Chapter 7. Geology and Soils

This chapter identifies and evaluates the potential impacts of the CWP on geology, seismicity, and soil resources. The chapter includes a description of local topography, geology, seismicity, and soil resources; summarizes applicable state, local, and regional plans and programs, objectives, and policies; identifies potential impacts related to geology and soils; and proposed mitigation measures to reduce potentially significant impacts.

7.1 Existing Setting

The proposed projects included in either CWP alternative would be constructed within the City of San Mateo; therefore, existing setting information is presented primarily for the City.

7.1.1 Geology and Topography

San Mateo is located on the west side of San Francisco Bay, within the Coast Ranges geomorphic province of California. The Coast Ranges geomorphic province extends from near the Oregon border southward to the Santa Barbara area; the San Francisco Bay separates the northern and southern Coast Ranges (Schoenherr, 1995). The Coast Ranges consists of northwest-to-southeast-trending ridges and valleys associated with faulting and folding (Schoenherr, 1995). The City is situated on the northeasterly flank of the central Santa Cruz Mountains but is separated from the mountain range by the San Andreas Fault and associated rift valley, which run subparallel to the fault. Geologic formations within and near the City include the Franciscan formation, which is typified by sedimentary-volcanic-metamorphic rocks including serpentenite, and the Santa Clara formation, which is typified by conglomerate sandstone and mudstone (City of San Mateo, 2009; 2010).

Landforms within the City are varied and include uplands, hillsides, valley, and alluvial fans (City of San Mateo, 2009; 2010). Western areas contain broad uplands and hills that have been extensively uplifted and dissected by the drainage canyons of Laurel Creek and San Mateo Creek. Near the shoreline are Bay muds and reclaimed lands, which extend to near US-101, where the historical shoreline existed prior to filling the Bay (City of San Mateo, 2009; 2010). Geologic units are shown on Figure 7-1; descriptions of the geologic units are provided in Appendix E (Brabb, et al., 1988).

Geologic hazards and soils are described in the following sections.

7.1.2 Earthquake Faults and Seismicity

The San Francisco Bay Area (Bay Area) is in a very seismically active region, with a high risk of geologic hazards that stem largely from movement of the earth's crust along well-defined active fault zones of the San Andreas Fault system (City of San Mateo, 2009). The San Andreas Fault is a northwest-southeast-trending fault zone located about 2 miles west of the City. The Hayward fault is located about 14 miles northeast of the City (City of San Mateo, 2009). There are no active faults or Alquist-Priolo Earthquake Hazard Zones located in the City; inactive fault traces, which are older features with no evidence of recent motion, have been mapped within the City. Geologic hazards that could potentially affect the CWP and its projects are described in the following sections.

7.1.2.1 Ground Shaking

Ground shaking from earthquakes can cause extensive damage to property and people. Factors that determine the amount of damage caused from ground shaking are interrelated and include the magnitude and depth of the earthquake, distance from the fault, duration of shaking, type of bedrock and soils, and topography, among others. The entire Bay Area, including the City of San Mateo, is subject to strong ground shaking during earthquakes (City of San Mateo, 2009) (see Figure 7-2). Historically, there have been several strong earthquakes in the vicinity, including the magnitude 6.9 Loma Prieta earthquake in October 1989 and the magnitude 7.8 San Francisco earthquake in 1906, both of which occurred on the San Andreas Fault

system. Ground shaking from these events was felt over large distances, and areas underlain by unconsolidated sediments experienced greater structural damage than areas underlain by bedrock. There are no mapped active or potentially active faults underlying the City; however, because of its proximity to the San Andreas Fault Zone, the Hayward Fault Zone, and other active faults, San Mateo could experience very strong intensity ground shaking during a large earthquake. According to the 2008 Uniform California Earthquake Rupture Forecast (U.S. Geological Survey, 2015) there is a 63 percent probability of a magnitude 6.7 or greater earthquake in the Bay Area within 30 years, with the greatest probabilities of earthquakes on the Hayward-Rogers Creek Fault and the San Andreas Fault. Therefore, San Mateo is very likely to experience very strong ground shaking from earthquakes in the future.

7.1.2.2 Landslides

Weak rocks and steep slopes are basic geologic characteristics that contribute to slope instability, including landslides. In susceptible areas, landslides can be triggered by earthquakes and high rainfall. In the City, the risk of landslides is greatest in the western hilly areas where landslides have occurred previously and in areas where slopes have been modified by grading (City of San Mateo, 2009; 2010). Despite recorded historic landslides, slope instability is not widespread in the City (City of San Mateo, 2009; 2010); however, during a major earthquake or heavy rainfall, landslides could occur where there has been overgrading that contributes to slope instability (City of San Mateo, 2009; 2010).

7.1.2.3 Liquefaction

Liquefaction is the transformation of saturated, unconsolidated, granular material from a solid state to a liquid state because of increased pore pressure that reduces the material's strength. During liquefaction, soil becomes fluid-like and mobile, and permanent displacement of the ground can occur, resulting in damage to utilities and structures (Association of Bay Area Governments [ABAG], 2001). Increased pore pressure in unconsolidated materials is caused by ground shaking during large earthquakes. Liquefaction can cause foundation failures in buildings and other facilities because of the reduction of foundation bearing strength. The potential for liquefaction depends on the duration and intensity of earthquake shaking, particle size distribution of the soil, density of the soil, and groundwater elevation. Areas at risk of liquefaction typically have a high groundwater table underlying low- to medium-density, granular sediments, particularly younger alluvium and artificial fill. In San Mateo, the potential for liquefaction exists in areas with fill material, Bay mud, and alluvium; Figure 7-3 shows areas of the City having potential for liquefaction (City of San Mateo, 2009).

7.1.2.4 Lateral Spreading

Lateral spreading is a ground failure that involves displacement of large blocks of ground down gentle slopes or toward stream channels. The potential for lateral spreading is highest in areas underlain by soft, saturated, liquefiable materials, especially where bordered by steep banks or adjacent hard ground. In San Mateo, lateral spreading is possible along the banks of drainage courses that are not constrained in concrete channels and/or by other protective measures (City of San Mateo, 2009).

7.1.3 Soils

The Program Area contains soil types that vary with landscape position (see Figure 7-4). On the east side of US-101, soils are mapped as Urban Land-Orthents reclaimed complex (U.S. Soil Conservation Service, 1991; Map Unit 134). These lands were once part of San Francisco Bay and tidal flats and were filled as the area was developed. Soil composition is variable because the fill material used for reclamation varied in composition. Recent subsurface investigations near Detroit Drive and J. Hart Clinton Drive, east of the WWTP, revealed that subsurface soil materials consist of fill, Bay mud, and alluvium (Engeo Inc., 2009; Ninyo and Moore, 2013). Areas within Map Unit 134 may have a groundwater table that is tidally influenced and fluctuates between 30 to 60 inches below ground surface. These soils are prone to settlement and liquefaction (see Figure 7-3).

Much of the Program Area comprises soils that have been cut and filled for development (U.S. Soil Conservation Service, 1991; Map Units 121, 122, 123, 124, 132, 133) (see Figure 7-4), such as construction of roads and buildings. Urban lands are covered by asphalt, concrete, buildings and other structures, and urban soils contain fill material, similar to Orthents. These soils are largely engineered and are unlikely to exhibit shrink-swell behavior. Where slopes are relatively flat, the erosion hazard is slight.

Within the western portion of the Program Area are steeply sloping uplands, with soils weathered from sandstone. Runoff and erosion potential on these soils (i.e., in Map Units 115 and 116) may be substantial.

Many soil types in the Program Area have physical properties that could limit construction. In the context of the CWP, such limitations include the erosion potential, shrink-swell behavior, and settlement. Settlement is the typically gradual drop in elevation of a ground surface caused by settling or compacting of soils under the weight of fill material or building loads. Settlement may continue over a long period. The degree of settlement is primarily influenced by the thickness of the settleable soils (e.g., Bay mud), site history, characteristics of fill material, and characteristics of building loads. Settlement is not always uniform; differential settlement is uneven, causing different parts of a structure to settle at a different rates. Differential settlement could potentially occur in areas with non-uniform fill material, such as the filled Bay lands (City of San Mateo, 2009). Up to 2 inches of liquefaction-induced settlement could occur along the Seal Slough Levee, near the Detroit Drive and Bayfront parcels, during a large seismic event (Engeo Inc., 2009).

Erosion is the process whereby soil particles become detached and are transported by wind or water. Rates of erosion can vary, depending on several factors including soil texture, structure, amount of soil cover, and slope factors. Steeply sloped uplands in the western Program Area have a high risk of erosion during storm events; however, other urbanized, relatively flat areas have a low erosion hazard.

Expansive soils exhibit a cycle of shrinking and swelling (contraction and expansion) with drying and wetting. This occurs in fine-textured soils containing expansive clay minerals. Structures built on expansive soils can be damaged over time, and foundations can crack or shift. Usually, proper engineering can mitigate this potential problem. Soils that have been engineered for development and reclaimed soils near the Bay would have a low shrink-swell capacity; limited areas with high shrink-swell potential may be found in the western uplands.

7.2 Regulatory Framework

This section describes the federal and state laws and regulations, and local policies and ordinances that are applicable to implementation of the CWP and selected projects with respect to geology and soil resources.

7.2.1 Federal Regulations

7.2.1.1 Clean Water Act

The federal CWA, as amended, is the fundamental federal law for regulating discharges of waste into waters of the U.S. Section 402 of the CWA provides NPDES requirements, which have been established for stormwater discharges from a range of industrial discharge categories, including construction activities. The U.S. Environmental Protection Agency (EPA) has delegated administrative authority for implementing the NPDES program to the State of California. The SWRCB and nine RWQCBs have authority to implement the CWA in California. In San Mateo, the San Francisco Bay RWQCB oversees implementation of the NPDES program. Construction projects with disturbance areas greater than 1 acre that are implemented as part of the CWP would require coverage under the State's Construction General Permit (CGP) (CAS0000001, Order 2009-0009-DWQ as amended by Orders 2010-0014-DWQ and 2012-0006-DWQ). The permit requires development and implementation of a site-specific storm water pollution prevention plan (SWPPP), which must include best management practices (BMPs) to provide an effective combination of erosion and sediment controls. Chapter 10 also contains a discussion of Clean Water Act requirements that are relevant to the CWP.

7.2.2 State Regulations

7.2.2.1 Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act provides for protection of the quality of all waters of the State of California. The act gives the SWRCB and the RWQCBs regulatory authority to establish water quality standards and an implementation plan for achieving those standards. SWRCB and RWQCB authority under the act includes implementation of the NPDES program in California.

7.2.2.2 Seismic Hazards Mapping Act of 1990

The Seismic Hazards Mapping Act of 1990 (Public Resources Code, Chapter 7.8, Sections 2690–2699.6) directs the Department of Conservation, California Geological Survey to identify and map areas prone to earthquake hazards, including liquefaction, earthquake-induced landslides, and amplified ground shaking. In addition, the act requires local permitting agencies to regulate certain development projects within these hazard zones. Before a local development permit is issued for a site within a seismic hazard zone, a geotechnical investigation of the site must be conducted and appropriate mitigation measures incorporated into the project design.

7.2.2.3 Alquist-Priolo Earthquake Fault Zoning Act of 1972

The Alquist-Priolo Earthquake Fault Zoning Act (Alquist-Priolo) prohibits the siting of structures for human occupancy across traces of active faults that represent a potential hazard to structures because of surface faulting or fault creep. Alquist-Priolo only addresses the hazard of surface fault rupture and is not directed toward other earthquake hazards. Alquist-Priolo requires the State Geologist to establish regulatory zones (known as Earthquake Fault Zones) around the surface traces of active faults and to issue appropriate maps. The maps are distributed to all affected cities, counties, and state agencies for use in planning and controlling new or renewed construction. All land division and most structures for human occupancy are regulated by local agencies within the Earthquake Fault Zones; however, local agencies can be more restrictive than state laws.

Before a project can be permitted, cities and counties must require a geologic investigation to demonstrate that proposed buildings would not be constructed across active faults. An evaluation and written report for the specific site must be prepared by a licensed geologist. If an active fault is found, structures for human occupancy must be set back from the fault (generally 50 feet) (California Geological Survey, 2015).

7.2.2.4 California Building Code

The California Building Code (CBC) is codified in 24 CCR Part 2. The California Building Standards Commission administers Title 24. The CBC establishes minimum standards to safeguard public health, safety, and general welfare through structural strength, means of egress facilities, and general stability. The CBC regulates and controls the design, construction, quality of materials, use and occupancy, location, and maintenance of all building and structures within its jurisdiction. In addition, the CBC contains requirements that are based on the American Society of Civil Engineers Minimum Design Standards 7-05, including requirements for general structural design and a means for determining earthquake loads and other loads (e.g., flood and wind) for inclusion in building codes. CBC provisions apply to the construction, alteration, movement, replacement, and demolition of every building, structure, and appurtenance connected or attached to such buildings or structures throughout California. The earthquake design requirements take into account the occupancy category of the structure, site class, soil classifications, and various seismic coefficients used to determine a Seismic Design Category (SDC) for projects. The SDC is a classification system that combines the occupancy categories with the level of expected ground motions at the site; classifications range from SDC A (very small seismic vulnerability) to SDC E/F (very high seismic vulnerability and near a major fault). Design specifications are determined in accordance with the SDC.

7.2.3 Local Regulations

7.2.3.1 Association of Bay Area Governments Manual of Standards for Erosion and Sediment Control

The *Manual of Standards for Erosion and Sediment Control* (ABAG, 1995) provides policy guidance, legal guidelines, and technical standards to control erosion and sediment control impacts for urban and developing areas, with an emphasis on construction erosion management.

7.2.3.2 City of San Mateo Site Development Code

The City of San Mateo Site Development Code (Chapter 23.40 of the Municipal Code [City of San Mateo, 2015]) establishes administrative procedures, regulations, required approvals, and performance standards for site grading, construction on slopes, and removal of major vegetation. Its intent is to minimize adverse impacts on people and property as the result of development. The code provides an exemption from applying for and obtaining a site development permit for various types of projects, including excavation below finished grade for installation of sewer facilities and excavations by public companies or the City within public utility easements, streets, rights-of-way, or property owned in fee title by the utility company for the purpose of maintaining or installing new facilities, either aboveground or belowground (Section 23.40.030(d) of the Municipal Code). Therefore, construction of many CWP projects may be exempt from requirements of the Site Development Code.

7.2.3.3 General Plan – Safety and Hazardous Waste Management

The following applicable safety and hazardous waste policies are listed as they appear in the General Plan (City of San Mateo, 2010):

> **Policy S 1.1: Geologic Hazards.** Require site specific geotechnical and engineering studies, subject to the review and approval of the City Engineer and Building Official, for development proposed on sites identified in Figure S-2 as having moderate or high potential for ground failure. Permit development in areas of potential geologic hazards only where it can be demonstrated that the project will not be endangered by, nor contribute to, the hazardous condition on the site or on adjacent properties.
>
> **Policy S 1.3: Erosion Control.** Require erosion control measures for all development sites where grading activities are occurring, including those having landslide deposits, past erosion problems, the potential for storm water quality impacts, or slopes of 15% or greater which are to be altered. Control measures shall retain natural topographic and physical features of the site if feasible.

7.3 Assessment Methods and Thresholds of Significance

Potential impacts on geology and soil resources were evaluated by using existing information regarding the geologic, soil, and seismic characteristics of the Program Area and overlaying CWP and project features on maps of geological and soil constraints. Impact thresholds were based on criteria in Appendix G of the CEQA Guidelines.

Impacts related to geology and soil resources may occur if the CWP would result in the following:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
  - Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault. Refer to Division of Mines and Geology Special Publication 42.
  - Strong seismic ground shaking
  - Seismic-related ground failure, including liquefaction
  - Landslides

- Substantial soil erosion or the loss of topsoil
- A project being located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in onsite or offsite landslide, lateral spreading, subsidence, liquefaction or collapse
- A project being located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property

7.4 Environmental Impacts

Potential impacts of the CWP related to geology and soils are summarized in Table 7-1 and described in subsequent sections.

TABLE 7-1
Summary of Geology and Soils Impacts
Programmatic Environmental Impact Report, City of San Mateo Clean Water Program

Impact	In-System Storage Program	Full Conveyance Program	New Headworks Project	Primary Clarifier Project
Impact 7-1. Implementation of the CWP could expose people or structures to potential substantial adverse effects involving rupture of a known earthquake fault, strong seismic shaking, and/or seismic-related ground failure, including liquefaction and landslides.	Less than significant impact with mitigation	Less than significant impact with mitigation	Less than significant impact with mitigation	Less than significant impact with mitigation
Impact 7-2. Implementation of the CWP could result in substantial soil erosion or loss of topsoil.	Less than significant impact with mitigation	Less than significant impact with mitigation	Less than significant impact with mitigation	Less than significant impact with mitigation
Impact 7-3. Projects constructed under the CWP may be located on a geologic unit or soil that is unstable or that would become unstable as a result of the project, potentially resulting in onsite or offsite landslides, lateral spreading, subsidence, liquefaction, or collapse.	Less than significant impact with mitigation	Less than significant impact with mitigation	Less than significant impact with mitigation	Less than significant impact with mitigation
Impact 7-4. Projects constructed under the CWP may be located on expansive soils, creating substantial risks to property.	Less than significant impact	Less than significant impact	Less than significant impact	Less than significant impact

Impact 7-1. Implementation of the CWP could expose people or structures to potential substantial adverse effects involving rupture of a known earthquake fault, strong seismic shaking, and/or seismic-related ground failure, including liquefaction and landslides.

In-System Storage Program

There are no active faults or potentially active faults within the Program Area, according to published geologic maps; the Program Area is not within an Alquist-Priolo Earthquake Fault Study Area. The San Andreas Fault is approximately 2 miles west of the City boundary, and the Hayward Fault is approximately 14 miles to the east (City of San Mateo, 2009). There is no evidence of surface rupturing in the Program Area during the last one million years, and inactive faults show no evidence of recent motion. Therefore, impacts related to rupture of a known earthquake fault resulting from implementation of the In-System Storage Program are considered to be less than significant.

The entire Bay Area is susceptible to strong ground shaking during major earthquakes because of the proximity to active earthquake faults. Ground shaking is amplified and lasts longer where soils are unconsolidated or saturated with water, such as the east part of the City near San Francisco Bay where soils are comprised of Bay muds (City of San Mateo, 2009; 2010). Ground shaking impacts would be less severe in upland areas underlain by hard bedrock (City of San Mateo, 2009). In San Mateo, ground shaking intensity is potentially very strong or violent (see Figure 7-2). Damage to buildings and utilities in San Mateo would likely be greatest east of US-101 in areas underlain by alluvial deposits, Bay mud, and artificial fill (ABAG, 2015).

Ground shaking associated with earthquakes could affect the In-System Storage Program by causing pipeline breakage or damage to WWTP, storage basin, or pump station structures. Most of the In-System Storage Program structures, including treatment facilities, pump stations, and in-system storage basins, would be unoccupied, with only occasional occupancy by operations staff for maintenance and related activities. The new administration building would be the only regularly occupied structure; damage to this building from ground shaking could expose people to potential adverse effects.

The WWTP Site and pump station project locations are located east of US-101, in areas with high liquefaction potential (see Figure 7-3). Proposed new and upgraded WWTP facilities and pump stations could be damaged by earthquake-induced liquefaction.

Most of the existing and proposed pipeline alignments are within areas of high to moderate liquefaction potential. Pipeline breaks resulting from ground displacement in liquefiable areas during earthquakes is common, and pipelines carrying domestic waste are particularly susceptible because that type of pipe is brittle and does not have sealed joints (ABAG, 2001). However, most of the proposed pipeline projects would be placed in City rights-of-way, primarily in streets, which are likely already composed of engineered fill and would be less prone to displacement.

The western portion of the Program Area has a low or very low risk of liquefaction. However, portions of this area have had landslides in the past and/or are at high risk of having landslides in the future (see Figure 7-3). Infrastructure in these areas could be damaged by a landslide.

Mitigation Measure 7-1 Perform site-specific geotechnical and engineering studies and implement recommendations would be implemented for all In-System Storage Program projects located in areas with moderate to high potential for ground shaking, liquefaction, or landslide. This mitigation would result in identification of appropriate site-specific and project-specific geotechnical and engineering methods to minimize risks from ground shaking, landslides or liquefaction to a level meeting City requirements, CBC earthquake design requirements, and other building safety codes. With implementation of **Mitigation Measure 7-1**, exposure of people or structures to potential adverse effects from ground shaking, landslide, or liquefaction of the In-System Storage Program would be a less than significant impact.

Full Conveyance Program

The Full Conveyance Program would be constructed and operated within the Program Area and would have similar impacts as described for the In-System Storage Program. There are no active faults or potentially active faults within the Program Area, it is not within an Alquist-Priolo Earthquake Fault Study Area, and does not contain evidence of recent inactive fault motion or of surface rupturing during the last one million years. Therefore, impacts related to rupture of a known earthquake fault resulting from implementation of the Full Conveyance Program are considered to be less than significant.

As described for the In-System Storage Program, ground shaking associated with earthquakes could affect the Full Conveyance Program by causing pipeline breakage or damage to structures, including WWTP facilities and pump stations. The new administration building would be the only regularly occupied structure; damage to this building from ground shaking could expose people to potential adverse effects.

The WWTP Site and pump station project locations are located east of US-101, in areas with high liquefaction potential (see Figure 7-3). Proposed new and upgraded WWTP facilities and pump stations could be damaged by earthquake-induced liquefaction. Although located in areas with moderate to high liquefaction potential, most of the proposed pipeline projects would be placed in City rights-of-way, primarily in streets, which are likely already composed of engineered fill and would be less prone to displacement.

The western portion of the Program Area has a low or very low risk of liquefaction. However, portions of this area have had landslides in the past and/or are at high risk of having landslides in the future (see Figure 7-3). Infrastructure in these areas could be damaged by a landslide.

Mitigation Measure 7-1 Perform site-specific geotechnical and engineering studies and implement recommendations would be implemented for all Full Conveyance Program projects located in areas with moderate to high potential for ground shaking, liquefaction, or landslide. This mitigation would result in identification of appropriate site-specific and project-specific geotechnical and engineering methods to minimize risks from ground shaking, landslides or liquefaction to a level meeting City requirements, CBC earthquake design requirements, and other building safety codes. With implementation of **Mitigation Measure 7-1**, exposure of people or structures to potential adverse effects from ground shaking, landslide, or liquefaction of the Full Conveyance Program would be a less than significant impact.

New Headworks Project and Primary Clarifier Project

The New Headworks Project and Primary Clarifier Project would be constructed and operated within the Program Area. As described for the In-System Storage Program, there are no active faults or potentially active faults within the Program Area, it is not within an Alquist-Priolo Earthquake Fault Study Area, and does not contain evidence of recent inactive fault motion or of surface rupturing during the last one million years. Therefore, impacts related to rupture of a known earthquake fault resulting from implementation of the New Headworks Project and Primary Clarifier Project are considered to be less than significant.

As described for the In-System Storage Program, ground shaking associated with earthquakes could affect the New Headworks Project and Primary Clarifier Project by causing damage to structures. These facilities would be generally unoccupied, with only occasional occupancy by operations staff for maintenance and related activities.

The WWTP Site, where the New Headworks Project and Primary Clarifier Project would be located, is in an area designated as having high liquefaction potential. The projects could be damaged by earthquake-induced liquefaction. The projects are located in a level area and landslides would not be expected to occur.

Mitigation Measure 7-1 Perform site-specific geotechnical and engineering studies and implement recommendations would be implemented for the New Headworks Project and Primary Clarifier Project. This mitigation would result in identification of appropriate site-specific and project-specific geotechnical and engineering methods to minimize risks from ground shaking or liquefaction to a level meeting City requirements, CBC earthquake design requirements, and other building safety codes. With implementation of **Mitigation Measure 7-1**, exposure of people or structures to potential adverse effects from ground shaking, landslide, or liquefaction of the New Headworks Project and Primary Clarifier Project would be a less than significant impact.

Impact 7-2. Implementation of the CWP could result in substantial soil erosion or loss of topsoil.

In-System Storage Program

The In-System Storage Program would include construction of WWTP facilities, pipeline installation or rehabilitation, pump station upgrade or rehabilitation, and new in-system storage basins. Construction activities (e.g., installation or rehabilitation of pipelines) in urbanized areas and within City rights-of-way, including roadways, would limit disturbance acreage to the excavation footprint and thereby limit the risk of erosion. Soils within the relatively flat areas in the eastern portion of the Program Area have low erosion

hazard, further reducing erosion risk (see Figures 7-1 and 7-4). However, steep slopes in the central and western portions of the Program Area have soils that are highly erodible, and measures would need to be implemented during construction to control erosion and loss of topsoil. See Appendix E for erosion hazards associated with geologic units and soils in the Program Area.

Construction of new pipeline sections, wastewater facilities, and storage basins would require substantial soil trenching and/or excavation. If not properly managed, substantial erosion of stockpiled soils could occur, and sediment could be transported into storm drains or sensitive receiving waters. Projects constructed during implementation of the CWP typically would not store soil materials within work areas but would instead stockpile materials in a central location where they could be effectively managed. This would aid stockpile management and reduce the risk of erosion and sediment transport outside of project work areas.

Projects constructed during implementation of the In-System Storage Program would require coverage under the State's CGP if the land disturbance area is greater than or equal to 1 acre. Because many of the proposed projects are within paved, urbanized areas, land disturbance would likely be less than 1 acre, and CGP coverage would not be required. However, General Plan Policy 1.3 requires erosion control measures for all development sites where grading activities occur, including those having landslide deposits, past erosion problems, the potential for stormwater quality impacts, or slopes of 15 percent or greater that are to be altered. Therefore, even projects with land disturbance acreage less than 1 acre would be required to implement appropriate erosion and sediment control measures where there is substantial risk of erosion and/or impacts on water quality. The *Manual of Standards for Erosion and Sediment Control* (ABAG, 1995) provides guidance and technical standards for erosion and sediment control measures during construction; conformance to the standards would provide further control of erosion and topsoil loss.

Implementation of **Mitigation Measure 7-2 Comply with regulations and policies for erosion control** would reduce impacts of the In-System Storage Program to a less than significant level. Compliance with the CGP, if required, and local policies for implementing appropriate erosion control measures, including appropriate management of soil stockpiles, would minimize erosion and topsoil loss.

Full Conveyance Program

The Full Conveyance Program would include construction of WWTP facilities, pipeline installation or rehabilitation, and pump station upgrade or rehabilitation in the same locations as the In-System Storage Program. In addition, the new Dale Avenue Pump Station would be constructed next to the existing pump station. Therefore, the same potential impacts from erosion described for the In-System Storage Program could occur during construction of the Full Conveyance Program. However, implementation of **Mitigation Measure 7-2 Comply with regulations and policies for erosion control** would reduce impacts of the Full Conveyance Program to a less than significant level.

New Headworks Project and Primary Clarifier Project

The New Headworks Project and Primary Clarifier Project would be constructed in the WWTP Site, which is part of the impact area evaluated for the In-System Storage Program. Therefore, the same potential impacts from erosion described for the In-System Storage Program could occur during construction of the New Headworks Project and Primary Clarifier Project. However, implementation of **Mitigation Measure 7-2 Comply with regulations and policies for erosion control** would reduce impacts of the Full Conveyance Program to a less than significant level.

Impact 7-3. Projects constructed under the CWP may be located on a geologic unit or soil that is unstable or that would become unstable as a result of the project, potentially resulting in onsite or offsite landslides, lateral spreading, subsidence, liquefaction, or collapse.

In-System Storage Program

Much of the Program Area contains geologic units or soils that are unstable and have a moderate to high potential for liquefaction, lateral spreading, landslides, subsidence, or collapse. Figure 7-3 shows areas prone to liquefaction. These areas are also prone to soil settlement (i.e., areas near the Bay with a high water table, non-uniform fill material, and liquefiable soils). Lateral spreading may also occur in areas underlain by soft, saturated, liquefiable materials, especially where bordered by steep banks or adjacent hard ground. In San Mateo, areas with potential for lateral spreading occur along the banks of water drainage courses that are not retained by concrete channels and/or other protective measures. Landslides have occurred in the past and could occur in the future in the central and western portions of the Program Area that have steep slopes and weak soils (City of San Mateo, 2009; 2010).

The In-System Storage Program could have geological, seismic, and soil impacts where projects would occur on geologic units or soils having potential for liquefaction, landslides, lateral spreading, settlement, shrink-swell behavior, and/or erosion. **Mitigation Measure 7-1 Perform site-specific geotechnical and engineering studies and implement recommendations** would require site-specific geotechnical and engineering studies, which are subject to the review and approval of the city engineer and building official, for development projects planned in areas with moderate or high potential for ground failure. By implementing geotechnical and engineering recommendations from these studies and by following CBC earthquake design requirements, implementation of the In-System Storage Program would not cause or contribute to increased instability of the soils or geologic unit. With **Mitigation Measure 7-1**, impacts of the In-System Storage Program would be less than significant.

Full Conveyance Program

The Full Conveyance Program would include WWTP, pipeline, and pump station projects in the same locations as the In-System Storage Program. In addition, the new Dale Avenue Pump Station would be constructed next to the existing pump station. Therefore, as described for the In-System Storage Program, the Full Conveyance Program could have geological, seismic, and soil impacts where projects would occur on geologic units or soils having potential for liquefaction, landslides, lateral spreading, settlement, shrink-swell behavior, and/or erosion. **Mitigation Measure 7-1 Perform site-specific geotechnical and engineering studies and implement recommendations** would require site-specific geotechnical and engineering studies, which are subject to the review and approval of the city engineer and building official, for development projects planned in areas with moderate or high potential for ground failure. By implementing geotechnical and engineering recommendations from these studies and by following CBC earthquake design requirements, implementation of the Full Conveyance Program would not cause or contribute to increased instability of the soils or geologic unit. With **Mitigation Measure 7-1**, impacts of the Full Conveyance Program would be less than significant

New Headworks Project and Primary Clarifier Project

The New Headworks Project and Primary Clarifier Project would be constructed in the WWTP Site, which is part of the impact area evaluated for the In-System Storage Program. Therefore, as described for the In-System Storage Program, the New Headworks Project and Primary Clarifier Project could have geological, seismic, and soil impacts because they are located on geologic units or soils having potential for liquefaction, lateral spreading, settlement, and/or erosion. **Mitigation Measure 7-1 Perform site-specific geotechnical and engineering studies and implement recommendations** would require site-specific geotechnical and engineering studies, which are subject to the review and approval of the city engineer and building official. By implementing geotechnical and engineering recommendations from these studies and by following CBC earthquake design requirements, implementation of the New Headworks Project and Primary Clarifier

Project would not cause or contribute to increased instability of the soils or geologic unit. With **Mitigation Measure 7-1**, impacts of the New Headworks Project and Primary Clarifier Project would be less than significant

Impact 7-4. Projects constructed under the CWP may be located on expansive soils, creating substantial risks to property.

In-System Storage Program

Many parts of the Program Area are urbanized and have previously been cut and filled for development, including areas within City streets where pipelines would be rehabilitated or new pipe installed. Engineered fill is well graded and would not shrink or and swell. Some areas in the eastern part of the Program Area were reclaimed from the Bay (i.e., filled) to allow development. Soils in these areas are also not considered to be subject to shrink-swell behavior (Ninyo and Moore, 2013). Impacts of the In-System Storage Program from expansive soils would be less than significant.

Full Conveyance Program

Many parts of the Program Area are urbanized and have previously been cut and filled for development, including areas within City streets where pipelines would be rehabilitated or new pipe installed. Engineered fill is well graded and would not shrink or and swell. Some areas in the eastern part of the Program Area were reclaimed from the Bay (i.e., filled) to allow development. Soils in these areas are also not considered to be subject to shrink-swell behavior (Ninyo and Moore, 2013). Impacts of the Full Conveyance Program from expansive soils would be less than significant.

New Headworks Project and Primary Clarifier Project

The New Headworks Project and Primary Clarifier Project would be located on the WWTP Site, which was reclaimed from the Bay (i.e., filled) to allow development. Soils in this area are not considered to be subject to shrink-swell behavior (Ninyo and Moore, 2013). Impacts of the New Headworks Project and Primary Clarifier Project from expansive soils would be less than significant.

7.5 Mitigation Measures

Mitigation Measure 7-1. Perform site-specific geotechnical and engineering studies and implement recommendations.

The City of San Mateo and its design engineers shall perform site specific geotechnical and engineering studies as required by General Plan Policy S 1.1. The studies shall be completed prior to completion of design and prior to submittal of applicable design permits, including building permits and SPAR requests. Studies shall be subject to the review and approval of the City Engineer and Building Official for projects proposed on sites identified as having moderate to high potential for ground failure. The review shall verify compliance with federal, state and local regulations related to reducing earthquake and soils hazards. The City shall approve projects in areas of potential geologic hazards only where it can be demonstrated that the project would not be endangered by, nor contribute to, the hazardous condition on the site or on adjacent properties.

The studies shall include identification of site specific geotechnical and engineering measures. Typical geotechnical or engineering report measures to reduce impacts related to liquefaction, settlement or other ground failure could include earthwork and foundation measures such as the following:

- Verify backfill material is suitable for its purpose. Areas for construction of WWTP facilities and storage basins may need to have soils overexcavated and replaced with engineered fill material. Bay muds having high organic matter content would not be used as fill material (Ninyo and Moore, 2013).

- Stone columns may be used as a measure to mitigate settlement, where needed. Stone columns installed well below the finished grade compress settleable soil layers and increase soil stiffness, thereby reducing settlement potential (Ninyo and Moore, 2013).
- For construction of lightly loaded structures, spread footings or mat foundations may be recommended in project design for areas where there is risk of substantial settlement. For design of structures having moderate to heavy loads, pile foundations may be recommended, with measures to reduce the potential for damage to nearby structures as a result of vibrations or ground displacement during pile driving operations (Ninyo and Moore, 2013).
- Consider potential for liquefaction-induced settlement in engineering design of new pipeline installations (Engeo Incorporated, 2009).
- Expansive or liquefiable soils may be overexcavated and replaced with engineered fill.
- Liquefiable soils may be stabilized by grouting, densification, or dewatering (ABAG, 2001).
- Soils in an area with potential for lateral spreading may be stabilized by installation of buttresses (ABAG, 2001).

Mitigation Measure 7-2. Comply with regulations and policies for erosion control.

The City of San Mateo and its construction contractors shall develop prior to start of construction and implement a project-specific SWPPP for construction projects with a land disturbance area equal to or greater than 1 acre. For projects with disturbance area less than 1 acre in size, a site-specific Erosion and Sediment Control Plan shall be prepared. For projects with any land disturbance, construction shall comply with the San Mateo Site Development Code and shall incorporate an effective combination of erosion and sediment control measures that are identified in ABAG and/or California Stormwater Quality Association guidance manuals. Construction erosion and sediment control BMPs typically include, but are not limited to, the following measures:

- Scheduling site grading during the non-rainy season (April 15 to October 15), where possible
- Segregation of topsoil during rough grading
- Temporary soil stabilization during site grading and active construction
- Permanent post-construction site soil stabilization
- Erosion and sediment controls during construction dewatering activities
- Control of site run-on and run-off to isolate the work area and prevent onsite or offsite erosion and sediment transport during construction
- Dust suppression
- Stockpile management; in accordance with City standard construction practices, materials shall be stockpiled at central location(s) instead of within work areas, where feasible

7.6 References

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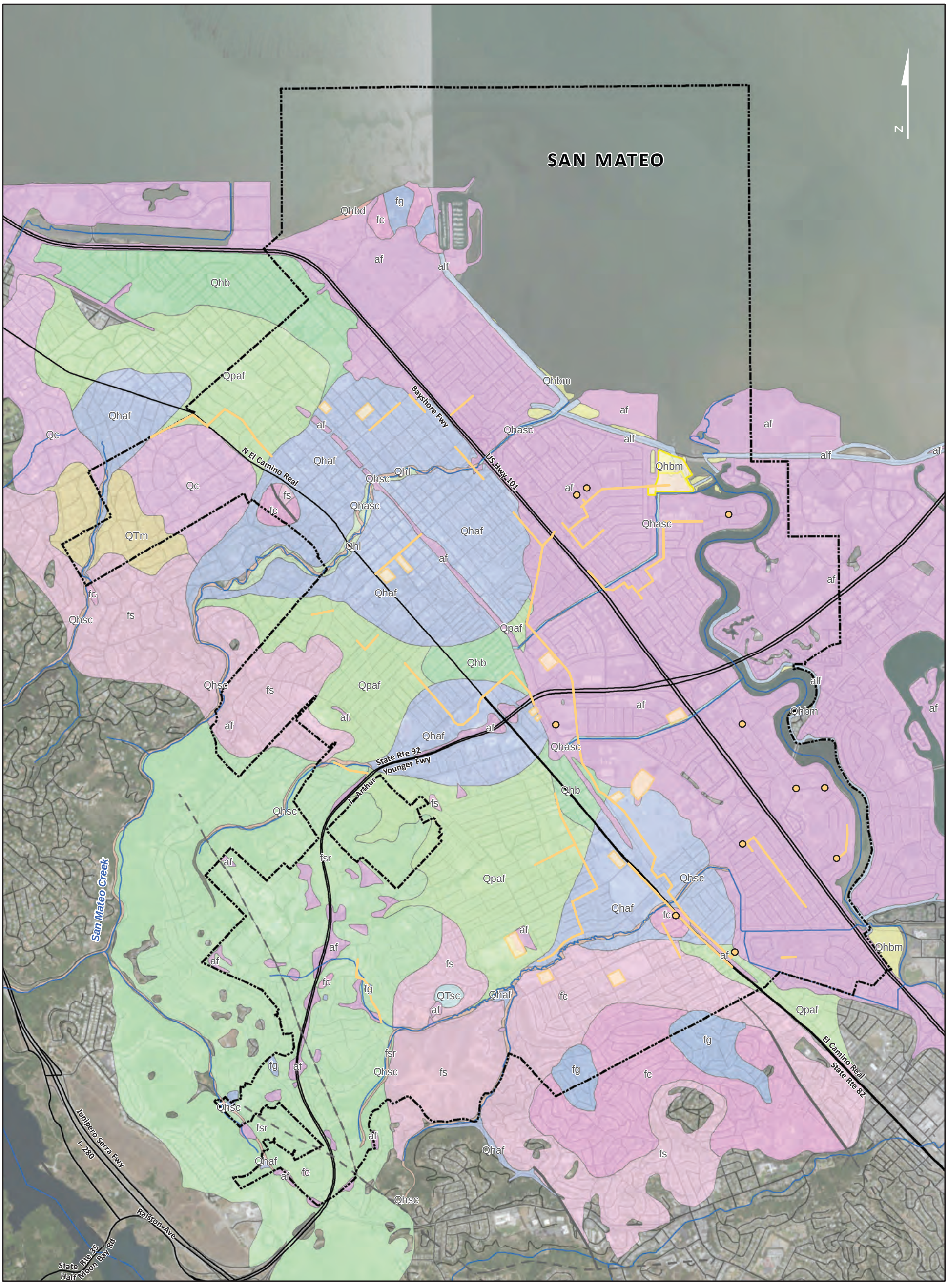

Legend

- Pump Station Project
- Pipeline Project
- In System Storage Location
- WWTP Site
- CWP Area
- Road
- Watercourse
- Fault - inferred
- Fault - certain
- Fault - concealed

Geologic Units

- QTm
- QTsc
- Qc
- Qhaf
- Qhasc
- Qhb
- Qhbd
- Qhbm
- Qhl
- Qhsc
- Qpaf
- af
- alf
- fc
- fg
- fs
- fsr

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

0 0.5 Miles

FIGURE 7-1
Program Area Geolog
Programmatic Environmental Impact Report
City of San Mateo Clean Water Program

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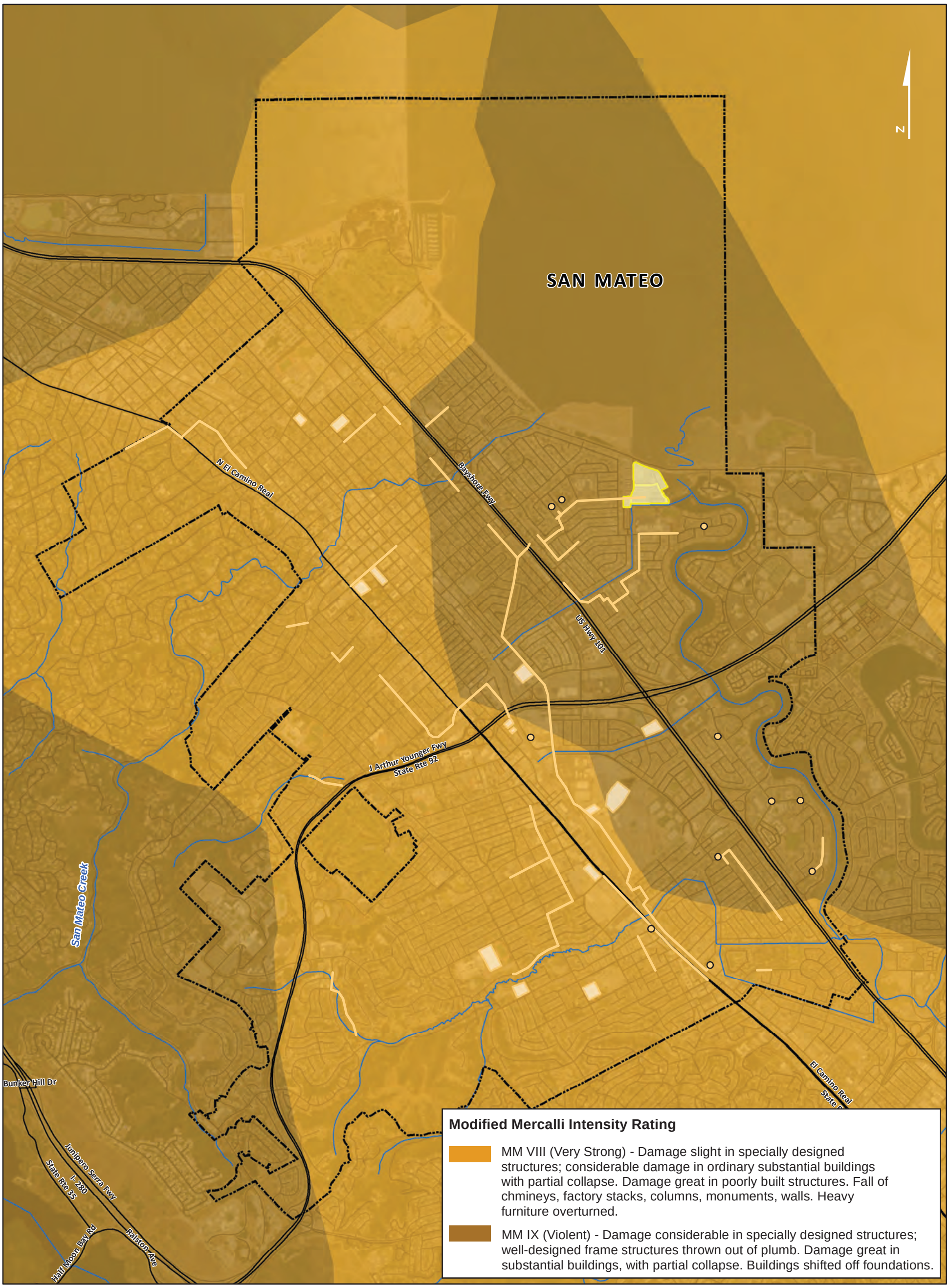

Legend

- Pump Station Project
- Pipeline Project
- In System Storage Location
- WWTP Site
- CWP Area
- Major Road
- Watercourse
- Road

0 0.5
Miles

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

FIGURE 7-2
Program Area Shaking Intensity
Programmatic Environmental Impact Report
City of San Mateo Clean Water Program

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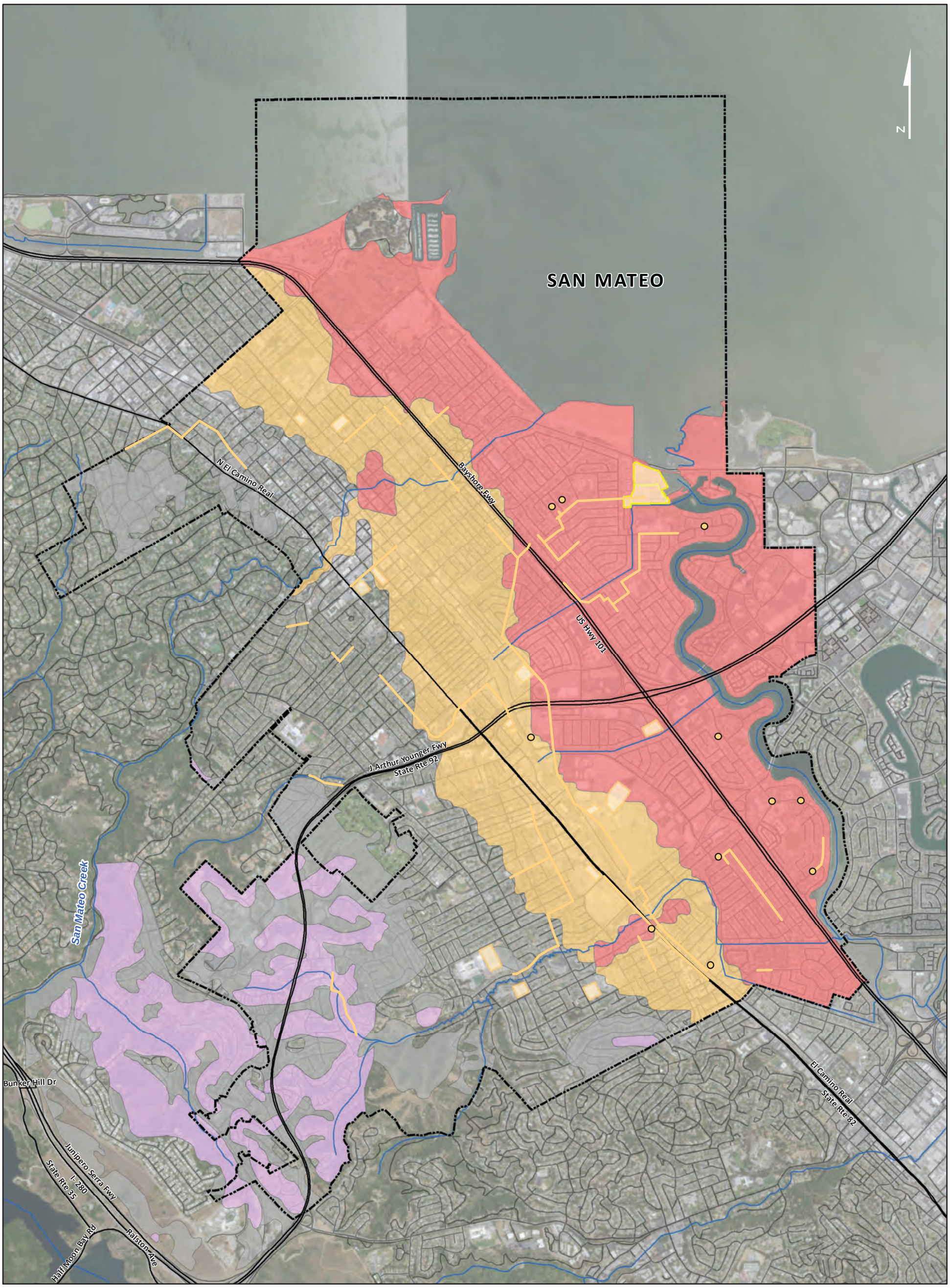

Legend

- Pump Station Project
- Pipeline Project
- In System Storage Location
- WWTP Site
- CWP Area
- Major Road
- Watercourse
- Road

Liquefaction Potential

- High
- Moderate

Slope Failure Potential

- High
- Moderate

0 0.5 Miles

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

FIGURE 7-3
Slope Stability and Liquefaction Potential
Programmatic Environmental Impact Report
City of San Mateo Clean Water Program

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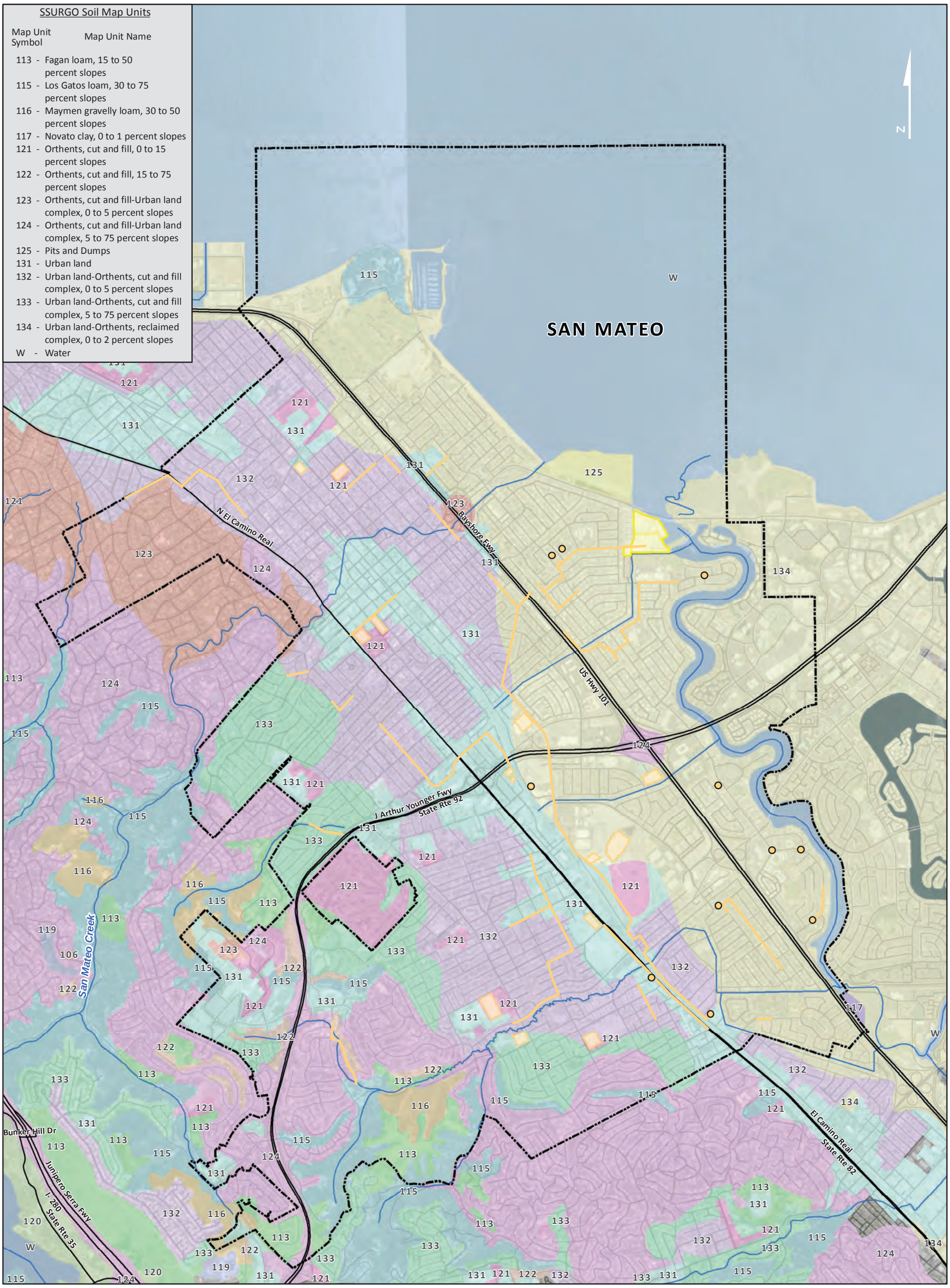

Legend

- Pump Station Project
- Pipeline Project
- In System Storage Location
- WWTP Site
- CWP Area
- Major Road
- Watercourse
- Road

Soil Map Unit Symbol			
106	119	125	
113	120	131	
115	121	132	
116	122	133	
117	123	134	
	124	W	

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

0 0.5 Miles

FIGURE 7-4
Program Area Soils
Programmatic Environmental Impact Report
City of San Mateo Clean Water Program

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