Appendix D

Desktop Geotechnical and Geologic Hazard Evaluation

Desktop Geotechnical and Geologic Hazard Evaluation
Kearny Mesa Community Plan Update
San Diego, California

Prepared For:
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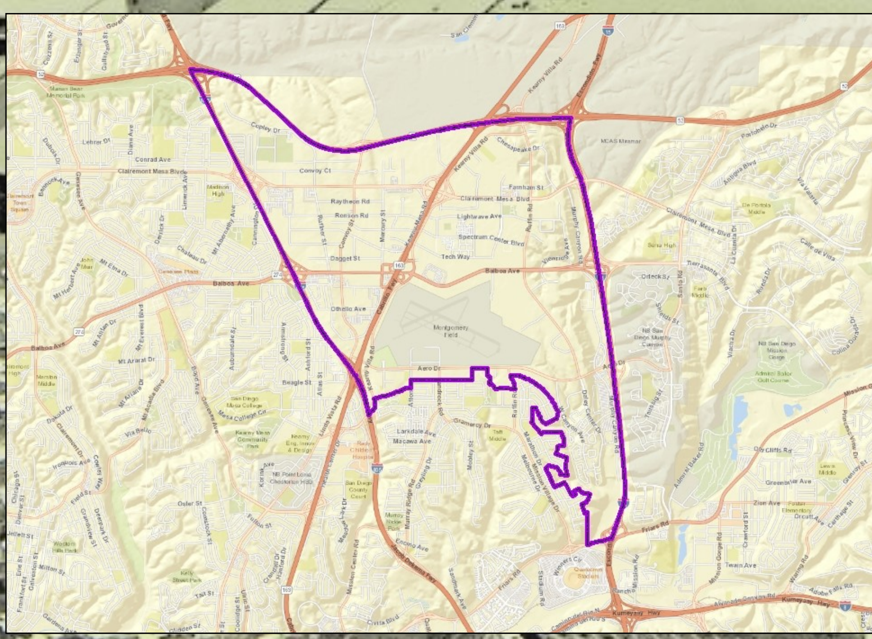

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Ms. Joanne Dramko
HELIX Environmental Planning, Inc.
7578 El Cajon Blvd.
La Mesa, CA 91942

Subject: Desktop Geotechnical and Geologic Hazard Evaluation
Kearny Mesa Community Plan Update
San Diego, California

Dear Ms. Dramko,

We are pleased to submit our Geotechnical and Geologic Hazard Study report. The report was prepared in support of the Kearny Mesa Community Plan Update and identifies geotechnical and geologic hazards within the Kearny Mesa Plan area and the significance of these hazards to existing and future land uses in the Plan area.

Respectfully submitted,

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EXECUTIVE SUMMARY

This Geotechnical and Geologic Hazard Evaluation (Study) identifies geotechnical and geologic hazards that could have potentially adverse effects on manmade improvements within the Kearny Mesa Community Plan Update (KMCPU) area (Study Area). For this study, we reviewed relevant geologic maps and guidelines published by the City of San Diego, State of California, and the United States Geologic Survey. In-house resources were also reviewed. We have also incorporated answers to comments and questions from Mr. Jim Quinn, Senior Engineering Geologist of the City of San Diego in an e-mail dated May 31, 2018, entitled “Kearny Mesa Community Plan Update EIR Technical Studies (PTS 607857).

A summary of the geology and geologic hazards is provided below.

- In increasing order of age, soils in the Study Area consist of artificial fill (both documented and undocumented), young alluvium, Very old paralic deposits (Units 8, 8a, and 9), and formational materials of the Mission Valley Formation, Stadium Conglomerate, and the Friars Formation. Undocumented fill, and young alluvium may be subject to consolidation under additional fill or structural loads. The other geologic formations are well consolidated to well cemented and will support most fill and structural loads. The formational materials contain layers of cemented sandstone, gravel and cobbles which may be difficult to excavate and may impact excavations like basements or underground utility trenches.
- The Study Area is not underlain by active or potentially active faults. The closest known active fault is the Rose Canyon Fault, which is located approximately 4 miles southwest of Kearny Mesa. The Study Area, like the rest of San Diego, is in a region of active faults and will be subject to strong ground motion in the event of an earthquake on these faults.
- Liquefaction occurs in soft, saturated soil during moderate to severe ground shaking during earthquakes. According to City of San Diego maps, most of the lower elevation portions of the Study Area (areas close to the bottom of Murphy Canyon and San Clemente Canyon) are defined as having a high potential for liquefaction.
- Landslide hazards are mapped both by the State of California and the City of San Diego. Both the State and City of San Diego show the slopes along the west side of Murphy Canyon to be potentially unstable. While no landslides are mapped in the area, the steeper slopes underlain by weak soil and formational material and are believed to be marginally stable. The mesa area, however, does not contain steep slopes and is not susceptible to landslide hazards according to the City of San Diego.
- Most the Study Area consists of soils that range from medium to highly expansive in nature. Expansive soil can adversely affect structures and pavements.
- Potentially corrosive soils may be present in some localized areas on the mesa.
- Infiltration rates for at grade soil will be affected by shallow impermeable formational material and soil types. In general, the earth materials within 10 feet of the current ground surface will have poor infiltration characteristics.

The geologic hazards identified above, that are encroached by planned development in the Study Area, can be mitigated through avoidance or by engineering design in accordance with established State of California and City of San Diego requirements and codes. There are no policies or recommendations of the KMCPU that will have a direct or indirect significant environmental effect with regards to geologic hazards. The proposed land uses are compatible with the known geologic hazards. Storm water infiltration into soils may be limited and alternative systems like bioswales or bioretention basins may be needed.

Geotechnical investigations are recommended for any construction adding additional loads to soils within 25 feet of the top of slopes exceeding 10 feet in height or on undocumented fills. This recommendation supersedes the exemptions discussed in The City of San Diego Information Bulletin 515; "Geotechnical Study Requirements" (2016).

1. INTRODUCTION

The Bodhi Group has completed a Geotechnical and Geologic Hazards Study (Study) of the Kearny Mesa Community Plan Update area (Study Area). The Study was performed at a California Environmental Quality Act (CEQA) level for the Study Area. This report presents the results of our "desktop" evaluation of the geotechnical and geologic hazards potentially affecting the Study Area. The purpose of our evaluation was to identify geotechnical and geologic conditions or hazards that might affect future development and/or redevelopment within the Study Area. The following services were provided:

- Reviewed relevant published geologic information including; State of California-issued geologic and hazard maps, the City of San Diego Seismic Safety Study Geologic Hazards and Faults maps, and the City of San Diego Guidelines for Geotechnical Reports.
- Reviewed and summarized regional and local geology and identified potential geotechnical and geologic hazards.
- Researched and identified relevant geologic hazards listed in the "Guidelines for Geologic/Seismic Consideration in Environmental Impact Reports," California Geological Survey (California Division of Mines and Geology) Note 46 and "Guidelines for Preparing Geologic Reports for Regional-Scale Environmental and Resource Management Planning," California Geological Survey (California Division of Mines and Geology) Note 52, as amended or updated.
- Researched other City and County resources, and our in-house library of historical vertical aerial photographs, geotechnical and geological hazards such as faulting, seismicity, liquefiable soils, etc.
- Prepared this technical report that identifies geotechnical and geologic hazards. Included in this report is a location map (Figure 1), a map of the regional and Study Area geology showing distribution of surficial deposits and geologic units (Figure 2); a map of the active regional faults in southern California (Figure 3); a map showing the inclination of slopes in the Study Area (Figure 4); a map showing the distribution of U.S. Department of Agriculture (USDA) soils in the Study Area (Figure 5) and a geologic hazards map identifying areas susceptible to the potential geologic hazards described in this report (Figure 6).

1.1. Significant Assumptions

Documentation and data provided by the client or from the public domain, and referred to in the preparation of this study, are assumed to be complete and correct and have been used and referenced with the understanding that the Bodhi Group assumes no responsibility or liability for their accuracy. The conclusions contained herein are based upon such information and documentation. Because Study Area conditions may change and additional data may become available, data reported and conclusions drawn in this report are limited to current conditions and may not be relied upon on a significantly later date or if changes have occurred at the Study Area.

Reasonable CEQA-level efforts were made during the Study to identify geologic hazards. "Reasonable efforts" are limited to information gained from information readily-accessible to the public. Such methods may not identify Study Area geologic or geotechnical issues that are not listed in these sources. In the preparation of this report, the Bodhi Group has used the degree of care and skill ordinarily exercised by a reasonably prudent environmental professional in the same community and in the same time frame given the same or similar facts and circumstances. No other warranties are made to any third party, either expressed or implied.

2. PROJECT LOCATION AND DESCRIPTION

The Study Area comprises approximately 4,423 acres and is near the geographic center of the City of San Diego. The Study Area is generally bound to the north by State Route 52 (SR-52), to the west by Interstate 805 (I-805) and to the east by Interstate 15 (I-15). The southern portion of the Study Area consists of properties south of Aero Drive and properties adjacent to the west side of I-15 that extend from Aero Drive southward to Friars Road (Figure 1). Topographically, most of the Study Area is situated on a gently rolling mesa top. The easternmost portion of the Study Area is located on or adjacent to the moderate to steep western slopes of Murphy Canyon (Figure 1). Tributary canyons from Murphy Canyon in the East and San Clemente Canyon to the north have incised the mesa in the northern and eastern portions of the Study Area.

The current Kearny Mesa Community Plan was approved in 1992 and last amended in 2018 (City 1992). The community was traditionally an industrial based regional employment center. Currently, the community includes commercial, office, and residential elements. Public transportation within the area is provided by the Metropolitan Transit System. Major thoroughfares include north-south interstates I-805, I-15, and SR-163; east-west route SR-52; east-west Clairemont Mesa Boulevard, Balboa Avenue, Aero Drive; and north-south Convoy Street and Ruffin Road. While Montgomery Field Municipal Airport, located north of Aero Drive, is within the Kearny Mesa Community Plan boundary, land use policies for the airport are contained in a separate planning document (adopted in 1980) and is not part of this Study. The StoneCrest Residential development southwest of Aero Drive is also subject to land use planning under a separate plan, the StoneCrest Specific Plan (adopted in 1988).

The current Kearny Mesa Community Plan provides the detailed framework to guide development in Kearny Mesa. Originally adopted in 1992, the plan has undergone 9 amendments in the intervening years. According to the City of San Diego website (2018), the Community Plan update seeks to bring the plan up-to-date by: analyzing current land use, development, and environmental characteristics; evaluating changes in demographics that may affect land use needs; understanding demand for housing and commercial development; working with community members and stakeholders to determine key issues of concern, desires, and preferences to establish a vision and objectives for the plan update; evaluating infrastructure and transportation needs to address climate change.

The Study Area is currently completely developed. Except for natural slopes along the west side of Murphy Canyon and south of SR-52, slopes and grades have been modified by grading. The current KMCPU shows all planned development will occur in areas previously graded into building pads and roadways.

3. HISTORY

Settlement of Kearny Mesa began around 1910 and consisted of homesteading, beekeeping, and cattle grazing. Wholesale flower farming began in the 1930's and continued though the 1970's. Airport operations began in the late 1930's with Gibbs Airfield. The City of San Diego purchased the land surrounding the airfield in 1948 for a new metropolitan airport. Airspace conflicts with Miramar Naval Air Station forced the City to abandon the airport planning and turned the area into an industrial park that was occupied by General Dynamics in 1955. Aerial photographs (USDA, 1953) show the initial stages of mining in Murphy Canyon near the southernmost portion of the Study Area. The quarry is shown on Figure 1 and was likely mining sand and gravel. Industrial and research development grew through the

1990's as well as commercial development along Convoy Street and Clairemont Mesa Boulevard. The County of San Diego's Operations Center has been located in Kearny Mesa since the 1970's.

4. GEOLOGY

San Diego is located within the western (coastal) portion of the Peninsular Ranges Geomorphic Province of California. 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 (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. Figure 2, Regional Geologic Map, modified from Kennedy and Tan (2008), shows the regional geology.

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 within or west-southwest of San Diego. 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 Study Area. Figure 3, Regional Fault map shows the proximity of the Study Area to nearby mapped Quaternary faults.

4.1. Local Geology

In increasing order of age, soils in the Study Area consist of artificial fill (both documented and undocumented), young alluvium, Very old paralic deposits (Units 9, 8 and 8a), the Mission Valley Formation, Stadium Conglomerate and Friars Formation. The distribution of the units is shown on Figure 2, Regional Geologic Map. Descriptions of the general characteristics of these units are presented below.

- *Af Artificial fill (late Holocene).* Although there are no mapped limits of artificial fill on Figure 2, manmade fill underlies large portions of the Study Area. Most areas underlain by fill are associated with construction of buildings or infrastructure. These fills are likely compacted. Uncompacted fills associated with the Miramar Landfill are located south of SR-52 between Convoy Street and Magnatron Boulevard. Uncompacted fill associated with the abandoned quarry is located in the southern portion of the Study Area, south and west of Murphy Canyon Road. The uncompacted fills are subject to settlement under building or additional fill loads.
- *Qya – Young alluvial flood-plain deposits (Holocene and late Pleistocene).* Young alluvial flood-plain deposits are characterized as poorly consolidated, poorly sorted, permeable floodplain deposits of sandy, silty, or clay-bearing alluvium. These deposits occur along the floodplain of the Murphy Canyon drainage. The alluvium underlies I-15 from the southernmost portion of the Study Area, northward to Clairemont Mesa Boulevard. North of Clairemont Mesa Boulevard, the alluvium thins in a natural drainage that forms the head of Murphy Canyon. Young alluvial deposits may settle under structural or additional fill loads. Compacted fill overlying settlement prone young alluvial flood plain deposits may settle under new building or additional fill loads.

- *Qvop9 – Very old paralic deposits, Unit 9 (middle to early Pleistocene).* The Unit 9 deposits consist of poorly sorted, moderately permeable, well consolidated, reddish brown, interfingered strandline, beach, estuarine, and colluvial deposits composed of siltstone, sandstone, and conglomerate. These paralic deposits are well consolidated and are usually suitable for light structural or thin fill loads. They are locally cemented and may create difficult excavation conditions for utility trenches or basements.
- *Qvop8 – Very old paralic deposits, Unit 8 (middle to early Pleistocene).* The Unit 8 deposits consist of poorly sorted, moderately permeable, well consolidated, poorly to moderately cemented, reddish brown, interfingered strandline, beach, estuarine, and colluvial deposits composed of siltstone, sandstone, and conglomerate. These paralic deposits are well consolidated and are typically suitable for light structural or thin fill loads. They are locally cemented and may create difficult excavation conditions for utility trenches or basements.
- *Qvop8a – Very old paralic deposits, Unit 8a (middle to early Pleistocene).* Unit 8a of the very old paralic deposits is characterized as poorly sorted, moderately permeable, reddish-brown, dune and back beach (“beach ridge”) deposits composed of cross bedded sandstone. The Unit 8a deposits form a topographic high in the northwestern portion of the Study Area. The sandstone is well consolidated, usually moderately to well cemented and is generally suitable for moderate structural and fill loads. The sandstone is frequently very difficult to excavate.
- *Tmv – Mission Valley Formation (middle Eocene).* The Mission Valley Formation is only locally preserved in the southwest central and southern portion of the Study Area. The Mission Valley Formation appears to pinch out beneath the very old paralic deposits in the central and northern portion of the Study Area. It is exposed near the top of natural canyon slopes just south of Aero Drive near the I-805 and in Mission Valley, north of Friars Road. It consists predominantly of light olive-gray, soft and friable, fine- to medium-grained marine and non-marine sandstone containing cobble conglomerate tongues. The Mission Valley Formation is erodible on slopes. It can typically support light to moderate structural and fill loads.
- *Tst – Stadium Conglomerate (middle Eocene).* The Stadium Conglomerate underlies the entire Kearny Mesa Community Planning Area, underlying the very old paralic deposits and, where preserved, the Mission Valley Formation. It is most exposed in the slopes along the west side of Murphy Canyon. It consists of massive cobble conglomerate with a dark-yellowish brown, coarse-grained sandstone matrix. The conglomerate contains slightly metamorphosed volcanic and volcaniclastic rocks and quartzite. The conglomerate is very well consolidated and locally very well cemented. The conglomerate can typically support very heavy structural and fill loads. The Stadium Conglomerate is difficult to excavate and is approximately 150 feet thick in the southern portion of the Study Area but thins to about 100 feet thick in the northern portion of the Study Area. (Kennedy and Tan, 2008).
- *Tf – Friars Formation (middle Eocene).* This formation consists of yellowish-gray, medium-grained, massive, poorly indurated non-marine and lagoonal sandstone and claystone with tongues of cobble conglomerate. Within the Study Area, it is exposed in the lower portions of the western slopes and bottom of Murphy Canyon. The Friars Formation is well consolidated where un-weathered and can typically support moderate structural and fill loads. In other portions of San Diego, the Friars Formation lagoonal claystone is very susceptible to massive landsliding and surficial slope failures. The Friars Formation in the Study Area is composed predominantly of sandstone and is somewhat more stable as evident by the steeper slopes along Murphy Canyon and a lack of identifiable landslides.

4.2. Local Structural Geology

The older geology (Mission Valley Formation, Stadium Conglomerate and Friars Formation) underlying the Study Area dips (tilts) gently to the west and east forming a north-south trending syncline (Figure 2). The very old paralic deposits are flat lying or dip gently to the west. The structure is considered favorable as it dips into the western slopes of Murphy Canyon along the eastern portion of the Study Area, enhancing stability.

The Murphy Canyon fault has been mapped in the bottom of Murphy Canyon (Kennedy and Tan, 1975). The fault is concealed (buried) and approximately located. Evidence for the fault is poorly documented and appears mostly based on linear character of Murphy Canyon and a reported 30-foot vertical offset of the contact between the very old paralic deposits on either side of the canyon. However, mapping by Kennedy (1975) show no such offset.

5. TECTONICS AND SEISMICITY

San Diego is affected by the boundary between the North American and Pacific tectonic plates. The boundary, in southern California is characterized by a wide zone of predominantly northwest-striking, right-slip faults that span the Imperial Valley and Peninsular Range to the offshore California Continental Borderland Province (from the California continental slope to the coast). The San Clemente fault zone located 60 miles west of San Diego and the San Andreas fault zone 70 miles east of San Diego define the boundary for the Study Area. The most active faults based on geodetic and seismic data are the San Andreas, San Jacinto, and Imperial faults. These faults take up most of the plate motion. Smaller faults, however, are active enough to create damaging earthquakes and these include the Elsinore, Newport-Inglewood-Rose Canyon, and the offshore Coronado Banks, San Diego Trough, and San Clemente fault zones (Figure 3).

5.1. Local and Regional Faults

Table 1 summarizes the local and regional fault characteristics for the active faults that will affect the Study Area. A Quaternary fault is defined by the State of California (2007) as a fault that shows evidence of movement in the last 1.6 million years. Quaternary (Holocene and Pleistocene) faults can be classified as either active or potentially active faults. Active faults are those Quaternary Holocene faults which have been shown to have ruptured in the last 11,000 years. Potentially active faults are those Quaternary Pleistocene faults which have been shown to have ruptured during the 1.6 million years but not within the last 11,000 years. Potentially active faults have a much lower probability for future activity than active faults. The Study Area is not underlain by active or potentially active faults. Earthquakes on the faults summarized below will, however, create ground shaking that can affect the Study Area.

The nearest active fault capable of causing ground rupture and strong earthquake shaking is the Rose Canyon fault zone located 4 miles southwest of the Study Area. The Rose Canyon fault zone is the southernmost portion of the Newport-Inglewood fault zone which extends from Long Beach to the north to the Descanso fault, offshore of Baja California. A Magnitude 6.3 earthquake occurred on the Newport-Inglewood fault in 1933 and caused serious damage in the Los Angeles area. There have been no historical damaging earthquakes documented on the Rose Canyon fault nor has there been historical fault rupture. Fault trenching on the Rose Canyon fault has shown that the fault has ruptured the ground surface several times in the last 10,000 years (Rockwell, 2010).

Table 1 - Fault Characteristics for Active Faults in the Region

Fault Name	Approximate Distance to Study Area	Slip Rate (mm/yr)	Fault Length (miles)	Estimated Magnitude (Maximum Moment Magnitude (Mw))
Newport-Inglewood-Rose Canyon Fault Zone	4	1.5	130	7.2
Coronado Bank Fault Zone (offshore)	16	3.0	115	7.6
San Diego Trough Fault Zone (offshore)	25	1.5	106	7.5
San Miguel-Vallecitos Fault Zone (Northern Baja California)	34	0.2	100	6.9
Elsinore Fault Zone	36	5.0	190	7.0
San Clemente Fault Zone (offshore)	23		129	7.7
San Jacinto Fault Zone	57	4.0	152	6.8
Southern San Andreas Fault Zone	84	25	140	7.2

Table References include; CDMG 2002, CGS 2010, Hirabayashi and others 1996, Kahle and others 1984, Ryan and others 2012.

The nearest potentially active fault to the Study Area is the La Nacion fault zone located about 5 miles southeast of the Study Area. The fault zone extends from just west of San Diego State, southward to the United States/Mexico border. The fault is a normal fault showing down to the west, extensional separations. The fault offsets the lower portion of the early Pleistocene very old paralic deposits in southern San Diego County but shows very little, if any geomorphic features typical of recent fault offset. The fault zone may be a secondary feature resulting from movement on the Rose Canyon fault zone (Marshall, 1989). Based on its length, the fault is estimated to be capable of causing Magnitude 6.7 earthquakes.

5.2. Historical Earthquakes

The available record of historical (dating back to the late 1700's) earthquakes larger than Magnitude 6 in the coastal San Diego area is as complete as other regions in the State of California (Anderson, et al 1989). Only a small number of earthquakes have been reported in coastal San Diego whereas other portions of southern California and Baja California, Mexico, have experienced many moderate to large earthquakes in the same historical window.

Strong shaking and minor damage has occurred in the coastal San Diego region as a result of large earthquakes on distant faults or smaller earthquakes on local faults (Agnew et al 1979; Toppozada et al 1981). Earthquakes in Imperial County and northern Baja California in 1800, 1862, and 1892 are believed to have produced the strongest intensities in the San Diego area.

In the 1930's seismographs were established in San Diego. Since that time, swarms of small to moderate magnitude earthquakes have been recorded in San Diego Bay. In 1964, a swarm of small earthquakes was reported generally in the south San Diego Bay (Simmons 1977). In 1985 a swarm of earthquakes with a maximum magnitude of M4.7 occurred just over one-half mile south of the Coronado Bay Bridge

(Reichle et al 1985). A magnitude M5.3 earthquake and a series of aftershocks occurred about 44 miles west of Oceanside in 1986 (Hauksson and Jones 1988). The 1986 earthquake was widely felt but did not cause significant damage.

6. LANDSLIDES AND SLOPE STABILITY

The Study Area is bound to the east and in the northwest corner by slopes associated with Murphy Canyon and San Clemente Canyon respectively. The slopes are underlain by the Friars Formation which is susceptible to landslides and other slope instabilities due to weak claystone layers in other portions of San Diego County. The upper portions of the slopes are underlain by Stadium Conglomerate and very old paralic deposits which have high shear strengths and provide the stable cap that creates the mesa on which Kearny Mesa was developed. A review of predevelopment aerial photographs (USDA, 1953) do not show evidence of large scale landslides or shallow slope failures. The combination of steep natural slopes, building and fill loads as well as infiltration of irrigation and storm water can create conditions that result in landslides in an urban development. The State of California has mapped the slopes along Murphy Canyon as being unstable and characterized as in Sub Area 4-1 which is "Generally located outside the boundaries of definite mapped landslides but contains observably unstable slopes underlain by expansive clay materials such as…Friars Formation…" (Tan, 1995). Figure 4 shows slope inclinations within the Study Area. Slopes in excess of 2:1 (horizontal : vertical) should be considered potentially unstable. The slopes along Murphy Canyon south of Aero drive have been stabilized by flattening the slope through grading associated with commercial and residential development. These slopes are assumed to have been engineered in accordance with City of San Diego requirements.

7. SOILS AND INFILTRATION

The USDA has mapped soil types (series) throughout the United States using a complex system of characteristics. Figure 5 shows the distribution of various soil series mapped by the USDA in the Study Area. The soil series descriptions can be used as a rough indicator of permeability. Permeability is the main factor that affects the infiltration of water. Infiltration of storm water into soil is a goal of the San Diego Regional Water Quality Control Board (RWQCB) and the City of San Diego. Table 2 summarizes the main soil series located on the mesa in areas of past and future development.

Table 2 - USDA Soil Series Descriptions

Name	Description	Thickness (Inches)	Permeability
Gaviota	Gravelly loam	10-17	Moderately rapid
Redding	Gravelly loam	22-35	Very slow
Altamont Clay	Clay	50-65	Slow
Chesterton	Fine sandy loam	34-42	Very slow to impermeable

The USDA series descriptions are based on natural soil development. Most of the soil in the mesa portion of the Study Area has been altered by grading to create level building sites or streets. As a result, the permeability estimates in Table 2 can only provide a rough indicator of the infiltration potential of the soils in the Study Area. Other factors should be considered in evaluating storm water infiltration feasibility including lateral migration of water on impermeable very old paralic deposits and groundwater mounding. A full list of criteria is enumerated in the City of San Diego Storm Water Standards, Part 1, 2017 Edition (City of San Diego, 2017).

8. HYDROGEOLOGY

According to the San Diego Basin Plan (RWQCB, 1994), the Study Area lies within three separate hydrologic basins. The hydrologic basins and beneficial use information is listed below.

- The northwestern portion of the Study Area is located in the Miramar Hydrologic Subarea (HSA) in the Miramar Hydrologic Area (HA) of the Penasquitos Hydrologic Unit (HU). The Miramar HA is excepted from beneficial use for municipal supply and has potential beneficial use for industrial supply.
- The western portion of the Study Area is located in the Tecolote HSA in the Tecolote HA of the Penasquitos HU. The Tecolote HA is excepted from beneficial use for municipal supply and does not have any other beneficial uses.
- The eastern portion of the Study Area is located within the Mission San Diego HSA in the Lower San Diego HA of the San Diego HU. The Mission San Diego HSA has existing beneficial uses for agricultural, industrial service supply, and industrial processing supply, and potential beneficial use for municipal supply.

Based on a review of previous environmental investigation reports and monitoring well data collected from State Water Resources Control Board-managed GeoTracker website (Geotracker), groundwater levels vary across the Study Area and groundwater has been encountered as shallow as 6 feet and deeper than 100 feet bgs. The groundwater flow directions will vary within the Study Area.

9. DRAINAGE AND FLOODING

The Study Area is situated mostly on a highly urbanized, gently rolling mesa. Drainage is mainly along streets, gutters and storm drain pipelines that empty into Murphy and San Clemente Canyons. Graded slopes use concrete swales that empty into storm drains for drainage. The relatively few natural slopes drain into adjacent canyons or tributaries. Low gradients on streets and storm drains as well as blocked storm drain inlets can create local, short duration flooding during very heavy rainfall. The Study Area is not shown to be in 100- or 500-year Federal Emergency Management Agency flood zones. The Study Area is outside the influence of any local or regional dam failure floodways.

10. MINERALOGIC RESOURCES

Data from the U.S. Geological Survey (USGS) Mineral Resource Data System show that there was one previous quarry in the Study Area (USGS 2015), Mission Sand Co. The quarry is located at the foot of the western slopes of Murphy Canyon, in the southern portion of the Study Area. The quarry appears to have been active from the early 1950's to the late 1970's. The quarry produced sand and crushed gravel from the Stadium Conglomerate and Friars Formation. Following closure of the quarry, mining fines appeared to have been stored in a number of holding ponds. The ponds were covered with fill soil and the land is currently occupied by a golf practice facility.

Conservation Element of the City of San Diego General Plan (City of San Diego 2008b) indicates the eastern portion of the Study Area is mapped in Mineral Resource Zone 2 (MRZ-2) which is described as areas underlain by mineral deposits (sand and gravel) where geologic data show that significant measured or indicated resources are present.

The MRZ-2 area is fully developed and is in a highly urbanized area. It is not considered available for future mining activities.

11. GEOLOGIC HAZARDS AND IMPACTS

This section identifies geologic hazards that may affect proposed policies and programs of the KMCPU and proposed land use. The proposed land uses were not finalized at the time of preparation of this report (AECOM, 2017). These hazards include seismicity and ground motion; liquefaction; seismically-induced settlement; slope instability; subsidence; expansive and corrosive soils; impermeable soils; and shallow groundwater. These hazards can be mitigated through administrative controls (e.g., avoiding with building in hazard-prone areas or structure setback) and/or engineering improvements (e.g., ground improvement, ground restraints, or appropriate structure foundation). Site-specific and hazard-specific geotechnical investigations would be required to evaluate the appropriate mitigation measure or combination of measures.

The City of San Diego Seismic Safety Study Geologic Hazards and Faults maps document the known and suspected geologic hazards and faults in the region. The maps show 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. The Study Area is shown on portions of map Sheets 26, and 31 of the City of San Diego Seismic Safety. Identified hazards are described below. Figure 6, Geotechnical Hazards shows the location of hazards as defined by the City maps. The mesa area is underlain by “level mesa underlain by terrace deposits or bedrock with nominal risk” (51) and “other level areas or gently sloping to steep terrain with favorable geologic structure.” Low risk (52). Slope areas are underlain by “Friars Formation with neutral or favorable geologic structure”. The areas at the top of slopes has been designated 53 “level or sloping terrain with unfavorable structure.” Low to moderate risk. The bottoms of drainages are designated as Category 31 or 32 which exhibit a “high potential for liquefaction due to high groundwater” or “low potential for liquefaction due to fluctuating groundwater levels”.

11.1. Seismicity and Ground Motion

An active fault is defined by the State Mining and Geology Board as one that has experienced surface displacement within the Holocene epoch, i.e., during the last 11,000 years (California Geological Survey, 2007). The Study Area is subject to potential ground shaking caused by activity along faults located near the Study Area.

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.

As noted, the Study Area is 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 Study Area is located in a zone where the horizontal peak ground acceleration having a 10 percent probability of exceedance in 50 years is 0.247g (where g represents the acceleration of gravity)[1].

11.2. Liquefaction, Seismically Induced Settlement

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. While lateral spreads are also associated with these ground failures, the liquefaction prone soil in the Study Area is not situated near or adjacent to slopes. 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. 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.

Liquefiable soil is located in San Clemente Canyon in the northern portion of the Study Area and Murphy Canyon in the eastern portion of the Study Area. These areas are currently in open space or underlie SR-52 and I-15.

11.3. Tsunamis, 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. However, no portion of the Study Area lies within a mapped tsunami inundation zone. A seiche is an earthquake-induced wave in a confined body of water, such as a lake, reservoir, or bay. However, no portion of the Study Area lies near a confined body of water on which a seiche could be expected to occur.

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, the Study Area is outside dam inundation zones.

11.4. Slope Instability

According to the City of San Diego Seismic Safety Study the slopes in the Study Area are underlain by Friars Formation with neutral to favorable structure (Geologic Hazard Category 23). The risk of landsliding is not discussed on the maps. The tops of the slopes are mapped as being at low to moderate risk for landsliding (Hazard Category 53). The slopes should be considered potentially unstable. Buildings or infrastructure older than 1985 within 50 feet of the tops of natural slopes may have been

[1] Peak ground acceleration is used to measure the effect of an earthquake on the ground. For example, 0.001 g is perceptible by people, 0.02 g causes people to lose their balance, and 0.5 g is very high but buildings can survive if the duration is short and if the mass and configuration has enough damping (Loran, 2012).

designed without consideration of slope stability (this area is in general agreement with Hazard Category 53, City of San Diego, 2008). Additions of new building loads in these locations may not meet current City of San Diego standards for slope stability.

11.5. Subsidence

Subsidence typically occurs when extraction of fluids (water or oil) cause the reservoir rock to consolidate. Water extraction is minimal in the Study Area and the geologic materials area well consolidated. Subsidence is not a hazard in the Study Area.

Settlement of unconsolidated soil (fill or alluvium) may occur locally where new loads are imposed on previously uncompacted fill, compacted fill on unconsolidated alluvium, or unconsolidated alluvium.

11.6. Expansive or Corrosive Soils

Other potential geological hazards include expansive or corrosive soils. 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. Figure 5 and Table 2 show the soils at the site area predominantly clayey and are considered potentially expansive. Grading has mixed the natural soils with the granular formational materials and will affect the potential for expansive soil greatly.

11.7. Impermeable Soil

The permeability of soil within 10 feet of the current ground surface is important when evaluating the potential for and the design of storm water infiltration devices. The soil in the Study Area exhibits very slow infiltration (Table 2) and the well consolidated, frequently cemented old paralic deposits are typically encountered at very shallow depths. As a result, the use of typical shallow infiltration systems may be problematic in the mesa portion of the Study Area.

Cemented old paralic deposits and Stadium Conglomerate often create difficult excavation conditions which may increase grading or excavation costs for basements, foundations, or trenching for underground utilities.

11.8. Groundwater

The permanent groundwater table is expected to be too deep to impact the planned developments shown on the KMCPU. Local shallow groundwater and perched groundwater may be present locally due to leaking storm drains, water lines, and irrigation. Excavations deeper than 5 feet may encounter groundwater conditions that might affect construction (temporary slope stability, shoring, dewatering and permanent drainage behind walls).

12. IMPACT MITIGATION

The impacts summarized above may be mitigated through administrative controls (e.g., avoiding building in hazard-prone areas or structural setback areas) and/or engineering improvements (e.g., ground improvement, ground restraints, remedial grading or foundation design). Site specific geotechnical investigations are required to recommend the appropriate mitigation measure(s).

12.1. Seismicity and Ground Motion

The entire Study Area will be affected by seismicity and ground motion. Mitigation can be accomplished by geotechnical and structural engineering design. Geotechnical investigations should be conducted in accordance with City of San Diego Guidelines for Geotechnical Reports and State of California requirements. Most mitigation measures will involve foundation design and or ground improvement.

12.2. Liquefaction, Seismically Induced Settlement

Predicted liquefaction will occur in Murphy Canyon and San Clemente Canyon. Mitigation can be accomplished by ground improvement and or foundation design. Geotechnical investigations should be conducted in accordance with City of San Diego Guidelines for Geotechnical Reports and State of California requirements.

12.3. Tsunamis, Seiches, and Dam Failures

No mitigation measures are necessary because the Study is not impacted by these hazards.

12.4. Slope Instability

Mitigation may be achieved by avoidance of development on slopes or stabilizing the slopes through grading or using specially designed foundations. Geotechnical investigations should be conducted in accordance with City of San Diego Guidelines for Geotechnical Reports with an emphasis on slope stability. Additions to existing structures or development of ancillary structures to existing development will need independent geotechnical investigations if located within 25 feet of slopes in excess of 10 feet high, and on undocumented fills. The investigations should be applied in Hazard Categories 23 and 53.

12.5. Subsidence

Construction of improvements in areas underlain by alluvium or fill should be designed to withstand settlement of unconsolidated soil. Geotechnical investigations for design of settlement resistant structures should be conducted in accordance with City of San Diego Guidelines for Geotechnical Reports. Mitigation measures typically include ground improvement and/or foundation design.

12.6. Expansive or Corrosive Soil

Expansive soil measures include specially reinforce foundations or removal and replacement of expansive soil with less expansive material. Roadways may need heavier pavement sections. Geotechnical investigations should be conducted in accordance with City of San Diego Guidelines for Geotechnical Reports to provide appropriate recommendations. Corrosive soil should be evaluated by a Corrosion Engineer for recommendations for soil replacement or cathodic protection.

12.7. Impermeable Soil

Infiltration potential should be evaluated in accordance with City of San Diego Storm Water Standards, Part 1, 2017 Edition (City of San Diego, 2017). Cemented subgrade will require heavier than normal equipment to excavate and may be predicted with subsurface geotechnical exploration or geophysical surveys.

12.8. Groundwater

The effects of potential groundwater on construction should be evaluated by geotechnical investigations in accordance with City of San Diego Guidelines for Geotechnical Report. Recommendations for dewatering, temporary and permanent slope stabilization, and subsurface drainage should be discussed.

13. THRESHOLDS OF SIGNIFICANCE

In accordance with Appendix G of the CEQA Guidelines, the project will have significant effect on the environment if:

G-1: Expose people to potential substantial adverse effects, including the risk of loss, injury or death involving: a) fault rupture, b) seismic shaking, c) seismic ground failure, d) landsliding.

G-2: Result in substantial soil erosion or loss of top soil.

G-3 Be located in a geologic unit or soil that is unstable (landsliding, settlement, lateral spreading) or that would become unstable as a result of the project.

G-4 :Be located on expansive soil causing substantial risk to life or property.

G-5: Having soils incapable of supporting the use of septic tanks where sewers are not available.

13.1. Threshold G-1 a) Fault Rupture

No significant effect. There are no active or potentially active faults in the Study Area.

13.2. Threshold G-1 b) Strong Seismic Ground Shaking

Less than significant effect. Construction of buildings and other civil works will be required to use seismic resistant designs in accordance with California and City standards and codes. If not constructed to these standards, the impact would be significant.

13.3. Threshold G-1 c) Seismic Ground Failure

Less than significant effect. The liquefiable soils in the Study Area are overlain by a freeways and open space. No construction is shown in these areas on the KMCPU.

13.4. Threshold G-1 d) Seismic Induced Landsliding

Less than significant effect. Planned development will be within areas previously developed. Slopes within developed areas have been constructed in accordance with City of San Diego standards and codes and are assumed to be stable under static and pseudostatic conditions.

13.5. Threshold G-2 Substantial Soil Erosion and Loss of Topsoil

Less than significant effect. The Study Area is almost fully developed with landscaping, buildings, and paving. Areas not developed are dedicated open space areas that are well covered with natural vegetation. Most of the Study Area is located on a mesa where gradients are very low. As a result, the potential for erosion is very low. Since construction will be required to follow City of San Diego standards and code that stipulate protection against temporary and permanent erosion, the impact of erosion and loss of topsoil is less than significant.

13.6. Threshold G-3 Unstable Soil (Landslide, Settlement, Lateral Spreading)

Landslide: Less than Significant. Landslide prone geologic formations are exposed along the eastern and northern edges of the Study Area. The KMCPU shows planned development only in areas previously developed that are underlain by Friars Formation. These areas have been stabilized by the previous development.

Settlement: Less than Significant. Settlement prone soil within the KMCPU consists of undocumented fills, fills placed on settlement prone soil (in the southeast corner of the Study Area) or soils within 25 feet of the tops of slopes 10 feet high or higher. The impact of these settlement prone soils will occur when additions or new fills place new loads on settlement prone soil. Geotechnical reports performed in accordance the City of San Diego Guidelines should be required for ANY new development that would add additional loads on undocumented fills, fills placed on settlement prone soil, or soil within 25 feet of slopes in excess of 10 feet in height to evaluate the effect of the additional loads. Without changing the requirements for geotechnical investigation for minor additions or fills, the effects of Settlement Prone Soil on the planned development could be significant.

Lateral Spreading: Less than Significant. Lateral Spreading occurs in sloping liquefaction prone soil or liquefaction prone soil with an open face (slope). Liquefaction prone soil in the Study Area is overlain be fill or is confined to stream channel bottoms. The potential for lateral spreading in the Study Area is insignificant.

13.7. Threshold G-4 Expansive Soil

Less than Significant. Expansive soil is present on the mesa portions of the Study Area. This area has been heavily modified by previous development, so the distribution of the expansive soil will be site dependent. Geotechnical investigations as required by the City of San Diego will identify the effects of expansive soil on the planned development. Typical remediation measures include removal of unsuitable soil and replacement with non-expansive soil, chemical treatment of expansive clay, or specially designed and reinforced foundations.

13.8. Threshold G-5 Soil Unsuitable for Onsite Sewage Disposal Systems

Less than Significant. Soil and geologic formations with poor percolation characteristics are widespread in the Study Area. The Study Area is currently well served by existing sewer systems. The use of onsite sewage disposal systems is not anticipated.

14. CONCLUSIONS

Conclusions of this Study are listed below.

- There are no geologic hazards that cannot be avoided or mitigated
- There are no policies or recommendations of the KMCPU which will have a direct or indirect significant environmental effect with regard to geologic hazards.
- The proposed land uses are compatible with the known geologic hazards.
- There are no potential impacts related to geologic hazards from the implementation of the KMCPU that can’t be avoided, reduced to an acceptable level of risk, or reduced below a level of significance through mandatory conformance with applicable regulatory requirements or the recommendations of this technical report

- The impact of unstable soil can be reduced to less than significant levels by requiring geotechnical investigations on ALL construction on ground underlain by settlement prone undocumented fills, fills on settlement prone soil, or soil within 25 feet of the tops of slopes in excess of 10 feet high.

15. LIMITATIONS

This report was prepared in general accordance with current guidelines and the standard-of-care exercised by professionals preparing similar documents near the Study Area. No warranty, expressed or implied, is made regarding the professional opinions presented in this document. 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. Please also note that this document did not include an evaluation of environmental hazards.

The conclusions, opinions, and recommendations as presented in this document, are based on a desktop analysis of data, some of which were obtained by others. It is our opinion that the data, as a whole, support the conclusions and recommendations presented in the report.

The purpose of this study was to evaluate geologic and geotechnical conditions within the planning areas 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 require site-specific geotechnical studies as required by State and City regulations.

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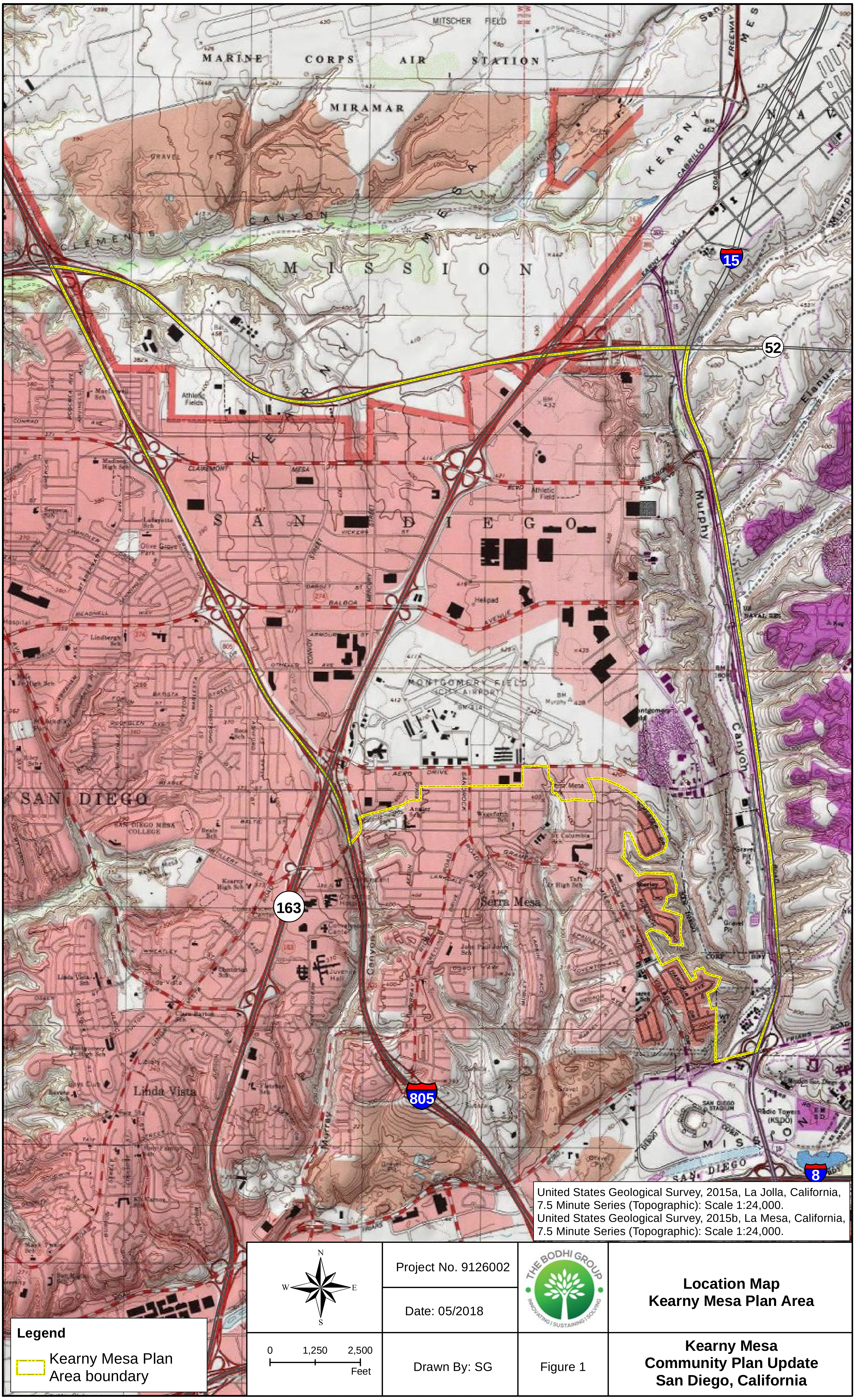
Figures



Project No. 9126002

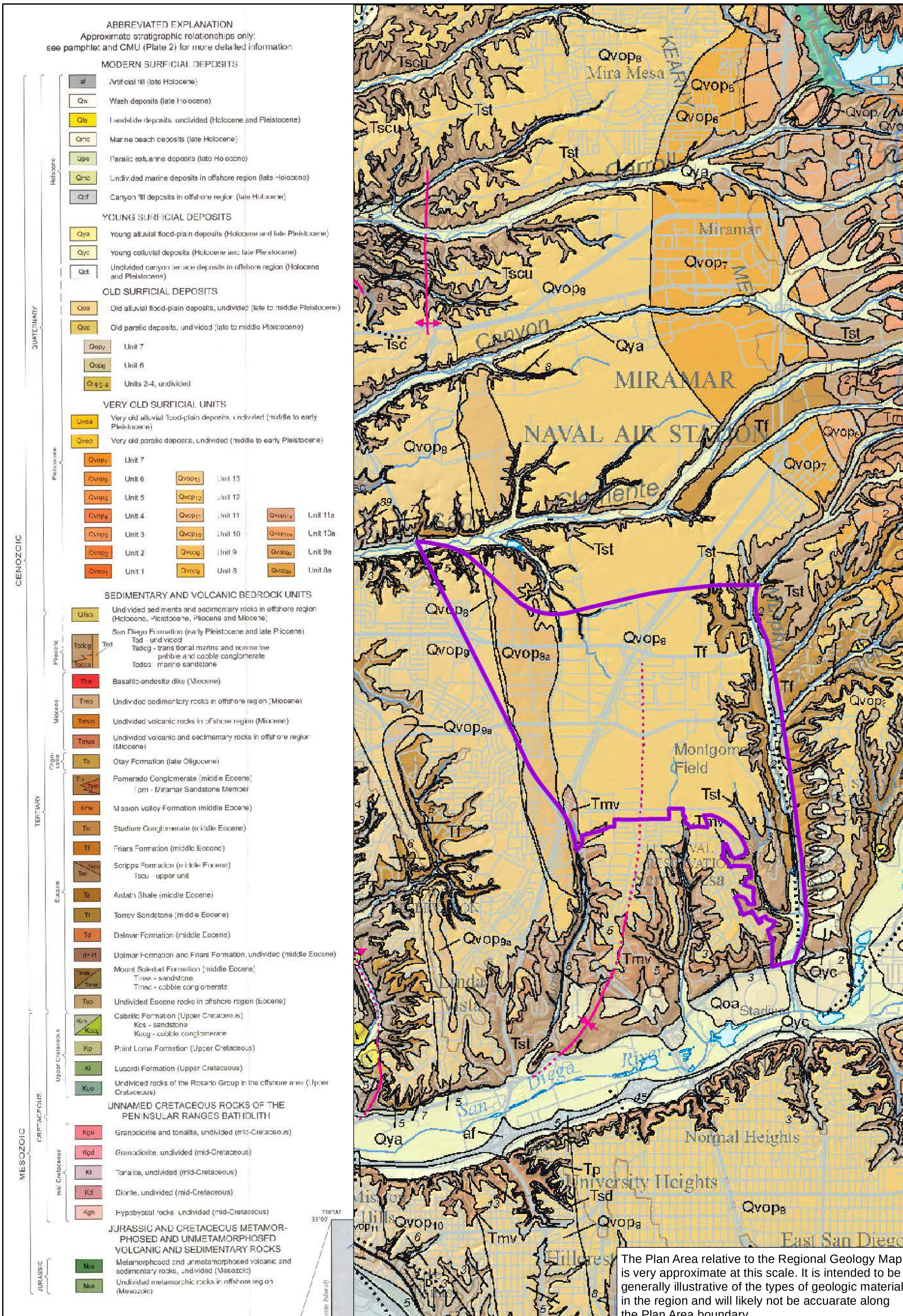
Date: 05/2018

Drawn By: SG

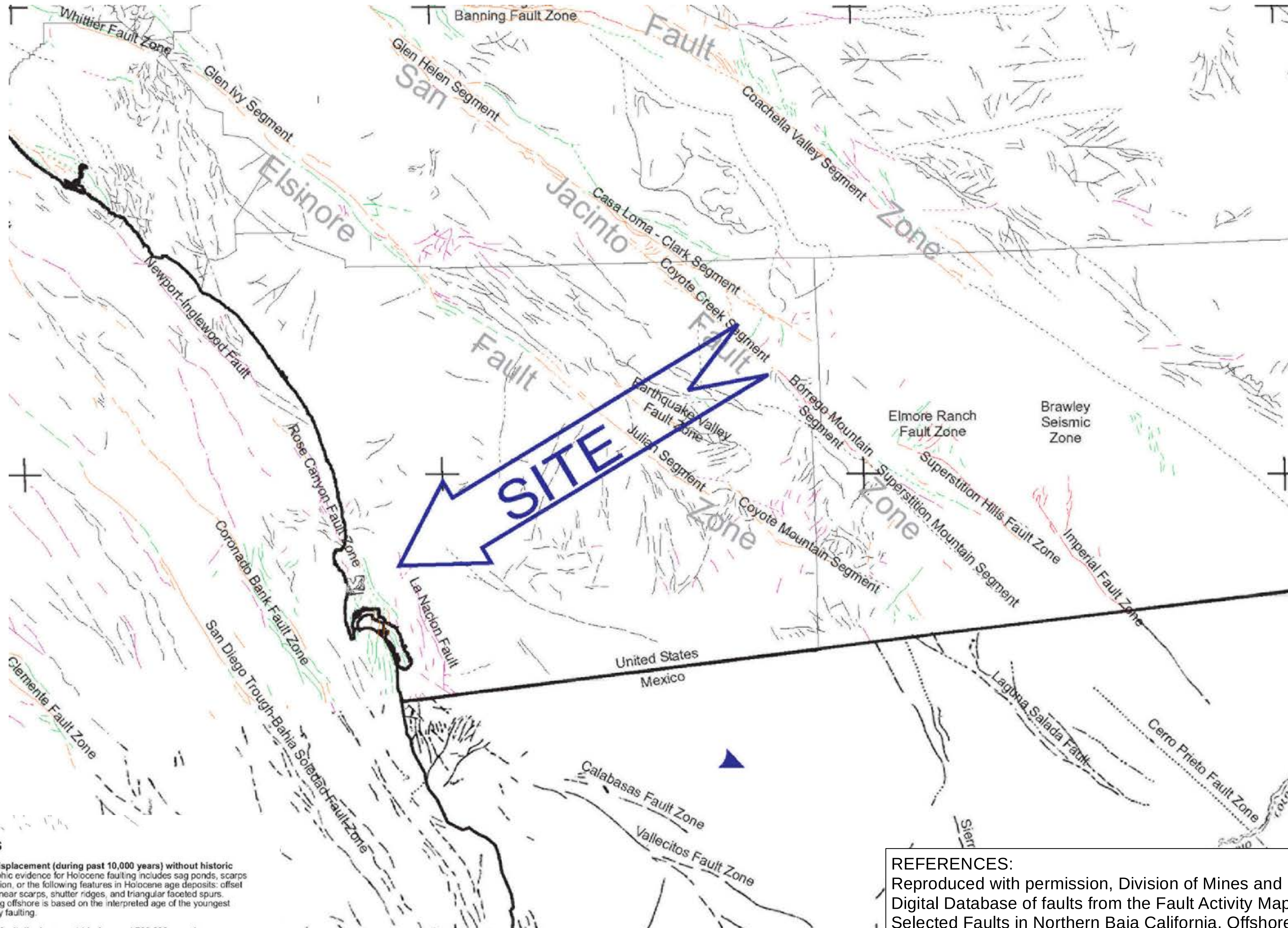
Figure 1

Location Map
Kearny Mesa Plan Area

Kearny Mesa
Community Plan Update
San Diego, California



Modified from: Kennedy, M.P., and Tan, S.S. 2008	N / W / E / S	Project No. 9126002	THE BODHI GROUP	**Regional Geology Kearny Mesa Plan Area**
		Date: 05/2018		
Legend Kearny Mesa Plan Area boundary	Not to Scale	Drawn By: SG	Figure 2	**Kearny Mesa Community Plan Update San Diego, California**



NOTATIONS

Holocene fault displacement (during past 10,000 years) without historic record. Geomorphic evidence for Holocene faulting includes sag ponds, scarps showing little erosion, or the following features in Holocene age deposits: offset stream courses, linear scarps, shutter ridges, and triangular faceted spurs. Recency of faulting offshore is based on the interpreted age of the youngest strata displaced by faulting.

Late Quaternary fault displacement (during past 700,000 years). Geomorphic evidence similar to that described for Holocene faults except features are less distinct. Faulting may be younger, but lack of younger overlying deposits precludes more accurate age classification.

Quaternary fault (age undifferentiated). Most faults of this category show evidence of displacement sometime during the past 1.6 million years; possible exceptions are faults that displace rocks of undifferentiated Plio-Pleistocene age. See Bulletin 201, Appendix D for source data.

Late Cenozoic faults within the Sierra Nevada including, but not restricted to, the Foothills fault system. Faults show stratigraphic and/or geomorphic evidence for displacement of late Miocene and Pliocene deposits. By analogy, late Cenozoic faults in this system that have been investigated in detail may have been active in Quaternary time (Data from PG&.E, I993.)

Pre-Quaternary fault (older than 1.6 million years) or fault without recognized Quaternary displacement. Some faults are shown in this category because the source of mapping used was of reconnaissance nature, or was not done with the object of dating fault displacements. Faults in this category are not necessarily inactive.

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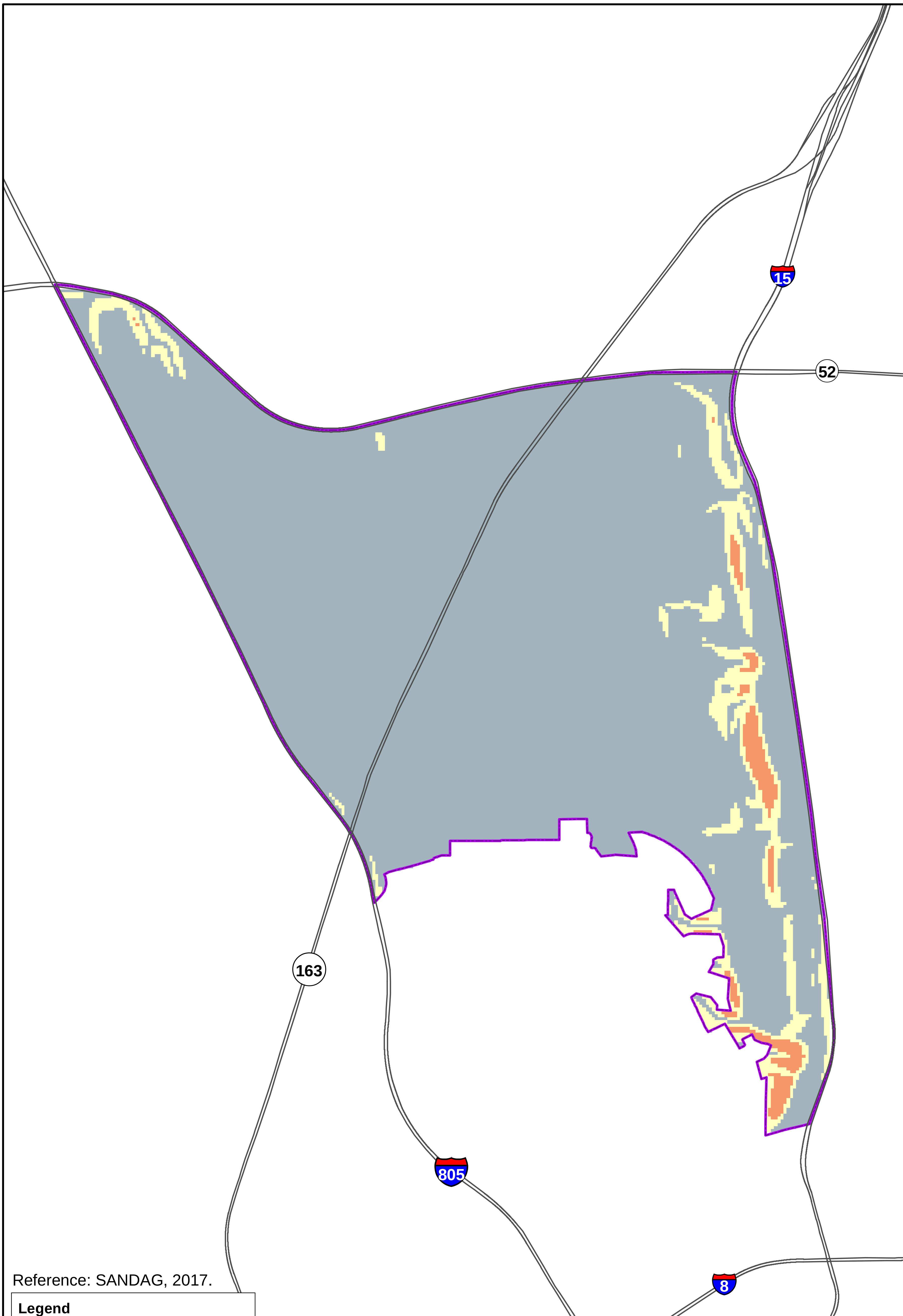
N / W / E / S	Project No. 9096001 Date: 05/2018	THE BODHI GROUP INNOVATING | SUSTAINING | SOLVING	**Regional Fault Map** **Kearny Mesa Plan Area**
Not To Scale	Drawn By: SG	Figure 3	**Keanry Mesa** **Community Plan Update** **San Diego, California**



Reference: SANDAG, 2017.

Legend

Slope expressed as a ratio

- 2H:1V and shallower
- 2H:1V to 1H:1V
- 1H:1V to 1H:2V
- 1H:2V and steeper
- Kearny Mesa Plan Area boundary

N W E S

0 1,250 2,500 Feet

Project No. 9126002

Date: 05/2018

Drawn By: SG

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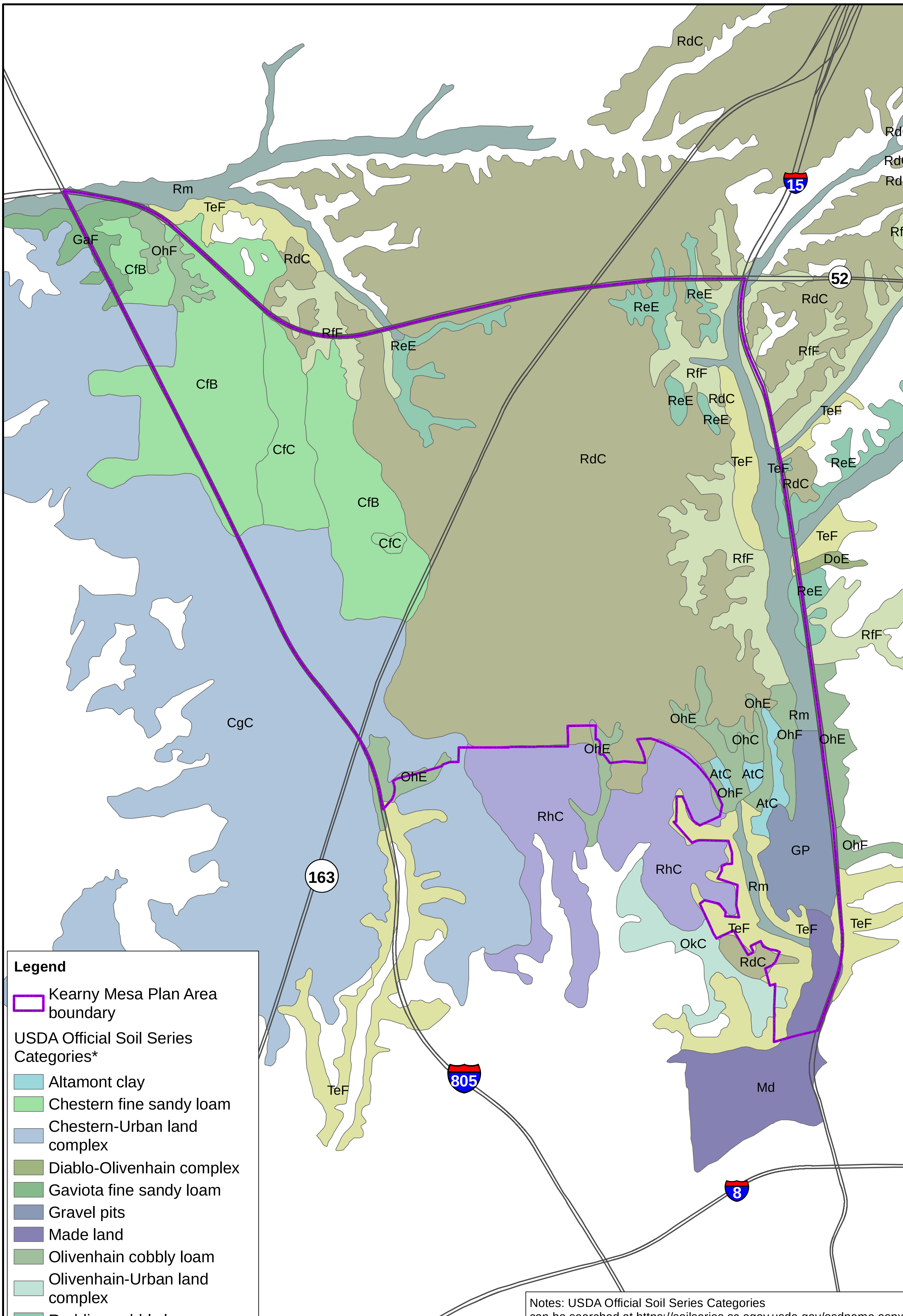
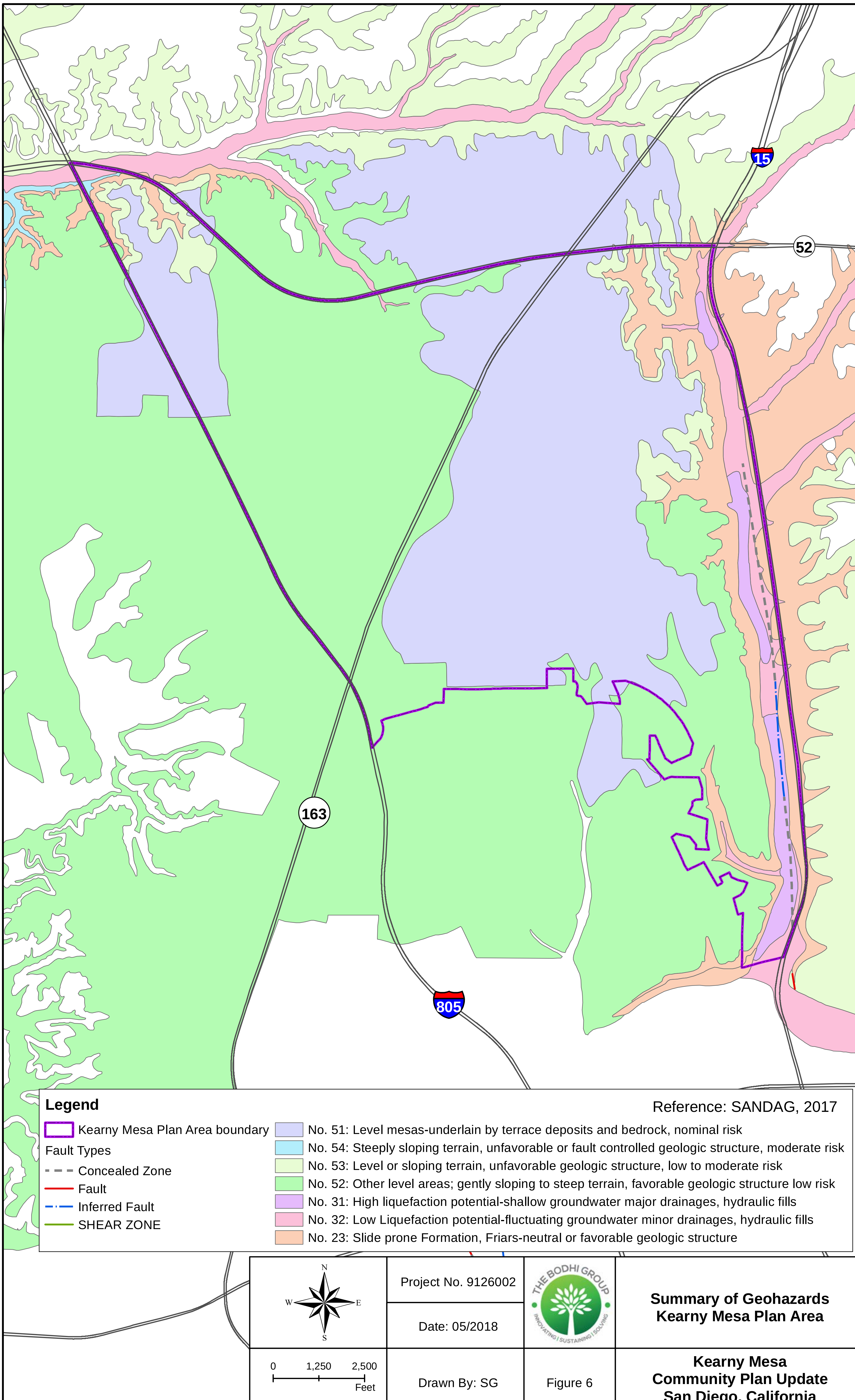
Figure 4

Slope Inclination
Kearny Mesa Plan Area

Kearny Mesa
Community Plan Update
San Diego, California



N / W / E / S	Project No. 9126002	THE BODHI GROUP	**USDA Soil Categories** **Kearny Mesa Plan Area**
	Date: 04/2018		
0 1,250 2,500 Feet	Drawn By: SG	Figure 5	**Kearny Mesa** **Community Plan Update** **San Diego, California**


15
52
163
805
Legend
Reference: SANDAG, 2017
Kearny Mesa Plan Area boundary
Fault Types
Concealed Zone
Fault
Inferred Fault
SHEAR ZONE
No. 51: Level mesas-underlain by terrace deposits and bedrock, nominal risk
No. 54: Steeply sloping terrain, unfavorable or fault controlled geologic structure, moderate risk
No. 53: Level or sloping terrain, unfavorable geologic structure, low to moderate risk
No. 52: Other level areas; gently sloping to steep terrain, favorable geologic structure low risk
No. 31: High liquefaction potential-shallow groundwater major drainages, hydraulic fills
No. 32: Low Liquefaction potential-fluctuating groundwater minor drainages, hydraulic fills
No. 23: Slide prone Formation, Friars-neutral or favorable geologic structure
N
W
E
S
0
1,250
2,500
Feet
Project No. 9126002
Date: 05/2018
Drawn By: SG
THE BODHI GROUP
INNOVATING | SUSTAINING | SOLVING
Figure 6
Summary of Geohazards
Kearny Mesa Plan Area
Kearny Mesa
Community Plan Update
San Diego, California