3.5 Geology and Soils

Environmental Setting

PHYSICAL SETTING

Geology and Soils

The city is located within the Coast Ranges Geomorphic Province, a relatively geologically young and seismically-active region on the western margin of the North American plate. The ranges and valleys trend northwest, sub-parallel to the San Andreas Fault. The Coast Ranges are composed of thick Mesozoic and Cenozoic sedimentary strata. The northern and southern ranges are separated by a depression containing the San Francisco Bay. 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.[1] Figure 3.5-1 shows the soil types most prevalent in Daly City.

Faults and Seismicity

The entire Bay Area is located within the San Andreas Fault Zone, a complex of active faults where moderate to strong earthquakes have been generated. The overall probability of a magnitude 6.7 or greater earthquake on a fault in the greater Bay Area in the next 30 years is estimated at 63 percent. The San Andreas Fault runs directly through the southwestern portion of the Serramonte Planning Area and Coastal Zone in Daly City (see Figure 3.5-2). The probability of a large earthquake on the San Andreas Fault—the fault responsible for the 1906 San Francisco earthquake and the 1989 Loma Prieta earthquake—in the next 30 years is about 21 percent.[2]

The Modified Mercalli Intensity (MMI) Scale describes shaking severity resulting from earthquakes. The scale is shown in Table 3.5-1. An earthquake of magnitude 7.2 on the San Andreas Fault would have MMI shaking severity levels of Strong to Very Violent throughout the city, depending on proximity to the fault zone. The most violent shaking would occur in the areas closest to the fault in the city's southwest and along the coast.[3] (See Figure 3.5-2)

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[1] California Department of Conservation, California Geologic Survey. California Geomorphic Provinces, Note 36, 2002.

[2] USGS 2008 Bay Area Earthquake Probabilities, 2008, available at http://earthquake.usgs.gov/regional/nca/ucerf/, accessed July 2012.

[3] Association of Bay Area Governments, Earthquake Hazard Map for Daly City, San Andreas (Peninsula) Scenario, available at www.abag.ca.gov/bayarea/eqmaps/pickcity.html, accessed July 2012

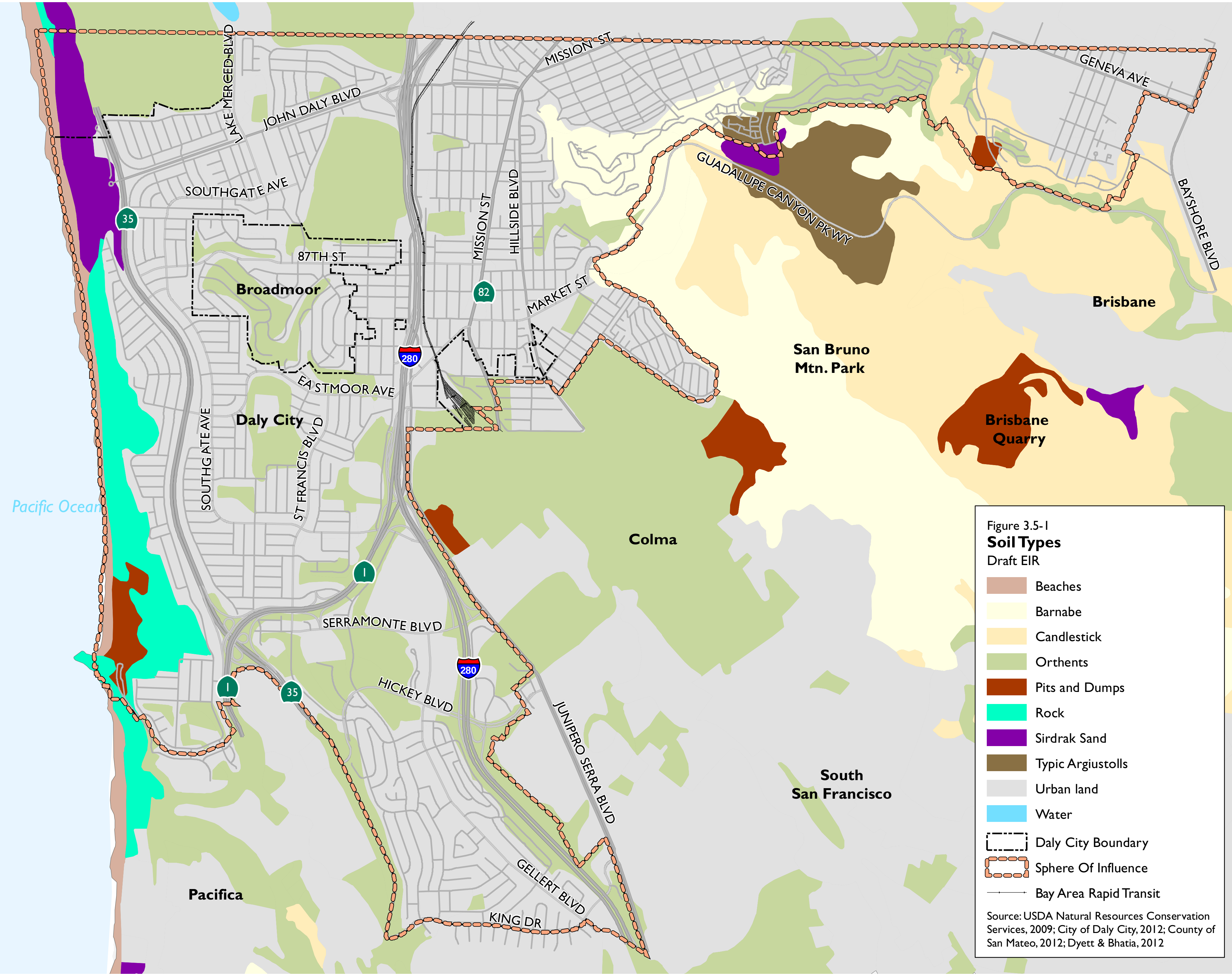
Figure 3.5-1
Soil Types
Draft EIR
Beaches
Barnabe
Candlestick
Orthents
Pits and Dumps
Rock
Sirdrak Sand
Typic Argiustolls
Urban land
Water
Daly City Boundary
Sphere Of Influence
Bay Area Rapid Transit
Source: USDA Natural Resources Conservation Services, 2009; City of Daly City, 2012; County of San Mateo, 2012; Dyett & Bhatia, 2012
Pacific Ocean
Broadmoor
Daly City
Colma
San Bruno Mtn. Park
Brisbane
Brisbane Quarry
South San Francisco
Pacifica
MISSION ST
GENEVA AVE
JOHN DALY BLVD
LAKE MERCED BLVD
SOUTHGATE AVE
87TH ST
EASTMOOR AVE
SOUTHGATE AVE
ST FRANCIS BLVD
MISSION ST
HILLSIDE BLVD
MARKET ST
GUADALUPE CANYON PKWY
BAYSHORE BLVD
SERRAMONTE BLVD
HICKEY BLVD
JUNIPERO SERRA BLVD
GELLERT BLVD
KING DR
35
82
280
1

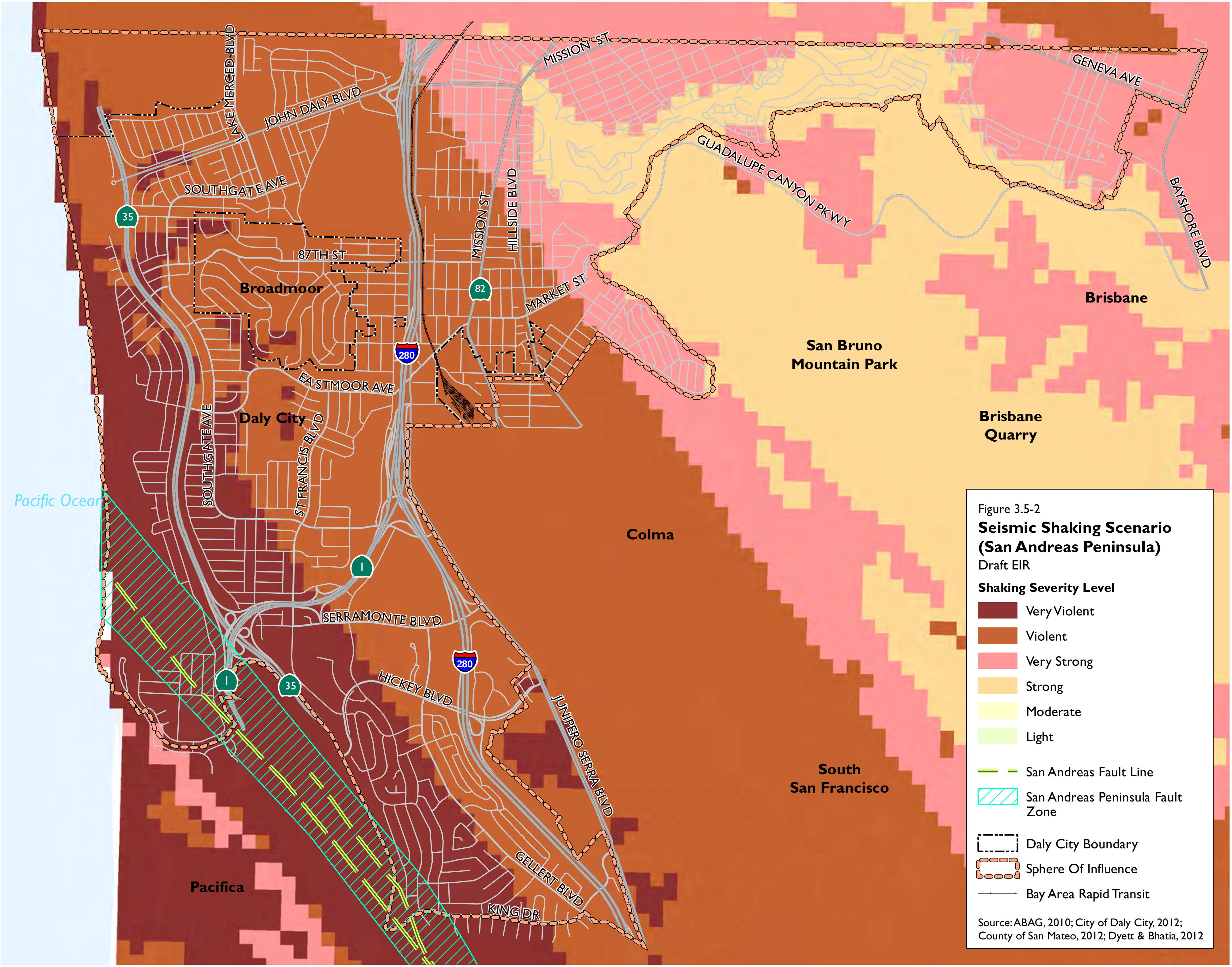
MISSION ST
GENEVA AVE
LAKE MERCED BLVD
JOHN DALY BLVD
GUADALUPE CANYON PKWY
SOUTHGATE AVE
35
87TH ST
MISSION ST
HILLSIDE BLVD
BAYSHORE BLVD
Broadmoor
82
MARKET ST
Brisbane
280
San Bruno
Mountain Park
EASTMOOR AVE
Brisbane
Quarry
Daly City
SOUTHGATE AVE
ST FRANCIS BLVD
Pacific Ocean
Colma
1
SERRAMONTE BLVD
280
HICKEY BLVD
1
35
JUNIPERO SERRA BLVD
South
San Francisco
GELLERT BLVD
Pacifica
KING DR
Figure 3.5-2
Seismic Shaking Scenario
(San Andreas Peninsula)
Draft EIR
Shaking Severity Level
Very Violent
Violent
Very Strong
Strong
Moderate
Light
San Andreas Fault Line
San Andreas Peninsula Fault Zone
Daly City Boundary
Sphere Of Influence
Bay Area Rapid Transit
Source: ABAG, 2010; City of Daly City, 2012; County of San Mateo, 2012; Dyett & Bhatia, 2012

TABLE 3.5-1: MODIFIED MERCALLI INTENSITY SCALE

MMI Value	*Shaking Severity*	*Full Description*
I.	Not mapped by ABAG.	Not felt. Marginal and long period effects of large earthquakes.
II.	Not mapped by ABAG.	Felt by persons at rest, on upper floors, or favorably placed.
III.	Not mapped by ABAG.	Felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration estimated. May not be recognized as an earthquake.
IV.	Not mapped by ABAG.	Hanging objects swing. Vibration like passing of heavy trucks; or sensation of a jolt like a heavy ball striking the walls. Standing motor cars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of IV, wooden walls and frame creak.
V.	Light	Felt outdoors; direction estimated. Sleepers wakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate.
VI.	Moderate	Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books, etc., off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry D cracked. Small bells ring (church, school). Trees, bushes shaken (visibly, or heard to rustle).
VII.	Strong	Difficult to stand. Noticed by drivers of motor cars. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roof line. Fall of plaster, loose bricks, stones, tiles, cornices (also unbraced parapets and architectural ornaments). Some cracks in masonry C. Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.
VIII.	Very Strong	Steering of motor cars affected. Damage to masonry C; partial collapse. Some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.
IX.	Violent	General panic. Masonry D destroyed; masonry C heavily damaged, sometimes with complete collapse; masonry B seriously damaged. (General damage to foundations.) Frame structures, if not bolted, shifted off foundations. Frames racked. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in ground. In alluvial areas sand and mud ejected, earthquake fountains, sand craters.
X.	Very Violent	Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. Rails bent slightly.

TABLE 3.5-1: MODIFIED MERCALLI INTENSITY SCALE

MMI Value	*Shaking Severity*	*Full Description*
XI.	Not mapped by ABAG because these intensities are typically limited to areas with ground failure.	Rails bent greatly. Underground pipelines completely out of service.
XII.	Not mapped by ABAG because these intensities are typically limited to areas with ground failure.	Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into the air.

Source: Association of Bay Area Governments, Modified Mercalli Intensity Scale, available at www.abag.ca.gov/bayarea/eqmaps/doc/mmi.html, accessed August 2012.

Ground Shaking and Liquefaction

The potential severity of ground shaking in the city during an earthquake depends on several factors; areas susceptible to the highest potential levels of seismic shaking are generally those areas closest to the active earthquake-generating faults and areas underlain by thick unconsolidated deposits, particularly soft, saturated mud and fill. Ground shaking is a potentially serious seismic hazard for Daly City since it is underlain by weak to moderately consolidated, loose to firm sands, and is in close proximity to the San Andreas Fault. A Geologic Units Map prepared by the Association of Bay Area Governments (ABAG) classifies geologic units into categories of similar susceptibility to ground shaking from very low to extremely high (see Figure 3.5-3). The ABAG map indicates that if an 8.3 earthquake on the San Andreas Fault occurred, the portions of Daly City underlain by the Colma and Merced Formations would have moderately high to very high susceptibility to ground shaking. Areas underlain by the Franciscan outcrop, such as those adjacent to San Bruno Mountain, have low to moderately low susceptibility. Some areas in the Bayshore neighborhood, however, have high to extremely high susceptibility due to the mixture of different geologic formations near the San Francisco Bay.

Liquefaction is the rapid transformation of saturated, loose, fine-grained sediment to a fluid-like state caused by seismic ground shaking. Soils susceptible to liquefaction include saturated loose to medium dense sands and gravels, low-plasticity silts, and some low-plasticity clay deposits. Liquefaction and associated failures could damage foundations, disrupt utility service, and cause damage to roadways. A composite liquefaction susceptibility map prepared by ABAG indicates that the majority of the city has a very low to low susceptibility level (see Figure 3.5-4). A portion of the City's sphere of influence, north of the Thornton State Beach area has moderate liquefaction susceptibility, while areas directly east of Lake Merced Boulevard and along the Daly City coastline are susceptible to very high liquefaction risk. Similarly to ground shaking, however, liquefaction susceptibility depends substantially on the proximity of individual faults involved during a seismic event.

Surface Rupture and Subsistence

Surface rupture is the fracturing or cracking of the earth's surface by fault displacement or fault movement during an earthquake. Surface rupture in the form of landslides occurred during both the 1906 and 1989 earthquakes—the latter produced cracks in sidewalks, streets, and residential lots causing curb separation, cracks on structures, and broken gutters.

Subsidence is the sinking or lowering of a part of the earth's surface, and may be either earthquake-induced or occur independent of earthquakes. In Daly City, the potential for seismically-induced land subsidence is greater in areas most susceptible to liquefaction (see Figure 3.5-3). Subsidence as a direct result of fault displacement is not as likely in Daly City due to the nature of the how the San Andreas Fault moves during an earthquake.

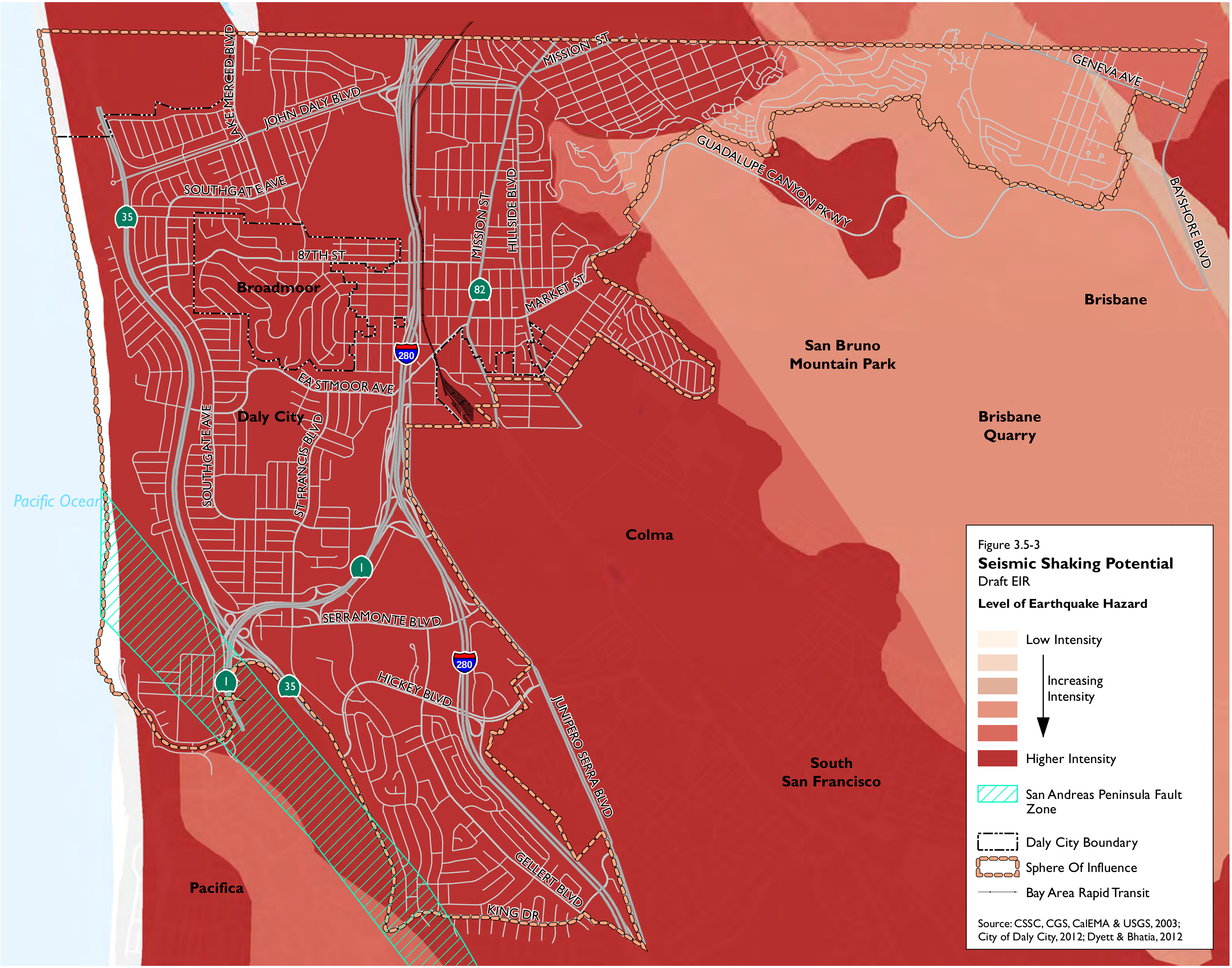

Figure 3.5-3
Seismic Shaking Potential
Draft EIR
Level of Earthquake Hazard
Low Intensity
Increasing Intensity
Higher Intensity
San Andreas Peninsula Fault Zone
Daly City Boundary
Sphere Of Influence
Bay Area Rapid Transit
Source: CSSC, CGS, CalEMA & USGS, 2003; City of Daly City, 2012; Dyett & Bhatia, 2012
Pacific Ocean
Broadmoor
Daly City
Colma
San Bruno Mountain Park
Brisbane
Brisbane Quarry
South San Francisco
Pacifica
LAKE MERCED BLVD
JOHN DALY BLVD
SOUTHGATE AVE
87TH ST
EASTMOOR AVE
ST FRANCIS BLVD
SERRAMONTE BLVD
HICKEY BLVD
GELLERT BLVD
KING DR
JUNIPERO SERRA BLVD
MISSION ST
HILLSIDE BLVD
MARKET ST
GUADALUPE CANYON PKWY
GENEVA AVE
BAYSHORE BLVD
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280
1

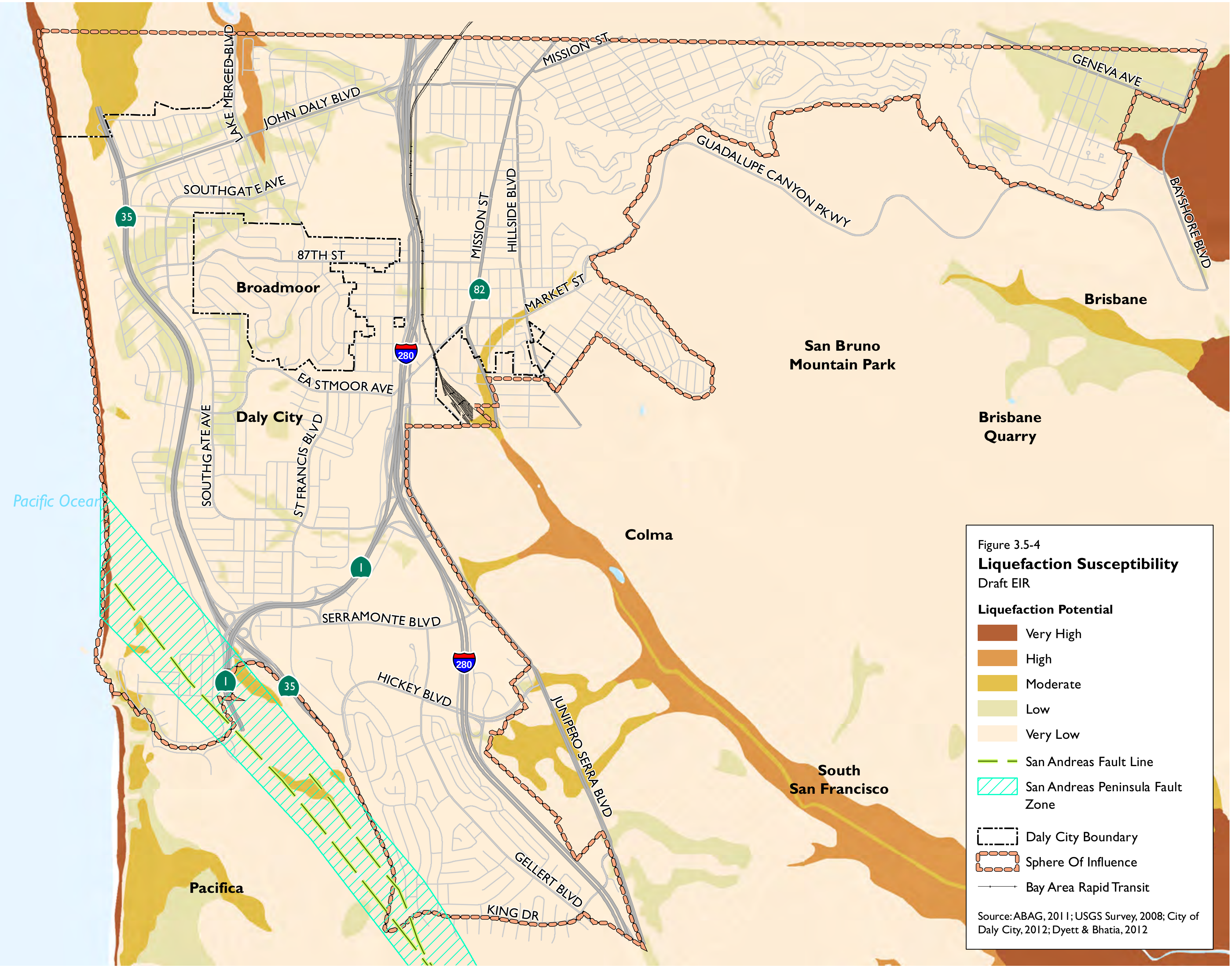


Figure 3.5-4
Liquefaction Susceptibility
Draft EIR

Slope Instability

A landslide is a mass of rock, soil and debris displaced down slope by sliding, flowing or falling (mudflows, or "mudslides" are types of landslides). Landslides can be a direct result of an earthquake, as occurred in Daly City during earthquakes in 1906, 1957, and 1989. More frequently, however, landslides are caused by other natural events such as heavy rainfall. Landslides can also be the result of human activities such as grading and deforestation or removal of vegetation.

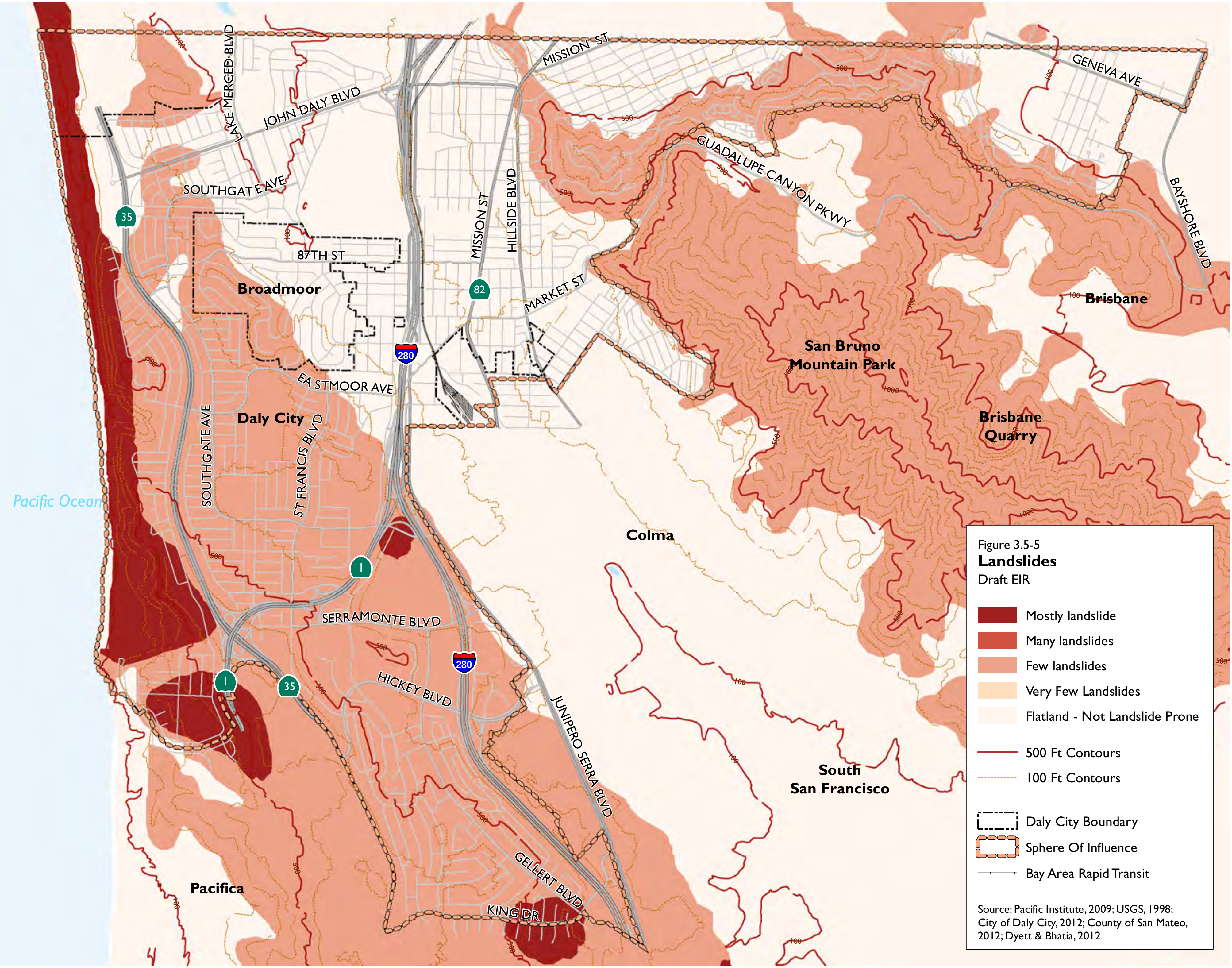
The effect of landslides in Daly City has been most prevalent in the Skyline Planning Area where, over the past several decades, a number of existing homes have been removed due to risks posed by landslides. The vulnerability of homes to landslide hazards in this area is exacerbated by the San Andreas Fault which bisects the neighborhood. Cliff erosion is often considered a type of landslide and is generally caused by an increase in moisture along the bluff line of a cliff which results in the breaking away of material along the face of the cliff. Development along the coastal bluffs can also contribute to increases in cliff erosion through increased runoff due to ineffective storm drainage design.

Moderate landslide risk is prevalent throughout the city, particularly in the city's Southern Hills and Crocker planning areas to the east, St. Francis planning area in the west, and Serramonte planning area to the south. There is a very high landslide risk along the city's entire coastline and in the neighborhoods directly adjacent to Mussel Rock Park in the south (see Figure 3.5-5).

Soil Erosion and Expansive Soils

Soil erosion is the process by which soils are worn away from the earth's surface by precipitation and runoff or wind. The rate of erosion depends on many factors, including soil type and geologic parent materials (inherent erodibility), degree of surface disturbance and resulting vegetative cover, degree of compaction, degree and length of slope, rainfall and/or wind amount and intensity, and erosion control practices. Soils that are high in silt and low in clay and organic matter are the most inherently erodible; but, regardless of soil texture, erosion potential may be high in steep, unvegetated areas—especially those areas disturbed by cut-and-fill or other construction activities. As shown in Figure 3.5-6, erosion susceptibility in the city is greatest in northeastern Daly City around San Bruno Mountain State Park in the Crocker and Bayshore neighborhoods, where erosion potential ranges from low to high, as well as in the northwest of the city at Thornton Beach State Park, where erosion potential is low to moderate.

Expansive soils possess a "shrink-swell" behavior. Shrink-swell is the cyclic change in volume (expansion and contraction) that occurs in fine-grained clay sediments from the process of wetting and drying. Structural damage to buildings can occur over a long period of time, usually as a result of inadequate soil and foundation engineering or the placement of structures directly on expansive soils. Soils in the northeast portion of the city in the Crocker and Bayshore Planning Areas have a shrink-swell potential of low to moderate (see Figure 3.5-6).



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SOUTHGATE AVE
GUADALUPE CANYON PKWY
BAYSHORE BLVD
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MISSION ST
HILLSIDE BLVD
MARKET ST
Broadmoor
Brisbane
San Bruno Mountain Park
EASTMOOR AVE
Daly City
SOUTHGATE AVE
ST FRANCIS BLVD
Brisbane Quarry
Pacific Ocean
Colma
SERRAMONTE BLVD
HICKEY BLVD
JUNIPERO SERRA BLVD
South San Francisco
GELLERT BLVD
KING DR
Pacifica
Figure 3.5-5
Landslides
Draft EIR
Mostly landslide
Many landslides
Few landslides
Very Few Landslides
Flatland - Not Landslide Prone
500 Ft Contours
100 Ft Contours
Daly City Boundary
Sphere Of Influence
Bay Area Rapid Transit
Source: Pacific Institute, 2009; USGS, 1998; City of Daly City, 2012; County of San Mateo, 2012; Dyett & Bhatia, 2012

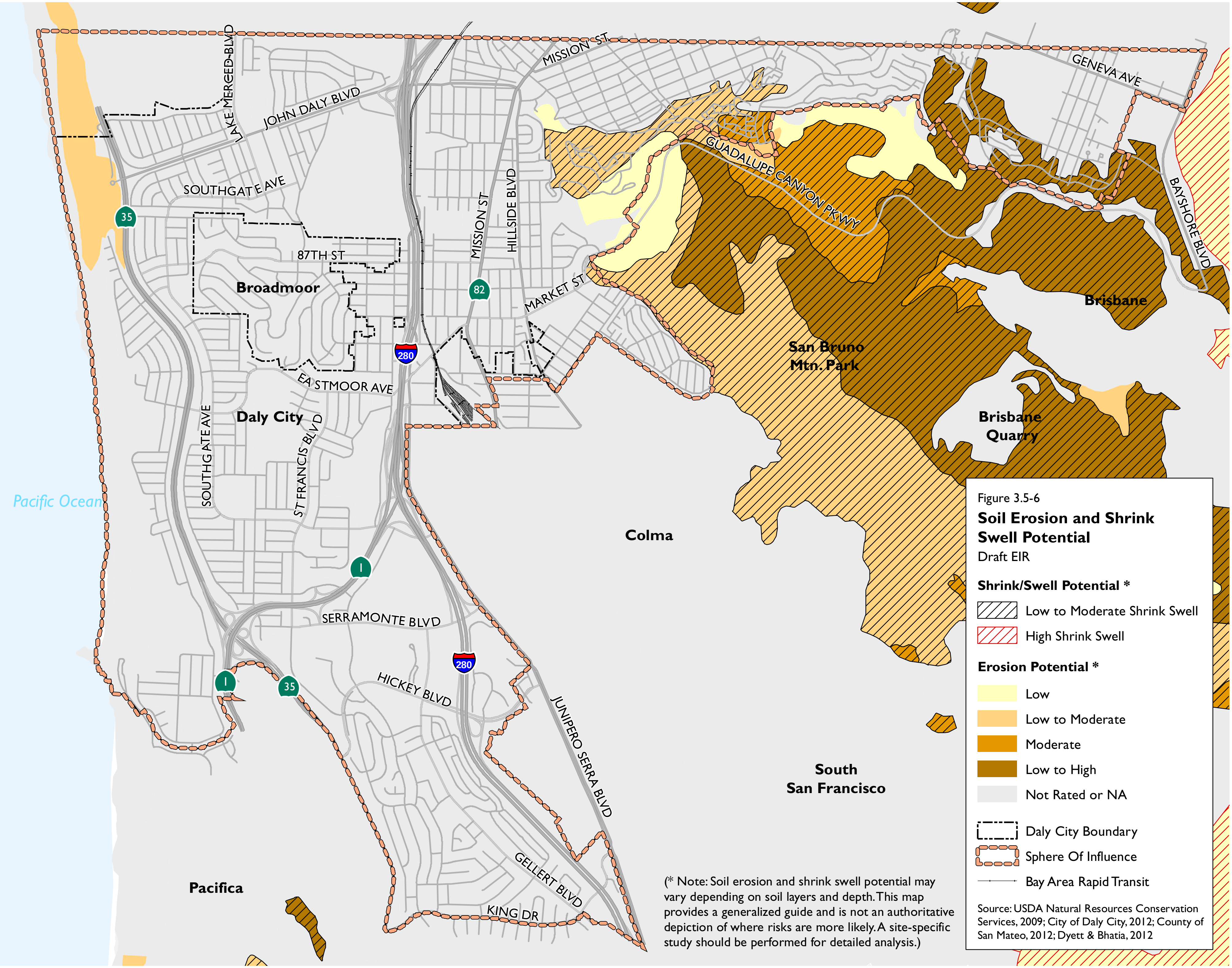

Figure 3.5-6

Soil Erosion and Shrink Swell Potential

Draft EIR

REGULATORY SETTING

State Regulations and Authorities

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act (formerly the Alquist-Priolo Special Studies Zone Act), signed into law December 1972, requires the delineation of zones along active faults in California. The Alquist-Priolo Act regulates development on or near active fault traces to reduce the hazard of fault rupture and to prohibit the location of most structures for human occupancy across these traces.[4] Cities and counties must regulate certain development projects within the delineated zones, and regulations include withholding permits until geologic investigations demonstrate that development sites are not threatened by future surface displacement[5]. Surface fault rupture, however, is not necessarily restricted to the area within an Alquist-Priolo Zone.

Part of the city is within an Alquist-Priolo Earthquake Fault Zone; specifically in the San Francisco South Quadrangle.[6] The San Andreas Fault is located within this Quadrangle.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act of 1990 addresses non-surface fault rupture earthquake hazards, including liquefaction and seismically induced landslides, and its purpose is to protect public safety from the effects of strong ground shaking, liquefaction, landslides, other ground failure, and other hazards caused by earthquakes. The Act requires the State Geologist to delineate various seismic hazard zones and requires cities, counties, and other local permitting agencies to regulate certain development projects within these zones. Before a development permit is granted 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. Mapping of the San Francisco South Quadrangle in which Daly City is located is currently in progress by the California Department of Conservation under its Seismic Hazards Zonation Program.

California Building Code

The California Building Code (CBC) has been codified in the California Code of Regulations (CCR) as Title 24, Part 2. Title 24 is administered by the California Building Standards Commission, which, by law, is responsible for coordinating all building standards. Under state law, all building standards must be centralized in Title 24 or they are not enforceable. The purpose of the CBC is to establish minimum standards to safeguard the public health, safety and general welfare through structural strength, means of egress facilities, and general stability by regulating and controlling the design, construction, quality of materials, use and occupancy, location, and maintenance of all building and structures within its jurisdiction. The CBC is based on the International Building Code. In addition, the CBC contains necessary California amendments which are based on the American Society of

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4 A "structure for human occupancy" is defined by the Alquist-Priolo Act as any structure used or intended for supporting or sheltering any use or occupancy that has an occupancy rate of more than 2,000 person-hours per year.

5 California Geological Survey, "Fault-Rupture Hazard Zones in California," Special Publication 42, 2007.

6 California Department of Conservation, California Geologic Survey, Alquist-Priolo Earthquake Fault Zones, available at http://www.conservation.ca.gov/CGS/rghm/ap/Pages/Index.aspx, accessed August 2012.

Civil Engineers (ASCE) Minimum Design Standards 7-05. ASCE 7-05 provides requirements for general structural design and includes means for determining earthquake loads as well as other loads (flood, snow, wind, etc.) for inclusion into building codes. The provisions of the CBC apply to the construction, alteration, movement, replacement, and demolition of every building or structure or any appurtenances 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 which are used to determine a Seismic Design Category (SDC) for a project. The SDC is a classification system that combines the occupancy categories with the level of expected ground motions at the site and ranges from SDC A (very small seismic vulnerability) to SDC E/F (very high seismic vulnerability and near a major fault). Design specifications are then determined according to the SDC.

In January 2011, the City of Daly City adopted the 2010 editions of the California Building, Plumbing, Electrical, Mechanical, and Energy Codes, and the 2009 edition of the International Property Maintenance Code with references to the California Health and Safety Code and with some Daly City amendments.

Hospital Facilities Seismic Safety Act of 1973

To ensure that hospitals in California conform to high construction standards, the Alfred E. Alquist Hospital Facilities Seismic Safety Act (HSSA) was passed in 1973. The intent of the HSSA is to assure that hospitals are reasonably capable of providing services to the public after a disaster. The HSSA requires the establishment of rigorous seismic design regulations for hospital buildings and requires that new hospitals and additions to hospitals have the capacity, as far as is practical, to remain functional after a major earthquake.

State law requires that all existing hospital buildings providing general acute care as licensed under provisions of Section 1250 of the California Health and Safety Code, be in compliance with the intent of the HSSA by the year 2030.

California Department of Transportation (Caltrans)

Jurisdiction of the California Department of Transportation (Caltrans) includes State and interstate routes within California. Any work within the right-of-way of a federal or State transportation corridor is subject to Caltrans regulations governing allowable actions and modifications to the right-of-way. Caltrans standards incorporate the CBC, and contain numerous rules and regulations to protect the public from seismic hazards such as surface fault rupture, and ground shaking. In addition, Caltrans standards require that projects be constructed to minimize potential hazards associated with cut and fill operations, grading, slope instability, and expansive or corrosive soils, as described in the Caltrans Highway Design Manual (HDM).

Impact Analysis

SIGNIFICANCE CRITERIA

Implementation of the proposed General Plan would have a potentially significant adverse impact if it would:

- 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 or based on other substantial evidence of a known fault
  - Strong seismic ground shaking
  - Seismic-related ground failure, including liquefaction
  - Landslides
  - Lateral spreading
- Be 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 on- or off-site erosion or topsoil loss, landslide, subsidence, or collapse; or
- Be located on expansive soils, as defined in as defined in Table 18-1-B of the Uniform Building Code, creating substantial risks to life or property.

METHODOLOGY AND ASSUMPTIONS

The impact analysis takes into account the geologic and seismic conditions within the city, and applicable regulations and guidelines. The proposed General Plan would facilitate development and growth within the city. The potential for seismic activity to affect people and structures in the city and the protection from seismic hazards provided by existing standards are assessed. Consideration is given to erosion associated with future development, related construction activities, as well as potential geologic hazards posed by liquefaction, ground shaking, and underlying geologic materials.

SUMMARY OF IMPACTS

Part of the city is located within an Alquist-Priolo Earthquake Fault Hazard Zone, and as a result there is considerable risk of surface fault rupture within the city. Potential geologic and soils impacts to proposed structures and infrastructure are primarily related to ground shaking and associated ground failure (e.g., liquefaction), soil expansion, settlement, and subsidence. The potential for soil erosion would increase during construction and the threat of landslides also exists in the city. These impacts would be addressed by mandatory compliance with existing regulations.

IMPACTS AND MITIGATION MEASURES

Impact 3.5-1

Implementation of the proposed General Plan will not expose people or structures to significantly adverse effects, including the risk of loss, injury, or death involving rupture of a known fault, strong seismic ground shaking, landslides or lateral spreading. (*Less than Significant*)

Surface Fault Rupture

The San Andreas Fault, considered one of the most geologically active faults in the world, traverses the city in a northwest-southeast direction and is located within an Alquist-Priolo Earthquake Fault Zone (see Figure 3.5-2). The potential risk of surface rupture is highest along active faults, although surface fault rupture is not restricted to the area within an Alquist-Priolo Earthquake Fault Zone. Potential for structural damage, injury, or death is related to the severity of the earthquake or type of construction. Damage caused by surface fault rupture could include displaced pavement, rupture of underground utilities, or damage to foundations, although modern design techniques focus on the preservation of life and lessening the risk of injury. All development under the proposed General Plan would be subject to the California Building Code, which would help reduce potential impacts related to surface fault rupture to less than significant.

Ground Shaking and Liquefaction

Ground shaking generated during an earthquake could result in structural damage to structures and project-related infrastructure. Seismic-related ground shaking is an unavoidable hazard in the San Francisco Bay Area. Structures and associated infrastructure within the city would likely experience at least one major earthquake (greater than Richter magnitude 6.7) during their functional lifetime. The degree of hazard depends on the geologic condition of the site, construction materials, and construction quality. The intensity of such an event would depend on the causative fault and distance to the epicenter, the moment magnitude, and the duration of shaking.

Although some structural damage is typically not avoidable, building codes and construction standards established by the California Building Code and contained in Title 24 of the CCR protect against building collapse and major injury during a seismic event. Future development in the city would be required to meet the requirements of the California Building Code to help prevent extensive structural damage due to seismic-related ground shaking.

Future development in the city may also be susceptible to secondary seismic hazards such as liquefaction. Liquefaction-induced ground failure can result in damage to underground utilities, shallow foundations, and paved areas. Liquefaction susceptibility maps prepared by ABAG indicate the majority of the city has a liquefaction hazard of low or very low, and mandatory compliance with the existing building codes and construction standards established in the California Building Code would reduce seismic-related liquefaction to less than significant levels.

Earthquake-Induced Landslides and Lateral Spreading

The potential for future development under the proposed General Plan to be significantly affected by earthquake-induced landslides is higher in hilly or mountainous areas, especially areas with historically active or inactive landslides and unstable slopes. Certain geologic formations, such as moderately consolidated sedimentary deposits, are more susceptible to landslides in the event of an earthquake. Saturated slopes in close proximity to the causative fault can also increase the likelihood of landslide hazards. Mandatory compliance with the existing building codes and construction standards established in the California Building Code would reduce seismic-related landslides to less than significant levels.

There is the potential for future development under the proposed General Plan to be significantly affected by earthquake-induced lateral spreading, which is the lateral displacement of gently sloping ground as a result of pore pressure build-up or liquefaction in a shallow underlying deposit during an earthquake. The geologic conditions conducive to lateral spreading (gentle surface slope, shallow water table, liquefiable cohesionless soils) are frequently found along streams and other waterfronts in recent alluvial or deltaic deposits.[7] Mandatory compliance with the existing building codes and construction standards established in the California Building Code would reduce seismic-related lateral spreading to less than significant levels.

Proposed General Plan Policies that Reduce the Potential Impact

Policy SE-1.1 Continue to investigate the potential for seismic and geologic hazards as part of the development review process and maintain this information for the public record. Update Safety Element maps as appropriate.

Policy SE-1.2 Require site specific geotechnical, soils, and foundation reports for development proposed on sites identified in the Safety Element and its Geologic and Hazard Maps as having moderate or high potential for ground failure.

Policy SE-1.3 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. All proposed development is subject to the City's Zoning Ordinance and Building Codes.

Policy SE-1.4 Prohibit development—including any land alteration, grading for roads and structural development—in areas of slope instability or other geologic concerns unless mitigation measures are taken to limit potential damage to levels of acceptable risk.

Policy SE-1.5 Design and improve all critical care facilities and services to remain functional following the maximum credible earthquake. Avoid placement of critical facilities and high-occupancy structures in areas prone to violent ground shaking or ground failure.

Policy SE-1.6 Work with San Mateo County, California Water Service Company, and the San Francisco Water Department to ensure that all water tanks and San Francisco's main water pipeline are capable of withstanding high seismic stress.

Policy SE-6.1 Regulate building construction practices to prevent hazardous structures and assure structural safety. Measures may include requiring conformance to an accepted set of construction standards, authorizing inspection of suspected dangerous structures, discontinuing improper construction activities, and eliminating hazardous conditions.

Policy SE-6.2 Support efforts to inform purchasers of existing buildings and structures that the City's building inspection services are available, upon request, to inspect structures, describe their condition and existing violations and provide construction history to the extent that such information is available.

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[7] Rauch, Alan F., 1997, "EPOLLS: An Empirical Method for Predicting Surface Displacements Due to Liquefaction-Induced Lateral Spreading in Earthquakes." http://scholar.lib.vt.edu/theses/available/etd-219182249741411/, accessed May 2012

Policy SE-6.4 Facilitate rehabilitation of hazardous structures through measures which offer financial as well as technical assistance.

Mitigation Measures

None required.

Impact 3.5-2

Future development under the proposed General Plan will not be significantly impacted by unstable geologic unit or soil. (*Less than Significant*)

Erosion hazards would be highest during construction activities. Construction activities such as excavation, backfilling, grading, and demolition can remove stabilizing vegetation and expose areas of loose soil that, if not properly stabilized during construction, can be subject to soil loss and erosion by wind and stormwater runoff. Short-term erosion during construction can result in sedimentation of downstream water bodies or undermine foundations. Poorly designed development projects can similarly result in long-term soil erosion hazards, potentially destabilizing building or roadway foundations due to sustained loss of underlying supporting soils.

As discussed in Section 3.8: Hydrology, Flooding, and Water Quality, proposed projects would be required to comply with NPDES General Construction Permit requirements. Project applicants would be required to prepare a Storm Water Pollution Prevention Plan (SWPPP) to minimize the discharge of pollutants, including silt and sediment, during construction. The SWPPP would include measures to control erosion and effectively manage runoff and retain sediment on-site during construction. Mandatory compliance with NPDES General Construction Permit requirements would reduce impacts related to geologic hazards to less than significant levels.

Areas at risk for landslides resulting from non-seismic events such as heavy rain are the same as those at risk for landslides caused by seismic events. For a discussion of landslide risk see Impact 3.5.1 above.

Subsidence is the downward settling of surface materials caused by natural or artificial removal of underlying support. Land subsidence would occur from one or more of several causes including withdrawal of fluids (oil, gas, or water) or the application of water to moisture-deficient unconsolidated deposits. Subsidence is a relatively slow process that may continue for several decades. Since there is no withdrawal of mineral resources within the city, the withdrawal of water by the City is heavily monitored, and the proposed General Plan does not involve widespread application of water to moisture-deficient unconsolidated deposits, the risk of subsistence is less than significant.

Proposed General Plan Policies that Reduce the Potential Impact

Proposed General Plan policies listed under Impact 3.5-1 help reduce the impact to less than significant levels.

Mitigation Measures

None required.

Impact 3.5-3

Future development under the proposed General Plan will not be significantly impacted by expansive soils. ***(Less than Significant)***

Due to the variability of soils in the city, it is possible that future development could be subject to soil expansion and settlement. Soils containing a high percentage of clays are generally most susceptible to expansion. If not properly engineered, loose, soft, soils composed of sand, silt, and clay have the potential to settle after a building or other load is placed on the surface. Differential settlement of loose soils would be a concern in areas that have not previously supported structures and where new structures would place loads heavier than the soils could tolerate.

Chapter 18A of the California Building Code regulates the allowable load-bearing values of various soil types while proposed General Plan policy requires review of development in areas vulnerable to expansive soils, and where necessary, the application of mitigation measures to lessen the impact. These regulatory and policy requirements reduce this potential impact to a less than significant level.

Proposed General Plan Policies that Reduce the Potential Impact

Proposed General Plan policies listed under Impact 3.5-1 help reduce the impact to less than significant levels.

Mitigation Measures

None required.