JUNE 30, 2015

PRELIMINARY GEOTECHNICAL ASSESSMENT REPORT TRANSMISSION MAINS MONTEREY PENINSULA WATER SUPPLY PROJECT MONTEREY COUNTY, CALIFORNIA

Prepared for

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June 30, 2015
Project 26818632.31000

Mr. John Kilpatrick
California American Water Company
511 Forest Lodge Road, Suite 100
Pacific Grove, California 93950

Subject: Preliminary Geotechnical Assessment Report
Transmission Mains
Monterey Peninsula Water Supply Project
Monterey County, California

Dear Mr. Kilpatrick,

AECOM is pleased to provide California American Water (CAW) with this preliminary geologic hazards and geotechnical assessment report for the transmission mains component of the proposed Monterey Peninsula Water Supply Project (MPWSP). The transmission mains will deliver product water from a proposed desalination plant in northern Marina to CAW's existing water distribution network throughout the Monterey Peninsula.

The purpose of this preliminary study is to provide and overview of the geologic, seismic and subsurface conditions along the project alignment and at locations where above ground facilities are planned, and to identify potential geologic/seismic hazards as well as geotechnical engineering considerations.

It has been a pleasure working with you on the initial design of this important project, and we look forward to providing continued assistance. Please contact our office if you have any questions or if we can be of further service.

Sincerely,

REGISTERED PROFESSIONAL ENGINEER PAUL J. BODDIE 152 Exp 3/31/2016 GEOTECHNICAL STATE OF CALIFORNIA

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TABLE OF CONTENTS

List of Tables

List of Figures

AECOM is pleased to provide California American Water (CAW) with this preliminary geologic hazards and geotechnical assessment report for the transmission mains component of the proposed Monterey Peninsula Water Supply Project (MPWSP).

1.1 PROJECT DESCRIPTION

CAW has selected AECOM to provide assistance in completing the preliminary design, permitting, easement development and easement acquisition for three components of the MPWSP. The three components are the transmission mains, Terminal Reservoir, and extension of the Aquifer Storage and Recovery (ASR) system. The transmission mains will deliver product water from a proposed Desalination Plant in northern Marina to CAW's existing water distribution network. The Terminal Reservoir will provide additional storage for the system and set a higher hydraulic grade for customers in Seaside. The ASR system will inject desalinated and excess Carmel River water into the Seaside Groundwater Basin during the winter months and extract the water during the summer months. The project will consist of several pipeline segments as shown on Figures 1-1 through 1-5 and as described below. The actual pipeline diameters and final lengths are still preliminary and are subject to revision.

The Transmission Mains will have the following components:

1. *Brine Pipeline*: Approximately 3,800 lineal feet (LF), 36 inches in diameter. This pipeline will convey brine water from the Desalination Plant to the Regional Wastewater Treatment Plant. It will be located within Coastal Zone One.
2. *Salinas Valley Return Pipeline*: Approximately 5,700 LF, 12 inches in diameter. This pipeline will convey water from the Regional Wastewater Treatment Plant to the Desalination Plant. It will be located within Coastal Zone One.
3. *Cemex Feed Water Pipeline*: Approximately 11,500 LF, 42 inches in diameter. This pipeline will convey salt water from the intake wells on the coast to the Desalination Plant. There is one jack and bore location along the alignment. It will be located within Coastal Zone One.
4. *Transfer Pipeline*: Approximately 49,500 LF, 36 inches in diameter. The Transfer Pipeline will deliver product water from the Desalination Plant to the existing 30 inch shared pipeline. The Transfer Pipeline will begin at the proposed Desalination Plant and connect to the shared pipeline approximately 1,100 LF south of the intersection of General Jim Moore Blvd and Coe Avenue in Seaside. There are four jack and bore locations along the alignment.
5. *Monterey Pipeline*: Approximately 35,200 LF, 36 inches in diameter. The Monterey Pipeline delivers product water from the Desalination Plant and extracted water from the ASR system to a connection point at the abandoned Eardley pump station in Pacific Grove. The Monterey Pipeline will be designed to operate in both directions. During certain scenarios, the Monterey Pipeline will also be used to deliver water from Forest Lake Reservoir to the ASR system for injection. The Monterey Pipeline alignment begins at a connection point near the intersection of Hilby Avenue and Yosemite Street in Seaside, continues west on Hilby Avenue, through Seaside and south through several streets in the City of Monterey, across the Presidio of

Monterey, and then terminates at Sinex Avenue in Pacific Grove. The pipeline will be installed in a new pipe bridge across Highway 68 in Monterey, spanning approximately 300 LF.

The Terminal Reservoir consists of the following components:

1. *Terminal Reservoirs:* Two, 3-million gallon (MG), pre-stressed concrete tanks.
2. *Inlet and Outlet Pipes:* The reservoir will feature separate inlet and outlet piping. Each pipe will be 16 inches in diameter and approximately 2,950LF in length.
3. *Overflow Pipe*: The overflow pipe will be 30 inches and diameter and approximately 900 LF in length. The pipe will direct overflow volumes to a nearby (future) soccer field.

The ASR Extension consists of the following components:

1. *ASR Extension*: The existing ASR piping will be extended to connect to two new ASR injection/extraction wells located at Fitch Park. The extension consists of three, 16-inch diameter pipelines, approximately 4,300 LF (each) in length. The ASR wells will be used to inject/extract water from the Seaside Basin Aquifer.

The pipelines will be constructed primarily by cut-and-cover methods with the depth of excavation expected to typically be on the order of 8 feet below grade. Deeper cuts may be necessary in areas with a sudden change in topography, at drainage channel crossings and at roadway crossings. Jack-and-bore construction methods will be required beneath four railway crossings as well as one crossing beneath State Route 1, under the jurisdiction of Caltrans District 5.

1.2 PURPOSE OF THE STUDY

The purpose of this study is to provide a preliminary characterization of the geologic, seismic and subsurface conditions along the project alignment and at locations where above ground facilities are planned, and to identify potential geologic/seismic hazards as well as geotechnical engineering considerations, including:

- Geologic setting;
- Subsurface soil and geologic conditions;
- General groundwater conditions;
- Potential geologic hazards, including faulting, ground motions, liquefaction, landslides, tsunami, and potentially corrosive soils;
- Pipeline construction considerations, including:
  - excavation characteristics
  - trench stability
  - dewatering
  - trenchless construction considerations

1.3 SCOPE OF WORK

The scope of work for the current phase included review of available geologic information from published maps and reports, Caltrans Log of Test Borings (LOTBs) from nearby bridge structures, review of available geotechnical consultant reports, geologic reconnaissance along the pipeline alignments, engineering evaluations, and preparation of this report. The preliminary investigation included the following key tasks:

- Perform a literature review of published geologic maps, reports, and previous nearby geotechnical investigations;
- Perform a site reconnaissance and geologic mapping along the proposed pipeline alignments;
- Prepare geologic maps based on literature review, reconnaissance and mapping;
- Prepare a summary of the various soil materials and groundwater conditions expected along the project alignment;
- Develop opinions regarding geologic hazards and preliminary geotechnical engineering design considerations; and
- Prepare this preliminary report.

No subsurface investigations were completed as part of this study. Geotechnical investigations were completed for the Desalination Plant site in northern Marina by URS Corporation (2013) and for the Terminal Reservoir site east of Seaside by AECOM (2015a). The results of these investigations are included in separate project reports. A separate geotechnical memorandum, which includes the logs of previous Caltrans' Log of Test Boring (LOTB) information, was prepared for the five jack-and-bore crossings along the Transfer pipeline and the Cemex Feed Water pipelines (AECOM, 2015b). Future subsurface investigations, laboratory testing, and engineering analysis are expected to be completed by the Contractor during the final design of the project.

1.4 DATA REVIEW AND SITE RECONNAISSANCE

A review of available sources of information and data relevant to the project geologic and seismic conditions was completed prior to performing the site reconnaissance. Sources of information included geologic maps of the project area completed mainly by the U.S. Geological Survey (USGS) and the California Geological Survey (CGS), formerly the California Division of Mines and Geology. Geologic, seismic and flood hazard maps available on-line from the Monterey County General Plan (2010) were also reviewed.

Over forty existing geotechnical reports completed in the vicinity of the pipeline alignments were obtained and reviewed to evaluate the subsurface and groundwater conditions in addition to the geotechnical investigations completed by URS Corporation (now AECOM) for the Desalinization Plant and the Terminal Reservoir site. A list of these reports, along with brief descriptions of the subsurface conditions, are referenced and included in Table 1. These previous reports were prepared mainly by Terratech, Dames & Moore and D&M Consulting Engineers, Inc., all legacy AECOM companies. Also included were reports by Geotechnical Consultants, Inc. for the Monterey Regional Wastewater Plant, a preliminary geotechnical report by Ninyo & Moore for the Monterey County Coastal Water Project in 2005, which is a predecessor to the current project, and a geotechnical report for the Monterey Peninsula Light

Rail Project by Kleinfelder (2011), which parallels a portion of the current project alignment. Other geotechnical projects by Woodward-Clyde Consultants (also a legacy AECOM company), Pacific Crest, Reynolds & Associates, and CH2M Hill were also obtained and reviewed. LOTBs for bridge structures available from Caltrans were also reviewed and are included in Table 1. The approximate locations of these previous investigations are shown on the Site Plan and Geologic Map (Figures 1-1 through 1-5).

A geologic site reconnaissance of the project alignment was completed on May 16, 2013 by Mark Schmoll, CEG, where access was available. During the site reconnaissance field notes and photographs were taken along the various pipeline alignments, and geologic contacts from published reports were field-checked where exposures of the geologic units were present.

2.1 REGIONAL GEOLOGIC AND SEISMIC SETTING

The project site extends from the northern limits of Marina, located in the northern Salinas Valley, southward into the Monterey Peninsula to Pacific Grove. Both the Salinas Valley and the Monterey Peninsula lie within the western margin of the Coast Ranges Geomorphic Province, at the northern end of the Santa Lucia Range. The Coast Ranges are generally characterized by northwest trending mountain ranges and intervening valleys. The Monterey Peninsula is located on the Salinian block, a tectonic terrain that is underlain by relatively competent basement rocks consisting of Cretaceous granitic intrusives and pre-Cretaceous metamorphic rocks (Page, 1970). The Cretaceous granitic basement rocks are present at or just below the surface over much of the Monterey Peninsula and Pacific Grove area, including portions of the Monterey Pipeline alignment. These older basement rocks are, in turn, partially overlain by the Miocene (24 million years to 5 million years before present) Monterey Shale, Pleistocene (2.6 million years to 11,700 years BP) marine terrace deposits, dune deposits, and Holocene (11,700 years to present) alluvium (Clark, et al., 1997; Wagner, et al., 2002).

As the Monterey Pipeline extends east and northeast into Sand City and Seaside, it enters into the west margin of the Salinas Valley. Four major geologic units have been identified within the western portion of the Salinas Valley (Wagner, et al., 2002) including Cretaceous granodiorite basement rock, the Miocene Monterey Formation, Pliocene to Pleistocene Paso Robles Formation, and Pleistocene to Holocene valley fill deposits. The valley fill deposits include a suite of coastal and near shore Quaternary deposits that will underlie the various pipeline segments and surface facilities that are located north and east of downtown Monterey and include relic (old) dune deposits, marine terrace deposits, alluvium, estuary deposits, and man-made fill. The depth to the granitic bedrock in the northern portion of the project area near Marina is expected to be over 1,000 feet.

The geology of the Monterey and Seaside 7.5 minute quadrangles, which include the southern portion of the project site, has been mapped by the USGS, CGS and other researchers (Clark, et al., 1974; Clark, et al., 1997, Dupre, 1990; and Wagner, et al., 2002). The geology of the northern portion of the project site, within the Marina 7.5 minute quadrangle, is included within the Monterey 30’ X 60’ quadrangle that has been mapped by the CGS (Wagner, et al., 2002) and the USGS (Dupre and Tinsley, 1980). The geologic map of the Marina 7.5 minute quadrangle (Dibblee and Minch, 2007) also covers the northern project site.

The Monterey Bay and Salinas Valley are in one of the most seismically active regions in the United States, dominated by the active San Andreas Fault System. The San Andreas Fault System is the boundary of the North American Plate (east of the fault) and Pacific Plate (west of the fault). The tectonic plate movement is distributed along a complex system of generally northwest-trending, parallel and subparallel, right lateral strike-slip faults. The San Andreas Fault System controls the geologic structure and geomorphic expression of the region. Several large active faults and numerous potentially active faults occur in this region including some that have experienced Holocene movement; therefore, they are judged to be active faults and potential sources of surface rupture. These include the Chupines fault zone, a complex north-northwest-trending fault zone up to 3 km wide that includes the Chupines, Seaside and Ord Terrace faults (USGS, 2010) and the Monterey Bay-Tularcitos fault zone (MBTFZ) located south and west of the Chupines fault zone mainly on the Monterey Peninsula and in Monterey Bay. The Monterey Bay-Tularcitos fault zone includes a complex north-northwest-trending fault zone up to 15 km wide that includes the Navy, Monterey Bay, Hatton Canyon, Berwick Canyon and Sylvan thrust faults. Some investigators include the Chupines fault zone within the MBTFZ (CGS, 2002).

2.2 SURFACE CONDITIONS

2.2.1 Monterey Pipeline

The Monterey Pipeline will be approximately 35,200 LF in length and 36 inches in diameter, based on preliminary designs. It extends from the abandoned Eardley Pump Station in Pacific Grove, where it will connect to CAW's existing water distribution network and end at a connection point in Seaside west of the Terminal Reservoir at the intersection of Hilby Avenue and Yosemite Street. Starting at the Eardley Pump Station on the Monterey Peninsula, the alignment trends southeast along Sinex Avenue in Pacific Grove and then turns northeast for a block along Withers Avenue before turning southeast again on Cypress Street, entering the City of Monterey. The alignment follows Cypress Street through residential neighborhoods for three blocks until turning northeast onto Hoffman Avenue trending downhill for about six blocks. The alignment turns southeast onto Spencer Street for about four blocks, reaching the Presidio of Monterey at Fitch Avenue. The alignment turns onto Stillwell Avenue through the Presidio, and then turns onto High Street as it exits the Presidio on the south side. The alignment then turns southeast onto Jefferson Street, again through residential neighborhoods, jogs southwest on Monroe Street for about two blocks and then turns southeast onto Madison Street, going downhill into the downtown Monterey area and off of the elevated Monterey peninsula.

Near Station 126+00 the alignment crosses Pacific Avenue and turns east onto Polk Street, southeast onto Hartnell Street, northeast onto Webster Street and then southeast onto Munras Avenue, passing by commercial and office buildings of downtown Monterey. The alignment turns east and then southeast onto Fremont Street, passing along the south side of El Estero Park. The section along the south side of El Estero Park has the lowest ground surface elevation along the alignment, ranging from about 10 to 15 feet. The pipeline alignment then turns onto Aguajito Road, gradually climbs in elevation and crosses State Route 1, and then follows Mark Thomas Drive, over the Highway 68/State Route 1 interchange on a 300-foot pipe bridge and then follows Fairgrounds Road. The alignment continues along Fairgrounds Road for a few blocks and then jogs north onto Fremont Street again at either Case Verde Way or Airport Road. The alignment continues east and northeast along Fremont Street, crosses Canyon Del Rey Boulevard into Seaside and then turns east onto Hilby Avenue, gradually gaining elevation through residential neighborhoods until it connects to the Terminal reservoir Inlet/Outlet pipeline at the intersection of Hilby Avenue and Yosemite Street.

2.2.2 Transfer Pipeline

The Transfer Pipeline is 49,500 LF and 36 inches in diameter and extends from a connection point with the shared pipeline west of existing ASR wells 1 and 2 on General Jim Moore Boulevard, about 1,100 feet south of Coe Avenue. The alignment trends north along General Jim Moore Boulevard reaching about elevation 360 feet and then turns west onto Lightfighter Drive, gradually descends in elevation, crosses under State Route 1 a few hundred feet north of the State Route 1/ Lightfighter Drive overpass in a jack-and-bore crossing and turns north along the Transportation Agency for Monterey County (TAMC) right-of-way.

The alignment continues along the TAMC right-of-way through old dune deposits west of State Route 1 and the City of Marina and east of Beach Range Road. The alignment crosses under one set of tracks in a jack-and-bore crossing at about Station 188+00 and continues along the east side of the TAMC right-of-way. Near Station 280+00 the alignment passes under State Route 1 at the South Marina Overhead along the west shoulder of Del Monte Boulevard within the TAMC right-of-way, where the alignment enters into mixed business and residential areas of Marina. The alignment continues within the TAMC right-of-way between Del Monte Boulevard and crosses the tracks in a jack-and-bore crossing about Station 288+00 and then continues along the west side of the TAMC right-of-way. The alignment reaches a low point at about Elevation 15 feet near Station 325+00 north of Reservation Road and adjacent to a small lake at Locke-Paddon Park west of the proposed pipeline. The ground surface elevation gradually climbs north of this point and the alignment leaves the developed area of Marina at about Station 380+00. At about Station 393+00, the pipeline crosses under the railroad track by jack-and-bore and continues along the east side of the TAMC right-of-way and west of Lapis Road through undeveloped older dune deposits. Approximately 2,300 feet south of the Salinas River the alignment turns east leaving the TAMC right-of-way, following a dirt road for about 4,800 feet into the Desalination Plant site and its termination point.

2.2.3 Cemex Feed Water Pipeline

The Cemex Feed Water Pipeline will be approximately 11,500 LF and 42 inches in diameter. It will extend from a connection point west of State Route 1 by the Cemex Plant and convey salt water from the intake wells to the Desalination Plant. The alignment follows Lapis Spur Road and trends northeast passing under State Route 1 and then into the TAMC right-of-way where is crosses under the tracks in a jack-and-bore crossing and then turns north along the west shoulder of Lapis Road, still within the TAMC right-of-way and parallel to the Transfer pipeline. Approximately 2,300 feet south of the Salinas River the alignment turns east, leaving the TAMC right-of-way, parallels the Transfer pipeline and follows a dirt road for about 4,800 feet into the Desalination Plant site and its termination point. The alignment passes through older dune deposits along the entire length. No development other than the Cemex sand plant, existing roads and railroads, and agricultural fields are present along this alignment.

2.2.4 Brine Pipeline

The Brine Pipeline will be approximately 3,800 LF in length and 36 inches in diameter. It extends from the Desalination Plant and coveys brine water to the Regional Wastewater Treatment Plant. After exiting the Desalination Plant, the alignment follows Charles Benson Road, jogging southeast and southwest until it reaches the treatment plant site. Elevations along the alignment range from about 90 to 110 feet and it passes through older dune deposits.

2.2.5 Salinas Valley Return Pipeline

The Salinas Valley Return Pipeline will be approximately 5,700 LF and 12 inches in diameter. It will begin at the Regional Wastewater Treatment Plant and return treated water to the Desalination Plant. This pipeline alignment follows the same route as the Brine Pipeline along Charles Benson Road, but extends a few hundred farther to the treated water pond at the treatment plant site. Elevations along the alignment range from about 90 to 150 feet.

2.2.6 Terminal Reservoir Pipelines

Separate inlet and outlet pipelines connect the terminal reservoirs to the distribution system. These two parallel pipelines are 2,950 LF and 16 inches in diameter and extend from a connection point near Hilby Avenue and Yosemite Street and trend east and north into the Terminal Reservoir site. An overflow pipeline will also extend from the reservoirs south to an overflow basin (future playing fields). This pipeline will be 900 LF and 30 inches in diameter. All of these pipelines are located within older dune deposits on the former Fort Ord and were characterized during Terminal Reservoir geotechnical investigation (AECOM, 2015a).

2.2.7 ASR Extension Pipelines

Three new pipelines will supplement the existing ASR piping. The pipelines will be 4,300 LF and 16 inches in diameter and will be extended to connect to two new ASR injection/extraction wells located at Fitch Park. These pipelines are located along General Jim Moore Boulevard and parallel the Transfer pipeline from about Station 35+00 to 78+00, passing through Older dune deposits.

2.3 GEOLOGIC UNITS

The various pipeline segments will cross a wide range of geologic units, including:

- Fill and surficial soils;
- Quaternary-age alluvium, flood plain and basin deposits;
- Quaternary-age stabilized and older sand dune deposits;
- Quaternary-age marine terrace deposits;
- Tertiary-age Monterey Shale, and;
- Cretaceous-age basement granitic rocks.

The geologic units expected to be encountered are described below. The areal extents of the geologic units, with the exception of the surficial soils and fill (unless widespread and shown on published geologic maps), are shown on the geologic map (Figures 1-1 through 1-5). This map is based on published USGS geologic maps by Dupre (1990) for the area from Pacific Grove to north of Seaside, and by Dupre and Tinsley (1980) for the area from Marina to the Desalination Plant. The anticipated geologic formation, liquefaction susceptibility and estimated depth to groundwater are presented in Tables 2 through 8 for those pipeline segments, based on the pipeline stationing shown on Figures 1-1 through 1-5. These tables also refer to nearby previous investigations that were reviewed to evaluate the subsurface conditions as listed on Table 1. The following geologic unit descriptions are summarized from the above-referenced published geologic maps.

2.3.1 Fill and Surficial Soils (unmapped)

Fills placed for railway and roadway embankments, as utility trench backfill, and canyon fills will be encountered throughout the proposed alignments. The majority of the roadway fill and utility trench backfill are relatively shallow (less than 5 feet deep) and are not shown on the geologic map. However, relatively deep fill soils that are widespread have been shown on the geologic map as canyon fills in the downtown Monterey area, and adjacent to El Estero Lake, Del Monte Lake and Roberts Lake along the Monterey Pipeline segment. The fills can be expected to have a wide variety of soil types ranging from silt and clay to gravel and possibly concrete, timbers, and boulders or old rip rap in some of the older fills in the downtown Monterey and waterfront areas.

In areas undisturbed by grading and site development, surficial soil generally overlies the formational materials. The surficial soils range in thickness from less than a foot to several feet and generally consist of silty to clayey sand where developed on the younger and older dune deposits, and consist of sandy lean to fat clay on the other formations. The actual depth, characteristics, and extent of the surficial soils should be evaluated during the final design geotechnical investigation. No subsurface exploration was performed for this preliminary study.

2.3.2 Beach Sand (Qbs)

Beach sand deposits occur as a thin strip along the active shoreline of Monterey Bay. No pipeline alignments are located within the beach sand deposits. The beach sand consists of unconsolidated, well-sorted fine- to coarse-grained sand with lenses of rounded gravel and cobbles.

2.3.3 Dune Sand (Qds)

Dune sand deposits occur as a linear strip of active dunes just inland of the beach sand deposits. These have been mapped only in the northern portion of the project area west of where the Cemex Feedwater Pipeline will connect to the intake wells, but they are not crossed by the current pipeline alignment. The dune sand consists of well-sorted, fine to medium-grained sand with little or no soil development. The dune sand is subject to rapid erosion where vegetation is absent or has been disturbed.

2.3.4 Flandrian Dune Deposits (Qfd)

Dune sand deposits that occur as a belt of parabolic stabilized dunes, just inland of the beach sand deposits, ranging up to 2,000 feet in width are described by Cooper (1967) as the "Flandrian" dune deposits. These deposits are associated with the general rise in sea level that began about 18,000 to 19,000 years ago. These deposits occur as a continuous strip along the coast from the Salinas River almost to the downtown area of Monterey. The Transfer Pipeline is located just east of the Flandrian dune deposits between Seaside and Marina where it parallels the TAMC right-of-way. The characteristics of the Flandrian dune deposits are similar to the dune sand described above, except that they are presently stabilized. However, they are subject to rapid erosion where vegetation is disturbed.

2.3.5 Basin Deposits (Qb)

The basin deposits occur in estuaries, lagoons, tidal flats and lakes throughout the project area including the low-lying farmlands along the Salinas River and within and adjacent to the lakes between downtown Monterey and Seaside where they are partially overlain by fill soils. The basin deposits consist of silt and clay with interbeds of fine sand and organic material.

2.3.6 Younger Floodplain Deposits (Qyf)

Younger floodplain deposits have been mapped along the margins of the Salinas River north of the Desalination Plant site. These deposits consist of unconsolidated fine-grained sand, silt and clay and are subject to seasonal flooding.

2.3.7 Alluvium (Qal)

Alluvial deposits of unconsolidated silt, sand, and gravel have been mapped along the bottom of small drainages that will be crossed by the pipeline alignments; these are mostly on the Monterey Peninsula and adjacent to El Estero Park, Del Monte Lake and Roberts Lake. Alluvium may also underlie some of the fill soils placed in drainages in the downtown Monterey and Seaside areas.

2.3.8 Older Coastal Dune Deposits (Qod/Qod_1/Qod_2)

Late Pleistocene age older dune sand deposits underlie a broad area of the project extending from Canyon Del Rey northward through Fort Ord to the Desalination Plant site. These older dune deposits have been subdivided into younger dune deposits (Qod_1) and older dune deposits (Qod_2) based on their stratigraphic position and time of deposition, or are undivided (Qod). The soil characteristics are similar for all three units, consisting of weakly consolidated fine to medium grained, and silty to poorly graded wind-blown sand. Based on recent borings completed at the Desalination Plant and the Terminal Reservoir, the older dune deposits are generally loose to medium dense in the upper 5 to 10 feet below the ground surface, becoming medium dense to dense below this depth. The older dune deposits are subject to erosion on slopes where vegetation is disturbed.

2.3.9 Coastal Terrace Deposits (Qct)

Pleistocene age coastal terrace deposits have been mapped along the proposed Monterey pipeline, extending from Pacific Grove to Seaside. These terrace deposits have been subdivided into six separate units based on their age and geographic position, three of which underlie the proposed Monterey Pipeline; the Oceanview coastal terrace (Qcto) being the lowest and youngest; the Peninsula College coastal terrace (Qctp) being intermediate in age and elevation; and the Sylvan coastal terrace (Qcts) being the oldest and highest in elevation. Older, higher elevation coastal terrace deposits (Monte Vista and Huckleberry) and a younger near shore terrace deposit (Lighthouse) are mapped in the Monterey area but do not underlie the proposed alignments. These terrace deposits are the remnants of a platform cut by waves into the underlying Tertiary sedimentary formations and basement granitic rocks during relatively higher stands in sea level. This relatively higher sea level is due more to uplift of coastline and less to higher absolute sea level. The terrace deposits are draped over the underlying bedrock and typically range from a few feet to several tens of feet in thickness. As a result, areas mapped as coastal terrace deposits may be underlain by Monterey Shale or granitic rock at a relatively shallow depth. The coastal terrace deposits consist of medium dense to dense, silty fine to medium-grained sand with clay and a few poorly graded sand interbeds. The terrace deposits also locally contain some coarse sand and gravel-size clasts of the underlying decomposed granodiorite on the Monterey Peninsula.

2.3.10 Monterey Shale (Tm, Tmd)

The Miocene Monterey Shale has been mapped along portions of the proposed Monterey pipeline alignment from about El Estero Park to Canyon Del Rey in Seaside. The Monterey Shale is mostly overlain by a thin veneer of coastal terrace deposits, alluvium or fill, but is exposed at the ground surface along drainage sidewalls that have eroded through the coastal terrace deposits. The Monterey Shale consists of light gray to yellowish brown, moderately weathered, thinly laminated diatomaceous shale with siliceous (chert) interbeds.

2.3.11 Porphyritic Granodiorite of Monterey (Kgdp)

Cretaceous age porphyritic granodiorite underlies the coastal terrace deposits and alluvium on the Monterey Peninsula along the proposed Monterey pipeline alignment from the Eardley Pump Station to downtown Monterey. The contact between the coastal terrace deposits and the underlying granodiorite is an erosional unconformity and the depth of the bedrock surface can be quite variable. The granodiorite is deeply weathered (decomposed) to medium to coarse-grained silty to clayey sand and is dense to very dense except in the near-surface where it is often completely weathered, clayey and medium dense. Although relatively rare, hard unweathered core stones of the granodiorite can occur near the ground surface.

2.4 GROUNDWATER

The project site is located within the Salinas Valley Groundwater Basin (Monterey County Water Resources Agency, 2007), which includes two sub-basins within the project area: the 180/400 foot aquifer located in the area north of Marina, and the Seaside sub-basin extending from Marina south to the Monterey Peninsula. Tables 2 through 8 list the approximate depths to groundwater along the various pipeline segments, as encountered in previous nearby investigations listed on Table 1.

Groundwater can be expected at shallow depths along the proposed Monterey Pipeline along Fremont Street from about Station 153+00 to 161+00 and 171+50 to 187+50. This low-lying area is generally below Elevation 20 feet and passes across the drainages that lead into El Estero Lake. Between Station 215+00 to 219+00 is another low-lying area crossed by the Monterey Pipeline near the Route 1/Highway 68 separation, south of Del Monte Lake. Shallow groundwater also may be encountered along the proposed Transfer pipeline in Marina between about Station 320+00 to 327+00, where the alignment will pass near the small lake in Locke-Paddon Park. The remaining sections of all the other pipelines are generally above the regional groundwater level. However, local perched groundwater may be present with the alluvium at drainage crossings, in poorly drained areas, and during the winter months during periods of prolonged rainfall.

No new subsurface exploration was performed for this preliminary study. Final design investigations should include and evaluation of groundwater elevation along all proposed pipeline alignments.

3.1 GEOLOGIC HAZARDS

Geologic hazards identified along the various pipeline alignments include the potential for ground rupture along and near mapped faults, strong ground shaking from proximal and more distant active faults, liquefaction, tsunami run-up along the coastal sections, potentially corrosive soils, and soil erosion of the beach and dune deposits. Soft, compressible and expansive soils are also present along some portions of the alignment where coastal estuaries will be crossed. The following sections describe the known geologic hazards. Detailed geologic and geotechnical site investigations and engineering will be required to provide specific mitigation during final design.

3.1.1 Faulting

The San Andreas Fault System controls the geologic structure and much of the geomorphic expression of the region. Several large active faults and numerous potentially active faults occur in this region. Figure 2 is a Regional Fault Map showing active faults relative to the project site.

No known faults, considered to be active by CGS and included in the Alquist-Priolo Earthquake Fault Zones (Hart and Bryant, 1997), cross the proposed project pipeline alignments. The nearest Alquist-Priolo zoned fault is the San Andreas fault, located about 15.2 miles (24.4 km) northeast of the proposed Desalination Plant site (i.e., the northern end of the project). Several faults that are considered capable of generating earthquakes, but whose ground rupture potential is not well established, cross the pipeline alignments; these include the Reliz fault zone and the Monterey Bay-Tularcitos fault zone, a complex north-northwest-trending fault zone up to 15 km (9.4 miles) wide that includes the Navy fault, and the Chupines fault zone that includes the Chupines fault, Seaside fault and Ord Terrace fault. The mapped locations of these faults relative to the alignments are shown on Figures 1-1 through 1-5.

The Reliz fault zone, a northwest trending concealed fault with two strands (north, south) that cross the Transfer pipeline alignment in Marina, is a late Quaternary, mostly high angle reverse dip-slip fault zone with a southwesterly dip (Rosenberg and Clark, 2009). The Reliz fault zone is thought to be Quaternary-active, but is not known to have ruptured the surface during the Holocene (USGS, 2008b; WGCEP, 2008) and is not shown as a through-going structure on geologic (Wagner *et al*., 2002) or fault compilation maps (USGS, 2008a); therefore, the surface rupture potential is considered to be low.

The Chupines fault zone, a complex north-northwest-trending fault zone up to 3 km wide that includes the Chupines, Seaside and Ord Terrace faults (USGS, 2010), is crossed by the Monterey pipeline in Seaside. The Seaside fault is shown by Bryant (2001) to connect to the Monterey Bay fault in the offshore.

The Monterey Bay-Tularcitos fault zone (MBTFZ) is located south and west of the Chupines fault zone mainly on the Monterey peninsula and in Monterey Bay and includes a complex north-northwest-trending fault zone up to 15 km wide that includes the Navy, Monterey Bay, Hatton Canyon, Berwick Canyon and Sylvan thrust faults. Some investigators include the Chupines fault zone within the MBTFZ (CGS, 2002). The Navy fault is crossed by the Monterey pipeline in the vicinity of the State Route 1/Highway 68 separation.

The strands of the Chupines fault zone and MBTFZ are classified by the California Geological Survey (Bryant, 2001; Jennings and Bryant, 2010) as either Quaternary active (active within last 1.6 million years) or late Quaternary active (active within last 700,000 years), although Bryant

(2001) cites several investigations showing that the faults locally displace Holocene deposits, particularly in the offshore. The USGS estimates the maximum moment magnitude for these faults ranges up to about **M**6.4 (Bryant, 2001); whereas, the maximum moment magnitude for the overall MBTFZ is estimated to be **M**6.9 based on the 52-mile (83 km) length.

Other more distant active faults include the San Gregorio fault located to the southwest offshore, and the Rinconada fault located southeast of the site forming a major structural element along the southwest side of the Salinas Valley. The Rinconada fault is on a similar strike with the closer Reliz fault discussed above and appears to join with it southeast of Marina; however, the Rinconada fault is considered to be a geologically separate fault based on faulting style, fault strike, and total magnitude of displacement.

Faults included in the statewide probabilistic hazard map (and the fault model used to derive it) have classified fault zones as “Type A,” “Type B,” and “Type C” (WGCEP, 2008). A “Type A” fault is an active fault with a slip rate of greater than 5 mm/yr and moment magnitude (**M**) greater than 7.0, and a “Type C” fault is a potentially active fault with a slip rate of less than 2 mm/yr and **M** of less than 6.5. “Type B” faults are defined as active or potentially active faults with a slip rate and **M** between a “Type A” and “Type C” fault. The nearest “Type A” fault to the project site is the San Andreas fault, located northeast of the site. The nearest “Type B” faults are the Reliz fault zone and the Monterey Bay-Tularcitos fault zone (including the Chupines fault zone), which cross the project alignments. Nearby active and potentially active faults, their distances from the site, their designated fault types (“A,” “B” or “C”), average slip rates, and maximum moment magnitudes are summarized in Table 9.

Large earthquakes occurring on these and more distant faults, including the historically active San Andreas fault, could result in strong ground motions within the project area.

3.1.2 Liquefaction

Liquefaction is a phenomenon in which a sudden increase in pore fluid pressure causes relatively loose, cohesionless soil beneath the water table to undergo temporary loss of strength and essentially total loss of shear resistance. The primary factors affecting liquefaction susceptibility include the intensity and duration of ground shaking, the depth to groundwater, and the soil type and relative density. Liquefaction is generally confined to saturated soil within 50 feet of ground surface. Below this depth the overburden pressures are generally high enough to preclude liquefaction.

The USGS (Dupre and Tinsley, 1980; Dupre, 1990) have published liquefaction potential maps of the project area. The Monterey County General Plan (2010, 2007) also provides a regional liquefaction potential hazard map that covers the project area. Figure 3 shows the liquefaction susceptibility of the various geologic formations along the project alignments based on the mapping by Dupre and Tinsley (1980) and Dupre (1990). Liquefaction hazards along the pipeline alignments are generally confined to the low-elevation coastal areas underlain by young, granular deposits with shallow groundwater. Tables 2 through 8 list the liquefaction susceptibility for each geologic unit crossed by the pipeline segments. The liquefaction susceptibility is based on the mapping by Dupre and Tinsley (1980) and Dupre (1990).

The young flood plain deposits are mapped as having a high to very high liquefaction susceptibility. The beach deposits, recent dune and Flandrian dunes, alluvium, basin deposits and artificial fills are shown as having moderate to high liquefaction susceptibility, depending on the depth to groundwater and degree of compaction for the artificial fill. The older dune deposits, which cover a majority of the area where the northern pipeline segments are proposed, and the coastal terrace deposits found on the Monterey Peninsula and southern Seaside area, are mapped as having low to very low liquefaction susceptibility, depending on the depth to groundwater. The bedrock units, consisting of Monterey Shale and granodiorite, have very low liquefaction susceptibility.

Portions of the Monterey pipeline that have the highest liquefaction hazard are where the alignment crosses through fill soils in the downtown area and crosses the alluvium-filled drainages that empty into El Estero Lake, Del Monte Lake and Roberts Lake in Canyon Del Rey. The soils in these areas have moderate to high liquefaction susceptibility. The remaining sections of the pipeline alignments are in terrace deposits, old dune deposits or bedrock and have moderate to very low liquefaction susceptibility.

Lateral spreading is a potential secondary effect of liquefaction where extensional ground cracking and settlement occur as a response to the lateral migration of liquefied material. This can occur adjacent to free faces such as steep slopes or incised creek channels. The potential for lateral spreading is considered to be high where the pipeline passes through liquefiable materials close to the banks of El Estero Lake and south of Del Monte Lake along the Monterey pipeline segment.

3.1.3 Landslides

Landslides have not been mapped along the project alignment nor were any landslides observed during site reconnaissance. Therefore, landsliding is not considered a significant hazard for the project.

3.1.4 Tsunamis, Flooding and Coastal Erosion

A tsunami is a large, transient long-period sea wave caused by submarine landslides, earthquakes, volcanic eruptions or meteor impacts. CGS, in cooperation with the California Emergency Management Agency and the University of Southern California Tsunami Research Center, has prepared tsunami inundation maps that cover the project area (California Emergency Management Agency, 2009a,b,c). The relevant portions of the Seaside and Marina quadrangles of these maps that cover the project area are presented on Figure 4. The areas that could be affected by tsunami inundation include the low-lying area along the south side of El Estero Park, where the Monterey pipeline follows Fremont Street.

Seiches are large waves that occur within enclosed bodies of water as a result of ground shaking caused by earthquakes. Seiches can cause damage from flooding caused by wave run-up on the shore, or if the waves overtop a dam. The Monterey pipeline alignment passes next to El Estero Lake. This section of the alignment adjacent to the lake could be subject to seiches during a large earthquake.

A review of the FEMA 100-year flood map presented in the Monterey County General Plan (Figure 8b, 2010) shows the majority of the project alignments are outside of the 100-year flood plain (i.e., the region that has approximately a one percent annual probability of flooding). Only the low-lying areas of El Estero Park are within the 100-year flood plain.

According to the Center for Ocean Solutions (2013) located in Monterey, the southern portion of Monterey Bay is eroding faster than any other coastline in California, with the coastal dunes between the Salinas River and downtown Monterey eroding at rates between 1 and 6 feet per year. With an estimated potential 4.6-foot sea level rise by 2100, these rates of erosion are expected to increase as well as cause more frequent coastal flooding of low-lying areas. The Pacific Institute (2009), in cooperation with Caltrans, has published USGS 7.5 minute scale maps for the Marina, Seaside and Monterey quadrangles showing the estimated amount of coastal erosion and sea level rise for the year 2100. These maps show that portions of downtown Monterey, and Del Monte Boulevard, the Naval Postgraduate School and Laguna Del Rey, as well as sections of State Route 1 in Seaside and near the Salinas River, will be inundated due to projected sea level rise. This projected sea level rise is similar to the tsunami inundation level shown on Figure 4.

3.1.5 Soil Erosion

Several of the geologic formations crossed by the pipeline alignments are subject to soil erosion. The formations most susceptible to erosion by wind and water include the beach sand deposits and the recent and Flandrian dune deposits, especially when they are not covered with vegetation. The older dune deposits are more consolidated and silty; however, when stripped of vegetation and exposed on steep slopes, they are also subject to rapid soil erosion by running water.

3.1.6 Expansive and Compressible Soils

The near-surface soils found along the majority of the pipeline alignments generally consist of silty to clayey sand or bedrock that are not expected to be expansive or compressible. However, the basin deposits, younger flood plain deposits and alluvium deposits that will be crossed by the pipeline alignments may be compressible and, if very clayey, could be expansive. These areas should be evaluated during future subsurface investigation along with laboratory testing to assess the potential for expansive or compressible soils.

3.1.7 Potentially Corrosive Soils

The United States Department of Agriculture (USDA) has estimated the corrosion potential of near-surface soils in the vicinity of the proposed MPWSP improvements based on generalized soil classifications contained in the USDA Soil Survey studies (USDA, 2013). The estimated soil corrosion potential along the various pipeline segments is graphically illustrated on Figure 5. The soil corrosion potential typically can be categorized as “Moderate” to “High” with respect to uncoated steel pipe. Site-specific corrosion studies should be performed during final design to obtain a more definitive estimate of the corrosion potential of the on-site soils.

3.2 PIPELINE CONSIDERATIONS

3.2.1 Trench Excavation and Support

Trench excavations are expected to encounter a wide range of materials including loose alluvium, basin deposits, and dune deposits; semi-consolidated marine terrace deposits and older dune deposits; poorly to moderately indurated Monterey Shale; and decomposed granodiorite. Short reaches of hard crystalline granodiorite may also be encountered. Heavy-duty excavation equipment should be capable of excavating the alluvial soils, dune and marine terrace deposits, and the Monterey Shale. Some weakly cemented siltstone chert beds within the Monterey Shale may result in oversize material that will require special handling and disposal.

The granodiorite is typically deeply weathered on the Monterey Peninsula and behaves much like a very dense sandstone formation that can be excavated with heavy duty ripping. However, it is possible that localized hard, rounded, unweathered core stones of the granodiorite could be present near the ground surface that will require the use of a hoe-ram or localized blasting to remove. If controlled blasting is required, specifications should be prepared to perform preconstruction surveys and to limit blasting vibrations. Vibrations also should be monitored during construction, to verify they do not exceeded specified limits.

In accordance with California Occupational Safety and Health Administration (OSHA) regulations, all trenches deeper than 5 feet will require shoring or sloping sidewalls if personnel are to enter them. Trenches shallower than 5 feet may require shoring if sidewall materials are not sufficiently stable to stand unsupported. Since the majority of the pipeline alignment is within city streets or in areas of limited right-of-way, the trench excavations will likely require shoring. Box shoring or trench shields may be suitable for most of the ground conditions anticipated within the project area, but these systems still require the ground to "stand up" prior to installing the shoring. Localized areas in the alluvium and terrace deposits, and most of the recent and Flandrian dune deposits, have zones with loose, clean sand or groundwater seepage that may not have sufficient stand-up time; consequently, a shoring system such as sheet piling or soldier piles and lagging will likely need to be installed prior to making the excavation. The proximity of adjacent fill soils in parallel utility trenches can also dramatically alter trench stability and the ability of soils to temporarily stand vertically.

3.2.2 Dewatering

Dewatering may be necessary as a result of encountering shallow perched water or in the alluvial areas where the groundwater level is within the depth of the trench excavation. A dewatering system, if needed, typically is the responsibility of the Contractor to design and install. Site specific information for proper design and construction of dewatering as well as discharge of pumped water will be required. If the soils below the groundwater table are relatively cohesive or have a low permeability, sumping from within the trench may be an effective dewatering method. However, if loose and/or uncemented, high permeability soils occur below the water table within the depth of the trench excavation, a dewatering system such as well points or deep dewatering wells will likely be required in advance of the excavation. The groundwater conditions along each of the proposed alignments should be evaluated in more detail during the design level geotechnical study. The more detailed groundwater information obtained from site-specific explorations can be used for design and construction purposes, and to minimize the potential for construction claims.

3.2.3 Trenchless Construction

Trenchless crossings will be required beneath roadway and railroad crossings, including State Route 1. Additional trenchless construction may be beneficial at busy road crossings and intersections, and in areas with environmental concerns that may limit surface disturbance. For this conceptual evaluation, we have assumed that trenchless crossings along the alignment will be accomplished using pipe jacking or horizontal directional drilling. Since dune sand deposits and relatively deep groundwater conditions are expected at the five trenchless crossings already identified, the selected alternative is likely to depend upon the crossing length. A general description of alternative construction methods and preliminary design considerations associated with these construction methods are summarized below.

3.2.3.1 Pipe Jacking

Pipe jacking is performed by pushing pipe sections through the ground with hydraulic jacks assembled in a jacking frame located in a shaft excavation called the jacking pit. This involves constructing the tunnel in a one-pass method by which the casing pipe is pushed directly behind the cutter head. These machines typically are steerable and use laser guided sights to maintain line and grade. Following the installation of an initial casing for ground support, the final carrier pipe can be constructed safely within the casing.

The main difference in the design of a casing or pipe installed by pipe jacking methods, as opposed to open cut trenching methods, is that the pipe must also be designed to withstand the axial forces applied to the pipe or casing during installation. The dune sand deposits anticipated at all five pipe crossings may be poorly cemented to cohesionless. Consequently, it should be expected sloughing of loose or poorly cemented dune sand may occur in the jacking and receiving pit excavations and "running sands" may be encountered in the face of the jack-and-bore excavation, which could result in loss of ground and surface settlement. The soil characteristics at each crossing should be investigated with subsurface investigations to evaluate the site specific soil conditions at the shaft excavations and the jack-and-bore crossing.

The design of the shoring systems at jacking and receiving pits, as well as design of the jacking system, should be performed by a California Registered Civil or Structural Engineer. It should be expected that frictional resistance will develop along the jacking pipe because of the granular nature of the dune sands. Passive resistance at the backstop for the jacking pit should be properly evaluated to provide the necessary jacking force; this is especially critical at the longer crossing of State Route 1 near Lightfighter Drive.

Where shaft or pit excavations are supported with temporary shoring, some settlement of the adjacent ground surface should be anticipated. If these shored excavations are placed in a paved street or highway, some cracking and settlement of the adjacent pavements should be anticipated. The project specifications should require restoration of these damaged pavements, curbs and gutters to their preconstruction condition.

At the base of the jacking and receiving pits, the Contractor should consider installing a working platform to stabilize the subgrade. Although the dune sand deposits are relatively dense, the exposed subgrade could become disturbed and weakened. Therefore, stabilization with drain rock or a concrete rat slab might be needed.

3.2.3.2 Horizontal Directional Drilling

HDD methods for constructing pipelines are widely used for pipe sizes of less than about 48 inches. The method involves drilling a pilot hole, which is subsequently enlarged by reaming (in one or more passes) to the final hole size required. Drilling mud is used to flush the cuttings from the hole and to stabilize the hole and prevent caving. When the hole has reached the required size, the carrier pipe is typically pulled through the hole in a continuous operation. One advantage of HDD installation is that shafts are not required. However, a significant staging area is required for drilling operations and for laying out the pipe for the pull back.

3.2.3.3 Vertical Cover Requirements

Vertical cover is a design and constructability issue, as it relates to the construction method used, the feature being crossed, allowable surface settlement and containment of pressures exerted on the face of the tunnel excavation by tunneling equipment. A minimum vertical cover above the installed pipeline of 3 times the outside pipe diameter should be provided. Caltrans requires 15 feet of vertical cover for a 36-inch pipeline installed under roadways within its right-of-way. Where unfavorable geotechnical conditions exist, the design pipe invert elevation should be lowered, if possible, to proceed through ground more favorable to the tunneling process.

3.2.3.4 Settlement Monitoring

The four crossings of TAMC right-of-way are relatively short and no active train services are currently using these tracks. Settlement monitoring at these locations is may not be required, unless stipulated in the encroachment permit. However, the crossing of State Route 1 near Lightfighter Drive is relatively long and will extend beneath a major highway along the Monterey Peninsula. It should be expected Caltrans will require monitoring of ground surface movement during pipeline installation. The settlement monitoring plan should conform to Caltrans requirements.

3.3 FOUNDATION CONSIDERATIONS

Foundation soils at the location of the proposed ASR terminal reservoirs and pump station have been identified as older coastal dune deposits (Qod1). It is our opinion foundation support for the tanks can consist of a structural mat foundation designed to accommodate the estimated total and differential settlements, whereas conventional spread footings are feasible for at-grade appurtenant structures.

The near-surface sandy soils associated with the older coastal dune deposits typically display variable consistencies from loose to dense to depths of at least 10 feet, or more. Left in-place, shallow foundations would likely exhibit unacceptable total and differential settlements. Over-excavation and replacement with compacted engineered fill is recommended to provide uniform support for the foundations. Over-excavation depths should be sufficient to remove all loose sand deposits and provide uniform foundation support.

As discussed in this report, this investigation is preliminary and is based on a limited initial study. The primary focus of this initial study is to evaluate potential geologic hazards and provide a preliminary assessment of geotechnical conditions along the currently proposed pipeline alignments and structure locations. Additional design-level geotechnical investigation will be required to develop geotechnical criteria for design and construction of the proposed improvements. We recommend that the following work be performed to prepare these geotechnical design recommendations:

- Perform additional subsurface exploration and laboratory testing to better define the subsurface soil conditions along proposed pipeline alignments and in areas proposed for new structures.
- Evaluate the depth to groundwater along the proposed pipeline alignments and in area proposed for new structures.
- Evaluate site seismicity and recommend seismic design parameters for structures and pipeline design.
- Evaluate liquefaction potential along pipeline alignments and estimate magnitude of potential displacements from liquefaction-induced settlements or lateral spreading.
- Evaluate construction characteristics along pipeline alignments including excavation characteristics, trench stability, temporary shoring, dewatering and mitigation of soft ground conditions.
- Evaluate the corrosion potential of the in-place soils along the proposed pipeline alignments and foundation areas; prepare recommendations to mitigate the impact of corrosive soils on proposed construction materials.
- Determine locations where trenchless construction will be required and provide site-specific information to select appropriate method and required design parameters.
- Prepare geotechnical recommendations for pipeline design including backfill requirement, traffic surcharge loading, and pipe bedding.
- Evaluate areas where suspected hazardous materials may significantly impact proposed pipeline construction costs or present an unacceptable risk to the public; determine if alternate alignments are preferred.
- Prepare geotechnical design recommendations for new structures including site preparation, grading and compaction, and foundation design.

The professional judgments and interpretations presented in this preliminary assessment report regarding the geology and anticipated subsurface conditions are preliminary in nature and are based on limited information obtained from published literature, in-house files, and a brief reconnaissance along the proposed alignment. Site-specific subsurface investigations and design analysis have not been completed to date. The information presented in this preliminary design conceptual study may be superseded by future geologic and geotechnical investigations, design analysis and cost estimates which may alter the interpretations and judgments presented in this report. Therefore, the information contained in this report should only be used for preliminary planning (conceptual) purposes and should not be relied upon for construction planning or bidding.

AECOM presents that the services were conducted in a manner consistent with the standard of care applied as the state of the practice in the profession within the limits prescribed by our client. No other warranty, expressed or implied, is included or intended in this report.

AECOM, 2015a, Geotechnical Investigation Report, Terminal Reservoir and Mechanical Building, Seaside, California, prepared for California American Water Company, June 2.

AECOM, 2015b, Preliminary Geotechnical Report for Pipeline Crossings, Transfer Pipeline and Cemex Feed Water Line, CAW Monterey Peninsula Water Supply Project (MPWSP), prepared for California American Water Company, June 11.

Bryant, W.A.,2001, Fault number 62a, Monterey Bay-Tularcitos fault zone, Monterey Bay section, in Quaternary fault and fold database of the United States: U. S. Geological Survey website: http://earthquakes.usgs.gov/regional/qfaults.

California Emergency Management Agency, 2009, Tsunami Inundation map for Emergency Planning, Marina Quadrangle, County of Monterey, California: California Emergency Management Agency, California Geological Survey and University of Southern California, dated July 1, 2009, map scale 1:24,000.

California Emergency Management Agency, 2009, Tsunami Inundation map for Emergency Planning, Monterey Quadrangle, County of Monterey, California: California Emergency Management Agency, California Geological Survey and University of Southern California, dated July 1, 2009, map scale 1:24,000.

California Emergency Management Agency, 2009, Tsunami Inundation map for Emergency Planning, Seaside Quadrangle, County of Monterey, California: California Emergency Management Agency, California Geological Survey and University of Southern California, dated July 1, 2009, map scale 1:24,000.

California Geological Survey, 2002, Quake table data by the Working Group on California Earthquake Probabilities, compiled by Rami Al-Ghanmi. http://quakesim.org/quaketables_api/fault.jsp?ds=CGS_02, accessed 2/18/2014.

Center for Ocean Solutions, 2013, http://www.centerforoceansolutions.org/montereybay/sea-level-rise/local-variability.

Clark, J.C., T.W. Diblee, H.G. Greene, and O.E. Bowen, 1974, Preliminary Geologic Map of the Monterey and Seaside 7.5-Minute Quadrangles, Monterey County, USGS Miscellaneous Field Studies Map MF-577.

Clark, J.C., W.R. Dupre, and C.I. Rosenburgh, 1997, Geologic Map of the Monterey and Seaside 7.5-Minute Quadrangles, Monterey County, California, USGS Open File Report 97-30. (Digital database).

Cooper, W.S., 1967, Coastal dunes of California: Geological Society of America Memoir 104, 131p.

Dibblee, T.W. and Minch, J.A., 2007, Geologic map of the Marina and Salinas quadrangles, Monterey County, California: Dibblee Geological Foundation, Dibblee Foundation Map DF-353, scale 1:24,000.

Dupré W.R. and Tinsley, J.C. 1980, Maps showing geology and liquefaction potential of northern Monterey and southern Santa Cruz counties, California, U.S. Geological Survey Miscellaneous Field Studies Map MF-1199.

Dupré W.R., 1990, Maps Showing Geology and Liquefaction Susceptibility of Quaternary Deposits in the Monterey, Seaside, Spreckles, and Carmel Valley Quadrangles, Monterey County, California, U.S. Geological Survey Miscellaneous Field Studies Map MF-2096.

Hart, E.W., and W.A. Bryant, revised 1997, Fault-Rupture Hazard Zones in California: California Division of Mines and Geology Special Publication 42, 38 p

Jennings, C.W. and Bryant, C.W., 2010, Fault activity map of California: California Geological Survey Geologic Data Map No. 6, scale 1:750,000, a digital database. http://www.consrv.ca.gov/cgs/cgs_history/Pages/2010_faultmap.aspx

Kleinfelder, 2011, Geotechnical Evaluation Report for the Monterey Peninsula Light Rail Project, prepared for Parson and Transportation Agency for Monterey County, Nov. 16.

Monterey County Water Resources Agency, 2007, Salinas Valley Basin August 2005, Lines of equal groundwater elevation in the pressure 180-foot and Eastside shallow aquifers.

Monterey County, 2007, Monterey County General Plan, Draft EIR, September 2008, http://www.co.monterey.ca.us/planning/gpu/2007_GPU_DEIR_Sept_2008/2007_GPU_DEIR_September_2008.htm, accessed 8/28/2013

Monterey County, 2010, Monterey County General Plan adopted Oct. 26, 2010, http://www.co.monterey.ca.us/planning/gpu/GPU_2007/2010_Mo_Co_General_Plan_Adopted_102610/2010_Mo_Co_General_Plan_Adopted_102610.htm, accessed 8/28/2013

Ninyo & Moore, 2005, Preliminary Geotechnical Evaluation, Monterey County Coastal Water Project, Monterey County, California, prepared for RBF Consulting, April, 29.

Pacific Institute, 2009, California Flood Rise: Sea Level Rise, in cooperation with the California Energy Commission, Caltrans, and Ocean Protection Council, Monterey, Seaside and marina quadrangles. http://www.pacinst.org/reports/sea_level_rise/hazmaps/Monterey.pdf, accessed 9-24-13

Page, B.M., 1970, Sur-Nacimiento fault zone of California: Continental margin tectonics; Geological Society of America Bulletin, v. 81, p. 667-690.

Rosenberg, L.I., and Clark, J.C., 2009, Map of the Rinconada and Reliz fault zones, Salina River Valley, California. Prepared in cooperation with the California Geological Survey and San Luis Obispo Planning and Building Department. Scientific Investigation Map 3059.

URS Corporation, 2013, Geotechnical Baseline Report, Proposed Desalination Plant, Marina, Monterey County, California, prepared for California American Water Company, June 20.

U.S. Department of Agriculture, 2013, Soil Corrosion Data for Monterey County, California (CA053), http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx.

U.S. Geological Survey, 2010, Quaternary fold and fault database for United States, U.S. Geological Survey website, http://earthquake.usgs.gov/hazards/qfaults/, accessed 6/12/2013

U.S. Geological Survey, 2008a, National Seismic Hazard Maps: U.S. Geological Survey website, http://earthquake.usgs.gov/research/hazmaps/products_data/2008/, accessed 8/28/2013.

U.S. Geological Survey, 2008b, Quaternary fault and fold database of the United States: U.S. Geological Survey website, http://earthquakes.usgs.gov/regional/qfaults, accessed 8/28/2013.

U.S. Geological Survey, 2010, Quaternary fold and fault database for United States, U.S. Geological Survey website, http://earthquake.usgs.gov/hazards/qfaults/, accessed 6/12/2013

Wagner, D.L., Greene, H.G., Saucedo, G.J. and Pridmore, C.L., 2002, Geologic map of the Monterey 30' X 60' quadrangle and adjacent areas, California; California Geological Survey, Regional Geologic Map Series, Map No.1, scale 1:100,000.

Working Group for California Earthquake Probabilities (WGCEP), 2008, the uniform earthquake rupture forecast, version 2 (UCERF2): U.S. Geological Survey Open-File Report 2007-1437.

Table 1
SUMMARY OF EXISTING FIELD EXPLORATION DATA - CAW PIPELINES

Report Number	Pipeline Segment	Location / Borings	Geotechnical Investigation Project Name	Project Location	Report Author	Report Year	Remarks
1-1	Brine/Salinas Valley Return	Located east of proposed desal plant at existing treatment plant. No GW to 50' depth.	Regional Wastewater Management Plant,Stage III, Monterey, California, prepared for Engineering Science, Inc., Sept. 1982	Regional WWTP, Marina	GTC	1982	Also: Desal Plant Site
1-2	Brine/Salinas Valley Return	Located at exisitng treatment plant and along proposed feedwater pipeline SE of desal plant. No GW to 26' depth	Geotechnical/Corrosion Report, prepared for Monterey Regional Water pollution control Agency, Nov.10, 1993	Regional WWTP, Marina	CH2M Hill	1993	
1-3	Brine/Salinas Valley Return	Located at exisitng treatment plant. No GW to 50' depth	Geotechnical Investigation, Proposed Biosolids Dewatering Building, Monterey Regional wastewater Treatment Plant, Marina, CA, prepared for HDR Engineering, Inc., Jan 9, 2006	Regional WWTP, Marina	DMCE	2006	Also: Desal Plant Site
1-4	Brine/Salinas Valley Return	Proposed Desalination Plant. Several borings in old dune deposits, GW at 57' depth at plant site	GeotechnicalBaseline Report, Proposed Desalination Plant, Marina, Monterey County, California, prepared for California American Water Company, June 2013.	Proposed Desalination Plant site, Marina	URS	2013	Also: Cemex Feedwater and Transfer Pipeline
1-5	Cemex Feed Water/ Transfer	5 borings to 60' in basin deposits over old dune deposits. GW at 6' bgs	Caltrans LOTB's for Neponset OC	Neponset Rd./Highway 1	Caltrans	1973	5' to 10' soft basin deposits over old dune deposits
1-6	Cemex Feed Water/ Transfer	9 borings to 80' in old dune deposits. GW at 35' bgs	Caltrans LOTB for Lapis Spur Overhead	Lapis Spur/Highway 1	Caltrans	1973	Former railroad spur now a dirt road
2-1	Transfer	4 borings to 70' in old dune deposits. GW at 19' bgs	Caltrans LOTB for Reservation Rd. UC	Reservation Rd/Highway 1	Caltrans	1973	
2-2	Transfer	Investigation for 15 unit apt. with 3 borings in older dune sand, no GW to 14'	california, prepared for Alliance Enterprises, july, 1980	San Pablo Court @ Marina Drive, Marina	Terratech	1980	
2-3	Transfer	4 borings to 65' in old dune deposits. GW at 32' bgs	Caltrans LOTB for Lake Dr. OC	Lake Dr./Highway 1	Caltrans	1973	
2-4	Transfer	30'bgs	Caltrans LOTB for S. Marina OC	Marina Dr./Highway 1	Caltrans	1973	
2-5	Transfer	Several borings in older dune deposits, dry to 20' depth	Geotechnical Investigation for Proposed FORA Partner's Complex, marina, California, prepared for Fort Ord Reuse Authority, june 24, 2005	Imjin Parkway @ 2nd Avenue, Marina	DMCE	2005	
2-6	Transfer	Several borings in older dunes, dry to 24' depth	Geotechnical Investigation for New Medical Facility, Marina, California, Prepared for Community hospital Properties, Sept 24, 2009	2nd Avenue @ Imjin Parkway, Marina at SE intersection corner	Pacific Crest	2009	
2-7	Transfer	4 borings to 58' in old dune deposits. No GW encouontered	Caltrans LOTB for Eighth St OC	Eighth St./Highway 1	Caltrans	1973	
2-8	Transfer	5 borings to 50' in old dune deposits. No GW encountered	Caltrans LOTB for Fort Ord (First St.) OH	First St./Highway 1	Caltrans	1971	

Table 1
SUMMARY OF EXISTING FIELD EXPLORATION DATA - CAW PIPELINES

Report Number	Pipeline Segment	Location / Borings	Geotechnical Investigation Project Name	Project Location	Report Author	Report Year	Remarks
2-9	Transfer	2 borings to 55' in old dune deposits. No GW encountered	Caltrans LOTB for First St UC	First St./Highway 1	Caltrans	1973	
2-1	Transfer	3 borings to 50' in old dune deposits. No GW encountered	Caltrans LOTB for Main Entrance (Light Fighter Dr.) OC	Light Fighter Dr./Highway 1	Caltrans	1967	
2-11	Transfer	7 borings to 20' in old dune, no GW	Preliminary Geotechnical Investigation, Proposed Military Housing, Fort Ord Military Rerservation, Seaside, CA, prepared for Clark Pinnacle family communities LLC, Nov. 6, 2002	Seaside	DMCE	2002	
2-12	Transfer	2 borings in older dune deposits to 46', no GW	Geotechnical Investigation, Proposed Gateway Sign Structure, California State University Monterey Bay, Seaside, California	Near General Jim Moore Blvd. and Light Fighter Dr., Seaside	DMCE	2003	
2-13	Transfer	7 borings in older dune deposits to 45', no GW	Geotechnical Investigation, Proposed Visitor Center Project, California State University Monterey Bay, Seaside, California	Near General Jim Moore Blvd. and Engineer Lane, Seaside	DMCE	2002	
2-14	Transfer	two borings to 34 ' in old dune, no GW	Geotechnical Investigation, Proposed "Switchgear" Building, CSUMB, seaside, CA, prepared for Cal State University Monterey Bay, March 12, 2004	Seaside	DMCE		
3-1	Monterey	6 borings to 50', GW 10' bgs	Caltrans LOTB for Highway Highway 1/ Del Monte Ramp OC	Del Monte Blvd/Highway 1	Caltrans	1966	about 5' fill over Qcto. Tm at 45' depth
3-2	Monterey	13 borings to 30', GW 5' bgs	Caltrans LOTB for Route 68/Highway 1 Seperation	Highway 68/Highway 1	Caltrans	1967	about 5' fill/Qal over Qcto. Tm at 10' -25' depth
3-3	Monterey	10 borings to 40', GW 3' to 6' bgs	Caltrans LOTB for Highway 68/Fairgrounds Rd. Rd. UC	Fairgrounds Rd.	Caltrans	1964	Qal up to 37' deep over Monterey Shale
3-4	Monterey	Monterey, GW at 5', site just west of Del Monte Lake	Naval Postgraduate School Development	Naval Postgraduate School, Monterey	M. Jacobs	1984	
3-5	Monterey	3 borings with Qal over Monterey Shale, GW at 13'	Academic Instruction Building	Naval Postgraduate School, Monterey	Terratech	1978	
3-6	Monterey	8 borings for library and service sta. Qal over Monterey shale, GW 3' to 18'	Proposed Technical Library and Service Station	Naval Postgraduate School, Monterey	Woodward-Clyd	1981	
3-7	Monterey	15 borings to 60', GW 4' to 6' bgs	Caltrans LOTB for Fremont St OC North	Fremont St/Highway 1	Caltrans	1966	Qal up to 50' deep over Monterey Shale
3-8	Monterey	9 borings 5' to 70 ', GW 1' to 12' bgs	Caltrans LOTB for Highway 1/Aquajito Rd. UC	Aquajito Rd	Caltrans	1969	Qal up to 45' deep over Monterey Shale
3-9	Monterey	6 borings to 21.5' in Monterey Shale, no GW	Geotechnical Investigation, Proposed Library, Monterey Peninsula College, Monterey, California	Southwest of intersection of Via Lavandera and Costanoan Dr.	Kleinfelder	2000	

Table 1
SUMMARY OF EXISTING FIELD EXPLORATION DATA - CAW PIPELINES

Report Number	Pipeline Segment	Location / Borings	Geotechnical Investigation Project Name	Project Location	Report Author	Report Year	Remarks
3-10	Monterey	3 test pits and 4 borings to 44.5'. Up to 17' Qal in canyon bottom, GW at 17'	Geotechnical Investigation, Lecture Forum Bridge Replacement, Monterey Peninsula College, Monterey, California	East of Fishnet Rd. in central campus area	DMCE	2007	
3-11	Monterey	4 borings/4 CPT's in sandy Qal over Monterey shale, GW ar 5', 'odor" in some borings, liquefaction issues	My Infiniti Auto Dealership	601 E. Franklin Street, Monterey	Kleinfelder	1988	
3-12	Monterey	9 borings between Washington and Cortes St along Del Monte, fill over Qal, borings to 11', GW at 4', petroleum odor	Del Monte Avenue Widening	Del Monte Avenue (Camino El Estero to Washington Street), Monterey	Reynolds	2004	
3-13	Monterey	Same site as 3-14	Monterey Swim/Gym Site	Del Monte Avenue @ Washington Street, Monterey	Terratech	1990	
3-14	Monterey	12 borings through fill, alluvium, Monterey Shale and into DG. GW at 7', petroleum oder in some borings	Monterey Sports Center	Del Monte Avenue @ Washington Street, Monterey	DMCE	1962	
3-15	Monterey	7 bucket borings for tunnel show fill over terrace over DG	Proposed Tunnel and Building Area	Del Monte Avenue @ Tyler Street, Monterey	Dames & Moore	1976	
3-16	Monterey	5 borings through fill/terrace/DG, GW at 5'	Olympia Block Parking Garage	Del Monte Avenue @ Tyler Street, Monterey	Woodward-Clyde	1976	
3-17	Monterey	WCC report with 5 borings. Fill/terrace over DG, GW at 5'	Custom House Parking Facility	Del Monte Avenue @ Tyler Street, Monterey	Woodward-Clyde	1977	
3-18	Monterey	4 borings with 15' terrace over DG, GW at 11'	Proposed Monterey Hotel Addition	406 Alverado Street, Monterey	DMCE	2000	
3-19	Monterey	3 HSA borings into DG, GW at 6'	Samson Center, Monterey Institute of International Studies	Van Buren Street @ W. Franklin Street, Monterey	DMCE	2000	
3-20	Monterey	2 hand auger and 1 HSA to refusal at 8' on DG	Proposed ADA Site Access Improvements, Bay View Elementary School	680 Belden Street, Monterey	DMCE	2008	
3-21	Monterey	7 borings with fill/ shallow terrace over DG. Perched GW 12' to 22' bgs on granitic rock	New District Office and Maintenance Facility	Hillcrest Avenue at Carmel Avenue, Pacific Grove	DMCE	2009	
4-1	Reservoir Inlet/Outlet, ASR Extension	10 HSA borings up to 103' in old dune deposits. No GW	Geotechnical Baseline Report, Proposed Terminal Reservoir, Seaside, Monterey County, California, prepared for California American Water Company, (in progress).	East of General Jim Moore Boulevard and Hilby Ave, Seaside	AECOM	2015 -Draft	

Table 2

Geologic Conditions for Monterey Pipeline

Station Interval	Geologic Formation [1]	Liquefaction Hazard [2]	Nearest Relevant Previous Investigation [3]	Estimated depth to Groundwater at nearest Boring	Comments
Eardley PS -9+50	Qctp	Low to very low	3-21, 750' west of Eardley Pump Sta.	Study 3-21 perched gw at 12' -22' depth	
9+50 - 21+50	Kgdp	Very low	3-21, 1600' west of Sta. 20+00	Study 3-21 perched gw at 12' -22' depth	
21+50 - 38+00	Qcts	Low to very low	3-20, 1700' northeast of Sta. 30+00	Study 3-20 no gw to 8' depth	
38+00 - 44+00	Kgdp	Very low	3-20, 1000' northeast of Sta. 40+00	Study 3-20 no gw to 8' depth	
44+00 - 82+00	Qctp	Low to very low	3-20, 1400' north of Sta. 60+00	Study 3-20 no gw to 8' depth	
82+00 - 83+00	Qal	Mod. to high			Possible shallow perched gw in alluvium
83+00 - 85+00	Qctp	Low to very low	3-19, 2600' east of Sta. 83+00	Study 3-19 gw at 6' in Kgdp	Possible perched gw at base of terrace deposits
85+00 - 99+00	Kgdp	Very low	3-19, 2300' east of Sta. 99+00	Study 3-19 gw at 6' in Kgdp	
99+00 - 117+00	Qctp	Low to very low	3-19, 1600' east of Sta. 110+00	Study 3-19 gw at 6' in Kgdp	
117+00 - 126+00	Qcto	Low to very low	3-19, 1200' northeast of Sta. 120+00	Study 3-19 gw at 6' in Kgdp	
126+00 - 131+00	Qaf over Qcto/Kgdp	Low to high	3-18, 1200' ' north of Sta.130+00; 3-16 & 3-17	gw at 11' in Study 3-18; Study 3-16 and 3-17 have gw at 5'	Study 3-16 & 3-17 show fill over Qcto and Kgdp.
131+00 - 151+00	Qcto	Low to very low	3-18, 1200' north of Sta.130+00	Study 3-18 has gw at 11'	
151+00 - 153+00	Tm	Very Low	3-9, 500' S of Sta. 171+00	Study 3-9 has no gw to 21' depth	
153+00 - 161+00	Qal/Qb	Mod. to high	3-11, 1700' north of Sta. 160+00	Study 3-11 has gw at 5'	Expect fill soils and shallow gw at El Estero lagoon crossing
161+00 - 171+50	Qcto	Low to very low	3-10, 1200' south of Sta. 165+00	gw likely at 5'-10' or less	Study 3-10 has 17 ' Qal over Tm
171+50 - 187+50	Qal/Qaf	Mod. to high	3-8, Aquajito Rd. UC; 3-7 Fremont St. OC	gw 1' to 12' depth	Expect a few feet of fill over alluvium Unnamed fault crossed at Sta. 183+00

Table 2 (continued)

Geologic Conditions for Monterey Pipeline

Station Interval	Geologic Formation [1]	Liquefaction Hazard [2]	Nearest Relevant Previous Investigation [3]	Estimated depth to Groundwater at nearest Boring	Comments
187+50 - 199+00	Tm	Very Low	3-8, Aquajito Rd. UC; 3-7 Fremont St. OC	gw likely at 10' or greater depth	
199+00 - 215+00	Qcto	Low to very low	3-6, 1500' north of Sta. 200+00	gw likely at 15' or greater depth	Tm expected to be at shallow depth. Pipeline parallels unnamed fault about Sta. 197+00 - 203+00
215+00 - 219+00	Qaf over Qal/Tm	Low to high	3-3, Fairgrounds Rd. UC and 3-2, Route 68/Highway 1 separation	gw 3' to 6' depth	Qal up to 37' depth over Tm
219+00 - 225+00	Tm	Very Low	3-2, Route 68/Highway 1 separation	gw likely at 10' or greater depth	Navy fault crossed at Sta. 222+00
225+00 - 227+00	Qal	Mod. to high	3-2, Route 68/Highway 1 separation	gw likely at 10' or greater depth	Expect fill over Qal due to 68/1 Caltrans interchange
227+00 - 228+50	Tm	Very Low	3-2, Route 68/Highway 1 separation	gw likely at 10' or greater depth	Expect fill over Tm due to 68/1 Caltrans interchange
228+50- 278+50	Qctp	Low to very low	3-1, 3300 feet north of Sta. 250+00	gw likely at 10' or greater depth	
278+50 - 282+00	Qaf over Qal/Tmd	Low to high		gw likely at 10' or greater depth	Canyon Del Rey crossing
282+00 - 315+50	Qctp	Low to very low		gw likely at 15' or greater depth	Chupines fault crossed at Sta. 292+00
315+50 - 350+00	Qod/Qod_1	Low to very low	4-1, 3000' east of Sta. 350+00	gw likely at 20' or greater depth	Seaside fault crossed at Sta. 330+00

Notes: 1. Qaf - artificial fill; Qal - alluvium; Qb - basin deposits; Qfd - Flandrian dune deposits (young stabilized dunes); Qod/Qod_1 - Older dune deposits; Qct - Pleistocene coastal terrace deposits (includes Qcts -Silvan terrace, Qctp-Peninsular terrace, Qcto -Ocean View terrace and Qctl -Lighthouse terrace) ; Tm/Tmd - Monterey Shale; Kgdp - granodiorite of Monterey.

2. Liquefaction hazards and geologic formations from "Map showing geology and liquefaction susceptibility of Quaternary deposits in the Monterey, Seaside, Spreckels and Carmel Valley quadrangles, Monterey County, California," by Dupre', W.R., 1990, USGS Misc. Field Studies Map MF-2096.

3. See Table 1 for cross reference to previous investigation number.

Table 3
Geologic Conditions for Transfer Pipeline

Station Interval	Geologic Formation [1]	Liquefaction Hazard [2]	Nearest Relevant Previous Investigation [3]	Estimate depth to Groundwater at nearest Boring	Comments
23+00 - 61+50	Qod	Low to very low	4-1, 6500' south of Sta.30+00 at Terminal Res.	Study 4-1, gw greater than 100' depth	
61+50 - 208+50	Qod_2	Low to very low	2-8 and 2-9 by Sta. 176+00 and 2-12 400' north of Sta. 133+00	gw greater than 50' in all studies	
208+50 - 368+00	Qod_1	Low to very low	2-3, 800' west of Sta. 295+00; 2-4 by Sta. 282+00 and 2-7 by Sta. 210+00	Study 2-3 gw at 32' depth, Study 2-4 gw at 30' and Study 2-7 gw greater than 58'	Possible shallow gw Sta. 320+00 to 327+00 near small lake in Locke-Paddon Park Reliz fault (south) crossed at Sta. 284+00; Reliz fault (north) crossed at Sta. 328+00
368+00 - 520+00	Qod2	Low to very low	1-4 at Desal Plant Sta. 520+00; 1-5, 500' west of Sta. 470+00; 1-6, 1200' west of Sta.425+00;	Study 1-4 gw at 57' depth, Study 1-5 gw at 6' depth Study 1-6 gw at 35' depth	

Notes:

1. Qod - older coastal dune deposits (undivided): Locally divided into Qod_1 - younger dune deposits and Qod_2 - older dune deposits.

2. Liquefaction hazards and geologic formations from "Map showing geology and liquefaction susceptibility of Quaternary deposits in the Monterey, Seaside, Spreckels and Carmel Valley quadrangles, Monterey County, California," by Dupre', W.R., 1990, USGS Misc. Field Studies Map MF-2096 and "Map showing geology and liquefaction potential of northern Monterey and southern Santa Cruz Counties, California," by Dupre', W.R. and Tinsley, J.C., 1980, USGS Misc. Field Studies Map MF-1199.

3. See Table 1 for cross reference to previous investigation number.

Table 4

Geologic Conditions for Reservoir Inlet/Outlet and Drain

Station Interval	**Geologic Formation [1]**	**Liquefaction Hazard [2]**	**Nearest Relevant Previous Investigation [3]**	**Estimate depth to Groundwater at nearest Boring**	**Comments**
Yosemite St. & Hilby Ave. to Terminal Reservoir	Qod/Qod_1	Low to very low	Study 4-1 at Terminal reservoir	Studies 4-1 no gw encountered to 103' depth	

Notes:

1. Qod - older coastal dune deposits (undivided): Locally divided into Qod_1 - younger dune deposits and Qod_2 - older dune deposits.

2. Liquefaction hazards and geologic formations from "Map showing geology and liquefaction susceptibility of Quaternary deposits in the Monterey, Seaside, Spreckels and Carmel Valley quadrangles, Monterey County, California," by Dupre', W.R., 1990, USGS Misc. Field Studies Map MF-2096 and "Map showing geology and liquefaction potential of northern Monterey and southern Santa Cruz Counties, California," by Dupre', W.R. and Tinsley, J.C., 1980, USGS Misc. Field Studies Map MF-1199.

3. See Table 1 for cross reference to previous investigation number.

Table 5

Geologic Conditions for ASR Extension Pipelines

Station Interval	Geologic Formation [1]	Liquefaction Hazard [2]	Nearest Relevant Previous Investigation [3]	Estimate depth to Groundwater at nearest Boring	Comments
1+00 to 44+00	Qod/Qod_2	Low to very low	Study 4-1 at Terminal reservoir	Studies 4-1 no gw encountered to 103' depth	Parallels Transfer pipeline

Notes:

1. Qod - older coastal dune deposits (undivided): Locally divided into Qod_1 - younger dune deposits and Qod_2 - older dune deposits.

2. Liquefaction hazards and geologic formations from "Map showing geology and liquefaction susceptibility of Quaternary deposits in the Monterey, Seaside, Spreckels and Carmel Valley quadrangles, Monterey County, California," by Dupre', W.R., 1990, USGS Misc. Field Studies Map MF-2096 and "Map showing geology and liquefaction potential of northern Monterey and southern Santa Cruz Counties, California," by Dupre', W.R. and Tinsley, J.C., 1980, USGS Misc. Field Studies Map MF-1199.

3. See Table 1 for cross reference to previous investigation number.

Table 6

Geologic Conditions for Cemex Feedwater Pipeline

Station Interval	**Geologic Formation [1]**	**Liquefaction Hazard [2]**	**Nearest Relevant Previous Investigation [3]**	**Estimate depth to Groundwater at nearest Boring**	**Comments**
23+00 - 32+00	Qod_1	Low to very low	1-6, 400' east of Sta. 30+00 (lapis Spur Rd./Hwy 1	gw at 35' depth in Study 1-6	
32+00 - 139+00	Qod2	Low to very low	1-4 at Desal Plant Sta. 139+00; 1-5, 500' west of Sta. 90+00; 1-6 at Sta. 34+00	Study 1-4 gw at 57' depth, Study 1-5 gw at 6' depth Study 1-6 gw at 35' depth	

Notes:

1. Qod - older coastal dune deposits (undivided): Locally divided into Qod_1 - younger dune deposits and Qod_2 - older dune deposits.

2. Liquefaction hazards and geologic formations from "Map showing geology and liquefaction susceptibility of Quaternary deposits in the Monterey, Seaside, Spreckels and Carmel Valley quadrangles, Monterey County, California," by Dupre', W.R., 1990, USGS Misc. Field Studies Map MF-2096 and "Map showing geology and liquefaction potential of northern Monterey and southern Santa Cruz Counties, California," by Dupre', W.R. and Tinsley, J.C., 1980, USGS Misc. Field Studies Map MF-1199.

3. See Table 1 for cross reference to previous investigation number.

Table 7

Geologic Conditions for Brine Pipeline

Geologic Formation [1]	Liquefaction Hazard [2]	Nearest Relevant Previous Investigation [3]	Estimate depth to Groundwater at nearest Boring	Comments
Qod2	Low to very low	1-4 at Desal plant; 1-1 and 1-3 at Treatment plant; 1-2 along road between Treatment plant and Desal Plant	Study 1-4 gw at 57' depth at desal plant site. Study 1-2 no gw to 26' depth. Studies 1-3 and 1-1 no gw to 50' depth	

Notes:

1. Qod - older coastal dune deposits (undivided): Locally divided into Qod_1 - younger dune deposits and Qod_2 - older dune deposits.

2. Liquefaction hazards and geologic formations from "Map showing geology and liquefaction potential of northern Monterey and southern Santa Cruz Counties, California," by Dupre', W.R. and Tinsley, J.C., 1980, USGS Misc. Field Studies Map MF-1199.

3. See Table 1 for cross reference to previous investigation number.

Table 8

Geologic Conditions for Salinas Valley Return Pipeline

Geologic Formation [1]	Liquefaction Hazard [2]	Nearest Relevant Previous Investigation [3]	Estimate depth to Groundwater at nearest Boring	Comments
Qod2	Low to very low	1-4 at Desal plant; 1-1 and 1-3 at Treatment plant; 1-2 along road between Treatment plant and Desal Plant	Study 1-4 gw at 57' depth at desal plant site. Study 1-2 no gw to 26' depth. Studies 1-3 and 1-1 no gw to 50' depth	

Notes:

1. Qod - older coastal dune deposits (undivided): Locally divided into Qod_1 - younger dune deposits and Qod_2 - older dune deposits.

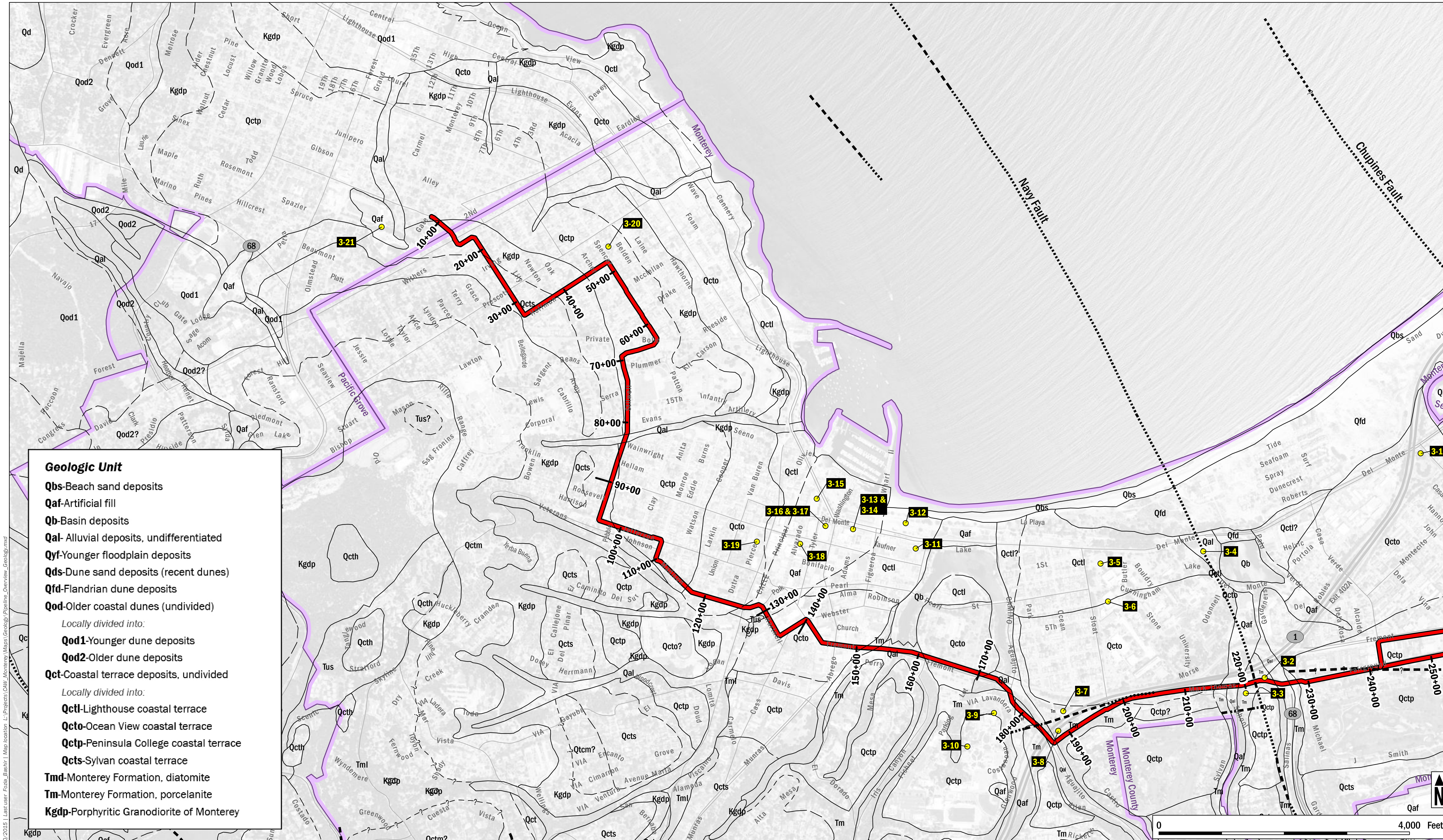
2. Liquefaction hazards and geologic formations from "Map showing geology and liquefaction potential of northern Monterey and southern Santa Cruz Counties, California," by Dupre', W.R. and Tinsley, J.C., 1980, USGS Misc. Field Studies Map MF-1199.

3. See Table 1 for cross reference to previous investigation number.

TABLE 9

Nearby Active and Potentially Active Faults

FAULT	TYPE	DISTANCE from Eardley Pump Sta. (km)	DISTANCE from Terminal Reservoir (km)	DISTANCE from Desalination Plant (km)	SLIP RATE (mm/yr)	MOMENT MAGNITUDE (maximum)
Reliz	B	11.9	8.3	4.9	0.2 - 0.1	6.25
Monterey Bay-Tularcitos	B	4.6	4.4	12	0.2 - 0.1	7.0
Rinconada	B	25.8	17.1	19.9	0.2 - 0.1	7.5
San Andreas	A	41.5	36.9	24.4	> 5.0	8.0
Cypress Point	B	5.5	12.5	22.5	0.2	6.0
Zayante-Vergales	B	35.0	30.5	18.0	0.1	7.0
San Gregorio (Southern)	B	10.6	17.7	28.0	1.0 - 5.0	7.5



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California American Water

Transmission Mains and Aquifer Storage & Recovery (ASR) Facilities

MONTEREY PENINSULA WATER SUPPLY PROJECT, MPWSP

Map Area

Pacific Grove · Marina · Seaside · Monterey City · Unincorporated Monterey County

City Limits, County
Monterey County

Geology
Dupre, W.R., U.S. Geological Survey. MF-2096. 1990.
Clark, Joseph C. Dupre, William R. Rosenberg, Lewis I. U.S. Geological Survey. OFR9730. 1997.
U.S. Geological Survey, 2010, Quaternary fold and fault database for United States, U.S. Geological Survey website, http://earthquake.usgs.gov/hazards/qfaults/.

Contact - Dashed where approximately located or gradational, dotted where concealed, queried where questionably located

Fault - Dashed where inferred, dotted where concealed, queried where doubtful.

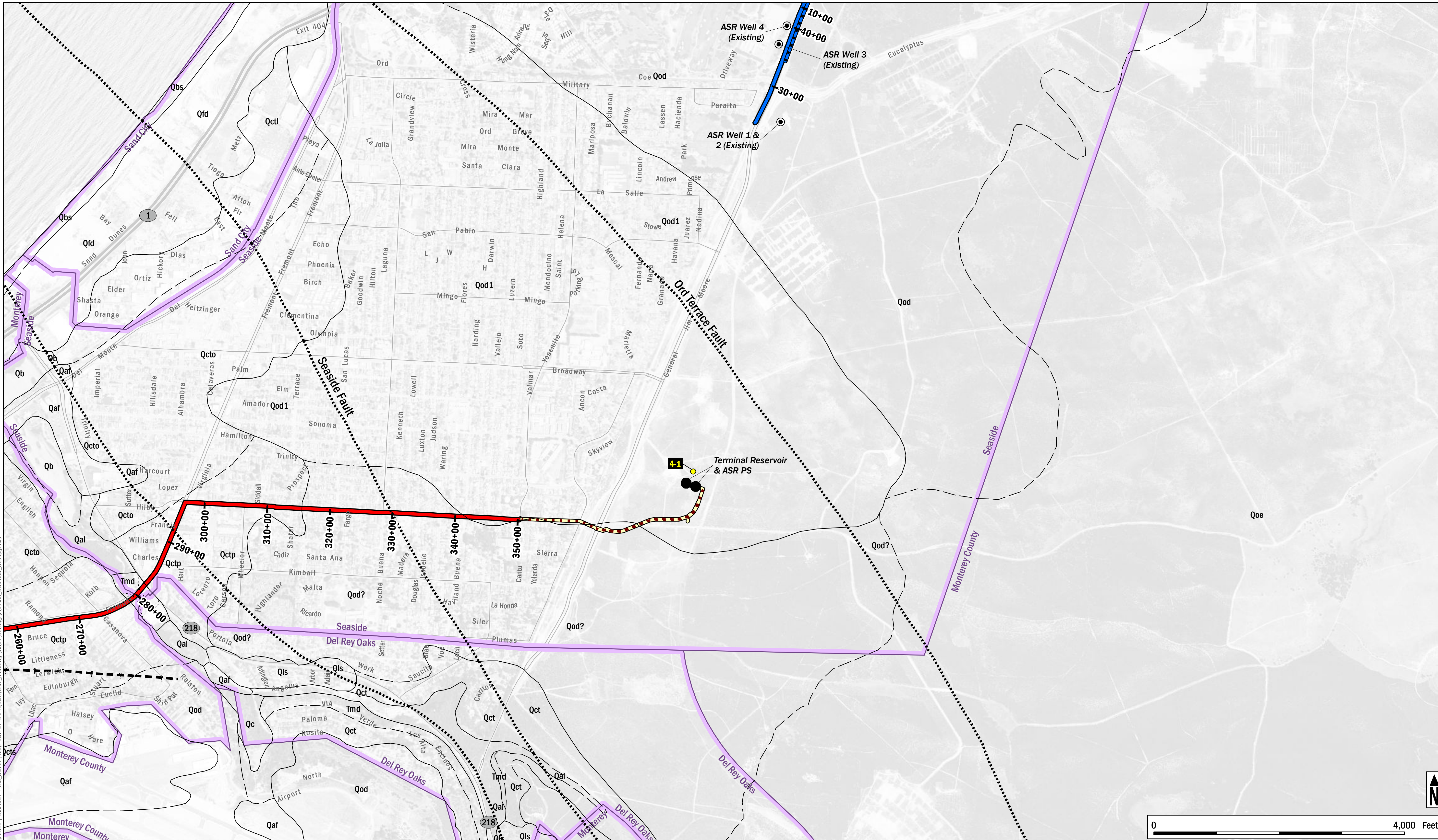
Location of Previous Geotechnical Study, Refer to Table 1

Monterey Pipeline

City

FIGURE 1-1

Site Plan and Geologic Map



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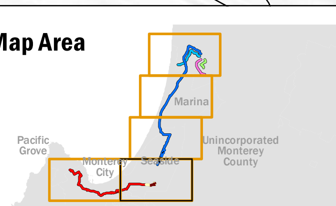
MONTEREY PENINSULA WATER SUPPLY PROJECT, MPWSP

Map Area



City Limits, County
Monterey County
Geology
Dupre, W.R.. U.S. Geological Survey. MF-2096. 1990.
Clark, Joseph C. Dupre, William R. Rosenberg, Lewis I. U.S. Geological Survey. OFR9730. 1997.
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Location of Previous Geotechnical Study, Refer to Table 1

Wells

ASR Extension

Reservoir Inlet/Outlet Drain

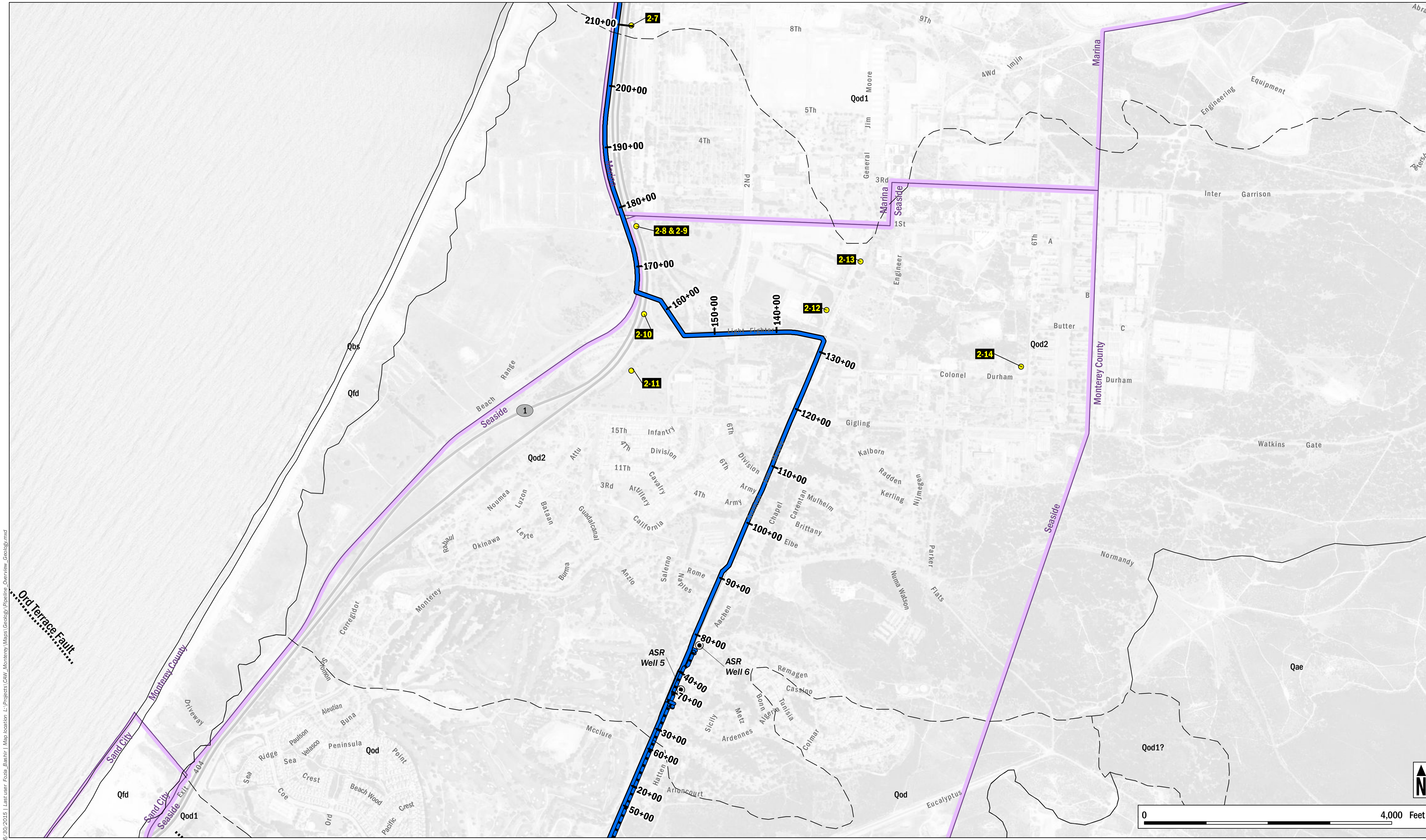
Monterey Pipeline

Transfer Pipeline

City

FIGURE 1-2

Site Plan and Geologic Map



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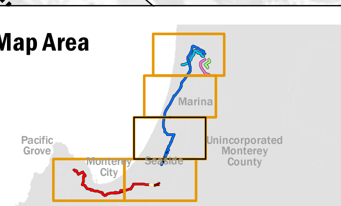
California American Water

Transmission Mains and Aquifer Storage & Recovery (ASR) Facilities

MONTEREY PENINSULA WATER SUPPLY PROJECT, MPWSP

Map Area



City Limits, County
Monterey County
Geology
Dupre, W.R., and Tinsley, J.C.. U.S. Geological Survey. MF-1199. 1980.
U.S. Geological Survey, 2010, Quaternary fold and fault database for United States, U.S. Geological Survey website, http://earthquake.usgs.gov/hazards/qfaults/.

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Location of Previous Geotechnical Study, Refer to Table 1

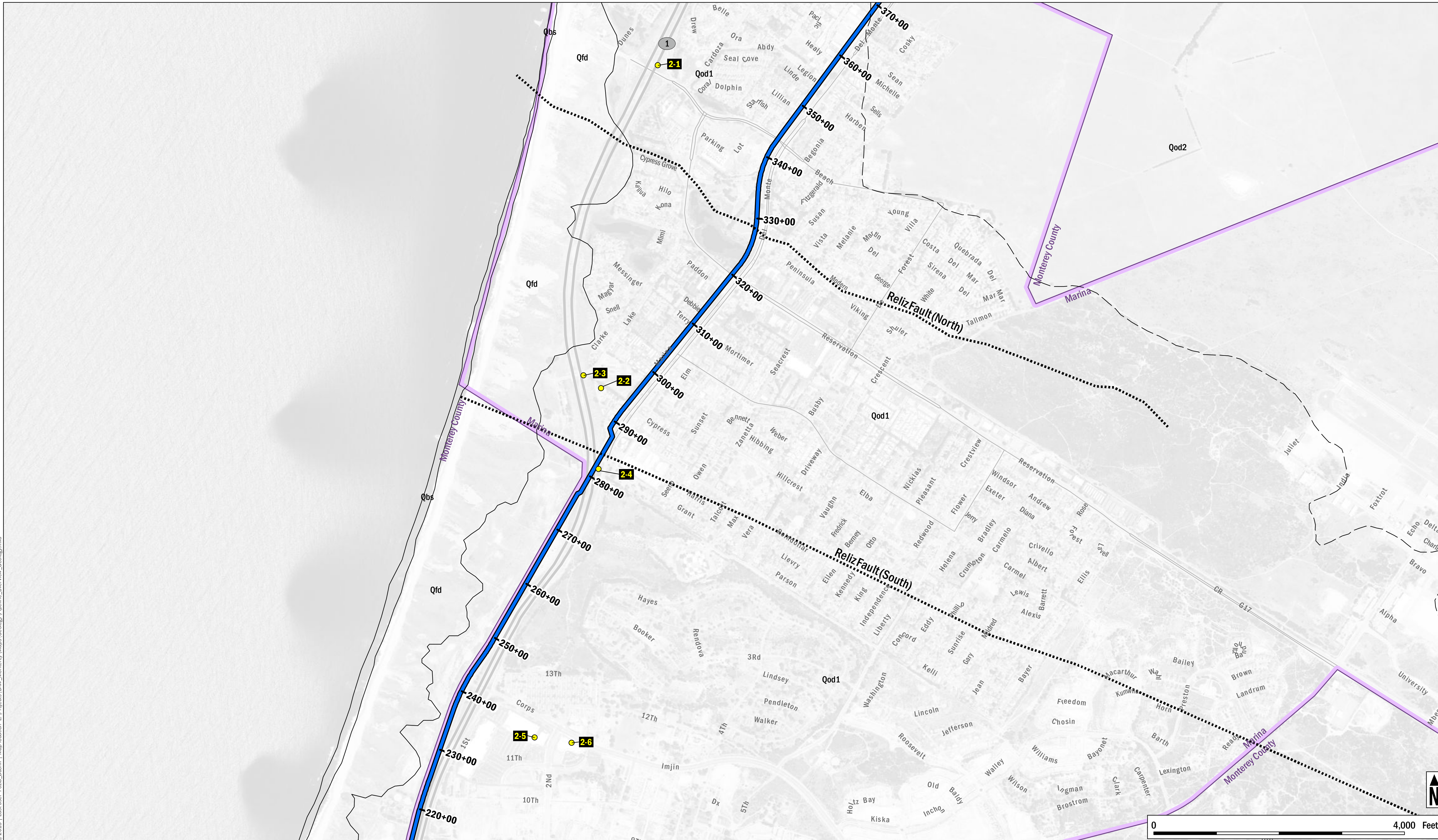
ASR Extension

Transfer Pipeline

City

FIGURE 1-3

Site Plan and Geologic Map



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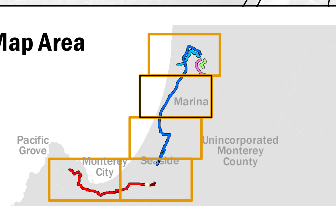
AECOM

California American Water

Transmission Mains and Aquifer Storage & Recovery (ASR) Facilities

MONTEREY PENINSULA WATER SUPPLY PROJECT, MPWSP

Map Area



City Limits, County
Monterey County
Geology
Dupre, W.R., and Tinsley, J.C.. U.S. Geological Survey. MF-1199. 1980.
U.S. Geological Survey, 2010, Quaternary fold and fault database for United States, U.S. Geological Survey website, http://earthquake.usgs.gov/hazards/qfaults/.

Contact - Dashed where approximately located or gradational, dotted where concealed, queried where questionably located

Fault - Dashed where inferred, dotted where concealed, queried where doubtful.

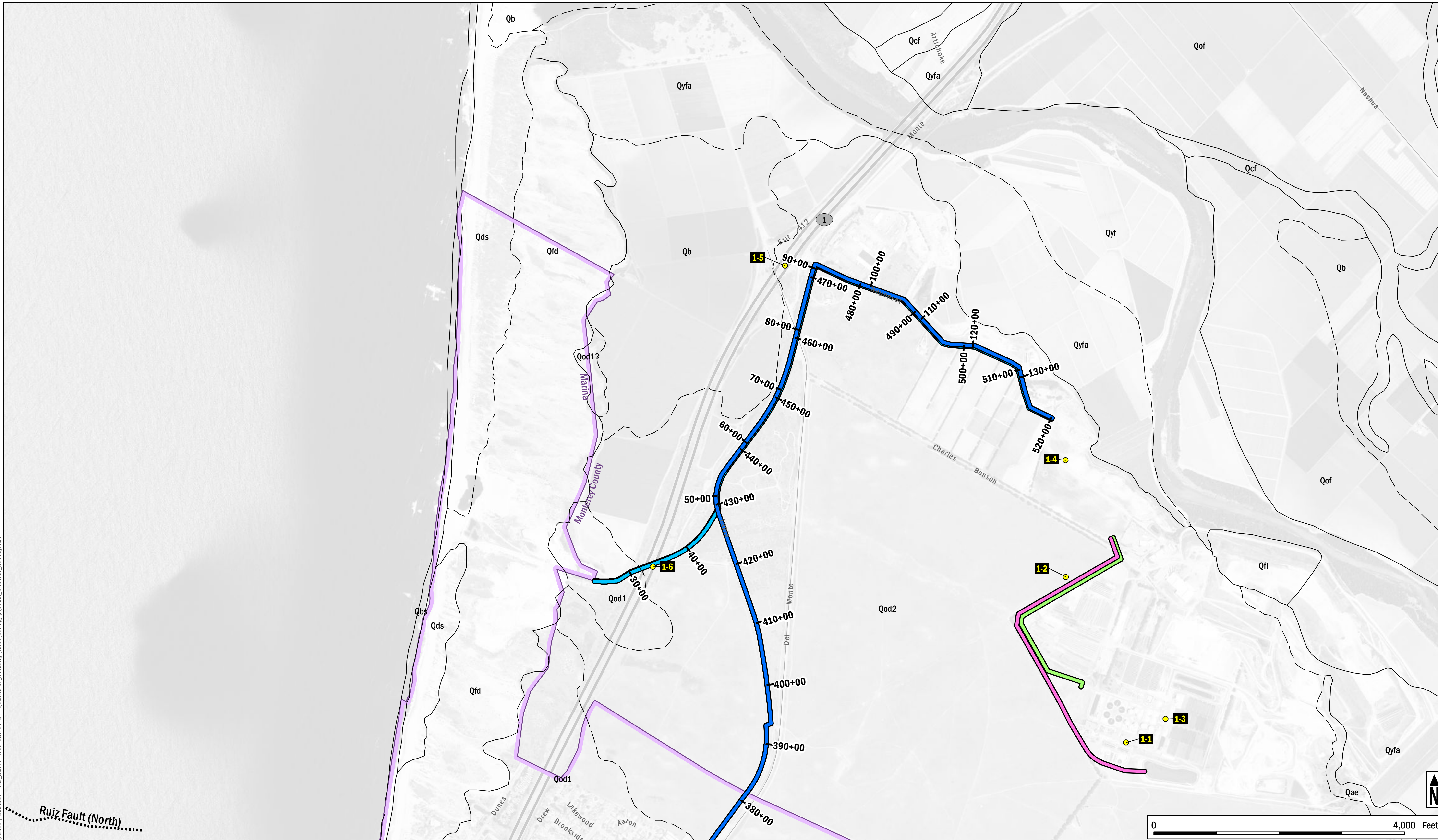
Location of Previous Geotechnical Study, Refer to Table 1

Transfer Pipeline

City

FIGURE 1-4

Site Plan and Geologic Map



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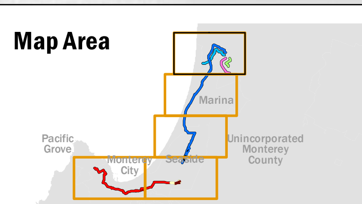
AECOM

California American Water

Transmission Mains and Aquifer Storage & Recovery (ASR) Facilities

MONTEREY PENINSULA WATER SUPPLY PROJECT, MPWSP

Map Area



City Limits, County
Monterey County
Geology
Dupre, W.R., and Tinsley, J.C.. U.S. Geological Survey. MF-1199. 1980.
U.S. Geological Survey, 2010, Quaternary fold and fault database for United States, U.S. Geological Survey website, http://earthquake.usgs.gov/hazards/qfaults/.

Contact - Dashed where approximately located or gradational, dotted where concealed, queried where questionably located

Fault - Dashed where inferred, dotted where concealed, queried where doubtful.

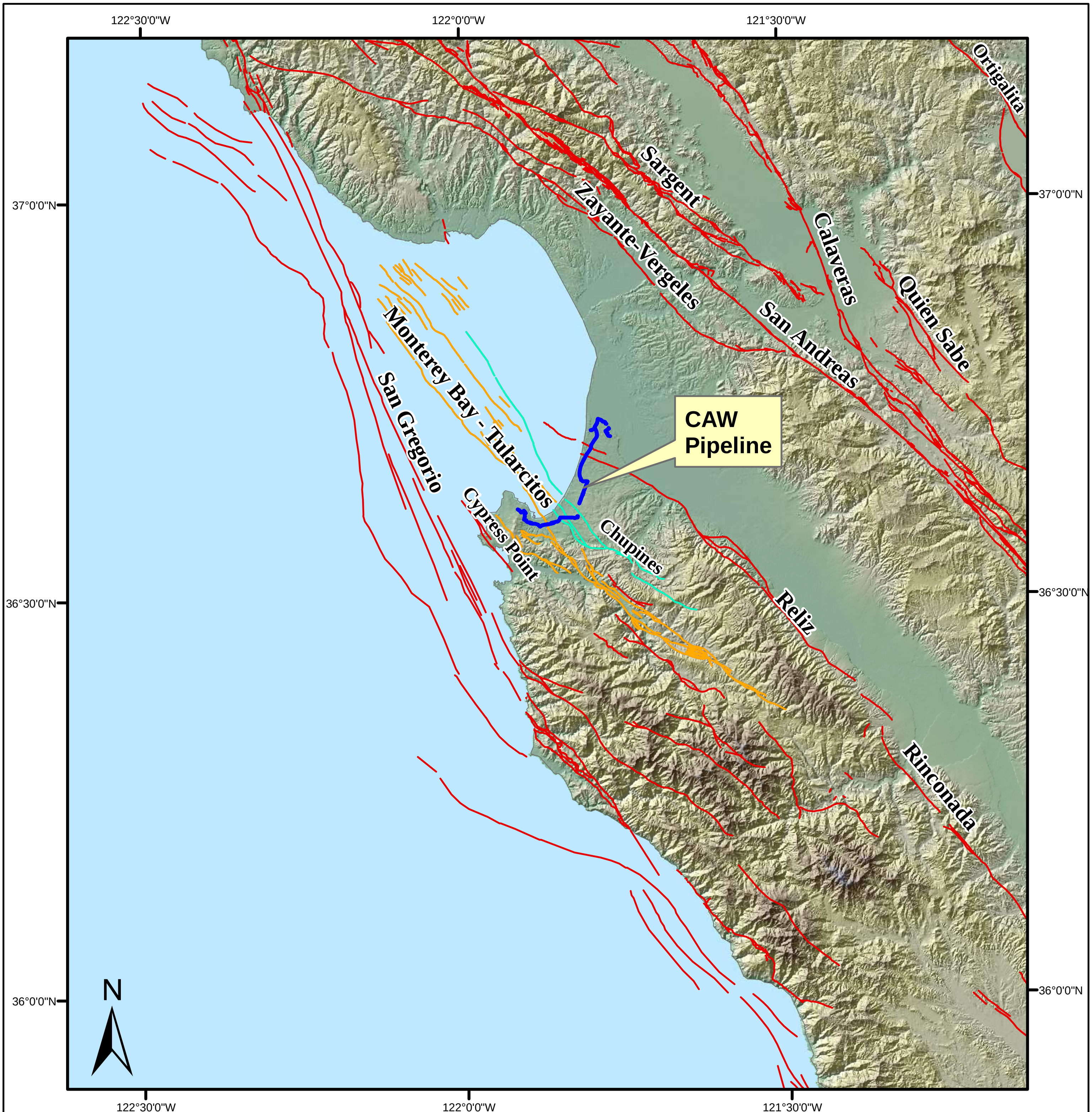
Location of Previous Geotechnical Study, Refer to Table 1

Brine Pipeline
Cemex Feed Water
Transfer Pipeline
Salinas Valley Return Alternative

City

FIGURE 1-5

Site Plan and Geologic Map

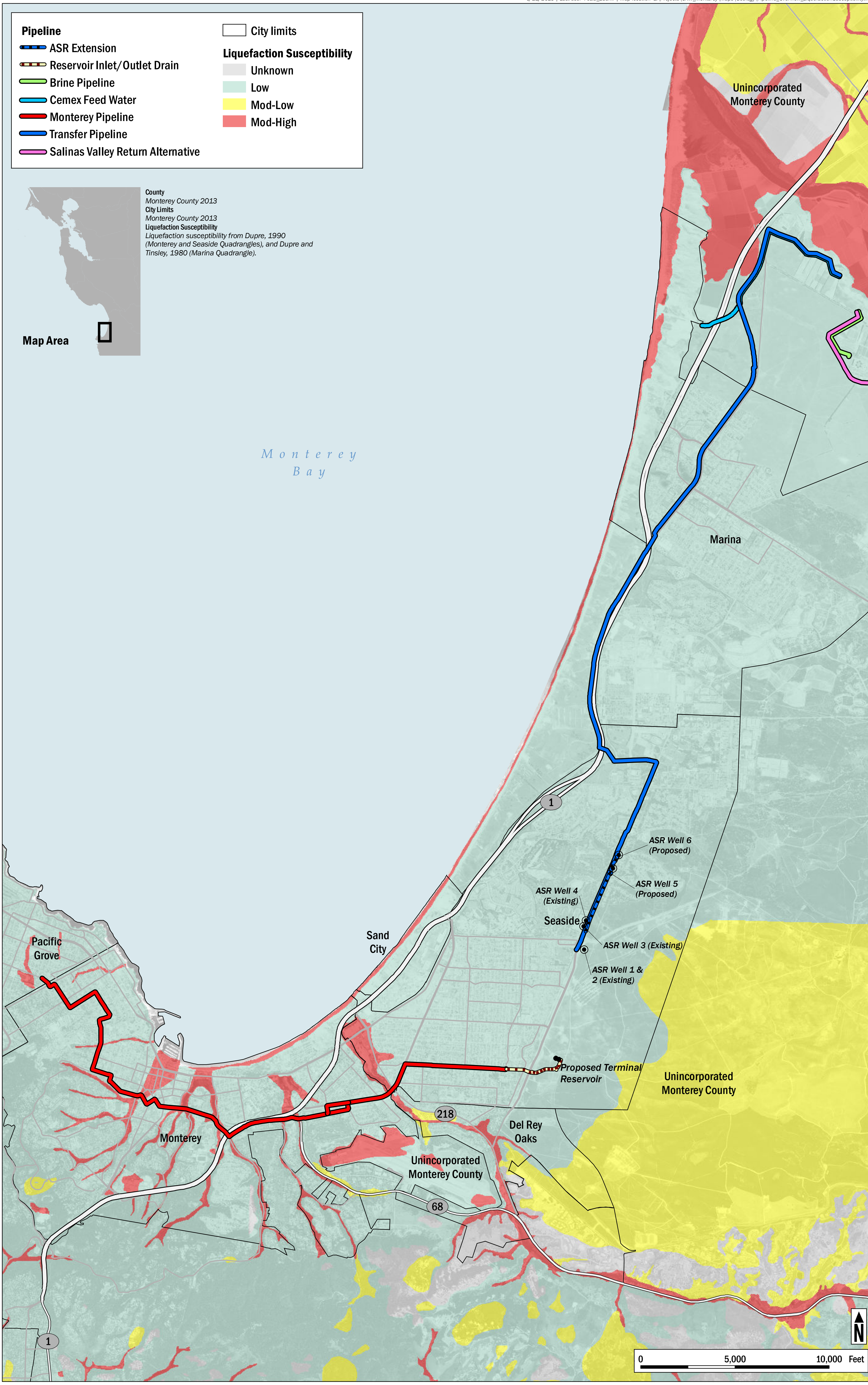


Kilometers
0 5 10 20 30 40

Miles
0 3.75 7.5 15 22.5 30

AECOM	Project No. 26818631	REGIONAL FAULT MAP	Figure
	California American Water Pipeline		2

6/22/2015 | Last user Fozia_Bashir | Map location L:\Projects\CAW_Monterey\Maps\Geology\Pipeline_Overview_LiquefactionSusceptibility.mxd



AECOM

California American Water

Transmission Mains and Aquifer Storage & Recovery (ASR) Facilities

MONTEREY PENINSULA WATER SUPPLY PROJECT, MPWSP

FIGURE 3

Liquefaction Susceptibility Map

6/22/2015 | Last user Fozia_Bashir | Map location L:\Projects\CAW_Monterey\Maps\Geology\Pipeline_Overview_TsunamiInundation.mxd

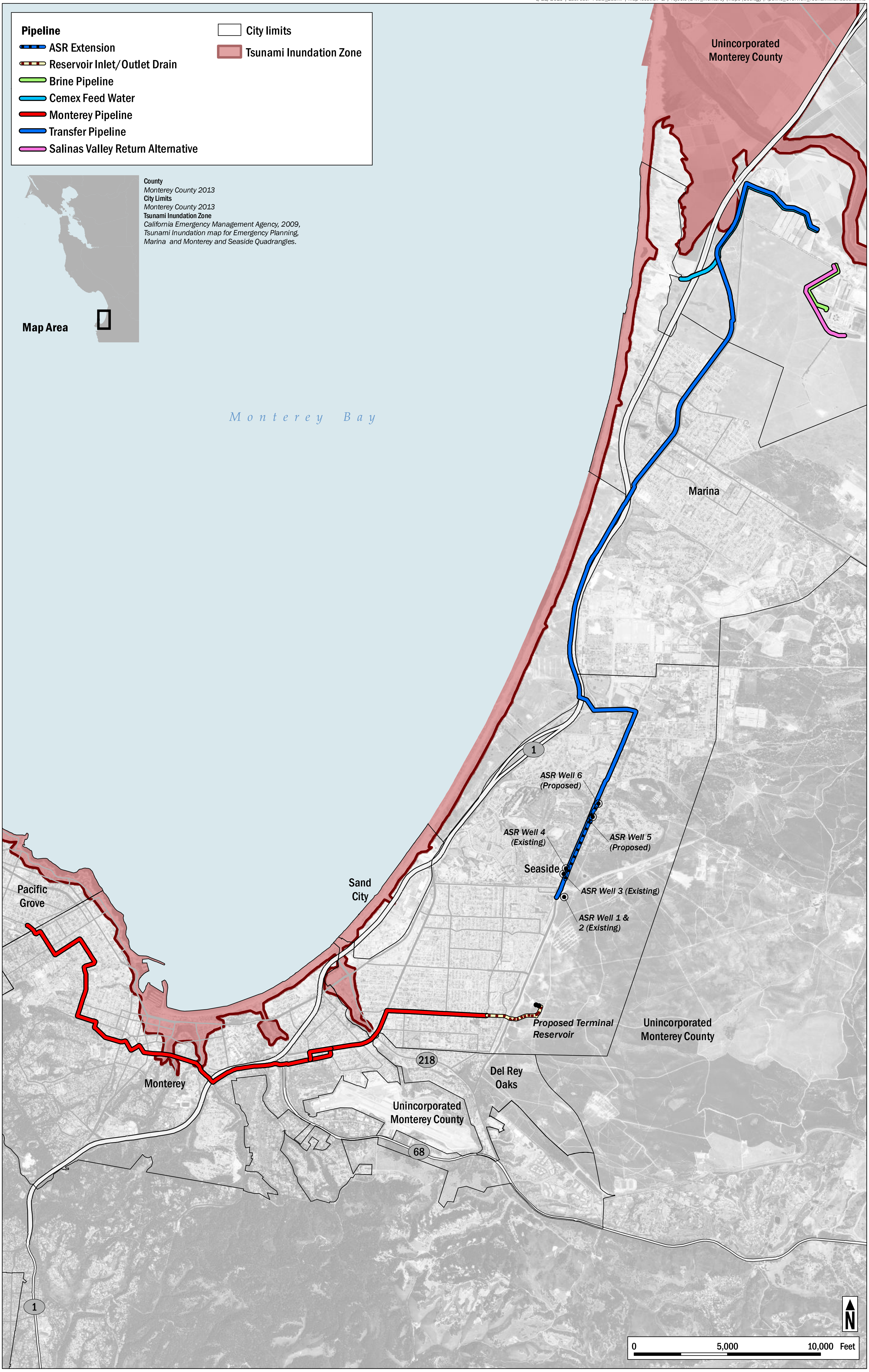


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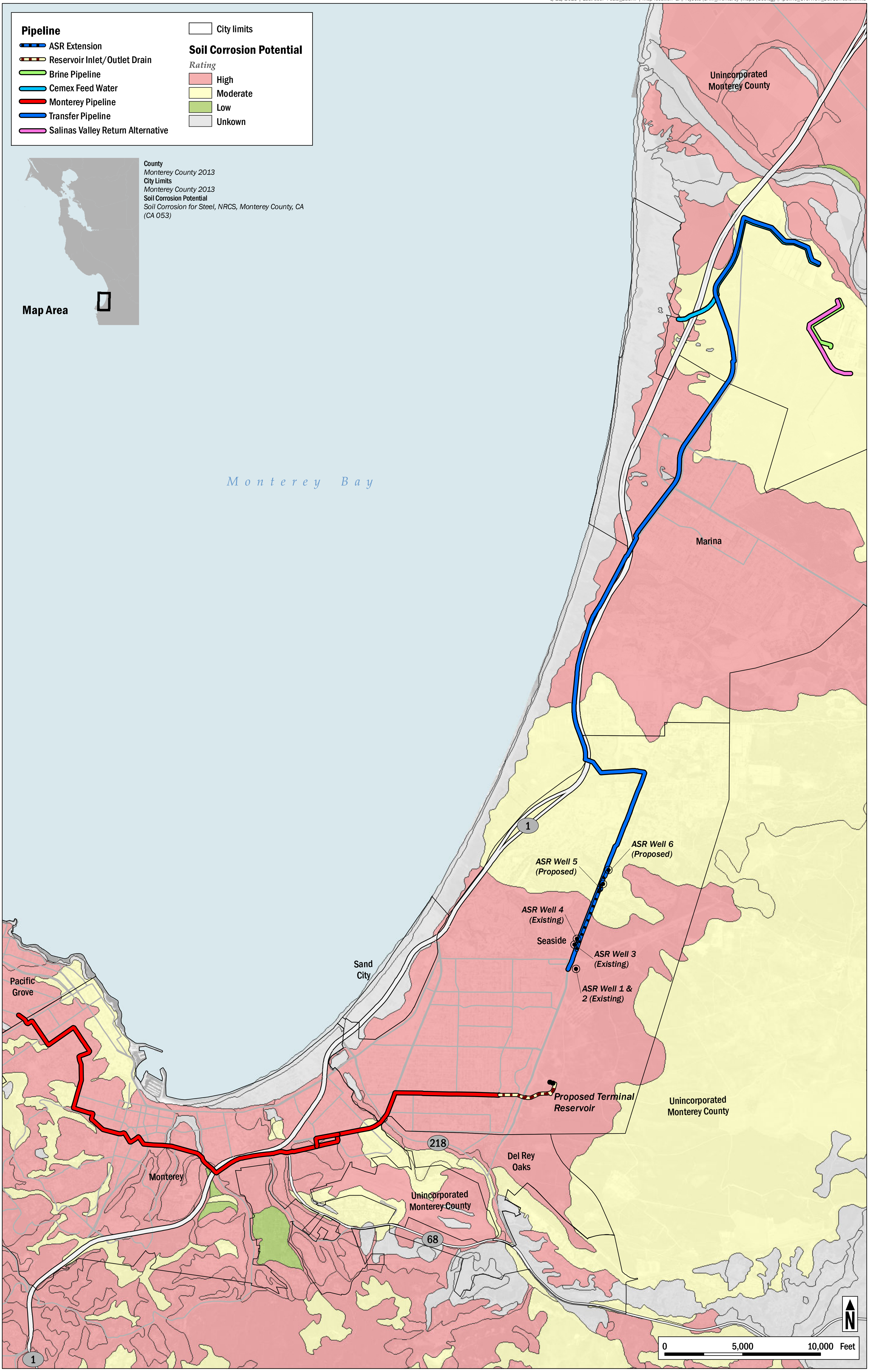
FIGURE 4

Tsunami Inundation Map

6/22/2015 | Last user Fozia_Bashir | Map location L:\Projects\CAW_Monterey\Maps\Geology\Pipeline_Overview_SoilCorrosion.mxd



AECOM

California American Water

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MONTEREY PENINSULA WATER SUPPLY PROJECT, MPWSP

FIGURE 5

Soil Corrosion Potential Map