Technical Memorandum – Geotechnical Site Assessment

Date:	**August 12, 2025**
From:	David Blankenhorn, P.G. Ben Pogue, AICP, PMP
RE:	**Heber 1 Parasitic Solar Project – Geotechnical Site Assessment** 604 Dogwood Road Heber, Imperial County, California

INTRODUCTION

This technical memorandum provides a summary of the geotechnical conditions associated with the Heber 1 Parasitic Solar site (Site) which is located at 604 Dogwood Road in Heber, Imperial County, California (Figure 1). The proposed project includes the following:

- A twenty (20) megawatt (MW) solar photovoltaic field dedicated to providing parasitic load to the existing Heber 1 geothermal plant approximately 10 feet tall.
- Medium voltage cable from solar facility to the Heber 1 geothermal plant. Three possible routes are proposed as alternatives from the solar facility to the geothermal plant.
- Demolition of a single-family home for solar development.

As provided in Table 1 below, the total project disturbance from the proposed development varies from 114.85 acres to 121.44 acres depending on the cable route/alternative. Figure 2 provides provide a site plan of the proposed facilities and brief descriptions of each facility are provided below.

Table 1 – Heber 1 Parasitic Solar Project Disturbance Estimate

Facility	***Disturbance (Acres)***
Parasitic Solar Field	106.19
Medium Voltage Cable	--
Route Option 1	11.03
Route Option 2	8.66
Route Option 3	15.25

Parasitic Solar Energy Facility

The 20 MW solar photovoltaic energy field would be developed to provide parasitic load to the existing Heber 1 Plant. These solar facilities are considered as behind-the-meter and would provide supplemental energy directly to the Heber 1 geothermal units (OEC), this energy would not enter the transmission grid. The solar facility would effectively allow for the more efficient generation of geothermal energy.

XMD Switch and Medium Voltage Cable

The energy generated by the solar facility may be collected at an on-site XMD switch and transmitted along a medium voltage cable. There are three route options proposed to connect the solar facility to the Heber 1 Plant **(Attachment A – Figures; Proposed Project).**

Route 1 – the medium voltage cable would exit the northeast corner of the solar site and travel north along an existing raised berm via monopoles. The cable would span the Central Main Canal and Willoughby Road and continue along Ware Road for approximately a third of a mile where it would meet an existing pipeline alignment that runs to the Heber 1 Plant. All road, canal, and rail crossings would be overhead via 30' monopoles or would go underground if feasible***.***

Route 2 – the medium voltage cable would exit the northeast corner of the solar site and travel north along an existing raised berm via monopoles. Before Willoughby Road, the cable would turn west for approximately 0.15 miles and then span Willoughby Road and the Central Main Canal to an existing geothermal well pad. The cable would run east along an existing pipeline alignment and then turn north along the same pipeline alignment along Ware Road for approximately a third of a mile where it would meet an existing pipeline alignment that runs to the Heber 1 Plant. All road, canal, and rail crossings would be overhead via 30' monopoles or would go underground if feasible.

Route 3 – the medium voltage cable would cross Dogwood Road and be attached via trays to the existing pipeline that runs west before turning north to cross the Beech Drain and Main Canal at the existing above-ground pipeline span. The cable would continue to follow the existing pipeline alignment to the Heber Geothermal Energy Complex and travel along the northern boundary to exit the HGEC's northeast corner. The cable would not connect to any HGEC energy facilities, simply pass through the site. The cable would then cross back over Dogwood Road and continue down an existing pipeline alignment to the Heber 1 Plant. All road, canal, and rail crossings would be overhead via 30' monopoles or would go underground if feasible.

Water Use and Source

Water required for facility construction activities, including grading and dust control, will be obtained from the applicant's existing contract with IID. Up to 5,000 gallons per day (gpd) of water will be required for the first 2-4 months of development of the facility. Approximately 2,000 gpd will be consumed during the remaining development schedule of approximately 12-18 months. Thus, approximately 1.1 million gallons of water (10.1 acre-feet) will be used on-site during construction. Once operating, up to approximately 325 gpd (0.36 acre-feet per year) of non-potable water will be required and provided by the applicant's existing IID contract/allocation.

The geotechnical information provided herein was gathered from the best publicly available online resources and extrapolated from the *Geotechnical Report Update* prepared by Landmark Consultants (Landmark, 2019). Landmark's report provides an update to previous geotechnical reports conducted at/near the Site (Landmark 2005, 2007) and reflects the adoption of the 2016 California Building Code (CBC) and Imperial County's geotechnical engineering standard of practice. In addition, desktop reconnaissance was conducted to provide an overview of the geological and geotechnical conditions at the Site including the regional geology, site soils, groundwater, seismic hazards, and stormwater infiltration potential. Collectively, this memorandum provides a comprehensive review of the Site's geotechnical conditions to support the preparation of a California

Environmental Quality Act (CEQA) Initial Study/Negative Declaration (IS/ND) or Environmental Impact Report (EIR), as opposed to an as-graded or as-built geotechnical report.

Soils and geotechnical conditions are characterized based on the best available data, including a geotechnical investigation conducted within the ROW of Cable Rout Option 3 for the Heber 2 geothermal complex. (Imperial 2019). Soil conditions are presumed to be the same or similar as those underlying conditions identified in the Heber 2 memo investigation.

1.0 SITE DESCRIPTION

The proposed facilities would be located within an approximate 130-acre site that is presently used for agricultural cultivation, with one residence and geothermal pipelines infrastructure present as shown in Figure 2. The Site is located at an elevation of approximately 5 feet below mean sea level and the topography is relatively flat. Surrounding land uses in the project vicinity are dominated by agricultural cultivation with a residence located directly west of the site, a construction/aggregates company to the north, and IID canals and geothermal well pads and pipelines present throughout the local vicinity.

2.0 REGIONAL GEOLOGY

The Site is located in Imperial County which is underlain by three geomorphic provinces: the Peninsular Ranges; the Colorado Desert; and, the Mojave Desert. Each of these provinces is a naturally defined geologic region that displays a distinct landscape or landform with defining features based on geology, faults, topographic relief, and climate. The Peninsular Ranges geomorphic province occupies the southwestern portion of the Imperial County and is composed of a series of ranges separated by northwest-trending valleys. The geology of the Peninsular Ranges province is similar to the Sierra Nevada, with granitic rock intruding into the older metamorphic rocks. The Colorado Desert geomorphic province spans the majority of central Imperial County, including the Site, and is dominated by the Salton Sea and the Imperial Valley; the province is composed of a low-lying barren desert basin situated between alluvium-covered, active branches of the San Andreas Fault. The Mojave Desert geomorphic province occupies the north-central and northeastern portions of the County. The Mojave is a broad, arid region that contains isolated mountain ranges separated by desert plains (CGS, 2002).

More specifically, the Site is situated within the Salton Trough which is a structural depression resulting from large scale, regional faulting. The trough represents the northward extension of the Gulf of California and is bounded by the San Andreas Fault and Chocolate Mountains to the northeast and by the Peninsular Range and the faults of the San Jacinto Fault Zone to the southwest. The Imperial Valley is underlain by lacustrine deposits consisting of interbedded lenticular and tabular silt, sand, and clay (Landmark, 2005). The Late Pleistocene to Holocene lake deposits are estimated at less than 100 feet thick and derived from periodic flooding of the Colorado River which intermittently formed a fresh water lake, Lake Cahuilla (Landmark, 2005). Older deposits consist of Miocene to Pleistocene non-marine and marine sediments deposited during intrusions of the Gulf of California. Basement rock consisting of Mesozoic granite and Paleozoic metamorphic rocks are estimated to exist at depths between 15,000 to 20,000 feet below the surface (Landmark, 2005).

3.0 SITE SOILS

Approximately 28 soil types are found in the region of the Site (Aco, Antho, Carrizo, Carsitas, Chuckwalla, Cibola, Coachella, Fluvaquents, Gadsden, Gilman, Glenbar, Holtville, Imperial, Indio, Kofa, Lagunita, Laposa, Laveen, Mecca, Meloland, Niland, Orita, Ripley, Rositas, Salorthids, Superstition, Torriorthents, and Vint).

Glenbar, Holtville, and Imperial parent spoils are formed from fine-textured, stratified alluvial basin deposits (ICPDS 2015). The clay material deposited during the formation of the Colorado River delta terrace is the original source of Holtville and Imperial parent soils. Many of the other soils were formed from fan sediment originating from large gullies created by runoff into the Salton Sea. Imperial County soils are characterized by hyperthermic soil temperature and aridic soil moisture regimes (Digital Desert, 2019).

Soils observed on Site indicate the presence of wet Holtville silty clay, wet Imperial silty clay, and wet Imperial-Glenbar silty clay loams with 0 to 2 percent slopes and 2 to 5% slopes (USDA NRCS). Soil types identified in the USDA NRCS data base are identical to those found the northern portion of the project area where a previous geotechnical investigation was conducted containing wet Holtville silty clay and wet Imperial-Glenbar silty clay loams with 0 to 2 percent slopes. Soils information from the investigation consist of surficial dry, very stiff lean silty clays to a depth of 4 to 5 feet bgs, stiff clays from approximately 6 to 40 feet bgs, and silty clay to clayey silt from 40 to 50 feet bgs, the maximum depth of exploration (Landmark, 2019).

The native surface clays exhibit moderate swell potential (Expansion Index, EI =- 51-90) when correlated to Plasticity index tests (ASTM D4318) performed on native clays (Landmark, 2005). The clay is expansive when wetted and can shrink with moisture loss (drying). In their 2005 report, Landmark indicated that development of building foundations, concrete flatwork, and asphaltic concrete pavements should include provisions for mitigating potential swelling forces and reduction in soil strength which can occur from saturation of the soil (Landmark, 2005).

In regard to corrosivity, native soil at the Site has moderate to very severe levels of chloride ion concentrations (Landmark, 2005). Chloride ions can cause corrosion of reinforced steel, anchor bolts, and other buried metallic conduits. Resistivity determinations on the soil indicate very severe potential for metal loss because of electrochemical corrosion processes (Landmark, 2005).

During field evaluation, representative samples will be obtained for laboratory testing. At a minimum, the following tests will be performed:

1. Sieve analysis
2. Atterberg Limits
3. Sodium sulfate and chloride content
4. Soil expansion test

Additional laboratory testing may also be conducted if needed during the evaluation. These tests may include consolidation testing, direct shear, in-situ moisture-density, solubility, or others as needed. Preparation of a geotechnical report which addresses the items shall be completed to include results of the tests listed above plus:

5. Grading recommendations including removals and compaction recommendations
6. Special fill or grading techniques where needed
7. A review of the proposed construction design conditions
8. Anticipated design criteria related to recommended foundations and pavements.

4.0 GROUNDWATER

The Site is located within the Imperial Valley Groundwater Basin which is bounded on the east by the Sand Hills, on the west by the impermeable rocks of the Fish Creek and Coyote Mountains, the California-Mexico border to the south, and the Salton Sea (the discharge point for groundwater in the basin) to the north (DWR, 2004).

The regional groundwater flow direction within the Imperial Valley is toward the Salton Sea, a closed basin with a surface elevation of approximately 225 feet below sea level. In the vicinity of the Site, groundwater flow is generally towards the northwest. Depth-to-groundwater at the Site typically ranges from 8 to 10 feet bgs (Landmark, 2019).

5.0 SEISMIC HAZARDS

5.1 Fault Rupture Hazard

The Imperial Valley is a seismically active area that is traversed by numerous mapped faults including the Brawley Fault Zone, San Jacinto Fault Zone (contains the Coyote Creek Fault, the Elmore Ranch Fault, and the Wienert Fault), the Elsinore Fault (contains the Laguna Salada Fault), the Imperial Fault, the San Andreas Fault Zone, and the Superstitions Hills Fault (ICPDS, 2015).

Several active and potentially active faults are situated in the vicinity of the Site as shown in Figure 3 (Landmark, 2019). Active faults are defined by the California Geological Survey as faults that have ruptured during Holocene time (within the last approximately 11,000 years). Potentially active faults are those that have ruptured during the last 1.8 million years (Quaternary time), but with no direct evidence of a movement within Holocene time. The Imperial Fault Zone is the nearest active fault zone to the Site and is situated approximately 9.4 miles to the southwest (Landmark, 2019).

Several significant earthquakes have occurred in the vicinity of the Site with corresponding surface fault ruptures and liquefaction events (McCrink et al. 2011). Four earthquakes greater than magnitude 5 were recorded near Heber between 1915 and 1979. A magnitude 7.2 earthquake, the El Mayor-Cucapah earthquake, occurred throughout southern Imperial valley in 2010.

The Site is not located within a currently mapped Alquist-Priolo Special Studies Fault Zone (CGS, 2023). Surface fault rupture is considered to be unlikely at the Site due to the well-delineated fault lines through the Imperial Valley; however, because of the high tectonic activity and deep alluvium of the region, a potential exists for a surface rupture on undiscovered or new faults that may underlie the Site (Landmark, 2005).

5.2 Ground Shaking

Ground shaking can occur during an earthquake, and its intensity is related to the proximity of the area to the fault, the focal depth, soil types, the location of the epicenter, and the size (magnitude) of the earthquake. Soils formed from alluvial deposits are more prone to ground shaking than dense materials such as bedrock.

The Site is considered likely to be subjected to moderate to strong ground motion from earthquakes in the region. Ground motions are primarily dependent on the earthquake magnitude and distance to the seismogenic (rupture) zone. Accelerations also are dependent upon attenuation by rock and soil deposits, direction of rupture and type of fault; therefore, ground motions may vary considerably in the same general area.

5.3 Liquefaction

Liquefaction occurs when loosely packed, saturated soil or sediment at or near the ground surface loses its strength, which can lead to excessive settlement, ground rupture, lateral spreading, or failure of shallow bearing foundations (Imperial County, 2015).

The El Mayor-Cucapah earthquake (magnitude 7.2) that occurred throughout southern Imperial valley in 2010 caused widespread liquefaction near the towns of Calexico (immediately south of Heber) and El Centro (immediately north of Heber).

Liquefaction zones have not been mapped in this area (ICPDS, 2015); however, the Colorado River Delta region of southern Imperial County (including Heber) is a seismically active area. Landmark (2019) evaluated liquefaction potential at the Site using the 1997 NCEER Liquefaction Workshop methods. Due to the cohesive nature of the subsurface soils, liquefaction is not anticipated at the Site, and mitigation is not recommended (Landmark, 2019).

5.4 Lateral Spreading

Lateral spreading typically occurs as a form of horizontal displacement of relatively flat-lying alluvial material toward an open or "free" face such as an open body of water, channel, or excavation. This movement is generally due to failure along a weak plane, and may often be associated with liquefaction. As cracks develop within the weakened material, blocks of soil displace laterally toward the open face. Cracking and lateral movement may gradually propagate away from the face as blocks continue to break free.

Due to the low potential for liquefaction and the fact that the Site is not located near free faces or bodies of water, the potential for lateral spreading is considered low.

5.5 Subsidence

The Project site is not located within a mapped area of known land subsidence (USGS 2023). Due to the depth of groundwater and the fact that the site is not located in a mapped subsidence area, the potential for subsidence is considered low. However, a study published in collaboration with the California Energy Commission in 2019 found surface deformation at the Heber Geothermal Field (HGF) connected to geothermal production and injection. The HGF is the area containing and surrounding the HGEC. Eneva et al. (2019) found that subsidence was occurring at the HGF up to -45 mm/year (-1.77 in/year). Furthermore, it was reported that an increase in injection resulted in ground uplift in the northwestern portion of the HGF, however over time this uplift transitioned to subsidence with an increase in geothermal production. Despite the occurrence of land subsidence, Eneva et al. (2019) found that without such significant levels of reinjection, the displacements would have been significantly larger and there may be potential to use production and injection for operation management. Continued operation of the Heber plan would have a continued background effect on the surrounding area.

5.6 Landslides

The Site is relatively flat, and the hazard of landslides is unlikely due to the planar topography of the Site and the region (Landmark, 2005). No ancient landslides are identified on geologic maps of the region and no indications of landslides were identified during a 2005 site investigation (Landmark, 2005).

6.0 STORMWATER INFILTRATION POTENTIAL

Encouraging stormwater infiltration by means of a stormwater management plan (SWMP) can improve water conservation by reducing evaporation and increasing groundwater recharge, as well avoiding erosion and potential damage to concrete foundations and slabs. Beneficial water quality of streams and rivers can also be maintained by preventing discharge of stormwater containing sediments and other materials. The City of El Centro and City of Imperial SMP provide best management practices (BMPs) for stormwater management by commercial businesses and industrial operations (City of El Centro and Imperial County, 2013).

Heber also has a Master Drainage Plan (established in 2006), although the town's management of stormwater defers to the Imperial County Planning and Development guidelines and the county Public Works Department. The Imperial Irrigation District board adopted the Imperial Integrated Regional Water Management Plan

(IRWMP) in 2012 (GEI, 2012). The plan was developed to support the efforts to meet the County's future water resource demands while conforming to California Department of Water Resources guidelines.

Groundwater is encountered at approximately 8 to 10 feet bgs at the Site (Landmark, 2019). Onsite infiltration potential (capacity of the most limiting layer to transmit water [Ksat]) ranges from very low to moderately low at 0.00 to 0.06 inches per hour for wet, Holtville silty clay (approximately 71% of the Site) to moderately high at 0.20 to 0.57 inches per hour for wet, Imperial-Glenbar silty clay loams (approximately 29% of the Site). These soil types are also considered to be moderately well drained (NRCS, 2019). Evaporation potential is considered poor at the Site.

7.0 SITE STABILITY

The Site is located within the seismically active Imperial Valley and has the potential for ground disturbance based on soil and subsurface characteristics. Recommendations for the Heber 1 project, include engineered design and earthquake-resistant construction complying with the latest edition of the CBC for Site Class D.

8.0 REFERENCES

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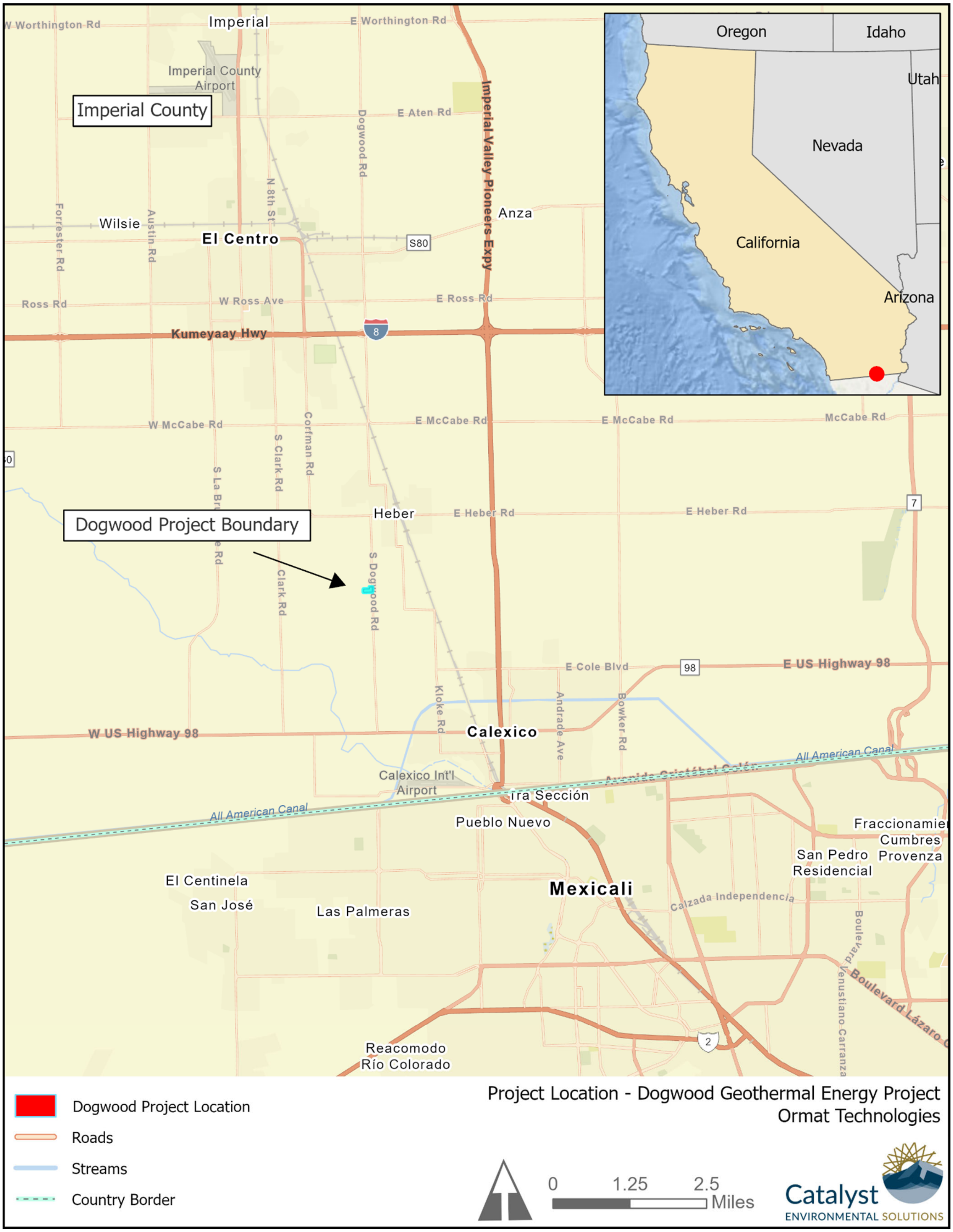
Figures



Project Location - Dogwood Geothermal Energy Project
Ormat Technologies

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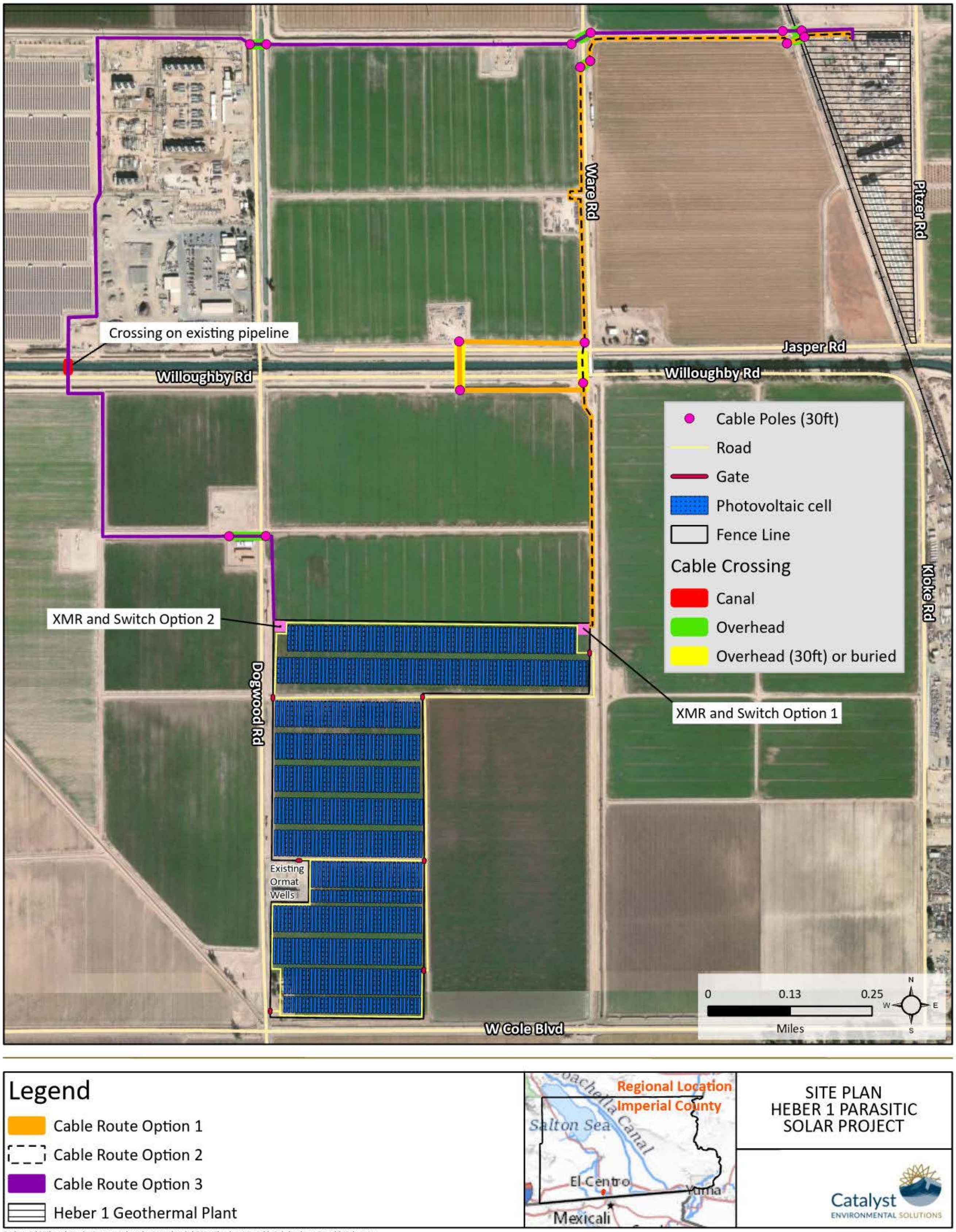

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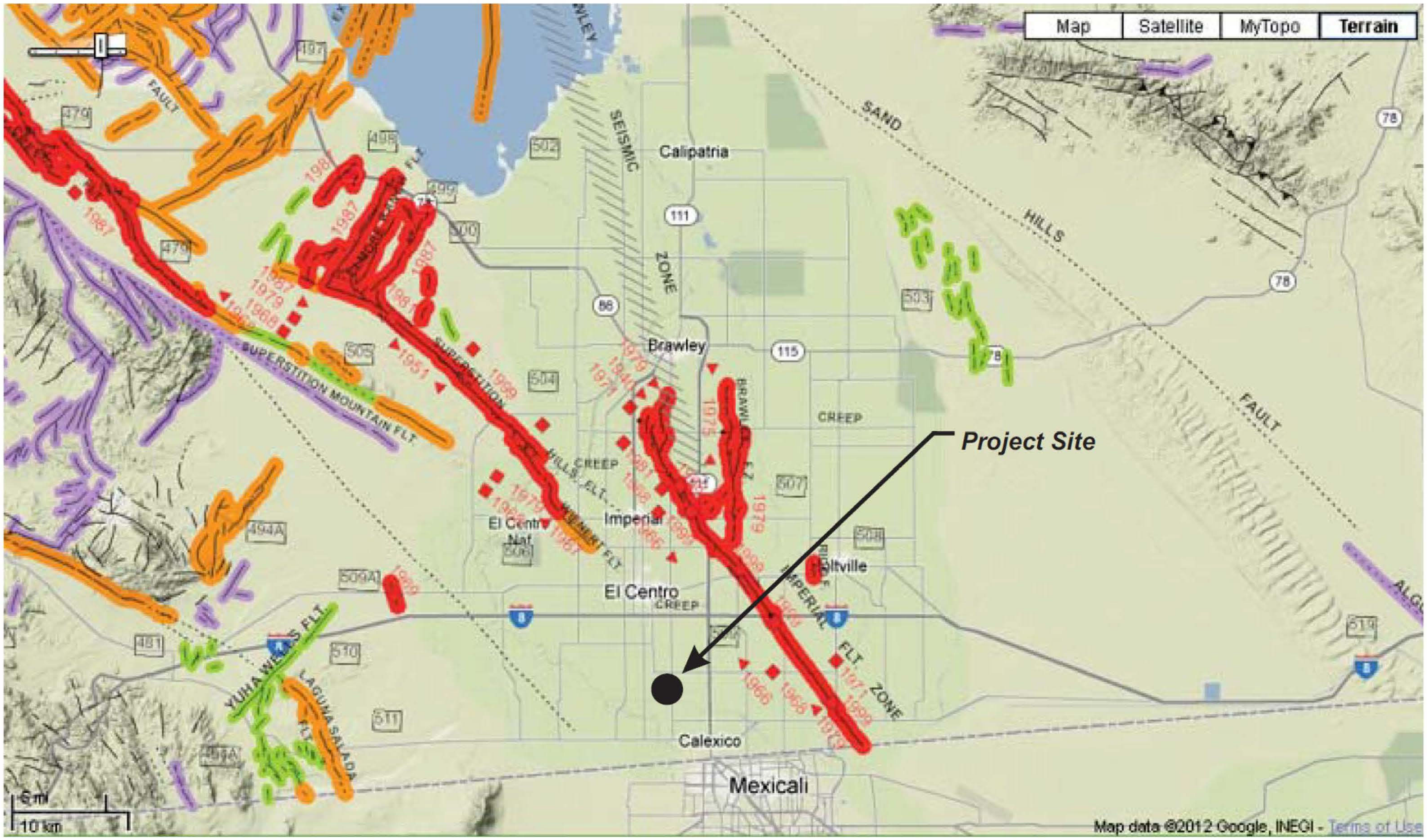

Source: California Geological Survey 2010 Fault Activity Map of California
http://www.quake.ca.gov/gmaps/FAM/faultactivitymap.html#

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Map of Local Faults

Figure 3