field to the plans and specifications, the Client must obtain written approval from Earth Systems' engineer that such changes do not affect our recommendations. Failure to do so will vitiate Earth Systems' recommendations.

Although available through Earth Systems, the current scope of our services does not include an environmental assessment or an investigation for the presence or absence of wetlands, hazardous or toxic materials in the soil, surface water, groundwater, or air on, below, or adjacent to the subject property.

6.2 Additional Services

This report assumes that an adequate program of client consultation, plan review, construction monitoring, and testing will be performed during the final design and construction phases to check compliance with these recommendations. Maintaining Earth Systems as the geotechnical consultant from beginning to end of the project will provide continuity of services.

The geotechnical engineering firm providing tests and observations shall assume the responsibility of Geotechnical Engineer of Record.

Construction monitoring and testing would be additional services provided by our firm. The costs of these services are not included in our present fee arrangements but can be obtained from our office. The recommended review, tests, and observations include, but are not necessarily limited to, the following:

- Consultation during the final design stages of the project;
- Onsite review of exposed condition during stripping.
- A review of the building and grading plans to observe that recommendations of our report have been properly implemented into the design;
- Observation and testing during site preparation, grading, and placement of engineered fill as required by CBC Sections 17 and Appendix J or local grading ordinances;
- Consultation as needed during construction.

-o0o-

Appendices as cited are attached and complete this report.

REFERENCES

Al Atik, L., and Sitar, N., 2010, Seismic Earth Pressures on Cantilever Retaining Structures, Journal of Geotechnical and Geoenvironmental Engineering, ASCE.

American Concrete Institute (ACI), 2015, ACI Manual of Concrete Practice, Parts 1 through 5.

American Concrete Institute (2014) "336.3R-14 Report on Design and Construction of Drilled Piers."

American Concrete Institute (2019) "Building Code Requirements for Structural Concrete (ACI 318-19) and Commentary (ACI 318R-19) and ACI 330R."

American Society of Civil Engineers (ASCE), 2019, Minimum Design Loads and Associates Criteria for Buildings and Other Structures, ASCE/SEI 7-16; including Supplements 1 to 3.

American Society of Civil Engineers, Standard Guidelines for the Design and Installation of Pile Foundations (20-96).

American Society for Testing Materials, 1989, STP 1013, Effects of Soil Characteristics on Corrosion (February 1989).

Boulanger, R. W., and Idriss, I. M., 2006, Liquefaction susceptibility criteria for silts and clays, J. Geotechnical and Geoenvironmental Eng., ASCE 132 (11), 1413-1426.

Bowles, J.E., 1988, Foundation Analysis and Design, Fourth Edition, McGraw-Hill Book Company.

California Department of Water Resources, 2025, Water Data Library Website, http://www.water.ca.gov/waterdatalibrary/.

California Division of Mines and Geology, 1978, Geologic Map of California, Santa Ana Sheet.

California Geological Survey-SP117A, 2008, Guidelines for Evaluating and Mitigating Seismic Hazards in California.

California Geological Survey, 2024, Fault Rupture Hazard Zones in California, Division of Mines and Geology, Special Publication 42.

California Geological Survey, 2025, Earthquake Zones of Required Investigations, Zone Info: 3024012917, https://maps.conservation.ca.gov/EGZApp/app/.

Coduto, D.P., 2000, Foundation Design: Principles and Practices (2nd Edition).

County of Los Angeles, Department of Public Works, 2013, Manual for the Preparation of Geotechnical Report, July 1, 2013.

County of Riverside, 2000, Technical Guidelines for Review of Geotechnical and Geologic Reports, Transportation and Land Management Agency, http://rctlma.org/Portals/4/Handouts/Grading/technical_guide_geotechnical_geologic_reports.pdf.

Day, R.W., 2000, Geotechnical Engineers Portable Handbook, McGraw-Hill Companies.

Dept. of the Navy, 1986, NAVFAC DM 7.01: Soil Mechanics, Naval Facilities Engineering Command, Alexandria, Virginia.

Dept. of the Navy, 1986, NAVFAC DM 7.02: Foundations and Earth Structures, Naval Facilities Engineering Command, Alexandria, Virginia.

Dibblee, Thomas W., 1967, Geologic Map of the Morongo Valley Quadrangle, San Bernardino and Riverside Counties, California, United States Geological Survey Miscellaneous Geologic Investigations Map I-517.

Ellsworth, W.L., 1990, "Earthquake History, 1769-1989" in: The San Andreas Fault System, California: U.S. Geological Survey Professional Paper 1515, 283 p.

FEMA, 2024, Map Service Center website http:// *msc.fema.gov/.*

Federal Highway Administration (FHWA), 2010, Drilled Shafts: Construction Procedures and LRFD Design Methods, May 2010, Publication No. FHWA-NHI-10-016.

Field, E.H., Biasi, G.P., Bird, P., Dawson, T.E., Felzer, K.R.10.ckson, D.D., Johnson, K.M., Jordan, T.H., Madden, C., Michael, A.J., Milner, K.R., Page, M.T., Parsons, T., Powers, P.M., Shaw, B.E., Thatcher, W.R., Weldon, R.J., II, and Zeng, Y., 2013, Uniform California earthquake rupture forecast, version 3 (UCERF3)—The time-independent model: U.S. Geological Survey Open-File Report 2013–1165, 97 p., California Geological Survey Special Report 228, and Southern California Earthquake Center Publication 1792, http://pubs.usgs.gov/of/2013/1165/.

Google Images; 2025; "Pioneertown"; Select Years from 1999 to 2023.

Hunt, Roy E., 1984, Geotechnical Engineering Practice, McGraw-Hill Book Company.

International Code Council ICC], 2022, California Building Code, 2022 Edition.

Jennings, C.W, 2010, Fault Activity Map of California and Adjacent Areas: California Division of Mines and Geology, Geological Data Map No. 6, scale 1:750,000.

Lommler, C. J. and Bandini, P. 2015, Characterization of Collapsible Soils, International Foundations Congress and Equipment Expo (IFCEE) 2015 ASCE 2015.

Mikola, R.G. and Sitar, N., 2013, Seismic Earth Pressures on Retaining Structures in Cohesionless Soils, University California Berkeley, Report No. UCB GT 13-01.

Occupational Safety and Health Standards – Excavations, Final Pub. 1989.

Scharer, Katherine M, and Yule, Doug, 2020, Geophysical Research Letter, A Maximum Rupture Model for the Southern San Andreas and San Jacinto Faults, California, Derived From Paleoseismic Earthquake Ages: Observations and Limitations, Volume 47, Issue 15.

Sneed, Michelle, et al, 2014, Land Subsidence, Groundwater Levels, and Geology in the Coachella Valley, California, United States Geological Survey, Scientific Investigations Report 2014-5075.

Sneed, Michelle, et al, 2020, Detection and Measurement of Land Subsidence and Uplift Using Global Positioning Systems Surveys and Interferometric Synthetic Aperture Radar, Coachella Valley, California, United States Geological Survey, Scientific Investigations Report 2020-5093.

Southern California Earthquake Center (S.C.E.C.), 1999, Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California: available at web site: http://www.scecdc.scec.org.

Southern California Earthquake Center, 2002, Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California.

Structural Engineers Association of California (SEAOC)/California's Office of Statewide Health Planning and Development (OSHPD), 2025, U.S. Seismic Design Maps Website, https://seismicmaps.org/.

The County of San Bernardino Areawide Stormwater Program, 2013, Technical Guidance Document for Water Quality Management Plans, CDM Smith Inc., NPDES No. CAS618036, Order No. R8-2010-0036, Effective Date: September 19, 2013.

Tokimatsu, K, and Seed, H.B., 1987, Evaluation of Settlements in Sands Due To Earthquake Shaking, ASCE, Journal of Geotechnical Engineering, Vol. 113, No. 8, August 1987.

United States Geological Survey, 2008, Documentation for the 2008 Update of the United States National Seismic Hazard Maps: U.S. Geological Survey Open-File Report 2008–1128, 61 p.

United States Geological Survey, 2025, Unified Hazards Tool, http://earthquake.usgs.gov/hazards/interactive.

Wallace, R. E., 1990, the San Andreas Fault System, California: U.S. Geological Survey Professional Paper 1515, 283 p.

Yazdi, J.S., and Yazid, R.E.S., 2016, Nonparametric Liquefaction Triggering and Postliquefaction Deformations, Journal of Geechnical and Geoenvironmental Engineering, Vol 143, No. 3, September 2016.

Youd, T.L., and Idriss, I.M., 2001, Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 127, No. 10, October 2001.

Youd, T.L., and Garris, C.T., 1995, Liquefaction-Induced Ground-Surface Disruption, Journal of Geotechnical Engineering, Vol. 121, No. 11, November 1995.

Youd, T.L., Hansen, C.M., and Bartlett, S.F., 2002, Revised Multilinear Regression Equations for Prediction of Lateral Spread Displacement, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 128, No. 12, December 2002.

Aerial Photographs:

Google Earth: 1997-2023

APPENDIX A

Plate 1 – Site Vicinity Map
Plate 2a & 2b – Exploration Location Map
Plate 3 – Regional Geologic Map
Plate 4 – Local Geologic Map
Plates 5a & 5b – Site Geologic Map & Civil Site Plan
Table A-1 – Fault Parameters
Table A-2 – Historic Earthquakes
Terms and Symbols Used on Boring Logs
Soil Classification System
Logs of Geotechnical Borings (12 pages)



Reference: Google Earth satellite image with USGS topographic map overlay image.

LEGEND

Approximate Site Location

Scale: 1" = 1 Mile

0 1 Mile 2 Miles

N

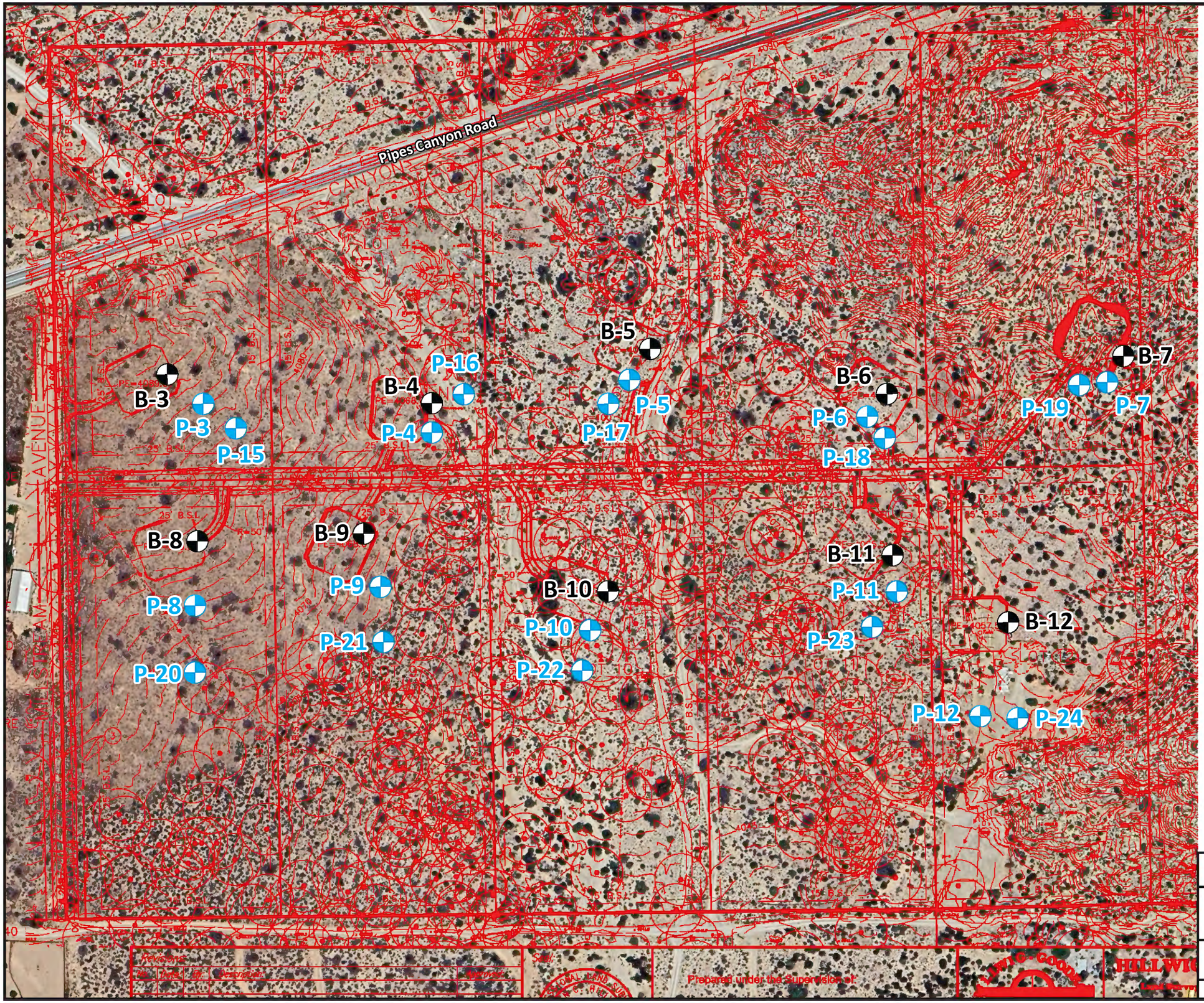
Plate 1
Site Vicinity Map

Proposed Subdivision Project
Pipes Canyon Road
Pioneertown, San Bernardino County, California

Earth Systems

7/21/2025

File No.: 307129-001



LEGEND

B-12 Approximate Exploration Locations

P-24 Approximate Percolation Test Locations

N

Approximate Scale: 1" = 150’

0 150’ 300’

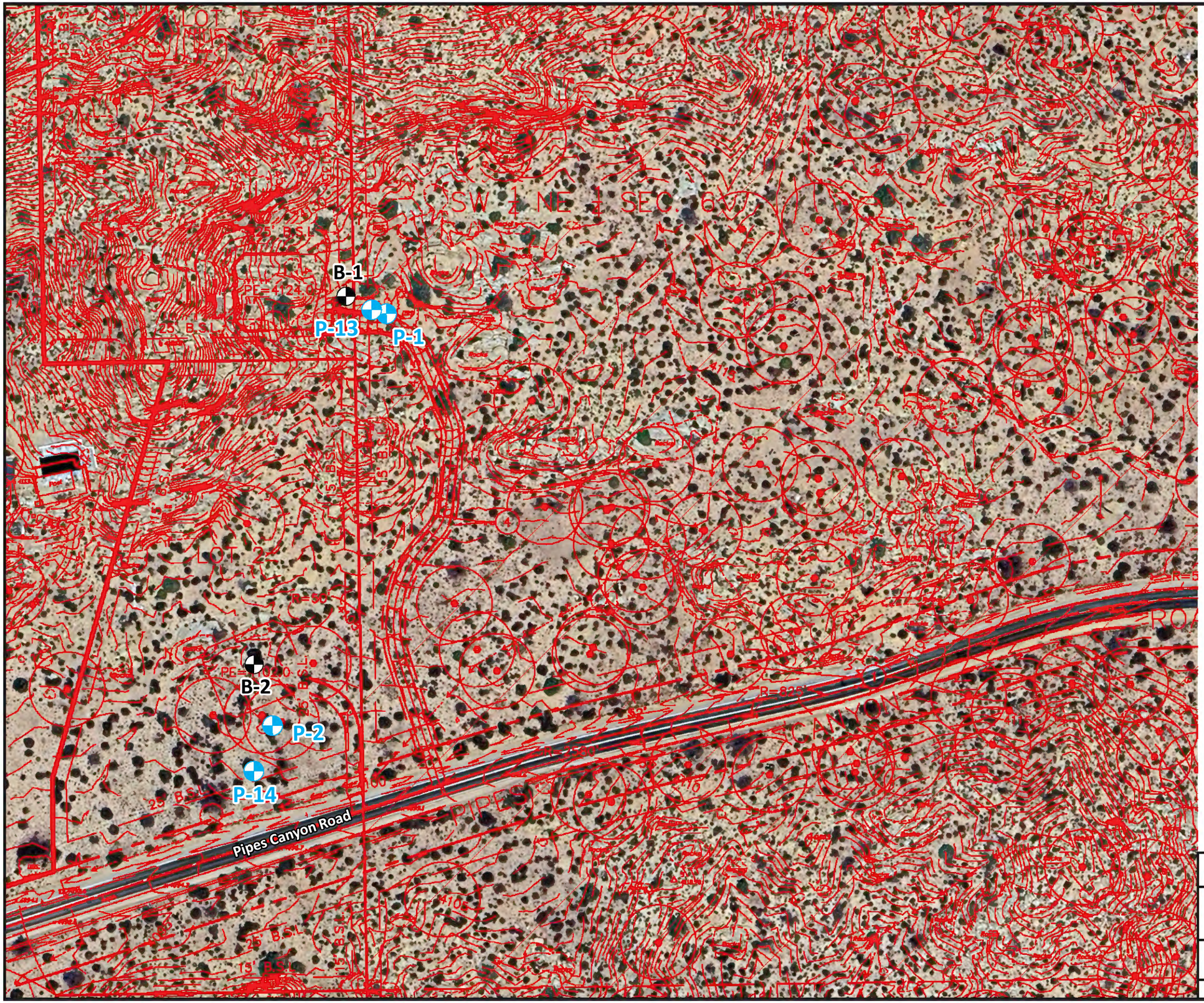
Source: Google Earth satellite image dated 5/29/2023 with Tentative Tract Map No. 20612 Sheet 2 overlay.

Plate 2a
Exploration Location Map

Proposed Subdivision Project
Pipes Canyon Road
Pioneertown, San Bernardino County, California

Earth Systems

7/21/2025 | File No.: 307129-001



LEGEND

B-12 Approximate Exploration Locations

P-24 Approximate Percolation Test Locations

N

Approximate Scale: 1" = 150’

0 150’ 300’

Source: Google Earth satellite image dated 5/29/2023 with Tentative Tract Map No. 20612 Sheet 3 overlay.

Plate 2b
Exploration Location Map

Proposed Subdivision Project
Pipes Canyon Road
Pioneertown, San Bernardino County, California

Earth Systems

7/21/2025 | File No.: 307129-001



LEGEND

Qs	Dune sand	Qc	Oligocene nonmarine
Qal	Alluvium	Ec	Eocene nonmarine
Ql	Lake deposits	E	Eocene marine
Qg	Glacial deposits	Ep	Paleocene marine
Qr	River terrace deposits	Tc	Tertiary nonmarine
Qm	Pleistocene marine and marine terrace deposits	Tm	Tertiary marine
Qpv	Pleistocene volcanic rocks Qpv^r-rhyolite Qpv^a-andesite Qpv^b-basalt Qpv^p-pyroclastic rocks	Ti	Tertiary intrusive (hypabyssal) rocks Ti^r-rhyolite Ti^a-andesite Ti^b-basalt
Qc	Pleistocene nonmarine	Tl	Tertiary lake deposits
QP	Plio-Pleistocene nonmarine	Tv	Tertiary volcanic rocks Tv^r-rhyolite Tv^a-andesite Tv^b-basalt Tv^p-pyroclastic rocks
	Quaternary and/or Pliocene cinder cones	Ku	Upper Cretaceous marine
Pc	Undivided Pliocene nonmarine	Ju	Upper Jurasssic marine
Pu	Upper Pliocene marine	gr	Mesozoic granitic rocks
Pmlc	Middle and/or lower Pliocene nonmarine	bi	Mesozoic basic intrusive rocks
Pml	Middle and/or lower Pliocene marine		Mesozoic ultrabasic intrusive rocks
Pv	Pliocene volcanic rocks Pv^r-rhyolite Pv^a-andesite Pv^b-basalt Pv^p-pyroclastic rocks	JTrv	Jurassic-Triassic metavolcanic rocks
Mc	Undivided Miocene nonmarine	ls	Pre-Cretaceous metamorphic rocks (ls=limestone)
Mu	Upper Miocene nonmarine	ms	Pre-Cretaceous metasedimentary rocks
Mu	Upper Miocene marine	mv	Pre-Cretaceous metavolcanic rocks
Mm	Middle Miocene marine	gr-m	Pre-Cenozoic granitic and metamorphic rocks
Ml	Lower Miocene marine	pC	Precambrian igneous and metamorphic rock complex
Mv	Miocene volcanic rocks Mv^r-rhyolite Mv^a-andesite Mv^b-basalt Mv^p-pyroclastic rocks	pC	Undivided Precambrian metamorphic rocks pCg=gneiss pCs=schist pCls=limestone and/or dolomite
		pCgr	Undivided Precambrian granitic rocks

– Fault: Dashed where approximate, dotted where concealed

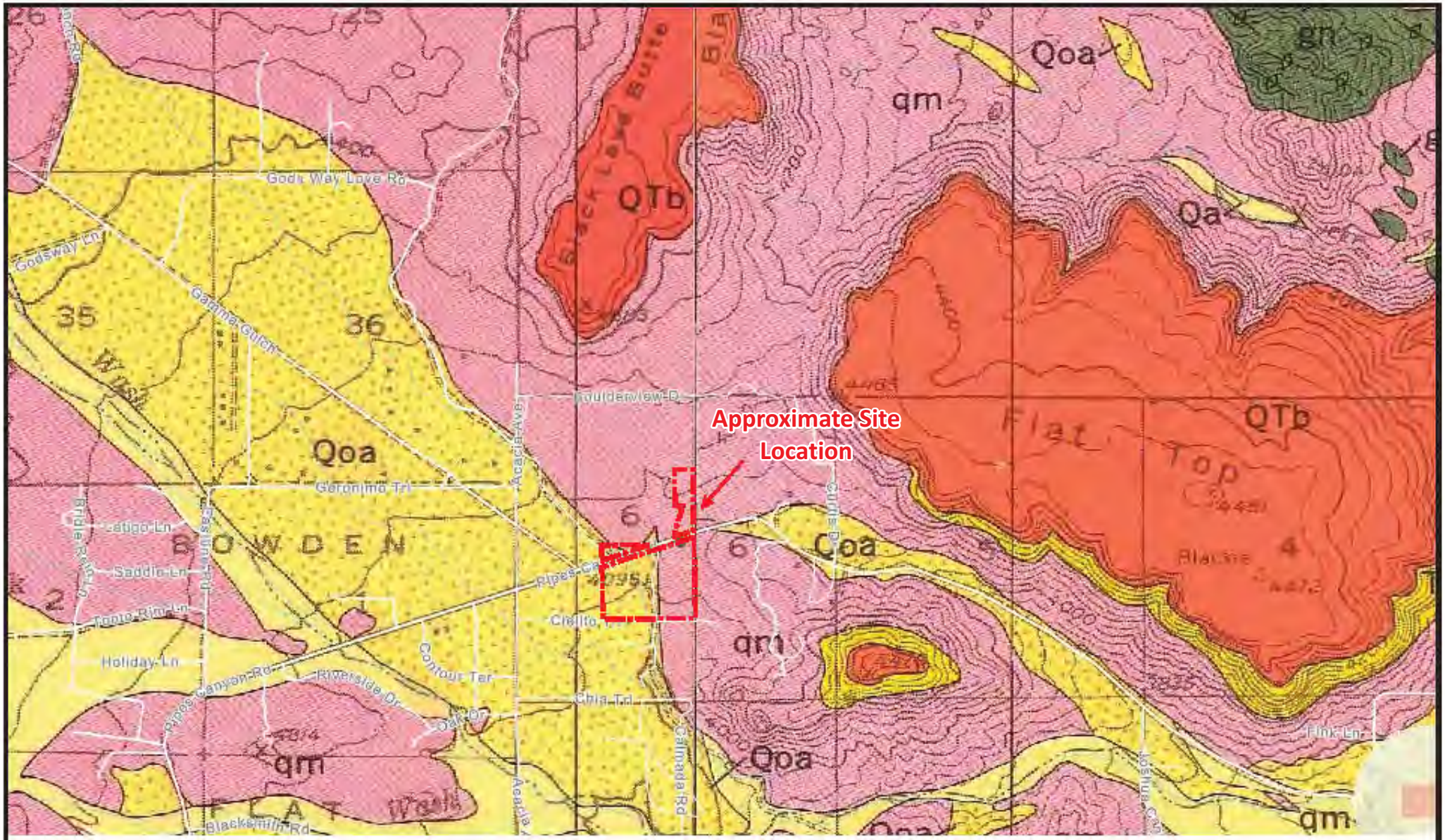
Source: USGS Geologic Map of California, Santa Ana sheet, dated 1965

Plate 3
Regional Geologic Map

Proposed Subdivision Project
Pipes Canyon Road
Pioneertown, San Bernardino County, California

Earth Systems

7/21/2025 | File No.: 307129-001



LEGEND

- **Qa** – Quaternary Younger Alluvium
- **Qoa** – Quaternary Older Alluvium
- **QTb** – Tertiary/Quaternary Basalt
- **To** – Tertiary Old Woman Sandstone
- **qm** – Mesozoic Quartz Monzonite
- **gn** – Precambrian Gneiss

Source: Dibble, T.W., 1967, USGS Misc Geologic Investigations Map I-517

N

Plate 4
Local Geologic Map

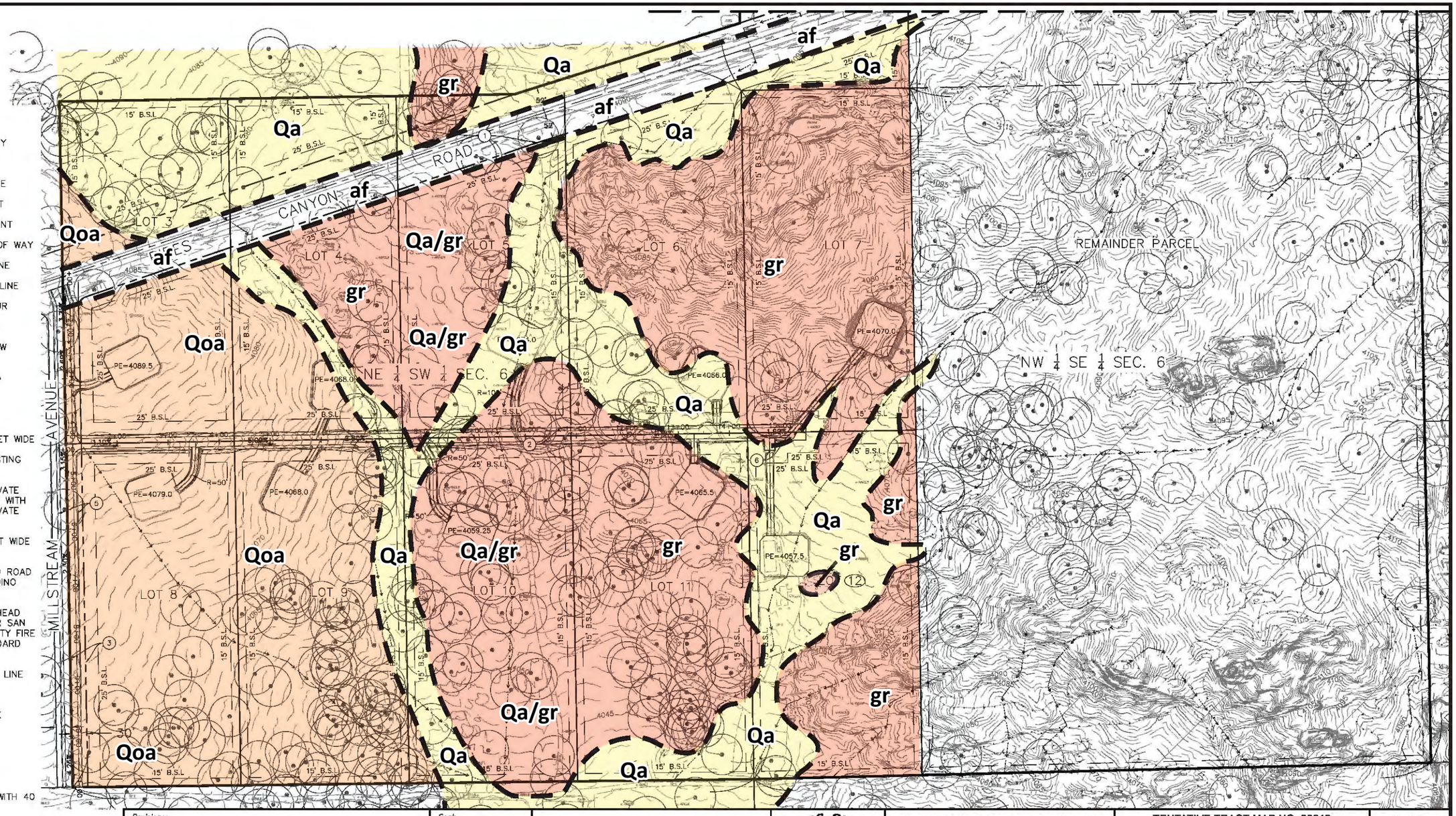
Proposed Subdivision Project
Pipes Canyon Road
Pioneertown, San Bernardino County, California

Earth Systems

7/21/2025

File No.: 307129-001

- DRIVEWAYS SHOWN ARE 12' WIDE
- BUILDING PADS AND DRIVEWAYS ARE SHOWN TO INDICATE FEASIBILITYMENT AND ARE NOT INTENDED TO BE A PART OF IMPROVEMENTS PERFORMED AS A PART OF THIS TRACT MAP.



LEGEND

- PROJECT BOUNDARY
- EXISTING LOT LINE
- PROPOSED LOT LINE
- EXISTING EASEMENT
- PROPOSED EASEMENT
- PROPOSED RIGHT OF WAY
- EXISTING CENTERLINE
- PROPOSED CENTERLINE
- PROPOSED CONTOUR
- EXISTING CONTOUR
- WATERCOURSE FLOW
- AREA ZONED RL-5
- AREA ZONED RC

① PROPOSED 104 FEET WIDE R.O.W. DEDICATION, CENTERED ON EXISTING IMPROVEMENTS

② 32 FEET WIDE PRIVATE ACCESS EASEMENT WITH 20 FEET WIDE PRIVATE GRADED ROAD

③ PROPOSED 30 FEET WIDE R.O.W. DEDICATION

⑤ PROPOSED GRADED ROAD PER SAN BERNARDINO COUNTY STD 114

⑥ MODIFIED HAMMERHEAD TURN AROUND PER SAN BERNARDINO COUNTY FIRE PREVENTION STANDARD DIAGRAM A-1.12

B.S.L. BUILDING SETBACK LINE
PM PARCEL MAP
P.M.B. PARCEL MAP BOOK
PROP. PROPOSED
ROW RIGHT OF WAY
SEC. SECTION
REGULATED TREE WITH 40 FT. RADIUS

100 0 50 100 200 400
1 inch = 100 ft.

Revisions:				
No.	Date:	By:	Description:	Approved:

Designed: | Drawn: | Checked: ACH

Seal: PROFESSIONAL LAND SURVEYOR ALAN C. HILLWIG No. 5137 EXP. 6-30-25 STATE OF CALIFORNIA

Prepared under the Supervision of:

PROFESSIONAL LAND SURVEYOR LICENSE NO. 5137 DATE

HILLWIG - GOODROW, INC.
Land Surveying - GPS Surveys - Aerial Mapping
31419 Outer Highway 10, Suite 1-200• Redlands, CA 92373 • (909) 794-2673

Scale: 1" = 100'
BENCHMARK: SEE BENCHMARK NOTE ON SHEET 1
Date: September 13, 2024
F.N. | For: | F.B.

TENTATIVE TRACT MAP NO. 20612
ACCESS AND PAD FEASABILITY EXHIBIT
PIPES CANYON ROAD, PIONEERTOWN

PREPARED FOR:
JONATHAN SHOKRIAN
53252 PIPES CANYON ROAD
PIONEERTOWN, CA 92268

Sheet No. 2 OF 3 SHEET
FILE NO. 0972-002

Source: Tentative Tract Map No. 20612 Sheet 2.

LEGEND

Qa – Quaternary younger alluvial deposits (fan, stream channel, alluvium, and terrace)
Qoa – Quaternary older alluvium
Qa/gr – Areas where thin deposits of soil and grus overlie shallow bedrock.
gr – Pre Tertiary intrusive igneous rocks (quartz monzonite)

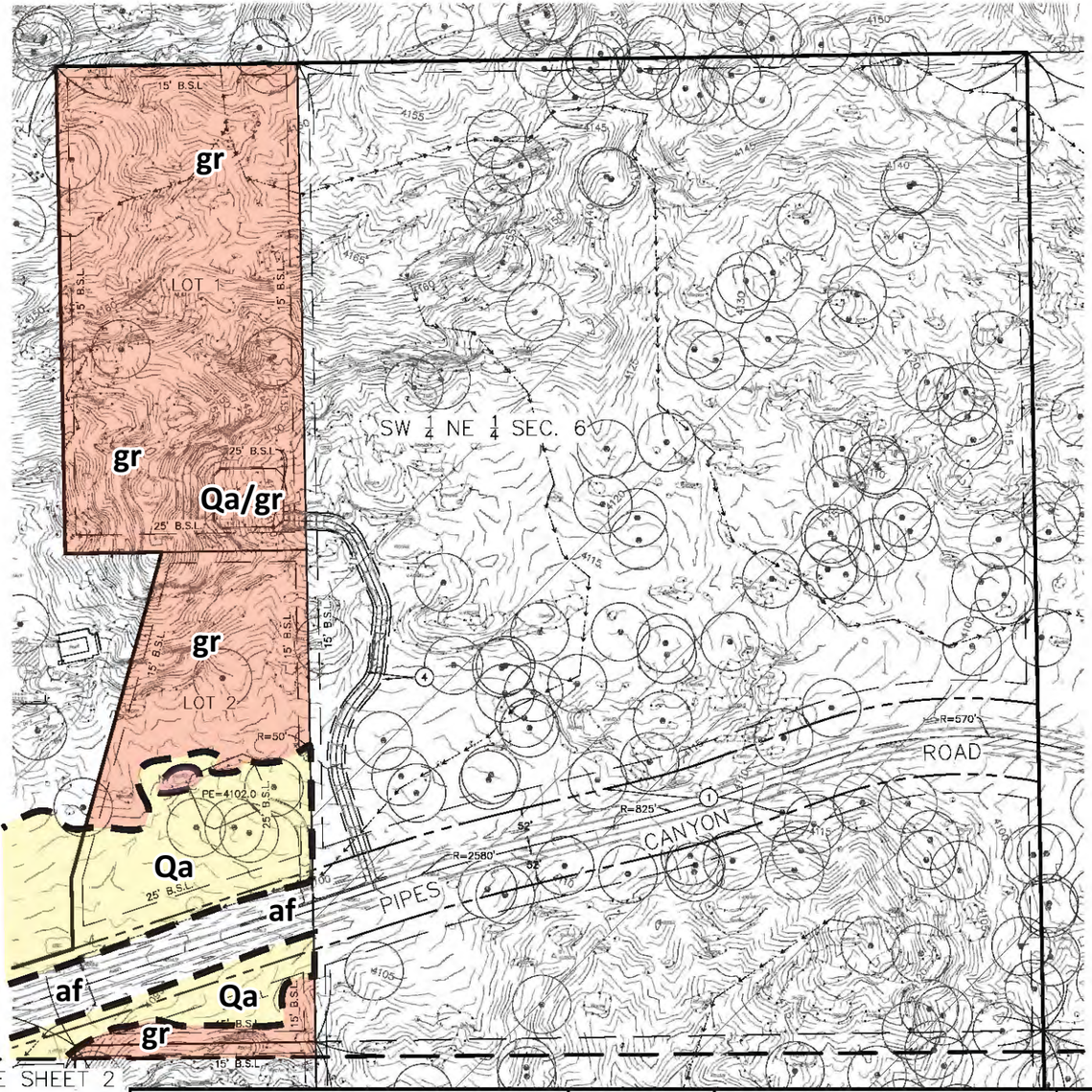
Plate 5a
Site Geologic Map & Civil Site Plan

Proposed Subdivision Project
Pipes Canyon Road
Pioneertown, San Bernardino County, California

Earth Systems

7/21/2025 | File No.: 307129-001

- DRIVEWAYS SHOWN ARE 12' WIDE
- BUILDING PADS AND DRIVEWAYS ARE SHOWN TO INDICATE FEASIBILITYMENT AND ARE NOT INTENDED TO BE A PART OF IMPROVEMENTS PERFORMED AS A PART OF THIS TRACT MAP.



LEGEND

	PROJECT BOUNDARY
	EXISTING LOT LINE
	PROPOSED LOT LINE
	EXISTING EASEMENT
	PROPOSED EASEMENT
	PROPOSED RIGHT OF WAY
	EXISTING CENTERLINE
	PROPOSED CENTERLINE
	PROPOSED CONTOUR
	EXISTING CONTOUR
	WATERCOURSE FLOW
	AREA ZONED RL-5
	AREA ZONED RC
①	PROPOSED 104 FEET WIDE R.O.W. DEDICATION, CENTERED ON EXISTING IMPROVEMENTS
④	PROPOSED 24 FEET WIDE DRIVEWAY EASEMENT
B.S.L.	BUILDING SETBACK LINE
PM	PARCEL MAP
P.M.B.	PARCEL MAP BOOK
PROP.	PROPOSED
ROW	RIGHT OF WAY
SEC.	SECTION
◎	REGULATED TREE WITH 40 FT. RADIUS

150 0 75 150 300 600
1 inch = 150 ft.

Revisions:

No.	Date:	By:	Description:	Approved:

Designed: | Drawn: | Checked: ACH

Seal: PROFESSIONAL LAND SURVEYOR ALAN C. HILLWIG No. 5137 EXP. 6-30-25 STATE OF CALIFORNIA

Prepared under the Supervision of:

PROFESSIONAL LAND SURVEYOR LICENSE NO. 5137 | DATE

HILLWIG - GOODROW, INC.
Land Surveying - GPS Surveys - Aerial Mapping
31419 Outer Highway 10, Suite 1-200• Redlands, CA 92373 • (909) 794-2673

Scale: 1" = 100' | BENCHMARK: SEE BENCHMARK NOTE ON SHEET 1
Date: September 13, 2024 | F.N. | For: | F.B.

TENTATIVE TRACT MAP NO. 20612
ACCESS AND PAD FEASABILITY EXHIBIT
PIPES CANYON ROAD, PIONEERTOWN

PREPARED FOR:
JONATHAN SHOKRIAN
53252 PIPES CANYON ROAD
PIONEERTOWN, CA 92268

Sheet No. 3 OF 3 SHEET
FILE NO. 0972-002

Source: Tentative Tract Map No. 20612 Sheet 3.

LEGEND

Qa – Quaternary younger alluvial deposits (fan, stream channel, alluvium, and terrace)
Qa/gr – Areas where thin deposits of soil and grus overlie shallow bedrock.
gr – Pre Tertiary intrusive igneous rocks (quartz monzonite)

Plate 5b
Site Geologic Map & Civil Site Plan

Proposed Subdivision Project
Pipes Canyon Road
Pioneertown, San Bernardino County, California

Earth Systems

7/21/2025 | File No.: 307129-001

Table A-1
Fault Parameters

Fault Section Name	Distance (miles)	Distance (km)	Upper Seis. Depth (km)	Lower Seis. Depth (km)	Avg Dip Angle (deg.)	Avg Dip Direction (deg.)	Avg Rake (deg.)	Trace Length (km)	Fault Type	**Mean Mag**	Mean Return Interval (years)	Slip Rate (mm/yr)
Johnson Valley (No) 2011 rev FM3.1, 3.2	3.7	5.9	0.0	15.9	90	51	180	52	B	**6.8**		0.6
Pinto Mtn FM3.1, 3.2	5.8	9.3	0.0	15.5	90	175	0	74	B	**7.2**		2.5
Burnt Mtn FM3.1, 3.2	7.5	12.0	0.0	15.9	67	265	180	21	B	**6.7**		0.6
North Frontal (East) FM3.1, 3.2	7.7	12.4	0.0	16.6	41	187	90	28	B	**6.9**		0.5
Kickapoo FM3.1, 3.2	7.9	12.7	0.0	15.1	90	na	na	6	B'	**6.1**		
Homestead Valley FM3.1, 3.2	8.1	13.0	0.0	15.9	90	na	na	46	B'	**7.0**		
Eureka Peak FM3.1, 3.2	8.2	13.1	0.0	15.0	90	75	180	19	B	**6.6**		0.6
Emerson-Copper Mtn FM3.1, 3.2	13.0	20.8	0.0	14.1	90	51	180	54	B	**7.0**		0.6
Lenwood-Lockhart-Old Woman Springs FM3.1,	13.1	21.0	0.0	13.2	90	43	180	145	B	**7.5**		0.9
San Andreas, (North Branch, Mill Creek) FM3.1,	14.0	22.6	0.0	18.2	76	204	180	106	A	**7.6**	219	34
Joshua Tree (Seismicity) FM3.1, 3.2	14.2	22.8	0.0	13.3	90	271	na	17	B'	**6.5**		
Mission Creek FM3.1, 3.2	14.2	22.9	0.0	17.7	65	5	180	31	B'	**6.9**		
Calico-Hidalgo FM3.1, 3.2	17.0	27.4	0.0	13.9	90	52	180	117	B	**7.4**		1.8
Helendale-So Lockhart FM3.1, 3.2	19.8	31.9	0.0	12.8	90	51	180	114	B	**7.4**		0.6
San Andreas (San Gorgonio Pass-Garnet HIll) FM	20.6	33.2	0.0	12.8	58	20	180	56	A	**7.6**	219	24
Pisgah-Bullion Mtn-Mesquite Lk FM3.1, 3.2	22.5	36.2	0.0	13.1	90	60	180	91	B	**7.3**		0.8
North Frontal (West) FM3.1, 3.2	23.1	37.2	0.0	15.7	49	171	90	50	B	**7.2**		1
San Gorgonio Pass FM3.1, 3.2	24.1	38.7	0.0	18.5	60	11	na	29	B'	**6.9**		
Hector Mine FM3.1, 3.2	24.4	39.3	0.0	14.6	90	246	na	28	B'	**6.7**		
Blue Cut FM3.1, 3.2	24.4	39.3	0.0	13.1	90	177	na	79	B'	**7.1**		
San Andreas (San Bernardino S) FM3.1, 3.2	24.7	39.7	0.0	12.8	90	210	180	43	A	**7.6**	150	29
Camp Rock FM3.1, 3.2	26.7	43.0	0.0	15.1	90	na	na	45	B'	**6.9**		
Bullion Mountains FM3.1, 3.2	27.5	44.3	0.0	13.0	90	na	na	38	B'	**6.8**		
San Andreas (Coachella) rev FM3.1, 3.2	32.0	51.5	0.0	11.1	90	224	180	69	A	**6.8**	89	9
Cleghorn Pass FM3.1, 3.2	33.5	53.9	0.0	13.0	90	na	na	20	B'	**6.5**		
San Jacinto (San Jacinto Valley, stepover)	37.0	59.6	0.0	16.1	90	224	180	24	A	**7.6**	219	9
Ludlow FM3.1, 3.2	38.4	61.7	0.0	11.1	90	239	na	70	B'	**7.0**		
Cleghorn Lake FM3.1, 3.2	38.5	62.0	0.0	13.0	90	na	na	29	B'	**6.7**		
San Jacinto (San Jacinto Valley) rev FM3.1, 3.2	39.4	63.4	0.0	16.1	90	223	180	18	A	**7.6**	219	18
San Jacinto (Stepovers Combined) FM3.1, 3.2	39.5	63.6	0.0	16.5	90	229	180	25	A	**7.5**	110	4
San Jacinto (Anza) rev FM3.1, 3.2	40.0	64.3	0.0	16.8	90	216	180	46	A	**7.6**	219	17
Cleghorn FM3.1, 3.2	40.5	65.2	0.0	15.5	90	187	0	25	B	**6.7**		3
San Andreas (San Bernardino N) FM3.1, 3.2	41.3	66.5	0.0	12.8	90	212	180	35	A	**7.5**	103	27
Sheephole FM3.1, 3.2	43.6	70.2	0.0	13.0	90	na	na	15	B'	**6.4**		
San Jacinto (San Bernardino) FM3.1, 3.2	43.9	70.7	0.0	16.1	90	225	180	37	A	**7.6**	219	17
San Jacinto (Lytle Creek connector) FM3.1, 3.2	47.5	76.5	0.0	16.1	90	na	na	23	B'	**6.7**		
Cady FM3.1, 3.2	47.9	77.0	0.0	13.9	90	182	na	19	B'	**6.5**		
San Jacinto (Clark) rev FM3.1, 3.2	49.1	79.0	0.0	16.8	90	214	180	47	A	**7.6**	219	17
San Jacinto (Coyote Creek) FM3.1, 3.2	50.6	81.4	0.0	15.9	90	223	180	43	A	**7.6**	219	17
Fontana (Seismicity) FM3.1, 3.2	52.0	83.6	0.0	16.3	80	313	na	24	B'	**6.7**		

Reference: USGS OFR 2013-1165 (CGS SP 228) Based on Site Coordinates of 34.20072 Latitude, -116.50162 Longitude

Mean Magnitude for Type A Faults based on 0.1 weight for unsegmented section, 0.9 weight for segmented model (weighted by probability of each scenario with section listed as given on Table 3 of Appendix G in OFR 2008-1437). Mean magntude is average of Ellworths-B and Hanks & Bakun moment area relationship.

Site Coordinates: 34.201 N 116.502 W

Table A-2

Historical Earthquakes in Vicinity of Project Site, M >= 5.0

Day	Year	Epicenter Latittude (Degrees)	Epicenter Longitude (Degrees)	Distance from Site (mi)	Magnitude M_W
6/28	1992	34.20	116.44	3.5	**7.3**
6/28	1992	34.12	116.43	6.9	**5.5**
6/28	1992	34.13	116.41	7.2	**5.8**
6/28	1992	34.10	116.42	8.4	**5.0**
6/29	1992	34.10	116.40	9.1	**5.7**
7/1	1992	34.33	116.46	9.2	**5.3**
6/29	1992	34.10	116.39	9.4	**5.4**
3/15	1979	34.33	116.44	9.6	**5.5**
6/28	1992	34.34	116.51	9.6	**5.4**
6/28	1992	34.06	116.47	9.9	**5.0**
7/25	1947	34.05	116.42	11.4	**5.2**
6/28	1992	34.12	116.32	11.8	**5.7**
7/24	1947	34.02	116.48	12.5	**5.3**
9/15	1992	34.06	116.36	12.6	**5.2**
2/7	1889	34.10	116.70	13.3	**5.6**
5/18	1940	34.08	116.30	14.2	**5.3**
7/8	1986	34.00	116.61	15.2	**6.0**
5/18	1940	34.05	116.30	15.5	**5.2**
8/21	1993	34.03	116.32	15.7	**5.0**
6/30	1992	34.00	116.36	16.1	**5.1**
6/12	1944	34.01	116.69	17.0	**5.2**
12/16	1988	33.98	116.68	18.3	**5.0**
6/12	1944	34.00	116.72	18.7	**5.1**
6/28	1992	34.20	116.83	18.8	**6.5**
7/9	1992	34.24	116.84	19.5	**5.3**
4/23	1992	33.96	116.32	19.6	**6.2**
6/28	1992	34.16	116.85	20.1	**5.5**
8/17	1992	34.20	116.86	20.5	**5.2**
12/4	1948	34.00	116.23	20.8	**6.0**
2/22	2003	34.31	116.85	21.3	**5.2**
6/1	1975	34.51	116.49	21.4	**5.3**
10/16	1999	34.44	116.25	21.9	**5.4**
1/16	1930	34.20	116.90	22.8	**5.5**
6/28	1992	34.26	116.91	23.7	**5.3**
1/16	1930	34.18	116.92	23.9	**5.1**
11/27	1992	34.34	116.90	24.7	**5.3**
8/29	1943	34.31	116.93	25.6	**5.3**
12/4	1992	34.37	116.90	25.6	**5.2**
2/10	2001	34.29	116.95	26.3	**5.1**
6/29	1992	33.87	116.27	26.4	**5.5**

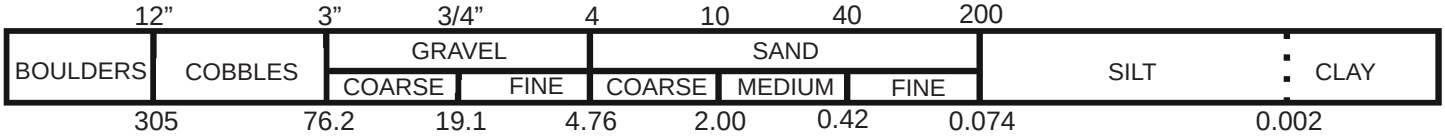
From full earthquake catalog in USGS OFR 2008-1437h as updated with current events through 2021. For events with an asterisk, alternate solutions are given in the OFR. Ordered By Closest Event. Maximum 40 Closest Events Shown.

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on ASTM Designations D 2487 and D 2488 (Unified Soil Classification System). Information on each boring log is a compilation of subsurface conditions obtained from the field as well as from laboratory testing of selected samples. The indicated boundaries between strata on the boring logs are approximate only and may be transitional.

SOIL GRAIN SIZE

U.S. STANDARD SIEVE



SOIL GRAIN SIZE IN MILLIMETERS

RELATIVE DENSITY OF GRANULAR SOILS (GRAVELS, SANDS, AND NON-PLASTIC SILTS)

Very Loose	*N=0-4	RD=0-30	Easily push a 1/2-inch reinforcing rod by hand
Loose	N=5-10	RD=30-50	Push a 1/2-inch reinforcing rod by hand
Medium Dense	N=11-30	RD=50-70	Easily drive a 1/2-inch reinforcing rod with hammer
Dense	N=31-50	RD=70-90	Drive a 1/2-inch reinforcing rod 1 foot with difficulty by a hammer
Very Dense	N>50	RD=90-100	Drive a 1/2-inch reinforcing rod a few inches with hammer

*N=Blows per foot in the Standard Penetration Test at 60% theoretical energy. For the 3-inch diameter Modified California sampler,140-pound weight, multiply the blow count by 0.63 (about 2/3) to estimate N. If automatic hammer is used, multiply a factor of 1.3 to 1.5 to estimate N. RD=Relative Density (%). C=Undrained shear strength (cohesion).

CONSISTENCY OF COHESIVE SOILS (CLAY OR CLAYEY SOILS)

Very Soft	*N=0-1	*C=0-250 psf	Squeezes between fingers
Soft	N=2-4	C=250-500 psf	Easily molded by finger pressure
Firm	N=5-8	C=500-1000 psf	Molded by strong finger pressure
Stiff	N=9-15	C=1000-2000 psf	Dented by strong finger pressure
Very Stiff	N=16-30	C=2000-4000 psf	Dented slightly by finger pressure
Hard	N>30	C>4000	Dented slightly by a pencil point or thumbnail

MOISTURE DENSITY

Moisture Condition: An observational term; dry, damp, moist, wet, saturated.
Moisture Content: The weight of water in a sample divided by the weight of dry soil in the soil sample expressed as a percentage.
Dry Density: The pounds of dry soil in a cubic foot.

MOISTURE CONDITION

Dry.....Absence of moisture, dusty, dry to the touch
Damp.....Slight indication of moisture
Slightly Moist.....Very quick (less than 1 minute) color change when exposed to air (granular soil), Below optimum (granular)
Moist.....Color change with period of air exposure (granular soil) Below optimum moisture content (cohesive soil)
Very Moist.....High degree of saturation by visual and touch (granular soil) Above optimum moisture content (cohesive soil), No free water
Wet.....Free surface water

PLASTICITY

DESCRIPTION	FIELD TEST
Nonplastic	A 1/8 in. (3-mm) thread cannot be rolled at any moisture content.
Low	The thread can barely be rolled.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit.
High	The thread can be rerolled several times after reaching the plastic limit.

GROUNDWATER LEVEL

Water Level (measured or after drilling)

Water Level (during drilling)

RELATIVE PROPORTIONS

Trace.....minor amount (<5%)
some.....significant amount
with.....(Typically greater than 15%)
modifier/and...sufficient amount to influence material behavior (Typically >30%)

LOG KEY SYMBOLS

Bulk, Bag or Grab Sample

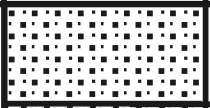
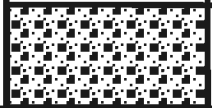
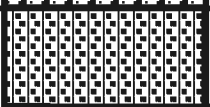
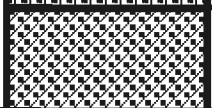
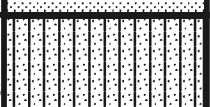
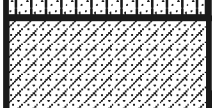
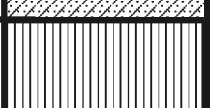
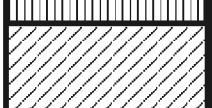
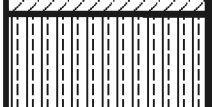
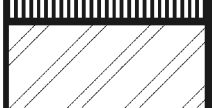
Standard Penetration Split Spoon Sampler (2” outside diameter)

Modified California Sampler (3” outside diameter)

No Recovery

Terms and Symbols Used on Boring Logs

Earth Systems

MAJOR DIVISIONS			GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS More than 50% of material is larger than No. 200 sieve size	GRAVEL AND GRAVELLY SOILS More than 50% of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS		GW	Well-graded gravels, gravel-sand mixtures, little or no fines
				GP	Poorly-graded gravels, gravel-sand mixtures. Little or no fines
		GRAVELS WITH FINES		GM	Silty gravels, gravel-sand-silt mixtures
				GC	Clayey gravels, gravel-sand-clay mixtures
	SAND AND SANDY SOILS More than 50% of coarse fraction passing No. 4 sieve	CLEAN SAND (Little or no fines)		SW	Well-graded sands, gravelly sands, little or no fines
				SP	Poorly-graded sands, gravelly sands, little or no fines
		SAND WITH FINES (appreciable amount of fines)		SM	Silty sands, sand-silt mixtures
				SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS More than 50% of material is smaller than No. 200 sieve size	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	Inorganic silts and very fine sands, rock flour, silty low clayey fine sands or clayey silts with slight plasticity
				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
				OL	Organic silts and organic silty clays of low plasticity
		LIQUID LIMIT GREATER THAN 50		MH	Inorganic silty, micaceous, or diatomaceous fine sand or silty soils
				CH	Inorganic clays of high plasticity, fat clays
				OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS				PT	Peat, humus, swamp soils with high organic contents
VARIOUS SOILS AND MAN MADE MATERIALS					Fill Materials
MAN MADE MATERIALS					Asphalt and concrete

Soil Classification System

Earth Systems

Earth Systems

1680 Illinois Ave., Perris, CA 92571
Phone (951) 928-9799, Fax (951) 928-9948

Boring No. B-1
Project Name: Proposed Subdivision Project
Project Number: 307129-001
Boring Location: See Plate 2

Drilling Date: June 5, 2025
Drilling Method: LAR w/auto hammer
Drill Type: 8" HSA
Logged By: JG

Depth (Ft.)	Sample Type (Bulk / BAG / RING)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units	Graphic Trend: Blow Count / Dry Density
0				SM			SILTY SAND: light brown, very dense, dry, fine to coarse grained sand, with some gravel to 3"	
5	RING	18,50		GR	114	2	GRANITIC BEDROCK: highly weathered, light brown, very dense, dry, recovered as: medium to coarse grained sand with silt	
10								
15								
20								
25							Refusal on bedrock at 6 feet due to hard drilling No groundwater encountered Backfilled with cuttings	
30								

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Earth Systems

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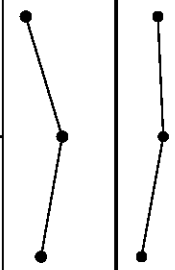
Boring No. B-2
Project Name: Proposed Subdivision Project
Project Number: 307129-001
Boring Location: See Plate 2

Drilling Date: June 5, 2025
Drilling Method: LAR w/auto hammer
Drill Type: 8" HSA
Logged By: JG

Depth (Ft.)	Sample Type (Bulk / BAG / RING)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0				SP-SM			SAND WITH SILT: light brown, very loose, dry, fine to coarse grained sand, with some gravel to 1" trace organics
	RING	7,11,19			113	1	
5	RING	37,28,50/5"		GR	121	5	GRANITIC BEDROCK: highly weathered, very dense, damp, recovered as: fine to coarse grained sand with gravel to 1/2"
	RING	50/5"			89	4	
10							Refusal on bedrock at 10 feet due to hard drilling
							No groundwater encountered
							Backfilled with cuttings
15							
20							
25							
30							

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density



Earth Systems

1680 Illinois Ave., Perris, CA 92571
Phone (951) 928-9799, Fax (951) 928-9948

Boring No. B-3
Project Name: Proposed Subdivision Project
Project Number: 307129-001
Boring Location: See Plate 2

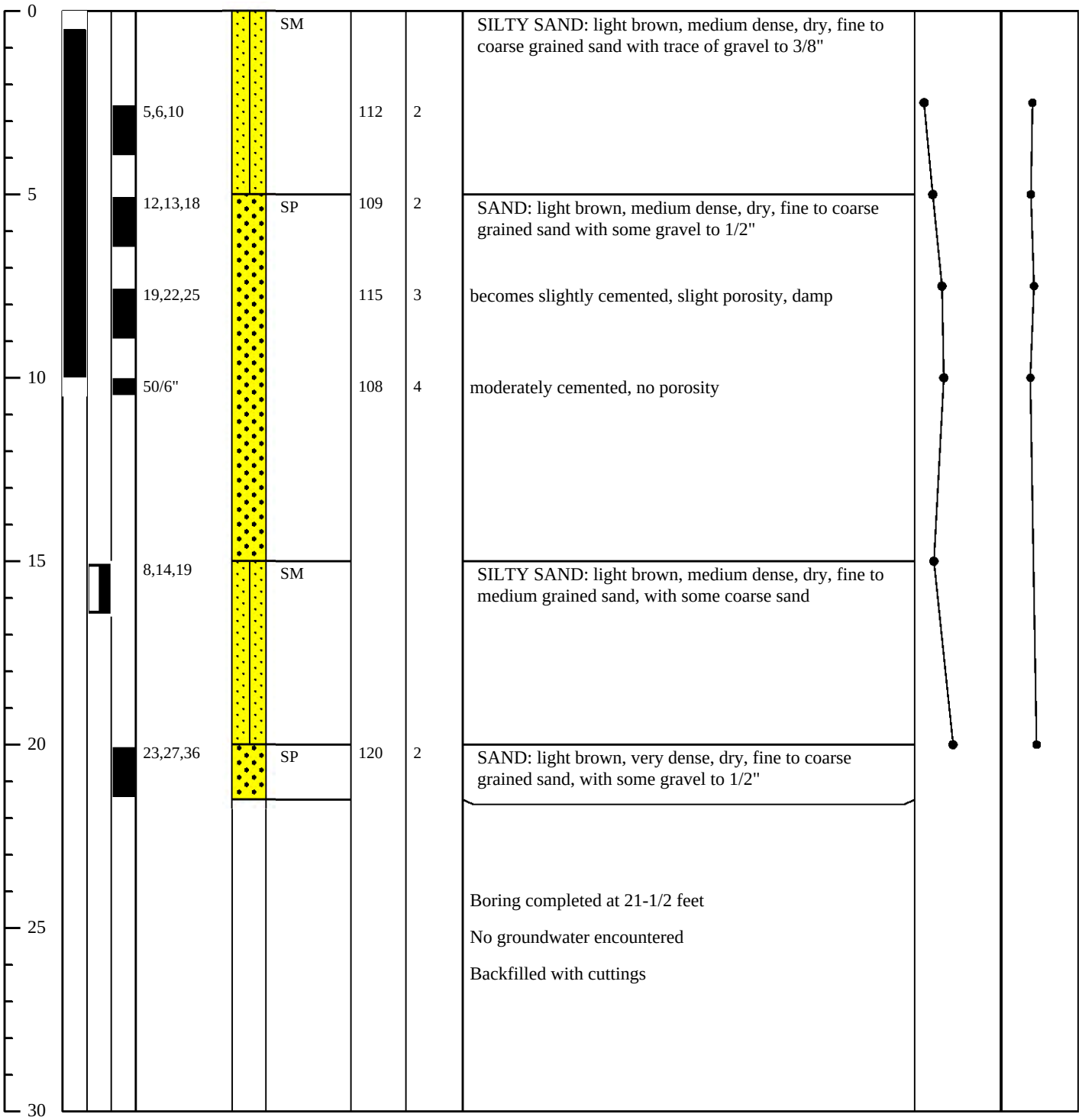
Drilling Date: June 5, 2025
Drilling Method: LAR w/auto hammer
Drill Type: 8" HSA
Logged By: JG

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density

Depth (Ft.)	Sample Type (Bulk / BAG / RING)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0				SM			SILTY SAND: light brown, medium dense, dry, fine to coarse grained sand with trace of gravel to 3/8"
	RING	5,6,10			112	2	
5				SP	109	2	SAND: light brown, medium dense, dry, fine to coarse grained sand with some gravel to 1/2"
	RING	12,13,18					
	RING	19,22,25			115	3	becomes slightly cemented, slight porosity, damp
10	RING	50/6"			108	4	moderately cemented, no porosity
15	RING	8,14,19		SM			SILTY SAND: light brown, medium dense, dry, fine to medium grained sand, with some coarse sand
20	RING	23,27,36		SP	120	2	SAND: light brown, very dense, dry, fine to coarse grained sand, with some gravel to 1/2"
25							Boring completed at 21-1/2 feet No groundwater encountered Backfilled with cuttings
30							



Earth Systems

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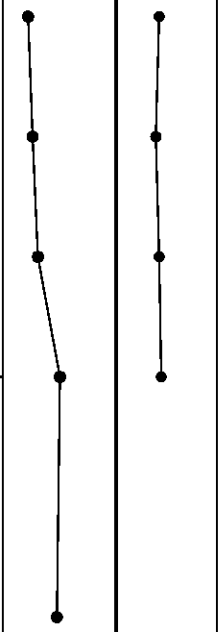
Boring No. B-4
Project Name: Proposed Subdivision Project
Project Number: 307129-001
Boring Location: See Plate 2

Drilling Date: June 5, 2025
Drilling Method: LAR w/auto hammer
Drill Type: 8" HSA
Logged By: JG

Depth (Ft.)	Sample Type (Bulk / BAG / RING)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0				SM			SILTY SAND: light brown, medium dense, dry, fine to coarse grained sand, trace of gravel to 1/2"
	RING	13,15,18			115	2	
5	RING	15,18,21			110	3	damp
	RING	18,22,24			115	2	dry
10	RING	17,25,50		GR	118	3	GRANITIC BEDROCK: highly weathered, very dense, dry, recovered as: fine to coarse grained sand
15	RING	20,30,41					
20							Refusal on bedrock at 19 feet due to hard drilling
25							No groundwater encountered
							Backfilled with cuttings
30							

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density



Earth Systems

1680 Illinois Ave., Perris, CA 92571
Phone (951) 928-9799, Fax (951) 928-9948

Boring No. B-5
Project Name: Proposed Subdivision Project
Project Number: 307129-001
Boring Location: See Plate 2

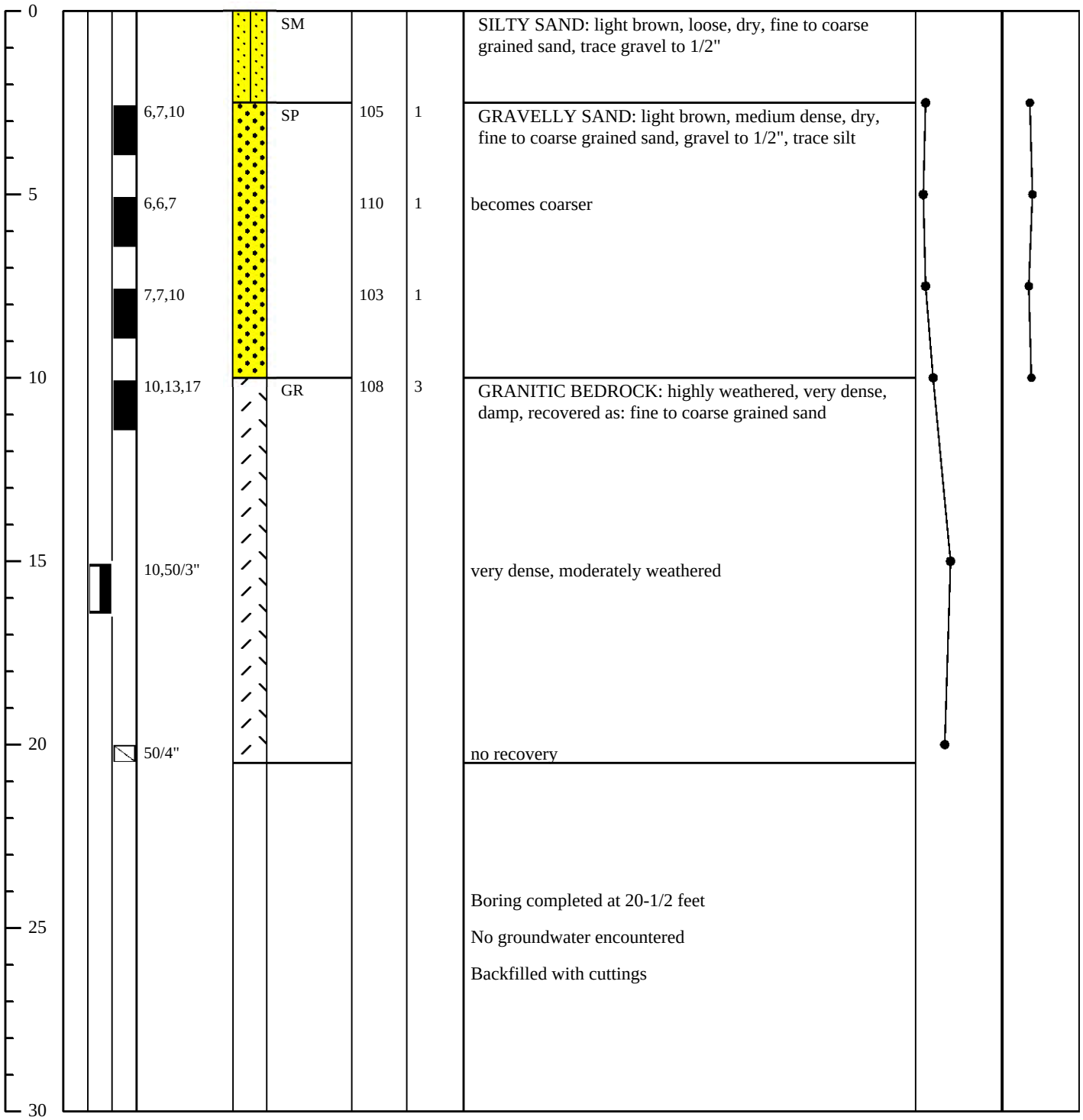
Drilling Date: June 5, 2025
Drilling Method: LAR w/auto hammer
Drill Type: 8" HSA
Logged By: JG

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density

Depth (Ft.)	Sample Type (Bulk, BAG, RING)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0				SM			SILTY SAND: light brown, loose, dry, fine to coarse grained sand, trace gravel to 1/2"
	RING	6,7,10		SP	105	1	GRAVELLY SAND: light brown, medium dense, dry, fine to coarse grained sand, gravel to 1/2", trace silt
5	RING	6,6,7			110	1	becomes coarser
	RING	7,7,10			103	1	
10	RING	10,13,17		GR	108	3	GRANITIC BEDROCK: highly weathered, very dense, damp, recovered as: fine to coarse grained sand
15	RING	10,50/3"					very dense, moderately weathered
20	RING	50/4"					no recovery
25							Boring completed at 20-1/2 feet No groundwater encountered Backfilled with cuttings
30							



Earth Systems

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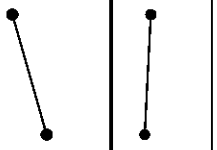
Boring No. B-6
Project Name: Proposed Subdivision Project
Project Number: 307129-001
Boring Location: See Plate 2

Drilling Date: June 5, 2025
Drilling Method: LAR w/auto hammer
Drill Type: 8" HSA
Logged By: JG

Depth (Ft.)	Sample Type (Bulk / BAG / RING)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0				SP			SAND: light brown, medium dense, dry, fine to coarse grained sand, some gravel to 1", trace silt
	RING	7,9,10			110	1	
5	RING	14,50/2"		GR	101	1	GRANITIC BEDROCK: highly weathered, very dense, dry, recovered as: fine to coarse grained sand
							moderately weathered
10							
15							
20							
25							Refusal on bedrock at 7-1/2 feet No groundwater encountered Backfilled with cuttings
30							

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density



Earth Systems

1680 Illinois Ave., Perris, CA 92571
Phone (951) 928-9799, Fax (951) 928-9948

Boring No. B-7
Project Name: Proposed Subdivision Project
Project Number: 307129-001
Boring Location: See Plate 2

Drilling Date: June 6, 2025
Drilling Method: LAR w/auto hammer
Drill Type: 8" HSA
Logged By: JG

Depth (Ft.)	Sample Type (Bulk / BAG / RING)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units	Graphic Trend: Blow Count / Dry Density
0				SP			GRAVELLY SAND: light brown, very dense, dry, fine to coarse grained sand, gravel and cobbles to 8", trace silt	
	RING	50		GR	92	1	GRANITIC BEDROCK: very highly weathered, dry, dense, recovered as: fine to medium sand	
5							hard	
10								
15								
20								
25							Refusal on bedrock at 7 feet due to hard frilling No groundwater encountered Backfilled with cuttings	
30								

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Earth Systems

1680 Illinois Ave., Perris, CA 92571
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Boring No. B-8
Project Name: Proposed Subdivision Project
Project Number: 307129-001
Boring Location: See Plate 2

Drilling Date: June 6, 2025
Drilling Method: LAR w/auto hammer
Drill Type: 8" HSA
Logged By: JG

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Depth (Ft.)	Sample Type (Bulk / BAG / RING)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description
0				SM			SILTY SAND: light brown, medium dense, dry, fine to coarse grained sand, some gravel to 1"
	RING	12,10,8			111	2	trace of roots
5	RING	9,10,13			121	2	moderately cemented, trace roots, no gravel
	RING	27,50/3"			113	7	very dense, moderately cemented, slight porosity, trace old roots, damp
10	RING	25,50/5"			122	5	tarce of carbonate stringers
15	BAG	22,31,29		SP			SAND: light brown, very dense, dry, fine to coarse grained sand, trace silt
20	BAG	10,12,13					
25							Boring completed at 21-1/2 feet No groundwater encountered Backfilled with cuttings
30							

Graphic Trend
Blow Count Dry Density

Earth Systems

1680 Illinois Ave., Perris, CA 92571
Phone (951) 928-9799, Fax (951) 928-9948

Boring No. B-9
Project Name: Proposed Subdivision Project
Project Number: 307129-001
Boring Location: See Plate 2

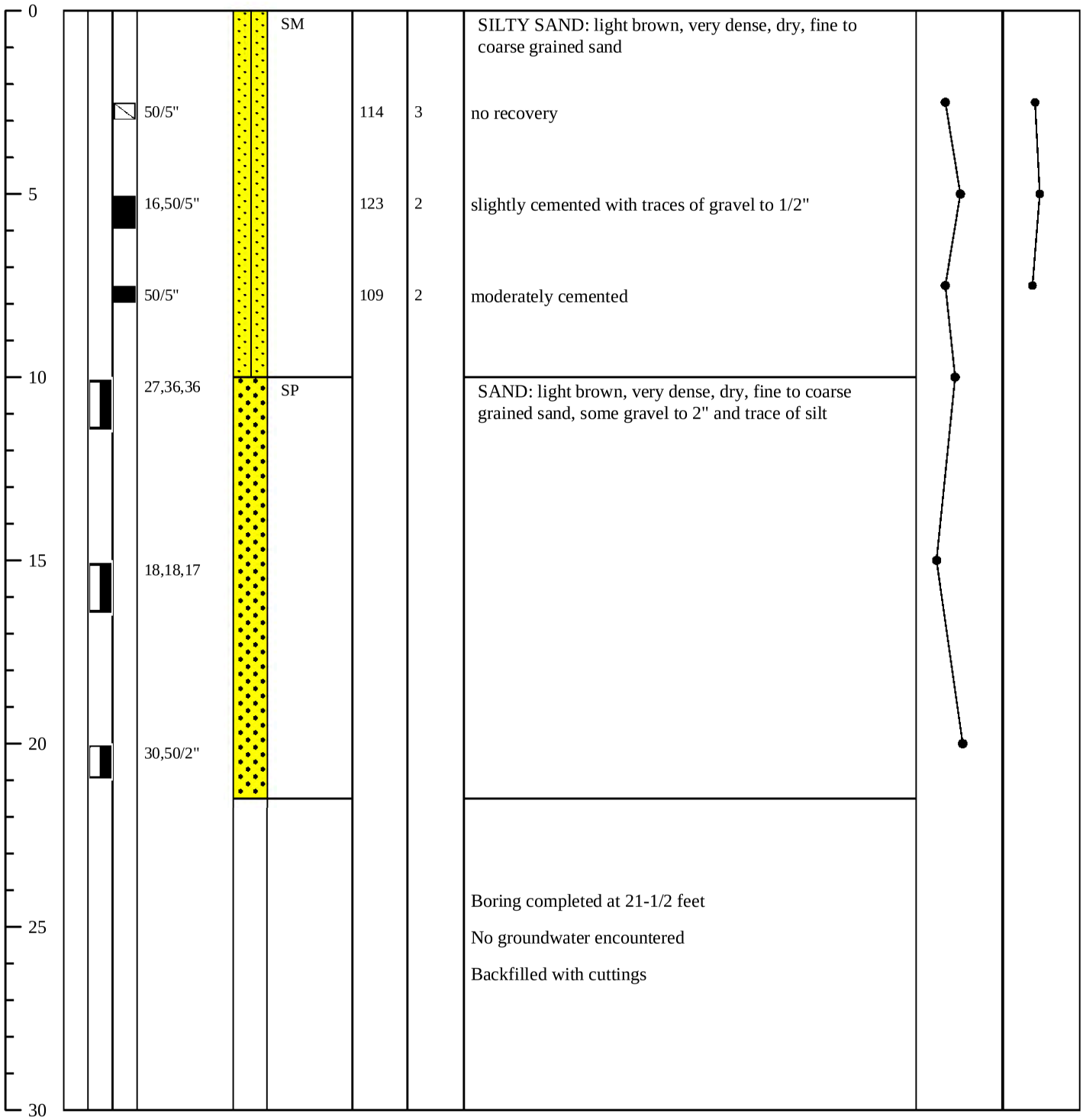
Drilling Date: June 6, 2025
Drilling Method: LAR w/auto hammer
Drill Type: 8" HSA
Logged By: JG

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density

Depth (Ft.)	Sample Type (Bulk / BAG / RING)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0				SM			SILTY SAND: light brown, very dense, dry, fine to coarse grained sand
	RING	50/5"			114	3	no recovery
5	RING	16,50/5"			123	2	slightly cemented with traces of gravel to 1/2"
	RING	50/5"			109	2	moderately cemented
10	BAG	27,36,36		SP			SAND: light brown, very dense, dry, fine to coarse grained sand, some gravel to 2" and trace of silt
15	BAG	18,18,17					
20	BAG	30,50/2"					
25							Boring completed at 21-1/2 feet No groundwater encountered Backfilled with cuttings
30							



Earth Systems

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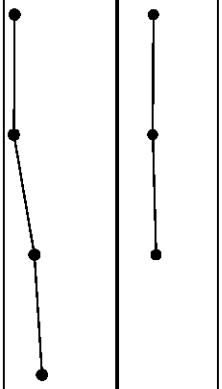
Boring No. B-10
Project Name: Proposed Subdivision Project
Project Number: 307129-001
Boring Location: See Plate 2

Drilling Date: June 6, 2025
Drilling Method: LAR w/auto hammer
Drill Type: 8" HSA
Logged By: JG

Depth (Ft.)	Sample Type (Bulk / BAG / RING)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0				SP			SAND: light brown, medium dense, dry, fine to coarse grained sand, trace gravel to 1/2", some silt
	RING	5,7,7			105	1	gravel to 3/4"
5	RING	5,6,7			104	1	
	RING	5,6,34			109	2	dense
10	BAG	50/2"					no recovery
							hard
15							
20							
25							Refusal on bedrock at 12 feet due to hard drilling No groundwater encountered Backfilled with cuttings
30							

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density



Earth Systems

1680 Illinois Ave., Perris, CA 92571
Phone (951) 928-9799, Fax (951) 928-9948

Boring No. B-11
Project Name: Proposed Subdivision Project
Project Number: 307129-001
Boring Location: See Plate 2

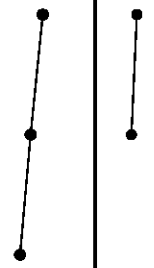
Drilling Date: June 6, 2025
Drilling Method: LAR w/auto hammer
Drill Type: 8" HSA
Logged By: JG

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Depth (Ft.)	Sample Type (Bulk / BAG / RING)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description
0				SP			SAND: light brown, very dense, dry, fine to coarse grained sand, trace gravel to 1", some silt
	RING	30,50/5"			113	3	damp
5	RING	19,24,40			105	3	very dense, becomes slightly cemented
	BAG	50/4"		GR			GRANITIC BEDROCK: highly weathered, dense, dry, recovered as: fine to coarse sand
10							
15							
20							
25							Refusal at 8 feet due to hard drilling No groundwater encountered Backfilled with cuttings
30							

Graphic Trend
Blow Count Dry Density



Earth Systems

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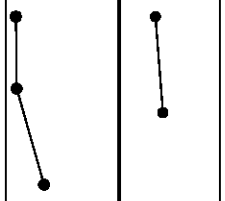
Boring No. B-12
Project Name: Proposed Subdivision Project
Project Number: 307129-001
Boring Location: See Plate 2

Drilling Date: June 6, 2025
Drilling Method: LAR w/auto hammer
Drill Type: 8" HSA
Logged By: JG

Depth (Ft.)	Sample Type (Bulk / BAG / RING)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0				SM			SILTY SAND: light brown, medium dense, dry, fine to coarse grained sand, trace gravel to 1"
	RING	5,6,7			105	3	damp
5	RING	5,5,9			116	2	dry
	RING	50/3"		GR			GRANITIC BEDROCK: highly weathered, dense, dry, recovered as: fine to coarse sand
10							
15							
20							
25							Refusal on bedrock at 9 feet due to hard drilling No groundwater encountered Backfilled with cuttings
30							

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density



APPENDIX B

Laboratory Test Results

File No.: 307129-001 July 21, 2025

Lab No.:

UNIT DENSITIES AND MOISTURE CONTENT ASTM D2937 & D2216

Job Name: Proposed Subdivision Project

Sample Location	Depth (feet)	Unit Dry Density (pcf)	Moisture Content (%)	USCS Group Symbol
B-1	2.5	114	2	GR
B-2	2.5	113	1	SP-SM
B-2	5	121	5	GR
B-2	7.5	89	4	GR
B-3	2.5	112	2	SM
B-3	5	109	2	SP
B-3	7.5	115	3	SP
B-3	10	108	4	SP
B-3	20	120	2	SP
B-4	2.5	115	2	SM
B-4	5	110	3	SM
B-4	7.5	115	2	SM
B-4	10	118	3	GR
B-5	2.5	105	1	SP
B-5	5	110	1	SP
B-5	7.5	103	1	SP
B-5	10	108	3	GR
B-6	2.5	110	1	SP
B-6	5	101	1	GR
B-7	2.5	92	1	SP
B-8	2.5	111	2	SM
B-8	5	121	2	SM
B-8	7.5	113	7	SM
B-8	10	122	5	SM

File No.: 307129-001 July 21, 2025

Lab No.:

UNIT DENSITIES AND MOISTURE CONTENT ASTM D2937 & D2216

Job Name: Proposed Subdivision Project

Sample Location	Depth (feet)	Unit Dry Density (pcf)	Moisture Content (%)	USCS Group Symbol
B-9	2.5	114	3	SM
B-9	5	123	2	SM
B-9	7.5	109	2	SM
B-10	2.5	105	1	SP
B-10	5	104	1	SP
B-10	7.5	109	2	SP
B-11	2.5	113	3	SP
B-11	5	105	3	SP
B-12	2.5	105	3	SM
B-12	5	116	2	SM

File No.: 307129-001 7/21/2025

Lab No.:

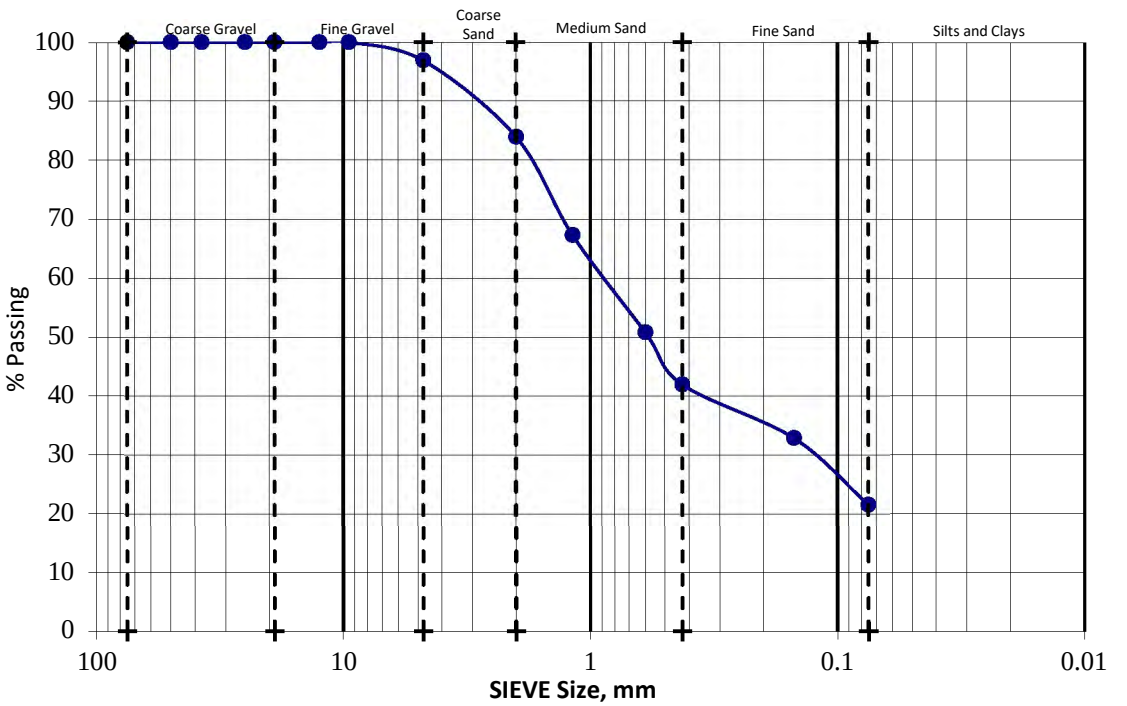
SIEVE ANALYSIS ASTM D6913

Job Name: Proposed Subdivision Project

Sample ID: B-3 @ 2.5'

Description: Silty Sand (SM)

Sieve Size	% Passing
3"	100
2"	100
1-1/2"	100
1"	100
3/4"	100
1/2"	100
3/8"	100
#4	97
#10	84
#16	67
#30	51
#40	42
#100	33
#200	21.6



FM= 2.36

% Coarse Gravel:	0	% Coarse Sand:	13			
% Fine Gravel:	3	% Medium Sand:	42	Cu:	NA	
		% Fine Sand:	20	Cc:	NA	Gradation
% Total Gravel	3	% Total Sand	75	% Fines:	21.6	NA

File No.: 307129-001 7/21/2025

Lab No.:

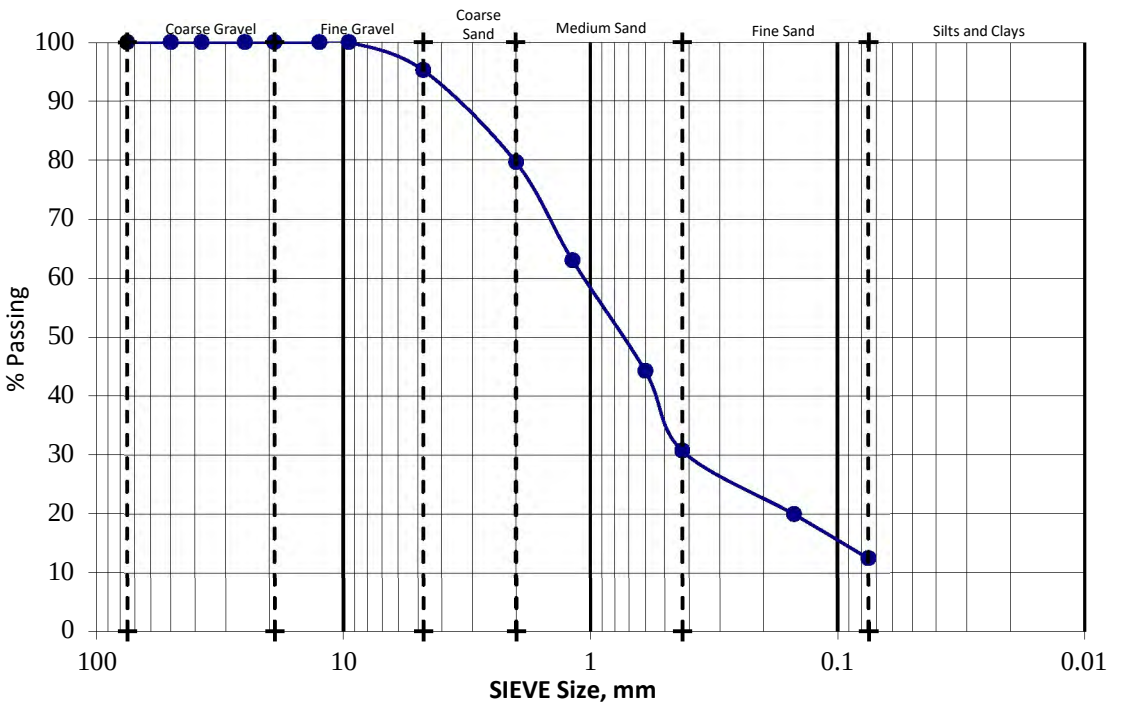
SIEVE ANALYSIS ASTM D6913

Job Name: Proposed Subdivision Project

Sample ID: B-4 @ 2.5'

Description: Silty Sand (SM)

Sieve Size	% Passing
3"	100
2"	100
1-1/2"	100
1"	100
3/4"	100
1/2"	100
3/8"	100
#4	95
#10	80
#16	63
#30	44
#40	31
#100	20
#200	12.5



FM= 2.76

% Coarse Gravel:	0	% Coarse Sand:	16			
% Fine Gravel:	5	% Medium Sand:	49	Cu:	NA	
		% Fine Sand:	18	Cc:	NA	Gradation
% Total Gravel	5	% Total Sand	83	% Fines:	12.5	NA

File No.: 307129-001 July 21, 2025

Job Name: Proposed Subdivision Project

Lab Number: 0

ASTM D-1140 or Earth Systems Method (circle one)

AMOUNT PASSING NO. 200 SIEVE (Earth Systems Method Transfers Sample until water runs clear)

Sample Location	Depth (feet)	Fines Content (%)	USCS Group Symbol	Soaking Time
B-1	2.5	14.3	SM	10
B-8	5	16.4	SM	10

File No.: 307129-001 July 21, 2025
Lab No.:

CONSOLIDATION TEST **ASTM D 2435 & D 5333**

Proposed Subdivision Project
B-3 @ 2.5'

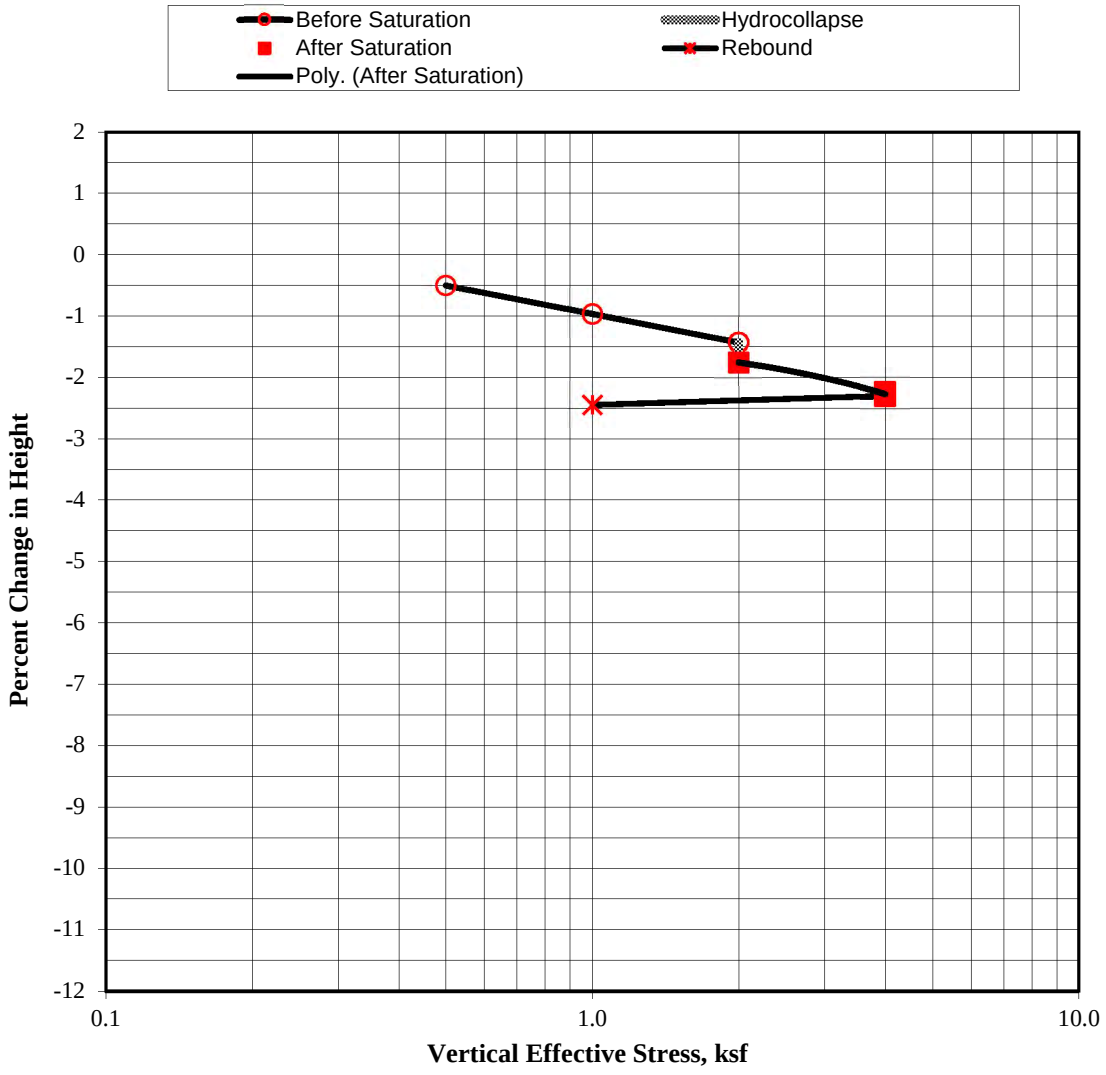
Silty Sand (SM)

Ring Sample

Initial Dry Density: 109.7 pcf
Initial Moisture: 2.3%
Specific Gravity: 2.67
Initial Void Ratio: 0.520

Hydrocollapse: 0.3% @ 2.0 ksf

% Change in Height vs Normal Pressure Diagram



File No.: 307129-001 July 21, 2025
Lab No.:

CONSOLIDATION TEST **ASTM D 2435 & D 5333**

Proposed Subdivision Project
B-5 @ 7.5'

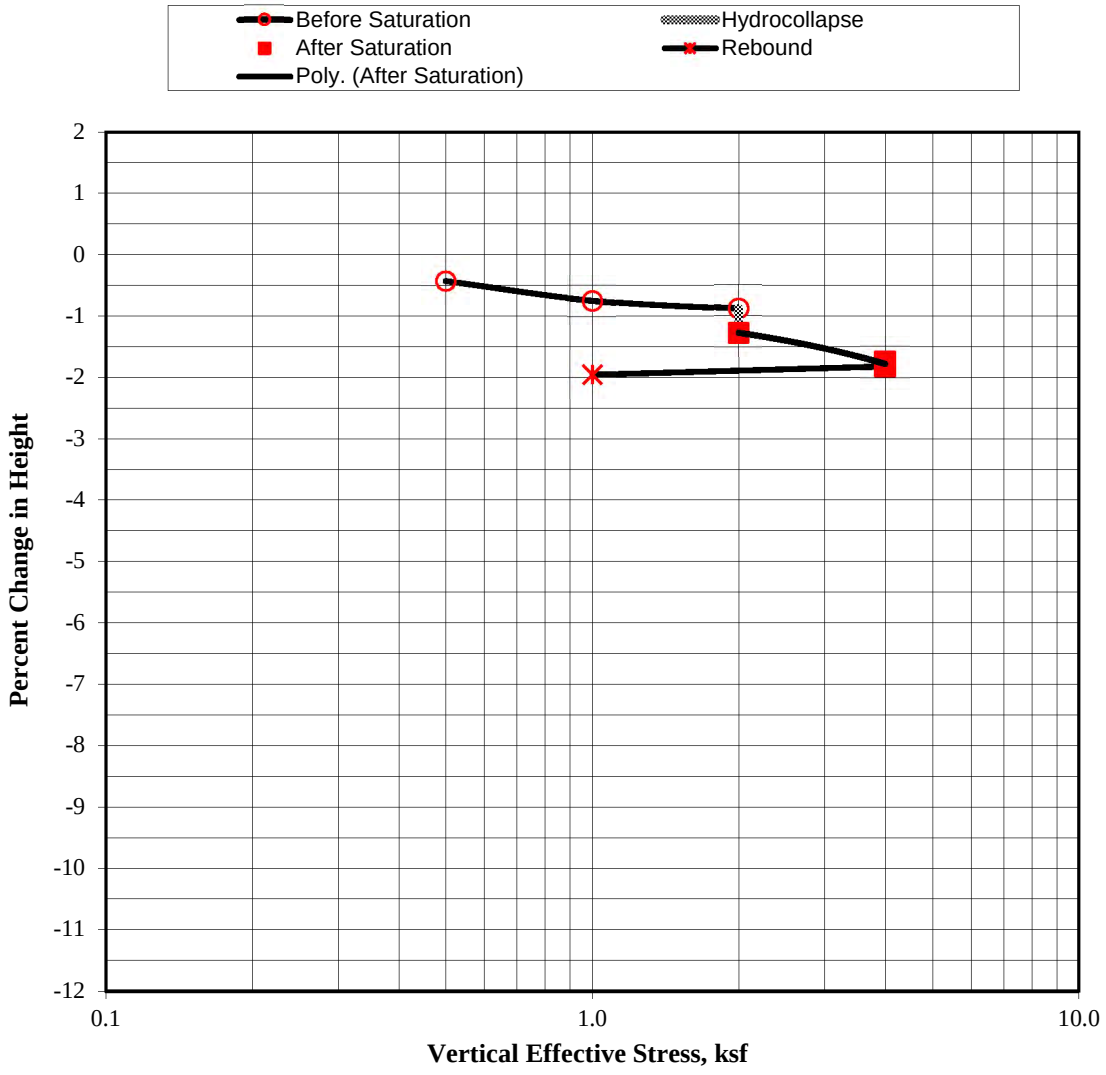
Sand (SP)

Ring Sample

Initial Dry Density: 104.8 pcf
Initial Moisture: 1.7%
Specific Gravity: 2.67
Initial Void Ratio: 0.591

Hydrocollapse: 0.4% @ 2.0 ksf

% Change in Height vs Normal Pressure Diagram



File No.: 307129-001 July 21, 2025
Lab No.:

CONSOLIDATION TEST **ASTM D 2435 & D 5333**

Proposed Subdivision Project
B-5 @ 10'

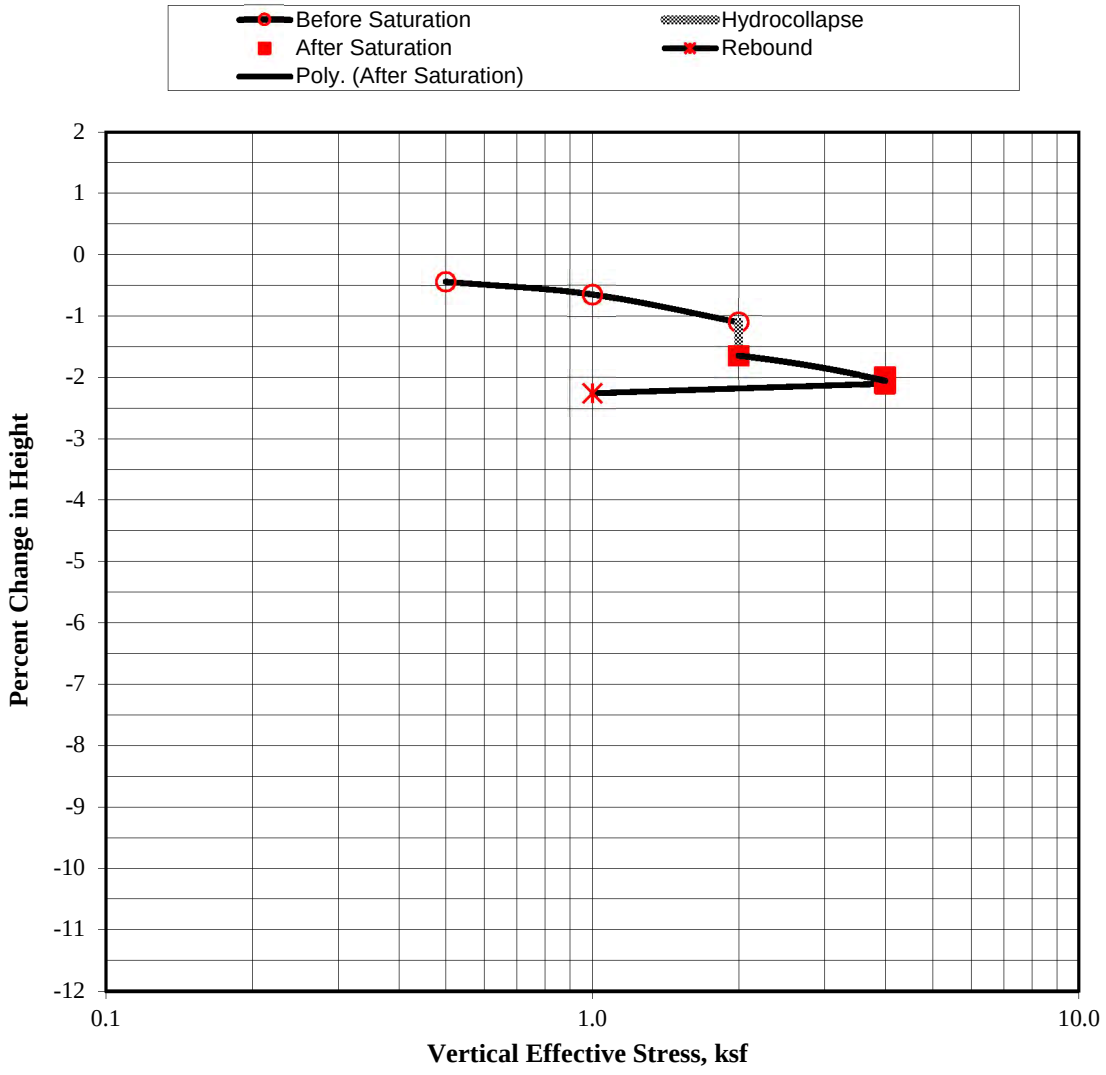
Granitic Bedrock (GR)

Ring Sample

Initial Dry Density: 107.2 pcf
Initial Moisture: 2.9%
Specific Gravity: 2.67
Initial Void Ratio: 0.555

Hydrocollapse: 0.5% @ 2.0 ksf

% Change in Height vs Normal Pressure Diagram



File No.: 307129-001 July 21, 2025
Lab No.:

CONSOLIDATION TEST **ASTM D 2435 & D 5333**

Proposed Subdivision Project
B-10 @ 5'

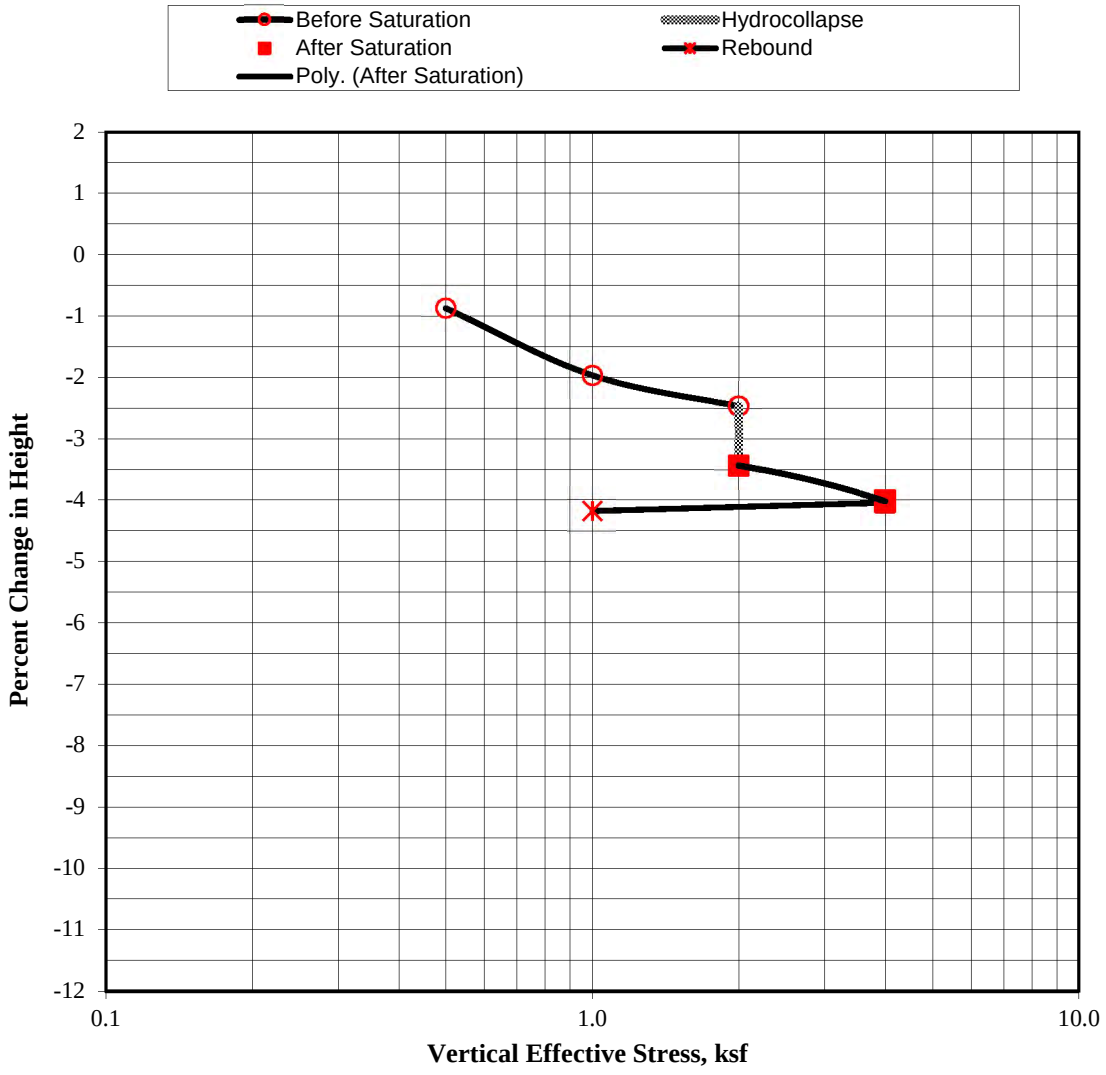
Sand (SP)

Ring Sample

Initial Dry Density: 107.6 pcf
Initial Moisture: 2.1%
Specific Gravity: 2.67
Initial Void Ratio: 0.549

Hydrocollapse: 1.0% @ 2.0 ksf

% Change in Height vs Normal Pressure Diagram



File No.: 307129-001 July 21, 2025
Lab No.:

CONSOLIDATION TEST **ASTM D 2435 & D 5333**

Proposed Subdivision Project
B-12 @ 2.5'

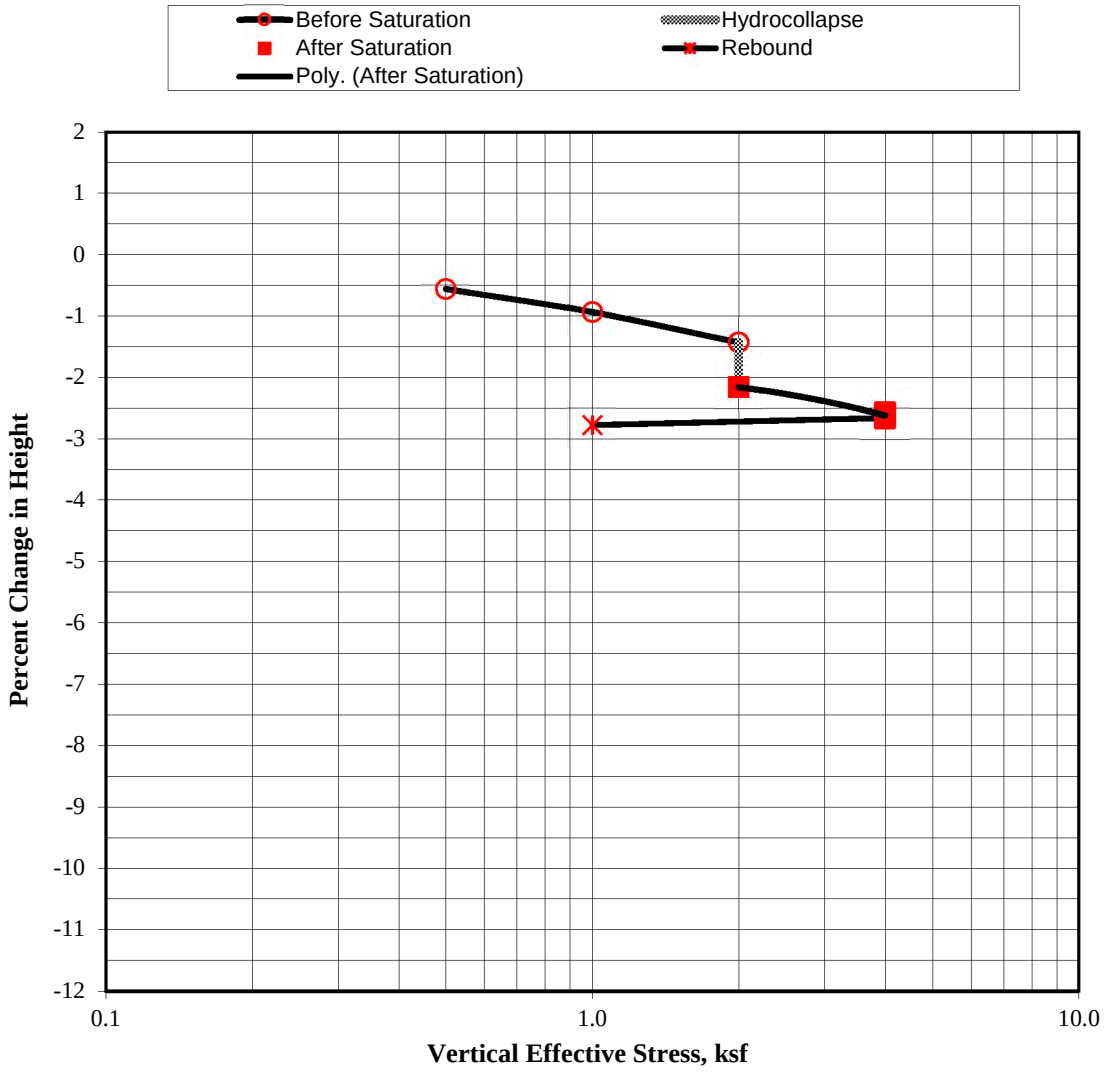
Silty Sand (SM)

Ring Sample

Initial Dry Density: 109.3 pcf
Initial Moisture: 1.4%
Specific Gravity: 2.67
Initial Void Ratio: 0.525

Hydrocollapse: 0.7% @ 2.0 ksf

% Change in Height vs Normal Pressure Diagram



File No.: 307129-001 July 21, 2025
Lab No.:

EXPANSION INDEX **ASTM D-4829**

Job Name: Proposed Subdivision Project
Sample ID: B-8 @ 2.5'
Soil Description: Silty Sand (SM)

Initial Moisture, %:	8.3	
Initial Compacted Dry Density, pcf:	114.7	
Initial Saturation, %:	48	*
Final Moisture, %:	17.8	
Volumetric Swell, %:	0.2	
Expansion Index, EI:	**1**	**Very Low**

EI	ASTM Classification
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
>130	Very High

File No.: 307129-001 July 21, 2025
Lab No.:

EXPANSION INDEX **ASTM D-4829**

Job Name: Proposed Subdivision Project
Sample ID: B-12 @ 2.5'
Soil Description: Silty Sand (SM)

Initial Moisture, %:	8.0	
Initial Compacted Dry Density, pcf:	115.6	
Initial Saturation, %:	47	*
Final Moisture, %:	14.8	
Volumetric Swell, %:	0.1	
Expansion Index, EI:	**0**	**Very Low**

EI	ASTM Classification
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
>130	Very High

File No.: 307129-001 July 21, 2025
Lab No.:

MAXIMUM DRY DENSITY / OPTIMUM MOISTURE ASTM D 1557 (Modified)

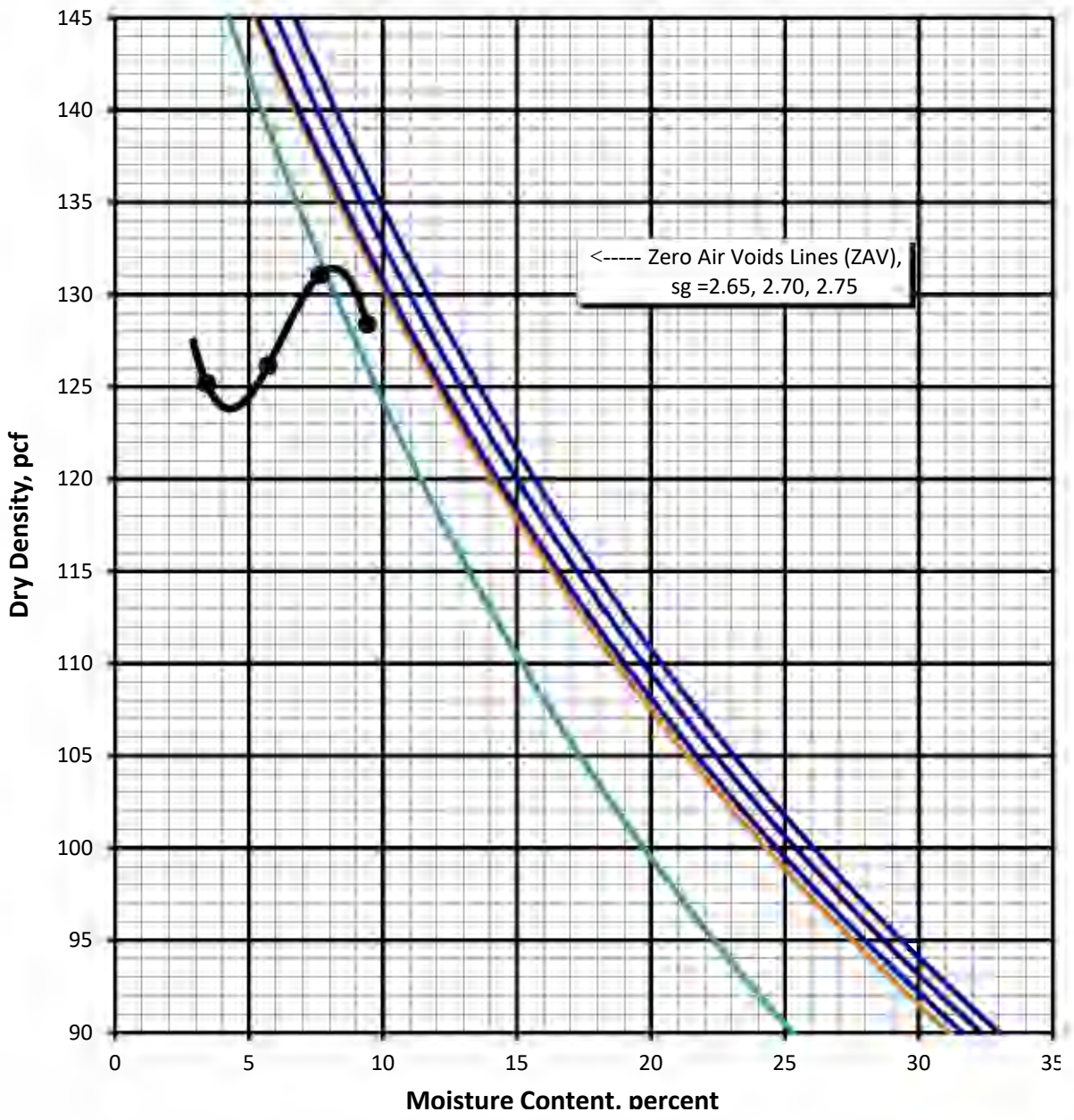
Job Name: Proposed Subdivision Project
Sample ID: N/A
Location: B-3 @ 0-10'

Procedure Used: A
Preparation Method: Moist
Rammer Type: Mechanical

Description: Silty Sand (SM)

Maximum Dry Density: **131.4 pcf**
Optimum Moisture: **8.1%**

Sieve Size	% Retained (Cumulative)
3/4"	0.0
3/8"	0.5
#4	3.3



File No.: 307129-001 7/21/2025

Lab No.:

SOIL CHEMICAL ANALYSES

Job Name:	Proposed Subdivision Project	
Job No.:	307129-001	
Sample ID:		
Sample Location:	B-1 @ 0-5'	B-3 @ 0-10'
Resistivity (Units)		
as-received (ohm-cm)	34,800	30,800
saturated (ohm-cm)	7,600	8,000
pH	7.7	8.1
Electrical Conductivity (mS/cm)	0.07	0.07
Chemical Analyses		
Cations		
calcium Ca^{2+} (mg/kg)	35	42
magnesium Mg^{2+} (mg/kg)	5	6
sodium Na^{1+} (mg/kg)	59	60
potassium K^{1+} (mg/kg)	4	5
ammonium NH41+ (mg/kg)	ND	ND
Anions		
carbonate CO_3^{2-} (mg/kg)	21	23
bicarbonate HCO_3^{1-}(mg/kg)	107	137
fluoride F^{1-} (mg/kg)	4	4
chloride Cl^{1-} (mg/kg)	4	3
sulfate SO_4^{2-} (mg/kg)	9	9
nitrate NO31- (mg/kg)	1	1
phosphate PO_4^{3-} (mg/kg)	5	6
Other Tests		
% moisture H_2O (%)	na	na
total acidity H^{1+} (mmol/kg)	na	na
sulfide S^{2-} (qual)	na	na
Redox (mV)	na	na

Note: Tests performed by Subcontract Laboratory:
HDR Engineering, Inc.
431 West Baseline Road
Claremont, California 91711 Tel: (909) 962-5485

mg/kg = milligrams per kilogram (parts per million) of dry soil.
Redox = oxidation-reduction potential in millivolts
ND = not detected
na = not analyzed
T.O.P. = top of pipe

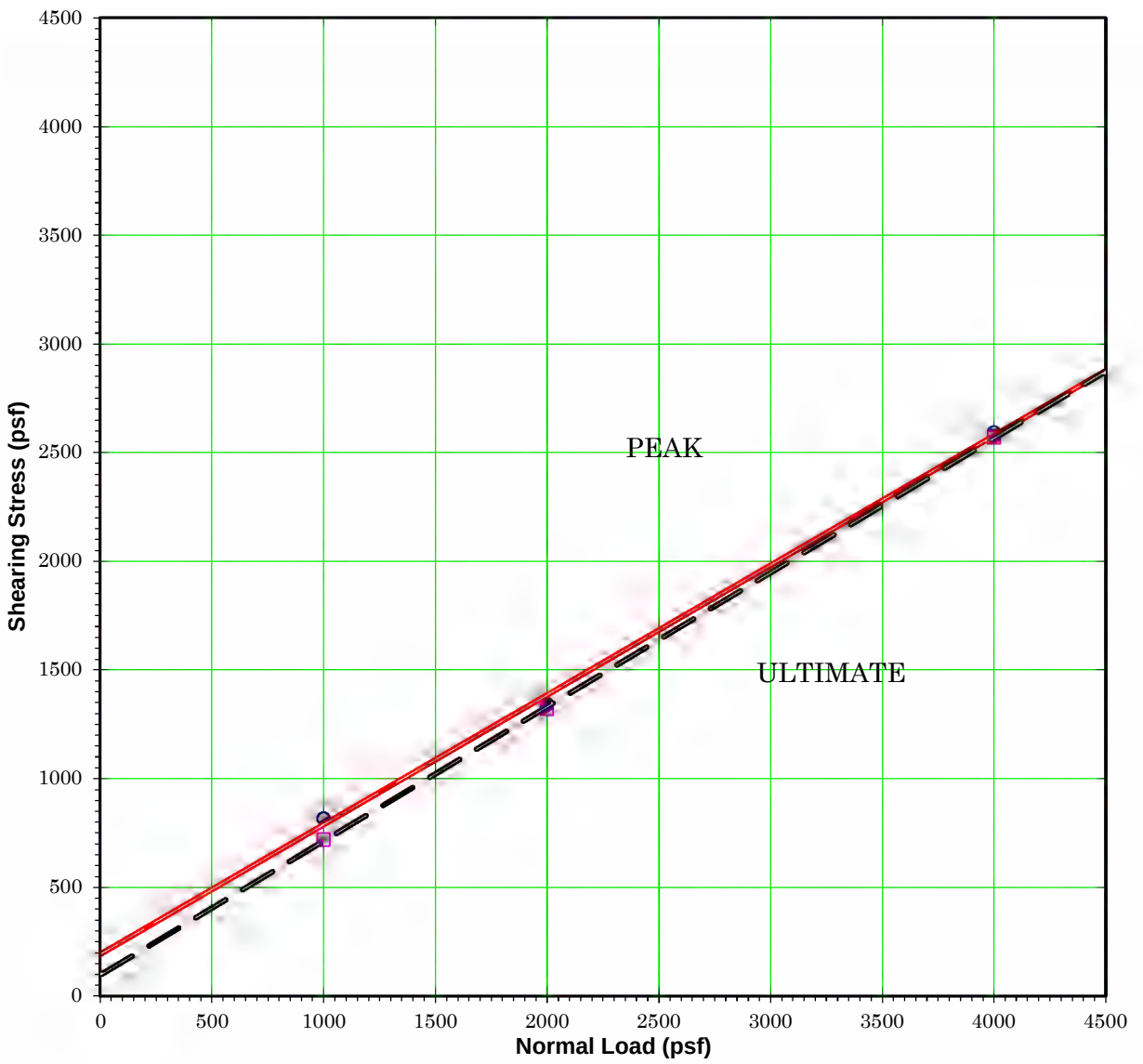
Resistivity per ASTM G187, Cations per ASTM D6919, Anions per ASTM D4327, and Alkalinity per APHA 2320-B. Electrical conductivity in millisiemens/cm and chemical analyses were made on a 1:5 soil-to-water extract.

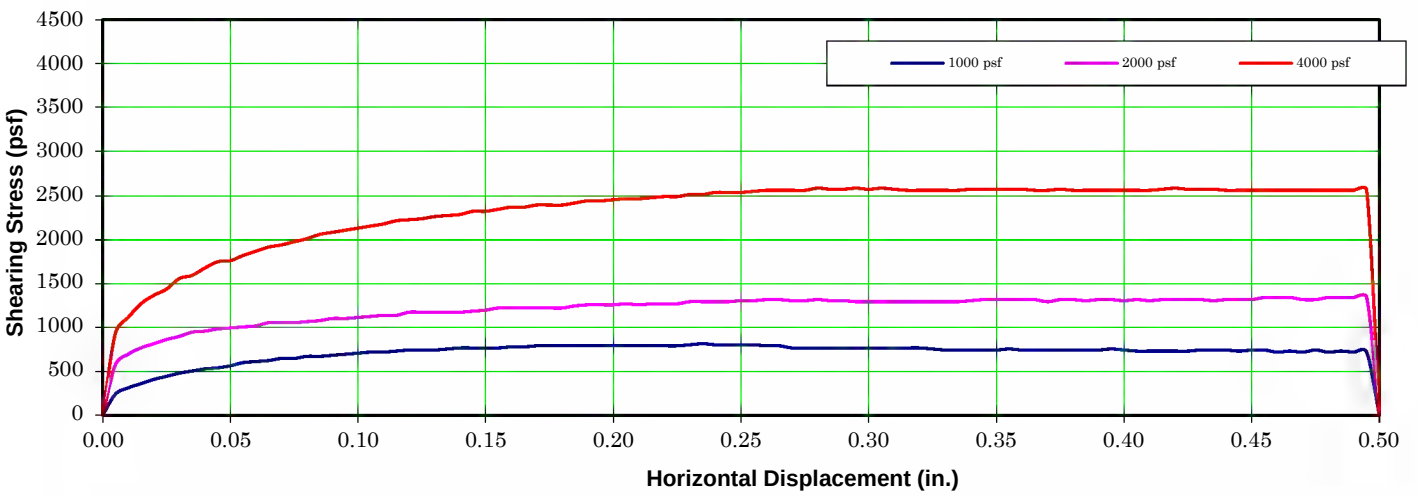
General Guidelines for Soil Corrosivity		
Chemical Agent	Amount in Soil	Degree of Corrosivity
Soluble Sulfates[1]	0 -1,000 mg/Kg (ppm) [0-.1%]	Low
	1,000 - 2,000 mg/Kg (ppm) [0.1-0.2%]	Moderate
	2,000 - 20,000 mg/Kg (ppm) [0.2-2.0%]	Severe
	> 20,000 mg/Kg (ppm) [>2.0%]	Very Severe
Resistivity[2] (Saturated)	0- 900 ohm-cm	Very Severely Corrosive
	900 to 2,300 ohm-cm	Severely Corrosive
	2,300 to 5,000 ohm-cm	Moderately Corrosive
	5,000-10,000 ohm-cm	Mildly Corrosive
	10,000+ ohm-cm	Progressively Less Corrosive

1 - General corrosivity to concrete elements. American Concrete Institute (ACI) Water Soluble Sulfate in Soil by Weight, ACI 318, Tables 4.2.2 - Exposure Conditions and Table 4.3.1 - Requirements for Concrete Exposed to Sulfate-Containing Solutions. It is recommended that concrete be proportioned in accordance with the requirements of the two ACI tables listed above (4.2.2 and 4.3.1). The current ACI should be referred to for further information.

2 - General corrosivity to metallic elements (iron, steel, etc.). Although no standard has been developed and accepted by corrosion engineering organizations, it is generally agreed that the classification shown above, or other similar classifications, reflect soil corrosivity. Source: Corrosionsource.com. The classification presented is excerpted from ASTM STP 1013 titled "Effects of Soil Characteristics on Corrosion" (February, 1989)

3 - Earth Systems does not practice corrosion engineering. Results should be reviewed by an engineer competent in corrosion evaluation, especially in regard to nitrites and ammonium.





DIRECT SHEAR DATA*

Sample Location: B-3 @ 0-10'
Material: Silty Sand (SM)
Dry Density (pcf): 131.4

	Initial	Final
Moisture Content (%):	8.1	13.0
Saturation (%):	81	100
	Peak	**Ultimate**
ϕ Angle of Friction (degrees):	31	32
c Cohesive Strength (psf):	190	90

Test Type: Peak and Ulitimate
Shear Rate (in/min): 0.005

* Test Method: ASTM D-3080

DIRECT SHEAR TEST

Proposed Subdivision Project

Pioneertown, CA

Earth Systems Pacific

7/21/2025 | 307129-001

July 3, 2025

File No.: 307129-001
Doc. No.: 25-06-707

Mr. Jonathan Shokrian
319 South Robertson Boulevard
Beverly Hills, California 90211

Subject: Geologic Memorandum – Draft Preliminary CEQA Information

Project: **Proposed Subdivision Project**
Pipes Canyon Road
APN 0594-351-36
Pioneertown, San Bernardino County, California

INTRODUCTION

In accordance with your request and authorization, Earth Systems Pacific (Earth Systems) is submitting this Memorandum for Draft Preliminary Design Information for the subject project. We are providing these preliminary findings to assist the design team in preliminary design given project time constraints. This letter contains findings and recommendations which are based on data from the current exploration at the site and prior to the completion of laboratory testing and overall analysis. As such, this letter is subject to change pending the final report.

Site Description

This Memorandum for Preliminary Design Information has been prepared for the new proposed subdivision project located at Pipes Canyon Road (APN 0594-351-36), Pioneertown, San Bernardino County, California.

We understand that the proposed site improvements will consist of subdividing the existing 122.98 acre parcel into twelve (12) individual parcels (approximately 5 acres each) with a "remainder parcel". The subdivision will be for individual lot sales to allow for custom builds. No formal house plans or grading plans were available. Building sites depicted for preliminary development purposes are for feasibility tract approval and are not necessarily where actual building sites may be constructed. The project has access to municipal power, but will require on-site septic systems for wastewater treatment for each lot. In addition, appurtenant site work is assumed to include underground utilities, landscaping, driveway approaches, and access drives.

Select Preliminary Conclusions and Recommendations

The following recommendations are considered preliminary and subject to change pending the final geotechnical report (forthcoming). These recommendations are to assist the design team in preliminary design and are subject to grading and other related recommendations of the forthcoming geotechnical report.

Stormwater Percolation Testing

Twelve test holes were drilled using a truck mounted drill rig. Test holes were drilled on June 5 and 6, 2025 and reached depths of approximately 5 feet below the ground surface. The test locations represent the soils at the assumed bottom of the proposed infiltration system.

Test procedures followed the procedures for deep boring percolation testing according to the Riverside County Flood Control and Water Conservation District Design Handbook for Low Impact Development Best Management Practices, June 2014 for Whitewater River Region. The soils encountered at the test location and the percolation rate as well as empirically correlated infiltration rate are presented in Table 1.

Table 1
Infiltration Rate Results

Test	Soil Condition	USCS Soil Description in Test Zone	Test Zone Below Existing Surface (feet)	Percolation Rate (min/in)	Porchet Empirical Infiltration Rate* (in/hr)
P-1	(Native)	Sand with Silt (SP-SM)	3 to 5	5.2	0.6 in/hr
P-2	(Native)	Sand with Silt (SP-SM)	3 to 5	1.8	1.7 in/hr
P-3	(Native)	Sand (SM)	3 to 5	1.0	4.7 in/hr
P-4	(Native)	Sand (SP)	3 to 5	0.8	6.3 in/hr
P-5	(Native)	Gravelly Sand (SP)	3 to 5	0.2	36 in/hr
P-6	(Native)	Sand (SP)	3 to 5	1.0	5.4 in/hr
P-7	(Native)	Sand (SP)	3 to 5	1.4	3.3 in/hr
P-8	(Native)	Sand with Silt (SP-SM)	3 to 5	1.8	1.9 in/hr
P-9	(Native)	Sand with Silt (SP-SM)	3 to 5	1.5	2.4 in/hr
P-10	(Native)	Gravelly Sand (SP)	3 to 5	0.1	103 in/hr
P-11	(Native)	Sand (SP)	3 to 5	1.3	3.4 in/hr
P-12	(Native)	Sand (SP)	3 to 5	0.6	9.6 in/hr

*Field Values, No factor of safety applied. Typical factors of safety range from 3 to 12 depending on the type of system which will be designed using the field values and depending on the level of pre-treatment and influent which will be discharged into the infiltration trenches (Riverside County Flood Control and Water Conservation District Design Handbook for Low Impact Development Best Management Practices, 2014).

Feasibility Percolation Testing for Onsite Wastewater Treatment System (Leach Fields)

Twelve test holes were drilled using the same drill rig as the exploration borings. Percolation tests reached depths of approximately 5 feet below the ground surface. The percolation tests were performed in substantial conformance to the County percolation test method for single

lots; however, as feasibility testing was scoped, only one test per lot was performed for this study. Tests were made at selected primary leach field areas in order to evaluate the general percolation rate at those areas where a potential leach field is feasible. The following is a table of the results of the shallow percolation tests performed on the referenced site.

Table 2
Percolation Rate Results

Test	Soil Condition	USCS Soil Description in Test Zone	Test Zone Below Existing Surface (feet)	Percolation Rate (min/in)*
P-13	(Native)	Sand (SP)	3 to 5	1.0
P-14	(Native)	Sand (SP)	3 to 5	1.0
P-15	(Native)	Sand (SP)	3 to 5	0.7
P-16	(Native)	Sand (SP)	3 to 5	0.5
P-17	(Native)	Sand (SP)	3 to 5	0.2
P-18	(Native)	Sand with Silt (SP-SM)	3 to 5	3.1
P-19	(Native)	Sand (SP)	3 to 5	1.4
P-20	(Native)	Sand with Silt (SP-SM)	3 to 5	2.7
P-21	(Native)	Sand (SP)	3 to 5	0.8
P-22	(Native)	Gravelly Sand (SP)	3 to 5	0.1
P-23	(Native)	Sand (SP)	3 to 5	1.4
P-24	(Native)	Sand (SP)	3 to 5	0.8

*mpi: minutes per inch

ADDITIONAL CONCLUSIONS

The following is a summary of our conclusions and professional opinions based on the data obtained from a review of selected technical literature and the site evaluation.

- Sites are not in a liquefaction zone.
- Sites are not in a fault zone.
- Dry seismic settlement potential exists for on-site soils. Nil settlement potentials exist for the on-site bedrock.
- Onsite soils are sandy and subject to erosion.
- Percolation test results indicate site soils are conducive to stormwater disposal and septic systems (leach beds).

- Percolation testing for septic systems will require further testing and evaluation in proposed leach areas and evaluation of impermeable layer.
- Landslides and debris flows are a potential where adjacent to hillsides.
- The sites are subject to earthquake shaking.
- Onsite soils are not expansive.

Limitations

Conclusions contained in this letter are based on our field observations and preliminary analyses, and our present understanding of the proposed construction. The recommendations within are preliminary and subject to change pending the final report.

Earth Systems has striven to provide our services in accordance with generally accepted geotechnical engineering practices in this locality at this time. No warranty or guarantee, express or implied is made.

Maintaining Earth Systems as the geotechnical consultant from beginning to end of the project will provide continuity of services. In accordance with the International Building Code *the geotechnical engineering firm providing tests and observations shall assume the responsibility of Geotechnical Engineer of Record.*

We appreciate the opportunity to provide our professional services. Please contact our office if there are any questions or comments concerning this report or its recommendations.

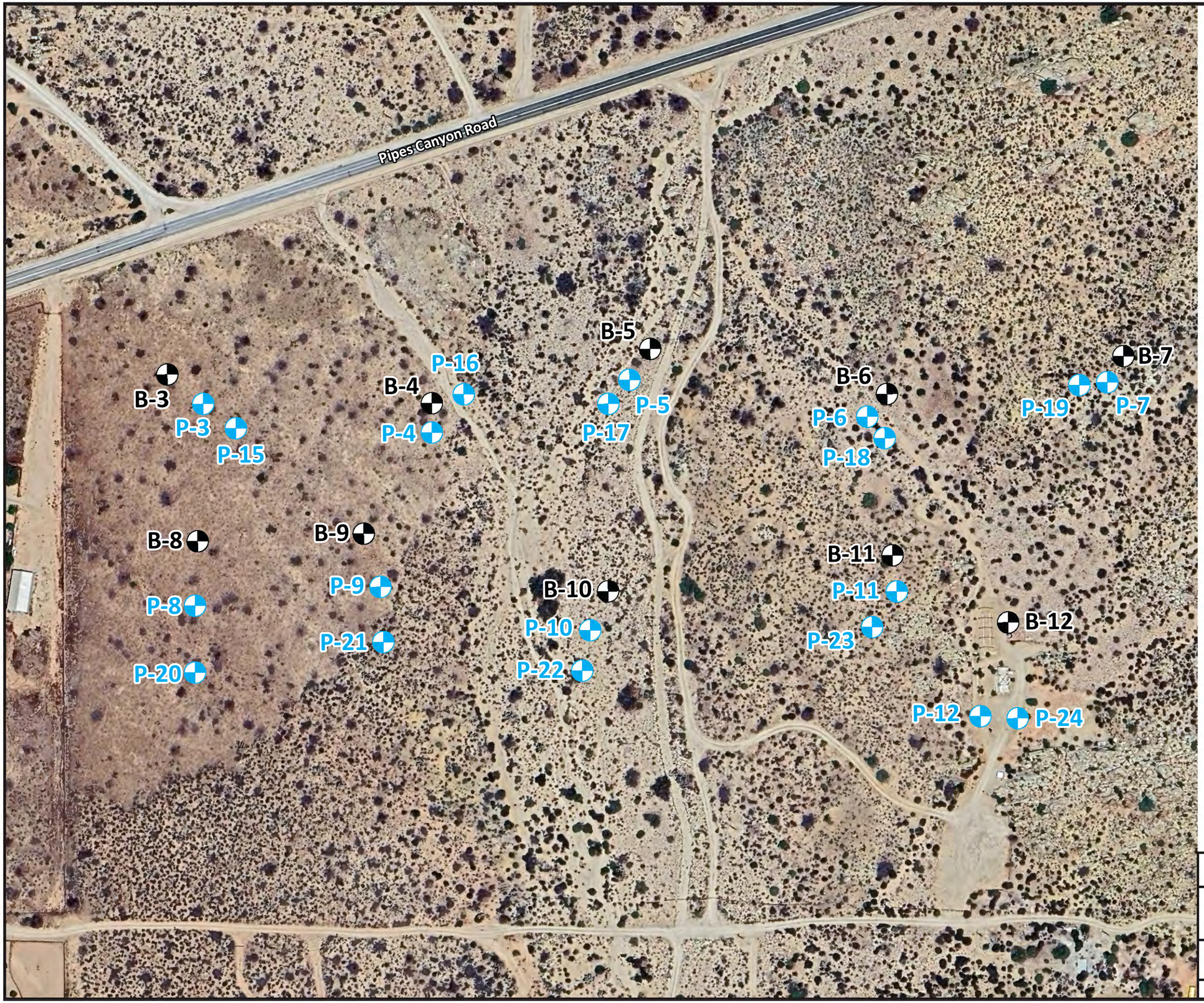
Respectfully submitted
EARTH SYSTEMS PACIFIC



Rocio Carrillo, PE
Project Engineer
CE 75721

Attachment/ Plates 1 & 2, Exploration Location Maps

Distribution: 1/via email
Bryce Dahlin: Bryce@hillwig-goodrow.com
Madeline Luke: madeline.luke@thealtumgroup.com
Rich Malacoff: rich.malacoff@thealtumgroup.com



LEGEND

B-12 Approximate Exploration Locations

P-24 Approximate Percolation Test Locations

N

Approximate Scale: 1" = 150’

0 150’ 300’

Source: Google Earth satellite image dated 5/29/2023 with Tentative Tract Map No. 20612 Sheet 2 overlay.

Plate 1
Exploration Location Map

Proposed Subdivision Project
Pipes Canyon Road
Pioneertown, San Bernardino County, California

Earth Systems

7/3/2025 | File No.: 307129-001



LEGEND

B-12 Approximate Exploration Locations

P-24 Approximate Percolation Test Locations

N

Approximate Scale: 1" = 150’

0 150’ 300’

Source: Google Earth satellite image dated 5/29/2023 with Tentative Tract Map No. 20612 Sheet 3 overlay.

Plate 2
Exploration Location Map

Proposed Subdivision Project
Pipes Canyon Road
Pioneertown, San Bernardino County, California

Earth Systems

7/3/2025 | File No.: 307129-001



NPDES PERMIT ASSISTANCE • SWPPP • TRAINING • INSPECTION • SUSMP • WQMP
WQTR • DUST CONTROL • LEAD COMPLIANCE • OSHA

SOCAL OFFICE: (909) 957-4239 NORCAL OFFICE: (530) 333-5696

Appendix F

Noise Memo

MD ACOUSTICS
Sound Solutions for Planning and Design

AZ Office
4960 S. Gilbert Road, Ste 1-461
Chandler, AZ 85249
p. (602) 774-1950

CA Office
1197 Los Angeles Avenue, Ste C-256
Simi Valley, CA 93065
p. (805) 426-4477

www.mdacoustics.com

February 3, 2025

Rich Malacoff
The Altum Group
44-600 Village Court Suite 100
Palm Desert, CA 92260

Subject: TTM 20612 – Noise Memo – San Bernardino County, CA

Dear Mr. Malacoff:

MD Acoustics, LLC (MD) has completed a noise impact assessment for the proposed Single-Family Residential Project TTM 20612 located on the north and south sides of Pipes Canyon Road in the City of Pioneertown, California, which is an unincorporated area of San Bernardino County, CA (APNs: 0594-351-32, 32).

This noise assessment intends to demonstrate the project's compliance with applicable noise regulations and lack of significant noise impacts. A list of definitions and terminology is located in Appendix A.

1.0 Project Description and Assessment Overview

The project site is approximately 123 acres and is currently designated by the County's General Plan as Rural Living single family homes (RL-5), with a minimum lot size of five acres, as well as Resource Conservation (RC). The project proposes to divide the property into 13 lots. 12 lots will be developed as five-acre residential parcels for single-family homes, consistent with the Rural Living RL-5 zoning. The remaining lot, within the Resource Conservation (RC) zoning area, will maintain its current designation to protect the site's natural resources and environmental features. The proposed project site plan is in Exhibit B.

Land uses and the closest existing sensitive receptors surrounding the site include single-family residential uses to the north, east, south, and west. The project is not within two miles of a public airport or public use airport. The proposed project location is in Exhibit A.

2.0 Local Acoustical Requirements and CEQA Guidelines

The County of San Bernardino has outlined the following within the County Code as it relates to noise regulation:

> Per Section 83.01.080(c), daytime noise standards for stationary noise sources are 55 dBA Leq for residential uses and professional services uses, 60 dBA Leq for all other commercial uses and 70 dBA Leq for industrial uses. Nighttime standards are the same as daytime, except for residential uses, where the limit is 45 dBA Leq. These noise levels must not be exceeded for the receiving land use for more than 30 minutes in an hour, more than 15 minutes at +5 dB(A), more than 5 minutes at +10 dB(A), more than 1 minute at +15 dB(A), or for more than any amount of time at +20 dB(A).

Per Section 83.01.080(d), mobile source noise standards at residential receptors are 45 dBA Ldn (or CNEL) for interior spaces and 60 dBA Ldn for exterior. An exterior noise level up to 65 dBA Ldn is allowed if exterior noise is mitigated with the best available technology and interior noise does not exceed 45 dBA Ldn with windows and doors closed.

Per Section 83.01.080(e), if the measured ambient level exceeds the noise standard, then the maximum allowable noise level shall be increased to reflect the ambient noise level.

Per Section 83.01.080(g)(3), construction operations are exempt from noise standards when they occur between the hours of 7 AM to 7 PM Monday through Saturday excluding Federal holidays.

According to CEQA guidelines, the project would have a potential impact if it resulted in:

a) Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?

b) Generation of excessive groundborne vibration or groundborne noise levels?

c) For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?

3.0 Study Method and Procedure

3.1 FHWA Construction Noise Model

The construction noise analysis utilizes the FHWA Roadway Construction Noise Model methodology, together with several key construction parameters. Key inputs include distance to the sensitive receiver, equipment usage, % usage factor, and baseline parameters for the project site. The project was analyzed based on the different construction phases. The FHWA has compiled data regarding the noise-generated characteristics of typical construction activities and is presented in Table 1.

Table 1: RCNM Measured Noise Emission Reference Levels[1]

Type	Typical Noise Level at 50 Feet (dBA)
Dozer	82
Grader	85
Tractor	84
Roller	80
Crane	81
Man Lift	75
Air Compressor	78

Notes:
[1] Referenced Noise Levels from the FHWA RCNM.

3.2 Construction Vibration Model

Construction activities can produce vibration that may be felt by adjacent land uses. The construction of the proposed project would not require the use of equipment such as pile drivers, which are known to generate substantial construction vibration levels. The primary vibration source during construction may be from a vibratory roller or a bulldozer. A vibratory roller has a vibration impact of 0.21 inches per second peak partible velocity (PPV) at 25 feet and a large bulldozer has a vibration impact of 0.089 inches per second PPV at 25 feet both of which are likely perceptible but below any risk of architectural damage.

The fundamental equation used to calculate vibration propagation through average soil conditions and distance is as follows:

$$PPV_{equipment} = PPV_{ref} (25/D_{rec})^n$$

Where: PPV_{ref} = reference PPV at 25ft.
D_{rec} = distance from equipment to receiver in ft.
n = 1.1 (the value related to the attenuation rate through ground)

The thresholds from the Caltrans Transportation and Construction Induced Vibration Guidance Manual provide general thresholds and guidelines as to the vibration damage potential from vibratory impacts.

4.0 Traffic Noise Level Projections

Traffic noise along Pipes Canyon Road will be the main source of noise impacting the project site and the surrounding area. The project is expected to generate 113 daily trips, with 8 AM peak hour trips and 11 PM peak hour trips.

Since the trip generation does not exceed the CMP threshold of 250 two-way peak hour trips per County guidelines, the project is exempt from a full traffic analysis. It takes a change of 3 dB or more to hear an audible difference, which would occur with a doubling of traffic. The traffic volume along Pipes Canyon Road is assumed to be much greater than 113 trips per day based on adjacent land uses and its connection to SR-247. Thus, the project-related traffic is not anticipated to audibly increase the existing noise level, and the impact is less than significant.

5.0 Project Operational Noise Level Projections

On-site operational noise includes HVAC units for each single-family residence. One 3-ton unit of HVAC equipment is assumed to be located on the ground near each of the single-family homes. The equipment will be at least 165 feet away from adjacent residences. The maximum sound power level from a single unit is 73 dBA. At 165 feet away, the sound pressure level is estimated to be 28 dBA. For all 12 units operating simultaneously, the sound level is 39 dBA. This is assuming all units are 165 feet away from the receiver when in reality most will be well over 165 feet away. The maximum sound level at the nearby residential receivers from on-site operations will be 39 dBA Leq. This is well below the County's residential nighttime noise limit of 45 dBA Leq. Thus, the impact is less than significant. See Appendix B for the reference HVAC unit noise level.

6.0 Construction Noise Level Projections

The degree of construction noise may vary for different areas of the project site and also vary depending on the construction activities. Noise levels associated with the construction will vary with the different phases of construction. The nearest sensitive receptor to construction operations is a residence to the west of the project site. All construction activities will be as close as 100 feet and an average of 1300 feet from the nearest sensitive receptor. Table 2 presents the construction noise levels at the nearest sensitive receptor. See Appendix C for calculations.

Table 2: Projected Construction Noise Levels (dBA, Leq)[1]

Location	Phase	Construction Noise Level	Exceeds Significant Threshold?
Adjacent Residential Properties	Site Prep	50.1	No
	Grade	50.8	No
	Build	48.5	No
	Pave	44.7	No
	Arch Coat	36.4	No

Per Section 83.01.080(g)(3) of the County code, construction operations are to occur between the hours of 7 AM and 7 PM Monday through Saturday excluding Federal holidays. During these hours, construction is exempt from noise standards. The impact is, therefore, less than significant.

7.0 Construction Vibration Level Projections

Vibratory rollers and bulldozers will get as close as 100 ft to the nearest residential buildings surrounding the project site. During construction, the vibratory rollers may generate vibration levels up to 0.046 in/sec PPV, while the bulldozers may generate up to 0.019 in/sec PPV. The vibrations from the rollers may be perceptible, whereas those from the bulldozers are unlikely to be noticeable. However, both vibration levels remain below the 0.2 in/sec PPV threshold for potential damage to nearby buildings. The impact is, therefore, less than significant. See Appendix E for calculations.

8.0 Conclusions

The Project will be compliant with the County's noise ordinance and CEQA guidelines. In addition, the project will not generate a noise impact during operation. MD is pleased to provide this noise assessment for the proposed project. If you have any questions regarding this analysis, please call our office at (805) 426-4477.

Sincerely,
MD Acoustics, LLC



Naomi Jensen, INCE-USA
Acoustical Consultant



Sarah Ostergaard, INCE-USA
Acoustical Consultant

Exhibit A
Location Map

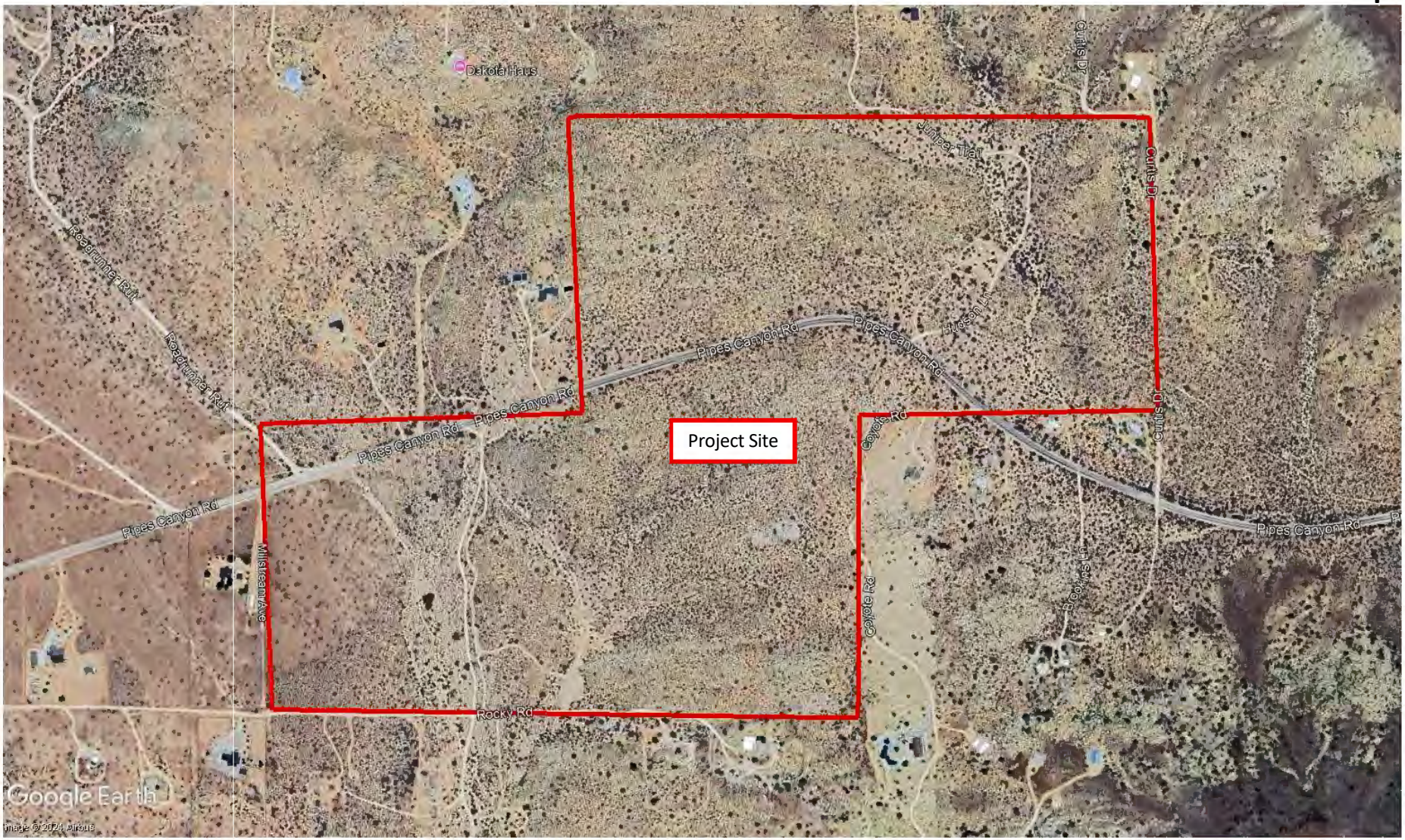
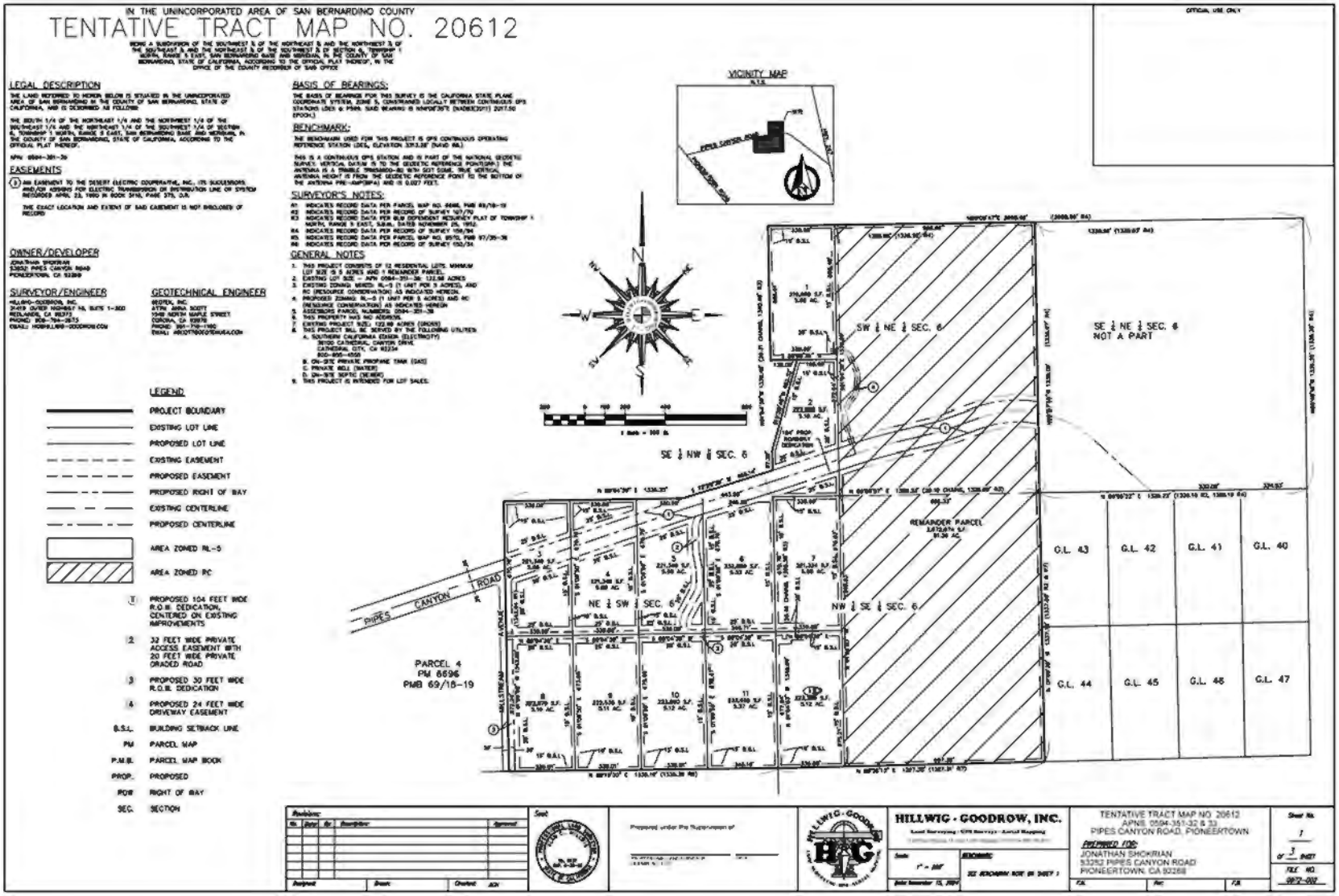


Exhibit B
Site Plan



Appendix A

Glossary of Acoustical Terms

Glossary of Terms

A-Weighted Sound Level: The sound pressure level in decibels as measured on a sound level meter using the A-weighted filter network. The A-weighting filter de-emphasizes the very low and very high-frequency components of the sound in a manner similar to the response of the human ear. A numerical method of rating human judgment of loudness.

Ambient Noise Level: The composite of noise from all sources, near and far. In this context, the ambient noise level constitutes the normal or existing level of environmental noise at a given location.

Community Noise Equivalent Level (CNEL): The average equivalent A-weighted sound level during a 24-hour day, obtained after the addition of five (5) decibels to sound levels in the evening from 7:00 to 10:00 PM and after the addition of ten (10) decibels to sound levels in the night before 7:00 AM and after 10:00 PM.

Decibel (dB): A unit for measuring the amplitude of a sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure, which is 20 micro-pascals.

dB(A): A-weighted sound level (see definition above).

Equivalent Sound Level (LEQ): The sound level corresponding to a steady noise level over a given sample period with the same amount of acoustic energy as the actual time-varying noise level. The energy average noise level during the sample period.

Habitable Room: Any room meeting the requirements of the Uniform Building Code or other applicable regulations which is intended to be used for sleeping, living, cooking, or dining purposes, excluding such enclosed spaces as closets, pantries, bath or toilet rooms, service rooms, connecting corridors, laundries, unfinished attics, foyers, storage spaces, cellars, utility rooms, and similar spaces.

L(n): The A-weighted sound level exceeded during a certain percentage of the sample time. For example, L10 in the sound level exceeded 10 percent of the sample time. Similarly L50, L90, L99, etc.

Noise: *A*ny unwanted sound or sound which is undesirable because it interferes with speech and hearing or is intense enough to damage hearing, or is otherwise annoying. The State Noise Control Act defines noise as "...excessive undesirable sound...".

Noise Criteria (NC) Method: This metric plots octave band sound levels against a family of reference curves, with the number rating equal to the highest tangent line value as demonstrated in Figure 1.

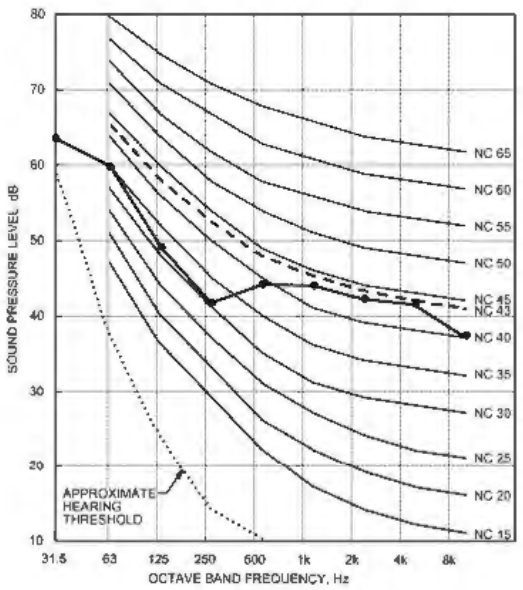
Percent Noise Levels: See L(n).

Room Criterion (RC) Method: When sound quality in the space is important, the RC metric provides a diagnostic tool to quantify both the speech interference level and spectral imbalance.

Sound Level (Noise Level): The weighted sound pressure level obtained by use of a sound level meter having a standard frequency filter for attenuating part of the sound spectrum.

Sound Level Meter: An instrument, including a microphone, an amplifier, an output meter, and frequency weighting networks for the measurement and determination of noise and sound levels.

FIGURE 1: Sample NC Curves and Sample Spectrum Levels



***Sound Transmission Class (STC)*:** To quantify STC, a Transmission Loss (TL) measurement is performed in a laboratory over a range of 16 third-octave bands between 125 – 4,000 Hertz (Hz). The average human voice creates sound within the 125 – 4,000 Hz 1/3rd octave bands.

STC is a single-number rating given to a particular material or assembly. The STC rating measures the ability of a material or an assembly to resist airborne sound transfer over the specified frequencies (see ASTM International Classification E413 and E90). In general, a higher STC rating corresponds with a greater reduction of noise transmitting through a partition.

STC is highly dependent on the construction of the partition. The STC of a partition can be increased by: adding mass, increasing or adding air space, and adding absorptive materials within the assembly. The STC rating does not assess low-frequency sound transfer (e.g. sounds less than 125 Hz). Special consideration must be given to spaces where the noise transfer concern has lower frequencies than speech, such as mechanical equipment and or/or music. The STC rating is a lab test that does not take into consideration weak points, penetrations, or flanking paths.

Even with a high STC rating, any penetration, air-gap, or “flanking path can seriously degrade the isolation quality of a wall. Flanking paths are the means for sound to transfer from one space to another other than through the wall. Sound can flank over, under, or around a wall. Sound can also travel through common ductwork, plumbing, or corridors. Noise will travel between spaces at the weakest points. Typically, there is no reason to spend money or effort to improve the walls until all weak points are controlled first.

Outdoor Living Area: Outdoor spaces that are associated with residential land uses typically used for passive recreational activities or other noise-sensitive uses. Such spaces include patio areas, barbecue areas, jacuzzi areas, etc. associated with residential uses; outdoor patient recovery or resting areas associated with hospitals, convalescent hospitals, or rest homes; outdoor areas associated with places of worship which have a significant role in services or other noise-sensitive activities; and outdoor school facilities routinely used for educational purposes which may be adversely impacted by noise. Outdoor areas usually not included in this definition are: front yard areas, driveways, greenbelts, maintenance areas and storage areas associated with residential land uses; exterior areas at hospitals that are not used for patient activities; outdoor areas associated with places of worship and principally used for short-term social gatherings; and, outdoor areas associated with school facilities that are not typically associated with educational uses prone to adverse noise impacts (for example, school play yard areas).

Percent Noise Levels: See L(n).

Sound Level (Noise Level): The weighted sound pressure level obtained by use of a sound level meter having a standard frequency filter for attenuating part of the sound spectrum.

Sound Level Meter: An instrument, including a microphone, an amplifier, an output meter, and frequency weighting networks for the measurement and determination of noise and sound levels.

Single Event Noise Exposure Level (SENEL): The dB(A) level which, if it lasted for one second, would produce the same A-weighted sound energy as the actual event.

Appendix B

HVAC Reference Sheet

50PG03–14
Ultra High Efficiency Single Package Electric Cooling with Optional Electric Heat Commercial Rooftop Units with Puron® (R–410A) Refrigerant, Optional EnergyX™ (Energy Recovery Ventilator)
2 to 12.5 Nominal Tons

Carrier
turn to the experts

Not equipment being used, but a similar assumption

Product Data

CENTURION



DEALER DESIGN AWARDS
the NEWS | GOLD

BUILDINGS magazine
Editors' Choice
TOP 100 PRODUCTS
2005

Puron
the environmentally sound refrigerant

AHRI* CAPACITY RATINGS

50PG03-14

UNIT 50PG	NOMINAL CAPACITY (Tons)	NET COOLING CAPACITY (Btuh)	TOTAL POWER (kW)	SEER	EER†	SOUND RATING (dB)	IEER
03	2.0	24,000	2.1	14.1	11.5	75	—
04	3.0	35,800	3.1	14.1	11.7	73	—
05	4.0	47,500	4.0	15.0	12.2	72	—
06	5.0	58,500	4.9	14.8	12.2	78	—
07	6.0	69,000	5.8	—	12.2	78	13.0
08	7.5	88,000	7.0	—	12.7	80	13.5
09	8.5	102,000	8.4	—	12.4	80	13.4
12	10.0	119,000	9.9	—	12.2	80	13.0
14	12.5	150,000	13.2	—	11.5	83	11.6

Assuming 1 3-ton unit per condo unit or single -family home

LEGEND
EER – Energy Efficiency Ratio
SEER – Seasonal Energy Efficiency Ratio

*Air Conditioning, Heating and Refrigeration Institute.
† AHRI does not require EER ratings for units with capacity below 65,000 Btuh.

NOTES:
1. Tested in accordance with AHRI Standards 210–94 (sizes 03–12), 360–93 (size 14).
2. Ratings are net values, reflecting the effects of circulating fan heat.
3. Ratings are based on:
Cooling Standard: 80°F db, 67°F wb indoor entering–air temperature and 95°F db air entering outdoor unit.
IPLV Standard: 80°F db, 67°F wb indoor entering–air temperature and 80°F db outdoor entering–air temperature.
4. All 50PG units are in compliance with Energy Star® and ASHRAE 90.1 2010 Energy Standard for minimum SEER and EER requirements.
5. Units are rated in accordance with AHRI sound standards 270 or 370.
6. Per AHRI, Integrated Energy Efficiency Ratio (IEER) became effective beginning January 1, 2010. Integrated Part–Load Value (IPLV) was superseded by IEER on January 1, 2010. IEER is intended to be a measure of merit for the part load performance of the unit. Each building may have different part load performance due to local occupancy schedules, building construction, building location and ventilation requirements. For specific building energy analysis, an hour–by–hour analysis program should be used.

Use of the AHRI Certified TM Mark indicates a manufacturer's participation in the program For verification of certification for individual products, go to www.ahridirectory.org.

Appendix C

Construction Noise and Vibration Calculations

5. Activity Data

5.1. Construction Schedule

Phase Name	Phase Type	Start Date	End Date	Days Per Week	Work Days per Phase	Phase Description
Site Preparation	Site Preparation	7/1/2025	7/16/2025	5.00	12.0	—
Grading	Grading	7/17/2025	9/3/2025	5.00	35.0	—
Building Construction	Building Construction	9/4/2025	1/6/2027	5.00	350	—
Paving	Paving	12/1/2026	1/6/2027	5.00	27.0	—
Architectural Coating	Architectural Coating	12/1/2026	1/6/2027	5.00	27.0	—

5.2. Off-Road Equipment

5.2.1. Unmitigated

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Site Preparation	Rubber Tired Dozers	Diesel	Average	3.00	8.00	367	0.40
Site Preparation	Tractors/Loaders/Backhoes	Diesel	Average	4.00	8.00	84.0	0.37
Grading	Excavators	Diesel	Average	2.00	8.00	36.0	0.38
Grading	Graders	Diesel	Average	1.00	8.00	148	0.41
Grading	Rubber Tired Dozers	Diesel	Average	1.00	8.00	367	0.40
Grading	Scrapers	Diesel	Average	2.00	8.00	423	0.48
Grading	Tractors/Loaders/Backhoes	Diesel	Average	2.00	8.00	84.0	0.37
Building Construction	Cranes	Diesel	Average	1.00	7.00	367	0.29
Building Construction	Forklifts	Diesel	Average	3.00	8.00	82.0	0.20
Building Construction	Generator Sets	Diesel	Average	1.00	8.00	14.0	0.74
Building Construction	Tractors/Loaders/Backhoes	Diesel	Average	3.00	7.00	84.0	0.37
Building Construction	Welders	Diesel	Average	1.00	8.00	46.0	0.45

Paving	Pavers	Diesel	Average	2.00	8.00	81.0	0.42
Paving	Paving Equipment	Diesel	Average	2.00	8.00	89.0	0.36
Paving	Rollers	Diesel	Average	2.00	8.00	36.0	0.38
Architectural Coating	Air Compressors	Diesel	Average	1.00	6.00	37.0	0.48

5.3. Construction Vehicles

5.3.1. Unmitigated

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Site Preparation	—	—	—	—
Site Preparation	Worker	17.5	18.5	LDA,LDT1,LDT2
Site Preparation	Vendor	—	10.2	HHDT,MHDT
Site Preparation	Hauling	0.00	20.0	HHDT
Site Preparation	Onsite truck	—	—	HHDT
Grading	—	—	—	—
Grading	Worker	20.0	18.5	LDA,LDT1,LDT2
Grading	Vendor	—	10.2	HHDT,MHDT
Grading	Hauling	35.7	20.0	HHDT
Grading	Onsite truck	—	—	HHDT
Building Construction	—	—	—	—
Building Construction	Worker	4.32	18.5	LDA,LDT1,LDT2
Building Construction	Vendor	1.28	10.2	HHDT,MHDT
Building Construction	Hauling	0.00	20.0	HHDT
Building Construction	Onsite truck	—	—	HHDT
Paving	—	—	—	—
Paving	Worker	15.0	18.5	LDA,LDT1,LDT2
Paving	Vendor	5.00	10.2	HHDT,MHDT
Paving	Hauling	0.00	20.0	HHDT

Receptor - Residences to the West

Construction Phase Equipment Item	# of Items	Item Lmax at 50 feet, dBA[1]	Edge of Site to Receptor, feet	Center of Site to Receptor, feet	Item Usage Percent[1]	Ground Factor[2]	Usage Factor	Receptor Item Lmax, dBA	Recptor. Item Leq, dBA
SITE PREP									
Tractor	4	84	100	1300	40	0.66	0.40	76.0	42.4
Dozer	3	82	100	1300	40	0.66	0.40	74.0	40.4
							Log Sum	76.0	50.1
GRADE									
Excavator	2	81	100	1300	40	0.66	0.40	73.0	39.4
Grader	1	85	100	1300	40	0.66	0.40	77.0	43.4
Dozer	1	82	100	1300	40	0.66	0.40	74.0	40.4
Scraper	2	84	100	1300	40	0.66	0.40	76.0	42.4
Tractor	2	84	100	1300	40	0.66	0.40	76.0	42.4
								77.0	50.8
BUILD									
Crane	1	81	100	1300	16	0.66	0.16	73.0	35.4
Man lift	3	75	100	1300	20	0.66	0.20	67.0	30.4
Generator	1	81	100	1300	50	0.66	0.50	73.0	40.4
Tractor	3	84	100	1300	40	0.66	0.40	76.0	42.4
Welder/Torch	1	74	100	1300	40	0.66	0.40	66.0	32.4
								76.0	48.5
PAVE									
Paver	2	77	100	1300	50	0.66	0.50	69.0	36.4
Compactor (ground)	2	83	100	1300	20	0.66	0.20	75.0	38.4
Roller	2	80	100	1300	20	0.66	0.20	72.0	35.4
								75.0	44.7
ARCH COAT									
Compressor (air)	1	78	100	1300	40	0.66	0.40	70.0	36.4
								70.0	36.4

[1]FHWA Construction Noise Handbook: Table 9.1 RCNM Default Noise Emission Reference Levels and Usage Factors

VIBRATION LEVEL IMPACT

Project:	TTM 20612	Date: 2/3/25
Source:	Vibratory Roller	
Scenario:	Unmitigated	
Location:	West Residences	
Address:	Pipe Canyon Road, San Bernardino County	

PPV = PPVref(25/D)^n (in/sec)

DATA INPUT

Equipment = Type	1	Vibratory Roller	INPUT SECTION IN BLUE
PPVref =	0.21	Reference PPV (in/sec) at 25 ft.	
D =	100.00	Distance from Equipment to Receiver (ft)	
n =	1.10	Vibration attenuation rate through the ground	

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

DATA OUT RESULTS

PPV =	**0.046**	IN/SEC	OUTPUT IN RED

VIBRATION LEVEL IMPACT

Project:	TTM 20612	Date: 2/3/25
Source:	Vibratory Roller	
Scenario:	Unmitigated	
Location:	West Residences	
Address:	Pipe Canyon Road, San Bernardino County	

PPV = PPVref(25/D)^n (in/sec)

DATA INPUT

Equipment = Type	2	Large Bulldozer	INPUT SECTION IN BLUE
PPVref =	0.089	Reference PPV (in/sec) at 25 ft.	
D =	100.00	Distance from Equipment to Receiver (ft)	
n =	1.10	Vibration attenuation rate through the ground	

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

DATA OUT RESULTS

PPV =	**0.019**	IN/SEC	OUTPUT IN RED

Appendix G.1

Trip Generation Assessment

INTEGRATED ENGINEERING GROUP
TRANSPORTATION PLANNING AND ENGINEERING

Date: January 10, 2025

To: Couty Traffic Engineer, County of San Bernardino

From: George Ghossain, Principal Engineer, Integrated Engineering Group

Subject: Trip Generation Assessment for Pipes Canyon Residential Lots Project

---

Integrated Engineering Group (IEG) is pleased to submit this trip generation assessment memo for the Pipes Canyon Residential Lots Subdivision Project located in Pioneer Town, unincorporated San Bernardino County, California. The proposed project seeks approval to subdivide 122.98 acres into 13 individual lots. Of these, 12 lots will be developed as single-family homes while the remaining lot will retain its current Resource Conservation designation, preserving the site's natural resources and environmental features.

Our goal is to ensure that this memo fully addresses the analysis requirements provided by the County of San Bernardino *Recommended Traffic Impact Analysis Guidelines for Vehicle Miles Traveled and Level of Service Assessment February 2020 (Guidelines)*.

The tentative tract map for the proposed Project is shown on **Attachment 1**. It is anticipated that the proposed development will be built in one phase.

TRAFFIC ANALYSIS SCREENING

TRIP GENERATION

Trip generation is a measure or forecast of the number of trips that begin or end at the project site. The traffic generated is a function of the extent and type of development proposed for the site. These trips will result in some traffic increases on the streets where they occur. Per the County Guidelines, trip generation rates from the *Trip Generation Manual, 11th Edition*, published by the Institute of Transportation Engineers (ITE) should be used to determine trip generation. Project ITE average trip generation rates and trip calculations summary are presented in **Table 1** and **Table 2**, respectively.

Table 1 – Project Trip Generation Rates

Land Use[1]	Units[2]	ITE LU Code	AM Peak Hour			PM Peak Hour			Daily
			In	Out	Total	In	Out	Total	
Single-Family Detached Housing	DU	210	0.18	0.52	0.7	0.59	0.35	0.94	9.43

[1] Trip Generation Source: Institute of Transportation Engineers (ITE), Trip Generation Manual, Eleventh Edition (2021).
[2] DU = Dwelling Unit

Table 2 – Project Trip Generation Summary

Land Use[1]	Intensity	Units[2]	AM Peak Hour			PM Peak Hour			Daily
			In	Out	Total	In	Out	Total	
Single-Family Detached Housing	12	DU	2	6	8	7	4	11	113
		Total	***2***	***6***	***8***	***7***	***4***	***11***	***113***

[1] Trip Generation Source: Institute of Transportation Engineers (ITE), Trip Generation Manual, Eleventh Edition (2021).
[2] DU = Dwelling Units

Table 2 summarizes the anticipated trip generated by the proposed project. As shown in above table, the proposed project is estimated to generate approximately a total of 113 daily trips, 8 AM peak hour trips and 11 PM peak hour trips.

EXEMPTION ASSESSMENT

Per County Guidelines, the project is exempt from conducting a full traffic analysis since the project trips are not forecasted to equal or exceed the CMP threshold of 250 two-way peak hour trips.

SIGNIFICANCE DETERMINATION

The project has demonstrated consistency with the adopted County of San Bernardino Guidelines.

PROJECT TRIP DISTRIBUTION AND ASSIGNMENT

Trip distribution and assignment is the process of identifying the probable destinations, directions and traffic routes that Project related traffic will likely affect. Trip distribution and assignment are not applicable in this case since this memo has demonstrated, per the County of San Bernardino Guidelines, that the project trip generation will be less than 250 vehicles during the peak hours; therefore, a full traffic impact analysis will not be required.

Intersection & roadway segment Capacity Analyses

Intersection and roadway capacity analyses are not applicable in this case since this memo has demonstrated, per the County of San Bernardino Guidelines, that the project trip generation will be less than 250 vehicles during the peak hours; therefore, a full traffic impact analysis will not be required.

Project Access

Access to the Project site will be provided via private access easements along the north and south sides of Pipes Canyon Road.

Parking

The proposed development will be required to provide on-site parking spaces consistent with County of San Bernardino parking requirements.

Conclusion

The proposed Project is located within the County of San Bernardino and consists of 12 single-family residential lots. It is determined that the proposed project qualifies for an exemption from conducting a detailed traffic impact analysis based on the traffic assessment and technical information provided in this memo.

If you have any questions or concerns, please feel free to contact George Ghossain at:

Email: george@intenggroup.com
Phone: (951) 239-1546
Address: 23905 Clinton Keith Road 114-280
Wildomar CA, 92595

Attachments: 1 – Project Tentative Tract Map

Attachment 1 – Project Tentative Tract Map

IN THE UNINCORPORATED AREA OF SAN BERNARDINO COUNTY

TENTATIVE TRACT MAP NO. 20612

BEING A SUBDIVISION OF THE SOUTHWEST ¼ OF THE NORTHEAST ¼ AND THE NORTHWEST ¼ OF THE SOUTHEAST ¼ AND THE NORTHEAST ¼ OF THE SOUTHWEST ¼ OF SECTION 6, TOWNSHIP 1 NORTH, RANGE 5 EAST, SAN BERNARDINO BASE AND MERIDIAN, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF, IN THE OFFICE OF THE COUNTY RECORDER OF SAID OFFICE

OFFICIAL USE ONLY

LEGAL DESCRIPTION

THE LAND REFERRED TO HEREIN BELOW IS SITUATED IN THE UNINCOPORATED AREA OF SAN BERNARDINO IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, AND IS DESCRIBED AS FOLLOWS:

THE SOUTH 1/4 OF THE NORTHEAST 1/4 AND THE NORTHWEST 1/4 OF THE SOUTHEAST 1/4 AND THE NORTHEAST 1/4 OF THE SOUTHWEST 1/4 OF SECTION 6, TOWNSHIP 1 NORTH, RANGE 5 EAST, SAN BERNARDINO BASE AND MERIDIAN, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF.

APN: 0594-351-36

EASEMENTS

(3) AN EASEMENT TO THE DESERT ELECTRIC COOPERATIVE, INC., ITS SUCCESSORS AND/OR ASSIGNS FOR ELECTRIC TRANSMISSION OR DISTRIBUTION LINE OR SYSTEM RECORDED APRIL 22, 1960 IN BOOK 5118, PAGE 375, O.R.

THE EXACT LOCATION AND EXTENT OF SAID EASEMENT IS NOT DISCLOSED OF RECORD

OWNER/DEVELOPER

JONATHAN SHOKRIAN
53252 PIPES CANYON ROAD
PIONEERTOWN, CA 92268

SURVEYOR/ENGINEER

HILLWIG-GOODROW, INC.
31419 OUTER HIGHWAY 10, SUITE 1-200
REDLANDS, CA 92373
PHONE: 909-794-2673
EMAIL: HG@HILLWIG-GOODROW.COM

GEOTECHNICAL ENGINEER

GEOTEK, INC.
ATTN: ANNA SCOTT
1548 NORTH MAPLE STREET
CORONA, CA 92878
PHONE: 951-710-1160
EMAIL: ASCOTT@GEOTEKUSA.COM

BASIS OF BEARINGS:

THE BASIS OF BEARINGS FOR THIS SURVEY IS THE CALIFORNIA STATE PLANE COORDINATE SYSTEM, ZONE 5, CONSTRAINED LOCALLY BETWEEN CONTINUOUS GPS STATIONS LDES & P599. SAID BEARING IS N59°08'35"E (NAD83(2011) 2017.50 EPOCH.)

BENCHMARK:

THE BENCHMARK USED FOR THIS PROJECT IS GPS CONTINUOUS OPERATING REFERENCE STATION LDES, ELEVATION 3313.28' (NAVD 88.)

THIS IS A CONTINUOUS GPS STATION AND IS PART OF THE NATIONAL GEODETIC SURVEY. VERTICAL DATUM IS TO THE GEODETIC REFERENCE POINT(GRP.) THE ANTENNA IS A TRIMBLE TRM59800-80 WITH SCIT DOME. TRUE VERTICAL ANTENNA HEIGHT IS FROM THE GEODETIC REFERENCE POINT TO THE BOTTOM OF THE ANTENNA PRE-AMP(BPA) AND IS 0.027 FEET.

SURVEYOR'S NOTES:

R1 INDICATES RECORD DATA PER PARCEL MAP NO. 6696, PMB 69/18-19
R2 INDICATES RECORD DATA PER RECORD OF SURVEY 107/70
R3 INDICATES RECORD DATA PER BLM DEPENDENT RESURVEY PLAT OF TOWNSHIP 1 NORTH, RANGE 5 EAST, S.B.M., DATED NOVEMBER 25, 1952.
R4 INDICATES RECORD DATA PER RECORD OF SURVEY 159/94
R5 INDICATES RECORD DATA PER PARCEL MAP NO. 8570, PMB 97/35-36
R6 INDICATES RECORD DATA PER RECORD OF SURVEY 150/34

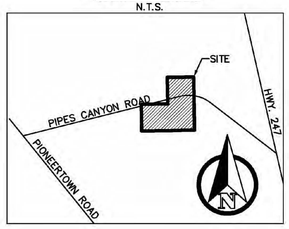
GENERAL NOTES

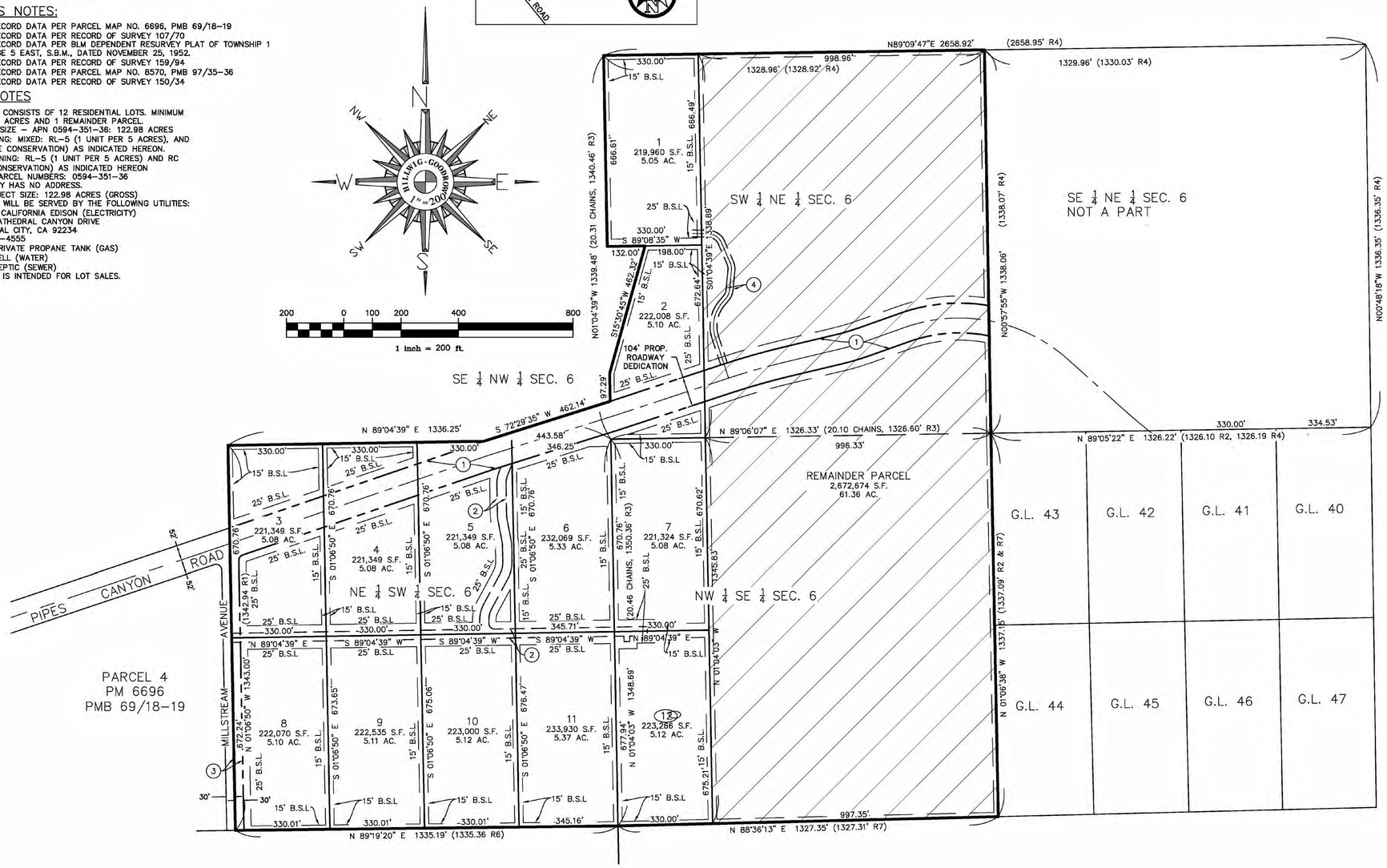
1. THIS PROJECT CONSISTS OF 12 RESIDENTIAL LOTS. MINIMUM LOT SIZE IS 5 ACRES AND 1 REMAINDER PARCEL.
2. EXISTING LOT SIZE - APN 0594-351-36: 122.98 ACRES
3. EXISTING ZONING: MIXED: RL-5 (1 UNIT PER 5 ACRES), AND RC (RESOURCE CONSERVATION) AS INDICATED HEREON.
4. PROPOSED ZONING: RL-5 (1 UNIT PER 5 ACRES) AND RC (RESOURCE CONSERVATION) AS INDICATED HEREON
5. ASSESSORS PARCEL NUMBERS: 0594-351-36
6. THIS PROPERTY HAS NO ADDRESS.
7. EXISTING PROJECT SIZE: 122.98 ACRES (GROSS)
8. THIS PROJECT WILL BE SERVED BY THE FOLLOWING UTILITIES:
   A. SOUTHERN CALIFORNIA EDISON (ELECTRICITY)
      36100 CATHEDRAL CANYON DRIVE
      CATHEDRAL CITY, CA 92234
      800-655-4555
   B. ON-SITE PRIVATE PROPANE TANK (GAS)
   C. PRIVATE WELL (WATER)
   D. ON-SITE SEPTIC (SEWER)
9. THIS PROJECT IS INTENDED FOR LOT SALES.

LEGEND

- PROJECT BOUNDARY
- EXISTING LOT LINE
- PROPOSED LOT LINE
- EXISTING EASEMENT
- PROPOSED EASEMENT
- PROPOSED RIGHT OF WAY
- EXISTING CENTERLINE
- PROPOSED CENTERLINE
- AREA ZONED RL-5
- AREA ZONED RC
- (1) PROPOSED 104 FEET WIDE R.O.W. DEDICATION, CENTERED ON EXISTING IMPROVEMENTS
- (2) 32 FEET WIDE PRIVATE ACCESS EASEMENT WITH 20 FEET WIDE PRIVATE GRADED ROAD
- (3) PROPOSED 30 FEET WIDE R.O.W. DEDICATION
- (4) PROPOSED 24 FEET WIDE DRIVEWAY EASEMENT
- B.S.L. BUILDING SETBACK LINE
- PM PARCEL MAP
- P.M.B. PARCEL MAP BOOK
- PROP. PROPOSED
- ROW RIGHT OF WAY
- SEC. SECTION

VICINITY MAP
N.T.S.





Revisions:				
No.	Date:	By:	Description:	Approved:

Designed: | Drawn: | Checked: ACH

Seal: PROFESSIONAL LAND SURVEYOR ALAN C. HILLWIG No. 5137 EXP. 6-30-25 STATE OF CALIFORNIA

Prepared under the Supervision of:

PROFESSIONAL LAND SURVEYOR
LICENSE NO. 5137

DATE

HILLWIG - GOODROW, INC.
Land Surveying - GPS Surveys - Aerial Mapping
31419 Outer Highway 10, Suite 1-200• Redlands, CA 92373 • (909) 794-2673

Scale: 1" = 200'
Date: November 15, 2024
BENCHMARK: SEE BENCHMARK NOTE ON SHEET 1

TENTATIVE TRACT MAP NO. 20612
APNS: 0594-351-32 & 33
PIPES CANYON ROAD, PIONEERTOWN

PREPARED FOR:
JONATHAN SHOKRIAN
53252 PIPES CANYON ROAD
PIONEERTOWN, CA 92268

F.N. | For: | F.B.

Sheet No. 1 OF 3 SHEET
FILE NO. 0972-002

Appendix G.2

Vehicle Miles Traveled

Pipes Canyon Residential Lots
Vehicle Miles Traveled
Screening Assessment

Prepared for:

The Altum Group
Strive Higher

44-600 Village Court, Suite 100
Palm Desert, CA 92260

Prepared by:

INTEGRATED ENGINEERING GROUP
TRANSPORTATION PLANNING AND ENGINEERING

23905 Clinton Keith Road 114-280
Wildomar, CA 92595

January 2025

1.0 PROJECT INTRODUCTION

The purpose of this report is to evaluate the Pipes Canyon Residential Lots Project's VMT analysis requirements and compliance with Senate Bill 743 (SB 743) and the California Environmental Quality Act (CEQA).

1.1 PROJECT DESCRIPTION

The proposed project seeks approval to subdivide 122.98 acres into 13 individual lots. Of these, 12 lots will be developed as single-family homes while the remaining lot will retain its current Resource Conservation designation, preserving the site's natural resources and environmental features. This VMT analysis evaluated the project using the 2019 and 2050 model years obtained from the San Bernardino County Transportation Authority (SBCTA).

Attachment 1 includes the Project tentative tract map.

1.2 SENATE BILL 743

On September 27, 2013, SB 743 was signed into State law and started a process intended to fundamentally change transportation impact analysis as part of the CEQA compliance. The California Natural Resource Agency updated the CEQA transportation analysis guidelines in 2018. In this update automobile delay and LOS metrics are no longer to be used in determining transportation impacts. Instead VMT metrics will serve as the basis in determining impacts. Furthermore, the guidelines stated that after July 1, 2020, transportation analysis under CEQA must use VMT to determine impacts for land use projects.

1.3 GUIDANCE DOCUMENTS

The project is within the jurisdiction of the County of San Bernardino. The County has adopted guidance on evaluating VMT for transportation impacts under CEQA. For this project the San Bernardino County Transportation Authority (SBCTA) *Recommended Traffic Impact Analysis Guidelines for Vehicle Miles Traveled (VMT) and Level of Service Assessment*, February 2020, hereafter referred to as "Guidelines", will be used for this analysis.

2.0 ANALYSIS METHODOLGY

2.1 SCREENING CRITERIA ASSESMENT

2.1.1 SBCTA Guidelines

The Guidelines detail the requirements for the project's VMT analysis consistent with CEQA including three (3) types of screening to determine if a project could be screened out from conducting a detailed project level VMT analysis.

- Transit Priority Area (TPA) Screening: Projects located within a TPA may be presumed to have a less than significant impact absent substantial evidence to the contrary.
- Low VMT Area Screening: Residential and office projects located within a low VMT-generating area may be presumed to have a less than significant impact absent substantial evidence to the contrary. In addition, other employment-related and mixed-use land use projects may qualify for the use of screening if the project can reasonably be expected to generate VMT per resident, per worker, or per service population that is similar to the existing land uses in the low VMT area.
- Project Type Screening:

a. Local serving retail projects less than 50,000 square feet may be presumed to have a less than significant impact absent substantial evidence to the contrary. Local serving retail generally improves the convenience of shopping close to home and has the effect of reducing vehicle travel.
b. In addition to local serving retail, the following uses can also be presumed to have a less than significant impact absent substantial evidence to the contrary as their uses are local serving in nature:
    i. Local-serving K-12 schools
    ii. Local parks
    iii. Day care centers
    iv. Local-serving gas stations
    v. Local-serving banks
    vi. Local-serving hotels (e.g. non-destination hotels)
    vii. Student housing projects on or adjacent to college campuses
    viii. Local-serving assembly uses (places of worship, community organizations)
    ix. Community institutions (Public libraries, fire stations, local government)
    x. Local serving community colleges that are consistent with the assumptions noted in the RTP/SCS
    xi. Affordable or supportive housing
    xii. Assisted living facilities
    xiii. Senior housing (as defined by HUD)
    xiv. Projects generating less than 110 daily vehicle trips. This generally corresponds to the following "typical" development potentials:
        - 11 single family housing units
        - 16 multi-family, condominiums, or townhouse housing units
        - 10,000 sq. ft. of office
        - 15,000 sq. ft. of light industrial
        - 63,000 sq. ft. of warehousing
        - 79,000 sq. ft. of high cube transload and short-term storage warehouse

2.2 VMT ASSESSMENT FOR NON-SCREENED DEVELOPMENT

Per the Guidelines, projects that do not meet any of the screening criteria identified would need to perform a VMT analysis. The project would need to evaluate the appropriate VMT metrics and compare them to the identified thresholds to determine the level of significance as defined per the Guidelines.

3.0 PROJECT VMT ASSESSMENT

The project is proposing to subdivide 122.98 acres into 13 individual lots.

3.1 SCREENING CRITERIA ASSESSMENT

Transit Priority Area (TPA) Screening: The project is not located in a transit priority area and therefore, the project cannot be screened using this criterion.

Low VMT Area Screening: The guidelines recommend the use of low VMT screening criteria for residential and office projects. The project is located in two separate traffic analysis zones (TAZs). While one TAZ is located in a low VMT screening area, the other TAZ is not within a low VMT area. Therefore, the project cannot be screened out using this criterion.

Project Type

The guidelines established that residential developments with 11 or less single-family dwelling units can be screened out of a detailed VMT analysis. However, the project includes 12 single family dwelling units and therefore, the project cannot be screened out of a VMT analysis based on this criterion.

As described above, the project doesn't meet any of the screening criteria identified in the guidelines. Hence, a full VMT analysis was conducted using the most recent version of San Bernardino County Transportation Analysis Model (SBTAM) – SBTAM Plus (SBTAM 3.2) as recommended in the City's guidelines. SBTAM Plus model is a socioeconomic data-based model and so the project land use was converted into model socioeconomic data which was used as input for the model runs.

3.2 VMT ANALYSIS

As Both baseline (2019) and horizon year (2050) model runs were used to estimate project's VMT impacts. SBTAM socioeconomic databases for both scenarios were updated with project land use to calculate project VMT. Typically, project VMT is calculated by isolating the project in a new TAZ or multiple TAZs depending on the diversity of project land uses and project size. Since SBTAM Plus does not allow for addition of new TAZs, one TAZ was borrowed for this project. Non-project related socioeconomic data for the borrowed TAZ was moved to an adjacent TAZ and only project land use was included for the borrowed TAZ. The project TAZ was utilized to calculate project specific VMT per service population.

No project specific network modifications were conducted for the model scenarios. Full model runs with feedback loops were conducted for all of the project scenarios. It should be noted that the project land use was included in the model as additional land use in the cumulative (2050) scenario and no shifting of land use from other TAZs was used. In that regard, the cumulative VMT analysis can be considered as a conservative estimate.
Based on the Guidelines, project's Origin/Destination (OD) VMT per service population can be used to evaluate project. The Origin/Destination (OD) method for calculating VMT sums all weekday VMT generated by trips with at least one trip-end in the study area and tracks those trips to their origin or destination. Origins are all vehicle trips that start in a specific TAZ, while destinations are all vehicle trips that end in a specific TAZ. The OD method accounts for all trip purposes and therefore provides a more complete estimate of VMT. Therefore, OD VMT per service population was used as the evaluation metric for the project.

Origin-destination matrix outputs were used as trips and the trip lengths were derived from the skimming step to estimate OD VMT as recommended in the guidelines. OD matrix outputs include vehicle trips and hence no conversion for auto occupancy was applied. The trip length or distance was obtained using the model outputs from the "Skimming" step. The model skim outputs include peak and off-peak skim matrices by mode, similar to trip outputs from the model. OD VMT was estimated for both peak and off- peak and added together to estimate the total daily VMT for the project. According to the guidelines, the project would constitute a significant impact if the project OD VMT per service population for base or cumulative scenarios is greater than San Bernardino County Baseline OD VMT per service population. Therefore, the project OD VMT per service population for base and cumulative scenarios was compared with San Bernardino County's Baseline OD VMT per service population to determine project's VMT impact. The San Bernardino County OD VMT per service population threshold was obtained from the online SBCTA VMT Map. (*https://sbcta.maps.arcgis.com/apps/instant/sidebar/index.html?appid=774fb0dfc0584db8b2aa1603c7a 8f5b4*)

Table 1 below shows the project VMT metrics for both baseline (2019) and cumulative (2050) conditions along with the regional VMT thresholds.

Table 1: Project VMT analysis

2019	**Pipes Canyon Residential (project)**	**Baseline San** Bernardino **County (Threshold)***
Population	27	
Employment	-	
Service Population	27	
Total OD VMT	972	
Total OD VMT per service population	35.34	37.99
2025 (interpolated)	**Pipes Canyon Residential (project)**	**Baseline San Bernardino County (Threshold)***
Population	27	
Employment	-	
Service Population	27	
Total OD VMT	980	
Total OD VMT per service population	35.65	37.99
2050	**Pipes Canyon Residential (project)**	**Baseline San Bernardino County (Threshold)***
Population	27	
Employment	-	
Service Population	27	
Total OD VMT	1,016	
Total OD VMT per service population	36.94	37.99

** Threshold value obtained from https://storymaps.arcgis.com/collections/0bf2baea98264893947b15c02bf7be07?item=2 https://sbcta.maps.arcgis.com/apps/instant/sidebar/index.html?appid=774fb0dfc0584db8b2aa1603c7a8f5b4*

Table 2 illustrates the project's effect on VMT. The project's effect on VMT is a comparison of roadway VMT within San Bernardino County for both "With project" and "Without project" conditions.

Table 2: Roadway VMT within San Bernardino County

2019	**With Project**	**Without Project**
Roadway VMT	68,975,027	68,975,804
Service population	3,082,048	3,082,020
VMT per service population	22.4	22.4
2025 (interpolated)	**With Project**	**Without Project**
Roadway VMT	73,922,521	73,923,305
Service population	3,213,500	3,213,472
VMT per service population	23.0	23.0
2050	**With Project**	**Without Project**
Roadway VMT	94,537,082	94,537,893
Service population	3,761,218	3,761,191
VMT per service population	25.1	25.1

4.0 CONCLUSION

Based on the VMT analysis as shown in above **Table 1** and **Table 2,** the project doesn't constitute a significant impact for both "project generated VMT" and "project's effect on VMT".

Should you have any questions, please feel free to contact George Ghossain at:

Email: george@intenggroup.com
Phone: (951) 239-1546
Address: 23905 Clinton Keith Road 114-280
Wildomar CA, 92595

Attachment 1 – Project Tentative Tract Map

Attachment 1 – Project Tentative Tract Map

IN THE UNINCORPORATED AREA OF SAN BERNARDINO COUNTY

TENTATIVE TRACT MAP NO. 20612

BEING A SUBDIVISION OF THE SOUTHWEST ¼ OF THE NORTHEAST ¼ AND THE NORTHWEST ¼ OF THE SOUTHEAST ¼ AND THE NORTHEAST ¼ OF THE SOUTHWEST ¼ OF SECTION 6, TOWNSHIP 1 NORTH, RANGE 5 EAST, SAN BERNARDINO BASE AND MERIDIAN, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF, IN THE OFFICE OF THE COUNTY RECORDER OF SAID OFFICE

OFFICIAL USE ONLY

LEGAL DESCRIPTION

THE LAND REFERRED TO HEREIN BELOW IS SITUATED IN THE UNINCOPORATED AREA OF SAN BERNARDINO IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, AND IS DESCRIBED AS FOLLOWS:

THE SOUTH 1/4 OF THE NORTHEAST 1/4 AND THE NORTHWEST 1/4 OF THE SOUTHEAST 1/4 AND THE NORTHEAST 1/4 OF THE SOUTHWEST 1/4 OF SECTION 6, TOWNSHIP 1 NORTH, RANGE 5 EAST, SAN BERNARDINO BASE AND MERIDIAN, IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF.

APN: 0594-351-36

EASEMENTS

(3) AN EASEMENT TO THE DESERT ELECTRIC COOPERATIVE, INC., ITS SUCCESSORS AND/OR ASSIGNS FOR ELECTRIC TRANSMISSION OR DISTRIBUTION LINE OR SYSTEM RECORDED APRIL 22, 1960 IN BOOK 5118, PAGE 375, O.R.

THE EXACT LOCATION AND EXTENT OF SAID EASEMENT IS NOT DISCLOSED OF RECORD

OWNER/DEVELOPER

JONATHAN SHOKRIAN
53252 PIPES CANYON ROAD
PIONEERTOWN, CA 92268

SURVEYOR/ENGINEER

HILLWIG-GOODROW, INC.
31419 OUTER HIGHWAY 10, SUITE 1-200
REDLANDS, CA 92373
PHONE: 909-794-2673
EMAIL: HG@HILLWIG-GOODROW.COM

GEOTECHNICAL ENGINEER

GEOTEK, INC.
ATTN: ANNA SCOTT
1548 NORTH MAPLE STREET
CORONA, CA 92878
PHONE: 951-710-1160
EMAIL: ASCOTT@GEOTEKUSA.COM

BASIS OF BEARINGS:

THE BASIS OF BEARINGS FOR THIS SURVEY IS THE CALIFORNIA STATE PLANE COORDINATE SYSTEM, ZONE 5, CONSTRAINED LOCALLY BETWEEN CONTINUOUS GPS STATIONS LDES & P599. SAID BEARING IS N59°08'35"E (NAD83(2011) 2017.50 EPOCH.)

BENCHMARK:

THE BENCHMARK USED FOR THIS PROJECT IS GPS CONTINUOUS OPERATING REFERENCE STATION LDES, ELEVATION 3313.28' (NAVD 88.)

THIS IS A CONTINUOUS GPS STATION AND IS PART OF THE NATIONAL GEODETIC SURVEY. VERTICAL DATUM IS TO THE GEODETIC REFERENCE POINT(GRP.) THE ANTENNA IS A TRIMBLE TRM59800-80 WITH SCIT DOME. TRUE VERTICAL ANTENNA HEIGHT IS FROM THE GEODETIC REFERENCE POINT TO THE BOTTOM OF THE ANTENNA PRE-AMP(BPA) AND IS 0.027 FEET.

SURVEYOR'S NOTES:

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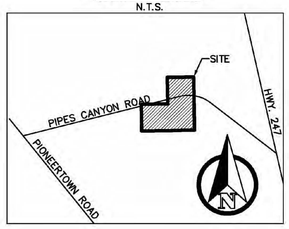
GENERAL NOTES

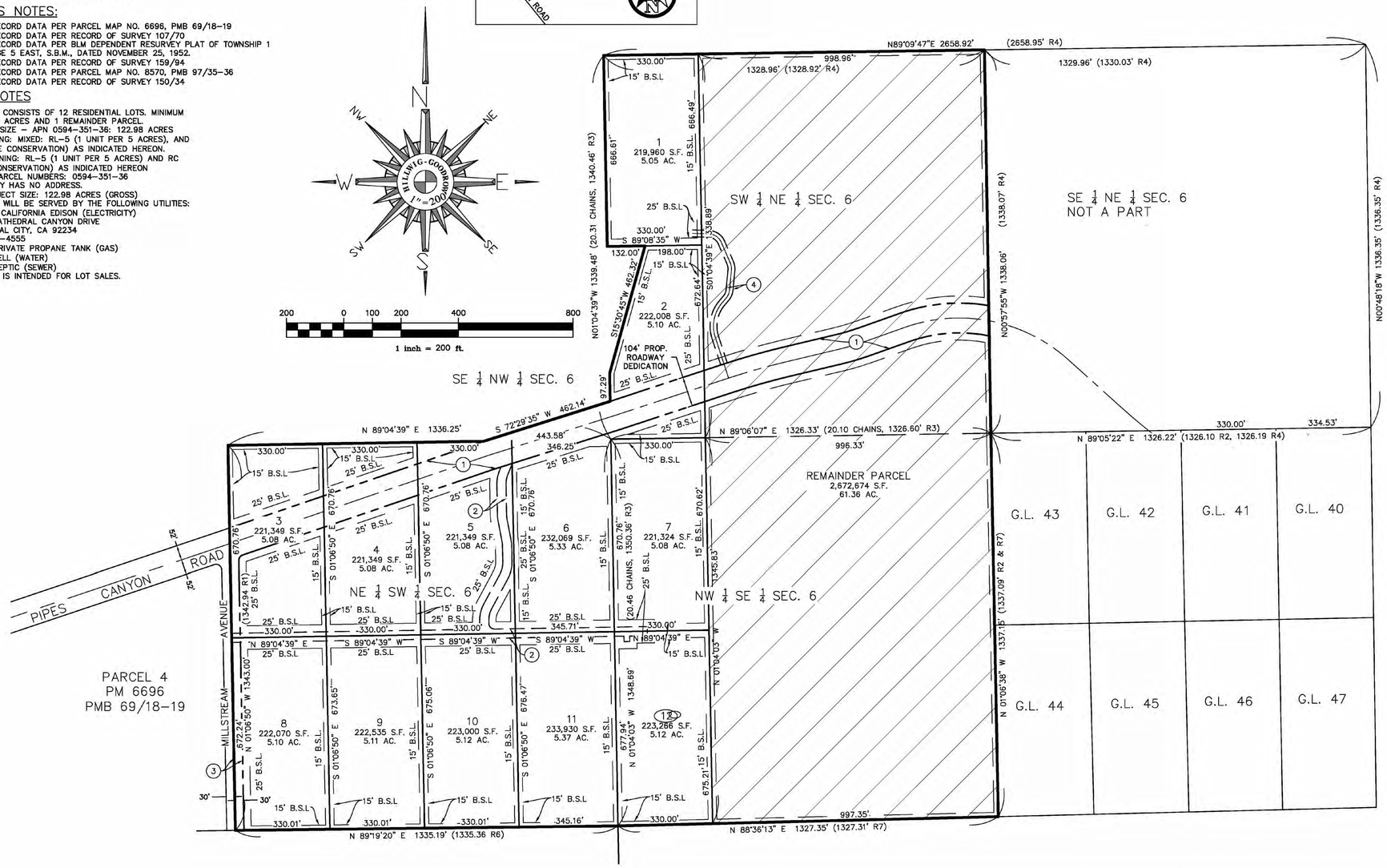
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2. EXISTING LOT SIZE - APN 0594-351-36: 122.98 ACRES
3. EXISTING ZONING: MIXED: RL-5 (1 UNIT PER 5 ACRES), AND RC (RESOURCE CONSERVATION) AS INDICATED HEREON.
4. PROPOSED ZONING: RL-5 (1 UNIT PER 5 ACRES) AND RC (RESOURCE CONSERVATION) AS INDICATED HEREON
5. ASSESSORS PARCEL NUMBERS: 0594-351-36
6. THIS PROPERTY HAS NO ADDRESS.
7. EXISTING PROJECT SIZE: 122.98 ACRES (GROSS)
8. THIS PROJECT WILL BE SERVED BY THE FOLLOWING UTILITIES:
   A. SOUTHERN CALIFORNIA EDISON (ELECTRICITY)
      36100 CATHEDRAL CANYON DRIVE
      CATHEDRAL CITY, CA 92234
      800-655-4555
   B. ON-SITE PRIVATE PROPANE TANK (GAS)
   C. PRIVATE WELL (WATER)
   D. ON-SITE SEPTIC (SEWER)
9. THIS PROJECT IS INTENDED FOR LOT SALES.

LEGEND

- PROJECT BOUNDARY
- EXISTING LOT LINE
- PROPOSED LOT LINE
- EXISTING EASEMENT
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- PROP. PROPOSED
- ROW RIGHT OF WAY
- SEC. SECTION

VICINITY MAP
N.T.S.





Revisions:				
No.	Date:	By:	Description:	Approved:

Designed: | Drawn: | Checked: ACH

Seal: PROFESSIONAL LAND SURVEYOR ALAN C. HILLWIG No. 5137 EXP. 6-30-25 STATE OF CALIFORNIA

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DATE

HILLWIG - GOODROW, INC.
Land Surveying - GPS Surveys - Aerial Mapping
31419 Outer Highway 10, Suite 1-200• Redlands, CA 92373 • (909) 794-2673

Scale: 1" = 200'
Date: November 15, 2024
BENCHMARK: SEE BENCHMARK NOTE ON SHEET 1

TENTATIVE TRACT MAP NO. 20612
APNS: 0594-351-32 & 33
PIPES CANYON ROAD, PIONEERTOWN

PREPARED FOR:
JONATHAN SHOKRIAN
53252 PIPES CANYON ROAD
PIONEERTOWN, CA 92268

F.N. | For: | F.B.

Sheet No. 1 OF 3 SHEET
FILE NO. 0972-002

Appendix H

Geotechnical Report

July 3, 2025

File No.: 307129-001
Doc. No.: 25-06-707

Mr. Jonathan Shokrian
319 South Robertson Boulevard
Beverly Hills, California 90211

Subject: Geologic Memorandum – Draft Preliminary CEQA Information

Project: **Proposed Subdivision Project**
Pipes Canyon Road
APN 0594-351-36
Pioneertown, San Bernardino County, California

INTRODUCTION

In accordance with your request and authorization, Earth Systems Pacific (Earth Systems) is submitting this Memorandum for Draft Preliminary Design Information for the subject project. We are providing these preliminary findings to assist the design team in preliminary design given project time constraints. This letter contains findings and recommendations which are based on data from the current exploration at the site and prior to the completion of laboratory testing and overall analysis. As such, this letter is subject to change pending the final report.

Site Description

This Memorandum for Preliminary Design Information has been prepared for the new proposed subdivision project located at Pipes Canyon Road (APN 0594-351-36), Pioneertown, San Bernardino County, California.

We understand that the proposed site improvements will consist of subdividing the existing 122.98 acre parcel into twelve (12) individual parcels (approximately 5 acres each) with a "remainder parcel". The subdivision will be for individual lot sales to allow for custom builds. No formal house plans or grading plans were available. Building sites depicted for preliminary development purposes are for feasibility tract approval and are not necessarily where actual building sites may be constructed. The project has access to municipal power, but will require on-site septic systems for wastewater treatment for each lot. In addition, appurtenant site work is assumed to include underground utilities, landscaping, driveway approaches, and access drives.

Select Preliminary Conclusions and Recommendations

The following recommendations are considered preliminary and subject to change pending the final geotechnical report (forthcoming). These recommendations are to assist the design team in preliminary design and are subject to grading and other related recommendations of the forthcoming geotechnical report.

Stormwater Percolation Testing

Twelve test holes were drilled using a truck mounted drill rig. Test holes were drilled on June 5 and 6, 2025 and reached depths of approximately 5 feet below the ground surface. The test locations represent the soils at the assumed bottom of the proposed infiltration system.

Test procedures followed the procedures for deep boring percolation testing according to the Riverside County Flood Control and Water Conservation District Design Handbook for Low Impact Development Best Management Practices, June 2014 for Whitewater River Region. The soils encountered at the test location and the percolation rate as well as empirically correlated infiltration rate are presented in Table 1.

Table 1
Infiltration Rate Results

Test	Soil Condition	USCS Soil Description in Test Zone	Test Zone Below Existing Surface (feet)	Percolation Rate (min/in)	Porchet Empirical Infiltration Rate* (in/hr)
P-1	(Native)	Sand with Silt (SP-SM)	3 to 5	5.2	0.6 in/hr
P-2	(Native)	Sand with Silt (SP-SM)	3 to 5	1.8	1.7 in/hr
P-3	(Native)	Sand (SM)	3 to 5	1.0	4.7 in/hr
P-4	(Native)	Sand (SP)	3 to 5	0.8	6.3 in/hr
P-5	(Native)	Gravelly Sand (SP)	3 to 5	0.2	36 in/hr
P-6	(Native)	Sand (SP)	3 to 5	1.0	5.4 in/hr
P-7	(Native)	Sand (SP)	3 to 5	1.4	3.3 in/hr
P-8	(Native)	Sand with Silt (SP-SM)	3 to 5	1.8	1.9 in/hr
P-9	(Native)	Sand with Silt (SP-SM)	3 to 5	1.5	2.4 in/hr
P-10	(Native)	Gravelly Sand (SP)	3 to 5	0.1	103 in/hr
P-11	(Native)	Sand (SP)	3 to 5	1.3	3.4 in/hr
P-12	(Native)	Sand (SP)	3 to 5	0.6	9.6 in/hr

*Field Values, No factor of safety applied. Typical factors of safety range from 3 to 12 depending on the type of system which will be designed using the field values and depending on the level of pre-treatment and influent which will be discharged into the infiltration trenches (Riverside County Flood Control and Water Conservation District Design Handbook for Low Impact Development Best Management Practices, 2014).

Feasibility Percolation Testing for Onsite Wastewater Treatment System (Leach Fields)

Twelve test holes were drilled using the same drill rig as the exploration borings. Percolation tests reached depths of approximately 5 feet below the ground surface. The percolation tests were performed in substantial conformance to the County percolation test method for single

lots; however, as feasibility testing was scoped, only one test per lot was performed for this study. Tests were made at selected primary leach field areas in order to evaluate the general percolation rate at those areas where a potential leach field is feasible. The following is a table of the results of the shallow percolation tests performed on the referenced site.

Table 2
Percolation Rate Results

Test	Soil Condition	USCS Soil Description in Test Zone	Test Zone Below Existing Surface (feet)	Percolation Rate (min/in)*
P-13	(Native)	Sand (SP)	3 to 5	1.0
P-14	(Native)	Sand (SP)	3 to 5	1.0
P-15	(Native)	Sand (SP)	3 to 5	0.7
P-16	(Native)	Sand (SP)	3 to 5	0.5
P-17	(Native)	Sand (SP)	3 to 5	0.2
P-18	(Native)	Sand with Silt (SP-SM)	3 to 5	3.1
P-19	(Native)	Sand (SP)	3 to 5	1.4
P-20	(Native)	Sand with Silt (SP-SM)	3 to 5	2.7
P-21	(Native)	Sand (SP)	3 to 5	0.8
P-22	(Native)	Gravelly Sand (SP)	3 to 5	0.1
P-23	(Native)	Sand (SP)	3 to 5	1.4
P-24	(Native)	Sand (SP)	3 to 5	0.8

*mpi: minutes per inch

ADDITIONAL CONCLUSIONS

The following is a summary of our conclusions and professional opinions based on the data obtained from a review of selected technical literature and the site evaluation.

- Sites are not in a liquefaction zone.
- Sites are not in a fault zone.
- Dry seismic settlement potential exists for on-site soils. Nil settlement potentials exist for the on-site bedrock.
- Onsite soils are sandy and subject to erosion.
- Percolation test results indicate site soils are conducive to stormwater disposal and septic systems (leach beds).

- Percolation testing for septic systems will require further testing and evaluation in proposed leach areas and evaluation of impermeable layer.
- Landslides and debris flows are a potential where adjacent to hillsides.
- The sites are subject to earthquake shaking.
- Onsite soils are not expansive.

Limitations

Conclusions contained in this letter are based on our field observations and preliminary analyses, and our present understanding of the proposed construction. The recommendations within are preliminary and subject to change pending the final report.

Earth Systems has striven to provide our services in accordance with generally accepted geotechnical engineering practices in this locality at this time. No warranty or guarantee, express or implied is made.

Maintaining Earth Systems as the geotechnical consultant from beginning to end of the project will provide continuity of services. In accordance with the International Building Code *the geotechnical engineering firm providing tests and observations shall assume the responsibility of Geotechnical Engineer of Record.*

We appreciate the opportunity to provide our professional services. Please contact our office if there are any questions or comments concerning this report or its recommendations.

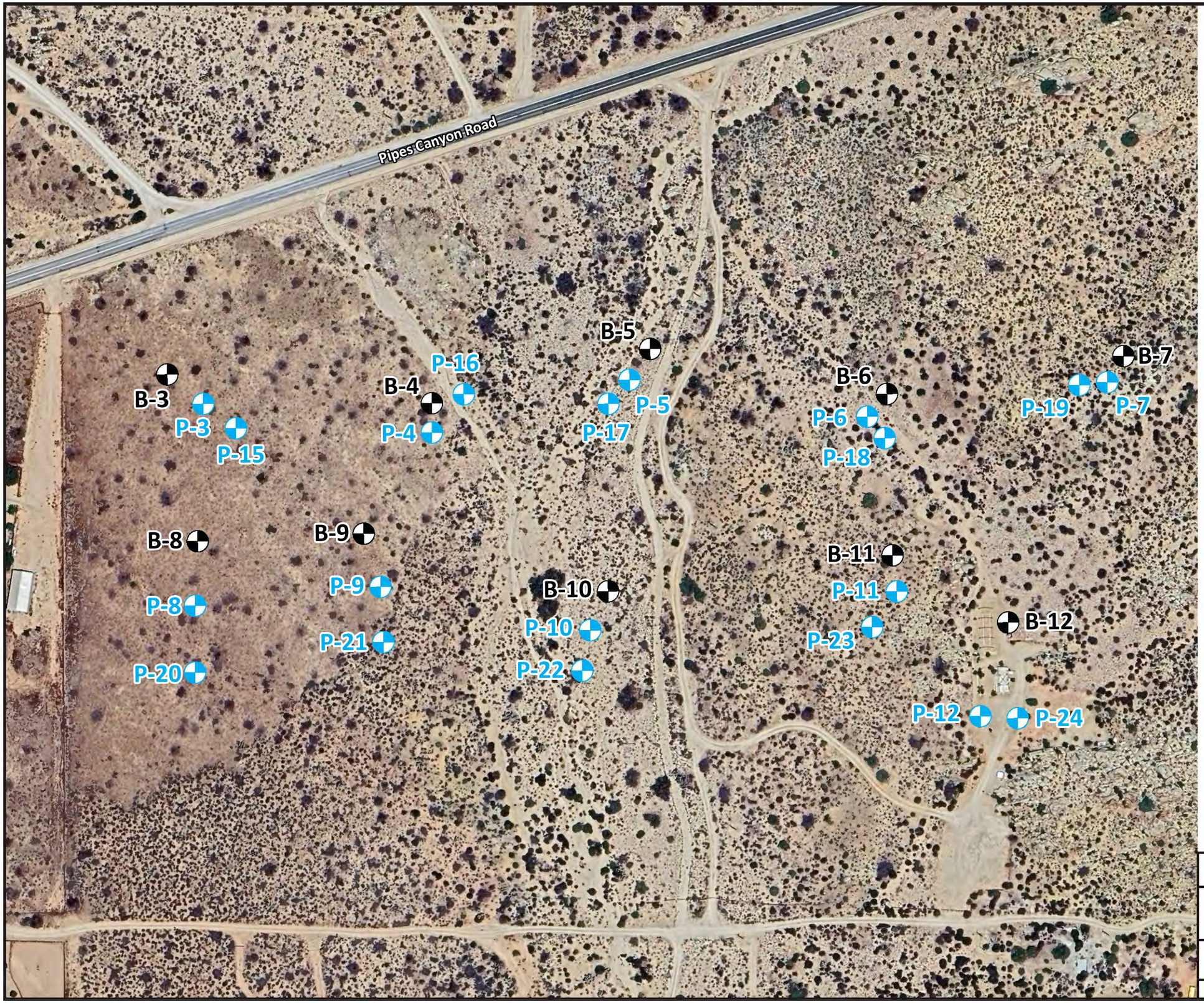
Respectfully submitted
EARTH SYSTEMS PACIFIC



Rocio Carrillo, PE
Project Engineer
CE 75721

Attachment/ Plates 1 & 2, Exploration Location Maps

Distribution: 1/via email
Bryce Dahlin: Bryce@hillwig-goodrow.com
Madeline Luke: madeline.luke@thealtumgroup.com
Rich Malacoff: rich.malacoff@thealtumgroup.com



LEGEND

B-12 Approximate Exploration Locations

P-24 Approximate Percolation Test Locations

N

Approximate Scale: 1" = 150’

0 150’ 300’

Source: Google Earth satellite image dated 5/29/2023 with Tentative Tract Map No. 20612 Sheet 2 overlay.

Plate 1
Exploration Location Map

Proposed Subdivision Project
Pipes Canyon Road
Pioneertown, San Bernardino County, California

Earth Systems

7/3/2025 | File No.: 307129-001



LEGEND

B-12 Approximate Exploration Locations

P-24 Approximate Percolation Test Locations

N

Approximate Scale: 1" = 150’

0 150’ 300’

Source: Google Earth satellite image dated 5/29/2023 with Tentative Tract Map No. 20612 Sheet 3 overlay.

Plate 2
Exploration Location Map

Proposed Subdivision Project
Pipes Canyon Road
Pioneertown, San Bernardino County, California

Earth Systems

7/3/2025

File No.: 307129-001

Jonathan Shokrian
319 South Robertson Boulevard
Beverly Hills, California 90211

Feasibility-Level Geotechnical Engineering Report
Proposed Subdivision Project
Pipes Canyon Road
APN 0594-351-36
Pioneertown, San Bernardino County, California

July 21, 2025

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File No.: 307129-001
Doc. No.: 25-07-703

July 21, 2025

File No.: 307129-001
Doc No.: 25-07-703

Mr. Jonathan Shokrian
319 South Robertson Boulevard
Beverly Hills, California 90211

Attention: Mr. Jonathan Shokrian

Subject: Feasibility-Level Geotechnical Engineering Report

Project: **Proposed Subdivision Project**
Pipes Canyon Road
APN 0594-351-36
Pioneertown, San Bernardino County, California

Earth Systems Pacific (Earth Systems) is pleased to present this feasibility-level geotechnical engineering report prepared for the proposed subdivision project located at Pipes Canyon Road, Pioneertown, San Bernardino County, California. This report presents our findings and recommendations for site grading and foundation design, incorporating the information provided to our office. On a feasibility level, the site is suitable for the proposed development, provided the recommendations in this report are followed in initial design. This report should stand as a whole, and no part of the report should be excerpted or used to the exclusion of any other part.

This report completes our scope of services in accordance with our proposal BER-25-2-001, dated February 24, 2025, and authorized March 21, 2025. Unless requested in writing, the client is responsible for distributing this report to the appropriate governing agency or other members of the design team. Once the project progresses to location and design of actual homesites, a design-level geotechnical report will need to be completed.

We appreciate the opportunity to provide our professional services. Please contact our office if there are any questions or comments concerning this report or its recommendations.

Respectfully submitted,
EARTH SYSTEMS PACIFIC



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Feasibility-Level Geotechnical Engineering Report
Proposed Subdivision Project
Pipes Canyon Road
APN 0594-351-36
Pioneertown, San Bernardino County, California

Section 1
INTRODUCTION

1.1 Project Description

This feasibility-level geotechnical engineering report has been prepared for the new proposed subdivision project located at Pipes Canyon Road (APN 0594-351-36), Pioneertown, San Bernardino County, California, see Plate 1 (Site Vicinity Map).

We understand that the proposed site improvements will consist of subdividing the existing 122.98 acre parcel into twelve (12) individual parcels (approximately 5 acres each) with a "remainder parcel". The subdivision will be for individual lot sales to allow for custom builds. No formal house plans or grading plans were available. Building sites depicted for preliminary development purposes are for feasibility tract approval and are not necessarily where actual building sites may be constructed. The project has access to municipal power, but will require on-site septic systems for wastewater treatment for each lot. In addition, appurtenant site work is assumed to include underground utilities, landscaping, driveway approaches, and access drives.

We have assumed the structures will be one to two-story in height made of masonry, concrete, wood-framed or metal construction founded on shallow permanent foundations, and that there will be no below grade basement levels. We have assumed the anticipated loads will be less than approximately 50 kips for isolated spread footings and 3 kip/lineal foot for continuous footings. As the basis for the foundation recommendations, all loading is assumed to be dead plus actual live load.

No preliminary design loading was provided by the structural engineer. If actual structural loading exceeds these assumed values, we will need to re-evaluate the given recommendations.

1.2 Site Description

The approximate 123-acre project is located adjacent to Pipes Canyon Road approximately 0.27 miles east of Acacia Avenue, and about 0.27 miles north of Chia Trail in the Pioneer Town area of San Bernardino County, California (see Plate 1). The property is described as Assessor Parcel Number APN 0594-351-36. Coordinates near the center of the property are 34.20072°N/116.50162°W.

The proposed 12-lot residential subdivision is located in the western 2/3 of the property, with a remainder (open-space) lot forming the eastern 1/3 of the property (see Figure 1). Access to the site is primarily via the paved Pipes Canyon Road that trends diagonally from southwest to northeast across the property. One moderately maintained dirt road trends north to south

through the western 1/3 for the site, with another dirt road along a portion of the south boundary.



Figure 1- Project Limits

Existing improvements include Pipes Canyon Road, several poorly to moderately maintained dirt roads, and an abandoned residence and associated improvements (within the proposed Lot 12 boundary). Vegetation consists of typical high desert-desert vegetation with abundant Joshua trees, junipers, creosote, and native weeds and grasses. Bold granitic outcrops are common in the eastern half of the property.

1.3 Purpose and Scope of Services

The purpose of our services was to evaluate the site soil and geologic conditions at our exploration locations and to provide professional opinions and recommendations from a geologic and geotechnical point of view, regarding the proposed tentative tract feasibility. We understand that the proposed site improvements will be developed in general under the regulation of the current California Building Code (2022). **Depending on the specific actual building sites selected by future builders, additional site specific geotechnical evaluations and reporting will be necessary to review the specific geologic/geotechnical constraints for those future sites, as well as develop percolation reports for onsite septic wastewater disposal**.

The scope of services included:

Task 1 - Literature and Photograph Reviews

We began our services by reviewing select geologic and geotechnical literature pertaining to the

project. This included a review of various hazard, fault, and geologic maps prepared by the California Geological Survey, the U.S. Geological Survey, the County of San Bernardino and other governmental agencies as they relate to the project area. Historical aerial photographs were reviewed using the Google Earth Pro website and Historical Aerials website.

Task 2 – Utility Clearance, USA Dig Alert

Each of our proposed field exploration locations was located and marked in the field and cleared with known utility lines as identified by Underground Service Alert (USA), "Dig Alert". Our exploration locations were located in the field by consumer grade Global Positioning System (GPS) accurate to ± 15 feet in conjunction with pacing based upon the control provided or sighting from landmarks identified on the project topographic map.

Task 3 – Field Exploration

Earth Systems' project engineer and engineering geologist performed a site reconnaissance on March 27, 2025 to locate and mark exploration borings and percolation test locations and document the general geologic conditions. We evaluated the general subsurface conditions at the site by drilling twelve small diameter borings, from approximately 6 feet to 21½ feet in depth. Plate 2 shows the approximate locations of the borings.

Task 4 – Percolation Testing for Onsite Wastewater Treatment System (Leach Fields)

Twelve test holes were drilled to maximum depths of approximately 5 feet below the existing ground surface for the proposed feasibility percolation testing (one test per parcel). These holes were drilled on June 5 and 6, 2025 with the same drill rig as the exploration borings. Plate 2 shows the approximate locations of the tests. The tests were run in general conformance with the standards of the County of San Bernardino.

Task 5 – Percolation Testing for Basin Infiltration

Twelve test holes were drilled to maximum depths of approximately 5 feet below the existing ground surface for the proposed feasibility infiltration testing, as approved by the client. These holes were drilled on June 5 and 6, 2025 with the same drill rig as the exploration borings. Plate 2 shows the approximate location of the tests. The tests were run in general conformance with the standards of the County of San Bernardino.

Task 6 - Laboratory Testing

Laboratory tests were performed on selected samples to evaluate the physical characteristics of the materials encountered during our field exploration. Laboratory testing included moisture content, dry unit weight, maximum dry density/optimum moisture content, sieve analysis, consolidation/collapse potential, Expansion Index, and direct shear. The testing was performed in general accordance with American Society for Testing and Materials (ASTM) or appropriate test procedures. Selected samples were tested for a preliminary screening level of corrosion potential (pH, electrical resistivity, water-soluble sulfates and water-soluble chlorides). Earth Systems does not practice corrosion engineering; however, these test results may be used by a qualified engineer in designing an appropriate corrosion plan for the project.

Task 7 – Analysis and Report

Earth Systems analyzed the field data obtained, performed engineering analyses, and provided recommended feasibility-level design parameters for earthwork and foundations for the structures as described within. Our report includes:

- A description of the proposed project including a site plan showing the approximate boring locations;
- A description of the surface and subsurface site conditions including groundwater conditions, as encountered in our field exploration;
- A description of the site geologic setting and possible associated geology-related hazards, including liquefaction, subsidence, and seismic settlement analysis;
- A discussion of regional geology and site seismicity;
- A description of local and regional active faults, their distances from the site, and the potential for future earthquakes;
- A discussion of other geologic hazards such as ground shaking, landslides, flooding, and tsunamis;
- A General Procedure seismic analysis including recommendations for geotechnical seismic design coefficients in accordance with the 2022 CBC.
- A discussion of site conditions, including the geotechnical suitability of the site for the general type of construction proposed;
- Recommendations for imported fill (if required) for use in compacted fills;
- Recommendations for feasibility foundation design including parameters for shallow foundations and subgrade preparation;
- Anticipated total and differential settlements for the assumed foundation system;
- Preliminary recommendations for the mitigation of liquefaction (if applicable);
- Recommendations for lateral load resistance (earth pressures and drainage) for below grade structures including drainage requirements and seismic earth pressures;
- Recommendations for site preparation, earthwork, and fill compaction specifications;
- Discussion of anticipated excavation conditions;
- Recommendations for underground utility trench backfill;
- Recommendations for stability of temporary trench excavations;
- Recommendations for slabs-on-grade, including recommendations for reducing the potential for moisture transmission through interior slabs;
- Recommendations for collapsible or expansive soils (if applicable);
- Recommendations for fire lanes and pavements;
- A discussion of the corrosion potential of the near-surface soils encountered during our field exploration; and

- An appendix, which includes a summary of the field exploration (computer generated boring logs) and laboratory testing program (computer generated plots).

Not Contained in This Report: Although available through Earth Systems, the current geotechnical scope of our services does not include:

- An environmental Phase 1 assessment.
- An investigation for the presence or absence of wetlands, hazardous or toxic materials in the soil, surface water, groundwater, or air on, below, or adjacent to the subject property.

Section 2
METHODS OF EXPLORATION AND TESTING

2.1 Field Exploration

The geotechnical subsurface exploration program included advancing twelve exploratory borings. The borings were drilled to depths ranging from approximately 6 to 21½ feet below existing grades using a limited access track rig equipped with 8-inch hollow-stem augers provided by Calpac Drilling of Calimesa, California. The borings were advanced to observe soil profiles and obtain samples for laboratory testing. The approximate boring locations are shown on Plate 2, in Appendix A. The locations shown are approximate, established by consumer grade Global Positioning System (GPS) accurate to ± 15 feet in conjunction with pacing based upon the control provided.

Staff from Earth Systems maintained a log of the subsurface conditions encountered and obtained samples for logging, classification and laboratory testing. Subsurface conditions encountered in the borings were categorized and logged in general accordance with the Unified Soil Classification System (USCS) and ASTM D 2487 and 2488 (current edition). Our typical sampling interval within the borings was approximately every 2½ or 5 feet to the full depth explored; however, sampling intervals were adjusted depending on the materials encountered onsite. Current samples were obtained within the test borings using a Modified California (MC) ring sampler (ASTM D 3550 with those similar to ASTM D 1586) and a Standard Penetration (SPT) sampler. The MC sampler has an approximate 3-inch outside diameter and 2.4-inch inside diameter, while the SPT sampler has an outside diameter of approximate 2 inches and an inside diameter of approximately 1.4 inches. The samplers were mounted on a drill rod and driven using a rig-mounted 140-pound automatic hammer falling for a height of 30 inches. The number of blows necessary to drive the samplers within the borings was recorded.

Design parameters provided by Earth Systems in this report have considered an estimated 78% hammer efficiency based on data provided by the drilling subcontractor, past report information, and limits per SP117A. The N-values (blow count) using the California sampler can be roughly correlated to SPT N-values using a conversion factor that may vary from about 0.5 to 0.7. In general, a conversion factor of approximately 0.63 from a study at the Port of Los Angeles (Zueger and McNeilan, 1998 per SP 117A) is considered satisfactory. A value of 0.63 was applied in our calculations for this project.

Bulk samples of the soil materials were obtained from the drill auger cuttings, representing a mixture of soils encountered at the depths noted. The depth to groundwater, if any, was measured in the boreholes. Following drilling, sampling, and logging, the borings were backfilled with the cuttings and tamped upon completion. Our field exploration was provided under the direction of a State of California Registered Geotechnical Engineer from our firm.

The logs of the borings represent our interpretation of the contents of the field data and the results of laboratory testing performed on the samples obtained during the subsurface exploration. The final logs are included in Appendix A of this report. The stratification lines represent the approximate boundaries between soil types, although the transitions may be gradual. In reviewing the logs and legend, the reader should recognize the legend is intended as

a guideline only, and there are a number of conditions that may influence the soil characteristics observed during drilling. These include, but are not limited to cementation, variations in soil moisture, presence of groundwater, and other factors.

The boring logs present field blow counts per 6 inches of driven embedment (or portion thereof) for a total driven depth attempted of 18 inches. Where gravel was observed in sufficient quantity, blows were recorded in 1-inch increments summed, and erroneous blows on rock discarded, as needed. The blow counts on the logs are uncorrected (i.e. not corrected for overburden, sampling, etc.). Consequently, the user must correct the blow counts per standard methodology if they are to be used for design and exercise judgment in interpreting soil characteristics, possibly resulting in soil descriptions that vary somewhat from the legend.

2.2 Laboratory Testing

Samples were reviewed along with field logs to select those that would be analyzed further. Those selected for laboratory testing include, but were not limited to, soils that would be exposed and those deemed to be within the influence of the proposed structures. Test results are presented in graphic and tabular form in Appendix B of this report. Testing was performed in general accordance with American Society for Testing and Materials (ASTM) or other appropriate test procedure. Selected samples were also tested for a screening level of corrosion potential (pH, electrical resistivity, water-soluble sulfates, and water-soluble chlorides). Earth Systems does not practice corrosion engineering; however, these test results may be used by a qualified corrosion engineer in designing an appropriate corrosion control plan for the project.

Our testing program consisted of the following:

- Density and Moisture Content of select samples of the site soils (ASTM D 2937 & 2216).
- Maximum Dry Density/Optimum Moisture Content tests to evaluate the moisture-density relationship of typical soils encountered (ASTM D 1557).
- Particle Size Analysis to classify and evaluate soil composition. The gradation characteristics of selected samples were made by sieve analysis procedures (ASTM D 6913 and D1140).
- Consolidation and Collapse Potential to evaluate the compressibility and hydroconsolidation (collapse) potential of the soil upon wetting (ASTM D 5333).
- Direct Shear to evaluate the relative frictional strength of the surficial slope soils. Specimens were in a saturated condition prior to and during testing and were sheared under normal loads ranging from 1.0 to 4.0 kips per square foot (ASTM D 3080).
- Expansion Index tests to evaluate the expansive nature of the soil. The samples were surcharged under 144 pounds per square foot at moisture contents of near 50% saturation. Samples were then submerged in water for 24 hours and the amount of expansion was recorded with a dial indicator (ASTM D 4829).
- Screening Level Chemical Analyses (Soluble Sulfates and Chlorides (ASTM D 4327), pH (APHA 2320-B), and Electrical Resistivity/Conductivity (ASTM G 187) to evaluate the potential for adverse effects of the soil on concrete and steel.

Section 3
DISCUSSION

3.1 Soil and Rock Conditions

The field exploration indicates that site soils consist predominantly of sand with varying amounts of silt and gravel and silty sand (Unified Soils Classification System symbols of SP, SP-SM, and SM) and weathered granitic bedrock to the maximum depth of exploration of 21½ feet below the ground surface. Exposed bedrock outcrops and rock encountered in the boring logs consists of moderately weathered and moderately hard to hard intrusive igneous rock (granodiorite/quartz monzonite) common referred to as "granitic rock". Decomposed granite and hard rock were observed at depths varying between 2½ to 10 feet below the ground surface and estimated to be greater than 20 feet bgs at borings B-3, B-8, and B-9. Refusal was encountered in eight (8) of the twelve (12) borings. See also Plates 5a and 5b for mapping.

The soils were observed to be dry. Site soils are classified as OSHA Class C, but decomposed rock may be classified as Class B. The boring logs provided in Appendix A include more detailed descriptions of the soils encountered.

General observations per lot are as follows:

Lot #	Soil Type	Debris Flow	Flooding	Rockfall	Rolling Boulders	Joshua Trees	Slope Instability
1	Qa/Rock		Minor	Yes	Yes	Yes	Outcrops
2	Qa/Rock					Yes	
3	Qoa						
4	Qt/Rock	Yes	Yes				
5	Qa		Yes			Yes	
6	Qa/Rock		Yes			Yes	
7	Qa/Rock	Yes	Yes			Yes	
8	Qoa					Yes	
9	Qoa					Yes	
10	Qa		Yes			Yes	
11	Qa/Rock					Yes	
12	Qa/Rock					Yes	

Qa = younger alluvial soil Rock = bedrock

Qt = terrace deposit Qoa = older alluvial soil

3.2 Groundwater

No free groundwater was encountered during our field exploration to the maximum depth of exploration of 21½ feet; however, due to bedrock conditions, perched water/high moisture conditions could occur at the soil/bedrock interface. Soil discoloration or mottling, suggestive of perched groundwater was not observed at the borings.

Nearby State monitoring wells were researched for their recent and historic well readings. The following is a summary of our findings for the well closest to the site.

- Well No. 01N04E01B001S located approximately 1.0 mile to the northwest of the site. The surface elevation of the well is approximately 4,171 feet and groundwater elevation reading as measured from 1971 was 4,095 feet.

Based on the above data, groundwater is not anticipated to be encountered during construction and is expected to be deeper than 50 feet at the site such that liquefaction is not a concern. Fluctuations of the groundwater level, and localized zones of increased soil moisture content may be anticipated during and following the rainy season or from irrigation.

3.3 Collapse and Consolidation Potential

Collapsible soil deposits generally exist in regions of moisture deficiency. Collapsible soils are generally defined as soils that have potential to suddenly decrease in volume upon increase in moisture content even without an increase in external loads. Soils susceptible to collapse include loess, weakly cemented sands and silts where the cementing agent is soluble (e.g. soluble gypsum, halite), valley alluvial deposits within semi-arid to arid climate, and certain granite residual soils above the groundwater table. In arid climatic regions, granular soils may have a potential to collapse upon wetting. Collapse (hydro-consolidation) may occur when the soils are lubricated or the soluble cements (carbonates) in the soil matrix dissolve, causing the soil to densify from its loose configuration from deposition.

The degree of collapse of a soil can be defined by the Collapse Potential [CP] value, which is expressed as a percent of collapse of the total sample using the Collapse Potential Test (ASTM Standard Test Method D 5333). Based on the Naval Facilities Engineering Command (NAVFAC) Design Manual 7.1, the severity of collapse potential is commonly evaluated by the following Table 3, Collapse Potential Values.

Table 1
Collapse Potential Values

Collapse Potential Value	Severity of Problem
0-1%	No Problem
1-5%	Moderate Problem
5-10%	Trouble
10-20%	Severe Trouble
> 20%	Very Severe Trouble

Table 3 can be combined with other factors such as the probability of ground wetting to occur on-site and the extent or depth of potential collapsible soil zone to evaluate the potential hazard by collapsible soil at a specific site. A hazard ranking system associated with collapsible soil as developed by Hunt (1984) is presented in Table 4, Collapsible Soil Hazard Ranking System.

Table 2
Collapsible Soil Hazard Ranking System

Degree of Hazard	Definition of Hazard
No Hazard	No hazard exists where the potential collapse magnitudes are non-existent under any condition of ground wetting.
Low Hazard	Low hazards exist where the potential collapse magnitudes are small and tolerable, or the probability of significant ground wetting is low.
Moderate Hazard	Moderate hazards exist where the potential collapse magnitudes are undesirable, or the probability of substantial ground wetting is low, or the occurrence of the collapsible unit is limited.
High Hazard	High hazard exists where potential collapse magnitudes are undesirably high and the probability of occurrence is high.

The results of collapse potential tests performed on five selected individual ring samples from depths ranging from 2.5 to 10 feet below the ground surface indicated a collapse potential ranging from 0.3 to 1.0 percent. Typically, the initial 1% is estimated to be from sampler disturbance as demonstrated by Table 1. Based on the above criteria and our field and laboratory findings, and assuming the grading is accomplished according to Section 5.1 of this report, we estimate the collapse potential is very low. Based on that, collapse settlement is estimated to be negligible.

3.4 Expansive Soils

Expansive soils are characterized by their ability to undergo significant volume change (shrink or swell) due to variations in moisture content. Changes in soil moisture content can result from rainfall, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors, and may cause unacceptable settlement or heave of structures, concrete slabs supported-on-grade, or pavements supported over these materials. Depending on the extent and location below finished subgrade, expansive soils can have a detrimental effect on structures. Based on our visual observations, laboratory testing, and past reporting, the Expansion Index of the onsite soils is “very low” as defined by ASTM D 4829 and the 2022 California Building Code. Samples of building pad soils should be tested during grading to confirm or modify these findings.

3.5 Corrosivity

Two samples of the near-surface soils within the site were currently tested for potential corrosion of concrete and ferrous metals. Soils were tested as blended (composite) samples. The tests were conducted in general accordance with the ASTM Standard Test Methods to evaluate pH, resistivity, and water-soluble sulfate and chloride content. The test results are presented in Appendix B. These tests should be considered as only an indicator of corrosivity for the samples tested. Other earth materials found on site may be more, less, or of a similar corrosive nature.

Water-soluble sulfates in soil can react adversely with concrete. ACI 318 provides the relationship between corrosivity to concrete and sulfate concentration, presented in the table below:

Table 3

Water-Soluble Sulfate in Soil (ppm)	Corrosivity to Concrete
0-1,000	Negligible
1,000 – 2,000	Moderate
2,000 – 20,000	Severe
Over 20,000	Very Severe

In general, the lower the pH (the more acidic the environment), the higher the soil corrosivity will be with respect to ferrous structures and utilities. As soil pH increases above 7 (the neutral value), the soil is increasingly more alkaline and less corrosive to buried steel structures, due to protective surface films, which form on steel in high pH environments. A pH between 5 and 8.5 is generally considered relatively passive from a corrosion standpoint. High chloride levels tend to reduce soil resistivity and break down otherwise protective surface deposits, which can result in corrosion of buried steel or reinforced concrete structures. Soil resistivity is a measure of how easily electrical current flows through soils and is the most influential factor. Based on the findings of studies presented in ASTM STP 1013 titled "Effects of Soil Characteristics on Corrosion" (ASTM, 1989), the approximate relationship between soil resistivity and soil corrosivity was developed as shown in Table 4.

Table 4

Soil Resistivity (Ohm-cm)	Corrosivity to Ferrous Metals
0 to 900	Very Severely Corrosive
900 to 2,300	Severely Corrosive
2,300 to 5,000	Moderately Corrosive
5,000 to 10,000	Mildly Corrosive
10,000 to >100,000	Very Mildly Corrosive

Test results show pH values of 7.7 to 8.1, chloride contents of 3 to 4 ppm, sulfate contents of 9 ppm and minimum resistivity's of 7,600 to 8,000 Ohm-cm. Although Earth Systems does not practice corrosion engineering, the corrosion values from the soils tested are normally considered as being mildly corrosive to buried metals and as possessing a "negligible" sulfate exposure to sulfate attack for concrete as defined in American Concrete Institute (ACI, 2011) 318, Section 4.3. The results of current chemical testing have been provided in Appendix B. The above values can potentially change based on several factors, such as importing soil from another job site and the quality of construction water used during grading and subsequent landscape irrigation.

3.6 Stormwater Percolation Testing

As indicated in Section 1.3 of this report, twelve test holes were drilled using the same drill rig as the exploration borings. Test holes were drilled on June 5 and 6, 2025 and reached depths of approximately 5 feet below the ground surface. The test locations represent the soils at the

assumed bottom of the proposed infiltration system. The percolation boring locations are shown on the Boring Location Map (Plate 2), in Appendix A.

The presence of gravel and PVC pipe (inserted in the boring) were accounted for in the percolation test results. The borings were pre-saturated with potable water prior to testing. Test results were taken with a water surface at approximate depths between 3 and 5 feet below existing grade at the test locations, respectively (see Table 5).

Test procedures followed the procedures for deep boring percolation testing according to the County of San Bernardino Technical Guidance Documents for Water Quality Management Plans, (Effective Date: September 19, 2013) for Santa Ana Region. The soils encountered at the test location and the percolation rate as well as empirically correlated infiltration rates are presented in Table 5.

Table 5
Infiltration Rate Results

Test	Soil Condition	USCS Soil Description in Test Zone	Test Zone Below Existing Surface (feet)	Percolation Rate (min/in)	Porchet Empirical Infiltration Rate* (in/hr)
P-1	(Native)	Sand with Silt (SP-SM)	3 to 5	5.2	0.6 in/hr
P-2	(Native)	Sand with Silt (SP-SM)	3 to 5	1.8	1.7 in/hr
P-3	(Native)	Sand (SP)	3 to 5	1.0	4.7 in/hr
P-4	(Native)	Sand (SP)	3 to 5	0.8	6.3 in/hr
P-5	(Native)	Gravelly Sand (SP)	3 to 5	0.2	36 in/hr
P-6	(Native)	Sand (SP)	3 to 5	1.0	5.4 in/hr
P-7	(Native)	Sand (SP)	3 to 5	1.4	3.3 in/hr
P-8	(Native)	Sand with Silt (SP-SM)	3 to 5	1.8	1.9 in/hr
P-9	(Native)	Sand with Silt (SP-SM)	3 to 5	1.5	2.4 in/hr
P-10	(Native)	Gravelly Sand (SP)	3 to 5	0.1	103 in/hr
P-11	(Native)	Sand (SP)	3 to 5	1.3	3.4 in/hr
P-12	(Native)	Sand (SP)	3 to 5	0.6	9.6 in/hr

*Field Values, No factor of safety applied. Typical factors of safety range from 3 to 12 depending on the type of system which will be designed using the field values and depending on the level of pre-treatment and influent which will be discharged into the infiltration trenches.

3.7 Percolation Testing for Onsite Wastewater Treatment System (Leach Fields)

As indicated in Section 1.3 of this report, twelve test holes were drilled using the same drill rig as the exploration borings. Percolation tests were performed at the test locations shown on Plate 2 and reached depths of approximately 5 feet below the ground surface to evaluate feasibility percolation for leach lines. The percolation tests were performed in substantial conformance to the County percolation test method for single lots. Tests were made at potential leach field areas, see Plate 2, in order to evaluate the general percolation rate at those areas where a potential leach field maybe feasible. Once actual leach field areas are known, final percolation testing as well as exploratory borings per County criteria will be required.

All percolation holes were approximately 8 inches in diameter. Two-inches of gravel was placed in the bottom of the holes after loose soils were removed and a section of perforated 3-inch diameter pipe was placed in each hole to guide the water to the bottom of the test hole to minimize sidewall disturbance and caving. All depths were measured from the top of the ¾ inch gravel. A total of twelve percolation tests were performed, see test location map in Appendix A.

Standard Percolation Test Procedure for Leach lines:

a) Each hole was presoaked with clean water per the San Bernardino Guidelines (San Bernardino, 2019) after drilling and on the day of testing.
b) All shallow percolation tests, number P-13 through P-24, had 10-inch water fill above the gravel and dropped away within 10 minutes of filling. Given the sandy, coarse texture and water drop, testing followed immediately after the presoaking (San Bernardino, page 15).

The percolation tests were performed on June 5, 6, and 9, 2025 and consisted of refilling each hole to 6 inches above the gravel level and measuring the drop in water level at typically 10-minute intervals for 1 hour. Because the gravel was added, the drop of 1 to 3 inches was recorded at the end (San Bernardino, page 15 “Rapid Readings”). After each reading the water level was readjusted by adding water to the same (similar) start level. Raw percolation rates are provided in Table 6 and were not corrected since they were within the diameter size suggested in the San Bernardino guidelines. Since gravel was used between the cylinder and native side walls, we calculated a gravel correction factor of 0.5. Holes did not cave. The following is a table of the results of the shallow percolation tests performed on the referenced site.

Table 6
Percolation Rate Results

Test	Soil Condition	USCS Soil Description in Test Zone	Test Zone Below Existing Surface (feet)	Percolation Rate (min/in)*
P-13	(Native)	Sand (SP)	3 to 5	1.0
P-14	(Native)	Sand (SP)	3 to 5	1.0
P-15	(Native)	Sand (SP)	3 to 5	0.7
P-16	(Native)	Sand (SP)	3 to 5	0.5
P-17	(Native)	Sand (SP)	3 to 5	0.2
P-18	(Native)	Sand with Silt (SP-SM)	3 to 5	3.1
P-19	(Native)	Sand (SP)	3 to 5	1.4
P-20	(Native)	Sand with Silt (SP-SM)	3 to 5	2.7
P-21	(Native)	Sand (SP)	3 to 5	0.8
P-22	(Native)	Gravelly Sand (SP)	3 to 5	0.1
P-23	(Native)	Sand (SP)	3 to 5	1.4
P-24	(Native)	Sand (SP)	3 to 5	0.8

*mpi: minutes per inch

3.8 Geologic Setting

Regional Geology: The site lies near the margin of the north-central portion of Transverse Ranges geomorphic province and the southerly margin of the Mojave Desert geomorphic province. This region consists of interspersed mountain ranges and intervening valleys oriented in an east-west direction across southern California. Multiple mountain ranges exist near the project area, including the San Bernardino and Little San Bernardino Mountains. Geomorphic/geopraphic areas in the project vicinity include Pipes Canyon, Little Morongo Valley, and several volcanic highlands north, east, and southerly of the project site. Major regional faults include the San Andreas, Landers, Johnson Valley, and Pinto Mountain fault zones.

Local Geology: The project site is located in the Pioneertown area (Plate 3), which is characterized by the northeastern foothills of the Little San Bernardino Mountains, and volcanic highlands of the Mojave Desert. The project is located near the intersection of Bowden Flat and Pipes Canyon Wash where Pre-Tertiary igneous rocks predominate. Granitic rocks are exposed within the site with Holocene alluvium and interspersed stream channel deposits adjacent to the

bedrock outcrops, with older alluvial fan deposits in the western portion of the site. No Holocene-active faults have been mapped through or in the immediate vicinity of the site.

The Johnson Valley fault, a fault zone within the Eastern California shear zone, ruptured during the 1992 Landers earthquake event and is located about 3 miles east of the site, within Johnson Valley. The predominate San Andreas fault is located about 14 miles southwest of the property. The Pinto Mountain fault is located about 6 miles southeast of the project. The site is not located within a currently delineated Alquist-Priolo Earthquake Fault Zone.

3.9 Geologic Hazards

Geologic hazards that may affect the region include seismic hazards (ground shaking, surface fault rupture, soil liquefaction, and other secondary earthquake-related hazards), slope instability, flooding, debris flows, rock falls, ground subsidence, and erosion. A discussion follows on the specific hazards to this site.

3.10 Primary Seismic Hazards

Seismic Sources: Several active faults or seismic zones lie within 62 miles (100 kilometers) of the project site as shown on Table 1 in Appendix A. The primary seismic hazard to the site is strong ground shaking from earthquakes along regional faults, including the Pinto Mountain, faults associated with the Eastern California shear zone, and San Andreas faults. The Maximum Magnitude Earthquake (M_{max}) listed is from published geologic information available for each fault (Cao et al., CGS, 2003). The M_{max} corresponds to the maximum earthquake believed to be tectonically possible.

Surface Fault Rupture: The project site does not lie within a currently delineated State of California, *Alquist-Priolo* Earthquake Fault Zone (CGS 2018). Well-delineated fault lines cross through this region as shown on California Geological Survey (CGS) maps (Jennings, 2010). However, based on our geologic review, no currently mapped faults, lineaments, or other fault related geologic features exist at the property. Therefore, active fault rupture is unlikely to occur at the project site. While fault rupture would most likely occur along previously established fault traces, future fault rupture could occur at other locations.

Historic Seismicity: The project site is located in seismically active southern California where approximately 34 earthquakes of magnitude 5.5 or greater have occurred within 60 miles of the site since 1880. Six historic seismic events (5.9 M or greater) have significantly affected the Pioneertown area in the last 100 years. They are as follows:

- *Desert Hot Springs Earthquake* – On December 4, 1948, a magnitude 6.5 M_L (6.0M_W) earthquake occurred east of Desert Hot Springs. This event was strongly felt in the project area.
- *North Palm Springs Earthquake* – A magnitude 5.9 M_L (6.2M_W) earthquake occurred on July 8, 1986 in the Painted Hills, causing minor surface creep of the Banning segment of the San Andreas fault.

- *Joshua Tree Earthquake* – On April 22, 1992, a magnitude 6.1 M_L (6.1M_W) earthquake occurred in the mountains east of Desert Hot Springs, approximately 20 miles from the the project site.
- *Landers and Big Bear Earthquakes* – Early on June 28, 1992, a magnitude 7.5 M_S (7.3M_W) earthquake occurred near Landers, the largest seismic event in Southern California for 40 years. Surface rupture occurred south of the town of Yucca Valley and extended some 43 miles toward Barstow. Associated surface fault rupture along the Eureka Peak fault occurred about 3 miles west of the project site. About three hours later, a magnitude 6.6 M_S (6.4M_W) earthquake occurred near Big Bear Lake. The epicenter of the Landers event was located approximately 4 miles from the site.
- *Hector Mine Earthquake* – On October 16, 1999, a magnitude 7.1M_W earthquake occurred on the Lavic Lake and Bullion Mountain faults north of Twentynine Palms.

States Geological Survey [USGS] presented new earthquake forecasts for California (USGS UCERF3). We have used these maps in our evaluation of the seismic risk at the site. The recent Working Group of California Earthquake Probabilities (WGCEP, 2014) estimated a 31 percent conditional probability that a magnitude 6.7 or greater earthquake may occur in 30 years (2014 as base year) along the nearby Coachella segments of the San Andreas fault. For the nearby Pinto Mountain fault, the 30-year probability is about 5 percent, and for the Landers associated faults 3%.

The primary seismic risk at the site is a potential earthquake along regional faults, including the Pinto Mountain and San Andreas faults. Geologists believe that the San Andreas fault has characteristic earthquakes that result from rupture of each fault segment. The estimated characteristic earthquake is magnitude 7.7 for the Southern Segment of the fault (USGS, 2002). This segment has the longest elapsed time since rupture of any part of the San Andreas fault. The last rupture occurred about 1690 AD, based on dating by the USGS near Indio (WGCEP, 1995). This segment has also ruptured on about 1020, 1300, and 1450 AD, with an average recurrence interval of about 220 years. The San Andreas fault may rupture in multiple segments, producing a higher magnitude earthquake. Recent paleoseismic studies suggest that the San Bernardino Mountain Segment to the north and the Coachella Segment may have ruptured together in 1450 and 1690 AD (WGCEP, 1995). The Pinto Mountain fault is characterized by the State as a “B” fault and is therefore considered to have a less probable risk of rupture than the nearby segments of the San Andreas fault. However, though less probable to rupture, the Pinto Mountain fault has a significant potential to produce strong ground motion.

3.11 Secondary Hazards

Secondary seismic hazards related to ground shaking include soil liquefaction, ground subsidence, tsunamis, and seiches. The site is far inland, so the hazard from tsunamis is non-existent. At the present time, no large water storage reservoirs are located in the immediate vicinity of the site. Therefore, hazards from seiches are considered negligible at this time. Other hazards include flooding, debris flows, rockfalls, and slope instability. Currently, existing on-site slopes are of minimal height and angle, thus the potential for on-site slope instability is considered low. However, adjacent to the bold bedrock ridges and outcrops, rockfall/rolling boulder hazards do exist.

Ground Subsidence: The potential for seismically induced ground subsidence is considered to be low at the site due to the presence of shallow or exposed bedrock. Dry sands tend to settle and densify when subjected to strong earthquake shaking. The amount of subsidence is dependent on relative density of the soil, ground motion, and earthquake duration. Uncompacted fill areas may be susceptible to seismically induced settlement. Based on Tokimatsu and Seed methodology, we estimate that less than 0.1 inch of total ground subsidence may occur in the shallow on-site soil profiles.

Soil Liquefaction and Lateral Spreading: Liquefaction is the loss of soil strength from sudden shock (usually earthquake shaking), causing the soil to become a fluid mass. In general, for the effects of liquefaction to be manifested at the surface, groundwater levels must be within 50 feet of the ground surface and the soils within the saturated zone must also be susceptible to liquefaction. The potential for liquefaction to occur at this site is considered low because the current and historic high groundwater at the site are deeper than 50 feet below the ground surface and bedrock is shallow. Setbacks are also recommended for structural areas from any leach fields to minimize any impact from water mounding. Due to the deep groundwater and low potential for liquefaction the potential for lateral spreading is considered very low.

Dry Seismic Settlement: The amount of dry seismic settlement is dependent on relative density of the soil, ground motion, and earthquake duration. In accordance with current CGS policy (Earth Systems discussion with Jennifer Thornburg, CGS May 2014), we used a site peak ground acceleration of ⅔ PGA_M and an earthquake magnitude of 7.9 to evaluate dry seismic settlement potential. The design peak ground acceleration value (0.87g) was obtained from the USGS online application (www.seismicmaps.org).

For coarse grained soils, we have used the data obtained from boring B-3, B-8, and B-9 that had the deepest excavation without experiencing refusal due to bedrock.

Typical guidance (SP117A) suggests the limiting depth profile should reach 50 feet below the ground surface. However, bedrock outcrops were observed at the site and explorations indicated that excavation refusal occurred at depths between 2.5 to 10 feet at most of the locations of the proposed structures. The deepest excavation reached a depth of 21½ feet below the ground surface. Therefore, 21½ feet was used to estimate the greatest dry seismic settlement that occurred at borings B-3, B-8, and B-9.

Based upon methods presented by Tokimatsu and Seed (1987), the potential for seismically induced dry settlement of soils having the deepest soil column height was estimated for borings B-3, B-8, and B-9. Estimated settlement was 0.1, 0.1, and 0 inches respectively for borings B-3, B-8, and B-9. Per SP117A, differential seismic settlement may be estimated to be the difference between zero and 0.1 inches. The estimate is based on the grading recommendations found in Section 5.1 of this report.

Fissuring and Ground Subsidence: The potential for ground subsidence do to groundwater removal is considered to be low at the site due to shallow bedrock

3.11.1 Other Hazards

Slope Stability**:** Most of the delineated/assumed building sites are relative flat. Some site grading is anticipated with cuts and fills estimated to be less than 10 feet high. Therefore, potential hazards from on-site slope instability or landslides are considered low. Rockfall hazard exists within the limits of Lots 1, 2, 6, 7 and 12 adjacent to the bold granitic outcrops, especially during earthquake events.

Flooding: Earth Systems searched a FEMA online service (https://msc.fema.gov/portal/search). Using project coordinates (Latitude = 34.20072°, Longitude = -116.50162°) we note the project lies in Zone D.: "Areas with Flood Risk due to Leve and Areas of Undetermined Flood Hazard.", (Area No. 06071C8100H, Effective 8/28/2008) see Figure 2 below. The project site is in an area where sheet flooding and erosion do occur. Appropriate project design by the civil engineer, construction, and maintenance can minimize the site sheet flooding and erosion potential.

Adjacent to and within defined drainage courses and re-entrant drainage courses, seasonal flooding and debris flows can occur.

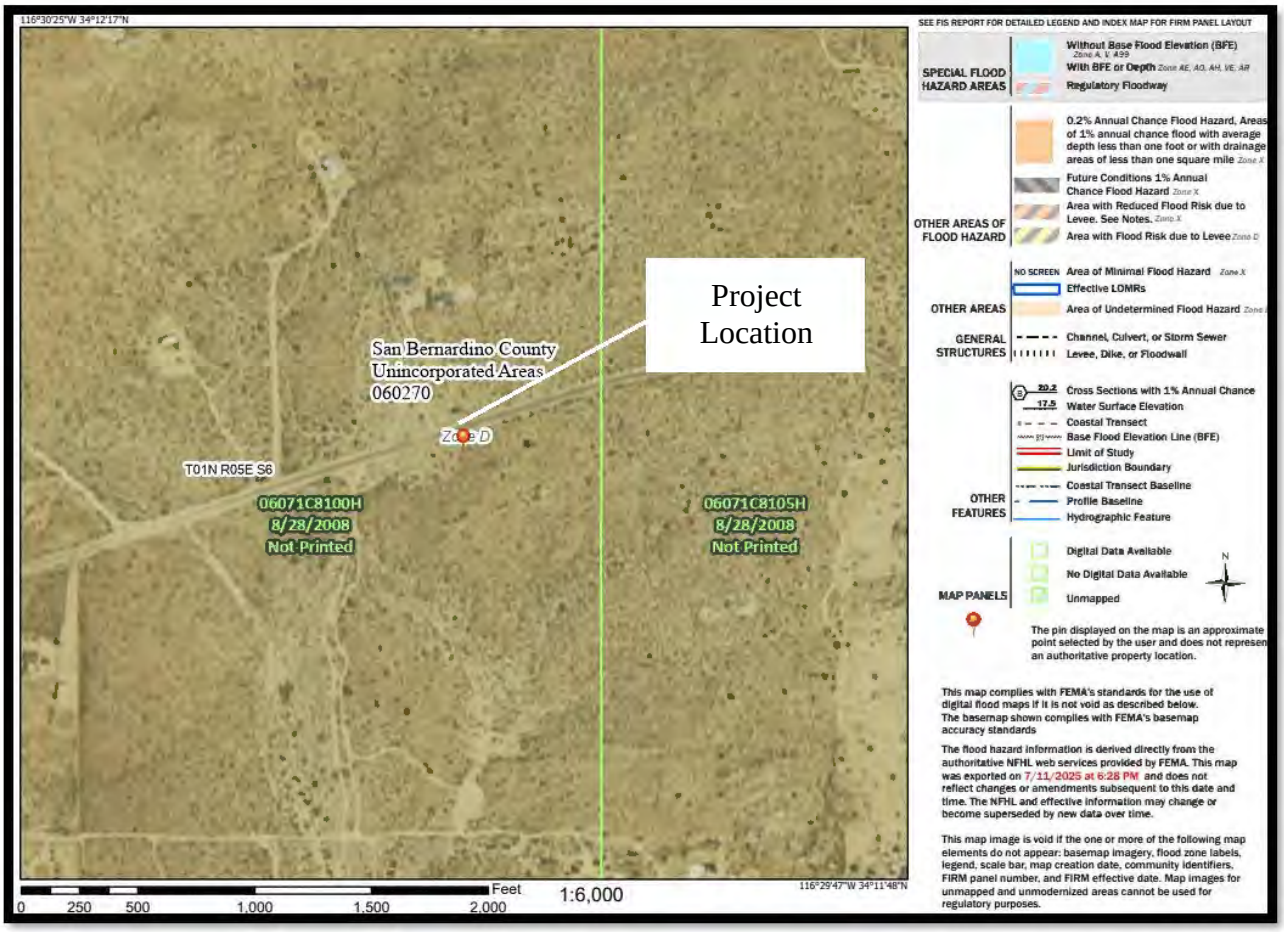


Figure 2 Flood Map per FEMA Website

Section 4
CONCLUSIONS

The following is a summary of our conclusions and professional opinions based on the data obtained from a review of selected technical literature and the site evaluation.

General:

From a geotechnical perspective, the site is suitable for the proposed developments, provided the recommendations in this report are followed in the design and construction of this project.

- The primary geologic hazard is moderate to severe ground shaking from earthquakes originating on regional southern California faults. A major earthquake originating on the nearby segments of the San Andreas fault, Pinto Mountain fault, faults associated with the Eastern California shear zone, and other regional faults would be the critical seismic events that may affect the site within the design life. Engineered design and earthquake-resistant construction increase safety and allow development within seismic areas.

- The underlying geologic condition for seismic design is Site Class C and D, see Appendix A. The lot is about 14 miles from a Type A seismic source as defined by the California Geological Survey. A qualified professional should design any permanent structure constructed on the site. The **minimum** seismic design should comply with the 2022 edition of the California Building Code.

- The potential for seismic settlement hazards are considered low for this project. The site is not within an area of significant documented areal subsidence. Nil settlement potentials exist for the on-site bedrock.

- The soils are susceptible to wind and water erosion. Preventative measures to reduce seasonal flooding and erosion should be incorporated into site grading plans. Dust control should also be implemented during construction. Site grading should be in strict compliance with the requirements of the South Coast Air Quality Management District (SCAQMD).

- Other geologic hazards, including landslides, are considered low potential on this site.

- Based on current conditions, groundwater is not anticipated to be encountered during construction; however, landscaped or watered areas may encounter moist to wet soils in the upper shallow profile.

- Based on our laboratory testing and experience with the project, the Expansion Index of the onsite soil is “very low” as defined by ASTM D 4829. Samples of pad soils should be evaluated to confirm or modify these findings.

- Laboratory testing of two samples showed potentially “mild” corrosivity to buried metallic elements and “negligible” for sulfate exposure to concrete. See Section 3.5 for further information. Site soils should be reviewed by an engineer competent in corrosion evaluation and protection for all elements embedded or founded upon site soils.

- Precise Grading and Foundation Plans have not been reviewed for geotechnical conformance. This report is valid only if Earth Systems reviews the precise grading and foundation plans for geotechnical conformance. Depth and limits of over-excavation are dependent upon the actual building location and should be defined during the plan review process. Design-level geotechnical and percolation reports will be required for future development as this report is for feasibility only.

Section 5
RECOMMENDATIONS

5.1 Site Development

Site Development and Grading

A representative of Earth Systems should observe site clearing, grading, and the bottoms of excavations before placing fill. Local variations in soil conditions may warrant increasing or decreasing the depth of recompaction and over-excavation. Proper geotechnical observation and testing during construction is imperative to allow the geotechnical engineer the opportunity to verify assumptions made during the design process, to verify that our geotechnical recommendations have been properly interpreted and implemented during construction and is required by the 2022 California Building Code. Preventative measures to reduce seasonal flooding and erosion should be incorporated into site grading plans. Dust control should also be implemented during construction. Site grading should be in strict compliance with the requirements of the South Coast Air Quality Management District [SCAQMD].

Observation of fill placement by the Geotechnical Engineer of Record should be in conformance with Section 17 of the 2022 California Building Code. California Building Code requires full time observation by the geotechnical consultant during site grading and pile/pier placement. Therefore, we recommend that Earth Systems be retained during the construction of the proposed improvements to provide testing and observe compliance with the design concepts and geotechnical recommendations, and to allow design changes in the event that subsurface conditions or methods of construction differ from those assumed while completing this study. Additionally, the California Building Code requires the testing agency to be employed by the project owner or representative (i.e. architect) to avoid a conflict of interest if employed by the contractor. Unless noted otherwise, grading should be performed in general accordance with Appendix J of the 2022 CBC.

Special Considerations for Specific Geologic Conditions: For future building sites adjacent to bold bedrock outcrops or where cutting into the bedrock is considered, site-specific geotechnical and geologic studies are recommended to address slope stability of cut faces, natural slopes, and rockfall hazards.

Where future building sites are located within, adjacent to, or at the mouth of drainages or re-entrant drainages, debris flow analysis is recommended.

Where future building sites are proposed for exposed bedrock areas, rippability studies are recommended to address rock hardness and constraints with respect to grading with conventional equipment and generation of over-size rock unsuitable for incorporation into typical engineered fill.

For all lot conditions, geotechnical review of grading and foundation plans for each building site and access roads is recommended.

FOR GENERAL REMEDIAL GRADING AND FOUNDATION DESIGN OF TYPICAL BUILDING SITES AS SHOWN ON THE TENTATIVE TRACT MAP, THE FOLLOWING PRELIMINARY RECOMMENDATIONS ARE PROVIDED.

Clearing and Grubbing: At the start of site grading, existing vegetation, trees (including the entire root system), large roots, overly wet and/or soft soil, undocumented fill, pavements, foundations, construction debris, deleterious material, trash, and abandoned underground utilities should be removed from the proposed building areas. Organic growth should be stripped off the surface and removed from the construction area. Areas disturbed during demolition and clearing should be properly backfilled and compacted as described below.

Undocumented fill, and buried utilities may be located in the vicinity of the planned structures and within other areas of the project site. All buried structures which are removed should have the resultant excavation backfilled with soil compacted as engineered fill described herein or with a minimum 2-sack cement sand slurry approved by the project geotechnical engineer. The demolition operations (removal of foundations, subsurface items, utilities, drywells) should be documented by the demolition contractor for future use. Abandoned utilities should be removed entirely, or pressure-filled with concrete or grout and be capped. Abandoned buried utilities structures, or foundations should not extend under building limits, and should be entirely removed.

After stripping and grubbing operations, areas to receive fill or over excavation should be stripped of loose or soft earth materials until a firm subgrade is exposed, as evaluated by the geotechnical engineer or geologist (or their representative).

Grading:

As foundation types are not known at this time, two options are presented:

1) Foundation on typical shallow foundations with a slab-on-grade floor. This foundation and slab system rely in part on the resistive nature of the existing soils placed as engineered fill for support of the residence.

2) Pile or pier (helical) or shallow foundations supported entirely on bedrock with a structural slab, which does not rely on soil support, but is supported by the foundation system. For Option 2, no building pad remedial grading is required for structure support because the foundation components (helical piers, piles, etc) are extended to bedrock and the slab is supported by the superstructure.

For Option 1, the grading should be performed as below and all soils shall be over-excavated to bedrock.

1) Remedial Grading Building Pad (Over-Excavation and Recompaction): Subsequent to stripping and grubbing operations, areas requiring grading should be stripped of loose or soft earth materials (this also includes all undocumented fill) until a uniform, firm bedrock subgrade is exposed, as evaluated by the geotechnical engineer or geologist. Because of the relatively non-uniform and unequal depths of soil over shallow bedrock of the site soils, especially after stripping, we recommend recompaction of soils in the building areas (including any foundation areas for column supported walkways, canopies, pool shells, etc.). Prior to the placement of fill or subsequent to cut, the existing surface soils within the building pad and foundation areas should be over-excavated to a competent surface of firm bedrock

across the entire pad as determined by the geotechnical engineer or his representative with direct field observations. The over-excavation depth across the building pad will be determined at the time of remedial grading.

To minimize the potential differential settlement of foundations, the minimum depth of excavation across the pad shall be ⅓ the total depth of the deepest excavation under the foundation. For example: If the deepest excavation on one side of the home's foundation is 9 feet under the foundation and on the shallowest side of the home's foundation bedrock located 2 feet below the foundation, then the shallow bedrock must be excavated an additional one (1) foot to make it 3 feet of engineered fill under the foundation—this is the ⅓ criteria. Note in the above example, bedrock term above is defined as "competent material" and this shall be designated by the geotechnical or geologist during grading. Competent material shall also be defined as "excavation refusal on bedrock using a Case 580E backhoe or direct equivalent". No placement of fill shall be permitted unless the geotechnical engineer of record or his representative has approved the competent material. Transitions between the deep over-excavation to the shallow over-excavation shall be benched (5-foot minimum width) to create level benches for fill support and transition the differential fill thicknesses across the building pad, see Figure 5.

For preliminary planning purposes, the extent of the remedial grading should extend a minimum of 5 feet beyond the limits of the structure and associated improvements. This can be adjusted at the time of grading by potholing the building pad area to verify the depth of remedial grading across the building pad prior to remedial grading. In general, the limits of remedial grading beyond the limits of the structure should equal the depth of the remedial grading adjacent to specific exterior points of the structure (5 feet minimum).

The undisturbed bedrock bottom of the exposed over-excavation should be approved by the project geologist or his representative to verify the presence of firm bedrock. If this criterion is not met, additional over-excavation may be required.

The approved bottom of the sub-excavation should then be scarified 12 inches, moisture conditioned to near optimum moisture content, and recompacted to at least 90% relative compaction (ASTM D 1557). Compaction should be verified by testing. Fill placed upon slopes should be benched into the existing slope a minimum of two feet for every one vertical foot of rise or as directed by the geotechnical engineer.

Over-excavations should extend to a depth where the project geotechnical engineer or his representative has deemed the exposed bedrock as being suitable for receiving compacted fill. The materials exposed at the bottom of excavations should be observed by a geotechnical engineer or geologist from our office prior to the placement of any compacted fill soils. Additional removals may be required as a result of observation and/or testing of the exposed subgrade subsequent to the required over-excavation.

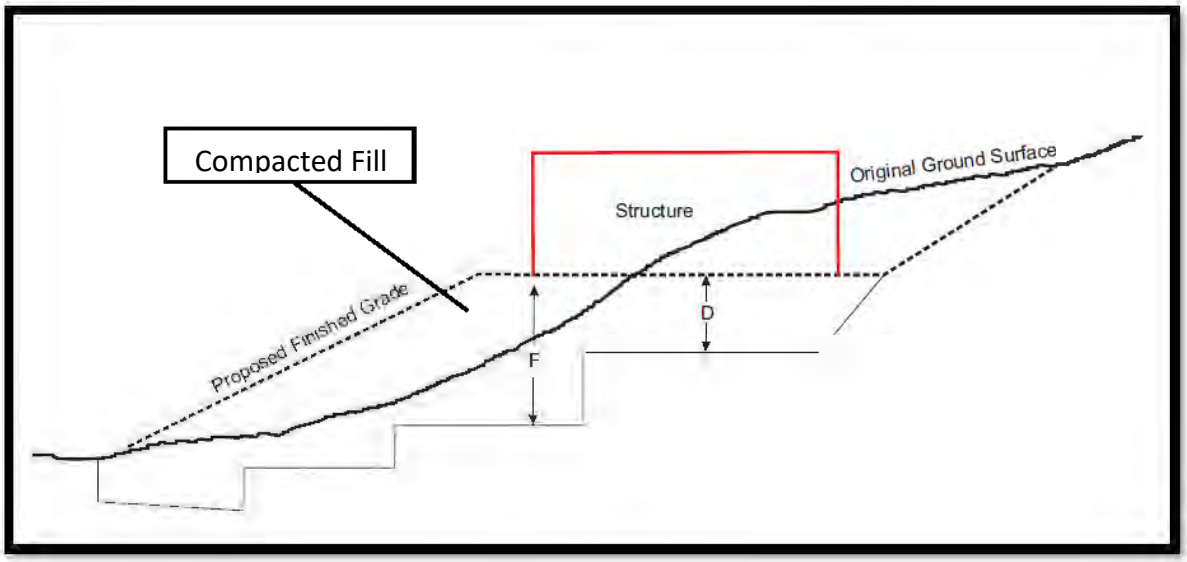


Figure 3
F equals deepest depth to bedrock in pad area;
D equals minimum depth of soil engineered fill (1/3 of F).

Helical Pier or Pile Geotechnical Parameters: Where the structure is planned currently, refusal depths vary from 2 to more than 12 feet below the ground surface, see Figure 3, Table 2, and the trench logs in the appendix. For the soil profile densities with no earth work performed, trench log T-3 provides the estimated soil profile showing approximate densities of the soil profile.

At locations where over-excavation is not desired, helical piles or piles drilled to bedrock and socketed into bedrock a minimum of 1 foot may be used. Minimum socketed embedment and depth needed into bedrock shall be determined by the structural engineer and/or pier/pile manufacturer based on the loads necessary to resist (lateral, uplift, and downward). The helical piers/piles shall be constructed with structural slab, grade beams, and footings per the structural engineer. For lateral loading resistance, see subsection "Minor Deep Foundations" and "Foundation" section of this report.

Auxiliary Structures Subgrade Preparation: Auxiliary structures such as garden, fence wall, or retaining walls should have the foundation subgrade prepared similar to the conditioning and building pad recommendations given above.

Pavement and Hardscape Subgrade Preparation: For pavement and hardscape that are not attached to building structures and are allowed to float freely, the standard of care for design can be the minimum over excavation depth of 2 feet shown below but with the expectation of continuous maintenance being performed due to possible settlement of native soils.

In pavement and hardscape areas, the subgrade should be over-excavated, moisture conditioned, and compacted to at least 95% relative compaction (ASTM D 1557) at near optimum moisture content such that pavement (and vehicular Portland cement concrete) is supported by at least two feet of engineered fill. The exposed subgrades should be moisture conditioned to at least optimum moisture for a minimum of two feet below existing or finished grade and then proof rolled prior to placement of fill to observe if undocumented fill, soft, or loose zones are

present. Any undocumented fill, loose. or soft zones should be over-excavated until a stable subgrade is established. Compaction should be verified by testing.

Engineered Fill Soils and Backfill: The native soil are suitable for use as engineered fill and utility trench backfill, provided they are free of significant organic material, oversize rock (6 inches or greater) or deleterious matter. Fill should be predominately soil classified as silty sand (SM) or poorly graded sand with silt (SP-SM). The native soil and undocumented fill (and any import) should be placed in maximum 8-inch lifts (loose) and each lift compacted to at least 90% relative compaction (ASTM D 1557) near its optimum moisture content (typically +/-2 percent of optimum). prior to the placement of subsequent lifts (unless noted otherwise). Moisture conditioning is required to allow adequate compaction. Vibratory compaction is recommended. Within pavement areas, the upper 24 inches of subgrade should be compacted to at least 95% relative compaction (ASTM D 1557) (98% in paver areas). Compaction should be verified by testing. Rocks larger than 6 inches in greatest dimension should be removed from fill or backfill material. The amount of rock shall not exceed the requirements of ASTM D1557 or per the Geotechnical Engineer of Record's observation and judgement.

Imported fill soils (if needed) should be very low expansion potential granular soils meeting the USCS classifications of SM, SP-SM, or SW-SM with a maximum rock size of 3 inches and 5 to 35% passing the No. 200 sieve (unless otherwise approved by the geotechnical engineer). The geotechnical engineer should evaluate the import fill soils before hauling to the site. However, because of the potential variations within the borrow source, import soil will not be prequalified by Earth Systems. Gap graded gravel should not be used as backfill.

A program of compaction testing, including frequency and method of test, should be developed by the project geotechnical engineer at the time of grading. Acceptable methods of test may include Nuclear methods such as those outlined in ASTM D 6938 (Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods). Alternative methods may include methods outlined in ASTM D 1556 (Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method) or correlation probing with a hand probe.

Sand-Cement Slurry Backfill (Controlled Low Strength Material, CLSM): Where approved by the geotechnical engineer for use, sand-cement "slurry" as backfill (controlled low strength material (CLSM)), shall comply with the provisions of this report for the following:

1. Specifications for the preparation of the site prior to placement of the CLSM.
    - Remove any spoils, uncertified fill, loose material, debris and standing water from the existing excavations to a firm subgrade as approved by the geotechnical engineer or his representative.
    - A representative of Earth Systems should observe bottoms of excavations before placing CLSM.
    - CLSM shall not be placed on a sloping surface with a gradient steeper than 5:1 (H:V).

Specifications for the CLSM:

2. CLSM shall be ready-mixed by an ACI approved batch plant. Use 2-sack sand-cement CLSM complying with Caltrans Standard Specification (2015) Section 19-3.02F Controlled Low-Strength Material. CLSM should have a low or non-shrinkage potential. CLSM must have a 28-day compressive strength of at least 120 psi; however, it is cautioned that increased strength may not be excavatable. Placement of CLSM After Item 1 above is Completed.
    - Place CLSM to the bottom of the foundation area or, in maximum 3-foot lifts (the minimum placement of CLSM should be 12 inches thickness), and allow the CLSM to cure at least for 24 hours or initial set, whichever is longer before placing a subsequent lift. Vibration and rodding of the entire lift should be accomplished during placement. Repeat as needed until the CLSM is at the bottom of the footing.
3. Laboratory or field test method(s) to be used to determine the compressive strength or bearing capacity of the CLSM.
    - Sample CLSM and fabricate test cylinder in accordance with ASTM D4832. Test for density in accordance with ASTM D6023 if there is concern about an as-delivered mix. Test for compressive strength at 28 days in accordance with ASTM D4832.
4. Test methods for determining the acceptance of the CLSM in the field.
    - ASTM D4832-16, Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
    - ASTM D6023-07, Density (Unit Weight), Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low-Strength Material (CLSM), where there is concern.
    - Number and frequency of field tests required to determine compliance with item 5: Fabricate one set of 5 cylinders and test for density for each 50 cubic yards or fraction thereof or as directed by the geotechnical engineer (GE) of record or the GE's representative.

Shrinkage and Bulking: The shrinkage factor for earthwork is expected to range from -2 to 31 percent for the upper excavated or scarified site soils. Negative shrinkage is bulking. This estimate is based on compactive effort to achieve an average relative compaction of about 92 percent. Shrinkage is highly dependent on and may vary with contractor methods for compaction. Losses from site clearing, oversize rock removal, and removal of existing site improvements may significantly affect earthwork quantity calculations and should be considered.

Limiting over-excavation is dependent on lowest elevation of utilities (including the required bedding layer) within the building area, finding native material elevation, and adequate density of the native material.

5.2 Excavations and Shoring

Excavations should be made in accordance with Cal/OSHA requirements. Using the Cal/OSHA standards and general soil information obtained from the field exploration, classification of the

near surface on-site soils will likely be characterized as Type C. Actual classification of site-specific soil type per Cal/OSHA specifications as they pertain to trench safety should be based on real-time observations and determinations of exposed soils by the contractors *Competent Person* (as defined by OSHA) during grading and trenching operations.

Our site exploration and knowledge of the general area indicates there is a high potential for caving and sloughing of site soil excavations (over excavation areas, utilities, footings, etc.) due to dry conditions. Excavations in bedrock may expose jointed or fractured rock where sluffing and rock popouts can occur off of trench walls. Hard cobble, core stones, and boulders are likely present. Where excavations in soils over 4 feet deep are planned, lateral bracing or appropriate cut slopes of 1.5:1 (horizontal/vertical) should be provided. No surcharge loads from stockpiled soils or construction materials should be allowed within a horizontal distance measured from the top of the excavation slope and equal to the depth of the excavation.

Excavations which parallel structures, pavements, or other flatwork, should be planned so that they do not extend into a plane having a downward slope of 1:1 (horizontal: vertical) from the bottom edge of the footings, pavements, or flatwork. Shoring or other excavation techniques may be required where these recommendations cannot be satisfied due to space limitations or foundation layout. Where over-excavation will be performed adjacent to existing structures, ABC slot cutting techniques (5-foot maximum width, minimum 5-foot lateral extent) may be used as pre-approved by the project geotechnical engineer. No oversize material shall be allowed to be located within a 45-degree plane protruding from the bottom of the cut.

Surcharge Load and Excavation Restrictions: No fill or other surcharge loads shall be placed adjacent to any building or structure unless such building or structure is capable of withstanding the additional loads caused by the fill or the surcharge. Existing footings or foundations that will be affected by any excavation shall be underpinned or otherwise protected against settlement and shall be protected against detrimental lateral or vertical movement, or both.

Exception: Minor grading for landscaping purposes shall be permitted where performed with walk-behind equipment, where the grade is not increased more than 1 foot from original design grade or where approved by the building official.

Where excavations will reduce support from any foundation, a registered design professional shall prepare an assessment for the structure as determined from examination of the structure, the review of available design documents and, if necessary, excavation of test pits. The registered design professional shall determine the requirements for underpinning and protection and prepare site-specific plans, details and sequence of work for submission. Such support shall be provided by underpinning, sheeting and bracing, or by other means acceptable to the building official.

Shoring: Shoring may be required where soil conditions, space, or other restrictions do not allow a sloped excavation or slot cutting is not an option. A braced or cantilevered shoring system may be used. Trench boxes should not be placed below or within the pipe zone elevation as their removal may loosen compacted backfill. Positive trench shoring may be required (jacks and plates).

A temporary cantilevered shoring system should be designed to resist an active earth pressure equivalent to a fluid weighing as shown in the table below. Braced or restrained excavations above the groundwater table should be designed to resist a uniform horizontal equivalent soil pressure as presented in the table below. Cuts in bedrock should be evaluated on a case-by-case basis.

Table 7
Temporary Cantilevered and Braced Shoring System Parameters

Equivalent Fluid Pressure pounds per cubic foot (pcf)	
Cantilevered	**Braced**
42	63

The values provided above assume a level ground surface adjacent to the top of the shoring and do not include a factor of safety. Fifty percent of an areal surcharge placed adjacent to the shoring may be assumed to act as an additional uniform horizontal pressure against the shoring. Special cases such as combinations of slopes and shoring or other surcharge loads may require an increase in the design values recommended above. These conditions should be evaluated by the project geotechnical or shoring engineer on a case-by-case basis. Retaining walls subjected to traffic loads should include a uniform surcharge load equivalent to at least 250 psf for auto or delivery truck (2 axle) traffic kept at least 3 feet from the back of the wall. Retaining walls with closer traffic or heavier traffic loads should be designed for a 400 psf surcharge load. Retaining walls should be designed with a minimum factor of safety of 1.5.

The wall pressures above the groundwater do not include hydrostatic pressures; it is assumed that drainage will be provided. If drainage is not provided, shoring extending below the groundwater level should be evaluated on a case-by-case basis.

Cantilevered shoring must extend to a sufficient depth below the excavation bottom to provide the required lateral resistance. We recommend required embedment depths be determined using methods for evaluating sheet pile walls and based on the principles of force and moment equilibrium. For this method, the allowable passive pressure against shoring, which extends below the level of excavation, may be assumed to be equivalent to a fluid weighing 300 pcf. Additionally, we recommend a factor of safety of at least 1.2 be applied to the calculated embedment depth and that passive pressure be limited to 2,000 psf.

The contractor should be responsible for the structural design and safety of all temporary shoring systems. The contractor should carefully review the boring logs in this report, and perform their own assessment of potential construction difficulties, and methods should be selected accordingly. Shoring should be sealed to prevent the piping of soil material and potential soil loss conditions which can cause settlement. The method of excavation and support is ultimately left to the contractor. We recommend that existing structures be monitored for both vertical and horizontal movement.

The contractor should carefully review the boring logs in this report, and perform their own assessment of potential construction difficulties, and methods should be selected accordingly. The method of excavation and support is ultimately left to the contractor. A representative from

our firm should be present during grading operations to monitor site conditions, substantiate proper use of materials, and evaluate compaction operations.

5.3 Utility Trenches and Backfill

Backfill of utilities within roads or public rights-of-way should be placed in conformance with the requirements of the governing agency (water district, public works department, etc.). Utility trench backfill within private property should be placed in conformance with the provisions of this report. Backfill operations should be observed and tested to monitor compliance with these recommendations.

For compaction testing of pipeline subgrades, where excavations require trench entry, the contractor should make allowance and provide proper shoring or stabilize the excavation in accordance with CalOSHA for safe entry by the testing lab and workers. Hard bedrock will likely be encountered in utility trench excavations.

Trench Width and Vertical Loads on Pipelines: Vertical loads to the pipeline are highly dependent upon the geometry of the trench. In general, the narrower the trench is at the top of the pipe/conduit with respect to the diameter of the conduit, the less vertical load is applied to the conduit. This is because as the trench backfill and bedding compress or consolidate over time, the weight of the soil mass is partially offset by the frictional resistance along the trench sidewalls. In addition, the type of bedding supporting the pipeline affects the bearing strength of the pipe. This is accounted by a load factor that is multiplied to the design strength of the pipe. The pipe manufacturer recommendations for trench installation and maximum width should be followed to reduce the potential for overloading the pipe due to excess backfill load.

Pipe Subgrade and Bedding: Pipeline subgrade should be compacted to a minimum of 90% relative compaction (ASTM D 1557) or to a firm condition as evaluated by the geotechnical engineer or his representative for a depth of 6 inches below any bedding. Bedding material should consist of sand 100 percent passing a No. 4 sieve and less than 5 percent fines (passing a No. 200 sieve), and a sand equivalent of 30 or more or as approved by the project inspector and geotechnical engineer and be a minimum of 6 inches in thickness. The unprocessed native soils are not typical of that used for bedding, and import will be required if needed. Bedding is recommended due to the rocky nature of soils exposed in trenches and the non-uniform and potentially abrasive pipe support.

Pipe-Zone, Trench–Zone, Trench Backfill and Compaction: Backfill of utilities should be placed in conformance with the requirements of the specifications. Backfill of utilities within roads or public rights-of-way should be placed in conformance with the requirements of the governing agency (water district, public works department, etc.).

Pipe zone backfill material (the pipe area from the bedding to 12 inches above the top of pipe) may consist of native soils with a ¾" maximum particle size or import sand (as described above for bedding) as dictated by the pipe designer or manufacturer. The pipe zone backfill material should be placed in maximum 8-inch lifts (loose) and compacted near its optimum moisture content prior to the placement of subsequent lifts. Pipe zone backfill should be compacted to a minimum of 90% relative compaction (ASTM D 1557) or to a firm condition as evaluated by the

geotechnical engineer or his representative. Compaction should be assured in the pipe haunches.

The native soil may be suitable for use as trench zone and street zone (and manholes) backfill (from the top of pipe zone up to finished subgrade), if approved suitable by the pipe manufacturer, provided it is free of significant organic or deleterious matter and oversize materials. Rocky soils, if encountered may not be suitable to support pipe haunches, there by requiring a sandy import, as above for bedding. Trench-zone backfill should contain no particles larger than 3 inches in greatest dimension. The final backfill material should be placed in maximum 8-inch lifts (loose) and compacted to at least 90% relative compaction (ASTM D 1557) near its optimum moisture content for the trench zone and 95% for the street zone (upper 12 inches) where below pavement. Compaction should be verified by testing.

Backfill materials should be brought up at substantially the same rate on both sides of the pipe or conduit. Reduction of the lift thickness may be necessary to achieve the above recommended compaction. Care should be taken to not overstress the piping during compaction operations. Mechanical compaction is recommended. Ponding or jetting is not recommended.

Alternatively, if the utility cannot accommodate the increased stress, or if compaction is difficult, we recommend the pipe be encased by at least 1 foot of 1-sack cement-sand slurry (at least 1 foot as measured from the top of pipe) or 2 sack in structural/pavement areas. Backfill operations should be observed and tested to monitor compliance with these recommendations.

In general, coarse-grained sand and/or gap graded gravel (i.e. ¾-inch rock or pea-gravel, etc.) should not be used for pipe or trench zone backfill due to the potential for soil migration into the relatively large void spaces present in this type of material and water seepage along trenches backfilled with coarse-grained sand and/or gravel. Water seepage or soil migration will cause settlement of the overlying soils. Gap graded backfill should be wrapped in filter fabric such as Mirafi 140N.

Compaction should be verified by testing. Backfill operations should be observed and tested to monitor compliance with these recommendations. Trench backfill compacted per these requirements can be expected to settle 0.1 to 0.3 percent of the trench depth. This can cause an elevation difference between backfilled trenches and the surrounding soil or pavement. Increased relative compaction can reduce settlement if the potentials presented are not acceptable. The geotechnical engineer should be consulted on a case-by-case basis to provide further recommendations to reduce the settlement potential.

STRUCTURES

5.4 Shallow Foundation Recommendations

In our professional opinion, foundations for new structures (as presented within) can be supported on shallow foundations bearing in properly prepared and compacted soils placed as recommended in Section 5.1 or entirely on bedrock. The following recommendations are based on “very low” expansion category soils in the upper 5 feet of subgrade. Soils which are found to

be more expansive than a "very low" Expansion Index should be relocated to non-improvement locations or per specific recommendations of the geotechnical engineer.

Footing design of widths, depths, and reinforcing are the responsibility of the Structural Engineer, considering the structural loading and the geotechnical parameters given in this report. A minimum footing depth of 12 inches (wall footings) (15 inches for 2 story structures) and 18 inches (column footings and three-story structures) below lowest adjacent grade should be maintained (lowest grade within 3 feet laterally as measured from the foundation bottom). Earth Systems should be retained to observe foundation excavations before placement of reinforcing steel or concrete. Loose soil or construction debris should be removed from footing excavations before placement of concrete. *All footing excavations should be probed for uniformity. Soft or loose zones should be excavated and recompacted to finish foundation bottom subgrade. The bottom of all foundations should be compacted and tested to confirm a minimum of 90% relative compaction (ASTM D 1557).*

Slope Setback for Foundations: Earth Systems recommends a minimum setback distance of 5 feet for the tops of slopes and 25 feet from any leach bed edge. The 2022 California Building Code provides setback distances for foundations along slopes. Setback distances are measured differently for foundations located at the top of the slope and those located at the bottom of the slope. For foundations located at the top of the slope, the measurement is taken horizontally from the outside face of the foundation footing to the face of the slope. For foundations located below the slope, the horizontal distance is measured from the face of the structure to the bottom of the slope. For pools and slopes steeper than 1(H):1(V), please contact Earth System for these setbacks with submittal of detailed information using plan form.

Shallow Foundations based on Grading per Section 5.1 Option 1 of this report: Allowable soil bearing pressures are given below for foundations bearing on recompacted soils as described in Section 5.1 or entirely on bedrock. Allowable bearing pressures are net (weight of footing and soil surcharge may be neglected).

- Continuous wall foundations, 12-inch minimum to 36-inch maximum width and 12 inches minimum to 30-inch maximum embedment depth:

  1,500 psf for dead plus design live loads

- Isolated pad foundations, 2 x 2-foot minimum, 5 x 5-foot maximum in plan dimension and 18 inches minimum to 30-inch maximum embedment depth:

  2,000 psf for dead plus design live loads

Shallow Foundations or Piers/Piles Founded in Bedrock (minimum of 1 foot socketing), Option 2 of Section 5.1.

- Foundations/Pile/Piers with minimum 4-foot embedment:

  4,000 psf for dead plus design live load which may be increased 500 psf for each additional foot of embedment to a maximum of 8,000 psf.

A one-third (⅓) increase in the allowable bearing pressure may be used when calculating resistance to wind or seismic loads if the structural engineer determines they are allowed per

California Building Code. The allowable bearing values indicated are based on the anticipated maximum loads stated in Section 1.1 of this report. If the anticipated loads exceed these values, the geotechnical engineer must reevaluate the allowable bearing values and the grading requirements.

Any maximum foundation sizes are based on settlement due to Dead + Live loads. Transient loads such as earthquake or wind loads are not subject to the stated size limitations; however, the allowable bearing pressure (including ⅓ increase) should be followed considering the relevant foundation sizes given above. Earth Systems recommends the structural engineer provide actual Dead, Live, and Transient Loads for analysis of allowed bearing stresses. Factors for Live Load related to sustained and transient loading should also be provided by the Structural Engineer.

The spacing between large spread footings should be evaluated by the geotechnical engineer during the plan review stage to confirm or modify the settlement estimates and bearing capacity due to large footings and the influences from adjacent footings. These settlements are based on exploration data obtained during our exploration. A preliminary analysis suggests spacing the footings (adjacent edge to adjacent edge) a lateral distance from one another of the width of the largest footing from any adjacent footing, such that influence effects are minor.

An average modulus of subgrade reaction, k, of 200 (new foundations) pounds per cubic inch (pci) can be used to design lightly loaded footings and slabs founded upon compacted fill. Other foundations such as mat slabs, will require the use of differing modulus of subgrade reaction values than used for lightly loaded slabs.

Stepped foundations should be designed in accordance with the 2022 CBC. The CBC 2022 and ACI Section 4.3, Table 4.3.1 should be followed for recommended cement type, water cement ratio, and compressive strength. Seismic Design Category for compressive strength determination is ‘D’.

Minimum Foundation Reinforcement: Minimum reinforcement should be provided by the structural engineer to accommodate the settlement potentials presented within.

Estimated Settlements for New Foundations Caused by Static Loading and Collapse Soils: Estimated total static load settlement is less than 1 inch, and seismic settlement is remediated for a combined settlement of 1 inch. These estimates are based on footings founded on firm soils as described in Section 5.1 of this report. The total estimated differential settlement for the combined static and remediated collapse settlement is estimated to less than 1 inch. As such, considering differential settlement applied over a typical foundation distance of 40 feet, we recommend the structural engineer design for the standard angular distortion of 1:480 for the differential condition.

Earthquake Performance Statement: Depending upon the extent of structural and geotechnical design of exterior flatwork, walls, utilities, roadways, and other similar site improvements, some damage due to seismic events will occur. Note that all of southern California in general is in earthquake country. Site developments in southern California are typically not designed to mitigate anticipated seismic events without some damage. In fact, the Building Code is intended to provide Life-Safety performance, not complete damage-free design. In other words, some

damage from earthquakes in the form of structural damage, settlement, cracking, and disruption of utilities can occur. It is not the current standard of care for site designers to fully mitigate all anticipated earthquake induced hazards.

According to literature from Robert W. Day, doors and windows may stick at distortion angles between 1:240 and 1:175. In this situation, a human being could be put in a life-threatening situation. Therefore, Earth Systems recommends (for shallow foundation design) the maximum distortion angle using all the settlement conditions including seismic settlements be 1:240. The estimated angular distortions for this project are better than this threshold.

Minor Depth Foundations (less than 15 foot embedment as described within): Although no specific elements were identified by the architect, for structural components, or similar may be supported on cast-in-place piles (pier), helical piers, or direct embed in drilled holes filled with concrete which are entirely supported on bedrock, and the design be based on parameters presented in the subsequent sections of this report. Piers will be very hard to drill in the rocky and dry soil (caving) soils. Construction employing poles or posts may utilize design methods presented in Section 1806 and 1807 and values of the CBC for Silty Sand (SM) material class of Table 1806.2 for lateral resistance and the allowable bearing pressures presented earlier. For designs utilizing allowable frictional resistance, Earth Systems recommends the use of Section 1810.3.3.1.4 and .5 of the CBC. Side friction and end bearing should not be considered to act concurrently for design except for drill (screwed) insertion of helical piers. For piles with an axial or lateral load, these design methods apply for piles spaced at least 3 pile diameters center to center for axial loads and 6 pile diameters for lateral load where the load is in the same direction as adjacent piers and their stress envelope overlaps. Piles spaced closer than these limits could have soil strength reduction and should be evaluated on a case-by-case basis by geotechnical engineer.

For piers founded in areas with native soil at the surface, an additional 3 feet should be added to the calculated pile embedment due to the potential effects of long-term surficial disturbance and erosion. For lateral evaluation, it should be considered that the upper 3 feet is unsupported. Additionally, where piers are constructed adjacent to the tops of slopes, there should be a minimum distance between the top of the slope and the closest edge of the pier of H/3, where ‘H’ is the height of the slope, otherwise a lateral resistance reduction must be applied. For piers founded closer than a distance H/3 to the crest or within the slope area itself, the calculated lateral resistance of the soil should be reduced by 30%. The above recommendations have considered slopes no steeper than 2:1 (horizontal:vertical). Steeper slopes will require additional analysis and may change the recommendations presented.

For estimated refusal depths, please see Figure 3 and Table 2 and trench logs in Appendix A. Drilled piers should have a minimum 3 inches of clearance between the embedded post and the soil side wall to allow for adequate placement and flow of concrete.

Drill holes may end up oversize. Casing or other means may be required in a drilled hole. Any "slough" or loose soils at the bottom of the shaft must be removed or tamped prior to setting rebar cages and placing concrete. Extreme care must be exercised to carefully position reinforcing steel cages and place concrete without disturbing the sidewalls of the drilled shafts. We recommend centralizers be used to positively locate rebar cages within the pier shaft. It is

recommended that pier excavations that have not received concrete, not be left open and concrete should be placed immediately. Caving is a very high concern.

Normally, drilled pier excavations are made without the use of water. If necessary, water may be used to facilitate removal of cuttings unless it aggravates caving problems. Samples during our geotechnical exploration were unrecoverable due to dry and cohesionless soils. Added water that may accumulate at the bottom of the hole should be removed from the drilled hole prior to placing the concrete. Sidewalls which have softened from the addition of water should be cleaned of the soft/loose material. Each excavation should be completed in a continuous operation and the concrete should be placed without undue delay. The contractor should use appropriate means to clean the bottom of the excavation so that no loose material is present at the base of the pier. We do not recommend over-drilling beyond specified pier tip elevations to eliminate the need for bottom cleaning in order to account for slough or loose materials at the excavation bottom. To reduce the potential for caving and sidewall sloughing which may contaminate concrete during placement, and segregation, concrete should be placed by tremie methods and not directly chute-dumped into the hole.

Where casing is used with drilled holes and cannot be withdrawn, the skin friction capacity is theoretically reduced, as are passive resistance and stiffness. The amount of reduction is subject to assessment by the geotechnical consultant. The use of casing with drilled holes should be approved prior to use by the geotechnical engineer.

If casing is required, it should be withdrawn as the concrete is being placed, maintaining a 3-foot minimum head of concrete within the casing. This is to prevent reduction in the diameter of the drilled shaft due to earth pressure on the fresh concrete and to prevent extraneous material from falling in from the sides and mixing with the concrete. Concrete placement should continue in this manner until suitable concrete extends to the top of the excavation or forms. The upper eight feet of the pier should be consolidated by vibratory means.

Pier capacity is greatly dependent on the soil conditions at the location of the pier and upon contractor means and methods of placement. It is recommended that drilling operations and concrete placement be performed in the continuous presence of the geotechnical consultant or his representative to confirm that suitable materials for pier support are penetrated, that the dimensions of the installed piers meet the design dimensions, and that the installation has been performed as specified by the 2022 California Building Code. Observation during drilling is required by the 2022 California Building Code on a full-time basis by the geotechnical engineer or his representative. If subsurface conditions noted during drilled pier installation are significantly different than those encountered in our borings, it may be necessary to adjust the overall length of the pier.

Prior to the placement of steel, and again prior to and during the placement of concrete, the excavation must be examined by the geotechnical consultant before proceeding with construction. The contractor should provide all aid and assistance required by the geotechnical and geologic consultants for field monitoring of the drilled pier operations.

Piers are accepted or rejected based on visual observation and testing during construction. The contractor should not allow nor cause any of this work to be permanently enclosed or covered

up until it has been observed, tested, and accepted by the geotechnical engineer and all legally constituted authorities having jurisdiction.

Pier Foundation Grading and Testing: If the design uses pile foundations, the GER recommends the use of end bearing only unless noted otherwise. The contractor shall prove that the bottom of the pier foundation is clean before placement of the concrete. The contractor shall also make safe the bottom of the pier footing to allow access to test the bottom of the pier foundation prior to placement of concrete—this may require contractor to provide shoring for safe access. Other options of obtaining samples at the bottom of the pier foundation to determine adequate compaction may be provide at the expense of the contractor but must be approved the GER.

5.5 Slope Construction

Site soils are highly susceptible to erosion. Compacted fill slopes protected against erosion (per approved methods such as significant planting, facing, or erosion blankets, etc.) should be constructed at 3:1 (horizontal: vertical) or flatter inclinations. Unprotected slopes or steeper slopes with exposed native soils or compacted fill at the surface should be expected to require repair after heavy nuisance or storm runoff occurs due to significant erosion. Slope recommendations may change pending a more in-depth geotechnical evaluation once design plans are developed. Slopes used as nuisance or storm drainage channel slopes should be no steeper than 3:1 and protected with heavy 12” minimum rip-rap or designed by the civil engineer to resist the anticipated flows. Positive lot drainage should be designed, constructed, and maintained to prevent flow of water off the pad over the descending fill slope. Berms, lined swales, and other means should be utilized to divert runoff away from the slope face.

Compacted fill should be placed at near optimum moisture content and compacted to a minimum 90 percent of the maximum dry unit weight, as measured in relation to ASTM D 1557 test procedures. The exposed face of any cut or fill slope (upper 12 inches) should have a minimum relative compaction of 90 percent, as measured in relation to ASTM D 1557 test procedures and be compacted at near optimum moisture content. Due to the erodible site soils, slope faces should be protected with facing or densely spaced vegetation to reduce the erosion potential.

Surficial Slope Failures: Site soils are highly susceptible to erosion from wind and water sources. All slopes will be exposed to weathering, resulting in decomposition of surficial earth materials, thus potentially reducing shear strength properties of the surficial soils. In addition, these slopes become increasingly susceptible to rodent burrowing. As these slopes deteriorate, they can be expected to become susceptible to surficial instability such as soil slumps, erosion, soil creep, and debris flows. Development areas immediately adjacent to ascending or descending slopes should address future surficial sloughing of soil material and erosion. Such measures may include debris fences, slope facing, catchment areas or walls, diversion ditches or berms, soil planting, velocity reducers or other techniques to contain soil material away from developed areas and reduce erosion. Additionally, foundations should be set back at least 5 feet from the edge of slope or as per the 2022 CBC, whichever is greater.

Operation and maintenance inspections should be done after a significant rainfall event and on a time-based criterion (annually or less) to evaluate distress such as erosion, slope condition, rodent infestation burrows, etc. Inspections should be recorded, and photographs taken to

document current conditions. The repair procedure should outline a plan for fixing and maintaining surficial slope failures, erosional areas, gullies, animal burrows, etc. Repair methods could consist of excavating and infilling with compacted soil erosional features, track walking the slope faces with heavy equipment, as determined by the type and size of repair. These repairs should be performed in a prompt manner after their occurrence. Slope inclinations should be maintained, and a maintenance program should include identifying areas where slopes begin to steepen. Where future maintenance is not possible, slopes should be faced to reduce the erosion and degradation potential.

Slope faces are erodible even if compacted and will gradually erode and move down slope presenting maintenance issues and debris deposited in drainage devices and flatwork areas. The minimum material necessary to support landscaping should be specified by the landscape consultant (typically less than 6 inches).

5.6 Slabs-on-Grade

Subgrade: Concrete slabs-on-grade and flatwork should be supported by compacted and moisture conditioned soil placed in accordance with Section 5.1 of this report.

Vapor Retarder: In areas of moisture-sensitive floor coverings, coatings, adhesives, underlayment, goods or equipment stored in direct contact with the top of the slab, bare slabs, humidity-controlled environments, or climate-controlled cooled environments, an appropriate vapor retarder that maintains a permeance of 0.01 perms or less after ASTM E1745's mandatory conditioning tests should be installed to reduce moisture transmission from the subgrade soil to the slab. For these areas, a vapor retarder (Stego wrap 15-mil thickness or equal) should underlie the floor slabs. If a Class A vapor retarder (ASTM E 1745) is specified, the retarder can be placed directly on non-expansive soil and be covered with a minimum 2 inches of clean sand.

Clean sand is defined as well or poorly-graded sand (ASTM D 2488) of which less than 5 percent passes the No. 200 sieve and all the material passes a No. 4 sieve. The site soils do not fulfill the criteria to be considered clean sand. Alternatively, the slab designer may consider the use of other vapor retarder systems that are recommended by the American Concrete Institute.

Low-slump concrete should be used to help reduce the potential for concrete shrinkage. The effectiveness of the membrane is dependent upon its quality, the method of overlapping, its protection during construction, the successful sealing of the membrane around utility lines, and sealing the membrane at perimeter terminations and of all penetrations. Capillary breaks, if any, beneath slabs should consist of a minimum of at least four inches of permeable base material (Caltrans) with the following specified gradation.

Table 8
Capillary Break

Sieve Size	Percent Passing
1 inch	100
¾ Inch	90-100
3/8 Inch	40-100
#4	25-40
#8	18-33
#30	5-15
#50	0-7
#200	0-3

Where vapor retarders are placed directly on a gravel capillary break, they should be a minimum of 15 mil thickness.

Where concrete is placed directly on the vapor retarder "plastic", proper curing techniques are essential to minimizing the potential of slab edge curl and shrinkage cracking. The edges of slabs can curl upward because of differential shrinkage when the top of the slab dries to lower moisture content than the bottom of the slab. Curling and cracking are caused by the difference in drying shrinkage between the top and bottom of the slab. Curling and cracking can be exacerbated by hot weather, or dry condition concrete placement, even with proper curing techniques.

The following minimum slab recommendations are intended to address geotechnical concerns such as potential variations of the subgrade and are not to be construed as superseding any structural design. A design engineer should be retained to provide building specific systems to handle subgrade moisture to ensure compliance with SB800 with regards to moisture and moisture vapor.

Slab Thickness and Reinforcement: Slabs on grade should be a minimum of 5 inches in actual thickness (4 inches for flatwork) and be reinforced with at least #3 bars at 18 inches on center both ways. Reinforcing bars should extend at least 40 bar diameters into the footings and slabs. Concrete slabs-on-grade and flatwork should be supported by compacted and moisture conditioned soil placed in accordance with this report.

Slab thickness and reinforcement of slabs-on-grade are contingent on the recommendations of the structural engineer or architect and the expansion index of the supporting soil. Based upon our findings, a modulus of subgrade reaction of approximately 200 pounds per cubic inch can be used in concrete lightly loaded (not mat) slab design for the expected compacted subgrade. Mat slab design will require differing modulus values. ACI Section 4.3, Table 4.3.1 should be followed for recommended cement type, water cement ratio, and compressive strength.

If heavily loaded flatwork is proposed (RV drive areas, heavy racking, etc.), the actual thickness should be designed by the structural engineer utilizing techniques of the American Concrete

Institute (ACI) and may be greater than 5 inches in thickness. Concrete floor slabs may either be monolithically placed with the foundations or doweled (No. 4 bar embedded at least 40 bar diameters) after footing placement. The thickness and reinforcing given are not intended to supersede any structural requirements provided by the structural engineer. The project architect or concrete inspector should continually observe all reinforcing steel in slabs during placement of concrete to check for proper location within the slab. The minimum concrete rebar cover should be as per the project architect or structural engineer.

Slab-On-Grade Control Joints: Control joints should be provided in all regular concrete slabs-on-grade at a maximum spacing of 36 times the slab thickness on-center, each way as recommended by American Concrete Institute [ACI] guidelines (sidewalks every 4 to 6 feet). All joints should form approximately square patterns to reduce the potential for randomly oriented shrinkage cracks. Control joints in the slabs should be tooled at the time of the concrete placement or saw cut (¼ of slab depth) as soon as practical but not more than 8 hours from concrete placement.

Construction (cold) joints should consist of thickened butt joints with ¾-inch dowels at 18 inches on center (12 inches at doorways) mid-slab embedded per ACI or a thickened keyed-joint to resist vertical deflection at the joint. All control joints in exterior flatwork should be sealed to reduce the potential of moisture or foreign material intrusion. These procedures will reduce the potential for randomly oriented cracks and lifting but may not prevent them from occurring.

Curing and Quality Control: The contractor should take precautions to reduce the potential of curling and cracking of slabs in this arid desert region using proper batching, placement, and curing methods. Curing and cracking is highly affected by temperature, wind, and humidity.

Quality control procedures should be used, including trial batch mix designs, batch plant inspection, and on-site special inspection and testing. Curing should be in accordance with ACI recommendations contained in ACI 211, 304, 305, 308, 309, and 318. Additionally, the concrete should be vibrated during placement. Concrete should be wet cured for at least 7 days with burlap or plastic and not allowed to dry out to minimize surface cracking.

5.7 Retaining Walls and Lateral Earth Pressures

Walls which are restrained at the top such as retaining wall returns, below-grade walls and walls tied to floor slabs should be designed with “at rest” earth pressures. Retaining walls, free to tilt at the top, may be designed for “active” earth pressures.

The following list presents lateral earth pressures for use in wall design. The values are given as equivalent fluid pressures ***without*** surcharge loads or hydrostatic pressure. Clay soils are not suitable for wall backfill as they are not free draining.

- Conventional cantilever retaining walls can be backfilled with compacted on-site engineered fill soils verified to be “very low” in expansion potential. Provided the wall is backfilled at a 1:1 projection upward from the heels of the wall footings with non-expansive engineered fill, an active pressure of 42 pcf of equivalent fluid weight for well-drained, level backfill may be used. Similarly, an active pressure of 52 pcf of equivalent fluid weight may be used for well-drained backfill sloping at 2H:1V (horizontal to vertical).

For the restrained level backfill condition, a pressure of 63 pcf of equivalent fluid weight should be used.

- In addition to the active or at rest soil pressure, where not excepted by code, the proposed wall structures should be designed to include forces from dynamic (seismic) earth pressure. Dynamic pressures are additive to active and at-rest earth pressure and should be considered as 57 pcf for flexible walls, and 73 pcf for rigid walls using engineered fill as backfill. Seismic pressures are based on PGA_M of 0.87 g, Friction Soil Angle of 31^o, and a total density of 125 pcf.
- Walls retaining bedrock should be evaluated on a case-by-case basis.
- Retaining wall foundations should be placed upon compacted fill or bedrock described in Section 5.1.
- A back-drain or an equivalent system of backfill drainage should be incorporated into the wall design, whereby the collected water is conveyed to an approved point of discharge. Design should be in accordance with the 2022 California Building Code. Drain rock should be wrapped in filter fabric such as Mirafi 140N as a minimum and should have a volume of 1 cubic foot per foot of length. Backfill immediately behind the retaining structure should be a free-draining granular material. Waterproofing should be according to the designer's specifications. Water should not be allowed to pond or infiltrate near the top of the wall. To accomplish this, the final backfill grade should divert water away from retaining walls.
- Compaction on the retained side of the wall within a horizontal distance equal to one wall height (to a maximum of 6 feet) should be performed by hand-operated or other lightweight compaction equipment (90% compaction relative to ASTM D 1557 at near optimum moisture content). This is intended to reduce potential locked-in lateral pressures caused by compaction with heavy grading equipment or dislodging modular block type walls.
- The above recommended values do not include compaction or truck-induced wall pressures. Care must be taken during the compaction operation not to overstress the wall. Heavy construction equipment should be maintained a distance of at least 3 feet away from the walls while the backfill soils are placed. Upward sloping backfill or surcharge loads from nearby footings can create larger lateral pressures. Should any walls be considered for retaining sloped backfill or placed next to foundations, our office should be contacted for recommended design parameters. Surcharge loads should be considered if they exist within a zone between the face of the wall and a plane projected 45 degrees upward from the base of the wall. The increase in lateral earth pressure should be taken as 50% of the surcharge load within this zone. Retaining walls subjected to traffic loads should include a minimum uniform surcharge load equivalent of 250 psf for auto and 400 psf for truck traffic kept back at least 3 feet from the wall back edge. Retaining walls should be designed with a minimum factor of safety of 1.5.

Frictional and Lateral Coefficients:

- Resistance to lateral loads (including those due to wind or seismic forces) may be provided by frictional resistance between the bottom of concrete foundations and the underlying soil, and by ½ of the passive soil pressure against the foundations if used together due to different rates of mobilization. An allowable coefficient of friction of 0.35 may be used between cast-in-place concrete foundations and slabs and the underlying soil or bedrock. An allowable coefficient of friction of 0.30 may be used between pre-cast or formed concrete foundations and slabs and the underlying soil or bedrock.
- Allowable passive pressure may be taken as equivalent to the pressure exerted by a fluid weighing 300 pounds per cubic foot (pcf). Vertical uplift resistance may consider a soil unit weight of 105 pounds per cubic foot. The upper 1 foot of soil should not be considered when calculating passive pressure unless confined by overlying asphalt concrete pavement or Portland cement concrete slab. The soils pressures presented have considered onsite fill soils. Testing or observation should be performed during grading by the soils engineer or his representative to confirm or revise the presented values.
- Passive resistance for thrust blocks bearing against firm natural soil or properly compacted backfill can be calculated using an equivalent fluid pressure of 300 pcf. The maximum passive resistance should not exceed 2,000 psf.
- Construction employing poles or posts (i.e. lamp posts) may utilize design methods presented in Section 1807.3 of the CBC for Silty Sand soils (SM) material class.
- The passive resistance of the subsurface soils will diminish or be non-existent if trench sidewalls slough, cave, or are over-widened during or following excavations. If this condition is encountered, our firm should be notified to review the condition and provide remedial recommendations, if warranted.

5.8 Seismic Design Criteria (2022 California Building Code)

This site is subject to strong ground shaking due to potential fault movements along regional faults including the San Andreas and Pinto Mountain fault zones. Engineered design and earthquake-resistant construction increase safety and allow development of seismic areas. The minimum seismic design should comply with the 2022 edition of the California Building Code and ASCE 7-16 (Supplement 3).

However, this site was found not to have liquefiable soil. Based on our site class estimator and the shallow site weathered bedrock, the site is classified as Site Class C. Note, Exception 11.4.8 in ASCE 7-16 is not required for Site Class C and a Site-Specific Ground Motion Analysis is not required.

General Procedure for seismic parameters is presented below considering a Site Class C. Values were obtained from a web site (https://seismicmaps.org/) using a coordinate location of Latitude 34.0748°N and Longitude 116.3314°W. The structural design engineer should use the most conservative results based of the specific building design and spectral response. A seismic evaluation should be performed for Site Class for each final homesite due to varying conditions of each site.

Table 9
2022 CBC (ASCE 7-16) Seismic Parameters

Site Class:	C
Risk Category:	II
Seismic Design Category	D
Maximum Considered Earthquake [MCE] Ground Motion	
Short Period Spectral Response S_s:	1.788 g
1 second Spectral Response, S_1:	0.6 g
Code Design Earthquake Ground Motion	
F_a	1.2
F_v	1.4
F_{PGA}	1.2
S_{MS}	2.145 g
S_{M1}	0.84 g
Short Period Spectral Response, S_{DS}	1.43 g
1 second spectral response, SD1	0.56 g
Peak Ground Acceleration (PGA_M) Eq 11.8-1	0.869 g

The intent of the CBC lateral force requirements is to provide a structural design that will resist collapse to provide reasonable life safety from a major earthquake but may experience some structural and nonstructural damage. A fundamental tenet of seismic design is that inelastic yielding is allowed to adapt to the seismic demand on the structure. In other words, *damage is allowed*. The CBC lateral force requirements should be considered a *minimum* design. The owner and the designer may evaluate the level of risk and performance that is acceptable. Performance-based criteria could be set in the design. The design engineer should exercise special care so that all components of the design are fully met with attention to providing a continuous load path. An adequate quality assurance and control program is urged during project construction to verify that the design plans and good construction practices are followed. This is especially important for sites lying close to the major seismic sources.

Spectral accelerations may exceed one g. Actual acceleration may be more or less than estimated. Vertical accelerations are typically ⅓ to ⅔ of the horizontal accelerations, but can equal or exceed the horizontal accelerations, depending upon the local site effects and amplification.

Earthquake Performance Statement: Depending upon the extent of structural and geotechnical design of exterior flatwork, walls, utilities, roadways, and other similar site improvements, some damage due to seismic events will occur. We recommend a standard statement for purchasers of the property and within title reports that seismic induced damage may occur. Note that all of southern California in general is in earthquake country. Site developments in southern California

are typically not designed to mitigate anticipated seismic events without some damage. In fact, the Building Code is intended to provide Life-Safety performance, not complete damage-free design. In other words, some damage from earthquakes in the form of structural damage, rock fall, settlement, cracking, and disruption of utilities is expected and that repair after an earthquake event will likely be required. It is not the current standard of care for site developers to fully mitigate all anticipated earthquake induced hazards. It is incumbent on the developer to advise the end-users of the project of the anticipated hazards in the form of disclosure statements during the initial and subsequent purchase processes.

According to literature from Robert W. Day, doors and windows may stick at distortion angles between 1:240 and 1:175. In this situation, a human being could be put in a life-threatening situation. Therefore, Earth Systems recommends the maximum distortion angle using all the settlement conditions including seismic settlements be 1:240. For all settlement conditions excluding seismic settlement, the structure's maximum distortion angle should be the typical County required 1:480.

5.9 Surface and Subsurface Site Drainage and Maintenance

Positive drainage should be maintained away from the structure foundations (5 percent for 10 feet minimum) to prevent ponding, water intrusion, and subsequent saturation of the foundation soils. Gutters and downspouts in conjunction with a 2 percent (%) hardscape grade sloped away from structures draining to area drains can be considered as a means to convey water away from foundations if increased fall is not provided. A minimum 2% fall is required by the 2022 CBC. There is an exception where less than 2 % grade is allowable if the area is for a door landing or ramp per ADA regulations:

- Water control and conveyance is a critical aspect of project design. It is highly recommended that landscape irrigation or other sources of water be collected and conducted to an approved drainage device. Landscaping grades should be lowered and sloped such that water drains to appropriate collection and disposal areas. All runoff water should be controlled, collected, and drained into proper drain outlets. Control methods may include curbing, ribbon gutters, 'V' ditches, or other suitable containment and redirection devices.

- Site drainage should be devised such that runoff should be directed away from the tops of all graded slopes. Water should not freely flow over slopes. Diversion and conveyance structures which can accommodate water and eroded soil should be constructed at the tops and toes of all slopes. Lined swales or berms at the top and bottom of slopes are recommended.

- Applied irrigation to maintain landscaping should be controlled to the minimum volume and frequency necessary to sustain plant material. Excess and frequent watering could lead to saturated areas and standing water which can cause slab and foundation distress. The irrigation system designer should consider these conditions in their design and control irrigation accordingly.

- In no instance should water be allowed to flow or pond against structures, slabs or foundations or flow over unprotected slope faces. Adequate provisions should be employed

to control and limit moisture changes in the subgrade beneath foundations or structures to reduce the potential for soil saturation and intrusion. Landscape borders should not act as traps for water within landscape areas. Potential sources of water such as piping, drains, over-spray broken sprinklers, etc., should be frequently examined. Any such leakage, over-spray, or plugging should be immediately repaired.

- Landscape areas should be cut off from slab or foundation areas by subsurface barriers which extend at least 2 feet below the top of slab grade.

- The drainage pattern should be established at the time of final grading and maintained throughout the life of the project. Additionally, drainage structures should be maintained (including the de-clogging of piping) throughout their design life. Structural performance is dependent on many drainage-related factors such as landscaping, irrigation, lateral drainage patterns and other improvements. Cleanout should be provided in drainage piping.

- Maintenance of drainage systems and infiltration structures can be the most critical element in determining the success of a design. They must be protected and maintained from sediment-laden water both during and after construction to prevent clogging of the surficial soils any filter medium. The potential for clogging can be reduced by pre-treating structure inflow through the installation of maintainable forebays, biofilters, or sedimentation chambers. In addition, sediment, leaves, and debris must be removed from inlets and traps on a regular basis. Since these and other factors (such as varying soil conditions) may affect the rate of water infiltration, it is imperative to apply a conservative factor of safety [FOS] to the unfactored Basic Percolation/Infiltration Rates to provide a reliable basis for design. In order to account not only for the unknown factors above but also for changes of conditions during the use of the structures such as potential clogging effects due to washing in of soil fines, a FOS between 3 and 10 should be applied to lower design infiltration rates as per Riverside County BMP Manual (2014) requirements.

- The factor of safety should be selected by the project drainage engineer and may be dependent on agency guidelines and the presence of filters and sedimentation structures. If these measures are provided, the factor of safety can be reduced.

- We recommend drywells or infiltrating structure be located at least 25 feet from structure foundations, slopes, or settlement sensitive features.

- Water should not be allowed to pond within 10 feet of building foundations. The civil engineer producing the grading plan is notified that a gap made of clean sand is typically found between the vapor barrier and bottom of slabs or foundations. If water intrusion into this gap is possible the civil engineer shall either provide for no ponding or an impervious material to prevent water intrusion into the sand gap.

When grades of 5 percent for 10 feet away from foundations are not possible, the CBC allows for alternative drainage systems (Section 1804.3). Earth Systems experience has found that alternative methods may include impervious surface material (such as concrete and asphalt),

area drains, and horizontal moisture barriers. Please contact Earth Systems for additional information or if the project has difficulty making grades.

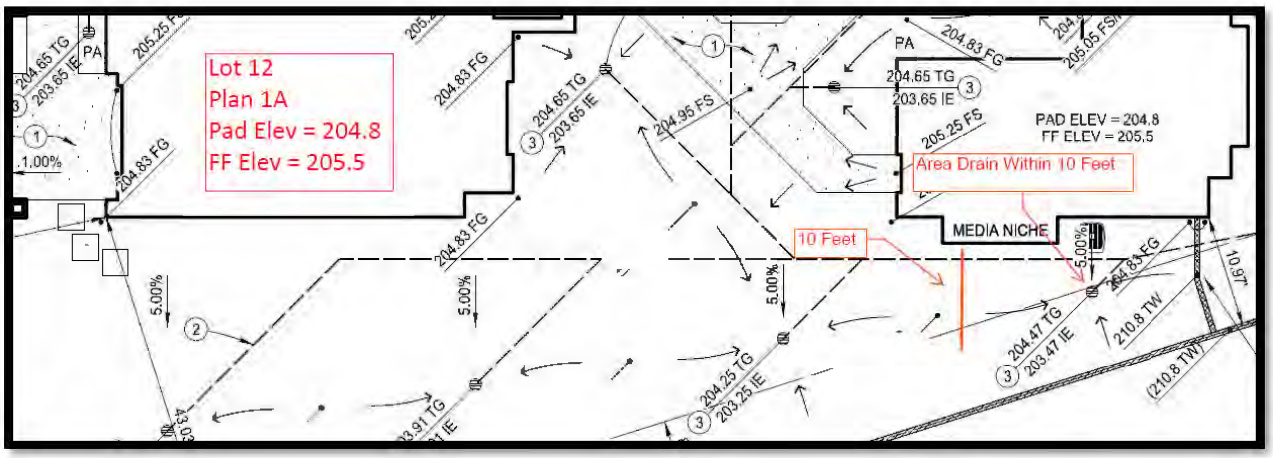


Figure 4 Example Area Drains Used Within 10 Feet of Foundations

5.10 Pavements

Pavement structural sections for associated drive areas including recommendations for standard asphalt concrete, and Portland cement concrete are provided below and are based upon on-site soils as described in Section 5.1. Soils differing from those described will require differing pavement sections. The appropriate pavement section depends primarily on the shear strength of the subgrade soil exposed after grading in the near finished subgrade elevation and the anticipated traffic over the useful life of the pavement. R-value testing or observation of subgrade soils should be performed of near finished subgrade elevation soils to verify and/or modify the preliminary pavement sections presented within this report.

Pavement Area Preparation: In street, drive, and parking areas, the exposed subgrade should be overexcavated as recommended in Section 5.1, moisture conditioned, and compacted. Compaction should be verified by testing. Aggregate base should be compacted to a minimum 95% relative compaction (ASTM D 1557).

Automobile Traffic and Parking Areas: Pavement sections presented in the following table for automobile type traffic areas and are based on a tested R-value, observed soil types likely present after grading, and current Caltrans design procedures. Traffic Indices (TI) of 5 and 7 were used to facilitate the design of asphalt concrete pavements for parking and main drives, including fire lanes. The fire lane calculation assumed a conservative traffic flow of one fire truck per day entering and exiting the site on the same path (20 year life cycle), and a maximum loading of an 88,000 lb Tandem Axle apparatus (approximate 24,000 lb front axle load and two 32,000 lb rear axles loads) which is based upon the *Emergency Vehicle Size and Weight Regulation Guideline*, dated November 22, 2011, prepared by the Fire Apparatus Manufacturers' Association.

Based on the above stated traffic pattern and apparatus loads, a Traffic Index of 4.6 is calculated for fire lanes. For comparison, a 40-year fire lane life cycle analysis results in a Traffic Index of 5. The TI's assumed below should be reviewed by the project Civil Engineer to evaluate the

suitability for this project. All design should be based upon an appropriately selected Traffic Index. Changes in the traffic indices will affect the corresponding pavement section.

Table 10
Preliminary Flexible Pavement Section Recommendations
On-site/Interior Automobile Drive Areas

R-Value of Subgrade Soils – (50 assumed) – Design Method – CALTRANS

Traffic Index (Assumed)*	Pavement Use	Flexible Pavements**	
		Asphaltic Concrete Thickness (inches)	Aggregate Base Thickness (inches)
5	Parking Areas & Fire Lanes***	3	4
7	Main Drive Areas	4	4.5

*The presented Traffic Indices should be confirmed by the project civil engineer. Changes to the Traffic Index will result in a differing pavement section required.

**Pavement Sections were calculated using Caltrans Methods.

***Where fire lanes will be a part of a main drive, the Main Drive Area pavement section should be used.

Conventional, rigid pavements, i.e. Portland cement concrete (PCC) pavements, are recommended in areas of typical residential driveways.

The pavement section below is based upon the American Concrete Institute (ACI) *Guide for Construction of Concrete Parking Lots, ACI 330R*, and the assumptions outlined below.

Table 11
Preliminary Portland Cement Concrete Pavement Sections

Area	Minimum Pavement PCC Thickness (inches)*	Minimum 28 Day Flexural Strength (psi)	Concrete Compressive Strength (psi)
Residence Driveway	5.0	500	3,250

*PCC may be placed on a compacted subgrade of engineered fill.

Should the actual traffic category vary from those assumed and listed above, these sections should be modified. All above recommended preliminary pavement sections are contingent on the following recommendations being implemented during construction:

- Pavement should be placed upon compacted fill processed as described in Section 5.1.

- Subsequent to utility installation, the entire pavement (including PCC) final subgrade should be scarified 8 inches, moisture conditioned to near optimum moisture content, and compacted to a minimum 95% relative compaction immediately prior (within a few days) to the placement and compaction of aggregate base to re-establish proper moisture content and compaction in site soils. Subgrade soils should be surface watered prior to the placement of aggregate base.
- Subgrade soils and aggregate base should be in a stable, non-pumping condition at the time of placement and compaction. Exposed subgrades should be proof-rolled to verify the absence of soft or unstable zones.
- Aggregate base materials should be compacted at near optimum moisture content to at least 95 percent relative compaction (ASTM D 1557) and should conform to Caltrans Class II criteria. Standard Specifications for Public Works Construction "Greenbook" standards (Crushed Aggregate Base class) may be used in lieu of Caltrans. Compaction efforts should include rubber tire proof-rolling of the aggregate base with heavy compaction-specific equipment (i.e. fully loaded water trucks).
- All concrete curbs separating pavement from landscaped areas should extend at least 6 inches into the subgrade soils to reduce the potential for movement of moisture into the aggregate base layer (this reduces the risk of pavement failures due to subsurface water originating from landscaped areas).
- Asphaltic concrete should be ½-in. or ¾-in. grading and compacted to a minimum of 95% of the 75-blow Marshall density (ASTM D 1559) or equivalent.
- Portland cement concrete pavements should be constructed with transverse joints at maximum spacing of 12 feet. A thickened edge should be used where possible and, as a minimum, where concrete pavements abut asphalt pavements. The thickened edge should be 1.2 times the thickness of the pavement (6 inches for a 5-inch thick pavement) and should taper back to the PCC thickness over a horizontal distance on the order of 3 feet.
- All longitudinal or transverse control joints should be constructed by hand forming or placing pre-molded filler such as "zip strips." Expansion joints should be used to isolate fixed objects abutting or within the pavement area.

  The expansion joint should extend the full depth of the PCC pavement. Joints should run continuously and extend through integral curbs and thickened edges. We recommend that joint layout be adjusted to coincide with the corners of objects and structures. In addition, the following is recommended for concrete pavements:

  1. Slope pavement at least ½ percent to provide drainage;
  2. Provide rough surface texture for traction;
  3. Cure PCC concrete with curing compound or keep continuously moist for a minimum of seven days;

4. Keep all traffic off concrete until PCC compressive strength exceeds 2,000 pounds per square inch (truck traffic should be limited until the concrete meets the design strength (3,250 psi); and
5. Consideration should be given to having PCC construction joints keyed or using slip dowels on 24-inch centers to strengthen control and construction joints. Dowels placed within dowel baskets should be incorporated into the concrete at each saw-cut control joint (i.e. dowel baskets and dowels are set in place prior to placement of concrete).

- Portland cement concrete placement and curing should, at a minimum, be in accordance with the American Concrete Institute [ACI] recommendations contained in ACI 211, 304, 305, 308, 309, and 318.
- Within the structural pavement section areas, positive drainage (both surface and subsurface) should be provided. In no instance should water be allowed to pond on the pavement. Roadway performance depends greatly on how well runoff water drains from the site. This drainage should be maintained both during construction and over the entire life of the project.
- Proper methods, such as hot-sealing or caulking, should be employed to limit water infiltration into the pavement base course and/or subgrade at construction/expansion joints and/or between existing and reconstructed asphalt concrete sections (if any). Water infiltration could lead to premature pavement failure.
- To reduce the potential for detrimental settlement, excess soil material, and/or fill material removed during any footing or utility trench excavation, should not be spread or placed over compacted finished grade soils unless subsequently compacted to at least 90% of the maximum dry unit weight, as evaluated by ASTM D 1557 test procedure, at near optimum moisture content, or 95% if placed under areas designated for pavement.
- Where new roadways will be installed against existing roadways, the repaired asphalt concrete pavement section should be designed and constructed to have at least the pavement and aggregate base section as the original pavement section thickness (for both AC and base) or upon the newly calculated pavement sections presented within, whichever is greater.
- Pavement designs assume that heavy construction traffic will not be allowed on the base cap or finished pavement sections.

Soil Access Roads: Based on our local knowledge of the project area, the ability of access roads on the site to support construction traffic and passenger vehicles will be dependent on soil moisture contents and compaction level. Light construction traffic and passenger vehicles should be able to traverse most portions of the site, either on or off roads, during the dry months of the year if the compaction recommendations provided below are followed. Surficial soils are expected to be silty in nature and may provide poor support under loading if they become saturated or overly wet or dry out and become loose. Rainfall events at the site are expected to last less than a few hours and have a low intensity. Compacted native soils may be used in these

areas; however, during or after a rainfall event, watering for dust control, other application of water, or general use, there may be some significant limitations on use in wet conditions and there may be increased roadway maintenance costs due to rutting and general soil disturbance. Assuming owners will be actively maintaining the roads, the option of compacted native soils use for roadways is a valid means of reducing construction costs in exchange for higher maintenance costs and reduced passability in wet or very dry conditions. Soil access roads are not considered "All Weather".

In improved access road areas, the subgrade should be scarified, moisture conditioned, and compacted to at least 95% relative compaction (ASTM D 1557) for a depth of at least one foot below subgrade. Fill compacted to a minimum 95% compaction relative to ASTM D 1557 should be placed to finished grade where required. Weak subgrade areas can be identified by proof rolling with heavy, rubber-tired equipment, such as a loaded water truck. Periodic moisture conditioning and rolling with heavy equipment will be required to maintain the compaction of the subgrade.

The site soils have a fine grained component of their composition. As such, native soil roadways may be subject to disturbed fine particulate matter (PM_{10}) which can create airborne dust if the roadways are not maintained. Daily moisture conditioning during construction will be necessary due to the warm desert climate. Traffic speed should be restricted to 10 mph to reduce the potential for "wash boarding" and further restricted to 5 mph at turns to avoid rutting. Compaction should be verified by testing.

Aggregate Roads: Where it is desired to have roads with increased passability in wet conditions, have a greater ability to handle heavy loads, or have reduced maintenance costs, Class 2 aggregate base or open graded gravel (3/4 inch or larger rock size) may be used on top of compacted native soils (95% relative compaction (ASTM D 1557)). Sections for access roads (light vehicles) and roads subject to a design level 100,000 pound fire truck (40,000 pound axle load) are provided. R-Value testing was estimated to evaluate pavement support characteristics (CTM 301).

We have based aggregate section design on TM 5-822-12, Technical Manual, Design of Aggregate Surfaced Roads and Airfields, Department of the Army, September 1990. For roads, considering a Group 3 condition (passenger vehicles, pickups, and three, four and five axle trucks) and a Category III (Traffic containing as much as 15 percent trucks, but not more than 1 percent of the total traffic composed of trucks having three or more axles (Group 3 trucks), Road Class of G (less than 70 vehicles per day) and a corresponding Design Index of 1, the minimum calculated aggregate thickness is 3.25 inches; however, 4 inches is the minimum allowed section per TM 5-822-12. Based upon TM 5-822-12, the minimum compacted subgrade beneath the aggregate section should be 6 inches (interpolated for the semi-cohesiveness of the very silty sand soils). Compaction should be at least 95% relative to ASTM D 1557.

For evaluation of the necessary aggregate section for fire access roads to support a 100,000 pound fire truck (HS20, 40,000 pound single axle load), we considered a CBR of the aggregate fill of 80, 100 psi tire pressure, maximum rut depth of 3 inches, two visits to the site each year for the fire truck, and considering the road is maintained at least on a yearly basis. We utilized the Spectrpave4 PRO software (Tensar International Corporation) for calculation. Based upon these

input parameters, the required minimum aggregate section thickness is 6 inches. Based upon TM 5-822-12, the minimum compacted subgrade beneath the aggregate section should be 8 inches (interpolated for the semi-cohesiveness of the very silty sand soils and the additional load for Design Index 2). Compaction should be at least 95% relative to ASTM D 1557. Aggregate sections are summarized in the Table below.

Table 12
Preliminary Aggregate/Compacted Subgrade Section Recommendations

CBR Value Subgrade Soils – 10 (assumed)

Pavement Use	Aggregate Roadway	
	Aggregate Thickness (inches)	Compacted Subgrade Thickness (inches)
Light Vehicles	4	6
Fire Lanes, Heavy Truck Access	6	8

Aggregate base should be compacted to a minimum 95% relative compaction (ASTM D 1557). To maintain roadway integrity and reduce the potential for roadway surface failure due to water infiltration and ponding, it is suggested that roadways be constructed with a minimum 4%-crown. It should be noted that the site lies within an area of moderate to high potential for wind erosion. The site soils have a fine grained component of their composition. As such, native soil roadways may be subject to disturbed fine particulate matter (PM_{10}) which can create airborne dust if the roadways are not maintained. Daily moisture conditioning during construction will be necessary due to the warm desert climate. Traffic speed should be restricted to 10 mph to reduce the potential for “wash boarding” and further restricted to 5 mph at turns to avoid rutting.

Section 6
LIMITATIONS AND ADDITIONAL SERVICES

6.1 Uniformity of Conditions and Limitations

Our findings and recommendations in this report are based on selected points of field exploration, laboratory testing, and our understanding of the proposed project. Furthermore, our findings and recommendations assume that soil conditions do not vary significantly from those found at specific exploratory locations. Variations in soil or groundwater conditions could exist between and beyond the exploration points. The nature and extent of these variations may not become evident until construction. Variations in soil or groundwater may require additional studies, consultation, and possible revisions to our recommendations.

The planning and construction process is an integral design component with respect to the geotechnical aspects of this project. Because geotechnical engineering is an inexact science due to the variability of natural processes and because we sample only a small portion of the soil and material affecting the performance of the proposed structure, unanticipated or changed conditions can be disclosed during demolition and construction. Proper geotechnical observation and testing during construction is imperative to allow the geotechnical engineer the opportunity to verify assumptions made during the design process and to verify that our geotechnical recommendations have been properly interpreted and implemented during construction. Therefore, we recommend that Earth Systems be retained during the construction of the proposed improvements to observe compliance with the design concepts and geotechnical recommendations, and to allow design changes in the event that subsurface conditions or methods of construction differ from those assumed while completing this investigation. If we are not accorded the privilege of performing this review, we can assume no responsibility for misinterpretation or the applicability of our recommendations. The above services can be provided in accordance with our current Fee Schedule.

Our evaluation of subsurface conditions at the site has considered subgrade soil and groundwater conditions present at the time of our study. The influence(s) of post-construction changes to these conditions such as introduction or removal of water into or from the subsurface will likely influence future performance of the proposed project. It should be recognized that definition and evaluation of subsurface conditions are difficult. Judgments leading to conclusions and recommendations are generally made with incomplete knowledge of the subsurface conditions due to the limitation of data from field studies. The availability and broadening of knowledge and professional standards applicable to engineering services are continually evolving. As such, our services are intended to provide the Client with a source of professional advice, opinions and recommendations based on the information available as applicable to the project location and scope. If the scope of the proposed construction changes from that described in this report, the conclusions and recommendations contained in this report are not considered valid unless the changes are reviewed, and the conclusions of this report are modified or approved in writing by Earth Systems.

Findings of this report are valid as of the issued date of the report. However, changes in conditions of a property can occur with passage of time, whether they are from natural processes or works of man, on this or adjoining properties. In addition, changes in applicable standards

occur, whether they result from legislation or broadening of knowledge. Accordingly, findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of one year.

This report is issued with the understanding that the owner or the owner's representative has the responsibility to bring the information and recommendations contained herein to the attention of the architect and engineers for the project so that they are incorporated into the plans and specifications for the project. The owner or the owner's representative also has the responsibility to verify that the general contractor and all subcontractors follow such recommendations. It is further understood that the owner or the owner's representative is responsible for submittal of this report to the appropriate governing agencies.

Earth Systems has striven to provide our services in accordance with generally accepted geotechnical engineering practices in this locality at this time. No warranty or guarantee, express or implied, is made. This report was prepared for the exclusive use of the Client and the Client's authorized agents.

Earth Systems should be provided the opportunity for a general review of final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications. If Earth Systems is not accorded the privilege of making this recommended review, we can assume no responsibility for misinterpretation or the applicability of our recommendations. The owner or the owner's representative has the responsibility to provide the final plans requiring review to Earth Systems' attention so that we may perform our review.

Any party other than the client who wishes to use this report shall notify Earth Systems of such intended use. Based on the intended use of the report, Earth Systems may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Earth Systems from any liability resulting from the use of this report by any unauthorized party.

In addition, if there are any changes in the field to the plans and specifications, the Client must obtain written approval from Earth Systems' engineer that such changes do not affect our recommendations. Failure to do so will vitiate Earth Systems' recommendations.

Although available through Earth Systems, the current scope of our services does not include an environmental assessment or an investigation for the presence or absence of wetlands, hazardous or toxic materials in the soil, surface water, groundwater, or air on, below, or adjacent to the subject property.

6.2 Additional Services

This report assumes that an adequate program of client consultation, plan review, construction monitoring, and testing will be performed during the final design and construction phases to check compliance with these recommendations. Maintaining Earth Systems as the geotechnical consultant from beginning to end of the project will provide continuity of services.

The geotechnical engineering firm providing tests and observations shall assume the responsibility of Geotechnical Engineer of Record.

Construction monitoring and testing would be additional services provided by our firm. The costs of these services are not included in our present fee arrangements but can be obtained from our office. The recommended review, tests, and observations include, but are not necessarily limited to, the following:

- Consultation during the final design stages of the project;
- Onsite review of exposed condition during stripping.
- A review of the building and grading plans to observe that recommendations of our report have been properly implemented into the design;
- Observation and testing during site preparation, grading, and placement of engineered fill as required by CBC Sections 17 and Appendix J or local grading ordinances;
- Consultation as needed during construction.

-o0o-

Appendices as cited are attached and complete this report.

REFERENCES

Al Atik, L., and Sitar, N., 2010, Seismic Earth Pressures on Cantilever Retaining Structures, Journal of Geotechnical and Geoenvironmental Engineering, ASCE.

American Concrete Institute (ACI), 2015, ACI Manual of Concrete Practice, Parts 1 through 5.

American Concrete Institute (2014) "336.3R-14 Report on Design and Construction of Drilled Piers."

American Concrete Institute (2019) "Building Code Requirements for Structural Concrete (ACI 318-19) and Commentary (ACI 318R-19) and ACI 330R."

American Society of Civil Engineers (ASCE), 2019, Minimum Design Loads and Associates Criteria for Buildings and Other Structures, ASCE/SEI 7-16; including Supplements 1 to 3.

American Society of Civil Engineers, Standard Guidelines for the Design and Installation of Pile Foundations (20-96).

American Society for Testing Materials, 1989, STP 1013, Effects of Soil Characteristics on Corrosion (February 1989).

Boulanger, R. W., and Idriss, I. M., 2006, Liquefaction susceptibility criteria for silts and clays, J. Geotechnical and Geoenvironmental Eng., ASCE 132 (11), 1413-1426.

Bowles, J.E., 1988, Foundation Analysis and Design, Fourth Edition, McGraw-Hill Book Company.

California Department of Water Resources, 2025, Water Data Library Website, http://www.water.ca.gov/waterdatalibrary/.

California Division of Mines and Geology, 1978, Geologic Map of California, Santa Ana Sheet.

California Geological Survey-SP117A, 2008, Guidelines for Evaluating and Mitigating Seismic Hazards in California.

California Geological Survey, 2024, Fault Rupture Hazard Zones in California, Division of Mines and Geology, Special Publication 42.

California Geological Survey, 2025, Earthquake Zones of Required Investigations, Zone Info: 3024012917, https://maps.conservation.ca.gov/EGZApp/app/.

Coduto, D.P., 2000, Foundation Design: Principles and Practices (2nd Edition).

County of Los Angeles, Department of Public Works, 2013, Manual for the Preparation of Geotechnical Report, July 1, 2013.

County of Riverside, 2000, Technical Guidelines for Review of Geotechnical and Geologic Reports, Transportation and Land Management Agency, http://rctlma.org/Portals/4/Handouts/Grading/technical_guide_geotechnical_geologic_reports.pdf.

Day, R.W., 2000, Geotechnical Engineers Portable Handbook, McGraw-Hill Companies.

Dept. of the Navy, 1986, NAVFAC DM 7.01: Soil Mechanics, Naval Facilities Engineering Command, Alexandria, Virginia.

Dept. of the Navy, 1986, NAVFAC DM 7.02: Foundations and Earth Structures, Naval Facilities Engineering Command, Alexandria, Virginia.

Dibblee, Thomas W., 1967, Geologic Map of the Morongo Valley Quadrangle, San Bernardino and Riverside Counties, California, United States Geological Survey Miscellaneous Geologic Investigations Map I-517.

Ellsworth, W.L., 1990, "Earthquake History, 1769-1989" in: The San Andreas Fault System, California: U.S. Geological Survey Professional Paper 1515, 283 p.

FEMA, 2024, Map Service Center website http:// *msc.fema.gov/.*

Federal Highway Administration (FHWA), 2010, Drilled Shafts: Construction Procedures and LRFD Design Methods, May 2010, Publication No. FHWA-NHI-10-016.

Field, E.H., Biasi, G.P., Bird, P., Dawson, T.E., Felzer, K.R.10.ckson, D.D., Johnson, K.M., Jordan, T.H., Madden, C., Michael, A.J., Milner, K.R., Page, M.T., Parsons, T., Powers, P.M., Shaw, B.E., Thatcher, W.R., Weldon, R.J., II, and Zeng, Y., 2013, Uniform California earthquake rupture forecast, version 3 (UCERF3)—The time-independent model: U.S. Geological Survey Open-File Report 2013–1165, 97 p., California Geological Survey Special Report 228, and Southern California Earthquake Center Publication 1792, http://pubs.usgs.gov/of/2013/1165/.

Google Images; 2025; "Pioneertown"; Select Years from 1999 to 2023.

Hunt, Roy E., 1984, Geotechnical Engineering Practice, McGraw-Hill Book Company.

International Code Council ICC], 2022, California Building Code, 2022 Edition.

Jennings, C.W, 2010, Fault Activity Map of California and Adjacent Areas: California Division of Mines and Geology, Geological Data Map No. 6, scale 1:750,000.

Lommler, C. J. and Bandini, P. 2015, Characterization of Collapsible Soils, International Foundations Congress and Equipment Expo (IFCEE) 2015 ASCE 2015.

Mikola, R.G. and Sitar, N., 2013, Seismic Earth Pressures on Retaining Structures in Cohesionless Soils, University California Berkeley, Report No. UCB GT 13-01.

Occupational Safety and Health Standards – Excavations, Final Pub. 1989.

Scharer, Katherine M, and Yule, Doug, 2020, Geophysical Research Letter, A Maximum Rupture Model for the Southern San Andreas and San Jacinto Faults, California, Derived From Paleoseismic Earthquake Ages: Observations and Limitations, Volume 47, Issue 15.

Sneed, Michelle, et al, 2014, Land Subsidence, Groundwater Levels, and Geology in the Coachella Valley, California, United States Geological Survey, Scientific Investigations Report 2014-5075.

Sneed, Michelle, et al, 2020, Detection and Measurement of Land Subsidence and Uplift Using Global Positioning Systems Surveys and Interferometric Synthetic Aperture Radar, Coachella Valley, California, United States Geological Survey, Scientific Investigations Report 2020-5093.

Southern California Earthquake Center (S.C.E.C.), 1999, Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California: available at web site: http://www.scecdc.scec.org.

Southern California Earthquake Center, 2002, Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California.

Structural Engineers Association of California (SEAOC)/California's Office of Statewide Health Planning and Development (OSHPD), 2025, U.S. Seismic Design Maps Website, https://seismicmaps.org/.

The County of San Bernardino Areawide Stormwater Program, 2013, Technical Guidance Document for Water Quality Management Plans, CDM Smith Inc., NPDES No. CAS618036, Order No. R8-2010-0036, Effective Date: September 19, 2013.

Tokimatsu, K, and Seed, H.B., 1987, Evaluation of Settlements in Sands Due To Earthquake Shaking, ASCE, Journal of Geotechnical Engineering, Vol. 113, No. 8, August 1987.

United States Geological Survey, 2008, Documentation for the 2008 Update of the United States National Seismic Hazard Maps: U.S. Geological Survey Open-File Report 2008–1128, 61 p.

United States Geological Survey, 2025, Unified Hazards Tool, http://earthquake.usgs.gov/hazards/interactive.

Wallace, R. E., 1990, the San Andreas Fault System, California: U.S. Geological Survey Professional Paper 1515, 283 p.

Yazdi, J.S., and Yazid, R.E.S., 2016, Nonparametric Liquefaction Triggering and Postliquefaction Deformations, Journal of Geechnical and Geoenvironmental Engineering, Vol 143, No. 3, September 2016.

Youd, T.L., and Idriss, I.M., 2001, Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 127, No. 10, October 2001.

Youd, T.L., and Garris, C.T., 1995, Liquefaction-Induced Ground-Surface Disruption, Journal of Geotechnical Engineering, Vol. 121, No. 11, November 1995.

Youd, T.L., Hansen, C.M., and Bartlett, S.F., 2002, Revised Multilinear Regression Equations for Prediction of Lateral Spread Displacement, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 128, No. 12, December 2002.

Aerial Photographs:

Google Earth: 1997-2023

APPENDIX A

Plate 1 – Site Vicinity Map
Plate 2a & 2b – Exploration Location Map
Plate 3 – Regional Geologic Map
Plate 4 – Local Geologic Map
Plates 5a & 5b – Site Geologic Map & Civil Site Plan
Table A-1 – Fault Parameters
Table A-2 – Historic Earthquakes
Terms and Symbols Used on Boring Logs
Soil Classification System
Logs of Geotechnical Borings (12 pages)



Reference: Google Earth satellite image with USGS topographic map overlay image.

LEGEND

Approximate Site Location

Scale: 1" = 1 Mile

0 1 Mile 2 Miles

N

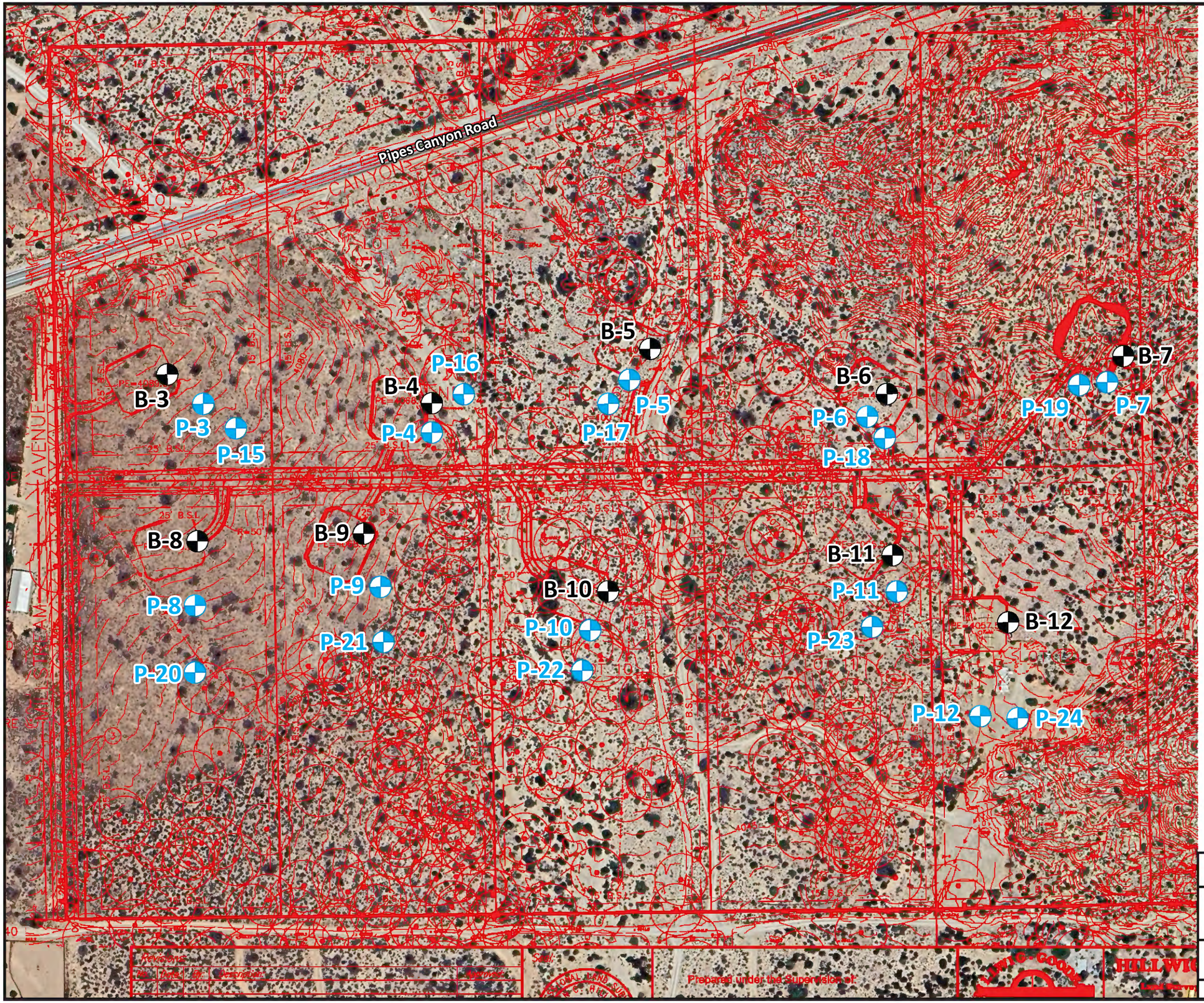
Plate 1
Site Vicinity Map

Proposed Subdivision Project
Pipes Canyon Road
Pioneertown, San Bernardino County, California

Earth Systems

7/21/2025

File No.: 307129-001



LEGEND

B-12 Approximate Exploration Locations

P-24 Approximate Percolation Test Locations

N

Approximate Scale: 1" = 150’

0 150’ 300’

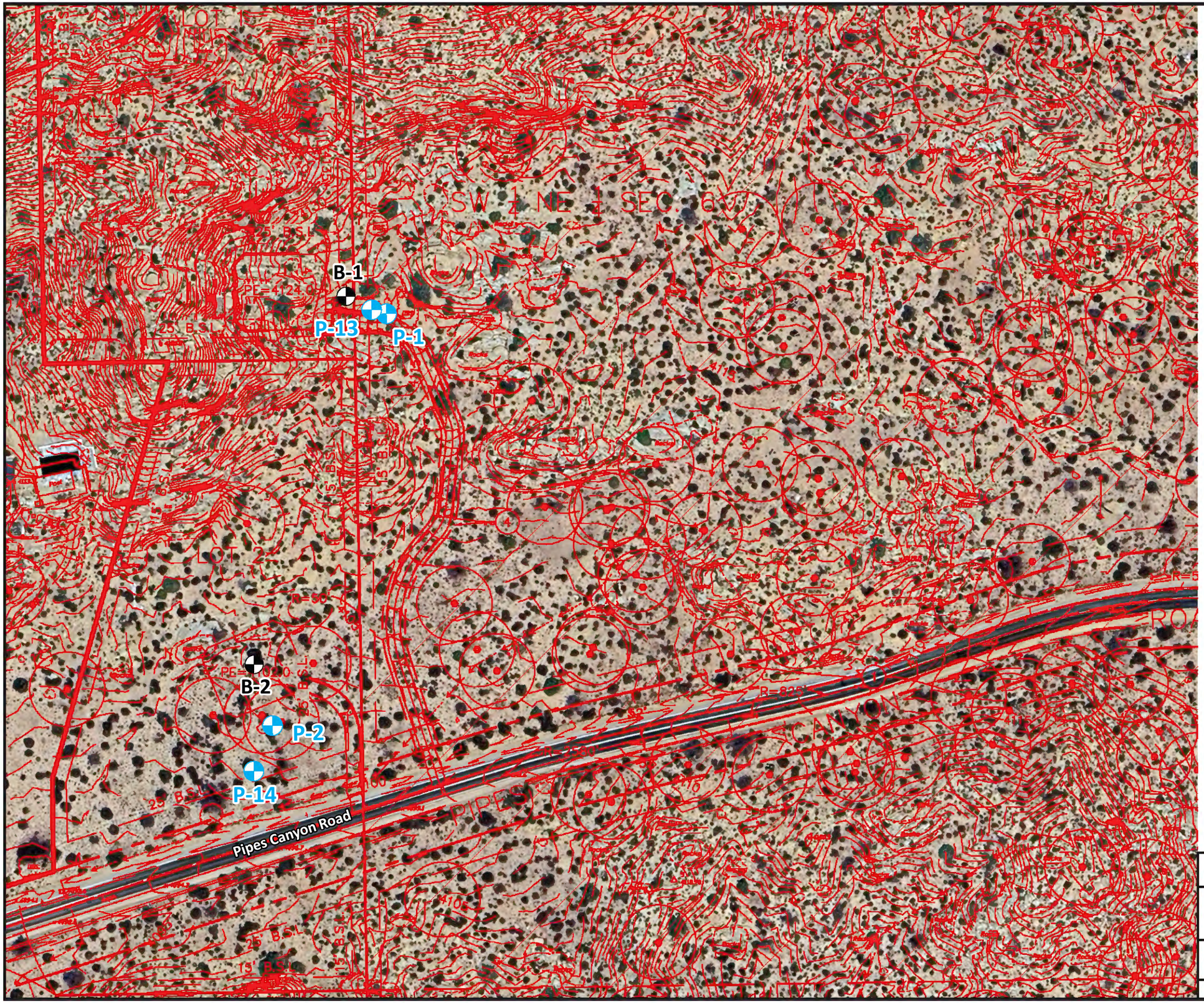
Source: Google Earth satellite image dated 5/29/2023 with Tentative Tract Map No. 20612 Sheet 2 overlay.

Plate 2a
Exploration Location Map

Proposed Subdivision Project
Pipes Canyon Road
Pioneertown, San Bernardino County, California

Earth Systems

7/21/2025 | File No.: 307129-001



LEGEND

B-12 Approximate Exploration Locations

P-24 Approximate Percolation Test Locations

N

Approximate Scale: 1" = 150’

0 150’ 300’

Source: Google Earth satellite image dated 5/29/2023 with Tentative Tract Map No. 20612 Sheet 3 overlay.

Plate 2b
Exploration Location Map

Proposed Subdivision Project
Pipes Canyon Road
Pioneertown, San Bernardino County, California

Earth Systems

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LEGEND

Qs	Dune sand	Qc	Oligocene nonmarine
Qal	Alluvium	Ec	Eocene nonmarine
Ql	Lake deposits	E	Eocene marine
Qg	Glacial deposits	Ep	Paleocene marine
Qr	River terrace deposits	Tc	Tertiary nonmarine
Qm	Pleistocene marine and marine terrace deposits	Tm	Tertiary marine
Qpv	Pleistocene volcanic rocks Qpv^r-rhyolite Qpv^a-andesite Qpv^b-basalt Qpv^p-pyroclastic rocks	Ti	Tertiary intrusive (hypabyssal) rocks Ti^r-rhyolite Ti^a-andesite Ti^b-basalt
Qc	Pleistocene nonmarine	Tl	Tertiary lake deposits
QP	Plio-Pleistocene nonmarine	Tv	Tertiary volcanic rocks Tv^r-rhyolite Tv^a-andesite Tv^b-basalt Tv^p-pyroclastic rocks
	Quaternary and/or Pliocene cinder cones	Ku	Upper Cretaceous marine
Pc	Undivided Pliocene nonmarine	Ju	Upper Jurasssic marine
Pu	Upper Pliocene marine	gr	Mesozoic granitic rocks
Pmlc	Middle and/or lower Pliocene nonmarine	bi	Mesozoic basic intrusive rocks
Pml	Middle and/or lower Pliocene marine		Mesozoic ultrabasic intrusive rocks
Pv	Pliocene volcanic rocks Pv^r-rhyolite Pv^a-andesite Pv^b-basalt Pv^p-pyroclastic rocks	JTrv	Jurassic-Triassic metavolcanic rocks
Mc	Undivided Miocene nonmarine	ls	Pre-Cretaceous metamorphic rocks (ls=limestone)
Mu	Upper Miocene nonmarine	ms	Pre-Cretaceous metasedimentary rocks
Mu	Upper Miocene marine	mv	Pre-Cretaceous metavolcanic rocks
Mm	Middle Miocene marine	gr-m	Pre-Cenozoic granitic and metamorphic rocks
Ml	Lower Miocene marine	pC	Precambrian igneous and metamorphic rock complex
Mv	Miocene volcanic rocks Mv^r-rhyolite Mv^a-andesite Mv^b-basalt Mv^p-pyroclastic rocks	pC	Undivided Precambrian metamorphic rocks pCg=gneiss pCs=schist pCls=limestone and/or dolomite
		pCgr	Undivided Precambrian granitic rocks

– Fault: Dashed where approximate, dotted where concealed

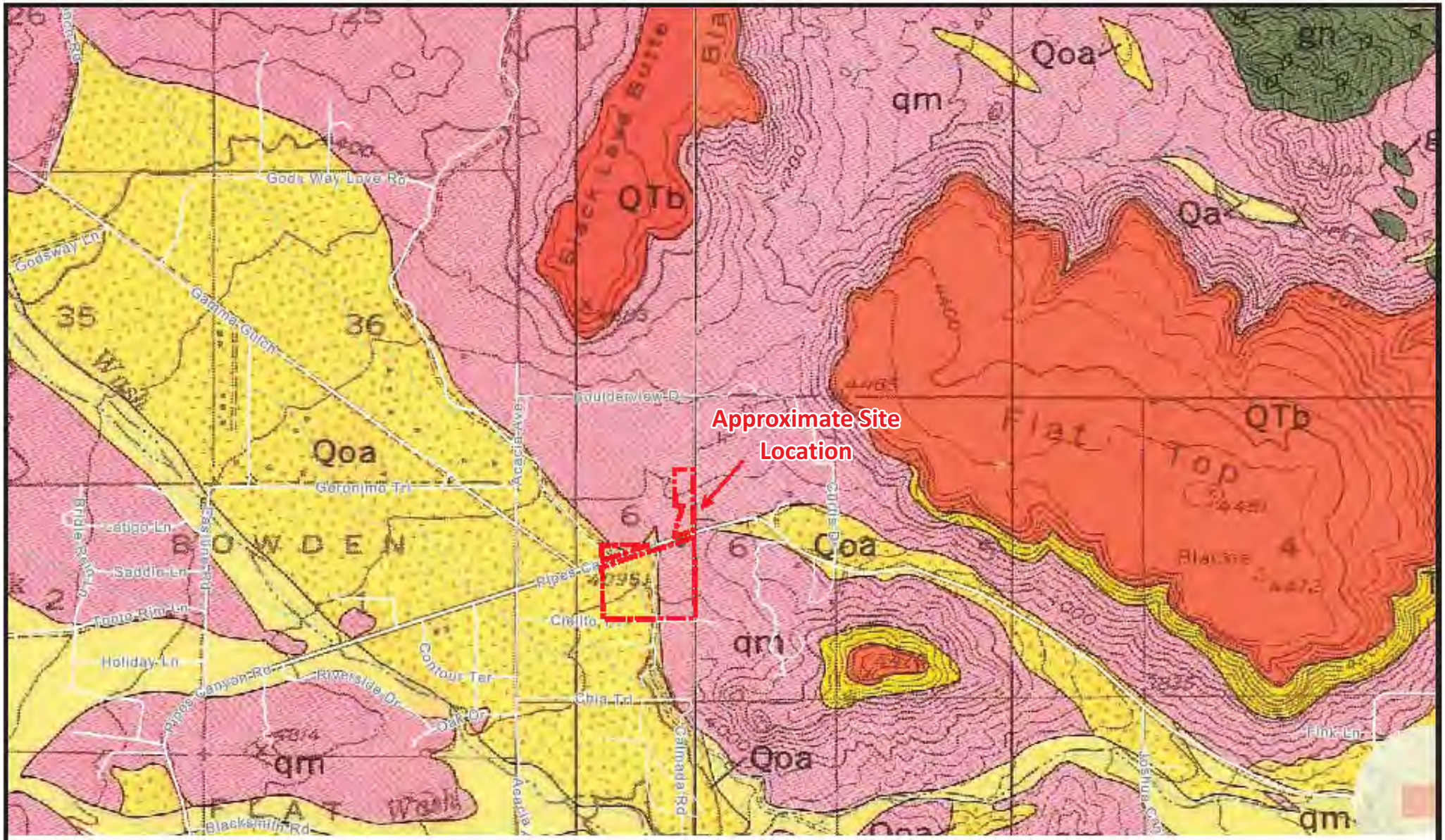
Source: USGS Geologic Map of California, Santa Ana sheet, dated 1965

Plate 3
Regional Geologic Map

Proposed Subdivision Project
Pipes Canyon Road
Pioneertown, San Bernardino County, California

Earth Systems

7/21/2025 | File No.: 307129-001



LEGEND

- **Qa** – Quaternary Younger Alluvium
- **Qoa** – Quaternary Older Alluvium
- **QTb** – Tertiary/Quaternary Basalt
- **To** – Tertiary Old Woman Sandstone
- **qm** – Mesozoic Quartz Monzonite
- **gn** – Precambrian Gneiss

Source: Dibble, T.W., 1967, USGS Misc Geologic Investigations Map I-517

N

Plate 4
Local Geologic Map

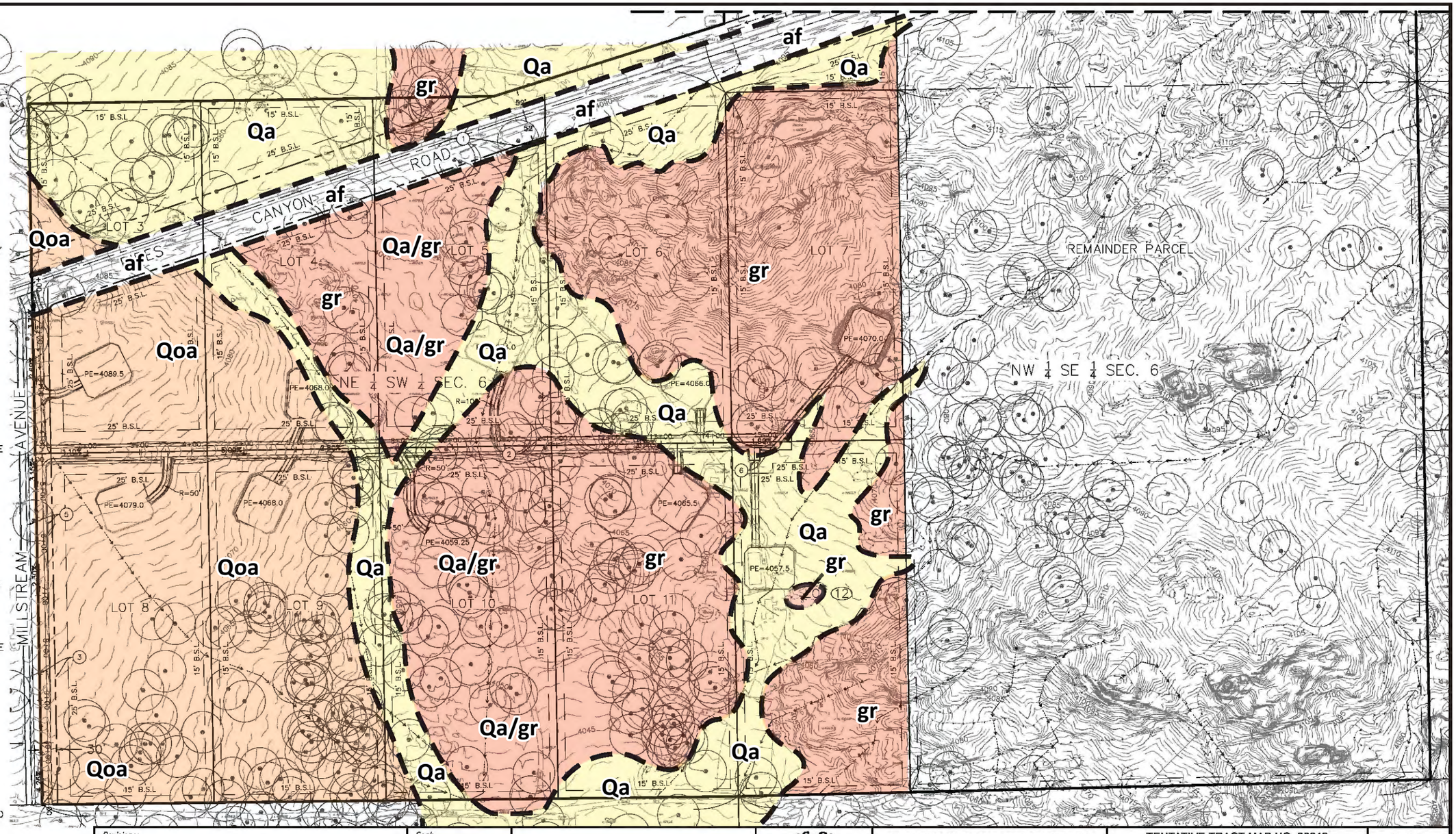
Proposed Subdivision Project
Pipes Canyon Road
Pioneertown, San Bernardino County, California

Earth Systems

7/21/2025

File No.: 307129-001

- DRIVEWAYS SHOWN ARE 12' WIDE
- BUILDING PADS AND DRIVEWAYS ARE SHOWN TO INDICATE FEASIBILITYMENT AND ARE NOT INTENDED TO BE A PART OF IMPROVEMENTS PERFORMED AS A PART OF THIS TRACT MAP.



LEGEND

	PROJECT BOUNDARY
	EXISTING LOT LINE
	PROPOSED LOT LINE
	EXISTING EASEMENT
	PROPOSED EASEMENT
	PROPOSED RIGHT OF WAY
	EXISTING CENTERLINE
	PROPOSED CENTERLINE
	PROPOSED CONTOUR
	EXISTING CONTOUR
	WATERCOURSE FLOW
	AREA ZONED RL-5
	AREA ZONED RC

① PROPOSED 104 FEET WIDE R.O.W. DEDICATION, CENTERED ON EXISTING IMPROVEMENTS

② 32 FEET WIDE PRIVATE ACCESS EASEMENT WITH 20 FEET WIDE PRIVATE GRADED ROAD

③ PROPOSED 30 FEET WIDE R.O.W. DEDICATION

⑤ PROPOSED GRADED ROAD PER SAN BERNARDINO COUNTY STD 114

⑥ MODIFIED HAMMERHEAD TURN AROUND PER SAN BERNARDINO COUNTY FIRE PREVENTION STANDARD DIAGRAM A-1.12

B.S.L.	BUILDING SETBACK LINE
PM	PARCEL MAP
P.M.B.	PARCEL MAP BOOK
PROP.	PROPOSED
ROW	RIGHT OF WAY
SEC.	SECTION
◎	REGULATED TREE WITH 40 FT. RADIUS

100 0 50 100 200 400
1 inch = 100 ft.

Revisions:				
No.	Date:	By:	Description:	Approved:

Designed: | Drawn: | Checked: ACH

Seal: PROFESSIONAL LAND SURVEYOR ALAN C. HILLWIG No. 5137 EXP. 6-30-25 STATE OF CALIFORNIA

Prepared under the Supervision of:

PROFESSIONAL LAND SURVEYOR LICENSE NO. 5137 DATE

HILLWIG - GOODROW, INC.
Land Surveying - GPS Surveys - Aerial Mapping
31419 Outer Highway 10, Suite 1-200• Redlands, CA 92373 • (909) 794-2573

Scale: 1" = 100'
BENCHMARK: SEE BENCHMARK NOTE ON SHEET 1
Date: September 13, 2024

TENTATIVE TRACT MAP NO. 20612
ACCESS AND PAD FEASABILITY EXHIBIT
PIPES CANYON ROAD, PIONEERTOWN

PREPARED FOR:
JONATHAN SHOKRIAN
53252 PIPES CANYON ROAD
PIONEERTOWN, CA 92268

F.N. | For: | F.B.

Sheet No. 2 OF 3 SHEET
FILE NO. 0972-002

Source: Tentative Tract Map No. 20612 Sheet 2.

LEGEND

Qa – Quaternary younger alluvial deposits (fan, stream channel, alluvium, and terrace)
Qoa – Quaternary older alluvium
Qa/gr – Areas where thin deposits of soil and grus overlie shallow bedrock.
gr – Pre Tertiary intrusive igneous rocks (quartz monzonite)

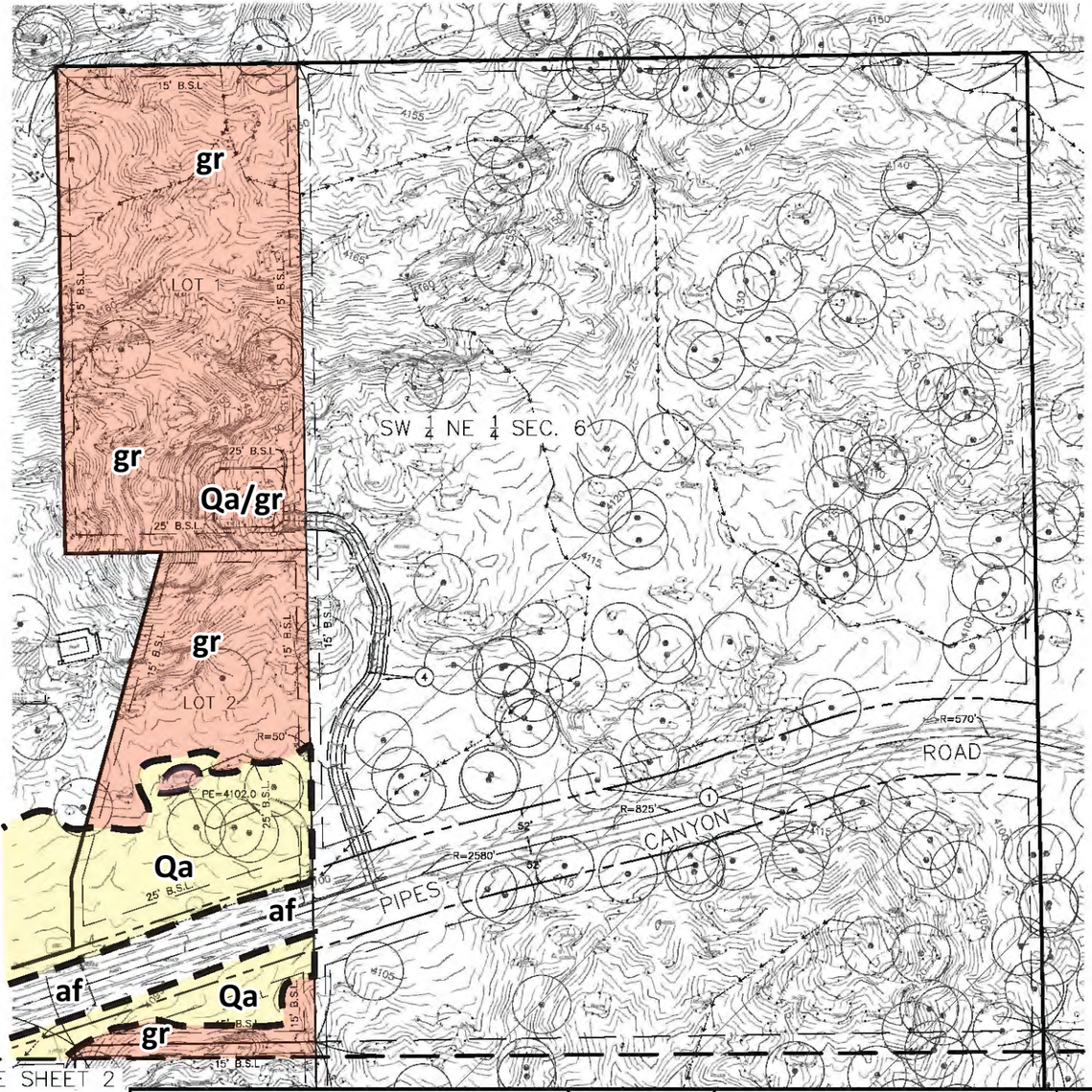
Plate 5a
Site Geologic Map & Civil Site Plan

Proposed Subdivision Project
Pipes Canyon Road
Pioneertown, San Bernardino County, California

Earth Systems

7/21/2025 | File No.: 307129-001

- DRIVEWAYS SHOWN ARE 12' WIDE
- BUILDING PADS AND DRIVEWAYS ARE SHOWN TO INDICATE FEASIBILITYMENT AND ARE NOT INTENDED TO BE A PART OF IMPROVEMENTS PERFORMED AS A PART OF THIS TRACT MAP.



LEGEND

	PROJECT BOUNDARY
	EXISTING LOT LINE
	PROPOSED LOT LINE
	EXISTING EASEMENT
	PROPOSED EASEMENT
	PROPOSED RIGHT OF WAY
	EXISTING CENTERLINE
	PROPOSED CENTERLINE
	PROPOSED CONTOUR
	EXISTING CONTOUR
	WATERCOURSE FLOW
	AREA ZONED RL-5
	AREA ZONED RC
①	PROPOSED 104 FEET WIDE R.O.W. DEDICATION, CENTERED ON EXISTING IMPROVEMENTS
④	PROPOSED 24 FEET WIDE DRIVEWAY EASEMENT
B.S.L.	BUILDING SETBACK LINE
PM	PARCEL MAP
P.M.B.	PARCEL MAP BOOK
PROP.	PROPOSED
ROW	RIGHT OF WAY
SEC.	SECTION
◎	REGULATED TREE WITH 40 FT. RADIUS

150 0 75 150 300 600
1 inch = 150 ft.

Revisions:

No.	Date:	By:	Description:	Approved:

Designed: | Drawn: | Checked: ACH

Seal: PROFESSIONAL LAND SURVEYOR ALAN C. HILLWIG No. 5137 EXP. 6-30-25 STATE OF CALIFORNIA

Prepared under the Supervision of:

PROFESSIONAL LAND SURVEYOR LICENSE NO. 5137 | DATE

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Scale: 1" = 100' | BENCHMARK: SEE BENCHMARK NOTE ON SHEET 1
Date: September 13, 2024 | F.N. | For: | F.B.

TENTATIVE TRACT MAP NO. 20612
ACCESS AND PAD FEASABILITY EXHIBIT
PIPES CANYON ROAD, PIONEERTOWN

PREPARED FOR:
JONATHAN SHOKRIAN
53252 PIPES CANYON ROAD
PIONEERTOWN, CA 92268

Sheet No. 3 OF 3 SHEET
FILE NO. 0972-002

Source: Tentative Tract Map No. 20612 Sheet 3.

LEGEND

Qa – Quaternary younger alluvial deposits (fan, stream channel, alluvium, and terrace)
Qa/gr – Areas where thin deposits of soil and grus overlie shallow bedrock.
gr – Pre Tertiary intrusive igneous rocks (quartz monzonite)

Plate 5b
Site Geologic Map & Civil Site Plan

Proposed Subdivision Project
Pipes Canyon Road
Pioneertown, San Bernardino County, California

Earth Systems

7/21/2025 | File No.: 307129-001

Table A-1
Fault Parameters

Fault Section Name	Distance (miles)	Distance (km)	Upper Seis. Depth (km)	Lower Seis. Depth (km)	Avg Dip Angle (deg.)	Avg Dip Direction (deg.)	Avg Rake (deg.)	Trace Length (km)	Fault Type	**Mean Mag**	Mean Return Interval (years)	Slip Rate (mm/yr)
Johnson Valley (No) 2011 rev FM3.1, 3.2	3.7	5.9	0.0	15.9	90	51	180	52	B	**6.8**		0.6
Pinto Mtn FM3.1, 3.2	5.8	9.3	0.0	15.5	90	175	0	74	B	**7.2**		2.5
Burnt Mtn FM3.1, 3.2	7.5	12.0	0.0	15.9	67	265	180	21	B	**6.7**		0.6
North Frontal (East) FM3.1, 3.2	7.7	12.4	0.0	16.6	41	187	90	28	B	**6.9**		0.5
Kickapoo FM3.1, 3.2	7.9	12.7	0.0	15.1	90	na	na	6	B'	**6.1**		
Homestead Valley FM3.1, 3.2	8.1	13.0	0.0	15.9	90	na	na	46	B'	**7.0**		
Eureka Peak FM3.1, 3.2	8.2	13.1	0.0	15.0	90	75	180	19	B	**6.6**		0.6
Emerson-Copper Mtn FM3.1, 3.2	13.0	20.8	0.0	14.1	90	51	180	54	B	**7.0**		0.6
Lenwood-Lockhart-Old Woman Springs FM3.1,	13.1	21.0	0.0	13.2	90	43	180	145	B	**7.5**		0.9
San Andreas, (North Branch, Mill Creek) FM3.1,	14.0	22.6	0.0	18.2	76	204	180	106	A	**7.6**	219	34
Joshua Tree (Seismicity) FM3.1, 3.2	14.2	22.8	0.0	13.3	90	271	na	17	B'	**6.5**		
Mission Creek FM3.1, 3.2	14.2	22.9	0.0	17.7	65	5	180	31	B'	**6.9**		
Calico-Hidalgo FM3.1, 3.2	17.0	27.4	0.0	13.9	90	52	180	117	B	**7.4**		1.8
Helendale-So Lockhart FM3.1, 3.2	19.8	31.9	0.0	12.8	90	51	180	114	B	**7.4**		0.6
San Andreas (San Gorgonio Pass-Garnet HIll) FM	20.6	33.2	0.0	12.8	58	20	180	56	A	**7.6**	219	24
Pisgah-Bullion Mtn-Mesquite Lk FM3.1, 3.2	22.5	36.2	0.0	13.1	90	60	180	91	B	**7.3**		0.8
North Frontal (West) FM3.1, 3.2	23.1	37.2	0.0	15.7	49	171	90	50	B	**7.2**		1
San Gorgonio Pass FM3.1, 3.2	24.1	38.7	0.0	18.5	60	11	na	29	B'	**6.9**		
Hector Mine FM3.1, 3.2	24.4	39.3	0.0	14.6	90	246	na	28	B'	**6.7**		
Blue Cut FM3.1, 3.2	24.4	39.3	0.0	13.1	90	177	na	79	B'	**7.1**		
San Andreas (San Bernardino S) FM3.1, 3.2	24.7	39.7	0.0	12.8	90	210	180	43	A	**7.6**	150	29
Camp Rock FM3.1, 3.2	26.7	43.0	0.0	15.1	90	na	na	45	B'	**6.9**		
Bullion Mountains FM3.1, 3.2	27.5	44.3	0.0	13.0	90	na	na	38	B'	**6.8**		
San Andreas (Coachella) rev FM3.1, 3.2	32.0	51.5	0.0	11.1	90	224	180	69	A	**6.8**	89	9
Cleghorn Pass FM3.1, 3.2	33.5	53.9	0.0	13.0	90	na	na	20	B'	**6.5**		
San Jacinto (San Jacinto Valley, stepover)	37.0	59.6	0.0	16.1	90	224	180	24	A	**7.6**	219	9
Ludlow FM3.1, 3.2	38.4	61.7	0.0	11.1	90	239	na	70	B'	**7.0**		
Cleghorn Lake FM3.1, 3.2	38.5	62.0	0.0	13.0	90	na	na	29	B'	**6.7**		
San Jacinto (San Jacinto Valley) rev FM3.1, 3.2	39.4	63.4	0.0	16.1	90	223	180	18	A	**7.6**	219	18
San Jacinto (Stepovers Combined) FM3.1, 3.2	39.5	63.6	0.0	16.5	90	229	180	25	A	**7.5**	110	4
San Jacinto (Anza) rev FM3.1, 3.2	40.0	64.3	0.0	16.8	90	216	180	46	A	**7.6**	219	17
Cleghorn FM3.1, 3.2	40.5	65.2	0.0	15.5	90	187	0	25	B	**6.7**		3
San Andreas (San Bernardino N) FM3.1, 3.2	41.3	66.5	0.0	12.8	90	212	180	35	A	**7.5**	103	27
Sheephole FM3.1, 3.2	43.6	70.2	0.0	13.0	90	na	na	15	B'	**6.4**		
San Jacinto (San Bernardino) FM3.1, 3.2	43.9	70.7	0.0	16.1	90	225	180	37	A	**7.6**	219	17
San Jacinto (Lytle Creek connector) FM3.1, 3.2	47.5	76.5	0.0	16.1	90	na	na	23	B'	**6.7**		
Cady FM3.1, 3.2	47.9	77.0	0.0	13.9	90	182	na	19	B'	**6.5**		
San Jacinto (Clark) rev FM3.1, 3.2	49.1	79.0	0.0	16.8	90	214	180	47	A	**7.6**	219	17
San Jacinto (Coyote Creek) FM3.1, 3.2	50.6	81.4	0.0	15.9	90	223	180	43	A	**7.6**	219	17
Fontana (Seismicity) FM3.1, 3.2	52.0	83.6	0.0	16.3	80	313	na	24	B'	**6.7**		

Reference: USGS OFR 2013-1165 (CGS SP 228) Based on Site Coordinates of 34.20072 Latitude, -116.50162 Longitude

Mean Magnitude for Type A Faults based on 0.1 weight for unsegmented section, 0.9 weight for segmented model (weighted by probability of each scenario with section listed as given on Table 3 of Appendix G in OFR 2008-1437). Mean magntude is average of Ellworths-B and Hanks & Bakun moment area relationship.

Site Coordinates: 34.201 N 116.502 W

Table A-2

Historical Earthquakes in Vicinity of Project Site, M >= 5.0

Day	Year	Epicenter Latittude (Degrees)	Epicenter Longitude (Degrees)	Distance from Site (mi)	Magnitude M_W
6/28	1992	34.20	116.44	3.5	**7.3**
6/28	1992	34.12	116.43	6.9	**5.5**
6/28	1992	34.13	116.41	7.2	**5.8**
6/28	1992	34.10	116.42	8.4	**5.0**
6/29	1992	34.10	116.40	9.1	**5.7**
7/1	1992	34.33	116.46	9.2	**5.3**
6/29	1992	34.10	116.39	9.4	**5.4**
3/15	1979	34.33	116.44	9.6	**5.5**
6/28	1992	34.34	116.51	9.6	**5.4**
6/28	1992	34.06	116.47	9.9	**5.0**
7/25	1947	34.05	116.42	11.4	**5.2**
6/28	1992	34.12	116.32	11.8	**5.7**
7/24	1947	34.02	116.48	12.5	**5.3**
9/15	1992	34.06	116.36	12.6	**5.2**
2/7	1889	34.10	116.70	13.3	**5.6**
5/18	1940	34.08	116.30	14.2	**5.3**
7/8	1986	34.00	116.61	15.2	**6.0**
5/18	1940	34.05	116.30	15.5	**5.2**
8/21	1993	34.03	116.32	15.7	**5.0**
6/30	1992	34.00	116.36	16.1	**5.1**
6/12	1944	34.01	116.69	17.0	**5.2**
12/16	1988	33.98	116.68	18.3	**5.0**
6/12	1944	34.00	116.72	18.7	**5.1**
6/28	1992	34.20	116.83	18.8	**6.5**
7/9	1992	34.24	116.84	19.5	**5.3**
4/23	1992	33.96	116.32	19.6	**6.2**
6/28	1992	34.16	116.85	20.1	**5.5**
8/17	1992	34.20	116.86	20.5	**5.2**
12/4	1948	34.00	116.23	20.8	**6.0**
2/22	2003	34.31	116.85	21.3	**5.2**
6/1	1975	34.51	116.49	21.4	**5.3**
10/16	1999	34.44	116.25	21.9	**5.4**
1/16	1930	34.20	116.90	22.8	**5.5**
6/28	1992	34.26	116.91	23.7	**5.3**
1/16	1930	34.18	116.92	23.9	**5.1**
11/27	1992	34.34	116.90	24.7	**5.3**
8/29	1943	34.31	116.93	25.6	**5.3**
12/4	1992	34.37	116.90	25.6	**5.2**
2/10	2001	34.29	116.95	26.3	**5.1**
6/29	1992	33.87	116.27	26.4	**5.5**

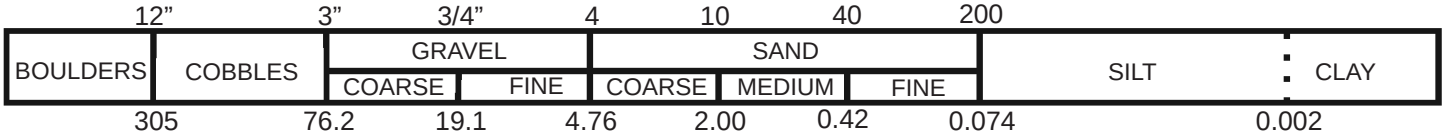
From full earthquake catalog in USGS OFR 2008-1437h as updated with current events through 2021. For events with an asterisk, alternate solutions are given in the OFR. Ordered By Closest Event. Maximum 40 Closest Events Shown.

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on ASTM Designations D 2487 and D 2488 (Unified Soil Classification System). Information on each boring log is a compilation of subsurface conditions obtained from the field as well as from laboratory testing of selected samples. The indicated boundaries between strata on the boring logs are approximate only and may be transitional.

SOIL GRAIN SIZE

U.S. STANDARD SIEVE



SOIL GRAIN SIZE IN MILLIMETERS

RELATIVE DENSITY OF GRANULAR SOILS (GRAVELS, SANDS, AND NON-PLASTIC SILTS)

Very Loose	*N=0-4	RD=0-30	Easily push a 1/2-inch reinforcing rod by hand
Loose	N=5-10	RD=30-50	Push a 1/2-inch reinforcing rod by hand
Medium Dense	N=11-30	RD=50-70	Easily drive a 1/2-inch reinforcing rod with hammer
Dense	N=31-50	RD=70-90	Drive a 1/2-inch reinforcing rod 1 foot with difficulty by a hammer
Very Dense	N>50	RD=90-100	Drive a 1/2-inch reinforcing rod a few inches with hammer

*N=Blows per foot in the Standard Penetration Test at 60% theoretical energy. For the 3-inch diameter Modified California sampler,140-pound weight, multiply the blow count by 0.63 (about 2/3) to estimate N. If automatic hammer is used, multiply a factor of 1.3 to 1.5 to estimate N. RD=Relative Density (%). C=Undrained shear strength (cohesion).

CONSISTENCY OF COHESIVE SOILS (CLAY OR CLAYEY SOILS)

Very Soft	*N=0-1	*C=0-250 psf	Squeezes between fingers
Soft	N=2-4	C=250-500 psf	Easily molded by finger pressure
Firm	N=5-8	C=500-1000 psf	Molded by strong finger pressure
Stiff	N=9-15	C=1000-2000 psf	Dented by strong finger pressure
Very Stiff	N=16-30	C=2000-4000 psf	Dented slightly by finger pressure
Hard	N>30	C>4000	Dented slightly by a pencil point or thumbnail

MOISTURE DENSITY

Moisture Condition: An observational term; dry, damp, moist, wet, saturated.
Moisture Content: The weight of water in a sample divided by the weight of dry soil in the soil sample expressed as a percentage.
Dry Density: The pounds of dry soil in a cubic foot.

MOISTURE CONDITION

Dry.....Absence of moisture, dusty, dry to the touch
Damp.....Slight indication of moisture
Slightly Moist.....Very quick (less than 1 minute) color change when exposed to air (granular soil), Below optimum (granular)
Moist.....Color change with period of air exposure (granular soil) Below optimum moisture content (cohesive soil)
Very Moist.....High degree of saturation by visual and touch (granular soil) Above optimum moisture content (cohesive soil), No free water
Wet.....Free surface water

PLASTICITY

DESCRIPTION	FIELD TEST
Nonplastic	A 1/8 in. (3-mm) thread cannot be rolled at any moisture content.
Low	The thread can barely be rolled.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit.
High	The thread can be rerolled several times after reaching the plastic limit.

GROUNDWATER LEVEL

Water Level (measured or after drilling)

Water Level (during drilling)

RELATIVE PROPORTIONS

Trace.....minor amount (<5%)
some.....significant amount
with.....(Typically greater than 15%)
modifier/and...sufficient amount to influence material behavior (Typically >30%)

LOG KEY SYMBOLS

Bulk, Bag or Grab Sample

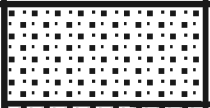
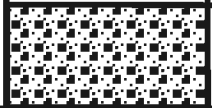
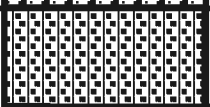
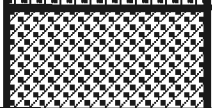
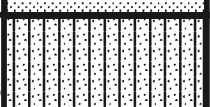
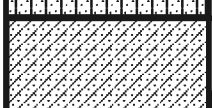
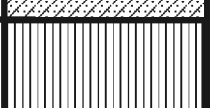
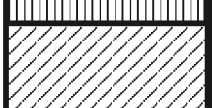
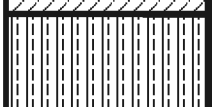
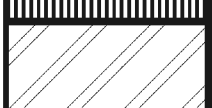
Standard Penetration Split Spoon Sampler (2” outside diameter)

Modified California Sampler (3” outside diameter)

No Recovery

Terms and Symbols Used on Boring Logs

Earth Systems

MAJOR DIVISIONS			GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS More than 50% of material is larger than No. 200 sieve size	GRAVEL AND GRAVELLY SOILS More than 50% of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS		GW	Well-graded gravels, gravel-sand mixtures, little or no fines
				GP	Poorly-graded gravels, gravel-sand mixtures. Little or no fines
		GRAVELS WITH FINES		GM	Silty gravels, gravel-sand-silt mixtures
				GC	Clayey gravels, gravel-sand-clay mixtures
	SAND AND SANDY SOILS More than 50% of coarse fraction passing No. 4 sieve	CLEAN SAND (Little or no fines)		SW	Well-graded sands, gravelly sands, little or no fines
				SP	Poorly-graded sands, gravelly sands, little or no fines
		SAND WITH FINES (appreciable amount of fines)		SM	Silty sands, sand-silt mixtures
				SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS More than 50% of material is smaller than No. 200 sieve size	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	Inorganic silts and very fine sands, rock flour, silty low clayey fine sands or clayey silts with slight plasticity
				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
				OL	Organic silts and organic silty clays of low plasticity
		LIQUID LIMIT GREATER THAN 50		MH	Inorganic silty, micaceous, or diatomaceous fine sand or silty soils
				CH	Inorganic clays of high plasticity, fat clays
				OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS				PT	Peat, humus, swamp soils with high organic contents
VARIOUS SOILS AND MAN MADE MATERIALS					Fill Materials
MAN MADE MATERIALS					Asphalt and concrete

Soil Classification System

Earth Systems

Earth Systems

1680 Illinois Ave., Perris, CA 92571
Phone (951) 928-9799, Fax (951) 928-9948

Boring No. B-1
Project Name: Proposed Subdivision Project
Project Number: 307129-001
Boring Location: See Plate 2

Drilling Date: June 5, 2025
Drilling Method: LAR w/auto hammer
Drill Type: 8" HSA
Logged By: JG

Depth (Ft.)	Sample Type (Bulk / BAG / RING)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units	Graphic Trend: Blow Count / Dry Density
0				SM			SILTY SAND: light brown, very dense, dry, fine to coarse grained sand, with some gravel to 3"	
5	RING	18,50		GR	114	2	GRANITIC BEDROCK: highly weathered, light brown, very dense, dry, recovered as: medium to coarse grained sand with silt	
10								
15								
20								
25							Refusal on bedrock at 6 feet due to hard drilling No groundwater encountered Backfilled with cuttings	
30								

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Earth Systems

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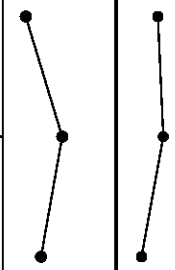
Boring No. B-2
Project Name: Proposed Subdivision Project
Project Number: 307129-001
Boring Location: See Plate 2

Drilling Date: June 5, 2025
Drilling Method: LAR w/auto hammer
Drill Type: 8" HSA
Logged By: JG

Depth (Ft.)	Sample Type (Bulk / BAG / RING)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0				SP-SM			SAND WITH SILT: light brown, very loose, dry, fine to coarse grained sand, with some gravel to 1" trace organics
	RING	7,11,19			113	1	
5	RING	37,28,50/5"		GR	121	5	GRANITIC BEDROCK: highly weathered, very dense, damp, recovered as: fine to coarse grained sand with gravel to 1/2"
	RING	50/5"			89	4	
10							Refusal on bedrock at 10 feet due to hard drilling
							No groundwater encountered
							Backfilled with cuttings
15							
20							
25							
30							

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density



Earth Systems

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Boring No. B-3
Project Name: Proposed Subdivision Project
Project Number: 307129-001
Boring Location: See Plate 2

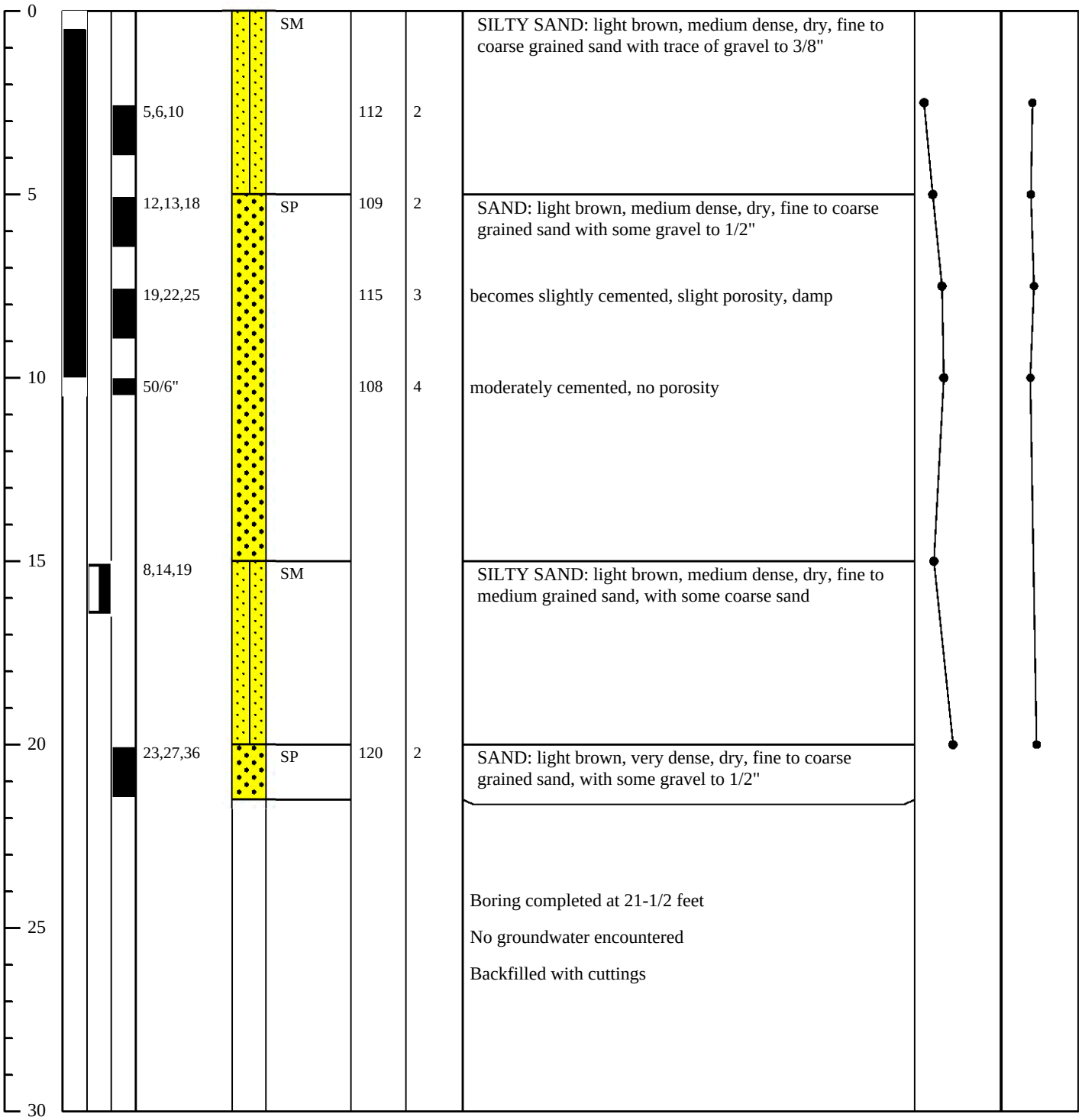
Drilling Date: June 5, 2025
Drilling Method: LAR w/auto hammer
Drill Type: 8" HSA
Logged By: JG

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density

Depth (Ft.)	Sample Type (Bulk / BAG / RING)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0				SM			SILTY SAND: light brown, medium dense, dry, fine to coarse grained sand with trace of gravel to 3/8"
	RING	5,6,10			112	2	
5				SP	109	2	SAND: light brown, medium dense, dry, fine to coarse grained sand with some gravel to 1/2"
	RING	12,13,18					
	RING	19,22,25			115	3	becomes slightly cemented, slight porosity, damp
10	RING	50/6"			108	4	moderately cemented, no porosity
15	RING	8,14,19		SM			SILTY SAND: light brown, medium dense, dry, fine to medium grained sand, with some coarse sand
20	RING	23,27,36		SP	120	2	SAND: light brown, very dense, dry, fine to coarse grained sand, with some gravel to 1/2"
25							Boring completed at 21-1/2 feet No groundwater encountered Backfilled with cuttings
30							



Earth Systems

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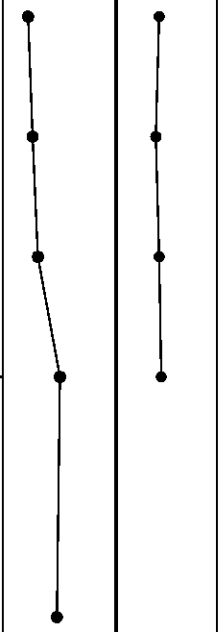
Boring No. B-4
Project Name: Proposed Subdivision Project
Project Number: 307129-001
Boring Location: See Plate 2

Drilling Date: June 5, 2025
Drilling Method: LAR w/auto hammer
Drill Type: 8" HSA
Logged By: JG

Depth (Ft.)	Sample Type (Bulk / BAG / RING)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0				SM			SILTY SAND: light brown, medium dense, dry, fine to coarse grained sand, trace of gravel to 1/2"
	RING	13,15,18			115	2	
5	RING	15,18,21			110	3	damp
	RING	18,22,24			115	2	dry
10	RING	17,25,50		GR	118	3	GRANITIC BEDROCK: highly weathered, very dense, dry, recovered as: fine to coarse grained sand
15	RING	20,30,41					
20							Refusal on bedrock at 19 feet due to hard drilling
25							No groundwater encountered
							Backfilled with cuttings
30							

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density



Earth Systems

1680 Illinois Ave., Perris, CA 92571
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Boring No. B-5
Project Name: Proposed Subdivision Project
Project Number: 307129-001
Boring Location: See Plate 2

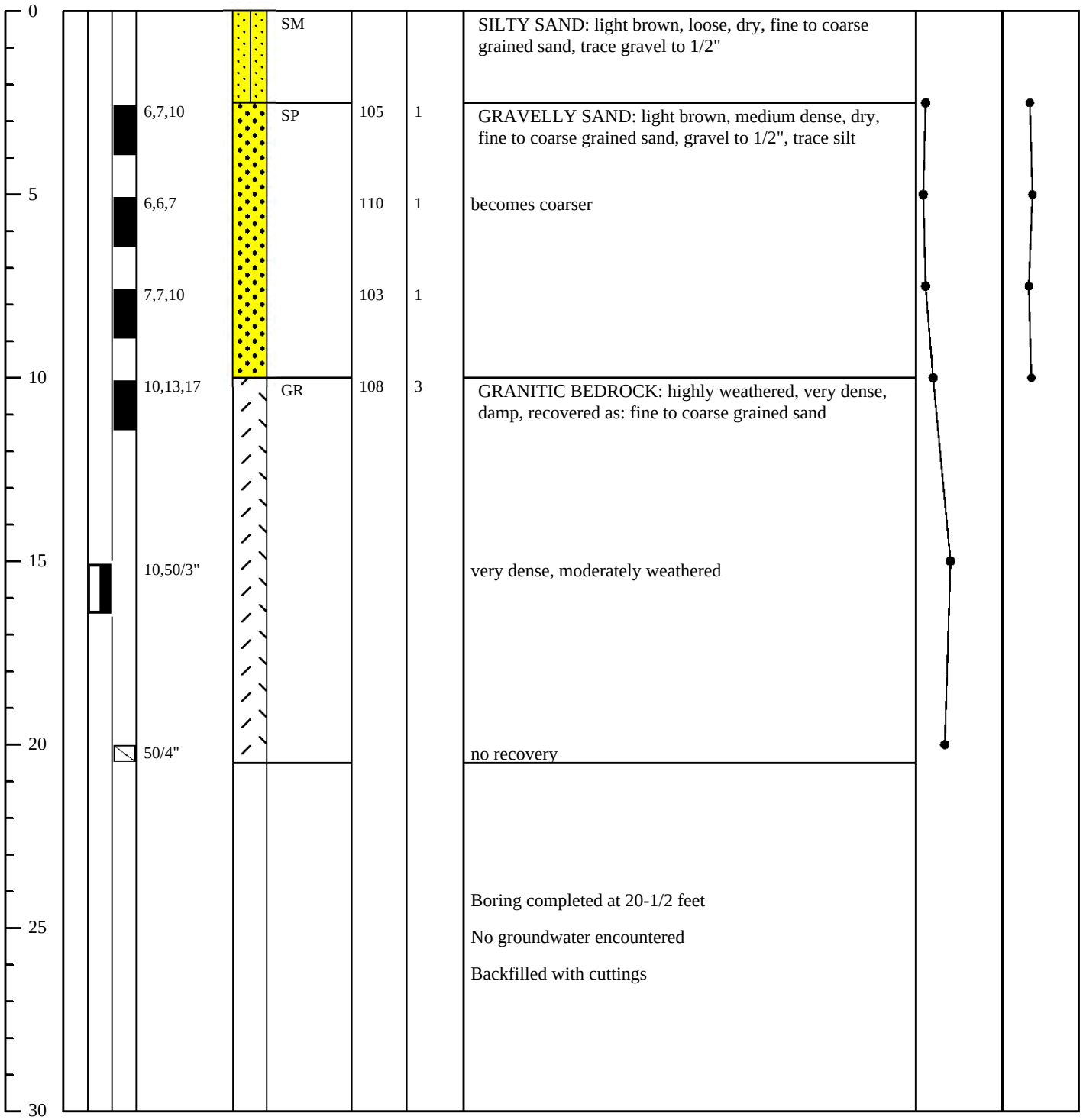
Drilling Date: June 5, 2025
Drilling Method: LAR w/auto hammer
Drill Type: 8" HSA
Logged By: JG

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density

Depth (Ft.)	Sample Type (Bulk, BAG, RING)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0				SM			SILTY SAND: light brown, loose, dry, fine to coarse grained sand, trace gravel to 1/2"
	RING	6,7,10		SP	105	1	GRAVELLY SAND: light brown, medium dense, dry, fine to coarse grained sand, gravel to 1/2", trace silt
5	RING	6,6,7			110	1	becomes coarser
	RING	7,7,10			103	1	
10	RING	10,13,17		GR	108	3	GRANITIC BEDROCK: highly weathered, very dense, damp, recovered as: fine to coarse grained sand
15	RING	10,50/3"					very dense, moderately weathered
20	RING	50/4"					no recovery
25							Boring completed at 20-1/2 feet No groundwater encountered Backfilled with cuttings
30							



Earth Systems

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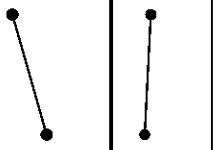
Boring No. B-6
Project Name: Proposed Subdivision Project
Project Number: 307129-001
Boring Location: See Plate 2

Drilling Date: June 5, 2025
Drilling Method: LAR w/auto hammer
Drill Type: 8" HSA
Logged By: JG

Depth (Ft.)	Sample Type (Bulk / BAG / RING)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0				SP			SAND: light brown, medium dense, dry, fine to coarse grained sand, some gravel to 1", trace silt
	RING	7,9,10			110	1	
5	RING	14,50/2"		GR	101	1	GRANITIC BEDROCK: highly weathered, very dense, dry, recovered as: fine to coarse grained sand
							moderately weathered
10							
15							
20							
25							Refusal on bedrock at 7-1/2 feet No groundwater encountered Backfilled with cuttings
30							

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density



Earth Systems

1680 Illinois Ave., Perris, CA 92571
Phone (951) 928-9799, Fax (951) 928-9948

Boring No. B-7
Project Name: Proposed Subdivision Project
Project Number: 307129-001
Boring Location: See Plate 2

Drilling Date: June 6, 2025
Drilling Method: LAR w/auto hammer
Drill Type: 8" HSA
Logged By: JG

Depth (Ft.)	Sample Type (Bulk / BAG / RING)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units	Graphic Trend: Blow Count / Dry Density
0				SP			GRAVELLY SAND: light brown, very dense, dry, fine to coarse grained sand, gravel and cobbles to 8", trace silt	
	RING	50		GR	92	1	GRANITIC BEDROCK: very highly weathered, dry, dense, recovered as: fine to medium sand	
5							hard	
10								
15								
20								
25							Refusal on bedrock at 7 feet due to hard frilling No groundwater encountered Backfilled with cuttings	
30								

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Earth Systems

1680 Illinois Ave., Perris, CA 92571
Phone (951) 928-9799, Fax (951) 928-9948

Boring No. B-8
Project Name: Proposed Subdivision Project
Project Number: 307129-001
Boring Location: See Plate 2

Drilling Date: June 6, 2025
Drilling Method: LAR w/auto hammer
Drill Type: 8" HSA
Logged By: JG

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Depth (Ft.)	Sample Type (Bulk / BAG / RING)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description
0				SM			SILTY SAND: light brown, medium dense, dry, fine to coarse grained sand, some gravel to 1"
	RING	12,10,8			111	2	trace of roots
5	RING	9,10,13			121	2	moderately cemented, trace roots, no gravel
	RING	27,50/3"			113	7	very dense, moderately cemented, slight porosity, trace old roots, damp
10	RING	25,50/5"			122	5	tarce of carbonate stringers
15	BAG	22,31,29		SP			SAND: light brown, very dense, dry, fine to coarse grained sand, trace silt
20	BAG	10,12,13					
25							Boring completed at 21-1/2 feet No groundwater encountered Backfilled with cuttings
30							

Graphic Trend
Blow Count Dry Density

Earth Systems

1680 Illinois Ave., Perris, CA 92571
Phone (951) 928-9799, Fax (951) 928-9948

Boring No. B-9
Project Name: Proposed Subdivision Project
Project Number: 307129-001
Boring Location: See Plate 2

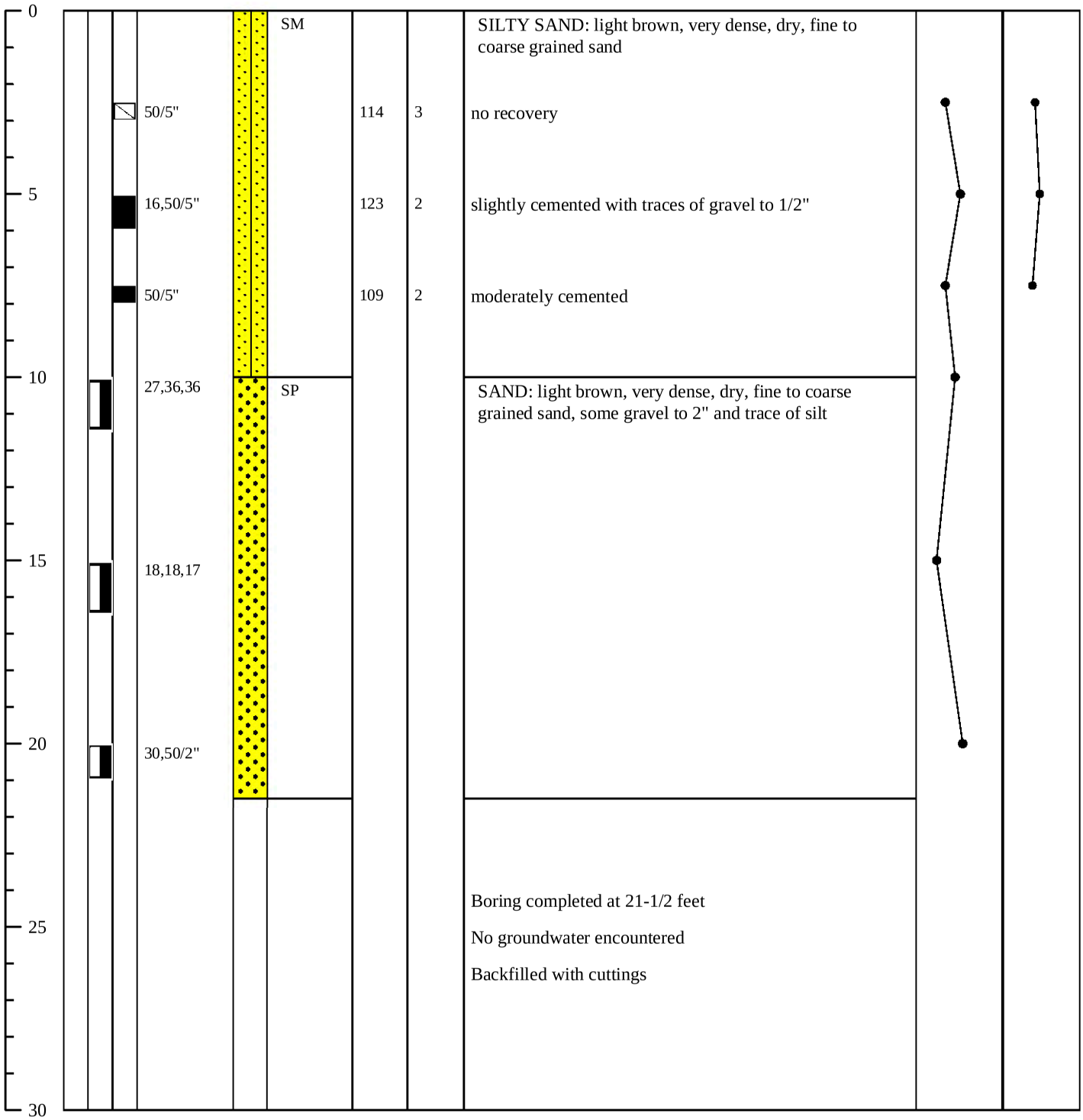
Drilling Date: June 6, 2025
Drilling Method: LAR w/auto hammer
Drill Type: 8" HSA
Logged By: JG

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density

Depth (Ft.)	Sample Type (Bulk / BAG / RING)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0				SM			SILTY SAND: light brown, very dense, dry, fine to coarse grained sand
	RING	50/5"			114	3	no recovery
5	RING	16,50/5"			123	2	slightly cemented with traces of gravel to 1/2"
	RING	50/5"			109	2	moderately cemented
10	BAG	27,36,36		SP			SAND: light brown, very dense, dry, fine to coarse grained sand, some gravel to 2" and trace of silt
15	BAG	18,18,17					
20	BAG	30,50/2"					
25							Boring completed at 21-1/2 feet No groundwater encountered Backfilled with cuttings
30							



Earth Systems

1680 Illinois Ave., Perris, CA 92571
Phone (951) 928-9799, Fax (951) 928-9948

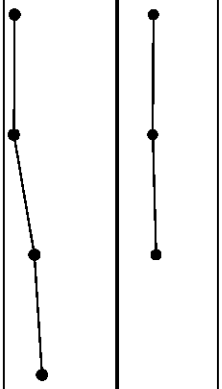
Boring No. B-10
Project Name: Proposed Subdivision Project
Project Number: 307129-001
Boring Location: See Plate 2

Drilling Date: June 6, 2025
Drilling Method: LAR w/auto hammer
Drill Type: 8" HSA
Logged By: JG

Depth (Ft.)	Sample Type (Bulk / BAG / RING)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0				SP			SAND: light brown, medium dense, dry, fine to coarse grained sand, trace gravel to 1/2", some silt
	RING	5,7,7			105	1	gravel to 3/4"
5	RING	5,6,7			104	1	
	RING	5,6,34			109	2	dense
10	BAG	50/2"					no recovery
							hard
15							
20							
25							Refusal on bedrock at 12 feet due to hard drilling No groundwater encountered Backfilled with cuttings
30							

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density



Earth Systems

1680 Illinois Ave., Perris, CA 92571
Phone (951) 928-9799, Fax (951) 928-9948

Boring No. B-11
Project Name: Proposed Subdivision Project
Project Number: 307129-001
Boring Location: See Plate 2

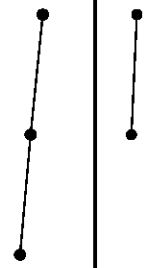
Drilling Date: June 6, 2025
Drilling Method: LAR w/auto hammer
Drill Type: 8" HSA
Logged By: JG

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Depth (Ft.)	Sample Type (Bulk / BAG / RING)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description
0				SP			SAND: light brown, very dense, dry, fine to coarse grained sand, trace gravel to 1", some silt
	RING	30,50/5"			113	3	damp
5	RING	19,24,40			105	3	very dense, becomes slightly cemented
	BAG	50/4"		GR			GRANITIC BEDROCK: highly weathered, dense, dry, recovered as: fine to coarse sand
10							
15							
20							
25							Refusal at 8 feet due to hard drilling No groundwater encountered Backfilled with cuttings
30							

Graphic Trend
Blow Count Dry Density



Earth Systems

1680 Illinois Ave., Perris, CA 92571
Phone (951) 928-9799, Fax (951) 928-9948

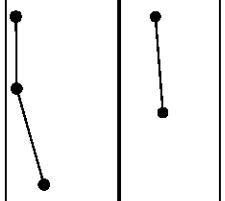
Boring No. B-12
Project Name: Proposed Subdivision Project
Project Number: 307129-001
Boring Location: See Plate 2

Drilling Date: June 6, 2025
Drilling Method: LAR w/auto hammer
Drill Type: 8" HSA
Logged By: JG

Depth (Ft.)	Sample Type (Bulk / BAG / RING)	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0				SM			SILTY SAND: light brown, medium dense, dry, fine to coarse grained sand, trace gravel to 1"
	RING	5,6,7			105	3	damp
5	RING	5,5,9			116	2	dry
	RING	50/3"		GR			GRANITIC BEDROCK: highly weathered, dense, dry, recovered as: fine to coarse sand
10							
15							
20							
25							Refusal on bedrock at 9 feet due to hard drilling No groundwater encountered Backfilled with cuttings
30							

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density



APPENDIX B

Laboratory Test Results

File No.: 307129-001 July 21, 2025

Lab No.:

UNIT DENSITIES AND MOISTURE CONTENT ASTM D2937 & D2216

Job Name: Proposed Subdivision Project

Sample Location	Depth (feet)	Unit Dry Density (pcf)	Moisture Content (%)	USCS Group Symbol
B-1	2.5	114	2	GR
B-2	2.5	113	1	SP-SM
B-2	5	121	5	GR
B-2	7.5	89	4	GR
B-3	2.5	112	2	SM
B-3	5	109	2	SP
B-3	7.5	115	3	SP
B-3	10	108	4	SP
B-3	20	120	2	SP
B-4	2.5	115	2	SM
B-4	5	110	3	SM
B-4	7.5	115	2	SM
B-4	10	118	3	GR
B-5	2.5	105	1	SP
B-5	5	110	1	SP
B-5	7.5	103	1	SP
B-5	10	108	3	GR
B-6	2.5	110	1	SP
B-6	5	101	1	GR
B-7	2.5	92	1	SP
B-8	2.5	111	2	SM
B-8	5	121	2	SM
B-8	7.5	113	7	SM
B-8	10	122	5	SM

File No.: 307129-001 July 21, 2025

Lab No.:

UNIT DENSITIES AND MOISTURE CONTENT ASTM D2937 & D2216

Job Name: Proposed Subdivision Project

Sample Location	Depth (feet)	Unit Dry Density (pcf)	Moisture Content (%)	USCS Group Symbol
B-9	2.5	114	3	SM
B-9	5	123	2	SM
B-9	7.5	109	2	SM
B-10	2.5	105	1	SP
B-10	5	104	1	SP
B-10	7.5	109	2	SP
B-11	2.5	113	3	SP
B-11	5	105	3	SP
B-12	2.5	105	3	SM
B-12	5	116	2	SM

File No.: 307129-001 7/21/2025

Lab No.:

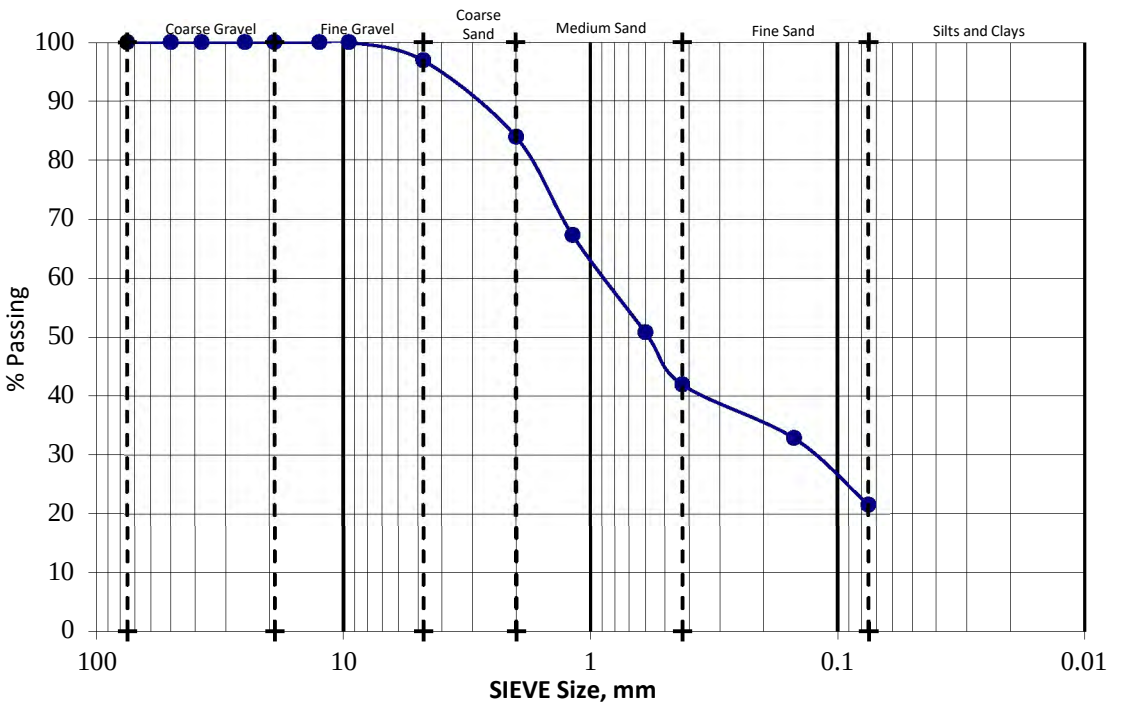
SIEVE ANALYSIS ASTM D6913

Job Name: Proposed Subdivision Project

Sample ID: B-3 @ 2.5'

Description: Silty Sand (SM)

Sieve Size	% Passing
3"	100
2"	100
1-1/2"	100
1"	100
3/4"	100
1/2"	100
3/8"	100
#4	97
#10	84
#16	67
#30	51
#40	42
#100	33
#200	21.6



FM= 2.36

% Coarse Gravel:	0	% Coarse Sand:	13			
% Fine Gravel:	3	% Medium Sand:	42	Cu:	NA	
		% Fine Sand:	20	Cc:	NA	Gradation
% Total Gravel	3	% Total Sand	75	% Fines:	21.6	NA

File No.: 307129-001 7/21/2025

Lab No.:

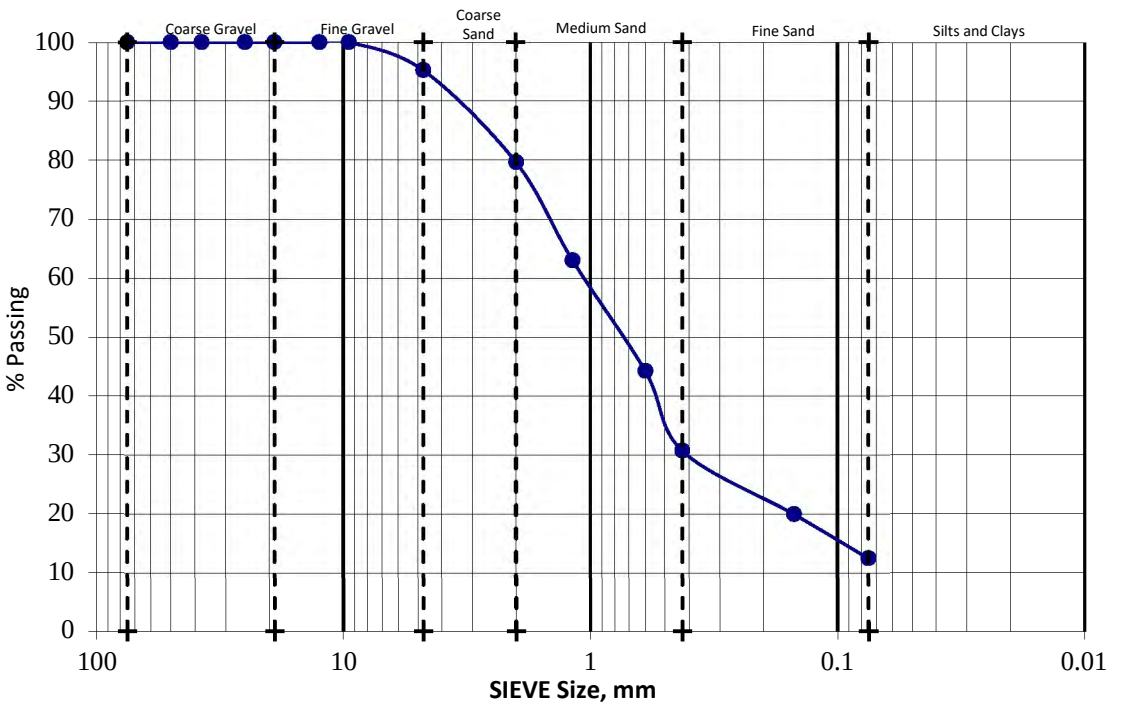
SIEVE ANALYSIS ASTM D6913

Job Name: Proposed Subdivision Project

Sample ID: B-4 @ 2.5'

Description: Silty Sand (SM)

Sieve Size	% Passing
3"	100
2"	100
1-1/2"	100
1"	100
3/4"	100
1/2"	100
3/8"	100
#4	95
#10	80
#16	63
#30	44
#40	31
#100	20
#200	12.5



FM= 2.76

% Coarse Gravel:	0	% Coarse Sand:	16			
% Fine Gravel:	5	% Medium Sand:	49	Cu:	NA	
		% Fine Sand:	18	Cc:	NA	Gradation
% Total Gravel	5	% Total Sand	83	% Fines:	12.5	NA

File No.: 307129-001 July 21, 2025

Job Name: Proposed Subdivision Project

Lab Number: 0

ASTM D-1140 or Earth Systems Method (circle one)

AMOUNT PASSING NO. 200 SIEVE (Earth Systems Method Transfers Sample until water runs clear)

Sample Location	Depth (feet)	Fines Content (%)	USCS Group Symbol	Soaking Time
B-1	2.5	14.3	SM	10
B-8	5	16.4	SM	10

File No.: 307129-001 July 21, 2025
Lab No.:

CONSOLIDATION TEST **ASTM D 2435 & D 5333**

Proposed Subdivision Project
B-3 @ 2.5'

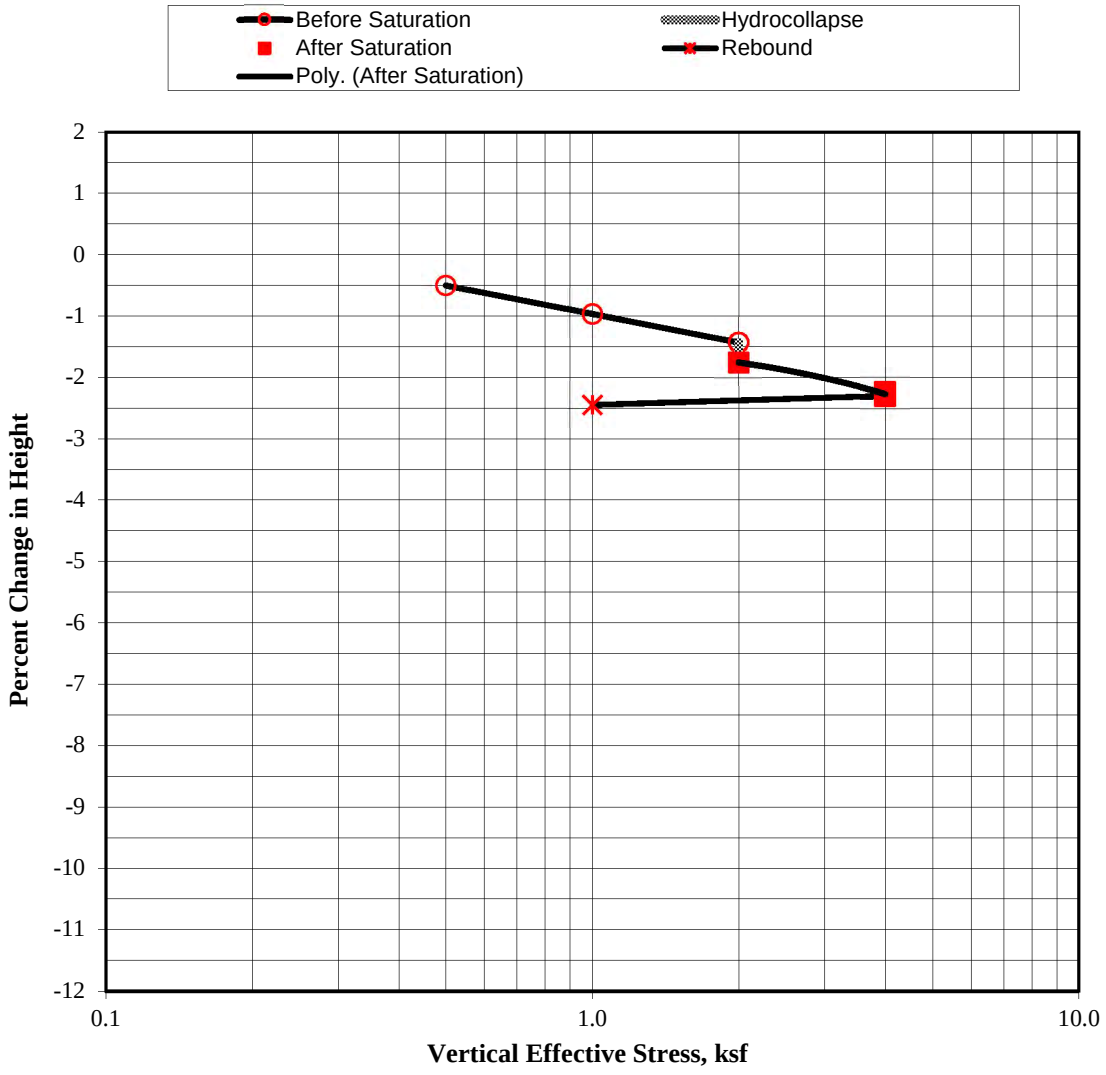
Silty Sand (SM)

Ring Sample

Initial Dry Density: 109.7 pcf
Initial Moisture: 2.3%
Specific Gravity: 2.67
Initial Void Ratio: 0.520

Hydrocollapse: 0.3% @ 2.0 ksf

% Change in Height vs Normal Pressure Diagram



File No.: 307129-001 July 21, 2025
Lab No.:

CONSOLIDATION TEST **ASTM D 2435 & D 5333**

Proposed Subdivision Project
B-5 @ 7.5'

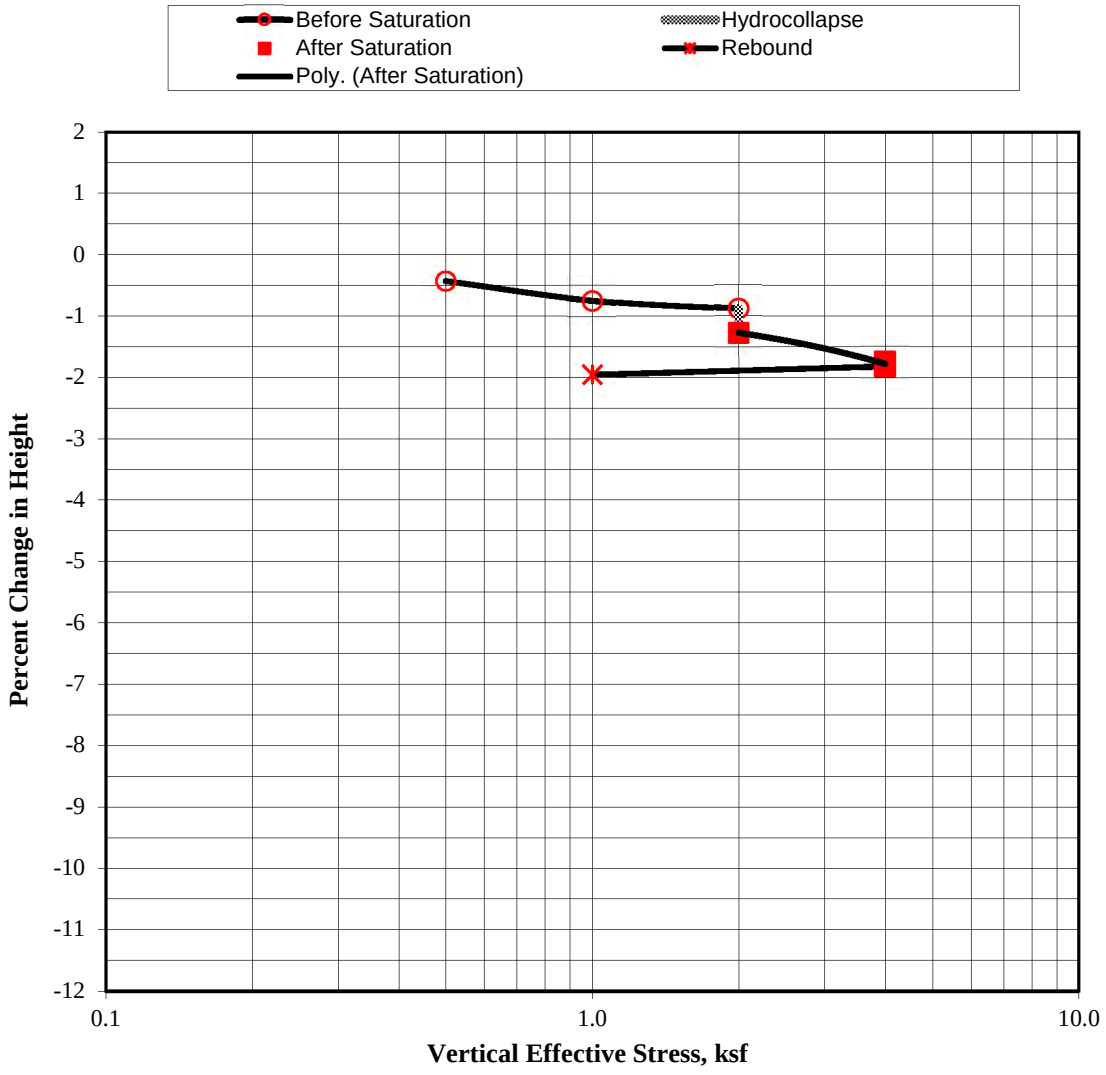
Sand (SP)

Ring Sample

Initial Dry Density: 104.8 pcf
Initial Moisture: 1.7%
Specific Gravity: 2.67
Initial Void Ratio: 0.591

Hydrocollapse: 0.4% @ 2.0 ksf

% Change in Height vs Normal Pressure Diagram



File No.: 307129-001 July 21, 2025
Lab No.:

CONSOLIDATION TEST **ASTM D 2435 & D 5333**

Proposed Subdivision Project
B-5 @ 10'

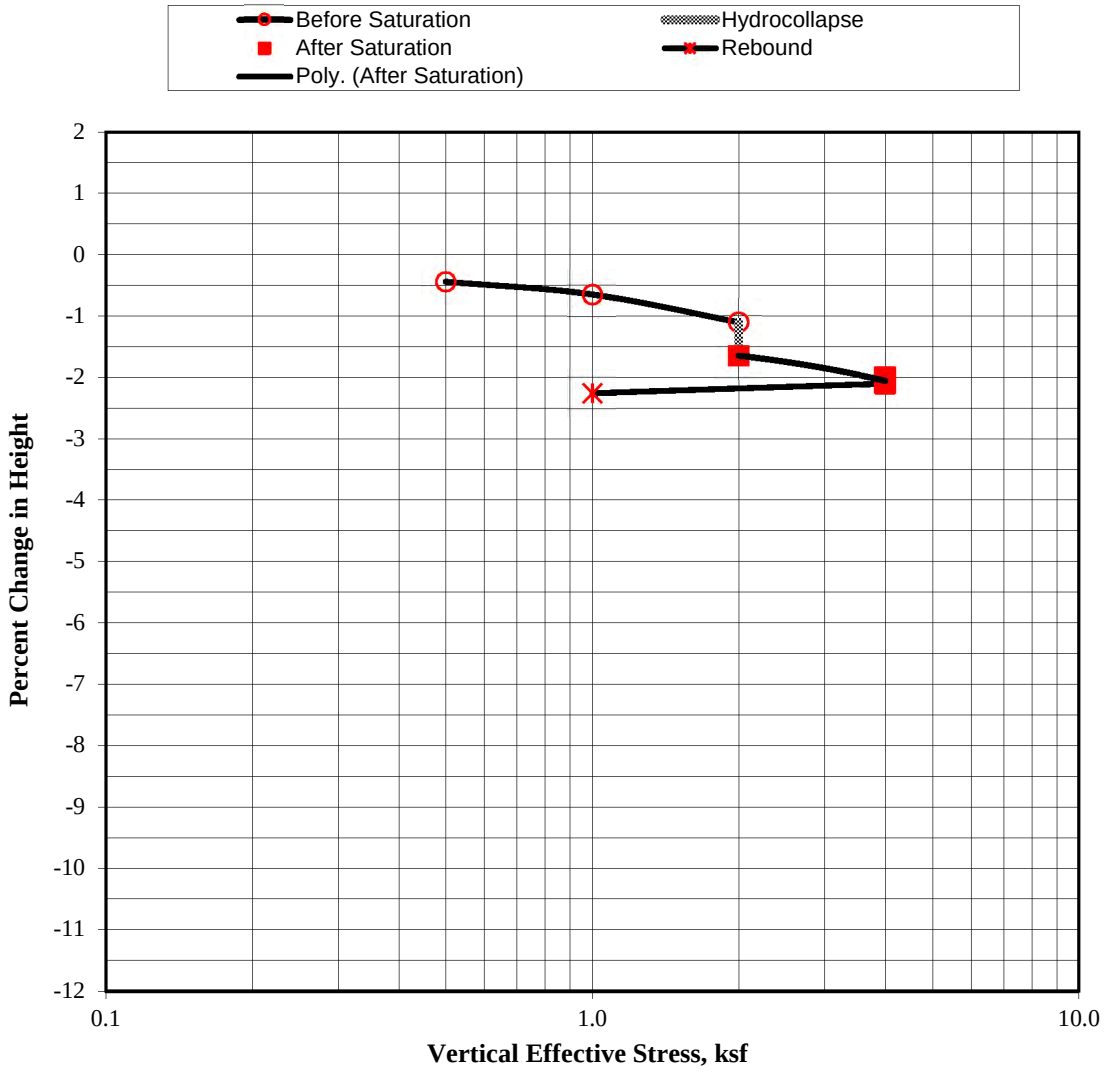
Granitic Bedrock (GR)

Ring Sample

Initial Dry Density: 107.2 pcf
Initial Moisture: 2.9%
Specific Gravity: 2.67
Initial Void Ratio: 0.555

Hydrocollapse: 0.5% @ 2.0 ksf

% Change in Height vs Normal Pressure Diagram



File No.: 307129-001 July 21, 2025
Lab No.:

CONSOLIDATION TEST **ASTM D 2435 & D 5333**

Proposed Subdivision Project
B-10 @ 5'

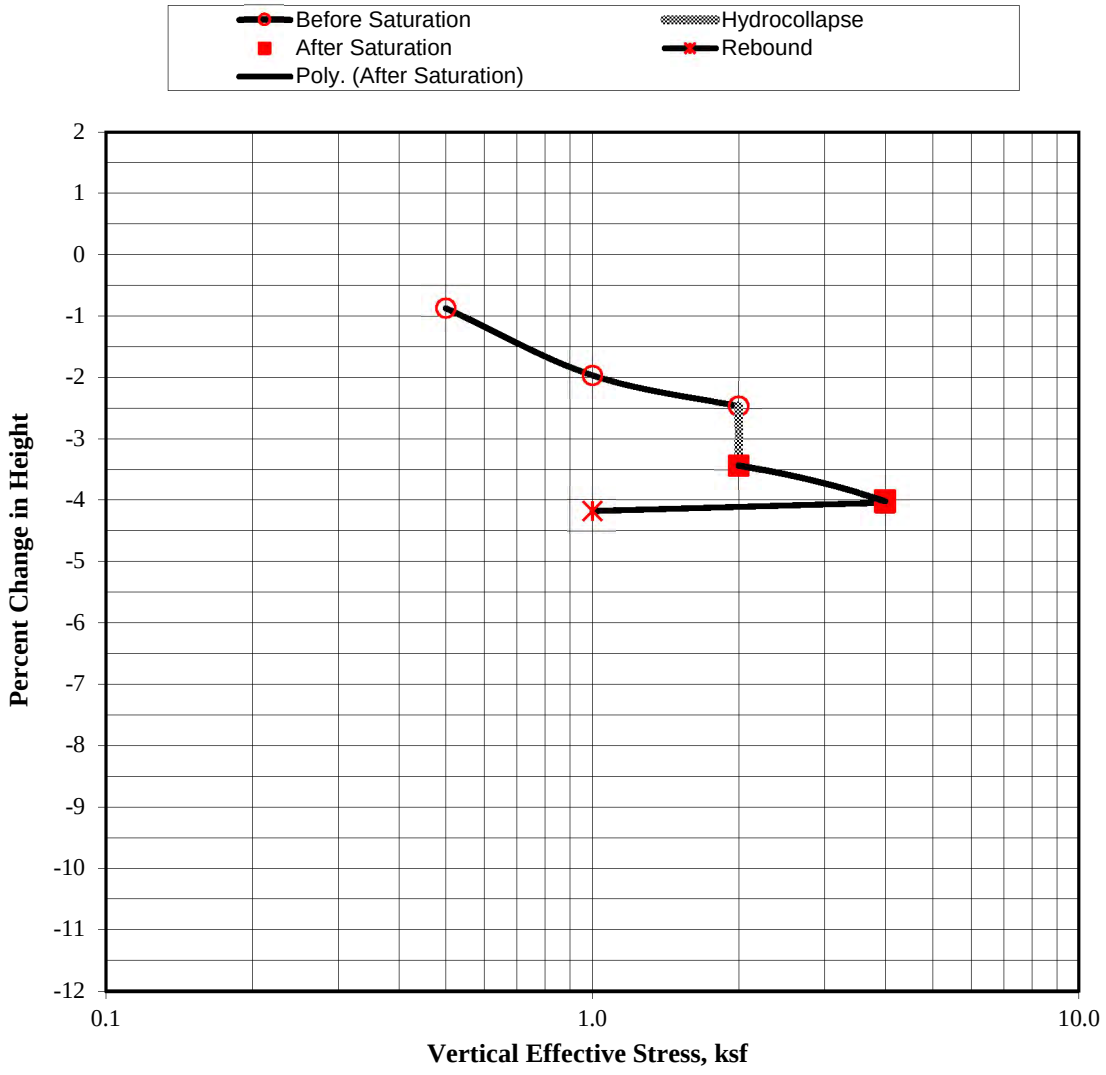
Sand (SP)

Ring Sample

Initial Dry Density: 107.6 pcf
Initial Moisture: 2.1%
Specific Gravity: 2.67
Initial Void Ratio: 0.549

Hydrocollapse: 1.0% @ 2.0 ksf

% Change in Height vs Normal Pressure Diagram



File No.: 307129-001 July 21, 2025
Lab No.:

CONSOLIDATION TEST **ASTM D 2435 & D 5333**

Proposed Subdivision Project
B-12 @ 2.5'

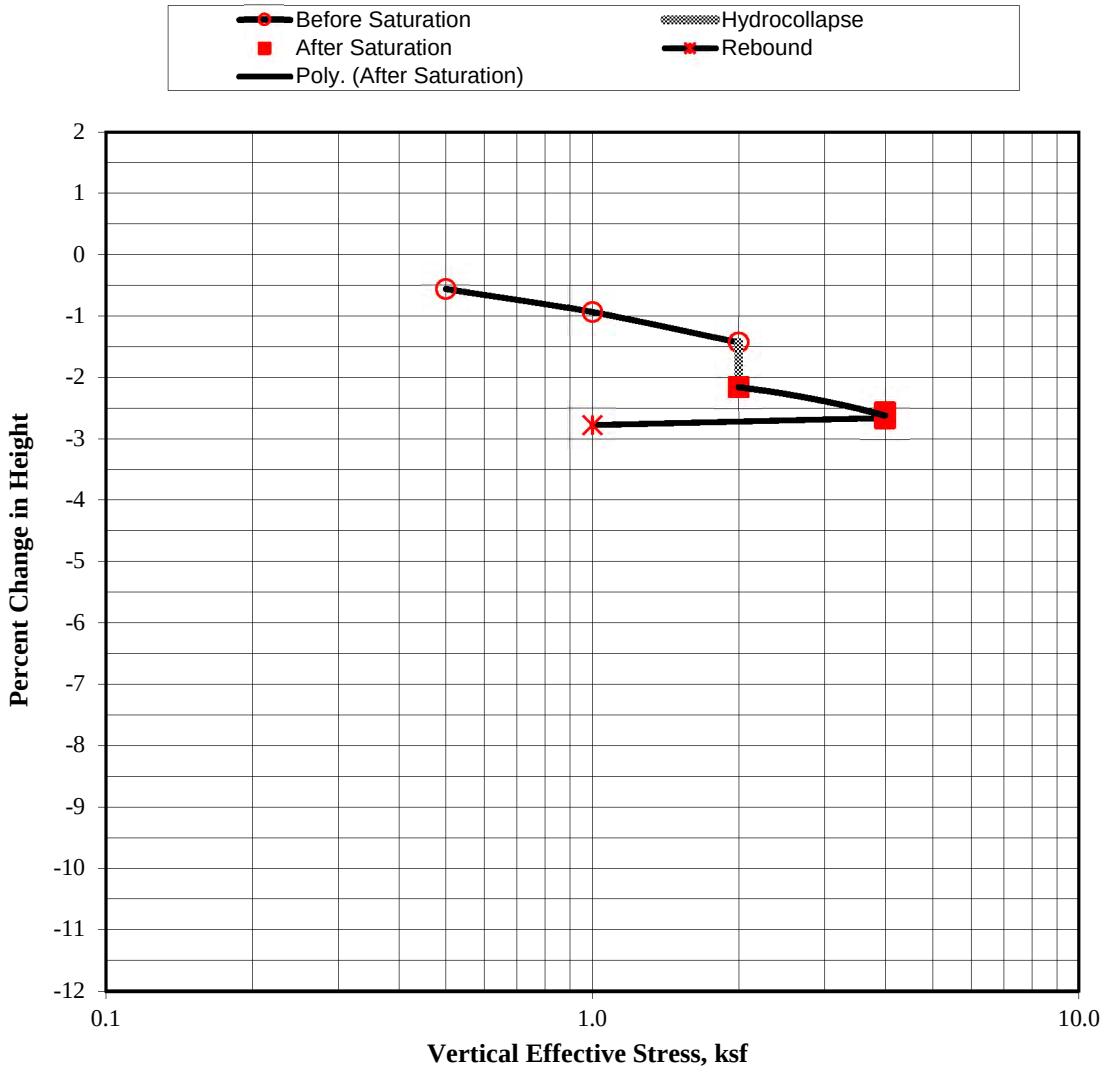
Silty Sand (SM)

Ring Sample

Initial Dry Density: 109.3 pcf
Initial Moisture: 1.4%
Specific Gravity: 2.67
Initial Void Ratio: 0.525

Hydrocollapse: 0.7% @ 2.0 ksf

% Change in Height vs Normal Pressure Diagram



File No.: 307129-001 July 21, 2025
Lab No.:

EXPANSION INDEX **ASTM D-4829**

Job Name: Proposed Subdivision Project
Sample ID: B-8 @ 2.5'
Soil Description: Silty Sand (SM)

Initial Moisture, %:	8.3	
Initial Compacted Dry Density, pcf:	114.7	
Initial Saturation, %:	48	*
Final Moisture, %:	17.8	
Volumetric Swell, %:	0.2	
Expansion Index, EI:	**1**	**Very Low**

EI	ASTM Classification
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
>130	Very High

File No.: 307129-001 July 21, 2025
Lab No.:

EXPANSION INDEX **ASTM D-4829**

Job Name: Proposed Subdivision Project
Sample ID: B-12 @ 2.5'
Soil Description: Silty Sand (SM)

Initial Moisture, %:	8.0	
Initial Compacted Dry Density, pcf:	115.6	
Initial Saturation, %:	47	*
Final Moisture, %:	14.8	
Volumetric Swell, %:	0.1	
Expansion Index, EI:	**0**	**Very Low**

EI	ASTM Classification
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
>130	Very High

File No.: 307129-001 July 21, 2025
Lab No.:

MAXIMUM DRY DENSITY / OPTIMUM MOISTURE ASTM D 1557 (Modified)

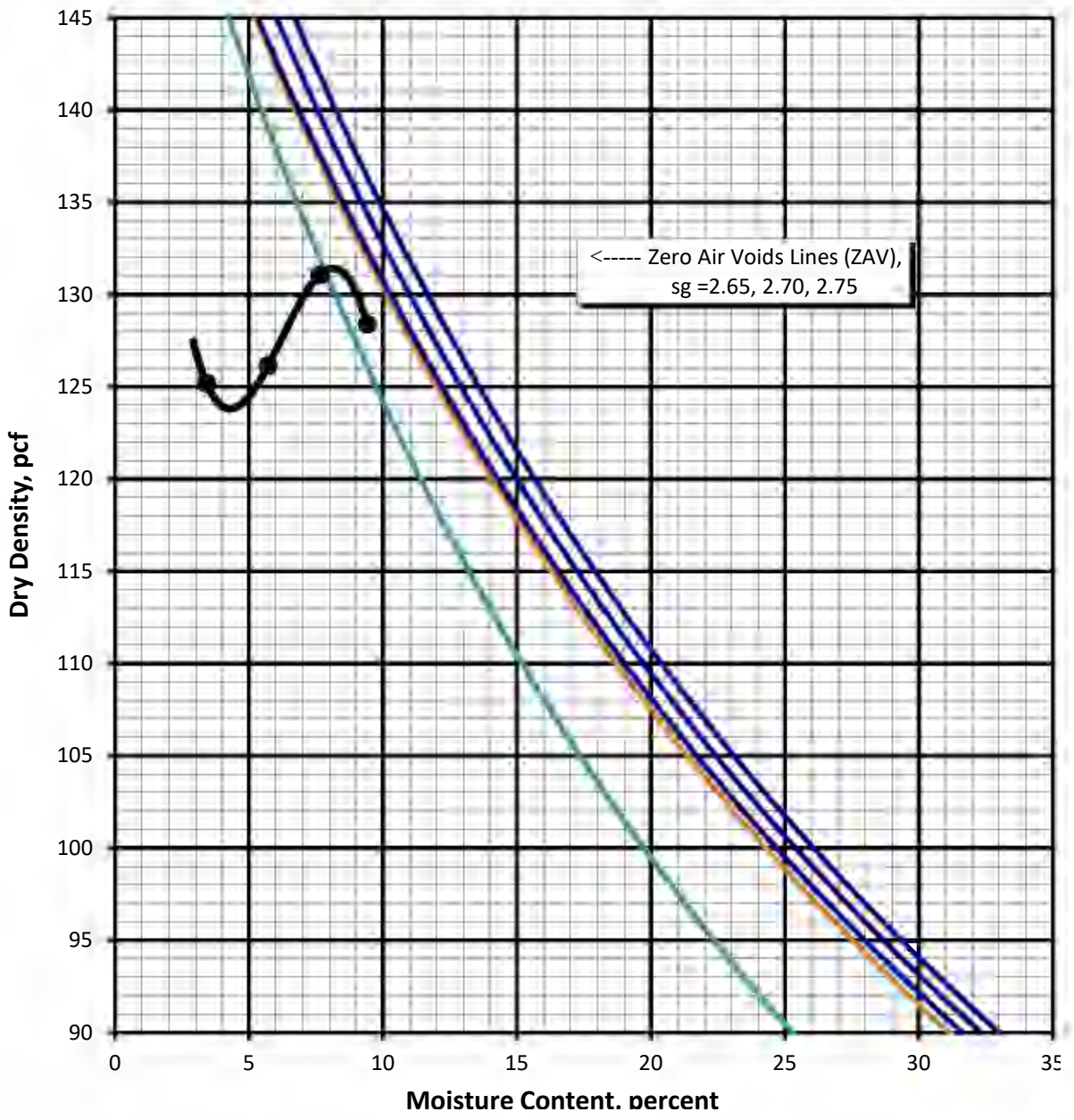
Job Name: Proposed Subdivision Project
Sample ID: N/A
Location: B-3 @ 0-10'

Procedure Used: A
Preparation Method: Moist
Rammer Type: Mechanical

Description: Silty Sand (SM)

Maximum Dry Density: **131.4 pcf**
Optimum Moisture: **8.1%**

Sieve Size	% Retained (Cumulative)
3/4"	0.0
3/8"	0.5
#4	3.3



File No.: 307129-001 7/21/2025

Lab No.:

SOIL CHEMICAL ANALYSES

Job Name:	Proposed Subdivision Project	
Job No.:	307129-001	
Sample ID:		
Sample Location:	B-1 @ 0-5'	B-3 @ 0-10'
Resistivity (Units)		
as-received (ohm-cm)	34,800	30,800
saturated (ohm-cm)	7,600	8,000
pH	7.7	8.1
Electrical Conductivity (mS/cm)	0.07	0.07
Chemical Analyses		
Cations		
calcium Ca^{2+} (mg/kg)	35	42
magnesium Mg^{2+} (mg/kg)	5	6
sodium Na^{1+} (mg/kg)	59	60
potassium K^{1+} (mg/kg)	4	5
ammonium NH41+ (mg/kg)	ND	ND
Anions		
carbonate CO_3^{2-} (mg/kg)	21	23
bicarbonate HCO_3^{1-}(mg/kg)	107	137
fluoride F^{1-} (mg/kg)	4	4
chloride Cl^{1-} (mg/kg)	4	3
sulfate SO_4^{2-} (mg/kg)	9	9
nitrate NO31- (mg/kg)	1	1
phosphate PO_4^{3-} (mg/kg)	5	6
Other Tests		
% moisture H_2O (%)	na	na
total acidity H^{1+} (mmol/kg)	na	na
sulfide S^{2-} (qual)	na	na
Redox (mV)	na	na

Note: Tests performed by Subcontract Laboratory:
HDR Engineering, Inc.
431 West Baseline Road
Claremont, California 91711 Tel: (909) 962-5485

mg/kg = milligrams per kilogram (parts per million) of dry soil.
Redox = oxidation-reduction potential in millivolts
ND = not detected
na = not analyzed
T.O.P. = top of pipe

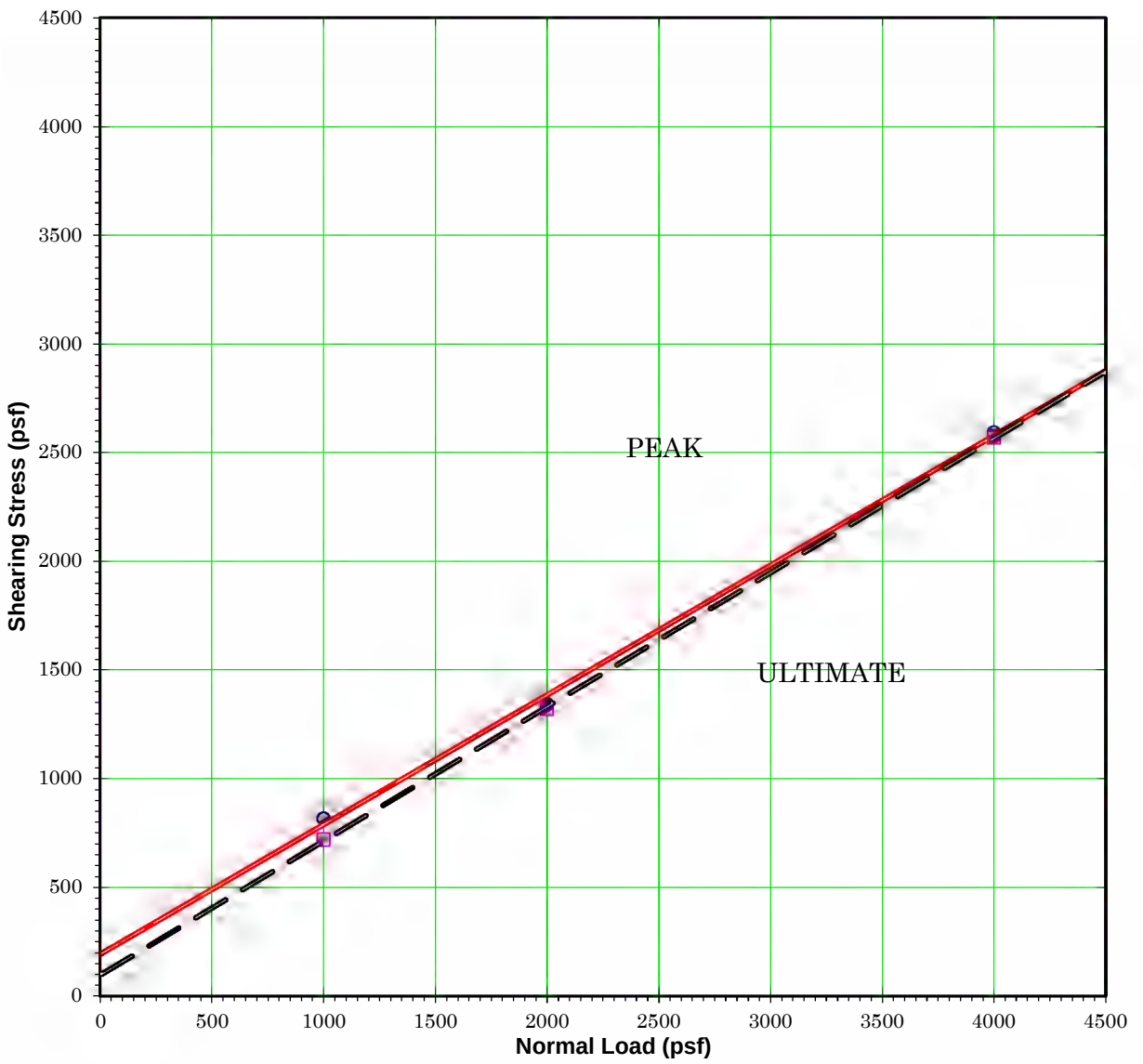
Resistivity per ASTM G187, Cations per ASTM D6919, Anions per ASTM D4327, and Alkalinity per APHA 2320-B. Electrical conductivity in millisiemens/cm and chemical analyses were made on a 1:5 soil-to-water extract.

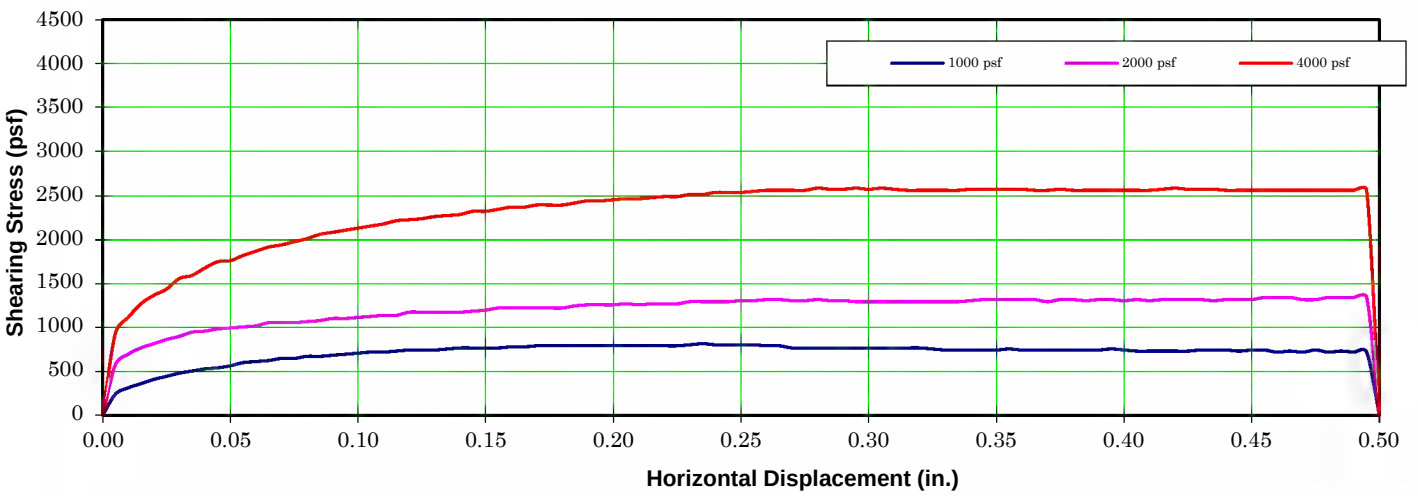
General Guidelines for Soil Corrosivity		
Chemical Agent	Amount in Soil	Degree of Corrosivity
Soluble Sulfates[1]	0 -1,000 mg/Kg (ppm) [0-.1%]	Low
	1,000 - 2,000 mg/Kg (ppm) [0.1-0.2%]	Moderate
	2,000 - 20,000 mg/Kg (ppm) [0.2-2.0%]	Severe
	> 20,000 mg/Kg (ppm) [>2.0%]	Very Severe
Resistivity[2] (Saturated)	0- 900 ohm-cm	Very Severely Corrosive
	900 to 2,300 ohm-cm	Severely Corrosive
	2,300 to 5,000 ohm-cm	Moderately Corrosive
	5,000-10,000 ohm-cm	Mildly Corrosive
	10,000+ ohm-cm	Progressively Less Corrosive

1 - General corrosivity to concrete elements. American Concrete Institute (ACI) Water Soluble Sulfate in Soil by Weight, ACI 318, Tables 4.2.2 - Exposure Conditions and Table 4.3.1 - Requirements for Concrete Exposed to Sulfate-Containing Solutions. It is recommended that concrete be proportioned in accordance with the requirements of the two ACI tables listed above (4.2.2 and 4.3.1). The current ACI should be referred to for further information.

2 - General corrosivity to metallic elements (iron, steel, etc.). Although no standard has been developed and accepted by corrosion engineering organizations, it is generally agreed that the classification shown above, or other similar classifications, reflect soil corrosivity. Source: Corrosionsource.com. The classification presented is excerpted from ASTM STP 1013 titled "Effects of Soil Characteristics on Corrosion" (February, 1989)

3 - Earth Systems does not practice corrosion engineering. Results should be reviewed by an engineer competent in corrosion evaluation, especially in regard to nitrites and ammonium.





DIRECT SHEAR DATA*

Sample Location: B-3 @ 0-10'
Material: Silty Sand (SM)
Dry Density (pcf): 131.4

	Initial	Final
Moisture Content (%):	8.1	13.0
Saturation (%):	81	100
	Peak	**Ultimate**
ϕ Angle of Friction (degrees):	31	32
c Cohesive Strength (psf):	190	90

Test Type: Peak and Ulitimate
Shear Rate (in/min): 0.005

* Test Method: ASTM D-3080

DIRECT SHEAR TEST

Proposed Subdivision Project

Pioneertown, CA

Earth Systems Pacific

7/21/2025 | 307129-001

Appendix I

Paleontological Resources Assessment

Paleontological Resources Assessment

Pipes Canyon Project, Pioneertown,
San Bernardino County, California

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Executive Summary

South Environmental was retained to complete a paleontological resources assessment for the Pipes Canyon Project (project), located near the unincorporated community of Pioneertown in San Bernardino County, California. The purpose of this assessment is to describe the results of a paleontological resources literature review and records search, summarize the paleontological sensitivity of the geologic units within the project site, assess the potential for the project to impact scientifically significant paleontological resources, and provide management recommendations for avoiding or reducing project-related impacts to paleontological resources. This study was completed in compliance with the California Environmental Quality Act (CEQA) and all applicable San Bernardino County paleontological resources requirements.

The project site is currently undeveloped desert within the Morongo Basin of the Mojave Desert. The project proposes to subdivide the 122.98 acres property into 13 individual lots, 12 of which would be developed into single-family residential lots with a minimum five-acre lot size, grouped on the western half of the project site. The one remaining lot on the eastern half of the project site lies within Resource Conservation zoning and will remain in its current undeveloped state.

The project site contains two major geologic formations: Mesozoic-age granitic rocks and Pleistocene-age alluvial deposits. The Mesozoic-age granitic rocks are igneous in origin and therefore have No Potential to contain paleontological resources. No paleontological resources mitigation measures are recommended for construction activities taking place in these areas, which cover a majority of the eastern half of the project site, except for a small area along the eastern border. This would include Proposed Lots 1, 2, 7 and 12 and most of the Remainder Parcel (see Figure 2).

The Pleistocene-age alluvial deposits have a High Potential to contain paleontological resources, and thus full-time paleontological monitoring is recommended for all ground-disturbing construction activities taking place in these areas, which cover most of the western half of the project site as well as a small section along the eastern border. This would include Proposed Lots 3 through 6, 8 through 11, and a small portion on the eastern border of the Remainder Parcel (see Figure 2).

Implementation of the recommended measures presented in Section 3.2 would satisfy compliance with Mitigation Measures 5-5 and 5-6 of the San Bernardino Countywide Plan Mitigation Monitoring and Reporting Program (County of San Bernardino, 2020).

1 Introduction

South Environmental was retained to complete a paleontological resources assessment for the Pipes Canyon Project (project), located near the unincorporated community of Pioneertown in San Bernardino County, California. The purpose of this assessment is to describe the results of a paleontological resources literature review and records search, summarize the paleontological sensitivity of the geologic units within the project site, assess the potential for the project to impact scientifically significant paleontological resources, and provide management recommendations for avoiding or reducing project-related impacts to paleontological resources.

This report was prepared in conformance with the California Environmental Quality Act (CEQA) and all applicable San Bernardino County ordinances by South Environmental Principal Paleontologist Justin Strauss, MS (resume provided in Appendix D).

1.1 Project Location

The project site is located on the north and south sides of Pipes Canyon Road at its northern apex, approximately halfway between Pioneertown Road and State Route 247 (Old Woman Springs Road) north of the unincorporated community of Pioneertown in San Bernardino County, California. More broadly, the site is within the Morongo Basin region of the Mojave Desert. The project site is divided into a northern section and southern section by Pipes Canyon Road and bordered by Cielito Trail/ Rocky Road to the south, Millstream Avenue to the west, and Coyote Road to the east, as well as unmarked open borders. The project site is currently undeveloped with an unmarked road that cuts through the southern section and connects Pipes Canyon Road to Rocky Road. The surrounding area is also relatively undeveloped with a few residential developments and dirt roads throughout.

The project site comprises the following Assessor's Parcel Number: 0594-351-36. The project site is located on the United States Geological Survey (USGS) *Rimrock*, *California* and *Yucca Valley*, *California* 7.5-minute quadrangle maps in Section 06 of Township 01 North and Range 05 East, San Bernardino Base and Meridian (Figure 1).

1.2 Project Description

The project site is currently undeveloped desert. The project proposes to subdivide the 122.98 acres property into 13 individual lots, 12 of which would be divided into development lots with a minimum five-acre lot size, grouped on the western half of the project site. The 61.36-acre Remainder Parcel will remain undeveloped and dedicated for resource conservation.

Figure 1. Project Location Map

1.3 Regulatory Setting

Paleontological resources are generally considered non-renewable scientific resources because they cannot be replaced once damaged or destroyed, and considerable scientific information can be lost should they be disturbed or displaced from their original location and geologic context without a proper record of their original placement and arrangement in their natural sediments. For this reason, fossils are typically protected under a variety of federal, state, and local laws and regulations to ensure that these basic scientific considerations are made and carried out whenever paleontological resources are going to be disturbed. The pertinent laws and regulations governing paleontological resources are discussed in this section.

1.3.1 State

California Environmental Quality Act (CEQA)

CEQA requires that public agencies and private interests identify the potential environmental impacts of their projects on any object or site of significance to the scientific annals of California (Division I, California Public Resources Code [PRC] Section 5020.1 [j]). Appendix G in California Code of Regulations (CCR) Section 15023 provides an Environmental Checklist (Section 15023, Appendix G, Section XIV, Part A) that includes the following: "Would the project directly or indirectly destroy a unique paleontological resource or site or unique geological feature?"

California Public Resources Code (PRC)

Section 5097.5 of the PRC states:

> No person shall knowingly and willfully excavate upon, or remove, destroy, injure, or deface any historic or prehistoric ruins, burial grounds, archaeological or vertebrate paleontological site, including fossilized footprints, inscriptions made by human agency, or any other archaeological, paleontological, or historical feature, situated on public lands, except with the express permission of the public agency having jurisdiction over such lands. Violation of this section is a misdemeanor. As used in this PRC section, 'public lands' means lands owned by, or under the jurisdiction of, the state or any city, county, district, authority, or public corporation, or any agency thereof.

Therefore, public agencies are required to comply with PRC Section 5097.5 for their activities including construction and maintenance as well as for permit actions (e.g., encroachment permits) undertaken by others.

1.3.2 Local

San Bernardino County General Plan

San Bernardino County has created a Countywide Plan which includes the County Policy Plan that updates and expands the County's General Plan (San Bernardino County, 2022). The County Policy Plan includes a section titled "Cultural Resources Element" (CRE) that establishes policies and guidelines for the protection of archaeological and paleontological resources that meet the requirements of CEQA. Specifically, Goal CR-2 Historic and Paleontological Resources within the CRE includes:

> **Policy CR-2.3 Paleontological and archaeological resources.** We strive to protect paleontological and archaeological resources from loss or destruction by requiring that new development includes appropriate mitigation to preserve the quality and integrity of these resources. We require new development to avoid paleontological and archaeological resources whenever possible. If avoidance is not possible, we require the salvage and preservation of paleontological and archeological resources.

Additionally, San Bernardino County has prepared a Mitigation Monitoring and Reporting Program (PlaceWorks, 2020) to detail the exact steps that should be taken by new developments to ensure that the impacts to paleontological resources in the County are kept at non-significant levels. Within this document is included Mitigation Measure (MM) 5.5 Cultural Resources, which includes the following:

> **MM 5-5** - In areas of documented or inferred paleontological resource presence, development projects proposed on previously undisturbed soils shall require consultation with a qualified paleontologist meeting the standards of SVP (2010). The initial consultation may be provided by a qualified paleontologist on staff at the County Museum. The qualified paleontologist will determine the degree of paleontological resource sensitivity, as outlined below, and will recommend a project-specific paleontological resources monitoring and mitigation plan (PRMMP). This plan will address specifics of monitoring and mitigation for the development project, and will take into account updated geologic mapping, geotechnical data, updated paleontological records searches, and any changes to the regulatory framework. This PRMMP should usually meet the standards of the SVP (2010), unless the project is on BLM land or subject to federal jurisdiction, in which case the BLM standards Paleontological Resource Definitions (2009) should be used. The following provisions would be typical for units mapped with the different levels of paleontological sensitivity:
>
> - High (SVP)/Class 4–5 (BLM)—All projects involving ground disturbances in previously undisturbed areas sediments mapped as having high paleontological sensitivity will be monitored by a qualified paleontological monitor (BLM, 2009; SVP, 2010) on a full-time basis under the supervision of

the Qualified Paleontologist. Undisturbed sediments may be present at the surface, or present in the subsurface, beneath earlier developments. This monitoring will include inspection of exposed sedimentary units during active excavations within sensitive geologic sediments. The monitor will have authority to temporarily divert activity away from exposed fossils to evaluate the significance of the find and, should the fossils be determined to be significant, professionally and efficiently recover the fossil specimens and collect associated data. Paleontological monitors will use field data forms to record pertinent location and geologic data, will measure stratigraphic sections (if applicable), and collect appropriate sediment samples from any fossil localities.

- Low to High (SVP)/Class 2 to Class 4–5 (BLM)—All projects involving ground disturbance in previously undisturbed areas mapped with low-to-high paleontological sensitivity will only require monitoring if construction activity will exceed the depth of the low sensitivity surficial sediments. The underlying sediments may have high paleontological sensitivity, and therefore work in those units might require paleontological monitoring, as designated by the Qualified Paleontologist in the PRMMP. When determining the depth at which the transition to high sensitivity occurs and monitoring becomes necessary, the Qualified Paleontologist should take into account: a) the most recent local geologic mapping, b) depths at which fossils have been found in the vicinity of the project area, as revealed by the museum records search, and c) geotechnical studies of the project area, if available.

- Low (SVP)/Class 2–3 (BLM)—All projects involving ground disturbance in previously undisturbed areas mapped as having low paleontological sensitivity should incorporate worker training to make construction workers aware that while paleontological sensitivity is low, fossils might still be encountered. The Qualified Paleontologist should oversee this training as well as remain on-call in the event fossils are found. Paleontological monitoring is usually not required for sediments with low (Low / Class 2-–3) paleontological sensitivity.

- None (SVP)/Class 1 (BLM)—Projects determined by the Qualified Paleontologist to involve ground-disturbing activities in areas mapped as having no paleontological sensitivity (i.e., plutonic igneous or high-grade metamorphic rocks) will not require further paleontological mitigation measures.

- Unknown (SVP)/Class U (BLM): All projects involving ground disturbance in previously undisturbed areas mapped as having unknown paleontological sensitivity should retain a Qualified Paleontologist to conduct a field survey of

the proposed Project area to determine the sensitivity of the geologic units, after which the relevant mitigation measures can be applied.

MM 5-6 - In the event of any fossil discovery, regardless of depth or geologic formation, construction work will halt within a 50-ft. radius of the find until its significance can be determined by a Qualified Paleontologist. Significant fossils will be recovered, prepared to the point of curation, identified by qualified experts, listed in a database to facilitate analysis, and deposited in a designated paleontological curation facility in accordance with the standards of the SVP (2010) and BLM (2009). A repository will be identified and a curatorial arrangement will be signed prior to collection of the fossils. Although the San Bernardino County Museum is specified as the repository for fossils found in the county in the current General Plan (San Bernardino County, 2007), the museum may not always be available as a repository. Therefore, any accredited institution may serve as a repository.

Finally, San Bernardino County has prepared a Final Program Environmental Impact Report (FPEIR) to examine the potential impacts on the environment of the County's General Plan Program (URS Corporation, 2007). *Chapter IV. Project Analysis, Section E. Cultural and Paleontological Resources* of the FPEIR provides mitigation measures required to mitigate impacts to paleontological resources in the county by future developments to less-than-significant levels. They are as follows:

Mitigation CR-9 – In areas of potential but unknown sensitivity, field surveys prior to grading shall be required to establish the need for paleontological monitoring.

Mitigation CR-10 - Projects requiring grading plans that are located in areas of known fossil occurrences or demonstrated in a field survey to have fossils present, shall have all rough grading (cuts greater than three feet) monitored by trained palaeontologic crews working under the direction of a qualified professional, in order that fossils exposed during grading can be recovered and preserved. Fossils include large and small vertebrate fossils; the latter recovered by screen washing of bulk samples.

Mitigation CR-11 - All recovered specimens shall be prepared to the point of identification and adequately curated into retrievable collections of the San Bernardino County Museum for their scientific information potential to be preserved.

Mitigation CR-12 - A report of findings with an itemized accession inventory shall be prepared as evidence that monitoring has been successfully completed. A preliminary report shall be submitted and approved prior to granting of building permits, and a final report shall be submitted and approved prior to granting of occupancy permits. The adequacy of paleontologic reports shall be determined in consultation with the Curator of Earth Science, San Bernardino County Museum.

> **Mitigation CR-18** - Within the County's Development Code, two overlay districts have been established relating specifically to preserving cultural resources within the County. These areas are designated Cultural Resources Preservation "CP" Overlay District and Paleontological Resources "PR" Overlay District. The intent of the "CP" District is to identify and preserve important archeological and historic resources. The intent of the "PR District is to identify and preserve significant paleontological resources since they are unique and non-renewable, thus promoting County identity and conserving scientific amenities for the benefit of future generations.

SVP Paleontological Resource Significance Determination

Toward the goal of providing guidance to federal, state, and local agencies in carrying out environmental assessments, the Society of Vertebrate Paleontology (SVP) has created a set of definitions to determine the significance of paleontological resources. Significant paleontological resources are defined as follows:

> Fossils and fossiliferous deposits consisting of identifiable vertebrate fossils, large or small, uncommon invertebrate, plant, and trace fossils, and other data that provide taphonomic, taxonomic, phylogenetic, paleoecologic, stratigraphic, and/or biochronologic information. Paleontological resources are considered to be older than recorded human history and/or older than middle Holocene (i.e., older than about 5,000 radiocarbon years). (SVP, 2010)

By this definition, significant paleontological resources are fossils (or fossil assemblages) that are unique, unusual, rare, diagnostically important, or even common with the potential to provide additional scientific information about evolutionary patterns or the paleoenvironmental conditions of a site. This includes fossils that may enhance our understanding of depositional histories, evolutionary trends and patterns within lineages, information regarding palaeoecological environments, that can be used to identify the sedimentary rock units they are within, or fossils that are unique to a particular geologic region. For this reason, even common or unidentifiable invertebrate and vertebrate fossil remains may be considered scientifically significant, particularly within the larger context of a geologic area from which many specimens have previously been collected and examined.

Because CEQA does not define a "unique paleontological resource or site", the definitions set forth by SVP are used for all paleontological projects that are subject to CEQA.

For additional information relating to the determination of the potential significance of paleontological resources based on SVP guidelines, please see Appendix A: Paleontological Resource Potential Classifications. These definitions have been used to determine the potential paleontological sensitivity of the project site.

2 Paleontological Sensitivity Determination Methods

To assess the paleontological sensitivity of the project site and determine its placement within the definitions provided by the SVP, and several sources of recorded data were examined:

1) Published geologic maps of the project site and surrounding vicinity.
2) A collections record search was performed by the Natural History Museum of Los Angeles County (NHLMA) and the San Bernardino County Museum (SBCM) to identify previously collected localities within one mile of the project site.
3) Searches of the following on-line databases were performed to determine additional fossil sites recorded within one mile of the project site and within similar rocks in the vicinity:
    a. The Paleobiology Database
    b. iDigBio
    c. University of California Museum of Paleontology (UCMP) Collections
    d. Additional published and unpublished paleontological literature pertaining to the project site and the surrounding vicinity.

2.1.1 Geologic Context

Geologic Setting

The project site sits within the Transverse Ranges Geomorphic Province. The Transverse Ranges are of particular interest because they consist of a series of east-west trending mountain ranges and valleys, which is distinctly different from the typical northwest-southeast trend seen throughout the mountain ranges of coastal California. The Transverse Ranges include the San Bernardino, San Gabriel, Santa Monica, and Santa Ynez Mountains, as well as the northern Channel Islands. The unusual positioning of these mountain ranges is the result of tectonic episodes related to the San Andreas fault system and the movements of the Pacific Plate. Currently, the Transverse Ranges are effectively being squeezed by north-south crustal shortening, which is causing a rapid rise of the mountain ranges in the area that began in mid-Pleistocene time (2 to 3 million years ago). The rocks found in the Transverse Ranges consist of a range of types and ages, including Precambrian and Mesozoic igneous and metamorphic rocks, particularly in the San Gabriel and San Bernardino Mountains. The western portion of the province contains younger sedimentary rocks and volcanics (Neogene-Paleogene in age), while the southern and western portions exhibit large surficial deposits of Quaternary-age sedimentary rocks (California Geological Survey, 2002; Hill, 1990; Onderdonk et al., 2022; Spotila et al., 2002).

Site Specific Geology and Paleontology

The geology of the project site is mapped as containing Pleistocene-age alluvial deposits (Qoa / Qc) and Mesozoic (Cretaceous or Jurassic) granitic rocks consisting primarily of white to gray biotite quartz monzonite (KJqm / Qm / Gra) (Bortugno and Spittler, 1986; Dibblee and Minch, 2008a/b; Jenkins, 1967) (Figure 2). Younger, Holocene-age alluvium (Q) is also noted in the area to a lesser degree (Bortugno and Spittler, 1986). While it is almost certain that the Mesozoic granitic rocks or Holocene-age alluvial deposits do not contain fossils, the Pleistocene-age alluvial deposits found in the area have been known to contain paleontologically significant ice-age fossils elsewhere, including bison, horse, camel, mammoth, giant ground sloth, saber-toothed cat and dire wolves (Harris, 2014; Scott and Cox 2008; Springer et al., 2009, 2010; Scott, 2010).

Summary of Geologic Units at the Project Site and their Paleontological Sensitivity

Geologic Units	Map Abbr.[1]	Age	Fossils[2]	Sensitivity
Older alluvium	Qoa / Qc	Pleistocene	Foraminifera (Orders: Lagenida, Lituolida, Miliolida, Rotaliida), Bison (*Bison*), Camel (*Camelops, Tanupolama*), Horse (*Equus*), Tortoises, Lizards, Rodents	High
Alluvium	Q	Holocene	None	Low
Granitic rocks	KJqm / Qm / Gra	Mesozoic	None	None

[1]Bortugno and Spittler, 1986; Dibblee and Minch, 2008a/b; Jenkins, 1967
[2]iDigBio, 2024; PBDB, 2024; Bell, 2024; Kottkamp, 2025; UCMP, 2024

Records Search Results

The Natural History Museum of Los Angeles County (NHMLA) and the San Bernardino County Museum (SBCM) conducted searches of their paleontological records (Bell, 2024; Kottkamp 2025) for all fossil localities recorded within one mile of the project site. The NHMLA found no previously recorded localities in the project site but found five scientifically significant fossil localities within one mile (Appendix B). The SBCM found no previously recorded fossil localities in the project site but found four scientifically significant fossil localities 2.5 miles southwest of the project site (Appendix C). South Environmental also performed a records search of the online paleontological records databases Paleobiology Database (PBDB) and iDigBio Online Database (iDigBio) for all fossil localities recorded within one mile of the project site, finding none in the PBDB, and one in iDigBio. Finally, the University of California Museum of Paleontology (UCMP) database was searched for all localities recorded within the county in the same geologic units as those found in the project site, returning twelve localities. The results of the records searches and online database searches are summarized below:

Source*	Localities	Age/Formation	Taxa	Depth	Distance
NHMLA[1]	LACM VP 3350	Pleistocene / Unknown	Bison (*Bison*), Camel (*Camelops*, *Tanupolama*), Horse (*Equus*)	Surface	1-mile
	LACM VP 4281 – 4283	Pleistocene / Unknown	Horse (*Equus*)	Surface	1-mile
	LACM VP 1269	Pleistocene / Unknown	Horse (*Equus*)	Unknown	1-mile
SBCM[2]	SBCM 1.94.6 SBCM 1.94.7 SBCM 1.94.8 SBCM 1.94.9	Miocene? (uncertain, potentially Pleistocene)	Rodent fossils	Unknown	2.5-miles southwest
PBDB	None	-	-	-	-
iDigBio	1	Miocene / Vaqueors Ss.	Foraminifera (Orders: Lagenida, Lituolida, Miliolida, Rotaliida)	Not recorded	1-mile
UCMP	12	Pleistocene	6 Vertebrate, 5 Invertebrate, 1 Plant (specific identifications not listed)	Not recorded	Unknown

*NHMLA=Natural History Museum of Los Angeles County; SBCM=San Bernardino County Museum; UCMP = University of California Museum of Paleontology Collections Online Database; PBDB = Paleobiology Online Database; iDigBio = iDigBio Online Database
[1]Bell, 2024; [2]Kottkamp, 2025

Figure 2. Project Geology Map

3 Findings and Recommendations

3.1 Findings

The project site contains two major geologic formations within it, Mesozoic-age granitic rocks (KJqm / Qm / Gra) and Pleistocene-age alluvial deposits (Qoa / Qc) (Bortugno and Spittler, 1986; Dibblee and Minch, 2008a/b; Jenkins, 1967).

The Mesozoic-age granitic rocks are igneous in origin and therefore have No Potential to contain paleontological resources. No paleontological resources mitigation measures are recommended for construction activities taking place in these areas, which include Proposed Lots 1, 2, 7 and 12, and most of the Remainder Parcel (see Figure 2).

The Pleistocene-age alluvial deposits in the area have a High Potential to contain paleontological resources, and thus full-time paleontological monitoring is recommended for all ground-disturbing construction activities taking place in these areas. This includes Proposed Lots 3 through 6, 8 through 11, and a small portion on the eastern border of the Remainder Parcel (see Figure 2). Although no scientifically significant fossils have been found in the project site previously, scientifically significant fossils have been found within one mile of the project site in these deposits, therefore they are considered to be of High Potential based on the records searches and literature review performed by the NHMLA (Bell, 2024), SBCM (Kottkamp, 2025), and South Environmental.

3.2 Recommendations

Because the project site contains geologic units that are of High Potential for yielding scientifically significant fossils, it is recommended that a Qualified Paleontologist be retained to monitor all ground disturbing activities of the project site within Proposed Lots 3 through 6, 8 through 11, and the small portion of the Remainder Parcel containing Pleistocene-age alluvial deposits along the eastern border of the project site (the area mapped as Qc) (see Figure 2). Understanding that the current project is a paper lot split; these recommendations should be applied to any ground disturbance associated with the future development of these lots/parcels. The following sections (Sections 3.2.1 to 3.2.6) provide specific recommendations to conduct paleontological monitoring in accordance with the San Bernardino County General Plan and CEQA. Implementation of the recommendations below would satisfy compliance with Mitigation Measures 5-5 and 5-6 of the San Bernardino Countywide Plan Mitigation Monitoring and Reporting Program (County of San Bernardino, 2020).

3.2.1 Paleontological Mitigation Plan

In accordance with the San Bernardino County General Plan Mitigation Monitoring and Reporting Program Mitigation Measure 5-5, a site proposed for development that has documented or inferred paleontological sensitivity requires that a paleontological resource monitoring and paleontological

resources monitoring and mitigation plan (PRMMP) be prepared prior to site grading (PlaceWorks, 2020). The PRMMP shall specify the steps to be taken to mitigate impacts to paleontological resources. The PRMMP shall state the requirement for pre-construction training and describe the methods for paleontological monitoring, fossil discovery protocol, fossil preparation and curation, and reporting requirements.

3.2.2 Pre-Construction Personnel Training

Prior to the beginning of any ground disturbing activities, the Qualified Paleontologist shall conduct a Paleontological Awareness Training Program for all personnel. The program should include descriptions of potential fossil resources that may be encountered in the project site during earth-moving activities, a discussion of the pertinent laws and regulations relating to said paleontological resources in the area, and a review of the steps that should be taken if a fossil discovery is made. The program shall be developed by the Qualified Paleontologist and delivered simultaneously with trainings on cultural and biological resources (if applicable), safety reviews and other matters of concern.

3.2.3 Paleontological Monitoring

Due to the high potential for the discovery of scientifically significant fossil materials during ground disturbance activities in areas mapped as Pleistocene-age alluvial deposits, full-time paleontological resource monitoring should be performed by a paleontological monitor in these areas (Proposed Lots 3 through 6, 8 through 11, and a small portion on the eastern border of the Remainder Parcel) under the direction of a Qualified Paleontologist during said activities. Monitoring should involve the visual inspection of all earth-moving activities, graded areas, trench sidewalls, and spoils piles. If the project paleontologist determines that full-time monitoring is no longer required based on the geologic conditions of the site, the paleontologist may recommend that monitoring be reduced or stopped entirely.

Paleontological monitors should prepare daily logs describing the activities of the construction crew, the types of excavation work being done, the equipment being used, recordings of the geology observed during these activities, and records of any fossil discoveries made, whether they be determined to be significant or not. Paleontological monitors should also attempt to record the stratigraphy of the rock that is exposed by construction activities, whether or not fossils were discovered within the exposed sediments.

3.2.4 Fossil Discoveries

Should fossil materials be discovered, either by the paleontological monitor or the construction field crew, the paleontological monitor shall have the authority to temporarily halt or divert construction activities and equipment within a 50-foot radius of the site to further assess the discovery. Should the fossils be determined to be of scientific significance, they should be collected as soon as possible.

Standard field procedures should be used in the collection of the fossils to ensure that no scientific data is lost in the recovery process. Fossil specimens discovered during construction can typically be collected by a single qualified paleontologist within a single day, usually in less than one hour. Occasionally, more extensive efforts may be required to properly salvage a fossil specimen, particularly for larger skeletal elements, entire skeletons, or large collections of smaller fossil remains. Should this be the case, the paleontological monitor should have the authority to temporarily halt, divert, or redirect construction activities to ensure that the fossil can be salvaged in a safe and timely manner. The paleontological monitor should work directly with the field crew to clearly communicate their intentions and determine the best way to safely protect and recover the fossils, with minimal disruption to construction efforts.

3.2.5 Fossil Preparation and Curation

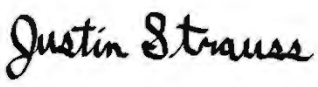
An accredited repository (typically the SBCM) should be identified for the long-term storage and care of any fossil specimens discovered during paleontological monitoring. Upon completion of the project, collected fossil specimens should be prepared to the standards required by the repository that has agreed to take them and delivered as soon as is feasible upon completion of the preparatory work. Preparatory work should include the removal of excess sedimentary matrix, as well as any steps necessary for the repair and stabilization of the specimens. The specimens should be identified to the lowest taxonomic level possible, and copies of all field notes and information related to the fossil should be kept and provided to the repository as well upon delivery of the specimen. The cost of curation will be determined by the repository, and the costs of preparation and curation will be the responsibility of the client.

3.2.6 Final Paleontological Mitigation Report

Upon completion of paleontological monitoring, the Qualified Paleontologist shall prepare a final monitoring and mitigation report to be submitted to all interested parties. This report should detail the monitoring activities and methods used during construction, a description of the construction activities that took place, stratigraphic sections created during monitoring, a review of any fossils discovered (whether or not they were deemed significant and collected), a detailed description of the fossils that were collected including their scientific significance, and information relating to the repository where the fossils will be curated.

4 Certification

I hereby certify that the statements furnished above and in the attached exhibits present the data and information required for this archaeological report, and that the facts, statements, and information presented are true and correct to the best of my knowledge and belief

Signed:  Date: January 27, 2025

Justin J. Strauss, MS
Paleontological Principal Investigator

5 References

Bell, A., 2024. Paleontological Resources Records Search for the Pipes Canyon Project (24-312) letter. Natural History Museum of Los Angeles County, Los Angeles, California. On file at South Environmental, Pasadena, California.

Bortungo, E.J. and T.E. Spittler, 1986. Geologic Map of the San Bernardino Quadrangle, California. Department of Conservation Division of Mines and Geology, California. Regional Geologic Map RGM-3A, scale 1:250,000.

California Geological Survey, 2002. CGS Note 36: California Geomorphic Provinces, Electronic document, https://www.conservation.ca.gov/cgs/documents/publications/cgs-notes/CGS-Note-36.pdf (accessed January 2025).

County of San Bernardino, 2020. San Bernardino Countywide Plan for County of San Bernardino Mitigation Monitoring and Reporting Program. https://countywideplan.sbcounty.gov/wp-content/uploads/sites/125/2021/01/MMRP_Final_Web.pdf (accessed February 2026).

Dibblee, T.W. and J.A. Minch, 2008a. Geologic map of the Joshua Tree & Twentynine Palms 15 minute quadrangles, Riverside & San Bernardino Counties, California. Dibblee Geological Foundation. Dibblee Foundation Map DF-390, scale 1:62,500. https://ngmdb.usgs.gov/Prodesc/proddesc_85245.htm (accessed January 2025).

Dibblee, T.W. and J.A. Minch, 2008b. Geologic map of the San Gorgonio Mountain & Morongo Valley 15 minute quadrangles, San Bernardino & Riverside Counties, California. Dibblee Geological Foundation. Dibblee Foundation Map DF-381, scale 1:62,500. https://ngmdb.usgs.gov/Prodesc/proddesc_84181.htm (accessed January 2025).

Harris, A. 2014. Pleistocene Vertebrates of Southwestern USA and Northwestern Mexico. TEP Biodiversity Collections, Department of Biological Sciences, and Centennial Museum, University of Texas at El Paso. El Paso, Texas. 10.13140/2.1.3490.7527. www.utep.edu/leb/pleistnm/ (accessed January 2025).

Hill, M.L., 1990. Transverse Ranges and neotectonics of southern California. Geology 18 (1): 23–25, https://doi.org/10.1130/0091-7613(1990)018<0023:TRANOS>2.3.CO;2 (accessed January 2025).

iDigBio, 2024, iDigBio: Integrated Digitized Biocollections: iDigBio Specimen Portal, http://portal.idigbio.org/portal (accessed December 2024).

Jenkins, O.P., 1967. Geologic Map of California San Bernardino Sheet. California Department of Conservation Division of Mines and Geology, California. Geologic Atlas of California, GAM 14, scale 1:250,000.

Kottkamp, S., 2025. Paleontological Records Review for proposed site of 24-312 Pipes Canyon Project, near Pioneertown, San Bernardino County, California. San Bernardino County Museum, San Bernardino, California. On file at South Environmental, Pasadena, California.

Norris, R.M., and R.W. Webb. 1990. *Geology of California*. Wiley and Sons, New York.

Onderdonk, N., A.F. Garcia, C. Kelty, A. Farris and E. Tyler, 2022. Topographic development of a compressional mountain range, the western Transverse Ranges of California, USA, resulted from localized uplift along individual structures and regional uplift from deeper shortening. *Geosphere* 18 (6): 1804–1830, https://doi.org/10.1130/GES02505.1 (accessed January 2025).

Paleobiology Database [PBDB], 2024, The Paleobiology Database: About the PBDB, https://paleobiodb.org/#/ (accessed December 2024).

PlaceWorks, 2020. Mitigation Monitoring and Reporting Program for the San Bernardino Countywide Plan, County of San Bernardino, California, State Clearinghouse No. 2017101033, https://www.sbcounty.gov/Uploads/LUS/Environmental/CWP_FEIR/MMRP_Final_Web.pdf (accessed December 2024).

Rogers, T.H., 1967. Geologic Map of California: San Bernardino Sheet. Department of Conservation Division of Mines and Geology, California. Geologic Atlas of California GAM-14, scale 1:250,000.

San Bernardino County, 2022. County Policy Plan. San Bernardino County, California, https://countywideplan.sbcounty.gov (accessed December 2024).

Scott, E., 2010. Extinctions, scenarios, and assumptions: changes in latest Pleistocene large herbivore abundance and distribution in western North America. In E. Scott and G. McDonald (eds.), *Faunal dynamics and extinction in the Quaternary: Papers honoring Ernest L. Lundelius, Jr.* Quaternary International 217: 225-239.

Scott, E. and S.M. Cox, 2008. Late Pleistocene distribution of Bison (Mammalia; Artiodactyla) in the Mojave Desert of southern California and Nevada. In X Wang and L.G. Barnes (eds.), *Geology and Vertebrate Paleontology of Western and Southern North America, Contributions in Honor of David P. Whistl*er. Natural History Museum of Los Angeles County Science Series No. 41, p. 359 - 382.

Society of Vertebrate Paleontology [SVP], 2010, Standard Procedures for the Assessment and Mitigation of Adverse Impacts to Paleontological Resources: Society of Vertebrate

Paleontology, Impact Mitigation Guidelines Revision Committee, https://vertpaleo.org/wp-content/uploads/2021/01/SVP_Impact_Mitigation_Guidelines-1.pdf (accessed August 2024).

Spotila, J. A., House, M. A., Blythe, A. E., Niemi, N. A., & Bank, G. C., 2002. Controls on the erosion and geomorphic evolution of the San Bernardino and San Gabriel Mountains, Southern California. *Contributions to crustal evolution of the Southwestern United States. Special Paper - Geological Society of America*, 365, 205-230.

Springer, K., E. Scott, J.C. Sagebiel, and L.K. Murray, 2009. The Diamond Valley Lake local fauna: late Pleistocene vertebrates from inland southern California. In L.B. Albright III (ed.), *Papers on geology, vertebrate paleontology, and biostratigraphy in honor of Michael O. Woodburne.* Museum of Northern Arizona Bulletin 65:217-235.

Springer, K., E. Scott, J.C. Sagebiel, and L.K. Murray, 2010. Late Pleistocene large mammal faunal dynamics from inland southern California: the Diamond Valley Lake local fauna. In E. Scott and G. McDonald (eds.), *Faunal dynamics and extinction in the Quaternary: papers honoring Ernest L. Lundelius, Jr.* Quaternary International 217: 256-265.

University of California Museum of Paleontology [UCMP], 2024, UCMP Specimen Search: University of California Museum of Paleontology, https://ucmpdb.berkeley.edu/ (accessed December 2024).

URS Corporation, 2007. Final Program Environmental Impact Report for the San Bernardino County 2007 General Plan Program, County of San Bernardino, California, State Clearing House No. 2005101038, https://www.sbcounty.gov/Uploads/lus/GeneralPlan/FinalEIR2007.pdf (accessed December 2024).

Appendix A:
Paleontological Resource Potential Classifications

Paleontological Resource Potential Classifications

When specific agency guidelines are not provided regarding the protection and preservation of paleontological resources, professional paleontologists in California will refer to the guidelines set forth by the Society of Vertebrate Paleontology (SVP) in order to determine the level of mitigation activities necessary for a particular project. These assessments are made by examining the geologic units in the area, known paleontological sites and localities recorded in the vicinity, and references made to the area by published literature. Based on the results of these analyses, the paleontological resource potential of the geology in the area can be classified into one of four categories: High Potential, Low Potential, Undetermined Potential, and No Potential.

Although these guidelines were created specifically for vertebrate fossil remains, they have generally been adopted for use in all fields of paleontology. The definitions for these categories are listed below:

High Potential

Rock units from which vertebrate or significant invertebrate, plant, or trace fossils have been recovered are considered to have a high potential for containing additional significant paleontological resources. Rocks units classified as having high potential for producing paleontological resources include, but are not limited to, sedimentary formations and some volcaniclastic formations (e. g., ashes or tephras), and some low-grade metamorphic rocks which contain significant paleontological resources anywhere within their geographical extent, and sedimentary rock units temporally or lithologically suitable for the preservation of fossils (e. g., middle Holocene and older, fine-grained fluvial sandstones, argillaceous and carbonate-rich paleosols, cross-bedded point bar sandstones, fine-grained marine sandstones, etc.). Paleontological potential consists of both (a) the potential for yielding abundant or significant vertebrate fossils or for yielding a few significant fossils, large or small, vertebrate, invertebrate, plant, or trace fossils and (b) the importance of recovered evidence for new and significant taxonomic, phylogenetic, paleoecologic, taphonomic, biochronologic, or stratigraphic data. Rock units which contain potentially datable organic remains older than late Holocene, including deposits associated with animal nests or middens, and rock units which may contain new vertebrate deposits, traces, or trackways are also classified as having high potential.

Low Potential

Reports in the paleontological literature or field surveys by a qualified professional paleontologist may allow determination that some rock units have low potential for yielding significant fossils. Such rock units will be poorly represented by fossil specimens in institutional collections, or based on general scientific consensus only preserve fossils in rare circumstances and the presence of fossils is the exception not the rule, e. g. basalt flows or Recent colluvium. Rock units with low potential typically will not require impact mitigation measures to protect fossils.

Undetermined Potential

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

No Potential

Some rock units have no potential to contain significant paleontological resources, for instance high-grade metamorphic rocks (such as gneisses and schists) and plutonic igneous rocks (such as granites and diorites). Rock units with no potential require no protection nor impact mitigation measures relative to paleontological resources.

Reference:

Society of Vertebrate Paleontology [SVP], 2010, Standard Procedures for the Assessment and Mitigation of Adverse Impacts to Paleontological Resources: Society of Vertebrate Paleontology, Impact Mitigation Guidelines Revision Committee, https://vertpaleo.org/wp-content/uploads/2021/01/SVP_Impact_Mitigation_Guidelines-1.pdf (accessed May 2024).

Appendix B:
Natural History Museum of Los Angeles County Records Search

Appendix C:
San Bernardino County Museum Records Search

Appendix D:
Preparer's Qualifications