APPENDIX M

Geology and Soils Evaluation

Geology and Soils Evaluation

Boulder Brush Facilities

San Diego County, California

Dudek

605 Third Street | Encinitas, California 92024

July 10, 2019 | Project No. 108619001





Geotechnical | Environmental | Construction Inspection & Testing | Forensic Engineering & Expert Witness

Geophysics | Engineering Geology | Laboratory Testing | Industrial Hygiene | Occupational Safety | Air Quality | GIS

Ninyo & Moore

Geotechnical & Environmental Sciences Consultants

July 10, 2019
Project No. 108619001

Mr. David Hochart
Dudek
605 Third Street
Encinitas, California 92024

Subject: Geology and Soils Evaluation
Boulder Brush Facilities
San Diego, California

Dear Mr. Hochart:

In accordance with your request, Ninyo & Moore has performed a Geology and Soils Evaluation for the Boulder Brush Facilities located in San Diego County, California. The attached report presents our methodology, findings, and recommendations regarding the geology and soils conditions at the project site.

We appreciate the opportunity to be of service to you on this important project.

Respectfully submitted,
NINYO & MOORE

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1 INTRODUCTION

In accordance with your request, Ninyo & Moore has completed a geology and soils evaluation for the proposed Boulder Brush Facilities (Project) in San Diego County, California (Figure 1). Our evaluation is based on a geologic reconnaissance, review of published and non-published reports, aerial photographs, in-house data, and the assessment of the potential geologic hazards in the Project area. The purpose of this geology and soils evaluation was to evaluate the potential for existing environmental impacts related to geologic or soils conditions to affect the project site and adjoining areas, and to discuss measures that can be implemented to reduce or mitigate the potential impacts with respect to the design and construction of the proposed project.

2 SCOPE OF SERVICES

Our scope of services included the following:

- Review of readily available regional, local, and site-specific geologic and geotechnical reports.
- Review of readily available background information including topographic, soils, mineral resources, geologic, and seismic and geologic hazard maps, and stereoscopic aerial photographs.
- Performance of a geologic reconnaissance of the site vicinity. Selected photographs taken during our geologic reconnaissance are included in Appendix A.
- Compilation and analysis of the data obtained from our background reviews and site reconnaissance.
- Preparation of this Geology and Soils Evaluation report presenting our findings, conclusions, and preliminary recommendations regarding the project.

3 SITE AND PROJECT DESCRIPTION

Based on the project description (Dudek, 2018), the land within the Boulder Brush Boundary (Project Site) contains approximately 2,246 acres in the McCain Valley area located north of the community of Boulevard in southeastern San Diego County (Figure 1). The irregularly-shaped Project Site is located north of Interstate 8 consists of 13 separate parcels which are privately owned and primarily comprised of undeveloped ranch land. The Boulder Brush Boundary is bordered by residential homes and ranches to the south and west and an existing wind project to the west, north and east. An existing 500-kV overhead transmission line also traverses the northern portion of the Boulder Brush Boundary. The Boulder Brush Facilities would be located in the In-Ko-Pah Mountains. The McCain Valley, Lark Canyon, and numerous small canyons and springs are present in the Project area. Elevations across the Project area range from approximately 3,280 to 4,120 feet above mean sea level (MSL).

Based on our understanding and review of the Project description (Dudek, 2019), the Boulder Brush Facilities would consist of the construction of an approximately 3.5 mile long transmission gen-tile line with support pole structures and pole structure access roads, a high-voltage substation, a 500-kV switchyard and a 30-foot wide paved access road linking the switchyard to an existing paved access road outside of the Boulder Brush Boundary..

4 GEOLOGIC AND SUBSURFACE CONDITIONS

The following sections present our findings relative to regional and site geology, geologic hazards (e.g., landslides or expansive soils), groundwater, faulting, and seismicity.

4.1 Regional Geologic Setting

The Boulder Brush Facilities would be situated in the coastal foothill section of the Peninsular Ranges Geomorphic Province. The province encompasses an area that extends approximately 900 miles from the Transverse Ranges and the Los Angeles Basin south to the southern tip of Baja California (Norris and Webb, 1990; Harden, 1998). The province varies in width from approximately 30 to 100 miles. In general, the province consists of rugged mountains underlain by Jurassic metavolcanic and metasedimentary rocks, and Cretaceous igneous rocks of the southern California batholith.

The Peninsular Ranges Province is traversed by a group of sub-parallel faults and fault zones trending roughly northwest (Jennings, 2010). Several of these faults are considered active. The Elsinore, San Jacinto, and San Andreas faults are active fault systems located northeast of the project area and the Rose Canyon, Coronado Bank, San Diego Trough, and San Clemente faults are active faults located west of the project site (Figure 3). Major tectonic activity associated with these and other faults within the regional tectonic framework consists primarily of right-lateral, strike-slip movement. Specifics of faulting are discussed in following sections of this report.

4.2 Project Site Geology

Based on our review of published geologic maps (Figure 4) and our Project Site reconnaissance, surficial soils within the Boulder Brush Boundary consist of fill, alluvium, and granitic rock in various states of weathering (Todd, 2004). A brief description of these units, as described in the cited literature or as observed on the Project Site, is presented below.

Fill soils were observed at the Project Site along the unpaved roads as well as in graded slopes. We anticipate these fills are relatively shallow and generally composed of locally derived, reworked decomposed granitic rock. Alluvium is anticipated in areas of drainages, creeks, and springs. Granitic rock at the site consists of the Tonalite of La Posta. Outcrops of resistant granitic corestones and boulders were observed scattered across the Project Site (Photographs1 through 4).

4.3 Faulting And Seismicity

The Project Site is not located within a State of California Earthquake Fault Zone (formerly known as Alquist-Priolo Special Studies Zone) (Hart and Bryant, 1997). However, it is located in a seismically active area, as is the majority of southern California, and the potential for strong ground motion in the Project areas is considered significant during the design life of the proposed improvements. The approximate locations of major faults in the region and their geographic relationship to the Project Site are shown on Figure 3.

Based on our document review, the active Coyote Mountain segment of the Elsinore Fault Zone is located approximately 9 miles northeast of the Project Site. Table 1 lists selected principal known active faults that may affect the Project Site and the maximum moment magnitude (M_{max}) as published by the United States Geological Survey (USGS, 2018a). The approximate fault-to-site distances were calculated using the USGS fault parameters web-based design tool (USGS, 2018b).

Table 1 – Principal Active Faults

Fault	Approximate Fault-to-Site Distance miles (kilometers)	Maximum Moment Magnitude (M_{max})
Elsinore (Coyote Mountain)	9.3 (15.0)	6.9
Elsinore (Julian Segment)	14.8 (23.8)	7.4
Earthquake Valley	23.8 (38.3)	6.8
Laguna Salada	23.9 (38.5)	7.3
San Jacinto (Borrego Segment)	25.7 (41.4)	6.8
San Jacinto (Superstition Mountain Segment)	27.0 (43.4)	6.7
Superstition Hills	30.6 (49.2)	6.8
Elmore Ranch	32.3 (52.0)	6.7
San Jacinto (Coyote Creek Segment)	32.4 (52.1)	7.0
San Jacinto (Clark Segment)	37.1 (59.7)	7.1
Imperial	44.9 (72.3)	7.0
Newport-Inglewood	50.7 (81.6)	7.5
Rose Canyon	50.7 (81.6)	6.9
San Jacinto (Anza Segment)	53.1 (85.5)	7.3
South San Andreas (Coachella Valley Segment)	53.7 (86.4)	7.0
Coronado Bank	57.5 (92.5)	7.4
Elsinore (Temecula Segment)	58.5 (94.1)	6.9

The principal seismic hazards at the Project Site are surface fault rupture and strong ground motion. Liquefaction is not a consideration for the Project due to the shallow depth of granitic rock at the site. A brief description of these hazards and the potential for their occurrences on site are discussed below.

4.3.1 Surface Ground Rupture

Based on our review of the referenced literature and our Project Site reconnaissance, no active faults are known to cross the Project Site. The active Coyote Mountain segment of the Elsinore Fault Zone is located approximately 9 miles northeast of the Project Site. Therefore, the probability of damage from surface ground rupture is considered to be low. However, lurching or cracking of the ground surface as a result of nearby seismic events is possible.

4.3.2 Ground Motion

The 2016 CBC specifies that the potential for liquefaction and soil strength loss be evaluated, where applicable, for the Maximum Considered Earthquake Geometric Mean (MCEG) peak ground acceleration with adjustment for site class effects in accordance with the American Society of Civil Engineers (ASCE) 7-10 Standard. The MCEG peak ground acceleration is based on the geometric mean peak ground acceleration with a 2 percent probability of exceedance in 50 years. The MCEG peak ground acceleration with adjustment for site class effects (PGAM) was calculated as 0.48g using the USGS (USGS, 2018a) seismic design tool that yielded a mapped MCE_G peak ground acceleration of 0.48g for the site and a site coefficient (F_{PGA}) of 1.000 for Site Class B.

4.4 Liquefaction and Seismically Induced Settlement

Liquefaction of cohesionless soils can be caused by strong vibratory motion due to earthquakes. Research and historical data indicate that loose granular soils and non-plastic silts that are saturated by a relatively shallow groundwater table are susceptible to liquefaction. Based on the dense nature of the subsurface materials, liquefaction is not anticipated be a design consideration.

4.5 Tsunamis and Seiches

Tsunamis are long wavelength seismic sea waves (long compared to the ocean depth) generated by sudden movements of the ocean bottom during submarine earthquakes, landslides, or volcanic activity. Based on the inland location and elevation of the Project, the potential for a tsunami to impact the Project Site is not a design consideration.

Seiches are oscillations of enclosed or partially enclosed bodies of water often generated by seismic activity. Based on the elevation of the Project Site and the absence of nearby bodies of water, the potential for seiches to impact the Project Site is considered low.

4.6 Landsliding and Slope Stability

Based on our review of published geologic literature, aerial photographs, and our Project Site reconnaissance, no landslides or related features are known to underlie or be adjacent to the Project Site. Therefore, the potential for landslides at the Project Site is considered low.

Global slope stability is not anticipated to be a design consideration at the Project due to the relatively competent nature of the subsurface materials. However, surficial stability and erosion may be design considerations in hilly portions of the Project area. Fill, alluvial soils, and decomposed granitic rock are anticipated to be erodible.

4.7 Expansive Soils

Expansive soils generally result from specific clay minerals that have the capacity to shrink or swell in response to changes in moisture content. Shrinking or swelling of foundation soils can lead to damage to slabs, foundations, and other engineered structures, including tilting and cracking. Based on our review of background materials and our geologic reconnaissance, soils in the Project area are anticipated to have a low potential for expansion.

4.8 Corrosive Soils

Caltrans corrosion criteria (2015) consider soils with more than 500 parts per million (ppm) chlorides, more than 0.2 percent sulfates, or a pH less than 5.5 to be corrosive. Site soils may be corrosive. Laboratory testing should be performed to evaluate the corrosivity of site soils, if warranted.

5 MITIGATION SUMMARY

Based on our geologic reconnaissance, geotechnical mitigation considerations for the Project include the following:

Near-surface fill and alluvial soils are generally compressible and considered unsuitable in their current condition for structural support. In general, excavation of the fill and alluvial material should be achievable with earthmoving equipment in good operating condition. While shallow excavation of granitic materials should also be achievable with earthmoving equipment in good operating condition, some areas underlain by less weathered rock and/or corestones may require heavy rock breaking.

6 LIMITATIONS

The field evaluation and geotechnical analyses presented in this report have been conducted in accordance with current engineering practice and the standard of care exercised by reputable geotechnical consultants performing similar tasks in this area. No warranty, implied or expressed, is made regarding the conclusions, recommendations, and professional opinions expressed in this report. Variations may exist and conditions not observed or described in this report may be encountered. Our preliminary conclusions and recommendations are based on an analysis of the observed conditions and the referenced background information.

The purpose of this study was to evaluate geologic and geotechnical conditions within the Project Site and to provide a preliminary geotechnical evaluation report to assist in the preparation of environmental impact documents for the Project. A comprehensive geotechnical evaluation, including subsurface exploration and laboratory testing, should be performed prior to design and construction of structural improvements.

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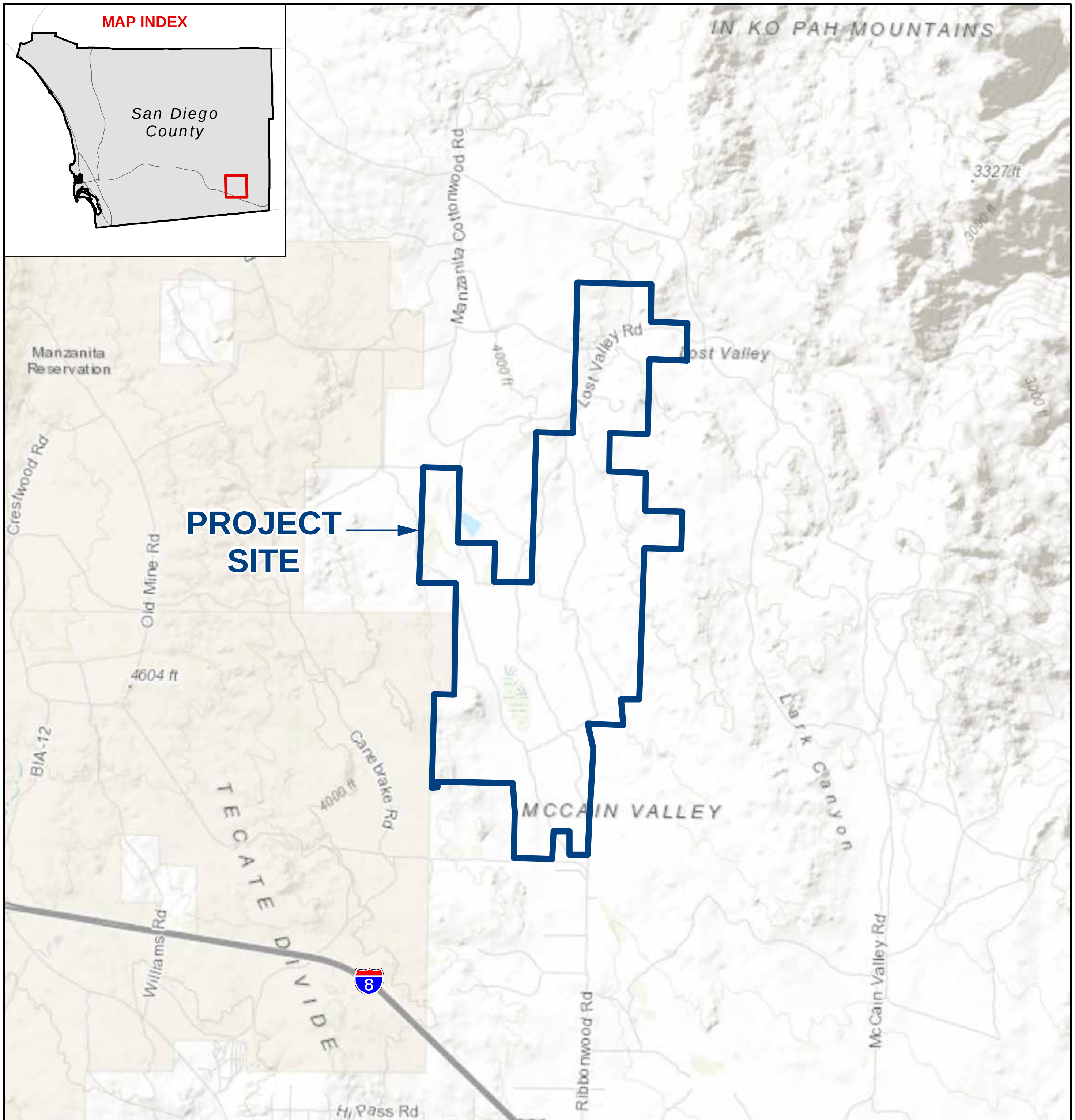
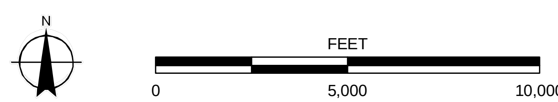
FIGURES





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NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE. | SOURCE: ESRI WORLD TOPO, 2017

FIGURE 1

PROJECT SITE LOCATION

BOULDER BRUSH FACILITIES
SAN DIEGO COUNTY, CALIFORNIA

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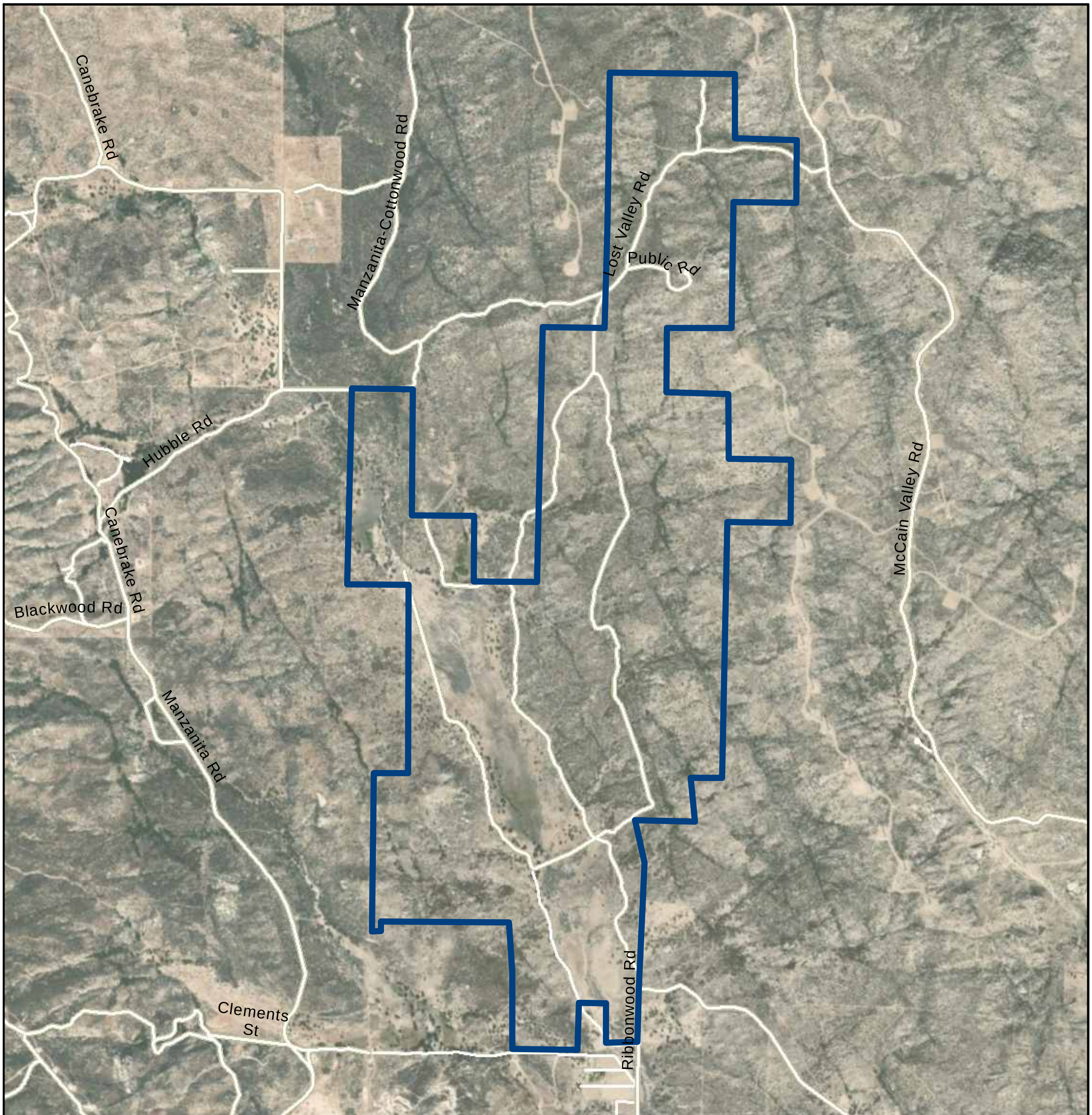

LEGEND

BOULDER BRUSH BOUNDARY

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE. | SOURCE: GOOGLE EARTH, 2017

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FIGURE 2

PROJECT AREA

BOULDER BRUSH FACILITIES
SAN DIEGO COUNTY, CALIFORNIA

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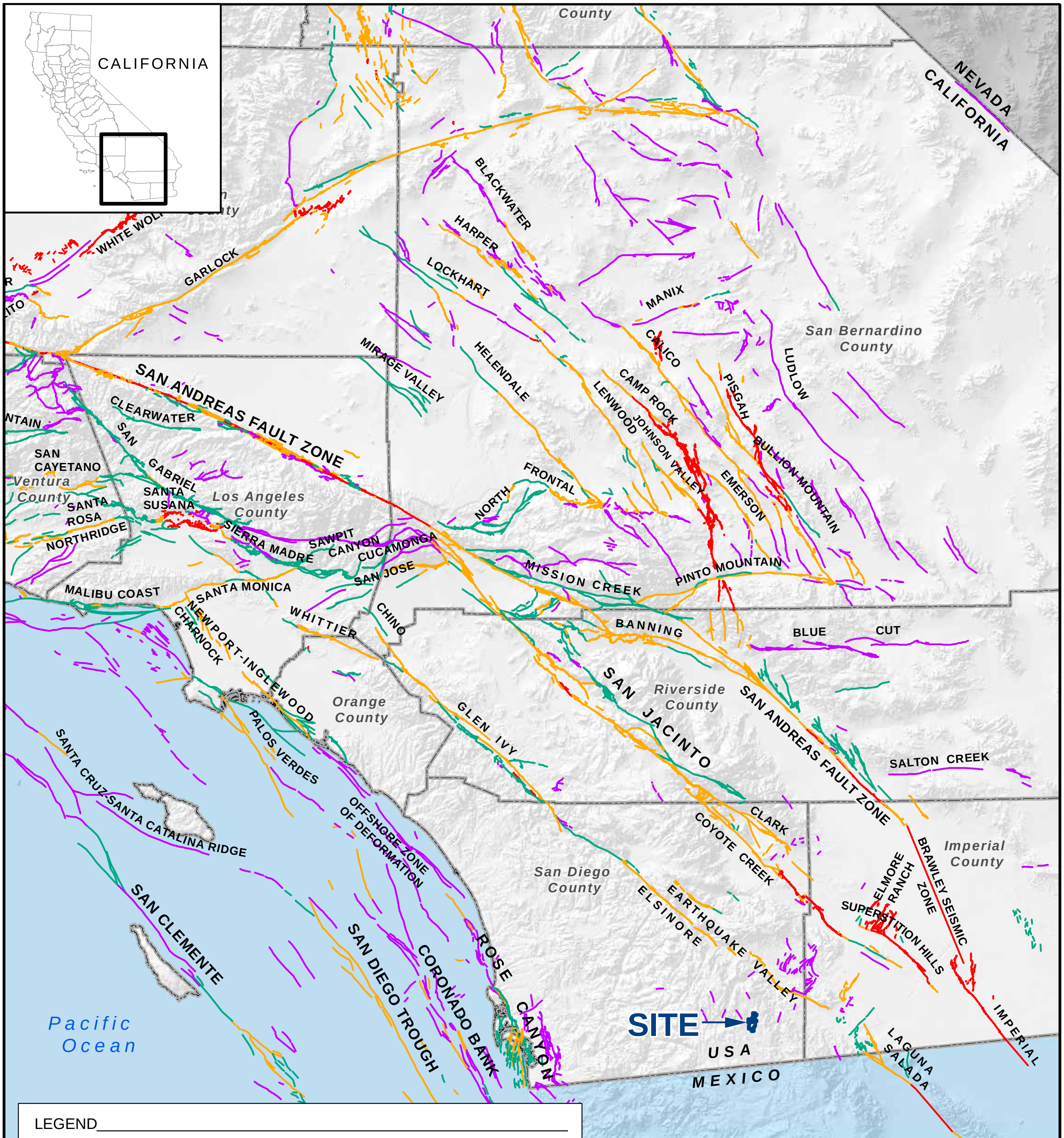

LEGEND

CALIFORNIA FAULT ACTIVITY

- HISTORICALLY ACTIVE
- HOLOCENE ACTIVE
- LATE QUATERNARY (POTENTIALLY ACTIVE)
- QUATERNARY (POTENTIALLY ACTIVE)
- STATE/COUNTY BOUNDARY

SOURCE: U.S. GEOLOGICAL SURVEY AND CALIFORNIA GEOLOGICAL SURVEY, 2006, QUATERNARY FAULT AND FOLD DATABASE FOR THE UNITED STATES.

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MILES

0 30 60

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

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FIGURE 3

FAULT LOCATIONS

BOULDER BRUSH FACILITIES
SAN DIEGO COUNTY, CALIFORNIA

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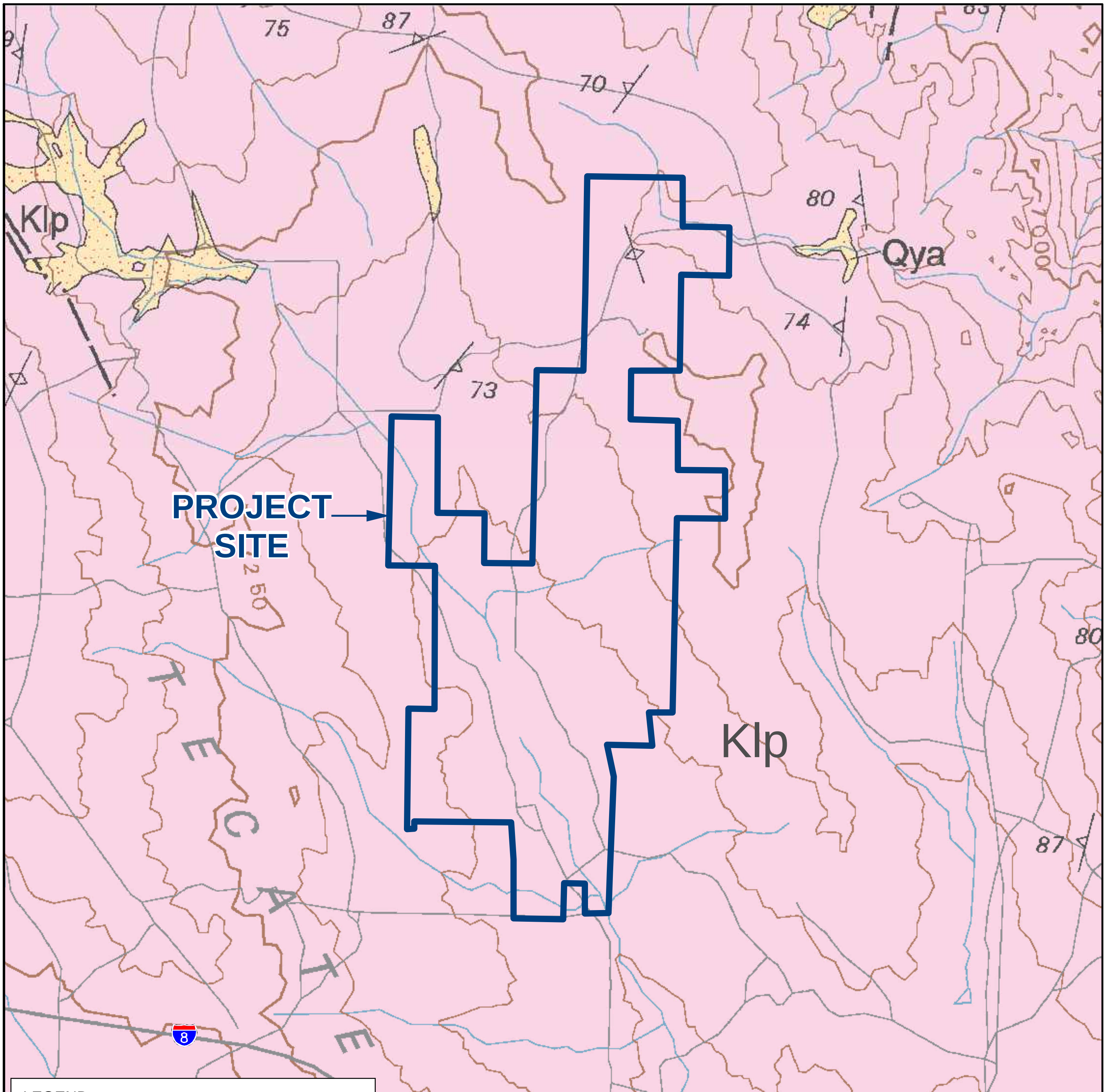

REFERENCE: TODD V.R., 2004, GEOLOGIC MAP OF THE EL CAJON 30 X 60-MINUTE QUADRANGLE, CALIFORNIA

LEGEND

- Qya — YOUNG ALLUVIUM
- Klp — TONALITE OF LA POSTA
- STRIKE AND DIP OF FOLIATION, PRIMARY IGNEOUS
  - 50 INCLINED
  - VERTICAL

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NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

FIGURE 4

GEOLOGY

BOULDER BRUSH FACILITIES
SAN DIEGO COUNTY, CALIFORNIA

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APPENDIX A

Photographs

Photograph 1: **Overall view of project area.**

Photograph 2: **McCain Valley looking south.**

FIGURE A-1

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PHOTOGRAPHS

BOULDER BRUSH FACILITIES
SAN DIEGO COUNTY, CALIFORNIA

Photograph 3: **Typical unpaved access roads through project area.**

Photograph 4: **Granitic rock outcrops on project site.**

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