5.5 GEOLOGY, SOILS, AND SEISMICITY

This section addresses soil, seismic, and geologic hazards in the City of Milpitas.

REGULATORY SETTING

FEDERAL

International Building Code (IBC)

The purpose of the International Building Code (IBC) is to provide minimum standards to preserve the public peace, health, and safety by regulating the design, construction, quality of materials, certain equipment, location, grading, use, occupancy, and maintenance of all buildings and structures. IBC standards address foundation design, shear wall strength, and other structurally related conditions.

Hazardous Materials Transportation Act

The Hazardous Materials Transportation Act, as amended, is the basic statute regulating hazardous materials transportation in the United States. The purpose of the law is to provide adequate protection against the risks to life and property inherent in transporting hazardous materials in interstate commerce. This law gives the U.S. Department of Transportation (USDOT) and other agencies the authority to issue and enforce rules and regulations governing the safe transportation of hazardous materials (DOE 2002).

Resource Conservation and Recovery Act

The 1976 Federal Resource Conservation and Recovery Act (RCRA) and the 1984 RCRA Amendments regulate the treatment, storage, and disposal of hazardous and non-hazardous wastes. The legislation mandated that hazardous wastes be tracked from the point of generation to their ultimate fate in the environment. This includes detailed tracking of hazardous materials during transport and permitting of hazardous material handling facilities.

The 1984 RCRA amendments provided the framework for a regulatory program designed to prevent releases from Underground Storage Tanks (UST). The program establishes tank and leak detection standards, including spill and overflow protection devices for new tanks. The tanks must also meet performance standards to ensure that the stored material will not corrode the tanks. Owners and operators of USTs had until December 1998 to meet the new tank standards. As of 2001, an estimated 85 percent of USTs were in compliance with the required standards.

Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (the Act) introduced active Federal involvement to emergency response, site remediation, and spill prevention, most notably the Superfund program. The Act was intended to be comprehensive in encompassing both the prevention of, and response to, uncontrolled hazardous substances releases. The Act deals with environmental response, providing mechanisms for reacting to emergencies and to chronic hazardous material releases. In addition to establishing procedures to prevent and remedy problems, it establishes a system for compensating appropriate individuals and assigning appropriate liability. It is designed to plan for and respond to failure in other regulatory programs and to remedy problems resulting from action taken before the era of comprehensive regulatory protection.

Natural Gas Pipeline Safety Act

The Natural Gas Pipeline Safety Act authorizes the U.S. Department of Transportation Office of Pipeline Safety to regulate pipeline transportation of natural (flammable, toxic, or corrosive) gas and other gases as well as the transportation and storage of liquefied natural gas. The Office of Pipeline Safety regulates the design, construction, inspection, testing, operation, and maintenance of pipeline facilities. While the Federal government is primarily responsible for developing, issuing, and enforcing pipeline safety regulations, the pipeline safety statutes provide for state assumption of the intrastate regulatory, inspection, and enforcement responsibilities under an annual certification. To qualify for certification, a state must adopt the minimum Federal regulations and may adopt additional or more stringent regulations as long as they are not incompatible.

STATE

The State of California has established a variety of regulations and requirements related to seismic safety and structural integrity, including the California Building Standards Code, the Alquist-Priolo Earthquake Fault Zoning Act and the Seismic Hazards Mapping Act.

California Building Standards Code

Title 24 of the California Code of Regulations, known as the California Building Standards Code (CBSC) or simply "Title 24," contains the regulations that govern the construction of buildings in California. The CBSC includes 12 parts: California Building Standards Administrative Code, California Building Code, California Residential Building Code, California Electrical Code, California Mechanical Code, California Plumbing Code, California Energy Code, California Historical Building Code, California Fire Code, California Existing Building Code, California Green Building Standards Code (CALGreen Code), and the California Reference Standards Code. Through the CBSC, the State provides a minimum standard for building design and construction. The CBSC contains specific requirements for seismic safety, excavation, foundations, retaining walls, and site demolition. It also regulates grading activities, including drainage and erosion control.

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act of 1972 sets forth the policies and criteria of the State Mining and Geology Board, which governs the exercise of governments' responsibilities to prohibit the location of developments and structures for human occupancy across the trace of active faults. The policies and criteria are limited to potential hazards resulting from surface faulting or fault creep within Earthquake Fault Zones, as delineated on maps officially issued by the State Geologist. Working definitions include:

- Fault – a fracture or zone of closely associated fractures along which rocks on one side have been displaced with respect to those on the other side;

- Fault Zone – a zone of related faults, which commonly are braided and sub parallel, but may be branching and divergent. A fault zone has a significant width (with respect to the scale at which the fault is being considered, portrayed, or investigated), ranging from a few feet to several miles;

- Sufficiently Active Fault – a fault that has evidence of Holocene surface displacement along one or more of its segments or branches (last 11,000 years); and

- Well-Defined Fault – a fault whose trace is clearly detectable by a trained geologist as a physical feature at or just below the ground surface. The geologist should be able to locate the fault in the field with sufficient precision and confidence to indicate that the required site-specific investigations would meet with some success.

"Sufficiently Active" and "Well Defined" are the two criteria used by the State to determine if a fault should be zoned under the Alquist-Priolo Earthquake Fault Zoning Act.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act, passed in 1990, addresses non-surface fault rupture earthquake hazards, including liquefaction and seismically-induced landslides. Under the Act, seismic hazard zones are to be mapped by the State Geologist to assist local governments in land use planning. The program and actions mandated by the Seismic Hazards Mapping Act closely resemble those of the Alquist-Priolo Earthquake Fault Zoning Act (which addresses only surface fault-rupture hazards) and are outlined below:

The State Geologist is required to delineate the various "seismic hazard zones."

- Cities and counties, or other local permitting authority, must regulate certain development "projects" within the zones. They must withhold the development permits for a site within a zone until the geologic and soil conditions of the site are investigated and appropriate mitigation measures, if any, are incorporated into development plans.

- The State Mining and Geology Board provides additional regulations, policies, and criteria to guide cities and counties in their implementation of the law. The Board also provides guidelines for preparation of the Seismic Hazard Zone Maps and for evaluating and mitigating seismic hazards.

- Sellers (and their agents) of real property within a mapped hazard zone must disclose that the property lies within such a zone at the time of sale.

Caltrans Seismic Design Criteria

The California Department of Transportation (Caltrans) has Seismic Design Criteria (SDC), which is an encyclopedia of new and currently practiced seismic design and analysis methodologies for the design of new bridges in California. The SDC adopts a performance-based approach specifying minimum levels of structural system performance, component performance, analysis, and design practices for ordinary standard bridges. The SDC has been developed with input from the Caltrans Offices of Structure Design, Earthquake Engineering and Design Support, and Materials and Foundations. Memo 20-1 Seismic Design Methodology (Caltrans 1999) outlines the bridge category and classification, seismic performance criteria, seismic design philosophy and approach, seismic demands and capacities on structural components, and seismic design practices that collectively make up Caltrans' seismic design

LOCAL

City of Milpitas General Plan

The existing City of Milpitas General Plan identifies the following policies related to geology, soils, and seismicity:

Seismic and Safety Element

5.a-G-1: Minimize threat to life and property from seismic and geologic hazards.

5.a-I-1: Require all projects within the Alquist-Priolo Special Studies Zone to have geologic investigations performed to determine the locations of active fault traces before structures for human occupancy are built.

5.a-I-2: Require applications of all projects in the Hillside Area and the Special Studies Zone to be accompanied by geotechnical reports ensuring safety from seismic and geologic hazards.

5.a-I-3: Require projects to comply with the guidelines prescribed in the City's *Geotechnical Hazards Evaluation* manual.

5.d-G-1: Use the City's Emergency Management Plan as the guide for emergency management in the Planning Area.

5.d-I-2: Maintain and upgrade the Emergency Management Plan as necessary.

5.d-I-2: Design critical public facilities to remain operational during emergencies.

Open Space and Environmental Conservation Element

4.d-G-4: Mitigate the effects that land development can have on water quality.

4.d-P-5: Where feasible, conform developments to natural landforms, avoid excessive grading and disturbance of vegetation and soils, retain native vegetation and significant trees, and maintain natural drainage patterns.

ENVIRONMENTAL SETTING

The City of Milpitas is located in northern Santa Clara County, California approximately 30 miles southeast of San Francisco and six miles north of San Jose. Milpitas extends between the south end of the San Francisco Bay and the Low Buellis Hills of the Mount Diablo Range.

The topography of the Planning Area is characterized by the relatively flat terrain with a hillside area in the eastern portion of the Planning Area near the foothills of the Diablo Range. Elevations in Milpitas range from 23 feet above mean sea level (MSL) in the central portion of the city to 1,270 feet above MSL at the highest peak in the eastern hillside portion of the city.

The City's hillside area is located in the foothills of the Diablo Range and consists of a series of parallel hills and valleys oriented generally northwest/southeast. The rounded hills in the western portion of the hillside area form a band about one-mile-wide with a maximum elevation of about 1,270 feet. Spring Valley, in the central portion of the Milpitas Planning Area, is roughly one-quarter mile wide and two and a half miles long. The central portion of the valley is relatively flat and has an elevation of about 600 feet. Along the eastern boundary of the hillside area rise the steep western slopes of Los Buellis Hills, where the elevation ranges from roughly 800 feet to 2,337 feet at Monument Peak in the north.

Geomorphic Province

California's geomorphic provinces are naturally defined geologic regions that display a distinct landscape or landform. Earth scientists recognize eleven provinces in California. Each region displays unique, defining features based on geology, faults, topographic relief, and climate. These geomorphic provinces are remarkably diverse. They provide spectacular vistas and unique opportunities to learn about Earth's geologic processes and history. Milpitas lies within the Coast Range Geomorphic Province.

The Coast Range is a northwest-trending mountain range (2,000 to 4,000, occasionally 6,000 feet elevation above sea level) and set of valleys. The ranges and valleys trend northwest, subparallel to the San Andreas Fault. Strata dip beneath alluvium of the Great Valley. To the west is the Pacific Ocean. The coastline is uplifted, terraced and wave-cut. The Coast Range is composed of thick Mesozoic and Cenozoic sedimentary strata. The northern and southern ranges are separated by a depression containing the San Francisco Bay. The northern Coast Ranges are dominated by irregular, knobby, landslide-topography of the Franciscan Complex. The eastern border is characterized by strike-ridges and valleys in Upper Mesozoic strata. In several areas, Franciscan rocks are overlain by volcanic cones and flows of the Quien Sabe, Sonoma, and Clear Lake volcanic fields. The Coast Ranges are subparallel to the active San Andreas Fault. The San Andreas is more than 600 miles long, extending from Pt. Arena to the Gulf of California. West of the San Andreas is the Salinian Block, a granitic core extending from the southern extremity of the Coast Ranges to the north of the Farallon Islands.

Regional Geology

As noted previously, the Coast Range Geomorphic Province is dominated by northwest-southeast trending ranges of low mountains and intervening valleys. The City of Milpitas is located near the southeastern margin of San Francisco Bay. The bay occupies the upper part of a geological structural depression which has formed over the last 1,000,000 years. However, the southern San Francisco Bay appears to have formed by tectonic subsidence that has occurred over the last 200,000 to 300,000 years. The bay margin is characterized by relatively flat topography developed on recently deposited unconsolidated alluvial and bay deposits. The bay margin lowlands are bounded to the east by the East Bay Hills formed on faulted and folded Franciscan Assemblage bedrock.

Faults

Faults are classified as Historic, Holocene, Late Quaternary, Quaternary, and Pre-Quaternary according to the age of most recent movement (California Geological Survey, 2002). These classifications are described as follows:

- **Historic:** faults on which surface displacement has occurred within the past 200 years;
- **Holocene:** shows evidence of fault displacement within the past 11,000 years, but without historic record;
- **Late Quaternary:** shows evidence of fault displacement within the past 700,000 years, but may be younger due to a lack of overlying deposits that enable more accurate age estimates;
- **Quaternary:** shows evidence of displacement sometime during the past 1.6 million years; and
- **Pre-Quaternary:** without recognized displacement during the past 1.6 million years.

Faults are further distinguished as active, potentially active, or inactive. (California Geological Survey, 2002).

- **Active:** An active fault is a Historic or Holocene fault that has had surface displacement within the last 11,000 years;
- **Potentially Active:** A potentially active fault is a pre-Holocene Quaternary fault that has evidence of surface displacement between about 1.6 million and 11,000 years ago; and

- **Inactive:** An inactive fault is a pre-Quaternary fault that does not have evidence of surface displacement within the past 1.6 million years. The probability of fault rupture is considered low; however, this classification does not mean that inactive faults cannot, or will not, rupture.

There are two known active or potentially active faults located within the Planning Area: the Arroyo Aguague Fault and the Hayward Fault. Additionally, there are numerous active faults located in the regional vicinity of Milpitas. Figure 5.5-1 illustrates the location of some of the closest faults. Below is a brief summary of the most notable faults in the regional vicinity:

- **Arroyo Aguague Fault**: The Arroyo Aguague fault, which is located in the eastern portion of the City's SOI, was previously considered active and was zoned under the Alquist-Priolo Act as potentially capable of surface rupture. However, studies over the past few decades have indicated that the Arroyo Aguague fault is not active and does not pose a surface-faulting hazard. The fault is no longer zoned by the State of California as an earthquake fault zone under the Alquist-Priolo Act.
- **Calaveras Fault:** The 75-mile-long Calaveras fault represents a significant seismic source in the southern and eastern San Francisco Bay region. It extends from an intersection with the Paicines fault south of Hollister, through the Diablo Range east of San Jose, and along the Pleasanton-Dublin-San Ramon urban corridor. The fault consists of three major sections: the southern Calaveras fault (from the Paicines fault to San Felipe Lake), the central Calaveras fault (from San Felipe Lake to Calaveras Reservoir), and the northern Calaveras fault (from Calaveras Reservoir to Danville). The level of contemporary seismicity along the southern section is low to moderate, whereas the central section has generated numerous moderate earthquakes in historic time. The northern section has a relatively low level of seismicity and may be locked. Paleoseismologic studies suggest a recurrence interval for large ruptures of between 250 and 850 years on the northern fault section. The timing of the most recent rupture on the northern Calaveras fault is unknown, but is estimated to have occurred several hundred years ago. Seismologic evidence suggests that the southern and central sections may produce earthquakes as large as MWMw 6.2. Geologic and seismologic data suggest that the northern section may produce earthquakes as large as MWMw 7.0. This fault is located approximately 1.3 miles east of the Milpitas SOI.
- **Hayward Fault:** The Hayward fault is approximately 62 miles long and has been divided into two fault segments: a longer southern segment and a shorter northern segment. This structure is considered to be the most likely source of the next major earthquake in the San Francisco Bay Area. A maximum earthquake of MWMw 6.9 has been estimated for both the northern and southern segments of the Hayward fault. This fault crosses the central portion of the City of Milpitas.
- **Silver Creek Fault Zone:** The Silver Creek fault zone is a northwest trending strike-slip fault approximately 25 miles long located in eastern Santa Clara Valley. The Silver Creek Fault does not show a spatial concentration of earthquakes that would indicate activity, in contrast to the Calaveras Fault, where earthquakes are densely concentrated. The pattern of Calaveras earthquakes does suggest influence from the Silver Creek Fault. The fault is no longer zoned by the State of California as an earthquake fault zone under the Alquist-Priolo Act. This fault is located approximately 0.9 miles west of the Milpitas SOI.

Seismic Hazards

Seismic hazards include both rupture (surface and subsurface) along active faults and ground shaking, which can occur over wider areas. Ground shaking, produced by various tectonic phenomena, is the principal source of seismic hazards in areas devoid of active faults. All areas of the state are subject to some level of seismic ground shaking.

Several scales may be used to measure the strength or magnitude of an earthquake. Magnitude scales (ML) measure the energy released by earthquakes. The Richter scale, which represents magnitude at the earthquake epicenter, is an example of an ML. As the Richter scale is logarithmic, each whole number represents a 10-fold increase in magnitude over the preceding number. The following table represents effects that would be commonly associated with Richter Magnitudes:

TABLE 5.5-1: RICHTER MAGNITUDES AND EFFECTS

MAGNITUDE	EFFECTS
< 3.5	Typically not felt
3.5 – 5.4	Often felt but damage is rare
5.5 – 6.0	Damage is slight for well-built buildings
6.1 – 6.9	Destructive potential over ±60 miles of occupied area
7.0 – 7.9	"Major Earthquake" with the ability to cause damage over larger areas
≥ 8	"Great Earthquake" can cause damage over several hundred miles

SOURCE: ASSOCIATION OF BAY AREA GOVERNMENTS, 2011.

Moment Magnitude (Mw) is used by the United States Geological Service (USGS) to describe the magnitude of large earthquakes in the U.S. The value of moment is proportional to fault slip multiplied by the fault surface area. Thus, moment is a measurement that is related to the amount of energy released at the point of movement. The Mw scale is often preferred over other scales, such as the Richter, because it is valid over the entire range of magnitudes. Moment is normally converted to Mw, a scale that approximates the values of the Richter scale.

Seismic ground shaking hazards are calculated as a probability of exceeding certain ground motion over a period of time, usually expressed in terms of "acceleration." The acceleration of the Earth during an earthquake can be described in terms of its percentage of gravity (g). For example, the 10% probability of exceedance in 50 years is an annual probability of 1 in 475 of being exceeded each year. This level of ground shaking has been used for designing buildings in high seismic areas. This probability level allows engineers to design buildings for larger ground motions than what is expected to occur during a 50-year interval, which will make buildings safer than if they were only designed for the ground motions that are expected to occur in the next 50 years.

The California Geological Survey estimates a 10% probability of exceeding 70 percent of gravity at peak ground acceleration over the next 50 years in the Milpitas Planning Area, as well as other communities within Santa Clara County. Moving east toward Modesto, the estimates decreases to 40 percent or less of gravity at peak ground acceleration.

In contrast, other scales describe earthquake intensity, which can vary depending on local characteristics. The Modified Mercalli Scale (MM) expresses earthquake intensity at the surface on a scale of I through XII. The Milpitas areas could experience considerable ground shaking generated by faults within Santa Clara County. For example, Milpitas could experience an intensity of MM VIII generated by seismic events occurring along the Hayward fault (ABAG, 2016). The following table represents the potential effects of an earthquake based on the Modified Mercalli Intensities.

TABLE 5.5-2: MODIFIED MERCALLI INTENSITIES AND EFFECTS

MM	EFFECTS
I	Movement is imperceptible
II	Movement may be perceived (by those at rest or in tall buildings)
III	Many feel movement indoors; may not be perceptible outdoors
IV	Most feel movement indoors; windows, doors, and dishes will rattle
V	Nearly everyone will feel movement; sleeping people may be awakened
VI	Difficulty walking; many items fall from shelves; pictures fall from walls
VII	Difficulty standing; vehicle shaking felt by drivers; some furniture breaks
VIII	Difficulty steering vehicles; houses may shift on foundations
IX	Well-built buildings suffer considerable damage; ground may crack
X	Most buildings and foundations and some bridges destroyed
XI	Most buildings collapse; some bridges destroyed; large cracks in ground
XII	Large scale destruction; objects can be thrown into the air

SOURCE: ASSOCIATION OF BAY AREA GOVERNMENTS, 2011.

The Significant United States Earthquakes 1568 – 2009 data published by the USGS in the National Atlas identifies earthquakes that caused deaths, property damage, geologic effects or were felt by populations near the epicenter. As shown in Table 5.5-3, no significant earthquakes are identified within Milpitas; however, significant earthquakes are documented in the region.

TABLE 5.5-3: SIGNIFICANT EARTHQUAKES IN THE REGION

MAGNITUDE	INTENSITY	LOCATION	YEAR
4.1	IV	Dublin	2003
4.6	V	Channel Islands Beach	2002
5.0	VII	Napa	2000
6.9	IX	Loma Prieta (San Andreas)	1989
5.4	N/A	Santa Cruz County	1989
6.2	N/A	Morgan Hill	1984
5.8, 5.8	VII	Livermore	1980
5.7	N/A	Coyote Lake	1979
5.7, 5.6	N/A	Santa Rosa	1969
5.3, 4.2	N/A	Daly City	1957
5.4	N/A	Concord	1954
6.5	N/A	Calaveras fault	1911
7.9	IX	San Francisco	1906
6.8	N/A	Mendocino	1898
6.2	N/A	Mare Island	1898
6.3	N/A	Calaveras fault	1893
6.2	VIII	Winters	1892
6.4	N/A	Vacaville	1892
6.8	VII	Hayward	1868

MAGNITUDE	INTENSITY	LOCATION	YEAR
6.5	VIII	Santa Cruz Mountains	1865
6.8	N/A	San Francisco Peninsula	1838

SOURCE: UNITED STATE GEOLOGICAL SURVEY, 2016.

The City of Milpitas could also be subject to major earthquakes along currently inactive or unrecognized faults. Two examples in California include the 1983 Coalinga Quake (6.5 magnitude) and the 1994 Northridge Quake (6.7 magnitude), which was an unknown fault, and a “blind” thrust fault over 10 miles below the surface, respectively.

Seismic Hazard Zones

ALQUIST-PRIOLO FAULT ZONES

An active earthquake fault, per California’s Alquist-Priolo Act, is one that has ruptured within the Holocene Epoch (≈11,000 years). Based on this criterion, the California Geological Survey identifies Earthquake Fault Zones. These Earthquake Fault Zones are identified in Special Publication 42 (SP42), which is updated as new fault data become available. The SP42 lists all counties and cities within California that are affected by designated Earthquake Fault Zones. The Fault Zones are delineated on maps within SP42 (Earthquake Fault Zone Maps).

There is one Alquist-Priolo Earthquake Fault Zone located within the City of Milpitas: the Hayward Fault Zone. There are four other major faults delineated as Alquist-Priolo Fault Zones between 10 and 30 miles from Milpitas (San Gregorio fault, Calaveras fault, Greenville fault, and the San Andreas fault). Figure 5.5-1 illustrates the location of the earthquake fault zones.

SEISMIC HAZARD ZONES

The State Seismic Hazards Mapping Act (1990) addresses hazards along active faults. The Northern California counties affected by the Seismic Hazard Zonation Program include Alameda, San Francisco, San Mateo and Santa Clara. The Southern California counties affected by the Program include San Bernardino, Los Angeles, Orange, and Ventura. Seismic hazard zones are currently mapped in Milpitas within the Milpitas quadrangle.

Liquefaction

Liquefaction, which is primarily associated with loose, saturated materials, is most common in areas of sand and silt or on reclaimed lands. Cohesion between the loose materials that comprise the soil may be jeopardized during seismic events and the ground will take on liquid properties. Thus, liquefaction requires specific soil characteristics and seismic shaking.

In collaboration with the USGS Earthquake Hazard Program, the California Geological Survey (CGS) produces Liquefaction Susceptibility Maps and identifies “Zones of Required Investigation” per the State’s Seismic Hazard Zonation Program.

The article *Mapping Liquefaction-Induced Ground Failure Potential* (Youd and Perkins, 1978) provides a generalized matrix to demonstrate the relationship between liquefaction potential and depositional landscapes. Table 5.5-4, which is recreated from Youd and Perkins, demonstrates the general relationship between the nature and age of sediment and the anticipated liquefaction potential.

TABLE 5.5-4: LIQUEFACTION POTENTIAL BASED ON SEDIMENT TYPE AND AGE OF DEPOSIT

SEDIMENT	*SUSCEPTIBILITY BASED ON AGE OF DEPOSITS (YEARS BEFORE PRESENT)*			
	MODERN (< 500)	*HOLOCENE (< 10,000)*	*PLEISTOCENE (< 2 MILLION)*	*PRE-PLEISTOCENE (> 2 MILLION)*
River Channel	Very High	High	Low	Very Low
Flood Plain	High	Moderate	Low	Very Low
Alluvial Fan/Plain	Moderate	Low	Low	Very Low
Lacustrine/Playa	High	Moderate	Low	Very Low
Colluvium	High	Moderate	Low	Very Low
Talus	Low	Low	Very Low	Very Low
Loess	High	High	High	- ? -
Glacial Till	Low	Low	Very Low	Very Low
Tuff	Low	Low	Very Low	Very Low
Tephra	High	High	- ? -	- ? -
Residual Soils	Low	Low	Very Low	Very Low
Sebka	High	Moderate	Low	Very Low
Un-compacted Fill	Very High	NA	NA	NA
Compacted fill	Low	NA	NA	NA

SOURCE: YOUD AND PERKINS, 1978.

The CGS Liquefaction Susceptibility Maps and "Zones of Required Investigation" are produced per the State's Seismic Hazard Zonation Program. In Northern California, the areas of high liquefaction potential identified by the CGS are confined to the nine counties comprising the Bay Area, which includes Santa Clara County. Figure 5.5-2 illustrates the liquefaction potential in the vicinity of the Planning Area.

Liquefaction potential in the Planning Area varies from very low to very high. The area designated "very low" potential for liquefaction is located in the hilly area in the western portion of City's SOI. Moving to the east, the potential for liquefaction increases to "moderate", "high", and "very high". The area designated "very high" potential for liquefaction is located along Coyote Creek.

OTHER GEOLOGIC HAZARDS

Soils

According to the Natural Resource Conservation Service (2016), there are thirty different soil series located in the Planning Area. Figure 5.5-3 presents a map of the soils located in the Planning Area. Information from the NRCS official soil description for these series is provided below.

- The Urban land-Still complex series of soils consists of well-drained soils with sandy loam and silt loam soil textures. They are found on alluvial fans and floodplains, and have moderately high to high permeability. These soils are found mainly in the eastern portion of the Planning Area, east of Highway 17, and have slopes of 0 to 2%.

- The Urban land-Elpaloalto complex series of soils consists of well-drained soils with clay loam and silty clay loam textures. They are found on alluvial fans and have moderately high permeability. These soils are found mainly in the northeastern and northwestern outer edges of the Planning Area, and have slopes of 0 to 2%.

- The Urban land-Flaskan complex series of soils consists of well-drained soils with sandy loam, sand clay loam, and gravelly sandy clay loam textures. They are found on alluvial fans and have moderately high permeability. These soils make up the majority of the Planning Area and are found mainly in the central and southern portions of the Planning Area. The slope of this soil series ranges from 0 to 2%.

- The Flaskan sandy clay loam series of soils consist of very deep, well-drained soils that formed in alluvium from mixed rock sources. They are found on alluvial fans and have an available water storage of 14.29 cm. These soils are not prominent but exist in small patches in the in the Eastern Portion of the Planning Area. The slope of this soil series ranges from 5 to 9%.

- The Urbanland-Hangerone complex series of soils consists of poorly-drained soils clay, clay loam, and gravelly loam textures. They are found on basin floors and have moderate available water storage of 16.6 cm. These soils occur in a large band along the western portion of the Planning Area. The slope of this soil series ranges from 0 to 2%.

- The Urbanland-Embarcadero complex series of soils consists of very poorly drained soils. They are found in basin floors and have an available water storage of 16.82 cm. These soils are in a patch located in between HWY 880 and 680, which run through the western half of the Planning Area. The slope of this soil series ranges from 0 to 2%.

- The Embarcadero silty clay loam series of soils consists of very poorly drained soils. They are found on basin floors and have an available water storage of 16.84 cm. These soils are located in a very small patch in the northwestern boarder of the Planning Area. The slope of this soil series ranges from 0 to 2%.

- The Urbanland-Clear Lake complex series of soils consists of very deep, poorly drained soils with clay and silty clay textures. They are found on basin floors alluvial fans and have available water storage of 16.3 cm. These soils are found in the limited amounts in the central and southern portion of the Planning Area. The slope of this soil series ranges from 0 to 2%.

- The Clear Lake silty clay series of soils consists of poorly-drained soils clay and silty clay textures. They are found on basin floors and alluvial fans and have available water storage of 16.1 cm. These soils are located in a small eastern patch of the Planning Area. The slope of this soil series ranges from 0 to 2%.

- The Urbanland-Campbell complex series of soils consists of moderately well-drained soils with silt loam, silty clay loam, and silty clay textures. They are found on alluvial fans and have high available water storage of 17.43 inches of available water storage. These soils are located in several large patches in the western half of the Planning Area. The slope of this soil series ranges from 0 to 2%.

- The Campbell silt loam series of soils consists of very deep, moderately well-drained soils with silt loam, silty clay loam, and silty clay textures. They are found on alluvial fans and basin floors and have available water storage of 17.41 cm. These soils are located in the northwestern corner of the Planning Area. The slope of this soil series ranges from 0 to 2%.

- The Elder series of soils consists of somewhat excessively drained soils with a fine sandy loam texture. They are found in streams and have high permeability. Within the Planning Area, this series is found mainly adjacent Highway 17, east of the Urban land-Elder complex series and west of the highway. The slope of the soil series ranges from 0 to 2%.

- The Urban land-Elder complex series of soils consists of somewhat excessively drained soils with a fine sandy loam texture. They are found on alluvial fans and in streams and have high permeability. Within the Planning Area, these soils are found mainly in a strip parallel to Highway 17, extending across most of the Planning Area. The slope of this soil series ranges from 0 to 2%.

- The Urbanland-Newpark complex series of soils consists of moderately well-drained soils with silty clay loam and fine sandy loam textures. They are found on alluvial fans and have available water storage of 19.33 cm. These soils are prevalent in the southwestern portion of the Planning Area. The slope of this soil series ranges from 0 to 2%.

- The Alo-Altamont complex series of soils consists of well-drained soils with clay, clay loam and silty clay textures. They are found on the backslope of hillsides and have about 14.5 cm of available water storage. These soils make up a large portion of the Planning Area and are found mainly in the central and eastern portions of the Planning Area. The slope of this soil series ranges from 15 to 50%.

- The Sehorn-Altamont complex series of soils consists of well-drained soils with silty clay and gravelly silty clay textures. They are found on the side slopes of hills and have low available water capacity. These soils are present along the northern edge of the planning area. The slope of this soil series ranges from 30 to 50%.

- The Kawenga-Alo complex series of soils consists of well-drained soils with fine-loamy textures. They are found on the backslope of hillsides and have 14.58 cm of available water storage. These soils are present in the southeastern portion of the Planning Area. The slope of this soil series ranges from 20 to 40%.

- The Cropley clay series of soils consists of moderately well-drained soils with clay and silty clay loam textures. They are found on alluvial fans, terraces, and hill slopes and have 15 cm of available water storage. These soils are present in small patches in the eastern half of the Planning Area. The slope of this soil series ranges from 2 to 9%.

- The Urban land-Cropley complex series of soils consists of very deep, well-drained soils with clay and sandy clay loam textures. They are found on alluvial fans and toe slopes have 15 cm of available water storage. These soils are found in abundance in the central portion of the Planning Area. The slope of this soil series ranges from 0 to 9%.

- The Argixerolls series of soils consists of well-drained soils with subangular gravel texture. They are found on the back slopes of hills and have an available water storage of 15.55 cm. These soils are present along Arroyo De Los Coches Creek and the Berryessa Creek in the southeastern portion of the Planning Area. The slope of this soil series ranges from 20 to 50%.

- The Kawenga-Lodo complex series of soils consists of well-drained soils with fine-loamy texture. They are found on alluvial fans and an available water storage of 10.58 cm. These soils are present in the northeastern section of the Planning Area. The slope of this soil series ranges from 15 to 30%.

- The Lodo-Rock outcrop complex series of soils consists of well-drained soils with a clay loam texture. They are found on the back slopes of mountains and have an available water storage of 6.57 cm. These soils are present along the northwestern section of the Planning Area. The slope of this soil series ranges from 50 to 75%.
- The Gaviota loam series of soils consists of well-drained soils with a gravelly loam texture. They are found on the back slopes of mountains and have 7.22 cm of available water storage. Graviota loam exists along the southeastern boarder of the Planning area. Graviota rocky sandy loam and Graviota gravelly loam are present in small patches on the northern border of the planning Area. The slope of this soil series ranges from 15 to 30%.
- The Gaviota-Los Gatos complex series of soils consists of well-drained soils with a loamy to fine-loamy texture. They are found on the back slopes of mountains and ridges and have 9.49 cm of available water storage. These soils are present in a very quantity in the northeastern section of the Planning Area. The slope of this soil series ranges from 30 to 50%.
- The Los Gatos-Gaviota complex series of soils consists of well-drained soils with a fine-loamy texture. They are found on mountain back slopes and have 11.8 cm of available water storage. These soils are found on the northeastern edge of the Planning Area. The slope of this soil series ranges from 50 to 75%.
- The Los Osos clay loam series of soils consists of well-drained soils with clay and clay loam textures. They are found on inland hills and mountains and have moderate water capacity. These soils are located in the southeastern section of the Planning Area. The slope of this soil series ranges from 30 to 50%.
- The Los Gatos-Los Osos complex series of soils consists of deep, well-drained and a loamy texture. They are found on alluvial fans These soils are located on the northeastern boarder of the Planning Area. The slope of this soil series ranges from 45 to 75%.
- The Los Osos series of soils consists of moderately deep, well-drained soils with loam, silt loam, and clay loam textures. They are found on uplands and have slow permeability. These soils are found in a small patch in the northeastern section of the Planning Area. The slope of this soil series ranges from 5 to 75%.
- The Millsholm series of soils consists of well-drained soils formed in material weathered from sandstone, mudstone, and shale. They are found on hills and mountains and have moderate permeability. These soils are found in small quantities in the northeastern section of the Planning Area. The slope of this soil series ranges from 5 to 75%.
- The San Andreas loam series of soils consists of well-drained soils formed in material weathered from soft sandstone. They are found on hills and mountainous uplands and have moderately rapid permeability. These soils Are prevalent in the northeastern section of the Planning Area. The slope of this soil series ranges from 9 to 75%.
- The San Ysidro series of soils consists of deep, moderately well-drained soils formed in alluvial from sedimentary rocks. They are found on old, low terraces and have very slow permeability. These soils are found in a small patch in the northeastern portion of the Planning Area. The slope of this soil series ranges from 0 to %.

Erosion

The U.S. Natural Resource Conservation Service (NRCS) delineates soil units and compiles soils data as part of the National Cooperative Soil Survey. The following description of erosion factors is provided by the NRCS Physical Properties Descriptions:

- Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water. Erosion factor Kw indicates the erodibility of the whole soil, whereas Kf indicates the erodibiity of the fine soils. The estimates are modified by the presence of rock fragments.

Soil erosion data for the City of Milpitas were obtained from the NRCS. As identified in Table 5.5-5, the erosion factor Kf varies from 0.17 to 0.43, which is considered moderately low to moderate potential for erosion. The NRCS does not provide erosion factors for the Urban land soils in the City of Milpitas. The erosion potential for the Urban land soils in the city is considered to be low.

TABLE 5.5-5: SOIL EROSION FACTORS

MAP SYMBOL AND SOIL NAME	KF	REPRESENTATIVE VALUE			ACREAGE
		% SAND	% SILT	% CLAY	
102: Urban land	--	--	--	--	290.35
115: Pits, mine	--	--	--	--	190.26
130: Urban land-Still complex	--	--	--	--	163.73
131: Urban land-Elpaloalto complex	--	--	--	--	52.77
140/141: Urban land-Flaskan complex	--	--	--	--	346.89
143: Flaskan sandy clay loam	0.24	58.2	17.8	24.0	6.82
145: Urbanland-Hangerone complex	--	--	--	--	107.62
150: Urbanland-Embarcadero complex	--	--	--	--	1,237.95
151: Embarcadero silty clay loam, drained	0.24	30.3	30.7	39.0	3.64
160: Urbanland-Clear Lake complex	--	--	--	--	299.60
161: Clear Lake silty clay	0.28	8.0	47.0	45.0	4.98
165: Urbanland-Campbell complex	--	--	--	--	1.23
166: Campbell silt loam	0.37	7.0	69.0	24.0	144.24
168/171: Elder fine sandy loam	--	--	--	--	32.12
169: Urbanland-Elder complex	--	--	--	--	894.98
180: Urbanland-Newpark complex	--	--	--	--	4.92
305/306: Alo-Altamont complex	0.17	26.1	28.9	45.0	49.68
305scl: Sehorn-Altamont complex	0.17	26.1	28.9	45.0	0.51
307: Kawenga-Alo complex	0.24	67.7	14.3	18.0	94.39
316: Cropley clay	0.24	26.1	28.9	45.0	395.64
317/318: Urban land-Cropley complex	--	--	--	--	0.02
345: Argixerolls, 20 to 50 percent slopes	0.32	26.1	41.9	32.0	91.56
391/392scl: Lodo-Rock outcrop complex	0.32	68.0	16.0	16.0	792.73
401/GcE: Gaviota loam	0.43	44.8	41.2	14.0	1.13

MAP SYMBOL AND SOIL NAME	KF	REPRESENTATIVE VALUE			ACREAGE
		% SAND	% SILT	% CLAY	
GaE2aa: Gaviota rocky sandy loam	0.24	66.8	19.2	14.0	1,837.96
GhG2/GhG3: Gaviota gravelly loam	0.43	44.8	41.2	14.0	5.70
GmF: Gaviota-Los Gatos complex	0.43	44.8	41.2	14.0	376.00
LhG: Los Gatos-Gaviota complex	0.24	39.2	37.3	23.5	1,110.54
LoE/LoF/LoG: Los Osos clay loam	0.28	35.0	30.0	35.0	346.50
LpF2aa: Los Gatos-Los Osos complex	0.37	39.8	49.0	31.0	1,700.70
LsCaa: Los Osos loam	0.32	39.2	37.3	23.5	6.13
MhE2aa: Millsholm silt loam	0.49	24.5	52.0	23.5	285.86
SaE2/SaG2: San Andreas fine sandy loam	0.17	66.9	20.1	13.0	144.77
SfC: San Ysidro loam	0.32	39.2	37.3	23.5	146.74
W: Water	--	--	--	--	286.67

SOURCE: NATURAL RESOURCE CONSERVATION SERVICE, 2016.

Expansive Soils

The NRCS delineates soil units and compiles soils data as part of the National Cooperative Soil Survey. The following description of linear extensibility (also known as shrink-swell potential or expansive potential) is provided by the NRCS Physical Properties Descriptions:

> *"Linear extensibility" refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. It is an expression of the volume change between the water content of the clod at 1/3- or 1/10-bar tension (33kPa or 10kPa tension) and oven dryness. The volume change is reported in the table as percent change for the whole soil. The amount and type of clay minerals in the soil influence volume change.*
>
> *The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent; moderate if 3 to 6 percent; high if 6 to 9 percent; and very high if more than 9 percent. If the linear extensibility is more than 3, shrinking and swelling can cause damage to buildings, roads, and other structures and to plant roots. Special design commonly is needed.*

The linear extensibility of the soils within Milpitas ranges from Low to Very High. Figure 5.5-4 illustrates the shrink-swell potential of soils in the Planning Area. The majority of the Planning Area has moderate to very high expansive soils, including most of the developed land. The eastern and western portions of the SOI have low expansive soils. Most of the area within the City's SOI with low expansive soils are located on undeveloped land. The areas with moderate to high expansive soils would require special design considerations due to shrink-swell potentials.

Landslide

The California Geological Survey classifies landslides with a two-part designation based on Varnes (1978) and Cruden and Varnes (1996). The designation captures both the type of material that failed and the type of movement that the failed material exhibited. Material types are broadly categorized as either rock or soil, or a combination of the two for complex movements. Landslide movements are categorized as falls, topples, spreads, slides, or flows.

Landslide potential is influenced by physical factors, such as slope, soil, vegetation, and precipitation. Landslides require a slope, and can occur naturally from seismic activity, excessive saturation, and wildfires, or from human-made conditions such as construction disturbance, vegetation removal, wildfires, etc.

Within Santa Clara County, the hillsides have some susceptibility for landslides, while the valleys have a low susceptibility. Figure 5.5-5 illustrates the landslide potential in the vicinity of the Planning Area. Given the relatively level slopes throughout Milpitas, the landslide potential is low. However, the landslide potential increases in the eastern portion of the Planning Area, which contains areas with elevation change.

Lateral Spreading

Lateral spreading generally is a phenomenon where blocks of intact, non-liquefied soil move down slope on a liquefied substrate of large areal extent. The potential for lateral spreading is present where open banks and unsupported cut slopes provide a free face (unsupported vertical slope face). Ground shaking, especially when inducing liquefaction, may cause lateral spreading toward unsupported slopes. The greatest potential for lateral spreading in the Planning Area is in the hilly terrain to the east.

Subsidence

Subsidence is the settlement of soils of very low density generally from either oxidation of organic material, or desiccation and shrinkage, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. In Santa Clara County, subsidence has occurred over much of the Santa Clara Valley, including land adjacent to the southern end of the San Francisco Bay.

Land uplift and subsidence in the Santa Clara Valley due to the recharge and withdrawal of fluids is well documented by several public agencies such as the Santa Clara Valley Water District (SCVWD) and the USGS.[1] An increase in the withdrawal of water from the aquifer and a decrease in rainfall for the first half of the twentieth century resulted in a substantial drop in well levels and a corresponding land subsidence of approximately four meters. Recovery efforts over the past quarter century, such as the import of water from outside sources and the construction of percolation ponds, have allowed water levels to partially recover.

Corrosivity

Corrosivity refers to potential soil-induced electrochemical or chemical action that could corrode or deteriorate concrete, reinforcing steel in concrete structures, and bare-metal structures exposed to these soils. The rate of corrosion is related to factors such as soil moisture, particle-size distribution, and the chemical composition and electrical conductivity of the soil. The natural soils found in the Planning Area may be low to moderately corrosive. The materials used in the construction of modern infrastructure is typically designed to resist the effects of corrosion over the design life of the infrastructure. In addition, native soils are typically replaced by engineered backfill which generally has a low corrosive potential.

[1] Schmidt, D., Bürgmann, R. 2002. Land Uplift and Subsidence in the Santa Clara Valley. Berkeley Seismological Laboratory. Accessed July 20, 2016. Available at: <https://seismo.berkeley.edu/annual_report/ar01_02/node26.html>.

Naturally Occurring Asbestos

The term “asbestos” is used to describe a variety of fibrous minerals that, when airborne, can result in serious human health effects. Naturally occurring asbestos is commonly associated with ultramafic rocks and serpentinite. Ultramafic rocks, such as dunite, peridotite, and pyroxenite are igneous rocks comprised largely of iron-magnesium minerals. As they are intrusive in nature, these rocks often undergo metamorphosis, prior to their being exposed on the Earth’s surface. The metamorphic rock serpentinite is a common product of the alteration process. Naturally occurring asbestos is mapped in Santa Clara County, although it is all located to the west of the Planning Area in mountainous areas as well as south of the Planning Area in San Jose. There is no naturally occurring asbestos mapped within Milpitas.

Tsunami/Seiches

Tsunamis and seiches are standing waves that occur in the ocean or relatively large, enclosed bodies of water (i.e., Lake Tahoe) that can follow seismic, landslide, and other events from local sources (California, Oregon, Washington coast) or distant sources (Pacific Rim, South American Coast, Alaska/Canadian coast). The City of Milpitas is not within a tsunami or seiche hazard area.

Tsunami hazards for the Santa Clara County coastline have been modeled by the California Emergency Management Agency (Cal EMA) to identify areas at risk for tsunami inundation. Multiple source events were selected to represent local and distant earthquakes, and hypothetical extreme undersea, near-shore landslides occurring around the San Francisco Bay region. As defined by the Tsunami Inundation Map for Emergency Planning Milpitas Quadrangle dated July 31, 2009, a tsunami hazard area is located approximately 2.3 miles west of the western city limits. The tsunami hazard area is shown in Figure 5.5-6.

STRUCTURAL DAMAGE

Fault Rupture Damage. There are known active faults that have been mapped within the Planning Area, and the potential for structures to be adversely affected by fault rupture is considered to be moderate. The California Geological Survey has established an Alquist-Priolo Earthquake Fault Zone, the Hayward Fault Zone, in the Planning Area.

Ground Shaking Damage. As is the case for most areas within California, the potential for seismic ground shaking in the Planning Area is expected. As a result, the State requires special design considerations for all structural improvements in accordance with the seismic design provisions in the California Building Code. California’s seismic design provisions require enhanced structural integrity based on several risk parameters with the ultimate objective of protecting the life and safety of building occupants and the public. For large earthquakes, the seismic design standards primarily ensure that the building will not collapse, but some structural and non-structural damage may be expected. Older buildings constructed of unreinforced masonry, including materials such as brick, concrete, and stone, pre-1940 wood frame houses, and pre-1973 tilt-up concrete buildings are particularly susceptible to structural damage from ground shaking. In most cases, these older buildings require retrofit, or they risk significant structural damage during an earthquake.

Liquefaction Damage. The liquefaction potential in the Planning Area varies from “very low” to “high,” with the majority of the Planning Area designated “moderate” or “high.” Liquefaction poses a substantial source of hazard to structures and infrastructure located throughout the Planning Area. There are a variety of geotechnical strategies that can be implemented to mitigate the potential for structural damage. These include appropriate foundation design, engineering soils, groundwater management, and the use of special flexible materials for construction.

Landslide and Lateral Spreading Damage. Given the relatively level slopes throughout the majority of the Planning Area, the landslide and lateral spreading potential is very low. The landslide and lateral spreading potential increases some in the hilly terrain in the eastern portion of the Planning Area. There are a variety of geotechnical strategies that can be implemented to mitigate the potential for landslide and lateral spreading in this area. These include engineering soils, groundwater management, surface water control, slope reconfiguration, and structural reinforcement if necessary.

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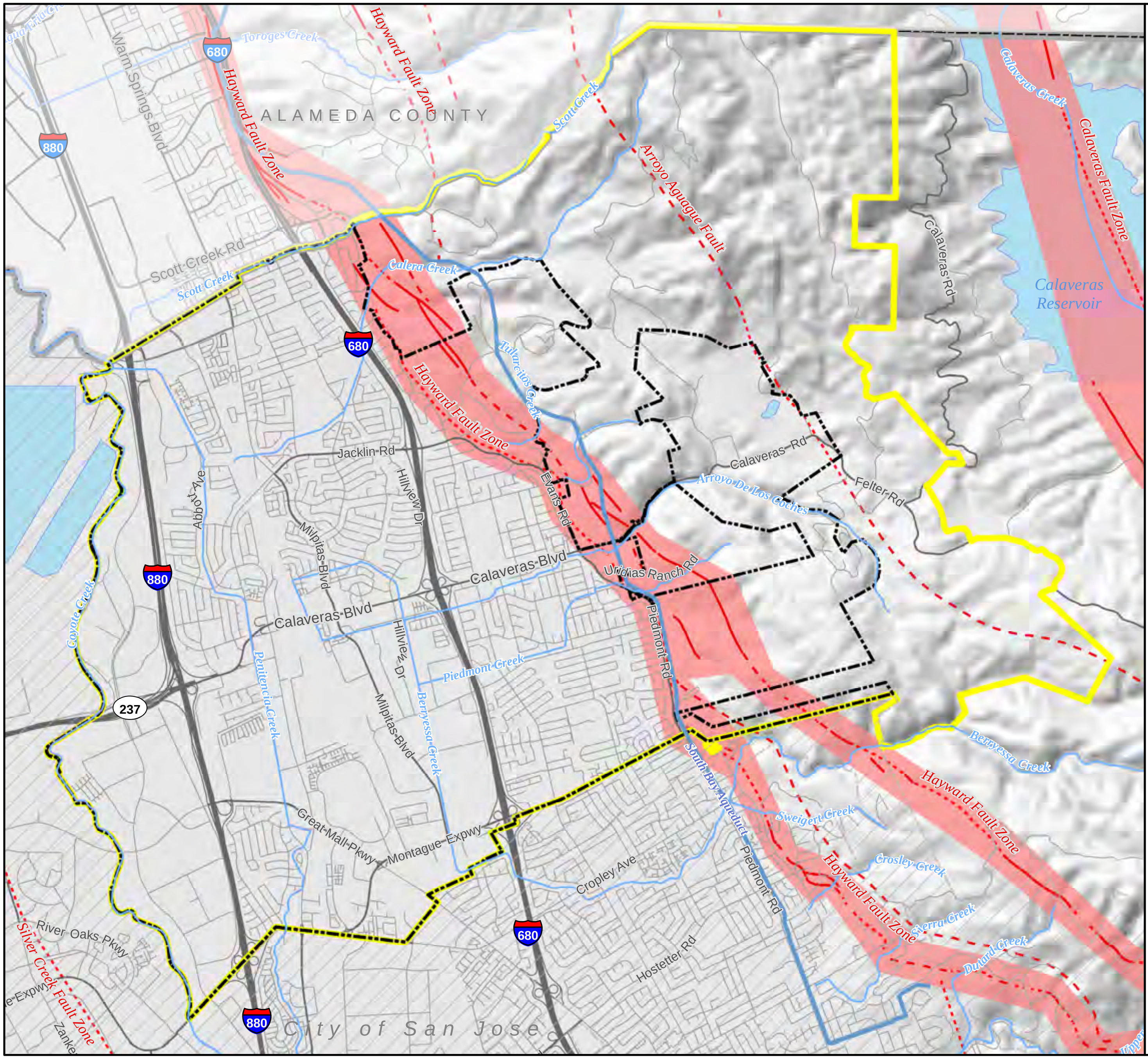
CITY OF MILPITAS
GENERAL PLAN UPDATE

Figure 5.5-1. Earthquake Faults



Quaternary Faults

- Well-constrained
- Moderately-constrained
- Inferred
- Alquist-Priolo Fault Zones

Planning Areas

- City of Milpitas
- Milpitas Sphere of Influence
- City of San Jose

0 ¼ ½
Miles
1:58,000

Sources: City of Milpitas GIS; Santa Clara County GIS; Alameda County GIS; USGS National Hydrography Dataset; Cal Atals; USGS Quaternary fault database; Cal Geology. Map date: June 13, 2016.

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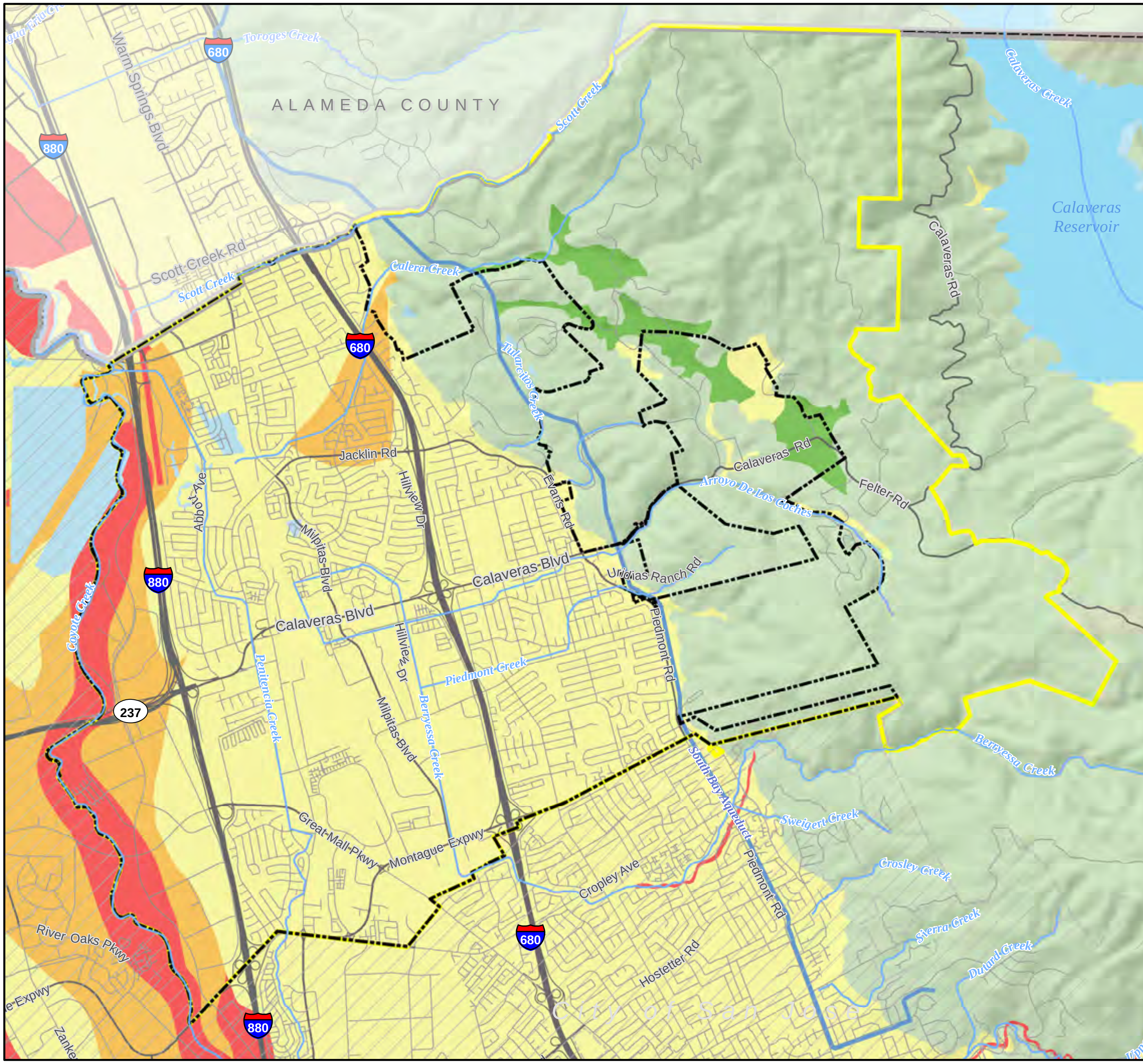
CITY OF MILPITAS
GENERAL PLAN UPDATE

Figure 5.5-2.
Liquefaction Susceptibility



Liquefaction Susceptibility

- Very Low
- Low
- Moderate
- High
- Very High
- Water

Planning Areas

- City of Milpitas
- Milpitas Sphere of Influence
- City of San Jose

N

0 ¼ ½
Miles
1:58,000

Sources: City of Milpitas GIS; Santa Clara County GIS; Alameda County GIS; USGS National Hydrography Dataset; CalAtlas; U.S. Geological Survey Open-File Report 2006-1037, Version 1.1. Map date: June 10, 2016.

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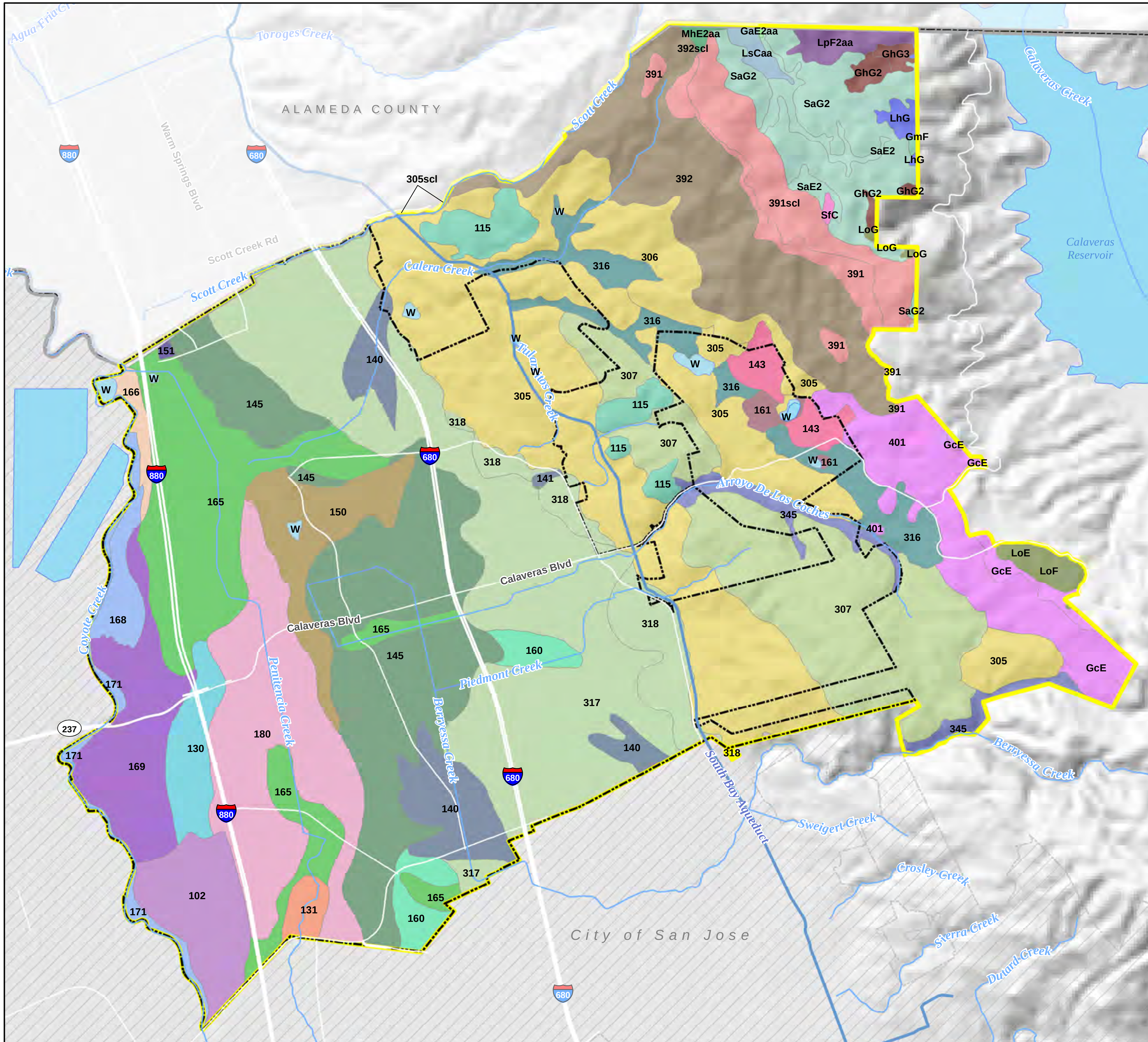
CITY OF MILPITAS
GENERAL PLAN UPDATE

Figure 5.5-3. NRCS Soils



NRCS Soil Classification

- 102 - Urban land
- 115 - Pits, mine
- 130 - Urban land-Still complex
- 131 - Urban land-Elpaloalto complex
- 140/141 - Urban land-Flaskan complex
- 143 - Flaskan sandy clay loam
- 145 - Urbanland-Hangerone complex
- 150 - Urbanland-Embarcadero complex
- 151 - Embarcadero silty clay loam, drained
- 160 - Urbanland-Clear Lake complex
- 161 - Clear Lake silty clay
- 165 - Urbanland-Campbell complex
- 166 - Campbell silt loam
- 168/171 - Elder fine sandy loam
- 169 - Urbanland-Elder complex
- 180 - Urbanland-Newpark complex
- 305/306 - Alo-Altamont complex
- 305scl - Sehorn-Altamont complex
- 307 - Kawenga-Alo complex
- 316 - Cropley clay
- 317/318 - Urban land-Cropley complex
- 345 -
- 391/391scl - Kawenga-Lodo complex
- 392/392scl - Lodo-Rock outcrop complex
- 401/GcE - Gaviota loam
- GaE2aa - Gaviota rocky sandy loam
- GhG2/GhG3 - Gaviota gravelly loam
- GmF - Gaviota-Los Gatos complex
- LhG - Los Gatos-Gaviota complex
- LoE/LoF/LoG - Los Osos clay loam
- LpF2aa - Los Gatos-Los Osos complex
- LsCaa - Los Osos loam
- MhE2aa - Millsholm silt loam
- SaE2/SaG2 - San Andreas fine sandy loam
- SfC - San Ysidro loam
- W - Water

Planning Areas

- City of Milpitas
- Milpitas Sphere of Influence
- City of San Jose

0 1,000 2,000
Feet
1:40,000

Sources: City of Milpitas GIS; Santa Clara County GIS; Alameda County GIS; NRCS Web Soil Survey, Alameda Area (CA609), Alameda County Western Part (CA610), Eastern Santa Clara Area (CA646), Santa Clara Area Western Part (CA641), accessed June 9, 2016. Map date: June 10, 2016.

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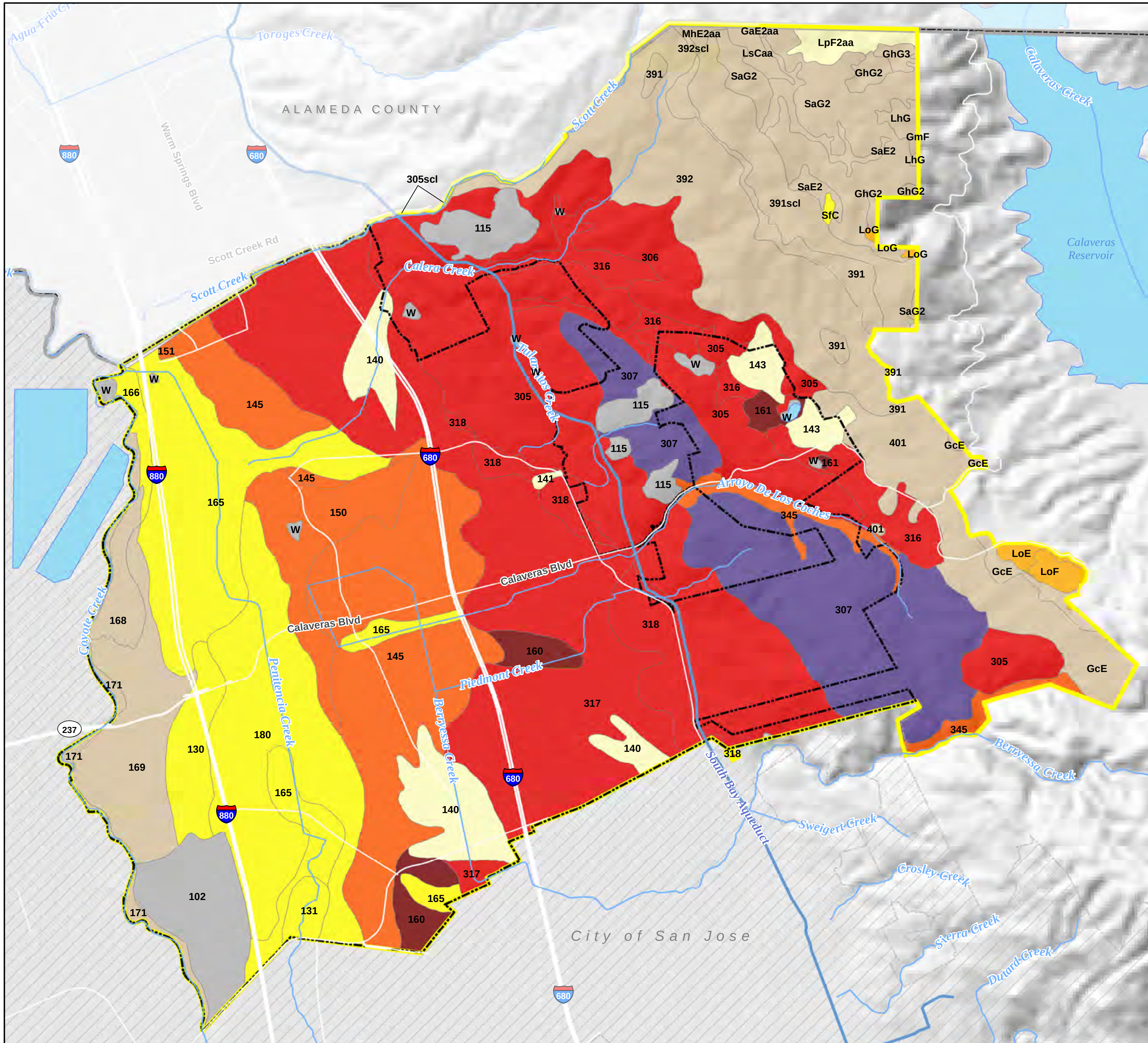
CITY OF MILPITAS
GENERAL PLAN UPDATE

Figure 5.5-4. Shrink-Swell Potential of Soils



Shrink-Swell Potential of Soils*

- L: Low
- L-M: Low to Moderate
- M: Moderate
- M-H: Moderate to High
- H: High
- H-VH: High to Very Hight
- VH: Very High
- L-H: Low to High
- NA: Water, Pits, Mines, or Urban Lands

Planning Areas

- City of Milpitas
- Milpitas Sphere of Influence
- City of San Jose

** Shrink-swell potential is determined by the "linear extensibility" of the soil. Linear extenisbility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. It is an expression of the volume change and is reported as a percent change for the whole soil. Shrink-swell potential is low if the soil has a linear extensibility of less than 3%; moderate if 3-6%; high if 6-9%; and very high if greater than 9%. Many of the soil types within the planning area are complexes, made up of more than one soil type, therefore the shink-swell potential may span multiple categories. The map is labeled by soil type and may be cross-referenced with Figure 5.5-3.*

0 1,000 2,000
Feet
1:40,000

Sources: City of Milpitas GIS; Santa Clara County GIS; Alameda County GIS; NRCS Web Soil Survey, Alameda Area (CA609), Alameda County Western Part (CA610), Eastern Santa Clara Area (CA646), Santa Clara Area Western Part (CA641), accessed June 9, 2016. Map date: June 10, 2016.

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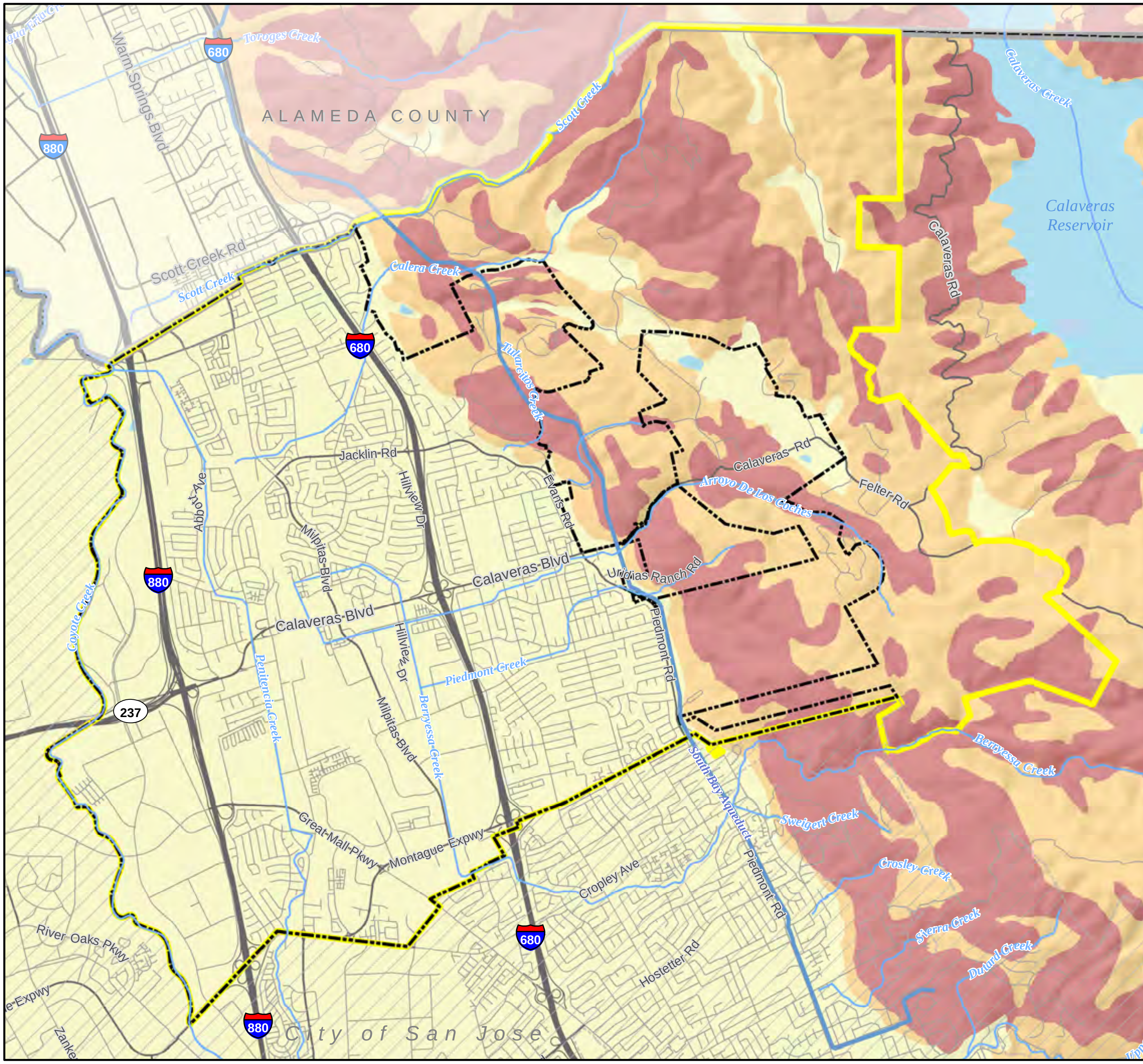
CITY OF MILPITAS
GENERAL PLAN UPDATE

Figure 5.5-5. Landslide Potential



Map Units *

Few Landslides

Mostly Landslide

Surficial Deposits (Flat Land)

Water

Planning Areas

City of Milpitas

Milpitas Sphere of Influence

City of San Jose

** The best available predictor of where movement of slides and earth flows might occur is the distribution of past movements (Nilsen and Turner, 1975).*

0 ¼ ½
Miles
1:58,000

Sources: City of Milpitas GIS; Santa Clara County GIS; Alameda County GIS; USGS National Hydrography Dataset; Cal Atlas; U.S. Geological Surve Open-File Report 97-745. Map date: June 10,

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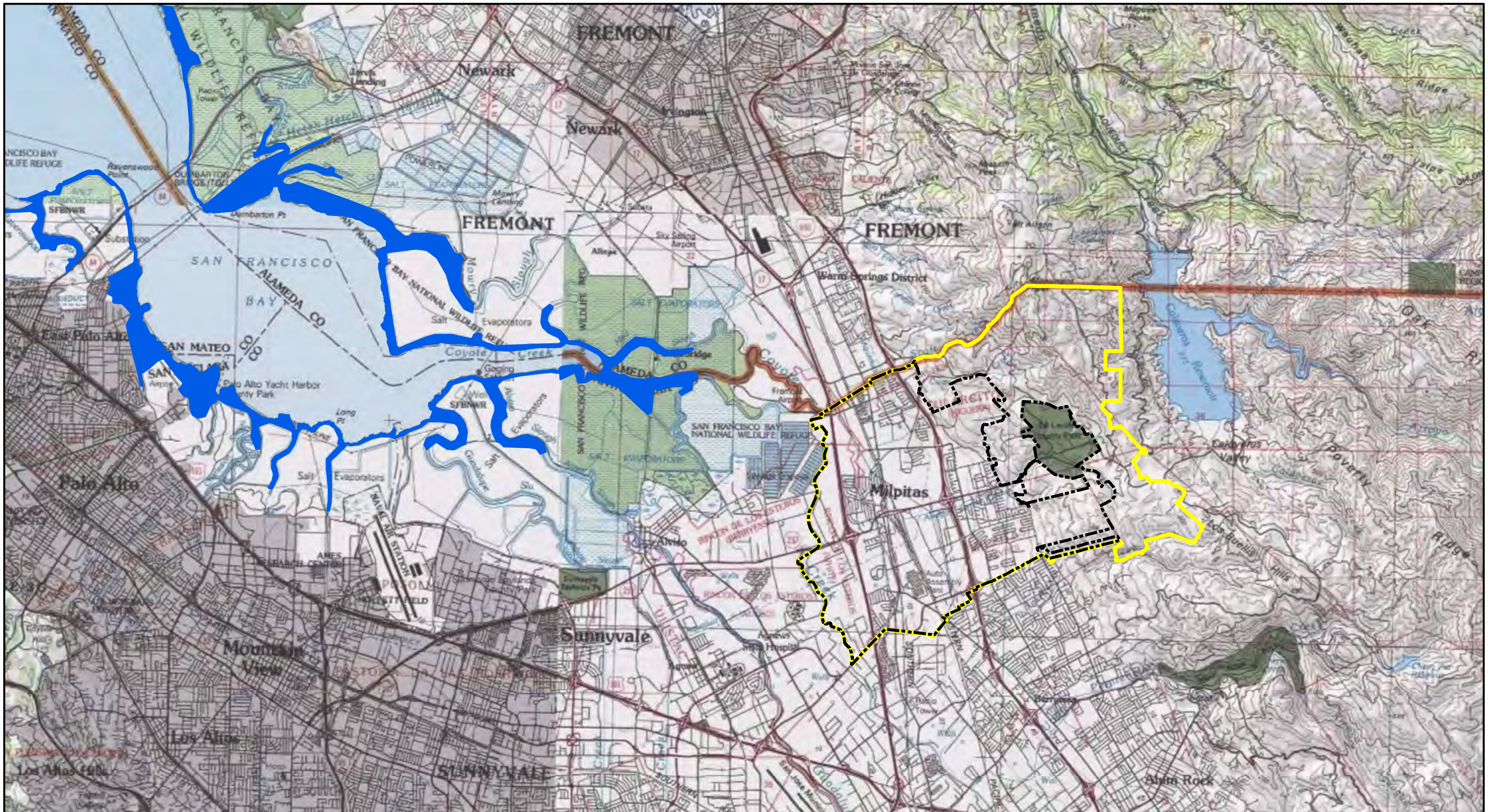

Legend

- Tsunami Inundation Areas for Emergency Planning
- City of Milpitas
- Milpitas Sphere of Influence

0 ½ 1
Miles
1:150,000

Sources: Association of Bay Area Governments, Tsunami Basics; City of Milpitas; ArcGIS Online USGS Topographic Map Service. Map date: March 2, 2017.

CITY OF MILPITAS
GENERAL PLAN UPDATE

Figure 5.5-6. Tsunami Hazard Areas

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