Appendix H:

Geotechnical Desktop Study

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DYETT & BHATIA
Urban and Regional Planners

Draft Geotechnical Desktop Study

Southeastern San Diego and Encanto Neighborhoods Community Plan Updates, City of San Diego
Project No. 386020
SCH No. 2014051075

Prepared for:
City of San Diego
Planning Department

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January 13, 2015

January 13. 2015

Josh Pollak, AICP
Dyett & Bhatia Urban and Regional Planners
755 Sansome Street, Suite 400
San Francisco, CA 94111

Subject: Draft Geotechnical Desktop Study
Southeastern San Diego and Encanto Neighborhoods Community Plan Updates
City of San Diego Project No. 386020

Dear Mr. Pollak,

The Bodhi Group has reviewed the geotechnical desktop study in support of the Southeastern San Diego and Encanto Neighborhoods Community Plan Update Programmatic EIR and found it to be satisfactory. The study summarizes the regional and local geology and focuses on the geologic hazards within the Community Plan Areas. This draft report addresses comments from the City of San Diego received in December 2014.

We appreciate this opportunity to provide our professional services. If you have any questions or require additional services, please do not hesitate to contact us.

Sincerely.

The Bodhi Group, Inc.

Jonathan Goodmacher, PG, CEG
Senior Geologist

Geotechnical Desktop Study
Southeastern San Diego and Encanto Community Plan Updates

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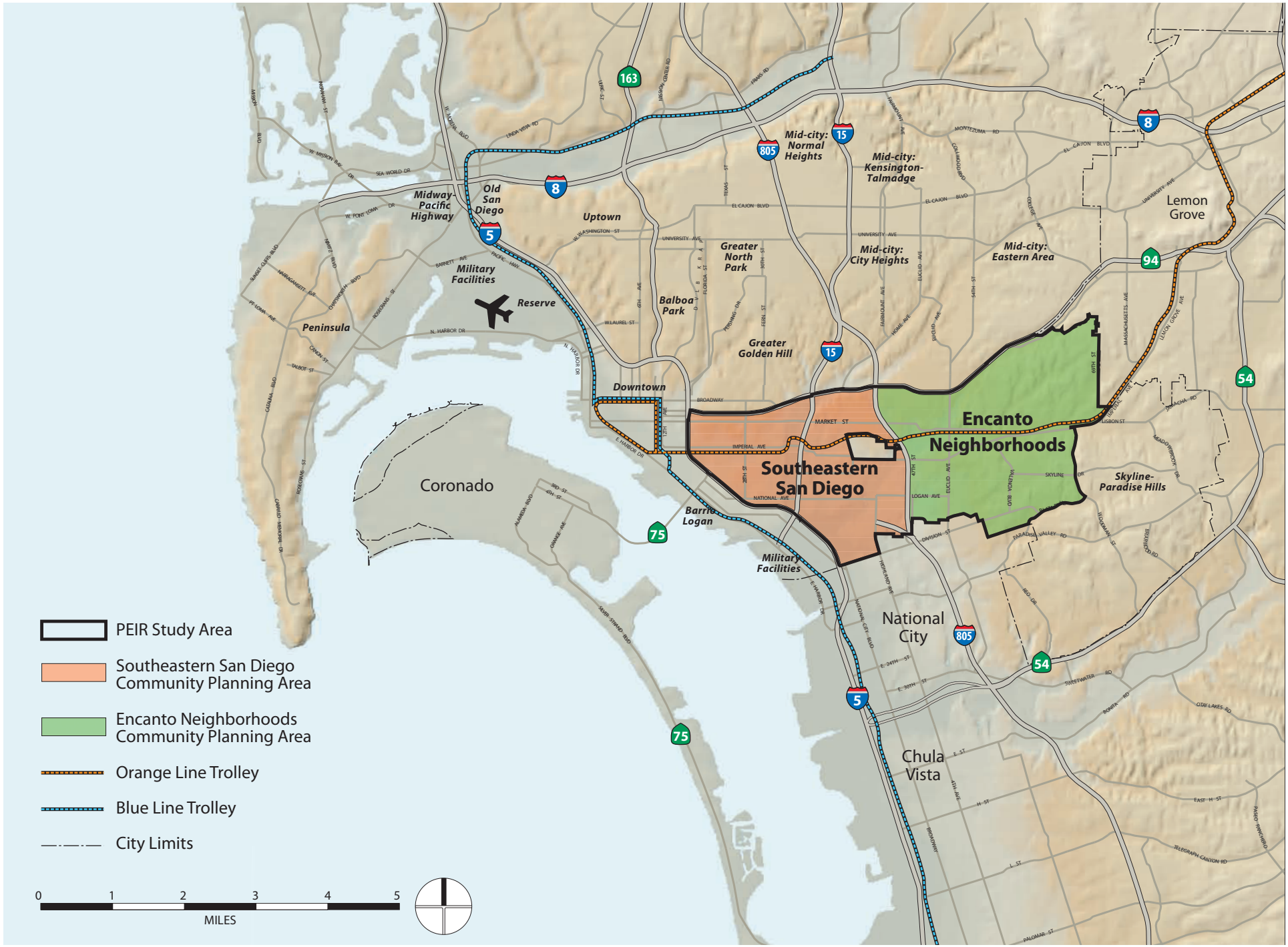
1. Introduction

This "desktop" geotechnical study evaluates the geological conditions underlying the Southeastern San Diego and Encanto Neighborhoods Community Planning Areas (**Figure 1:** Regional Location). The purpose of the evaluation is to summarize regional and local geologic conditions, focusing on hazards that might affect the proposed Southeastern San Diego and Encanto Neighborhoods Community Plan Updates.

This study was conducted using spatial analysis and review of existing documentation. It covers topics relevant to preliminary geotechnical reports as outlined by the City of San Diego's Guidelines for Geotechnical Reports, though at a more generalized level of detail than that required for a project-based study. Resources used to develop the technical study are: previous work conducted for the Southeastern San Diego Community Plan and Encanto Neighborhoods Community Plan existing conditions reports; the City of San Diego Seismic Safety Study; the City of San Diego General Plan; the San Diego County Multi-Jurisdictional Hazard Mitigation Plan; and, seismic and geologic hazard maps and tools provided by the California Department of Conservation and the United States Geological Survey (USGS). A list of references cited is included at the end of this report.

Figure 1: Regional Location



2. Proposed Project

The proposed project is an update to the Southeastern San Diego Community Plan, which was originally adopted in 1969, comprehensively updated in 1987, and has undergone several smaller amendments in the intervening years. As part of the update effort, the community plan area has been split into two smaller areas—the Southeastern San Diego and Encanto communities—to enable a more detailed focus on each community. Separate community plans are being prepared for each community: the Southeastern San Diego Community Plan Update and the Encanto Neighborhoods Community Plan (collectively referred to as the "CPUs"). The update will ensure consistency of the CPUs with and incorporate relevant policies from the 2008 City of San Diego General Plan (General Plan), as well as provide a long-range, comprehensive policy framework for growth and development in the two communities through 2035.

The proposed CPUs provide detailed neighborhood-specific land use policies and development regulations (zoning) that are consistent with city-wide zoning classifications, development design guidelines, and numerous other mobility and public realm guidelines, incentives, and programs to revitalize the urban core in accordance with the general goals stated in the General Plan. The proposed CPUs would additionally serve as the basis for guiding a variety of other actions, such as parkland acquisitions and transportation improvements. This report evaluates geologic conditions in both the Southeastern San Diego and Encanto Neighborhoods Planning Areas.

Southeastern San Diego

Under the Southeastern San Diego CPU the existing inventory of 15,204 housing units (as of 2012) could increase by 3,214 (21 percent) to a total of 18,418. Commercial, office, and industrial development is projected to increase by 36 percent, 30 percent, and 20 percent respectively (Dyett & Bhatia, 2014a). As outlined by Dyett & Bhatia (2014a) the goals of the Southeastern San Diego CPU are:

- A vibrant and pedestrian-oriented community that provides residential, commercial, office, institutional, industrial, and civic, including governmental, uses.
- A compatible mix of land uses that promote a healthy environment.
- Stable base sector employment uses and supportive commercial and industrial services
- A diverse mix of residential opportunities including affordable rental and market rate housing, senior and multi-generational housing, and small lot townhome development.

- Well-designed and aesthetically pleasing neighborhood and community-serving commercial and institutional uses to meet the daily needs of the residents.

- Special districts and villages to address the unique commercial needs of the community, including the Southeastern Village centered along the Commercial/Imperial Corridor. The eastern Commercial Street corridor is to remain industrial.

- A vibrant, pedestrian-oriented village with a mix of residential, commercial, industrial, and civic facilities for the enjoyment of community residents, with unique, local character.

- Preservation of the present employment opportunities in the community and increased opportunities through education.

- Make improvements to and stimulate investments in this area.

Encanto Neighborhoods

Under the Encanto Neighborhoods Community Plan a majority of the community is not anticipated to change significantly in land use or development intensity over the next 20 years. Heightened development potential for reuse or intensification over the next 20 years is targeted specifically along major transit corridors including Imperial Avenue, Euclid Avenue, Market Street, and 47th Street. (Dyett & Bhatia, 2014b). As outlined by Dyett & Bhatia (2014b) the goals of the Encanto Community Plan are:

- A mix of uses and development intensity that supports transit use within the designated community village area and promotes transit-oriented-development.
- A diverse mixture of residential opportunities including affordable rental and for sale housing, senior and multi- generational housing, and small lot townhome development.
- A vibrant and connected pedestrian- oriented community with unique, local character that provides higher density residential, commercial, office and civic uses within the village areas and along transportation corridors.
- A compatible mix of land uses that promote a healthy environment.
- Increased job opportunities, stable base sector employment uses, and supportive commercial and industrial services.
- Well-designed and aesthetically pleasing neighborhood and community-serving commercial and institutional uses that provide destinations and which meet the daily needs of the residents.
- Special districts and villages that address the unique commercial needs of the community including the Village at Market Creek and along Imperial Avenue.
- Preservation of existing historical resources, and a framework for identification and evaluation of historic properties.
- A community that understands and celebrates the important periods, events, themes,

and historical context of the neighborhood, including its history of ethnic diversity and community resiliency.

- Walkable, mixed-use development with integrated land use and mobility planning that encourages active modes of transportation, including wayfinding and designated routes for walking and biking.
- Collaboration with public health professionals and others to reduce undesirable health outcomes through neighborhoods that support healthy and active living.
- Convenient and equitable opportunities to obtain healthy foods and fresh fruits and vegetables in all neighborhood restaurants and markets, with safe and walkable routes to food retail opportunities.

3. Planning Area Description

Southeastern San Diego

The Southeastern San Diego Community Planning Area is located just east of Downtown San Diego, proximate to major employment and commercial centers in the South Bay and Downtown and linked to them by trolleys and buses. Southeastern San Diego encompasses approximately 2,930 acres, excluding 121 acres of unincorporated San Diego County land (Greenwood Cemetery). Southeastern San Diego lies south of State Route 94 (SR-94), between Interstate 5 (I-5) and Interstate 805 (I-805), and north of the city limits of National City. Neighborhoods contained in Southeastern San Diego include Sherman Heights, Grant Hill, Stockton, Mt. Hope, Logan Heights, Mountain View, Southcrest, and Shelltown. Several other community planning areas surround the Southeastern San Diego Community Planning Area: Golden Hill and City Heights to the north, Barrio Logan to the west, and Encanto Neighborhoods to the east. National City forms the southern border of the planning area.

Encanto Neighborhoods

The Encanto Neighborhoods Planning Area lies just east of the Southeastern San Diego community. It encompasses 3,811 acres and is located approximately five miles east of Downtown. It is bounded by SR-94 to the north and I-805 to the west. Specific neighborhoods in the community include Chollas View, Lincoln Park, Valencia Park, O'Farrell, Alta Vista, Encanto, and Broadway Heights. The Mid-City community is to the north of the planning area, and Skyline-Paradise Hills is to the southeast. The City of Lemon Grove defines the northeast boundary of the planning area roughly along 69th Street, while the City of National City defines the western half of the planning area's southern boundary. Plaza Boulevard marks the southern boundary to the east.

4. Physical Setting and Geology

TOPOGRAPHY

Southeastern San Diego

The Southeastern San Diego Community Planning Area's terrain is characterized by a series of terraces that rise from just a few feet above sea level to over 180 feet above sea level in the northeast. Within the planning area, these terraces have been cut by streams into three upland areas. The western portion of the community has a rolling appearance, and contains a prominent knoll at Grant Hill Park. The eastern portion of the community is divided from the western portion by the Main Branch of Chollas Creek, which roughly parallels Interstate 15. This portion has flatter terrain, descending from the lightly rolling highland area in the north to a relatively level area in the south near the confluence of the Main and South Branches of Chollas Creek. Elevations in Southeastern San Diego range from approximately 180 feet above mean sea level (MSL) at Mount Hope, in the northeastern part of the planning area, to approximately 40 feet MSL in the southwestern part of the planning area.

Encanto Neighborhoods

The Encanto Neighborhoods Community Planning Area is also characterized by a series of terraces, which build up toward steeper slopes and higher elevations in the east. The Chollas Creek drainage bisects the planning area into two topographically comparable northern and southern highland areas. Elevations range from approximately 100 feet above mean sea level (MSL) at Solola Avenue in the southwest portion to 460 feet MSL at 69th Street and Klauber Avenue in the northeast.

SURFACE WATER

Southeastern San Diego

Three creeks are present in the Southeastern San Diego Community Planning Area. The Main Branch of Chollas Creek flows to the south-southwest along Interstate 15 (I-15), and the South Branch of Chollas Creek flows southwesterly through the eastern portion of the planning area. The branches join just south of the planning area, and flow into San Diego Bay. Paleta Creek, which drains into the Seventh Street Channel, flows along the southern portion of the planning area. The natural channel and floodplain have been significantly altered by urban development, and in some sections the creeks have been culverted or covered. However, many creek segments, particularly along the South Branch, run through an undeveloped channel corridor. Certain reaches have intermittent flow, while other sections have water throughout the year.

Encanto Neighborhoods

There are three creeks present within or adjacent to the Encanto Neighborhoods Planning Area. The Emerald Hills and Encanto branches of Chollas Creek flow southwesterly and westerly across the eastern and central neighborhoods of the planning area. These branches join in the vicinity of Euclid Avenue and Market Street, and become the South Branch of Chollas Creek, which continues to the southwest and crosses under I-805 into the Southeastern San Diego community and on to San Diego Bay. Paleta Creek flows along the southern portion of the planning area toward Seventh Street Channel, and Paradise Valley Creek flows along part of Encanto's southern boundary. The natural channel and floodplain have been significantly altered by urban development, and in some sections the creeks have been culverted or covered. However, many creek segments, particularly along the South Branch, run through an undeveloped channel corridor. Certain reaches have intermittent flow, while other sections have water throughout the year.

GROUNDWATER

According to the Regional Water Quality Control Board (RWQCB) Water Quality Control Plan for the San Diego Basin (1994, amended 2011), the two planning areas are part of the Pueblo San Diego Hydrologic Unit (designated 8.00).

Southeastern San Diego

The Southeastern San Diego Community Planning Area is situated within the following hydrologic subareas and areas:

- Chollas Hydrologic Subarea (HSA) of the San Diego Mesa Hydrologic Area.
- El Toyan HSA within the National City Hydrologic Area and Pueblo San Diego Hydrologic Unit (on the south-central portion).

Based on the topography and site elevation groundwater in the Southeastern San Diego Community Planning Area is expected to occur at depths from 15 feet at the southwestern portion to greater than approximately 100 feet below ground surface (bgs) in the east. Based on the topography and direction of surficial water flow, the regional groundwater flow is expect to be west to southwest toward the San Diego Bay.

Encanto Neighborhoods

The Encanto Neighborhoods Community Planning Area is situated within the following hydrologic subareas and areas:

- Chollas Hydrologic Subarea (HSA) of the San Diego Mesa Hydrologic Area (on the northern portion).
- El Toyan HSA within the National City Hydrologic Area (on the south-central portion).
- Paradise HSA within the National City Hydrologic Area (on the southeastern portion).

Based on the topography and site elevation groundwater in the Encanto Neighborhoods Planning Area is expected to occur at depths greater than approximately 80 feet). Based on the topography and direction of surficial water flow, the regional groundwater flow is expect to be west to southwest toward the San Diego Bay.

GEOLOGY

Regional Geology

The project study area is situated in the western (coastal) portion of the Peninsular Ranges geomorphic province of southern California. The Peninsular Ranges province is one of 11 geomorphic provinces recognized in California. Each province displays unique, defining features based on geology, faults, topographic relief, and climate (California Geological Survey, 2002). The Peninsular Ranges encompass an area that roughly extends from the Transverse Ranges and the Los Angeles Basin, south to the Mexican border, and beyond another approximately 800 miles to the tip of Baja California (Norris and Webb, 1990; Harden, 1998). The geomorphic province varies in width from approximately 30 to 100 miles, most of which is characterized by northwest trending mountain ranges separated by subparallel fault zones. In general, the Peninsular Ranges are underlain by Jurassic-age metavolcanic and metasedimentary rocks and by Cretaceous-age igneous rocks of the southern California batholith. Geologic cover over the basement rocks in the westernmost portion of the province in San Diego County generally consists of Upper Cretaceous-, Tertiary-, and Quaternary-age sedimentary rocks. Structurally, the Peninsular Ranges are traversed by several major active faults. The Elsinore, San Jacinto, and the San Andreas faults are major active fault systems located northeast of San Diego and the Rose Canyon, San Diego Trough, Coronado Bank and San Clemente faults are major active faults located to the west-southwest. Major tectonic activity associated with these and other faults within this regional tectonic framework is generally right-lateral strike-slip movement. These faults, as well as other faults in the region, have the potential for generating strong ground motions in the project area. Further discussion of faulting relative to the site is provided in following sections of this report.

Geologic units, for each planning area, as mapped by the California Department of Conservation (2008) are described below and are shown in **Figure 2** (Southeastern San Diego Geology) and **Figure 3** (Encanto Neighborhoods Geology).

Figure 2: Southeastern San Diego Geology

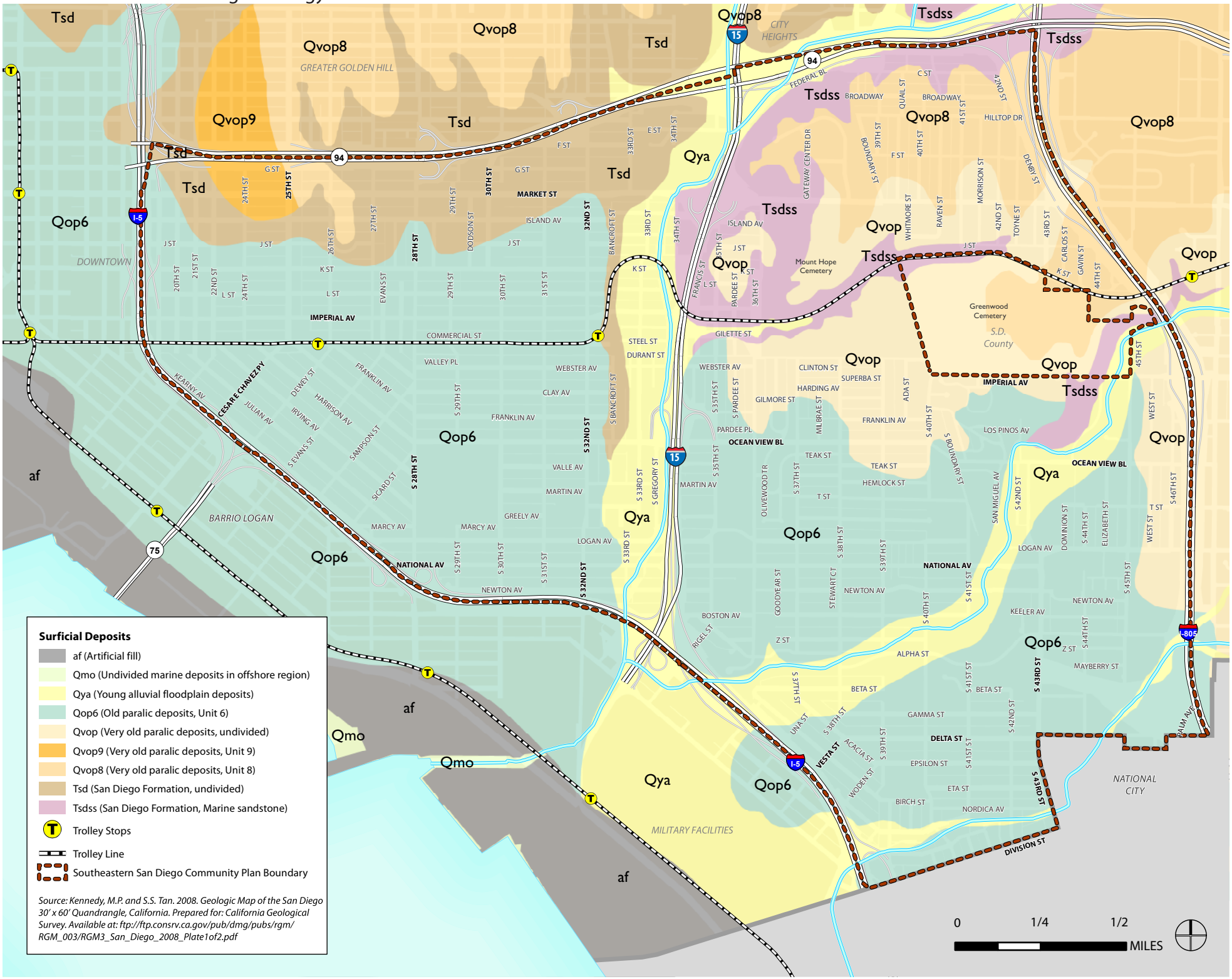
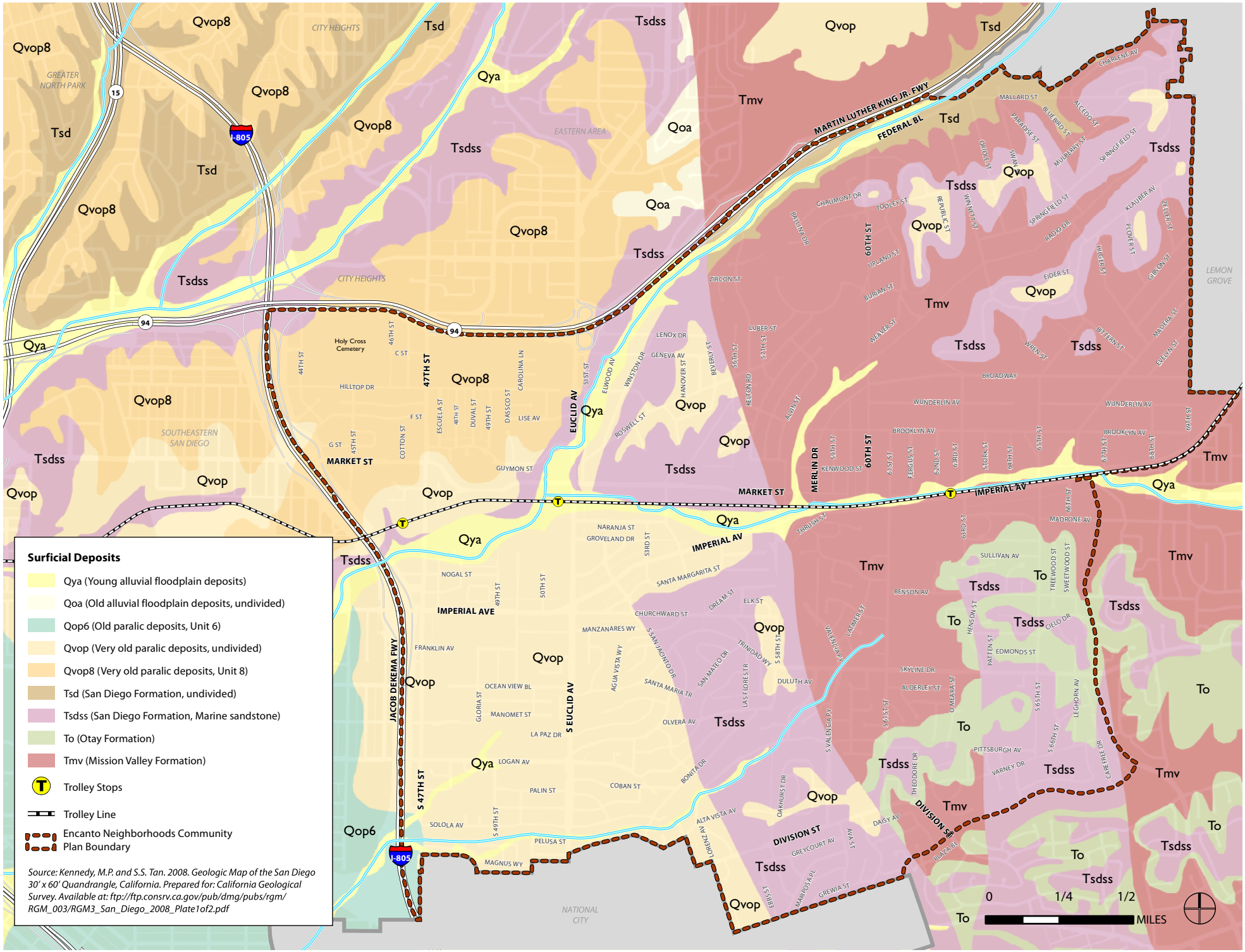


Figure 3: Encanto Neighhborhoods Geology



Southeastern San Diego

Based on the most recent regional geologic mapping (Kennedy and Tan, 2008), surficial geologic units in the Southeastern San Diego Planning Area include Young Alluvial flood-plain deposits, Old paralic deposits (Unit 6), Very old paralic deposits (undivided, Units 8 and 9), and San Diego Formation (undivided and marine sandstone).

Qya – Young alluvial flood-plain deposits (Holocene and late Pleistocene)

Young alluvial flood-plain deposits are characterized as poorly consolidated, poorly sorted, permeable flood-plain deposits of sandy, silty, or clay-bearing alluvium. These deposits overlay the planning area along the floodplains within a quarter-mile of both Chollas Creek (main stem) and South Branch Chollas Creek, as well as in smaller areas along the Seventh Street Channel.

Qop6 – Old paralic deposits, Unit 6 (late to middle Pleistocene)

Unit 6 of the old paralic deposits is characterized as poorly sorted, moderately permeable, reddish-brown, interfingered strandline, beach, estuarine, and colluvial deposits composed of siltstone, sandstone, and conglomerate. These deposits rest on the 22- to 24-meter Nestor terrace. They are found over a large portion of the planning area: south of Market Street west of Bancroft Street, and south of the trolley line east of I-15.

Qvop – Very old paralic deposits, undivided (middle to early Pleistocene)

These deposits of reddish-brown interfingered strandline, beach, estuarine, and colluvial deposits are composed of siltstone, sandstone, and conglomerate. They are poorly-sorted and moderately permeable, and rest on the now emergent wave cut abrasion platforms preserved by regional uplift. Undivided portions of these deposits are found in the northeast of the planning area, overlaying the marine sandstone of the San Diego Formation just north and south of the trolley line.).

Qvop9 – Very old paralic deposits, Unit 9 (middle to early Pleistocene)

Unit 9 of the very old paralic deposits is characterized as poorly sorted, moderately permeable, reddish-brown, interfingered strandline, beach, estuarine, and colluvial deposits composed of siltstone, sandstone, and conglomerate. These deposits rest on the 113- to 115-meter Linda Vista terrace. They are found in the northwest of the planning area, over a roughly six-block area surrounding Market Street between 21st and 25th streets.

Qvop8 – Very old paralic deposits, Unit 8 (middle to early Pleistocene)

Unit 8 of the very old paralic deposits is characterized as poorly sorted, moderately permeable, reddish-brown, interfingered strandline, beach, estuarine, and colluvial deposits composed of siltstone, sandstone, and conglomerate. These deposits rest on the 123- to 124-meter Tierra Santa terrace. They are found in the northeast of the planning area, north of the Greenwood and Mount Hope cemeteries, west of I-15.

Tsd – San Diego Formation, undivided (early Pleistocene and late Pliocene)

The San Diego Formation is characterized as predominantly yellowish-brown and gray, fine- to medium-grained, poorly indurated fossiliferous marine sandstone and reddish-brown transitional marine and non-marine pebble and cobble conglomerate, both divided and undivided. Undivided portions of the formation are exposed in the northwestern portion of the planning area, specifically along SR-94 west of I-15 and following the edge of the Chollas Creek floodplain along Bancroft Street.

Tsdss – San Diego Formation, marine sandstone (early Pleistocene and late Pliocene)

This predominantly yellowish-brown and gray, fine- to medium-grained, poorly indurated fossiliferous marine sandstone is part of the San Diego Formation. It is found in the northeastern portion of the planning area along the edge of the floodplain to the east of Chollas Creek, following the trolley line east of I-15, and along the floodplain to the west of South Branch Chollas Creek north of Ocean View Boulevard.

Encanto Neighborhoods

Based on the most recent regional geologic mapping (Kennedy and Tan, 2008), surficial geologic units in the Encanto Neighborhoods Planning Area include Young Alluvial flood-plain deposits, Old paralic deposits (Unit 6), Very old paralic deposits (undivided, Unit 8) overlying sedimentary rock from the San Diego (undivided and marine sandstone), Mission Valley, Otay, and San Diego Formations.

Qya – Young alluvial flood-plain deposits (Holocene and late Pleistocene)

Young alluvial flood-plain deposits are characterized as poorly consolidated, poorly sorted, permeable flood-plain deposits of sandy, silty, or clay-bearing alluvium. These deposits overlay the Planning Area along the floodplains within a quarter-mile of South Branch Chollas Creek, as well as in smaller areas along the Seventh Street Channel. Some deposits also branch from these waterways along the Chollas Radio Canyon and in the Southwest corner of the planning area.

Qop6 – Old paralic deposits, Unit 6 (late to middle Pleistocene)

Unit 6 of the old paralic deposits is characterized as poorly sorted, moderately permeable, reddish-brown, interfingered strandline, beach, estuarine, and colluvial deposits composed of siltstone, sandstone, and conglomerate. These deposits rest on the 22- to 24-meter Nestor terrace. They are found in a small portion of the planning area, in the southwest corner along I-805.

Qvop – Very old paralic deposits, undivided (middle to early Pleistocene)

These deposits of reddish-brown interfingered strandline, beach, estuarine, and colluvial deposits are composed of siltstone, sandstone, and conglomerate. They are poorly-sorted and moderately permeable, and rest on the now emergent wave cut abrasion platforms preserved by regional uplift. Undivided portions of these deposits are found throughout the planning

area, overlaying the marine sandstone of the San Diego Formation. Areas include a portion north of South Branch Chollas Creek west of Euclid Avenue, a portion east of Euclid Avenue north of the trolley line, in the vicinity of Valencia Parkway south of Imperial Avenue, and in the northeast of the Encanto neighborhood.

Qvop8 – Very old paralic deposits, Unit 8 (middle to early Pleistocene)

Unit 8 of the very old paralic deposits is characterized as poorly sorted, moderately permeable, reddish-brown, interfingered strandline, beach, estuarine, and colluvial deposits composed of siltstone, sandstone, and conglomerate. These deposits rest on the 123- to 124-meter Tierra Santa terrace. They are found in the northwest corner of the planning area, on the northern side of South Branch Chollas Creek.

Tsd – San Diego Formation, undivided (early Pleistocene and late Pliocene)

The San Diego Formation is characterized as predominantly yellowish-brown and gray, fine- to medium-grained, poorly indurated fossiliferous marine sandstone and reddish-brown transitional marine and non-marine pebble and cobble conglomerate, both divided and undivided. Undivided portions of the formation are exposed along the northern border of the planning area, overlaying the Mission Valley Formation along South Branch Chollas Creek.

Tsdss – San Diego Formation, marine sandstone (early Pleistocene and late Pliocene)

This predominantly yellowish-brown and gray, fine- to medium-grained, poorly indurated fossiliferous marine sandstone is part of the San Diego Formation. It is exposed throughout the planning area: running north-south through the center, in the west along South Branch Chollas Creek, overlaying the Mission Valley Formation in the northeast corner, and overlaying the Otay Formation in the southeast.

To – Otay Formation (late Oligocene)

The Otay Formation is characterized as light gray and light-brown, medium- and coarse-grained, non-marine arkosic sandstone intertongued with light-brown siltstone and light-gray claystone. Much of the claystone is composed of light-gray bentonite that occurs in beds up to one meter in thickness. The Otay Formation is exposed in the southeast of the planning area, in the vicinity of the South Encanto neighborhood.

Tmv – Mission Valley Formation (middle Eocene)

The Mission Valley Formation is characterized as predominantly light olive-gray, soft and friable, fine- to medium-grained marine and non-marine sandstone containing cobble conglomerate tongues. It is a source of both mammalian and molluscan remains. It is exposed predominantly in the eastern half of the planning area, where it is the dominant geologic unit.

5. Geologic Hazards

Southern California is one of the most seismically active regions in the United States, with numerous active faults and a history of destructive earthquakes. Portions of the City of San Diego are located above active strands of the Rose Canyon Fault. Other active faults in the region include the San Andreas, San Jacinto, Elsinore, Coronado Bank, San Clemente, and San Diego Trough faults.

The City of San Diego Seismic Safety Study documents the city's known and suspected geologic hazards and faults. The 2008 updated Seismic Safety Study maps potential hazards and rates them by relative risk, on a scale from nominal to high. The Seismic Safety Study is intended as a tool to determine the level of geotechnical review to be required by the City for planning, development, or building permits.

Geologic and seismic hazards, as mapped by the City of San Diego (2008), are depicted for each planning area in **Figure 4** (Southeastern San Diego Geological Hazards) and **Figure 5** (Encanto Neighborhoods Geological Hazards).

Figure 4: Southeastern San Diego Geological Hazards

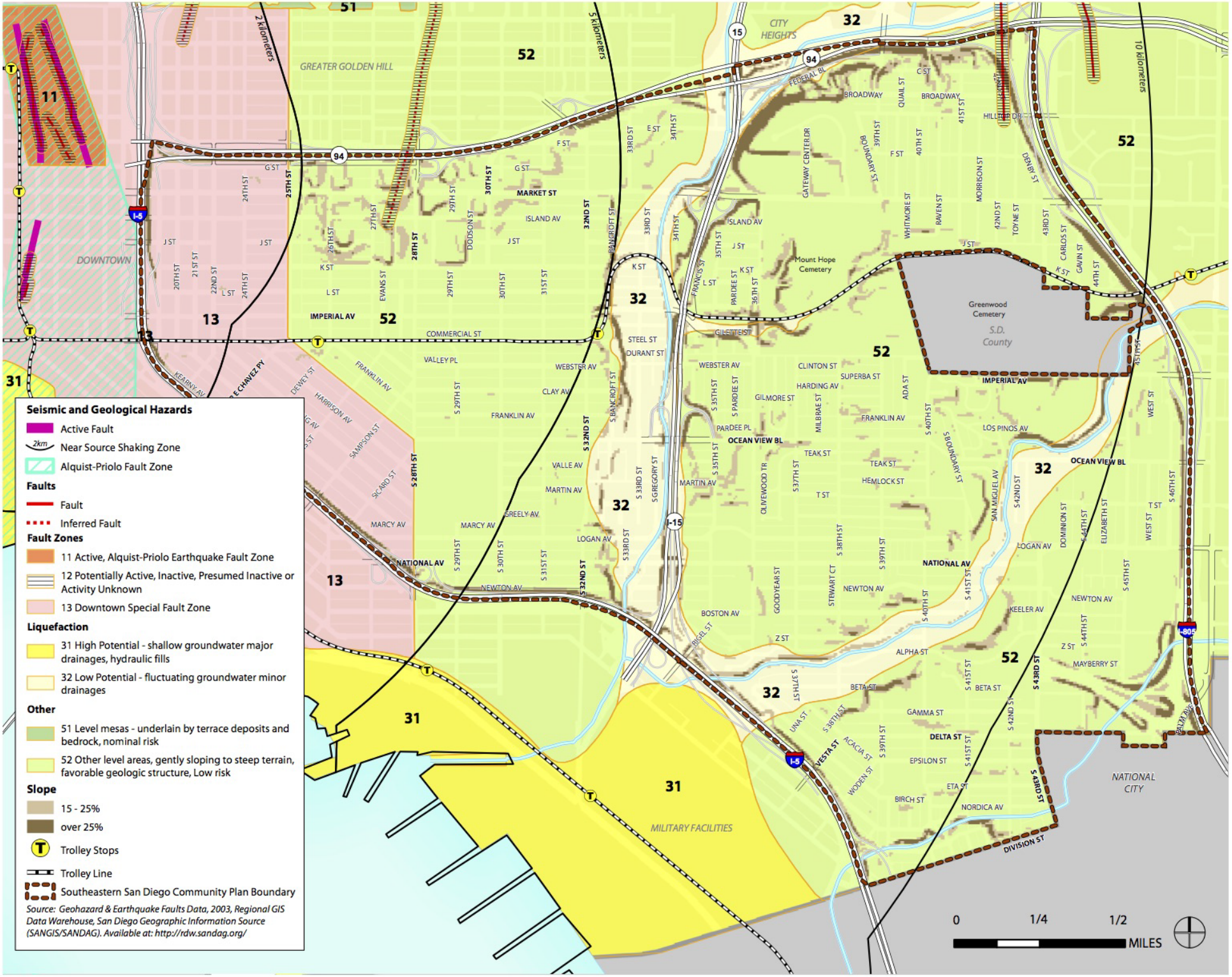
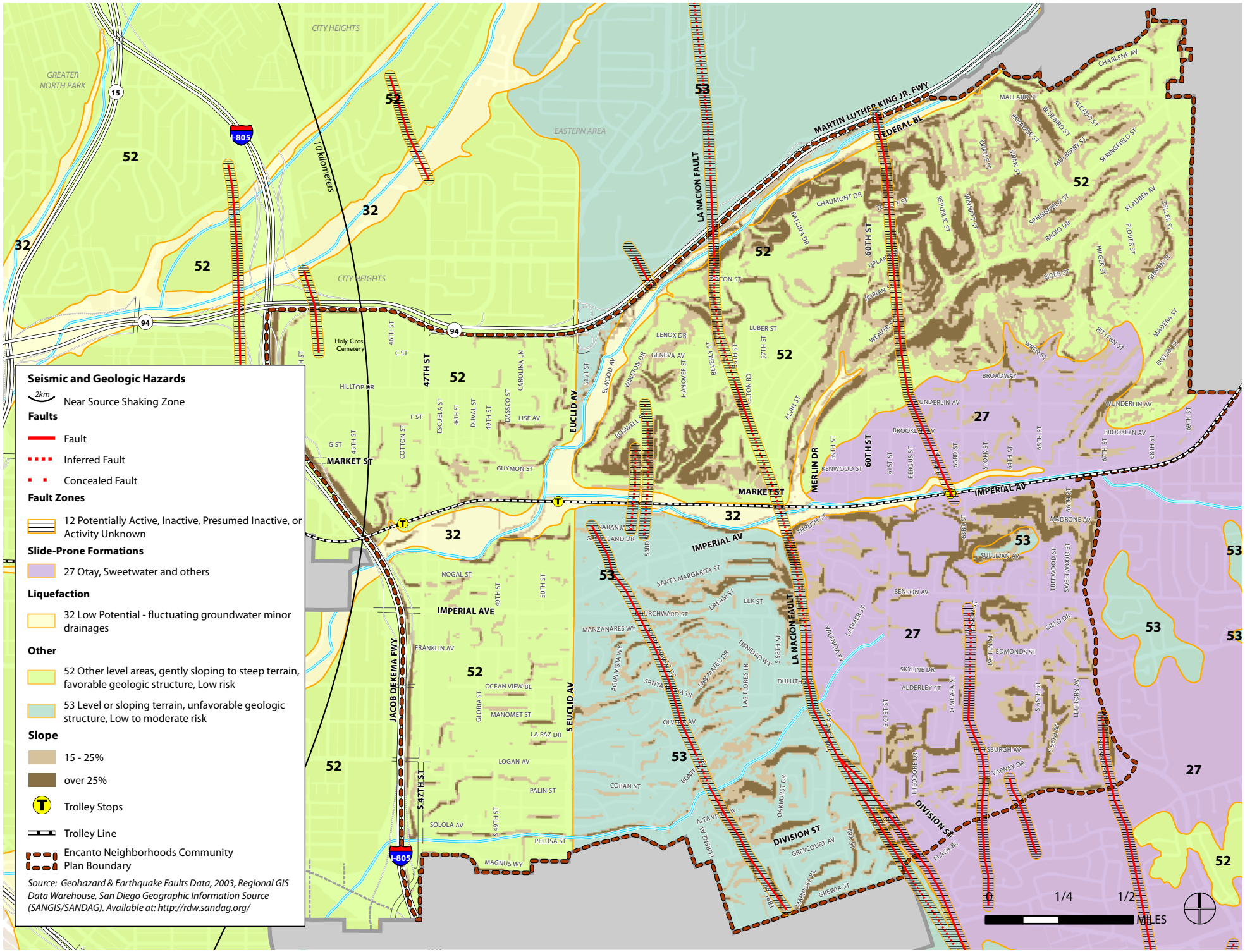


Figure 5: Encanto Neighborhoods Geological Hazards



SEISMICITY

An active fault is defined by the State Mining and Geology Board as one which has experienced surface displacement within the Holocene epoch, approximately the last 11,000 years (California Geological Survey, 2007). There are no known active faults within either planning area, though both are subject to potential ground shaking due to activity along faults located nearby. The Rose Canyon Fault, an active fault located west of the planning areas in San Diego, is capable of producing a magnitude 7.2 earthquake (Cao et al, 2003). Portions of the Elsinore and San Jacinto Fault zones, located east of San Diego, have the capacity to produce earthquakes at maximum magnitudes from 6.4 to 7.2 (Cao et al, 2003). Active faults underlie parts of downtown San Diego, and include associated Earthquake Fault Zone areas (California Geological Survey, 2003).

Ground shaking during an earthquake can vary depending on the overall magnitude, distance to the fault, focus of earthquake energy, and the type of geologic material underlying the area. The composition of underlying soils, even those relatively distant from faults, can intensify ground shaking. Areas that are underlain by bedrock tend to experience less ground shaking than those underlain by unconsolidated sediments such as artificial fill or unconsolidated alluvial fill. Both of the planning areas are subject to ground shaking hazards caused by earthquakes on regional active faults.

Based on a Probabilistic Seismic Hazards Ground Motion Interpolator provided by the California Department of Conservation (2008), the planning areas are located in a zone where the horizontal peak ground acceleration having a 10 percent probability of exceedance in 50 years ranges from 0.2 g (where g represents the acceleration of gravity) to 0.3g. Within the Southeastern San Diego Community Planning Area, the tool estimates peak ground acceleration ranging from 0.24g to 0.26g. Within the Encanto Neighborhoods Community Planning Area, the tool estimates peak ground acceleration around 0.24g. In both areas, the higher values tend to occur towards the west and lower values tend to occur towards the east.

SURFACE RUPTURE

Surface rupture is the result of movement on an active fault reaching the surface. Active faults are not mapped as occurring within either CPU area. However, as discussed below the western portion of the Southeastern San Diego Community Planning Area is immediately east of the mapped, active Rose Canyon Fault. In addition, there are several faults that are mapped as being potentially active by the City of San Diego (City of San Diego, 2008).

Southeastern San Diego

As noted, the Southeastern San Diego Community Planning Area is located directly east of mapped active faults located in Downtown San Diego. Further, the western portion of this area is within the City of San Diego Downtown Special Fault Zone (Hazard Category 13). The affected portions extend into the planning area as far east as 25th Street north of the trolley line, Ocean View Boulevard south of the trolley line to 28th Street, and 28th Street

south of Ocean View Boulevard. The risk of surface rupture due to faulting in the areas within the Downtown Special Fault Zone is moderate to high.

In addition, there are unnamed faults projecting generally north-northeast that are mapped as being "Potentially Active, Presumed Inactive, or Activity Unknown" by the City of San Diego (2008). Faults of this type are given the Hazard Category designation 12. One fault extends into the planning area between 27th and 28th Streets as far south as approximately "J" Street and another one is at the eastern end of the Southeastern Community Planning Area. The locations of these faults are shown on Figure 4. In our opinion, the probability of surface rupture due to faulting in areas given the Hazard Category designation 12 is low.

Encanto Neighborhoods

Within the Encanto Neighborhoods planning area there are several faults designated by as being "Potentially Active, Presumed Inactive, or Activity Unknown" by the City of San Diego (2008). As noted above, these are given the Hazard Category designation 12. Within the Encanto Neighborhoods planning area these faults trend generally northward. The most prominent of these faults is the La Nacion Fault. It extends entirely through the planning area from near Division Street, on the south, to Federal Boulevard, on the north. The other faults mapped by the city are unnamed but may be considered as subsidiary strands of the La Nacion Fault system. The locations of these faults are shown on Figure 5. In our opinion, the probability of surface rupture due to faulting in areas given the Hazard Category designation 12 is low.

LIQUEFACTION

Liquefaction is a phenomenon whereby unconsolidated and/or near-saturated soils lose cohesion as a result of severe vibratory motion. The relatively rapid loss of soil shear strength during strong earthquake shaking results in temporary, fluid-like behavior of the soil. Soil liquefaction causes ground failure that can damage roads, pipelines, underground cables, and buildings with shallow foundations. Research and historical data indicate that loose granular soils and non-plastic silts that are saturated by a relatively shallow groundwater table are susceptible to liquefaction.

Among the potential hazards related to liquefaction are seismically induced settlement and lateral spread. Seismically induced settlement is caused by the reduction of shear strength due to loss of grain-to-grain contact during liquefaction, and may result in dynamic settlement on the order of several inches to several feet. Lateral spreading of the ground surface during an earthquake usually takes place along weak shear zones that have formed within a liquefiable soil layer. Lateral spreading has generally been observed to take place in the direction of a free-face (i.e., retaining wall, slope, channel, etc.) but has also been observed to a lesser extent on ground surfaces with gentle slopes. An empirical model developed by Bartlett and Youd (1995, revised 1999) is typically used to predict the amount of horizontal ground displacement within a site. For sites located in proximity to a free-face, the amount of lateral ground displacement is strongly correlated with the distance of the site from the free-face. Other factors such as earthquake magnitude, distance from the earthquake epicenter,

thickness of the liquefiable layers, and the fines content and particle sizes of the liquefiable layers will also affect the amount of settlement or lateral ground displacement.

Southeastern San Diego

Portions of the Southeastern San Diego Community Planning Area along the Main and South Branches of Chollas Creek, accounting for about 360 acres or 12 percent of the planning area. The City of San Diego has designated these portions of the community planning area as being within Geologic Hazard Category 32. These areas are considered to have some liquefaction potential due to fluctuating groundwater or minor drainages. However, the city has indicated that the risk is low.

Encanto Neighborhoods

Similarly, portions of the Encanto Neighborhoods Community Planning Area along the South Branch and the Emerald Hills and Encanto branches of Chollas Creek, accounting for about 178 acres or five percent of the planning area, are considered to have some liquefaction potential due to fluctuating groundwater or minor drainages. The City of San Diego has designated these portions of the community planning area as being within Geologic Hazard Category 32. These areas are considered to have some liquefaction potential due to fluctuating groundwater or minor drainages. However, the city has indicated that the risk is low.

SLOPE INSTABILITY

Steep slopes can introduce the risk of landslides or slope failure. Slope failure is dependent on topography and underlying geologic materials, as well as factors such as rainfall, excavation, or seismic activities that can precipitate slope instability. Earthquake motions can induce significant horizontal and vertical dynamic stresses along potential failure surfaces within a slope.

Southeastern San Diego

The Southeastern San Diego Community Planning Area includes some steep (15 percent or greater) slopes in the Sherman Heights, Grant Hill, and Stockton neighborhoods. Slopes of over 25 percent are found near the I-15 and I-94 interchange, in and near the Mount Hope Cemetery, and in some areas around Chollas Creek, the freeways, and Grant Hill. The City of San Diego has designated elevated portions of this community planning area as being within Geologic Hazard Category 52. These areas are relatively level, have low topographic relief and are considered to consist of gently sloping to steep terrain, with favorable geologic structure and, hence, are at low risk.

Encanto Neighborhoods

The Encanto Neighborhood Community Planning Area includes a significant amount of very hilly topography, especially in the northeastern part of the Encanto neighborhood, and on both sides of Imperial Avenue (which follows the canyon through which the Encanto branch of Chollas Creek flows).

Though steep slopes are more widespread, only the southeastern part of the planning area, generally east of Valencia Parkway and south of Broadway, is considered by the Development Services Department to have underlying geology that produces a slide-prone formation. This area covers an estimated 917 acres, or 24 percent of the planning area. The City of San Diego has designated elevated portions of this community planning area as being within Geologic Hazard Categories 52 and 53. Areas designated with Category 52 have low topographic relief and are considered to consist of gently sloping to steep terrain, with favorable geologic structure and, hence, are at low risk. Areas designated with Category 53 have level to sloping to steep terrain, unfavorable geologic structure and, hence, are at low to moderate risk.

TSUNAMI, SEICHES, AND DAM FAILURE

A tsunami is a sea wave generated by a submarine earthquake, landslide, or volcanic action. Submarine earthquakes are common along the edge of the Pacific Ocean, thus exposing all Pacific coastal areas to the potential hazard of tsunamis. Tsunami inundation hazards for the planning areas are mapped on the National City Quadrangle of the Tsunami Inundation Map for Emergency Planning (California Emergency Management Agency, 2009). No portion of either planning area is mapped in the anticipated tsunami inundation area.

A seiche is an earthquake-induced wave in a confined body of water, such as a lake, reservoir, or bay. San Diego Bay lies within a mile of the Southeastern San Diego Community Planning Area, and just over two miles from the Encanto Neighborhoods Community Planning Area. According to the Safety Element (2005) for nearby Coronado, seiches have historically not been known to have caused damage beyond San Diego Bay's shoreline. Another study for the Coronado Yacht Club (Geotechnics, 2007) has stated that the natural period of the San Diego Bay is often considered to be too long to develop an earthquake-induced seiche.

An earthquake-induced dam failure can result in a severe flood event. When a dam fails, a large quantity of water is suddenly released with a great potential to cause human casualties, economic loss, lifeline disruption, and environmental damage. Based on review of the 2010 San Diego County Multi-Jurisdictional Hazard Mitigation Plan Dam Failure map, neither planning area is within a dam inundation area.

OTHER CONDITIONS

Within the two planning areas, other potential geological hazards including soil erosion, expansive soils, settlement and/or subsidence due to unstable soil. These issues may require further study.

The potential for soil erosion is variable throughout the two community planning area. Erosion is most likely on sloped areas with exposed soil, especially where unnatural slopes are created by cut-and-fill activities. However, the potential for soil erosion is reduced once the soil is graded and covered with concrete, structures, or asphalt.

Expansive soils are characterized significant volume changes (shrink or swell) due to variations in moisture content. Expansion of the soil may result in unacceptable settlement or

heave of structures or concrete slabs supported on grade. Changes in soil moisture content can result from precipitation, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors. Soils with a relatively high fines content (clays dominantly) are generally considered expansive or potentially expansive. However, if required, measures (including capping or replacement, special grading techniques, or chemical treatment of expansive soils) can mitigate these problems for any new development or redevelopment projects.

Unstable soil conditions can lead to settlement and/or subsidence of structures or the earth's surface. Such conditions are often encountered in areas of loose, surficial soils (e.g. within young alluvial deposits or fills that were placed without engineering supervision). However, if required, measures (including capping or replacement, special grading techniques, or special foundations) can mitigate these problems for any new development or redevelopment projects.

6. Conclusions

Updates to the Southeastern San Diego Community Plan will not have direct or indirect significant environmental impacts regarding geologic hazards in either of the planning areas. The majority of land in the two planning areas has been categorized by the City of San Diego (2008) as having Low Risk to geologic hazards. Proposed land use changes in areas of Moderate Risk are not anticipated to cause significant impacts due to State and local development regulations. Additionally, the updated CPUs contain a number of safety and conservation policies that seek to mitigate safety hazards and improve the stability of urban landforms and other natural features.

Seismic Shaking and Liquefaction Hazards

All new development and redevelopment would be required to comply with the current adopted California Building Code (CBC), which includes design criteria for seismic loading and other geologic hazards, including design criteria for geologically induced loading that govern sizing of structural members and provide calculation methods to assist in the design process. Thus, while shaking impacts could be potentially damaging, they would also tend to be reduced in their structural effects due to CBC criteria that recognize this potential. The CBC includes provisions for buildings to structurally survive an earthquake without collapsing and includes measures such as anchoring to the foundation and structural frame design.

As noted, portions of each of the planning areas have been designated as being within Hazard Category 32 and are, therefore, considered to be at low risk to damage from liquefaction-related hazards. All new development and redevelopment in these areas would be required to comply with City of San Diego requirements regarding mitigation by grading or special foundations to mitigate liquefaction hazards (if encountered during a site-specific geotechnical evaluation).

Surface Rupture

As noted, portions of the two planning areas include zones with City of San Diego Hazard Categories 12 and 13. All new development and redevelopment in areas mapped by the City of San Diego as being within Hazard Category 13 will require a site-specific fault rupture hazard study (City of San Diego, 2011). In addition, the city may require similar studies for new development and redevelopment for areas designated with Hazard Category 12. These studies would mitigate any potential surface rupture hazards.

Slope Instability

As noted, portions of the two planning areas include zones with City of San Diego Hazard Categories 52 and 53. Areas designated as being within Hazard Category 52 have low topographic relief, which minimizes slope stability hazards or erosion. Areas designated as

being with Hazard Category 53 are considered to be at low to moderate risk to slope failure due to unfavorable geologic structure or slide-prone geologic formations.

Regardless of hazard category designation slopes steeper than 2:1 (horizontal: vertical) and higher than 8 feet may be subject to erosion, or instability due to adverse drainage or geologic structure and will require site-specific geotechnical evaluations to assess slope stability.

Proposed Safety and Conservation Policies

Policies proposed in the Community Plans serve to mitigate adverse impacts from geological hazards on future development in the planning areas. Policies in the Geologic and Seismic Hazard sections of each community plan direct future development to implement all applicable seismic safety development requirements for areas subject to surface fault rupture, liquefaction, slope instability and requires the City to work with developers to ensure that seismically hazardous areas are reserved as open space where development cannot take place. Conformance to the standards and conditions established by the City of San Diego will mitigate geologic hazards to currently accepted levels.

The Conservation and Sustainability chapters of each community plan also establish policies to preserve the stability of the city's landforms, particularly regarding erosion and siltation around each planning area's water features, as well as erosion in the city's open spaces. Policies related to urban runoff and forestry also serve to prevent erosion and improve the stability of developed areas.

Further Geotechnical Study

Geologic conditions identified during this study that may impact development include poorly consolidated surficial deposits such as the young alluvial deposits surrounding the planning areas' creeks, exposure to the Downtown Special Fault Zone in the eastern portion of the Southeastern San Diego Community Planning Area, and potential slide-prone formations in the southeastern Encanto neighborhoods. Regardless, any future projects in these areas will require more intensive geotechnical investigation per the City's guidelines for geotechnical study. Additionally, though no landslide risk has been identified within either planning area, many of the present geologic units are sedimentary in nature and may be subject to erosion unless protected.

7. Limitations

The purpose of this study was to evaluate geologic and geotechnical conditions within the planning areas and to provide a geotechnical reconnaissance report to assist in the preparation of environmental impact documents for the project. Comprehensive geotechnical evaluations, including subsurface exploration and laboratory testing, should be performed prior to design and construction of structural improvements. Any future projects on individual sites in the planning areas will therefore require site-specific geotechnical study as required by State and City regulations.

As this report represents a review of existing documentation on geotechnical conditions of the planning areas rather than in-depth on-site investigation, it cannot account for variations in individual site conditions or changes to existing conditions. The geotechnical analyses presented in this report have been conducted in accordance with current engineering practice and the standard of care exercised by reputable geotechnical consultants performing similar tasks in this area. No warranty, implied or expressed, is made regarding the conclusions, recommendations, and professional opinions expressed in this report. Our preliminary conclusions and recommendations area based on an analysis of the referenced background information.

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