Appendix M. Geotechnical and Geological Hazards Technical Memorandum

This page intentionally left blank.

Harris & Associates

MEMORANDUM

To: Jordan Moore, Senior Planner, City of San Diego
From: Kelsey Hawkins, Project Manager, Harris & Associates
RE: De Anza Natural Amendment to the Mission Bay Park Master Plan – Geotechnical and Geologic Hazard Evaluation
Date: March 6, 2023
Att: Figures; 1, 2019 Geotechnical and Geologic Hazard Evaluation

---

A Geotechnical and Geologic Hazard Evaluation for the De Anza Cove Amendment to the Mission Bay Park Master Plan was prepared by the Bodhi Group in April 2019. Since preparation of the Geotechnical and Geologic Hazard Evaluation, the project has been revised to accommodate additional marshland habitat (De Anza Natural Amendment to the Mission Bay Park Master Plan). The purpose of this memorandum is to compare the components of the Updated Project (Proposed Project) to the Previous 2019 Project (2018 Proposal) to determine whether the Proposed Project would result in any geological impacts that were not addressed for the 2018 Proposal. The 2019 Geotechnical and Geologic Hazard Evaluation is included as Attachment 1 to this memorandum.

Environmental Setting

The Proposed Project area is in the northeastern corner of Mission Bay Park in the City of San Diego (City) (Figure 1, Regional Location). The Proposed Project area is approximately 505.2 acres, including both land and water areas. It includes the Kendall-Frost Marsh Reserve/Northern Wildlife Preserve (KFMR/NWP), Campland on the Bay (Campland), Pacific Beach Tennis Club, athletic fields, Mission Bay Golf Course and Practice Center, and De Anza Cove area, including a vacated mobile home park and supporting infrastructure, Mission Bay RV Resort, public park, public beach, parking, and water areas (Figure 2, Project Location). The Proposed Project area falls within the boundaries of Mission Bay Park, a regional park that serves San Diego residents and visitors.

Description of the Proposed Project

The Proposed Project is an amendment to the Mission Bay Park Master Plan (MBPMP) to update existing language in the MBPMP and add new language and recommendations pertaining to the project area to serve local and regional recreation needs while preserving and enhancing the natural resources of the De Anza Cove area. The Proposed Project expands the Proposed Project area's natural habitat and improves water quality through the creation of additional wetlands while implementing nature-based solutions to protect the City against the risk of climate change, in line with the City's Climate Resilient SD Plan. The Proposed Project would enhance the existing regional parkland by providing a variety of uses, including low-cost visitor guest accommodations (recreational vehicles and other low-cost camping facilities), active and passive recreational opportunities to enhance public use of the area, and improvements to access to recreational uses. Finally, the Proposed Project would recognize the history and ancestral homelands of the Iipay-Tipay Kumeyaay people, providing opportunities to partner and collaborate on the planning and restoration of the area. The Proposed Project would include a combination of habitat restoration, active recreation, low-cost visitor guest accommodations, and open beach and regional parkland and would modify the open water portions of De Anza Cove (Figure 3, Site Plan). The proposed land use designations for the Proposed Project area are summarized in Table 1, Proposed Land Use Acreages.

The Proposed Project would include wetlands enhancement and restoration within the existing KFMR/NWP, the area currently occupied by Campland, the eastern side of Rose Creek, and the areas in De Anza Cove currently occupied by the vacated mobile home park and open water (Figure 3). The Proposed Project would provide a total of approximately 227.4 acres of wetlands, consisting of approximately 30.7 acres in the area currently occupied by Campland, approximately 86.8 acres of wetlands at the existing KFMR/NWP, and approximately 109.8 acres of other new wetlands. Approximately 37.4 acres of upland habitat, including dune, sage, and buffer area, would also be provided. Two new upland islands would be created: one in the area currently occupied by Campland and the other in the De Anza Cove area at the eastern terminus of the vacated mobile home park. Two possible locations for a new Interpretive Nature Center have been identified: one at the northwestern edge of the restoration area along Pacific Beach Drive and another within the regional parkland area just north of the open beach. The nature center and its parking/service areas would be buffered by native vegetation. The open water area of De Anza Cove would be increased to approximately 95.9 acres with the creation of new east and west outfalls that would allow water and sediment flows to proposed wetlands on either side of Rose Creek.

In addition, the Proposed Project would incorporate a range of active recreational uses on approximately 60.1 acres in the northeastern area of the Proposed Project area (Figure 3). A portion of the Mission Bay RV Resort and the vacated mobile home park would be replaced with approximately 48.5 acres of low-cost visitor guest accommodations land use. A new channel connecting Rose Creek to the De Anza Cove water area would be constructed at approximately Lilac Drive, creating a new island that would be accessed via two new bridges. Approximately 26.3 acres of regional parkland would be enhanced with new recreational amenities and opportunities. Three open beach areas totaling approximately 5.5 acres would be provided with access to De Anza Cove. The Proposed Project would also include approximately 2.6 acres for boat facilities and a clubhouse that could potentially be co-located with another user or public use. Two potential water lease locations would be located in the cove. Water quality design features are proposed along the edges of the active recreational areas. The proposed water quality detention basins would be of differing sizes and would capture and treat stormwater before flowing into Mission Bay. New water quality basins would be located to treat the entire Proposed Project area in accordance with local and state requirements.

Multi-use paths would be throughout areas proposed for active recreation, regional parkland, low-cost visitor guest accommodations, and dune and upland areas and along the beach shorelines. Vehicular access to the Proposed Project area would be provided from Pacific Beach Drive, Grand Avenue, and North Mission Bay Drive. Service roads, vehicular access, and parking would be in areas proposed for low-cost visitor guest accommodation, regional parkland, boating, and active recreation.

Table 1 also provides a comparison of the Proposed Project's proposed land uses to the 2018 Proposal's proposed land uses, summarizing the changes in land use designations and acreages between the Proposed Project and the 2018 Proposal. Overall, the Proposed Project area (approximately 505.2 total acres) is larger compared to the 2018 Proposal area (approximately 457 total acres) because the Proposed Project would provide additional opportunities for habitat enhancement (open water). The Proposed Project includes additional enhancement and restoration opportunities, including approximately 177.9 acres of expanded marshland and upland habitat, compared to the approximately 131 acres of marshland and upland habitat under the 2018 Proposal. The additional wetland enhancement would occur on either side of the connection to Rose Creek and as part of the redesign of the open water portion of the Proposed Project area, which includes an approximately 40-acre increase in open water compared to the 2018 Proposal. In addition, the Proposed Project reduces the amount of active recreational activities and eliminates the 1-acre restaurant lease space. Overall, the Proposed Project provides more habitat restoration and greater protection of natural resources compared to the 2018 Proposal.

Table 1. Proposed Land Use Acreages

Land Use	Proposed Project (Acres)	2018 Proposal (Acres)
KFMR/NWP	86.8	90
Expanded Marshland/Habitat	140.5[1]	124
Upland Habitat (Dune, Sage) and Buffer Area	37.4	—
Low-Cost Visitor Guest Accommodations	48.5	—
Guest Housing	—	50
Regional Parkland	26.3	8
Boat Facilities/Clubhouse	2.6	—
Interpretive Nature Center (1 Location)[2]	—	—
Boat Rental Lease – Land Boat Rental Lease – Water	— —	1 4
Water Leases (2 Locations)[3]	2.1	—
Active Recreation	60.1	Not a Part
Athletic Fields/Tennis, Golf Course, and Water Quality Design Feature	—	63
Open Water	95.9	55
Open Beach	5.5	7
Road[4]	1.6	19
Natural Recreation	—	24
Upland/Developed	—	7
Coastal Landscape	—	4
Restaurant Lease	—	1
Total	**505.2**	**457**

Notes: KFMR/NWP = Kendall-Frost Marsh Reserve/Northern Wildlife Preserve

1 Expanded wetlands includes approximately 30.7 acres currently occupied by Campland and approximately 109.8 acres of other new wetlands.

2 Area for the Interpretive Nature Center has not been determined, and programming for the center is assumed to occur after adoption of the amendment as part of a future General Development Plan. Two alternative locations are shown, allowing for the final location to be determined in the General Development Plan process.

3 Lease areas overlap with other land uses; therefore, acreages are not included in the total.

4 Service roads, vehicular access, and parking would be in areas proposed for low-cost visitor guest accommodations, regional parkland, boating, and active recreation, subject to future design and subsequent approvals.

Thresholds of Significance

The 2018 Proposal was analyzed for the following potential impacts based on Appendix G of the California Environmental Quality Act (CEQA) Guidelines. For impacts related to geologic conditions, a significant impact could occur if implementation of the project would:

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

2. Result in substantial soil erosion or the loss of topsoil;
3. Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse; or
4. Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property.

Impact 1: Would the proposed project expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving rupture of a known earthquake fault; strong seismic ground shaking; seismic-related ground failure, including liquefaction; or landslides?

Summary of 2018 Proposal Impacts

The 2019 Geotechnical and Geologic Hazard Evaluation concluded that the entire 2018 Proposal would be affected by seismicity and ground motion. However, the 2019 Geotechnical and Geologic Hazard Evaluation concluded that most of the proposed land use is passive park or wetland that would not be adversely affected by ground shaking. Guest housing and lease areas would include improvements that would be affected by ground motion. The 2019 Geotechnical and Geologic Hazard Evaluation concluded that future geotechnical investigations should be conducted in accordance with the City's Guidelines for Geotechnical Reports and State of California requirements to reduce impacts to a less than significant level.

In addition, the 2019 Geotechnical and Geologic Hazard Evaluation concluded that although the 2018 Proposal area is underlain by liquefiable soils, liquefication and seismically induced settlement would not likely impact the park and wetland areas. However, guest housing and lease areas would need to take liquefaction and post-liquefaction settlement into consideration during design of habitable structures. Geotechnical investigations should be conducted in accordance with the City's Guidelines for Geotechnical Reports and State of California requirements and would be reduced to a less than significant level.

The 2019 Geotechnical and Geologic Hazard Evaluation concluded that ground rupture on active faults may affect Mission Bay Drive and the southeasternmost portion of the 2018 Proposal area. Habitable structures should be located away from active faults. Geologic investigations would be required to locate active faults within the Alquist-Priolo Earthquake Fault Zone in the 2018 Proposal area so appropriate setbacks can be recommended. Impacts would be less than significant.

Finally, the 2019 Geotechnical and Geologic Hazard Evaluation concluded that the 2018 Proposal area is relatively flat. Landslides and slope stability would not affect the 2018 Proposal area unless the slopes are created during development. Impacts would be less than significant.

Proposed Project Consistency Evaluation

The Proposed Project's proposed land uses are consistent with what was evaluated for the 2018 Proposal. The Proposed Project proposes enhancement and restoration within City-owned portions of the existing KFMR/NWP and the expansion of wetlands in areas currently occupied by Campland and the developed area of De Anza Cove occupied by the former mobile home park. Similarly, ground rupture on active faults could affect Mission Bay Drive and the easternmost area of the Proposed Project area. Liquefaction and seismically induced settlement would not adversely impact the natural areas, such as upland areas, wetland areas, and open beach. However, liquefaction, post-liquefaction settlement, and lateral spread should be taken into consideration during design of structures for human occupancy. Similarly, geotechnical investigations would be required for future projects developed under the Proposed Project if they involve the construction of structures or other improvements. Such investigation reports would provide recommendations for grading and foundation design to minimize potential geologic hazards. Adherence to state and local regulations, including the California Building Code and San Diego Municipal Code, as well as recommendations from future project-specific geotechnical investigation reports, would ensure an acceptable level of risk. Therefore, impacts from seismic hazards would be less than significant.

Impact 2: Would the proposed project result in substantial soil erosion or the loss of topsoil?

Summary of 2018 Proposal Impacts

The 2019 Geotechnical and Geologic Hazard Evaluation concluded that the majority of the 2018 Proposal area is located on dredged fill where gradients are very low. As a result, the potential for erosion is very low. Since construction would be required to follow the City's standards and code that stipulate protection against temporary and permanent erosion, the impact from erosion and loss of topsoil is less than significant.

Proposed Project Consistency Evaluation

The Proposed Project's proposed land uses are consistent with what was evaluated for the 2018 Proposal. The Proposed Project proposes enhancement and restoration within City-owned portions of the existing KFMR/NWP and the expansion of wetlands in areas currently occupied by Campland and the developed area of De Anza Cove occupied by the former mobile home park. Similarly, erosion control measures would be implemented within and surrounding the Proposed Project area during excavation and demolition. Topsoil would be maintained through long-term best management practices, such as revegetation, and stormwater would be directed to areas that are reinforced with riprap and erosion-reducing permanent best management practices in accordance with the National Pollutant Discharge Elimination System Permit and required Stormwater Pollution Prevention Plan. Therefore, topsoil is not expected to be substantially lost, and the Proposed Project area is not expected to have substantial erosion. Impacts would be less than significant.

Impact 3: Would the proposed project be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?

Summary of 2018 Proposal Impacts

The 2019 Geotechnical and Geologic Hazard Evaluation concluded that liquefaction and seismically induced settlement would not likely impact park and wetland areas. Guest housing and lease areas would need to take liquefaction and post-liquefaction settlement into consideration during design of habitable structures. Geotechnical investigations should be conducted in accordance with the City's Guidelines for Geotechnical Reports and State of California requirements. In addition, the 2019 Geotechnical and Geologic Hazard Evaluation concluded that construction of improvements in areas underlain by alluvium or fill should be designed to withstand settlement of unconsolidated soil. A geotechnical investigation should be prepared for design of settlement-resistant structures in accordance with the City's Guidelines for Geotechnical Reports, reducing impacts to a less than significant level.

Proposed Project Consistency Evaluation

The Proposed Project's proposed land uses are consistent with what was evaluated for the 2018 Proposal. The Proposed Project proposes enhancement and restoration within City-owned portions of the existing KFMR/NWP and the expansion of wetlands in areas currently occupied by Campland and the developed area of De Anza Cove occupied by the former mobile home park. Similarly, liquefaction and lateral spread would not adversely impact the natural areas, such as upland areas, wetland areas, and open beach. Liquefaction, post-liquefaction settlement, and lateral spread shall be taken into consideration during design of structures for human occupancy, such as the proposed guest housing. Potential impacts would be reduced to an acceptable level of risk by implementing geotechnical and structural engineering design recommendations in accordance with the California Building Code and other applicable standards. With the implementation of existing regulatory requirements, such as the California Building Code, potential impacts from geologic instability would be less than significant.

Impact 4: Would the proposed project be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?

Summary of 2018 Proposal Impacts

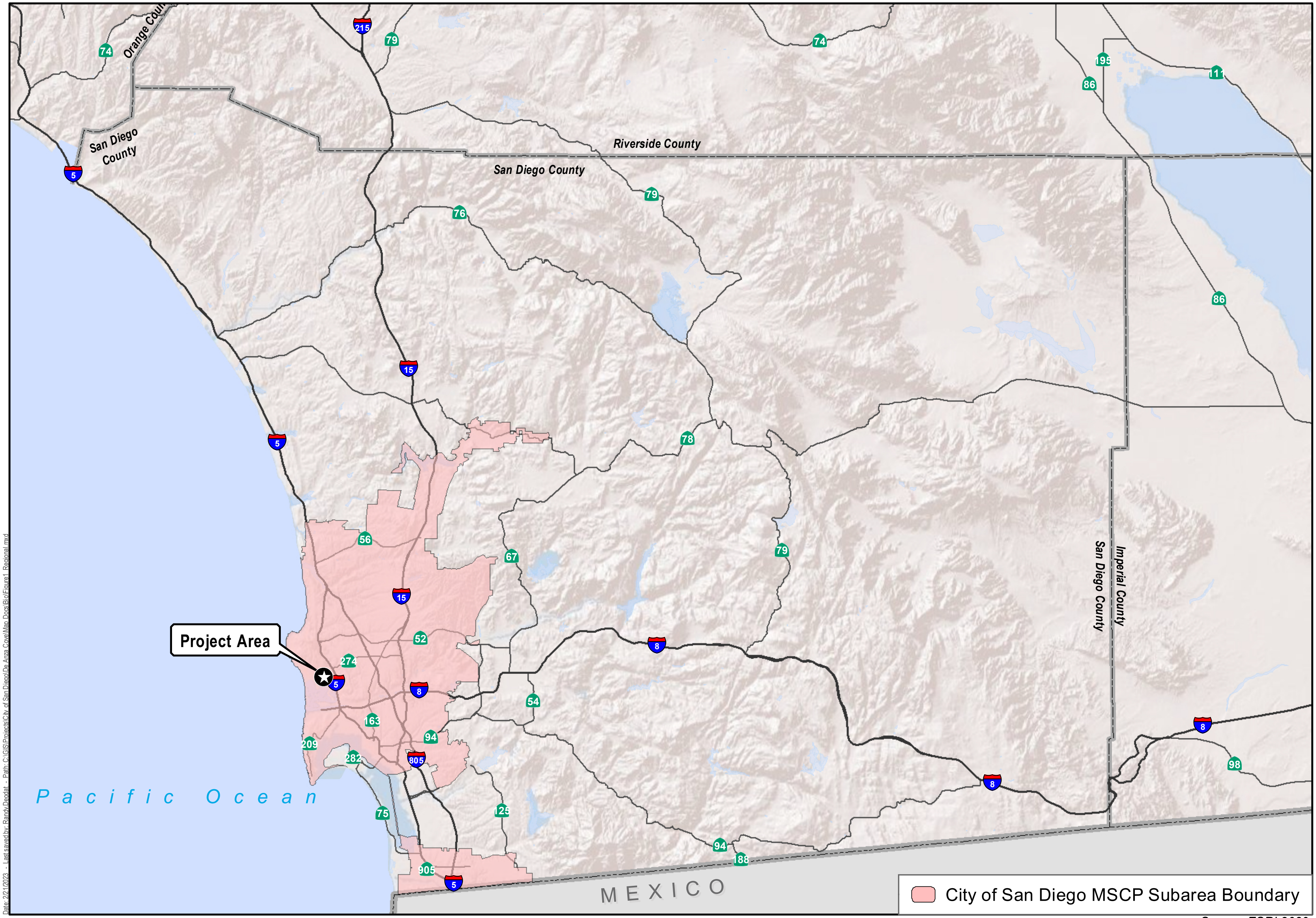
The 2019 Geotechnical and Geologic Hazard Evaluation concluded that expansive soils are generally not present within the 2018 Proposal area, and impacts would be less than significant.

Proposed Project Consistency Evaluation

The Proposed Project's proposed land uses are consistent with what was evaluated for the 2018 Proposal. The Proposed Project proposes enhancement and restoration within City-owned portions of the existing KFMR/NWP and the expansion of wetlands in areas currently occupied by Campland and the developed area of De Anza Cove occupied by the former mobile home park. Similarly, the Proposed Project area includes soils ranging from low- to non-expansive in nature. The low-expansive soil would not pose a significant risk to the development of the Proposed Project. Impacts would be less than significant.

Summary

Consistent with the 2018 Proposal, the Proposed Project would not result in significant geological impacts.



Source: ESRI 2020.

N
0 5 10
Miles

Figure 1

Regional Location

De Anza Natural Amendment to the Mission Bay Park Master Plan

Source: SanGIS Imagery 2019.

Figure 2

Project Location

De Anza Natural Amendment to the Mission Bay Park Master Plan

Source: City of San Diego 2023.

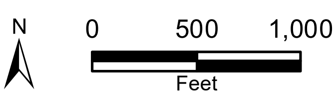


Figure 3

Site Plan

This page intentionally left blank.

Attachment 1. 2019 Geotechnical and Geologic Hazard Evaluation

This page intentionally left blank.

Geotechnical and Geologic Hazard Evaluation
De Anza and Marshland Restoration Area Revitalization Plan
San Diego, California

Prepared For:
Dudek
605 Third Street
Encinitas, California 92024

PREPARED BY:
The Bodhi Group Inc.

April 2019
Project No. 9127001

THE BODHI GROUP
INNOVATING / SUSTAINING / SOLVING

April 8, 2019
Project No. 9127001

Ms. Asha Bleier
Dudek
605 Third Street.
Encinitas, California 92024

Subject: Geotechnical and Geologic Hazard Evaluation
De Anza and Marshland Restoration Area Revitalization Plan
San Diego, California

Dear Ms. Bleier,

We are pleased to submit our Geotechnical and Geologic Hazard Evaluation for the De Anza and Marshland Restoration Area Revitalization Plan in San Diego, California. This revised report identifies geotechnical and geologic hazards that have the potential to affect the study area and incorporates comments from the City of San Diego.

Respectfully submitted,

THE BODHI GROUP, INC.

Lee Vanderhurst, P.G.
Senior Geologist

REGISTERED GEOLOGIST
W. LEE VANDERHURST
No. 1125
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Sree Gopinath
Principal Engineer

Distribution: 1) Addressee

TABLE OF CONTENTS

Figures

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 De Anza Cove Amendment to the Mission Bay Park Master Plan (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 researched, and a brief site reconnaissance was performed. Comments from the City of San Diego LDR-Geology have been incorporated into this document. A summary of the geology and geologic hazards is provided below.

- The geologic units in the Study Area consists of fill (dredged hydraulic fill and rubble fill). Although not exposed in the Study Area, it is believed that the fill is underlain locally by young alluvium, and young estuarine deposits. The young deposits are likely underlain by Very old paralic deposits (Unit 6). Fill, and young alluvium/estuarine deposits may be subject to consolidation under additional fill or structural loads.
- A small portion of the eastern De Anza Cove Amendment area is underlain by an Alquist-Priolo Special Studies Zone and a potentially active fault. Ground rupture on an active fault within the active Alquist-Priolo Zone will affect only a very small portion of the Study Area. The closest known active fault is the Rose Canyon fault, which is located approximately 350 feet east of the eastern edge of the Study Area. The Study Area, like the rest of San Diego, is in a region of local and regional 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, the Study Area is defined as having a high potential for liquefaction.
- Changes in sea level will affect the coastline portions of the Study Area. Long-term-sea-level rise is estimated to be 37 $\pm$ 10 inches above current mean sea level by 2100.
- Coastal flooding will occur following tsunami events caused by large offshore earthquakes or submarine landslides. Seiches may cause flooding during large earthquakes on the nearby Rose Canyon fault zone.
- Landslide hazards have not been mapped in the Study Area. The lack of steep or high slopes precludes landslides. Local lateral spreading during liquefaction should be expected due to shallow submarine slopes or surcharged submarine slopes due to fills placed during revitalization of the Study Area.
- Most of the Study Area is blanketed with soils that range from low to non-expansive in nature.
- Potentially corrosive soils may be present in some localized areas due to shallow, salty groundwater. The groundwater in most of the site originates from the salt water in Mission Bay. Salt content will likely vary with freshwater surcharge from Rose Creek and irrigation from the Mission Bay Golf Course.
- Infiltration rates for at grade soil will be affected by shallow (within 10 feet of the current ground surface) groundwater.

All of the geologic hazards can be mitigated through avoidance, land use, or by engineering design in accordance with established State of California and City of San Diego requirements and codes. Storm water infiltration into soils may be limited and alternative systems like bioswales or bioretention basins may be needed.

1. INTRODUCTION

The Bodhi Group has completed a Geotechnical and Geologic Hazards Study (Study) of the De Anza and Marshland Restoration Area and Revitalization Plan (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 the Conceptual Land Use Plan and Draft De Anza Cove Amendment to the Mission Bay Park Master Plan.
- 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.
- A brief site reconnaissance was performed on August 17, 2018. Access was limited by private property, locked fences, and hazardous conditions around abandoned mobile homes
- 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) and a geologic hazards map identifying areas susceptible to the potential geologic hazards described in this report (Figure 5).

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 is located in the northeast corner of Mission Bay Park in the City and County of San Diego (Figure 1) and includes the existing Kendall-Frost Marsh Reserve/Northern Wildlife Preserve, (KFMR/NWP), Campland on the Bay (Campland), the Mission Bay Tennis Center, Athletic Fields, and Golf Course, and the De Anza Cove Area (City of San Diego, 2018). The Study Area is currently occupied by vegetative wetlands on the west (KFMR/NWP); recreational vehicle (RV) and tent camping (Campland), RV camp sites, RV and boat storage yards, and an abandoned mobile home park surrounding two sides of De Anza Cove; a public beach, grass park, and associated parking on the north shore of De Anza Cove; and the Mission Bay Golf Course and Athletic fields in the northeast portions of the Study Area.

The Study Area is generally bound to the north by Grand Avenue, residences, and Mission Bay High School; to the east by commercial properties, residences, and Interstate 5 (I-5); the south by Fiesta Bay, and the west by Crown Point Drive and Residences. Topographically, the Study Area is situated on flat to gently sloping marshlands and dredged fill supporting the Study Area improvements.

The most current plan for the Study Area is shown on Figure 4. The proposed project components include expansion of the KFMR/NWP eastward into the area of the existing Campland; to upgrade existing recreational facilities (golf course, athletic fields, and tennis courts); and to develop camp and RV sites, and associated facilities. In addition, regional parkland and recreational swimming area and associated facilities (snack shack, restrooms, picnic area, and a boat rental and dock), walking trails, and an elevated scenic outlook will be constructed in the existing De Anza Cove area. The project also proposes to include water quality basins to capture and treat storm water and an enhanced pedestrian and bike waterfront trail (City, 2018). The draft amendment indicates that major grading will be required to expand the wetlands into the area currently occupied by Campland and improve camping and other facilities around De Anza Cove. Soil material will be excavated from the Campland area to be used as fill around the western and southern shores of De Anza Cove.

3. HISTORY

Mission Bay was developed from the 1940s through the 1960s. The Bay was named “False Bay” by Juan Rodriguez Cabrillo in 1542 due to a northern shift of the San Diego River Terminus from San Diego Bay to “False Bay”. In 1852 the United States Army constructed the first dike along the south side of the river to prevent it from shifting back to San Diego Bay and created an estuary outlet for the river drainage (which failed soon after construction was completed). During the late 1800s, recreational development took place, but the facilities were destroyed by flooding years later. In the late 1940s, dredging and filling operations began converting the marsh into Mission Bay Park which is almost entirely man-made. Approximately one half (1/2) of the park was once tidelands. Today levees are present on the north and south sides of the San Diego River and it no longer drains to Mission Bay (City of San Diego, 2018).

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

The geologic units in the Study Area consists of fill (hydraulic fill dredged from Mission Bay and rubble fill from other construction sites), underlain by young alluvial and estuarine deposits. Although not exposed in the Study Area, it is believed that the fill is underlain locally by young alluvium, and young estuarine deposits. The young deposits are likely underlain by Old paralic deposits (Unit 6). Older Pliocene and Eocene sedimentary rocks unconformably underlie the Old paralic deposits. Fill, and young alluvium/estuarine deposits may be subject to consolidation under additional fill or structural loads (Figure 2, Regional Geologic Map). Descriptions of the general characteristics of these units are presented below.

- Af – Artificial fill (late Holocene). The Study Area is underlain by a variable thickness of fill consisting of dredged, hydraulically place materials sourced from Mission Bay and rubble fill composed of construction debris. Based on old topographic maps (United States Coast & Geodetic Survey, 1895), the fill likely ranges from 5-feet thick along the shore line to about 20-feet thick in the northern portions of the Study Area. The fill likely consists of loose to medium dense sand. (SCST, 2018 pers com). There is anecdotal evidence that portions of fill used to create Campland consist of construction debris (concrete and brick rubble) mixed with sand. Portions of the fill may have been compacted during construction of existing streets and building pads although we did not find documentation of compaction. The fill will probably be subject to settlement under building or additional fill loads.
- Qya – Young alluvial and estuarine deposits (Holocene and late Pleistocene). The young alluvial and estuary (estuarine) deposits are not exposed at the ground surface in the Study Area. Young alluvial and estuarine deposits likely underlie the fill and are characterized as poorly consolidated, sand, silt and clay layers. The alluvium and estuarine deposits are likely loose, to soft and saturated. The young alluvial and estuarine deposits are subject to settlement under building or additional fill loads and are liquefiable.

- Qop6 – Old paralic deposits, Unit 6 (middle to early Pleistocene). The Old paralic deposits are not exposed in the Study Area. They are believed to underlie the young alluvial and estuarine deposits at an approximate depth of 50 feet below the existing ground surface. Where exposed at the surface east and west of the Study Area, the Unit 6 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 might be sufficient to support deep foundations for light structural loads.

4.2. Local Structural Geology

The older geology (Pliocene and Eocene sedimentary rocks) underlying the Study Area dips (tilts) gently to the west and east forming a north-south trending syncline (Figure 2). The old paralic deposits are flat lying or dip gently to the west. The older geology, including the Old paralic deposits have been tilted and faulted just east of the Study Area by the Rose Canyon fault zone.

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 plate boundary that affects 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. Earthquakes on the faults summarized in Table 1 below will 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 approximately 350 feet east of the eastern edge of the Study Area (Figure 2). 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). The previously mapped traces of the Rose Canyon fault zone are located beneath the Interstate 5 freeway or east of the freeway.

The Rose Canyon fault zone in the vicinity of the Study Area consists of a wide zone of anastomosing and branching fault traces with varying lengths of continuity. The vicinity of the Study Area has been modified by grading for the freeway, Mission Bay Park and residential construction along Morena Boulevard. The State of California has established an Alquist-Priolo Earthquake Fault Zone over the area from Mission Bay Drive eastward to approximately Lloyd Street in the vicinity of the southeast corner of the Study Area. Improvements within the Alquist-Priolo Earthquake Fault Zone (e.g., buildings with human occupancy, critical utilities, bridges, etc.) are required to investigate whether there are active faults transecting the proposed improvements. While there are no previously mapped active faults in the Study Area, a small portion of the Alquist-Priolo Earthquake Fault Zone does extend west, beyond East Mission Bay Drive into the Study Area (Figure 5). For planning purposes, it may be assumed that active faults may exist in the area within the Alquist-Priolo Zone shown in Figure 5.

Table 1 - Fault Characteristics for Active Faults in the Region

Fault Name	Approximate Distance to Study Area (mi)	Slip Rate (mm/yr)	Fault Length (miles)	Estimated Magnitude (Maximum Moment Magnitude (Mw))
Newport-Inglewood-Rose Canyon Fault Zone	0.2 mi	1.5	130	7.2
Coronado Bank Fault Zone (offshore)	14	3.0	115	7.6
San Diego Trough Fault Zone (offshore)	20	1.5	106	7.5
San Miguel-Vallecitos Fault Zone (Northern Baja California)	30	0.2	100	6.9
Elsinore Fault Zone	41	5.0	190	7.0
San Clemente Fault Zone (offshore)	23		129	7.7
San Jacinto Fault Zone	63	4.0	152	6.8
Southern San Andreas Fault Zone	90	25	140	7.2

Table References include; CDMG 2002, CGS 2010, Hirabayashi and others 1996, Kahle and others 1984, Ryan and others 2012 and USGS 2015b.

The nearest potentially active fault is the northern extension of the Mission Bay fault associated with the Rose Canyon fault zone. The Mission Bay fault extends from the southern portion of Mount Soledad, southward where it joins the Rose Canyon fault. The fault, as mapped, offsets the Pliocene San Diego Formation but not early Pleistocene, Very old paralic deposits.

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 relatively flat. Landslides and slope stability will not affect the Study Area unless the slopes are created by during development.

7. SOILS AND INFILTRATION

The fill at the site is predominantly granular and unconsolidated which should create high infiltration rates. Shallow groundwater may affect storm water recharge systems. Other factors should be considered in evaluating storm water infiltration feasibility including lateral migration of water 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 Regional Water Quality Control Board (RWQCB) San Diego Basin Plan (RWQCB, 1994), 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.

Groundwater data for the Study Area was not available; however, based on the site elevation and proximity to Fiesta Bay (adjacent) of the land portion of the Study area, groundwater is anticipated to be relatively shallow (approximately 10 feet bgs). The groundwater flow direction is anticipated toward De Anza Cove and Fiesta Bay, south of the land portions of the Study Area.

9. DRAINAGE AND FLOODING

The study area is situated on a mixed recreation and residential land use area. Current drainage is into streets, storm drains, and gutters that flow into Mission Bay. Grassy park land sheet flows into the bay. Rose Creek flows in a rip-rap lined dredged channel into the Bay. The Study Area is within Zone-X of the San Diego County Flood Insurance Rate Map (FIRM 2012). The Study Area has a 1% chance of flood with average depths of less than 1 foot.

Prediction of future sea level rise is based on historical state-wide trends and estimates of sea level changes due to sea temperature increases and melting of polar and other glaciers. These effects are influenced by predicted increases in greenhouse gases (predominantly from combustion of petroleum and coal). Based on these factors and using NRC South of Mendocino, Los Angeles Projection (Table A-2, California Coastal Commission, 2015), the estimated sea level rise for the Study Area is 37 ± 10 inches for the year 2100.

10. MINERALOGIC RESOURCES

Data from the USGS Mineral Resource Data System show that there are no mineral resources in the Study Area. Reuse of materials excavated from the Study Area in new construction may be affected locally by oversized rubble. The rubble may need special handling and processing before use as structural fill.

11. GEOLOGIC HAZARDS AND IMPACTS

This section identifies geologic hazards that may affect proposed policies, programs, and land use incorporated into the De Anza Cove Amendment of the Mission Bay Park Master Plan. These hazards include seismicity and ground motion; ground rupture; liquefaction; seismically-induced settlement; and flooding due to long term sea level rise and tsunamis and seiches. These hazards can be mitigated through administrative controls (e.g., avoiding 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 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. The Study Area occupies a portion of map Sheet 25. Identified hazards and others are described below. Figure 5, Summary of Geohazards, shows the location of hazards as defined by the City maps. The Study Area is designated Geologic Hazard Category 31; "high potential for liquefaction due to high groundwater...and hydraulic fills". The easternmost portion of the Study Area is shown to be underlain by potentially active and active buried faults.

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 fill or unconsolidated alluvium.

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 (Longitude -117.21770, Latitude 32.799344) is located in a zone where the horizontal peak ground acceleration having a 10 percent probability of exceedance in 50 years is 0.570g (where g represents the acceleration of gravity)[1].

11.2. Ground Rupture

Large earthquakes (usually in excess of Magnitude M5) often rupture the ground surface, shifting the ground up or down or shearing sideways on either side of the fault. An active fault within the

[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).

Alquist-Priolo Fault Zone in the Study Area (Figure 5) could possibly cause a combination of sideways (right-lateral) and vertical displacement on the order of several inches to a foot if a large magnitude earthquake occurred on that specific trace.

11.3. Liquefaction, Seismically Induced Settlement and Lateral Spreading

Liquefaction is a phenomenon where the strength and stiffness of a soil is reduced by earthquake or other rapid loading. 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 spreads. 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. While slopes in the Study Area are very gentle, there is sufficient gradient along the shoreline to create conditions for lateral spreading where during liquefaction, the ground surfaces moves laterally. The potential for lateral spreads can increase in areas where fills placed for development create an artificial gradient.

The entire Study Area is underlain by liquefiable soil.

11.4. 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. The State of California Tsunami Inundation Maps, La Jolla Quadrangle (Cal EMA, 2009) shows the coastal portion of the Study Area below elevation 10 to be within the inundation zone. Seiches are seismically induced waves within enclosed bodies of water such as Mission Bay. A seiche could be created by a large magnitude earthquake occurring on the Rose Canyon fault zone. However, the seiche inundation would likely be less than the inundation caused by a tsunami. of the

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.

11.5. Sea Level Rise

Prediction of future sea level rise is based on historical state-wide trends and estimates of sea level changes due to sea temperature increases and melting of polar and other glaciers. These effects are influenced by predicted increases in greenhouse gases (predominantly from combustion of petroleum and coal). Based on these factors and using NRC South of Mendocino, Los Angeles Projection (Table A-2, California Coastal Commission, 2015), the estimated sea level rise for the Study Area is 37 ± 10 inches for the year 2100

11.6. 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 alluvial/estuarine sediments) may occur locally where new loads are imposed on previously uncompacted fill or unconsolidated alluvium.

11.7. Infiltration

The soil under the Study Area is predominantly granular and will likely exhibit high infiltration rates. Onsite storm water infiltration facilities will need take shallow groundwater (approximately 10 feet below ground) into consideration during design.

11.8. Expansive or Corrosive Soils

The soil in the Study Area is granular and is not expected to be expansive. Because the groundwater under the Study Area is derived from Mission Bay, it will be salty or brackish. Corrosion of metal will occur if the metal is in contact with ground water.

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. Most of the proposed land use is passive park or wetland that will not be adversely affected by ground shaking. Guest Housing and Lease areas will include improvements that will be affected by 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

Liquefaction and seismically induced settlement will not likely impact park and wetland areas. Guest Housing and Lease areas will need to take liquefaction and post liquefaction settlement into consideration during design of habitable structures. 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.

Damage to pavements due to liquefaction will be repairable which may be preferential to mitigation measures.

12.3. Fault Rupture

Ground rupture on active faults may affect Mission Bay Drive and the south easternmost portion of the Study Area. Damage to pavements will be repairable. Habitable structures will need to be located away from active faults. Geologic investigations will be required to locate active faults within the Alquist-Priolo Earthquake Fault Zone in the Study Area so appropriate setbacks can be recommended.

12.4. Flooding due to Tsunamis, Seiches, and Sea Level Rise

Flooding of passive park and wetlands will not require mitigation. Guest Housing and Lease areas may be affected depending on final grades. Mitigation will include relocation to higher elevations or construction of protective walls. Docks or other recreational facilities may need to be replaced following flooding events.

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. Corrosive Soil

Corrosive soil should be evaluated by a Corrosion Engineer for recommendations for soil replacement or cathodic protection.

12.7. Infiltration

Infiltration potential should be evaluated in accordance with City of San Diego Storm Water Standards, Part 1, 2017 Edition (City of San Diego, 2017).

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. While there are active and potentially active faults in the Study Area, no improvements are proposed in these areas.

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

Less than significant effect. Construction of graded camp sites, cabins, and other habitable structures, parking lots and underground utilities will be required to use seismic resistant designs in accordance with California and City standards and codes.

13.3. Threshold G-1 c) Seismic Ground Failure

Less than significant effect. Most improvements are not susceptible to damage due to ground failure (passive park, wetland and habitat improvements). Construction of graded camp sites, cabins, and other habitable structures, parking lots and underground utilities will be required to use seismic resistant designs in accordance with California and City standards and codes.

13.4. Threshold G-1 d) Seismic Induced Landsliding

Less than significant effect. The Study Area is relatively flat and low lying. Any slopes planned for the improvements should constructed in accordance with City of San Diego standards and codes and should be stable under static and pseudostatic conditions.

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

Less than significant effect. Most of the Study Area is located on dredged fill 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)

<u>Landslides</u>: Less than Significant. Landslide prone geologic formations and tall, steep slopes are not present in the Study Area.

<u>Settlement</u>: Less than Significant. Most of the improvements underlain by settlement prone soil are not susceptible to damage due to settlement (passive parks, wetland and habitat improvements). Construction

of graded pads to be used for camp sites and cabins as well as other habitable structures will be required to use designs resistant to settlement in accordance with California and City standards and codes.

Lateral Spreading: Less than Significant. Most of the improvements are underlain by conditions not susceptible to damage due to lateral spreading. Where habitable structures are constructed in areas susceptible to lateral spreads or where fill embankments are required, geotechnical recommendations to reduce lateral spread impacts to acceptable levels will be required. This may be accomplished by design and construction in accordance with current state and city standards and codes.

13.7. Threshold G-4 Expansive Soil

Less than Significant. Expansive soils are generally not present in the Study Area.

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

Less than Significant. Shallow groundwater will preclude the use of onsite sewage disposal systems in the Study Area.

14. CONCLUSIONS

The conclusions from this Study are listed below.

- There are no geologic hazards that cannot be avoided or addressed.
- There are no policies or recommendations of the De Anza Cove Amendment to the Mission Bay Park Master Plan Update (Roberts & Todd, 1994) 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 De Anza Cove Amendment to the Mission Bay Park Improvement Projects that cannot be avoided, reduced to an acceptable level of risk, or reduced below a level of significance through mandatory conformance with applicable regulatory requirements and the recommendations of this technical report
- The impact of unstable soil can be reduced to less than significant levels by requiring geotechnical investigations on settlement sensitive projects (buildings and improvements like swimming pools, underground utilities and areas where substantial amounts of fill may be placed).

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.

16. REFERENCES

Agnew, D. C., Legg, M., and Strand, C., 1979, Earthquake History of San Diego, Earthquake and Other Perils, San Diego Region, Abbott, P. L., and Elliott, W. J. eds., San Diego Association of Geologists.

Allen, C. R. and St. Armand, P., 1965, Relationship between Seismicity and Geologic Structure in the Southern California Region, Seismological Society of America Bulletin, v 55, No. 4.

Anderson, J. G., Rockwell, T. K., and Agnew, D. C., 1989, Past and Possible Future Earthquakes of Significance to the San Diego Region, Earthquake Spectra, v. 5.

Brune, J. N., Simons, R. S., Rebollar, C., and Reyes, A., 1979, Seismicity and Faulting in Baja California in Earthquakes and Other Perils, San Diego Region, Abbott, P. L. and Elliott. W. J. eds., San Diego Association of Geologists.

California Coastal Commission, 2015, Sea Level Rise Policy Guidance'

California Department of Conservation, 2008. Ground Motion Interpolator. Online. http://www.quake.ca.gov/gmaps/PSHA/psha_interpolator.html. Accessed: May 2017.

California Department of Water Resources, 2017, Water Data Library Website: www.water.ca.gov/waterdatalibrary: accessed May.

California Division of Mines and Geology, 1963, Geology and Mineral Resources of San Diego County, California, by F. H. Weber Jr., County Report 3

California Division of Mines and Geology, 2002, California Department of Conservation, Division of Mines and Geology Open File Report 96-08, U.S. Department of the Interior, U.S. Geological Survey Open File Report 96-706 Probabilistic Seismic Hazard Assessment for the State of California, Appendix A: Fault Source Parameters, 1996, revised in 2002.

California Emergency Management Agency, California Geological Survey, and the University of Southern California, 2009. Tsunami Inundation Map for Emergency Planning, San Diego Bay, Scale 1:24,000.

California Geological Survey, 2003, State of California, Earthquake Fault Zones, La Jolla Quadrangle: Scale 1:24,000.

California Geological Survey, 2010, Fault Activity Map of California, http://www.quake.ca.gov/gmaps/FAM/faultactivitymap.html#.

California Geological Survey, 2013, Note 52 Guidelines for Preparing Geological Reports for Regional-Scale Environmental and Resource Management Planning.

California Geological Survey, 2018, Special Publication 42, Fault-Rupture Hazard Zones in California.

California Regional Water Quality Control Board, San Diego Region, 1994 (with amendments effective on or before April 4, 2011), Water Quality Control Plan for The San Diego Basin (9).

California State Water Resources Control Board, 2017, Geotracker Website: http://geotracker.waterboards.ca.gov: accessed May.

Cao, T., Bryant, W.A., Rowshandel, B., Branum, D., and Willis, C.J., 2003, The Revised 2002 California Probabilistic Seismic Hazards Maps: California Geological Survey.

City of San Diego Development Services Department, 2018, De Anza Amend Tech Studies, Project No. 621335, dated November 11.

City of San Diego Planning Department (City), 2018, Public Notice of Preparation of a Program Environmental Impact Report and Scoping Meeting: dated June 11.

City of San Diego Seismic Safety Study, Geologic Hazards and Faults, 2008a, Grids 26 and 31, Scale 1: 800, updated: 2018.

City of San Diego, 2008b, City of San Diego General Plan, Adopted March 10, 2008, Resolution No. R-303473.

City of San Diego, 2017, Storm Water Standards, Part 1, BMP Design Manual, Chapters for Permanent Site Design and Storm Water Treatment and Hydromodification, November 2017 Edition.

City of San Diego, 2018, Guidelines for Geotechnical Reports.

City of San Diego, 2018, Mission Bay History, https://www.sandiego.gov/park-and-recreation/parks/regional/missionbay/history: accessed June.

County of San Diego, 2004, revised 2010, http://www.sandiegocounty.gov/content/dam/sdc/oes/docs/DRAFT_COSD_DamFailure1.pdf.

Hauksson, E. and Jones, L .M, 1988, The July 1988 Oceanside (ML=5.3) Earthquake Sequence in the Continental Borderland, Southern California, Bulletin of the Seismological Society of America, Vol 78.

Hirabayashi, C. K., Rockwell, T. K., Wesnousky, S. G., Sterling, M. W., Surez-Vidal, F., 1996, A Neotectonic Study of the San Miguel-Vallecitos Fault, Baja California, Mexico, Bulletin of the Seismological Society of America, Vol. 86.

Jennings, C.W. and Bryant, W.A., 2010, Fault Activity Map of California and Adjacent Areas: California Geological Survey, California Geological Map Series, Map No. 6): Scale 1:250,000.

Kahle, J. E., Bodin, P. A. Morgan, G. J. 1984, Preliminary Geologic Map of the California-Baja California Border Region.

Kahle, J. E., 1988, A Geomorphic Analysis of the Rose Canyon, La Nacion and Related Faults in the San Diego Area, California, California Division of Mines and Geology Fault Evaluation Report FER-196.

Kennedy, M. P. 1975, Geology of the San Diego Metropolitan Area, California, California Division of Mines and Geology Bulletin 200.

Kennedy, M. P. and Tan, S. S. 1975 Character and Recency of Faulting, San Diego Metropolitan Area, California, California Division of Mines and Geology, Special Report 123.

Kennedy, M.P., and Tan, S.S. compilers, 2008, Geologic Map of the San Diego 30’X60’ Quadrangle, California, California Geological Survey, Regional Geologic Map No. 3, Scale 1:100,000.

Reichle, M., Bodin, P., Brune, J. 1985, The June 1985 San Diego Earthquake Swarm (Abs), EOS Transactions, American Geophysical Union, Vol. 66

Rockwell, T., Hatch, M. E. and Shug. D. L., 1987, Late Quaternary Rates, Agua Blanca and Borderland Faults, U.S. Geological Survey, Final Technical Report.

Rockwell, T., 2010, The Rose Canyon Fault Zone in San Diego, Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics and Symposium in honor of Professor I. M. Idriss, San Diego California.

Ryan, H. F., Conrad, J. F., Paul, C. K., McGann, M., 2012, Slip Rate on the San Diego Trough Fault Zone, Inner California Borderland and the 1986 Oceanside Earthquake Swarm Revisited, Bulletin of the Seismological Society of America, Vol. 102.

San Diego Association of Governments (SANDAG), 2017, http://www.arcgis.com/home/webmap/viewer.html?url=https://services.arcgis.com/oxInpRhVIBx lo4pO/ArcGIS/rest/services/City_of_San_Diego_Potentially_Active_Faults/FeatureServer/0&sou rce=sd, accessed April.

SCST, 2018, Thomas B. Canady, Personal Communication, Geotechnical Investigation of Mission Bay Golf Course Clubhouse Renovation.

Simmons, R. S., 1977 Seismicity of San Diego, 1934-1974, Bulletin of the Seismological Society of America, Vol. 67.

Tan, S.S., 1995, Landslide Hazards in the Southern Part of the San Diego Metropolitan Area, San Diego County, California, OFR 95-03.

Toppozada, J. A., Real, C. R., and Parke, D. L., 1981, Preparation of Isoseismal Maps and Summaries of Reported Effects for Pre-1990 California Earthquakes, California Division of Mines and Geology Open File Report 81-11.

United States Coastal and Geodetic Survey, 1895, San Diego Bay, 1:40,000.

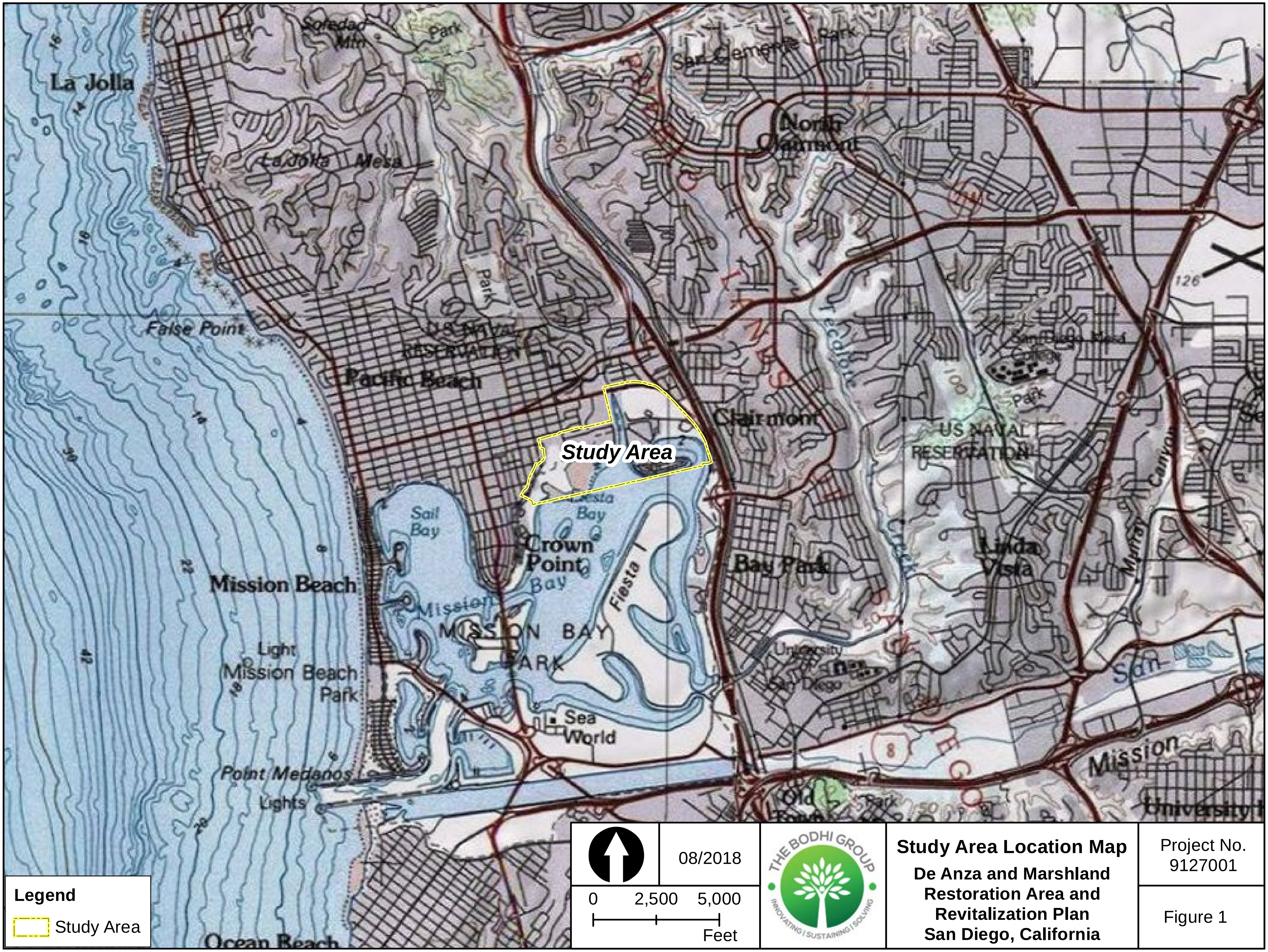
United States Department of Agriculture, 1953, Stereo Aerial Photographs, Flight AXN, Line 4M, Frames 90 and 91.

United States Geological Survey, 2015a Mineral Resources Data System, http://mrdata.usgs.gov/mrds/, accessed April

United States Geological Survey, 2015b, Hazard Curve Application, http://geohazards.usgs.gov/hazardtool/application.php, accessed April.

University of California at Davis, California Soil Resource Laboratory, 2017, https://casoilresource.lawr.ucdavis.edu/gmap/, accessed April.

Figures



Legend

Study Area

08/2018

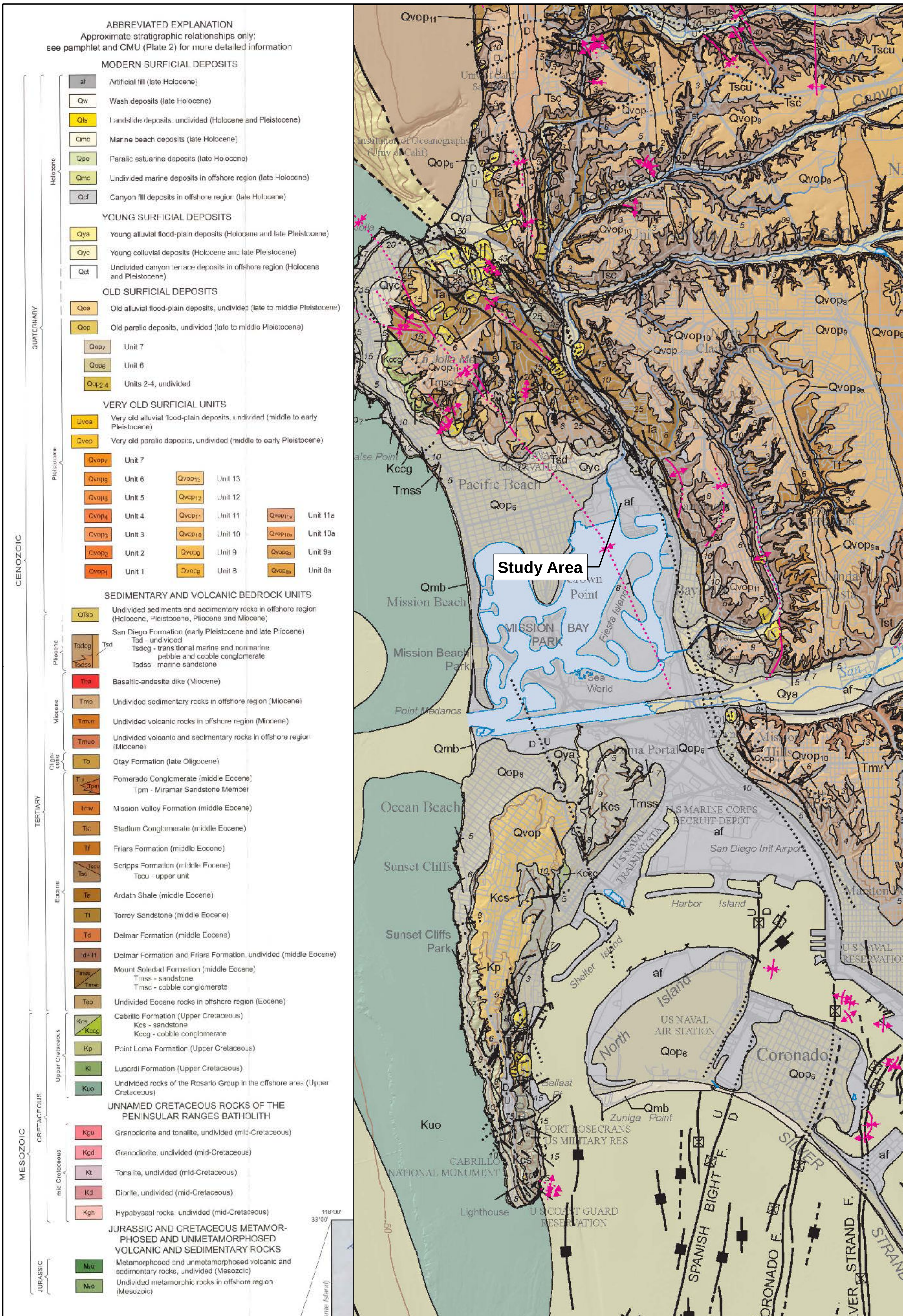
0 2,500 5,000 Feet

Study Area Location Map

De Anza and Marshland Restoration Area and Revitalization Plan
San Diego, California

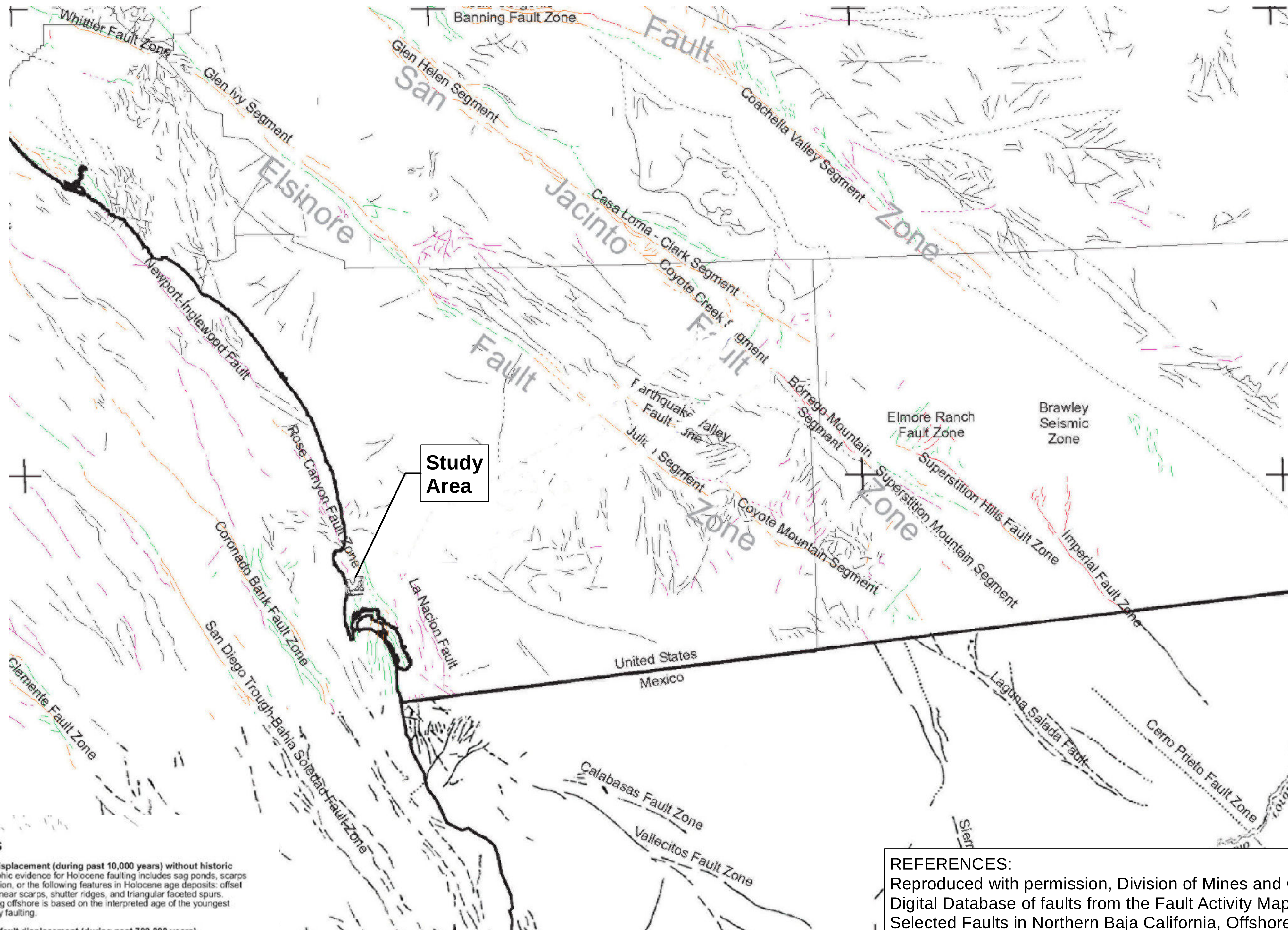
Project No. 9127001

Figure 1



Modified from:
Kennedy, M.P., and Tan, S.S. 2008

N / W / E / S	Project No. 9127001	**Regional Geology**	
	08/2018	**De Anza and Marshland Restoration Area and Revitalization Plan San Diego, California**	
Not to Scale	Drawn By: SG		Figure 2



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, l993.)

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.

REFERENCES:
Reproduced with permission, Division of Mines and Geology, CD-ROM 2000-006 (2000),
Digital Database of faults from the Fault Activity Map of California and Adjacent Areas. IBID (1994),
Selected Faults in Northern Baja California, Offshore, and the Adjacent Southern California Area.

N / W / E / S	Project No. 9127001	THE BODHI GROUP — INNOVATING | SUSTAINING | SOLVING	**Regional Fault Map** **De Anza and Marshland Restoration Area and Revitalization Plan** **San Diego, California**
	Date: 08/2018		
Not To Scale	Drawn By: SG	Figure 3	**Keanry Mesa** **Community Plan Update** **San Diego, California**

SOURCE: City San Diego 2018; SANGIS 2017, 2018

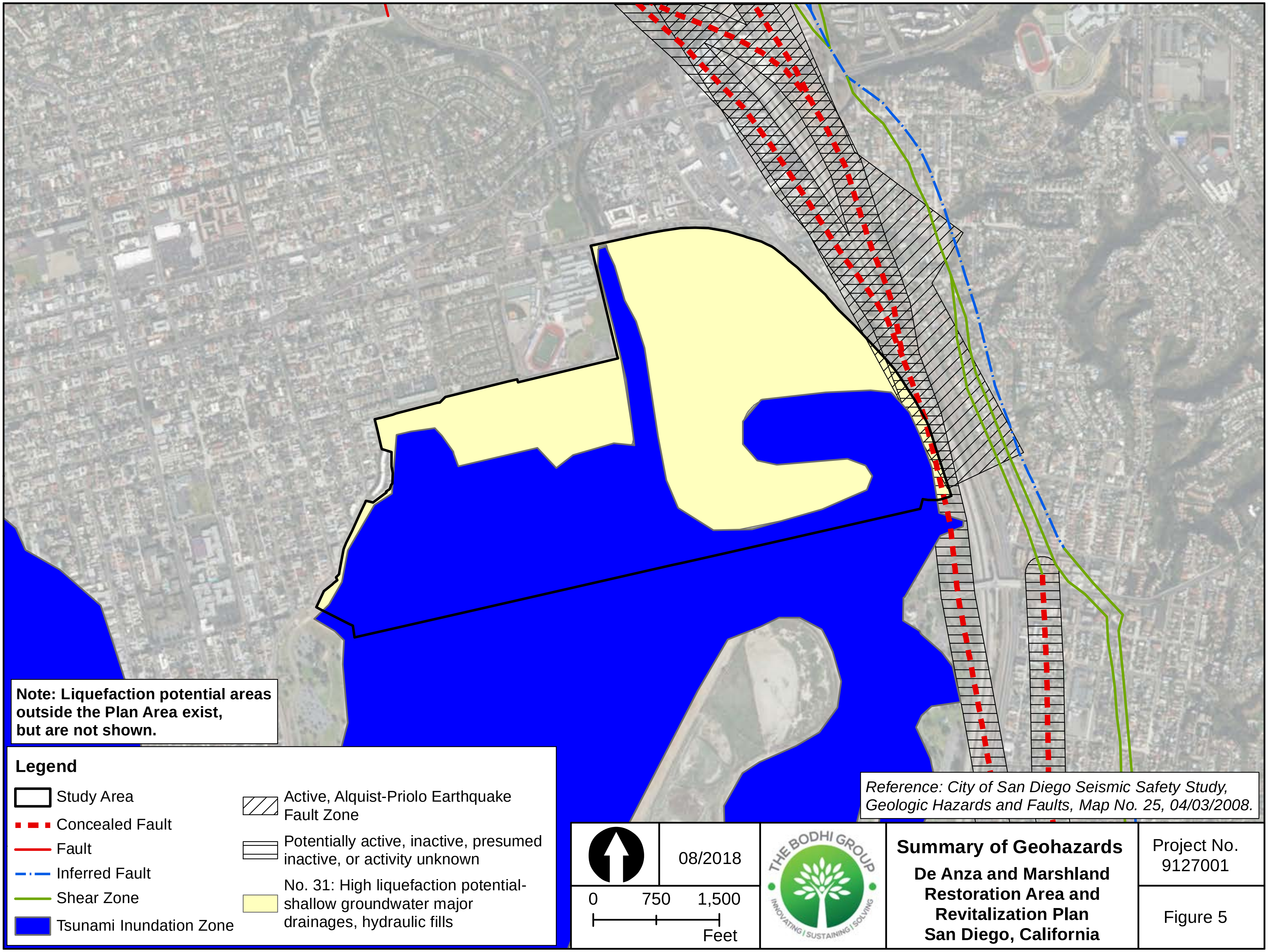
SD Planning

0 500 1,000 Feet

FIGURE 4

Conceptual Land Use Plan

De Anza Cove Amendment to the Mission Bay Park Master Plan


Note: Liquefaction potential areas outside the Plan Area exist, but are not shown.
Legend
Study Area
Concealed Fault
Fault
Inferred Fault
Shear Zone
Tsunami Inundation Zone
Active, Alquist-Priolo Earthquake Fault Zone
Potentially active, inactive, presumed inactive, or activity unknown
No. 31: High liquefaction potential-shallow groundwater major drainages, hydraulic fills
Reference: City of San Diego Seismic Safety Study, Geologic Hazards and Faults, Map No. 25, 04/03/2008.
08/2018
0 750 1,500
Feet
THE BODHI GROUP
INNOVATING | SUSTAINING | SOLVING
Summary of Geohazards
De Anza and Marshland Restoration Area and Revitalization Plan
San Diego, California
Project No. 9127001
Figure 5