Appendix C

Botanical Resource Survey Report

BOTANICAL RESOURCE SURVEY REPORT

NORTH LIVERMORE
R700 GAS LINE 131 REPLACEMENT PROJECT
ALAMEDA COUNTY, CALIFORNIA

NOVEMBER 2016

Prepared for

Pacific Gas and Electric Company®

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Section 1. INTRODUCTION

At the request of Pacific Gas & Electric Company (PG&E), Nomad Ecology, LLC (Nomad) conducted protocol-level botanical surveys for PG&E's R700 Gas Line 131 Replacement Project (Project) which is located in north Livermore Valley, Alameda County, California. The study area stretches approximately 4 miles through the north Livermore Valley in unincorporated eastern Alameda County (Figure 1 and 2). It lies within the Central Valley Coast Ranges ecoregion (USDA 1997). It is also located within the San Joaquin Valley subregion of the California Floristic Province (Baldwin et al. 2012) and inside the boundaries of the East Alameda County Conservation Strategy (ICF International 2010).

Previously, a botanical reconnaissance was prepared for the R700 project in February 2016 (Nomad 2016). The purpose of the botanical reconnaissance was to map upland vegetation communities within the study area[1] and to determine which special-status plant species known from the region have the potential to occur within the study area based on the presence of suitable habitat. The botanical reconnaissance identified 25 special-status plant species with the potential to occur within the study area. The results of this Botanical Resource Survey Report are intended to supersede the results of the Botanical Reconnaissance (Nomad 2016).

For this project, Nomad focused on upland habitats as the identification of aquatic features within the study area were undertaken independently. . Therefore, wetland vegetation types within the study area are not mapped as they are being investigated in a separate wetland delineation report prepared by Area West Environmental, Inc. dated November 30, 2016. Therefore, the wetlands information in this report is intended to be supplemented by that wetland delineation document.

1.1. PURPOSE OF THE REPORT

The purpose of this Botanical Resource Survey Report is to present the results of protocol-level botanical surveys that targeted 25special-status plant species that were identified in the Botanical Reconnaissance (Nomad 2016). Protocol-level botanical surveys were conducted within the study area in March, April, May, July, and September 2016 by Nomad Ecology botanists. Additionally, these surveys were intended to inform impact assessment for California Environmental Quality Act (CEQA) and regulatory permitting.

This document provides: (1) a description of study methodologies; (2) a discussion of the regulatory context; (3) an assessment of the existing conditions and natural communities; (4) the results of protocol-level and floristic surveys for special-status botanical resources including the numbers, size, and condition of all listed species occurrences observed; potential threats and impacts to these occurrences; and photographs of special-status plant occurrences encountered; (5) a brief discussion of threats posed by non-native plant species; (6) recommendations for impact avoidance, minimization, and/or mitigation, as necessary; (7) a comprehensive list of all vascular plants observed; and (8) maps that identify the locations of sensitive natural communities and special-status plant species found on site.

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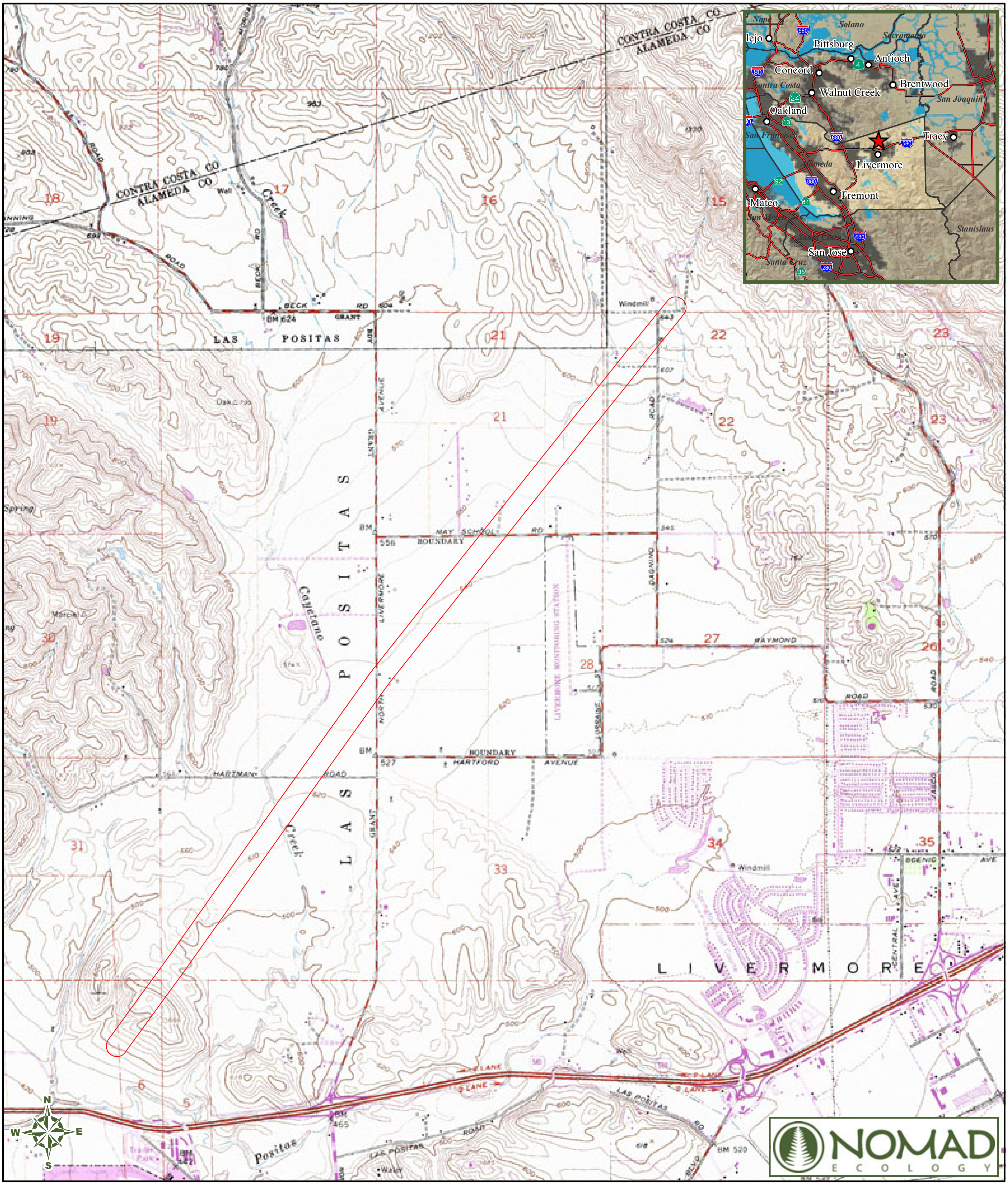
[1] The study area for this project includes 250-feet on either side of the transmission line and access routes identified by PG&E at the time of reconnaissance scoping.



November 2016

Botanical Resources Survey Report

Legend

▭ Study Area

Figure 1

Location of Study Area

Gas Line 131 Replacement Project

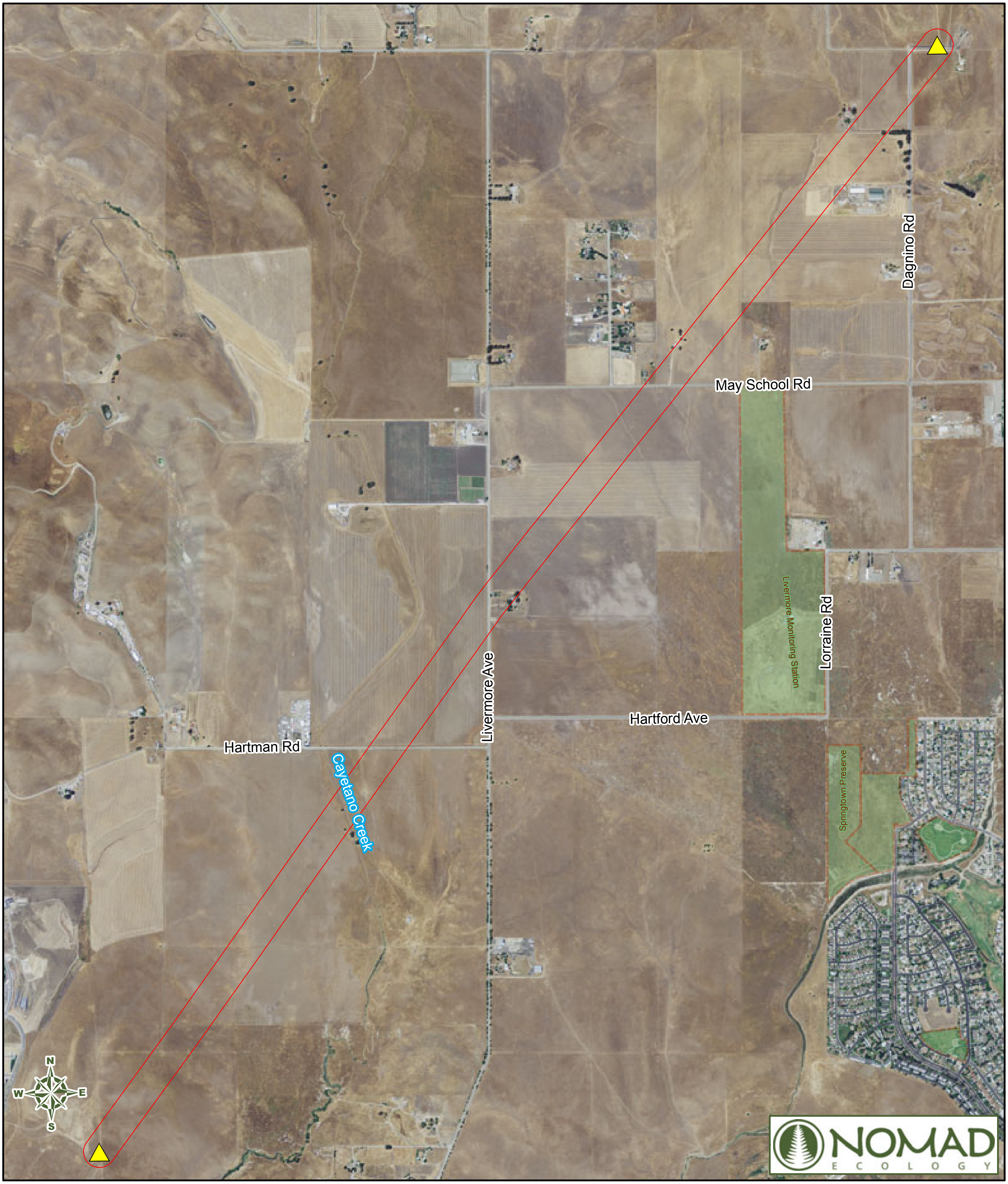
Pacific Gas & Electric

1:36,000

0 1,500 3,000 Feet

Sources: USGS, California Spatial Information Library,

Livermore, Alameda County, California



November 2016

Botanical Resources Survey Report

Legend

🟥 Study Area

▲ Gas Line 131 Endpoints

Figure 2

Aerial Photo of the Study Area

Gas Line 131 Replacement Project

Pacific Gas & Electric

1:24,000

0 1,000 2,000

Feet

Sources: USGS, California Spatial Information Library,

Livermore, Alameda County, California

Based on the results of these studies, further botanical surveys are not considered necessary within the study area presented in this report. However, the study area was designed early in 2016 before project work spaces had been identified. If any additional project features are identified outside of the current study area, these areas should be evaluated to determine if they contain suitable habitat for special-status plant species. Additional surveys may be required to adequately address all potential impacts in these areas.

1.2. PROJECT DESCRIPTION

Pipeline replacement activities are anticipated to begin in 2018. The new pipeline will replace the existing pipeline in place or parallel to the existing line. Slight deviations from the existing route may occur to avoid physical and environmental features, developments, or to otherwise accommodate landowners. It's anticipated that all of (or the majority of) the new pipeline route would be located within the 500-foot survey corridor used for the study area. The study area was designed early in 2016 before project work spaces had been identified. The work area would be restored to its approximate original contours after construction. The old gas pipeline will either be abandoned in place or removed.

Section 2. STUDY METHODS

2.1. DEFINITIONS

The following terms were used to evaluate the sensitivity of on-site biological resources and potential impacts of the proposed project. Terms and definitions are derived from the CEQA Guidelines and regulatory agencies, where applicable (Appendix A).

Study Area	The approximately 4 mile study area totals 255 acres and includes a 250 foot buffer on either side of the existing gas line 131 alignment; access routes are also included.
Project Footprint	The area on which the project physically stands. For the purposes of this report, the project footprint is as described above in Section 1.1 and in PG&E's project description.
Direct Impact	Impacts (or primary effects) which are caused by the project and occur at the same time and place [CEQA Guidelines, Title 14 CCR, Section 15358(a)(1)].
Indirect Impact	Impacts (or secondary effects) which are caused by the project and are later in time or farther removed in distance, but are still reasonably foreseeable. These may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems, including ecosystems [CEQA Guidelines, Title 14 CCR, Section 15358(a)(2)].
Cumulative Impact	Two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts. The individual effects may be changes resulting from a single project or a number of separate projects. The cumulative impact from several projects is the change in the environment which results from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable probable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time [CEQA Guidelines, Title 14 CCR, Section 15355].
Critical Habitat	Defined by the Endangered Species Act (ESA), as amended (Code of Federal Regulations, Title 50, Section 17), as "a specific geographic area(s) that is essential for the conservation of a threatened or endangered species and that may require special management and protection. Critical habitat may include an area that is not currently occupied by the species but that will be needed for its recovery." Critical habitat designations are published in the Federal Register. The final boundaries of the critical habitat area are also published in the Federal Register for federally listed species by U.S. Fish and Wildlife Service and National Marine Fisheries Service.

2.2. DATA RESOURCES

Background information for listed and special-status plant and wildlife species, and sensitive natural communities was compiled through a review of the following resources:

U.S. Fish and Wildlife Service (USFWS):

- Endangered and Threatened Wildlife and Plants (USFWS 1999, 2014)
- Federal Endangered and Threatened Species that Occur in or May Be Affected by Projects in Alameda County (USFWS 2016a, Appendix D)
- National Wetland Inventory for the Livermore, Altamont, and Byron Hot Springs Quadrangles (USFWS 2016b)

California Department of Fish and Wildlife (CDFW):

- List of California Vegetation Alliances and Associations. The Vegetation Classification and Mapping Program (CDFG 2010)
- State and Federally Listed Endangered, Threatened and Rare Plants of California (CDFW 2016a)
- California Natural Diversity Database (CNDDB) Query for the Altamont, Byron Hot Springs, Diablo, Dublin, La Costa Valley, Livermore, Mendenhall Springs, Niles, and Tassajara USGS 7 ½ Minute Quads (CDFW 2016b, Appendix E)
- Special Vascular Plants, Bryophytes, and Lichens List (CDFW 2016c)

Other Sources:

- The Jepson Manual, 2nd Edition (Baldwin et al. 2012)
- The California Native Plant Society's Inventory of Rare and Endangered Plants of California (CNPS 2001a, 2016)
- A Manual of California Vegetation (Sawyer et al. 2009)
- Consortium of California Herbaria (CCH 2016)
- East Alameda County Conservation Strategy (ICF International 2010)
- Annotated Checklist of the East Bay Flora (CNPS 2013)
- Unusual and Significant Plants of Alameda and Contra Costa Counties. Eighth Edition (Lake 2010)
- North Livermore Resource Conservation Study (Nomad 2009)
- Alameda Area Soil Survey, California (USDA 1966)

Botanical taxonomy and nomenclature conforms to *The Jepson Manual, 2nd Edition* (Baldwin et al. 2012) and recent circumscriptions in the Jepson eFlora (Jepson Flora Project 2016). Common names of plant species are derived from The Calflora Database (Calflora 2016). Nomenclature for special-status plant species conforms to the *Inventory of Rare and Endangered Plants of California* (CNPS 2001a, 2016) and *Special Vascular Plants, Bryophytes and Lichens List* (CDFW 2016c).

Vegetation communities described herein conform to *California Vegetation* (Holland and Keil 1995), the *Preliminary Descriptions of the Terrestrial Natural Communities of California* (Holland 1986), and/or *A Manual of California Vegetation* (Sawyer et al. 2009) and are crosswalked to other commonly used vegetation classifications such as those used in the EACCS (ICF International 2012). Wetland and deepwater habitat classifications conform to *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979), where appropriate.

2.3. IDENTIFICATION OF TARGET SPECIES

The identification of target species for this protocol-level survey effort is based on the results of the February 2016 Botanical Reconnaissance (Nomad 2016). In that report a total of 25 special-status plant species were determined to have the potential to occur within the study area based on the presence of suitable habitat. These potentially occurring special-status plant species have peak blooming periods during the months of March, April, May, June/ July, and August/September (Nomad 2016). For details on how these 25target species were determined for survey target status refer to Appendix D of the Botanical Reconnaissance (Nomad 2016).

2.4. REGULATORY FRAMEWORK

Sensitive Natural Communities

Sensitive natural communities are characterized as plant assemblages that are unique in constituent components, restricted in distribution, supported by distinctive edaphic conditions, considered locally rare, potentially support special-status plant or wildlife species and/or receive regulatory protection from municipal, county, state and/or federal entities. The regulatory framework that protects sensitive natural communities is derived from local, state and federal laws and regulations including Section 10 of the federal Rivers and Harbors Act, Sections 401 and 404 of the federal Clean Water Act, Section 1600 et seq. of the California Fish and Game Code, Section 15065 of the CEQA guidelines, and various other city or county codes. Implementation and enforcement of these regulations are conducted by their respective regulatory entities such as the U.S. Army Corps of Engineers, California Regional Water Quality Control Board, CDFW, lead agency and/or various cities or counties. The CNDDB treats a number of natural communities as rare, which are given the highest inventory priority (Holland 1986; CDFG 2010).

Special-Status Species

Special-status plant species are defined as those species listed as endangered or threatened, are proposed or candidates for listing under one or more of the following regulatory statutes: ESA, as amended (Code of Federal Regulations, Title 50, Section 17); California Endangered Species Act (CESA) (California Code of Regulations Title 14, Section 670.5); California Fish and Game Code (Sections 1901, 2062, 2067); and the Native Plant Protection Act (NPPA) of 1977. Special-status species may also include locally rare species defined by CEQA guidelines 15125(c) and 15380, which may include species that are designated as sensitive, declining, rare, locally endemic or as having limited or restricted distribution by various federal, state, and local agencies, organizations, and watchlists. Their status is based on their rarity and endangerment throughout all or portions of their range. Such species are referred to as special-status species or “target species” herein.

The California Native Plant Society (CNPS) has developed and maintains an inventory of rare, threatened and endangered plants of California. This information is published in the *Inventory of Rare and Endangered Vascular Plants of California* (CNPS 2001a; 2016). The rarity ranking contained in the CNPS inventory is endorsed by the CDFW and effectively serves as its list of “candidate” plant species. The following identifies the definitions of the CNPS California Rare Plant Ranks:

- Rank 1A: Plants presumed to be extinct in California;
- Rank 1B: Plants that are Rare, Threatened, or Endangered in California and elsewhere;
- Rank 2A: Plants Presumed Extirpated in California, But More Common Elsewhere;
- Rank 2B: Plants Rare, Threatened, or Endangered in California, But More Common Elsewhere;
- Rank 3: Plants about which more information is needed (a review list); and

- Rank 4: Plants of limited distribution (a watch list).

California Rare Plant Rank 1B and 2B species are considered eligible for state listing as Endangered or Threatened pursuant to the California Fish and Game Code. As part of the CEQA process, such species should be fully considered, as they meet the definition of Threatened or Endangered under the NPPA and Sections 2062 and 2067 of the California Fish and Game Code. California Rare Plant Rank 3 and 4 species are considered to be either plants about which more information is needed or are uncommon enough that their status should be regularly monitored. Such plants may be eligible or may become eligible for state listing, and CNPS, and CDFW recommend that these species be evaluated for consideration during the preparation of CEQA documents (CNPS 2001a, 2016), as some of these species may meet NPPA and CESA criteria as threatened or endangered.

East Alameda County Conservation Strategy (EACCS)

The primary goal of the East Alameda County Conservation Strategy (EACCS) is to “develop a coordinated and biologically sound approach to mitigation that will both support conservation and/or recovery of listed species and streamline state and federal permitting by providing guidance on avoidance, minimization, and mitigation for projects.” The EACCS assesses areas across east Alameda County for their habitat conservation value and establishes guiding biological principles for conducting conservation in this part of the County.

The Conservation Strategy has two purposes. First, it is designed to convey the project-level permitting and environmental compliance requirements of the Endangered Species Act (ESA), California Endangered Species Act (CESA), California Environmental Quality Act (CEQA), and the National Environmental Protection Act (NEPA), as well as other applicable laws, for all projects within the study area with impacts on biological resources. Second, it is intended to create a vision for how biological resources in the study area should be conserved through the project permitting process and through non-regulatory conservation actions.

To support the project permitting process, the EACCS identifies a set of mitigation standards, which include avoidance and minimization measures and a compensation program to offset impacts expected from projects in the study area. It also includes a set of specific management prescriptions to benefit natural communities and focal species. The EACCS is designed to contribute to species recovery to help to delist the listed focal species and prevent the listing of non-listed focal species through the protection, restoration, and enhancement of natural communities and species habitat. By focusing on conservation at the natural community level as well as at the focal species level, the EACCS will also ensure that common habitats and common species continue to be common in the strategy area. There are 6 plant species that are included as focal species, listed below in Table 1.

Table 1. Focal Plant Species of the EACCS

FOCAL PLANT SPECIES	
PLANT SPECIES	**LISTING STATUS**
Blepharizonia plumosa big tarplant	Federal: None CA: None CNPS: 1B.1
Centromadia parryi subsp. *congdonii* Congdon's tarplant	Federal: None CA: None CNPS: 1B.2
Chloropyron palmatum palmate-bracted bird's beak	Federal: Endangered CA: Endangered CNPS: 1B.1
Deinandra bacigalupii Livermore Valley tarplant	Federal: Endangered CA: None CNPS: 1B.1
Delphinium recurvatum recurved larkspur	Federal: None CA: None CNPS: 1B.2
Extriplex joaquinana San Joaquin spearscale	Federal: None CA: None CNPS[1]: 1B.2

[1] CNPS: California Native Plant Society Ranking. 1B: Rare or endangered in California and elsewhere. Threat Rankings: .1: Seriously threatened in California; .2: Fairly threatened in California

Locally Rare Plant Species

In addition, CEQA requires that impacts to "resources that are rare or unique to that region" be evaluated [CEQA Guidelines 15125(c)]. This includes botanical resources that include, but are not limited to, peripheral populations and disjunct subpopulations. These are informal terms that refer to those species that might be declining or are in need of concentrated conservation actions to prevent decline, but have no legal protection of their own. Also, CEQA Guidelines Section 15380 states "a species not included in any listing…shall nevertheless be considered to be rare or Endangered if the species is likely to become Endangered within the foreseeable future throughout all or a significant portion of its range and may be considered Threatened as that term is used in the ESA." Locally rare species tracked by the East Bay Chapter of CNPS meet these criteria (Lake 2010). Their status is based on their rarity and endangerment throughout all or portions of their range.

2.5. PERSONNEL AND FIELD INVESTIGATION

The following personnel conducted the field investigations:

Heath Bartosh
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Erin McDermott
Botanist and Wetland Specialist
Nomad Ecology, LLC

Claire Brown
Botanist
Nomad Ecology, LLC

Gregg Weber
Botanist
Nomad Ecology, LLC

Jaclyn Inkster
Botanist and Restoration Ecologist

Protocol-level rare plant surveys were conducted by Nomad senior botanists Heath Bartosh (HB) and Michael Park (MP), as well as Nomad botanists Erin McDermott (EM), Brian Peterson (BP), Claire Brown (CB), Gregg Weber (GW), and Jaclyn Inkster (JI). These surveys were conducted during the months of March, April, May, July, and September 2016. Table 2 details the dates and personnel for these studies. This report was prepared by Mr. Bartosh and Nomad botanist Adam Chasey.

Table 2. 2016 Survey Effort Details for Target Plant Species

SURVEY TIMING			TARGETS	PERSONNEL
Month	Day(s)	Year		
March	25	2016	Contra Costa goldfields alkali milk-vetch round-leaved filaree small-flowered morning glory recurved larkspur diamond-petaled poppy San Joaquin spearscale stinkbells little mousetail California alkali grass caper-fruited tropidocarpum	HB, EM, BP, MP
April	26	2016	big-scale balsamroot legenere adobe navarretia shining navarretia prostrate vernal pool navarretia hairless popcornflower	EM, MP
May	25	2016	crownscale spiny-sepaled button-celery	HB, MP, BP, JI
July	5	2016	brittlescale lesser saltscale saline clover	HB, MP, CB, GW
September	6	2016	Livermore tarplant Congdon’s tarplant	HB, BP, CB, GW

The purpose of these surveys was to conduct an inventory of vascular plants of the study area to document occurrences of rare, threatened or endangered species and other special-status plants and vegetation communities. All surveys generally began at 07:00am and concluded at approximately 3:00pm each day (with short breaks for meals). All vegetation communities within the study area, which included all proposed impact areas known to date, were visited and evaluated for their potential to support sensitive botanical resources. Surveys for target species were conducted by walking transects up to 10 meters apart depending on the target species, topography, or subject plant community, which covered 100 percent of the study area. Surveys were conducted on foot and on each date, surveys began at the southern end of the study area and concluded at the northern end of the study area. All plant species in bloom, or otherwise recognizable, were identified to a level necessary (floristic) to determine their regulatory status. During these surveys, an inventory of plant species observed was recorded (Appendix C).

Botanical surveys were conducted in accordance with the California Native Plant Society's *Botanical Survey Guidelines* (CNPS 2001b), California Department of Fish and Game's *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities* (CDFG 2009), and the U.S. Fish and Wildlife Service's *Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed and Candidate Plants* (USFWS 2000).

2.6. RESOURCE DOCUMENTATION AND MAPPING

Field data, including locations of special-status and locally rare plant species occurrences, were collected using a handheld Trimble GeoXT Global Positioning System (GPS), Backcountry Navigator Pro on an Android device, or hand-drawn on paper maps. A data point was collected for each aforementioned feature. These data points were then transferred to a desktop computer Geographic Information System (GIS) platform operating ESRI ArcGIS 10.1 for creating polygons, where necessary, and populating attribute tables.

2.6.1 SPECIAL-STATUS SPECIES OCCURRENCES

Special-status plants encountered within the study area were recorded using California Natural Diversity Database Field Survey Forms (Appendix F). A GPS data point was recorded for each occurrence that included fewer than 10 individuals. For occurrences that were greater than 10 individuals a polygon was created that included the outer extent of the population observed. Digital photographs were also taken. Voucher specimens were collected and will be donated to the Jepson Herbarium at the University of California Berkeley.

2.6.2 HERBARIUM VOUCHERS

In addition to the collection of special-status species voucher specimens, other plant species with regional significance were collected during the course of our study. Plant species considered as having regional significance include those not previously known as occurring in Alameda County. A GPS data point was recorded for each of these locations.

2.6.3 REFERENCE SITES AND HERBARIUM SPECIMENS

To ensure the timing of botanical surveys coincided with the flowering phenology of the target species, reference populations and collection dates of herbaria specimens were examined. Information on known populations of the target species were visited at reference sites with similar characteristics to the study area such as habitat, topography, and climate to determine appropriate survey timing. Table 3 depicts the details of reference population observations and provides an optimal survey timing by which surveys for the subject taxon should be completed by, based on observed phenology. For the remaining taxa, examination of herbaria specimens was performed using the Consortium of California Herbaria Database (CCH 2016).

Table 3. Reference Population Observation Details

Species Name / Common Name	Date Visited	Location	CNDDB Occurrence (Y/N)	Present (Y/N)	# of Individuals	Survey Duration
Federal/State Endangered or Threatened and California Rare Species						
Deinandra bacigalupii Livermore tarplant	9/6/16	North Livermore Valley (Springtown Preserve)	Yes (EONDX # 44494)	Yes	> 10,000 in bud, flower and fruit	3 weeks
California Rare Plant Rank Species						
Astragalus tener var. tener alkali milk-vetch	3/9/16	North Livermore Valley	No	Yes	500 in bud and flower	3 weeks
Atriplex coronata var. coronata crownscale	6/10/16	Vaquero Farms (Byron area)	No	Yes	500 mostly in fruit	1 month
Atriplex depressa brittlescale	6/10/16	Vaquero Farms (Byron area)	No	Yes	11,000 mostly in bud and early flower	1 month
California macrophylla round-leaved filaree	3/16/16	Black Diamond Mines Regional Preserve (Antioch area)	Yes (EONDX #45807)	Yes	325 in flower and fruit	3 weeks
Centromadia parryi subsp. *congdonii* Congdon's tarplant	7/5/16	North Livermore Valley	Yes (EONDX #42350)	Yes	375 in bud, flower, and early fruit	3 weeks
Convolvulus simulans small-flowered morning glory	3/16/16	Black Diamond Mines Regional Preserve (Antioch area)	No	Yes	215 in bud, flower, and fruit	3 weeks
Eschscholzia rhombipetala diamond-petaled California poppy	2/26/16	Bethany Reservoir	No	Yes	5 not yet in bud	1 month
Extriplex joaquinana San Joaquin spearscale	4/10/16	Vaquero Farms (Byron area)	No	Yes	150 – 85% in bud	1 month
Hesperevax caulescens hogwallow starfish	4/10/16	Vaquero Farms (Byron area)	No	Yes	65 all in flower	3 weeks
Navarretia nigelliformis subsp. *radians* shining navarretia	5/19/16	Black Diamond Mines Regional Preserve (Antioch area)	Yes (EONDX #87633)	Yes	600 – equally in bud, flower, and fruit	3 weeks

For target species that did not have accessible reference populations or were not visited, an estimation of blooming periods was attained by averaging the collection dates of herbarium specimens by month (CCH 2016). Duplicate collections and specimens with label information lacking a collection month were not included in the averages. The purpose of this analysis is to ensure survey timing corresponds with flowering and reproductive maturation since plant species are typically collected at peak flowering phenology. Herbaria specimen collection dates and corresponding survey timing are presented in Table 4. All of the species appearing in Table 4, which were considered targets for this survey, have peak blooming periods during the months of March, April, May, or July, and match the months during which the botanical survey was conducted for this project, with the exception of stinkbells (*Fritillaria agrestis*) which would have been detectable during the March survey by their persistent fruits.

Table 4. Herbaria Specimen Collection Dates and Correspondence of Survey Timing

Species	Herbaria Specimen Collections Averaged By Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Federal/State Endangered or Threatened and California Rare Species												
Lasthenia conjugens Contra Costa goldfields	0%	7%	**48%**	43%	0%	0%	0%	0%	2%	0%	0%	0%
California Rare Plant Rank Species												
Atriplex minuscula lesser saltscale	0%	0%	7%	10%	14%	17%	**24%**	17%	12%	0%	0%	0%
Balsamorhiza macrolepis var. *macrolepis* big-scale balsamroot	0%	7%	30%	**43%**	20%	0%	0%	0%	0%	0%	0%	0%
Delphinium recurvatum recurved larkspur	0%	21%	**58%**	20%	1%	0%	0%	0%	0%	0%	0%	0%
Eryngium spinosepalum spiny-sepaled button-celery	0%	0%	15%	**19%**	30%	17%	9%	7%	2%	0%	2%	0%
Fritillaria agrestis stinkbells	3%	**43%**	36%	18%	0%	0%	0%	0%	0%	0%	0%	3%
Legenere limosa legenere	0%	0%	19%	**62%**	19%	0%	0%	0%	0%	0%	0%	0%
Myosurus minimus subsp. *apus* little mousetail	1%	18%	**42%**	21%	11%	4%	1%	1%	1%	0%	0%	1%
Navarretia nigelliformis subsp. *nigelliformis* adobe navarretia	0%	0%	23%	**71%**	6%	0%	0%	0%	0%	0%	0%	0%
Navarretia prostrata prostrate vernal pool navarretia	0%	0%	41%	**53%**	5%	2%	0%	0%	0%	0%	0%	0%
Plagiobothrys glaber Hairless popcorn flower	0%	0%	0%	**75%**	25%	0%	0%	0%	0%	0%	0%	0%
Puccinellia simplex California alkali grass	0%	29%	**41%**	20%	5%	2%	2%	0%	2%	0%	0%	0%
Trifolium hydrophilum saline clover	0%	0%	5%	0%	11%	21%	**39%**	11%	13%	0%	0%	0%
Tropidocarpum capparideum caper-fruited tropidocarpum	6%	39%	**56%**	0%	0%	0%	0%	0%	0%	0%	0%	6%

Note: Shaded areas indicate months when botanical surveys were conducted. Bolded numbers denote peak period(s) for survey. Species flowering phenology represented as a percent (%) by month, percentages are rounded; months where collection dates have not been reported are designated as 0%.

2.7. LIMITATIONS

Survey efforts were carefully designed to maximize the likelihood that the timing and effort of the surveys coincided with the optimum timing of phenology and were conducted in appropriate locations for each of the target species. This subsection discusses the unavoidable limitations inherent in rare plant surveys, with respect to specifics of this project. This report only presents the results of protocol-level rare plant surveys within the entire study area. Although wetland areas were investigated for rare plants they were not classified, mapped, or delineated as that task was given to Area West Environmental, Inc and those results are provided in a separate report dated November 30, 2016.

Based on the timing of this assessment, a determination of presence within the study area was possible for special-status plant species with blooming periods corresponding to the March, April, May, July, and September 2016 surveys or with vegetative or fruiting material that would have been detectable during the survey as described above. Based on the timing of the survey, all plant species possibly growing within the study area may not have been observed due to varying floral phenology and life forms, such as bulbs, biennials, and annuals. Annuals may be absent in some years due to annual variations in temperature and rainfall, which influence germination and plant phenology. Colonization of new populations within an area may also occur from year to year.

Since vegetation descriptions are based on survey dates described above, vegetation descriptions and their associate species may be subject to change if additional data are collected, as species dominance, with regard to annuals, may change depending on the sample season or year. The phrase "in part" is used to signify that vegetation descriptions may include additional annual species present if surveyed during other seasons or years. Other potentially dominant species within vegetation communities or sensitive natural communities on site may be present or identified during other times of the year.

Some specific plant species identifications in this report may be tentative due to the absence of morphological characters, resulting from immature reproductive structures or seasonal desiccation, which may be required to make species level determinations, however, all plant species in bloom or otherwise recognizable were identified to a level necessary to determine their regulatory status. In these cases *cf* (compares to) is used to indicate provisional species identification based on gestalt, vegetative morphology, and/or its known range. It is highly unlikely that any of the provisional species identifications would be revised to recognize a sensitive taxon.

The proposed activities and work areas evaluated in this report are based on the study area provided by PG&E. Significant changes in the project design may warrant further analysis.

Section 3. ENVIRONMENTAL SETTING

3.1. SETTING

The approximately 4-mile (255 acre) study area is located in the northern portion of the Livermore Valley in an unincorporated area of north-central Alameda County, California. The mid-point of the study area is approximately 3 miles north of downtown Livermore and approximately 12.5 miles southeast of the summit of Mount Diablo. It lies within the San Joaquin Valley Subregion of the California Floristic Province and Alameda Creek Watershed. The study area appears on the Livermore (37121F7), Altamont (37121F6), and Byron Hot Spring (37121G6) 7.5 minute USGS topographic quadrangles.

3.1.1 REGIONAL SETTING

Regionally, this part of the interior East Bay supports a large number of special-status plant species and is floristically considered more similar to the San Joaquin Valley than the surrounding Diablo Range foothills.

As described in the *Ecological Subregions of California* (USDA 1997), the area is located within the Fremont-Livermore Hills and Valleys subsection of the Central Valley Coast Section. This subsection is described in detail below. The *Ecological Subregions of California* form the basis for describing regional variation in California alliance descriptions in *A Manual of California Vegetation* (Sawyer et al. 2009).

Fremont-Livermore Hills and Valleys

The Fremont-Livermore Hills and Valleys consist of the Livermore/San Ramon Valley and the hills around it, between the Greenville and Calaveras faults, and hills southeast of Fremont that are between the Calaveras fault and Santa Clara Valley. In this subsection the climate is hot and sub-humid.

This subsection includes a late Quaternary alluvial plain running east to west across the middle of the Livermore/San Ramon Valley with moderately steep to steep hills with flat summits south of the alluvial plain and moderately steep to steep hills along the Calaveras fault and between the fault and the Santa Clara Valley. Elevation ranges from 300 feet to 1,200 feet in Livermore Valley to 2,594 feet on Monument Peak, which lies west of the Alameda Watershed boundary. Mass wasting and fluvial erosion are the main geomorphic processes. This subsection contains mainly Miocene marine sediments along the Calaveras fault south of the Livermore/San Ramon Valley and Plio-Pleistocene nonmarine sediments in the south end of the Livermore Valley (USDA 1997). The older soils are leached free of carbonates, but calcium carbonates accumulate in the subsoils of many others. The soils are well-drained, except for small areas of somewhat poorly drained soils on alluvial plains.

For this region, the mean annual precipitation ranges from 15 to 20 inches and most of the precipitation is rainfall. The mean annual temperature is generally between 55° and 60°F and the mean freeze-free period is from 250 to 275 days. Hydrologically, runoff to the alluvial plain is rapid and all but the larger streams are dry through most of the summer (USDA 1997).

3.1.2 LOCAL SETTING

The study area is located immediately north of the City of Livermore in unincorporated Alameda County. The gas line runs in a southwest to northeast alignment from Portola Road, spanning approximately 4-miles, terminating at Dagnino Road. From Portola Road the study area ascends a small hill before descending into north Livermore Valley proper. North of this hill lie the plains that flank Cayetano Creek where the gas line intersects several parcels. After crossing through the banks of Cayetano Creek the study area crosses Hartman Road then enters another parcel before passing underneath North Livermore Avenue, a major thoroughfare connecting central portions of Alameda and Contra Costa counties. On the east side of North Livermore Avenue the study area passes through the front yard of a single family resident unit before entering several undeveloped parcels and then reaching May School Road. North of May School Road the study area intersects several undeveloped parcels as well as a horse boarding facility, and two additional residences near Dagnino Road.

Topography and Climate

Topography of the study area includes flat to gently sloping valley bottoms and low hills ranging from 550 feet (168 meters) to 660 feet (201 meters) in elevation. Although the topography is generally flat, vegetation in this ecosystem can change significantly due to small changes in the microtopography. Small depressions with slightly different hydrology will often harbor higher native plant diversity.

Locally the climate of the study area is characterized as Mediterranean with cool wet winters and warm, dry summers. However, the low precipitation received in the Valley and summer temperatures trend the climate towards semi-arid. The Valley is oriented west to east and receives consistent evening winds through the summer as the cool air from the Pacific Ocean is drawn into the Central Valley.

Geology and Soils

The underlying geology mainly comprises surficial deposits of Quaternary origins (Graymer et al. 1996). A total of five soil mapping units are located within the study area as described by *Soil Survey of the Alameda Area* (USDA 1966). Each soil mapping unit and the represented acreage in the study area is shown in Table 5. The symbol column in this table refers to the abbreviation for this soil type used in the soil survey (USDA 1966). Alkaline soils are considered important in this region because they influence the presence of edaphic vegetation communities including alkali grassland, alkali wetland, and in some cases vernal pools. In addition, several special-status plant species that occur in the region are alkaline soil obligates. Brady and Weil (1999) define alkaline soils as any soil that has a pH greater than 7.0. Runoff that is influenced by the marine sedimentary rocks which contribute sodium chloride as well as carbonates and sulfates, which are concentrated upward in the soils through capillary action driven by evaporation rates that are four times the local rainfall, contributes to this basic chemistry (Edwards and Thayer 2008). Clear Lake Series soils are considered, in some locations, to have alkaline characteristics in the North Livermore Valley (Nomad 2009). Due to this potential, the Clear Lake Series is described in more detail below. No other edaphic[2] vegetation communities resulting from specific soil types, such as serpentine habitats, were observed within the study area.

Clear Lake Series

The Clear Lake Series consists of very deep, moderately and imperfectly drained clayey soils in nearly level basins in the Livermore and Amador Valleys. These soils formed in fine-textured alluvium from sedimentary rock. The Clear Lake soils are in the same general area as the Pescadero and Sunnyvale soils of the valleys and the Altamont, Diablo, and Linne soils of the uplands. The upper 36 inches, which consists of the surface and subsurface soil, is dark-gray, very hard, and slightly acid to moderately alkaline clay.

Soil taxonomy for Clear Lake soils indicate they are aquert, which is a type of vertisol (USDA 1966). Due to the high clay content of vertisols this soil is prone to exaggerated shrinking and swelling which

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[2] Edaphic refers to plant communities that are driven or distinguished by soil conditions rather than by the climate.

can form large deep cracks when soil dries in June or July. In this region vertisols have been observed to harbor an abundance of native forbs and in some cases rare annual plant species and low cover of non-native grasses, likely due to the high clay content and resulting shrink/swell potential (Bartosh and Peterson, unpublished data).

Table 5. Soil Mapping Units in the Study Area

SYMBOL	SOIL MAPPING UNIT	ACREAGE	ALKALINE
CdA	Clear Lake clay, drained, 0 to 3 percent slopes	188	alkaline
DvC	Diablo clay, very deep, 3 to 15 percent slopes	19	no
LaC	Linne clay loam, 3 to 15 percent slopes	0.13	no
LaD	Linne clay loam, 15 to 30 percent slopes	29	no
LaE2	Linne clay loam, 30 to 45 percent slopes, eroded	0.03	no

Clear Lake clay, drained, 0 to 3 percent slopes (CdA), occurs mostly in large bodies in nearly level basins. This area is transitional to the Pescadero soils and is slightly affected by salts and alkali which is indicated by the USDA (1966). In some areas this soil is calcareous throughout, with seams of gypsum and nodules of lime. In the field, evidence for alkali soils were apparent south of Hartman Road during the botanical reconnaissance where small patches of alkali soils harboring high native cover were documented. This soil is slowly permeable and runoff is very slow.

Other Soil Series

The other four remaining soil mapping units include: Diablo clay, very deep, 3 to 15 percent slopes, and three mapping units from the Linne series. These soils range from silty clay to loamy clay that are moderately to very deep (USDA 1966). None of these soil mapping units supports edaphic alkaline soil vegetation communities.

Hydrology Characteristics

Hydrology onsite is influenced by precipitation, surface water runoff, geologic stratigraphy, topography, soil permeability, and plant cover. Obvious drainages within the study area include Cayetano Creek and other unnamed drainages as well as areas that may be considered seasonal wetlands. For more information regarding wetlands and aquatic features please refer to the wetland delineation report.

Land-Use

The study area traverses mostly flat land used for dryland farming or pasture. The history and intensity of dryland farming varies from parcel to parcel with some fields currently under cultivation and others left fallow. In addition to these agricultural land uses there are several scattered single-family homes along the study area as well as a horse boarding facility.

3.2. VEGETATION COMMUNITIES

This subsection describes vegetation utilizing three vegetation classification systems developed by Holland (1986) or Holland and Keil (1995) and Sawyer et al. (2009). Holland (1986) or Holland and Keil (1995) provide a generalized natural community-level description for natural communities present within the study area which include Dry Land Farmed (Agrestal), Ruderal, Non-Native Grassland, Alkali

Grassland, Native Grassland, and wildflower fields (Table 6; Figure 3). In some cases more detail is included for these natural community-levels by providing a description of the alliance[3], association[4], stand[5], or mapping unit[6] based on the *Manual of California Vegetation* (Sawyer et al. 2009) system. These vegetation communities are described below.

Another land cover type, developed, is not considered a vegetation community and is therefore not discussed further. This area is mapped to include subdivisions, paved roadways, and graveled road shoulders.

Initially, as part of the Botanical Reconnaissance (Nomad 2016), some portions of the study area were mapped as "undifferentiated grassland/ forb land." This vegetation type was found in areas that were both non-cultivated pasture and dry land farmed. Based on the timing of the reconnaissance surveys it was not possible to effectively and accurately map and classify these vegetation types. However, based on the results of the protocol-level botanical surveys these areas were reclassified and mapped as either non-native grassland, alkali grassland, or wildflower fields.

Wetland vegetation types within the study area are not mapped as they are being investigated by another firm in a separate wetland delineation report. Therefore, the wetlands information in this report is only intended to inform the evaluation of sensitive natural communities within the study area.

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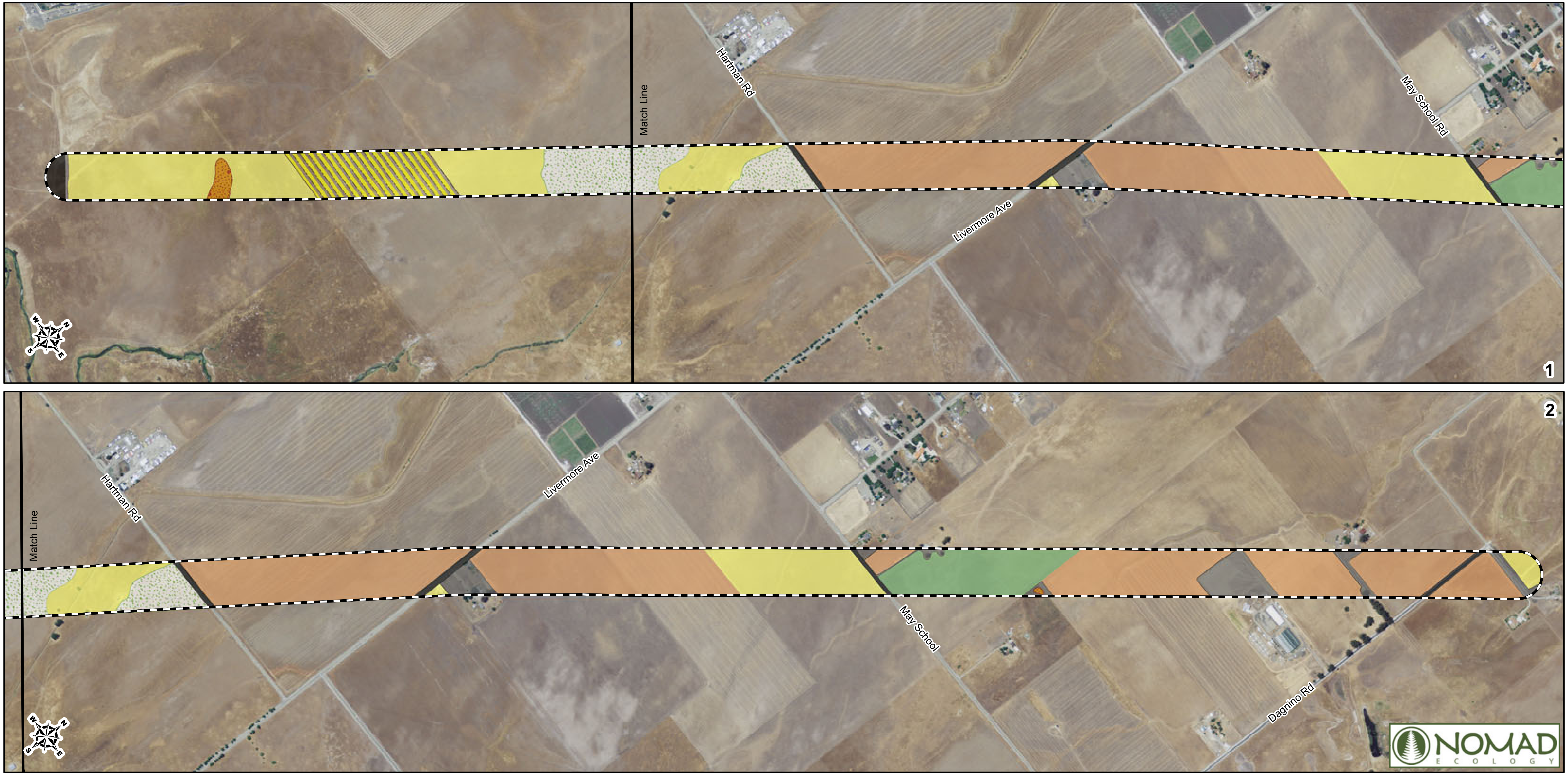
[3] A classification unit of vegetation, containing one or more associations and defined by one or more diagnostic species, often of high cover, in the uppermost layer or the layer with the highest canopy cover.

[4] A vegetation classification unit defined by a diagnostic species, a characteristic range of species composition, physiognomy, and distinctive habitat conditions.

[5] An actual area of vegetation that is homogenous in species composition and structure and in a uniform habitat.

[6] This term is used for stands of vegetation that were recurring on the landscape with an obvious dominant species but have not yet been described by CDFW/CNPS.



November 2016

Botanical Resources Survey Report

Legend

Study Area

▭

Vegetation Type

Natural Communities

⬛ Developed

🟧 Dry Land Farmed

🟨 Non-Native Grassland

▨ Non-Native Grassland (tilled)

⬛ Ruderal

Sensitive Natural Communities

▨ Alkali Grassland

▨ Creeping Rye (Elymus triticoides) Grass Turfs

🟩 Wildflower Fields

*Wetland areas investigated by GANDA.

1:12,000
0 500 1,000
Feet

Figure 3
Vegetation Communities
North Livermore
Gas-Line 131 Replacement Project
Pacific Gas & Electric

Sources: NAip 2012, California Spatial Information Library,

Livermore, Alameda County, California

Table 7 relates vegetation types identified within the study area to other commonly used vegetation classification systems including *Preliminary Descriptions of the Terrestrial Natural Communities of California* (Holland 1986), *Manual of California Vegetation, Second edition* (Sawyer et al. 2009), *CNPS Inventory of Rare and Endangered Plants of California* (CNPS 2001a, 2016), and *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979). The codes used in Table 7 reflect those associated with Holland (1986) types and the *Vegetation Classification and Mapping Program List of California Vegetation Alliances* (CDFG 2010).

Table 6. Land Cover Types in the Study Area

LAND COVER	ACREAGE
Cultivated Lands	
Dry Land Farmed	101.11
Upland Herbaceous Dominated Vegetation Types	
Alkali Grassland	22.11
Creeping Ryegrass Turfs (*Elymus triticoides* Herbaceous Alliance)	1.89
Non-native Grassland	74.94
Non-native Grassland (tilled)	17.38
Ruderal	13.65
Wildflower Fields	18.77
Wetland Herbaceous Dominated Vegetation Types	
Seasonal Wetlands	NA[7]
Total:	**249.85**[8]

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[7] Locations and acreages of seasonal wetland types can be found in the wetland delineation report completed by Area West Environmental, Inc. dated November 30, 2016.

[8] This total does not include the acreage attributed to the developed land cover type.

Table 7. Vegetation Community Classification Systems Comparison

VEGETATION COMMUNITY CLASSIFICATION SYSTEMS				
TERRESTRIAL COMMUNITIES[9]	CALIFORNIA VEGETATION[10]	EAST ALAMEDA COUNTY CONSERVATION STRATEGY[11]	CNPS INVENTORY[12]	WETLANDS & DEEPWATER HABITATS[13]
CULTIVATED LANDS				
Dry Land Farm (Agrestal) (Holland and Keil 1995)	Not Described	Cropland	Valley and Foothill Grassland	Upland
UPLAND HERBACEOUS DOMINATED VEGETATION TYPES				
Alkali Grassland (45300)	Alkali Meadow (45310) (Holland 1986), in part (S2) California Annual Grassland Alliance (42.040.00), in part	Alkali Meadow and Scalds	Valley and Foothill Grassland on Alkaline Soils	Upland
Native Grassland (42100)	*Elymus triticoides* Herbaceous Alliance (creeping ryegrass turfs) (41.080.00) (S3)	Nonserpentine Native Bunchgrass Grassland	Valley and Foothill Grassland	Upland
Non-native Grassland [14](42200)	*Avena fatua* Semi-Natural Herbaceous Stand (wild oats grassland) (44.150.00), in part *Bromus hordeaceus* Semi-Natural Herbaceous Stand (soft chess grassland) (42.026.00), in part	California Annual Grassland	Valley and Foothill Grassland	Upland
Ruderal (Holland and Keil 1995)	Not Described	Ruderal	Not Described	Upland

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[9] List of California Natural Communities (CDFG 2010)

[10] A Manual of California Vegetation (Sawyer et al. 2009)

[11] East Alameda County Conservation Strategy (ICF International 2010)

[12] CNPS Inventory of Rare and Endangered Plants of California Habitat Types (CNPS 2001A)

[13] Classification of Wetlands & Deepwater Habitats of the U.S. (Cowardin et al. 1979)

[14] In Figure 3, there is a distinction between Non-native Grassland that is tilled and not tilled.

VEGETATION COMMUNITY CLASSIFICATION SYSTEMS				
TERRESTRIAL COMMUNITIES[9]	CALIFORNIA VEGETATION[10]	EAST ALAMEDA COUNTY CONSERVATION STRATEGY[11]	CNPS INVENTORY[12]	WETLANDS & DEEPWATER HABITATS[13]
Wildflower Field	Wildflower Field (41.290.00), in part (S2)	California Annual Grassland	Valley and Foothill Grassland	Upland
Wetland Herbaceous Dominated Vegetation Types				
Seasonal Wetland (Not Described)	Not Described	Seasonal Wetland	Meadows and Seeps	Palustrine non-persistent emergent wetland

3.2.1 CULTIVATED LANDS

Dry Land Farmed (Agrestal)

In dry land farming, periodic fall tillage and seeding is employed to plant and grow various crops, including oats, barley, wheat, and mixed forbs for hay production. In such areas, tillage may not occur every year, therefore areas mapped as dry land farmed are not considered static. Areas mapped as non-native grassland may also be dry land farmed in some years. Dry land farming typically consists of oat, wheat, and hay production. As mapped, these areas comprise large acreages which can fluctuate from year to year. Within the study area several parcels were tilled, seeded, and harvested in 2016. Some of these fields had standing water from February through April. Specifically, these fields are located between North Livermore Avenue and May School Road. Despite this land-use, pockets of native wildflowers and forbs can persist in areas that are dry land farmed therefore the presence of dry land farming does not rule out the presence of special-status plant species or sensitive natural communities. One of the areas that was dry land farmed in 2016 was initially mapped as Undifferentiated Grassland / Forb Land due to the presence of many native plant seedlings that had germinated with the seeded grasses. This area was reclassified as Wildflower Fields and is discussed below.

Photo 1. Dry land farmed field west of North Livermore Avenue.

Photo 2. Harvested dry land farmed field.

3.2.2 UPLAND HERBACEOUS VEGETATION TYPES

Alkali Grassland

These grasslands resemble valley non-native grassland except that cover of non-native annual grasses and forbs is low while native grass and forb cover is high. Of the vegetation communities described by Holland (1986), the most similar is alkali meadow. Alkali meadow is characterized by a sparse to densely vegetated plant community consisting of relatively few low-growing plant species with a strong component of perennial species (Holland 1986). It is usually supported by fine-textured, seasonally or perennially moist alkaline soils. Alkali meadow is distributed in poorly drained valley bottoms and on the lower edges of alluvial slopes east of the Cascades and the Sierra Nevada as well as throughout the Sacramento and San Joaquin valleys and into the Livermore Valley. Features commonly referred to as alkali scalds are frequently associated with alkali grassland. Alkali scalds exhibit saline or alkaline crusts on the soil surface, supporting little or no vegetation, due to an elevated soil pH, which can be toxic to most plant species. These features occur in this community as well as in alkali wetland/seeps as described below.

Within the study area, alkali grassland was mapped in the valley bottom south of Hartman Road. Within areas mapped as Alkali grassland the dominant plant species include stalked popcornflower (*Plagiobothrys stipitatus* var. *stipitatus*), Douglas' silverpuffs (*Microseris douglasii* subsp. *douglasii*), few flowered evax (*Hesperevax sparsiflora* var. *sparsiflora*), butter n' eggs (*Triphysaria eriatha* subsp. *eriantha*), roughfruit popcorflower (*Plagiobothrys trachycarpus*), chick lupine (*Lupinus bicolor*), red-stemmed filaree (*Erodium cicutarium*) [*], and the rare plant hogwallow starfish (*Hesperevax caulescens*).

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[*] Denotes a non-native species that has an origin other than that of California.

Photo 3. Alkali grassland in April 2016 dominated by native plant species.

Native Grassland

Although listed as a vegetation community by Holland (1986), this reference does not provide a general narrative of characteristics, habitat, or range for this vegetation type. Generally the specific native grassland types that are described are dominated by perennial tussock-forming grasses. Both native and introduced annuals occur between the perennials, sometimes exceeding the native grasses in cover.

Within the study area, native grasslands are represented by one vegetation alliance: *Elymus triticoides* Herbaceous Alliance described below.

Elymus triticoides[15] *(Creeping Rye Grass Turfs) Herbaceous Alliance*

This alliance is described with creeping rye being dominant to co-dominant in the herbaceous layer with other native grasses and herbs. Herbs are less than 3.3 feet (1 meter) and the canopy is open to continuous. The membership rule for this alliance is creeping rye is greater than 50% relative cover in the herb layer. Habitat for this alliance is poorly drained floodplains, drainage and valley bottoms, mesic flat to sloping topography, and marsh margins between 0 to 7,546 feet (0-2,300 meters) in elevation (Sawyer et al. 2009). Within the study area this alliance was observed north of Portola Road and west of Dagnino.

Non-Native Grassland

Non-native grassland is dominated by a sparse to dense cover of non-native grasses and weedy annual and perennial forbs, primarily of Mediterranean origin, that have replaced native perennial grasslands as a result of human disturbance. However, where not completely out-competed by weedy non-native plant species, scattered native wildflower species and native perennial grass species considered remnants of the original vegetation, may also be common (Holland 1986). This community occurs on fine-textured, usually clay soils, which are moist or waterlogged during the winter rainy season and very dry during the summer and fall. Germination occurs with the onset of the late fall rains while growth, flowering, and

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[15] Based on recent taxonomic changes in Baldwin et al. (2012) *Leymus triticoides* is now recognized as *Elymus triticoides*

seed-set occur from winter through spring. With a few exceptions, the plants are dead through the summer and fall dry season, persisting as seeds. This community usually occurs below 3,000 feet (914 meters), but reaches 4,000 feet (1,219 meters) in the Tehachapi Mountains and interior San Diego County, and intergrades with coastal prairie along the Central Coast (Holland 1986).

This vegetation type in the study area is characterized by a high density and abundance of non-native annual grasses and is often in parcels where cattle graze. In one parcel south of Hartman Road, tilling/furrowing had occurred but it appeared that this field had never been planted with oats, barley, or other row crops therefore it retained composition of plant species consistent with non-native grassland.

This community is characterized by wild oats (*Avena fatua**), soft chess (*Bromus hordeaceus**), Italian ryegrass (*Festuca perennis**), common groundsel (*Senecio vulgaris**), storks bill (*Erodium cicutarium**), long beaked filaree*, chick lupine, common gumplant (*Grindelia camporum*), large mouse ears (*Cerastium glomeratum**), dwarf pepperweed (*Lepidium nitidum*), red-maids (*Calandrinia menziesii*), bur clover (*Medicago polymorpha**), sheppard's purse (*Capsella bursa-pastoris**), butter and eggs, succulent lupine (*Lupinus succulentus*), common fiddleneck (*Amsinckia intermedia*), charlock mustard (*Sinapis arvensis*)*, birdeye speedwell (*Veronica persica*), purple owl's clover (*Castilleja exserta* subsp. *exserta*), blow wives (*Achyrachaena mollis*), California poppy (*Eschscholzia californica*), rose clover (*Trifolium hirtum*), bellardia* (*Bellardia trixago*), and crane's bill geranium (*Geranium molle**). A few scattered individuals of blue oaks (*Quercus douglasii*) are also present in this community.

Photo 4. Native and non-native species in tilled non-native grassland.

Ruderal

Based on the description by Holland and Keil (1995), ruderal vegetation is an assemblage of plants, often a mixture of both native and nonnative weed species that thrive in waste areas, heavily grazed pastures, cultivated and fallow fields, roadsides, parking lots, footpaths, around residences and similar disturbed sites in towns and cities and along rural roadways. Ruderal communities are difficult to characterize and are often temporary assemblages. In areas of frequent human disturbance, the majority of wild plants are often introduced weeds rather than natives. Some urban weeds are ornamentals that have escaped from cultivation. Ruderal species may at times be integrated into various other communities (Holland and Keil 1995).

Within the study area ruderal vegetation is located in areas that have been disturbed through grading or previously subjected to disturbance and left fallow, such as cattle grazing pastures or open fields. These areas can support little to an abundance of vegetation depending on the frequency of disturbance. Non-native plant species typical of ruderal vegetation within the study area include charlock mustard*, black mustard (*Brassica nigra**), long beaked filaree (*Erodium botrys**), hoary mustard (*Hirschfeldia incana**), redstem filaree*, whitestem filaree (*Erodium moschatum**), wild oats (*Avena fatua**), burclover, smooth cat's ear (*Hypochaeris glabra**), common groundsel (*Senecio vulgaris**), crane's bill geranium*, and bristly ox-tongue (*Helminthotheca echioides**).

Wildflower Field

According to Holland (1986), wildflower field is an amorphous assemblage of herb-dominated associations noted for conspicuous annual wildflower displays. Species dominance varies from site to site and from year to year at a particular site. Wildflower fields are usually on poor sites that are droughty or low in nutrients, and are associated with grasslands or oak woodlands on surrounding, more productive sites. Throughout its range, this community is distributed in valleys and foothills of the California Floristic Province, except the north coast and the desert regions, which are respectively too wet and too dry (Holland 1986).

Within the study area, one area was mapped as wildflower fields, located between May School Road and Dagnino Road. Dominant species in this area represented uncommon wildflowers of the Livermore Valley, but were very abundant here, including Great Valley Phacelia (*Phacelia ciliata*), cupped monolopia (*Monolopia major*), and blue dicks (*Dichelostemma capitatum* subsp. *capitatum*).

3.2.3 WETLAND HERBACEOUS DOMINATED VEGETATION TYPES

Seasonal Wetland

Although a wetland delineation had not been undertaken as a part of Nomad's studies, field surveys completed through spring 2016 did find evidence of possible seasonal wetlands vegetation types within the study area. These features were saturated from February through April 2016.

In general, seasonal wetlands on site conformed to the following description. Seasonal wetlands are freshwater wetlands that support ponded or saturated soil conditions during winter and spring, and are dry through the summer and fall. Seasonal wetlands, although not specifically described in Holland (1986) or Holland and Keil (1995), would be classified by Cowardin et al. (1979) as seasonally persistent palustrine emergent wetlands. As defined, this classification indicates that surface water is present for extended periods, especially early in the growing season, but is absent by the end of the season in most years. When surface water is absent, the water table is often near the land surface. Vegetation is characterized by species of annual and perennial native and non-native grasses and forbs that begin their growth as aquatic or semiaquatic plants, typically resembling a wetland community, that make a transition to a dry-land environment as the pool dries. Upland grasses and forbs can become established while wetland species desiccate. The length of time that water persists has a major effect on species composition. During and after the establishment of upland species, these sites may no longer resemble wetlands. These plant species usually have a wetland indicator status between hydrophytic or facultative. Although seasonal wetlands and vernal pools share similar hydrologic characteristics, species composition of seasonal wetlands is typically ruderal in nature. Therefore, seasonal wetlands are not considered vernal pools, which support a more specialized and less common native flora.

Photo 5. Presence of possible seasonal wetland in the study area immediately south of May School Road.

Section 4. RESULTS

During this study, a total of 148 plant species were observed within the study areas. Of these species, 85 (approximately 57%) observed are considered non-native species that have an origin other than California. Generally, native species comprised higher cover and abundance than non-native plant species within the alkali grassland and wildflower field vegetation communities. Where grasslands and ruderal vegetation are present, non-native species were more abundant. A complete list of plant species observed within the study area is presented in Appendix C.

In evaluating habitat suitability and occurrence potential for special-status plant species within the study area, relevant literature, knowledge of regional biota, and observations made during the field investigations were applied to analysis criteria. Criteria determinations for occurrence potential of special-status plant species are divided into the five categories described below. These determination categories appear in Appendix B which provides a summary of the status, habitat affinities, flowering phenology, habitat suitability, and local distribution and potential for occurrence for each of the target special-status species. It should be noted that local distribution references refer to the CNDDB Element Occurrence Index (EONDX) number. The EONDX is an integer primary key (unique for each record) used within the CNDDB for GIS relational databases. Although the EONDX is assigned sequentially, gaps may appear as records are merged or updated. Factors influencing which determination criteria are applied to target species are described below.

- None denotes a complete lack of habitat suitability, local range restrictions, and/or regional extirpations.
- Not Expected denotes situations where suitable habitat or key habitat elements may be present, but may be of poor quality or isolated from the nearest extant occurrences. Incompatible habitat suitability refers to elevation, soil chemistry and type, vegetation communities, microhabitats, and degraded/significantly altered habitats. These factors create unsuitable ecological conditions for the consideration of even a low occurrence potential within the study area.
- Not Observed refers to plant species that were considered to have a potential to occur within the study area but were not observed during the course of the botanical surveys. This designation is primarily used for annual plant species that may not be present every year.
- Absent indicates specified taxa not observed during field investigations and were consequently ruled out. This category refers to diagnostic vegetative material of shrubby perennial or tree species not observed on site.
- Present indicates the target species was observed directly during field investigations.

4.1. SENSITIVE NATURAL COMMUNITIES

A total of three sensitive communities were observed within the study area: Alkali Grassland, Native Grassland, and Wildflower Fields. There is also the possibility of a fourth sensitive natural community to be present, seasonal wetland, which was confirmed based on the results Area West Environmental, Inc’s wetland delineation report dated November 30, 2016 These communities, with the exception of seasonal wetlands, appear in Table 8 and are described below. The locations of these communities are depicted in Figure 3.

Table 8. Sensitive Natural Communities in the Study Area

VEGETATION TYPE	NUMBER OF POLYGONS	ACREAGE
UPLAND HERBACEOUS DOMINATED VEGETATION TYPES		
Alkali Grassland (S2)	2	22.11
Creeping Ryegrass Turfs (*Elymus triticoides* Herbaceous Alliance) (S3)	1	1.89
Wildflower Fields (S2)	1	18.77
WETLAND HERBACEOUS DOMINATED VEGETATION TYPES		
Seasonal Wetland	See Areas West Report	See Areas West Report
Total	**107**	**42.77**

Alkali grassland and Wildflower Fields have a Conservation Status Rank of S2 (CDFG 2010). A rank of S2 indicates a vegetation alliance or association is “Imperiled” because of rarity due to very restricted range, very few populations, steep declines, or other factors making it very vulnerable to extirpation from the jurisdiction (NatureServe 2016).

As recognized by Sawyer et al. (2009) Creeping Rye Grass Turfs on-site is expressed as *Elymus triticoides* Herbaceous Alliance. This alliance may be considered of high inventory priority as it has a Subnational Conservation Status Rank of S3 (CDFG 2010). A rank of S3 indicates a vegetation alliance or association as “Vulnerable” meaning it is at moderate risk of extinction or elimination due to a restricted range, relatively few populations, recent and widespread declines, or other factors (NatureServe 2016).

If present, seasonal wetlands would be considered a sensitive natural community as they may qualify as wetlands or waters of the U.S. and/or waters of the State falling under U.S. Army Corps of Engineers or Regional Water Quality Control Board jurisdictions through the Clean Water Act and/or the Porter-Cologne Water Quality Control Act.

4.2. SPECIAL-STATUS PLANTS

Based on the field studies, a review of available databases and literature (USFWS 1999, 2014, 2016; CDFW 2016a, 2016b, 2016c; CNPS 2001a, 2016; CCH 2016; Baldwin et al. 2012) and familiarity with the regional flora, a total of 25 special-status plant species are known to occur within the vicinity of the study area and have the potential to occur (Nomad 2016). These 25 target species were the subject of protocol-level botanical surveys conducted during the appropriate blooming periods in 2016. A summary of the survey results are presented in Table 9 and their locations appear in Figure 4.

Table 9. Occurrence Summary of Special-Status Plants Within the Study Area

SPECIES NAME	COMMON NAME	STATUS[1]	SURVEY RESULTS
FEDERAL/STATE LISTED SPECIES			
None			
CALIFORNIA NATIVE PLANT SOCIETY LISTED SPECIES			
Centromadia parryi subsp. *congdonii*	Congdon's tarplant	CEQA, 1B.2	Observed
Extriplex joaquinana	San Joaquin spearscale	CEQA, 1B.2	Observed
Hesperevax caulescens	hogwallow starfish	CEQA, 4.2	Observed

[1] Explanation of State and Federal Listing Codes

California Native Plant Society codes:

1B	Rare or Endangered in California and elsewhere
4	Plants of limited distribution - Watch list

California Native Plant Society Threat Codes:

.2	Moderately threatened in California (20-80% occurrences Threatened)

Locally Rare Ranks:

A2	Seriously Species is currently known from 3 to 5 regions in Alameda and Contra Costa counties, or if more, meeting other important criteria such as small populations, stressed or declining populations, small geographical range, limited or threatened habitat, etc.

-

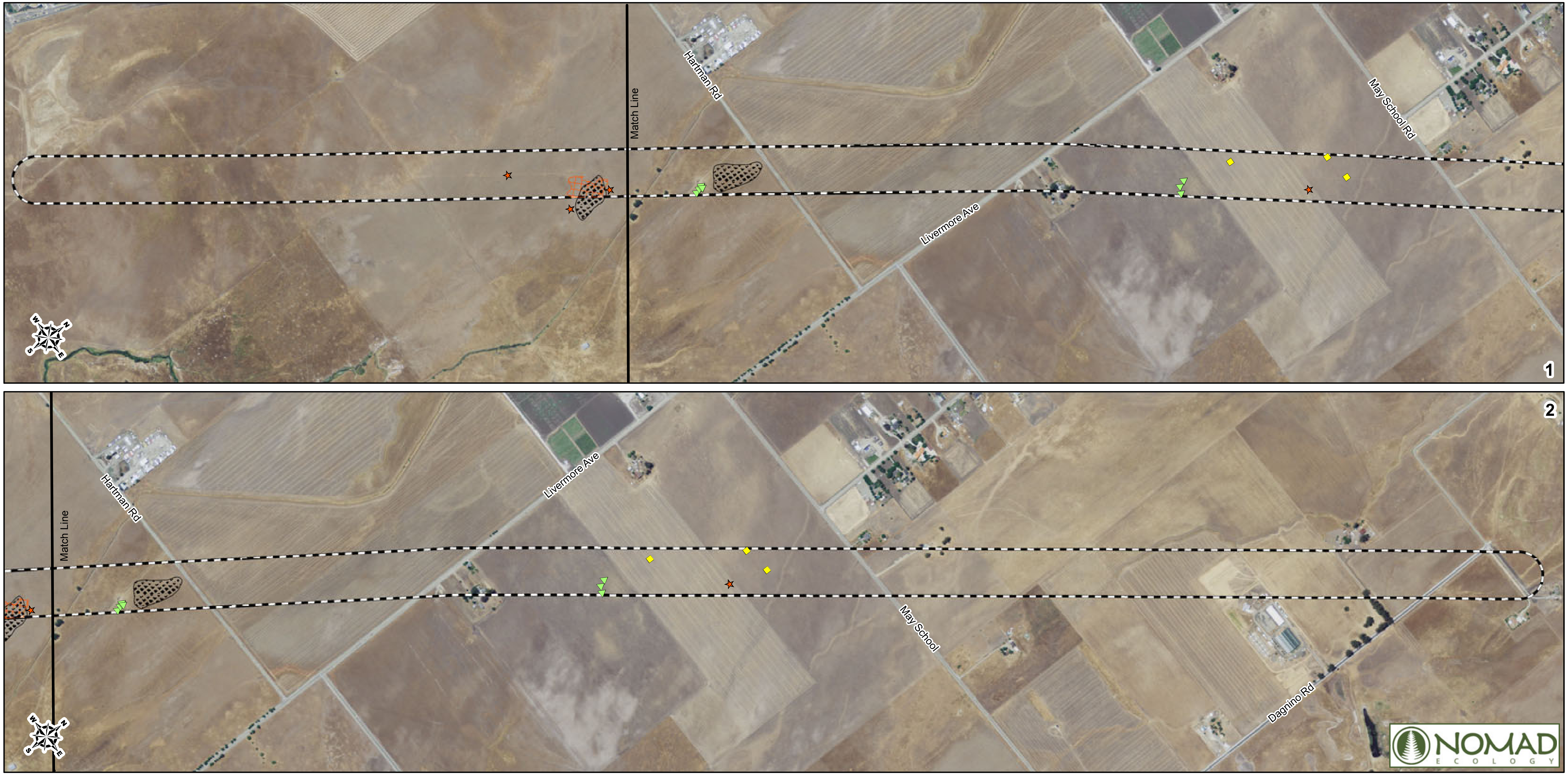

Figure 4
Special-Status Plant Species
North Livermore
Gas-Line 131 Replacement Project
Pacific Gas & Electric

Sources: NAip 2012, California Spatial Information Library,

4.2.1 FEDERAL- AND/OR STATE-LISTED AND CALIFORNIA RARE PLANT SPECIES

Based on the field investigations, review of available databases and literature, familiarity with local flora, and on-site habitat suitability, no federal- and/or State-listed and California rare plant species were observed. Please refer to Appendix B for a treatment on potential for occurrence based on habitat suitability and local distribution.

4.2.2 CALIFORNIA RARE PLANT RANK SPECIES

Based on the field investigations, review of available databases and literature, familiarity with local flora, and on-site habitat suitability, three California Rare Plant Rank species were observed within the study area: Congdon's tarplant (*Centromadia parryi* subsp. *congdonii*; CRPR 1B.2); San Joaquin spearscale (*Extriplex joaquinana*; CRPR 1B.2); and hogwallow starfish (*Hesperevax caulescens*; CRPR 4.2). A brief description of these species, their habitat requirements, occurrence information, threats, and potential project related affects are discussed below. CNDDB field survey forms for these occurrences appear in Appendix F.

Congdon's tarplant (*Centromadia parryi* subsp. *congdonii*)

Status, Distribution and Habitat Requirements

Congdon's tarplant [*Centromadia parryi* (Greene) subsp. *congdonii* (B.L. Rob. & Greenm.) B.G. Baldwin[16]] has a California Rare Plant Rank of 1B.2 indicating it is rare and moderately threatened in California (CNPS 2016). This is an annual species of the sunflower family (Asteraceae). The type locality[17] for this species was collected by J.W. Congdon in Salinas, Monterey County, California (Abrams 1955).

Congdon's tarplant is an erect annual herb growing to 4 to 27.5 inches (1 to 7 dm) in height (Baldwin et al. 2012). The distal leaves and peduncle bracts are spine-tipped, the leaves are glabrous to more-or-less coarsely hairy, and the plant is seldom glandular but can have minute, stalked more or less yellow glands interspersed among non-glandular hairs (Baldwin et al. 2012). Both the ray and disk flowers are yellow. Disk flowers have yellow to brown anthers and are subtended by 3-5 linear or awl-like scales (Baldwin et al. 2012). This taxon flowers from May to November (CNPS 2016).

Congdon's tarplant usually occupies alkaline valley and foothill grasslands (CNPS 2016) and terraces, swales, floodplains, grassland, and disturbed sites (Baldwin et al. 2012). It is a California endemic that occurs in the central western California geographic region from 0 to 984 feet (300 meters) (CNPS 2016).

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[16] In botanical literature, binomial scientific names are followed immediately by the name of or the abbreviation for the publishing author(s) who validated the name. A scientific name is not strictly complete without the name(s) of the validating author(s) attached. Plant species that appear in this report that have regulatory significance are referred to by their binomial scientific name and author for nomenclatural relevance.

[17] A type locality is the geographical location where the type specimen, which is used to describe a species for the first time, was originally found.

Congdon’s tarplant blooming in North Livermore.

Occurrence Data and Habitat Characteristics

There are no previously known records of Congdon’s tarplant within the study area. The nearest recorded CNDDB occurrence (EONDX #42350, from 1998) is from 0.5 miles southeast of the study area, near Hartford Avenue.

During the surveys on July 5, 2016, two populations of Congdon’s tarplant were observed within the study area. One population is represented by approximately 1,132 individuals located south of Hartman Road and west of North Livermore Avenue. This population is located along the gas line 131 in a valley bottom in areas of alkaline clay barrens grassland co-occurring with species typical of those habitats described above.

The second population is represented by 19 individuals located south of May School Road and east of North Livermore Avenue. This population is located along gas line 131 in non-native grassland with bristly ox-tongue (*Helminthoetheca echioides**) and yellowstar thistle*.

Threats and Project Related Impacts

The CNPS Inventory (CNPS 2016) indicates that this species is potentially threatened by development and possibly by grazing and non-native plants. Currently, the biggest threat to these populations of Congdon’s tarplant is non-native yellow starthistle (*Centaurea solstitialis*) and bristly ox-tongue (*Helminthotheca echioides*) which could potentially take over in the area.

Construction activities associated with pipeline replacement have a high probability of directly impacting individuals, and the live seed bank, of both populations as they are both located directly over the pipeline where movement of heavy equipment at the inappropriate time of year and excavation may take place. Indirect impacts are also possible resulting from the introduction of additional non-native and invasive weed species as a result of ground disturbance. Appropriate mitigation, minimization and/or avoidance measures should be undertaken. Recommended measures are included in Section 5 below.

Cumulative Effects

Although there is a possibility of both direct and indirect impacts to these populations, significant cumulative impacts are not anticipated as there are a total of 54 occurrences of Congdon's tarplant within Alameda and Contra Costa counties that are presumed extant (CDFW 2016c).

San Joaquin spearscale (*Extriplex joaquinana*)

Status, Distribution and Habitat Requirements

San Joaquin spearscale [*Extriplex joaquinana* (A. Nelson) E.H. Zacharias] has a California Rare Plant Rank of 1B.2 indicating it is rare and moderately threatened in California (CNPS 2015). This is an annual species of the goosefoot family (Chenopodiaceae). The type locality for this species is from Altamont Pass (formerly Livermore Pass), Alameda County, California (Abrams 1955). The collector of this specimen was not readily available. The etymology of *Extriplex* is based on the Latin 'beyond or outside *Atriplex'*, the genus in which this taxon was formerly placed (Baldwin et al. 2012).

San Joaquin spearscale is an ascending to more or less erect annual herb with stems 12 to 39 inches (1 to 10 dm) tall (Baldwin et al. 2012). The leaf blades are ovate to deltate, and are fine-scaly in youth but become glabrous with age (Baldwin et al. 2012). It is a monoecious taxon with staminate flowers exhibiting four calyx lobes, four stamens, and lacking corolla lobes, and pistillate flowers exhibiting two stigmas, and lacking both calyx and corolla lobes (Baldwin et al. 2012). This taxon flowers from April to October (CNPS 2016).

San Joaquin spearscale usually occupies alkaline soils in chenopod scrub, meadows and seeps, playas, and valley and foothill grasslands (Baldwin et al. 2012; CNPS 2016). It is a California endemic occurring in a patchy distribution from the coast of San Luis Obispo to Contra Costa County between 0 to 1148 feet (350 meters) and rarely up to 2,755 feet (840 meters) (Baldwin et al. 2012).

San Joaquin spearscale growing in North Livermore. Photo taken 2016.

Occurrence Data and Habitat Characteristics

There are no previously known records of San Joaquin spearscale within the study area. However, there are several CNDDB occurrences near the study area. The closest (EONDX 6737, from 1991) was from approximately one mile east, near the Springvale housing development.

During the 2016 surveys, two populations of San Joaquin spearscale were observed within the study area. One population is represented by one individual located south of Hartman Road and west of North Livermore Avenue. This population, observed May 25, 2016, is located east of the gas line 131 centerline in a non-native grassland that is occasionally grazed by cattle. It is dominated by soft chess (*Bromus hordeacus**), foxtail barley (*Hordeum murinum* subsp. *leporinum**), prickly lettuce (*Lactuca serriola**), black mustard (*Brassica nigra**), Italian ryegrass (*Festuca perennis**), and hayfield tarweed (*Hemizonia congesta* subsp. *luzulifolia*).

The second population is represented by approximately 11 individuals located south of May School Road and east of North Livermore Avenue along the PG&E pipeline. This population is located east of the gas line 131 centerline in a non-native grassland that is occasionally grazed by cattle. It is dominated by yellow starthistle*, field bindweed (*Convolvulus arvensis**), and hayfield tarweed. While not saturated during this observation on July 5, 2016, this area was saturated with standing water in both March and April of 2016.

Threats and Project Related Impacts

The CNPS Inventory (CNPS 2016) indicates that this species is threatened by grazing, agriculture, development, and non-native plants. Currently, the biggest threat to this population is a large mustard patch located approximately 150 feet to the west.

Construction activities associated with pipeline replacement are not likely to directly impact individuals, or the live seed bank, of both populations as they are not directly located over the pipeline where movement of heavy equipment may take place. However, indirect impacts are possible resulting from the introduction of additional non-native and invasive weed species as a result of ground disturbance. Appropriate mitigation, minimization and/or avoidance measures should be undertaken. Recommended measures are included in Section 5 below.

Cumulative Effects

Although there is a possibility of indirect impacts to these populations, significant cumulative impacts are not anticipated as there are a total of 48 occurrences of San Joaquin spearscale within Alameda and Contra Costa counties that are presumed extant (CDFW 2016c).

Hogwallow starfish (*Hesperevax caulescens*)

Status, Distribution and Habitat Requirements

Hogwallow starfish [*Hesperevax caulescens* (Benth.) A. Gray] has a California Rare Plant Rank of 4.2, indicating it has limited distribution and is moderately threatened in California (CNPS 2016). This species is an annual herb of the sunflower family (Asteraceae). The type locality for this species is from an 1812 K. T. Hartweg collection in the Sacramento Valley, Sacramento County, California (Abrams 1955). The etymology of *Hesperevax* is from the Greek meaning “western *Evax*” (Baldwin et al. 2012).

Hogwallow starfish flowering in North Livermore. Photo taken April 26, 2016.

Hogwallow starfish is differentiated from other members of the genus by having 10-40 distal heads per group, a strongly thickened petiole base, and heads subtended by, not mixed with, leaves (Baldwin et al. 2012). This taxon flowers from March to June (CNPS 2016).

Hogwallow starfish sometimes occupies alkaline soils in shallow vernal pools and valley and foothill grassland habitats (CNPS 2016). It has been recorded as occurring in Alameda, Amador, Butte, Contra Costa, Colusa, Fresno, Glenn, Kern, Merced, Monterey, Napa, Sacramento, San Diego, San Joaquin, San Luis Obispo, Solano, Stanislaus, Sutter, Tehama, and Yolo counties between 0 to 1,657 feet (0 to 505 meters) in elevation (CNPS 2016).

Occurrence Data and Habitat Characteristics

There are no previously known records of hogwallow starfish within the study area. The closest herbarium record is a Barbara Ertter collection (Accession# UC2031481) from Springtown wetlands.

During the 2016 surveys, a single population represented by 200,000 individuals of Hogwallow starfish was observed within the study area, south of Hartman Road and west of North Livermore Avenue. This population is located just east of the gas line 131 centerline on silty clay in remnants of degraded alkali vernal pools and swales. Associated species include blow wives (*Achyrachaena mollis*), wild oats*, burclover*, Douglas' silverpuffs *, soft chess (*Bromus hordeaceus**), Italian ryegrass*, and few flowered evax. At the time of this observation, April 26, 2016, this population was threatened by charlock mustard (*Sinapis arvensis**), wild oats, and soft chess.

Threats and Project Related Impacts

The CNPS Inventory (CNPS 2012) indicates that this species is threatened by development, agriculture, and possible overgrazing. Currently the biggest threat to this population is charlock mustard that is establishing in the alkali scald area. In addition, a population of alkali Russian thistle (*Sasola soda*) is growing in proximity of the hogwallow starfish and could potentially establish in the alkali scald in the future. Although overgrazing is cited as a potential threat, the level of grazing observed at this location appears compatible with long-term persistence of this species.

Construction activities associated with pipeline replacement have a possibility of directly impacting individuals, and the live seed bank, of this population as it is immediately adjacent to the pipeline where movement of heavy equipment may take place. Indirect impacts are also possible resulting from the introduction of additional non-native and invasive weed species as a result of ground disturbance. Appropriate mitigation, minimization and/or avoidance measures should be undertaken. Recommended measures are included in Section 5 below.

Cumulative Effects

Although there is a possibility of both direct and indirect impacts to these populations, significant cumulative impacts are not anticipated as there are an abundance of populations of hogwallow starfish within Alameda and Contra Costa counties based on personal observations of Nomad senior botanist Heath Bartosh.

4.2.3 LOCALLY RARE PLANT

As consistent with CEQA's Article 9 and Guidelines §15125(a) and §15380 which state that "special emphasis should be placed on environmental resources that are rare or unique to that region" and CNPS' goal of preserving plant biodiversity on a regional and local scale, this study also assessed the occurrence of locally significant plant species. Locally significant plant species, also known as "peripheral populations" are those considered to be at the outer limits of their known distribution, a range extension, a rediscovery, or rare or uncommon in a local context (CNPS 2001b, CDFG 2010). These species are not regarded as special-status species by the USFWS or CDFW. However, the East Bay Chapter of CNPS has a program, started in 1991, that tracks rare, unusual, and significant plants that occur within Contra Costa and Alameda counties. East Bay CNPS has three ranked designations for these species: A (which includes [♦]A1, A1, *A1x, A1x, *A2, and A2); B; and C. This determination is partially based on the number of botanical regions the subject taxon occurs in. The criteria of each ranking are presented in Table 10.

[♦] A diamond indicates that the plant species is also listed statewide as rare.

Table 10. Ranking Criteria for Rare, Unusual, and Significant Plants of the East Bay

RANKING	DEFINITION
♦A	This category includes ♦A1, ♦A1x, and ♦A2. The asterisk indicates that these species in Alameda and Contra Costa counties are listed as rare, threatened, or endangered by federal or state agencies or by the state level of CNPS.
A1	Species from 2 or less botanical regions in Alameda and Contra Costa counties, either currently or historically.
A1x	Species previously known from Alameda or Contra Costa counties, but now believed to have been extirpated and no longer occurring here.
A2	Species is currently known from 3 to 5 regions in the two counties, or if more, meeting other important criteria such as small populations, stressed or declining populations, small geographical range, limited or threatened habitat, etc.
B	A high-priority watch list: Species currently known from 6 to 9 regions in the two counties, or if more, meeting other important criteria as described for A2.
C	A second-priority watch list: Species is currently known from 10 or more regions in the two counties, but potentially threatened if certain conditions persist such as over-development, water diversions, excessive grazing, weed or insect invasions, etc.

The East Bay Chapter, which includes Contra Costa and Alameda counties, has been divided into 40 botanical regions based on vegetation, geology, habitats, soil types, and other factors. The study area is included within the Livermore area botanical region (Lake 2010).

A single plant species treated as locally rare by the East Bay Chapter of CNPS that may have regulatory significance was observed within the study area. These species, yellow beak owl's clover (*Triphysaria versicolor* subsp. *faucibarbata*) has a locally rare rank of A2 (Table 11). These species should be considered in local planning and management efforts, however including them in environmental review documents is up to the discretion of the lead agency (Lake 2010).

Table 11. Locally Rare, Unusual, and Significant Plants Observed within the Study Area

SCIENTIFIC NAME	COMMON NAME	NUMBER OF OCCURRENCES	GENERAL LOCATIONS
A1-Ranking			
None			
A2-Ranking			
Triphysaria versicolor subsp. *faucibarbata*	yellow beak owl's clover	1	- in the valley bottom south of Hartman Road

Source: Lake 2010. All plants with a CNPS East Bay Chapter ranking of A are protected under CEQA in Sections 15380 and 15125(a) which address species of local concern and environmental resources that are rare or unique to a region.

Yellow beak owl's clover (*Triphysaria versicolor* subsp. *faucibarbata*)

Yellow beak owl's clover [*Triphysaria versicolor* Fischer & C. Meyer subsp. *faucibarbata* (A. Gray) Chuang & Heckard] is an A2-ranked species. This taxon is an annual species of the Broomrape family (Orobanchaceae). The type locality for this species is from a collection in Corte Madera, Marin County, California (Abrams 1955). The etymology of *Triphysaria* is Greek for "3 bladders" due to the presence of three lower lip pouches in the genus (Baldwin et al. 2012).

Yellow beak owl's clover is an ascending annual herb, green to yellow-brown in color with stems 4 to 24 inches (10 to 60 cm) tall (Baldwin et al. 2012). The plant itself is generally glabrous and the corolla is yellow with purple-dotted margins (Baldwin et al. 2012). This taxon flowers from April to June (Baldwin et al. 2012).

California Yellow beak owl's clover occurs in coastal and inland grasslands up to 1640 feet (500 meters) in elevation in the North Coast, Sacramento Valley, Central Coast, and San Francisco Bay Area Subregions (Baldwin et al. 2012). Locally this species is known from the Anthony Chabot Regional Park, East Dublin, Franklin Canyon, Knightsen, and Sunol Regional Wilderness.

Within the study area this taxon co-occurred with abundant yellow starthistle* and Douglas' silverpuffs in alkaline habitat south of Hartman Road. Construction activities associated with pipeline replacement could potentially impact this species in the study area if it is directly harmed by machinery or earth moving operations. Appropriate avoidance measures should be undertaken.

4.3. NOXIOUS/INVASIVE WEEDS

During the course of this study, 85 (approximately 57 percent) of the plant species observed within the study area were non-native plant species. A non-native plant species is defined as a species that is occurring outside of its native distributional range and the species has arrived there by human activity. Some of the non-native plant species encountered on-site are tracked by the California Department of Food and Agriculture (CDFA 2016) and the California Invasive Plant Council (Cal-IPC 2016) due to their noxious/invasive weedy behavior. Species tracked by these organizations are given a certain rating based on criteria such as ecological impacts, treatment or eradication priority, and threats they pose to agricultural economics. Rating classifications given by Cal-IPC and CDFA are shown in Table 12.

Of the non-native plant species tracked by Cal-IPC and CDFA, the following discussion only includes those that were dominant on the landscape in a given area, serve as a record of existing infestations, pose a potential threat to adjacent botanical resources, or have the potential to be more widely spread during project related activities. A total of 15 plant species with elevated threat rankings were observed within the study area (Table 12). The majority of these species were observed in the hill section south of Hartman Road and south of the valley bottom, between North Livermore Avenue and May School Road, and west of Dagnino Road in areas associated with horse boarding facilities. It should be noted that trace individuals of other non-native plant species with weed ratings were also observed within the study area. Because of the low number, limited location, and lack of perceived threats these species are not included below.

Table 12. Noxious/Invasive Plants Observed in the Study Area

SPECIES NAME	COMMON NAME	California Invasive Plant Council Rank (Cal-IPC 2016)*	California Department of Food and Agriculture Noxious Weed List (CDFA 2016)**
Brassica nigra	black mustard	Moderate	---
Carduus pycnocephalus	Italian thistle	Moderate	On List
Carduus tenuiflorus	slender flowered thistle	Limited	On List
Centaurea melitensis	tocalote	Moderate	---
Centaurea solstitialis	yellow star thistle	High	On List
Cirsium vulgare	bull thistle	Moderate	On List
Convolvulus arvensis	bindweed	---	On List
Cynara cardunculus	cardoon	Moderate	On List
Cynodon dactylon	Bermuda grass	Moderate	On List
Dittrichia graveolens	dittrichia	Moderate	---
Elymus caput-medusae	medusahead grass	High	On List
Foeniculum vulgare	fennel	High	---
Helminthotheca echioides	bristly ox-tongue	Limited	---
Hirschfeldia incana	hoary mustard	Moderate	---
Phalaris aquatica	Harding grass	Moderate	---

*Cal-IPC Weed Ranking Definitions:

High: These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.

Moderate: These species have substantial and apparent - but generally not severe - ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.

Limited: These species are invasive but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic (Cal-IPC 2016).

** Species considered a noxious weed by CDFA are listed on the California Noxious Weed List (CDFA 2016).

Section 5. SUMMARY

5.1. SUMMARY

The following table and discussion summarizes the results associated with the protocol-level botanical surveys for the North Livermore Gas Line 131 Replacement Project. It should also be noted that although there is a critical habitat unit for vernal pool species nearby, the study area does not intersect this unit, therefore no critical habitat is present.

Table 13: Summary of Sensitive Communities and Special-Status Plants within the Study Area

SPECIES NAME	COMMON NAME	STATUS[1,2]	LOCATION IN THE STUDY AREA
SENSITIVE NATURAL COMMUNITIES[1]			
---	Alkali Grassland	S2	- In the valley bottom south of Hartman Road
Elymus triticoides Herbaceous Alliance	Creeping Ryegrass Turfs	S3	- On a north facing slope south of the valley bottom on the south side of Hartman Road - Between May School and Dagnino Roads
---	Wildflower Fields	S2	- North of May School Road
---	Seasonal Wetland	Potential Jurisdictional Wetlands	- To be determined based on the results of GANDA wetlands studies.
SPECIAL-STATUS PLANTS			
FEDERAL/STATE LISTED SPECIES			
None			
CALIFORNIA RARE PLANT RANK SPECIES[2]			
Centromadia parryi subsp. *congdonii*	Congdon's tarplant	CEQA, 1B.2	- In the valley bottom south of Hartman Road - Between North Livermore Avenue and May School road
Extriplex joaquinana	San Joaquin spearscale	CEQA, 1B.2	- In the valley bottom south of Hartman Road - Between North Livermore Avenue and May School road
Hesperevax caulescens	hogwallow starfish	CEQA, 4.2	- In the valley bottom south of Hartman Road
LOCALLY RARE PLANTS[2]			
Triphysaria versicolor subsp. *faucibarbata*	yellow beak owl's clover	CEQA, A2	- In the valley bottom south of Hartman Road

[1] **Explanation of Sensitive Natural Communities Status**

Subnational Conservation Status Ranks (Nature Serve 2016):

S2 "Imperiled"
S3 "Vunerable"

[2] **Explanation of California Rare Plant Ranks**

1B Rare or Endangered in California and elsewhere
4 Plants of limited distribution - Watch list

CRPR Threat Codes:

.2 Moderately threatened in California (20-80% occurrences Threatened)

Locally Rare Ranks:

A2 Species is currently known from 3 to 5 regions in Alameda and Contra Costa counties, or if more, meeting other important criteria such as small populations, stressed or declining populations, small geographical range, limited or threatened habitat, etc.

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APPENDIX A LAWS, ORDINANCES & REGULATIONS

FEDERAL

FEDERAL ENDANGERED SPECIES ACT (FESA)

The Federal Endangered Species Act of 1973, as amended (FESA), was created to "conserve the ecosystems upon which Endangered and Threatened species depend." The U.S. Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Administration, National Marine Fisheries Service have authority over projects that may result in a "take" of a species listed as Threatened or Endangered under the FESA. Under the FESA, plant and wildlife species, including all lower taxa including subspecies and varieties, are listed Threatened or Endangered based on (A) the present or Threatened destruction, modification, or curtailment of their habitat or range, (B) overutilization for commercial, recreational, scientific, or educational purposes, (C) disease or predation, (D) the inadequacy of existing regulatory mechanisms, or © other natural or manmade factors affecting their continued existence. FESA listing categories include Endangered, Threatened and candidates for listing. FESA provides protection for species listed as Endangered, and prohibits the "take" of such species in areas under federal jurisdiction or in violation of state law. A "take" is defined as any action to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Species listed as Threatened do not warrant listing as Endangered and are not provided the same protection under Section 9; however, USFWS often applies the same protection as authorized by Section 4(d) of the FESA. Section 4(d) also allows for exceptions to the take rule under special circumstances. If a project would result in a take of a federally listed species, either an incidental take permit, under Section 10(a) of the FESA, or a federal interagency consultation under Section 7 of FESA, is required prior to the take. Current inventories published for species listed under the FESA include the *Endangered and Threatened Wildlife and Plant*s, *Endangered and Threatened Wildlife and Plants; Review of Native Species That are Candidates or Proposed for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions; Proposed Rule*, *Endangered and Threatened Species; Establishment of Species of Concern List, Addition of Species to Species of Concern List, Description of Factors for Identifying Species of Concern, and Revision of Candidate Species List Under the Endangered Species Act*.

CLEAN WATER ACT OF 1977

The U.S. Army Corps of Engineers (USACE) and the U.S. Environmental Protection Agency (EPA) have jurisdiction over "Waters of the United States," which include navigable waters of the United States, interstate waters, all other waters where the use or degradation or destruction of the waters could affect interstate or foreign commerce, tributaries to any of these waters, and wetlands that meet any of these criteria or that are adjacent to any of these waters or their tributaries. Waters of the United States include marine waters, tidal areas, and stream channels. Under federal regulations, wetlands are defined as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" [33 C.F.R. §328.3(b)]. Presently, to be considered a wetland, a site must exhibit three criteria: hydrophytic vegetation, hydric soils, and wetland hydrology existing under the "normal circumstances" for the site.

Wetlands that are nonnavigable, isolated, and intrastate only may not be subject to USACE jurisdiction under Section 404 of the CWA, pursuant to the "SWANCC" decision, *Solid Waste Agency of Northern Cook County vs. United Stated Army Corps of Engineers* (2001) 531 U.S. 159. Although isolated wetlands may not be subject to USACE jurisdiction under Section 404, they are considered "waters of the State" under California's Porter-Cologne Water Quality Control Act (Cal. Water Code §§ 13020, et seq.)

and, as such, are subject to regulation by Regional Water Quality Control Boards (RWQCBs). There are nine RWQCBs under the State Water Resources Control Board.

STATE

CALIFORNIA ENDANGERED SPECIES ACT (CESA)

The California Endangered Species Act of 1984, administered by the California Department of Fish and Game (CDFG), recognizes that certain species of fish, wildlife and plants are in danger of, or Threatened with, extinction because their habitats are Threatened with destruction, adverse modification, or severe curtailment, or because of overexploitation, disease, predation, or other factors. The Legislature recognized that these species of fish, wildlife and plants are of ecological, educational, historical, recreational, aesthetic, economic and scientific value to the people of the state, and the conservation, protection and enhancement of these species and their habitat is of statewide concern. The CESA built on the California Native Plant Protection Act (NPPA) (discussed below) and increased regulatory protection for plant species to parallel the CESA. Listing categories under the CESA include Endangered, Threatened, rare or candidate for listing (Cal. Fish and Game Code §§ 2062, 2067 and 2068). The current inventories published for plants listed under the CESA are the *State and Federally Listed Endangered, Threatened and Rare Plants of California* and the *Special Vascular Plants, Bryophytes and Lichens List* CDFG. Current inventories for fish and wildlife species include *State and Federally Listed Endangered and Threatened Animals of California* and the *Special Animals*.

CESA requires state agencies to consult with the CDFG when preparing California Environmental Quality Act (CEQA) documents to ensure that the state lead agency actions do not jeopardize the existence of listed species. It directs agencies to consult with CDFG on projects or actions that could affect listed species, directs CDFG to determine whether jeopardy would occur, and allows CDFG to identify “reasonable and prudent alternatives” to the project consistent with conserving the species.

CESA prohibits the taking of state-listed Endangered or Threatened plant and wildlife species. CDFG exercises authority over mitigation projects involving state-listed species, including those resulting from CEQA mitigation requirements. CDFG may authorize a taking through an incidental take permit, if the impacts of the take are minimized and fully mitigated. Mitigation often takes the form of an approved habitat management plan or management agreement that avoids or compensates for possible jeopardy. CDFG requires preparation of mitigation plans in accordance with published guidelines.

CALIFORNIA FISH AND GAME CODE

The California Department of Fish and Game (CDFG) administers §1600-1603 of the Fish and Game Code which pertains to wetland and riparian resources associated with rivers, streams, and lakes. Pursuant to §1600-1603, CDFG regulates activities that divert or obstruct the natural flow of, or substantially change or use any material from the bed, bank, or channel of any river, stream, or lake, or its associated riparian vegetation, 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. The jurisdiction of CDFG with respect to a river, stream, or creek is considered to be with the limits measured from the top-of-bank or the outermost edges of riparian vegetation.

NATIVE PLANT PROTECTION ACT (NPPA)

The Native Plant Protection Act of 1977, which is implemented by the CDFG, was created to “preserve, protect and enhance rare and Endangered plants in this State.” The NPPA gave the CDFG the authority to designate native plants as Endangered or rare and to regulate, through permits, activities such as collecting, transporting, or selling plants protected by the NPPA. The NPPA also provides the definitions of native, Threatened and Endangered plants in Section 1901 of the California Fish and Game Code.

CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA)

The California Environmental Quality Act of 1970 requires public agencies to evaluate the environmental implications of their actions, and to prevent environmental effects by avoiding or reducing significant impacts of their decisions, where feasible. CEQA was intended to assist public agencies in systematically identifying both the significant effects of proposed projects and the feasible alternatives or feasible mitigation measures which will avoid or substantially lessen such significant effects. In enacting CEQA, the Legislature expressed a policy that public agencies should not approve projects as proposed if there are such feasible alternatives or mitigation measures. Among its goals, CEQA was intended “to preserve for future generations representations of all plant and animal communities” (Cal. Pub. Res. Code §21001c). Through this process impacts and mitigation to state and federally listed plant species are discussed.-

The California Native Plant Society (CNPS) has developed and maintains an inventory of rare, Threatened and Endangered plants of California. This information is published in the Inventory of Rare and Endangered Vascular Plants of California. The inventory presents a ranking system for rare plants within the state known as California Rare Plant Ranks. The CNPS inventory is endorsed by the CDFG and effectively serves as its list of “candidate” plant species. The following identifies the definitions of the California Rare Plant Ranks:

- Rank 1A: Plants presumed to be extinct in California;
- Rank 1B: Plants that are rare, Threatened, or Endangered in California and elsewhere;
- Rank 2A: Plants presumed extirpated in California, but more common elsewhere;
- Rank 2B: Plants that are rare, Threatened, or Endangered in California, but are more common elsewhere;
- Rank 3: Plants about which more information is needed (a review list): and
- Rank 4: Plants of limited distribution (a watch list).

Rank 1B and 2 species are considered eligible for state listing as Endangered or Threatened pursuant to the California Fish and Game Code. As part of the CEQA process, such species should be fully considered, as they meet the definition of Threatened or Endangered under the NPPA and Sections 2062 and 2067 of the California Fish and Game Code. Rank 3 and 4 species are considered to be either plants about which more information is needed or are uncommon enough that their status should be regularly monitored. Such plants may be eligible or may become eligible for state listing, and CNPS and CDFG recommend that these species be evaluated for consideration during the preparation of CEQA documents (CNPS 2001), as some of these species may meet NPPA and CESA criteria as Threatened or Endangered.

In addition, CEQA requires that impacts to “resources that are rare or unique to that region” be evaluated [CEQA Guidelines 15125(c)]. This includes botanical resources that are, but not limited to, peripheral populations and disjunct subpopulations. These are informal terms that refer to those species that might be declining or be in need of concentrated conservation actions to prevent decline, but have no legal protection of their own. Also, CEQA Guidelines Section 15380 states “a species not included in any listing…shall nevertheless be considered to be rare or Endangered if the species is likely to become Endangered within the foreseeable future throughout all or a significant portion of its range and may be considered Threatened as that term is used in the ESA.”

APPENDIX B SPECIAL-STATUS PLANT SPECIES KNOWN TO OCCUR OR POTENTIALLY OCCURRING IN THE STUDY AREA

SPECIES NAME COMMON NAME	FEDERAL, STATE, CNPS LISTING	HABITAT PREFERENCES, DISTRIBUTION INFORMATION, & ADDITIONAL NOTES*	FLOWERING PHENOLOGY/ LIFE FORM	HABITAT SUITABILITY & LOCAL DISTRIBUTION	POTENTIAL FOR OCCURRENCE
FEDERAL/STATE ENDANGERED OR THREATENED AND CALIFORNIA RARE SPECIES					
Amsinckia grandiflora large-flowered fiddleneck	FE CEQA 1B.1	Occurs in cismontane woodland and valley and foothill grassland between 275 and 550 meters. Known from fewer than 5 natural occurrences around ALA and SJQ counties. Presumed extirpated from CCA.	April-May annual herb	Although suitable vegetation associations are present the only known natural populations known (either extant or extirpated) are from vicinities of Corral Hollow and Black Diamond Mines. This species has also never been recorded from valley bottomlands. The nearest CNDDB occurrence (EONDX 5817, from 1992) is 4.2 miles north of the study area, at Los Vaqueros Reservoir. This occurrence is a failed reintroduction site.	Not Expected
Arctostaphylos pallida pallid manzanita	FT SE 1B.1	Occurs on siliceous shale, sandy, or gravelly sites in broadleaf upland forest, closed-cone coniferous forest, chaparral, cismontane woodland, and coastal scrub between 185-465 meters. Known only from ALA and CCA counties.	December-March evergreen shrub	No suitable vegetation associations or substrates are present.	Absent Would have been detectable during the February 2016 site visit
Chloropyron palmatum palmate-bracted birds beak	FE SE 1B.1	Occurs on alkaline soils in chenopod scrub and valley and foothill grassland, between 5-155 meters. Known from ALA, COL, FRE, GLE, MAD and YOL counties. Presumed extirpated from SJQ.	May-October annual herb (hemiparasitic)	Although suitable vegetation associations are present the necessary host suspected for this species in the Livermore Valley is saltgrass (*Distichlis spicata*) (Coats et al. 1988; Chuang and Heckard 1973) which is absent from the study area. The nearest CNDDB occurrence (EONDX 3037, from 2012) is about 1 mile east of the study area, at Springtown Wetlands Reserve.	Not Expected
Chorizanthe robusta var. *robusta* robust spineflower	FE CEQA 1B.1	Occurs on sandy or gravelly soils in maritime chaparral, cismontane woodland, coastal dunes and coastal scrub between 3 and 300 meters. Known from MNT, SCR, SFO counties; presumed extirpated from ALA, SCL, and SMT counties.	April-September annual herb	No suitable vegetation associations or substrates are present.	None

Species Name Common Name	Federal, State, CNPS Listing	Habitat Preferences, Distribution Information, & Additional Notes*	Flowering Phenology/ Life Form	Habitat Suitability & Local Distribution	Potential for Occurrence
Clarkia franciscana Presidio clarkia	FE SCE 1B.1	Occurs on serpentine sites in coastal scrub, valley and foothill grassland between 25 and 335 meters. Known from ALA and SFO counties.	May-July annual herb	Although suitable vegetation associations are present the necessary serpentine substrate is absent. The nearest CNDDB occurrence (EONDX 13632, from 2004) is about 21 miles west of the study area, at Redwood Regional Park.	Not expected
Deinandra bacigalupii Livermore tarplant	None SCE 1B.2	Occurs in alkaline meadows and seeps between 150 and 185 meters. Known only from ALA county.	June-October annual herb	Suitable vegetation associations and substrates are present. The nearest CNDDB occurrence (EONDX 44494, from 2010) is about 1.2 miles east of the study area, near the intersection of Ames street and Raymond Road.	Not Observed Would have been detectable during the 2016 protocol-level surveys
Holocarpha macradenia Santa Cruz tarplant	FT SE 1B.1	Occurs in coastal prairie, coastal scrub and valley and foothill grassland often on clayey and sandy substrates. Last remaining natural population in the San Francisco Bay area extirpated by development in 1993.	June-October annual herb	Although suitable vegetation associations are present this species only occurs in with a coastal or bay side influence. The nearest CNDDB occurrence (EONDX 48966, from 1915) is about 17 miles west of the study area, near Hayward.	Not expected
Lasthenia conjugens Contra Costa goldfields	FE CEQA 1B.1	Occurs in cismontane woodland, alkaline playas, valley and foothill grassland, and vernal pools. Occurs on mesic sites counties from between 0-470 meters. Known from ALA, CCA, MNT, NAP, and SOL. Presumed extirpated from MEN, SBA, and SCL counties.	March-June annual herb	Suitable vegetation communities and vernal hydrology are present. The nearest CNDDB occurrence (EONDX 30917, from 2010) is about 17 miles southwest of the study area, in Fremont.	Not Observed Would have been detectable during the 2016 protocol-level surveys
Sanicula saxatilis rock sanicle	None SR 1B.2	Occurs on rocky soils in broadleafed upland forest, chaparral, and valley and foothill grassland between 620-1,175 meters. Known from CCA and SCL counties.	April-May perennial herb	No suitable vegetation associations or substrates are present.	None
Suaeda californica California seablite	FE CEQA 1B.1	Occurs in marshes and swamps, margins of coastal salt marshes from 0-15 meters. Known from SLO county, presumed extirpated from ALA, CCA, SCL, and SFO counties.	July-October perennial evergreen shrub	No suitable vegetation associations or tidally influenced habitat are present.	None
CALIFORNIA NATIVE PLANT SOCIETY LISTED AND LOCALLY RARE SPECIES					
Acanthomintha lanceolata Santa Clara thorn-mint	None CEQA 4.2	Occurs in rocky soils and sometimes serpentine sites in chaparral, cismontane woodland, and coastal scrub between 80 and 1200 meters. Known from ALA, FRE, MER, MNT, SBT, SCL, SJQ, and STA counties.	March-June annual herb	No suitable vegetation associations or substrates are present.	None

SPECIES NAME COMMON NAME	FEDERAL, STATE, CNPS LISTING	HABITAT PREFERENCES, DISTRIBUTION INFORMATION, & ADDITIONAL NOTES*	FLOWERING PHENOLOGY/ LIFE FORM	HABITAT SUITABILITY & LOCAL DISTRIBUTION	POTENTIAL FOR OCCURRENCE
Amsinckia lunaris bent-flowered fiddleneck	None CEQA 1B.2	Occurs in coastal bluff scrub, cismontane woodland and valley and foothill grassland between 3-500 meters. Many collections are old. Known from ALA, CCA, COL, LAK, MRN, NAP, SCR, SMT and SON counties. May be present in SIS and SHA counties.	March-June annual herb	Although suitable vegetation associations are present this taxon prefers the ecotone of multiple habitats listed. The nearest CNDDB occurrence (EONDX 62466, from 2008) is about 17 miles northwest of the study area, near Rocky Ridge.	Not expected
Androsace elongata subsp. *acuta* California androsace	None CEQA 4.2	Occurs in chaparral, cismontane woodland, coastal scrub, meadows and seeps, pinyon and juniper woodland, and valley and foothill grassland between 150 and 1200 meters. Known from throughout California, Baja, and Oregon.	March-June annual herb	Although suitable vegetation associations are present this species prefers exposed slopes and cut banks in the vicinity of the study area. The closest herbarium record is a Ertter collection (Accession# UC1606382) from Mines Rd.	Not expected
Anomobryum julaceum slender silver moss	None CEQA 4.2	Occurs on damp rock and soil on outcrops, usually on roadcuts, in broadleaved upland forest, lower montane coniferous forest, and North Coast coniferous forest between 100-1000 meters. Known in BUT, CCA, HUM, LAX, MPA, SBA, SCR, SHA, and SON counties.	Wet Season moss	No suitable vegetation associations or substrates are present.	None
Arctostaphylos auriculata Mt. Diablo manzanita	None CEQA 1B.3	Occurs on sandstone in chaparral and cismontane woodland between 135 and 650 meters. Known only from CCA county.	January-March perennial evergreen shrub	No suitable vegetation associations or substrates are present. This species is endemic to Contra Costa County.	Absent Would have been detectable during the February 2016 site visit
Arctostaphylos manzanita subsp. *laevigata* Contra Costa manzanita	None CEQA 1B.2	Occurs on rocky soils in chaparral between 430 and 1100 meters. Known only from CCA county.	January-April perennial evergreen shrub	No suitable vegetation associations or substrates are present. This species is endemic to Contra Costa County.	Absent Would have been detectable during the February 2016 site visit
Astragalus tener var. *tener* alkali milk-vetch	None CEQA 1B.2	Occurs on alkaline substrates in playas, valley and foothill grassland on adobe clay, and vernal pools between 1-60 meters. Known from ALA, MER, NAP, SOL and YOL counties. Presumed extirpated from CCA, MNT, SBT, SCL, SFO, SJQ, SON, and STA counties.	March-June annual herb	Suitable vegetation associations and substrates are present. The nearest CNDDB occurrence (EONDX 6925, from 1958) is a nonspecific location mapped about 2.8 miles east of the study area, at the East end of the Livermore Valley.	Not Observed Would have been detectable during the 2016 protocol-level surveys

Species Name Common Name	Federal, State, CNPS Listing	Habitat Preferences, Distribution Information, & Additional Notes*	Flowering Phenology/ Life Form	Habitat Suitability & Local Distribution	Potential for Occurrence
Atriplex cordulata var. *cordulata* heartscale	None CEQA 1B.2	Occurs on saline or alkaline soil in chenopod scrub, meadows and seeps, and sandy valley and foothill grassland between 0 and 560 meters. Known from ALA, BUT, CCA, COL, FRE, GLE, KRN, MAD, MER, SLO, SOL, counties in elevation. Presumed extirpated from SJQ, STA, and YOL counties.	April-October annual herb	Although suitable vegetation associations and substrates are present mis-identifications of *Atriplex* species have perpetuated the occurrence of this taxon in the East Bay. Nomad senior botanist Heath Bartosh has checked the identifications of all CNDDB occurrences of this species in these counties and found them to be *Atriplex coronata* var. *coronata*.	Not expected
Atriplex coronata var. *coronata* crownscale	None CEQA 4.2	Occurs in alkaline, often clay soils in chenopod scrub, valley and foothill grassland, and vernal pools between 1 and 590 meters in elevation. Known from ALA, CCA, FRE, GLE, KNG, KRN, MER, MNT, SLO, SOL and STA counties.	March-October annual herb	Suitable vegetation and substrates present. The closest herbarium record is a Ertter collection (Accession# UC2031481) from Spring Town Wetlands.	Not Observed Would have been detectable during the 2016 protocol-level surveys
Atriplex depressa brittlescale	None CEQA 1B.2	Occurs on alkaline and clay soils in chenopod scrub, meadows and seeps, playas, valley and foothill grassland, and vernal pools between 1 and 320 meters in elevation. Known from ALA, CCA, COL, FRE, GLE, KRN, MER, SOL, STA, TUL and YOL counties.	April-October annual herb	Suitable vegetation and substrates present. There is a cluster of several CNDDB occurrences just east of the study area, with the nearest one (EONDX 51025, from 2000) being within 0.5 mile.	Not Observed Would have been detectable during the 2016 protocol-level surveys
Atriplex minuscula lesser saltscale	None CEQA 1B.1	Occurs on alkaline and sandy soils in chenopod scrub, playas, and valley and foothill grassland. Known from ALA, BUT, FRE, KRN, MAD, MER, and TUL counties between 15 and 200 meters. Presumed extirpated from STA county.	May-October annual herb	Suitable vegetation and substrates present. There is a CNDDB occurrence (EONDX 83626, from 2010) within one mile of the study area, just south of the Hartford Avenue and Lorraine St intersection.	Not Observed Would have been detectable during the 2016 protocol-level surveys
Balsamorhiza macrolepis big-scale balsamroot	None CEQA 1B.2	Occurs often on serpentine sites in chaparral, cismontane woodland, and valley and foothill grassland. Known from ALA, AMA, BUT, COL, ELD, LAK, MPA, NAP, PLA, SCL, SHA, SOL, SON, TEH, and TUO counties between 90-1555 meters.	March-June perennial herb	Suitable vegetation associations are present. In the Livermore Valley this species occurs in non-serpentine habitat. The nearest CNDDB occurrence (EONDX 32783), from 1993) is 7.1 miles southeast of the study area, near Poppy Ridge.	Not Observed Would have been detectable during the 2016 protocol-level surveys
Blepharizonia plumosa big tarplant	None CEQA 1B.1	Occurs in valley and foothill grassland. Known from ALA and CCA, KRN, MNT, SBT, SJQ, SLO, and STA counties between 30-505 meters. Presumed extirpated in SOL county.	July-October annual herb	Although suitable vegetation associations are present, this taxon prefers Altamont series soils found on the east side of the Diablo Range crest, east of the Greenville fault. The nearest CNDDB occurrence (EONDX 90694, from 2007) is from 5 miles northeast of the study area, near Vasco Caves Regional Preserve.	Not Observed Would have been detectable during the 2016 protocol-level surveys

SPECIES NAME COMMON NAME	FEDERAL, STATE, CNPS LISTING	HABITAT PREFERENCES, DISTRIBUTION INFORMATION, & ADDITIONAL NOTES*	FLOWERING PHENOLOGY/ LIFE FORM	HABITAT SUITABILITY & LOCAL DISTRIBUTION	POTENTIAL FOR OCCURRENCE
California macrophylla round-leaved filaree	None CEQA 1B.1	Occurs on clay soils in cismontane woodland, valley and foothill grassland on clay soils. Known from ALA, CCA, COL, FRE, GLE, KNG, KRN, LAK, LAS, LAX, MER, MNT, NAP, RIV, SBA, SBT, SDG, SJQ, SLO, SMT, SOL, STA, THE, VEN, and YOL counties between 15-1,200 meters.	March-May annual Herb	Suitable vegetation associations and substrates are present. There is a cluster of 4 CNDDB occurrences within 5 miles of the study area, with the nearest (EONDX 82257, from 2010) being 2.4 miles northeast, from Canada de los Vaqueros.	Not Observed Would have been detectable during the 2016 protocol-level surveys
Calochortus pulchellus Mt. Diablo fairy-lantern	None CEQA 1B.2	Occurs in chaparral, cismontane woodland, riparian woodland, and valley and foothill grassland between 30-840 meters. Known from ALA and CCA counties.	April-June perennial herb (bulbiferous)	Although suitable vegetation associations are present this taxon has never been recorded from the Livermore Valley, and it prefers the ecotones listed habitats. The nearest CNDDB occurrence (EONDX 84606, from 2003) is 3.5 miles north, at the Los Vaqueros Reservoir.	Not Expected
Calochortus umbellatus Oakland star-tulip	None CEQA 4.2	Occurs in chaparral, cismontane woodland, riparian woodland, and valley and foothill grassland between 30 and 840 meters. Known from ALA, CCA, and SOL counties.	April-June perennial bulbiferous herb	Although suitable vegetation associations are present this taxon has never been recorded from the Livermore Valley, and it prefers the ecotones listed habitats. This species is not tracked by the CNDDB.	Not Expected
Campanula exigua chaparral harebell	None CEQA 1B.2	Occurs in rocky and serpentine soils in chaparral from 275-1250 meters in elevation. Known from ALA, CCA, MER, SBT, SCL, and STA counties.	May-June annual herb	No suitable vegetation associations or substrates are present.	None
Centromadia parryi subsp. *congdonii* Congdon's tarplant	None CEQA 1B.2	Occurs on alkaline soils in valley and foothill grassland. Known from ALA, CCA, MNT, SCL, SLO, and SMT counties between 1-230 meters. Presumed extirpated from SCR and SOL counties.	June-November annual herb	Suitable vegetation associations and substrates are present. Seedlings of a *Centromadia* species were observed in multiple places within the study area that may be identified as this taxon during the proper blooming period. There is a CNDDB occurrence (EONDX 42350, from 1998) within 0.5 mile southeast of the study area, near Hartford Avenue.	Present within the study area between May School Road and Livermore Avenue as well as south of Hartman Road

Species Name Common Name	Federal, State, CNPS Listing	Habitat Preferences, Distribution Information, & Additional Notes*	Flowering Phenology/ Life Form	Habitat Suitability & Local Distribution	Potential for Occurrence
Chloropyron molle subsp. *hispidum* hispid bird's-beak	None CEQA 1B.1	Occurs on alkaline soils in meadows and seeps, playas, and valley and foothill grassland between 1 and 155 meters. Known from ALA, FRE, KRN, MER, PLA, and SOL counties.	June-September annual herb (hemiparasitic)	Although suitable vegetation associations are present the necessary host suspected for this species in the Livermore Valley is saltgrass (*Distichlis spicata*) (Coats et al. 1988; Chuang and Heckard 1973) which is absent from the study area. There is a CNDDB occurrence (EONDX 4686, from 2003) from 1.3 miles east of the study area, from Springtown Wetlands Reserve.	Not Expected
Clarkia concinna subsp. *automixa* Santa Clara red ribbons	None CEQA 4.3	Occurs in chaparral and cismontane woodland between 90 and 1500 meters. Known from ALA, SCL, and SCR counties.	April-July annual herb	No suitable vegetation associations or substrates are present.	None
Convolvulus simulans small-flowered morning glory	None CEQA 4.2	Occurs on clay soils and serpentine seeps in chaparral, coastal scrub, and valley and foothill grassland between 30 and 700 meters in elevation. Known from CCA, FRE, KRN, LAX, ORA, RIV, SBA, SBT, SCM, SCT, SCZ, SDG, SJQ, SLO, and STA counties.	March-July annual herb	Suitable vegetation associations and substrates present The closest herbarium record is a Taylor collection (Accession# JEPS100237) from Byron Hot Springs.	Not Observed Would have been detectable during the 2016 protocol-level surveys
Delphinium californicum subsp. *interius* Hospital Canyon larkspur	None CEQA 1B.2	Occurs in openings of chaparral, mesic cismontane woodland, and coastal scrub between 195 and 1095 meters elevation. Known from ALA, CCA, MER, MNT, SBT, SCL, SJQ, and STA counties.	April-June perennial herb	No suitable vegetation associations or substrates are present.	None
Delphinium recurvatum recurved larkspur	None CEQA 1B.2	Occurs on alkaline soils in chenopod scrub, cismontane woodland, and valley and foothill grassland between 3 and 790 meters elevation. Known from ALA, CCA, FRE, GLE, KNG, KRN, MAD, MER, MNT, SJQ, SLO, SOL, SUT, and TUL counties. Presumed extirpated from BUT and COL counties.	March-June perennial herb	Suitable vegetation associations and substrates present .The nearest CNDDB occurrence (EONDX 2452, from 1991) is 8.5 miles northeast, on the county line.	Not Observed Would have been detectable during the 2016 protocol-level surveys
Dirca occidentalis western leatherwood	None CEQA 1B.2	Occurs on mesic sites in broadleaved upland forest, closed-cone coniferous forest, chaparral, cismontane woodland, North Coast coniferous forest, riparian forest, and riparian woodland between 50-395 meters. Known from ALA, CCA, MRN, SCL, SMT, and SON counties.	January-April deciduous shrub	No suitable vegetation associations or substrates are present.	None

Species Name Common Name	Federal, State, CNPS Listing	Habitat Preferences, Distribution Information, & Additional Notes*	Flowering Phenology/ Life Form	Habitat Suitability & Local Distribution	Potential for Occurrence
Eriogonum truncatum Mt. Diablo buckwheat	None CEQA 1B.1	Occurs in sandy soils in chaparral, coastal scrub, and valley and foothill grassland between 3 and 350 meters elevation. Known from CCA counties. Presumed extirpated from SOL county.	April-December annual herb	Although suitable vegetation associations are present this taxon has never been recorded from the Livermore Valley and it prefers the ecotone of listed habitats. No suitable vegetation associations or substrates are present.	None
Eriophyllum jepsonii Jepson's woolly sunflower	None CEQA 4.3	Occurs occasionally on serpentine sites in chaparral, cismontane woodland, and coastal scrub between 200 and 1025 meters elevation. Known from ALA, CCA, KRN, MNT, SBT, SCL, STA, and VEN counties.	April-June subshrub	No suitable vegetation associations or substrates are present.	None
Eryngium spinosepalum spiny-sepaled button-celery	None CEQA 1B.2	Occurs in valley and foothill grassland and vernal pools between 80 and 975 meters elevation. Known from CCA, FRE, KRN, MAD, MER, SLO, STA, TUL, and TUO counties.	April-June annual/perennial herb	Suitable vegetation associations and substrates present. The nearest CNDDDB occurrence (EONDX 92244, from 2007) is from 8.3 miles northeast of the study area, near Byron Airport.	Not Observed Would have been detectable during the 2016 protocol-level surveys
Eschscholzia rhombipetala diamond-petaled California poppy	None CEQA 1B.1	Occurs on alkaline and clay soils in valley and foothill grassland between 0 and 975 meters elevation. Known from ALA, SJQ, SLO counties. Presumed extirpated from CCA, COL and STA counties.	March-April annual herb	Suitable vegetation associations and substrates present. The nearest CNDDB occurrence (EONDX 96884, from 2015) is from 8 miles northeast of the study area, near Bethany Reservoir.	Not Observed Would have been detectable during the 2016 protocol-level surveys
Extriplex joaquinana San Joaquin spearscale	None CEQA 1B.2	Occurs in alkaline soils in chenopod scrub, meadows and seeps, playas and valley and foothill grasslands between 1 and 835 meters elevation. Known from ALA, CCA, COL, FRE, GLE, MER, MNT, NAP, SBT, SOL and YOL counties. Presumed extirpated from SCL, SJQ and TUL counties.	April-October annual herb	Suitable vegetation associations and substrates present. There are several CNDDB occurrences near the study area, with the nearest (EONDX 6737, from 1991) being about a mile east, near the Springvale housing development.	Present within the study area between May School Road and Livermore Avenue as well as south of Hartman Road
Frittilaria agrestis stinkbells	None CEQA 4.2	Occurs on clay, sometimes serpentine soils, in chaparral, cismontane woodland, pinyon and juniper woodland, and valley and foothill grassland between 10 and 1555 meters elevation. Known from ALA, CCA, FRE, KRN, MEN, MER, MNT, MPA, PLA, SAC, SBA, SBT, SCL, SLO, STA, TUO, VEN and YUB counties. Presumed extirpated from SCR and SMT counties.	March-June perennial bulbiferous herb	Suitable vegetation associations and substrates present. The nearest CNDDB occurrence (EONDX 6156, from 1992) is 0.4 miles east of the study area, about ¼ mile west of Vasco road.	Not Observed Would have been detectable during the 2016 protocol-level surveys

Species Name Common Name	Federal, State, CNPS Listing	Habitat Preferences, Distribution Information, & Additional Notes*	Flowering Phenology/ Life Form	Habitat Suitability & Local Distribution	Potential for Occurrence
Fritillaria liliacea Fragrant fritillary	None CEQA 1B.2	Occurs on clay or serpentine sites in cismontane woodland, coastal prairie, coastal scrub, valley and foothill grassland near the coast between 3-410 meters. Known from ALA, CCA, MNT, MRN, SBT, SCL, SFO, SMT, SOL and SON counties.	February-April perennial herb (bulbiferous)	Although suitable vegetation associations are present this taxon does not occur east of Mount Diablo as it is associated with the coastal fog incursion zone and the study areas is beyond this zone. The nearest CNDDB occurrence (EONDX 94652) is a historical, nonspecific point 14 miles northwest of the study area, near Danville.	Not expected
Helianthella castanea Diablo helianthella	None CEQA 1B.2	Occurs in broadleaved upland forest, chaparral cismontane woodland, coastal scrub, riparian woodland, and valley and foothill grassland between 60-1,300. Known from ALA, CCA, and SMT counties. Presumed extirpated from MRN and SFO counties.	March-June perennial herb	Although suitable vegetation associations are present this taxon has never been recorded from the Livermore Valley and it prefers the ecotone of listed habitats. The nearest CNDDB occurrence (EONDX 851, from 1988) is 2.5 miles northeast of the study area, near Los Vaqueros Reservoir.	Not expected
Hesperevax caulescens hogwallow starfish	None CEQA 4.2	Occurs sometimes on alkaline soils in mesic valley and foothill grassland and shallow vernal pools between 0 and 505 meters elevation. Known from ALA, AMA, BUT, CCA, COL, FRE, GLE, KRN, MER, MNT, SAC, SJQ, SLO, SOL, STA, SUT, THE, and YOL counties. Presumed extirpated from NAP and SDG counties.	March-June annual herb	Suitable vegetation associations and substrates present. Seedlings of a *Hesperevax* species were observed in multiple places within the study area that may be identified as this taxon during the proper blooming period. The closest herbarium record is a Ertter collection (Accession# UC2031481) from Springtown wetlands.	Present within the study area south of Hartman Road
Hesperolinon breweri Brewer's western flax	None CEQA 1B.2	Occurs often in serpentine soils in chaparral, cismontane woodland and valley and foothill grassland. Known from CCA, NAP and SOL counties between 30 and 945 meters elevation.	May-July annual herb	Although suitable vegetation associations are present this taxon has never been recorded from the Livermore Valley and it prefers the ecotone of listed habitats. The nearest CNDDB occurrence (EONDX 9470, from 1988) is 2.7 miles north of the study area, near Morgan Territory Rd.	Not Expected
Legenere limosa legenere	None CEQA 1B.1	Occurs in vernal pools between 1 and 880 meters. Known from ALA, LAK, MNT, NAP, PLA, SAC, SCL, SHA, SJQ, SMT, SOL, SON, TEH and YUB counties; presumed extirpated from STA county.	April-June annual herb	No suitable vegetation associations or substrates are present.	None
Leptosiphon acicularis bristly leptosiphon	None CEQA 4.2	Occurs in chaparral, cismontane woodland, coastal prairie, and valley and foothill grassland between 55 and 1500 meters. Known from ALA, BUT, FRE, HUM, LAK, MEN, MRN, NAP, SCL, SMT, and SON counties.	April-July annual herb	Although suitable vegetation associations are present this species has only been recorded west of the Oakland/Berkeley Hills in the East Bay counties. The closest herbarium record is a Ertter collection (Accession# UC2014597) from Pleasanton Ridge.	Not Expected

Species Name Common Name	Federal, State, CNPS Listing	Habitat Preferences, Distribution Information, & Additional Notes*	Flowering Phenology/ Life Form	Habitat Suitability & Local Distribution	Potential for Occurrence
Leptosiphon ambiguus serpentine leptosiphon	None CEQA 4.2	Occurs often in serpentine soils in cismontane woodland, coastal scrub, and valley and foothill grassland between 120 and 1,130 meters. Known from ALA, CCA, MER, SBT, SCL, SCR, SJQ, SMT, and STA counties.	March-June annual herb	Although suitable vegetation associations are present in the study area this species prefers serpentine habitat and has never been recorded from the Livermore Valley. The closest herbarium record is a Ertter collection (Accession# RSA721361) from Rancho Los Mochos Boy Scout Camp.	Not Expected
Leptosyne hamiltonii Mt. Hamilton coreopsis	None CEQA 1B.2	Occurs in rocky soils in cismontane woodland between 550 and 1300 meters. Known from ALA, SCL, and STA counties.	March-May annual herb	No suitable vegetation associations or substrates are present.	None
Malacothamnus hallii Hall's bush-mallow	None CEQA 1B.2	Occurs in chaparral and coastal scrub between 10 and 760 meters elevation. Known from CCA, MER, SCL, SMT, and STA counties.	May-October perennial evergreen shrub	No suitable vegetation associations or substrates are present.	None
Monardella antonina subsp. *antonina* San Antonio Hills monardella	None CEQA 3	Occurs in chaparral and cismontane woodland from 320-1000 meters. Known from MNT and FRE, possibly ALA, CCA, SCL and SBT counties. This taxon is no longer recognized in TJM2, it has been synonomized with *Monardella villosa* subsp. *villosa*	June-August perennial rhizomatous herb	No suitable vegetation associations or substrates are present.	None
Monolopia gracilens woodland woollythreads	None CEQA 1B.2	Occurs on serpentine soil in broadleaved upland forest, chaparral, cismontane woodland, North Coast coniferous forest, and valley and foothill grassland between 100 and 1200 meters elevation. Known from ALA, CCA, MNT, SBT, SCL, SCR, SLO, and SMT counties.	February-July annual herb	Although suitable vegetation associations are present this species is a fire follower and the study areas have not burned within the last five years. The nearest CNDDB occurrence (EONDX 80189, from 1935) is 12.8 miles northwest of the study area, from Mt. Diablo State Park.	Not expected
Myosurus minimus subsp. *apus* little mousetail	None CEQA 3.1	Occurs in valley and foothill grassland and alkaline vernal pools between 20 and 640 meters. Known from ALA, CCA, COL, LAK, MER, RIV, SBD, SDG, SOL, TUL, and YOL counties.	March-June annual herb	Suitable vegetation associations and substrates present. The closest herbarium record is a Greenhouse collection (Accession# JEPS107030) from Springtown Wetland Preserve.	Not Observed Would have been detectable during the 2016 protocol-level surveys
Navarretia nigelliformis subsp. *nigelliformis* adobe navarretia	None CEQA 4.2	Occurs in clay, sometimes serpentine soils in valley and foothill grassland and vernal pools between 100 and 1000 meters. Known from ALA, BUT, CCA, COL, FRE, KRN, MER, MNT, PLA, SUT, and TUL counties.	April-June annual herb	Suitable vegetation associations and substrates present. The closest herbarium record is a Gowen collection (Accession# JEPS116990) from the west end of Horse Valley.	Not Observed Would have been detectable during the 2016 protocol-level surveys

Species Name Common Name	**Federal, State, CNPS Listing**	**Habitat Preferences, Distribution Information, & Additional Notes***	**Flowering Phenology/ Life Form**	**Habitat Suitability & Local Distribution**	**Potential for Occurrence**
Navarretia nigelliformis subsp. *radians* shining navarretia	None CEQA 1B.2	Occurs in clay soils in cismontane woodland, valley and foothill grassland and vernal pools between 76 and 1000 meters. Known from ALA, CCA, COL, FRE, MAD, MER, MNT, SBT, SJQ and SLO counties.	April-July annual herb	Suitable vegetation associations and substrates present. The nearest CNDDB occurrence (EONDX 84678, from 1986) is 12 miles southeast of the study area, from Corral Hollow.	Not Observed Would have been detectable during the 2016 protocol-level surveys
Navarretia prostrata prostrate vernal pool navarretia	None CEQA 1B.1	Occurs in mesic soils in coastal scrub, meadows and seeps, alkaline valley and foothill grassland, and vernal pools between 3 and 1210 meters. Known from ALA, FRE, LAX, MER, MNT, ORA, SBT, SCL, SDG, and SLO counties.	April-July annual herb	Suitable vegetation associations and substrates present. The nearest CNDDB occurrence (EONDX 84401, from 2010) is 3 miles west of the study area, near Dublin.	Not Observed Would have been detectable during the 2016 protocol-level surveys
Phacelia phacelioides Mt. Diablo phacelia	None CEQA 1B.2	Occurs on rocky substrates in chaparral and cismontane woodland counties between 500-1,370 meters. Known from CCA, SBT, SCL, and STA. This taxon is a fire-follower.	April-May annual herb	No suitable vegetation associations or substrates are present.	None
Plagiobothrys glaber Hairless popcorn flower	None CEQA 1A	Occurs in alkaline meadows and seeps and coastal salt marshes and swamps between 15 and 180 meters. Presumed extirpated from ALA, MRN, SBT, and SCL counties- last confirmed sighting in 1954.	March-May annual herb	Suitable vegetation associations and substrates present. The nearest CNDDB occurrence (EONDX 22577, from 1942) is 2.5 miles southeast of the study area, near Downtown Livermore.	Not Observed Would have been detectable during the 2016 protocol-level surveys
Polemonium carneum Oregon polemonium	None CEQA 2B.2	Occurs in coastal prairie, coastal scrub, and lower montane coniferous forest between 0 and 1830 meters. Known from ALA, DNT, HUM, MRN, SFO, SMT, SIS, and SON counties.	April-September perennial herb	No suitable vegetation associations or substrates are present.	None
Puccinellia simplex California alkali grass	None CEQA 1B.2	Occurs in alkaline and vernally mesic soils, sinks, flats and lake margins in chenopod scrub, meadows and seeps, valley and foothill grassland and vernal pools between 2 and 930 meters elevation. Known from ALA, BUT, CCA, COL, FRE, GLE, KRN, LAK, LAX, MAD, MER, NAP, SBD, SCL, SCR, SLO, SOL, STA, TUL, and YOL counties. Presumed extirpated from KNG county.	March-May annual herb	Suitable vegetation associations and substrates present. The closest herbarium record is a Jensen collection (Accession# UCD92246) near the town of Altamont.	Not Observed Would have been detectable during the 2016 protocol-level surveys
Senecio aphanactis rayless ragwort	None CEQA 2.2	Occurs on alkaline soils in coastal scrub, chaparral, and cismontane woodland between 15-800 meters. Known from ALA, CCA, FRE, LAX, MER, MNT, ORA, RIV, SBA, SCL, SCT, SCZ, SDG, SLO, SOL, SRO, and VEN counties.	January-April annual herb	No suitable vegetation associations or substrates are present.	None

SPECIES NAME COMMON NAME	FEDERAL, STATE, CNPS LISTING	HABITAT PREFERENCES, DISTRIBUTION INFORMATION, & ADDITIONAL NOTES*	FLOWERING PHENOLOGY/ LIFE FORM	HABITAT SUITABILITY & LOCAL DISTRIBUTION	POTENTIAL FOR OCCURRENCE
Streptanthus albidus subsp. *peramoenus* most beautiful jewelflower	None CEQA 1B.2	Occurs on serpentine soils in chaparral, cismontane woodland, and valley and foothill grassland from 95-1,000 meters elevation. Known from ALA, CCA, MNT, SCL and SLO counties. This species is no longer recognized in TJM2, as it has been synonomized with *Streptanthus glandulosus* subsp. *glandulosus*	March-October annual herb	Although suitable vegetation associations are present the preferred substrate is absent. This species has also never been recorded as occurring in Livermore Valley. The nearest CNDDB occurrence (EONDX 18964, from 1993) is 14 miles northwest of the study area, at Mt. Diablo State Park.	Not Expected
Streptanthus hispidus Mt. Diablo jewelflower	None CEQA 1B.3	Occurs in rocky soils in chaparral and valley and foothill grassland between 365 and 1200 meters elevation. Known from CCA county.	March-June annual herb	Although suitable vegetation associations are present the preferred substrate is absent. This species has also never been recorded as occurring in Livermore Valley. It is also a strict endemic to Mount Diablo. The nearest CNDDB occurrence (EONDX 4878, from 2010) is 13 miles northwest of the study area, at Mt. Diablo.	None
Stuckenia filiformis subsp. *alpina* slender-leaved pondweed	None CEQA 2B.2	Occurs in assorted shallow freshwater marshes and swamps from 300-2,150 meters elevation. Known from ALA, BUT, CCA, ELD, LAS, MER, MNO, MOD, MPA, NEV, PLA, SCL, SHA, SIE, SMT, SOL, and SON counties.	May-July perennial rhizomatous herb	No suitable vegetation associations or substrates are present.	None
Trifolium hydrophilum saline clover	None CEQA 1B.2	Occurs in marshes and swamps, alkaline and mesic valley and foothill grassland, and vernal pools between 0 and 300 meters. Known from ALA, CCA, LAK, MNT, NAP, SAC, SBT, SCL, SCR, SJQ, SLO, SMT, SOL, SON, and YOL counties.	April-June annual herb	Suitable vegetation associations and substrates present. The nearest CNDDB occurrence (EONDX 49391, from 2006) is about 1.7 miles southeast of the study area, from Springtown Reserve.	Not Observed Would have been detectable during the 2016 protocol-level surveys
Triquetrella californica coastal triquetrella	None CEQA 1B.2	Occurs on soil in coastal bluff scrub and coastal scrub between 10-100 meters. Known from CA, DNT, MEN, MRN, SDG, SFO, SMT, and SON counties.	Moss wet season	No suitable vegetation associations or substrates are present.	None

SPECIES NAME COMMON NAME	FEDERAL, STATE, CNPS LISTING	HABITAT PREFERENCES, DISTRIBUTION INFORMATION, & ADDITIONAL NOTES*	FLOWERING PHENOLOGY/ LIFE FORM	HABITAT SUITABILITY & LOCAL DISTRIBUTION	POTENTIAL FOR OCCURRENCE
Tropidocarpum capparideum caper-fruited tropidocarpum	None CEQA 1B.1	Occurs on alkaline sites in valley and foothill grassland between 1-455 meters elevation. Known from FRE, MNT, and SLO counties. Presumed extirpated from ALA, CCA, GLE, SCL, SJQ counties.	March-April annual herb	Suitable vegetation associations and substrates present. The nearest CNDDB occurrence (EONDX 31866) is a historical, nonspecific point mapped as 3.2 miles southeast of the study area.	Not Observed Would have been detectable during the 2016 protocol-level surveys
Viburnum ellipticum oval-leaved viburnum	None CEQA 2B.3	Occurs on chaparral, cismontane woodland, and lower montane coniferous forest between 215-1,400 meters. Known from CCA, FRE, ELD, GLE, HUM, MEN, NAP, SHA, and SON counties.	May-June shrub (deciduous)	No suitable vegetation associations or substrates are present.	None

[1]Explanation of State and Federal Listing Codes and HCP/NCCP Coverage

Federal listing codes:

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 Category 1 candidates)
SC	Species of Concern – No longer maintained by USFWS
SLC	Species of local concern or conservation importance – No longer maintained by USFWS

California listing codes:

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

California Rare Plant Ranks:

1A	Presumed extinct in California
1B	Rare or Endangered in California and elsewhere
2	Rare or Endangered in California, more common elsewhere
3	Plants for which we need more information - Review list
4	Plants of limited distribution - Watch list

California Native Plant Society Threat Codes:

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

Notes: CNPS List 1A and some List 3 plant species lacking any threat information receive no threat code extension.
CNPS R-E-D Codes have been discontinued

Survey Recommendation Determinations Based On

- Observed phenology at the time of reconnaissance
- Seasonal weather patters
- Collection dates of herbarium specimens
- Blooming times given by the CNPS Inventory

EONDX # is the CNDDB Element Occurrence Index Number which corresponds to unique records in the California Natural Diversity Database (CDFG 2012c).

Abbreviations

AMA Amador
BUT Butte
CAL Calaveras
CCA Contra Costa
CNDDB CA Natural Diversity Database
CNPS CA Native Plant Society
COL Colusa
DNT Del Norte
ELD El Dorado
FRE Fresno
GLE Glenn
HUM Humboldt
KRN Kern
LAK Lake
LAS Lassen
LAX Los Angeles
LCP Local Coastal Plan
MAD Madera
MOD Modoc
MEN Mendocino
MER Merced
MNT Monterey
MPA Mariposa
MRN Marin
NAP Napa
NEV Nevada
ORA Orange
PLA Placer
PLU Plumas
RIV Riverside
SAC Sacramento
SBA Santa Barbara
SBD San Bernardino
SBT San Benito
SCL Santa Clara
SCR Santa Cruz
SCT Santa Catalina Island
SCZ Santa Cruz Island
SDG San Diego
SFO San Francisco
SHA Shasta
SIE Sierra
SIS Siskiyou
SJQ San Joaquin
SMI San Miguel Island
SMT San Mateo
SNI San Nicolas Island
SOL Solano
SON Sonoma
SRO Santa Rosa Island
TEH Tehama
TJM The Jepson Manual
TJMII The Jepson Manual, 2nd. Ed.
TRI Trinity
TUL Tulare
VEN Ventura
YOL Yolo
YUB Yuba

APPENDIX C PLANT SPECIES OBSERVED ON SITE

SPECIES NAME	COMMON NAME	ORIGIN	COLLECTION	LOCALLY RARE	CAL-IPC RATING	CDFA RATING
EUDICOTS						
Amaranthaceae – Amaranth Family						
Amaranthus albus	tumbleweed	Non-Native	---	---	---	---
Amaranthus blitoides	prostrate amaranth	Native	---	C	---	---
Amaranthus deflexus	large fruited amaranth	Non-native	---	---	---	---
Apiaceae – Carrot Family						
Bowlesia incana	bowlesia	Native	---	---	---	---
Foeniculum vulgare	fennel	Non-Native	---	---	High	---
Sanicula bipinnatifida	purple sanicle	Native	---	---	---	---
Torilis arvensis	hedge parsley	Non-Native	---	---	Moderate	---
Torilis nodosa	knotted-hedge parsley	Non-Native	---	---	---	---
Bowlesia incana	bowlesia	Native	---	---	---	---
Apocynaceae – DogbaneFamily						
Asclepias fascicularis	narrow-leaved milkweed	Native	---	---	---	---
Asteraceae – Sunflower Family						
Achyrachaena mollis	blow-wives	Native	---	---	---	---
Anthemis cotula	mayweed	Non-Native	---	---	---	---
Artemisia douglasiana	mugwort	Native	---	---	---	---
Baccharis pilularis subsp. *consanguinea*	Coyote brush	Native	---	---	---	---
Carduus pycnocephalus subsp. *pycnocephalus*	Italian thistle	Non-Native	---	---	Moderate	On List
Carduus tenuiflorus	slender flowered thistle	Non-Native	---	---	Limited	On List
Centaurea melitensis	tocalote	Non-Native	---	---	Moderate	---
Centaurea solstitialis	yellow star thistle	Non-Native	---	---	High	On List
Centromadia fitchii	Fitch's spikeweed	Native	---	---	---	---
Centromadia parryi subsp. *congdonii* (CRPR 1B.2)	Congdon's tarplant	Native	---	*A2	---	---
Centromadia pungens subsp. pungens	common tarweed	Native	---	---	---	---
Cirsium vulgare	bull thistle	Non-Native	---	---	Moderate	On List

SPECIES NAME	COMMON NAME	ORIGIN	COLLECTION	LOCALLY RARE	CAL-IPC RATING	CDFA RATING
Cynara cardunculus	cardoon	Non-Native	---	---	Moderate	On List
Deinandra lobbii	Lobb's tarplant	Native	---	B	---	---
Dittrichia graveolens	dittrichia	Non-Native	---	---	Moderate	---
Erigeron canadensis	horseweed	Native	---	---	---	---
Grindelia camporum	Great Valley gumweed	Native	---	---	---	---
Helminthotheca echioides	bristly ox-tongue	Non-Native	---	---	Limited	---
Hemizonia congesta subsp. *luzulifolia*	hayfield tarweed	Native	---	---	---	---
Hesperevax caulescens (CRPR 4.2)	hogwallow starfish	Native	---	*A2	---	---
Hesperevax sparsiflora var. *sparsiflora*	few-flowered evax	Native	---	---	---	---
Heterotheca grandiflora	telegraph weed	Native	---	---	---	---
Holocarpha virgata subsp. *virgata*	narrow tarplant	Native	---	---	---	---
Hypochaeris glabra	smooth cat's ear	Non-Native	---	---	Limited	---
Hypochaeris radicata	rough cat's ear	Non-Native	---	---	Moderate	---
Lactuca saligna	willowleaf lettuce	Non-Native	---	---	---	---
Lactuca serriola	prickly lettuce	Non-Native	---	---	---	---
Microseris douglasii subsp. douglasii	silver puffs	Native	---	---	---	---
Microseris douglasii subsp. *tenella*	Douglas' silverpuffs	Native	---	---	---	---
Monolopia major	cupped monolopia	Native	---	B	---	---
Senecio vulgaris	groundsel	Non-Native	---	---	---	---
Silybum marianum	milk-thistle	Non-Native	---	---	Limited	---
Sonchus asper subsp. *asper*	prickly sowthistle	Non-Native	---	---	---	---
Sonchus oleraceus	common sowthistle	Non-Native	---	---	---	---
Tragopogon porrifolius	purple salsify	Non-Native	---	---	---	---
Boraginaceae – Borage Family						
Amsinckia intermedia	common fiddleneck	Native	---	---	---	---
Amsinckia lycopsoides	bugloss fiddleneck	Native	---	B	---	---
Amsinckia menziesii	ranchers fireweed	Native	---	---	---	---
Phacelia ciliata	Great Valley phacelia	Native	---	B	---	---
Plagiobothrys stipitatus var. *micranthus*	stalked popcorn flower	Native	---	---	---	---
Plagiobothrys stipitatus var. *stipitatus*	stalked popcorn flower	Native	HB	---	---	---

SPECIES NAME	COMMON NAME	ORIGIN	COLLECTION	LOCALLY RARE	CAL-IPC RATING	CDFA RATING
Plagiobothrys trachycarpus	roughfruit popcornflower	Native	---	B	---	---
Brassicaceae – Mustard Family						
Brassica nigra	black mustard	Non-Native	---	---	Moderate	---
Capsella bursa-pastoris	shepherd's purse	Non-Native	---	---	---	---
Hirschfeldia incana	hoary mustard	Non-Native	---	---	Moderate	---
Lepidium coronopus	Swine cress	Non-Native	---	---	---	---
Lepidium nitidum	shining peppergrass	Native	---	---	---	---
Raphanus sativus	wild radish	Non-Native	---	---	---	---
Sinapis arvensis	charlock	Non-native	---	---	Limited	---
Caryophyllaceae – Pink Family						
Silene gallica	windmill pink	Non-Native	---	---	---	---
Stellaria media	common chickweed	Non-Native	---	---	---	---
Chenopodiaceae – Goosfoot Family						
Chenopodium album	lambs quarters	Non-Native	---	---	---	---
Chenopodium murale	Nettle leaf goosefoot	Non-native	---	---	---	---
Chenopodium vulvaria	stinking goosefoot	Non-Native	---	---	---	---
Extriplex joaquinana (CRPR 1B.2)	San joaquin spearscale	Native	MP	---	---	---
Salsola tragus	Russian thistle	Non-Native	---	---	Limited	---
Copnvolvulaceae – Morning Glory Family						
Convolvulus arvensis	bindweed	Non-Native	---	---	---	On List
Crassulaceae – Stonecrop Family						
Crassula connata	pygmy weed	Native	---	---	---	---
Cucurbitaceae – Gourd Family						
Marah fabacea	California man-root	Native	---	---	---	---
Euphorbiaceae – Spurge Family						
Croton setiger	turkey mullein	Native	---	---	---	---
Euphorbia spathulata	warty spurge	Native	---	---	---	---
Fabaceae – Legume Family						
Acmispon wrangelianus	calf lotus	Native	---	---	---	---
Lathyrus sativus	white pea	Non-Native	---	---	---	---
Lupinus bicolor	dove lupine	Native	---	---	---	---

Species Name	Common Name	Origin	Collection	Locally Rare	Cal-IPC Rating	CDFA Rating
Lupinus microcarpus var. *densiflorus*	dense-flowered lupine	Native	---	---	---	---
Lupinus succulentus	succulent lupine	Native	---	---	---	---
Medicago polymorpha	burclover	Non-Native	---	---	Limited	---
Melilotus indicus	sourclover	Non-Native	---	---	---	---
Trifolium dubium	shamrock clover	Non-Native	---	---	---	---
Trifolium fucatum	sour clover	Native	---	C	---	---
Trifolium glomeratum	clustered clover	Non-Native	---	---	---	---
Trifolium gracilentum	pinpoint clover	Native	---	---	---	---
Trifolium hirtum	rose clover	Non-Native	---	---	Moderate	---
Trifolium willdenovii	tomcat clover	Native	---	---	---	---
Vicia sativa subsp. *nigra*	spring vetch	Non-Native	---	---	---	---
Vicia villosa subsp. *varia*	smooth vetch	Non-Native	---	---	---	---
Vicia villosa subsp. *villosa*	woolly vetch	Non-Native	---	---	---	---
Acmispon wrangelianus	calf lotus	Native	---	---	---	---
Fagaceae – Oak Family						
Quercus lobata	valley oak	Native	---	---	---	---
Geraniaceae – Geranium Family						
Erodium botrys	long-beaked filaree	Non-Native	---	---	---	---
Erodium brachycarpum	foothill filaree	Non-Native	---	---	---	---
Erodium cicutarium	red-stemmed filaree	Non-Native	---	---	Limited	---
Erodium moschatum	white-stem filaree	Non-Native	---	---	---	---
Geranium dissectum	cut-leaf geranium	Non-Native	---	---	Moderate	---
Lamiaceae – Mint Family						
Lamium amplexicaule	henbit	Non-Native	---	---	---	---
Trichostema lanceolatum	vinegar weed	Native	---	---	---	---
Lythraceae – Loosestrife Family						
Lythrum hyssopifolia	hyssop loostrife	Non-Native	---	---	Limited	---
Malvaceae – Mallow Family						
Malva nicaeensis	bull mallow	Non-Native	---	---	---	---
Malva parviflora	cheeseweed	Non-Native	---	---	---	---
Malvella leprosa	alkali mallow	Native	---	---	---	---
Montiaceae – Miner's Lettuce Family						

SPECIES NAME	COMMON NAME	ORIGIN	COLLECTION	LOCALLY RARE	CAL-IPC RATING	CDFA RATING
Calandrinia menziesii	red maids	Native	---	---	---	---
Claytonia perfoliata subsp. *perfoliata*	miner's lettuce	Native	---	---	---	---
Myrsinaceae – Myrsine Family						
Lysimachia arvensis	scarlet pimpernel	Non-Native	---	---	---	---
Onagraceae – Evening Primrose Family						
Epilobium brachycarpum	tall annual willow-herb	Native	---	---	---	---
Orobanchaceae – Broomrape Family						
Bellardia trixago	bellardia	Non-Native	---	---	Limited	---
Castilleja attenuata	valley tassels	Native	---	---	---	---
Castilleja exserta subsp. *exserta*	purple owl's clover	Native	---	---	---	---
Triphysaria eriantha subsp. *eriantha*	johhny tuck	Native	---	---	---	---
Triphysaria versicolor subsp. *faucibarbata*	yellow beak owl's-clover	Native	---	A2	---	---
Papaveraceae – Poppy Family						
Eschscholzia californica	California poppy	Native	---	---	---	---
Plantaginaceae – Poppy Family						
Kickxia elatine	sharp leaved fluellin	Non-Native	---	---	---	---
Plantago lanceolata	English plantain	Non-Native	---	---	Limited	---
*Veronica peregrina s*ubsp. *xalapensis*	purslane speedwell	Native	---	---	---	---
Veronica persica	bird's eye speedwell	Non-Native	---	---	---	---
Polygonaceae – Buckwheat Family						
Polygonum aviculare subsp. *depressum*	common knotweed	Non-Native	---	---	---	---
Rumex crispus	curly dock	Non-Native	---	---	Limited	---
Rumex pulcher	fiddle dock	Non-Native	---	---	---	---
Ranunculaceae – Buttercup Family						
Ranunculus muricatus	spiny buttercup	Non-Native	---	---	---	---
Rubiaceae – Madder Family						
Sherardia arvensis	field madder	Non-Native	---	---	---	---
Urticaceae – Nettle Family						
Urtica urens	dwarf nettle	Non-Native	---	---	---	---
MONOCOTS						
Agavaceae – Agave Family						

SPECIES NAME	COMMON NAME	ORIGIN	COLLECTION	LOCALLY RARE	CAL-IPC RATING	CDFA RATING
Chlorogalum pomeridianum var. *pomeridianum*	soap plant	Native	---	---	---	---
Juncaceae – Rush Family						
Juncus bufonius var. *congestus*	clustered toad rush	Native	---	---	---	---
Poaceae – Grass Family						
Avena barbata	slender oats	Non-Native	---	---	Moderate	---
Avena fatua	wild oats	Non-Native	---	---	Moderate	---
Bromus diandrus	ripgut brome	Non-Native	---	---	Moderate	---
Bromus hordeaceus	soft chess	Non-Native	---	---	Limited	---
Bromus madritensis subsp. *madritensis*	foxtail chess	Non-Native	---	---	---	---
Bromus racemosus	smooth brome	Non-Native	---	---	---	---
Bromus sterilis	poverty brome	Non-Native	---	---	---	---
Cynodon dactylon	Bermuda grass	Non-Native	---	---	Moderate	On List
Distichlis spicata	saltgrass	Native	---	---	---	---
Elymus caput-medusae	medusahead grass	Non-Native	---	---	High	On List
Elymus ponticus	rush wheatgrass	Non-Native	---	---	---	---
Elymus triticoides	creeping wildrye	Native	---	---	---	---
Festuca bromoides	brome fescue	Non-Native	---	---	---	---
Festuca microstachys	Eastwood fescue	Native	---	C	---	---
Festuca myuros	foxtail fescue	Non-Native	---	---	Moderate	---
Festuca perennis	Italian ryegrass	Non-Native	---	---	Moderate	---
Hordeum marinum subsp. *gussoneanum*	Mediterranean barley	Non-Native	---	---	Moderate	---
Hordeum murinum subsp. *glaucum*	smooth barley	Non-Native	---	---	---	---
Hordeum murinum subsp. *leporinum*	hare barley	Non-Native	---	---	Moderate	---
Hordeum vulgare	common barley	Non-Native	---	---	---	---
Phalaris aquatica	Harding grass	Non-Native	---	---	Moderate	---
Phalaris paradoxa	Hood canary grass	Non-Native	---	---	---	---
Polypogon monspeliensis	rabbitsfoot grass	Non-Native	---	---	Limited	---
Triticum aestivum	common wheat	Non-Native	---	---	---	---
Themidaceae – Brodiaea Family						
Brodiaea elegans subsp. *elegans*	harvest brodiaea	Native	---	---	---	---
Dichelostemma capitatum subsp. *capitatum*	blue dicks	Native	---	---	---	---

SPECIES NAME	COMMON NAME	ORIGIN	COLLECTION	LOCALLY RARE	CAL-IPC RATING	CDFA RATING
Triteleia laxa	Ithuriel's spear	Native	---	---	---	---
Zannichelliaceae – Horned Pondweed Family						
Zannichellia palustris	horned pondweed	Native	---	---	---	---

APPENDIX D U.S. FISH AND WILDLIFE SERVICE SPECIES LIST

IPaC resource list

Location

Alameda County, California

Local offices

Sacramento Fish And Wildlife Office

☎ (916) 414-6600
📠 (916) 414-6713

Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846

San Francisco Bay-delta Fish And Wildlife

☎ (916) 930-5603
📠 (916) 930-5654

650 Capitol Mall
Suite 8-300
Sacramento, CA 95814

http://kim_squires@fws.gov

Endangered species

This resource list is for informational purposes only and should not be used for planning or analyzing project level impacts.

Section 7 of the Endangered Species Act **requires** Federal agencies to *"request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action"* for any project that is conducted, permitted, funded, or licensed by any Federal agency.

A letter from the local office and a species list which fulfills this requirement can only be obtained by requesting an official species list either from the Regulatory Review section in IPaC or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by creating a project and making a request from the Regulatory Review section.

Listed species[1] are managed by the Endangered Species Program of the U.S. Fish and Wildlife Service.

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1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information.

The following species are potentially affected by activities in this location:

Amphibians

NAME	STATUS
California Red-legged Frog Rana draytonii There is a **final** critical habitat designated for this species. Your location overlaps the designated critical habitat. http://ecos.fws.gov/ecp/species/2891	Threatened
California Tiger Salamander Ambystoma californiense There is a **final** critical habitat designated for this species. Your location overlaps the designated critical habitat. http://ecos.fws.gov/ecp/species/2076	Threatened

Birds

NAME	STATUS
California Clapper Rail Rallus longirostris obsoletus **No critical habitat** has been designated for this species. http://ecos.fws.gov/ecp/species/4240	Endangered
California Least Tern Sterna antillarum browni **No critical habitat** has been designated for this species. http://ecos.fws.gov/ecp/species/8104	Endangered
Western Snowy Plover Charadrius alexandrinus nivosus There is a **final** critical habitat designated for this species. Your location overlaps the designated critical habitat. http://ecos.fws.gov/ecp/species/8035	Threatened
Yellow-billed Cuckoo Coccyzus americanus There is a **proposed** critical habitat for this species. Your location is outside the proposed critical habitat. http://ecos.fws.gov/ecp/species/3911	Threatened

Not for consultation

Crustaceans

NAME	STATUS
Conservancy Fairy Shrimp Branchinecta conservatio There is a **final** critical habitat designated for this species. Your location is outside the designated critical habitat. http://ecos.fws.gov/ecp/species/8246	Endangered
Longhorn Fairy Shrimp Branchinecta longiantenna There is a **final** critical habitat designated for this species. Your location overlaps the designated critical habitat. http://ecos.fws.gov/ecp/species/4294	Endangered
Vernal Pool Fairy Shrimp Branchinecta lynchi There is a **final** critical habitat designated for this species. Your location overlaps the designated critical habitat. http://ecos.fws.gov/ecp/species/498	Threatened
Vernal Pool Tadpole Shrimp Lepidurus packardi There is a **final** critical habitat designated for this species. Your location overlaps the designated critical habitat. http://ecos.fws.gov/ecp/species/2246	Endangered

Fishes

NAME	STATUS

Delta Smelt Hypomesus transpacificus There is a **final** critical habitat designated for this species. Your location overlaps the designated critical habitat. http://ecos.fws.gov/ecp/species/321	Threatened
Steelhead Oncorhynchus (=Salmo) mykiss There is a **final** critical habitat designated for this species. Your location overlaps the designated critical habitat. http://ecos.fws.gov/ecp/species/1007	Threatened
Tidewater Goby Eucyclogobius newberryi There is a **final** critical habitat designated for this species. Your location is outside the designated critical habitat. http://ecos.fws.gov/ecp/species/57	Endangered

Flowering Plants

NAME	STATUS
California Seablite Suaeda californica **No critical habitat** has been designated for this species. http://ecos.fws.gov/ecp/species/6310	Endangered
Contra Costa Goldfields Lasthenia conjugens There is a **final** critical habitat designated for this species. Your location overlaps the designated critical habitat. http://ecos.fws.gov/ecp/species/7058	Endangered
Large-flowered Fiddleneck Amsinckia grandiflora There is a **final** critical habitat designated for this species. Your location is outside the designated critical habitat. http://ecos.fws.gov/ecp/species/5558	Endangered
Pallid Manzanita Arctostaphylos pallida **No critical habitat** has been designated for this species. http://ecos.fws.gov/ecp/species/8292	Threatened
Palmate-bracted Bird's Beak Cordylanthus palmatus **No critical habitat** has been designated for this species. http://ecos.fws.gov/ecp/species/1616	Endangered
Presidio Clarkia Clarkia franciscana **No critical habitat** has been designated for this species. http://ecos.fws.gov/ecp/species/3890	Endangered
Robust Spineflower Chorizanthe robusta var. robusta There is a **final** critical habitat designated for this species. Your location is outside the designated critical habitat. http://ecos.fws.gov/ecp/species/9287	Endangered
San Mateo Thornmint Acanthomintha obovata ssp. duttonii **No critical habitat** has been designated for this species. http://ecos.fws.gov/ecp/species/2038	Endangered
Santa Cruz Tarplant Holocarpha macradenia There is a **final** critical habitat designated for this species. Your location is outside the designated critical habitat. http://ecos.fws.gov/ecp/species/6832	Threatened

Insects

NAME	STATUS
Bay Checkerspot Butterfly Euphydryas editha bayensis There is a **final** critical habitat designated for this species. Your location is outside the designated critical habitat. http://ecos.fws.gov/ecp/species/2320	Threatened

Not for consultation

Callippe Silverspot Butterfly *Speyeria callippe callippe* **No critical habitat** has been designated for this species. http://ecos.fws.gov/ecp/species/3779	Endangered
Mission Blue Butterfly *Icaricia icarioides missionensis* **No critical habitat** has been designated for this species. http://ecos.fws.gov/ecp/species/6928	Endangered
San Bruno Elfin Butterfly *Callophrys mossii bayensis* **No critical habitat** has been designated for this species. http://ecos.fws.gov/ecp/species/3394	Endangered
Valley Elderberry Longhorn Beetle *Desmocerus californicus dimorphus* There is a **final** critical habitat designated for this species. Your location is outside the designated critical habitat. http://ecos.fws.gov/ecp/species/7850	Threatened

Mammals

NAME	STATUS
Salt Marsh Harvest Mouse *Reithrodontomys raviventris* **No critical habitat** has been designated for this species. http://ecos.fws.gov/ecp/species/613	Endangered
San Joaquin Kit Fox *Vulpes macrotis mutica* **No critical habitat** has been designated for this species. http://ecos.fws.gov/ecp/species/2873	Endangered

Not for consultation

Reptiles

NAME	STATUS
Alameda Whipsnake (=striped Racer) *Masticophis lateralis euryxanthus* There is a **final** critical habitat designated for this species. Your location overlaps the designated critical habitat. http://ecos.fws.gov/ecp/species/5524	Threatened
Giant Garter Snake *Thamnophis gigas* **No critical habitat** has been designated for this species. http://ecos.fws.gov/ecp/species/4482	Threatened
San Francisco Garter Snake *Thamnophis sirtalis tetrataenia* **No critical habitat** has been designated for this species. http://ecos.fws.gov/ecp/species/5956	Endangered

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

This location overlaps the critical habitat for the following species:

NAME	TYPE
Alameda Whipsnake (=striped Racer) *Masticophis lateralis euryxanthus* http://ecos.fws.gov/ecp/species/5524#crithab	Final designated
California Red-legged Frog *Rana draytonii* http://ecos.fws.gov/ecp/species/2891#crithab	Final designated
California Tiger Salamander *Ambystoma californiense* http://ecos.fws.gov/ecp/species/2076#crithab	Final designated
Contra Costa Goldfields *Lasthenia conjugens* http://ecos.fws.gov/ecp/species/7058#crithab	Final designated

Delta Smelt Hypomesus transpacificus http://ecos.fws.gov/ecp/species/321#crithab	Final designated
Longhorn Fairy Shrimp Branchinecta longiantenna http://ecos.fws.gov/ecp/species/4294#crithab	Final designated
Steelhead Oncorhynchus (=Salmo) mykiss http://ecos.fws.gov/ecp/species/1007#crithab	Final designated
Steelhead Oncorhynchus (=Salmo) mykiss http://ecos.fws.gov/ecp/species/1007#crithab	Final designated
Steelhead Oncorhynchus (=Salmo) mykiss http://ecos.fws.gov/ecp/species/1007#crithab	Final designated
Steelhead Oncorhynchus (=Salmo) mykiss http://ecos.fws.gov/ecp/species/1007#crithab	Final designated
Steelhead Oncorhynchus (=Salmo) mykiss http://ecos.fws.gov/ecp/species/1007#crithab	Final designated
Vernal Pool Fairy Shrimp Branchinecta lynchi http://ecos.fws.gov/ecp/species/498#crithab	Final designated
Vernal Pool Tadpole Shrimp Lepidurus packardi http://ecos.fws.gov/ecp/species/2246#crithab	Final designated
Western Snowy Plover Charadrius alexandrinus nivosus http://ecos.fws.gov/ecp/species/8035#crithab	Final designated

Not for consultation

Migratory birds

Birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any activity that results in the take (to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct) of migratory birds or eagles is prohibited unless authorized by the U.S. Fish and Wildlife Service[3]. There are no provisions for allowing the take of migratory birds that are unintentionally killed or injured.

Any person or organization who plans or conducts activities that may result in the take of migratory birds is responsible for complying with the appropriate regulations and implementing appropriate conservation measures.

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1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Conservation measures for birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Year-round bird occurrence data http://www.birdscanada.org/birdmon/default/datasummaries.jsp

The migratory birds species listed below are species of particular conservation concern (e.g. Birds of Conservation Concern) that may be potentially affected by activities in this location, not a list of every bird species you may find in this location. Although it is important to try to avoid and minimize impacts to all birds, special attention should be made to avoid and minimize impacts to birds of priority concern. To view available data on other bird species that may occur in your project area, please visit the AKN Histogram Tools and Other Bird Data Resources.

NAME	SEASON(S)

Allen's Hummingbird Selasphorus sasin http://ecos.fws.gov/ecp/species/9637	Breeding
Bald Eagle Haliaeetus leucocephalus http://ecos.fws.gov/ecp/species/1626	Year-round
Bell's Sparrow Amphispiza belli http://ecos.fws.gov/ecp/species/9303	Year-round
Black Oystercatcher Haematopus bachmani http://ecos.fws.gov/ecp/species/9591	Year-round
Black Rail Laterallus jamaicensis http://ecos.fws.gov/ecp/species/7717	Breeding
Black Skimmer Rynchops niger http://ecos.fws.gov/ecp/species/5234	Breeding
Black-chinned Sparrow Spizella atrogularis http://ecos.fws.gov/ecp/species/9447	Breeding
Black-vented Shearwater Puffinus opisthomelas	Wintering
Burrowing Owl Athene cunicularia http://ecos.fws.gov/ecp/species/9737	Year-round
Common Yellowthroat Geothlypis trichas sinuosa http://ecos.fws.gov/ecp/species/2084	Breeding
Costa's Hummingbird Calypte costae http://ecos.fws.gov/ecp/species/9470	Breeding
Fox Sparrow Passerella iliaca	Wintering
Lawrence's Goldfinch Carduelis lawrencei http://ecos.fws.gov/ecp/species/9464	Breeding
Least Bittern Ixobrychus exilis http://ecos.fws.gov/ecp/species/6175	Breeding
Lesser Yellowlegs Tringa flavipes http://ecos.fws.gov/ecp/species/9679	Wintering
Lewis's Woodpecker Melanerpes lewis http://ecos.fws.gov/ecp/species/9408	Wintering
Loggerhead Shrike Lanius ludovicianus http://ecos.fws.gov/ecp/species/8833	Year-round
Long-billed Curlew Numenius americanus http://ecos.fws.gov/ecp/species/5511	Wintering
Marbled Godwit Limosa fedoa http://ecos.fws.gov/ecp/species/9481	Wintering
Mountain Plover Charadrius montanus http://ecos.fws.gov/ecp/species/3638	Wintering
Nuttall's Woodpecker Picoides nuttallii http://ecos.fws.gov/ecp/species/9410	Year-round

Not for consultation

Oak Titmouse Baeolophus inornatus http://ecos.fws.gov/ecp/species/9656	Year-round
Olive-sided Flycatcher Contopus cooperi http://ecos.fws.gov/ecp/species/3914	Breeding
Peregrine Falcon Falco peregrinus http://ecos.fws.gov/ecp/species/8831	Year-round
Pink-footed Shearwater Puffinus creatopus	Year-round
Red Knot Calidris canutus ssp. roselaari http://ecos.fws.gov/ecp/species/8880	Wintering
Rufous-crowned Sparrow Aimophila ruficeps http://ecos.fws.gov/ecp/species/9718	Year-round
Short-billed Dowitcher Limnodromus griseus http://ecos.fws.gov/ecp/species/9480	Wintering
Short-eared Owl Asio flammeus http://ecos.fws.gov/ecp/species/9295	Wintering
Snowy Plover Charadrius alexandrinus	Breeding
Song Sparrow Melospiza melodia pusillula http://ecos.fws.gov/ecp/species/3509	Year-round
Swainson's Hawk Buteo swainsoni http://ecos.fws.gov/ecp/species/1098	Breeding
Tricolored Blackbird Agelaius tricolor http://ecos.fws.gov/ecp/species/3910	Year-round
Western Grebe aechmophorus occidentalis http://ecos.fws.gov/ecp/species/6743	Year-round
Whimbrel Numenius phaeopus http://ecos.fws.gov/ecp/species/9483	Wintering
Yellow Rail Coturnicops noveboracensis http://ecos.fws.gov/ecp/species/9476	Wintering
Yellow Warbler dendroica petechia ssp. brewsteri http://ecos.fws.gov/ecp/species/3230	Breeding
Yellow-billed Magpie Pica nuttalli http://ecos.fws.gov/ecp/species/9726	Year-round

Not for consultation

What does IPaC use to generate the list of migratory bird species potentially occurring in my specified location?

Landbirds:

Migratory birds that are displayed on the IPaC species list are based on ranges in the latest edition of the National Geographic Guide, Birds of North America (6th Edition, 2011 by Jon L. Dunn, and Jonathan Alderfer). Although these ranges are coarse in nature, a number of U.S. Fish and Wildlife Service migratory bird biologists agree that these maps are some of the best range maps to date. These ranges were clipped to a specific Bird Conservation Region (BCR) or USFWS Region/Regions, if it was indicated in the 2008 list of Birds of Conservation Concern (BCC) that a species was a BCC species only in a particular Region/Regions. Additional modifications have been made to some ranges based on more local or refined range information and/or information provided by U.S. Fish and Wildlife Service biologists with species expertise. All migratory birds that show in areas on land in IPaC are those that appear in the 2008 Birds of Conservation Concern report.

Atlantic Seabirds:

Ranges in IPaC for birds off the Atlantic coast are derived from species distribution models developed by the National Oceanic and Atmospheric Association (NOAA) National Centers for Coastal Ocean Science (NCCOS) using the best available seabird survey data for the offshore Atlantic Coastal region to date. NOAANCCOS assisted USFWS in developing seasonal species ranges from their models for specific use in IPaC. Some of these birds are not BCC species but were of interest for inclusion because they may occur in high abundance off the coast at different times throughout the year, which potentially makes them more susceptible to certain types of development and activities taking place in that area. For more refined details about the abundance and richness of bird species within your project area off the Atlantic Coast, see the Northeast Ocean Data Portal. The Portal also offers data and information about other types of taxa that may be helpful in your project review.

About the NOAANCCOS models: the models were developed as part of the NOAANCCOS project: Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf. The models resulting from this project are being used in a number of decision-support/mapping products in order to help guide decision-making on activities off the Atlantic Coast with the goal of reducing impacts to migratory birds. One such product is the Northeast Ocean Data Portal, which can be used to explore details about the relative occurrence and abundance of bird species in a particular area off the Atlantic Coast.

All migratory bird range maps within IPaC are continuously being updated as new and better information becomes available.

Not for consultation

Can I get additional information about the levels of occurrence in my project area of specific birds or groups of birds listed in IPaC?

Landbirds:

The Avian Knowledge Network (AKN) provides a tool currently called the "Histogram Tool", which draws from the data within the AKN (latest,survey, point count, citizen science datasets) to create a view of relative abundance of species within a particular location over the course of the year. The results of the tool depict the frequency of detection of a species in survey events, averaged between multiple datasets within AKN in a particular week of the year. You may access the histogram tools through the Migratory Bird Programs AKN Histogram Tools webpage.

The tool is currently available for 4 regions (California, Northeast U.S., Southeast U.S. and Midwest), which encompasses the following 32 states: Alabama, Arkansas, California, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, New Hampshire, New Jersey, New York, North, Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Vermont, Virginia, West Virginia, and Wisconsin.

In the near future, there are plans to expand this tool nationwide within the AKN, and allow the graphs produced to appear with the list of trust resources generated by IPaC, providing you with an additional level of detail about the level of occurrence of the species of particular concern potentially occurring in your project area throughout the course of the year.

Atlantic Seabirds:

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAANCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Facilities

Wildlife refuges and fish hatcheries

REFUGE AND FISH HATCHERY INFORMATION IS NOT AVAILABLE AT THIS TIME

Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local
U.S. Army Corps of Engineers District.

WETLAND INFORMATION IS NOT AVAILABLE AT THIS TIME

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

Not for consultation

APPENDIX E CALIFORNIA NATURAL DIVERSITY DATABASE SPECIES LIST

Selected Elements by Scientific Name

California Department of Fish and Wildlife

California Natural Diversity Database

Query Criteria: Taxonomic Group IS (Dune OR Scrub OR Herbaceous OR Marsh OR Riparian OR Woodland OR Forest OR Alpine OR Inland Waters OR Marine OR Estuarine OR Riverine OR Palustrine OR Ferns OR Gymnosperms OR Monocots OR Dicots OR Lichens OR Bryophytes)
 AND Quad IS (Altamont (3712166) OR Byron Hot Springs (3712176) OR Diablo (3712178) OR Dublin (3712168) OR La Costa Valley (3712157) OR Livermore (3712167) OR Mendenhall Springs (3712156) OR Niles (3712158) OR Tassajara (3712177))

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Alkali Meadow Alkali Meadow	CTT45310CA	None	None	G3	S2.1	
Alkali Seep Alkali Seep	CTT45320CA	None	None	G3	S2.1	
Amsinckia grandiflora large-flowered fiddleneck	PDBOR01050	Endangered	Endangered	G1	S1	1B.1
Anomobryum julaceum slender silver moss	NBMUS80010	None	None	G5?	S2	4.2
Arctostaphylos auriculata Mt. Diablo manzanita	PDERI04040	None	None	G2	S2	1B.3
Arctostaphylos manzanita ssp. laevigata Contra Costa manzanita	PDERI04273	None	None	G5T2	S2	1B.2
Astragalus tener var. tener alkali milk-vetch	PDFAB0F8R1	None	None	G2T2	S2	1B.2
Atriplex cordulata var. cordulata heartscale	PDCHE040B0	None	None	G3T2	S2	1B.2
Atriplex depressa brittlescale	PDCHE042L0	None	None	G2	S2	1B.2
Atriplex minuscula lesser saltscale	PDCHE042M0	None	None	G2	S2	1B.1
Balsamorhiza macrolepis big-scale balsamroot	PDAST11061	None	None	G2	S2	1B.2
Blepharizonia plumosa big tarplant	PDAST1C011	None	None	G2	S2	1B.1
California macrophylla round-leaved filaree	PDGER01070	None	None	G3?	S3?	1B.2
Calochortus pulchellus Mt. Diablo fairy-lantern	PMLIL0D160	None	None	G2	S2	1B.2
Campanula exigua chaparral harebell	PDCAM020A0	None	None	G2	S2	1B.2
Centromadia parryi ssp. congdonii Congdon's tarplant	PDAST4R0P1	None	None	G3T2	S2	1B.1

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Chloropyron molle ssp. hispidum hispid salty bird's-beak	PDSCR0J0D1	None	None	G2T2	S2	1B.1
Chloropyron palmatum palmate-bracted salty bird's-beak	PDSCR0J0J0	Endangered	Endangered	G1	S1	1B.1
Cismontane Alkali Marsh Cismontane Alkali Marsh	CTT52310CA	None	None	G1	S1.1	
Clarkia concinna ssp. automixa Santa Clara red ribbons	PDONA050A1	None	None	G5?T3	S3	4.3
Deinandra bacigalupii Livermore tarplant	PDAST4R0V0	None	Candidate Endangered	G1	S1	1B.1
Delphinium californicum ssp. interius Hospital Canyon larkspur	PDRAN0B0A2	None	None	G3T3	S3	1B.2
Delphinium recurvatum recurved larkspur	PDRAN0B1J0	None	None	G2?	S2?	1B.2
Eriogonum truncatum Mt. Diablo buckwheat	PDPGN085Z0	None	None	G2	S2	1B.1
Eryngium jepsonii Jepson's coyote-thistle	PDAPI0Z130	None	None	G2	S2	1B.2
Eryngium spinosepalum spiny-sepaled button-celery	PDAPI0Z0Y0	None	None	G2	S2	1B.2
Eschscholzia rhombipetala diamond-petaled California poppy	PDPAP0A0D0	None	None	G1	S1	1B.1
Extriplex joaquinana San Joaquin spearscale	PDCHE041F3	None	None	G2	S2	1B.2
Fritillaria agrestis stinkbells	PMLIL0V010	None	None	G3	S3	4.2
Fritillaria liliacea fragrant fritillary	PMLIL0V0C0	None	None	G2	S2	1B.2
Helianthella castanea Diablo helianthella	PDAST4M020	None	None	G2	S2	1B.2
Hesperolinon breweri Brewer's western flax	PDLIN01030	None	None	G2?	S2?	1B.2
Legenere limosa legenere	PDCAM0C010	None	None	G2	S2	1B.1
Malacothamnus hallii Hall's bush-mallow	PDMAL0Q0F0	None	None	G2	S2	1B.2
Monolopia gracilens woodland woollythreads	PDAST6G010	None	None	G3	S3	1B.2
Navarretia nigelliformis ssp. radians shining navarretia	PDPLM0C0J2	None	None	G4T2	S2	1B.2
Navarretia prostrata prostrate vernal pool navarretia	PDPLM0C0Q0	None	None	G2	S2	1B.1

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Northern Claypan Vernal Pool Northern Claypan Vernal Pool	CTT44120CA	None	None	G1	S1.1	
Phacelia phacelioides Mt. Diablo phacelia	PDHYD0C3Q0	None	None	G2	S2	1B.2
Plagiobothrys glaber hairless popcornflower	PDBOR0V0B0	None	None	GH	SH	1A
Polemonium carneum Oregon polemonium	PDPLM0E050	None	None	G3G4	S2	2B.2
Puccinellia simplex California alkali grass	PMPOA53110	None	None	G3	S2	1B.2
Senecio aphanactis chaparral ragwort	PDAST8H060	None	None	G3	S2	2B.2
Streptanthus albidus ssp. peramoenus most beautiful jewelflower	PDBRA2G012	None	None	G2T2	S2	1B.2
Streptanthus hispidus Mt. Diablo jewelflower	PDBRA2G0M0	None	None	G2	S2	1B.3
Stuckenia filiformis ssp. alpina slender-leaved pondweed	PMPOT03091	None	None	G5T5	S3	2B.2
Suaeda californica California seablite	PDCHE0P020	Endangered	None	G1	S1	1B.1
Sycamore Alluvial Woodland Sycamore Alluvial Woodland	CTT62100CA	None	None	G1	S1.1	
Trifolium hydrophilum saline clover	PDFAB400R5	None	None	G2	S2	1B.2
Triquetrella californica coastal triquetrella	NBMUS7S010	None	None	G2	S2	1B.2
Tropidocarpum capparideum caper-fruited tropidocarpum	PDBRA2R010	None	None	G1	S1	1B.1
Valley Needlegrass Grassland Valley Needlegrass Grassland	CTT42110CA	None	None	G3	S3.1	
Valley Sink Scrub Valley Sink Scrub	CTT36210CA	None	None	G1	S1.1	
Viburnum ellipticum oval-leaved viburnum	PDCPR07080	None	None	G4G5	S3?	2B.3

Record Count: 54

APPENDIX F CALIFORNIA NATURAL DIVERSITY DATABASE FIELD FORMS

CALIFORNIA NATIVE PLANT SOCIETY

Email to:
treasurehunt@cnps.org
Mail to:
CNPS Rare Plant Program
2707 K Street, Suite 1
Sacramento, CA 95816

For Office Use Only
Source Code: ______ Quad Code: ______
Elm Code: ______ Occ. No.: ______
EO Index: ______ Map Index: ______

Date of Field Work (mm/dd/yyyy): 7/5/16

CNPS Rare Plant Treasure Hunt Field Survey Form

Scientific Name: Centromadia parryi subssp. Congdonii

Common Name (optional): Congdon's tarplant

Species Found? ☒ Yes ☐ No (If not found, please explain why in comments field)

Total No. Individuals 222 north +(220 HB + 240 GW + 250 CB + 200 MP Subsequent Visit? ☐ Yes ☐ No

Is this an existing NDDB occurrence? ______ Yes, Occ. # ☐ No ☐ Unk.

Collection? If yes: ______ Number ______ Herbarium

Phenology:
80 % vegetative
20 % flowering
0 % fruiting

Reporter: Heath Bartosh
Address: 822 Main Street
Martinez CA 94553
E-mail Address: hbartosh@nomadecology.com
Phone: 925-228-1027

CNPS Chapter: ______
Team Name & Members: ______

~~***California Plant Rescue Seed Information***~~
~~Deposited at: ______~~
~~Rec. Future Col. Dates: ______~~
~~Est. # seeds per fruit ______ Est. # fruits col. per plant ______ # Plants Sampled (ideal min. 50) ______~~
~~Fruit and Seed Notes (% fruit dehisced, dehiscence notes, flagging required?, etc.):~~
~~Est. # Seeds Col. (ideal min. 2500) ______~~

Location Description
In north Livermore Valley South of Hartman and west of North Livermore Avenue In field along PG&E Gas Line

Location Information (please attach map, spreadsheet, AND/OR fill out your choice of coordinates, below)

County: Alameda Landowner / Mgr: Private
Quad Name: ______ Elevation: 497 meters/feet
Source of Coordinates (GPS, Google Earth, camera, phone, topo. map & type): Phone GPS Make & Model: Galaxy S7
DATUM: NAD27 ☐ NAD83 ☐ WGS84 ☒ (NAD83 or WGS84 is preferred) Horizontal Accuracy: ______ meters/feet
Coordinate System: UTM Zone 10 ☐ UTM Zone 11 ☐ ***OR*** Geographic (Latitude & Longitude) ☐ (decimal degrees are preferred)
Coordinates:
37.717934, -121.778898

Habitat Description *(plant communities, dominants, associates):*
In valley Bottom in area of alkaline Clay Barrens with non-native annual Grasses and Hemizonia congesta luzulifolia, Hirschfeldia incana, Centaurea solstitialis, and Lactuca serriola

Please fill out separate forms for other rare taxa seen at this site.

Microhabitat Description *(please circle or select all that apply):*
Exposure: [✓ sunny], open, edges, filtered, partial shade, full shade
Slope: [✓ flat], gentle, steep, cliff **Aspect:** north, south, east, west
Moisture: [✓ dry], mesic, moist, seep, wet, submerged to ______ m
Topog: ridge, [✓ valley], canyon, trail, roadside, bank, ditch, swale
Substrate: serpentinite, granitic, carbonate, gabbroic, volcanic, metamorphic, sandstone, shale, other: heavy clay
Soil: sand, gravel, rock, scree, talus, [✓ clay], pumice, loam, alluvium
Other: Alkaline Soils

Site Information Overall site/occurrence quality/viability (site + population): ☐ Excellent ☒ Good ☐ Fair ☐ Poor
Immediate AND surrounding land use: Grazing land and row crops
Visible disturbances: none
Threats: Possible threats from Centaurea solstitialis in the next 20 years
Comments: (site info, notes on ID, reason sp. not found)

Determination: *(check one or more, and fill in blanks)*
☐ Keyed (cite reference): ______
☐ Compared with specimen at: ______
☐ Compared with image from: ______
☒ By another person (name): Heath Bartosh
☐ Other: ______

Photographs:
☐ Plant
☐ Habitat
☐ Diagnostic feature

Submitted elsewhere?
☐ CalPhotos (ID#): ______
☐ Calflora (ID#): ______
☐ Other: ______

Donate photos to CNPS Rare Plant Image Collection? ☐ yes ☐ no

CALIFORNIA NATIVE PLANT SOCIETY

Email to:
treasurehunt@cnps.org
Mail to:
CNPS Rare Plant Program
2707 K Street, Suite 1
Sacramento, CA 95816

For Office Use Only

Source Code: ______ Quad Code: ______
Elm Code: ______ Occ. No.: ______
EO Index: ______ Map Index: ______

Date of Field Work (mm/dd/yyyy): 5/25/16

CNPS Rare Plant Treasure Hunt Field Survey Form

Scientific Name: EXtriplex joaginana

Common Name (optional):

Reporter: H73
Address:
E-mail Address:
Phone:

CNPS Chapter:
Team Name & Members:

Species Found? ☒ Yes ☐ No (If not found, please explain why in comments field)
Total No. Individuals 1 Subsequent Visit? ☐ Yes ☐ No
Is this an existing NDDB occurrence? ______ Yes, Occ. # ☐ No ☒ Unk.
Collection? If yes: ______ Number ______ Herbarium

Phenology:
______ % vegetative
______ % flowering
______ % fruiting

California Plant Rescue Seed Information
Deposited at: ______
Rec. Future Col. Dates: ______
______ Est. # seeds per fruit
______ Est. # fruits col. per plant
______ # Plants Sampled (ideal min. 50)
Fruit and Seed Notes (% fruit dehisced, dehiscence notes, flagging required?, etc.):
______ Est. # Seeds Col. (ideal min. 2500)

Location Description
South of hartman Road west of N. Livermore ~~[illegible]~~ Ave In Cattle pasture near tank and trough

Location Information (please attach map, spreadsheet, AND/OR fill out your choice of coordinates, below)
County: Alameda Landowner / Mgr: Private
Quad Name: ______ Elevation: 502 meters/feet
Source of Coordinates (GPS, Google Earth, camera, phone, topo. map & type): Phone GPS Make & Model: Galaxy S7
DATUM: **NAD27** ☐ **NAD83** ☐ **WGS84** ☒ (NAD83 or WGS84 is preferred) Horizontal Accuracy: ______ meters/feet
Coordinate System: UTM Zone 10 ☐ UTM Zone 11 ☐ ***OR*** Geographic (Latitude & Longitude) ☐ (decimal degrees are preferred)
Coordinates: 37.720085, -121.776455

Habitat Description *(plant communities, dominants, associates):*
In nonnative annual grassland that is occasionally grazed Dominated by Bro hord, Ho mur lep, lactuca serriola, Brassica nigra, Festuca perennis & Hem cong ing.
Please fill out separate forms for other rare taxa seen at this site.

Microhabitat Description *(please circle or select all that apply):*
Exposure: [✓ sunny], open, edges, filtered, partial shade, full shade
Slope: [✓ flat], gentle, steep, cliff **Aspect:** north, south, east, west
Moisture: [✓ dry], mesic, moist, seep, wet, submerged to ______ m
Topog: ridge, [✓ valley], canyon, trail, roadside, bank, ditch, swale
Substrate: serpentinite, granitic, carbonate, gabbroic, volcanic, metamorphic, sandstone, shale, other: ______
Soil: sand, gravel, rock, scree, talus, [✓ clay], pumice, loam, alluvium
Other:

Site Information Overall site/occurrence quality/viability (site + population): ☐ Excellent ☒ Good ☐ Fair ☐ Poor
Immediate AND surrounding land use: Grazing, Dry land farmed
Visible disturbances: none
Threats: large mustard patch to the west ~ 150 ft.
Comments: (site info, notes on ID, reason sp. not found) Given good rating Based on abundance of Tall ungrazed(this year) non native annuals and low abundance of mustard.

Determination: *(check one or more, and fill in blanks)*
☐ Keyed (cite reference): ______
☐ Compared with specimen at: ______
☐ Compared with image from: ______
☐ By another person (name): ______
☐ Other: ______

Photographs:
☐ Plant
☐ Habitat
☐ Diagnostic feature

Submitted elsewhere?
☐ CalPhotos (ID#): ______
☐ Calflora (ID#): ______
☐ Other: ______

Donate photos to CNPS Rare Plant Image Collection? ☐ yes ☐ no

Mail to:
California Natural Diversity Database
Department of Fish and Game
1807 13th Street, Suite 202
Sacramento, CA 95811
Fax: (916) 324-0475 *email: CNDDB@dfg.ca.gov*

Date of Field Work (mm/dd/yyyy): 04/26/2016

For Office Use Only

Source Code ______ Quad Code ______
Elm Code ______ Occ. No. ______
EO Index No. ______ Map Index No. ______

Reset

California Native Species Field Survey Form

Send Form

Scientific Name: Hesperevax caulescens

Common Name: Hogwallow Starfish

Species Found? ☒ Yes ☐ No ______ If not, why?

Total No. Individuals 200K Subsequent Visit? ☐ yes ☒ no

Is this an existing NDDB occurrence? ______ Yes, Occ. # ☐ no ☒ unk.

Collection? If yes: s.n. Number JEPS Museum / Herbarium

Reporter: Michael Park
Address: 1001 VLSB #2465
Berkeley, CA 94720
E-mail Address: mp.calplants@gmail.com
Phone: (510) 393-5030

Plant Information

Phenology: 0 % vegetative 90 % flowering 10 % fruiting

Animal Information

______ # adults ______ # juveniles ______ # larvae ______ # egg masses ______ # unknown

☐ wintering ☐ breeding ☐ nesting ☐ rookery ☐ burrow site ☐ other

Location Description **(please attach map AND/OR fill out your choice of coordinates, below)**

County: Alameda Landowner / Mgr.: Private

Quad Name: ______ Elevation: ______

T____ R____ Sec ____, ____ ¼ of ______¼, Meridian: H☐ M☐ S☐ Source of Coordinates (GPS, topo. map & type): ______

T____ R____ Sec ____, ____ ¼ of ______¼, Meridian: H☐ M☐ S☐ GPS Make & Model ______

DATUM: NAD27 ☐ NAD83 ☐ WGS84 ☒ Horizontal Accuracy ______ meters/feet

Coordinate System: UTM Zone 10 ☐ UTM Zone 11 ☐ **OR** Geographic (Latitude & Longitude) ☒

Coordinates: N 37.71759
W 121.77934

Habitat Description (plants & animals) *plant communities, dominants, associates, substrates/soils, aspects/slope:*
Animal Behavior *(Describe observed behavior, such as territoriality, foraging, singing, calling, copulating, perching, roosting, etc., especially for avifauna):*

Silty Clay .... possibly related to Altamont series
Assoc: Achyracheena mollis, Medicago polymorpha, Microseris douglasii subsp. tenella, Bromus hordeaceus, Festuca perennis Avena fatua, Hesperevax sparsiflora

Please fill out separate form for other rare taxa seen at this site.

Site Information Overall site/occurrence quality/viability (site + population): ☐ Excellent ☐ Good ☐ Fair ☒ Poor

Immediate AND surrounding land use:

Visible disturbances: Overgrown by Sinapis arvensis, Avena fatua, Bromus hordeaceus.

Threats:

Comments: Pls. found in remnants of degraded vernal pools & swales. Other vernal pool species not found.

Determination: *(check one or more, and fill in blanks)*

☐ Keyed (cite reference): ______
☐ Compared with specimen housed at: ______
☐ Compared with photo / drawing in: ______
☐ By another person (name): ______
☒ Other: Known well by reporter.

Photographs: *(check one or more)*

	Slide	Print	Digital
Plant / animal	☐	☐	☒
Habitat	☐	☐	☐
Diagnostic feature	☐	☐	☐

May we obtain duplicates at our expense? yes ☒ no ☐

Appendix D1

Cultural Resources Inventory and Evaluation

Cultural Resources Inventory and Evaluation, Pacific Gas and Electric Company's Gas Transmission Pipeline 131 R707, R700 & R649 Replacement Projects, Alameda County, California

Prepared for:
Pacific Gas and Electric
Company

Prepared by:
Stantec Consulting Services Inc.

January 18, 2017

This document entitled Cultural Resources Inventory and Evaluation, Pacific Gas and Electric Company's Gas Transmission Pipeline 131 R707, R700 & R649 Replacement Projects, Alameda County, California was prepared by Stantec Inc. ("Stantec") for the account of Pacific Gas and Electric Company (PG&E) (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Ashley L. Hallock

Prepared by
Ashley Hallock, Archaeologist

Meagan Kersten

Reviewed by
Meagan Kersten, Archaeologist

Reviewed by
Hubert Switalski, Archaeologist

Reviewed by
Ryan Jolley, Senior Environmental Planner

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LIST OF APPENDICES

Management Summary

On October 20 and 21st and November 7th, 2016, Stantec Consulting Services Inc. (Stantec) conducted an archaeological Phase I study on behalf of Pacific Gas and Electric Company (PG&E) for the proposed Pipeline 131 R707, R700, and R649 Replacement Projects, near the City of Livermore, Alameda County, California. PG&E will replace approximately five miles of existing gas pipeline 131 (L131) with the following three contiguous projects (collectively referred to as the proposed project in this report): 1) between pipeline Mile Points (MPs) 28.00 and 27.02 (Project R707); 2) approximately four miles between MPs 28.00 and 31.93 (Project R700); and 3) approximately 400 between MPs 31.83 and 31.90 and approximately 100 feet at 32.29 (Project R649) (see Appendix A, Figure 1, 2a, 2b).

As the proposed project will require Section 404 permit from the United States Army Corps of Engineers (USACE), thus the project is considered an undertaking subject to compliance with Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended and its implementing regulations (36 Code of Federal Regulations [CFR] 800). While the proposed project may require additional States permits from Regional Water Quality Control Board (RWQCB) and the California Department of Fish and Wildlife (CDFW), and may be subject to compliance with the California Environmental Quality Act (CEQA), this document addresses cultural resources at a Section 106 level and assumes that the level of effort for identification, documentation, and recordation of such resources will meet and exceed CEQA requirements for impact to significant cultural resources. The purpose of this archaeological study was to identify and document archaeological and historic resources within the Project Area of Potential Effects (APE), to evaluate such resources for National Register of Historic Places (NRHP) eligibility, and to assess any future project effects on historic properties.

The archaeological study consisted of an archival records search of the entire Area of Potential Effects (APE), including a 1/4-mile surrounding the APE, conducted at the Northwest Information Center (NWIC) in Rohnert Park, background research of PG&E MapGuide cultural resource database system, as well as an intensive pedestrian survey of the entire 192.4-acre Project APE. Of those 192.4-acres, approximately 4.5 acres (or 2.3% of the APE) were not surveyed as permission to access the property was not given by the property owner. No cultural resources were identified during the course of the study. Therefore, based on the analysis of this study it is recommended that a determination of "No Historic Properties Affected" (36 CFR §800.4) by the proposed undertaking be made.

Because of the lack of archaeological or historic period resources in the project APE, the Project does not have the potential to impact known cultural resources under Section 106 of the NHPA or under CEQA. However, given the moderate to high archaeological buried site sensitivity within 500 feet of Cayetano Creek, there is the potential to impact previously unknown buried prehistoric cultural resources. Therefore, it is recommended that a qualified archaeological monitor, in consultation with the PG&E Cultural Resources Specialist (CRS) conduct archaeological monitoring of all Project ground disturbing activities within this area and that spot check archaeological monitoring occur within the APE along the alignment 3,500 feet north of the sensitive area around the creek and 1,000 feet southwest of the sensitive area around the creek (see Appendix A, Figure 5).

1.0 PROJECT DESCRIPTION

The L131 Project extends from Interstate-580 (I-580) immediately east of Isabel Avenue (Ave) and extends in a northeast direction past Vasco Road (Rd) and into Contra Costa County (see Attachment A, Project Vicinity and Location Maps). PG&E is currently planning on replacing approximately five miles of L131 between I-580 and Vasco Road. Replacement of L131 at this location is composed of the following three PG&E projects:

- R707 Project: Replacement of an approximately 1-mile segment of L131 between MP 27.02 and 28.00, extending from near Vasco Road in the north to a location just east of the end of Dagnino Road to the southwest.

- R700 Project: Replacement of an almost 4-mile segment of L131 between MP 28.00 and 31.93, beginning south of the R707 project. Retirement activities will include the removal of an above-ground span of pipe where it crosses Cayetano Creek.

- R649 Project: Replacement of approximately 400 feet of L131 immediately north of Portola Ave between MPs 31.83 and 31.90 and approximately 100 feet of L131 north of I-580 at MP 32.29.

The existing L131 pipeline is a 24-inch diameter pipeline originally installed in 1944. Recent studies have determined the original asphalt pipe coating to be in poor condition, and corrosion engineering assessments have concluded that the piping in this section of L131 cannot be adequately protected by the existing cathodic protection (CP) system. In addition, the R700 Project segment requires additional improvements where it crosses the Greenville Fault. Replacement of the R649 Project segments will also serve to meet design requirements under 49 CFR 192.5 where the pipeline passes within 220 feet of buildings associated with a new Shea Homes Development. Due to concerns of corrosion, PG&E is aiming to have these projects completed by the end of 2018.

The Project involves both installation of new 24-inch diameter pipe, retirement of the existing pipeline, and replacement of the CP system. Installation of the new pipe will primarily consist of open trench installation and mechanical (trenchless) bores at certain roadway locations. The new 24-inch diameter pipeline will be primarily installed parallel to the existing L131 pipeline. Retirement of the existing pipe will occur after the new pipeline is installed and tied into the gas system. Pipeline retirement consists of a set of procedures to inspect and potentially clean the pipe, removing an above ground span crossing Cayetano Creek for the R700 project, and filling buried sections with slurry or inert gas. The existing CP system will be removed and new system installed.

1.1 AREA OF POTENTIAL EFFECT (APE)

The Area of Potential Effect (APE) includes all construction areas associated with the proposed project including a right-of-way (ROW) work corridor, larger staging areas, and access routes. For the purposes of this report, the Project Study Area (PSA) includes the APE and a ¼-mile radius.

The APE for this project was designed to consider both direct and indirect effects on cultural resources from the undertaking. An APE is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if any properties exist" (36 CFR 800.16(d)). The APE for direct effects to archaeological and historical resources for this undertaking includes the 30-meter wide buffer along portions of L131, including staging areas and access routes, for the total of 192.4-acres. It is expected that any potential adverse impacts arising from any future development activities will be contained within this acreage.

PG&E will acquire temporary construction easements for additional space during construction of the project. A 150- to 200-foot right-of-way (ROW) work corridor will be established for construction along the new pipeline alignment. The ROW will typically provide sufficient space for trenching/boring, pipe stringing, welding operations, a passing lane for construction vehicles, replacement of the CP system, and pipeline retirement activities. Several work, staging, and laydown areas are also proposed along the pipeline alignment to allow for longer-term storage of equipment and materials, stockpiling of soils, and additional workspace such as for pipeline fabrication. PG&E will use designated existing roads and driveways, as well as new temporary overland routes, to access Project work areas. Mowing and potentially blading may be required for overland access routes. All temporary routes will be restored to pre-project conditions upon completion of the Project.

1.2 REGULATORY CONTEXT

Since the undertaking required a permit from the USACE, the proposed undertaking is subject to compliance with Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, and its implementing regulations (36 Code of Federal Regulations [CFR] 800). The purpose of the archaeological study was to identify and document cultural resources within the APE, to evaluate such resources for NRHP eligibility, and to assess future project effects on historic properties.

1.2.1 National Historic Preservation Act (NHPA)

The NHPA of 1966, as amended, requires federal agencies, or those they fund or permit, to consider the effects of their actions on historic properties. The Advisory Council on Historic Preservation (ACHP) section 106 implementing regulations (36 Code of Federal Regulations [CFR] Part 800) defines "historic properties" as follows:

- Any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places (NRHP) maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization that meet the National Register criteria (36 CFR Part 800.16[l]).

To determine whether an undertaking could affect NRHP-eligible properties, cultural resources (including archaeological, ethnographical, and architectural properties) must be inventoried and evaluated for listing in the NRHP. For a property to be considered for inclusion in the NRHP, it must be at least 50 years old and meet the criteria for evaluation set forth in 36 CFR Part 60.4, as follows:

> The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of design, setting, materials, workmanship, feeling, and association and:
>
> A) That are associated with events that have made a significant contribution to the broad patterns of our history; or
>
> B) That are associated with the lives of persons significant in our past; or
>
> C) That embody the distinctive characteristics of a type, period, or method of construction or that represent the work of a master or that possess high artistic values or that represent a significant and distinguishable entity whose components may lack individual distinction; or
>
> D) That have yielded, or may be likely to yield, information important in prehistory or history.

If a particular resource meets one of these criteria, it is considered as a historic property eligible for listing in the NRHP. Among other criteria considerations, a property that has achieved significance within the last 50 years is not considered eligible for inclusion in the NRHP unless certain exceptional conditions are met.

A full explanation of the procedures for evaluating historic resources can be found in publications issued by the NPS, including National Register Bulletin 15, How to Apply the National Register Criteria for Evaluation (USDI National Park Service 1982).

1.2.2 California Environmental Quality Act (CEQA)

Under CEQA, public agencies must consider the effects of their actions on both "historical resources" and "unique archaeological resources." In addition to assessing whether historical resources potentially impacted by a proposed project are listed or have been identified in a survey process (PRC 5024.1 [g]), lead agencies have a responsibility to evaluate them against the CRHR criteria prior to making a finding as to a proposed project's impacts to historical resources (PRC Section 21084.1 and CCR Section 15064.5 [a][3]). Following CCR Section 15064.5 (a) a historical resource is defined as any object, building, structure, site, area, place, record, or manuscript that:

Is historically or archeologically significant, or is significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political or cultural annals of California; and meets any 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; or
4) Has yielded, or may be likely to yield, information important in prehistory or history.

Integrity is evaluated with regard to the retention of location, design, setting, materials, workmanship, feeling and association. It must also be judged with reference to the particular CRHR criteria under which a resource is significant. A resource that meets at least one of the significance criteria and retains most aspects of integrity is considered eligible for listing in the CRHR and is a historical resource under CEQA.

2.0 SETTING

2.1.1 Geographic Context

The PSA is located within the Alameda Creek watershed, in Livermore Valley, in California's Coastal Range geographic region and is nestled within the Diablo Mountain Range to the east and the Berkeley Hills to the west (Alt and Hyndman 2000). Alameda Creek drains into San Francisco Bay via Niles Canyon. The Coast Ranges Geomorphic Province consists of northwest trending mountain ranges and valleys extending from beyond the northern California border to the Transverse Ranges in Southern California. At the western edge of the Coast Ranges is the Pacific Ocean where the coastline is uplifted, terraced, and wave-cut. To the east is the Great Valley where rock is overlain by deep alluvial deposits. The Coast Ranges are sub-parallel to the San Andreas Fault, which lies along most of its western edge. The northern California Coast Ranges are dominated by irregular topography formed on the underlying rocks of the Late Jurassic to Cretaceous age Franciscan Complex (Schoenherr 1992).

Specifically, soils in the APE are predominantly composed of Clear Lake clay, which consists of basin alluvium derived from igneous, metamorphic, and sedimentary rock; Pescadero clay, which is comprised of alluvium derived from sandstone and shale; Linne clay loam, comprised of clay loam and weathered bedrock derived from residuum weathered from sandstone and shale; and Diablo clay, which consists of alluvium derived from shale and siltstone (USDA Web Soil Survey 2016). The geologic age of deposition in the APE is classified as "Q" by the California Department of Conservation. "Q" rock types are generally marine and nonmarine (continental) sedimentary rocks of Pleistocene to Holocene age (State of California Department of Conservation 2010 Geologic Map of California). More specifically, the APE is underlain by both Pre-Holocene undifferentiated deposits and Holocene era deposits (Meyer and Rosenthal (2007).

2.1.1.1 Flora and Fauna

The PSA is generally located within a hilly prairieland environment with some oak woodland. However, vegetation within the APE is ruderal, and consisted of weeds and introduced species, along with a few oak trees. Trees common to California's oak woodland environment include Valley Oak (*Quercus lobata*), Coast Live Oak (*Quercus agrifolia*), Black Oak (*Quercus kelloggii*), Tanbark Oak (*Lithocarpus desniflora*), and California Buckeye (*Aesculus californica*). Common fauna to the area include Wild Turkey (*Meleagris gallopavo)*, California Thrasher (*Toxostoma redivivum*), Brush Rabbit (*Sylvilagus bachmani*), Mule Deer (*Odocoileus hemionus*), Coyote (*Canis latrans*), Brown Towhee (*Melozone crissalis)*, Canyon Wren (*Catherpes mexicanus)*, Oak Titmouse (*Baeolophus inornatus)*, Spotted Skunk (*Spilogale gracilis)*, Gray Fox (*Urocyon cineroargenteus*), Red-Tailed Hawk (*Buteo jamaicensis)* and California quail (*Callipepla californica)*(Levy 1978; Schoenherr 1992).

Native groups prehistorically and ethnographically would have gathered and used a wide variety of resources, such as acorns (mainly from Tan Bark Oak [*Lithocarpus densiflora]* and Black Oak [*Quercus kelloggii]*), Buckye nuts, California laurel nuts (*Umbellularia califronica*), roots, wild onion and garlic, berries and other fruits, such as gooseberries (*Ribes* sp, subgenus *Grossularia*), and Grapes (*Vitis californica*). Additionally, a variety of game was hunted, including Mule Deer, Elk (*Cervus canadensis*), California Mountain Lion (*Felis concolor*), as well as smaller game, such as Jackrabbit (*Lepus californicus*), rodents, grasshoppers, and waterfowl, such as the mallard (*Anas platyrhynchos*). Fish, such as salmon and sturgeon, and shellfish, including clams and mussels were gathered. Native groups also hunted birds and caught and consumed ant larvae and pupae, as well as frogs and lizards (Levy 1978).

2.1.2 Prehistoric Context for the East Bay, San Francisco Bay Region

Milliken et al. (2007) present a series of culture changes in the San Francisco Bay Area. The period of occupation during the 11,500 to 8,000 cal B.C. time frame, when Clovis big-game hunters, then initial Holocene gatherers, presumably lived in the area, lacks evidence, presumably because it has been washed away by stream action, buried under more recent alluvium, or submerged on the continental shelf (Rosenthal and Meyer 2004a:1). There is evidence, however, for an in-place forager economic pattern, beginning around 8000 cal B.C., followed by a series of five cycles of change that began at approximately 3500 cal B.C.

Due to the intense and rapid urban development in the Bay Area during the late nineteenth and early twentieth centuries, many archaeological resources suffered damage or destruction before scientific inquiry could be conducted. Many of the archaeological excavations in this region have been salvage efforts, often conducted without the time or resources necessary to perform adequate data recovery and professional reporting. However, over the past several years, the understanding of this region's prehistory has changed, partly because of intensive fieldwork resulting from compliance with environmental laws.

The earliest organized archaeological surveys in the Bay Area were conducted in 1906 and 1908 by N. C. Nelson of the University of California, Berkeley. During these surveys, Nelson (1909a, 1910) documented 425 "earth mounds and shell middens". Excavations of shell middens in Alameda County began around the same time. By 1916, 11 of the sites identified by Nelson had been excavated (Moratto 1984:227, 235–236).

By the 1940s, enough information had been gathered to permit the development of a tentative regional prehistory. At that time, what was to become known as the Central California Taxonomic System (CCTS) that had been developed for the Central Valley was expanded to correlate the Bay Area sequence with those of the Sacramento River–San Joaquin River Delta, and for over twenty years afterwards, the CCTS was the standard device for ordering prehistory in the Bay Area and Central Coast regions. However, as more work was conducted, it became obvious that this and other systems lacked refinement (Moratto 1984:237).

Since the 1950s, archaeological work in the Bay Area has encompassed numerous surveys and excavations, particularly in Santa Clara, Alameda, and Contra Costa Counties. Based on their findings at CA-Ala-328, Davis and Treganza (1959) developed a sequence of components that apply to the East Bay shore. Bickel (1976 summarized in Moratto 1984:253–261) later updated this sequence.

The present account of the San Francisco Bay Area's prehistory draws from Chapter 8, *Punctuated Culture Change in the San Francisco Bay Area* (Milliken et al. 2007), which is based to a great extent on Fredrickson's (1973, 1974a) synthesis for central California. Fredrickson used the CCTS (.) as a point of departure for his model of California prehistory, but moved beyond its cultural historical orientation and placed more emphasis on subsistence and settlement, regional interactions, and development and interplay arising from technological, economic, and ecological aspects.

2.1.2.1 The Early Holocene (Lower Archaic), cal 8000-3500 B.C.

Between cal 8000 and 3500 B.C., the Bay Area appears to have been occupied by a widespread but sparse population of hunter-gatherers. The milling slab and handstone, as well as a variety of large, wide-stemmed and leaf-shaped projectile points, all emerged during this period (Milliken et al. 2007:114).

The earliest Bay Area date for a milling stone component is 7920 cal B.C., obtained in the mid-1990s from a discrete charcoal concentration beneath an inverted milling slab at CCO-696 at Los Vaqueros Reservoir in the hills east of Mount Diablo (Meyer and Rosenthal 1997). Archaeobotanical remains from CCO-696 suggest an economy focused on acorns and wild cucumbers (Wohlgemuth 1997). The earliest documented grave in west-central California was also recovered from Contra Costa County, within a few hundred meters of CCO-696 at CCO-637. A single radiocarbon date of 6570 cal B.C. was returned from a loosely flexed burial (Meyer and Rosenthal 1998).

2.1.2.2 The Early Period (Middle Archaic), cal 3500-500 B.C.

Several technological and social developments characterize this period in the Bay Area. Rectangular *Haliotis* and *Olivella* shell beads, the markers of the Early Period bead horizon, continued in use until at least 2,800 years ago (Ingram 1998; Wallace and Lathrop 1975:19). The mortar and pestle were first documented in the Bay Area shortly after 4000 B.C., and by 1500 cal B.C., cobble mortars and pestles, and not millingslabs and handstones, were used at sites throughout the Bay Area, including ALA-307 (West Berkeley), CCO-308 (San Ramon Valley) (Fredrickson 1966), and ALA-483 (Livermore Valley) (Wiberg 1996a:373).

In the central Bay Area, burial complexes with ornamental grave associations (at CA-ALA-307 and Ellis Landing [CA-CCO-295]) and elliptical house floors with postholes (at Rossmoor [CA-CCO-309]) characterized the Lower Berkeley Pattern. These features represent a movement from forager to semi-sedentary land use (Milliken et al. 2007:115). The earliest known *Olivella* rectangle beads with drilled perforations were found at CCO-637 (Los Vaqueros Reservoir) and date to 4,800 years ago. They were found in a burial that contained red ocher and exhibited pre-interment burning (Rosenthal and Meyer 2000).

In the central Bay Area, the Lower Berkeley Pattern, marked by mortars and pestles and a burial complex with ornamental grave associations, represents a movement from forager to semi sedentary land use at shell mounds like West Berkeley (ALA-307), Ellis Landing (CCO-295), and Pacheco (MRN-152). Elliptical house floors with postholes dating to 1500 cal B.C. were discovered at the Rossmoor site, CCO-309. Such sites suggest sedentism or semi-sedentism in the interior East Bay (Price et al. 2006).

2.1.2.3 Lower Middle Period (Initial Upper Archaic), 500 cal B.C. to cal A.D. 430

Although it is unclear when the "major disruption in symbolic integration systems" originated, it is clear in the record around 500 cal B.C. and may have begun several hundred years earlier (Milliken et al. 2007:115). Rectangular shell beads disappeared from the Bay Area, Central Valley, and portions of Southern California during this time; and a whole new suite of decorative and presumed religious objects appeared during the Early Period-Middle Period Transition (EMT) (Elsasser 1978), which corresponds to the beginning of this period. Net sinkers, a typical early period marker throughout the bay, disappeared from most sites, with the exception of SFR-112, where they continued in use well into the Middle Period (Pastron and Walsh 1988a:90).

Bead Horizon M1 of the Middle Period (Upper Archaic, 200 cal B.C. to cal A.D. 430), which developed out of the EMT, marked the first of a series of bead horizons that marked central California bead trade until cal A.D. 1000 (Groza 2002). M1 brought more tiny Olivella saucer beads into the Bay Area, as well as new circular Haliotis ornaments. New bone tools, including barbless fish spears, elk femur spatula, tubes, and whistles, appeared for the first time during this period (Elsasser 1978:39). Bead horizons M2-M4 are discussed in the Upper Middle Period, which follows. Basketry awls (split cannon bones) with shouldered tips, indicating coiled basketry manufacture, appeared in the Central and North Bay (Bennyhoff 1986:70; Bieling 1998:218).

2.1.2.4 Upper Middle Period (Late Upper Archaic), cal A.D. 430 to cal 1050

Around 430 cal A.D., the Olivella saucer bead trade network collapsed, and over half of known bead horizon M1 sites were abandoned, while the remaining sites saw a large increase in sea otter bones. Additionally, the Meganos extended burial mortuary pattern began to spread in the interior East Bay (Bennyhoff 1994a, 1994c). At the same time that these changes were happening, a series of Olivella saddle bead horizons that would come to be known as M2, M3, and M4 were developing.

During Bead Horzion M2a, the M1 saucer beads were replaced as burial accompaniments by rough-edged, full-saddle Olivella beads with very small perforations. The six saddle beads that have been dated thus far (as of 2007) have calibrated median intercepts in the narrow cal A.D. 420–450 time range (Groza 2002); hence the change in estimated transition date from the Lower Middle Period to the Upper Middle Period. The dated beads come from ALA-329 and CCO-269 along the bay shore and from ALA-415 and CCO-151 farther inland (Milliken et al. 2007:116).

Bead Horizon M2b is marked by mixed *Olivella* saddle beads with very small perforations. They have been dated to cal A.D. 430-600. The Meganos mortuary style continued to spread westward during this horizon (Milliken et al. 2007:116).

Bead Horizon M3, cal A.D. 600–800, is considered to be the climax of Upper Middle Period stylistic refinement (Milliken et al. 2007:116). Burials from this horizon contained mostly small, delicate square saddle *Olivella* beads; however, *Olivella* saucer beads were also found in burial contexts (often in off-village single component cemeteries). The Meganos mortuary complex spread from the interior bay-ward, as evidenced at the Fremont BART site (CA-ALA-343), and into the Santa Clara Valley at Wade Ranch (SCL-302), but did not extend into the North Bay. Single-barbed bone fish spears, ear spools, and large mortars all appeared for the first time during this horizon (Milliken et al. 2007:116).

During Bead Horizon M4, cal A.D. 800–1050, the *Olivella* saddle bead template is replaced by a variety of wide and tall bisymmetrical forms, and by the appearance of distinctive Haliotis ornament styles, such as unperforated rectangles and horizontally perforated half ovals. The Santa Teresa Locality Mazzoni site (SCL-131), one of the few mortuary sites that can be dated to this time period, contained no grave accompaniments (Milliken et al. 2007:116).

At the Santa Rita village site in the Livermore Valley (CA-ALA-413), the dorsally extended burial of a 30-year-old man exemplified the Meganos-style pattern. Buried at the end of the M1 horizon, this burial contained the largest known California bead lot (30,000 *Olivella* saucer beads), as well as quartz crystals and bead appliquéd bone spatulae (Wiberg 1988). During Bead Horizons M2b (cal A.D. 430-600) and M3 (cal A.D. 600-800), several new items appeared in Central Bay sites, including show blades, fishtail charmstones, new *Haliotis* ornament forms, and mica ornaments (Elsasser 1978:39:Fig. 3). The Meganos mortuary complex spread from the interior bay-ward, as evidenced at the Fremont BART site (CA-ALA-343) (Milliken et al. 2007:116).

2.1.2.5 Initial Late Period (Lower Emergent), cal A.D. 1050 to cal 1550

Fredrickson (1973) coined the term "Emergent" to describe this period, in recognition of the appearance of a new level of sedentism, status ascription, and ceremonial integration in lowland central California. The Middle/Late Transition (MLT) bead horizon, previously thought to have occurred around cal A.D. 300, is now largely believed to have occurred around cal A.D. 1000 (Milliken et al. 2007:116). During the MLT, burial objects became much more elaborate, and initial markers of the Augustine Pattern appeared in the form of multiperforated and bar-scored Haliotis ornaments, fully shaped show mortars, and new Olivella bead types. Classic Augustine Pattern markers, which appeared in Bead Horizon L1 (after cal A.D. 1250), include the arrow, flanged pipe, Olivella callus cup bead, and the banjo effigy ornament (Bennyhoff 1994c). The Stockton serrated series, the first arrow-sized projectile point in the Bay Area, also appeared after cal A.D. 1250. The Stockton serrated series was a unique central California type (Bennyhoff 1994b:54; Hylkema 2002; Justice 2002:352).

Obsidian production and mortuary practices both provide evidence for increased social stratification after 1250 cal A.D. Napa Valley obsidian manufacturing debris increased dramatically in the interior East Bay (Milliken et al. 2007:117); while with burials, although the quantity of shell beads contained in burials decreased, the quality of burial items increased in high-status burials and cremations (Fredrickson 1994b:62). This development may have reflected a new regional ceremonial system that was the precursor of the ethnographic Kuksu cult, a ceremonial system that unified the many language groups around the Bay during Bead Horizon L1 (Fredrickson 1974b:66; Bennyhoff 1994b:70, 72 in Milliken et al. 2007:117).

2.1.2.6 Terminal Late Period: Protohistoric Ambiguities

Changes in artifact types and mortuary objects characterized cal A.D.1500–1650. The signature Olivella sequin and cup beads of the central California L1 Bead Horizon abruptly disappeared, and clamshell disk beads, markers of the L2 Bead Horizon, spread across the North Bay. However, until around cal A.D. 1650, the only beads found in South Bay and Central Bay mortuaries were Olivella lipped and spire-lopped beads; and they occurred in far smaller numbers than the bead offerings of the L1 Horizon (Milliken and Bennyhoff 1993:392). The earliest date for clam disks south of the Carquinez Strait, obtained from a charcoal lens at CCO-309, is cal A.D. 1670 (Fredrickson 1968).

Indications are that another upward cycle of regional integration was commencing when it was interrupted by Spanish settlement in the Bay Area beginning in 1776. Such regional integration was a continuing characteristic of the Augustine Pattern, most likely brought to the Bay Area by Patwin speakers from Oregon, who introduced new tools (such as the bow) and traits (such as preinterment grave pit burning) into central California. Perhaps the Augustine Pattern, with its inferred shared regional religious and ceremonial organization, was developed as a means of overcoming insularity, not in the core area of one language group but in an area where many neighboring language groups were in contact (Milliken et al. 2007:118).

2.1.3 Ethnographic Context

The PSA borders Ohlone ethnographic territory to the west, and to the east, is within the western boundary of the region where ethnographically, the Northern Valley Yokuts resided (Kroeber 1925).

2.1.3.1 Ohlone

Ohlone territory includes the Monterey bay area and the regions to the immediate east, up to the Diablo Range. The Ohlone spoke Miwok-Costanoan (Utian), which is a sub-branch of the Yok-Utian branch of the Penutian language stock (Golla 2007). Recent linguistic evidence suggests that Miwok-Costanoan originated in the San Joaquin foothills, with a possible ancestral base in the Great Basin (Golla 2007).

The PSA is situated within the tribelet territory of the *Chochenyo*. Their territory included the northwestern portion of the Livermore Valley. Neighboring tribelets included the *Souyen*, whose territory included western Livermore Valley and the Tassajara Creek drainage. Unfortunately, Ohlone culture was dramatically affected by missionization and information (e.g., mission records and traveler's logs) regarding its pre-contact organization is incomplete and inconsistent (Levy 1978).

Ohlone political organization was the tribelet, which consisted of 200-500 people, organized into several villages. Each tribelet was autonomous from other tribelets. Tribelets were separated by geographic barrier and were led by chiefs. Chiefs were descended by the patrilineal line, although in the event of the chief's death, with no one to carry on the patrilineal line, the chief's sister or daughter could inherit the position. The chief functioned mainly as the leader of the Elder's Council. The tribelet was further divided into clans, which were subdivided into moieties: deer or bear. Households were large, consisting of mainly patrilineal family (Harrington 1933, Levy 1978).

The Ohlone usually moved between several semi-permanent camps and villages to take full advantage of seasonally available resources. Dwellings at these camps and villages were dome-shaped, with pole frameworks and thatch for roof and walls. Other structures typically found in Ohlone villages included: acorn granaries; sweathouses; menstrual houses; and dance and/or assembly houses, generally located in the center of a village (Broadbent 1972).

A wide variety of ecological zones, including foothills, valleys, sloughs, and coastal areas, were exploited by the Ohlone to obtain subsistence resources. These resources included: various seeds; nuts (e.g., acorn, buckeye, laurel, and hazelnuts); berries; grasses; corms; roots; insects; birds (e.g., geese, mallard, and coot); fish (e.g., steelhead, salmon, and sturgeon); shellfish (e.g., abalone, mussel, and clam); and both marine and terrestrial mammals (e.g., sea otter, sea lion, harbor seal, deer, elk, grizzly bear, rabbits, antelope, raccoon, and squirrels) (Kroeber 1925, Levy 1978).

The Ohlone were known to engage in warfare, either prearranged, or by surprise attack with neighboring groups, including the Esselen, Salinan, and the Northern Valley Yokuts. However, they engaged in trade with the Plains Miwok, Sierra Miwok, and Yokuts. Levy notes that the only item known to have been imported by the Ohlone was pinon nuts, which were traded from the Yokuts for mussels, abalone shells, and salt (1978). Spiritualism centered on the shaman, but dreams and symbolism were also used as spiritual guides. The Ohlone are said to have a very similar mythology to the Yokuts and Salinan (Levy 1978).

A variety of resources were used for subsistence. Acorns were a dominant source of food, but hazelnuts (*Corylus cornuta* var. *californica*), buckeye (*Aesculus californica*) and California laurel nuts (*Umbellularia californica*) were also consumed. Berries, roots, clover shoots, and thistle were all gathered. Small game, such as dog, skunk, raccoon, rabbit, ground squirrel, moles, and mice were caught. Larger game, such as black-tailed deer, grizzly bear, antelope, mountain lion, and on the coast, sea lion and whale were all sources of food (Levy 1978). While the Ohlone did consume hawks, robin, and doves, the dominant bird consumed was waterfowl (Levy 1978). Fish, such as lampreys (*Entosphenus tridentatus*) and salmon (*Oncorhynchus* sp.), were also caught and used as a primary food source.

Material cultural included the use of tule balsas for water navigation, the bow and arrow for hunting and warfare, chert for stone tools, cordage, skins, furs, stone mortars, wood mortars, bone and wood awls, soaproot brushes, paddles and shell spoons. Chert was locally quarried and obsidian was obtained by trade. The Ohlone people also mined for hematite and cinnabar, which were used as pigments. The majority of Ohlone basketry was twined using such materials as tule (*Scirpus* sp.), rush (*Juncus* sp.) and willow (*Salix* sp.). Baskets were used not only as storage containers, but as cooking vessels and as carrying receptacles (Levy 1978).

2.1.3.2 Northern Valley Yokuts

The approximate Northern Valley Yokuts ethnographic territory extends as far west as the Diablo Range, as far east as the entrance of the San Joaquin River into the Sierra Nevada Mountains, and to the north, where the San Joaquin River bends to the north, between the Calaveras and Mokelumne Rivers (Wallace 1978).

Permanent villages and population centers appear to have been focused along the bank of the San Joaquin River, with sparser pockets of population oriented near the semi-permanent streams and waterways located within the foothills of the Diablo and Sierra Nevada Mountain (Wallace 1978). The Northern Valley Yokuts built a variety of structures, basketry, and watercraft using tule. They constructed small, lightly built houses, as well as basketry, mats, and cradles. Rafts made of lashed together bundles of tule were used for travel and fishing. A variety of tools were constructed from bone, stone, and wood.

Arrowpoints, knives, and scraping tools were manufactured from local chert, jasper, and chalcedony (Wallace1978). Subsistence patterns depended upon the San Joaquin River and its tributaries. Although the Northern Valley Yokuts gathered tule roots, acorns and seeds, and hunted deer, fishing, especially salmon, was their dominant food source. Fowl, such as duck and geese, were also available in the riverine environment. While summers in the valley were extremely hot and winters cool, resources created an environment favorable for year-round habitation.

Northern Valley Yokuts used both water and foot travel to exploit an extensive trade network. They traded for baskets and bows and arrows with the Miwok to the north, and mussel and abalone shell with the Ohlone to the west (Wallace 1978).

2.1.4 Historic Context

The PSA is located north of the City of Livermore. A review of background literature indicates that the northern portion of the APE is within the 8,877 acre former Mexican land grant of Rancho Las Positas. The rancho was petitioned to the Mexican governor of California by William Gulnac in 1834 and eventually, the rights to the land were ceded to Robert Livermore and Jose Noriega in 1837 (Hoover et al. 2002). Robert Livermore was an English sailor who originally arrived in California in 1821. He eventually became a Mexican citizen in 1844. It was not until 1839 that Governor Alvarado approved the grant to Salvio Pacheco, who then transferred the land rights back to Livermore and Noriega. Livermore primarily utilized the Rancho land for cattle grazing, although his real passion was viticulture. Eventually the Rancho land was expanded by purchasing the Rancho Canada de los Vaqueros to the north (Hoover et al. 2002).

Despite Livermore's viticulture hopes, the cattle industry continued to dominate the former Rancho lands and the Livermore Valley beyond Livermore's death in 1858. By the end of the 1860s, small scale farming was more common throughout the Livermore Valley. The transition from cattle ranching to small scale farming was encouraged by the increased use of barbed wire fencing, which kept livestock out of crops. Several events occurred which encouraged new settlement and dry land farming in the valley: the construction of the Central Pacific Railroad through Livermore Valley in 1869, 2) in 1873 the United States' Supreme Court confirmed both the Las Positas and Los Vaqueros land grants, and 3) the subsequent availability of 40,000 acres of land. By the 1870s, as the gold rush died down, the Livermore Valley became a center for wheat farming (Buckley 1998).

The city of Livermore was first established in 1850, when Alphonso Ladd built a house within the city limits. Not long after, in 1855, a hotel was established (Ladd Hotel). The city grew in size, partly due the railroad, but also the cattle industry and the increasingly important wine production which was occurring in Livermore Valley. The Livermore Collegiate Institute was founded in 1870 by Dr. and Mrs. WB. Kingsbury; it later was in use as a sanatorium. In 1942, the Livermore Naval Base was established, and in 1952, the University of California initiated the Lawrence Livermore Laboratory (Hoover et al. 2002).

3.0 METHODS

Completion of the proposed Project included background research, planning and fieldwork. Prefield work included Native American outreach and coordination (on-going), review of

PG&E's MapGuide cultural resources layer, and conducting a formal CHRIS records search at the NWIC in Rohnert Park, California. Fieldwork included a pedestrian survey of the entire project APE in those areas which were accessible.

3.1 PREFIELD

3.1.1 Native American Coordination and Outreach

Pursuant to the California Public Resources Code Section 5097.9, state and local agencies cooperate with and assist the Native American Heritage Commission (NAHC) in its efforts to preserve and protect locations of sacred or special cultural and spiritual significance to Native Americans. Stantec contacted those individuals and/or tribes listed by the NAHC on the Sacred Lands Search Response (SLS), to determine whether they have information on sacred or special sites in the study area. Those included on the list will be contacted by letter, telephone, and/or e-mail to request information about the APE.

3.1.2 PG&E MapGuide Cultural Layer Review and CHRIS Records Search.

The entire PSA, including the APE and a ¼-mile radius around the APE, was assessed for the presence of previously conducted studies or previously recorded cultural resources.

A formal CHRIS records search of the entire project APE was conducted at the NWIC in Rohnert Park, California. Historic topographic maps, GLO plat maps, Sanborn maps (as available), state and local landmarks, and listings of resources on the Archaeological Determinations of Eligibility listing (ADOE) and Office of Historic Preservation (OHP) Historic Property Directory (OHP) were reviewed. Supplemental background research was conducted using PG&E's MapGuide Cultural Resources layer. PG&E's Mapguide is a GIS system which has a confidential Cultural Resources Layer available to qualified archaeologists conducting work for PG&E. Copies of previously conducted studies and site records are available on MapGuide. The use of MapGuide is helpful when conducting background research or desktop reviews for PG&E projects, but does not replace a formal CHRIS records search. It is not all inclusive and only includes previously complete studies or previously recorded site records that PG&E Cultural Resources Specialists (CRS) or PG&E contractor CRS's have uploaded to the system.

The following historic topographic maps were consulted during the CHRIS records search and background research review:

- 1911, 1916 Byron Hot Springs 1:62500 scale USGS Topographic Maps
- 1916, 1940 Byron 1:62500 scale USGS Topographic Maps
- 1941 Pleasanton 1:62500 scale USGS Topographic Map
- 1953, 1961 Livermore 1:62500 scale USGS Topographic Maps

- 1953, 1961, 1968, 1973, 1980 Livermore 1:24000 scale USGS Topographic Maps
- 1953 Byron 1:24000 scale USGS Topographic Map
- 1968 Byron Hot Springs 1:24000 scale USGS Topographic Map

3.2 FIELD

The survey was conducted of the APE, discussed in detail above, in approximate 15-meter transects to ensure maximum ground coverage in a timely manner and encompassed 97.7% of the total APE. A Trimble GeoXT GPS with sub-meter accuracy pre-loaded with the Project APE was utilized by the survey team.

Trowel scrapings were employed to clear small patches of vegetation in areas with poor ground visibility due to thick ground coverage. During the field survey, all accessible areas were examined closely for evidence of prehistoric archaeological site indicators such as obsidian or chert flakes; grinding and mashing implements (such as groundstone, mortars, and pestles); bone, and discolored soils (which could contain lithics, bone, shell, and/or fire-affected rocks). The areas were also examined closely for evidence of historic period-site indicators such as glass and ceramic fragments; metal objects; milled and split lumber, and structure or feature remains such as building foundations, fence posts, and discrete trash deposits such as wells, privy pits, or dumps.

If any cultural resources were identified within the APE, they would have been formally recorded or updated on the appropriate Department of Parks and Recreation (DPR) 523-series forms. Photographs of the survey area and any recorded cultural resources were taken. GPS points and polygons were recorded for resource point data, or to record resource boundaries.

4.0 REPORT OF FINDINGS

4.1 PREFIELD

4.1.1 Native American Correspondence and Outreach

On November 3, 2016, Stantec sent an e-mail and map depicting the Project APE to the Native American Heritage Commission (NAHC) requesting a review of their sacred lands files for any Native American cultural resources that might be affected by the proposed Project (Appendix B). On November 14, 2016, the NAHC responded stating that the search of the Sacred Lands Search File (SLF) was negative.

A list of Alameda County Native individuals and groups to contact, who may have more information about tribal cultural resources within the APE, was provided, as follows: Chairperson Tony Cerda, Coastanoan Rumsen Carmel Tribe; Chairperson Irenne Zwierlein, Amah Mutsun Tribal Band of Mission San Juan Bautista; Chairperson Katherine Erolinda Perez, North Valley Yokuts Tribe; Chairperson Rosemary Cambra, Muwekma Ohlone Indian Tribe of the SF Bay Area, and Chairperson Ann Marie Sayers, Indian Canyon Mutsun Band of Coastanoan. Per this response from the NAHC, PG&E Cultural Resources Specialist (CRS), Kimberly Cuevas, sent a letter to each individual on November 22nd, 2016.

Stantec received a response from Chairperson Perez of the Northern Valley Yokuts/Ohlone/Bay Miwuk Tribe, via email on November 27th, 2016. Chairperson Perez recommended that the project construction be monitored by both a qualified archaeologist and a Native American monitor, as the Project is within the Livermore Valley and Vasco area, which the tribe considers to be highly sensitive. On December 2nd, 2016, Meagan Kersten, Stantec Archaeologist, called each individual who was initially mailed a letter, per the NAHC response. No other concerns were identified by the individuals that Ms. Kersten contacted.

4.1.2 Desktop Review and PG&E MapGuide Results

The PSA is located within the western fringes of Northern Yokuts territory and within the northern extent of Ohlone territory. The closest recorded ethnographic village is *sewnen*, an Ohlone village, located near what is now the modern city of Livermore (Levy 1978).

A review of historic topographic maps does not indicate any historic period structures within the APE. Several formally extant historic structures were located within ¼-mile of the APE. The structures include: 1) May School, first depicted on the 1941 Pleasanton 1:62500 scale USGS topographic map, and once located on May School Road, approximately 175 feet east of the APE; 2) a house within the road right-of-way of North Livermore Avenue and first depicted on the 1941 1:62500 scale Pleasanton USGS topographic map, located approximately 0.62 mile south of May School Road; and 3) a corral, first depicted on the Byron 1916 1:62500 scale topographic map, located approximately 110 feet northwest of the APE, 0.62 mile southwest of the intersection of the APE with North Vasco Road. In general, and as detailed in the Historic Context of this report, the land was in use historically, from the Mexican through the American periods for both cattle ranching and agricultural uses (Section 2.1.4).

No structures listed on the NRHP or CRHR were identified as being within the APE. The nearest structures listed on the NRHP and CRHR are approximately 1.78 miles southeast of the APE, within the City of Livermore. They include the Bank of Italy, located at 2250 1st Street and the D.J. Murphy House, located at 291 McLeod Street.

Background research conducted for this Project did not indicate the presence of previously recorded cultural resources within the APE, but did identify the following four (4) previously recorded cultural resources within ¼-mile search radius of the APE:

1) an isolated hammerstone, located south of Portola Avenue (approximately 1,300 feet southeast of the southern end of the APE near Portola Avenue, near MP 31.83, and north of the far southern end of the APE for R649);

2) P-01-002194, an isolated wooden trough, located approximately 1,142 feet northwest of the southernmost segment of R649, located along a dirt access road south of Portola Avenue;

3) P-01-002195 (CA-ALA-584H),the remains of a concrete foundation and footings, located approximately 580 feet northwest of MP 32.29 and the dirt access road south of Portola Avenue; and

4) the Contra Costa-Las Positas transmission line, located within ¼-mile of the northern end of the APE, near MP 27.02.

Six (6) studies within a ¼-mile radius of the APE were identified from MapGuide: S-24986 (Basin Research Associates, Inc. 2000), S-39498 (Far Western Anthropological Research Group, Inc. (FWARG) 2012), Report 30988326 (Harper 2013), S-40503 (Thomas 2013), S-42468 (Green 2011) and a memorandum for L-131 MP 32.31 (Foutch 2012). Of these studies, S-20335, specific locations assessed as part of S-39498, S-24986, S-40503, and Harper 2013 cover portions of the APE.

Meyer and Rosenthal (2007:8) indicate that the APE is underlain by both Pre-Holocene undifferentiated deposits and Holocene era deposits. A review of Far Western's 2012 study, covering other portions of L131, indicates that archaeological buried site sensitivity is high at the extreme southern end of the APE, near the overland access route, located south of Portola Avenue and within the R649 portion of the Project APE. This portion of the APE is within 350 feet of a drainage that feeds into Las Positas Creek (Thomas and Meyer 2012). Additionally, the portion of the APE which crosses Cayetano Creek has a high sensitivity for buried archaeological resources. The portion of the APE from Hartford Road, trending northeast to May School Avenue has moderate archaeological buried site sensitivity (Thomas and Meyer 2012).

4.1.3 Archaeological Buried Site Sensitivity Analysis

As twenty-one (21) archaeological surveys have been previously conducted in the PSA, and/or portions of the APE, and six previously documented cultural resources have been documented within the PSA, but none within the APE, the likelihood of encountering buried deposits appears to be low. However, as portions of the APE appear to be located along an existing water source (Cayetano Creek) underlain by Holocene age deposits, and are within an area previously deemed to have a high archaeological buried site sensitivity, areas within the APE that are adjacent or are located along Cayetano Creek, are more likely to contain buried archaeological deposits.

4.1.4 Northwest Information Center (NWIC) Records Search Results

A formal records search through the CHRIS at the NWIC in Rohnert Park, California was conducted for the Project Study Area, which includes a ¼ mile radius around the APE (see Appendix A, Figures 3a, 36 and Appendix D – CONFIDENTIAL DO NOT DISTRIBUTE). Cumulatively, between a review of PG&E's MapGuide cultural layer and the CHRIS records search, six previously recorded cultural resources were identified within the ¼-mile search radius, or just outside the ¼-mile radius: an isolated hammerstone, the Contra Costa-Las Positas transmission line, P-01-000067 (CA-ALA-47), P-01-002194, P-01-002195 (CA-ALA-584H), and P-01-002197. No cultural resources were identified from the records search as being within the APE (Table 1 below).

Table 1. Previously Recorded Cultural Resources Located within 1/4 Mile of the APE

Primary Number	Trinomial Number	Source	Site Type	Description	Location
N/A	N/A	CHRIS records search	Prehistoric	Isolated hammerstone	Located south of Portola Avenue, approximately 1,300 feet southeast of the southern end of the APE near Portola Avenue and MP 31.83

N/A	N/A	PG&E MapGuide	Historic	Contra Costa-Las Positas transmission line	Located within ¼-mile of the northern end of the APE, near MP 27.02.
P-01-000067	CA-ALA-47	CHRIS records search	Prehistoric	Two (2) pestles, midden	Located 0.25 mile southeast of the southern terminus of the APE; site was originally recorded in 1951 and was not relocated per the 1991 update (Holman and Associates 1991); It has not been evaluated for the NRHP or CRHR
P-01-002194	None	PG&E's MapGuide; CHRIS Records Search	Historic	Large wooden trough	Located approximately 0.25 mile southwest of the southern terminus of the APE; site has not been evaluated for the NRHP or CRHR
P-01-002195	CA-ALA-584H	PG&E's MapGuide; CHRIS Records Search	Historic	Concrete foundation, footings, fence remnants	Located approximately 0.25 mile southwest of the southern terminus of the APE; site has not been evaluated for the NRHP or CRHR
P-01-002197	None	CHRIS Records Search	Historic	Collapsed well house, well, piece of machinery or tool, possible modern corral	Located approximately 0.25 mile southeast of the southern terminus of the APE; site has not been evaluated for the NRHP or CRHR

Table 1. Previously Conducted Studies within 1/4 Mile of the APE

Study Number	Source	Author	Study Type	Within APE/Outside APE
S-848	Records Search	Winzler & Kelly nd	General regional ethnographic overview	Yes, but did not include survey
S-934	Records Search	Fredrickson 1978	General overview Upper Alameda Creek archaeology and history	Yes, but did not include survey
S-2458	Records Search	Stewart 1981	General overview of prehistoric archaeology for the county	Yes, but did not include survey
S-7507	Records Search	Garaventa et al. 1983	Archaeological survey report for Foley Parcel Project, along Highway 580, Livermore	Yes, covered portions of APE
S-9462	Records Search	Miller 1977	Thesis regarding the identification and recordation of prehistoric petroglyphs in bay area counties	Yes, covered portions of APE
S-9583	Records Search	Mayfield 1978	Thesis regarding the ecology of the pre-Spanish San Francisco bay area	Yes, but did not include survey
S-16660	Records Search	Fentress 1992	Thesis regarding the prehistoric rock art of Alameda and	Yes, but did not include survey

			Contra Costa Counties	
S-17835	Records Search	Suchey 1975	Dissertation regarding prehistoric Central California populations and their cranium measurements	Yes, but did not include survey
S-18217	Records Search	Gmoser 1996	Cultural resource evaluations for a Caltrans District 4 Phase 2 seismic retrofit program	Yes, but did not include survey
S-20335	Records Search	Wiberg et al. 1998	Cultural resources study for Alameda County	Yes, covered portions of the APE
S-20395	Records Search	Gillette 1998	Master's Thesis	Yes, but did not include survey
S-24986	MapGuide; Records Search	Basin Research Associates, Inc. 2000	Cultural resources study for PG&E for the proposed Tri-Valley 2002 Electric Power Capacity Increase Project	Specific locations cover APE
S-27958	Records Search	Maniery 2001	Finding of Effect for the Isabel Avenue/Interstate 580 Interchange Construction Project, Livermore	Yes, portions of APE
S-32596	MapGuide; Records Search	Milliken 2006	General overview ethnographic study	Yes, but did not include survey

S-33239	Records Search	Chavez 1994	Regional overview of the cultural and natural resources of the Alameda watershed	Yes, but did not include survey
S-33432	Records Search	Maniery 2004	Supplemental Historic Property Survey Report for the Isabel Avenue/Interstate 580 Interchange Construction Project, Livermore	Yes, portions of APE
S-33815	Records Search	Caltrans nd	Positive Historic Property Survey Report, Caltrans, District 4	Yes, portions of APE
S-39498	MapGuide; Records Search	Far Western 2012	Cultural resources study for PG&E's L131 gas pipeline, Alameda and Contra Costa Counties	Specific locations cover APE
#30988326	MapGuide	Harper 2013	Cultural resources constraints report for PG&E (HPR replacement)	Specific locations cover APE
S-40503	MapGuide; Records Search	Thomas 2013	Cultural resources study for PG&E's Line L131 ILI Investigation Digs Project, Alameda County	Specific locations cover APE
S-42368	MapGuide	Green 2011	Historic property survey report for the Freeway Initiative	No

			Project, Alameda County	
L-131 MP 32.31	MapGuide	Foutch 2012	Cultural resources constraints review desktop memorandum	Yes

Cumulatively, twenty-two studies were identified within the ¼ mile records search radius from MapGuide and NWIC review. Of these studies, twenty-one cover portions of the APE. However, of the twenty-one that cover portion of the APE, twelve (12) did not include pedestrian survey (Attachment D; Table 2 above).

4.2 FIELD

An archaeological field survey of the APE was conducted by Stantec archaeologists Joanne Grant, MA and Meagan Kersten, MA, on October 20 and 21, 2016 and by Stantec archaeologists Joanne Grant, MA and Laurel Zickler-Martin, MA on November 7th, 2016. Please see Appendix A for Survey Coverage Maps (Figures 4a and 4b) and Appendix C for survey photographs.

Throughout the APE, ground surface visibility varied between excellent (100%) to poor visibility (less than 5%). Some of the fields had been cleared of all vegetation, which provided for excellent ground visibility. Soils were generally consistent throughout the APE and consisted of medium to dark brown soils with small to medium pebbles.

Approximately 98% of the APE was surveyed. Approximately 2.3% (4.5 acres) of the APE were not surveyed due to safety issues. Additionally, the landowner of the proposed access road heading northwest from North Vasco Road denied access to this area; therefore, this proposed access road was not surveyed. Based on observations of this area from the project alignment, the proposed access road is a well-maintained dirt road that loops around various permanent and temporary (trailers) residences, and leads down to North Vasco Road. An abandoned residence and several oak trees were observed along the access road, but were not closely examined for the reasons noted above.

The paved access road (Tranquility Circle) at the western edge of the property was bordered by imported fill on its western boundary, with no native soils visible within approximately 20 feet of the road. Where this road bends east (becoming Sandalwood Drive), both sides of the road had been completely covered by newly constructed homes, sidewalks, and landscaping, leaving no native soils visible; surveying was thus not conducted along this stretch of road. The survey then proceeded toward Arroyo Las Positas, bordering the southern edge of the property and along the PG&E easement at the southern and eastern borders of the property. This easement was completely covered with imported fill, with no native soils visible; the only exception was a narrow stretch of easement between the easement berm and a silt fence bordering the southeastern edge of the property.

Along the outside (eastern edge) of the silt fence, landscaping activity had occurred (rows of young trees planted); while this had disturbed native soils, none were visible, being overgrown by grasses. A previously recorded (but not relocated since 1951) archaeological site (CA-ALA-47) had been reported to be along Arroyo Las Positas adjacent to the southeastern corner of the overland access route located at the extreme southern terminus of the APE. However, no survey was conducted along this stretch of the creek because it was outside the APE and was thus not at risk of being impacted by construction or PG&E activities—and because of safety concerns.

No cultural resources were identified as a result of the pedestrian survey.

5.0 MANAGEMENT CONSIDERATIONS

As part of the current archaeological study the entire 192.4-acre APE was inventoried to determine whether cultural resources would be affected by the proposed project. No cultural resources were identified during the course of the study; therefore, based on the findings in this study the proposed project will not cause a substantial adverse change to the significance of cultural resources as defined in Section 15064.5. Therefore, no additional cultural resources studies or additional construction constraints are recommended at this time.

The methods and techniques used by Stantec are considered sufficient for the identification and evaluation of cultural resources visible at the ground surface.

However, archaeological buried site sensitivity analysis indicates that the portion of the project area which crosses Cayetano Creek, and proceeds along the alignment approximately 1,500 feet to the southwest and 4,450 feet to the northeast has moderate to high buried site sensitivity. It is recommended that a qualified archaeologist monitor be present during ground disturbing activities within 500 feet of the creek and that spot check archaeological monitoring occur within the APE along the alignment 3,500 feet north of the sensitive area around the creek and 1,000 feet southwest of the sensitive area around the creek (see Appendix A, Figure 5).

Additionally, we recommend that a cultural resources tailboard presentation be presented to the construction crew prior to the onset of ground disturbing activities.

There is always a possibility that buried archaeological deposits could be found during construction and earth disturbing activities. In the event that cultural resources are encountered during construction activities, all work must stop and a qualified archaeologist shall be contacted immediately. Further, in the event that any human remains are encountered or in the event that unassociated funerary objects or grave goods are discovered, State Health and Safety Code Section 7050.5 requires that no further work shall continue at the location of the find until the County Coroner has made all the necessary findings as to the origin and distribution of such remains pursuant to Public Code Resources Code Section 5097.98.

5.1 INADVERTENT DISCOVERY

It is always possible that archaeological deposits or human remains that were not identified by this study could occur in the APE. The procedures described below address such eventualities.

5.1.1 Archaeological Deposits

If any cultural resources are located during project activities, Best Management Practice 25 (Environmental Services Procedure P-002) should be implemented, which includes stopping all work in the vicinity of the discovery and immediately notifying a PG&E Cultural Resources Specialist. Archaeological and historic-period resources in the region may include:

- Archeological materials: flaked stone tools (projectile point, biface, scraper, etc.) and debitage (flakes) made of chert, obsidian, etc., groundstone milling tools and fragments (mortar, pestle, handstone, millingstone, etc.), faunal bones, fire-affected rock, dark middens, housepit depressions and human interments.

- Historic-era resources: may include, but are not limited to, small cemeteries or burial plots, cut (square) nails, containers or miscellaneous hardware, glass fragments, cans with soldered seams or tops, ceramic or stoneware objects or fragments, milled or split lumber, earthworks, feature or structure remains and trash dumps.

5.1.2 Human Remains

Section 7050.5 of the California Health and Safety Code (CHSC) states that it is a misdemeanor to knowingly disturb a human burial. In keeping with the provisions provided in 7050.5 CHSC and Public Resource Code 5097.98, if human remains are encountered (or are suspected) during any project-related activity:

- Stop all work within 100 feet;

- Immediately contact a PG&E CRS, who will then notify the county coroner (and other appropriate agency staff as appropriate);

- Secure location and make sure that construction personnel or other people on site do not touch or remove remains and associated artifacts;

- Keep any associated spoils on site and do not allow unauthorized people to remove or pick through them;

- Record the location and keep notes of all calls and events;

- Treat the find as confidential and do not publically disclose the location; and

- Do not excavate or otherwise remove human remains or associated funerary objects unless consultation between the appropriate Native American representative(s), PG&E and other relevant stakeholders has concluded and you have been explicitly instructed to do so.

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1916, 1940 Byron 1:62500 scale USGS Topographic Maps

1941 Pleasanton 1:62500 scale USGS Topographic Map

1953, 1961 Livermore 1:62500 scale USGS Topographic Maps

1953, 1961, 1968, 1973, 1980 Livermore 1:24000 scale USGS Topographic Maps

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APPENDICES

APPENDIX A – PROJECT MAPS

APPENDIX B – NATIVE AMERICAN OUTREACH AND CORRESPONDENCE

From:	Kersten, Meagan
To:	"nahc@nahc.ca.gov"; "nahc@pacbell.net"
Subject:	Sacred Lands File & Native American Contacts List Request - PG&E Bundled L131 Replacement Projects
Date:	Thursday, November 03, 2016 12:35:00 PM
Attachments:	pg&e_L131_nahc_form.pdf
Importance:	High

To Whom it May Concern,

Attached is a Sacred Lands File & Native American Contacts List Request form, project description, and project location maps for the PG&E Bundled L131 Replacement Projects in Alameda County.

If you have any questions or require any further information, please feel free to call or e-mail me.

Thank you.

Sincerely,
Meagan Kersten

Meagan Kersten
Archaeologist, Environmental Compliance Specialist
Stantec
Phone: (530) 470-0515
meagan.kersten@stantec.com

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Please consider the environment before printing this email.

Sacred Lands File & Native American Contacts List Request

NATIVE AMERICAN HERITAGE COMMISSION
1550 Harbor Blvd, Suite 100
West Sacramento, CA 95501
(916) 373-3710
(916) 373-5471 – Fax
nahc@nahc.ca.gov

Information Below is Required for a Sacred Lands File Search

Project: PG&E Bundled L131 Replacement Projects

County: Alameda County

USGS Quadrangle
Name: Altamont, Livermore, Byron Hot Springs

Township: 2S; 3S Range: 2E Section(s): 15, 21, 22, 28, 29, 31; 6

Company/Firm/Agency:
Stantec Consulting Services Inc. on behalf of PG&E

Contact Person: Meagan Kersten, Archaeologist

Street Address: 101 Providence Mine Road, Suite 202

City: Nevada City Zip: 95959

Phone: (530) 470-0515 Extension: n/a

Fax:

Email: meagan.kersten@stantec.com

Project Description:
See attached Project Understanding.

☑ Project Location Map is attached

PG&E BUNDLED L131 REPLACEMENT PROJECT UNDERSTANDING

North of Livermore in Alameda County, Pacific Gas and Electric Company's (PG&E) Pipeline 131 (L131) extends from Interstate-580 (I-580) immediately east of Isabel Avenue (Ave) and extends in a northeast direction past Vasco Road (Rd) and into Contra Costa County. PG&E is currently planning on replacing approximately five miles of L131 between I-580 and Vasco Road. Replacement of L131 at this location is composed of the following three PG&E projects:

- **R649. Replace L131 between Mile Points (MPs) 31.83 and 31.90 & at 32.29:** Shea Homes began developing a parcel of land between I-580 and Portola Ave for a new residential development in 2016. At the request of Shea Homes, PG&E relocated a segment of L131 to accommodate the new development layout. PG&E will replace segments of L131 on either side of the segment relocated for the housing development, including approximately 400 feet (ft) of L131 immediately north of Portola Ave between MPs 31.83 and 31.90 and approximately 100 ft of L131 north of I-580 at MP 32.29.
- **R700. Replace L131 between MPs 28.00 and 31.83:** PG&E will replace an almost four mile segment of L131 between MPs 28.00 and 31.93, north of and contiguous to the R649 project. Replacement is necessary to upgrade aging vintage pipe.
- **R707. Replace L131 between MPs 28.00 and 27.02:** PG&E will replace an approximately one mile segment of L131 between MPs 28.00 and 27.02, north of and contiguous to the R700 project and ending at Vasco Rd. Replacement will improve how L131 crosses a fault along this segment.

The new pipeline for all three projects will likely be installed in parallel to the existing L131 pipeline, but PG&E is evaluating all potential routes along the alignment. Construction will primarily consist of open trench installation and trenchless bores will be used as deemed necessary to avoid sensitive drainages, roadways, and other features. The existing PG&E easement is 15 feet wide and its expected modified or new pipeline easements will be necessary from all or the majority of property owners along the new alignment. Temporary work space/easements will also be required along the alignment for construction and additional offsite staging areas will be necessary at a few locations.

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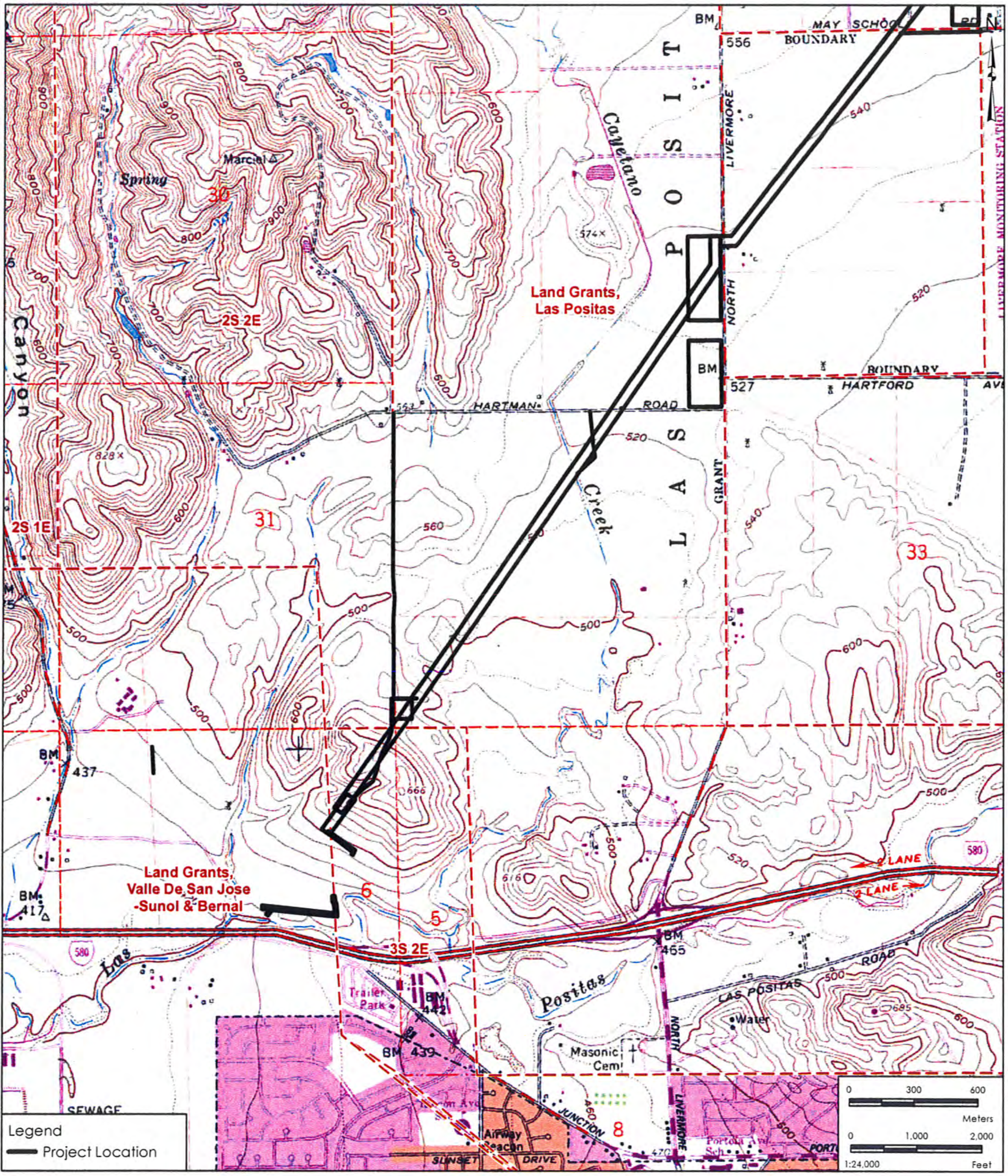

Map Information:
Projection: UTM, NAD83 Zone 10 North
Topo Date: Linear Unit: Meter

Project Information:
PLSS: Valle De San Jose -Sunol & Bernal and Las Positas Land Grants, T2S R2E and T3S R2E
Projected PLSS: T2S R2E S15, 21, 22, 28, 29, 31 and T3S R2E S6

Stantec

Pacific Gas and Electric
PG&E Bundled L131 Replacement Projects, Alameda County

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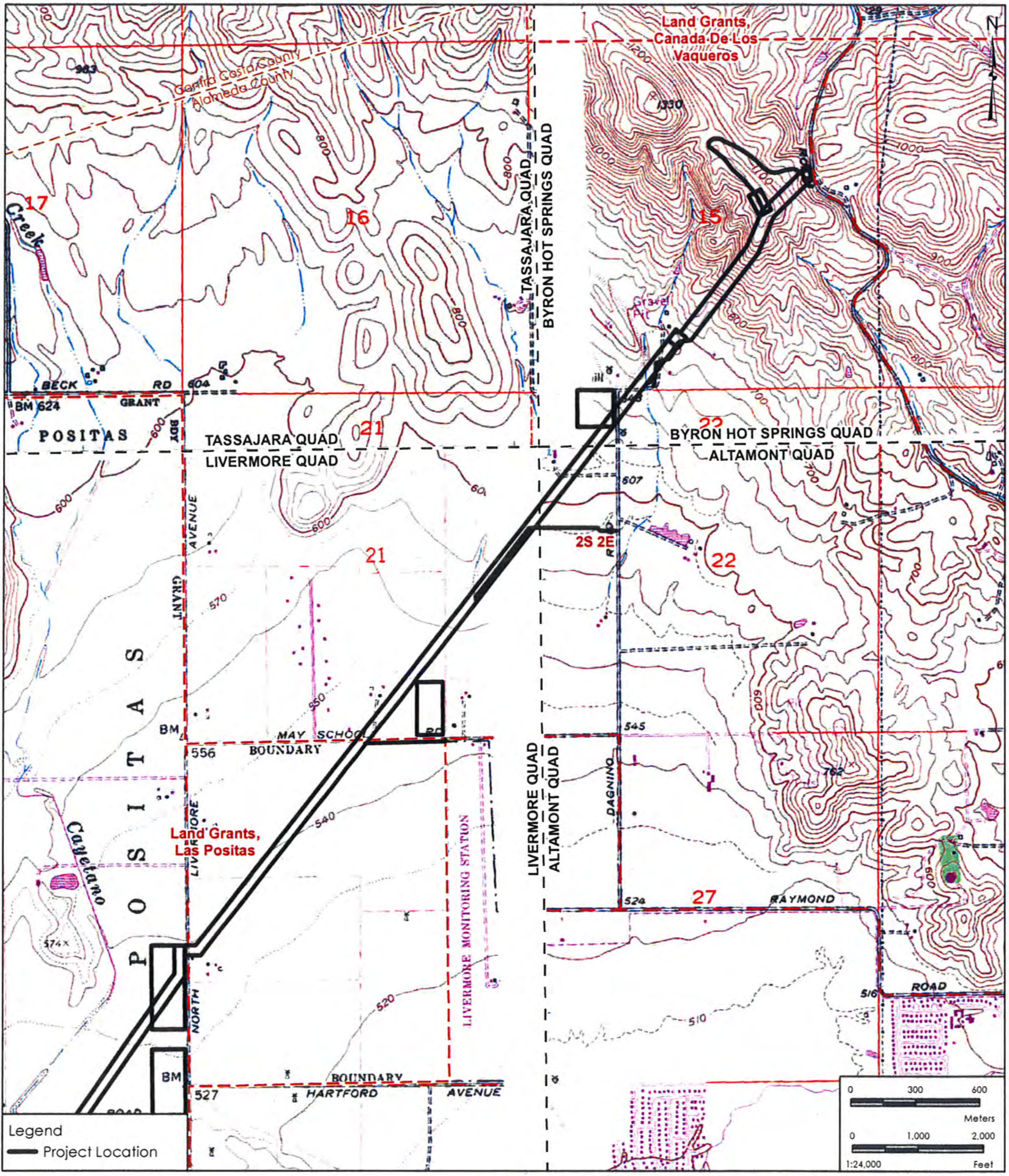
Figure 2a. Project Location Map

Prepared: MNugent, 11/2/2016

C:_GIS\185703511_L131\mxd\Cultural\L131_CultProjLocation_8x11P_02.mxd mnugent 2016-10-31



Map Information:
Projection: UTM, NAD83 Zone 10 North
Topo Date: Linear Unit: Meter

Project Information:
PLSS: Valle De San Jose -Sunol & Bernal and Las Positas Land Grants, T2S R2E and T3S R2E
Projected PLSS: T2S R2E S15, 21, 22, 28, 29, 31 and T3S R2E S6

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Pacific Gas and Electric
PG&E Bundled L131 Replacement Projects, Alameda County

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Figure 2b. Project Location Map

Prepared: MNugent, 10/31/2016

STATE OF CALIFORNIA Edmund G. Brown, Jr., *Governor*

NATIVE AMERICAN HERITAGE COMMISSION
1550 Harbor Blvd., Suite 100
West Sacramento, CA 95691
(916) 373-3710
(916) 373-5471 Fax

November 14, 2016

Meagan Kersten
Stantec

Sent by: Meagan.kersten@stantec.com

RE: PG&E Bundled L131 Replacement Project, Alameda County

Dear Ms. Kersten,

Attached is a list of tribes that have cultural and traditional affiliation to the area of potential project effect (APE) referenced above. I suggest you contact all of those listed, if they cannot supply information, they might recommend others with specific knowledge. The list should provide a starting place to locate areas of potential adverse impact within the APE. By contacting all those on the list, your organization will be better able to respond to claims of failure to consult, as may be required under particular state statutes. If a response has not been received within two weeks of notification, the Native American Heritage Commission (NAHC) requests that you follow-up with a telephone call to ensure that the project information has been received.

The NAHC also recommends that project proponents conduct a record search of the NAHC Sacred Lands File (SLF) at the appropriate regional archaeological Information Center of the California Historic Resources Information System (CHRIS) (http://ohp.parks.ca.gov/?page_id=1068) to determine if any tribal cultural resources are located within the area(s) affected by the proposed action. The SFL, established under Public Resources Code section 5094, are sites submitted for listing to the NAHC by California Native American tribes. The SFL, established under Public Resources Code section 5094, are sites submitted for listing to the NAHC by California Native American tribes. A record search of the SLF was completed for the APE referenced above with negative results. Please note records maintained by the NAHC and CHRIS is not exhaustive, and a negative response to these searches does not preclude the existence of tribal cultural resources. A tribe may be the only source of information regarding the existence of tribal cultural resources.

If you receive notification of change of addresses and phone numbers from any of these tribes, please notify me. With your assistance we are able to assure that our lists contain current information. If you have any questions or need additional information, please contact via email: frank.lienert@nahc.ca.gov

Sincerely,

Frank Lienert
Associate Governmental Program Analyst

Native American Contacts

November 14, 2016

Coastanoan Rumsen Carmel Tribe
Tony Cerda, Chairperson
244 E. 1st Street
Pomona , CA 91766
rumsen@aol.com
(909) 524-8041 Cell
(909) 629-6081
Ohlone/Costanoan

Amah MutsunTribal Band of Mission San Juan Bautista
Irenne Zwierlein, Chairperson
789 Canada Road
Woodside , CA 94062
amahmutsuntribal@gmail.com
(650) 400-4806 Cell

(650) 332-1526 Fax
Ohlone/Costanoan

North Valley Yokuts Tribe
Katherine Erolinda Perez, Chairperson
P.O. Box 717
Linden , CA 95236
canutes@verizon.net
(209) 887-3415
Ohlone/Costanoan
Northern Valley Yokuts
Bay Miwok

Muwekma Ohlone Indian Tribe of the SF Bay Area
Rosemary Cambra, Chairperson
P.O. Box 360791
Milpitas , CA 95036
muwekma@muwekma.org
(408) 314-1898
(510) 581-5194
Ohlone / Costanoan

The Ohlone Indian Tribe
Andrew Galvan
P.O. Box 3152
Fremont , CA 94539
chochenyo@AOL.com
(510) 882-0527 Cell

(510) 687-9393 Fax
Ohlone/Costanoan
Bay Miwok
Plains Miwok
Patwin

Indian Canyon Mutsun Band of Costanoan
Ann Marie Sayers, Chairperson
P.O. Box 28
Hollister , CA 95024
ams@indiancanyon.org
(831) 637-4238
Ohlone/Costanoan

This list is current only as of the date of this document and is based on the information available to the Commission on the date it was produced.

Distribution of this list does not relieve any person of statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resource Section 5097.98 of the Public Resources Code

This list is only applicable for contacting local Native Americans with regard to cultural resources assessments for
PG&E Bundled L131 Replacement Project, Alameda County.

Pacific Gas and Electric Company

Kimberly M. Cuevas
Senior Cultural Resources Specialist
Environmental Planning and Permitting

Mailing Address
6111 Bollinger Canyon Road,
3rd Floor, 3310-F, San Ramon, CA 94583
Office: 925-328-5138
Mobile: 925-407-6751
Email: k3c4@pge.com

November 22, 2016

Costanoan Rumsen Carmel Tribe
Attn: Tony Cerda, Chairperson
244 E. 1st Street
Pomona, CA 91766

Reference: Pacific Gas and Electric Company (PG&E) Bundled Pipeline 131 (L131) Replacement Projects in Alameda County

Dear Chairperson Cerda,

I am writing regarding the Pacific Gas and Electric Company (PG&E) Bundled Pipeline 131 (L131) Replacement Projects (project). North of Livermore in Alameda County, PG&E's L131 extends from Interstate-580 (I-580) immediately east of Isabel Avenue (Ave) and extends in a northeast direction past Vasco Road (Rd) and into Contra Costa County. PG&E is currently planning to replace approximately five miles of L131 between I-580 and Vasco Road. Replacement of L131 at this location is composed of the following three PG&E projects:

R649. Replace L131 between Mile Points (MPs) 31.83 and 31.90 & at 32.29: Shea Homes began developing a parcel of land between I-580 and Portola Ave for a new residential development in 2016. At the request of Shea Homes, PG&E relocated a segment of L131 to accommodate the new development layout. PG&E will replace segments of L131 on either side of the segment relocated for the housing development, including approximately 400 feet (ft) of L131 immediately north of Portola Ave between MPs 31.83 and 31.90 and approximately 100 ft of L131 north of I-580 at MP 32.29.

R700. Replace L131 between MPs 28.00 and 31.83: PG&E will replace an almost four mile segment of L131 between MPs 28.00 and 31.93, north of and contiguous to the R649 project. Replacement is necessary to upgrade aging vintage pipe.

R707. Replace L131 between MPs 28.00 and 27.02: PG&E will replace an approximately one mile segment of L131 between MPs 28.00 and 27.02, north of and contiguous to the R700 project and ending at Vasco Rd. Replacement will improve how L131 crosses a fault along this segment.

The new pipeline for all three projects will likely be installed in parallel to the existing L131 pipeline, but PG&E is evaluating all potential routes along the alignment. Construction will primarily consist of open trench installation and trenchless bores will be used as deemed necessary to avoid sensitive drainages, roadways, and other features. The existing PG&E easement is 15 feet wide and it is expected that modified or new pipeline

easements will be necessary from all or the majority of property owners along the new alignment. Temporary work space/easements will also be required along the alignment for construction and additional offsite staging areas will be necessary at a few locations. A project map is attached with this letter. The project requires compliance with both the California Environmental Quality Act (CEQA) and Section 106 of the National Historic Preservation Act (NHPA).

The project cultural resources study is in progress, which includes contacting the Native American Heritage Commission (NAHC) for a search of the Sacred Lands File (SLF), a records search through the California Historical Resources Information System (CHRIS) and PG&E MapGuide database, and a pedestrian cultural resources survey. The NAHC sacred lands file did not indicate cultural resources in the immediate project area.

A records search through the CHRIS at the Northwest Information Center (NWIC) and a review of PG&E's MapGuide was conducted for the project APE, which includes a ¼ mile radius around the entire project APE. No cultural resources were identified within the APE but four previously recorded cultural resources were identified within the ¼-mile search radius or just outside the ¼-mile radius. Nineteen studies within a ¼-mile radius of the APE were identified as a result of the MapGuide and NWIC searches. Of the nineteen studies, seven included pedestrian surveys that covered portions of the APE and twelve covered portions of the APE but did not include a pedestrian survey. No cultural resources were identified as a result of the pedestrian survey.

If you have any questions, concerns, or areas of sensitivity that should be identified, please contact PG&E Cultural Resource Specialist, Kimberly Cuevas whose contact information is provided below. A cultural resources specialist will be following up this letter with a phone call to you at the number listed by the NAHC within ten(10) business days. We sincerely request you respond within 30 days of the receipt of this letter. Thank you in advance for your help with this and I look forward to speaking with you.

Respectfully,

Kimberly M. Cuevas, MA
Senior Cultural Resources Specialist
Environmental Management - Gas Transmission
Pacific Gas & Electric Company
Office: 925-328-5138
Mobile: 925-407-6751
Address: 6111 Bollinger Canyon Road, 3rd Floor, 3310-F
San Ramon, CA 94583

Attachment: Project Map

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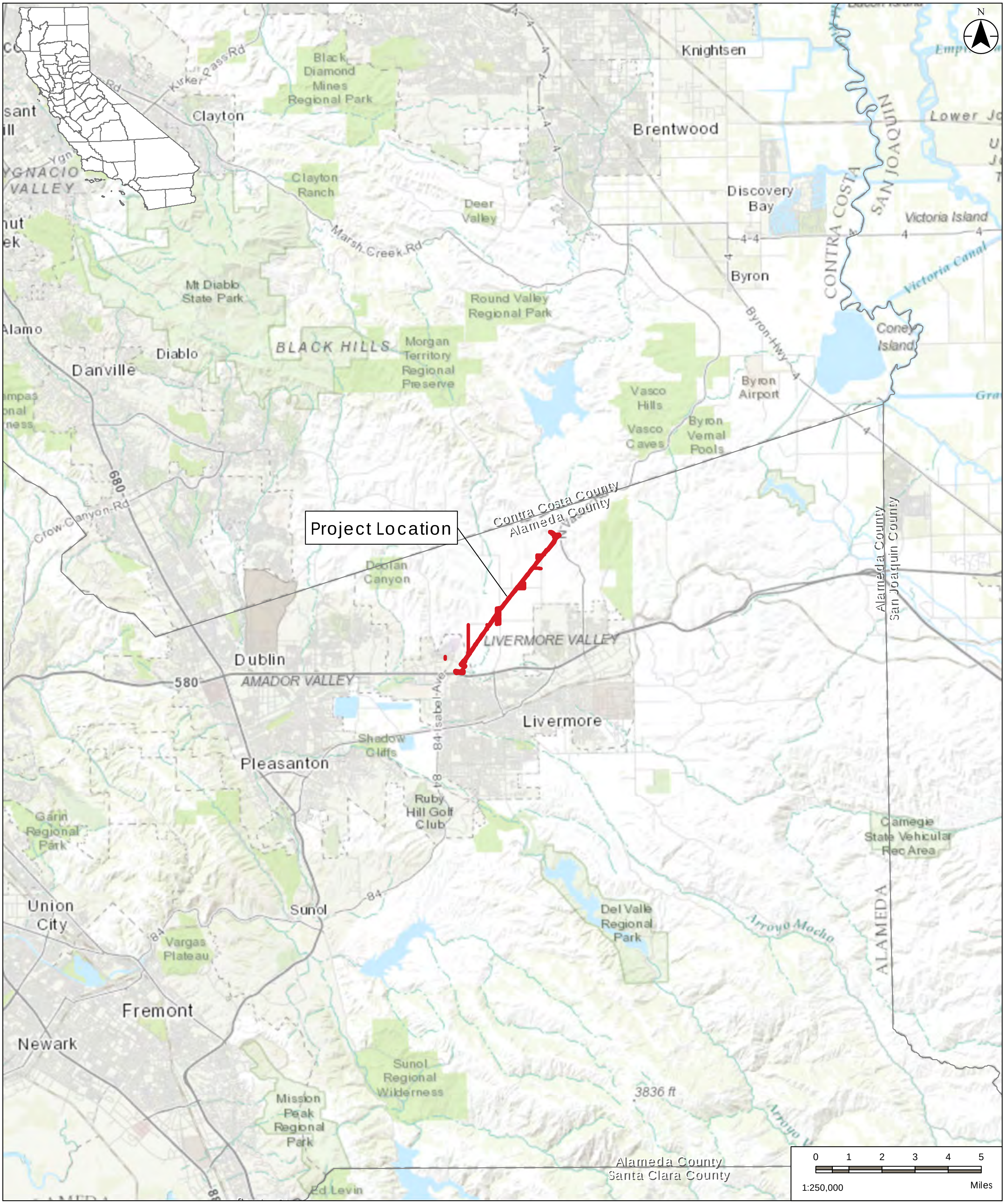

Pacific Gas and Electric
PG&E Bundled L131 Replacement Projects, Alameda County

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Figure 1. Vicinity Map

Prepared: MNugent, 11/3/2016

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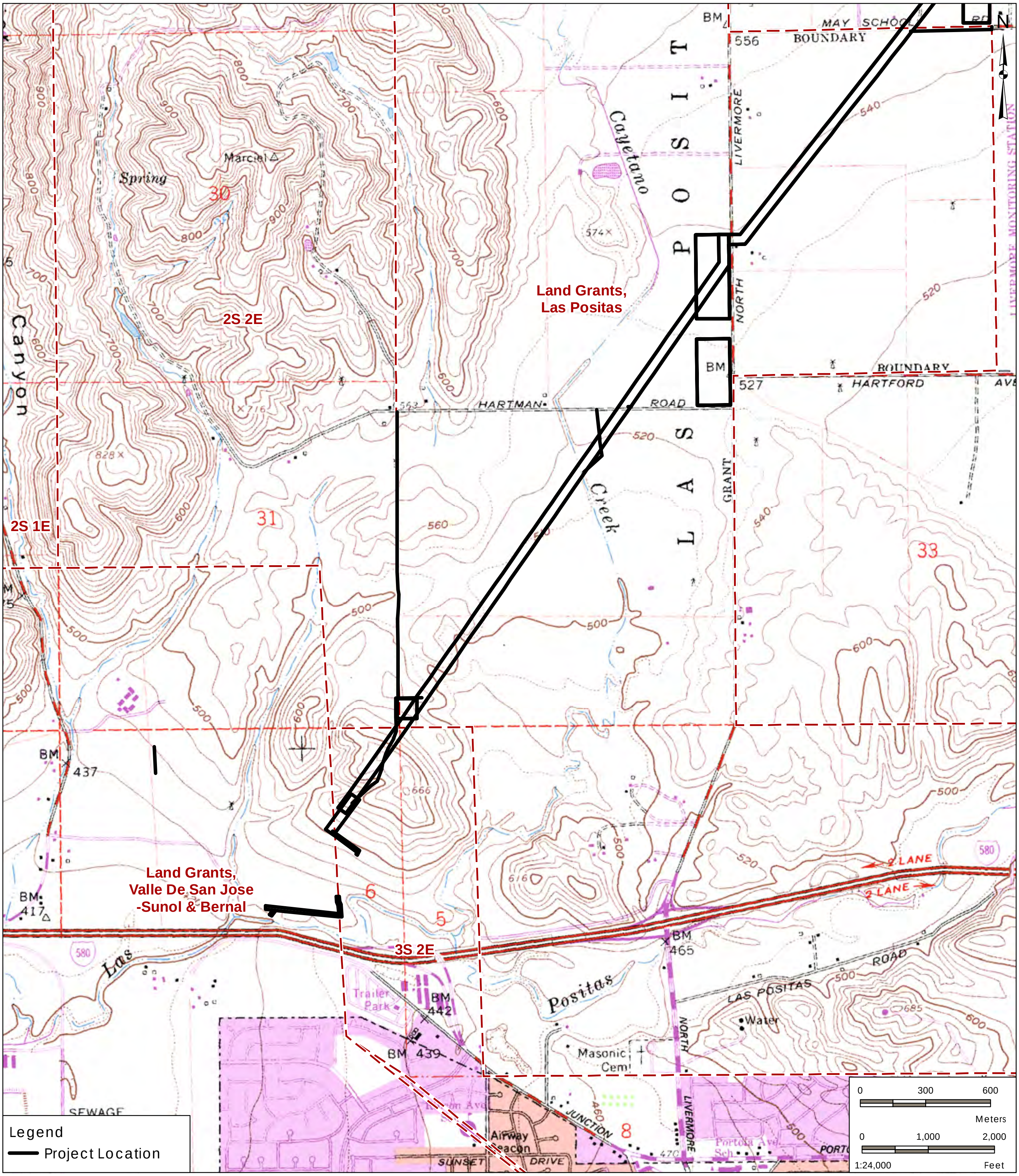

Map Information:
Projection: UTM, NAD83 Zone 10 North
Topo Date: Linear Unit: Meter

Project Information:
PLSS: Valle De San Jose -Sunol & Bernal and Las Positas
Land Grants, T2S R2E and T3S R2E
Projected PLSS: T2S R2E S15, 21, 22, 28, 29, 31 and T3S R2E S6

Pacific Gas and Electric
PG&E Bundled L131 Replacement Projects, Alameda County

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Figure 2a. Project Location Map

Prepared: MNugent, 11/2/2016

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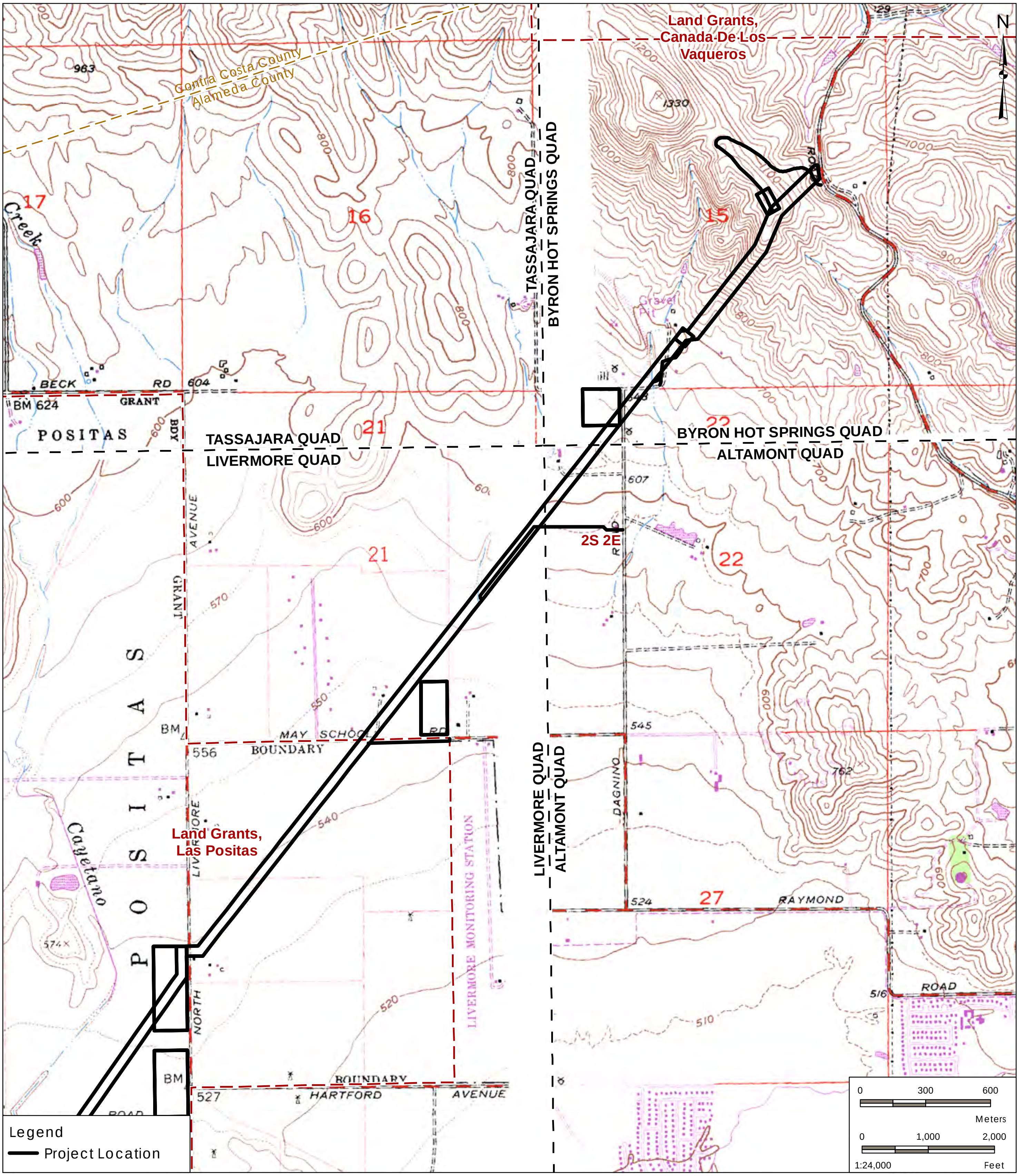

Map Information:
Projection: UTM, NAD83 Zone 10 North
Topo Date: Linear Unit: Meter

Project Information:
PLSS: Valle De San Jose -Sunol & Bernal and Las Positas Land Grants, T2S R2E and T3S R2E
Projected PLSS: T2S R2E S15, 21, 22, 28, 29, 31 and T3S R2E S6

Stantec

Pacific Gas and Electric
PG&E Bundled L131 Replacement Projects, Alameda County

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Figure 2b. Project Location Map

Prepared: MNugent, 10/31/2016

From:	Kersten, Meagan
To:	rumsen@aol.com
Subject:	Cultural Resources Information Request for the PG&E Bundled Pipeline 131 Replacement Projects in Alameda County
Date:	Wednesday, November 23, 2016 9:50:00 AM
Attachments:	PG&E_L131_letter_cerda_20161122.pdf
Importance:	High

Dear Chairperson Cerda,

Please see the attached letter and maps in regards to the Pacific Gas and Electric Company (PG&E) Bundled Pipeline 131 (L131) Replacement Projects (project). A hard copy of the letter and maps was also mailed to you via certified U.S. Postal Service on 11/22/2016.

If you have any questions, concerns, or areas of sensitivity that should be identified, please contact PG&E Cultural Resource Specialist, Kimberly Cuevas whose contact information is provided below.

Kimberly M. Cuevas, MA
Senior Cultural Resources Specialist
Environmental Management - Gas Transmission
Pacific Gas & Electric Company
Office: 925-328-5138
Mobile: 925-407-6751
Address: 6111 Bollinger Canyon Road, 3rd Floor, 3310-F
San Ramon, CA 94583

I will follow up this email with a phone call to you at the number listed by the Native American Heritage Commission (NAHC) within ten(10) business days. We sincerely request you respond within 30 days of the receipt of this letter. Thank you in advance for your help with this and I look forward to speaking with you.

Respectfully,
Meagan Kersten

Meagan Kersten
Archaeologist, Environmental Compliance Specialist
Stantec
Phone: (530) 470-0515
meagan.kersten@stantec.com

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Pacific Gas and Electric Company

Kimberly M. Cuevas
Senior Cultural Resources Specialist
Environmental Planning and Permitting

Mailing Address
6111 Bollinger Canyon Road,
3rd Floor, 3310-F, San Ramon, CA 94583
Office: 925-328-5138
Mobile: 925-407-6751
Email: k3c4@pge.com

November 22, 2016

Amah Mutsun Tribal Band of Mission San Juan Bautista
Attn: Irenne Zwierlein, Chairperson
789 Canada Road
Woodside, CA 94062

Reference: Pacific Gas and Electric Company (PG&E) Bundled Pipeline 131 (L131) Replacement Projects in Alameda County

Dear Chairperson Zwierlein,

I am writing regarding the Pacific Gas and Electric Company (PG&E) Bundled Pipeline 131 (L131) Replacement Projects (project). North of Livermore in Alameda County, PG&E's L131 extends from Interstate-580 (I-580) immediately east of Isabel Avenue (Ave) and extends in a northeast direction past Vasco Road (Rd) and into Contra Costa County. PG&E is currently planning to replace approximately five miles of L131 between I-580 and Vasco Road. Replacement of L131 at this location is composed of the following three PG&E projects:

R649. Replace L131 between Mile Points (MPs) 31.83 and 31.90 & at 32.29: Shea Homes began developing a parcel of land between I-580 and Portola Ave for a new residential development in 2016. At the request of Shea Homes, PG&E relocated a segment of L131 to accommodate the new development layout. PG&E will replace segments of L131 on either side of the segment relocated for the housing development, including approximately 400 feet (ft) of L131 immediately north of Portola Ave between MPs 31.83 and 31.90 and approximately 100 ft of L131 north of I-580 at MP 32.29.

R700. Replace L131 between MPs 28.00 and 31.83: PG&E will replace an almost four mile segment of L131 between MPs 28.00 and 31.93, north of and contiguous to the R649 project. Replacement is necessary to upgrade aging vintage pipe.

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The new pipeline for all three projects will likely be installed in parallel to the existing L131 pipeline, but PG&E is evaluating all potential routes along the alignment. Construction will primarily consist of open trench installation and trenchless bores will be used as deemed necessary to avoid sensitive drainages, roadways, and other features. The existing PG&E easement is 15 feet wide and it is expected that modified or new pipeline

easements will be necessary from all or the majority of property owners along the new alignment. Temporary work space/easements will also be required along the alignment for construction and additional offsite staging areas will be necessary at a few locations. A project map is attached with this letter. The project requires compliance with both the California Environmental Quality Act (CEQA) and Section 106 of the National Historic Preservation Act (NHPA).

The project cultural resources study is in progress, which includes contacting the Native American Heritage Commission (NAHC) for a search of the Sacred Lands File (SLF), a records search through the California Historical Resources Information System (CHRIS) and PG&E MapGuide database, and a pedestrian cultural resources survey. The NAHC sacred lands file did not indicate cultural resources in the immediate project area.

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Mobile: 925-407-6751
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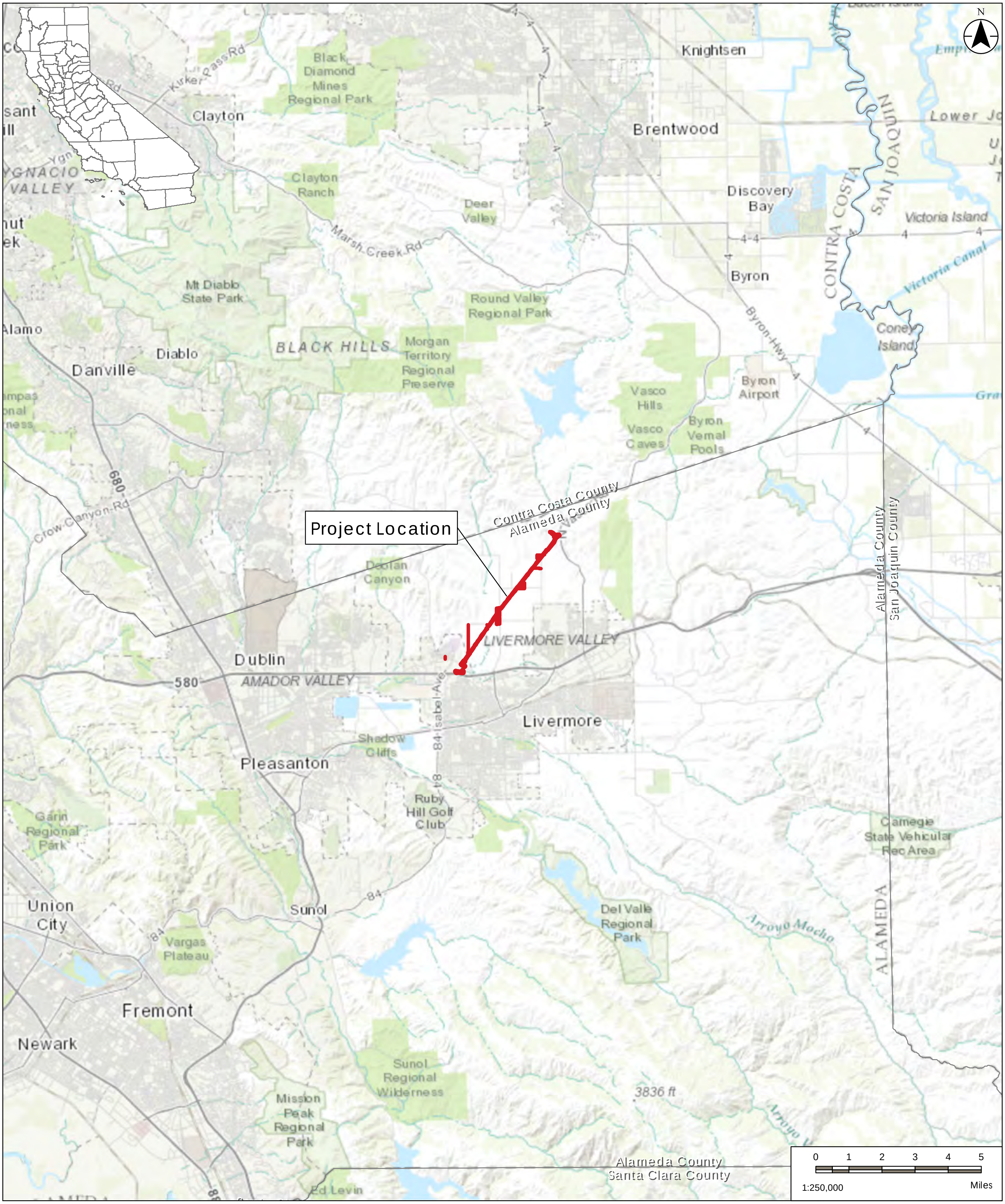
San Ramon, CA 94583

Attachment: Project Map

C:_GIS\185703511_L131\mxd\Cultural\L131_CultVicinity_8x11P_01.mxd mnugent 2016-11-03



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Pacific Gas and Electric
PG&E Bundled L131 Replacement Projects, Alameda County

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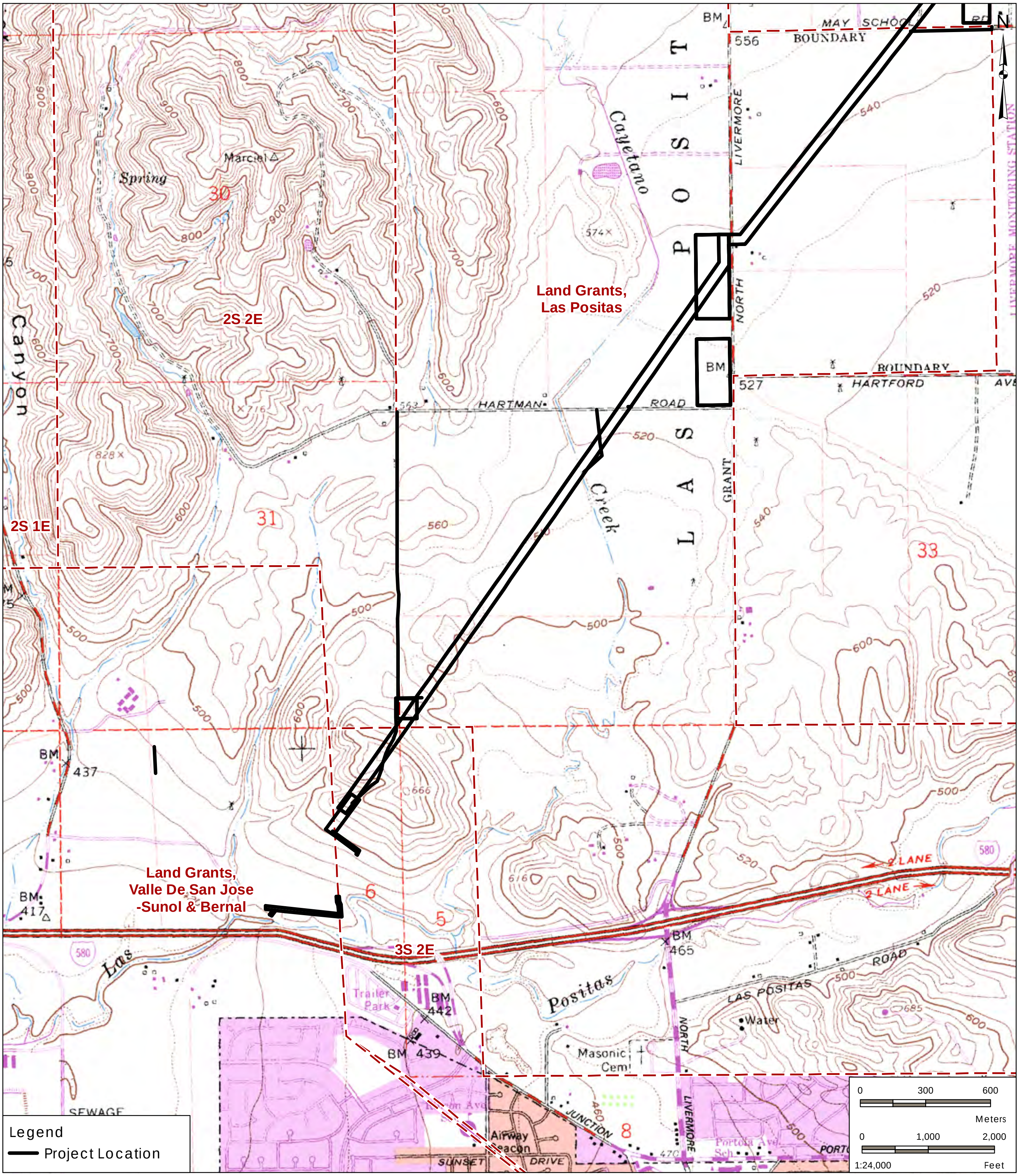
Figure 1. Vicinity Map

Prepared: MNugent, 11/3/2016

C:_GIS\185703511_L131\mxd\Cultural\L131_CultProjLocation_8x11P_02.mxd mnugent 2016-11-02



Map Information:
Projection: UTM, NAD83 Zone 10 North
Topo Date: Linear Unit: Meter

Project Information:
PLSS: Valle De San Jose -Sunol & Bernal and Las Positas Land Grants, T2S R2E and T3S R2E
Projected PLSS: T2S R2E S15, 21, 22, 28, 29, 31 and T3S R2E S6

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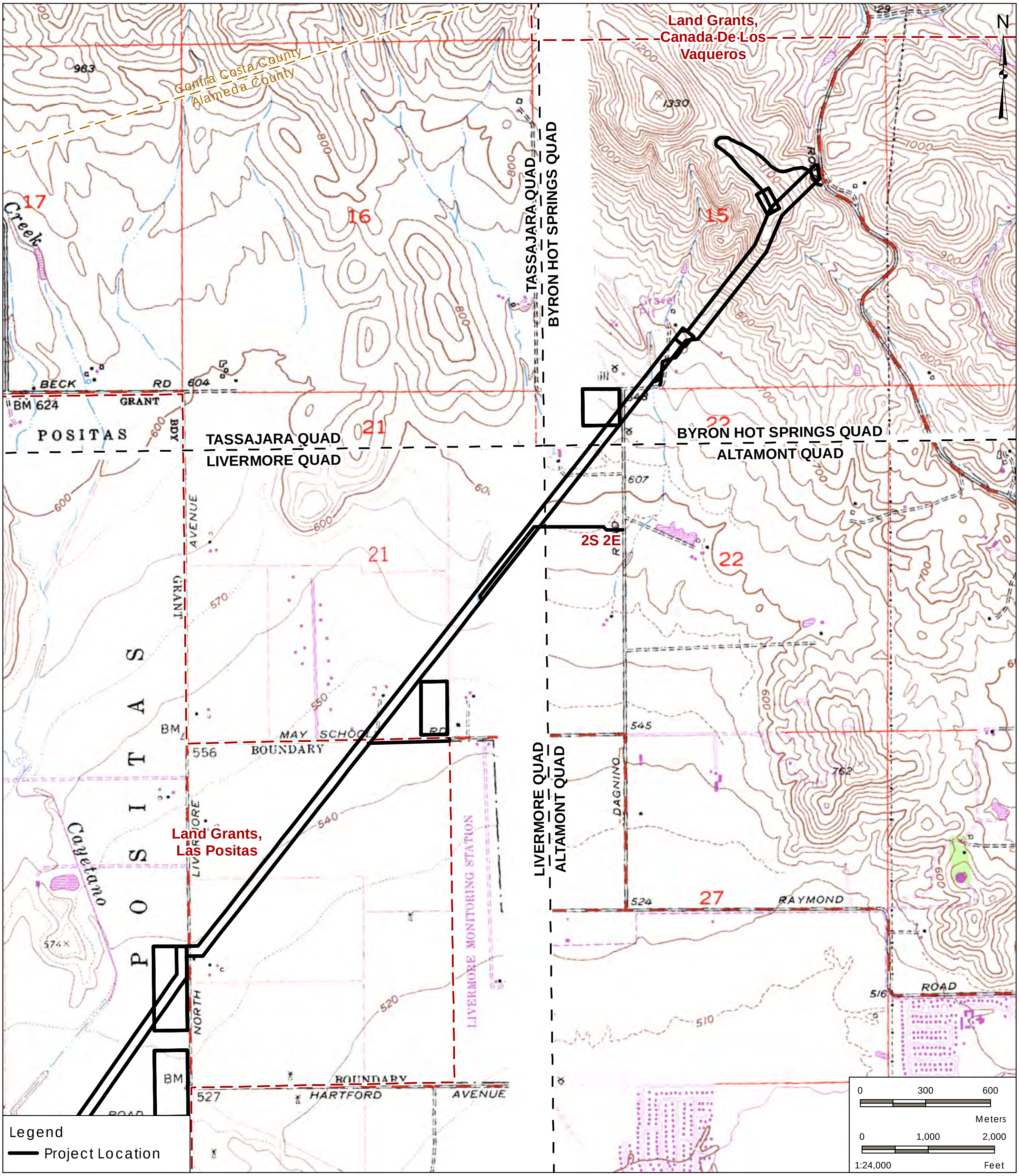
Figure 2a. Project Location Map

Prepared: MNugent, 11/2/2016

C:_GIS\185703511_L131\mxd\Cultural\L131_CultProjLocation_8x11P_02.mxd mnugent 2016-10-31



Map Information:
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Figure 2b. Project Location Map

Prepared: MNugent, 10/31/2016

From: Kersten, Meagan
To: "amahmutsuntribal@gmail.com"
Subject: Cultural Resources Information Request for the PG&E Bundled Pipeline 131 Replacement Projects in Alameda County
Date: Wednesday, November 23, 2016 9:53:00 AM
Attachments: PG&E_L131_letter_zwierlein_20161122.pdf
Importance: High

Dear Chairperson Zwierlein,

Please see the attached letter and maps in regards to the Pacific Gas and Electric Company (PG&E) Bundled Pipeline 131 (L131) Replacement Projects (project). A hard copy of the letter and maps was also mailed to you via certified U.S. Postal Service on 11/22/2016.

If you have any questions, concerns, or areas of sensitivity that should be identified, please contact PG&E Cultural Resource Specialist, Kimberly Cuevas whose contact information is provided below.

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Environmental Management - Gas Transmission
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San Ramon, CA 94583

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Office: 925-328-5138
Mobile: 925-407-6751
Email: k3c4@pge.com

November 22, 2016

North Valley Yokuts Tribe
Attn: Katherine Erolinda Perez, Chairperson
P.O. Box 717
Linden, CA 95236

Reference: Pacific Gas and Electric Company (PG&E) Bundled Pipeline 131 (L131) Replacement Projects in Alameda County

Dear Chairperson Erolinda Perez,

I am writing regarding the Pacific Gas and Electric Company (PG&E) Bundled Pipeline 131 (L131) Replacement Projects (project). North of Livermore in Alameda County, PG&E's L131 extends from Interstate-580 (I-580) immediately east of Isabel Avenue (Ave) and extends in a northeast direction past Vasco Road (Rd) and into Contra Costa County. PG&E is currently planning to replace approximately five miles of L131 between I-580 and Vasco Road. Replacement of L131 at this location is composed of the following three PG&E projects:

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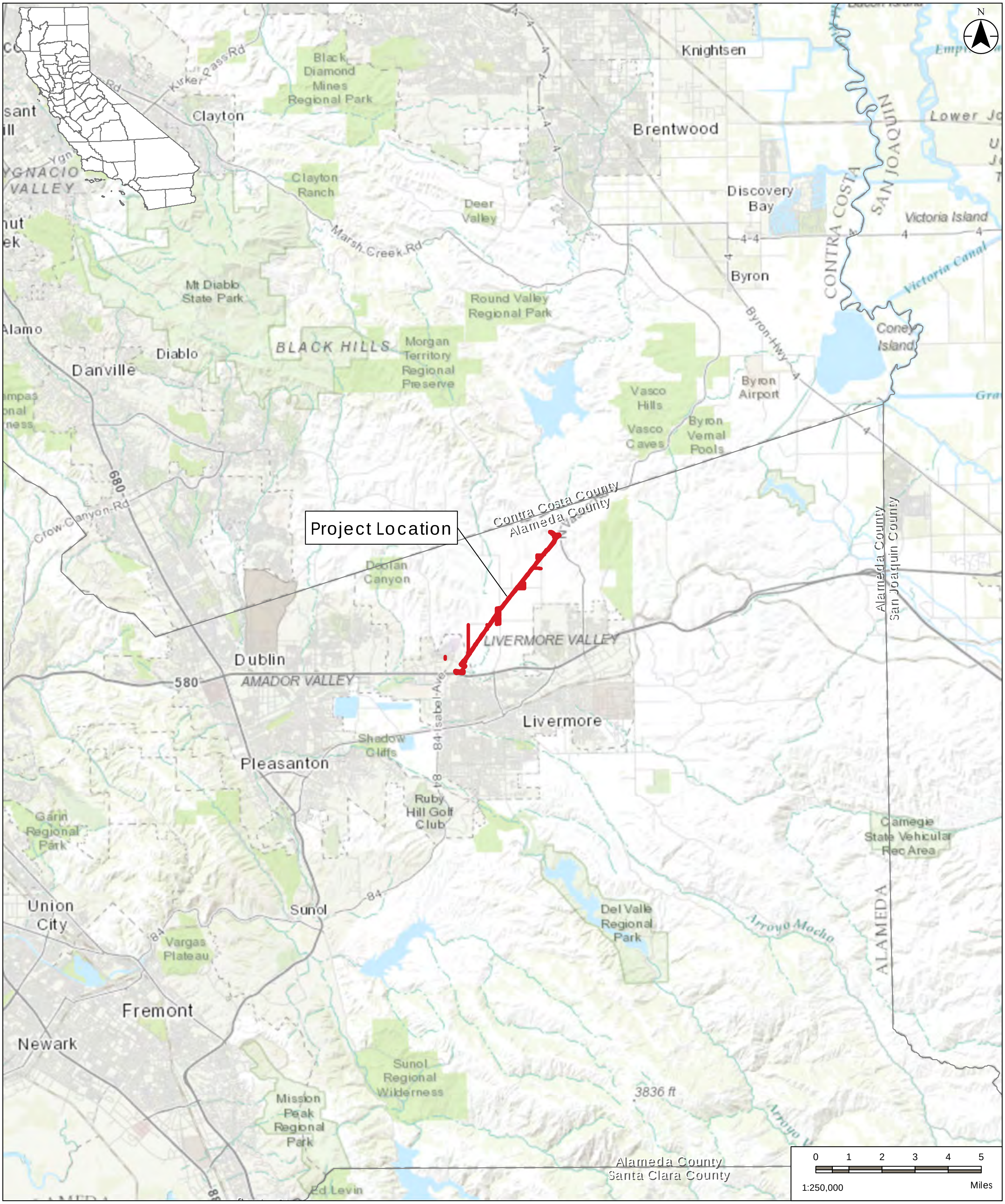

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PG&E Bundled L131 Replacement Projects, Alameda County

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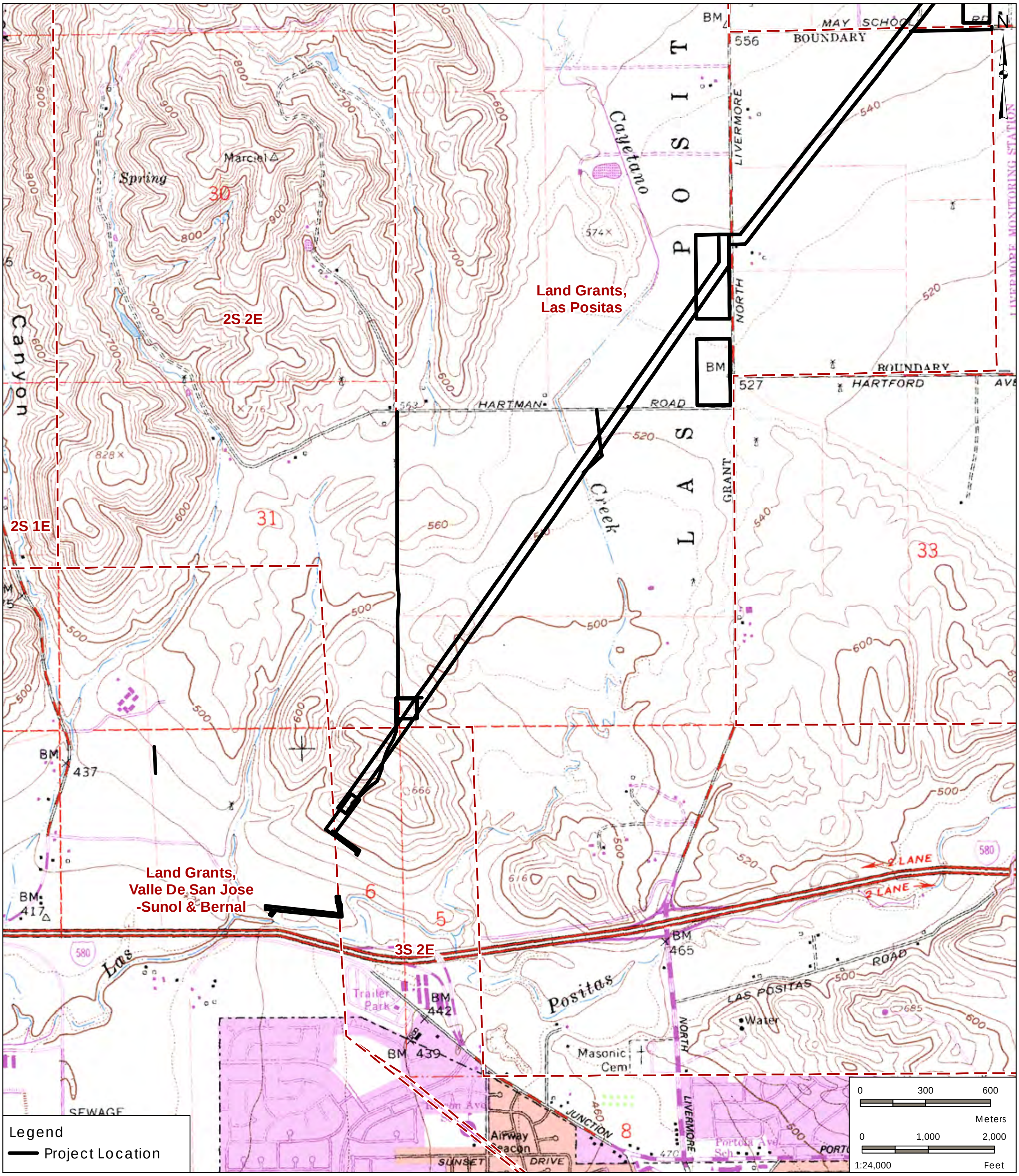

Map Information:
Projection: UTM, NAD83 Zone 10 North
Topo Date: Linear Unit: Meter

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Prepared: MNugent, 11/2/2016

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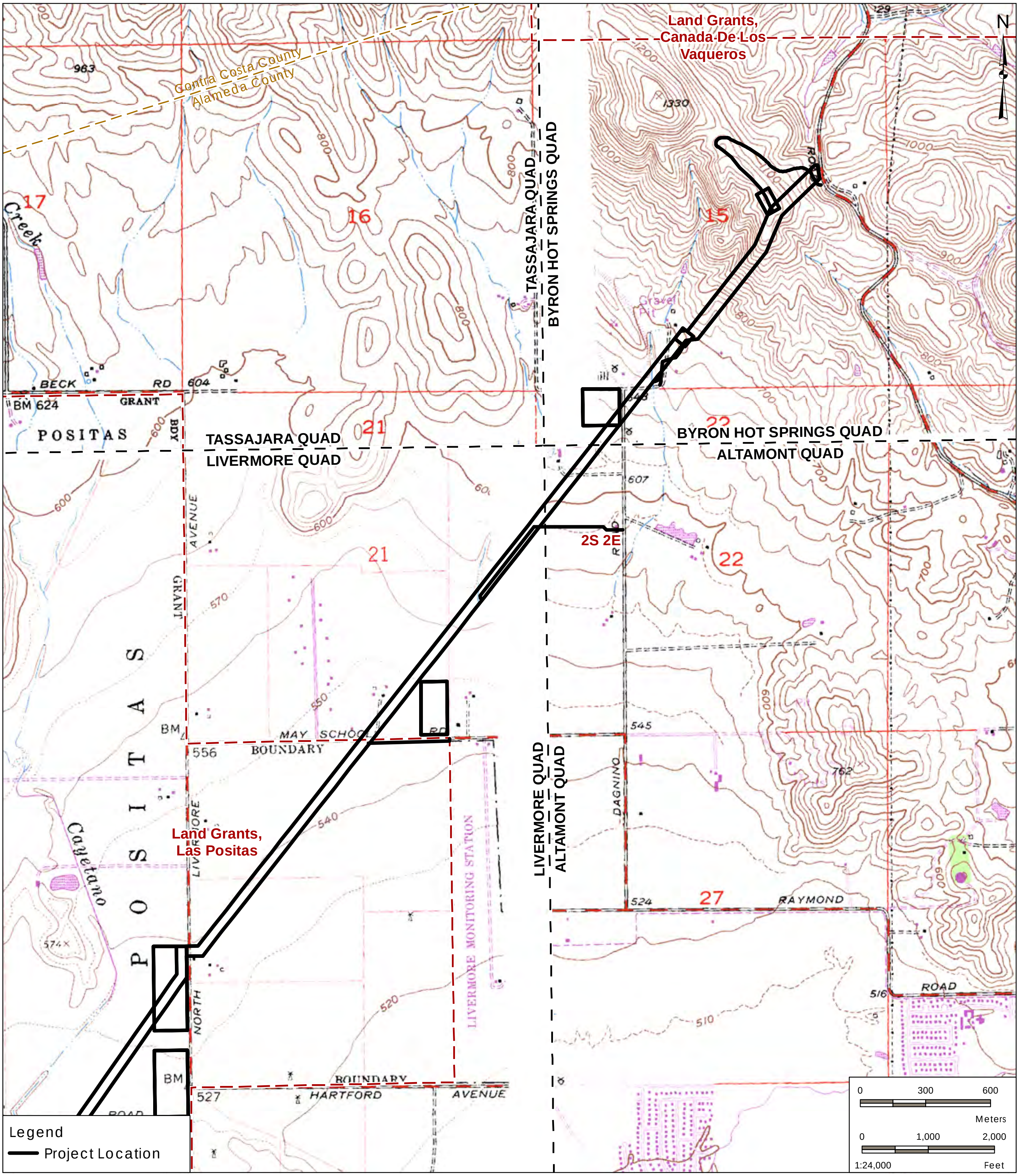

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Figure 2b. Project Location Map

Prepared: MNugent, 10/31/2016

From: Kersten, Meagan
To: "canutes@verizon.net"
Subject: Cultural Resources Information Request for the PG&E Bundled Pipeline 131 Replacement Projects in Alameda County
Date: Wednesday, November 23, 2016 9:54:00 AM
Attachments: PG&E_L131_letter_erolinda_perez_20161122.pdf
Importance: High

Dear Chairperson Erolinda Perez,

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Kimberly M. Cuevas
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Environmental Planning and Permitting

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Office: 925-328-5138
Mobile: 925-407-6751
Email: k3c4@pge.com

November 22, 2016

Muwekma Ohlone Indian Tribe of the SF Bay Area
Attn: Rosemary Cambra, Chairperson
P.O. Box 360791
Milpitas, CA 95036

Reference: Pacific Gas and Electric Company (PG&E) Bundled Pipeline 131 (L131) Replacement Projects in Alameda County

Dear Chairperson Cambra,

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Attachment: Project Map

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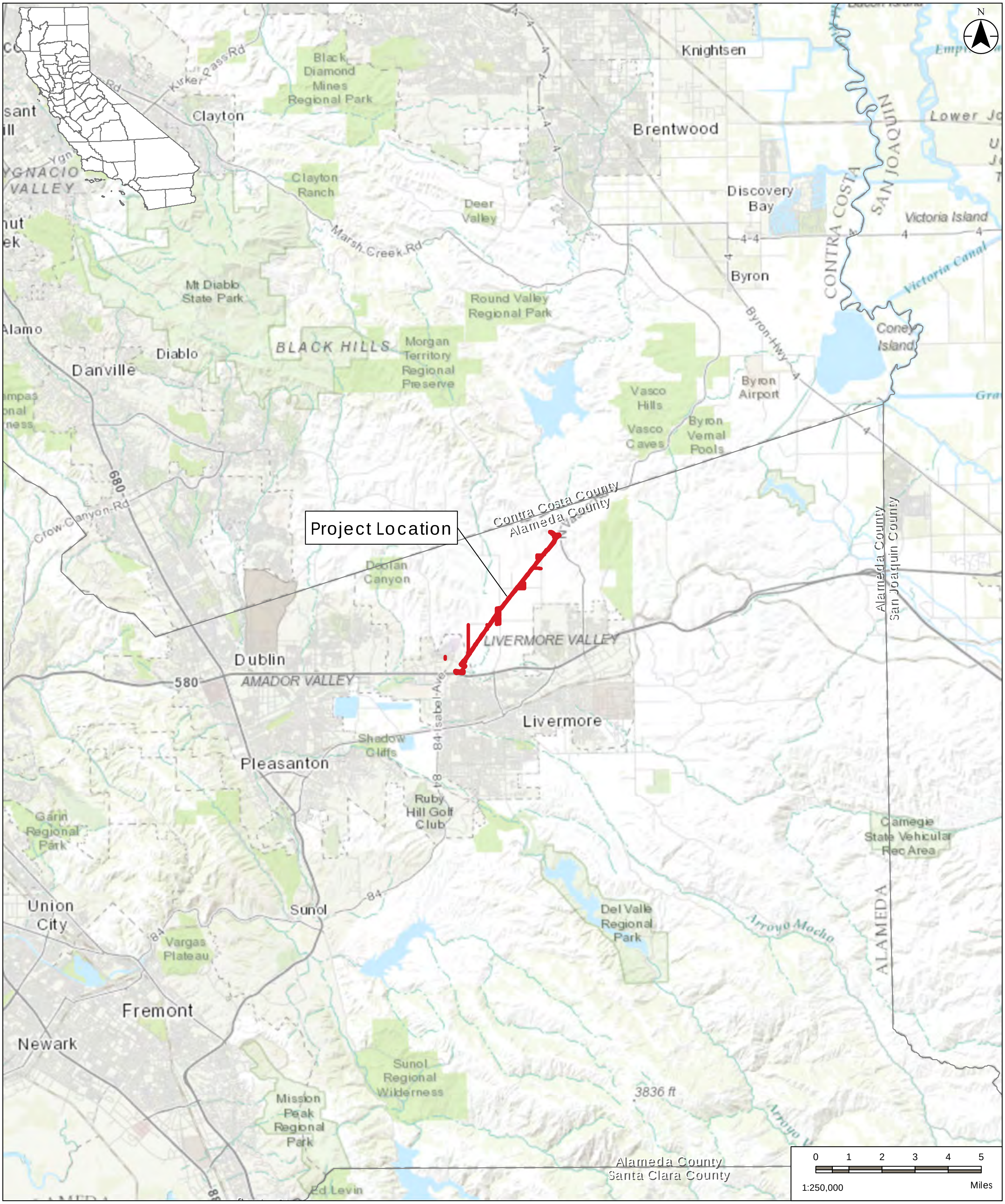

Pacific Gas and Electric
PG&E Bundled L131 Replacement Projects, Alameda County

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Figure 1. Vicinity Map

Prepared: MNugent, 11/3/2016

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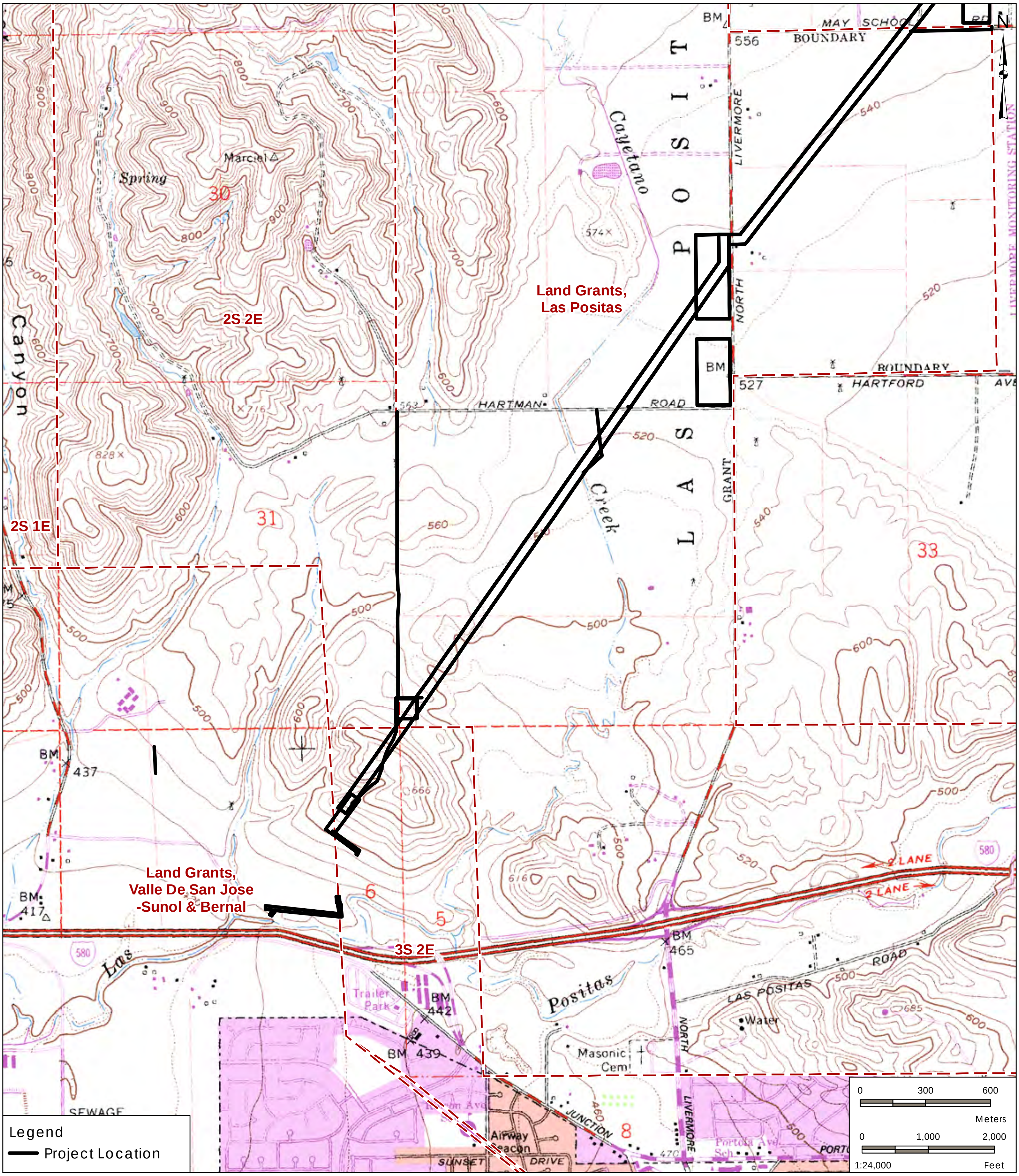

Map Information:
Projection: UTM, NAD83 Zone 10 North
Topo Date: Linear Unit: Meter

Project Information:
PLSS: Valle De San Jose -Sunol & Bernal and Las Positas Land Grants, T2S R2E and T3S R2E
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Prepared: MNugent, 11/2/2016

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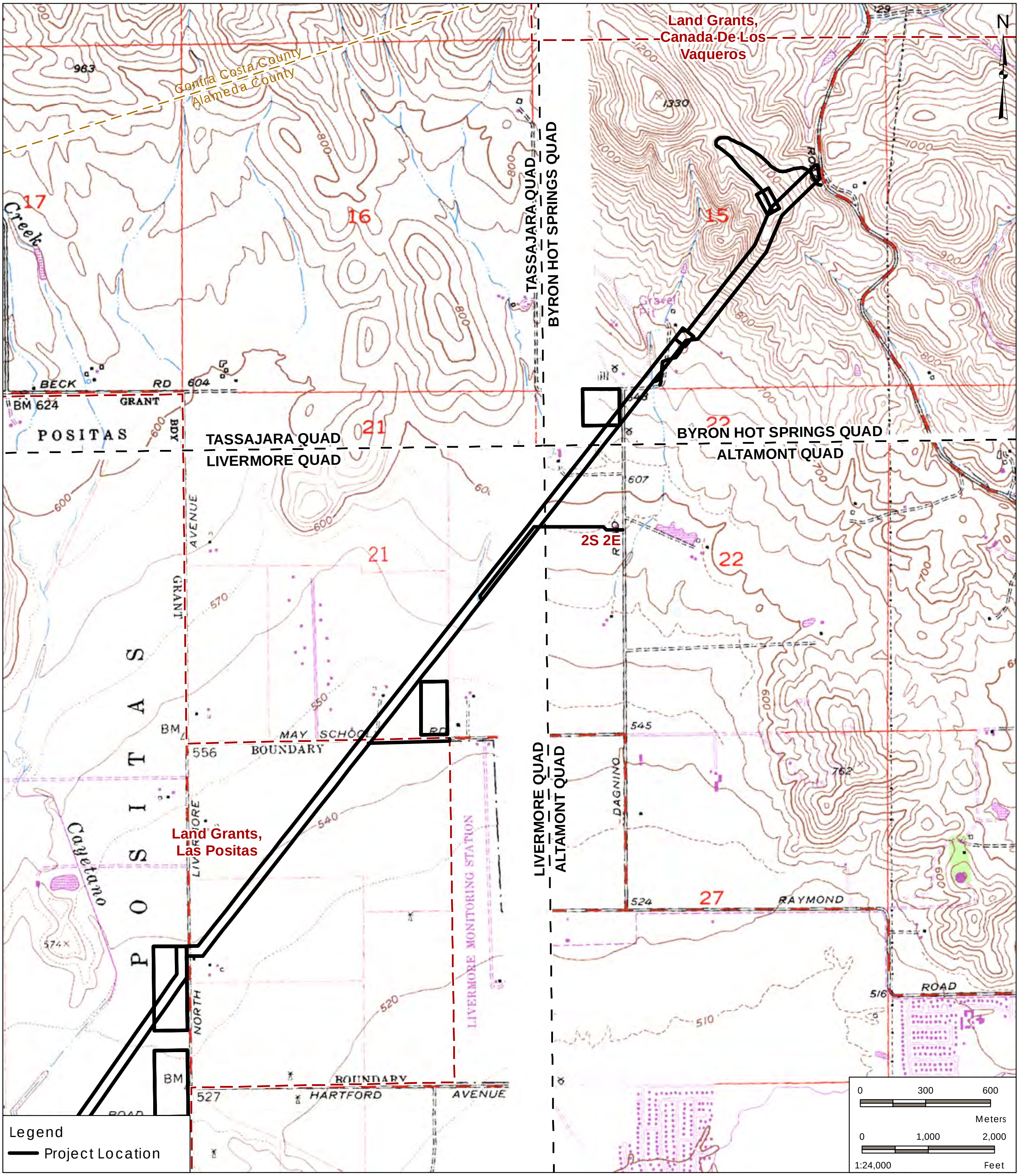

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Figure 2b. Project Location Map

Prepared: MNugent, 10/31/2016

From: Kersten, Meagan
To: "muwekma@muwekma.org"
Subject: Cultural Resources Information Request for the PG&E Bundled Pipeline 131 Replacement Projects in Alameda County
Date: Wednesday, November 23, 2016 9:56:00 AM
Attachments: PG&E_L131_letter_cambra_20161122.pdf

Dear Chairperson Cambra,

Please see the attached letter and maps in regards to the Pacific Gas and Electric Company (PG&E) Bundled Pipeline 131 (L131) Replacement Projects (project). A hard copy of the letter and maps was also mailed to you via certified U.S. Postal Service on 11/22/2016.

If you have any questions, concerns, or areas of sensitivity that should be identified, please contact PG&E Cultural Resource Specialist, Kimberly Cuevas whose contact information is provided below.

Kimberly M. Cuevas, MA
Senior Cultural Resources Specialist
Environmental Management - Gas Transmission
Pacific Gas & Electric Company
Office: 925-328-5138
Mobile: 925-407-6751
Address: 6111 Bollinger Canyon Road, 3rd Floor, 3310-F
San Ramon, CA 94583

I will follow up this email with a phone call to you at the number listed by the Native American Heritage Commission (NAHC) within ten(10) business days. We sincerely request you respond within 30 days of the receipt of this letter. Thank you in advance for your help with this and I look forward to speaking with you.

Respectfully,
Meagan Kersten

Meagan Kersten
Archaeologist, Environmental Compliance Specialist
Stantec
Phone: (530) 470-0515
meagan.kersten@stantec.com

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Please consider the environment before printing this email.

Pacific Gas and Electric Company

Kimberly M. Cuevas
Senior Cultural Resources Specialist
Environmental Planning and Permitting

Mailing Address
6111 Bollinger Canyon Road,
3rd Floor, 3310-F, San Ramon, CA 94583
Office: 925-328-5138
Mobile: 925-407-6751
Email: k3c4@pge.com

November 22, 2016

The Ohlone Indian Tribe
Attn: Andrew Galvan
P.O. Box 3152
Fremont, CA 94539

Reference: Pacific Gas and Electric Company (PG&E) Bundled Pipeline 131 (L131) Replacement Projects in Alameda County

Dear Mr. Galvan,

I am writing regarding the Pacific Gas and Electric Company (PG&E) Bundled Pipeline 131 (L131) Replacement Projects (project). North of Livermore in Alameda County, PG&E's L131 extends from Interstate-580 (I-580) immediately east of Isabel Avenue (Ave) and extends in a northeast direction past Vasco Road (Rd) and into Contra Costa County. PG&E is currently planning to replace approximately five miles of L131 between I-580 and Vasco Road. Replacement of L131 at this location is composed of the following three PG&E projects:

R649. Replace L131 between Mile Points (MPs) 31.83 and 31.90 & at 32.29: Shea Homes began developing a parcel of land between I-580 and Portola Ave for a new residential development in 2016. At the request of Shea Homes, PG&E relocated a segment of L131 to accommodate the new development layout. PG&E will replace segments of L131 on either side of the segment relocated for the housing development, including approximately 400 feet (ft) of L131 immediately north of Portola Ave between MPs 31.83 and 31.90 and approximately 100 ft of L131 north of I-580 at MP 32.29.

R700. Replace L131 between MPs 28.00 and 31.83: PG&E will replace an almost four mile segment of L131 between MPs 28.00 and 31.93, north of and contiguous to the R649 project. Replacement is necessary to upgrade aging vintage pipe.

R707. Replace L131 between MPs 28.00 and 27.02: PG&E will replace an approximately one mile segment of L131 between MPs 28.00 and 27.02, north of and contiguous to the R700 project and ending at Vasco Rd. Replacement will improve how L131 crosses a fault along this segment.

The new pipeline for all three projects will likely be installed in parallel to the existing L131 pipeline, but PG&E is evaluating all potential routes along the alignment. Construction will primarily consist of open trench installation and trenchless bores will be used as deemed necessary to avoid sensitive drainages, roadways, and other features. The existing PG&E easement is 15 feet wide and it is expected that modified or new pipeline

easements will be necessary from all or the majority of property owners along the new alignment. Temporary work space/easements will also be required along the alignment for construction and additional offsite staging areas will be necessary at a few locations. A project map is attached with this letter. The project requires compliance with both the California Environmental Quality Act (CEQA) and Section 106 of the National Historic Preservation Act (NHPA).

The project cultural resources study is in progress, which includes contacting the Native American Heritage Commission (NAHC) for a search of the Sacred Lands File (SLF), a records search through the California Historical Resources Information System (CHRIS) and PG&E MapGuide database, and a pedestrian cultural resources survey. The NAHC sacred lands file did not indicate cultural resources in the immediate project area.

A records search through the CHRIS at the Northwest Information Center (NWIC) and a review of PG&E's MapGuide was conducted for the project APE, which includes a ¼ mile radius around the entire project APE. No cultural resources were identified within the APE but four previously recorded cultural resources were identified within the ¼-mile search radius or just outside the ¼-mile radius. Nineteen studies within a ¼-mile radius of the APE were identified as a result of the MapGuide and NWIC searches. Of the nineteen studies, seven included pedestrian surveys that covered portions of the APE and twelve covered portions of the APE but did not include a pedestrian survey. No cultural resources were identified as a result of the pedestrian survey.

If you have any questions, concerns, or areas of sensitivity that should be identified, please contact PG&E Cultural Resource Specialist, Kimberly Cuevas whose contact information is provided below. A cultural resources specialist will be following up this letter with a phone call to you at the number listed by the NAHC within ten(10) business days. We sincerely request you respond within 30 days of the receipt of this letter. Thank you in advance for your help with this and I look forward to speaking with you.

Respectfully,

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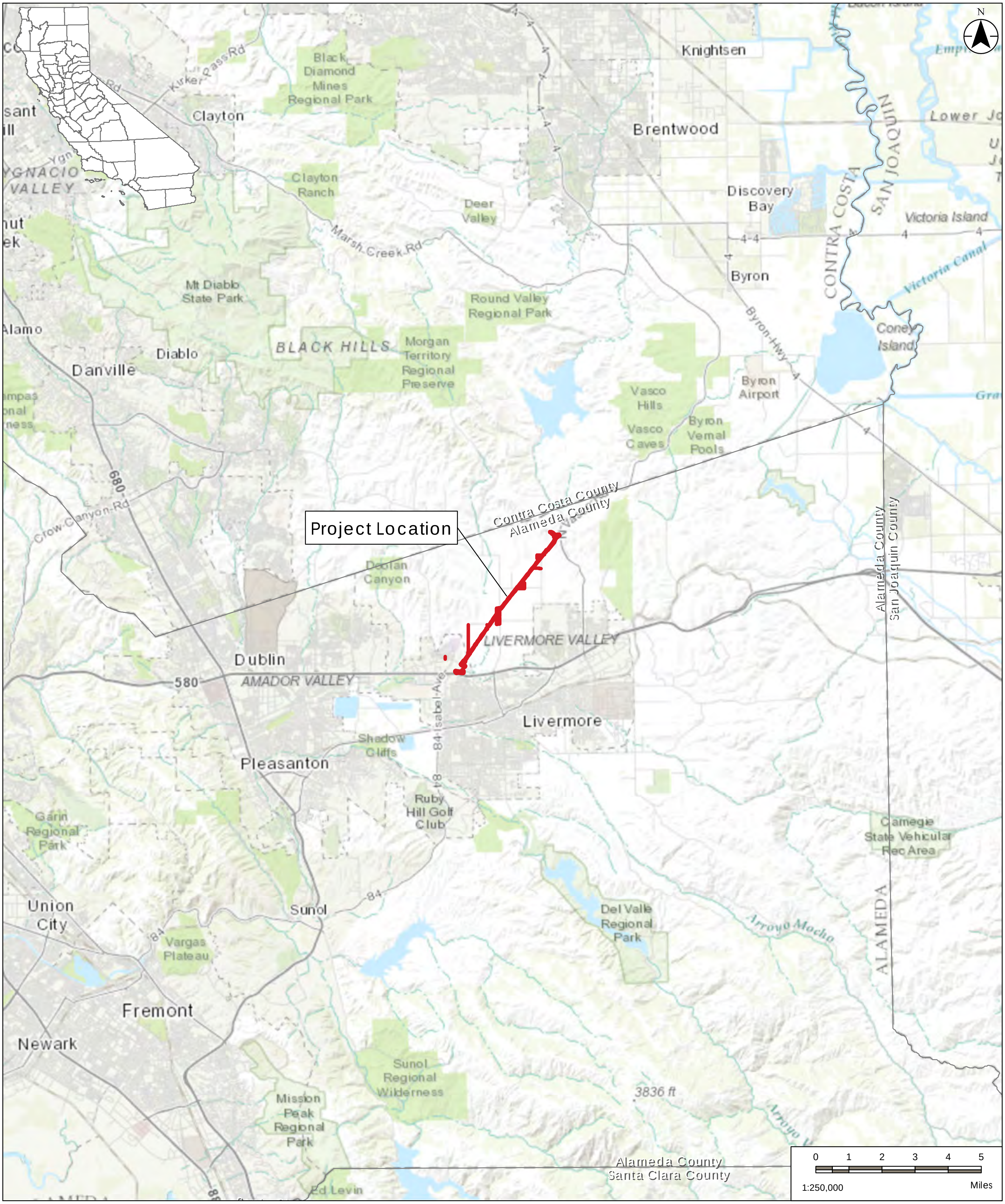
Environmental Management - Gas Transmission
Pacific Gas & Electric Company
Office: 925-328-5138
Mobile: 925-407-6751
Address: 6111 Bollinger Canyon Road, 3rd Floor, 3310-F
San Ramon, CA 94583

Attachment: Project Map

C:_GIS\185703511_L131\mxd\Cultural\L131_CultVicinity_8x11P_01.mxd mnugent 2016-11-03



Stantec

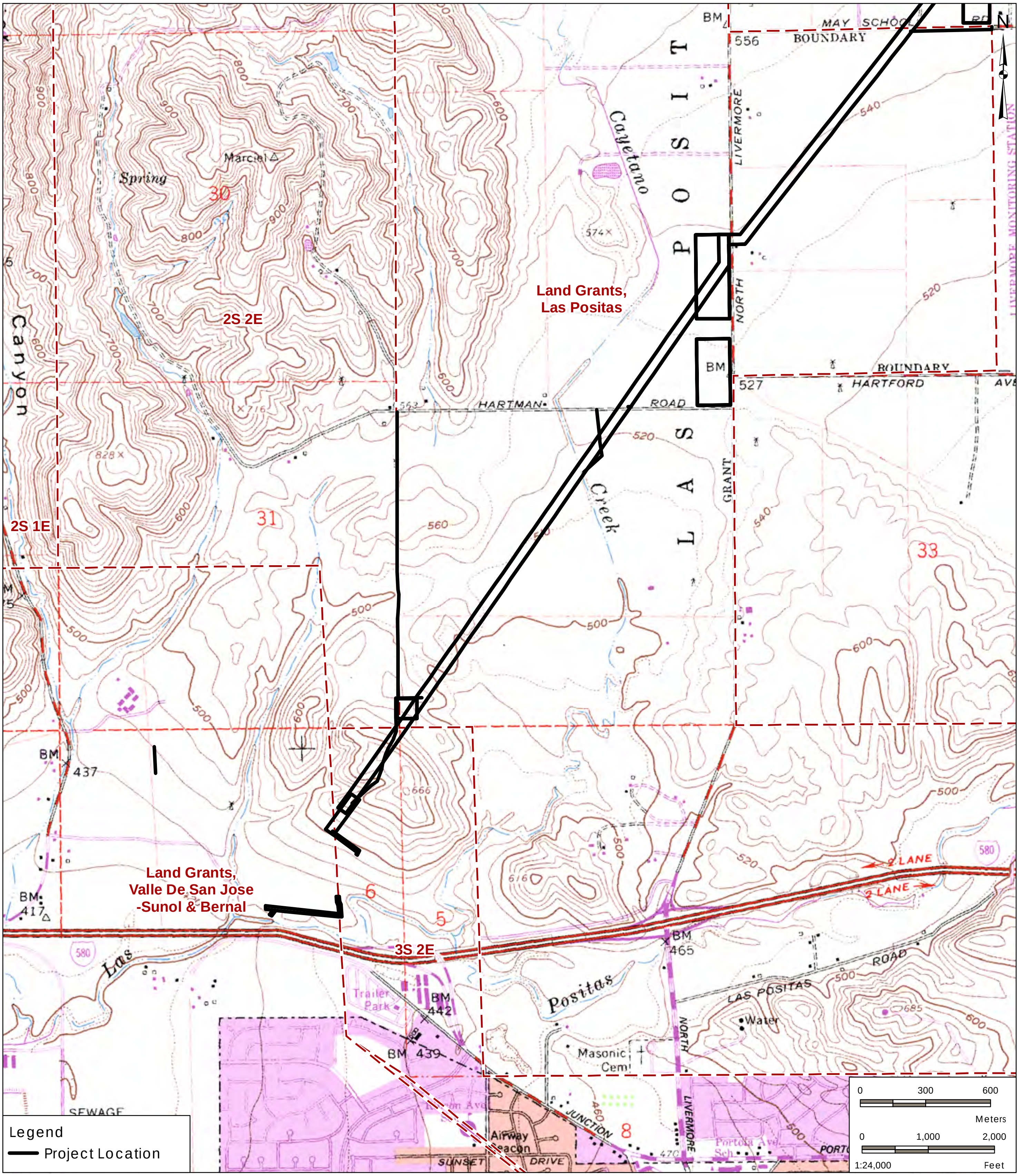
Pacific Gas and Electric
PG&E Bundled L131 Replacement Projects, Alameda County

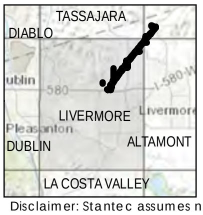
Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

Figure 1. Vicinity Map

Prepared: MNugent, 11/3/2016

C:_GIS\185703511_L131\mxd\Cultural\L131_CultProjLocation_8x11P_02.mxd mnugent 2016-11-02





Map Information:
Projection: UTM, NAD83 Zone 10 North
Topo Date: Linear Unit: Meter

Project Information:
PLSS: Valle De San Jose -Sunol & Bernal and Las Positas
Land Grants, T2S R2E and T3S R2E
Projected PLSS: T2S R2E S15, 21, 22, 28, 29, 31 and T3S R2E S6

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Pacific Gas and Electric
PG&E Bundled L131 Replacement Projects, Alameda County

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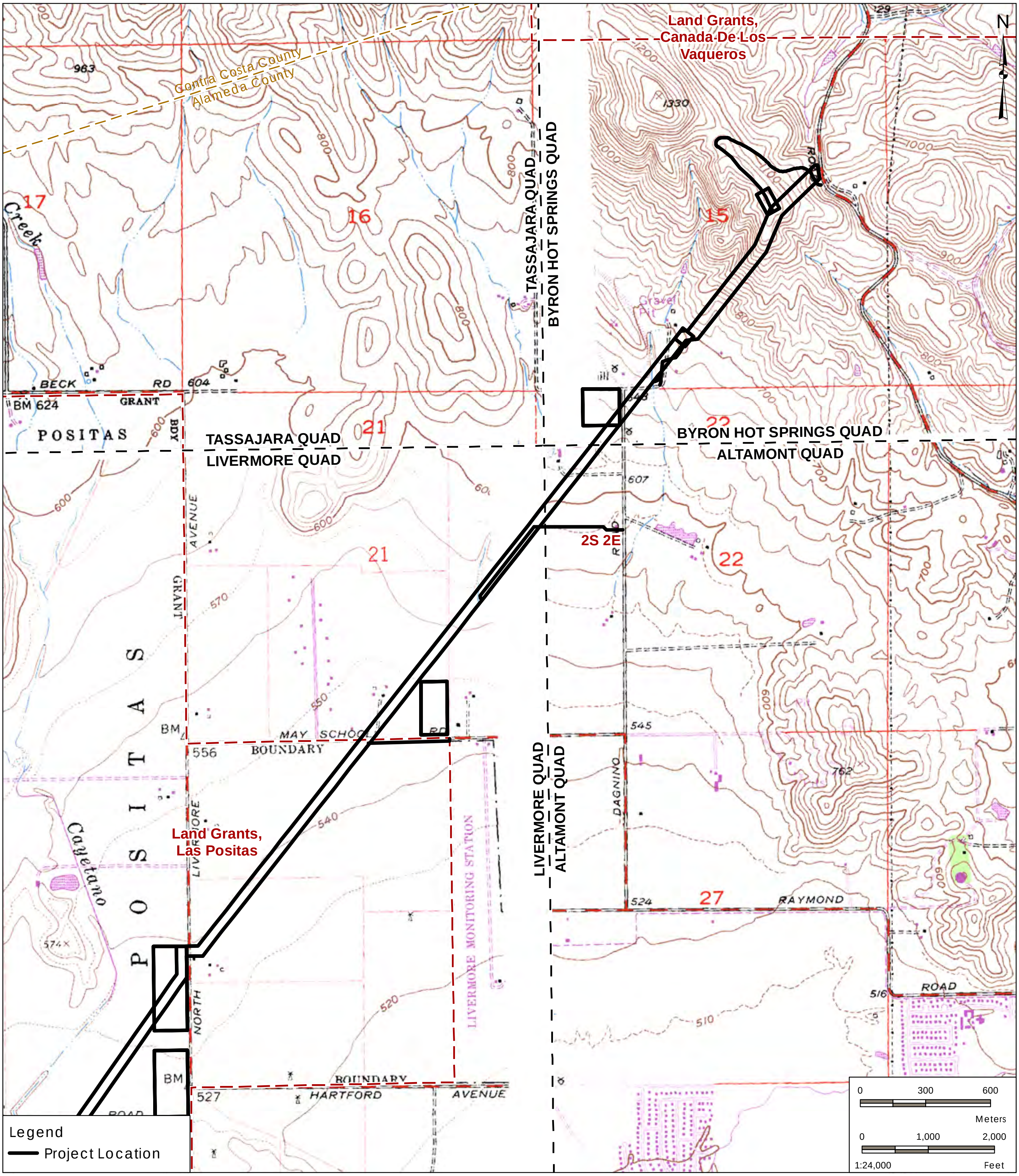
Figure 2a. Project Location Map

Prepared: MNugent, 11/2/2016

C:_GIS\185703511_L131\mxd\Cultural\L131_CultProjLocation_8x11P_02.mxd mnugent 2016-10-31



Map Information:
Projection: UTM, NAD83 Zone 10 North
Topo Date: Linear Unit: Meter

Project Information:
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PG&E Bundled L131 Replacement Projects, Alameda County

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Figure 2b. Project Location Map

Prepared: MNugent, 10/31/2016

From: Kersten, Meagan
To: "chochenyo@AOL.com"
Subject: Cultural Resources Information Request for the PG&E Bundled Pipeline 131 Replacement Projects in Alameda County
Date: Wednesday, November 23, 2016 9:57:00 AM
Attachments: PG&E_L131_letter_galvan_20161122.pdf
Importance: High

Dear Mr. Galvan,

Please see the attached letter and maps in regards to the Pacific Gas and Electric Company (PG&E) Bundled Pipeline 131 (L131) Replacement Projects (project). A hard copy of the letter and maps was also mailed to you via certified U.S. Postal Service on 11/22/2016.

If you have any questions, concerns, or areas of sensitivity that should be identified, please contact PG&E Cultural Resource Specialist, Kimberly Cuevas whose contact information is provided below.

Kimberly M. Cuevas, MA
Senior Cultural Resources Specialist
Environmental Management - Gas Transmission
Pacific Gas & Electric Company
Office: 925-328-5138
Mobile: 925-407-6751
Address: 6111 Bollinger Canyon Road, 3rd Floor, 3310-F
San Ramon, CA 94583

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Respectfully,
Meagan Kersten

Meagan Kersten
Archaeologist, Environmental Compliance Specialist
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Phone: (530) 470-0515
meagan.kersten@stantec.com

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Kimberly M. Cuevas
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Environmental Planning and Permitting

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3rd Floor, 3310-F, San Ramon, CA 94583
Office: 925-328-5138
Mobile: 925-407-6751
Email: k3c4@pge.com

November 22, 2016

Indian Canyon Mutsun Band of Costanoan
Attn: Ann Marie Sayers, Chairperson
P.O. Box 28
Hollister, CA 95024

Reference: Pacific Gas and Electric Company (PG&E) Bundled Pipeline 131 (L131) Replacement Projects in Alameda County

Dear Chairperson Sayers,

I am writing regarding the Pacific Gas and Electric Company (PG&E) Bundled Pipeline 131 (L131) Replacement Projects (project). North of Livermore in Alameda County, PG&E's L131 extends from Interstate-580 (I-580) immediately east of Isabel Avenue (Ave) and extends in a northeast direction past Vasco Road (Rd) and into Contra Costa County. PG&E is currently planning to replace approximately five miles of L131 between I-580 and Vasco Road. Replacement of L131 at this location is composed of the following three PG&E projects:

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easements will be necessary from all or the majority of property owners along the new alignment. Temporary work space/easements will also be required along the alignment for construction and additional offsite staging areas will be necessary at a few locations. A project map is attached with this letter. The project requires compliance with both the California Environmental Quality Act (CEQA) and Section 106 of the National Historic Preservation Act (NHPA).

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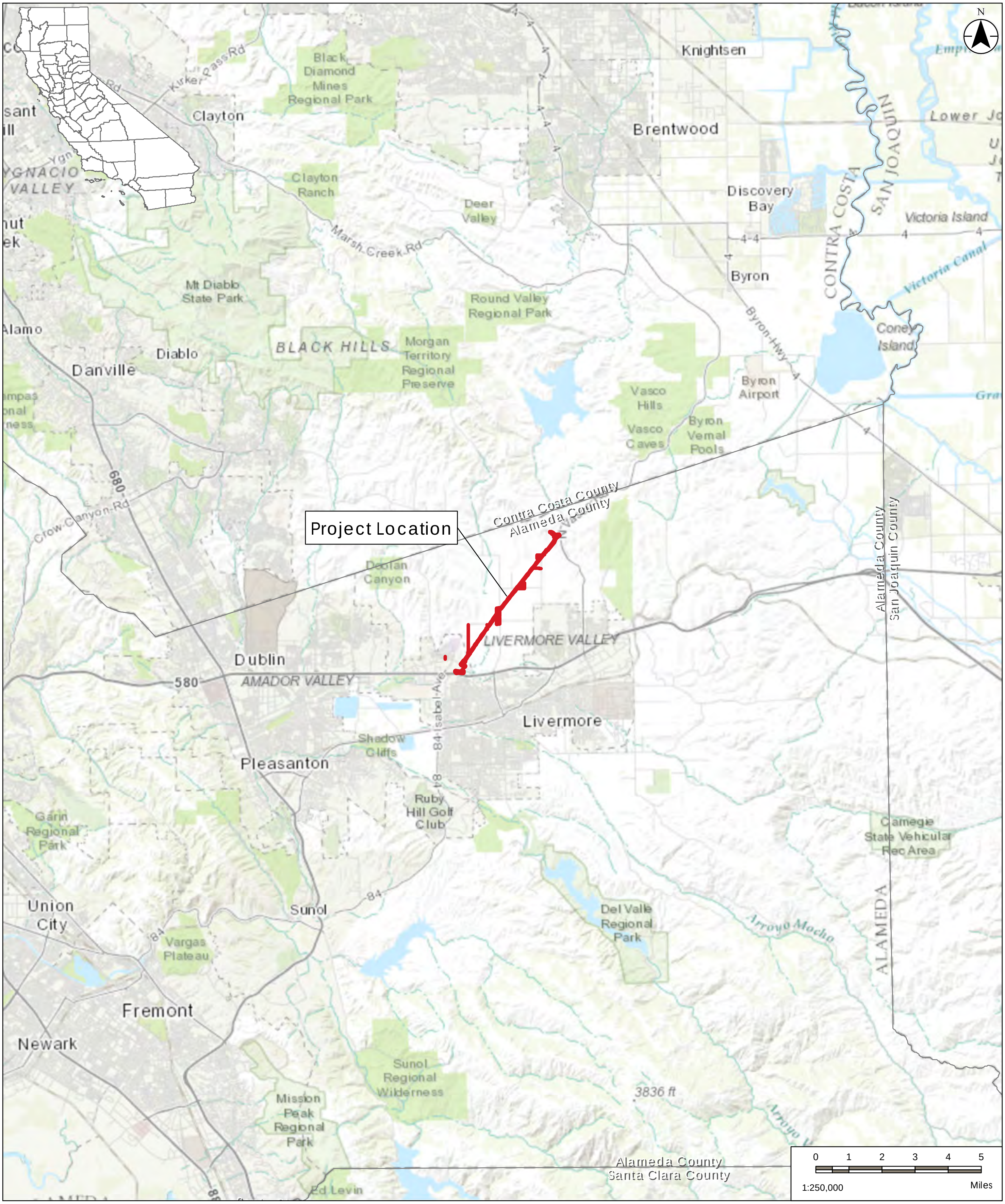
San Ramon, CA 94583

Attachment: Project Map

C:_GIS\185703511_L131\mxd\Cultural\L131_CultVicinity_8x11P_01.mxd mnugent 2016-11-03



Pacific Gas and Electric
PG&E Bundled L131 Replacement Projects, Alameda County

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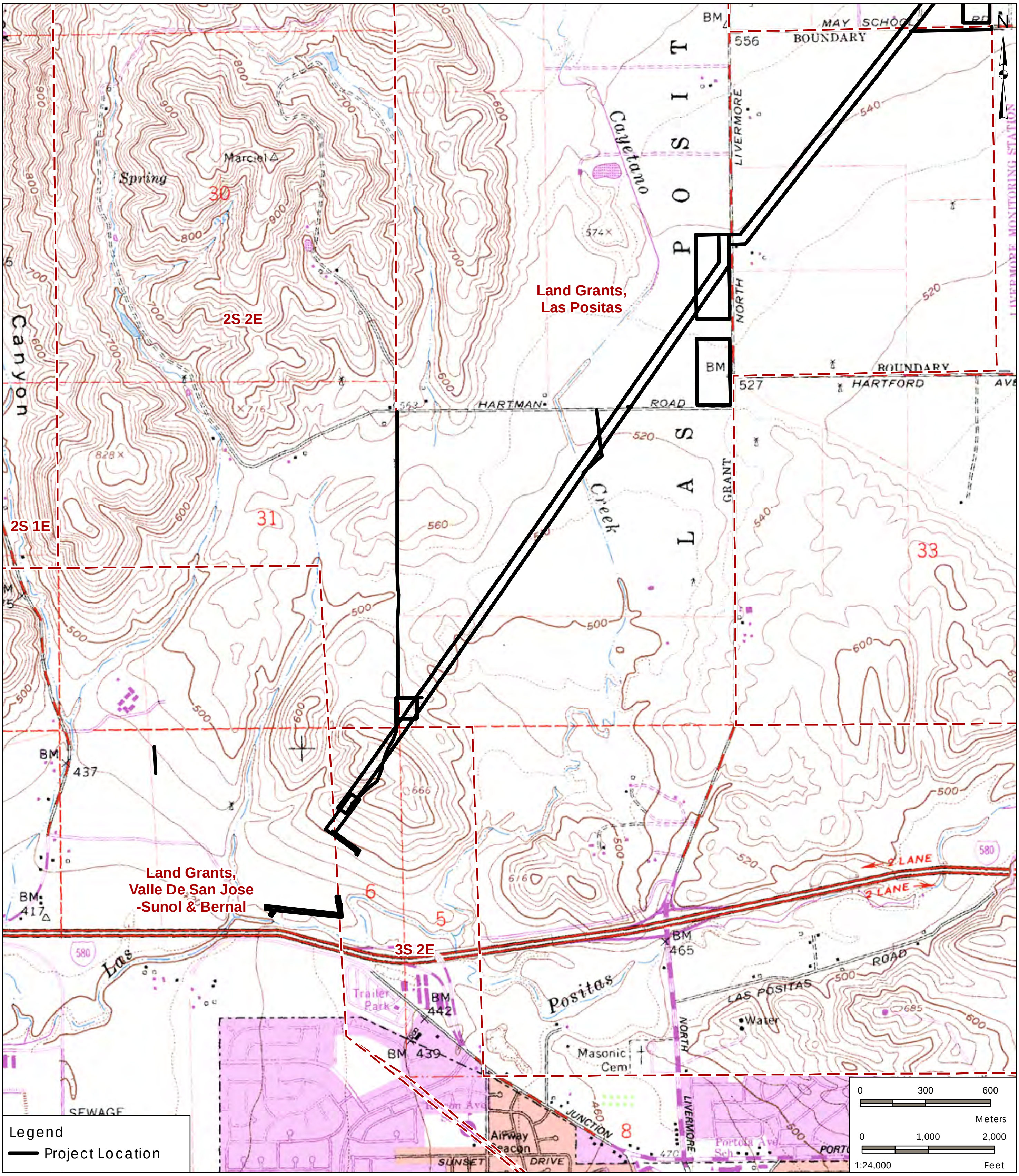
Figure 1. Vicinity Map

Prepared: MNugent, 11/3/2016

C:_GIS\185703511_L131\mxd\Cultural\L131_CultProjLocation_8x11P_02.mxd mnugent 2016-11-02



Map Information:
Projection: UTM, NAD83 Zone 10 North
Topo Date: Linear Unit: Meter

Project Information:
PLSS: Valle De San Jose -Sunol & Bernal and Las Positas
Land Grants, T2S R2E and T3S R2E
Projected PLSS: T2S R2E S15, 21, 22, 28, 29, 31 and T3S R2E S6

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PG&E Bundled L131 Replacement Projects, Alameda County

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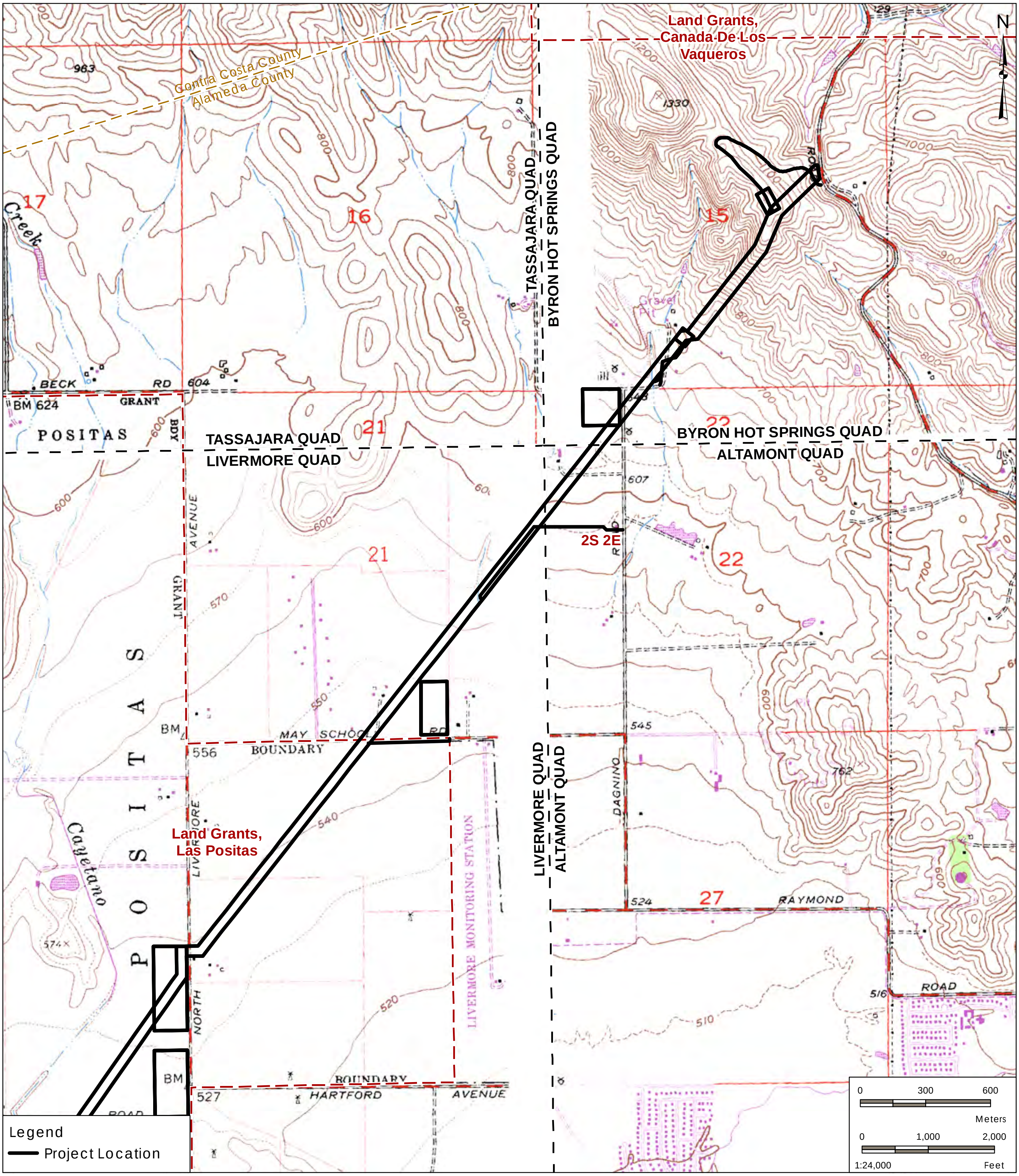
Figure 2a. Project Location Map

Prepared: MNugent, 11/2/2016

C:_GIS\185703511_L131\mxd\Cultural\L131_CultProjLocation_8x11P_02.mxd mnugent 2016-10-31



Map Information:
Projection: UTM, NAD83 Zone 10 North
Topo Date: Linear Unit: Meter

Project Information:
PLSS: Valle De San Jose -Sunol & Bernal and Las Positas Land Grants, T2S R2E and T3S R2E
Projected PLSS: T2S R2E S15, 21, 22, 28, 29, 31 and T3S R2E S6

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Stantec

Pacific Gas and Electric
PG&E Bundled L131 Replacement Projects, Alameda County

Figure 2b. Project Location Map

Prepared: MNugent, 10/31/2016

From: Kersten, Meagan
To: "ams@indiancanyon.org"
Subject: Cultural Resources Information Request for the PG&E Bundled Pipeline 131 Replacement Projects in Alameda County
Date: Wednesday, November 23, 2016 9:58:00 AM
Attachments: PG&E_L131_letter_sayers_20161122.pdf
Importance: High

Dear Chairperson Sayers,

Please see the attached letter and maps in regards to the Pacific Gas and Electric Company (PG&E) Bundled Pipeline 131 (L131) Replacement Projects (project). A hard copy of the letter and maps was also mailed to you via certified U.S. Postal Service on 11/22/2016.

If you have any questions, concerns, or areas of sensitivity that should be identified, please contact PG&E Cultural Resource Specialist, Kimberly Cuevas whose contact information is provided below.

Kimberly M. Cuevas, MA
Senior Cultural Resources Specialist
Environmental Management - Gas Transmission
Pacific Gas & Electric Company
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Mobile: 925-407-6751
Address: 6111 Bollinger Canyon Road, 3rd Floor, 3310-F
San Ramon, CA 94583

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Respectfully,
Meagan Kersten

Meagan Kersten
Archaeologist, Environmental Compliance Specialist
Stantec
Phone: (530) 470-0515
meagan.kersten@stantec.com

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Please consider the environment before printing this email.

From: canutes@verizon.net
To: Kersten, Meagan
Subject: Re: Cultural Resources Information Request for the PG&E Bundled Pipeline 131 Replacement Projects in Alameda County
Date: Sunday, November 27, 2016 4:54:49 PM

Ms. K. Cuevas,

After reviewing the information regarding the Pacific Gas and Electric Company Bundled Pipeline 131 (;131) Replacement Projects. It is the recommendation of the Tribe to have the project monitored by both a qualified archeological firm and Native American monitor. The proposed ground disturbance of the area's of the replacement of the pipeline are in sensitive area's. Livermore Valley and Vasco area's is highly sensitive as far as we are concerned. These are area's which our ancestor's traveled through to get to and from the San Joaquin Valley and the Bay Area, Our ancestor's live and died in these area's, Our ancestor's even have pictograph's in the hills of the Vasco area. Even-though, the report from the NAHC, Northern Information Center and the Cultural Resource Specialist field survey result were negative. It does not preclude that there are burials. It has been our experience that once you start doing ground disturbance it is highly likely that you would impact burials. Again, it is the recommendation of the tribe to have the project monitored by both archaeologist and Native American monitor.

Northern Valley Yokut/Ohlone/Bay Miwuk Tribe
Katherine Perez
P.O Box 717
Linden, CA 95236
Cell: (209) 649-8972
Office: (209) 887-3415

-----Original Message-----
From: Kersten, Meagan <Meagan.Kersten@stantec.com>
To: 'canutes@verizon.net' <canutes@verizon.net>
Sent: Wed, Nov 23, 2016 9:55 am
Subject: Cultural Resources Information Request for the PG&E Bundled Pipeline 131 Replacement Projects in Alameda County

Dear Chairperson Erolinda Perez,

Please see the attached letter and maps in regards to the Pacific Gas and Electric Company (PG&E) Bundled Pipeline 131 (L131) Replacement Projects (project). A hard copy of the letter and maps was also mailed to you via certified U.S. Postal Service on 11/22/2016.

If you have any questions, concerns, or areas of sensitivity that should be identified, please contact PG&E Cultural Resource Specialist, Kimberly Cuevas whose contact information is provided below.

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meagan.kersten@stantec.com

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Please consider the environment before printing this email.

APPENDIX C – SURVEY PHOTOGRAPHS

Photo 0974: Overview of possible staging area in field on west side of Dagnino Road, from the northeast corner of the parcel. View is toward the South. Photographed by Joanne Grant on 10/20/2016.

Photo 0975: Overview of possible staging area in field on west side of Dagnino Road, from the southwest corner of the parcel. View Towards the North. Photographed by Joanne Grant on 10/20/2016.

Photo 0976: View of tall grasses/thick ground cover in parcel on east side of Dagnino Road, along project alignment. View is toward the South. Photographed by Joanne Grant on 10/20/2016.

Photo 0977: View to parcel north of May School Road (possible staging area in far right corner of photo). View Towards the North. Photographed by Joanne Grant on 10/20/2016.

Photo 0978: View to possible staging area north of May School Road, from northeast corner of parcel. View Towards the South. Photographed by Joanne Grant on 10/20/2016.

Photo 0979: View to end of Dagnino Road and hills beyond. View Towards the North. Photographed by Joanne Grant on 10/20/2016.

Photo 0980: View to agricultural field on east side of North Livermore Avenue, north of Hartford Avenue. Photographed by Joanne Grant on 10/20/2016.

Photo 0981: Close-up of ground surface, agricultural field on east side of North Livermore Avenue, north of Hartford Avenue. Photographed by Joanne Grant on 10/20/2016.

Photo 0982: View to agricultural field north of Hartman Road and west of North Livermore Ave. View Towards the North. Photographed by Joanne Grant on 10/20/2016.

Photo 0983: View to possible staging area in field north of Hartman Road and west of North Livermore Avenue (the northernmost possible staging area; the alignment goes through this one). View Towards the South. Photographed by Joanne Grant on 10/20/2016.

Photo 0984: View of dirt access road along fence line that heads south from Hartman Road, from Hartman Road. View Towards the South. Photographed by Joanne Grant on 10/20/2016.

Photo 0985: View of dirt access road along fence line that heads south from Hartman Road, from northwest corner of small, square staging area where the access road and the alignment intersect. View Towards the South. Photographed by Joanne Grant on 10/20/2016.

Photo 0986: View along alignment, halfway between the southern end of the project area and the small, square staging area where the access road and the alignment intersect. View Towards the North. Photographed by Joanne Grant on 10/20/2016.

Photo 0987: View from the southern end of the project area, approximately 400 feet east of Portola Avenue, with view to gas pipeline marker. View Towards the South. Photographed by Joanne Grant on 10/20/2016.

Photo 0988: View to well-drilling equipment just east of the pipeline alignment, just east of the small, square staging area where the access road and the alignment intersect. View Towards the North. Photographed by Joanne Grant on 10/20/2016.

Photo 0989: View to delineated square re-ceding area within alignment approximately 1600 feet west of Hartman Road.. View Towards the South. Photographed by Joanne Grant on 10/20/2016.

Photo 3593: Overview of project area near Line 131 MP28. Photographed by Meagan Kersten on 10/20/2016.

Photo 3594: Overview of project area near Line 131 MP28. Photographed by Meagan Kersten on 10/20/2016.

Photo 1015: View to imported fill west of access road, with gravel parking lot to the north. View Towards the North. Photographed by Joanne Grant on 11/7/2016.

Photo 1016: View to imported fill west of access road, with paved roadway and newly built houses. Photographed by Joanne Grant on 11/7/2016.

Photo 1017: View to gravel access road and newly built houses, from the southwest portion of the site (near the proposed detention basin). View Towards the North. Photographed by Joanne Grant on 11/7/2016.

Photo 1018: View to the new housing development from south of Sandalwood Drive. View is toward the North. Photographed by Joanne Grant on 11/7/2016.

Photo 1019: View to the berm, showing the flags indicating the buried pipeline, and imported fill. View Towards the Southeast. Photographed by Joanne Grant on 11/7/2016.

Photo 1020: View to fencing protecting vegetation along Arroyo de las Positas, with the Arroyo beyond (right of photo). View is toward the North. Photographed by Joanne Grant on 11/7/2016.

Photo 1021: View to the new housing development from the east. View Towards the West. Photographed by Joanne Grant on 11/7/2016.

Photo 1022: View from the northeastern portion of the project area, just south of Portola Ave, from top of berm. View is toward the South. Photographed by Joanne Grant on 11/7/2016.

Photo 1023: View to new housing development, from northeast portion of project area, from Portola Ave. View Towards the Southwest. Photographed by Joanne Grant on 11/7/2016.

APPENDIX D – RECORDS SEARCH RESULTS (CONFIDENTIAL – DO NOT DISTRIBUTE)

Appendix D2

Native American Outreach

Appendix D.2 CDFW Native American Outreach – PG&E Line 131 Replacement Project

The following table provides a summary of the CDFW outreach to the Native American Tribes for the PG&E Line 131 Replacement Project. Copies of the communication are provided.

CDFW Native American Outreach Communication Log

Date	From	Contact/Address	Phone	Email	Type	Subject	Follow up
1/18/18	CDFW Regional Manager (Acting): Greg Erickson	Honorable James Ramos Chairperson Native American Heritage Commission 1550 Harbor Boulevard, Suite 100 West Sacramento, CA 95691	(916) 373-3710	nahc@nahc.ca.gov	Letter/email	Sacred Lands File Search and list of tribal contacts for Line 131 Replacement Project	
1/26/18	NAHC Associate Governmental Program Analyst: Frank Lienert	Serge Glushkoff, CDFW		Serge.glushkoff@wildlife.ca.gov	Email	Record search of the NAHC Sacred Lands File for the PG&E Gas Pipeline Replacement. Included an attachment with the Native American Contacts	
2/7/18	CDFW Regional Manager (Acting): Greg Erickson	Honorable Buffy McQuillen, Tribal Historic Preservation Officer Federated Indians of Graton Rancheria 6400 Redwood Drive, Suite 300 Rohnert Park, CA 94928		bmcquillen@gratonrancheria.com	Letter/email	Notification Pursuant to CEQA Section 21080.3.1 of the PG&E Pipeline 131 Replacement Project. Invites the contact to formal government to government consultation.	
2/7/18	CDFW Regional Manager (Acting): Greg Erickson	Honorable Rosemary Cambra, Chairperson Muwekma Ohlone Indian Tribe of the San Francisco Bay Area Post Office Box 360791 Milpitas, CA 95036		muwekma@muwekma.org	Letter/email	Notification Pursuant to CEQA Section 21080.3.1 of the PG&E Pipeline 131 Replacement Project.	
2/7/18	CDFW Regional Manager (Acting): Greg Erickson	Honorable Tony Cerda, Chairperson Costanoan Rumsen Carmel Tribe 244 East 1st Street Pomona, CA 91766		rumsen@aol.com	Letter/email	Notification Pursuant to CEQA Section 21080.3.1 of the PG&E Pipeline 131 Replacement Project.	
2/7/18	CDFW Regional Manager (Acting): Greg Erickson	Mr. Andrew Galvan The Ohlone Indian Tribe Post Office Box 3152 Fremont, CA 94539		chochenyo@aol.com	Letter/email	Notification Pursuant to CEQA Section 21080.3.1 of the PG&E Pipeline 131 Replacement Project.	

CDFW Native American Outreach Communication Log

Date	From	Contact/Address	Phone	Email	Type	Subject	Follow up
2/7/18	CDFW Regional Manager (Acting): Greg Erickson	Honorable Katherine Erolinda Perez, Chairperson North Valley Yokuts Tribe Post Office Box 717 Linden, CA 95236		Canutes@verizon.net	Letter/email	Notification Pursuant to CEQA Section 21080.3.1 of the PG&E Pipeline 131 Replacement Project. Letter references the previous communications between the Tribal Representative and the applicant PG&E made on November 27, 2016. Notes that PG&E provided a record of the previous communication	
2/7/18	CDFW Regional Manager (Acting): Greg Erickson	Honorable Ann Marie Sayers Chairperson Indian Canyon Mutsun Band of Costanoan Post Office Box 28 Hollister, CA 95024		ams@indiancanyon.org	Letter/email	Notification Pursuant to CEQA Section 21080.3.1 of the PG&E Pipeline 131 Replacement Project.	
2/7/18	CDFW Regional Manager (Acting): Greg Erickson	Honorable Irenne Zwierlein, Chairperson Amah Mutsun Tribal Band of Mission San Juan Bautista 789 Canada Road Woodside, CA 94062		amahmutsuntribal@gmail.com	Letter/email	Notification Pursuant to CEQA Section 21080.3.1 of the PG&E Pipeline 131 Replacement Project.	
3/3/18	Nototomne Cultural Preservation Northern Valley Yokut/Ohlone/Bay Miwuk Katherine Perez	Nathan Voegeli CDFW		Tribal.liaison@wildlife.ca.gov	Email	Request to consult on the project as the construction may have inadvertent discoveries of human remains and destroy areas of medicinal plants. Area used by ancestors.	Yes
3/5/18	CDFW Tribal Liaison: Nathan Voegeli	Nototomne Cultural Preservation Northern Valley Yokut/Ohlone/Bay Miwuk Katherine Perez		canutes@verizon.net	Email	Introduces Katherine Perez to Serge Glushkoff who is overseeing project to provide an initial call after which Nathan is available for further follow up or consultation.	Yes
3/6/18	CDFW Senior Environmental Scientist: Serge Glushkoff	Nototomne Cultural Preservation Northern Valley Yokut/Ohlone/Bay Miwuk Katherine Perez		canutes@verizon.net	Call & email	Left a voice message and sent an email to follow up regarding any questions or details she may have about the project and any possible steps forward.	No

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Bay Delta Region
7329 Silverado Trail
Napa, CA 94558
www.wildlife.ca.gov

EDMUND G. BROWN, Jr., Governor
CHARLTON H. BONHAM, Director

January 18, 2018

Honorable James Ramos
Chairperson
Native American Heritage Commission
1550 Harbor Boulevard, Suite 100
West Sacramento, CA 95691
(916) 373-3710
nahc@nahc.ca.gov

SUBJECT: SACRED LANDS FILE SEARCH AND LIST OF TRIBAL CONTACTS FOR THE PACIFIC GAS & ELECTRIC COMPANY (PG&E) NATURAL GAS TRANSMISSION PIPELINE 131 REPLACEMENT PROJECT, ALAMEDA COUNTY

Dear Chairperson Ramos:

The California Department of Fish and Wildlife (CDFW) is proposing the PG&E Natural Gas Transmission Pipeline 131 Replacement Project (Project). CDFW is the Project lead agency and requests your assistance in identifying appropriate California Native American tribes for noticing pursuant to the California Environmental Quality Act section 21080.3.1. CDFW requests a search of the Sacred Lands File and a list of tribes that are culturally or traditionally affiliated with the geographic area of the Project.

This Project would replace approximately five miles of the Pacific Gas & Electric Company (PG&E) Natural Gas Transmission Pipeline 131 in Alameda County. The Project is composed of three separate segments. The R649 segment will increase the wall thickness of the pipeline as it will be replaced with a heavier gauged pipe. The R700 segment will install pipe which can be maintained by cathodic protection and includes the replacement of pipeline spanning Cayetano Creek by removing the above-ground span and burying a new pipe segment below the creek. The R707 Project replaces the pipeline crossing the Greenville Fault, changing the alignment to a perpendicular crossing with the fault at a 90-degree angle to reduce strain on the pipeline in the event of an earthquake. At all three segments the pipeline will primarily be replaced by open-cut excavation, except at certain roadways where the pipe may be installed by trenchless boring. Excavation typically involves depths of 5 to 7 feet, and widths of 3 to 5 feet. Additional ground-disturbing activities include staging of materials and equipment along the segments. The pipeline spanning Cayetano Creek will be replaced by removing the above-ground span and burying a new pipe segment below the creek.

To assist you in the Sacred Lands File search, we are providing the Project location data. The three project segments are located as follows (see Figure 1). R649 Project: two segments, 1)approximately 300 feet between pipeline mile post (MP) 31.83 and MP 31.90, beginning at the south end of the R700 Project and extending to immediately north of Portola Avenue; and 2) approximately 100 feet north of I-580 at MP 32.29 between a residential development and Arroyo Las Positas; R700 Project: an approximately 4-mile segment between MPs 28.00 and 31.83, beginning at the south end of the R707 Project and extending south to the north end of the R649 Project north of Portola Avenue; R700 Project: across Hartman Road, North Livermore Avenue, May School Road, and Dagnino Road as it continues northeast from Portola Avenue to the R707 Project; R707 Project: an approximately 1-mile segment between MPs 27.02 and 28.00, extending from the Vasco Crossover Station adjacent to Vasco Road in the north to a location just east of the end of Dagnino Road to the southwest, at the north end of the R700 Project. The center of the project length is at]Latitude 37.720017, Longitude -121.775281 or Section 31, Township T25, and Range R2E, Livermore topo quad.

Thank you for your assistance. Please respond with the list of tribes or any questions to Serge Glushkoff at Serge.Glushkoff@wildlife.ca.gov, or 707-339-6191.

Sincerely,

Greg Erickson, Regional Manager (Acting)
Bay Delta Region

Enclosure: Project Location Map

ec: California Department of Fish and Wildlife

Nathan Voegeli, Tribal Liaison, tribal.liaison@wildlife.ca.gov.
Karen Carpio, Senior Environmental Scientist (Specialist),
Karen .Carpio@wildllife.ca.gov
Craig Weightman, Environmental Program Manager,
Craig.Weightman@wildlife.ca.gov

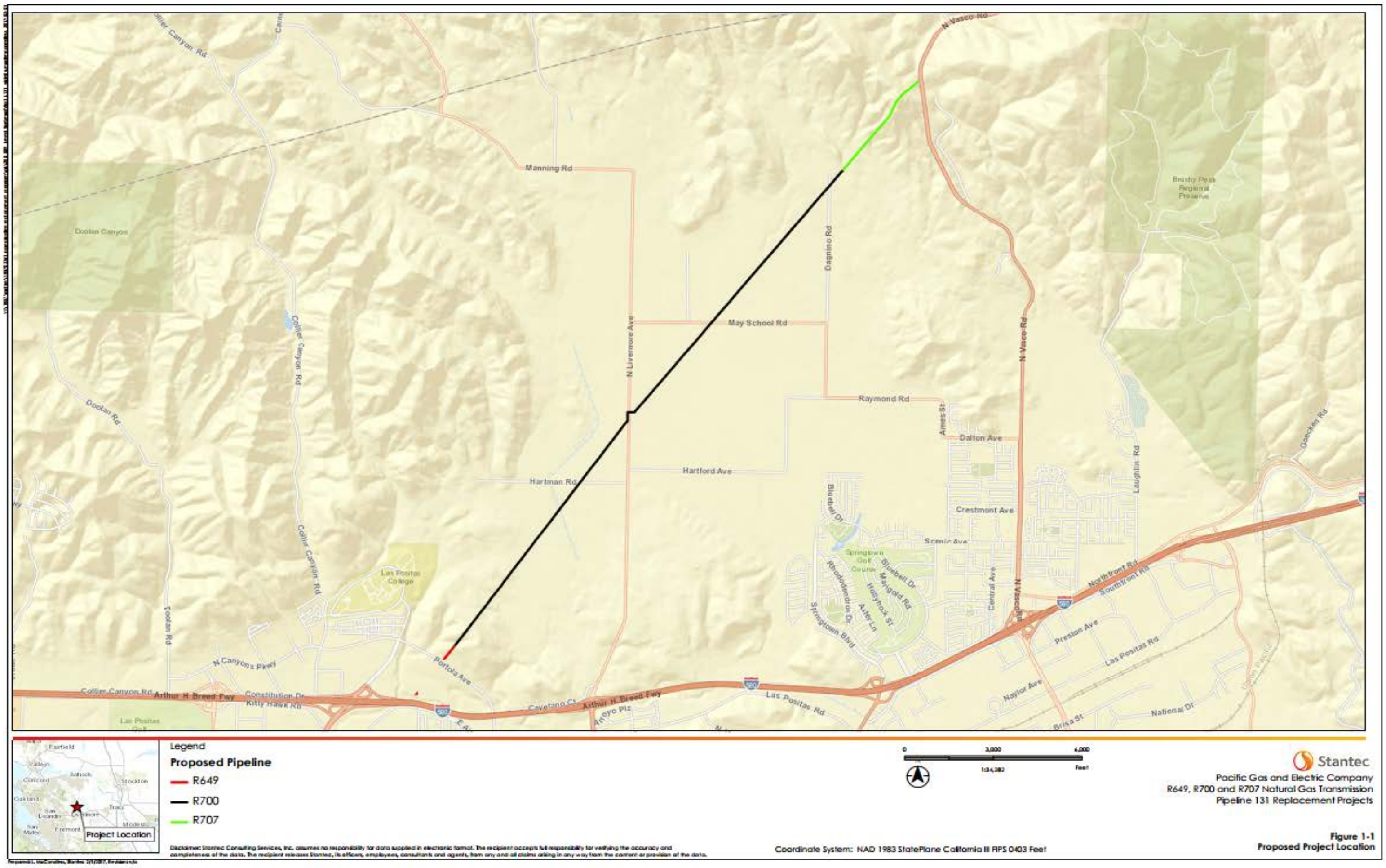

Figure 1-1
Proposed Project Location

STATE OF CALIFORNIA Edmund G. Brown, Jr., *Governor*

NATIVE AMERICAN HERITAGE COMMISSION
Environmental and Cultural Department
1550 Harbor Blvd., ROOM 100
West SACRAMENTO, CA 95691
(916) 373-3710
Fax (916) 373-5471

January 26, 2018

Serge Glushkoff
CA Department of Fish and Wildlife

Email to: serge.glushkoff@widlife.ca.gov

RE: PG&E Gas Pipeline replacement, Alameda County

Dear Mr. Glushkoff,

A record search of the Native American Heritage Commission (NAHC) Sacred Lands File (SLF) was completed for the information you have submitted for the above referenced project. The results were negative. However, the absence of specific site information in the SLF does not preclude the presence of cultural resources in any project area. Other sources for cultural resources should also be contacted for information regarding known and/or recorded sites.

Enclosed is a list of Native Americans tribes who may have knowledge of cultural resources in the project area. I suggest you contact all of those indicated, if they cannot supply information, they might recommend others with specific knowledge. By contacting all those listed, your organization will be better able to respond to claims of failure to consult with the appropriate tribe. If a response has not been received within two weeks of notification, the Commission requests that you follow-up with a telephone call to ensure that the project information has been received.

If you receive notification of change of addresses and phone numbers from any of these tribes, please notify me. With your assistance we are able to assure that our lists contain current information. If you have any questions or need additional information, please contact me at 916-573-1033 or frank.lienert@nahc.ca.gov.

Sincerely,

Frank Lienert
Associate Governmental Program Analyst

Native American Heritage Commission
Native American Contacts
1/25/2018

Coastanoan Rumsen Carmel Tribe
Tony Cerda, Chairperson
244 E. 1st Street
Pomona , CA 91766
rumsen@aol.com
(909) 524-8041 Cell
(909) 629-6081
Ohlone/Costanoan

Indian Canyon Mutsun Band of Costanoan
Ann Marie Sayers, Chairperson
P.O. Box 28
Hollister , CA 95024
ams@indiancanyon.org
(831) 637-4238
Ohlone/Costanoan

Amah MutsunTribal Band of Mission San Juan Bautista
Irenne Zwierlein, Chairperson
789 Canada Road
Woodside , CA 94062
amahmutsuntribal@gmail.com
(650) 851-7489 Cell
(650) 851-7747 Office
(650) 332-1526 Fax
Ohlone/Costanoan

North Valley Yokuts Tribe
Katherine Erolinda Perez, Chairperson
P.O. Box 717
Linden , CA 95236
canutes@verizon.net
(209) 887-3415
Ohlone/Costanoan
Northern Valley Yokuts
Bay Miwok

Muwekma Ohlone Indian Tribe of the SF Bay Area
Rosemary Cambra, Chairperson
P.O. Box 360791
Milpitas , CA 95036
muwekma@muwekma.org
(408) 314-1898

(510) 581-5194
Ohlone / Costanoan

The Ohlone Indian Tribe
Andrew Galvan
P.O. Box 3152
Fremont , CA 94539
chochenyo@AOL.com
(510) 882-0527 Cell

(510) 687-9393 Fax
Ohlone/Costanoan
Bay Miwok
Plains Miwok
Patwin

This list is current only as of the date of this document and is based on the information available to the Commission on the date it was produced.

Distribution of this list does not relieve any person of statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resource Section 5097.98 of the Public Resources Code.

This list is only applicable for contacting local Native American Tribes with regard to cultural resources assessments for the proposed:
PG&E Gas Pipeline replacement, Alameda County

State of California – The Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Bay Delta Region
7329 Silverado Trail
Napa, CA 94558
(707) 944-5500
www.wildlife.ca.gov

***EDMUND G. BROWN JR.**, Governor*
***CHARLTON H. BONHAM,** Director*

February 7, 2018

Honorable Buffy McQuillen, Tribal Historic Preservation Officer
Federated Indians of Graton Rancheria
6400 Redwood Drive, Suite 300
Rohnert Park, CA 94928
bmcquillen@gratonrancheria.com

Dear Honorable Tribal Representative:

Subject: Notification Pursuant to California Environmental Quality Act Section 21080.3.1 of the Pacific Gas and Electric Company Pipeline 131 Replacement Project, Alameda County

The California Department of Fish and Wildlife (CDFW) would like to inform you that its Bay Delta Region has received a permit application for the Pacific Gas and Electric Company Pipeline 131 Replacement Project (Project). CDFW is providing this formal notice as the Project lead agency pursuant to the California Environmental Quality Act (CEQA), Public Resources Code section 21080.3.1. Your input can be provided to CDFW through direct communication and consultation or during the public comment period for the Project planned to begin in March 2018. CDFW welcomes direct communication and consultation prior to the public review process to discuss the Project and identify any Project impacts to Tribal interests or cultural resources. Please note that you may already be familiar with this Project as the Project Applicant, the Pacific Gas and Electric Company (PG&E) has indicated that it previously mailed you Project information on November 22, 2016 and followed this with an email on November 23, 2016.

This Project would replace approximately five miles of the PG&E Natural Gas Transmission Pipeline 131 in Alameda County. The Project is composed of three separate segments. The R649 segment will increase the wall thickness of the pipeline as it will be replaced with a heavier gauged pipe. The R700 segment will install pipe which can be maintained by cathodic protection and includes the replacement of pipeline spanning Cayetano Creek by removing the above-ground span and burying a new pipe segment below the creek. The R707 Project replaces the pipeline crossing the Greenville Fault, changing the alignment to a perpendicular crossing with the fault at a 90-degree angle to reduce strain on the pipeline in the event of an earthquake. At all three segments, the pipeline will primarily be replaced by open-cut excavation, except at certain roadways where the pipe may be installed by trenchless boring. Excavation typically involves depths of 5 to 7 feet, and widths of 3 to 5 feet. Additional ground-disturbing activities include staging of materials and equipment along the segments. The pipeline spanning Cayetano Creek will be replaced by removing the above-ground span and burying a new pipe segment below the creek.

The three Project segments are located as follows (see Figure 1). R649 Project: two segments, 1) approximately 300 feet between pipeline mile post (MP) 31.83 and MP 31.90, beginning at the south end of the R700 Project and extending to immediately north of Portola Avenue; and 2) approximately 100 feet north of I-580 at MP 32.29 between a residential development and

Arroyo Las Positas; R700 Project: an approximately 4-mile segment between MPs 28.00 and 31.83, beginning at the south end of the R707 Project and extending south to the north end of the R649 Project north of Portola Avenue; R700 Project: across Hartman Road, North Livermore Avenue, May School Road, and Dagnino Road as it continues northeast from Portola Avenue to the R707 Project; R707 Project: an approximately 1-mile segment between MPs 27.02 and 28.00, extending from the Vasco Crossover Station adjacent to Vasco Road in the north to a location just east of the end of Dagnino Road to the southwest, at the north end of the R700 Project. The center of the Project length is at Latitude 37.720017, Longitude -121.775281 or Section 31, Township T25, and Range R2E, Livermore topo quad.

The Project is anticipated to impact the habitat for the California tiger salamander and the bed and bank of a pond, which may be of interest to your Tribe.

CDFW's goal is to understand Tribal interests and concerns early in the Project and to work collaboratively to resolve any concerns. CDFW is committed to open communication with your Tribe under its Tribal Communication and Consultation Policy, which is available through CDFW's Tribal Affairs webpage at https://www.wildlife.ca.gov/General-Counsel/Tribal-Affairs.

CDFW respectfully requests your preliminary input regarding the Project by March 9, 2018. If you would like more Project information, please contact Mr. Serge Glushkoff, Senior Environmental Scientist (Specialist), at Serge.Glushkoff@wildlife.ca.gov or (707) 339-6191, or write to Serge Glushkoff, 7329 Silverado Trail, Napa, CA 94558.

To request formal government to government consultation pursuant to the CDFW Tribal Communication and Consultation Policy or CEQA section 21080.3.1, please respond in writing within 30 days to Tribal Liaison Nathan Voegeli by email at Tribal.Liaison@wildlife.ca.gov or by mail to California Department of Fish and Wildlife, 1416 9th Street, Suite 1341, Sacramento, CA 95814. Please designate and provide contact information for the appropriate Tribal lead person.

We look forward to your response and input on the Project.

Sincerely,

Gregg Erick

Gregg Erickson
Acting Regional Manager
Bay Delta Region

Enclosure: Project Area Map

ec: California Department of Fish and Wildlife

Nathan Voegeli, Tribal Liaison, Tribal.Liaison@wildlife.ca.gov
Serge Glushkoff, Bay Delta Region – Serge.Glushkoff@wildllife.ca.gov
Craig Weightman, Bay Delta Region – Craig.Weightman@wildlife.ca.gov

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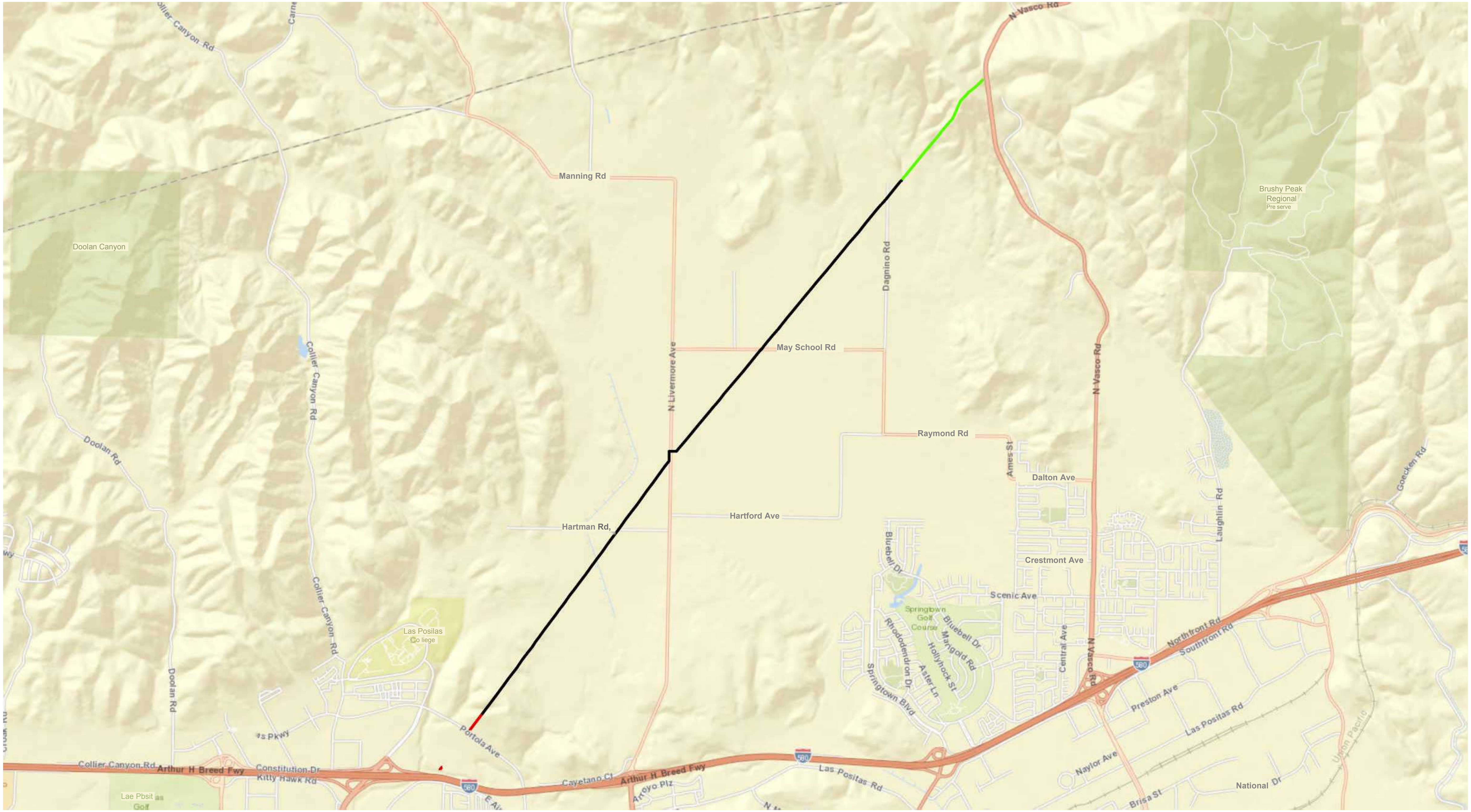

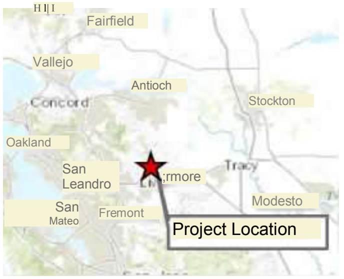

Legend

Proposed Pipeline

----- R649

----- R700

----- R707

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Coordinate System: NAD 1983 StatePlane California III FIPS 0403 Feet

Stantec

Pacific Gas and Electric Company R649, R700 and R707 Natural Gas Transmission Pipeline 131 Replacement Projects

Figure 1 Project Location

Prepared: L. McCandless, Stantec 2/1/2017, Revision: n/a

State of California – The Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Bay Delta Region
7329 Silverado Trail
Napa, CA 94558
(707) 944-5500
www.wildlife.ca.gov

EDMUND G. BROWN JR., *Governor*
CHARLTON H. BONHAM, *Director*

February 7, 2018

Honorable Rosemary Cambra, Chairperson
Muwekma Ohlone Indian Tribe of the San Francisco Bay Area
Post Office Box 360791
Milpitas, CA 95036
muwekma@muwekma.org

Dear Honorable Tribal Representative:

Subject: Notification Pursuant to California Environmental Quality Act Section 21080.3.1 of the Pacific Gas and Electric Company Pipeline 131 Replacement Project, Alameda County

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The Project is anticipated to impact the habitat for the California tiger salamander and the bed and bank of a pond, which may be of interest to your Tribe.

CDFW's goal is to understand Tribal interests and concerns early in the Project and to work collaboratively to resolve any concerns. CDFW is committed to open communication with your Tribe under its Tribal Communication and Consultation Policy, which is available through CDFW's Tribal Affairs webpage at https://www.wildlife.ca.gov/General-Counsel/Tribal-Affairs.

CDFW respectfully requests your preliminary input regarding the Project by March 9, 2018. If you would like more Project information, please contact Mr. Serge Glushkoff, Senior Environmental Scientist (Specialist), at Serge.Glushkoff@wildlife.ca.gov or (707) 339-6191, or write to Serge Glushkoff, 7329 Silverado Trail, Napa, CA 94558.

To request formal consultation pursuant to the CDFW Tribal Communication and Consultation Policy or CEQA section 21080.3.1, please respond in writing within 30 days to Tribal Liaison Nathan Voegeli by email at Tribal.Liaison@wildlife.ca.gov or by mail to California Department of Fish and Wildlife, 1416 9th Street, Suite 1341, Sacramento, CA 95814. Please designate and provide contact information for the appropriate Tribal lead person.

We look forward to your response and input on the Project.

Sincerely,

Gregg Erickson

Gregg Erickson
Acting Regional Manager
Bay Delta Region

Enclosure: Project Area Map

ec: California Department of Fish and Wildlife

Nathan Voegeli, Tribal Liaison, Tribal.Liaison@wildlife.ca.gov
Serge Glushkoff, Bay Delta Region – Serge.Glushkoff@wildllife.ca.gov
Craig Weightman, Bay Delta Region – Craig.Weightman@wildlife.ca.gov

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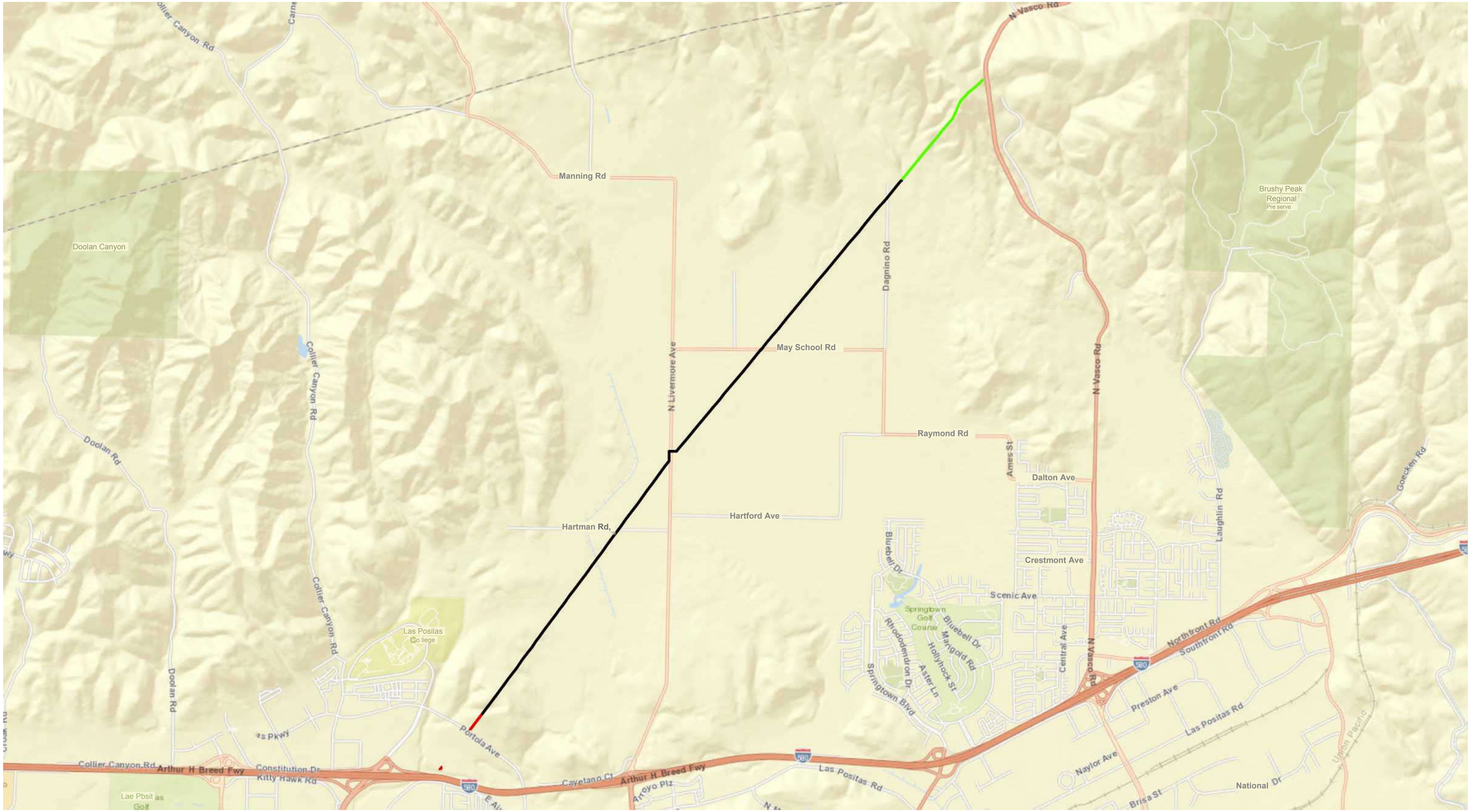

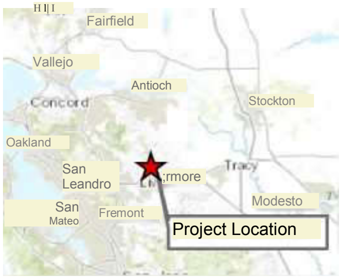

Legend

Proposed Pipeline

----- R649

----- R700

----- R707

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Coordinate System: NAD 1983 StatePlane California III FIPS 0403 Feet

Stantec

Pacific Gas and Electric Company R649, R700 and R707 Natural Gas Transmission Pipeline 131 Replacement Projects

Figure 1 Project Location

Prepared: L. McCandless, Stantec 2/1/2017, Revision: n/a

State of California – The Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Bay Delta Region
7329 Silverado Trail
Napa, CA 94558
(707) 944-5500
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***EDMUND G. BROWN JR.**, Governor*
***CHARLTON H. BONHAM,** Director*

February 7, 2018

Honorable Tony Cerda, Chairperson
Costanoan Rumsen Carmel Tribe
244 East 1st Street
Pomona, CA 91766
rumsen@aol.com

Dear Honorable Tribal Representative:

Subject: Notification Pursuant to California Environmental Quality Act Section 21080.3.1 of the Pacific Gas and Electric Company Pipeline 131 Replacement Project, Alameda County

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We look forward to your response and input on the Project.

Sincerely,

Gregg Erickson

Gregg Erickson
Acting Regional Manager
Bay Delta Region

Enclosure: Project Area Map

ec: California Department of Fish and Wildlife

Nathan Voegeli, Tribal Liaison, Tribal.Liaison@wildlife.ca.gov
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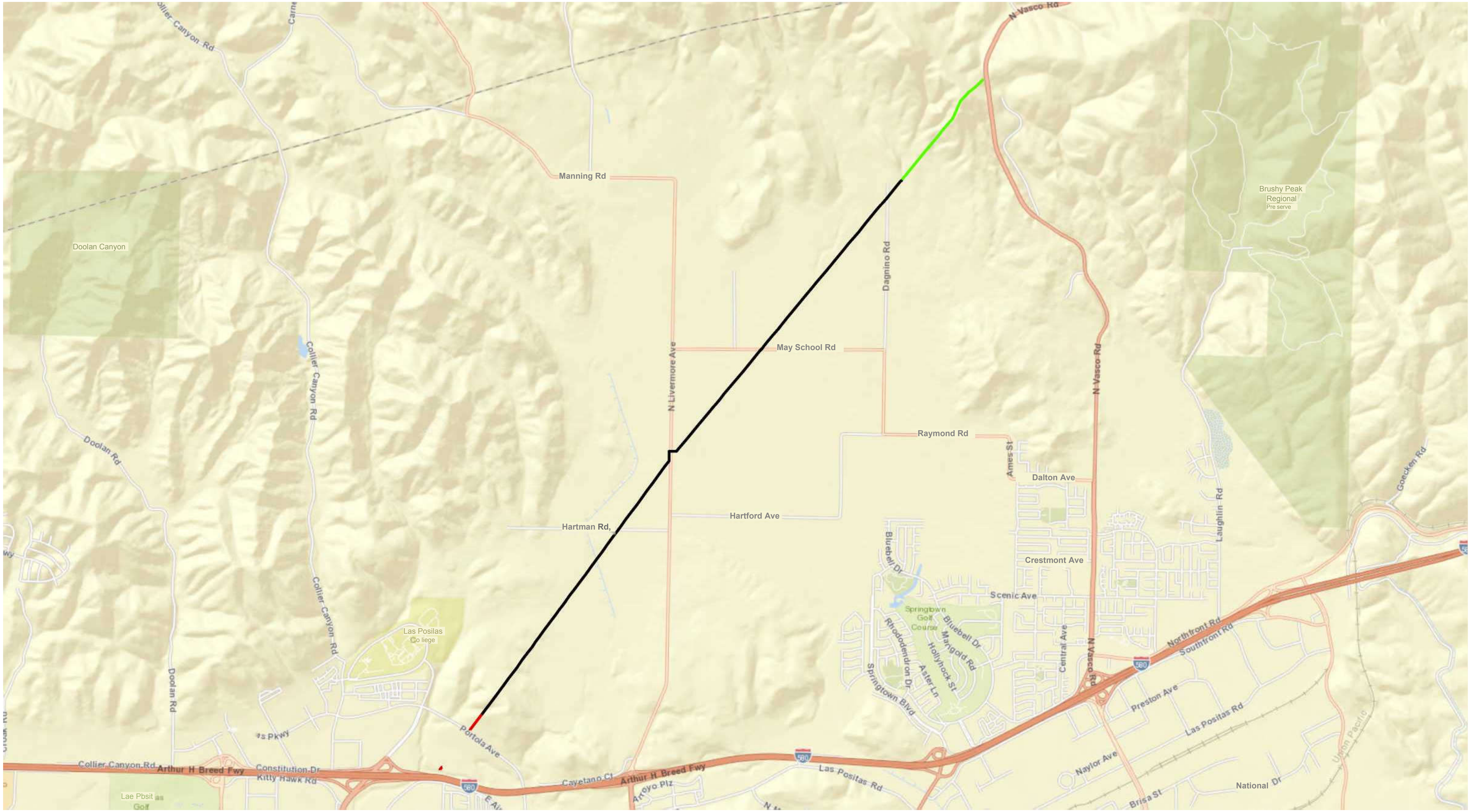

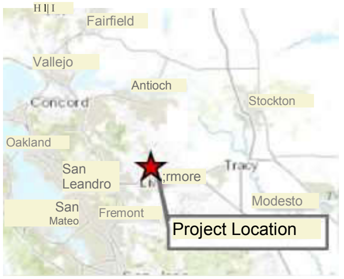

Legend

Proposed Pipeline

----- R649

----- R700

----- R707

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Coordinate System: NAD 1983 StatePlane California III FIPS 0403 Feet

Stantec

Pacific Gas and Electric Company R649, R700 and
R707 Natural Gas Transmission Pipeline 131
Replacement Projects

Figure 1 Project Location

Prepared: L. McCandless, Stantec 2/1/2017, Revision: n/a

State of California – The Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Bay Delta Region
7329 Silverado Trail
Napa, CA 94558
(707) 944-5500
www.wildlife.ca.gov

EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

February 7, 2018

Mr. Andrew Galvan
The Ohlone Indian Tribe
Post Office Box 3152
Fremont, CA 94539
chochenyo@aol.com

Dear Honorable Tribal Representative:

Subject: Notification Pursuant to California Environmental Quality Act Section 21080.3.1 of the Pacific Gas and Electric Company Pipeline 131 Replacement Project, Alameda County

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Acting Regional Manager
Bay Delta Region

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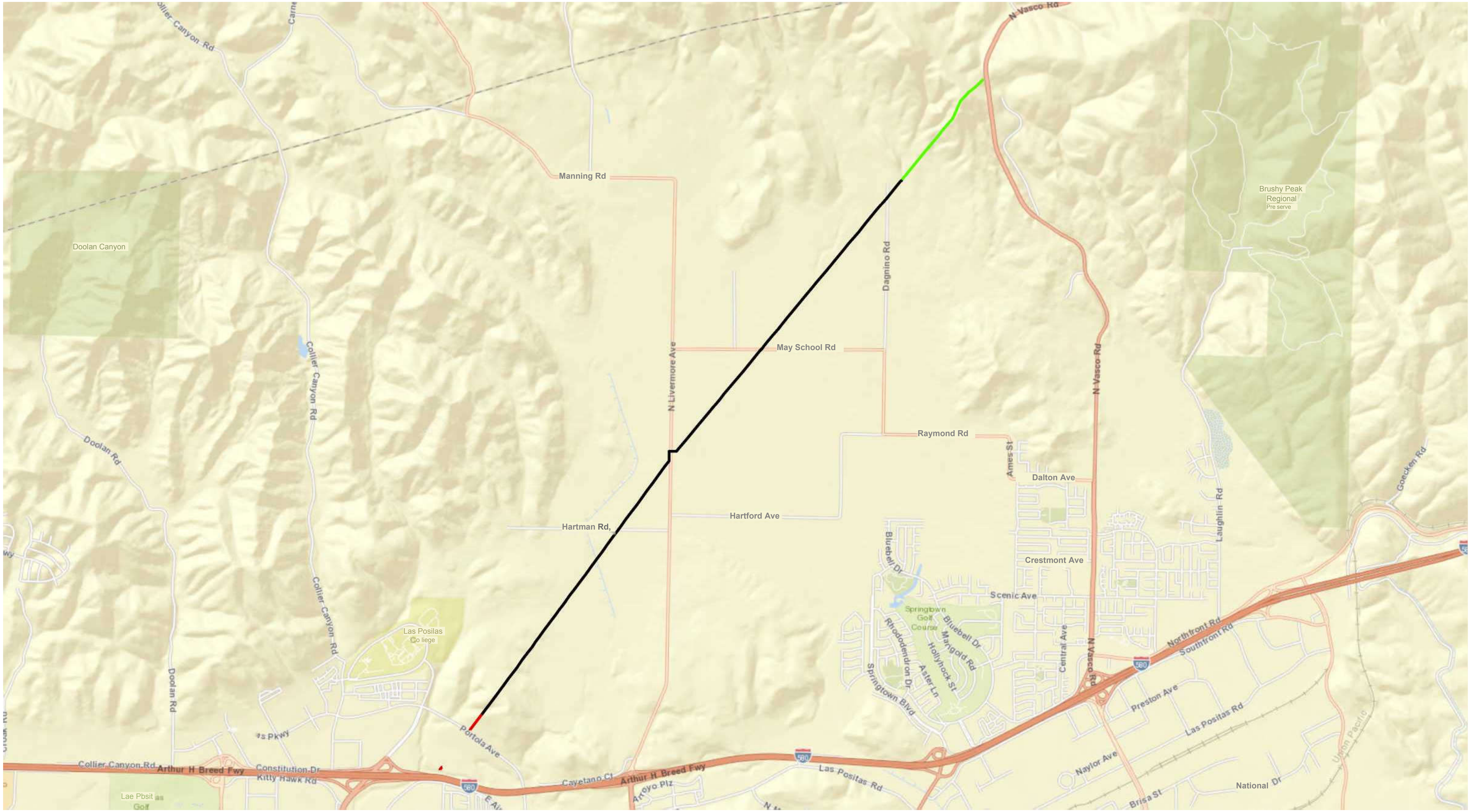

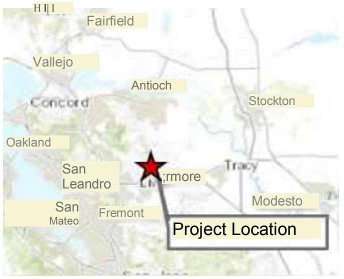

Legend

Proposed Pipeline

----- R649

----- R700

----- R707

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Stantec

Pacific Gas and Electric Company R649, R700 and
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Replacement Projects

Figure 1 Project Location

Prepared: L. McCandless, Stantec 2/1/2017, Revision: n/a

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EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

February 7, 2018

Honorable Katherine Erolinda Perez, Chairperson
North Valley Yokuts Tribe
Post Office Box 717
Linden, CA 95236
Canutes@verizon.net

Dear Honorable Tribal Representative:

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This Project would replace approximately five miles of the PG&E Natural Gas Transmission Pipeline 131 in Alameda County. The Project is composed of three separate segments. The R649 segment will increase the wall thickness of the pipeline as it will be replaced with a heavier gauged pipe. The R700 segment will install pipe which can be maintained by cathodic protection and includes the replacement of pipeline spanning Cayetano Creek by removing the above-ground span and burying a new pipe segment below the creek. The R707 Project replaces the pipeline crossing the Greenville Fault, changing the alignment to a perpendicular crossing with the fault at a 90-degree angle to reduce strain on the pipeline in the event of an earthquake. At all three segments, the pipeline will primarily be replaced by open-cut excavation, except at certain roadways where the pipe may be installed by trenchless boring. Excavation typically involves depths of 5 to 7 feet, and widths of 3 to 5 feet. Additional ground-disturbing activities include staging of materials and equipment along the segments. The pipeline spanning Cayetano Creek will be replaced by removing the above-ground span and burying a new pipe segment below the creek.

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Enclosure: Project Area Map

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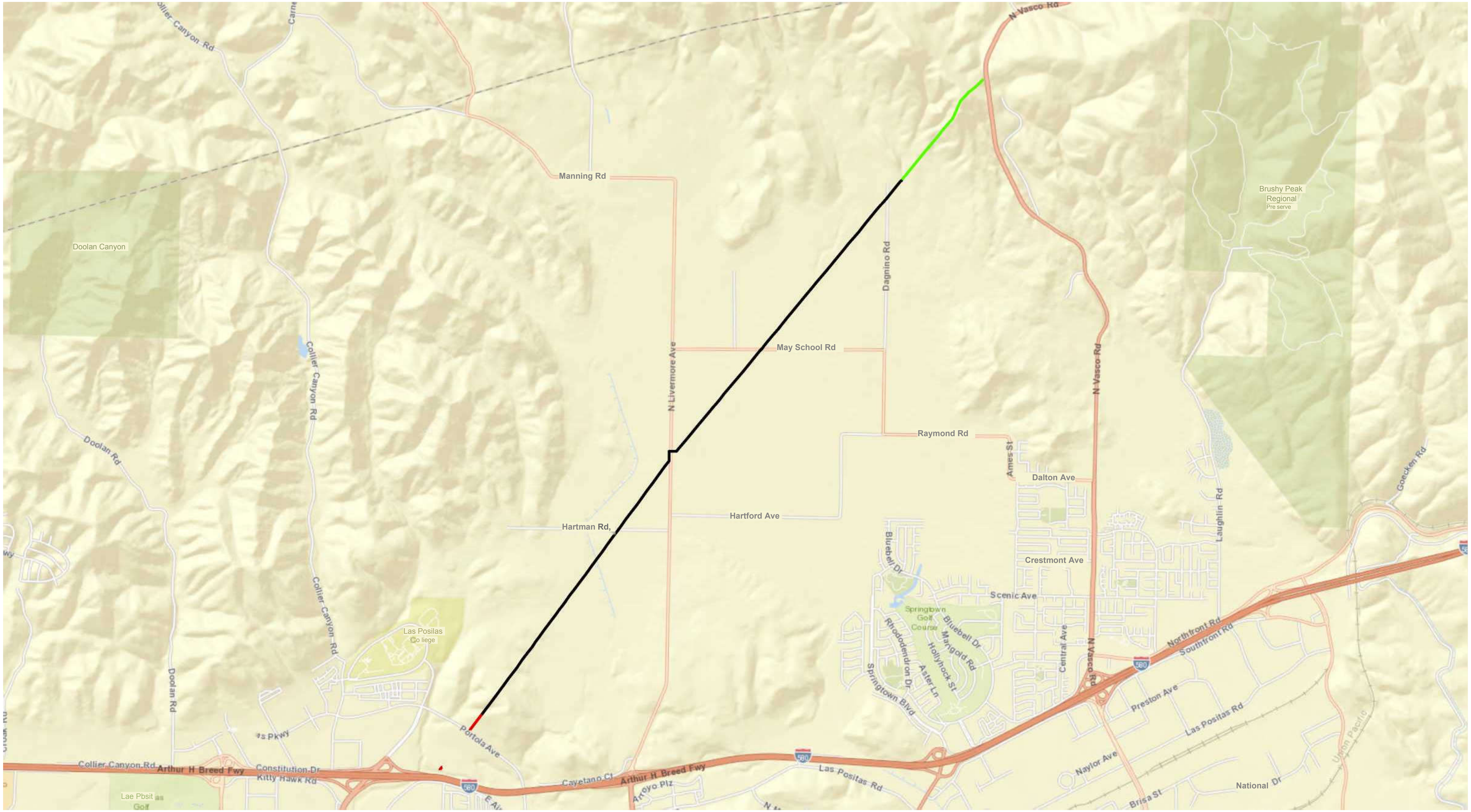

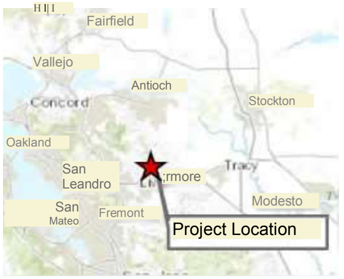

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----- R649

----- R700

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***EDMUND G. BROWN JR.**, Governor*
***CHARLTON H. BONHAM,** Director*

February 7, 2018

Honorable Ann Marie Sayers Chairperson
Indian Canyon Mutsun Band of Costanoan
Post Office Box 28
Hollister, CA 95024
ams@indiancanyon.org

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Bay Delta Region

Enclosure: Project Area Map

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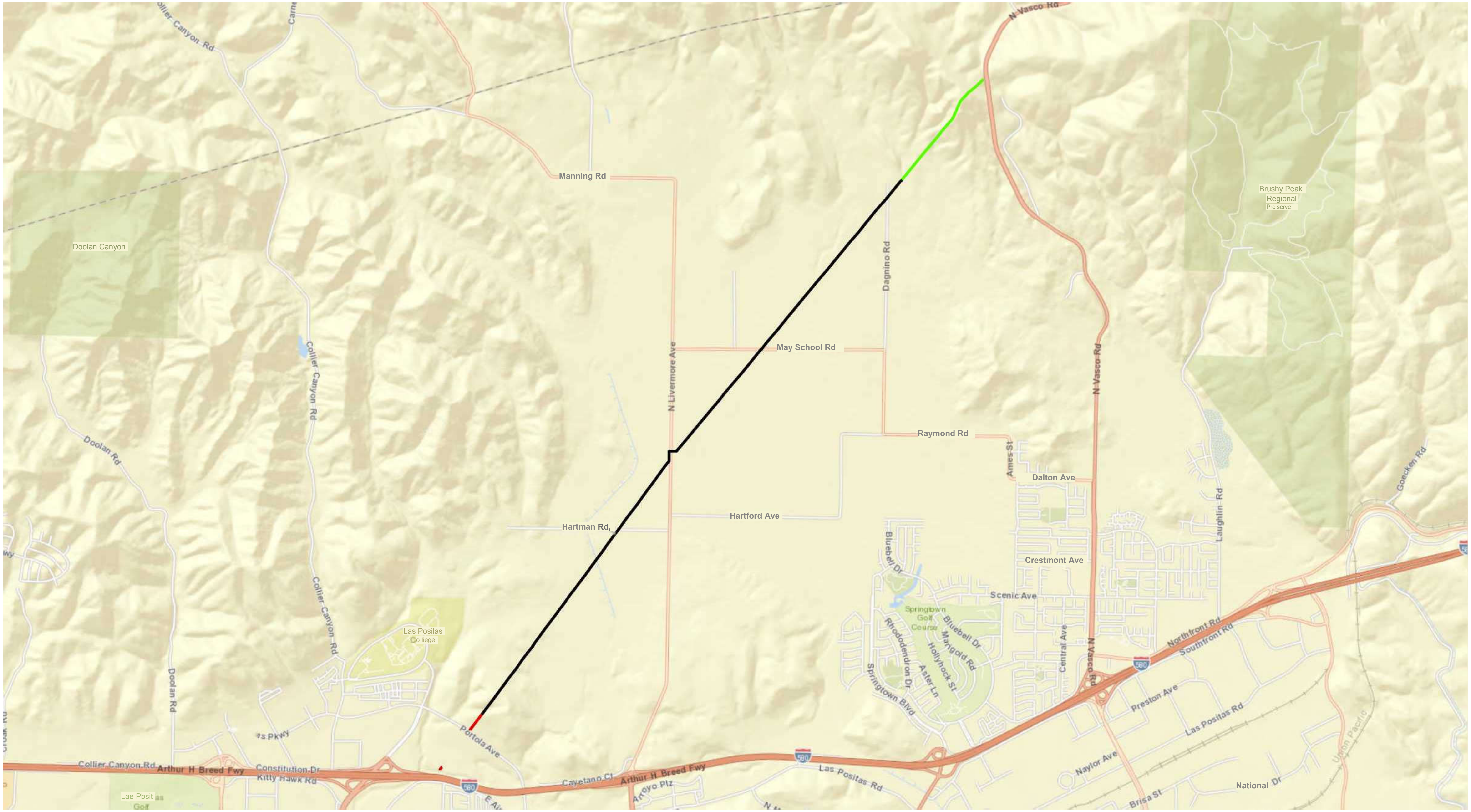

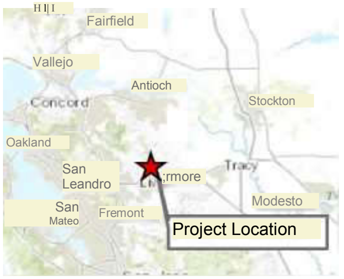

Legend

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----- R649

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February 7, 2018

Honorable Irenne Zwierlein, Chairperson
Amah Mutsun Tribal Band of Mission San Juan Bautista
789 Canada Road
Woodside, CA 94062
amahmutsuntribal@gmail.com

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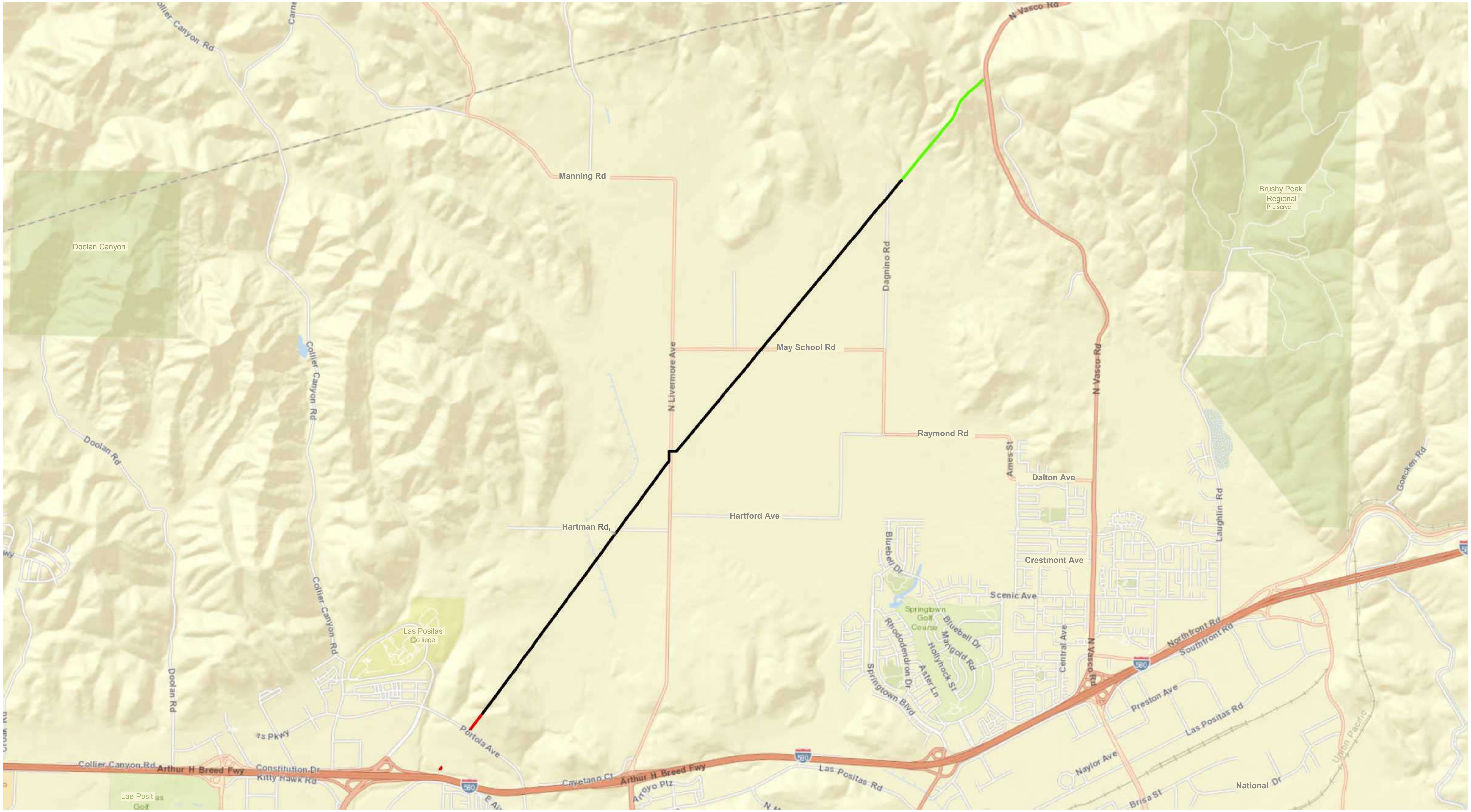

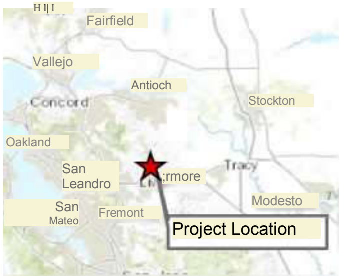

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----- R649

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Figure 1 Project Location

Prepared: L. McCandless, Stantec 2/1/2017, Revision: n/a

From: Emily Capello
To: Emily Capello
Subject: Perez communication March 3 to March 6, 2018
Date: Thursday, May 17, 2018 12:56:34 PM

-----Original Message-----
From: Glushkoff, Serge@Wildlife
Sent: Tuesday, March 06, 2018 12:03 PM
To: canutes <canutes@verizon.net>
Cc: Wildlife Tribal Liaison <Tribal.Liaison@wildlife.ca.gov>
Subject: RE: PG&E. Replacement 131. Alameda

Hello Katherine,
As per the email below, I left you a vmail earlier today, and look forward to hearing back from you to start getting into some detail about your concerns and possible steps forward.

My contact information follows.

Thank you,

Serge Glushkoff
Senior Environmental Scientist
California Department of Fish and Wildlife Bay Delta Region
7329 Silverado Trail, Napa CA 94558

Serge.Glushkoff@wildlife.ca.gov
(cell/text) 707-339-6191

-----Original Message-----
From: Wildlife Tribal Liaison
Sent: Monday, March 05, 2018 11:06 AM
To: canutes <canutes@verizon.net>; Wildlife Tribal Liaison <tribal.liaison@wildlife.ca.gov>
Cc: Glushkoff, Serge@Wildlife <Serge.Glushkoff@wildlife.ca.gov>
Subject: RE: PG&E. Replacement 131. Alameda

Katherine,

Thank you for the Tribe's consultation request on this project. I've cc'd Serge Glushkoff, who is overseeing this project for CDFW. If it is acceptable to the Tribe, I'd suggest that you and Serge schedule an initial call to go over the project details, discuss any information that may be available regarding cultural resources, and better determine any potential impacts to Tribal interests. After that call, if there are any issues or concerns about the project that the Tribe would like to discuss, I will be available to help arrange follow up discussions or a formal consultation meeting. Let me know if you have any concerns with this approach. Otherwise, I'll ask Serge reach out to try to schedule the initial call.

Best,
Nathan

--
Nathan Voegeli
Attorney and Tribal Liaison

California Department of Fish and Wildlife
916-653-1070

-----Original Message-----
From: canutes [mailto:canutes@verizon.net]
Sent: Saturday, March 03, 2018 9:27 AM
To: Wildlife Tribal Liaison <tribal.liaison@wildlife.ca.gov>
Subject: PG&E. Replacement 131. Alameda

Nathan Voegeli,

We the Northern Valley Yokut/Ohlone/Bay Miwuk tribe received your letter dated February 7, 2018. Regarding the PG&E Pipeline Replacement Project in the Alameda County. We are requesting to consult on this project as the proposed construction and new ground disturbances may have inadvertent discoveries of human remains and destroy the areas of medicinal plants. This area is also an area used by our ancestors to travel from the San Joaquin Valley to the Bay Area.

Nototomne Cultural Preservation
Northern Valley Yokut/Ohlone/Bay Miwuk
Katherine Perez
P. O. Box 717
Linden, Ca. 95236
Cell: 209.649.8972
Email: canutes@verizon.net

Sent from my iPad

Appendix E

Geotechnical Study

Geotechnical Study

Pacific Gas & Electric Co.
R700 / R707 Pipeline Project
Livermore, California

Prepared for:

EN Engineering, LLC.
3000 Executive Parkway, Suite 505
San Ramon, CA 94583

Attention: Mr. Colin Lakin

September 2, 2016

TRINITY Geotechnical Engineering, Inc.
13230 Evening Creek Drive, Suite 206
San Diego, CA 92128

TGE Project No.: T185

TRINITY
GEOTECHNICAL ENGINEERING, INC.

EN Engineering, LLC
3000 Executive Parkway, Suite 505
San Ramon, CA 94583

September 2, 2016
Project No.: T185

Attention: **Mr. Colin Lakin**

Subject: GEOTECHNICAL STUDY

Project: Pacific Gas & Electric Co.
R700 / R707 Pipeline Project
Livermore, California

Dear Mr. Lakin:

As requested, Trinity Geotechnical Engineering, Inc. (TGE) has performed a geotechnical study for the 30-inch R700 / R707 Pipeline Project. This report presents the results of our study which included research, field investigation and laboratory testing and provides geotechnical design parameters and construction recommendations for the proposed 4.5 mile replacement of the existing underground natural gas transmission line located in Livermore, California.

TGE appreciates the opportunity to provide this geotechnical engineering service for this project and we look forward to continuing our role as your geotechnical engineering consultant.

Respectfully submitted,
TRINITY Geotechnical Engineering, Inc.

Jeffrey Magalong, PE
President

JEFFREY JAN ALVAREZ MAGALONG
C81303
EXP. 9/30/17

Dennis Poland, PG, CEG
Principal Engineering Geologist

DENNIS M. POLAND
No. C.E.G. 2079
Exp. 8-31-17

Reviewed by,
VO Engineering, Inc.

Van Olin, PE, GE
Principal Geotechnical Engineer

VAN OLIN
No. C-60076
No. GE-2578
Exp. 6/30/18
RCE, RGE

9/1/16

JM/DP/VO

Distribution: (1) Addressee, via email

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EXECUTIVE SUMMARY

The study was performed at the direction of EN Engineering, LLC. The purpose of this study was to evaluate the geological and geotechnical conditions within the project site and provide recommendations to support engineering design and construction. This report summarizes the data collected and presents our findings, considerations, conclusions, and geotechnical design recommendations.

The proposed project includes the replacement of approximately 4.5 miles of 30-inch diameter natural gas pipeline. The new pipeline will follow the existing NE-SW oriented alignment, which traverses largely undeveloped parcels of land located north of I-580 and west of North Vasco Road in the Las Positas area of Livermore, California. This portion of Alameda County is rural and area roads dissect active agricultural fields, which are suppo.0rted by artificial irrigation. The pipeline alignment traverses mountainous terrain for approximately half a mile at the northeast corner and then crosses a relatively flat lying valley for approximately four miles to the southwest terminus. Elevations for the project range from a high of approximately 1,160 feet above mean sea level (MSL) at the northeast corner of the alignment to a low of approximately 515 feet MSL at the southwestern end of the alignment.

The new steel pipeline will be placed through a combination of open-trench and trenchless installation construction methods. Project plans were not available at the time of this report, however, it is our understanding that the proposed pipeline invert is approximately 5-feet below the existing ground surface in the trench sections; and the pipe invert for the bored sections will be approximately 10-feet below existing swales or creeks. Installation of temporary bore and receiving pits will be required to facilitate the jack and bore construction method and will have floor elevations of about 15 -feet below the existing ground surface.

Our geotechnical field exploration program consisted of six Hollow-Stem Auger borings (HSA) at select locations along the proposed project alignment. The geotechnical borings, designated B-1 through B-6 were generally located in close proximity to a bore pit. Representative bulk and in-situ “undisturbed” drive samples were obtained for the purpose of testing and analyses. The subsurface conditions were recorded and logged in the field.

The study area is generally underlain by sedimentary formational materials in the northeast and southwest sections of the alignment and recent (Quaternary aged) alluvial deposits along the middle region of the alignment. The formational materials consists of weathered Sandstone and Siltstone with gravel; and the alluvial deposits generally consists of silty sand and sandy silts with traces of clay, gravel and cobbles. The materials are generally characterized as soft / loose to hard / very dense. Groundwater was only encountered during our subsurface investigation within boring B-4 at a depth of approximately 38 feet. As encountered, the depth to groundwater is projected below the proposed pipe invert and bore pit floors. Therefore, groundwater is not anticipated to impact the proposed construction.

The project alignment begins within the boundaries of an established Alquist-Priolo Earthquake Fault Zone or EFZ (see Figure No. 9, Earthquake Fault Zone Map). Specifically, mapped active and / or potentially active major and secondary fault traces project across the northeast section of the proposed pipeline. Identifying and confirming mapped, inferred, concealed or other traces of faulting is beyond the scope of this study. However, it is our understanding a detailed fault study / fault risk evaluation is being performed by others and will be presented under separate cover.

Design considerations for strong ground shaking are provided herein. The Seismic Hazard Zones Map (see Figure No. 11) indicates that the project alignment is within an area of liquefaction potential (i.e., area consisting of alluvial deposits with presence of shallow groundwater). Based on our analyses, there is potential for liquefaction to occur at the site with attendant dynamic settlements ranging from ***0 to 0.5 inch***. It is unlikely that this level of ground disturbance would warrant geotechnical remediation, however this should be confirmed with the structural engineer.

The near surface soils exhibit medium expansion characteristics, as such, they are acceptable for use as backfill in ***non-structural areas only***. Soil corrosion test results suggest corrosion protection is warranted for ground contact concrete and metal materials, test results and mitigation considerations are provided herein.

Construction considerations include variable ground conditions along the entire project alignment. Additionally, given the variable conditions and sensitive facilities (existing underground utilities, etc.) it is recommended that a suitable monitoring program be established for the jack and bore operations, as well as the lineal pipeline installation operations. Suggestions for monitoring the jack and bore operations, as well as the lineal pipeline installation operations are provided herein and should be considered monitoring minimums. Temporary earth shoring design parameters are also included in this report.

The attached report includes the subsurface soil conditions observed and inferred during our study, a review of available relevant geotechnical documents, and geotechnical engineering analyses. It is our opinion that the site is suitable for the proposed improvements, provided recommendations and parameters contained in this report are incorporated during the design and construction of the proposed project. Specific recommendations have been made in this report to address the varying subsurface conditions underlying representative open trenching and jack-and-bore sites requiring sizable excavations. Deviations from these recommendations should be brought to our attention for consideration of technical feasibility and engineering merit.

1. INTRODUCTION

This report provides the results of our geotechnical study conducted for the R700 / R707 Pipeline Project. The approximate location of the project in relation to surrounding streets and landmarks is presented on *Figure No. 1, Vicinity Map.*

The purpose of this study was to evaluate the subsurface conditions within the project site and to provide geotechnical recommendations and parameters for consideration in the design and construction of the project. This report summarizes the data collected and presents our findings, conclusions, and geotechnical design recommendations.

2. SCOPE OF SERVICES

Our scope of geotechnical services for this project included the following tasks:

- Review of available background data, in-house geotechnical data and geotechnical reports, geotechnical literature, geologic maps, topographic maps, and literature relevant to the subject site;
- Performing a site reconnaissance to observe general site conditions, check for accessibility, and provide DigAlert mark-out;
- Obtaining Alameda County permits for drilling;
- Performing a fieldwork exploration program which included advancement of (6) hollow stem auger borings (HSA) to a maximum depth of 51.5 feet (see *Appendix A, Exploratory Boring Logs*);
- Obtaining in-situ “undisturbed” and bulk soil samples for the purpose of engineering characterization and laboratory testing;
- Recording subsurface conditions on a geotechnical field log;
- Preparing a laboratory test program;
- Performing laboratory testing on selected representative bulk and relatively “undisturbed” soil samples obtained during the field exploration program, to evaluate the geotechnical engineering properties of these materials (see *Appendix B, Laboratory Test Results*);
- Evaluating the accumulated information and developing geotechnical conclusions and recommendations for use in the design and construction of the proposed project. The report includes the following:
    - Geotechnical / geologic maps along the project alignment depicting the location of the borings pertinent geologic information;
    - Discussion of geotechnical / geologic conditions that may impact the project design or construction;
    - Regional geology, subsurface soil, rock, and groundwater conditions;

- Field investigation findings including boring logs;
- Data reduction and summary of laboratory testing program;
- Construction considerations for pipeline installation, temporary shoring of bore pits and conceptual dewatering recommendations.

3. SITE & PROJECT DESCRIPTION

The project study area is limited to approximately 4.5-miles of the existing R700 / R707 natural gas pipeline. The pipeline extends from NE-SW traversing largely undeveloped parcels of land located north of I-580 and west of North Vasco Road in the Las Positas area of Livermore, California. This portion of Alameda County is rural and area roads dissect active agricultural fields which are supported by artificial irrigation. The pipeline alignment traverses mountainous terrain for approximately half a mile at the northeast corner and then crosses a relatively flat lying valley for approximately four miles to the southwest terminus. Elevations for the project range from a high of approximately 1,160 feet above mean sea level (MSL) at the northeast corner of the alignment to a low of approximately 515 feet MSL at the southwestern end of the alignment. Detailed geographic and topographic information for the project alignment is presented on *Figure No. 1, Vicinity Map*.

The new steel pipeline will be placed through a combination of open-trench and trenchless installation construction methods. Project plans were not available at the time of this report, however, it is our understanding that the invert for the proposed pipeline is approximately 5-feet below the existing ground surface in the trench sections; and the pipe invert for the bored sections will be approximately 10-feet below existing swales or creeks. Installation of temporary bore and receiving pits will be required to facilitate the jack and bore construction method and will have floor elevations of about 15 -feet below the existing ground surface.

4. FIELD EXPLORATION PROGRAM

Our field exploration program consisted of six (6) HSA exploratory borings which were advanced at various locations along the project alignment. The locations of the borings were previously determined by others in areas where trenchless installation construction method(s) may be utilized.

The exploratory borings were advanced at various locations along the alignment using a Marl M10 XLC drill rig utilizing 8-inch diameter hollow-stem augers. The drill rig utilized an automatic hammer with about 80% hammer efficiency for obtaining soil / formation samples. The borings were extended to a maximum depth of 50 feet below existing grades. The upper 5 feet of each bore hole was hand augered as a precaution to existing underground utilities. Representative bulk and in-situ “undisturbed” drive samples were obtained at various depths within the boreholes. The subsurface soil conditions were recorded and logged in the field. A laboratory test program was developed to facilitate our geotechnical analysis and is described in the following section. The samples were examined and classified according to the Unified Soil Classification System (USCS). Upon completion, each hole was backfilled with grout in accordance with permit requirements.

The field operations were supervised by a representative from TGE. The approximate locations of the HSA borings are shown on *Figure Nos. 2 to 6, Plot Plans.* A log of the subsurface conditions encountered in the borings are presented in *Appendix A, Exploratory Boring Logs.*

5. LABORATORY TESTING

Laboratory testing was performed on selected representative bulk and relatively undisturbed soil samples obtained from the exploratory borings, to aid in the soil classification and to evaluate engineering properties of the foundation soils. The following tests were performed:

- In-situ moisture content and Dry Density (ASTM D-2216 and ASTM D-2937);
- Particle size analyses and No. 200-wash (ASTM D-422 and ASTM D-1140);
- Direct Shear (ASTM D-3080);
- Corrosivity series including sulfate content, chloride content, pH-value, and resistivity (CTM 417, 422, and 643).

Testing was performed in general accordance with applicable ASTM standards and California Test Methods. A summary of the laboratory testing program and the laboratory test results are presented in *Appendix B, Laboratory Test Results*.

6. GEOLOGIC SETTING

The project alignment is situated in the Livermore Valley sediment basin, along one of the valley’s edges. A map of the project geology is shown in *Figure No. 7, Regional Geology Map*. The east-west trending Livermore Valley lies within the northwest-southeast trending Diablo Range, a range within the greater California Coastal Ranges geomorphic province. The alignment trends northeast-southwest and generally parallels the border between the Livermore Valley and low lying foothills of the Diablo Range to the northwest. The very northeastern most portion of the alignment begins to climb these foothills.

The Livermore Valley basin has largely been infilled with relatively young Miocene to Pleistocene aged sediments. It is bounded by Cretaceous volcanic and sedimentary rocks in the north and south. The Calaveras and the Greenville faults form the western and eastern margins of the basin, respectively, and the northeastern most portion of the project alignment lies near or in the Greenville fault zone. Both of the major faults are right-lateral strike-slip faults. Other major faults in the region are the Hayward Fault Zone (~15 mi to the west) and the San Andreas Fault Zone (~35 mi to the west).

7. SUBSURFACE CONDITIONS

Based on our site reconnaissance, subsurface exploration and review of geologic maps, the subsurface materials generally consist of Miocene Sedimentary Rocks (Tms), Alluvial Deposits (Qpa), early Pleistocene and or Pliocene Sediments (Qts) and Colluvial deposits. A map of the project geology is shown on *Figure No. 7, Regional Geology Map.*

Brief descriptions of the subsurface conditions encountered and inferred at this site are presented below. A more detailed description of these materials is provided in *Appendix A, Exploratory Boring Logs.*

7.1 Alluvial Deposits (Qpa)

Alluvial Deposits were encountered in borings B-2, B-3 and B-4 generally overlain with about 7 to 8 feet of top soil. The deposits generally consisted of brown alternating layers of clayey to silty SAND and sandy SILT with traces of gravels, and cobbles. The materials can be characterized as loose / soft to very dense / hard.

7.2 Early Pleistocene and/or Pliocene Sediments (Qts) and Colluvium

Early Pleistocene and Pliocene sediments were encountered in borings B-5 and B-6. The deposits generally consist of gray to light brown fine to coarse grained sandstone with silt and clay. These units are poorly to moderately consolidated. At boring B-5, the Sediments unit was encountered at about 23 feet below ground surface and overlain by colluvial deposits.

7.3 Miocene Sedimentary Rocks (Tms)

Miocene sedimentary rocks, also known as Cierbo Formation, were encountered in B-1 below existing grades. The formation generally consisted of weathered tan to yellowish-brown friable sandstone, sandy gravel and traces of tan shale. The sandstone is typically medium to coarse grained with round gravel and pebbles. Where encountered the materials are characterized as very dense.

7.4 Groundwater

Groundwater was encountered within Boring B-4 at 38 feet. However, a “capillary fringe” saturated condition was inferred from laboratory testing from about 29 to 38-feet. In addition, the historic high groundwater level ranges from approximately 10 to 30 feet below grade along the project alignment (see *Figure No. 8, Historical High Groundwater Map*). In any case, groundwater is not anticipated to affect the proposed project. It should be noted that perched groundwater seepage zones may occur in near surface permeable materials depending on the seasonal rainfall and other variable site conditions.

8. GEOLOGIC HAZARDS

The proposed pipeline project is located within a very seismically active area of California, a region that has experienced numerous earthquakes in the past. There is the potential for the project area to be subject to strong ground shaking from local and regional seismic events. This geological hazard is common and the effects of ground shaking can be mitigated by proper engineering design and construction in conformance with current building codes and engineering practices. A detailed discussion of fault activity and related geoseismic hazards is provided herein.

8.1 Faults

There are several major active fault zones (i.e., the fault has displaced within about the last 11,000 years, or Holocene time) within close proximity of the project alignment and a number of potentially active fault zones in proximity of the project as shown on *Figure No. 10, Regional Fault Map*. Each of these zones contains multiple active fault strands which could produce large seismic events.

Recent notable earthquakes near the project sites are the 1989 Loma Prieta earthquake the 1980 Livermore earthquake. The two were subject to strong ground motion and had magnitudes of M 5.7 and M 5.2, respectively, and produced as much as 5 centimeters of surface offset over a discontinuous surface rupture of 6 kilometers.

The project site is located within an Alquist Priolo Earthquake Fault Zone (EFZ) Boundary as shown in *Figure No. 10, Earthquake Fault Zone Map*. This indicates that the site is within an area with potential fault rupture. Based on review of maps, active and / or potentially active major and secondary fault traces projects the northeast section of the proposed pipeline. Since the precise locations of the major and secondary faulting are unknown, potential for surface rupture due to faulting occurring beneath the proposed pipeline section is significantly elevated. Identifying and confirming mapped, inferred, concealed or other traces of faulting will require a detailed fault evaluation including trenching / test pits which are beyond the scope of this study and will be provided by others.

8.2 Ground Shaking

The site is located in a seismically active area. The most significant seismic hazard at the site is considered to be shaking caused by an earthquake occurring on a nearby or distant active fault (e.g., Greenville Fault Zone, Calaveras Fault Zone, & Hayward Fault Zone). Provided the improvements are designed with considerations for the hazard of seismic shaking, the potential for failure due to ground shaking is considered low (see *Section 9.9, Seismic Design Parameters*).

8.3 Liquefaction and Dynamic Settlement

Liquefaction of soils can be caused by ground shaking during earthquakes. Research and historical data indicate that loose, relatively clean granular soils are most susceptible to liquefaction and dynamic settlement, whereas the stability of the majority of clayey silts, silty clays and clays are not adversely affected by ground shaking. Liquefaction is generally known to occur in saturated cohesionless soils at depths shallower than approximately 50 feet in depth. Dynamic settlement due to earthquake shaking can occur in both dry and saturated sands.

Based on our subsurface investigation and review of geologic maps, the project site is underlain by loose to very dense silty sand and soft to hard sandy silt. TGE performed a liquefaction analysis to determine the potential liquefaction-induced settlement following the California Geologic Survey's (CGS) Guidelines for Evaluating and Mitigating Seismic Hazards in California (2008) which suggests "*Generally, the historic high groundwater level should be used unless other information indicates a higher or lower level is appropriate"* (CGS Special Publication 117A, p.38). Based on the historical high groundwater table at 10 feet below grade, the project site has a potential for liquefaction.

The liquefaction analyses utilized an earthquake magnitude value of 7.5M. Multiple analyses were performed for 3 separate peak ground accelerations (PGA) corresponding to three separate probabilities of exceedance (2%, 5%, and 10% Probability of Exceedance in 50 years); these probabilistic methods for determining the PGA's are the most commonly used for liquefaction analyses in Southern California. Other methods for deriving the PGA include 1) historical, 2) code or regulatory and 3) deterministic (Ref.: Geotechnical Earthquake Engineering Handbook, Robert Day, 2002, pg. 5.34). A conservative assumption of groundwater table at 10 feet below ground surface was used in the analyses. In addition, the liquefaction-settlement analyses utilized two separate methods for calculation of total settlement, Tokimatsu/Seed and Ishihara/Yoshimine. The different peak ground accelerations, attenuation characteristics, and settlement analyses methods provide varying estimates of the total settlement resulting from liquefaction. The structural designer should choose the appropriate Probability of Exceedance and analysis method given the importance of the proposed structure.

Based on our analyses, using the computer program LiquefyPro Version 5.8, the occurrence of liquefaction is predicted within soils underlying the project site. ***The estimated liquefaction-induced settlement was calculated to range from approximately 0 to 0.5 inch depending on the method of analysis.*** A summary of the results are provided in *Table 1* below. The liquefaction and attendant dynamic settlement analyses are presented in *Appendix C, Liquefaction Analyses*.

Table 1: Liquefaction Analyses Results

Subsurface Investigation	**Type of Structure[1]**	**Probability of Exceedance**	**Peak Ground Acceleration[2] (g)**	**Estimated Settlement by Tokimatsu[3,5] (in.)**	**Estimated Settlement by Ishihara[4,5] (in.)**
B-4	Minor Structure	10% in 50 years	0.453	0.19	0.01
	Significant Structure	5% in 50 years	0.584	0.43	0.02
	Critical Structure	2% in 50 years	0.774	0.48	0.03

Notes: (1) Typical examples of structures are as follows:

- Minor Structures (single story residences, agricultural facilities, storage facilities);
- Significant Structures (schools, commercial buildings, multi-story buildings);
- Critical Structures (hospitals, power generating stations, high occupancy buildings, life-line utilities).

(2) Peak ground acceleration (PGA) is dependent on the earthquake moment magnitudes and attenuation characteristics of the subsurface median between the seismic source (i.e. faults) and structure location. The attenuation characteristics utilized to determine the PGA's above were based on the Ground Motion Interpolator by the California Geologic Survey (http://www.quake.ca.gov/gmaps/PSHA/psha_interpolator.html).

(3) Estimated settlement by Tokimatsu is discussed in Liquefy Pro page 36 (2010).

(4) Estimated settlement by Ishihara is discussed in Liquefy Pro page 37 (2010).

(5) The differential seismic settlements should be estimated to be 0.5 of the estimated total seismic settlements, given the geologic setting (i.e., uniform thickness alluvial deposits within an essentially level topographical setting). In addition, the estimated differential seismic settlements should be expected to occur over distances ranging from 20 to 40-feet (reference: Recommended Procedures for Implementation of DMG Special Publication 117 Guidelines for Analyzing and Mitigating Liquefaction in California, page 31).

It is unlikely that this hazard would warrant geotechnical remediation, however this should be confirmed with the structural engineer.

8.4 Lateral Spread, Landslides, and Tsunamis

Lateral displacement is not anticipated at the site since any potentially liquefiable materials are physically constrained (i.e., no open face to allow lateral spread).

A portion of the project alignment, located at the southwest section, are within an area with earthquake induced landslide potential (see *Figure No. 11, Seismic Hazards Zones Map*). The sediments (Qts) within this area are susceptible to erosion and slope failure, with susceptibility increasing with slope. Evaluation for landslide potential are beyond the scope of this study; however, it is our understanding that monitoring of slope movement will be provided by others.

Finally, the site is located approximately 24 miles from the San Francisco Bay and 40 miles from the coastline at an approximate elevation of 515 MSL, the project is not considered susceptible to impact from tsunamis.

8.5 Expansive Soils

The site is underlain by layers of silty sand, sandy to clayey silt and sandy clay and the Expansion Index of these on-site materials are in the "Low" to "Medium" range. Therefore, on-site soils should be used as backfill within non-structural areas only.

9. DESIGN RECOMMENDATIONS

9.1 General

Based on the results of the field exploration and engineering analyses, it is TGE's opinion that the proposed project is feasible from a geotechnical standpoint, provided that the recommendations in this report are incorporated into the design plans and implemented during construction. Deviations from these recommendations should be brought to our attention for consideration of technical feasibility and engineering merit.

9.2 Site Earthwork

Clearing and Grubbing

Prior to the excavation of the bore and receiving pits, the project area should be cleared of existing pavement, debris, etc. Any buried organic debris or other unsuitable contaminated material encountered during subsequent excavation and grading work should also be removed.

Excavations for removal of any existing footings, utility lines, tanks, and any other subterranean structures should be processed and backfilled in the following manner:

1. Clear the excavation bottom and sidecuts of all loose and/or disturbed material.

2. Prior to placing backfill, the excavation bottom should be moisture conditioned to within 2 percent of the optimum moisture content and compacted to at least 90 percent of the ASTM D-1557 laboratory test standard.

3. Backfill should be placed, moisture conditioned (i.e., watered and/or aerated as required and thoroughly mixed to a uniform, near optimum moisture content), and compacted by mechanical means in approximate 6-inch lifts. The degree of compaction obtained should be at least 90 or 95 percent of the ASTM D-1557 laboratory test standard, as applicable.

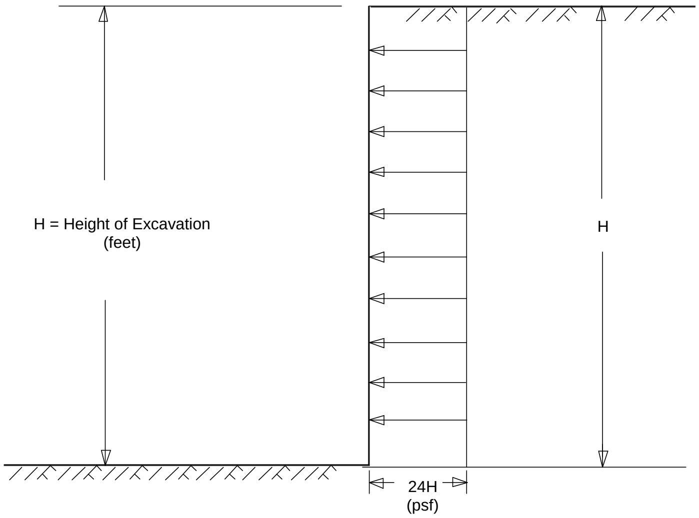
It is also critical that any surficial subgrade materials disturbed during initial demolition and clearing work be removed and/or recompacted in the course of subsequent site preparation earthwork operations.

9.3 Temporary Excavations

Excavation of the on-site soils may be achieved with conventional heavy-duty grading equipment within the alluvial / formational materials. Temporary, shallow excavations with vertical side slopes less than 4 feet high will generally be stable, although there is a potential for localized sloughing. Vertical excavations greater than 4 feet high should not be attempted without proper shoring to prevent local instabilities. Shoring may be accomplished with hydraulic shores and trench plates, and/or trench boxes, soldier piles and lagging. The actual method of a shoring system should be provided and designed by a contractor experienced in installing temporary shoring under similar soil conditions. If soldier piles and lagging are to be used, we should be contacted for additional recommendations.

All trench excavations should be shored in accordance with CalOSHA regulations. For your planning purposes, the alluvium and fill materials may be considered a Type B soil, as defined the current CalOSHA soil classification.

Braced excavations should be designed to resist a trapezoidal distribution of lateral earth pressure. The recommended pressure distribution, for the case where the grade is level behind the shoring, is illustrated in the following diagram with the maximum pressure equal to 24H in pounds per square foot, where H is the height of the excavation in feet.



Any surcharge (live, including traffic, or dead load) located within a 1(H): 1 (V) plane drawn upward from the base of the shored excavation should be added to the lateral earth pressures. The lateral load contribution of a uniform surcharge load located across the 1(H): 1(V) zone behind the excavation walls may be calculated by using *Figure No. 12, Lateral Surcharge Loads*. Lateral load contributions of surcharges can be provided once the load configurations and layouts are known. As a minimum, a 2-foot equivalent soil surcharge is recommended to account for nominal construction loads.

Stockpiled (excavated) materials should be placed no closer to the edge of a trench excavation than a distance defined by a line drawn upward from the bottom of the trench at an inclination of 1(H): 1(V), but no closer than 10 feet. All trench excavations should be made in accordance with CalOSHA requirements.

9.4 Jack-and-Bore

The Jack-and-Bore (auger bore) method is proposed to replace the R700 / R707 30-inch high pressure supply line at specific locations due to environmental restrictions. This trenchless technology method is facilitated by excavating launching and receiving pits on opposite ends of the proposed pipeline section. Pit construction can be facilitated by back-sloping or by shored solution (e.g. sheet piles) in accordance with the recommendations provided in *Section 9.3*. The auger boring machine is placed in the launching pit and the machine advances an auger and casing horizontally into the ground simultaneously while the machine is turning a cutting head through the ground. The auger carries the cuttings along the auger flight within the casing back to the machine where they can be removed from the bore pit.

Borings conducted in the vicinity of the proposed work area indicate that the proposed Jack-and-Bore operation is feasible with the appropriate equipment and tooling in good working order. It is recommended that an experienced specialty contractor should be used for Jack-and-Bore operations (i.e., minimum 5 years of experience and similar ground conditions described herein). The expected soil conditions in the boring area generally consist of soft to firm, cohesive sandy clay / silty clay with lenses of sandy silt / clayey silt. It should be noted zones of clean sand were not encountered during drilling. However, if encountered, these sands may be susceptible to sloughing which can reduce the effects of lubrication and increase the jacking loads.

It is anticipated that the casing / boring installation would occur within a single working shift. Given the nature of the Jack-and-Bore procedures (i.e., continuous casing during drilling), and provided the contractor take precautionary measures (Note: especially when drilling on loose saturated material), it is not anticipated that ground surface settlements will occur due to loss of materials. However, given the variable conditions and sensitive facilities it is recommended that a bore monitoring program be established to include:

- Installation of ground surface settlement monuments on landmark structures / locations to monitor ground movement, before, during and after construction;

- Continuously monitor spoil volume recovered from the boring during construction, establish a baseline excavation volume during initial augering stage to compare with the theoretical excavation volume, monitor consistency during operations;

- The contractor should also provide a jack-and-bore construction work plan and include a process for mitigation, should loss of materials arise;

We recommend that a pre-construction meeting be held prior to the start of construction. The contractor should be in attendance to discuss the construction plans and procedure. In addition, TGE should review the forthcoming project plans and specifications for consistency with our report prior to the start of construction in order to avoid possible conflicts, misinterpretations, inadvertent omissions, etc. TGE should also perform observation / testing services during the auger boring operations.

9.5 Temporary Construction Dewatering

Groundwater was encountered during our subsurface investigation at a depth of about 38 feet in B-4, and it is not anticipated to affect the proposed construction. However, a “capillary fringe” saturated condition was inferred from laboratory testing from about 29 to 38-feet. In any case, if groundwater is encountered during construction, temporary dewatering may be required. The means and method of dewatering should be established by a contractor with local experience. It is important to note that temporary dewatering, if necessary, may require a permit and plan that complies with RWQCB regulations

9.6 Thrust Forces

If thrust blocks are used, the blocks may be designed using a passive resistance equal to an equivalent fluid pressure of 300 pounds per cubic foot (pcf).

9.7 Vertical Pressures

Loads exerted on the pipes should not exceed the manufacturer’s recommendations. TGE has provided the following tables as estimates of the vertical pressures. If more specific pressures are needed at spot locations, TGE may be contacted for more in depth analysis.

Table 2: Design Vertical Pressures (soil) (1)

Depth of Cover (feet)	D (psf)
0-5	650
6-10	1,300

(1) Dead load vertical pressure from soil prism considering load coefficients for cohesionless backfill.

Table 3: Design Vertical Pressures (Dynamic Loads) (1)

Depth of Cover (feet)	D (psf)
2	3,200
4	1,150
6	600
8	360
10	240

(1) Dead load vertical pressure equivalent based on a dynamic load from a truck with a contact pressure of 100 psi.

9.8 Backfill Operations

Following completion of the underground pipeline installation, backfilling will be required (see *Figure No. 13, Utility Trench Backfill*). The pipe bedding and cover (Note: minimum 6-inches bedding and 12-inches cover) will be placed as a 0 sack slurry with a minimum sand equivalent of 20. All backfill above the pipe cover should be mechanically compacted to at least 95 percent relative compaction based on the latest version of the ASTM D-1557 procedure.

Based on field and laboratory classification, the on-site soils are acceptable for use as backfill in ***non-structural areas only***. All imported fill should consist of granular, non-expansive soil with an Expansion Index of 20 or less. Import material should be evaluated by our firm prior to transport to the site and not contain any contaminated soil, expansive soil, debris, organic matter, or other deleterious materials.

9.9 Seismic Design Parameters

Preliminary seismic design parameters for the project site were also developed for possible use in the design of ancillary structures, as per the guidelines outlined in the 2013 CBC, Volume 2, Chapter 16 (Note: 2012 International Building Code). **TGE should be contacted with latitude/longitude coordinates for site specific improvements requiring seismic parameters.** The seismic design parameters for Site Class “D” were developed using a JAVA ™ application, Java Ground Motion Parameter Calculator–Version 5.0.9 available on the USGS website (http://earthquake.usgs.gov). The preliminary seismic design parameters for the project site are presented in *Table 4* below.

Table 4: 2012 IBC Seismic Design Parameters

Boring Locations	Site Class	S_{DS} (g)	S_{D1} (g)
B-1	D	1.558	0.812
B-2	D	1.534	0.819
B-3	D	1.383	0.801
B-4	D	1.236	0.604
B-5	D	1.231	0.600
B-6	D	1.230	0.600

9.10 Soil Corrosion

The corrosion potential of the on-site materials to steel and buried concrete was evaluated. Laboratory testing was performed on representative samples of the existing surficial materials to evaluate pH, minimum resistivity, and chloride and soluble sulfate content. Laboratory test procedures are discussed in *Appendix B*. Table 6 of *Appendix B* presents the results of our corrosivity testing. General recommendations to address the corrosion potential of the on-site materials are also provided in the subsections below. If additional recommendations are desired, it is recommended that a corrosion specialist be consulted.

9.10.1 Reinforced Concrete

Laboratory tests indicate that the potential of sulfate attack on concrete in contact with the on-site soils is “Not Applicable” based on ACI 318-11, Table 4.2.1 and 4.3.1. It is recommended that Type II cement be used for all proposed structure foundations.

The results of chloride content testing at the near-surface soil indicate the potential of chloride attack on concrete structures is low. Reinforcing steel in concrete structures and pipes in contact with soil may be susceptible to chloride attack; TGE recommends that the level of protection should anticipate a chloride content of 1,00 parts per million (ppm). The pH-values are near-neutral and do not warrant corrosion consideration. If considered necessary, possible methods of protection that could be used include increased concrete cover, low water-cement ratio, corrosion inhibitor admixture, silica fume admixture, and waterproof coating on the concrete exterior.

9.10.2 Metallic

Laboratory tests indicate that the on-site surficial materials have a very low to high electrical resistivity. Very low electrical resistivity presents a severe potential for corrosion to buried ferrous metals. Corrosion mitigation for steel pipes should be given (i.e., sacrificial metal or use of protective coatings).

10. CONSTRUCTION CONSIDERATIONS

Construction considerations for the proposed improvements are presented below.

1. Groundwater was encountered during our subsurface investigation at a depth of about 38 feet in B-4; in addition, a “capillary fringe” saturated condition was inferred from laboratory testing from about 29 to 38-feet Groundwater is not anticipated to affect the proposed construction activities. Periodic ground water seepage zones and ground water mounding may occur during the wet weather season.

2. The contractor should anticipate variable subsurface conditions ranging from medium dense to very dense silty sand or hard, moist sandy / clayey silt within the bore path.

3. A construction monitoring program should be established to include: ground surface monitoring, spoils excavation monitoring and a contingency work plan.

4. Temporary excavations may be required for removal and/or installation of underground elements. The Occupational Safety and Health Administration (OSHA) regulations provide trench sloping and shoring design parameters for excavations up to 20-feet in depth, based on a description of the soil types encountered. TGE recommends that a Type B OSHA Classifications be used for temporary excavations within the on-site alluvial materials. Excavations should be inspected by the geotechnical engineer and the performance evaluated.

5. All fills should be compacted to at least 90 or 95 percent relative compaction, as applicable, based on the ASTM D-1557 laboratory test method.

6. If materials at the bottom of receiving or jacking pit subgrades and/or any other excavations are disturbed during construction activities, they should be removed and recompacted to a minimum 90 percent relative compaction, based on ASTM D-1557.

11. LIMITATIONS

The recommendations and opinions expressed in this report are based on TGE's review of background documents and on information developed during this study. More detailed limitations of the geotechnical engineering report are presented in the ASFE's information bulletin in *Appendix D*.

Due to the limited nature of our field explorations, conditions not observed and described in this report may be present at the site. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation and laboratory testing can be performed upon request. It should be understood that conditions different from those anticipated in this report may be encountered during substation expansion construction operations.

Site conditions, including ground-water level, can change with time as a result of natural processes or the activities of man at the subject site or at nearby sites. Changes to the applicable laws, regulations, codes, and standards of practice may occur as a result of government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which TGE has no control.

TGE's recommendations for this site are, to a high degree, dependent upon appropriate quality control of subgrade preparation, fill placement, and other construction activities. Accordingly, the recommendations are made contingent upon the opportunity for TGE to observe grading operations and foundation excavations for the proposed construction. If parties other than TGE are engaged to provide such services, such parties must be notified that they will be required to assume complete responsibility as the geotechnical engineer of record for the geotechnical phase of the project by concurring with the recommendations in this report and/or by providing alternative recommendations.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. TGE should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document.

TGE has endeavored to perform this study using the degree of care and skill ordinarily exercised under similar circumstances by reputable geotechnical professionals with experience in this area in similar soil conditions. No other warranty, either expressed or implied, is made as to the conclusions and recommendations contained in this study.

12. REFERENCES

1. ASTM, 2001, Soil and Rock: American Society for Testing and Materials: vol. 4.08 for ASTM test methods D-420 to D-4914; and vol. 4.09 for ASTM test methods D-4943 to highest number;

2. ASTM, 2001, Geotechnical Engineering Standards: American Society for Testing and Materials: and ASTM test method D-7012;

3. California Building Code 2013, California Code of Regulations, Title 24, Part 2, January 1, 2014

4. California Department of Conservation, Division of Mines and Geology, 1997, Guidelines for Evaluation and Mitigation of Seismic Hazards in California: Special Publication 117;

5. California Department of Conservation, Division of Mines and Geology, 1998, Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada: International Conference of Building Officials, dated February , Scale 1” = 4 km;

6. California Geological Survey, 2010 Fault Activity Map of California and Adjacent Areas with Locations and Ages of Recent Volcanic Eruptions; California Department of Conservation, Division of Mines and Geology, Geologic Data Map No. 6, scale 1:750,000;

7. California Geological Survey, Special Publication 117A, Guidelines for Evaluating and Mitigating Seismic Hazards in California, Revised and Re-adopted September 11, 2008;

8. Civiltech Software, LiquefyPro, Version 5.8, 2007-3, Liquefaction and Settlement Analysis Software Manual;

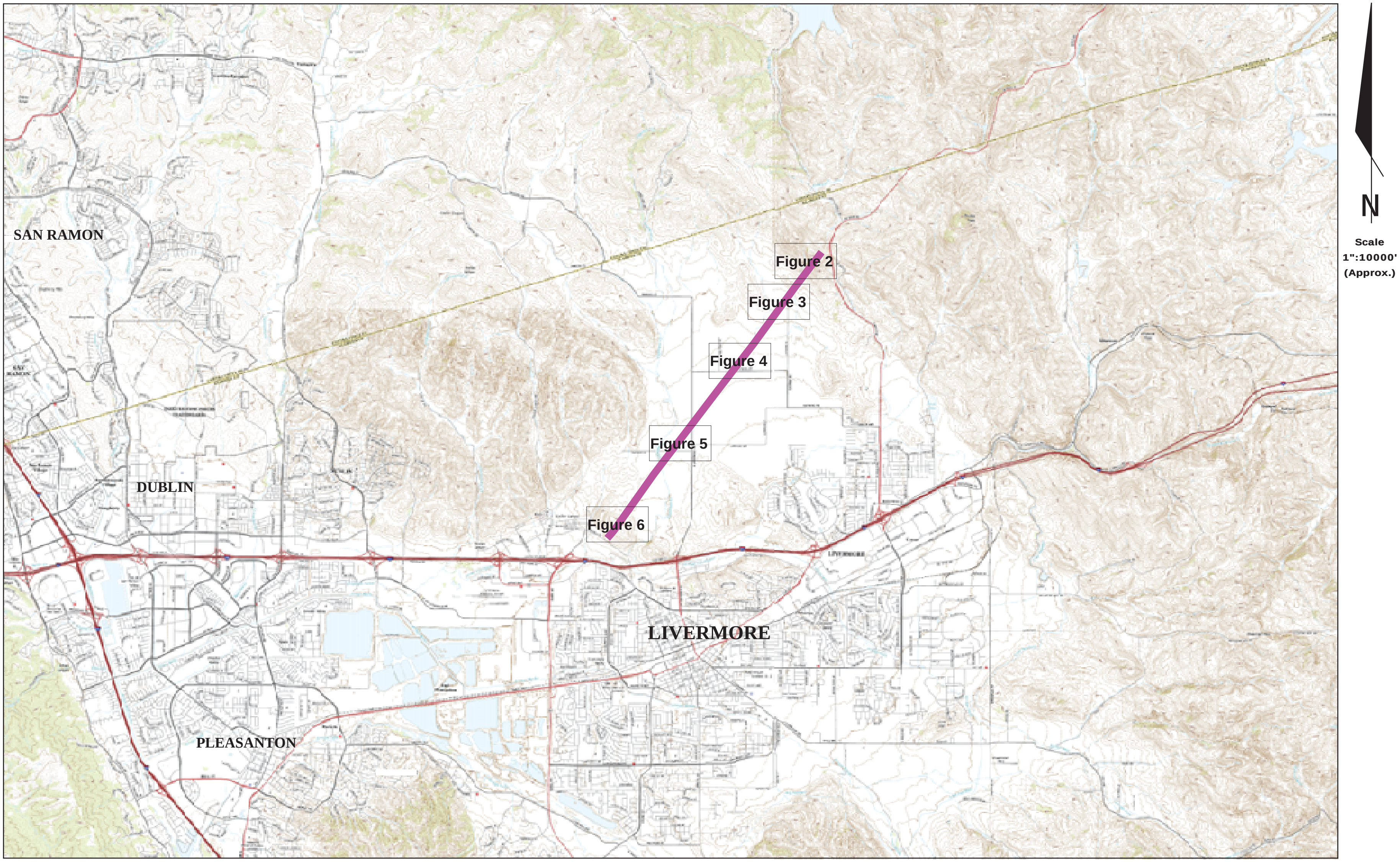
9. Day, Robert, 2002, Geotechnical Earthquake Engineering Handbook;

10. Hunt, Roy E., 1986, Geotechnical Engineering Analysis and Evaluation;

11. International Building Code, 2012;

12. Macnab, A., 2002, Earth Retention Systems Handbook.

FIGURES



Reference: USGS 2015 Topographic Maps (Altamont, Byron Hot Springs, Clifton Court Forebay, Livermore, Midway, Tassajara, CA - 7.5 minute Quadrangles)

TRINITY
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Legend

▬ R-700 / R-707 Alignment

Gas Transmission & Distribution
Pacific Gas and Electric Co.
San Francisco, California

Vicinity Map

R700 / R707 Pipeline Project
Livermore, CA

TGE Project No.: T185 | **Figure No.: 1**

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Legend

● Approximate Boring Location

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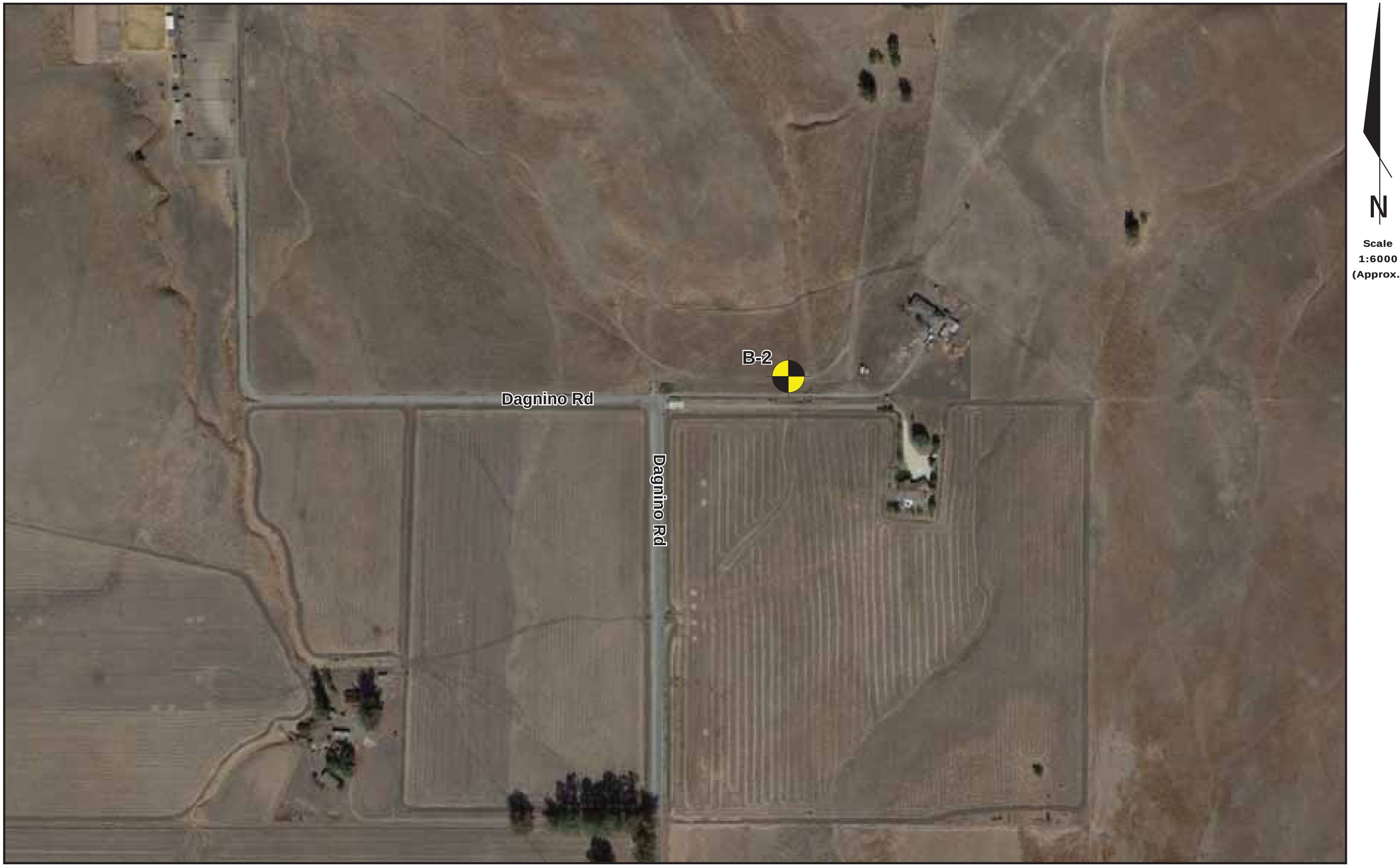
Pacific Gas and Electric Co.
San Francisco, California

Plot Plan (1 of 5)

R700 / R707 Pipeline Project
Livermore, CA

TGE Project No.: T185	**Figure No.: 2**



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Legend

◐ Approximate Boring Location

Gas Transmission & Distribution
Pacific Gas and Electric Co.
San Francisco, California

Plot Plan (2 of 5)

R700 / R707 Pipeline Project
Livermore, CA

TGE Project No.: T185 **Figure No.: 3**

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Legend

◐ Approximate Boring Location

Gas Transmission & Distribution
Pacific Gas and Electric Co.
San Francisco, California

Plot Plan (3 of 5)

R700 / R707 Pipeline Project
Livermore, CA

TGE Project No.: T185	**Figure No.: 4**

Reference: Google Earth PRO

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Legend

◐ Approximate Boring Location

Gas Transmission & Distribution
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San Francisco, California

Plot Plan (4 of 5)

R700 / R707 Pipeline Project
Livermore, CA

TGE Project No.: T185	**Figure No.: 5**

Reference: Google Earth PRO

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Legend

⊕ Approximate Boring Locations

Gas Transmission & Distribution
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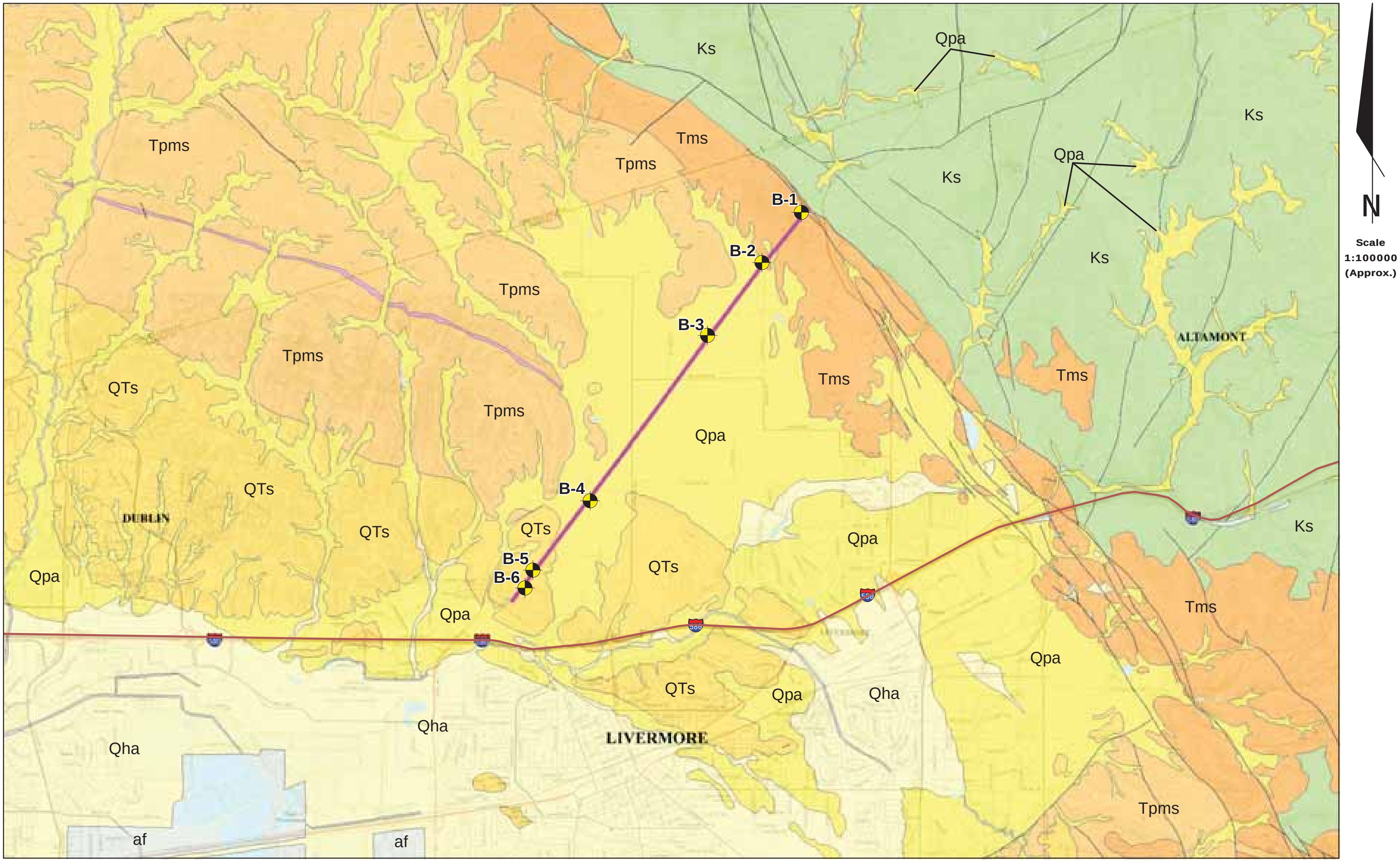
San Francisco, California

Plot Plan (5 of 5)

R700 / R707 Pipeline Project
Livermore, CA

TGE Project No.: T185	**Figure No.: 6**



Reference: USGS Scientific Investigations Map #2918, Geologic Map of the Alameda County

MAP UNITS

af	Artificial Fill	Qpa	Alluvium (Pleistocene)
Qha	Alluvium (Holocene)	QTs	Sediments (early Pleistocene and (or) Pliocene)
Tpms	Sedimentary rocks (Pliocene early Miocene)	Tpmv	Volcanic rocks (Pliocene early Miocene)
Tms	Sedimentary rocks Miocene	Ks	Great Valley complex sedimentary rocks (Cretaceous)

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Legend

- ⊕ Approximate Boring Locations
- ▬ R-700 / R-707 Alignment

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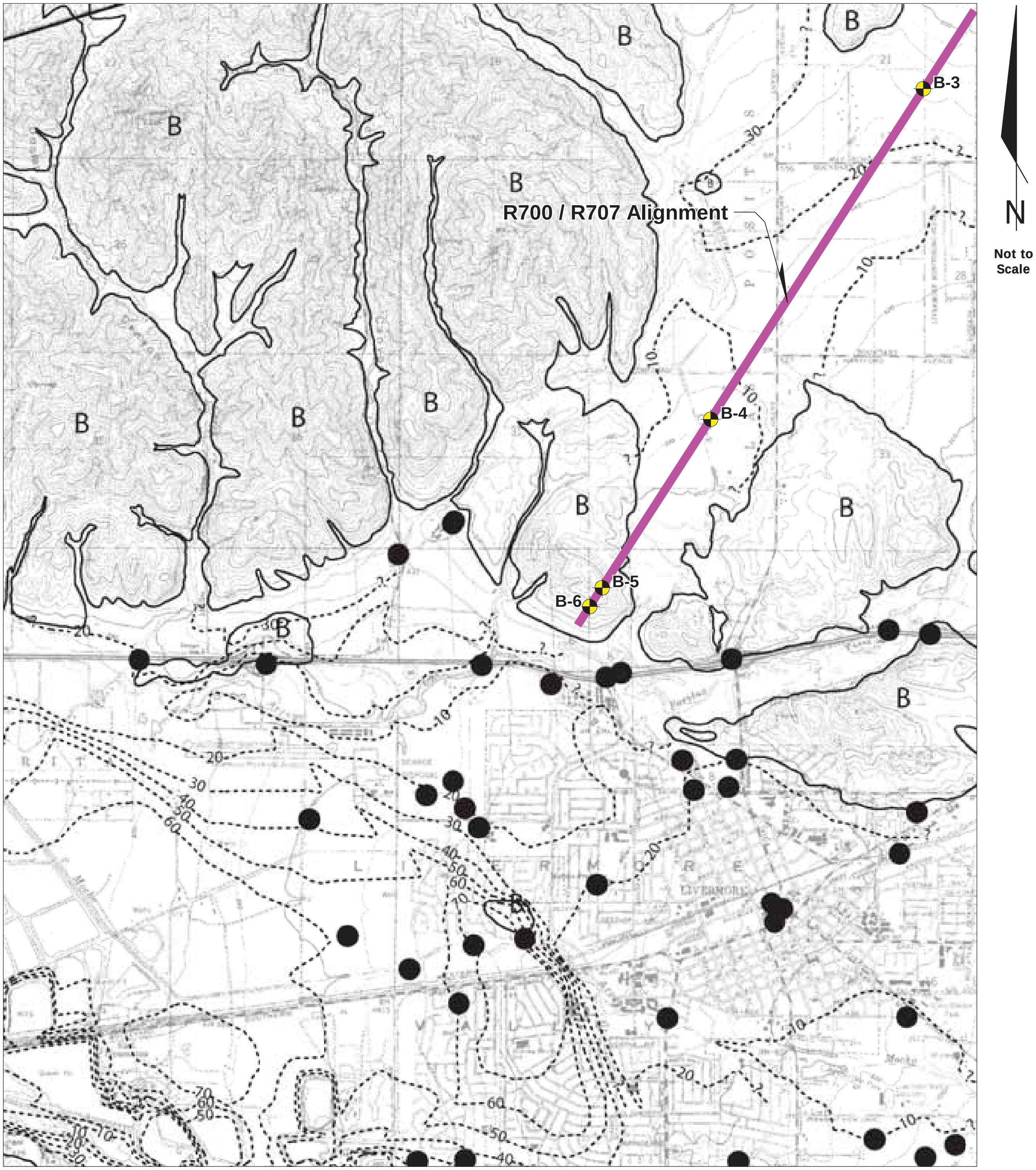
Regional Geology Map

R700 / R707 Pipeline Project
Livermore, CA

TGE Project No.: T185 | **Figure No.: 7**



Reference: California Department of Conservation, Division of Mines and Geology, Seismic Hazard Zone Report, Livermore Quadrangle (2008)

Legend

● Historic Borehole Sites

30 Depth to Groundwater in Feet

⊕ Approximate Boring Locations (Note: Borings B-1 and B-2 are not within mapped historical groundwater zone)

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Historical High Groundwater Map

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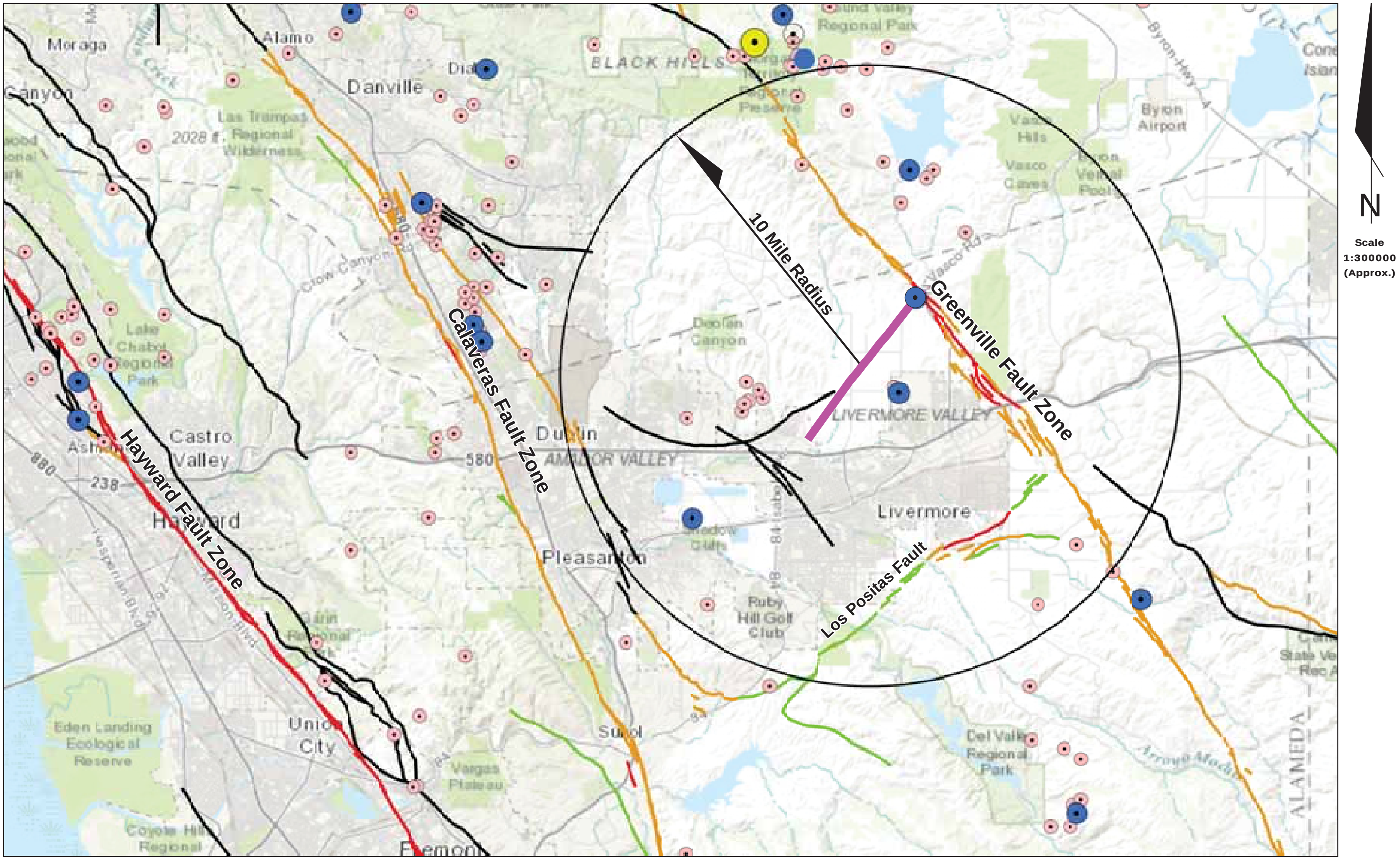
TGE Project No.: T185 **Figure No.: 8**



Reference: Esri; U.S. Geological Survey and California Geological Survey, 2006, Quaternary fold and fault database for the United States; USGS Earthquake Archives

Quaternary Faults - Faults are classified by age of last known movement.

Historic 🟥 <150 years ago   Holocene to Latest Pleistocene 🟧 <15,000 years ago   Late Quaternary 🟩 <130,000 years ago   Quaternary ⬛ >1.6 Ma

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Legend

▬ R-700 / R-707 Alignment

Earthquake Epicenter by Magnitude

● 3.0 - 3.9
● 4.0 - 4.9
● 5.0 - 5.9

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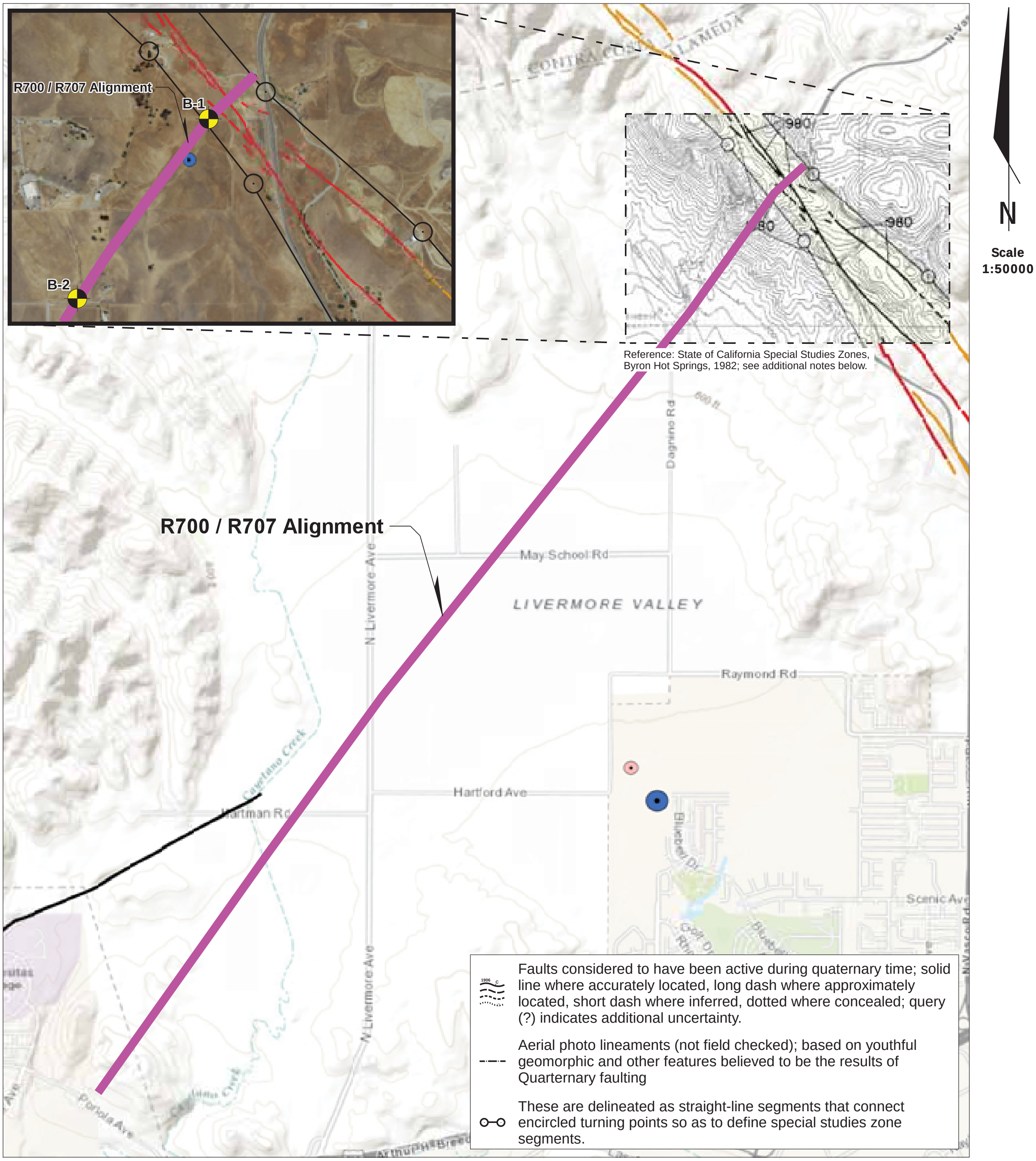
Regional Fault Map

R700 / R707 Pipeline Project
Livermore,CA

TGE Project No.: T185   **Figure No.: 9**



Faults considered to have been active during quaternary time; solid line where accurately located, long dash where approximately located, short dash where inferred, dotted where concealed; query (?) indicates additional uncertainty.

Aerial photo lineaments (not field checked); based on youthful geomorphic and other features believed to be the results of Quaternary faulting

These are delineated as straight-line segments that connect encircled turning points so as to define special studies zone segments.

Legend

- Approximate Boring Locations
- ● Earthquake Epicenter (Magnitude 4.0 - 4.9)
- ⊙ Earthquake Epicenter (Magnitude 3.0 - 3.9)
- R-700 / R-707 Alignment
- Historic Quaternary Fault (Last movement < 150 years ago)

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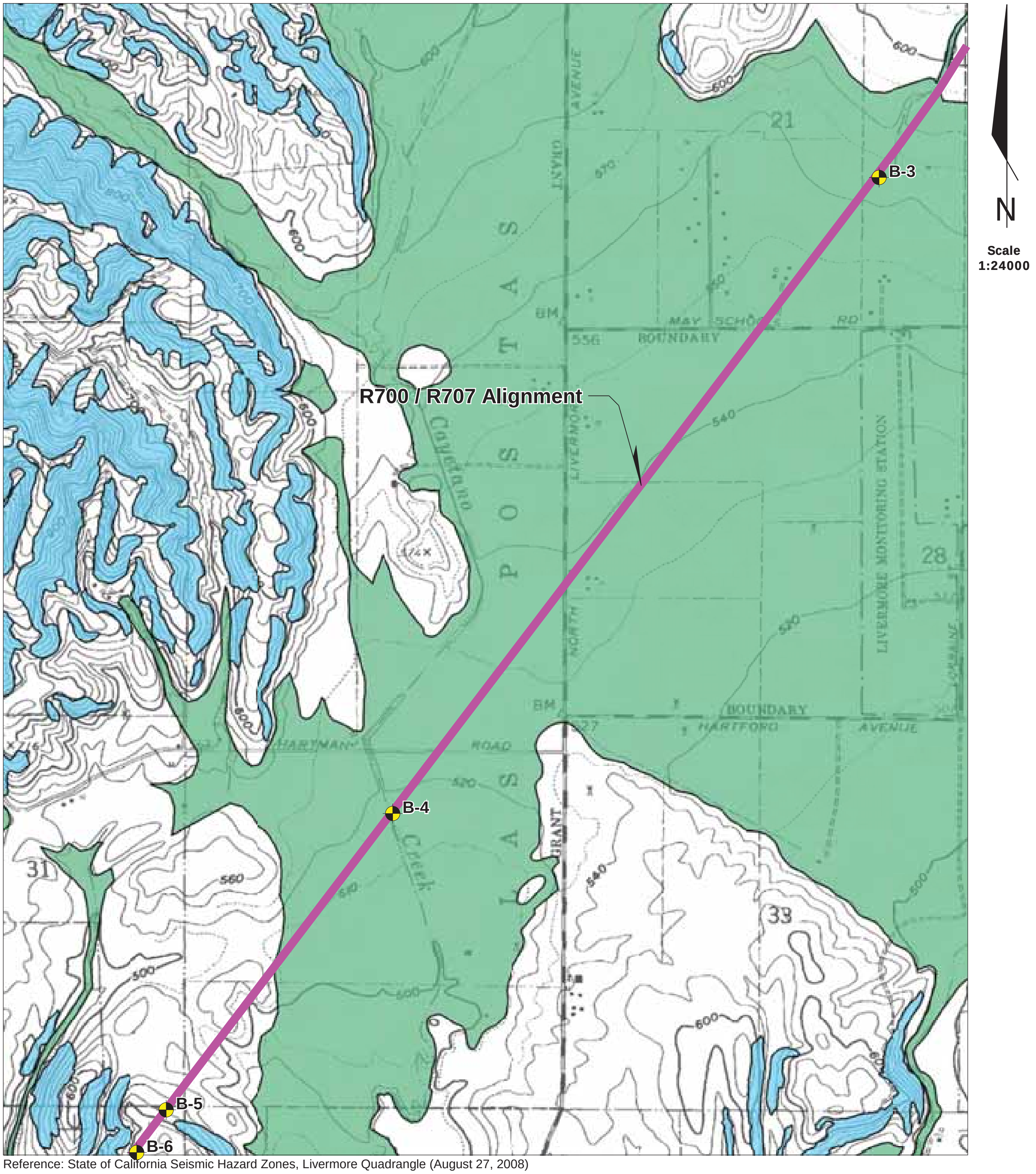
Earthquake Fault Zone Map

R700 / R707 Pipeline Project
Livermore, CA

TGE Project No.: T185 | **Figure No.: 10**



Reference: State of California Seismic Hazard Zones, Livermore Quadrangle (August 27, 2008)

Legend

🟩 Liquefaction - Areas where historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

🟦 Earthquake Induced Landslides - Areas where previous occurence of landslide movement, or local topographic, geological, geotechnical, and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

⊕ Approximate Boring Locations (Note: Borings B-1 and B-2 are not within mapped seismic hazard zones)

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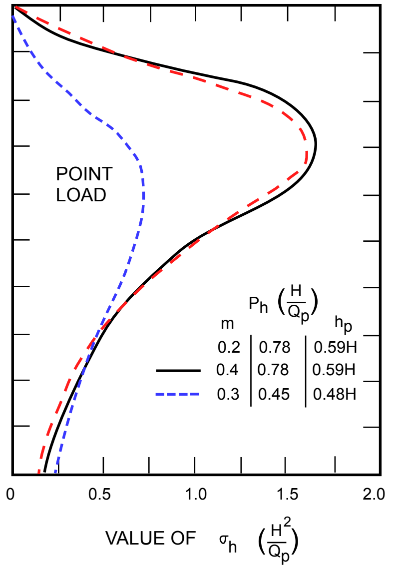
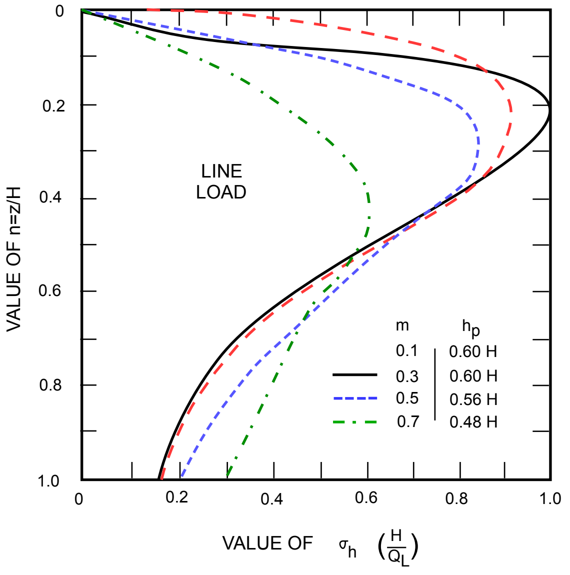
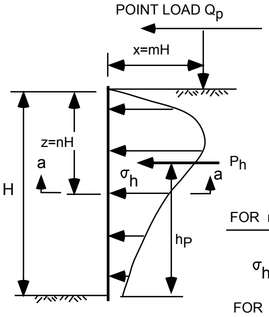
Seismic Hazard Zones Map

R700 / R707 Pipeline Project
Livermore, CA

TGE Project No.: T185 | **Figure No.: 11**







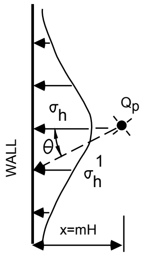
FOR m ≦ 0.4 :

$$\sigma_h\left(\frac{H^2}{Q_p}\right)=\frac{0.28\,n^2}{(0.16+n^2)^3}$$

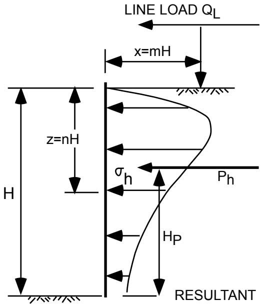
FOR m > 0.4 :

$$\sigma_h\left(\frac{H^2}{Q_p}\right)=\frac{1.77\,m^2\,n^2}{(m^2+n^2)^3}$$

$$\sigma_h{}^1 = \sigma_h \cos 2\,(1.1\,\theta)$$



SECTION a ~a
PRESSURE FROM POINT LOAD Q_p
(BOUSSINESQ EQUATION MODIFIED BY EXPERIMENT)



FOR m ≦ 0.4 :

$$\sigma_h\left(\frac{H}{Q_L}\right)=\frac{0.20\,n}{(0.16+n^2)^2}$$

$P_H=0.55\,Q_L$

FOR m > 0.4 :

$$\sigma_h\left(\frac{H}{Q_L}\right)=\frac{1.28\,m^2n}{(m^2+n^2)^2}$$

RESULTANT $P_H = \frac{0.64\,Q_L}{(m^2+1)}$

PRESSURE FROM LINE LOAD Q_L
(BOUSSINESQ EQUATION MODIFIED BY EXPERIMENT)

Reference: Navfac, DM 7.02, Chapter 3, Analysis of Walls and Retaining Structures, Figure 11, Horizontal Pressures on Rigid Wall from Surface Loads, pg. 7.2.74, September, 1986.

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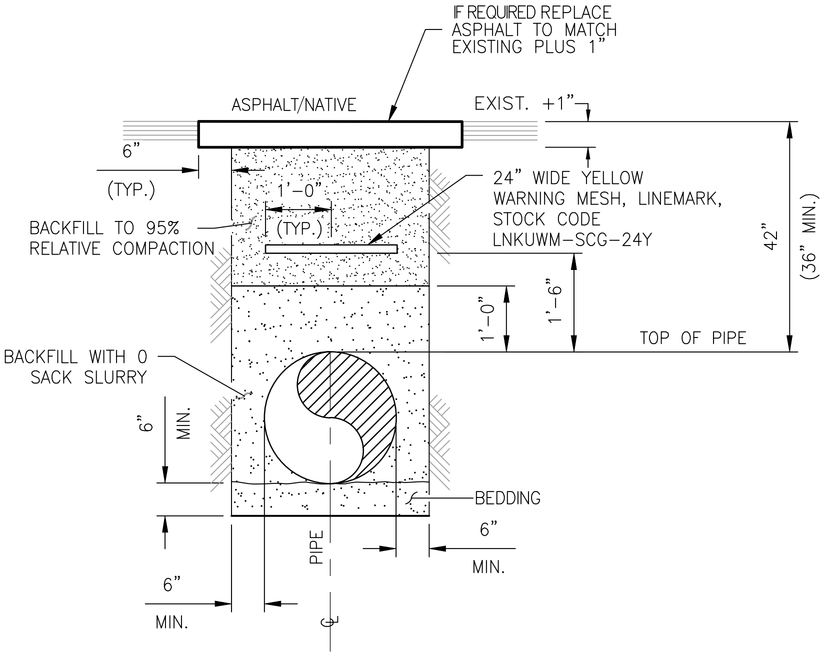
Lateral Surcharge Loads

R700 / R707 Pipeline Project
Livermore, CA

TGE Project No.: T185 | **Figure No.: 12**



TYPICAL TRENCH DETAIL FOR REPLACEMENT SEGMENTS

Notes: (1) 0 Sack slurry within the bedding and shading material should consist of free-draining sand with a minimum sand equivalent (SE) of 20

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Utility Trench Backfill

R700 / R707 Pipeline Project
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TGE Project No.: T185

Figure No.: 13

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APPENDIX A

Exploratory Boring Logs

FIELD TESTING AND SAMPLING

The Standard Penetration Test (SPT)

The SPT were performed in accordance with test method ASTM D 1586-99. The SPT sampler was typically driven into the ground 12 to 18-inches with a 140-pound hammer free falling from a height of 30-inches. Blow counts were recorded for every 6-inches of penetration. The N-values were determined for the SPT Sampler by taking the sum for the last two 6-inch intervals of the 18-inch sampler penetration. The split-barrel sampler has an external diameter of 2-inches and an unlined internal diameter of 1-3/8-inches. The samples of earth materials collected in the sampler were classified in the field, bagged, sealed and transported to the laboratory for testing.

The California Sampler (Ring)

The Ring sampler was driven into the ground in accordance with test method ASTM D 3550-84. The sampler, with an external diameter of 3.0-inches, was lined with 1-inch long, thin brass rings with inside diameters of approximately 2.4 inches. The sampler was driven into the ground 12 to 18-inches with a 140-pound hammer free falling from a height of 30-inches. Blow counts were recorded for every 6-inches of penetration. The N-values were estimated for the California Sampler by multiplying the sum of the blow counts for the last two 6-inch intervals of the 18-inch sampler penetration by a factor of 0.6 (Reference: Recommended Procedures for Implementation of DMG Special Publication 117 Guidelines for Analyzing and Mitigating Liquefaction in California, G.R. Martin and M. Lew, 1999). The samples were removed from the sample barrel in the brass rings, sealed and transported to the laboratory for testing.

Large Bulk Samples

Samples of representative earth materials over 20 pounds in weight were collected from the auger cuttings, placed in bags, sealed and transported to the laboratory for testing.

Small Bulk Samples

Samples less than 5-pounds in weight of representative earth materials were collected from the split spoon sampler, hand digging or exploratory cuttings. These samples were used for determining natural moisture content and classification indices.

LOG SYMBOLS:

■	Bulk/Bag sample
⧗	Modified California sampler (3 inch outside diameter)
☒	Standard penetration Split spoon sampler (2 inch outside diameter)
▯	Shelby tube
‖	Rock Core Drilling (2-inch diameter)
▼	Water level (level after completion)
▽	Water level (level where first encountered)

Abbreviations:

SA - (38% SAND analysis (percent passing #200 sieve)
WA - (38%) - One point grain size analysis (Percent passing #200 sieve)
PI - Plasticity index
LL - Liquid limit
DS - Direct shear test
'R' - R-value test
CORR - Corrosivity test
EI - UBC expansion index
LC - Laboratory compaction test

General Notes:

1. Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.
2. No warranty is provided as to the continuity of soil conditions between individual sample locations.
3. Logs represent general soil conditions observed at the point of exploration on the date indicated.
4. In general, unified soil classification designations presented on the logs were evaluated by visual methods only. Therefore, actual designations (based on laboratory tests) may vary.

Consistency criteria based on field tests

Granular Soils

Relative density	SPT* (# blows/ft)	Relative density (%)
Very Loose	<4	0 - 15
Loose	4 - 10	15 - 35
Medium Dense	10 - 30	35 - 65
Dense	30 - 50	65 - 85
Very dense	>50	85 - 100

Cohesive Soils

		Torvane	Pocket** penetrometer
Consistency	SPT (# blows/ft)	Undrained shear strength (tsf)	Unconfined compressive strength
Very soft	<2	<0.13	<0.25
Soft	2 - 4	0.13 - 0.25	0.25 - 0.5
Firm	4 - 8	0.25 - 0.5	0.5 - 1.0
Stiff	8 - 15	0.5 - 1.0	1.0 - 2.0
Very stiff	15 - 30	1.0 - 2.0	2.0 - 4.0
Hard	>30	>2.0	>4.0

* Number of blows of 140 pounds hammer falling 30 inches to drive a 2 inch O.D. (1 3/8" I.D.) split barrel samler (ASTM - D 1586-99 standard penetration test)

** Unconfined compressive strength in Tons/ft^2. Read from pocket penetrometer

Moisture content

Description	Field test
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

Cementation

Description	Field test
Weakly	Crumbles or breaks with handling or slight finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumble or break with finger pressure

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San Francisco, California

Log Legend

R700 / R707 Pipeline Project
Livermore, CA

TGE Project No.: T185 | **Figure No.: 2**

Boring Log B-1

Sheet 1 of 1

Date Drilled: 8/17/16

Logged By: CC

Exploratory Equipment: MARL M10 XLC

Approximate Surface Elevation: 1170 feet above MSL

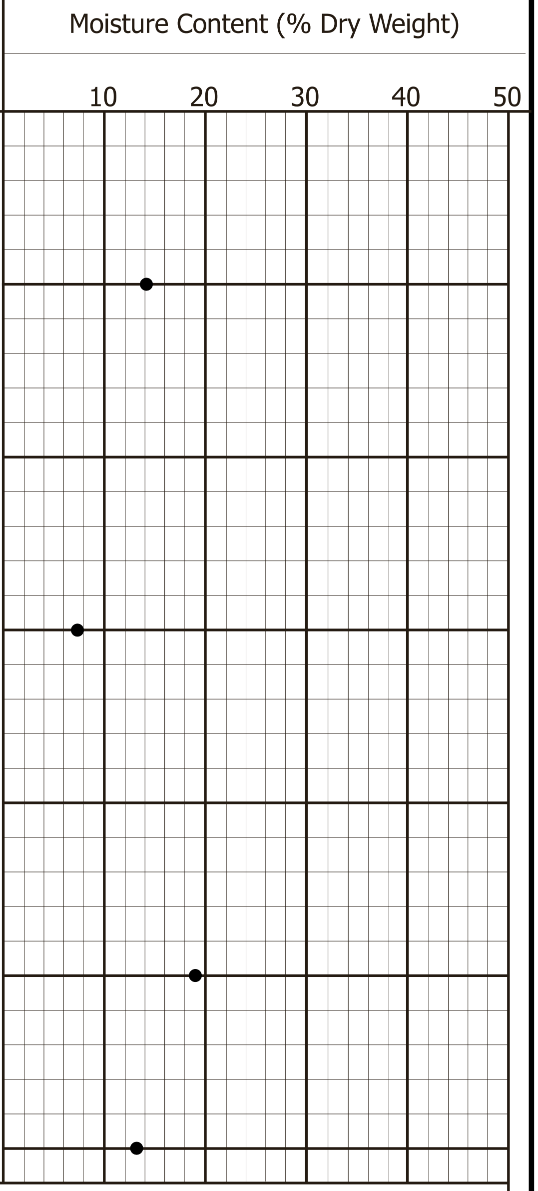
Driving Weight: 140 lb - 30" drop

Total Depth of Boring: 31.0 feet

Drilling Method: HSA 8" OD

Groundwater Elevation During Drilling: Not encountered

Depth in Feet	Driven Sample	Blow Counts	N value	Material Description	USCS	Color	Consistency	Moisture	Time (Min:Sec)	Dry Density (pcf)
				Miocene Sedimentary Rocks (Tms) - Completely weathered formation, silty SAND with rounded gravel	SM	Light Brown to Buff	Very Loose to Loose	Dry to Damp		
5		20 50/5"	50+	Well graded SAND with increasing amounts of rounded gravel, medium to coarse grained, trace of Fe_2O_3 staining	SW		Very Dense	Moist		105.4
10		50/4"	50+	No return						
15		46 50/3"	50+	Silty SAND, fine grained, moderate Fe_2O_3 staining	SM	Brown		Damp		104.7
20		50/4"	50+	No return						
25		50/5"	50+	Becomes more cemented, significant Fe_2O_3 staining				Moist to Very Moist		103.2
30		48 50/3"	50+							100.1
35										



End of boring at 31.0 feet

Note: 1. Groundwater not encountered.

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B-1

R700 / R707 Pipeline Project
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TGE Project No.: T185 | **Figure No.: 3**

Boring Log B-2

Sheet 1 of 1

Date Drilled: 8/17/16

Logged By: CC

Exploratory Equipment: MARL M10 XLC

Approximate Surface Elevation: 655 feet above MSL

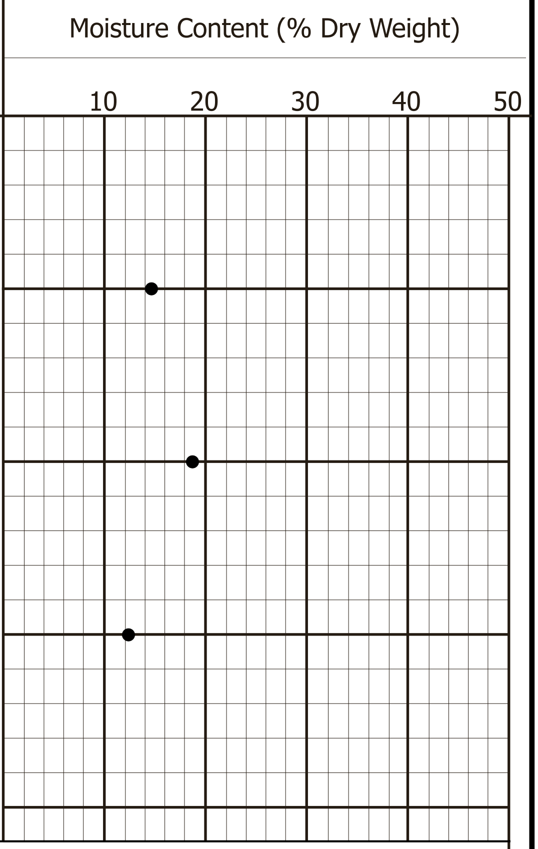
Driving Weight: 140 lb - 30" drop

Total Depth of Boring: 21.0 feet

Drilling Method: HSA 8" OD

Groundwater Elevation During Drilling: Not encountered

Depth in Feet	Driven Sample	Blow Counts	N value	Material Description	USCS	Color	Consistency	Moisture	Time (Min:Sec)	Dry Density (pcf)
				Topsoil - Clayey SILT	ML	Dark Brown	Firm to Stiff	Dry to Damp		
5		8 8 7	9					Moist to Very Moist		96.8
				Alluvium (Qpa) - Silty SAND with interbedded lenses of silt, fine to medium grained	SM	Light Brown	Medium Dense			
10		11 15 21	22							102.5
15		22 50/5"	50+	Sandy SILT with rounded gravel and trace of clay	ML		Hard			101.3
20		50/5" 50/2"		No return No return						
25										
30										
35										



End of boring at 21.0 feet

Notes:
1. Groundwater not encountered.
2. Refusal encountered at 21 feet BGS.

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B-2

R700 / R707 Pipeline Project
Livermore, CA

TGE Project No.: T185

Figure No.: 4

Boring Log B-3

Sheet 1 of 1

Date Drilled: 8/18/16

Logged By: CC

Exploratory Equipment: MARL M10 XLC

Approximate Surface Elevation: 570 feet above MSL

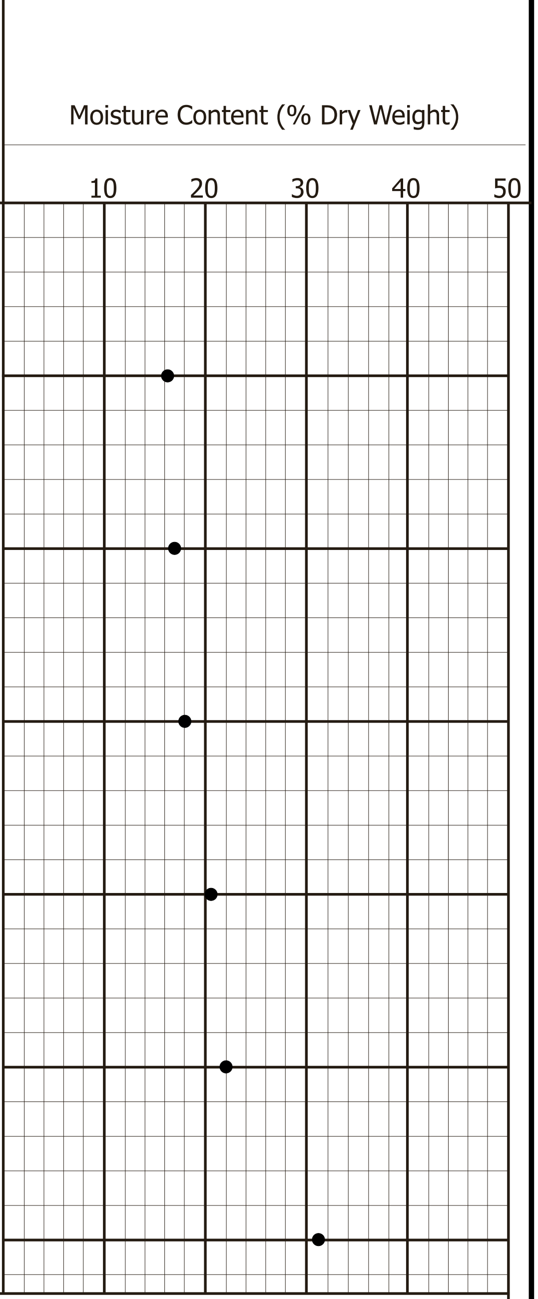
Driving Weight: 140 lb - 30" drop

Total Depth of Boring: 31.5 feet

Drilling Method: HSA 8" OD

Groundwater Elevation During Drilling: Not encountered

Depth in Feet	Driven Sample	Blow Counts	N value	Material Description	USCS	Color	Consistency	Moisture	Time (Min:Sec)	Dry Density (pcf)
	■			**Topsoil** - Sandy CLAY, fine to medium grained	CL	Dark Brown	Firm to Stiff	Dry to Damp		
5	⧗	16 14 17	19	Increase in clay content			Very Stiff	Moist to Very Moist		100.9
				Alluvium (Qpa) - Clayey SAND, fine grained, trace of roots	SC	Brown	Medium Dense			
10	⧗	9 10 15	15							98.2
15	⧗	10 15 15	18							107.6
20	⧗	16 21 17	23	Silty to poorly graded SAND, fine to coarse grained	SM/SP	White/ Very Light Brown	Medium Dense			104.6
25	⧗	12 20 23	26	Medium to coarse grained, trace of gravel and small cobble fragments		Light Brown				98.0
				Sandy SILT, fine grained, contains caliche deposits	ML	Grey	Very Stiff	Wet		
30	⧗	12 18 30	29							90.3
35										



End of boring at 31.5 feet

Note: 1. Groundwater not encountered; however, "Capillary Fringe" implied at about 29 feet based on laboratory test results.

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B-3

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TGE Project No.: T185

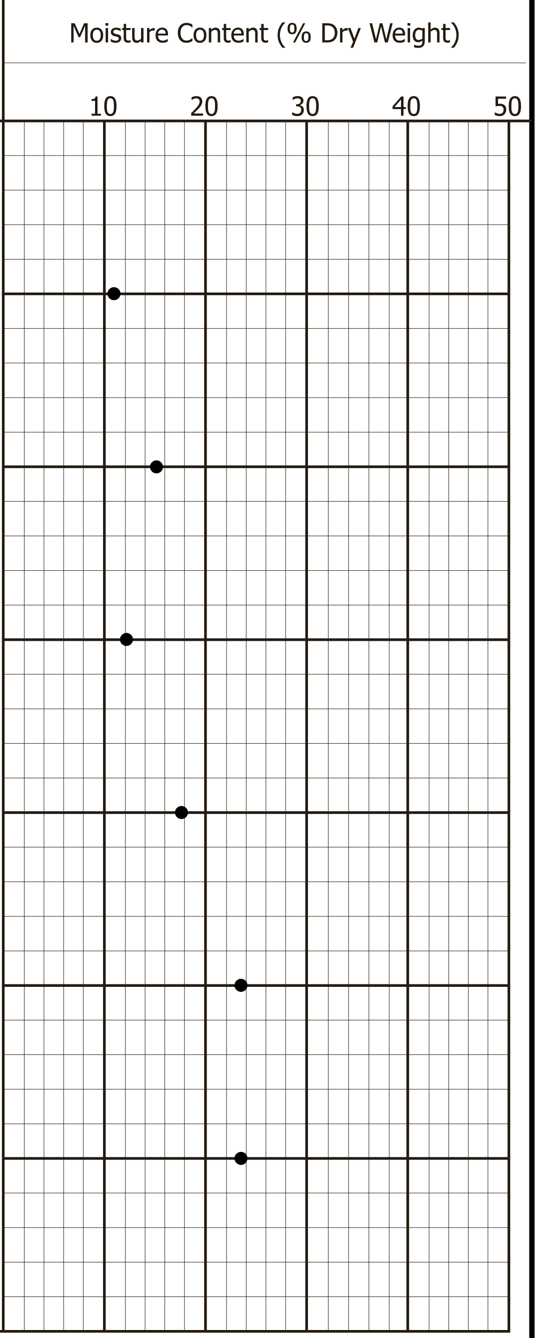
Figure No.: 5

Boring Log B-4

Sheet 1 of 2

Date Drilled: 8/17/16
Logged By: CC
Exploratory Equipment: MARL M10 XLC
Approximate Surface Elevation: 520 feet above MSL
Driving Weight: 140 lb - 30" drop
Total Depth of Boring: 51.5 feet
Drilling Method: HSA 8" OD
Groundwater Elevation During Drilling: 482 feet above MSL

Depth in Feet	Driven Sample	Blow Counts	N value	Material Description	USCS	Color	Consistency	Moisture	Time (Min:Sec)	Dry Density (pcf)
				Topsoil - Sandy/clayey SILT	ML	Dark Brown	Soft/ Firm	Dry		
							Very Stiff			
5		7 12 16	17	Few root structures						97.8
				Alluvium (Qpa) - Silty SAND, fine grained	SM		Medium Dense			
10		8 14 24	23	Sandy SILT, abundant root structures	ML	Light Brown to Brown	Very Stiff			97.7
15		11 10 15	15	Silty SAND with gravel, fine to coarse grained	SM		Medium Dense	Moist		108.5
20		7 15 25	24							108.0
								Very Moist		
25		9 11 19	18	Clayey/sandy SILT with gravel, slight Fe_2O_3 staining	ML		Very Stiff			99.2
30		8 16 24	24					Wet		102.5
35										



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B-4

R700 / R707 Pipeline Project
Livermore, CA

TGE Project No.: T185
Figure No.: 6

Boring Log B-4

Sheet 2 of 2

Date Drilled: 8/17/16

Logged By: CC

Exploratory Equipment: MARL M10 XLC

Approximate Surface Elevation: 520 feet above MSL

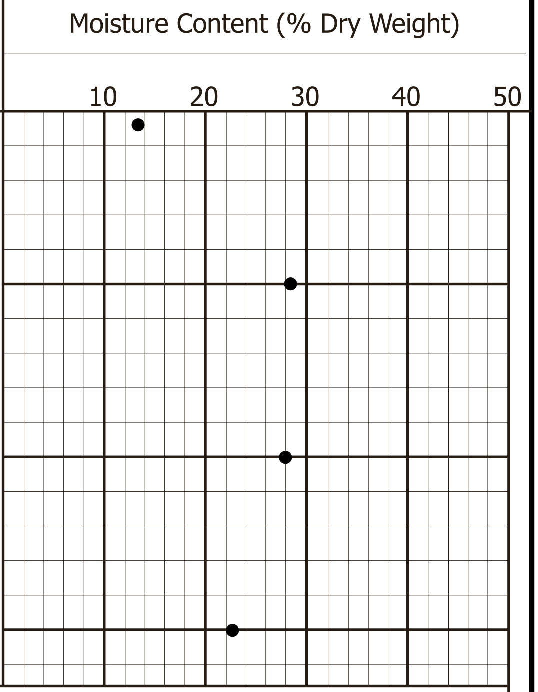
Driving Weight: 140 lb - 30" drop

Total Depth of Boring: 51.5 feet

Drilling Method: HSA 8" OD

Groundwater Elevation During Drilling: 482 feet above MSL

Depth in Feet	Driven Sample	Blow Counts	N value	Material Description	USCS	Color	Consistency	Moisture	Time (Min:Sec)	Dry Density (pcf)
35	⧗	11 23 42	50+	**Alluvium (Qpa, Cont.)** - Silty SAND with gravel, fine to coarse grained, multi-colored staining.	SM	Brown	Hard	Wet		114.4
				Groundwater encountered at ~38'				∇		
40	⧗	11 17 19	22	Silty CLAY, trace of caliche deposits	CL		Very Stiff			92.0
45	⧗	18 50/5"	50+				Hard			93.3
50	⧗	17 27 35	37	Becomes sandy CLAY						102.3
55										



End of Boring at 51.5 Feet

Note: 1. Groundwater encountered at 38 feet; however, “Capillary Fringe” implied at about 30-feet based on laboratory test results.

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R700 / R707 Pipeline Project
Livermore, CA

TGE Project No.: T185 | **Figure No.: 7**

Boring Log B-5

Sheet 1 of 1

Date Drilled: 8/18/16

Logged By: CC

Exploratory Equipment: MARL M10 XLC

Approximate Surface Elevation: 566 feet above MSL

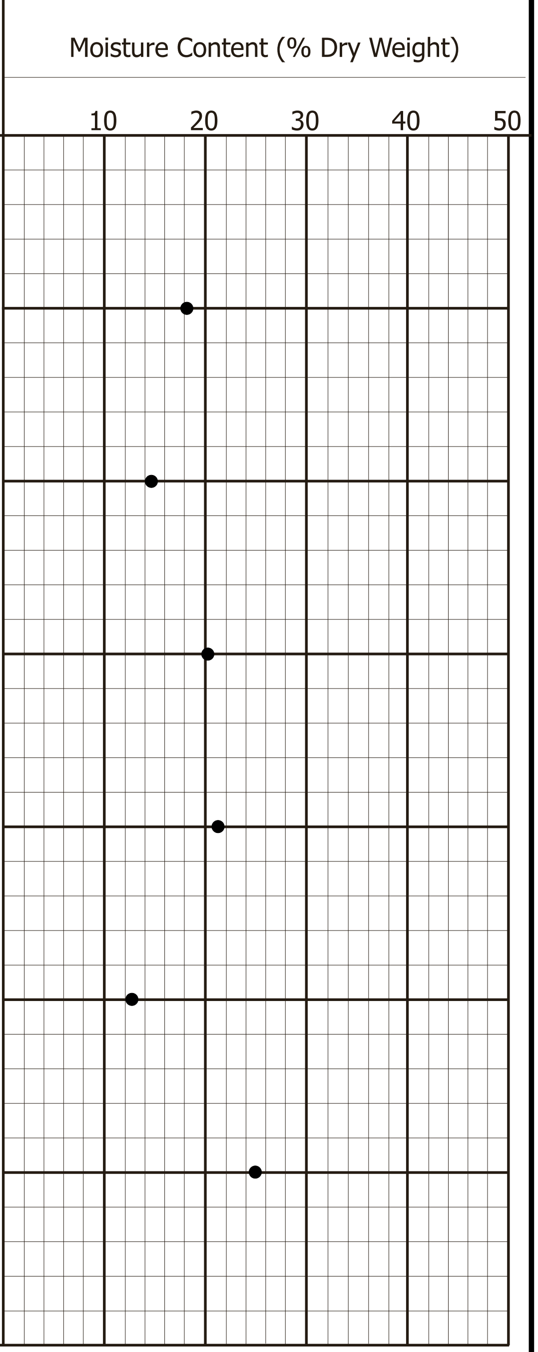
Driving Weight: 140 lb - 30" drop

Total Depth of Boring: 36.5 feet

Drilling Method: HSA 8" OD

Groundwater Elevation During Drilling: Not encountered

Depth in Feet	Driven Sample	Blow Counts	N value	Material Description	USCS	Color	Consistency	Moisture	Time (Min:Sec)	Dry Density (pcf)
				Topsoil - Silty CLAY, fine to medium grained	CL	Brown/ Grey	Loose	Dry		
5		6 10 11	13	**Colluvium (Qcol)** - Silty SAND, fine grained, occasional gravel sized caliche nodules, punky	SM	Light Brown to Buff	Medium Dense	Moist to Very Moist		88.0
10		19 26 35	37	Increase in silt content, few root structures			Dense			102.1
15		21 29 45	44	Abundant angular fine gravel sized chunks of gray siltstone/claystone and caliche						103.3
20		14 26 35	37	Trace of clay						92.1
				Alluvium - Early Pleistocene/Pliocene Sediments (Qts) - Sandstone, fine grained						
25		18 32 43	45							109.8
30		11 16 27	26	Increase in fines content			Medium Dense	Wet		100.3
35										



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B-5

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TGE Project No.: T185

Figure No.: 8

Boring Log B-5

Sheet 2 of 2

Date Drilled: 8/18/16

Logged By: CC

Exploratory Equipment: MARL M10 XLC

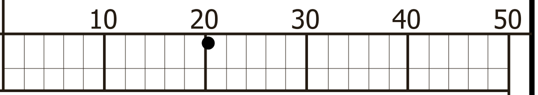
Approximate Surface Elevation: 566 feet above MSL

Driving Weight: 140 lb - 30" drop

Total Depth of Boring: 36.5 feet

Drilling Method: HSA 8" OD

Groundwater Elevation During Drilling: Not encountered

Depth in Feet	Driven Sample	Blow Counts	N value	Material Description	USCS	Color	Consistency	Moisture	Time (Min:Sec)	Dry Density (pcf)	Moisture Content (% Dry Weight)
35	⧗	16 25 50	45	**Alluvium - Early Pleistocene/Pliocene Sediments (Qts, Cont.)** - Sandstone, fine grained, some silt		Light Brown to Buff	Dense	Wet		105.9	
40											

End of Boring at 36.5 Feet

Note: 1. Groundwater not encountered; however, “Capillary Fringe” implied at about 30-feet based on laboratory test results.

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B-5

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TGE Project No.: T185

Figure No.: 9

Boring Log B-6

Sheet 1 of 1

Date Drilled: 8/18/16

Logged By: CC

Exploratory Equipment: MARL M10 XLC

Approximate Surface Elevation: 644 feet above MSL

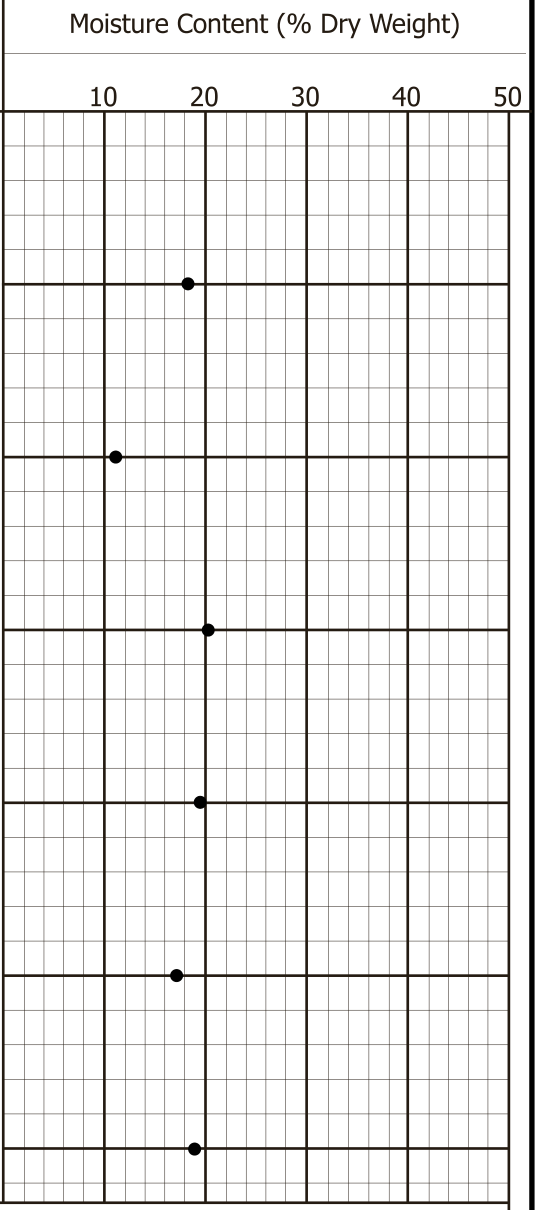
Driving Weight: 140 lb - 30" drop

Total Depth of Boring: 31.5 feet

Drilling Method: HSA 8" OD

Groundwater Elevation During Drilling: Not encountered

Depth in Feet	Driven Sample	Blow Counts	N value	Material Description	USCS	Color	Consistency	Moisture	Time (Min:Sec)	Dry Density (pcf)
				Topsoil - Sandy SILT, fine grained	ML	Brown/ Grey	Soft to Firm	Dry		
				Alluvium - Early Pleistocene/Pliocene Sediments (Qts) - Sandy SILT, fine grained	ML	Light Brown	Hard	Moist to Very Moist		
5		13 32 39	43							101.7
10		29 31 38	41	Some root structures and caliche veins		Brown				91.0
15		14 30 39	41							104.0
20		12 21 34	33	Becomes silty SAND with trace of clay	SM		Dense			104.0
25		15 28 39	40							102.2
30		18 23 41	38							107.5
35										



End of boring at 31.5 feet

Note: 1. Groundwater not encountered.

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B-6

R700 / R707 Pipeline Project
Livermore, CA

TGE Project No.: T185

Figure No.: 10

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APPENDIX B

Laboratory Test Results

Laboratory Test Results

In-Situ Moisture Content and Dry Density

The in-situ moisture content and dry density of the soils were determined in accordance with ASTM D-2216 and ASTM D-2937 laboratory test methods, respectively. The ASTM D-2216 method involves obtaining the moist weight of the sample and then drying the sample to obtain its dry weight, the moisture content is calculated by taking the difference between the wet and dry weights, dividing it by the dry weight of the sample and expressing the result as a percentage. Dry density is calculated by dividing the dry weight by the total volume expressed in pounds per cubic foot (Note: test performed on relatively undisturbed samples only). The results of the in-situ moisture content and dry density tests are presented in the table below and on *Appendix A, Exploratory Boring Logs*:

Table 1: Moisture Content and Dry Density Test Results (ASTM D-2216 & D-2937)

Location	Moisture Content (%)	Dry Density (pcf)
B-1 @ 5’	14.5	105.4
B-1 @ 15’	7.8	104.7
B-1 @ 25’	18.9	103.2
B-1 @ 30’	13.1	100.1
B-2 @ 5’	14.5	96.8
B-2 @ 10’	18.8	102.5
B-2 @ 15’	12.2	101.3
B-3 @ 5’	16.4	100.9
B-3 @ 10’	17.2	98.2
B-3 @ 15’	18.1	107.6
B-3 @ 20’	20.9	104.6
B-3 @ 25’	22.0	98.0
B-3 @ 30’	31.1	90.3
B-4 @ 5’	10.7	97.8
B-4 @ 10’	15.4	97.7
B-4 @ 15’	12.1	108.5
B-4 @ 20’	17.8	108.0
B-4 @ 25’	23.8	99.2
B-4 @ 30’	21.8	102.5
B-4 @ 35’	13.5	114.4
B-4 @ 40’	28.8	92.0
B-4 @ 45’	28.0	93.3
B-4 @ 50’	22.7	102.3
B-5 @ 5’	18.3	88.0
B-5 @ 10’	14.6	102.1
B-5 @ 15’	20.3	103.3
B-5 @ 20’	21.7	92.1
B-5 @ 25’	12.8	109.8
B-5 @ 30’	24.3	100.3
B-5 @ 35’	20.4	105.9
B-6 @ 5’	18.3	101.7
B-6 @ 10’	11.1	91.0
B-6 @ 15’	20.4	104.0
B-6 @ 20’	19.8	104.0
B-6 @ 25	17.5	102.2
B-6 @ 30’	19.3	107.5

Particle Size Analyses

In accordance with ASTM D-422, quantitative determinations of the distribution of coarse-grained particle sizes in selected samples were made. Mechanically actuated sieves were utilized for separating the various classes of coarse-grained (gravel and sand) particles. For soil samples containing fine-grained particle sizes, additional testing was conducted in accordance with ASTM D-1140 to determine the fines content (i.e., soil passing a No. 200 Sieve). The sieve analysis test results are provided in the tables below:

Table 2: Sieve Analysis Test Results (ASTM D-422 & D-1140)

Sieve Size	B-1 @ 1-5' Percent Passing	B-2 @ 1-5' Percent Passing	B-3 @ 1-5' Percent Passing	B-4 @ 1-5' Percent Passing	B-5 @ 1-5' Percent Passing	B-6 @ 1-5' Percent Passing
2 in	100	100	100	100	100	100
1 in	100	100	100	100	100	100
¾ in	100	100	100	100	100	100
½ in	100	100	100	100	100	97
$^3/_8$ in	100	100	100	100	100	97
¼ in	100	100	100	100	100	95
#4	99	99	100	100	100	95
#8	99	99	100	100	99	93
#10	98	98	100	100	99	92
#16	95	97	99	99	99	91
#30	79	92	97	98	98	87
#40	61	87	95	96	97	83
#50	45	80	91	81	95	78
#100	27	66	81	64	86	68
#200	18	56	74	62	75	59
Classification	SM	ML	CL	ML	CL	ML

Table 3: Percent Passing No. 200 Sieve (ASTM D-1140)

Location	Percent Passing No. 200 Sieve	Classification
B-4 @ 5'	47	SM
B-4 @ 10'	75	ML
B-4 @ 15'	35	SM
B-4 @ 20'	38	SM
B-4 @ 25'	70	ML
B-4 @ 30'	57	ML
B-4 @ 35'	31	SM
B-4 @ 40'	96	CL
B-4 @ 45'	90	CL
B-4 @ 50'	66	CL

Direct Shears

Direct shear tests were performed on relatively undisturbed samples in accordance with ASTM D-3080 to evaluate the shear strength characteristics of the in-situ materials. The test method consists of placing the soil sample in the direct shear device, applying a series of normal stresses, and then shearing the sample at a constant rate of shearing deformation. The shearing force and horizontal displacements are measured and recorded as the soil specimen is sheared. The shearing is continued well beyond the point of maximum stress until the stress reaches a constant or residual value. Final test results are presented in the table below:

Table 4: Direct Shear Test Results (ASTM D-3080)

Location	Apparent Cohesion (psf)	Friction Angle (degrees)
B-2 @ 10'	220	36
B-3 @ 10'	330	32
B-4 @ 10'	380	30
B-5 @ 10'	520	33
B-6 @ 10'	500	43

Expansion Index

Testing was performed on a representative on-site sample in in accordance with the referenced ASTM standard and 2013 California Building Code (Section 18503.5.3). Test results are provided in the table below:

Table 5: Expansion Index Test Results (ASTM D-4829)

Sample No.	Expansion Index	Expansion Potential
B-3	81	Medium

Corrosion Tests

Chemical analytical tests were performed on bulk soil samples collected during the field exploration program to evaluate the corrosion potential of the on-site materials. These tests were performed in accordance with California Test Method Nos. 417 (sulfate), 422 (chloride), and 643 (pH and resistivity). The results of the tests are summarized below:

Table 6: Corrosion Test Results (CTM Nos. 417, 422, & 643)

Location	Depth (feet)	pH	Resistivity (ohm-cm)	Chloride Content (ppm)	Sulfate Content (ppm)
B-1	1-5	6.5	5550	60	5
B-2	1-5	6.7	775	90	130
B-3	1-5	7.3	800	80	95
B-4	1-5	7.0	1100	80	80
B-5	1-5	7.2	770	90	120
B-6	1-5	7.5	1050	70	65

APPENDIX C

Liquefaction Analyses

Liquefaction Analyses

Given the conditions encountered in B-4, liquefaction and attendant settlement analyses using the subsurface data were performed with CivilTech software program “LiquefyPro” Version 5.8.

The LiquefyPro Version 5.8 software is based on the most recent publications of the NCEER Workshop. The calculation procedure involves four steps:

- Calculation of cyclic stress ratio (CSR, earthquake “load”) induced in the soil by an earthquake;
- Calculation of cyclic resistance ratio (CRR, soil “strength”) based on an in-situ test data from SPT or CPT tests;
- Evaluation of liquefaction potential by calculating the factor of safety against liquefaction, by dividing CRR by CSR; and
- Estimation of liquefaction-induced settlement.

The analyses also addressed the recommendations in Chapter 5 of “Recommended Procedures for Implementation of DMG Special Publication 117 Guidelines for Analyzing and Mitigating Liquefaction in California”, organized through the Southern California Earthquake Center, University of Southern California, 1999.

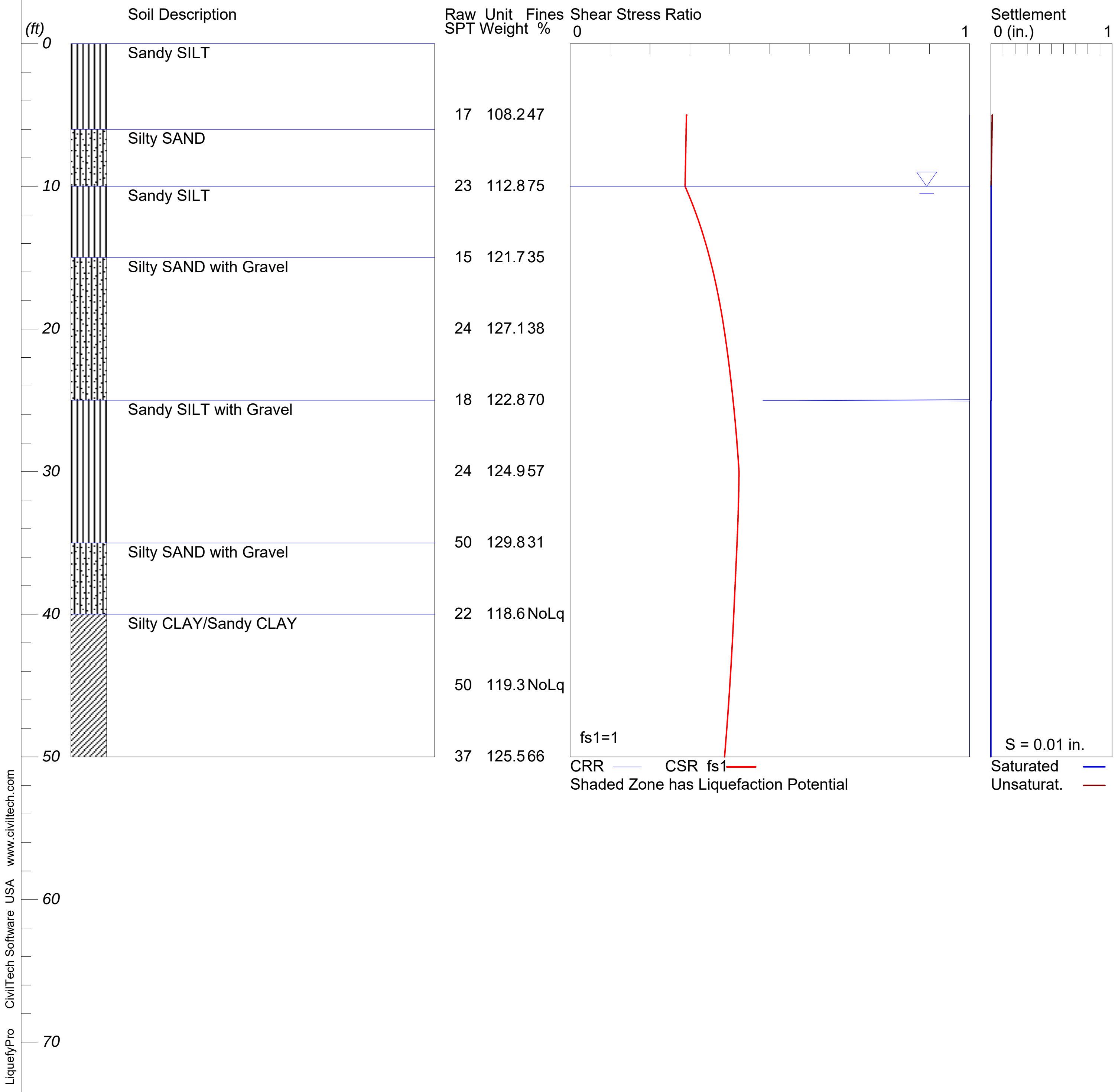
The analyses utilized an assumed high ground water level of 10 feet in depth for conservative analyses. The liquefaction analyses utilized an earthquake magnitude value of 7.5M and a peak ground acceleration of 0.45g, 0.58g, 0.77g derived from the California Geologic Survey (CGS) which has a program that calculates the ground motion for a 10, 5, and 2 percent, respectively, probability of exceedence in 50 years based on an average of several attenuation relationships. This analysis included the consideration of all potentially liquefiable untreated deposits for the post graded condition, and a safety factor of 1.3 to determine the liquefaction susceptibility. The liquefaction-settlement analyses utilized two separate methods for the wet settlement calculation (Ishihara/Yoshimine and Tokimatsu/Seed), as well as the Stark/Olson method for fines correction during liquefaction.

LIQUEFACTION ANALYSIS

R700 / R707 Pipeline Project

Hole No.=B-4   Water Depth=10 ft   Surface Elev.=520

Magnitude=7.5
Acceleration=.4534g



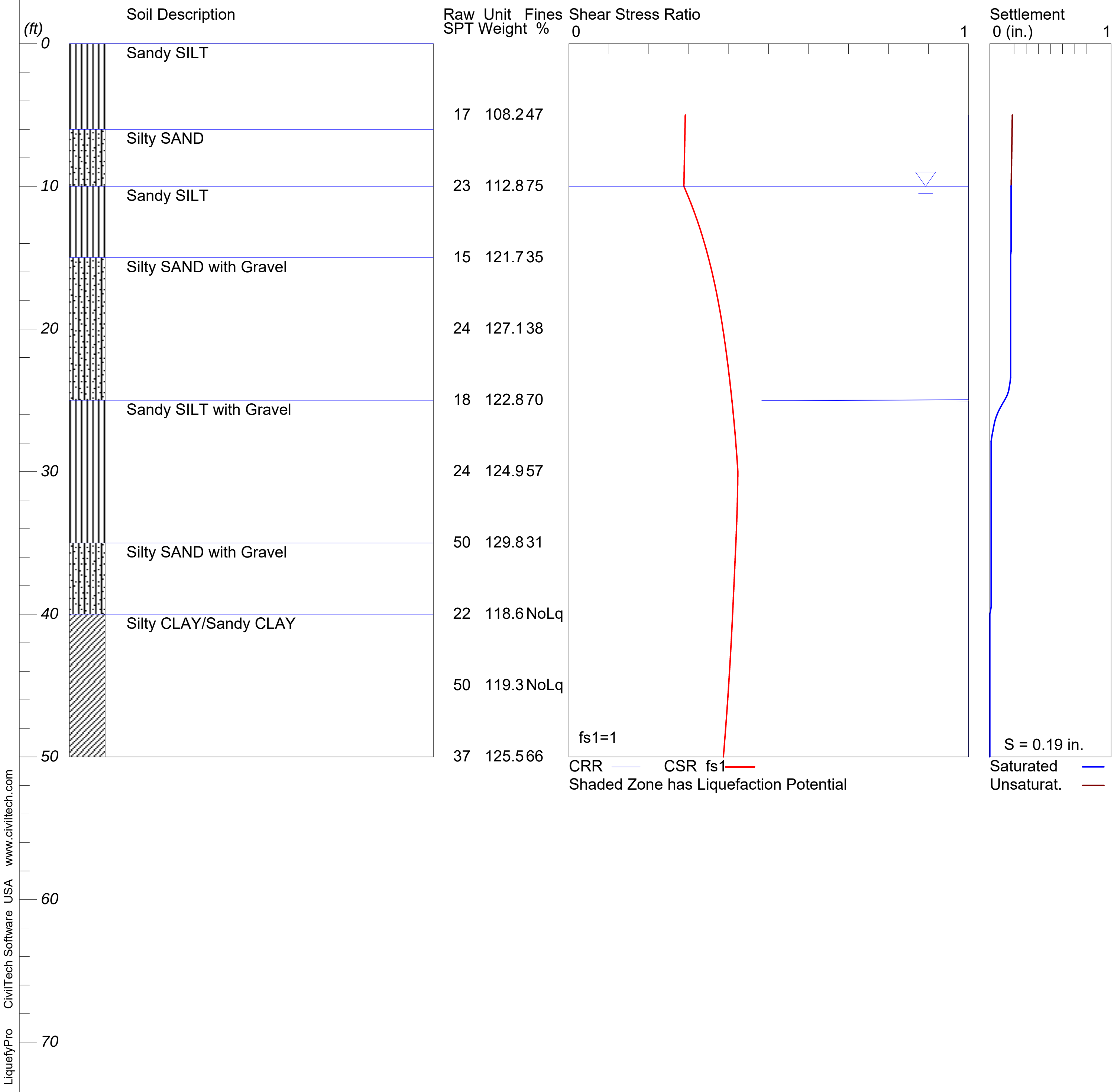
10% in 50 years (Ishihara/Yoshimine)

LIQUEFACTION ANALYSIS

R700 / R707 Pipeline Project

Hole No.=B-4 Water Depth=10 ft Surface Elev.=520

Magnitude=7.5
Acceleration=.4534g



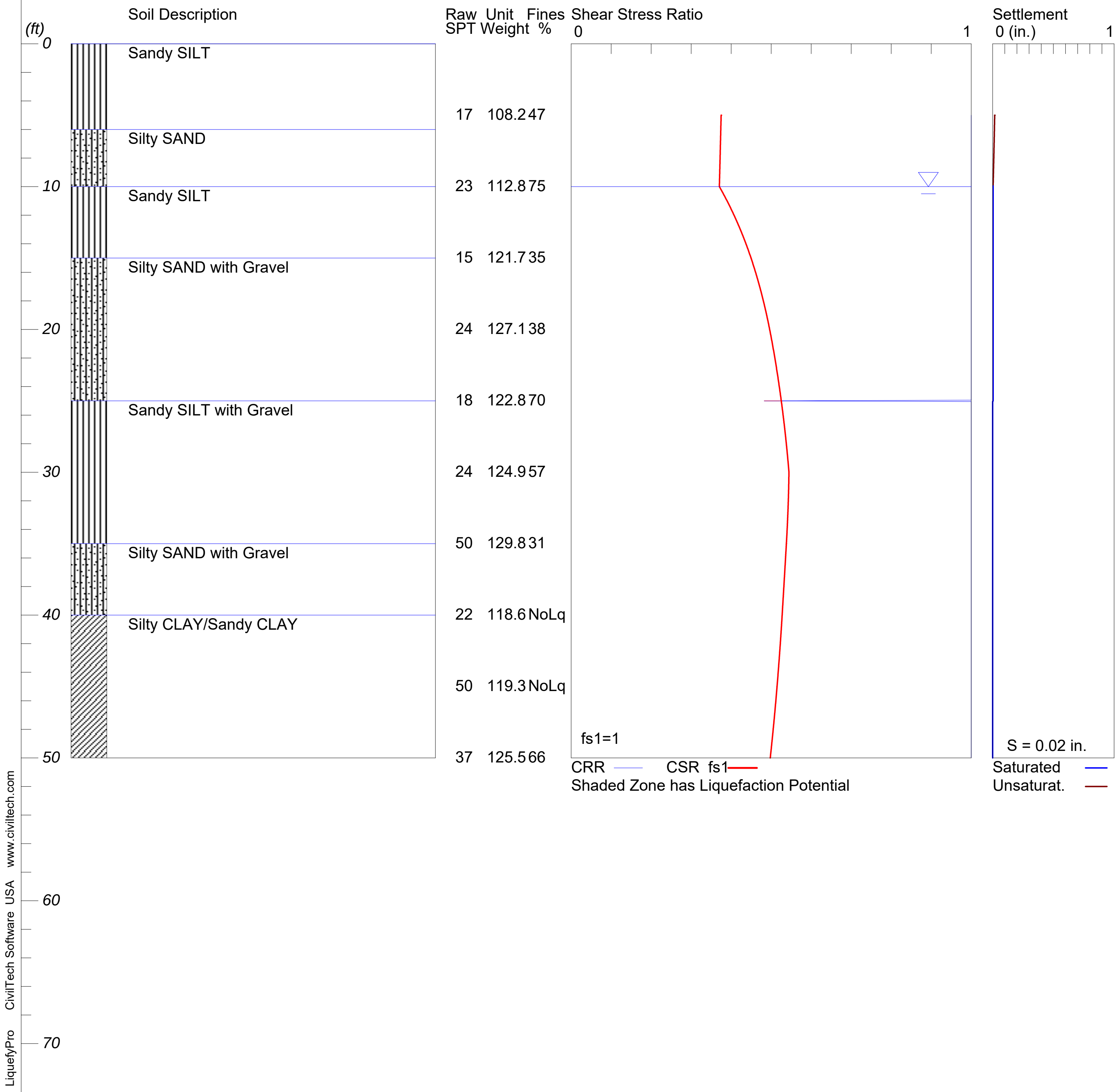
10% in 50 years (Tokimatsu/Seed)

LIQUEFACTION ANALYSIS

R700 / R707 Pipeline Project

Hole No.=B-4   Water Depth=10 ft   Surface Elev.=520

Magnitude=7.5
Acceleration=.5836g



TGE

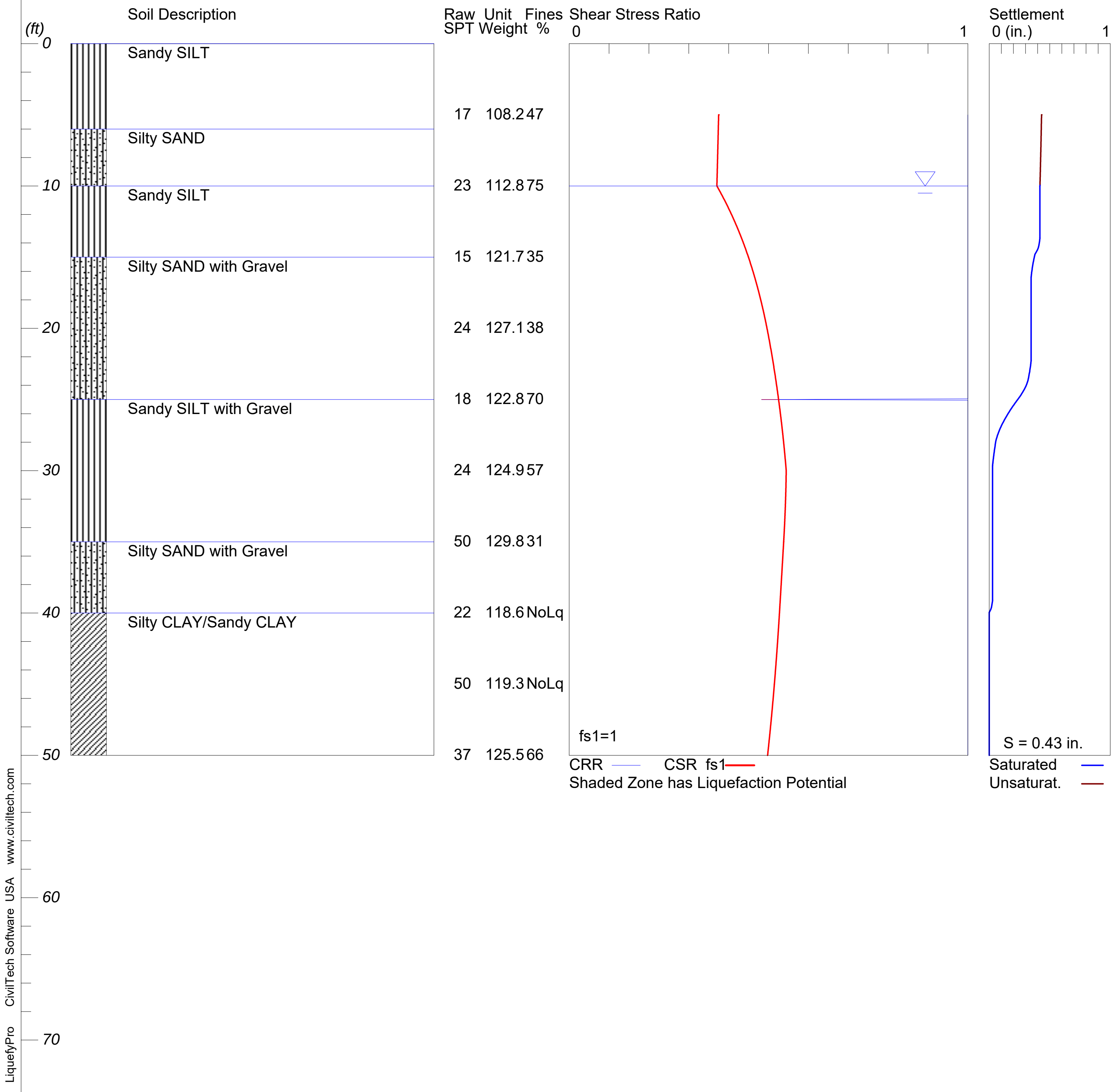
5% in 50 years (Ishihara/Yoshimine)

LIQUEFACTION ANALYSIS

R700 / R707 Pipeline Project

Hole No.=B-4 Water Depth=10 ft Surface Elev.=520

Magnitude=7.5
Acceleration=.5836g



TGE

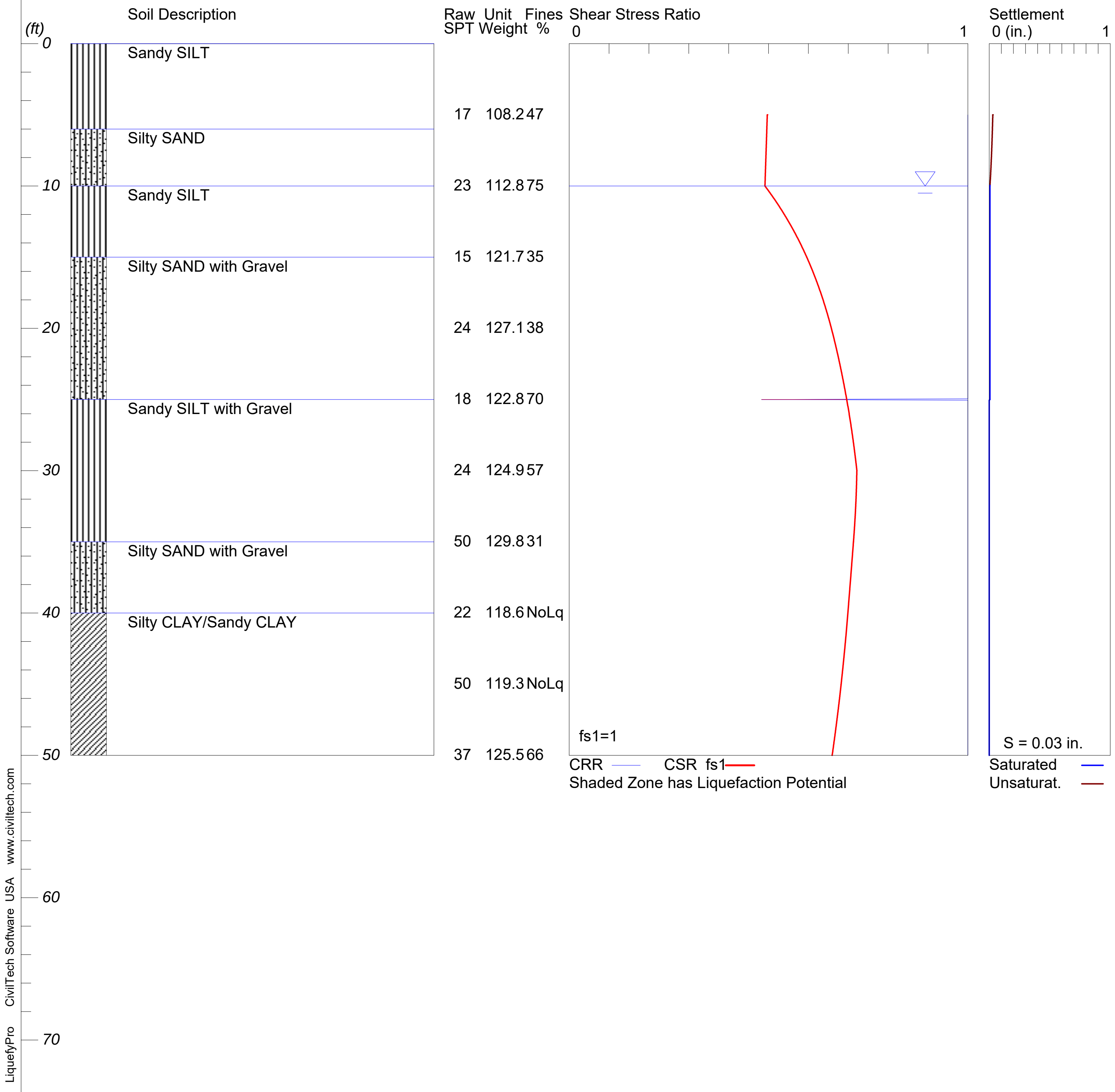
5% in 50 years (Tokimatsu/Seed)

LIQUEFACTION ANALYSIS

R700 / R707 Pipeline Project

Hole No.=B-4   Water Depth=10 ft   Surface Elev.=520

Magnitude=7.5
Acceleration=.7735g



TGE

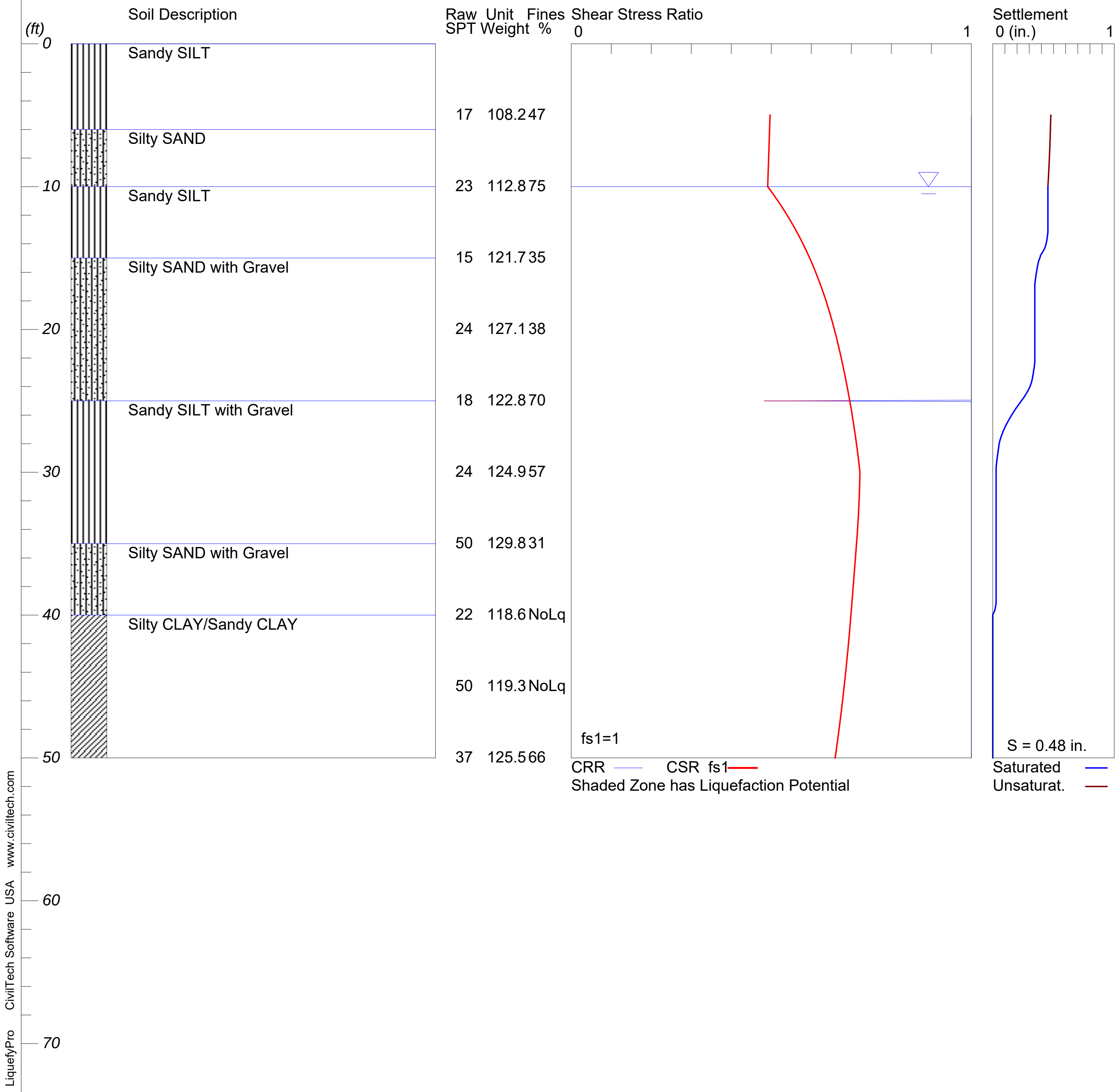
2% in 50 years (Ishihara/Yoshimine)

LIQUEFACTION ANALYSIS

R700 / R707 Pipeline Project

Hole No.=B-4 Water Depth=10 ft Surface Elev.=520

Magnitude=7.5
Acceleration=.7735g



2% in 50 years (Tokimatsu/Seed)

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APPENDIX D

ASFE Important Information About Your Geotechnical Engineering Report

Important Information About Your
Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

ASFE
The Best People on Earth

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Appendix F

Greenville Fault Geological Assessment

GREENVILLE FAULT
GEOLOGICAL ASSESSMENT

GREENVILLE FAULT GEOLOGICAL ASSESSMENT

PG&E Gas Transmission Lines 114, 131, and 303, Alameda County, California

Submitted To: Pacific Gas and Electric Company
6121 Bollinger Canyon Rd.
San Ramon, CA 94583

Submitted By: Golder Associates Inc.
1575 Treat Blvd, Suite 100
Walnut Creek, CA 94598

REV	DATE	ISSUED FOR	AUTHOR	CHK	APPV
A	11/02/16	Internal Review	***AH***	***CL***	***AH***
B	11/10/16	Client Review	***AH***	***CF/AH***	***CL***

Distribution:
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Golder Redmond – electronic copy
Golder Walnut Creek – electronic & file copy

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1.0 INTRODUCTION

This report presents the results of a geological assessment of the surface fault rupture hazard where Pacific Gas and Electric Company (PG&E) gas transmission pipelines 114, 131, and 303 (L-114, L-131, L-303) intersect strands of the Greenville fault (GF) in Alameda County, California (CA) (Figures 1 and 2). The geological assessment is primarily an office-based review of available geological data and tectonic geomorphic analysis. The assessment included a one-day field reconnaissance surrounding the GF pipeline crossing locations. The purposes and background of the PG&E fault crossing program are described further in the Summary Report.

2.0 GREENVILLE FAULT CROSSING WORK SCOPE

PG&E identified one location on L-114, one location on L-131, and two locations on L-303 where these three gas transmission lines cross the GF in Alameda County, CA (Figure 1). The GF and pipeline crossing locations are based on PG&E fault database version 9I and on the PG&E pipeline alignment from the PODS_Centerline as shown in Figure 1.

The purpose of this geological assessment is to assess the GF location, activity, width of faulting, and style of deformation (amount and sense of slip) based on available information from the area surrounding the L-114, L-131, and L-303 pipeline crossing locations. The four pipeline-GF crossings are located within about 550 ft (165 m) northwest (X00015, L-131-01) and southeast (X00013, L-114; X00026 and X00027, L-303) of North Vasco Road about 4 mi (6.5 km) north of its intersection and off-ramp with Interstate 580 near Livermore in Alameda County (Figure 2).

A range of geological, geomorphological, and seismological data were evaluated to estimate the potential for, and amount of, surface fault displacement at each GF pipeline crossing. These data were evaluated to estimate the potential for, and amount of, surface fault displacement at the pipeline-fault crossings. The surface fault displacement information will be used—as part of a separate engineering pipeline integrity assessment—to evaluate the capacity of the existing L-114, L-131, L-303 gas transmission pipelines to maintain pressure integrity following a future GF design-level fault displacement. Pipeline integrity modeling uses simplifying assumptions for the pipe's mechanical properties, geotechnical properties of the soils surrounding the existing buried pipe, and the pipe's response to the estimated GF design-level fault displacement.

Specific goals of this GF geological assessment are to:

- Identify and locate active and potentially active stands of the GF where they intersect the L-114, L-131, and L-303 buried transmission gas pipelines
- Estimate GF parameters such as average slip rate, active creep rate, sense of displacement, and coseismic rupture dimension of a large earthquake (defined as the maximum considered earthquake, or MCE)
- Incorporate the MCE fault displacement parameters and associated uncertainties into the standardized Deterministic Fault Displacement Hazard Analysis (DFDHA) procedures developed by PG&E (2015). These procedures are used to estimate the MCE surface displacement(s) to be considered for pipeline pressure integrity assessment
- Use the results of the DFDHA to provide median (50th percentile) and 84th percentile estimates of GF displacement at each pipeline crossing

The results of the DFDHA are used to model the displacement capacity of the pipe at the L-114, L-131, and L-303 pipeline crossings. Modeling results are used as input for the accompanying pipe stress analyses and pipeline integrity assessments in Attachment B1 of the Summary Report.

Individual tasks completed for this GF geological assessment were as follows:

- Compilation and desktop review of available geological maps, fault evaluation maps and reports, published geological research, and consultant reports that describe the nature and activity of the GF near the pipeline crossing locations
- Acquisition and review of available information on historical earthquakes and past surface-fault rupture for the GF
- Review of available geomorphic evidence for surface fault rupture based on historical aerial photographs and LiDAR topographic data
- Development of a geographic information systems (GIS) database of relevant data
- A one-day field reconnaissance of the GF at and surrounding the pipeline crossing locations
- Estimation of the following key GF parameters:
  - Fault location and width
  - Fault dip and strike
  - Fault zone complexity (i.e., multiple strands vs. a single strand)
  - Fault slip and creep rate (where applicable)
- Presentation of available data and initial interpretations of GF parameters and displacement amounts and uncertainties to PG&E through discussion of preliminary results and a joint workshop
- Preparation of a draft and a final GF geological assessment report

2.1 Methods of Investigation

The following sections provide additional detail on the activities undertaken for the GF geological assessment.

2.1.1 Available Geological Data

Golder Associates Inc. (Golder) reviewed existing formal and informal publications, maps, consultant reports, and government agency reports related to the location, activity, and geological setting of the GF, particularly its location in the northeastern Livermore Valley. For this assessment, Golder reviewed, and in places incorporated, fault parameters available from the US Geological Survey (USGS) *Quaternary Fault and Fold Database for the United States* (USGS 2006) and the fault database developed by the California Geological Survey (CGS 2001, 2010). Concurrently, Golder gathered and evaluated fault parameters estimated from peer-reviewed research articles published in academic journals, USGS and CGS open file reports,-and available consultant investigations of active faults commissioned as part of the approval process for local urban development.

The state of California recognizes the section of the GF in the eastern Livermore Valley as an active fault and designated it as an Earthquake Fault Zone (Figure 1 and 2). This designation was first established in 1971 under the Alquist-Priolo Earthquake Fault Zoning (AP) Act. The AP maps typically include mapped traces of the GF and define the limits of the Earthquake Fault Zone. AP maps are published as 7.5-minute quadrangle maps (scale 1:24,000). Five AP maps—Tassajara, Byron Hot Springs, Altamont, Cedar Mountain, and Eylar Mountain—cover the mapped extent of the GF and became effective on January 1, 1982.

The CGS published Fault Evaluation Reports (FERs) on a quadrangle-by-quadrangle basis to provide information on the locations of tectonic geomorphic features and evidence for the existence of the GF and its recency of faulting. The FERs are generally based on reviews of existing geological mapping, patterns of historical seismicity, historical aerial photograph interpretations, and field investigations. The L-114, L-131, and L-303 pipeline crossings are located within the Byron Hot Springs 7.5-minute quadrangle in Alameda County. FER 117 (Hart 1981a) provides information for the GF in the Byron Hot Springs quadrangle. CGS (2001, 2010) provide digital locations for GF traces from the 1982 AP maps for the Byron Hot Springs and Altamont quadrangles, respectively.

The AP Act requires that local agencies regulate most development projects, including land divisions and most structures for human occupancy, within a designated Earthquake Fault Zone. To permit these developments, an investigation must be conducted and documented in a Fault Investigation Report, also known as an “AP Report.” The AP Report is filed with the local government agencies and forwarded to the CGS (Bryant and Hart 2007). Many AP Reports include logs of fault investigation trenches that provide direct evidence for the presence or absence of active faults at specific locations. AP Reports provided to the CGS are available online up to 2000, and post-2000 reports can be obtained from the CGS or from local cities and counties (Table 1). Golder searched for AP Reports near the L-114, L-131, and L-303 GF crossing locations as part of this assessment’s compilation of available tectonic geomorphic and subsurface information on the location and character of the GF. However, no AP reports were identified within the immediate vicinity of the GF crossings.

Geospatial data developed from Golder’s review of existing reports, including the FER and results of the field reconnaissance, were incorporated into a GIS database developed for geomorphic analysis, data compilation, and presentation of information on the GF near the L-114, L-131, and L-303 pipeline crossing locations. Scanned or hardcopy maps available from multiple sources were georeferenced and incorporated into the GIS database, where applicable. In addition, a USGS expert on this section of the GF—James Lienkaemper—was contacted as part of this assessment (Table 1). He provided his unpublished fault trace mapping for the full length of the GF. Lienkaemper’s fault traces are based largely on interpretation of low-altitude aerial photographs, and in the area of the PG&E fault crossings, the post-earthquake fault traces mapped by Bonilla et al. (1980).

Table 1: List of Government and/or Local Experts Contacted for this Study

Contact Name/Purpose	Position at Agency/Company	Date	Correspondence Detail
Timothy Dawson/ Seek any post-2003 AP Reports surrounding pipeline crossing sites	Senior Engineering Geologist Seismic Hazards Assessment and Zonation Program at California Geological Survey (CGS)	8/10/2016	Golder contacted Mr. Dawson to request any new or updated AP Reports for the GF along the east side of the Livermore Valley and surrounding the pipeline crossings. Mr. Dawson confirmed that no new AP Reports had been filed, post-2001. He confirmed that pre-2003 reports (Golder has on file) are the most up-to-date AP Reports in the immediate vicinity of the GF pipeline crossings.
James J. Lienkaemper/Seek additional information on creep measurements on GF. Discuss results of his unpublished mapping	Senior Research Scientist, United States Geological Survey, Menlo Park, CA	07/26/2016 and 08/31/2016	Contacted Mr. Lienkaemper by phone (07/26/2016) and visited him at his office (08/31/2016). He noted that creep measured on GF was very episodic, and no detectable movements have occurred in the last 5 years or more. He provided a *.kml* file for his mapped GF trace. We reviewed aerial photographs and field maps prepared by Mr. Lienkaemper surrounding the pipeline crossings. The nature and lengths of named GF sections and total fault length estimates were reviewed. Mr. Lienkaemper confirmed that his three attempts at trenching GF traces had revealed no useful results, mostly because the vertisol soils and bioturbation had largely destroyed the near-surface stratigraphy.

Notes:
Golder = Golder Associates Inc.; AP Report = Alquist-Priolo Earthquake Fault Zoning Fault Investigation Report; GF = Greenville fault

In addition to the subject experts listed in Table 1, Dr. Jeff Unruh from Lettis Consultants International (LCI) has contributed to this geological assessment. Dr. Unruh undertook detailed studies of the GF (e.g., Sawyer and Unruh 2002, 2009; Unruh and Sawyer 1998) and has specialist knowledge of the fault location and activity, including past paleoseismic trenching investigations. Dr. Unruh's contribution to this geological assessment includes development of the work scope, participation in the field reconnaissance, and detailed review of this assessment report.

2.1.2 Interpretation of Aerial Photography

Golder also examined historical aerial photographs of the area surrounding the L-114, L-131, and L-303 pipeline crossing locations. Aerial photograph interpretation was used to evaluate the GF location(s) and to assess the presence or absence of tectonic geomorphic evidence for fault trace locations, and potential activity. Table 2 lists the aerial photographs and Google Earth™ imagery reviewed for this assessment. Stereoscopic aerial photographic pairs were used, where available. In addition to examining and interpreting aerial photographs, Golder also incorporated the aerial photograph interpretations completed by the CGS in the FER as reported in FER 117 (Hart 1981a) and Unruh and Sawyer (1998).

Table 2: Historical Aerial Photographs Reviewed

Run Number and Date	Photo Numbers (scale)
BUT-340, August 6, 1940	82, 83, 84 (1;20,000)
BUT-2GG, May 15, 1966	73,74 (1:20,000)
Google Earth™	Selected images from May 2002 to October 2015

2.1.3 Site Reconnaissance

Golder (Hull), LCI (Unruh), and PG&E (Madugo) staff inspected the area surrounding the L-114, L-131, and L-303 pipeline crossing locations on July 27, 2016. During field reconnaissance, the field team reviewed the existing mapped fault locations from the PG&E fault database v9I surrounding the L-114, L-131, and L-303 pipeline crossing locations. Evidence for active fault creep and the 1980 surface rupture (Bonilla et al. 1980) was sought, but not found. Fault trace inspection extended to about 1.5 mi (2.5 km) southeast of the pipeline crossing to review the locations and mapping of the fault trench investigations of Sawyer and Unruh (2002). The field team reviewed several tonal lineaments, linear drainages, scarps, and saddles, and a potential sag pond identified in existing fault maps. The field team also made field-based estimates of fault location uncertainty at the fault crossing locations. Subsurface investigations were not undertaken.

3.0 GREENVILLE FAULT

This section contains a description and summary of the geological and tectonic setting of the GF and the information available to define the locations of the GF surrounding the four L-114, L-131, and L-303 pipeline crossing locations indicated by PG&E in Alameda County. Also included is information on the width of the fault deformation zone, sense of slip, and amount of surface fault displacement and creep, including an assessment of the uncertainties associated with identifying the fault location.

3.1 Tectonic and Geological Setting

The GF is the easternmost right-lateral strike slip fault of the San Andreas Fault System that accommodates relative motion between the Pacific and North American plates in the San Francisco Bay Region (Figure 1). About 1.61 in/yr (41 mm/yr) of right-lateral (dextral) shear occurs across the San Andreas Fault System at the latitude of San Francisco Bay, representing about 75% to 80% of the total present-day relative plate motion (e.g., Bennett et al. 2003; Hammond and Thatcher 2007). Geological, geodetic, and seismic studies indicate that most of the dextral shear is accommodated on three subparallel strike-slip fault zones: approximately 0.98 in/yr (25 mm/yr) on the San Andreas fault, approximately 0.31 to 0.39 in/yr (8 to 15 mm/yr) on the combined Calaveras and Hayward-Rodgers Creek-Healdsburg fault zones, and about 0.08 to 0.2 in/yr (2 to 5 mm/yr) on the Concord-Green Valley-Bartlett Springs fault zones (Schwartz et al. 2014; WGCEP 2003). Other mapped faults such as the GF (Figure 1) accommodate additional right-lateral motion in this part of coastal California.

Analysis of focal plane mechanisms in the eastern San Francisco Bay area by Unruh and Lettis (1998) showed that principal crustal strain east of the Hayward fault is rotated clockwise relative to the Oakland-San Francisco area. Unruh and Lettis (1998) argue that the GF, Calaveras fault, and Concord fault strike more northerly than faults farther west, and progressively transfer slip from the western edge of the Central Valley to the west through a series of restraining left stepovers. For example, their model argues that the GF transfers slip to the Concord fault in a restraining left-step across Mount Diablo anticline (Unruh and Sawyer 1998).

The GF comprises a series of northwest-striking, discontinuous fault traces between the Mount Diablo anticline and Livermore Valley in the northwest, and within the northern Diablo Range as far southeast as the eastern parts of Henry Coe State Park (Figures 1 and 2). Cotton (1972) and Wagner et al. (1990) mapped the geology and approximate locations of the GF within the Diablo Range southeast of the Livermore Valley, while Herd (1977) and Dibblee (1980a, 1980b, 1980c) mapped the geology surrounding the GF along the eastern side of the Livermore Valley (Figure 3A) and northwest onto the slopes of Mount Diablo (Figure 2). Hart (1981a, 1981b), Unruh and Sawyer (1998), and Lienkaemper (unpublished) mapped surface traces and other tectonic geomorphic features along the known length of the GF.

Average slip rate estimates for the GF are about 2 mm/yr in the vicinity of the PG&E pipeline crossings (e.g., Petersen et al. 1996; Unruh and Sawyer 1998). Estimates for aseismic fault creep in the vicinity of the PG&E pipeline crossings range from about 0.5 mm/yr to 2 mm/yr (Lienkaemper et al. 2013; Sweeney 1982; Wright et al. 1982). In general, estimates of long-term average fault slip rate agree with short-term aseismic fault creep, suggesting to Lienkaemper et al. (2013) that strain accumulates at a relatively low rate along the northern sections of the GF. Further details regarding estimates for long term average slip rate and creep rate are included in sections 4.1 and 4.2, respectively.

A series of earthquakes occurred near the GF in January of 1980 (Figure 2), with the two largest earthquakes occurring on January 24, 1980 (**M** 5.8) and January 27, 1980 (**M** 5.4) (Bolt et al. 1981, Field et al. 2013, Appendix K). Based on hypocenter data from Field et al. (2013, Appendix K), the January 1980 earthquake series occurred on the northwestern section of the GF and east of the trace of the Marsh Creek fault (Figure 2). Discontinuous surface fractures were mapped along a 4 mi (6.5 km) section of the northwestern GF as reported by Bonilla et al. (1980), California Division of Mines and Geology staff (CDMG Staff 1980), and Woodward-Clyde Consultants (1980). Ruptures occurred on some traces previously mapped by Herd (1977). Maximum observed surface displacements were about 1 in (25 mm) right-lateral and 2 in (50 mm) vertical. Apart from the 1980 surface fractures, the timing of past surface ruptures is unknown (Field et al. 2013, Appendix R; Sawyer and Unruh 2002).

3.2 Greenville Fault Geomorphology

Hart (1981a, Figures 5a to 5F) mapped about 34 mi (55 km) of the GF fault (from N37°20′30″ to N37°50′) as part of FER 117 that is the basis of the GF AP maps published in 1982. Fault traces shown in Figures 1 and 2 are from the PG&E fault database v9I, which generally correspond to those mapped by Hart (1981a). Fault traces mapped by Hart (1981a) built upon earlier fault mapping of the Altamont quadrangle by Herd (1977), and were based on aerial photograph interpretation and field reconnaissance of the central and northwestern sections of the GF. Hart (1981a) identified many tectonic geomorphic indicators of recent right-lateral and vertical fault displacement, such as sidehill benches and troughs; closed depressions; deflected, offset, and beheaded drainages; and tonal and vegetation lineaments (e.g., Figure 3B). Hart (1981a) did not map in detail the southern section of the GF within the Cedar Mountain and Eylar Mountain quadrangles. Fault traces mapped within these two quadrangles were based on aerial photograph interpretation only.

Hart (1981a, 1981b) divided the GF into six segments: Marsh Creek, Tassajara and Byron Hot Springs, Livermore Valley, Arroyo Seco, Corral Hollow, and Arroyo Mocho. These six segments were based largely on geographic location, although for some segments Hart (1981a) appears to define the segment based on a qualitative assessment of the variation in the mapped tectonic geomorphology. The segments were not specifically considered by Hart (1981a) to be individual coseismic rupture segments. The Tassajara and Byron Hot Springs segment, however, appear to be defined by the extent of surface ruptures observed following the January 1980 earthquakes (Bonilla et al. 1980; CDMG Staff 1980; Woodward-Clyde Consultants 1980). Hart (1981a) terminated the GF at about N37°47′30″ latitude, noting that his Marsh Creek segment appeared to be part of the Marsh Creek fault of Dibblee (1980c).

Unruh and Sawyer (1998) remapped the GF, and extended the GF farther south for a total fault length (from latitude N37°15′ to N37°50′) of about 45 mi (72 km). GF maps prepared by Unruh and Sawyer (1998) were based on their compilation of existing fault mapping (e.g., Hart 1981a, 1981b; Herd 1977), aerial photography and other imagery analysis, aerial reconnaissance, and field geomorphic mapping. Unruh and Sawyer (1998) revised the six GF segments of Hart (1981a, 1981b) to define four GF sections based on their differences in geomorphic and structural character. From southeast to northwest, the four sections are as follows:

- **Coyote Creek section**—The 6.8-mi-long (11 km) Coyote Creek section is the southernmost part of the mapped GF. The GF is poorly expressed geomorphically, and the fault location is based largely on the trace of the bedrock fault mapped by Cotton (1972). Unruh and Sawyer (1998) mapped a number of northeast-trending tonal and vegetation lineaments and aligned valleys along the eastern margin of Henry Coe State Park to define the southern extent of the GF.
- **San Antonio Valley section**—The 15-mi-long (24 km) San Antonio Valley section is a 1.3- to 1.9-mi-wide (2 to 3 km) zone of north-northeast- and north-northwest-trending tonal and vegetation lineaments and related tectonic geomorphic features that extend along and to the northwest of the GF bedrock trace mapped by Cotton (1972). Fault-related tectonic features along the San Antonio Valley include bedrock scarps, linear stream valleys, springs and drainage deflections, and possibly right-lateral offsets of bedrock ridges.
- **Arroyo Mocho section**—When compared to the two sections of the GF to the southeast, the Arroyo Mocho section has a higher number and density of well-expressed fault-related geomorphic features along its approximately 17 mi (27 km) length. Northwest-striking (N27°W) tectonic geomorphic features are located within a narrow (≤ 0.63 mi [1 km]) zone, and form a single, well-expressed fault trace near the northern end of the section southeast of the Livermore Valley (Figure 2). The presence of well-expressed tectonic geomorphic features such as linear drainages and troughs, sidehill benches, uphill facing scarps, and drainage deflections suggest evidence of recent (Holocene) surface rupture along this section of the GF.
- **Livermore section**—The northwest-striking (N27°W) Livermore section extends about 18.6 mi (30 km) northwest from north of Crane Ridge, where the fault splits into two splays, along the eastern margin of Livermore Valley, through the Altamont Hills, to terminate on the southeast flank the Diablo Anticline (Figures 1 and 2). The Livermore section of the GF comprises a zone of faulting about 0.3 to 0.6 mi (0.5 to 1 km) wide that is geomorphically well defined by scarps on bedrock and alluvial fans and has shutter and pressure ridges; deflected, offset, and beheaded drainages of linear drainages; hillside benches; and ponds and closed depressions.

Lienkaemper (unpublished) remapped the length of the GF based on interpretation of high- and low-altitude stereo aerial photographs, satellite imagery, and field observations. He compiled mapped fault traces into a digital database of recently active fault traces. As in the digital database for the recently active traces of the Hayward fault (e.g., Lienkaemper 2008), the GF mapped by Lienkaemper (unpublished) has quantitative assessments of fault location certainty (i.e., certain ±66 ft [20 m], certain ±131 ft [40 m], and “queried”). Also included in the GF database of Lienkaemper (unpublished) are the geomorphic features used to identify the fault at specific locations (i.e., closed depression, sidehill bench, scarp, linear trough).

3.3 Geology and Tectonic Geomorphology Surrounding the PG&E Pipeline Fault Crossings

The four pipeline crossings of the GF identified by PG&E in Alameda County are located at the northwest part of the GF Livermore section of Unruh and Sawyer (1998) (Figure 2). The geology and tectonic geomorphology surrounding the GF pipeline crossings is described further in the sections below. Figure 3A shows the geology as mapped by Dibblee (1980a, 1980b) within about 1.5 mi (2.5 km) of the four crossings of the L-114, L-131, and L-303 pipelines. Figure 3B shows the GF traces as mapped by Hart (1981b) in an area similar to that shown in Figure 3A. Figure 4 shows the GF surrounding the pipeline crossings area as mapped by Bonilla et al. (1980), Hart (1981a), Unruh and Sawyer (1998), and Lienkaemper (unpublished), and in the PG&E fault database v9I.

3.3.1 Geology

Huey (1948) first mapped and named the GF in the Livermore area, although he did not extend the fault to the southeast beyond the Livermore Valley. The GF mapped by Huey (1948) was part of the Riggs Canyon fault of Vickery (1925). Colburn (1961) divided the GF into several strands to the northwest of Livermore, where he considered it to be a part of his Mount Diablo complex. In his map of the Neogene geology of the Altamont quadrangle, Herd (1977) described the GF along the west side of the Altamont Hills as a zone of northwest-aligned valleys, scarps, and notches that suggested right-lateral offset along this section of the GF. Dibblee (1980a, 1980b, 1980c) mapped the geology of the Altamont, Byron Hot Springs, and Tassajara quadrangles (1:24,000 scale), respectively. Dibblee (1980a, 1980b) provide stratigraphic and structural information and the location of GF traces surrounding the pipeline crossings.

Figure 3A shows that the geology surrounding the GF near the pipeline crossings as mapped by Dibblee (1980a) in the Altamont quadrangle and Dibblee (1980b) in the Byron Hot Springs quadrangle. Southeast of the pipeline crossings, the GF is mapped by Herd (1977) and Dibblee (1980a) as a structure within the Neogene (Upper Miocene) marine sandstone and conglomerate of the Neroly Formation. The Neroly Formation was further subdivided by Dibblee (2006) into the Briones Formation, which is locally known as the Cierbo sandstone. The Cierbo sandstone that crops out within the pipeline crossings area is a distinctive light gray to tan, thinly bedded, and predominantly medium to coarse grained to pebbly arkosic and fossiliferous sandstone (Dibblee 2006).

For about 0.5 mi (800 m) southwest of the GF, beds of Cierbo sandstone dip steeply southwest or are vertical (Figure 3A). Farther from the fault, the Briones Formation rocks are folded into northwest-trending anticlines and synclines (Figure 2). Unruh and Sawyer (1997) argued that this folding west of the GF along the northwestern part of the Livermore section marks the beginning of a restraining left stepover where the dextral shear accommodated at the GF is transferred northwestward to the Concord fault (Figure 1, inset). Crustal strain is generally conserved within the stepover region and results in the growth of anticlines and synclines such as the Springtown Anticlines, Tassajara Anticline, and the Sycamore Valley Anticline on the southern flanks of Mount Diablo (Figure 2).

Northwest of North Vasco Road (Figure 2), the GF forms the contact between steeply dipping to vertical Neogene Briones Formation sedimentary rocks and moderately to steeply dipping and vertical, hard, light gray to light brown shale and fine sandstone rocks of the Mesozoic (Cretaceous) Panoche Formation (Figure 3A). Southwest of the GF, the Neogene rocks have a general northwest strike, while to the east of the GF, the Cretaceous rocks show a more westerly strike (Dibblee 1980b). Dibblee (1980a, 1980b) maps the GF as inferred along much of this section because there is limited outcrop of the Neogene and Cretaceous units to locate accurately any shear zone or other features that confirm the GF location.

The plane of the GF is not naturally exposed in the area surrounding the pipeline crossings. Paleoseismic investigations reported by Sawyer and Unruh (2002) near Laughlin Road (Figure 3B) about 1.6 mi (2.5 km) southeast of L-303 crossing X00027 document the nearest location to the pipeline crossings where the orientation of the near-surface GF fault plane. Sawyer and Unruh (2002) found a 10-ft-wide (3 m) zone of distributed faults and high-angle fractures in their fault-normal Trench 1 (Figure 3B). The east side of the fault zone was bounded by a steeply southwest-dipping (76°SW) to vertical, N46°W-striking fault plane that juxtaposed Cierbo sandstone and Holocene channel-fill alluvium. Well-developed slickensides within a fault gouge plunged 5°NW to confirm the predominately strike-slip sense of GF displacement. The west side of the fault zone was bounded by a N29°W-striking fault plane that dipped 73°NE. Slickensides plunged 2°NW.

3.3.2 Mapped Fault Traces

Golder's review of available data surrounding the four crossings of the pipelines L-114 (X00013), L-131 (X00015), and L-303 (X00026, X00027) indicates that the GF location, sense of displacement, and location uncertainty can be constrained with information from the following sources:

- Geological maps (e.g., Dibblee 1980a, 1980b; Herd 1977) and tectonic geomorphic mapping (e.g., Hart 1981a, 1981b; Lienkaemper unpublished; Sawyer and Unruh 2002; Unruh and Sawyer 1998) that provide estimates for the GF location, structural setting, and sense of slip
- Observations of surface deformation during and following the January 1980 earthquakes (Bonilla et al. 1980; CDMG Staff 1980; Woodward-Clyde Consultants 1980)
- Interpretation of aerial photographs and Google Earth imagery; the Northern California GeoEarthScope LiDAR hillshades; and LiDAR acquired by PG&E for the 2,000-ft-wide (610 m) swath either side of its gas transmission lines
- Observations and measurements made during the July 27, 2016, reconnaissance-level field study undertaken for this assessment

Figure 4 shows GF traces mapped by CGS (2010), Unruh and Sawyer (1998), and Lienkaemper (unpublished), and in the PG&E fault database v9I. Also indicated in Figure 4 are the three pipeline alignments (blue) and the crossing locations provided by PG&E (red). Figure 4 includes observations of fractures and other surface ground displacements (yellow traces with fracture numbers and summary notes) mapped by Bonilla et al. (1980) following the January 1980 earthquakes and aftershocks.

Review of the GF traces mapped by Hart (1981a) indicates that they are those included in CGS (2010). In general, the GF traces mapped by Hart (1981a) and CGS (2010) are the same as those within the PG&E fault database v9I. However, Hart (1981a) and CGS (2010) map several short traces that are not indicated as active fault traces within the PG&E fault database v9I, perhaps because these short traces were mapped by Hart (1981a) as "inferred." Fault traces mapped by Unruh and Sawyer (1998) are similar to those of Hart (1981a) in the areas surrounding the pipeline crossings, although Unruh and Sawyer (1998) map other features that may be related to the strike of sub-vertical beds of the Cierbo sandstone. The GF trace locations of Lienkaemper (unpublished) are similar to those of earlier workers, except directly northwest of present-day North Vasco Road between crossings X00013 and X00015 (Figure 4). In this area, Lienkaemper (unpublished) has the GF trace marked by the 1980 surface fractures.

The area surrounding the pipeline crossings is located within the region of surface fractures mapped following the January 1980 earthquakes. Figure 4 indicates the locations and summary observations reported by Bonilla et al. (1980). The features mapped in 1980 were discontinuous, left-steeping *en echelon* cracks, fractures in soil, cracks in the pavement of North Vasco Road (old), and fractures in the slopes directly northwest of North Vasco Road (Figure 4). Hart et al. (1980) note that some cracks were not observed three hours after the January 24 earthquake, but appeared by January 25 (local time), when they measured about 0.1 in (2 mm) of right-lateral slip. This cracking preceded the earthquake of January 26 (local time), which had an epicenter located southeast of the crossings in the eastern Livermore Valley (Field et al. 2013, Appendix K) (Figure 2). Hart et al. (1980) reported that most of the slip observed in early 1980 occurred incrementally or as creep following the earthquakes, and is probably mostly afterslip. Lienkaemper et al (2013) also argue that most of the observed GL slip in 1980 was afterslip based on analyses of trilateration measurments on the Green Net network about 4.5 mi (7 km) southeast of the 1980 observations (Figure 2) of Bonilla et al. (1980).

Figure 5 shows Golder's interpretation of the location and types of geomorphic features mapped directly to the northwest and southeast of the pipeline crossings on the 1940 aerial photograph BUT-34-83 (Table 2). Other aerial imagery was also reviewed (Table 2) to compile the interpretation of the tectonic geomorphology shown in Figure 5. Also shown are the approximate locations of the surface fractures mapped by Bonilla et al. (1980) and described in detail in Figure 4.

Northwest-trending linear drainages form well-expressed tectonic geomorphic indicators surrounding the pipeline crossings. The southeast-flowing, ephemeral linear drainages are best developed along the mapped western trace where they are nearly continuous between crossing X00015 (L-131) in the northwest and crossing X00027 (L-303) in the southeast. Sense-of-slip indicators were not observed along or associated with the mapped linear drainages. Dibblee (1980b) mapped the Cierbo sandstone as very steeply dipping to vertical in this area, so differential erosion of contrasting lithologies and/or a fault or gouge zones may create the linear drainages. In most cases, however, the linear drainages are close to the location of soil fractures mapped in 1980 (Bonilla et al. 1980), suggesting that these linear drainages represent active strands of the GF in this area.

The eastern trace is less well expressed and mapped for this assessment on the basis of a small northwest-trending mid-slope sidehill bench that extends either side of North Vasco Road (old). A northwest-trending linear drainage is located at the base of the slope south of North Vasco Road (old), but like the sidehill bench, it is not well expressed. This trace was mapped by Hart (1981a), Unruh and Sawyer (1998), and Lienkaemper (unpublished). The 1980 surface fracture locations are the best evidence for the location and activity of this trace of the GF.

Existing GF mapping, the 1980 surface fracture observations, and fault mapping undertaken for this assessment (Figure 5) indicate two active strands of the GF at the pipeline crossings. For this assessment, the western strand is interpreted to be the GF main strand and the eastern strand, a GF secondary strand (Figure 5). Key observations supporting this interpretation are as follows:

- The western strand has a reasonably well-expressed tectonic geomorphology characterized by northwest-trending linear drainages in the fault crossings area.
- The western strand has along-strike continuity to the northwest and southeast of the pipeline crossing areas (Hard 1981a; Unruh and Sawyer 1998). To the southeast, the linear drainages align with deflected drainages, a possible closed depression, scarps, and saddles mapped by Hart (1981a), Unruh and Sawyer (1998), and Lienkaemper (unpublished) (Figures 5 and 6)
- In 1980, the mapped surface fractures extended farther along strike along the western strand, although the amounts of displacement in 1980 are similar on both west and east traces in the pipeline crossing areas (Figure 3B)
- The eastern strand has a mapable length of only about 2,000 ft (600 m) before terminating to the northwest and becoming very poorly expressed to the southeast (Hart 1981a; Lienkaemper unpublished; Unruh and Sawyer 1998)
- Lienkaemper (unpublished) maps the eastern trace as “questionable” based on its surface expression, total length, and quality of surface ruptures observed in 1980 (Lienkaemper 2016, pers. comm.).

3.4 Greenville Fault Pipeline Crossings

In this section the GF at individual pipeline crossings is further described, including the evidence for the GF strand in the direct vicinity of the pipeline crossing and its location uncertainty. Figure 7 shows the locations and estimated width of the fault uncertainty zone. Also included in Figure 7 are summary information on fault trace observations made by the reconnaissance field team from July 2016. Uncertainty estimates are based on direct observations made at the crossing site during field reconnaissance (Figure 6) supported by analysis of aerial photographs and the estimates for the locations surface fractures and ground deformation mapped by Bonilla et al. (1980).

As is PG&E convention, each crossing is numbered based on the fault (GF), the pipeline (e.g., L-131) and a crossing number that increases from north to south with the direction of gas flow in the three pipelines considered in this assessment. The crossing numbers are in addition to the unique ID assigned by PG&E in its pipeline features list (Figures 3 to 6). For example, Unique ID crossing X00026 GF where L-303 crosses the GF is numbered as GF-303-01 where it crosses the GF secondary strand (Figure 7). South of GF-303-01 and in the direction of gas flow, crossing GF-303-02 is where L-303 crosses the main strand of the GF.

3.4.1 Greenville Fault Main Strand Pipeline Crossings

All three pipelines included in this assessment (i.e., L-114, L-131, and L-303) cross the main strand of the GF (Figure 7). Details of the location of the GF main strand and uncertainties in its location are described further in the subsections below. Pipeline crossings of the GF main and secondary strands by L-131, L-114, and L-303 are described from northwest to southeast.

3.4.1.1 GF-131-01

Crossing GF-131-01 is located about 50 ft (15 m) northwest of the northwestern edge of a 100-ft-high (33 m) benched road cut on the northwest side of present-day North Vasco Road (Figure 7). Based on a review of Google Earth imagery, excavation of the benched roadcut for the present alignment of North Vasco Road was in progress in March 2009 and complete by August 2009. Prior to 2009, the GF main strand was marked by a linear drainage that could be mapped to within about 350 ft (108 m) of GF-131-01 (Figures 5 and 6), although the 100-ft-long fracture #6 mapped by Bonilla et al. (1980) (Figure 4) extended northwest of this linear drainage to within about 70 ft (21 m) of GF-131-01.

Field reconnaissance in July 2016 found no evidence for the GF main strand or the 1980 post-earthquake fracture at or near crossing GF-131-01. However, review of the post-August 2009 Google Earth imagery reveals a strong tonal lineament within the benched roadcut that is interpreted to indicate the GF main strand location as shown in Figure 6A. The tonal lineament is probably caused by the juxtaposition of different units within the Cierbo sandstone of the Briones Formation. The tonal lineament extends to the northwest of the linear drainage, and both the tonal lineament and linear drainage likely indicate the general location of the GF main strand.

The tonal lineament can be confidently traced to within about 100 ft (33 m) of GF-131-01 where it is within about 30 ft (9 m) of the estimate of the location of the 1980 soil fracture #6 mapped by Bonilla et al. (1980) (Figure 4). By continuing the tonal lineament strike of N32°W to the L-131 alignment, it intersects L-131 about 30 ft (10 m) northeast of X00015 as mapped by PG&E. The northwest extension of the tonal lineament intersects L-131 about 45 ft (14 m) northeast of X00015. Similarly, if the 1980 fracture #5 mapped by Bonilla et al. (1980) to the northwest of L-131 is extended southeast along its N40°W trend, it intersects L-131 about 40 ft (12 m) southwest of X00015.

The location of GF-131-01 is based on projections of 1980 surface ruptures mapped northwest and southeast of L-131, and the northwest projection of a tonal lineament within the North Vasco Road (new) roadcut. Because the 1980 fractures generally align with the GF main strand and perhaps also the tonal lineament, then GF-131-01 has a location error of about ±50 ft (±15 m). However, the locations of the 1980 fractures have been digitized from a 1:24,000-scale paper map, so it is not certain that the fractures are corrected located and/or oriented. Golder suggests, therefore, that increasing the error estimate above to ±66 ft (20 m), as mapped by Lienkaemper (unpublished), provides a reasonable estimate for the GF-131-01 location uncertainty.

Review of the trend of the tonal lineament, 1980 fractures, and linear drainages either side of GF-131-01 shows a range from N27°W to N50°W. Closer to the pipeline the tonal lineament and 1980 fractures are oriented at about N35°W to N50°W. Based on these observations, the estimated strike of the GF in the vicinity of GF-131-01 is N40°W ±5°.

3.4.1.2 GF-114-02

The location of the GF main strand at GF-114-02 (X00013) is moderately well constrained. The area surrounding GF-114-02 has been substantially modified by engineering works associated with 2009 realignment of North Vasco Road and recent erosion control measures that appear to have been designed specifically to protect this part of L-114 (Figure 6). Information available to constrain the crossing comes from interpretation of aerial photographs (Figure 5) and the location of ridges and fractures of the North Vasco Road (old) pavement surface following the 1980 earthquakes (Figure 4).

Crossing GF-114-02 is located about 200 ft (61 m) northwest of the N30°W-trending 1980 fracture #12 measured on North Vasco Road (old) by Bonilla et al. (1980). There are now no obvious surface features to locate the GF main strand accurately to the southwest of fracture #12. Bonilla et al. (1980) show that fractures #10 and #11 trend at N27°W to N30°W and subparallel to a shallow, N47°W-trending, 330-ft-long (100 m) linear drainage about 600 ft (183 m) northwest of North Vasco Road. Projection of 1980 fracture

#11 trend (Figure 4) 190 ft (58 m) southeast results in the GF intersection of L-114 about 35 ft (10.6 m) northeast of X00013. Projecting the N30°W trend of fracture #12 190 ft (58 m) northwest results in a GF intersection with L-114 about 45 ft (13.8 m) southwest of X00013.

Based on the 1980 fracture projection measurements, GF-114-02 has a minimum location error of about ±50 ft (±15 m). As noted above, the locations of the 1980 fractures have been digitized from a 1:24,000-scale paper map, so it is not certain that the fractures are correctly located or oriented. Golder suggests, therefore, that increasing the error estimate above to ±66 ft (±20 m) provides a reasonable estimate of the GF-114-02 location uncertainty.

The trend of 1980 fractures and linear drainages either side of GF-114-02 shows a range from N27°W to N47°W, although the 1980 fractures were consistently mapped at a N30°W trend by Bonilla et al. (1980). Based on the trend of 1980 fractures either side of GF-114-02, the estimated strike of the GF is at N30°W ±2°.

3.4.1.3 GF-303-02

The location of the GF main strand trace at GF-303-02 is not well constrained. The nearest 1980 soil fracture #12 measurement is about 460 ft (140 m) to the northwest where fractures were measured in North Vasco Road (old). Southeast of North Vasco Road (old), there are no clear tectonic geomorphic features to locate the GF main strand trace other than a linear, N35°W-trending linear drainage that forms an approximately 180-ft-wide (55 m) valley. Field measurements indicate that the fault could be located anywhere between the margins of the linear channel to the southwest and the break in slope to the northeast—a distance of about 150 ft (46 m). Crossing GF-303-02 is located near the middle of the small linear valley, andt the GF main strand location uncertainty at crossing GF-303-02 is estimated at ±75 ft (±23 m). This is slightly higher than the ±66 ft (±20 m) location uncertainty estimate of Lienkaemper (unpublished).

The trend of 1980 fracture #12 to the northwest of GF-303-02 is N30°W (Bonilla et al. 1980), and the linear drainage and valley trend about N35°W. Hart (1981a) and Lienkaemper (unpublished) both map the GF main trace at this location with a N40°W strike. Based on the trend of 1980 fractures to the northwest and the mapping of either side of GF-114-02 by Hart (1981a) and Lienkaemper (unpublished), the estimated strike of the GF at GF-3-3-02 is N35°W ±5°.

3.4.2 Greenville Fault Secondary Strand Pipeline Crossings

3.4.2.1 GF-114-01 (new)

PG&E did not identify a crossing of L-114 by the GF secondary strand because the nearby northwest-striking GF secondary strand in the PG&E fault database v9I does not intersect the L-114 pipeline alignment. The northwest end of 1980 fracture #26 as mapped by Bonilla et al. (1980) and digitized for this assessment, however, intersects L-114. Fracture #26 comprised a 16-ft-wide (5 m), N38°W-trending zone of fractures without any clear indications of the sense of slip, although N38°W- to N55°W-trending fractures located to the southeast had up to about 0.9 in (20 mm) of right-lateral displacement. No fractures were observed or mapped northwest of fracture #26 (Bonilla et al. 1980).

Golder recommends that crossing GF-114-01 be added because of its intersection with 1980 fracture #26. There are, at present, no geomorphic indicators for the location of the GF secondary strand at GF-114-01; the crossing location is based only on the mapped location for fracture #26 of Bonilla et al. (1980). The uncertainty of the location of fracture #26 from original mapping and subsequent digitizing is conservatively estimated at about ±30 ft (±9.1 m). The width of fractures mapped at location #26 was 16 ft (5 m), which is probably captured within the mapping error. Accordingly, the GF-114-01 crossing location error is estimated at ±30 ft (±9.1 m) based largely on errors associated with mapping of the 1980 fractures.

The trend of the1980 fractures and linear drainages either side of GF-114-01 shows a range from N38°W to N55°W, although the zone of 1980 fractures at GF-114-01 trends N38°W. Given the range in estimated trends for 1980 soil fractures, the strike of the GF is estimated at N38°W ±5° at crossing GF-114-01.

3.4.2.2 GF-303-01

GF-303-01 intersects the GF secondary strand northwest of North Vasco Road (old) and fracture #29 of Bonilla et al. (1980) (Figure 4). The N48°W-trending zone of open 1980 soil fractures was traced for 328 ft (100 m) northwest, and intersects GF-303-01 about 20 ft south of the mapped crossing. Because 1980 soil fractures were mapped to cross L-114, which did not exist at that time, the location of GF-303-01 is constrained to the location errors of the measurement and digitizing of the 1980 soil fractures. Golder considers that mapping errors are about ±30 ft (±9.1 m); thus, the GF-303-01 fault location error is estimated at ±30 ft (±9.1 m).

The trend of the 1980 fractures mapped either side of GF-303-01 shows a range from N38°W to N58°W (Bonilla et al. 1980). The N26°W-trending soil fracture measurement of fracture #29 was located about 40 m northwest of North Vasco Road (old) and had 0.8 ±0.4 in (20 ±10 mm) of left-lateral displacement. The strike and sense of slip appears anomalous when compared to the other right-lateral offset measurements along the GF secondary strand, and may indicate downslope displacement in response to shaking.

The 1980 fractures are mapped Bonilla et al. (1980) with a N45°W trend on both sides of GF-303-01, suggesting a consistent strike along this part of the GF. Accordingly, the estimated strike of the GF at GF-303-01 is N45°W ±5°.

3.4.3 Summary

The GF comprises four major sections (Unruh and Sawyer 1998) that can be distinguished from their geomorphic and structural character as indicated by the nature and degree of expression of mapped traces. Three PG&E gas tranission pipelines cross the GF toward the northwestern end of the northwest-striking Livermore section—a 0.3- to 0.6-mi-wide (0.5 to 1 km) zone that is geomorphically well defined by scarps, sidehill benches and troughs; shutter and pressure ridges; right-laterally deflected drainages; and closed depressions (Hart 1981a, 1981b; Lienkaemper unpublished; Unruh and Sawyer 1998). One trench observation of the GF by Sawyer and Unruh (2002) at Laughlin Road southeast of the crossing locations (Figure 3B) suggest that the GF has a vertical to steep southwest (76°SW) and northeast (73°NE) dip.

Existing geological and fault maps of the GF combined with the 1980 post-earthquake fracture mapping by Bonilla et al. (1980), aerial imagery interpretation and field reconnaissance undertaken for this assessment provide good constraint on the location uncertainties for three existing crossings of the GF main strand (GF-114-01-02, GF-131-02, and GF-303-02), one existing crossing of the GF secondary strand (GF-303-01), and one new GF secondary strand crossing (GF-114-01).

The locations and trend of soil fractures mapped in 1980 by Bonilla et al. (1980) are particularly valuable in constraining the location uncertainties of fault crossings and developing estimates for the uncertainty in fault strike at the crossings. The locations of the four existing crossings (GF-114-01-02, GF-131-01, GF-303-01, and GF-303-02) remain unchanged from those provided by PG&E at the commencement of this assessment. Location uncertainties for the five crossings range from ±20 ft (±6.1 m) to ±75 ft (±23 m) depending upon the proximity to mapped 1980 soil fractures and linear drainages. Similarly, estimated fault strike uncertainty ranges from ±2° to ±5° depending on their proximity to mapped 1980 soil fractures (Figures 4 and 7).

4.0 GREENVILLE FAULT PARAMETERS

Table 3 lists key parameters for the five GF crossing locations at L-114, L-131, and L-303. These key parameters can be used for future pipe stress modeling and integrity analyses and for any future probabilistic fault displacement analyses. Table 4 is a summary of GF geological and seismic properties from analyses of existing data and interpretive reports, publications, maps, and other available data (e.g., creep measurements). The parameters can be used for the GF crossing study areas described in this assessment.

Long-term average slip and aseismic creep rates are two key GF geological parameters needed to develop coseismic displacement estimates for pipe stress analyses. These parameters are described further below.

4.1 Long-Term Average Slip Rate

Wright et al. (1982) estimated the apparent total GF right-lateral slip at the Arroyo Mocho section based on an approximately 5.5-mi (8.75 km) right-lateral offset of a 160 ±8 million years old (Jurassic) serpentine body within the local bedrock. Using the same serpentinite body as a piercing point, Petersen et al. (1996) estimated a 6.2-mi (10 km) late Cenozoic dextral separation across the GF. With the assumption that offset of the body has occurred in the past 3 to 10 million years, Petersen et al. (1996) estimated a long-term average Cenozoic slip rate of 0.08 ±0.04 in/yr (2.1 ±1 mm/yr) for the GF.

Northwest along the Marsh Creek-Greenville segment of Wright et al. (1982) (Livermore section of Unruh and Sawyer [1998]), Wright et al. (1982) report a total offset of 4.4 to 4.7 mi (7 to 7.5 km) of a Pliocene-cored syncline to yield an average dextral strike-slip rate of 0.02 to 0.03 in (0.5 to 0.8 mm/yr) over the last 10 to 15 million years. The Pliocene (or younger) synclines, however, may have developed directly within the transpressional tectonic environment of the Livermore Valley and Mount Diablo region at that time. If so, then synclinal axes across the GF are not appropriate markers to evaluate the dextral separation across the GF.

Wright et al. (1982) also estimated a total slip of 295 ft (90 m) of right-laterally offset channels correlated to a stream terrace preserved along the lower reaches of Arroyo Mocho. They derived a minimum, late-Pleistocene average fault slip rate between 0.02 and 0.03 in/yr (0.5 and 0.7 mm/yr) based on the terrace age of 125,000 to 180,000 years, although the basis of this terrace age estimate is not reported by Wright et al. (1982).

Sweeney (1982) estimated about 1.1 to 1.3 mi (1.7 to 2 km) of offset along the modern, active branch of the GF during the past 4.5 million years based on Neogene sedimentary bedrock and subsurface stratigraphic relations interpreted from drillholes within the Livermore Valley. Sweeney (1982) argued for a long-term average dextral strike-slip rate for this part of the GF of about 0.02 in/yr (0.5 mm/yr).

Sawyer and Unruh (2002) investigated the GF horizontal slip rate with paleoseismic trenching investigations at the Laughlin Road site about 1.2 mi (2 km) north of Interstate 580 (Figure 3B). They found two channel-fill units and a paleo-channel offset right-laterally by the GF at the Laughlin Road site. Based on a 17.2 to 25.0 m right-lateral offset of the channel-fill deposit (dated at 4,100 to 8,500 radiocarbon years from soil carbonate), Sawyer and Unruh (2002) calculated an average Holocene right-lateral slip rate for the main trace of the GF of 0.16 ±0.07 in/yr (4.1 ±1.8 mm/yr).

Sawyer and Unruh (2012) revised their earlier GF average right-lateral slip rate estimate based on photon-stimulated luminescence dating of sand-sized grains taken from horizontally offset channels. The channel deposits were exposed in trenches excavated across the GF Livermore section at the Laughlin Road site (Figure 3B). Based on 53.5 to 71 ft (16.3 to 21.6 m) of right-lateral offset over the past 9,000 to 12,000 years, Sawyer and Unruh (2012) calculated an average right-lateral slip rate of 0.075 ±0.001 in/yr (1.9 ±0.3 mm/yr). However, Sawyer and Unruh (2012) regard their horizontal slip rate estimate for this section of the GF as a minimum because their study did not incorporate potential slip along a known secondary strand of the GF about 100 ft (30 m) or less to the east of the 1980 fault trace where they excavated their trenches.

The 0.08 ±0.04 in/yr (2.1 ±1 mm/yr) average geological slip rate for the GF estimated by Petersen et al. (1996) is the generally accepted rate used in the UCERF3 model (Field et al. 2013, Appendix B). The Sawyer and Unruh (2012) slip rate generally agrees with the estimated long-term average Cenozoic slip rate of Petersen et al. (1996), particularly as Sawyer and Unruh (2012) recognize that some additional slip could occur on one or more secondary strands that were not included in their analysis. Accordingly, this assessment adopts the 0.08 ±0.04 in/yr (2.1 ±1 mm/yr) average right-lateral slip rate for the GF at the pipeline crossings.

4.2 Creep Rate

Lienkaemper et al. (2013) estimated the rate of right-lateral creep at the GF for its southern third (part San Antonio Valley section of Unruh and Sawyer [1998]), central third (part Arroyo Mocho and San Antonio sections of Unruh and Sawyer [1998]), and for the northern third (Southern part of Livermore and northern Arroyo Mocho sections of Unruh and Sawyer [1998]). The Lienkaemper et al. (2013) estimates for fault creep are based on interpretation of 47 years of trilateration net data (Green Net, Figure 2), crustal velocities from continuous Global Postioning Satelite (cGPS) measurements from 2000 to 2012 and 2.4 years of measurements (2009 to 2012) from a creep alignment array (GALT, Figure 2) installed by McFarland et al. (2009).

The best-constrained creep data are from the Green Net trilateration network and GALT alignment array measurments from the southern part of the Livermore section (Figure 2). The Green Net measurements indicate an average total creep rate of 0.08 ± 0.001 in/yr (2.0 ± 0.3 mm/yr) across three GF strands from

1988 to 1999 (11 yrs). This creep rate is consistent with the short term (2.4 yrs) average creep rate of 0.09 ± 0.004 in/yr (2.28 0 ± 0.1 mm/yr) measured at the GALT alignment array (Lienkaemper et al. 2013).

The along-strike variation in creep rate is difficult to evaluate beyond the site-specific rate near the Green Net and GALT measurments (Figure 2). Lienkaemper et al. (2013) used the cGPS measurments to infer that the average creep rate along the Livermore section is 0.06 to 0.10 in/yr (1.6 to 2.6 mm/yr) and along the Arroyo Mocho and sections to the southeast is about 0 to 0.04 in/yr (0 to 1.0 mm/yr). The spacing of the cGPS measurements is such that they cannot easily distinguish between near-surface creep at the GF trace and deeper, more regional regional crustal strain. The lack of obvious surface fault creep on the GF traces northwest of the Lienkaemper at al. (2013) measurement sites (Figure 2) does not exclude its existence because the creep rate may be too low to be preserved in the abscense of anthropogenic featues such as sidewalks, curbs and older buildings. For this assessment, however, Golder considers that continuous surface creep at the full long term average rate is yet to been proven for the area of the pipeline corssings. Some fault creep is accounted for in the fault displacement analysis (Section 4.2).

Table 3: Pipeline Crossing Details and Geometry for the Greenville Fault

Crossing /Unique ID[1]	Longitude/ Latitude[1]	Route	Pipe Diameter (in)	Pipe Installation Date (mm/dd/year)	Population Grouping	Revised or new Location?	Fault Strike[2] (°)	Pipe Strike[2] (°)	Crossing Angle (°)	Fault Strand Location Uncertainty (ft)
GF-114-01 Not assigned	121.7351960°W 37.7584850°N	114-01	24	11/30/2007	ND	New	320 ±5	354	34 ±5	±30
GF-114-02 X00013	121.7348720°W 37.7562163°N	114-02	24	11/30/2007	TOC = 0	No	322 ±5	353	31 ±5	±50
GF-131-01 X00015	121.738007°W 37.7602462°N	131-01	24	09/26/1944	TOC = 0	No	340 ±2	227	67 ±2	±66
GF-303-01 X00026	121.7332297°W 37.75720669°N	303-01	36	12/12/1966	TOC = 0	No	315 ±5	180	45 ±5	±30
GF-303-02 X00027	121.733224°W 37.75439808°N	303-02	36	12/12/1966	TOC = 0	No	325 ±5	179	35 ±5	±75

Notes:

GF = Greenville fault; ND = not determined; TOC = total occupancy count

1 Unique ID assigned by PG&E in Pipeline Features List

2 Coordinate system: NAD 1983 UTM Zone 10N

3 See Table 4 for source information for the values adopted for this table

Table 4: Summary of Greenville Fault Geological and Seismological Parameters

Parameter	Summary	Discussion of Known Information
Sense of Slip	Right lateral	Based on geomorphic expression of surface traces of the fault from maps of Herd (1977), Hart (1981a, 1981b), and Unruh and Sawyer (1998). Post-earthquake investigations in 1980 (Bonilla et al. 1980) and focal mechanisms from 1980 earthquakes (Bolt et al. 1981) confirm predominately right-lateral sense of slip
Fault Strike	GF-114-01: 320 ±5° GF-114-02: 322 ±5° GF-131-01: 340 ±2° GF-303-01: 315 ±5° GF-303-02: 325 ±5°	Fault strikes at crossings are based on measured or extrapolated mapped trends of 1980 fractures mapped by Bonilla et al. (1980). Strikes mapped by Lienkaemper (unpublished) and in PG&E fault database v9I generally agree with measurements for this assessment
Fault Dip	GF North: 84°	Estimated average dip used in UCERF3 (Field et al. 2013, Appendix A)
	76°SW	Measurement from trench by Sawyer and Unruh (1998)
	70°NE	Based on the focal plane solution for the 01/27/1980 earthquake reported by Bolt et al. (1981)
Fault Length	Total length: 49.4 mi (79.5 km)	Total of estimated lengths used in UCERF3 (Field et al. 2013, Appendix A)
	GF North: 31.4 mi (50.5 km)	Estimated length of northern section n UCERF3 (Field et al. 2013, Appendix A)
	Greenville South: 18 mi (29.0 km)	Estimated length used in UCERF3
	33.7 mi (54 km)	Full rupture length from Lienkaemper et al. (2013)
	56 mi (91 km)	Total fault length of 91 km based on mapping by Wright et al. [1982]) and Unruh and Sawyer (1998). The Arroyo Mocho and Livermore sections of Unruh and Sawyer (1998) generally agree with Wright et al. (1982)
Age of Most Recent Surface Rupture	January 27, 1980 **M**5.4	Post-earthquake investigations by Bonilla et al. (1980), CDMG Staff (1980), and Woodward-Clyde Consultants (1980)
Number of Past Holocene Displacements	Unknown	Trenching investigations and tectonic geomorphic analyses have been unable to identify and date paleoseismic events (e.g., Sawyer and Unruh 2002, 2012; Unruh and Sawyer 1998)
Historical Earthquakes	January 24, 1980 **M**5.6 to **M**5.8	From Bakun (1999); originally from Bolt et al. (1981); Field et al. (2013, Appendix K)
	January 27, 1980 **M**5.4	Field et al. (2013, Appendix K)
Average Slip Rate	0.08 ±0.04 in/yr (2.1 ±1 mm/yr)	Petersen et al. (1996) estimated long-term average Cenozoic right-lateral slip rate based on total offset of serpentine body
	0.07 ±0.01 in/yr (1.9 ±0.3 mm/yr)	GF average rate based on 53.5 to 71 ft (16.3 to 21.6 m) of right-lateral offset of alluvial sediments dated at 9 to 12,000 years in Laughlin Road trench site of Sawyer and Unruh (2002, 2012)

Parameter	Summary	Discussion of Known Information
	0.08 in/yr (2.0 mm/yr)	Rate adopted in UCERF3 by Field et al. (2013, Appendix A)
Total Offset	5.5 to 6.2 mi (8.5 to 10 km)	Lower estimate based on estimate by Wright et al. (1982) and refined by Petersen et al. (1996)
Creep Rate	0.08 ± 0.012 in/yr (2.0 ± 0.3 mm/yr) (northern third)	Lienkaemper et al. (2013) showed that the northern third of the GF creeps at 0.08 ±0.012 in/yr (2.0 ±0.3 mm/yr) based on 11 years of trilateration net data, and 2.4 years of alignment array measuremnts.
	0-0.4 in/yr (0 to 1 mm/yr) (central third)	
	0 in/yr (southern third)	
Aseismicity Factor	5%–25% (0.05 to 0.25) aseismic-release	Lienkaemper et al. (2013); aseismicity factor based on modeled depth ranges of creep along the GF
	0.40	Value for northern GF adopted in UCERF3 by Field et al. (2013, Appendix D)
Characteristic Earthquake Magnitude	**M**7.25 **M**6.9 **M**6.9	Caltrans California Seismic Hazard Map (Mualchin 1996) Greenville (North) from Caltrans (2012) Greenville fault from Lienkaemper et al. (2013)

Notes:
GF = Greenville fault; UCERF3 = Uniform California Earthquake Rupture Forecast, version 3.

4.3 Deterministic Fault Displacement Hazard Analysis

Expected surface fault displacements at the GF main strand crossings (GF-114-02, GF-131-01, and GF-303-02; Figure 7) were estimated using the standardized (DFDHA) procedure for PG&E gas pipelines, Rev 1, dated September 16, 2015 (PG&E 2015). These procedures were developed specifically for application to the PG&E Earthquake Fault Crossings Program. The method and procedures were developed to estimate the net fault displacement hazard to PG&E gas pipelines that cross active faults, such as the GF. The DFDHA method includes two primary steps:

Step 1: Estimate the range of MCE magnitudes using area- and length-magnitude empirical relationships (e.g., Hanks and Bakun 2014)

Step 2: Estimate the range of possible surface fault rupture displacements resulting from the MCEs using available fault displacement prediction equations (FDPEs; e.g., Wells and Coppersmith 1994)

Unlike traditional deterministic fault displacement analyses, the DFDHA approach explicitly considers both epistemic uncertainty in defining the MCE and epistemic uncertainty and aleatory variability in the fault displacement prediction equations. Results are continuous uncertainty distributions. The uncertainty percentile (e.g., 50th, 84th, 90th) is selected for a given fault crossing based on a consequence-hazard matrix developed specifically for the PG&E pipeline fault crossings project. The consequence-hazard matrix considers both the fault activity (represented by fault slip rate) and the consequence of pipeline failure (represented by the pipeline class). PG&E (2015) provides full details of the method and two worked examples. The DFDHA calculations were undertaken within an Excel workbook supplied by PG&E and LCI (PGE_DFDHA_Rev2 draft.xlsx).

Section 4.3.1. describes the available information used to develop the MCE estimates for the GF, specifically, the logic tree inputs for fault rupture length, rupture width, and rupture area-earthquake magnitude scaling.

4.3.1 Primary Greenville Fault Strand Rupture Estimate

The general rupture source characterization logic tree and displacement calculation approach described by Golder (2016a) and LCI (2016) for the Southern Calaveras fault and Golder (2016b) for the Hayward fault is used in this assessment of the GF primary fault displacement. This approach is adopted because all three faults (Southern Calaveras fault, Hayward fault, and GF) are multi-segment faults with demonstrated active creep, historical earthquakes, and evidence for past coseismic surface rupture. The adopted approach considers variations in creep rate, long-term geological slip rate, and fault geometry to define the potential fault rupture scenarios. An assessment of the relative likelihood of each scenario is included in the source characterization logic tree.

The GF is considered to have four sections by Unruh and Sawyer (1998) as described in Section 3.2 of this assessment. Field et al. (2013, Appendix A) simplified the GF into two sections: 1) a northern GF section with a length of 31.4 mi (50.5 km) that coincides with the Livermore, Arroyo Mocho, and about 4.4 mi (7 km) of the San Antonio Valley sections of Unruh and Sawyer (1998); and 2) a shorter 18-mi-long (29.0 km) southern GF section that coincides with most of the San Antonio Valley and Coyote Creek sections of Unruh and Sawyer (1998).

The total length of the four GF sections reported by Unruh and Sawyer (1998) is about 57 mi (92 km), about 8 mi (12.8 km) less than the GF length estimate used in UCERF3 (Field et al. 2013, Appendix A). This total length discrepancy appears to arise because uncertaintty in the definition of the northwestern limit of the Livermore section. Hart (1981a, 1981b) extended the GF to coincide with the Marsh Creek fault mapped by Dibblee (1980a), with poorly expressed tectonic geomorphology for about 7.5 mi (12 km) northwest of the crossing sites. Unruh and Sawyer (1998) also incorporated the Marsh Creek fault as mapped by Hart (1981a) into their definition of the Livermore section, although their mapping extended only about 1.2 mi (2 km) northwest of the PG&E crossing sites. Field et al. (2013, Appendix A) extended the northern GF about 5 mi (8 km) northwest of fault traces mapped by Hart (1981a), perhaps because the USGS Quaternary Fault and Fold Database contains a Quaternary-age fault that connects the Marsh Creek fault to the Clayton fault (Figure1).

Because of the uncertainty associated with the northwestern limit of the active GF, the section lengths defined by Unruh and Sawyer (1998) are used to evaluate the rupture lengths for the DFDHA analysis in this assessment. Rupture lengths for the four sections were normalized by calculating the fault area (fault rupture length by rupture width) of each rupture section and dividing each rupture area by 6.2 mi (10 km). The normalizing process was needed because fault rupture scenarios had rupture lengths with different rupture widths. This normalizing method simplifies input into the DFDHA spreadsheet by combining rupture sections of varying rupture widths and by applying aseismicity factors to each rupture section.

Table 5 lists the fault rupture sections, lengths, and widths considered in this assessment for the four GF sections of Unruh and Sawyer (2012). For each potential rupture section, lengths listed in Table 5 include mapped fault section lengths and seismogenic depth to calculate fault areas. Fault lengths are normalized to a 6.2 mi (10 km) width, and their effective normalized fault lengths. Effective normalized fault lengths are the normalized fault lengths reduced by an aseismicity factor to account for the aseismic proportion of the total slip. Aseismicity factors listed in Table 5 are maximum aseismic release estimates of Lienkaemper et al. (2013) for the northern sections of the GF and the geological model from UCERF3 (Field et al. 2013, Appendix A) for the southern GF. Field et al. (2013, Appendix A) used a 0.40 aseismicity factor the northern GF, but for this assessment Golder selected the lower value from Lienkaemper et al. (2013) because it is based on fault-specific measurements rather than a region-wide model. The aseismicity factors act to reduce the coseismic rupture length (and area), the earthquake seismic moment, and estimated MCE.

Table 5: Greenville Fault Length Characterization for Potential Rupture Segments

Fault Segment/Section	Length (km)	Width (km)	Area (km^2)	Length Normalized to 10 km Width	Aseismicity Factor (R)	Area Reduced by Aseismicity Factor (km^2)	Effective Length (km) (reduced by creep) Normalized to 10 km Fault Width
Livermore section (LS)	30	14.9	447	44.7	0.25	335	33.5
Arroyo Mocho section (AMS)	27	14.9	402	40.2	0.25	302	30.2
San Antonio Valley section (AVS)	24	10.6	254	25.4	0.10	229	22.9
Coyote Creek section (CCS)	11	10.6	117	11.7	0.10	105	10.5

Table 6 lists the four possible rupture lengths for the GF where the five pipeline crossing are located. Golder (2016a) and LCI (2016) considered three rupture lengths for the Southern Calaveras fault instead of all possible permutations of linked fault section ruptures. The reduction to three scenarios supports the goal of the DFDHA to develop a set of weighted earthquake magnitudes that represent epistemic uncertainty in the probable MCE rather than compiling an exhaustive list of all possible earthquake scenarios and their magnitudes. Accordingly, the DFDHA spreadsheet, at present, permits consideration of up to three rupture scenarios to represent the most probable rupture of the fault at the pipeline crossing. Reduction of the four scenarios listed in Table 6 to the three scenarios used in the DFDHA is described below.

Table 6: Potential Fault Rupture Segment Combinations and Lengths for Greenville Fault

Rupture Scenario	**Fault Section Combinations**	**Length Normalized (km)**	**Effective Normalized Length (km)**
1	LS	44.7	33.5
2	LS+AMS	84.9	63.7
3	LS+AMS+SAVS	110.3	86.6
4	LS+AMS+SAVS+CCS	122	97.1

Notes:
LS = Livermore section; AMS = Arroyo Mocho section; SAVS = San Antonio Valley section; CCS = coyote Creek section

The shortest rupture length (or “low” branch for the rupture length node in the logic tree) analyzed is the Livermore section (LS) rupturing alone, with a normalized effective rupture length of 20.6 mi (33 km; rupture scenario 1 in Table 6). A branch weight of 0.6 is assigned in the DFDHA because it has a unique tectonic geomorphology that suggests it may behave as an individual rupture section. That is, the fault’s surface expression is different than the Arroyo Mocho section (AMS) to the southeast, implying it has ruptured independent of the GF section to the south.

The middle branch of the logic tree is the LS + AMS scenario (scenario 2 in Table 6) with a normalized effective rupture length of 39.8 mi (63.7 km). This branch was assigned the weight of 0.3 to reflect a reasonable likelihood that both the LS and AMS sections rupture together. These two sections have well-expressed tectonic geomorphology when compared to section to the southeast and northwest. Furthermore, these two sections have good evidence of episodic fault creep, in contrast to sections to the northwest and southeast.

The longest rupture length considered is the arithmetic mean of the two rupture scenarios that involve three or more rupture sections (rupture scenarios 3 and 4 in Table 6). The mean rupture length of 57.4 mi (91.9 km) was assigned the lowest weight (0.1) of the three rupture length branches because the tectonic geomorphic expression of the two southeastern sections is very weak, suggesting very little evidence that either or both of these sections have been involved in coseismic rupture of the two northern sections. The low probability is further supported by the analyses of Biasi and Wesnousky (2016), who argue for a decreased likelihood of a coseismic rupture propagating as the number of steps between fault sections increases.

The median, median plus 0.25 magnitude units (HB14+0.25), and median minus 0.25 magnitude units (HB14-0.25) area-magnitude relationships from Hanks and Bakun (2014) were weighted 0.6, 0.2, and 0.2, respectively. The weights remain unchanged from the Example 1 discussion in PG&E 2015.

Golder considered three fault dips of 90°, 85°, and 70° for the DFDHA, with weights of 0.6, 0.3, and 0.1, respectively (Table 7). The dip range was assigned based on the general linear geomorphic expression of the GF (linear drainages and tonal lineaments across a range of topography), a dip estimate from Field et al. (2013, Appendix A) for the GF north (84°) and southwest (76°) measured in a nearby trench by Sawyer and Unruh (1998).

Table 7: Logic Tree Values and Weights to Estimate a Maximum Considered Earthquake for the Greenville Fault

Parameter	Value	Weight
Magnitude Model	Magnitude-log$_{10}A$	1.0
	Fixed magnitude	0.0
Rupture Length (km)	33.5	0.6
	63.7	0.3
	91.9	0.1
Seismogenic Thickness (km)	15	1.0
Fault Dip (degrees)	90	0.6
	80	0.3
	70	0.1
Magnitude-log$_{10}A$ relation	$\boldsymbol{M} = \log_{10} A + 3.98, A \leq 537\ km^2$ $\boldsymbol{M} = \frac{5}{4}\log_{10} A + 3.30, A > 537\ km^2$	0.2
	$\boldsymbol{M} = \log_{10} A + 4.23, A \leq 537\ km^2$ $\boldsymbol{M} = \frac{5}{4}\log_{10} A + 3.55, A > 537\ km^2$	0.6
	$\boldsymbol{M} = \log_{10} A + 3.73, A \leq 537\ km^2$ $\boldsymbol{M} = \frac{5}{4}\log_{10} A + 3.05, A > 537\ km^2$	0.2

The logic tree values used as inputs in the DFDHA procedure (PG&E 2015) are shown in Figure 8. The MCE magnitude estimates have a weighted mean of **M**6.84 and a range of **M**6.4 to **M**7.5. The Caltrans (2012) estimate of **M**6.9 for the GF (north) and **M**6.9 estimate of Lienkaemper et al. (2013) both fall in this range; and have values close to the mean value of **M**6.84 estiamted in this assessment. For the GF, UCERF3 (Field et al. 2013) estimated earthquakes of up to approximately magnitude **M**6.85 has a modeled recurrence at about 750 years, while Lienkaemper et al. (2013) argue for a retrun period of about 575 years for an **M**6.9 earthquake that ruptures their full 54 km length for the GF..

This range of MCE magnitudes was used as input to the DFDHA to estimate fault displacements for the primary GF at crossings GF-114-02, GF-131-01, and GF-303-02 (Figure 8). The DFDHA approach uses a series of FDPEs and additional sources of uncertainty (both aleatory and epistemic) to estimate a range of possible fault displacements as part of a complementary cumulative distribution function.

The displacement characterization logic tree that weights the $\log_{10}AD$-**M** branch at 1.0 was considered for the FDPE approach because there are no site-specific, single-event displacements to apply reasonable estimates of horizontal displacement for the paleo-slip case (PG&E 2015). Golder used the magnitude-displacement prediction equations of Wells and Coppersmith (1994) and Hecker et al. (2013), with the Wells and Coppersmith (1994) "all," the Wells and Coppersmith (1994) "strike-slip," and Hecker et al. (2013) relationships weighted 0.5, 0.2, and 0.3, respectively. The rationale for these weights is described in PG&E (2015).

The range of potential fault displacement estimates is from 2.8 ft (0.85 m, 50th percentile) to 8.0 ft (2.4 m, 84th percentile) (Table 8) from the DFDHA approach. The PG&E (2015) consequence-hazard matrix classified the GF as a "moderate slip rate" fault because it has an average slip rate of "0.04 to < 0.20 in/yr (1 to < 5 mm/yr)." When coupled with a population grouping of total occupancy count (TOC) = 0 (Table 3), pipeline pressure integrity assessment uses the 50th percentile fault displacement. The 90th and 84th percentile displacement estimates are listed in Table 8 for completeness only.

Table 8: Estimated Fault Displacements for the Greenville Fault Using the DFDHA Approach

Percentile (Exceedance Probability)	Strike-Slip Displacement (m) Reduced by Creep	Strike-Slip Displacement (ft) Reduced by Creep
50th (0.5)	**0.85**	**2.8**
84th (0.16)	2.42	8.0
90th (0.10)	3.27	10.7

Notes:
PG&E's (2015) consequence hazard matrix specifies 50th percentile displacement estimates (values in bold) for evaluation the pipeline pressure integrity.

The 50th percentile displacement estimates for the GF listed in Table 8 can be used for pipeline pressure integrity assessment atcrossings GF-114-02, GF-131-01, and GF-303-02 that cross the GF main strand.

4.3.2 Displacement Calculation for Greenville Fault Secondary Strand

Petersen et al. (2011) evaluated data on distributed deformation away from the main fault during large surface-rupturing, strike-slip earthquakes. Petersen et al. (2011) calculated the ratio of displacements on secondary faults located off the primary fault to the average displacement on the primary fault (d/AD) for 709 observations. They noted that there was a minor negative trend of distributed displacement with distance from the primary GF, suggesting that the distance from the main fault was not important to secondary displacement. Crossings GF-114-01 (new) and GF-303-01 are located the GF secondary strand about 430 ft (130 m) and 570 ft (175 m) northeast of the GF main strand, respectively (Figure 7). This primary to secondary fault distance ranges were well represented in the Petersen et al. (2011) dataset, suggesting that their conclusions are likely valid for the estimation of slip at the GF secondary strand crossings (GF-114-01 and GF-303-01).

To estimate the displacement that may occur on the on the GF secondary strand, a simple statistical analysis of the Petersen et al. (2011) dataset was undertaken to determine the mean and standard deviation of d/AD. The mean d/AD is approximately 0.10 for a secondary displacement to the primary fault displacement, with one standard deviation of 0.12. There are only small differences between the entire dataset of net slip measurements (mean d/AD = 0.10), the subset of horizontal measurements only (mean d/AD = 0.08), and the subset of data excluding the Landers earthquake observations (mean d/AD = 0.11). The distribution of all measurements suggests that d/AD ranges from 0.005 at the 5th percentile to 0.35 at the 95th percentile, with a 50th percentile d/AD of 0.06, and 84th percentile d/AD of 0.18.

Golder multiplied the DFDHA displacement estimates for the GF main strand slip by 0.1 to develop displacement estimates for the GF secondary strand. Displacement estimates were not reduced for creep because the Petersen et al. (2011) secondary fault dataset has few faults that have evidence for creep. The unreduced primary fault slip estimates were calculated using the length-normalized fault parameters listed in Tables 5 and 6, but without the aseismic reduction factors. Golder used the same logic tree and weightings as used in the GF main strand slip calculations with the DFDHA procedure as described in Section 4.3.1. The slip values developed from the DFDHA results were then multiplied by a d/AD fraction of 0.10 to estimate the displacement on the GF secondary strand. The 0.10 value represents the mean of the Petersen et al. (2011) data and includes more than half of the distribution of 709 measurements.

Table lists the secondary displacements estimated for the two GF secondary strand crossings (i.e., GF-114-01 and GF-303-01).

Table 9: Estimated Fault Displacements on the Secondary Strand of the Greenville Fault

Percentile (Exceedance Probability)	Strike-Slip Displacement (m) Not Accounting for Creep	Strike-Slip Displacement (ft) Not Accounting for Creep	Strike-Slip Displacement on Secondary Fault (m)	Strike-Slip Displacement on Secondary Fault (ft)
50th (0.5)	**1.07**	**3.5**	**0.11**	**0.35**
84th (0.16)	3.03	9.9	0.3	0.99
90th (0.10)	4.09	13.4	0.41	1.34

Notes:
Displacements estimated using the d/AD (ratio of displacements on secondary faults located off the primary fault to the average displacement on the primary fault) fraction from Petersen et al. (2011).
PG&E's (2015) consequence hazard matrix specifies the 50th percentile displacement estimates (values in bold) for evaluation the pipeline pressure integrity for TOC = 0

The 50th percentile displacement estimates for the GFlisted for in Table 9 can be used for pipeline pressure integrity at crossings GF-114-01 and GF-303-01 that cross the GF secondary strand..

5.0 PIPELINE CROSSING SOIL PROPERTIES

Golder used existing soil maps to estimate the geotechnical soil properties needed to support the pipe stress analysis for five GF crossings at L-114, L-131, and L-303. The soil maps were compiled from regional soil surveys undertaken by the US Department of Agriculture Natural Resource Conservation Service (NRCS). While the NRCS data do not include detailed geotechnical data, they do include descriptions and American Association of State Highway and Transportation Officials and Unified Soil Classification System classifications. These classifications can be used to estimate general soil geotechnical parameters at the GF pipeline crossings (Table 10). The NRCS mapping is regional in scale, and the soils data at a given site may vary significantly from that inferred from the regional soils data.

NRCS (2014) soil maps indicate that crossings GF-303-02, GF-303-01, GF-114-01, and GF-131-01 are located on Altamont clay soils. NRCS descriptions indicate that the Altamont clay soil unit comprises about 35% to 60% clay (CH, CL) from the surface to a depth of between 28 to 50 in (0.7 to 1.3 m). The soil maps indicate that crossing GF-114-02 is located on the Gaviota rocky sandy loam, which comprises sandy loam with about 10% to 18% clay from the surface to a depth of 17 in (0.43 m), where unweathered bedrock is encountered.

Table 10: Estimated Soil Properties at Greenville Fault Pipeline Crossings

Crossing Number	Soil Map Unit[1]	Unified Soil Classification System[1]	Range of Internal Friction Angle (ϕ)[2,3]	Liquid Limit (%)[1]	Plasticity Index[1]	Moist Bulk Density (g/cc)[1]
GF-L-303-02	Altamont clay	CH, CL	17–35	35–65	15–45	1.25–1.35
GF-L-114-02	Gaviota rocky sandy loam	SM	27–34	20–30	NP–10	1.50–1.60
GF-L-303-01	Altamont clay	CH, CL	17–35	35–65	15–45	1.25–1.35
GF-L-114-01	Altamont clay	CH, CL	17–35	35–65	15–45	1.20–1.45
GF-L-131-01	Altamont clay	CH, CL	17–35	35–65	15–45	1.20–1.45

Notes:
GF = Greenville fault; NP = non-plastic.
1. NRCS (2014)

6.0 CONCLUSIONS

The GF has been identified in the area where it intersects PG&E transmission gas pipelines L-114, L-131, and L-303 near North Vasco Road, about 5.5 mi (9 km) northeast of Livermore, Alameda County, CA (Figure 7). For this assessment, the location and sense of slip of the main and secondary strands of the GF were identified from the analysis and interpretation of the following:

- Geological maps (e.g., Dibblee 1980a, 1980b; Herd 1977), and tectonic geomorphic maps and reports (e.g., Hart 1981a, 1981b; Sawyer and Unruh 2002; Lienkaemper unpublished; Unruh and Sawyer 1998) that provide estimates for the location of the traces of the GF, its structural geological setting, and sense and rate of slip
- Observations of surface deformation during and following the January 1980 earthquake sequence (e.g., Bonilla et al. 1980; CDMG Staff 1980; Woodward-Clyde Consultants 1980)
- Interpretation of aerial photographs and Google Earth imagery; the Northern California GeoEarthScope LiDAR hillshades; and LiDAR acquired by PG&E for the 2,000-ft wide (610 m) swath either side of its gas transmission lines
- Observations and measurements made during the July 27, 2016, reconnaissance-level field study undertaken for this assessment.

There are no known paleoseismic trenches within about 1 mi (1.6 km) of the crossing sites.

Fault crossings GF-114-02, GF-131-01, and GF-303-02 (Figure 7) are located on the northwest-striking (N27°W to N35°W) main strand of the GF (Figure 7). The main strand designated in this assessment includes the GF locations from the PG&E fault database v9I and CGS (2010). The GF main strand is moderately well defined on the basis of geomorphic indicators such as linear drainages and tonal lineaments apparent in historical aerial imagery. Although there are no definitive tectonic geomorphic features at the three GF main strand crossings sites (e.g., the geomorphology surrounding GF-114-02 is completely modified from road construction and pipe erosion protection works), estimates of the GF at the pipeline crossing locations have been developed by the projection of the well-mapped soil fractures of Bonilla et al. (1980). On the assumption that these fractures occurred on the GF main strand, the location of the fault at the three crossings ranges from ±50 ft (±15 m) to ±75 ft (±23 m). Similarly, the northwest strike of the GF at the crossings has an error estimated at about ±5° (Table 3).

Fault crossings GF-114-01 (new) and GF-303-01 (Figure 7) are located on an approximately 2,000-ft-long (610 m) secondary strand of the GF that is subparallel to the GF main strand at this location (Figure 7). The location of this secondary strand in the PG&E fault database is likely based on the mapping of Hart (1981a). Interpretation of historical aerial imagery indicates that this GF strand is marked by a weakly developed linear drainage and hillside bench. The location of the GF secondary strand was confirmed by northwest-striking (N45°W to N55°W) soil fractures with up to 1 in (25 mm) of horizontal and vertical displacements mapped by Bonilla et al. (1980) (Figure 4). Soil fractures were mapped at both L-114-01 and L-303 pipeline crossing locations, although only L-303 existed at the time of the 1980 earthquakes (Table 3). On the assumption that these fractures occurred on the GF secondary strand, the location error for the GF at the two crossings is ±30 ft (±9.1 m). The strike of the fault at the crossings has an error of about ±5° (Table 3).

Golder compiled existing data for a range of fault parameters (Table 4), such as the long-term average slip rate, active creep rate, and calculated length-normalized fault segment lengths (Table 5) and potential rupture scenarios (Table 6) involving four sections of the GF as defined by Unruh and Sawyer (1998). The average Cenozoic GF slip rate estimated by Petersen et al. (1996) at 0.08 ±0.04 in/yr (2.1 ±1 mm/yr) from a right-laterally offset serpentine body, and at 0.07 ±0.01 in/yr (1.9 ±0.3 mm/yr) based on 53.5 to 71 ft (16.3 to 21.6 m) of right-lateral offset early Holocene alluvial sediments indicates that the GF is in the “moderate slip rate” category for application of the PG&E (2015) consequence-hazard matrix. With a population grouping at the crossings of TOC = 0, PG&E (2015) indicates that the 50th-percentile fault displacement should be used for pipeline integrity analysis for the four existing crossings (GF-114-02, GF-131-01, GF-303-01, and GF-303-02) and one new crossing (GF-114-01), assuming it is also has a TOC = 0 population grouping.

Golder used the DFDHA method (PG&E 2015) to estimate the surface fault displacement at the GF main strand crossings (GF-114-02, GF-131-01; and GF-303-02) (Figure 7). The DFDHA procedures indicated a range of MCEs between **M**6.4 to **M**7.5 with a weighted mean of **M**6.84. The range of creep-reduced net surface displacements calculated was 2.8 ft (0.85 m) and 8.0 ft (2.42 m) for the 50th and 84th percentile, respectively (Table 8). These displacement values represent the sum of coseismic and afterslip displacements.

Golder considered displacement on the GF secondary strand during an MCE event on the GF to estimate potential surface displacements at crossings GF-114-01 (new, Figure 7) and GF-303-01. Using the MCE values (not creep corrected) calculated for the GF as the primary earthquake source, GF secondary strand displacements were estimated to range from 0.35 ft (0.11 m) and 0.99 ft (0.3 m) for the 50th and 84th percentile, respectively (Table 9).

Table 11 lists summary information for L-114, L-131, and L-303 where these gas transmission pipelines cross main and secondary strands of the GF near North Vasco Road (Figure 7). Golder identified one new crossing GF-114-01 (across the GF secondary strand) in this assessment.

Table 11: Summary of Fault Crossing Details, Geometry, and Displacement Estimates for the Greenville Fault

Crossing /Unique ID[1,2]	Longitude/ Latitude[1]	Route	Pipe Diameter (in)	Pipe Installation Date (mm/dd/year)	Population Grouping[3]	Revised or new Location ?	Fault Strike[2] (°)[4]	Pipe Strike[2] (°)	Crossing Angle (°)	Fault Strand Location Uncertainty (ft)	Estimated Fault Displacements
GF-114-01 Not assigned	121.7351960ºW 37.7584850ºN	114-01	24	11/30/2007	ND	New	320 ±5	354	34 ±5	±30 ft (±9.1 m)	0.35 ft (0.11 m)–50th
GF-114-02 X00013	121.7348720ºW 37.7562163ºN	114-02	24	11/30/2007	TOC = 0	No	322 ±5	353	31 ±5	±50 ft (±15 m)	2.8 ft (0.85 m)–50th
GF-131-01 X00015	121.738007ºW 37.7602462ºN	131-01	24	09/26/1944	TOC = 0	No	340 ±2	227	67 ±2	±66 ft (20 m)	2.8 ft (0.85 m)–50th
GF-303-01 X00026	121.7332297ºW 37.75720669ºN	303-01	36	12/12/1966	TOC = 0	No	315 ±5	180	45 ±5	±30 ft (±9.1 m)	0.35 ft (0.11 m)–50th
GF-303-02 X00027	121.733224ºW 37.75439808ºN	303-02	36	12/12/1966	TOC = 0	No	325 ±5	179	35 ±5	±75 ft (±23 m)	2.8 ft (0.85 m)–50th

Notes:
ND= not designated; TOC = total occupancy count
1 Coordinate system: NAD 1983 UTM Zone 10N.
2 X00013, X00015, X00026, and X00027 are PG&E Unique ID numbers.
3 Class location and population grouping designation to be confirmed by PG&E.
4 Fault strike based on actual or projected strike of soil fractures reported by Bonilla et al. (1980)
6 Estimated fault displacement values for the GF main strand and GF secondary stand are from Tables 8 and 9, respectively.

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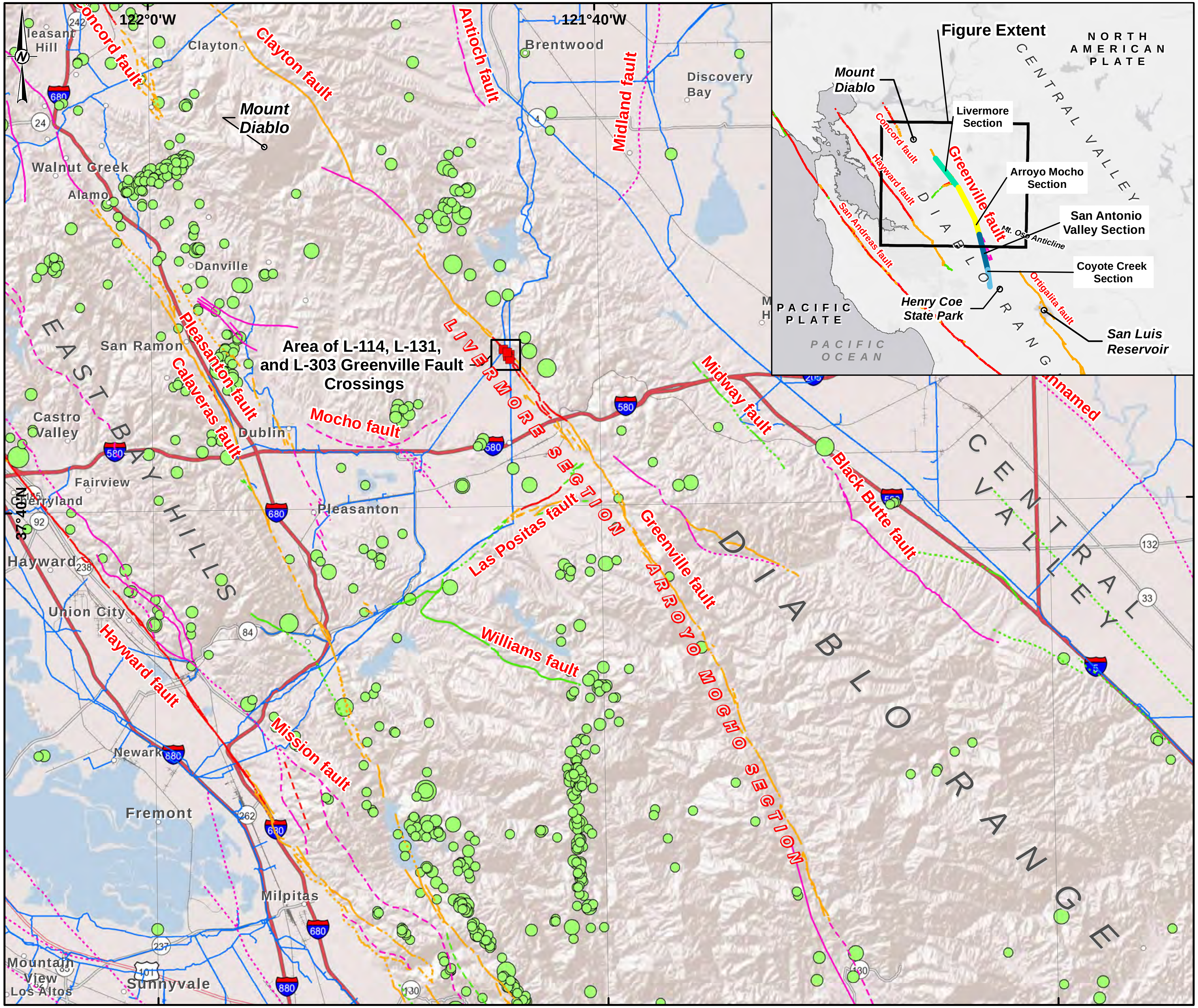
FIGURES



LEGEND

PG&E Pipeline Alignments

🟥 PG&E Fault Crossings (Updated 2016)

Historical Earthquakes, Magnitude (M)

- ● 2.01 - 3.00
- ● 3.01 - 4.00
- ● 4.01 - 5.00
- ● 5.01 - 6.00
- ● 6.01 - 7.00

PG&E Fault Database v9I (Age of Most Recent Rupture)

- Historical
- Holocene
- Late Quaternary
- Quaternary

For All Faults Above: Solid line where certain, dashed line where uncertain, dotted line where concealed.

DRAFT

0 2 4
MILES

0 5 10
KILOMETERS

REFERENCE(S)
1. PG&E (2016) - FAULTS, PIPELINES
2. FIELD, ET AL. (2013) - EARTHQUAKE EPICENTERS
3. COORDINATE SYSTEM: NAD 1983 UTM 10 N
4. SERVICE LAYER CREDITS: COPYRIGHT:© 2014 ESRI
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CLIENT
PACIFIC GAS AND ELECTRIC COMPANY

PROJECT
EARTHQUAKE FAULT CROSSINGS PROGRAM

YYYY-MM-DD	2016-11-08
DESIGNED	HJ
PREPARED	HJ
REVIEWED	AH
APPROVED	AH

TITLE
TECTONIC SETTING, ACTIVE FAULTS, AND HISTORICAL EARTHQUAKE EPICENTERS SURROUNDING THE GREENVILLE FAULT SYSTEM, EAST SAN FRANCISCO BAY, AND THE LIVERMORE VALLEY

CONSULTANTS

GOLDER PROJECT NO.
140825362

REV.
B

FIGURE
1

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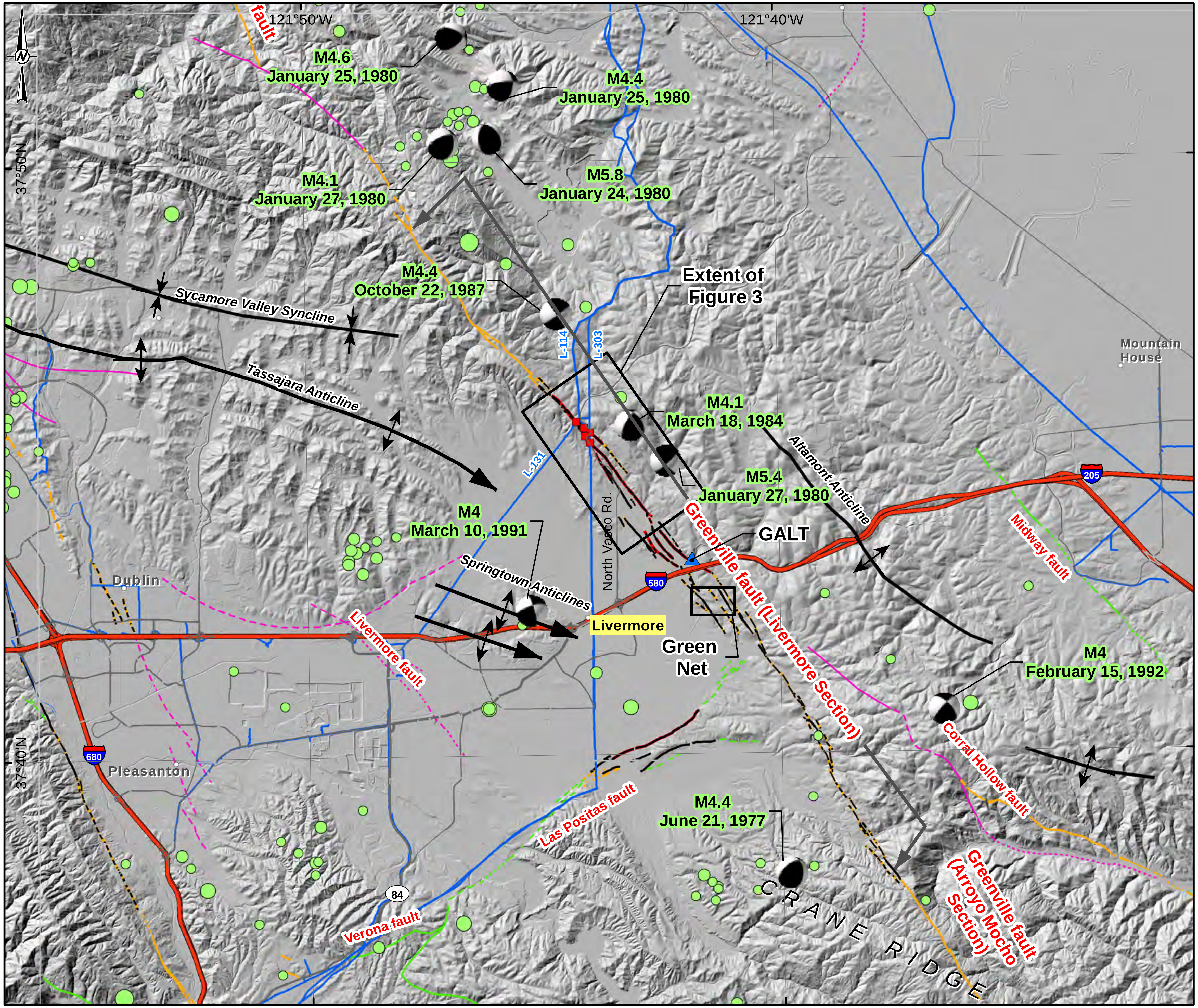

LEGEND

- PG&E Pipeline Alignment
- 🟥 PG&E Fault Crossing (Updated 2016)

Unruh and Sawyer (1998) Folds

- Anticline
- Syncline

Historical Earthquakes, Magnitude (M)

- ● 2.01 - 3.00
- ● 3.01 - 4.00
- ● 4.01 - 5.00
- ● 5.01 - 6.00

Earthquake focal mechanism solutions (M>4), moment magnitude and earthquake date (Universal time) shown

- CGS Fault (2012)
- ▲ GALT - Alignment Array of MacFarland et al. (2009)

PG&E Fault Database v9I (Age of Most Recent Rupture)

- Historical
- Holocene
- Late Quaternary
- Quaternary

For All Faults: Solid line where certain, dashed line where uncertain, dotted line where concealed.

DRAFT

0 2 4
Miles

0 2 4
Kilometers

REFERENCE(S)

1. PG&E (2016) - FAULTS AND PIPELINES
2. CGS (2012) - FAULTS
3. NCEDC (2014) - FOCAL MECHANISM DATA
4. UNRUH AND SAWYER (1998) - FOLDS
5. COORDINATE SYSTEM: NAD 1983 UTM 10 N
6. SERVICE LAYER CREDITS: USGS, NGA, NASA, CGIAR,N ROBINSON,NCEAS,NLS,OS,NMA,GEODATASTYRELSEN AND THE GIS USER COMMUNITY

CLIENT
PACIFIC GAS AND ELECTRIC
COMPANY

YYYY-MM-DD	2016-11-08
DESIGNED	HJ
PREPARED	HJ
REVIEWED	AH
APPROVED	AH

PROJECT
EARTHQUAKE FAULT CROSSINGS
PROGRAM

TITLE
GREENVILLE FAULT, HISTORIC EARTHQUAKE EPICENTERS, AND MAJOR STRUCTURES SURROUNDING THE LIVERMORE VALLEY

CONSULTANTS
Golder Associates
LCI Lettis Consultants International, Inc. EARTH SCIENCE CONSULTANTS

GOLDER PROJECT NO.	REV.	FIGURE
140825362	B	2

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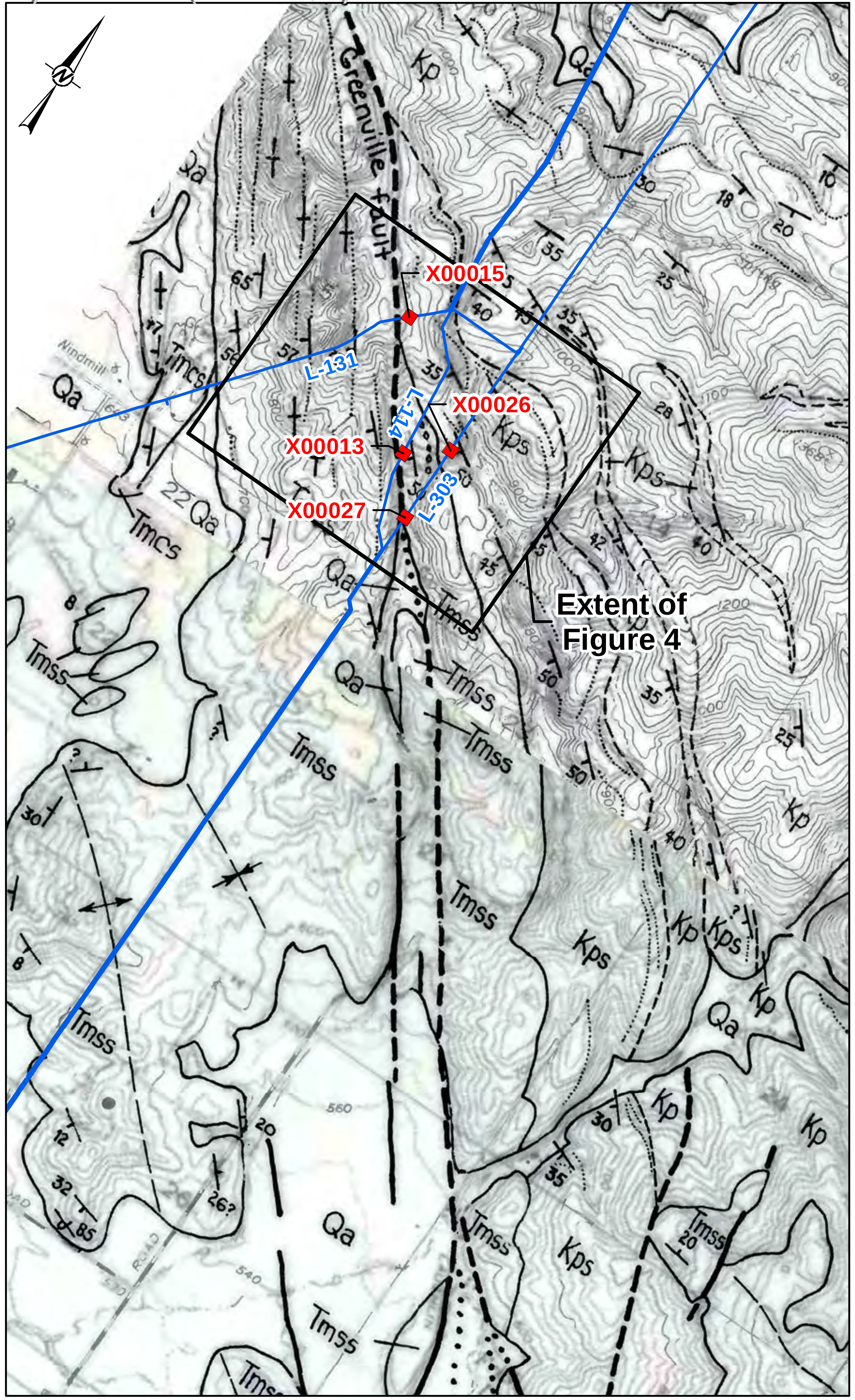
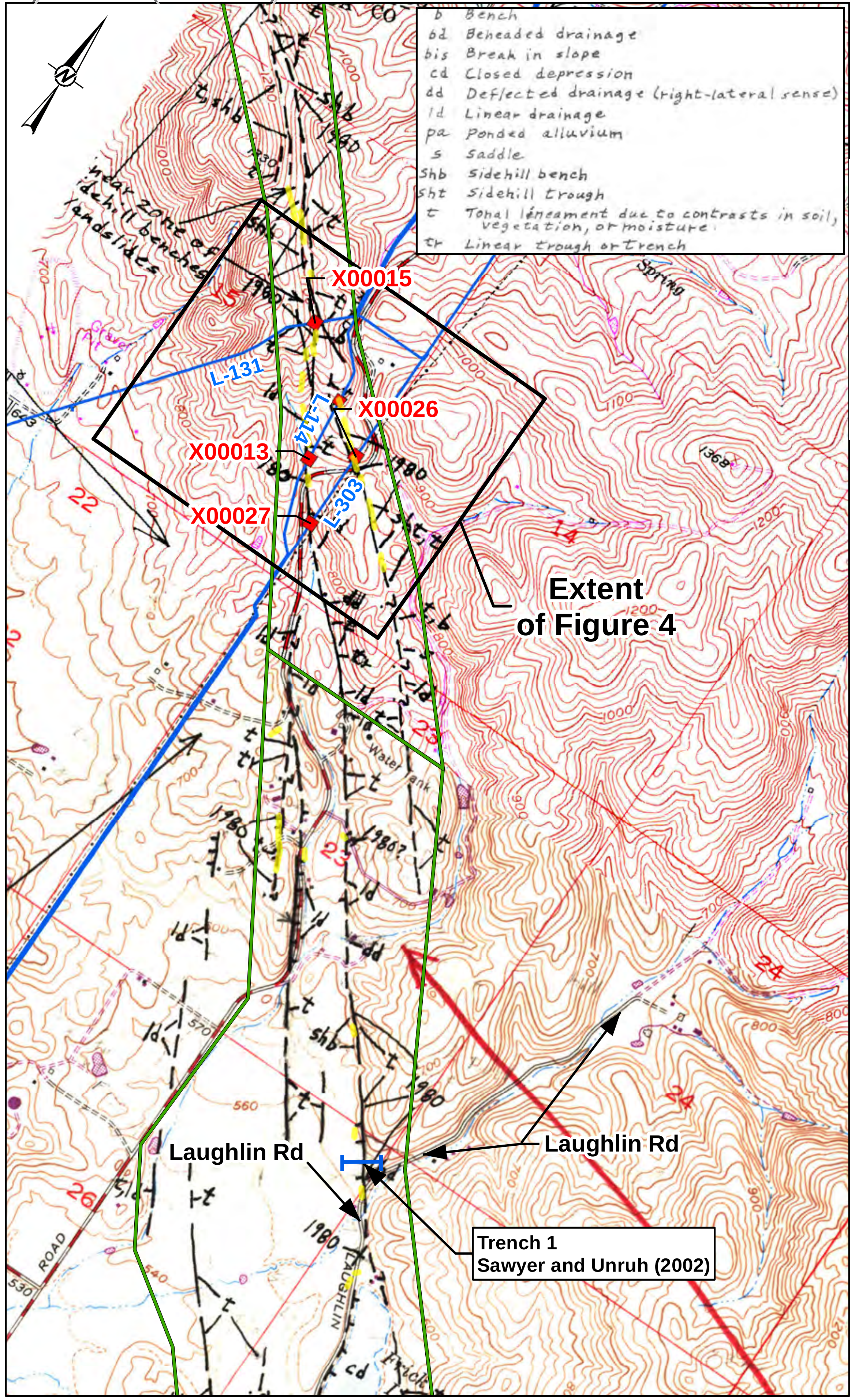
A) Diblee (1980a,b)



B) Hart (1981a) - FER 117



LEGEND

- PG&E Pipeline Alignments
- 🟥 PG&E Fault Crossing (Updated 2016)
- Bonilla et al. (1980) Fractures
- 🟩 AP Special Study Zone Boundary
- Trench

Diblee (1980 a,b) Geology

Qa	alluvium (Holocene)	
Tmcs	nonmarine and brackish marine(?) claystone, siltstone, gray sandstone and pebble conglomerate (Upper Miocene)	Briones Formation
Tmss	marine, tan pebbly arkostic sandstone (Upper Miocene)	
Kps	arkostic sandstone, contains large concretions, minor interbedded shale (Upper Cretaceous)	Panoche Formation
Kp	micaceous clay shale, some thin sandstone strata (Upper Cretaceous)	

Bedding strike direction and measure
Anticline
Syncline

DRAFT

0 1,000 2,000
Feet

0 500 1,000
Meters

REFERENCE(S)
1. PG&E (2016) - PIPELINES
2. DIBLEE (1980A,B) - GEOLOGY
3. HART (1981A) - FAULTS
4. COORDINATE SYSTEM: NAD 1983 UTM 10 N
5. SERVICE LAYER CREDITS:

CLIENT
PACIFIC GAS AND ELECTRIC COMPANY

PROJECT
EARTHQUAKE FAULT CROSSINGS PROGRAM

YYYY-MM-DD	2016-11-08
DESIGNED	HJ
PREPARED	HJ
REVIEWED	AH
APPROVED	AH

TITLE
GEOLOGY AND TECTONIC GEOMORPHOLOGY OF GREENVILLE FAULT SURROUNDING PIPELINE CROSSINGS

CONSULTANTS
Golder Associates
LCI Lettis Consultants International, Inc. EARTH SCIENCE CONSULTANTS

GOLDER PROJECT NO.	REV.	FIGURE
140825362	B	3

PATH: G:\PacifcGasAndElectric_PGE\PGE_SystemWide_Landslides_Faults\99_PROJECTS\140825362_FaultCrossings_2016\02_PRODUCTION\MXD\FIGURES\Group_2_Reports\Greenville\RevB\140825362_003_F03_RevB_FER_Diblee_GreenvilleFault.mxd

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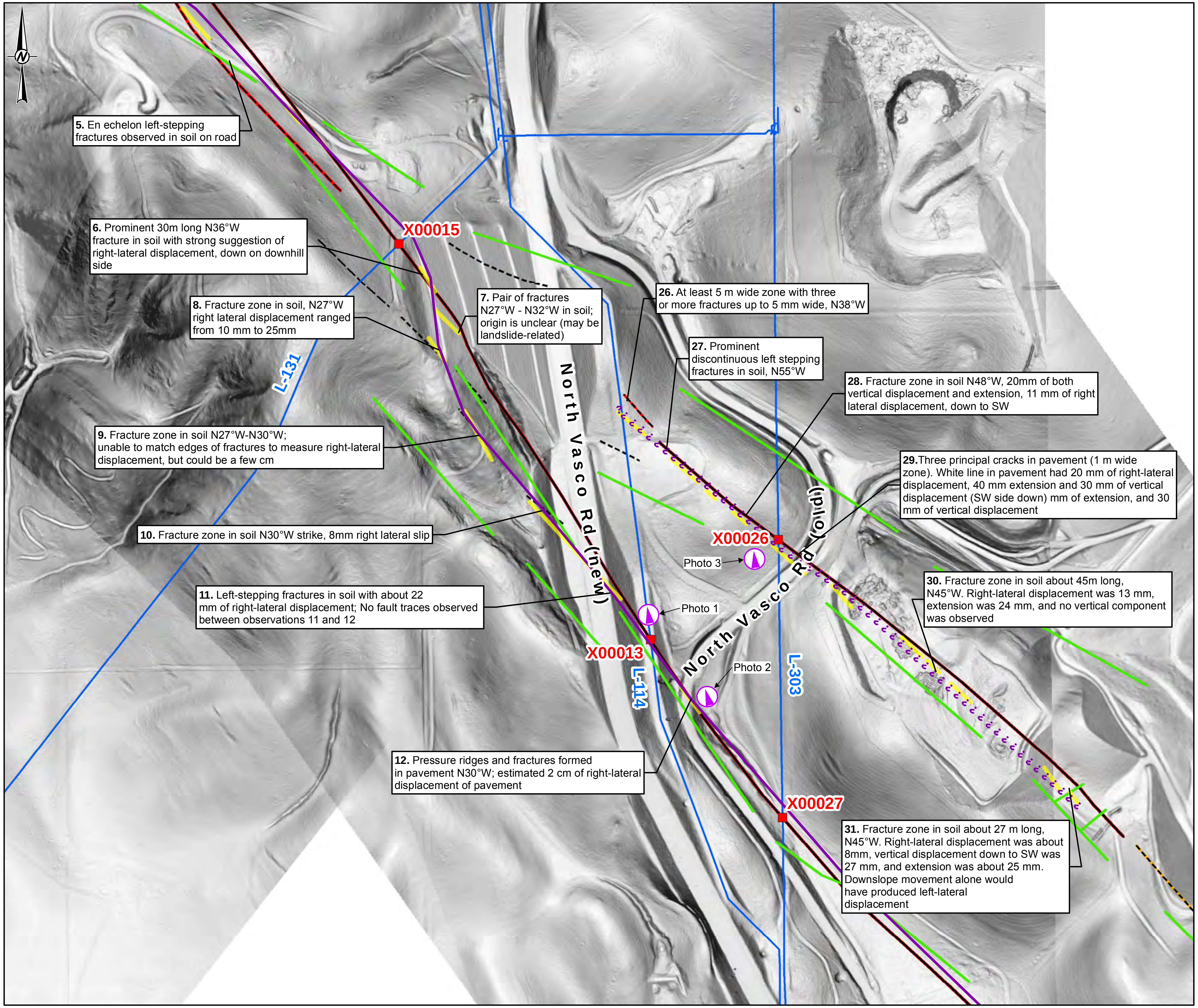

5. En echelon left-stepping fractures observed in soil on road

6. Prominent 30m long N36°W fracture in soil with strong suggestion of right-lateral displacement, down on downhill side

7. Pair of fractures N27°W - N32°W in soil; origin is unclear (may be landslide-related)

8. Fracture zone in soil, N27°W right lateral displacement ranged from 10 mm to 25mm

9. Fracture zone in soil N27°W-N30°W; unable to match edges of fractures to measure right-lateral displacement, but could be a few cm

10. Fracture zone in soil N30°W strike, 8mm right lateral slip

11. Left-stepping fractures in soil with about 22 mm of right-lateral displacement; No fault traces observed between observations 11 and 12

12. Pressure ridges and fractures formed in pavement N30°W; estimated 2 cm of right-lateral displacement of pavement

26. At least 5 m wide zone with three or more fractures up to 5 mm wide, N38°W

27. Prominent discontinuous left stepping fractures in soil, N55°W

28. Fracture zone in soil N48°W, 20mm of both vertical displacement and extension, 11 mm of right lateral displacement, down to SW

29. Three principal cracks in pavement (1 m wide zone). White line in pavement had 20 mm of right-lateral displacement, 40 mm extension and 30 mm of vertical displacement (SW side down) mm of extension, and 30 mm of vertical displacement

30. Fracture zone in soil about 45m long, N45°W. Right-lateral displacement was 13 mm, extension was 24 mm, and no vertical component was observed

31. Fracture zone in soil about 27 m long, N45°W. Right-lateral displacement was about 8mm, vertical displacement down to SW was 27 mm, and extension was about 25 mm. Downslope movement alone would have produced left-lateral displacement

LEGEND

- PG&E Pipeline Alignments
- 🟥 PG&E Fault Crossing (Updated 2016)
- Bonilla et al. (1980) Fractures and Observation Numbers (Approximate Locations)
- Golder photo location (2016)
- Unruh and Sawyer (1998) Traces
- CGS (2012) Fault

Lienkaemper (unpublished) Traces

- ≤20-m uncertainty
- ? ? Queried

PG&E Fault Database v9I (Age of Most Recent Rupture)

- Historical
- Holocene

For All Faults: Solid line where certain, dashed line where uncertain, dotted line where concealed.

DRAFT

0 500 1,000
FEET

0 100 200
METERS

REFERENCE(S)
1. PG&E, 2016 - FAULTS AND ALIGNMENT
2. UNRUH AND SAWYER (1998) - FAULTS
3. BONILLA ET AL. (1980) - 1980 RUPTURES
4. CGS (2012) - FAULTS
5. COORDINATE SYSTEM: NAD 1983 UTM 10 N
6. SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, DELORME, USGS, INTERMAP, INCREMENT P CORP., NRCAN, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), ESRI (THAILAND), MAPMYINDIA, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

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PACIFIC GAS AND ELECTRIC COMPANY

PROJECT
EARTHQUAKE FAULT CROSSINGS PROGRAM

YYYY-MM-DD	2016-11-08
DESIGNED	HJ
PREPARED	HJ
REVIEWED	AH
APPROVED	AH

TITLE
GREENVILLE FAULT TRACES, PIPELINE CROSSINGS, AND FIELD OBSERVATIONS FOLLOWING 1980 EARTHQUAKES

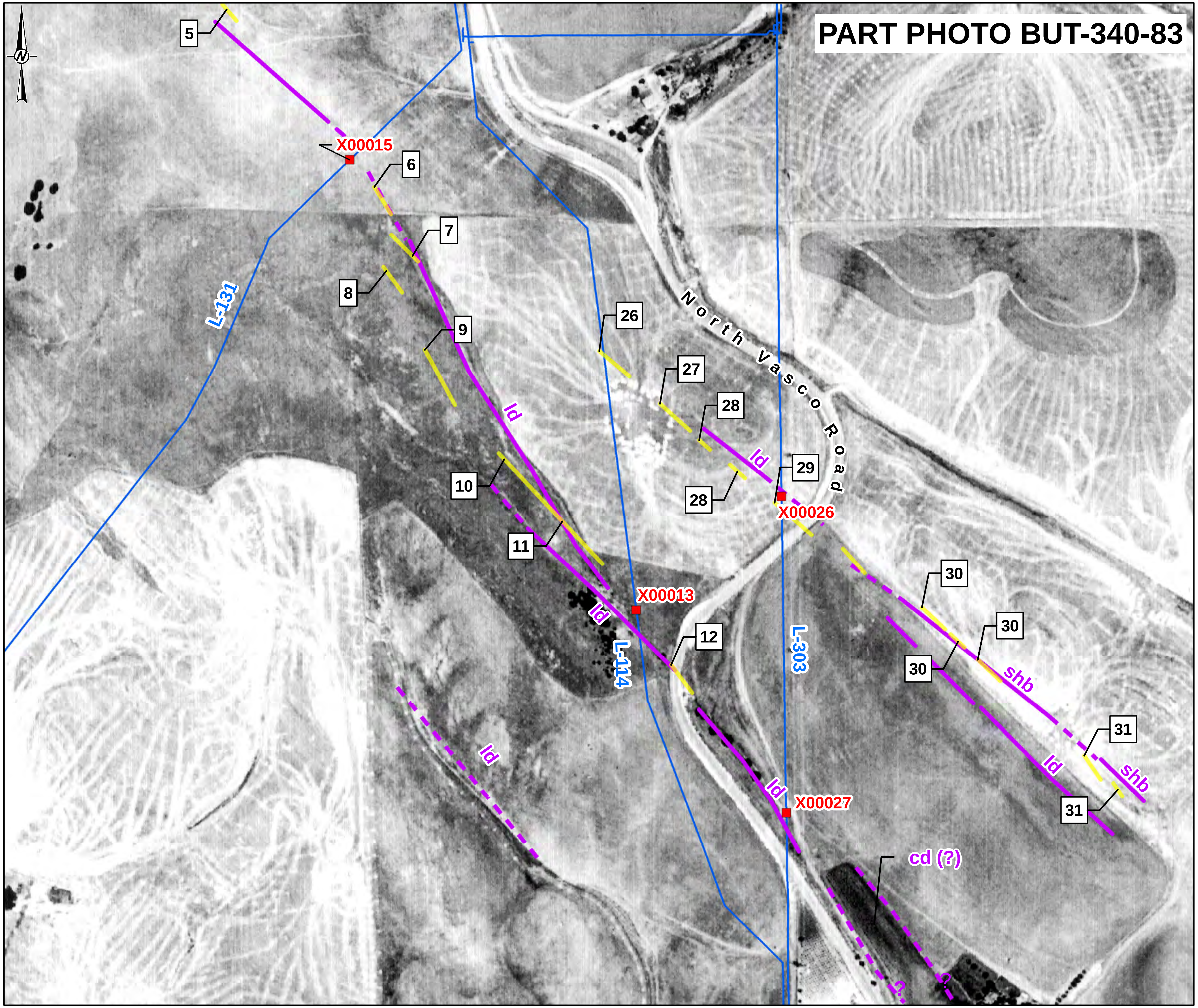
CONSULTANTS

GOLDER PROJECT NO.
140825362

REV.
B

FIGURE
4

0 1 in IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B



LEGEND

- PG&E Pipeline Alignments
- 🟥 PG&E Fault Crossing (Updated 2016)
- Surface Fracture from Bonilla et al. (1980)
- 12 Fracture Number
- Golder Observation (2016)

shb = bench

ld = linear drainage

cd = closed depression

DRAFT

0 500 1,000

FEET

0 100 200

METERS

REFERENCE(S)

1. PG&E (2016)
2. AERIAL PHOTO, UCSB (2016)
3. COORDINATE SYSTEM: NAD 1983 UTM 10 N
4. SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, DELORME, USGS, INTERMAP, INCREMENT P CORP., NRCAN, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), ESRI (THAILAND), MAPMYINDIA, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

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PACIFIC GAS AND ELECTRIC COMPANY

PROJECT
EARTHQUAKE FAULT CROSSINGS PROGRAM

YYYY-MM-DD	2016-11-08
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PREPARED	HJ
REVIEWED	AH
APPROVED	AH

TITLE
INTERPRETATION OF GREENVILLE FAULT TRACES AND 1980 SOIL FRACTURES SURROUNDING PIPELINE CROSSINGS

CONSULTANTS

GOLDER PROJECT NO. 140825362

REV. B

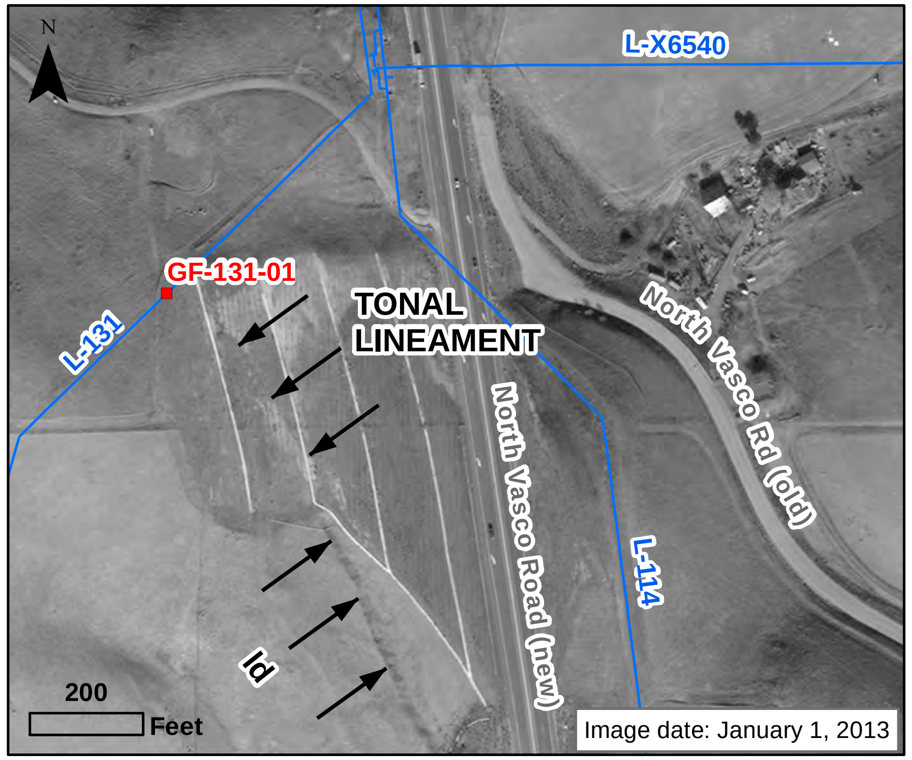
FIGURE **5**

PATH: G:\PacifcGasAndElectric_PGE\PGE_SystemWide_Landslides_Faults\99_PROJECTS\140825362_FaultCrossings_2016\02_PRODUCTION\MXD\FIGURES\Group_2_Reports\Greenville\RevB\140825362_005_F05_RevB_HistoricalAerial_Imagery_GreenvilleFault.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

1 in

0



Aerial image indicating linear drainage and tonal lineament that marks the trace of the Greenville fault main strand northwest of North Vasco Rd (new)

PHOTO 1: View southeast from GF-114-02 to former linear drainage now modified from road construction and erosion protection. Trees mark linear drainage to south of North Vasco Rd (old) (Photo 2)

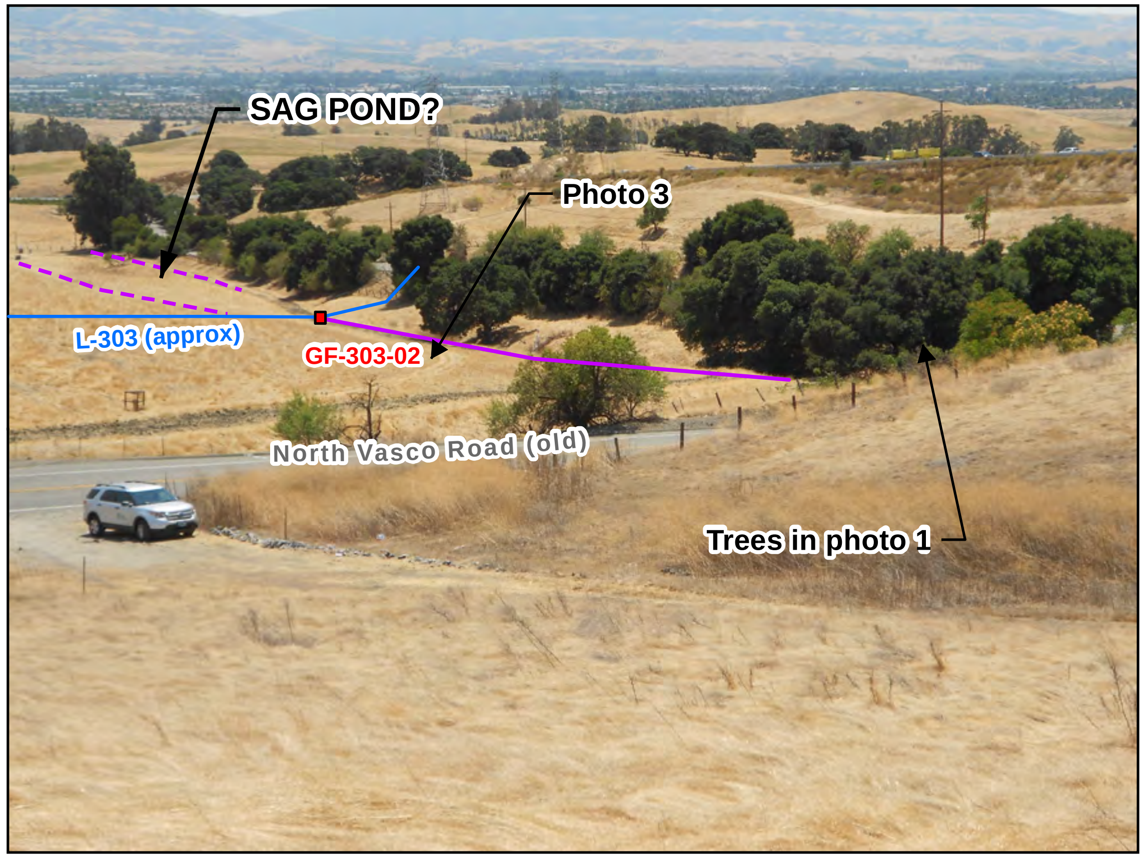


PHOTO 2: View south to Greenville fault main strand adjacent southeast of North Vasco Rd (old)

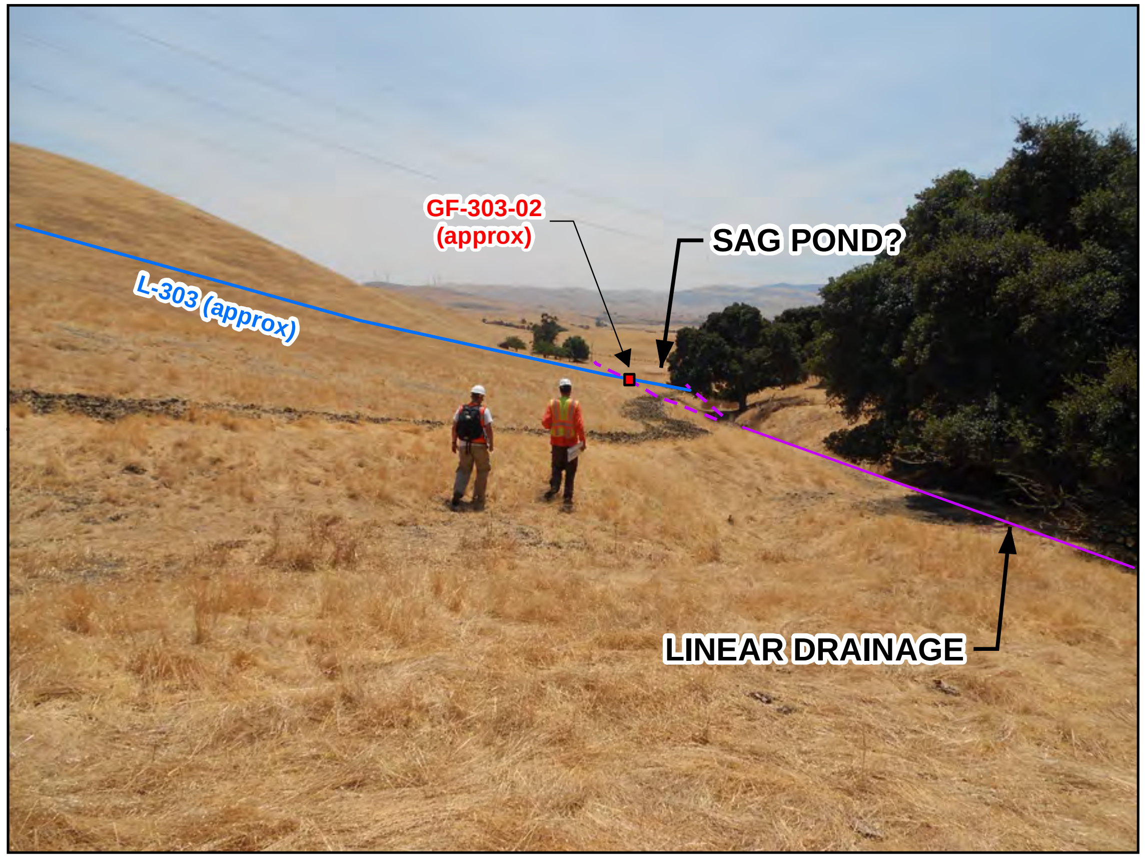


PHOTO 3: View southeast to GF-303-02 and parallel to linear drainage marking Greenville fault main strand. The linear drainage extends southeast to a possible stepover and sag pond

DRAFT

REFERENCE(S)
1. GOLDER (FIELD PHOTOS; DATE TAKEN: 7/28/2016)
2. PG&E (ALIGNMENT)
3. GOOGLE EARTH AERIAL IMAGE (JANUARY 1, 2013)

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YYYY-MM-DD	2016-11-08
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REVIEWED	AH
APPROVED	AH

PROJECT
EARTHQUAKE FAULT CROSSINGS PROGRAM

TITLE
TECTONIC GEOMORPHIC FEATURES SURROUNDING SELECTED PIPELINE CROSSINGS NEAR NORTH VASCO ROAD, ALAMEDA COUNTY

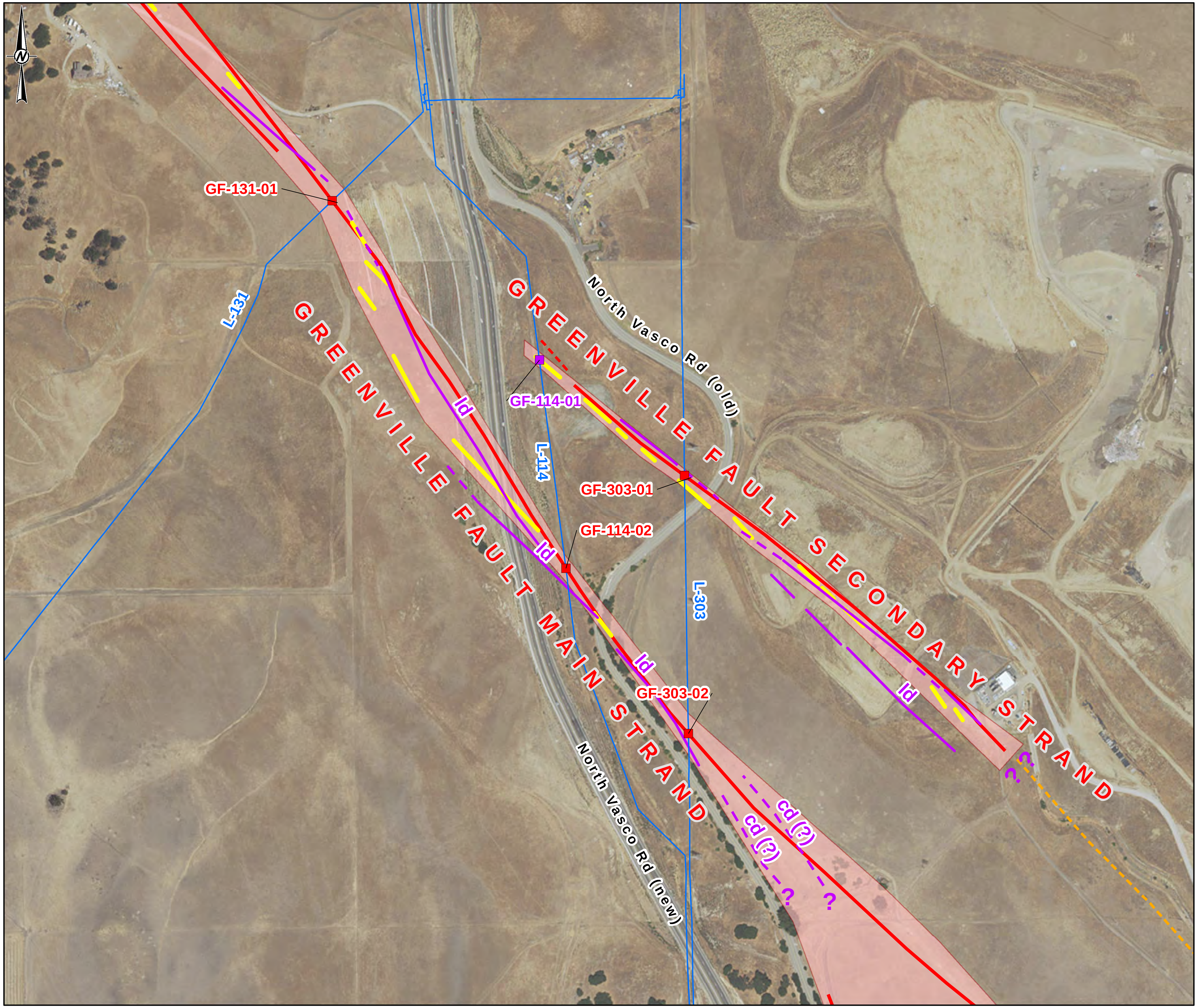
CONSULTANTS
Golder Associates
LCI Lettis Consultants International, Inc. EARTH SCIENCE CONSULTANTS

GOLDER PROJECT NO.
140825362

REV.
B

FIGURE
6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
1 in
0



LEGEND

- PG&E Pipeline Alignments
- 🟥 PG&E Fault Crossing (Updated 2016)
- 🟪 Additional Fault Crossing (2016)
- 1980 Fractures from Bonilla et al. (1980)
- Golder Mapped Traces

PG&E Fault Database v9I (Age of Most Recent Rupture)

- Historical
- Holocene
- ▭ Fault Uncertainty Zone

For All Faults: Solid line where certain, dashed line where uncertain, dotted line where concealed.

DRAFT

0 500 1,000
FEET

0 100 200
METERS

REFERENCE(S)
1. PG&E (2016) - FAULTS AND PIPELINE ALIGNMENTS
2. GOLDER ASSOCIATES (2016) - FAULTS
3. BONILLA ET AL. (1980) - FAULTS
4. COORDINATE SYSTEM: NAD 1983 UTM 10 N
5. SERVICE LAYER CREDITS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY

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APPROVED AH

PROJECT
EARTHQUAKE FAULT CROSSINGS PROGRAM

TITLE
GREENVILLE MAIN AND SECONDARY FAULT STRANDS AT PIPELINE CROSSINGS SHOWING FAULT UNCERTAINTY ZONE AND EXISTING MAPPED FAULT TRACES

CONSULTANTS
Golder Associates
LCI Lettis Consultants International, Inc. EARTH SCIENCE CONSULTANTS

GOLDER PROJECT NO. 140825362
REV. B
FIGURE 7

PATH: G:\PacifcGasAndElectric_PGE\PGE_SystemWide_Landslides_Faults\99_PROJECTS\140825362_FaultCrossings_2016\02_PRODUCTION\MXD\FIGURES\Group_2_Reports\Greenville\RevB\140825362_007_F07_RevB_FieldObservations_GreenvilleFault.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
0 1 in

"Informed Deterministic" Fault Displacement Hazard Analysis Worksheet

Rev. 1, September 16, 2015, SCT (LCI)

USER INPUTS (items in bold within cells)

Displacement Prediction Approach		sum, wts
No. Branches	1	1
Branch No.	Value	Weight
1	From Magnitude	**1**
2	From Paleoslip	0

Magnitude Model		sum, wts
No. Models	1	1
Model No.	Name	On/OFF
1	Mag-Log(Area)	**1**
2	Fixed Magnitude	0

Length, km		sum, wts
No. Branches	3	1
Branch No.	Value	Weight
1	**33.5**	**0.6**
2	**63.7**	**0.3**
3	**91.9**	**0.1**

Thickness, km		sum, wts
No. Branches	1	1
Branch No.	Value	Weight
1	**14.9**	**1**

Dip, deg		sum, wts
No. Branches	3	1
Branch No.	Value	Weight
1	**90**	**0.5**
2	**85**	**0.4**
3	**70**	**0.1**

Mag(Log A) Relation		sum, wts				
No. Branches	3	1	slope1	Intercept1	slope2	Intercept2
Branch No.	Relation	Weight	Value	Value	Value	Value
1	**HB14 Median**	**0.6**	**1**	**3.98**	**1.25**	**3.3**
2	**HB14 + 0.25**	**0.2**	**1**	**4.23**	**1.25**	**3.55**
3	**HB14 - 0.25**	**0.2**	**1**	**3.73**	**1.25**	**3.05**
4	**L10 Median**	**0**	**1**	**4.00**	**1**	**4**
5	**L10 + 0.25**	**0**	**1**	**4.25**	**1**	**4.25**
6	**L10 - 0.25**	**0**	**1**	**3.75**	**1**	**3.75**

Magnitude, Fixed		sum, wts
No. Branches	3	1
Branch No.	Value	Weight
1	**6.8**	**0.1**
2	**7.9**	**0.8**
3	**8.2**	**0.1**
4	**7.25**	**0**
5	**7.5**	**0**
6	**7.7**	**0**

Log(D)=aM+b+/- sigma-total		sum, wts			Sigma (log10 units)				
No. Branches	3	1	Slope	Intercept					
Branch No.	Relation	Weight	a	b	Regression	Alongstrike	Total	Aleatory	Epistemic
1	**WC94, all**	**0.5**	**0.69**	**-4.8**	**0.36**	**0.24**	0.43	**0.22**	0.37
2	**WC94, ss**	**0.2**	**0.9**	**-6.32**	**0.28**	**0.24**	0.37	**0.22**	0.3
3	**HEA13, all**	**0.3**	**0.41**	**-2.79**	**0.33**	**0.24**	0.41	**0.22**	0.35

5-point approx. (MR83)		sum, wts
No. Branches	5	1
Branch No.	probability	wt, prob
1	0.034893	0.10108
2	0.211702	0.24429
3	0.5	0.30926
4	0.788298	0.24429
5	0.965107	0.10108

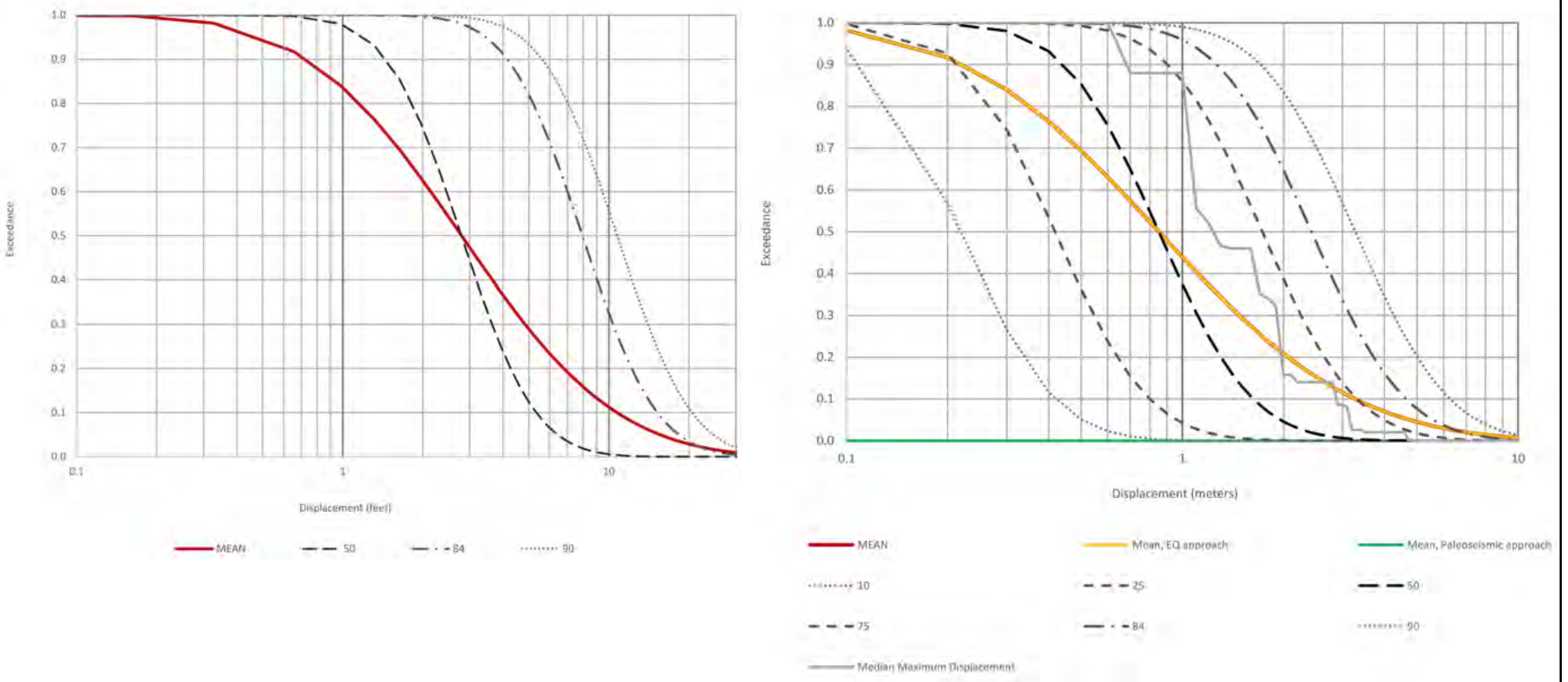
Log(MD)=aM+b+/- sigma		sum, wts			
No. Branches	1	1	Slope	Intercept	Sigma
Branch No.	Relation	Weight	a	b	Regression
1	WC94, all	1	0.82	-5.46	0.42

Paleoseismic slip	**N=1 slip event**	sum, wts		
No. Branches	3	1	Sigma (log10 units)	
Branch No.	Net slip, m	wt., slip	Aleatory	Epistemic
1	**2.1**	**0.3**	0.22	0.22
2	**2.7**	**0.6**	0.22	0.22
3	**5.2**	**0.1**	0.22	0.22

SUMMARY RESULTS (for Mean Hazard Curve)

Exceedance	Percentile	Displacement	
		Meters	Feet
0.90	10	0.22	0.7
0.75	25	0.42	1.4
0.50	50	0.85	2.8
0.25	75	1.73	5.7
0.16	84	2.42	8.0
0.1	90	3.27	10.7

Displacement Exceedance Curves



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PACIFIC GAS AND ELECTRIC COMPANY

PROJECT
EARTHQUAKE FAULT CROSSINGS PROGRAM

YYYY-MM-DD	2016-11-08
DESIGNED	HJ
PREPARED	HJ
REVIEWED	AH
APPROVED	AH

TITLE
INPUT PARAMETERS, RESULTS, AND DISPLACEMENT EXCEEDANCE CURVES FROM APPLICATION OF DFDHA PROCEDURES FOR GREENVILLE FAULT CROSSINGS

CONSULTANTS
Golder Associates
LCI Lettis Consultants International, Inc.

GOLDER PROJECT NO.	REV.	FIGURE
140825362	B	8

Established in 1960, Golder Associates is a global, employee-owned organization that helps clients find sustainable solutions to the challenges of finite resources, energy and water supply and management, waste management, urbanization, and climate change. We provide a wide range of independent consulting, design, and construction services in our specialist areas of earth, environment, and energy. By building strong relationships and meeting the needs of clients, our people have created one of the most trusted professional services organizations in the world.

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North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

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Walnut Creek, CA 94598 USA
Tel: (925) 956-4800
Fax: (925) 956-4801

Engineering Earth's Development, Preserving Earth's Integrity

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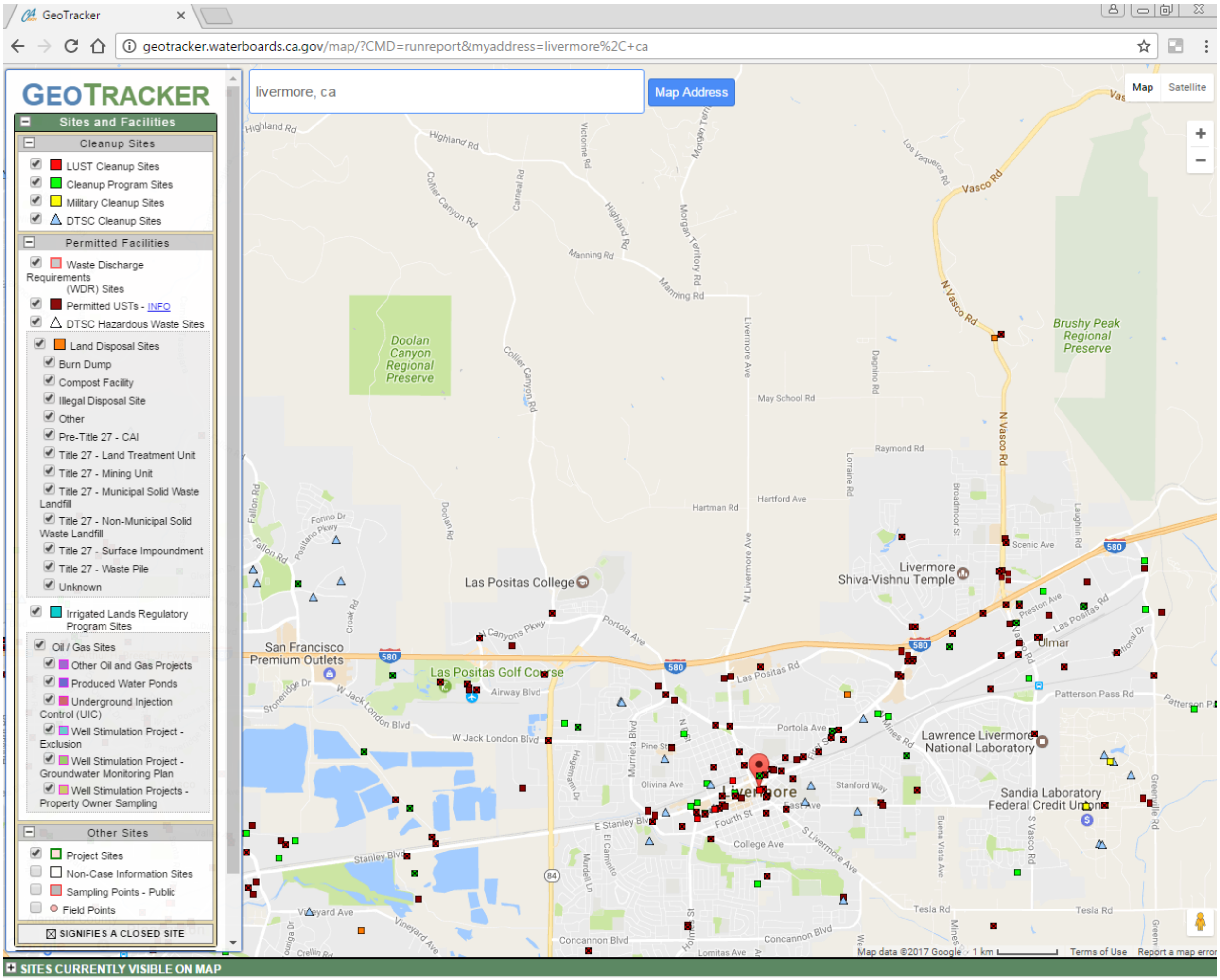
Appendix G

Hazmat Database Results



GeoTracker

geotracker.waterboards.ca.gov/map/?CMD=runreport&myaddress=livermore%2C+ca

livermore, ca

GEOTRACKER

Sites and Facilities

Cleanup Sites

- ☑ 🟥 LUST Cleanup Sites
- ☑ 🟩 Cleanup Program Sites
- ☑ 🟨 Military Cleanup Sites
- ☑ △ DTSC Cleanup Sites

Permitted Facilities

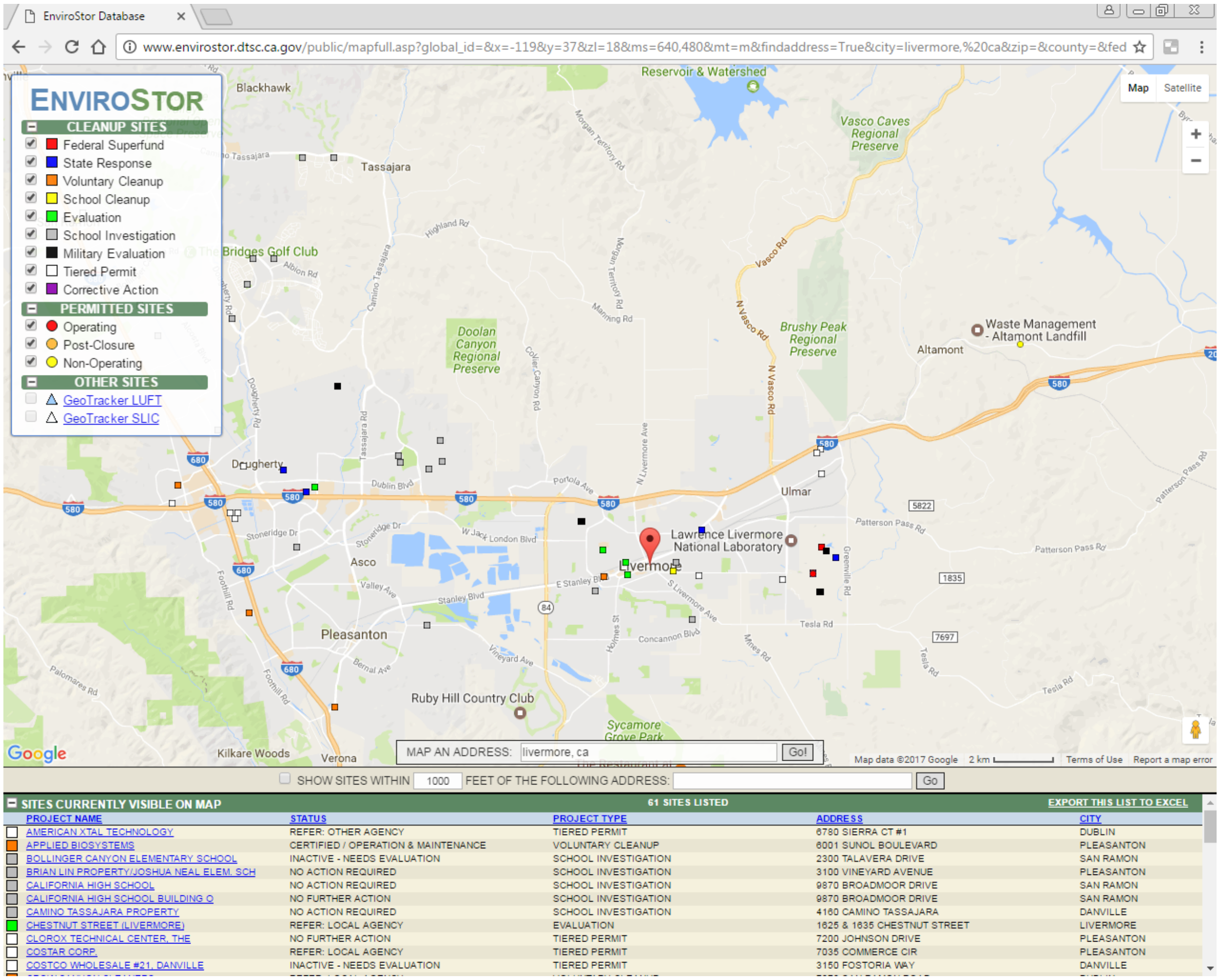
- ☑ ▨ Waste Discharge Requirements (WDR) Sites
- ☑ 🟥 Permitted USTs - INFO
- ☑ △ DTSC Hazardous Waste Sites
- ☑ 🟧 Land Disposal Sites
  - ☑ Burn Dump
  - ☑ Compost Facility
  - ☑ Illegal Disposal Site
  - ☑ Other
  - ☑ Pre-Title 27 - CAI
  - ☑ Title 27 - Land Treatment Unit
  - ☑ Title 27 - Mining Unit
  - ☑ Title 27 - Municipal Solid Waste Landfill
  - ☑ Title 27 - Non-Municipal Solid Waste Landfill
  - ☑ Title 27 - Surface Impoundment
  - ☑ Title 27 - Waste Pile
  - ☑ Unknown
- ☑ 🟦 Irrigated Lands Regulatory Program Sites
- ☑ Oil / Gas Sites
  - ☑ 🟪 Other Oil and Gas Projects
  - ☑ 🟪 Produced Water Ponds
  - ☑ 🟥 Underground Injection Control (UIC)
  - ☑ 🟦 Well Stimulation Project - Exclusion
  - ☑ 🟩 Well Stimulation Project - Groundwater Monitoring Plan
  - ☑ 🟨 Well Stimulation Projects - Property Owner Sampling

Other Sites

- ☑ ☐ Project Sites
- ☐ ☐ Non-Case Information Sites
- ☐ ▨ Sampling Points - Public
- ☐ ● Field Points

☒ SIGNIFIES A CLOSED SITE

SITES CURRENTLY VISIBLE ON MAP



www.envirostor.dtsc.ca.gov/public/mapfull.asp?global_id=&x=-119&y=37&zl=18&ms=640,480&mt=m&findaddress=True&city=livermore,%20ca&zip=&county=&fed

MAP AN ADDRESS: livermore, ca

☐ SHOW SITES WITHIN 1000 FEET OF THE FOLLOWING ADDRESS:

SITES CURRENTLY VISIBLE ON MAP 61 SITES LISTED EXPORT THIS LIST TO EXCEL

	PROJECT NAME	STATUS	PROJECT TYPE	ADDRESS	CITY
☐	AMERICAN XTAL TECHNOLOGY	REFER: OTHER AGENCY	TIERED PERMIT	6780 SIERRA CT #1	DUBLIN
🟧	APPLIED BIOSYSTEMS	CERTIFIED / OPERATION & MAINTENANCE	VOLUNTARY CLEANUP	6001 SUNOL BOULEVARD	PLEASANTON
▨	BOLLINGER CANYON ELEMENTARY SCHOOL	INACTIVE - NEEDS EVALUATION	SCHOOL INVESTIGATION	2300 TALAVERA DRIVE	SAN RAMON
▨	BRIAN LIN PROPERTY/JOSHUA NEAL ELEM. SCH	NO ACTION REQUIRED	SCHOOL INVESTIGATION	3100 VINEYARD AVENUE	PLEASANTON
▨	CALIFORNIA HIGH SCHOOL	NO ACTION REQUIRED	SCHOOL INVESTIGATION	9870 BROADMOOR DRIVE	SAN RAMON
▨	CALIFORNIA HIGH SCHOOL BUILDING O	NO FURTHER ACTION	SCHOOL INVESTIGATION	9870 BROADMOOR DRIVE	SAN RAMON
▨	CAMINO TASSAJARA PROPERTY	NO ACTION REQUIRED	SCHOOL INVESTIGATION	4160 CAMINO TASSAJARA	DANVILLE
🟩	CHESTNUT STREET (LIVERMORE)	REFER: LOCAL AGENCY	EVALUATION	1625 & 1635 CHESTNUT STREET	LIVERMORE
☐	CLOROX TECHNICAL CENTER, THE	NO FURTHER ACTION	TIERED PERMIT	7200 JOHNSON DRIVE	PLEASANTON
☐	COSTAR CORP.	REFER: LOCAL AGENCY	TIERED PERMIT	7035 COMMERCE CIR	PLEASANTON
☐	COSTCO WHOLESALE #21, DANVILLE	INACTIVE - NEEDS EVALUATION	TIERED PERMIT	3150 FOSTORIA WAY	DANVILLE

Cortese List Data Resources

Below are the data resources that provide information regarding the facilities or sites identified as meeting the "Cortese List" requirements.

- List of Hazardous Waste and Substances sites from Department of Toxic Substances Control (DTSC) EnviroStor database
- List of Leaking Underground Storage Tank Sites by County and Fiscal Year from Water Board GeoTracker database
- List of solid waste disposal sites identified by Water Board with waste constituents above hazardous waste levels outside the waste management unit (PDF).
- List of "active" CDO and CAO from Water Board (MS Excel, 1,453 KB). PLEASE NOTE: This list contains many Cease and Desist Orders and Cleanup and Abatement Orders that do NOT concern the discharge of wastes that are hazardous materials. Many of the listed orders concern, as examples, discharges of domestic sewage, food processing wastes, or sediment that do not contain hazardous materials, but the Water Boards' database does not distinguish between these types of orders. If there is a question about whether a specific order concerns the discharge of wastes that are hazardous materials, please contact the applicable Regional Water Board.
- List of hazardous waste facilities subject to corrective action pursuant to Section 25187.5 of the Health and Safety Code, identified by DTSC.

For more information regarding the "Cortese List" statute, go to Background and History.

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