APPENDIX L

GEOLOGY AND SOILS EVALUATION SHIPYARD SEDIMENT ALTERNATIVE ANALYSIS CONVAIR LAGOON

Page Intentionally Left Blank

GEOLOGY AND SOILS EVALUATION
SHIPYARD SEDIMENT
ALTERNATIVE ANALYSIS
CONVAIR LAGOON
SAN DIEGO, CALIFORNIA

PREPARED FOR:
Brown & Winters
120 Birmingham Drive, #110
Cardiff By The Sea, California 92007

PREPARED BY:
Ninyo & Moore
Geotechnical and Environmental Sciences Consultants
5710 Ruffin Road
San Diego, California 92123

May 27, 2011
Project No. 106997002

May 27, 2011
Project No. 106997002

Ms. Wentzelee Botha
Brown & Winters
120 Birmingham Drive, #110
Cardiff By The Sea, California 92007

Subject: Geology and Soils Evaluation
Shipyard Sediment Alternative Analysis
Convair Lagoon
San Diego, California

Dear Ms. Botha:

In accordance with your request and authorization, we have performed a geology and soils evaluation for the Shipyard Sediment Alternative Analysis for the Convair Lagoon project. The project proposes to dispose of contaminated dredge materials to a confined disposal facility to be constructed at Convair Lagoon in San Diego Bay. The attached report presents our methodology, findings, opinions, and recommendations regarding the geology and soils conditions at the site.

We appreciate the opportunity to be of service on this project.

Respectfully submitted,
NINYO & MOORE

Emil Rudolph, GE
Senior Engineer

Jonathan Goodmacher, CEG
Manager/Principal Geologist

PROFESSIONAL GEOLOGIST
JONATHAN C. GOODMACHER
Exp. 12/31/11
No. 2136
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

MJB/ER/JG/gg

Distribution: (1) Addressee

TABLE OF CONTENTS

Figures

EXECUTIVE SUMMARY

The Convair Lagoon Alternative site consists of approximately 15 acres of water and land located within the San Diego Bay in the City of San Diego, California. The site is bounded by the San Diego Bay to the south; North Harbor Drive, a greenway, and the San Diego International Airport to the north; the United States North Harbor Drive Coast Guard Facility (U.S. Coast Guard Station) to the east; and a rental car parking lot to the west. A concrete pier extends into the lagoon from the northern shoreline and asphalt-paved dock. Several municipal storm drains outlet into the lagoon from the northwest and northeast margins of the lagoon and from beneath the pier. These include a 60-inch diameter, a 54-inch diameter, and two 30-inch diameter pipeline outlets on the northern shoreline, as well as three smaller outlets on the western shore of the lagoon. The storm drain outlets are protected by energy dissipaters consisting of concrete erosion control mattresses and rock riprap. The elevation of the project site ranges from approximately 10 feet above mean lower low water (MLLW) at its northern end to -15 feet below MLLW on the floor of the lagoon.

The Convair Lagoon Alternative involves the construction of a confined disposal facility (CDF) for the placement of contaminated marine sediment dredged from the Shipyard Sediment Site. A rock jetty confinement barrier will extend the general shoreline of the adjacent rental car facility and will contain the fill material placed during earthwork operations.

Geologic and geotechnical constraints evaluated for the project include:

- The site is underlain by fill material and bay deposits, and underlain at depth by Pleistocene-age old paralic deposits. The fill includes material placed as part of a capping operation in the 1990s. Recent bay sediments, deposited along the edges of San Diego Bay, underlie the fill. Geotechnical constraints related to soils at the project are:
    - *Hydrocollapse* – Exposed existing site soils and proposed fill materials within and overlying the zone of fluctuating groundwater may be subject to hydrocollapse.
    - *Soft Ground* – Soft ground or loose soils are expected to be present at the project site.
    - *Expansive Soils* –Exposed and buried existing site soils may have a moderate to high potential for expansion. Dredged and imported fill materials are proposed to raise site grade. Based on our familiarity with the potential dredge source (San Diego Bay), granular materials are likely to be placed as fill. Further, capping import materials would likely be specified as granular, therefore the potential for near-surface expansive soils at the project is low.
    - *Compressible Soils* – The existing fill and bay deposits underlying the project are thought to consist of silty sand, silt, and sandy clay, which are considered compressible under loading.

  - *Fill Soils* – Existing fill soils placed without engineering supervision may be loosely or inadequately compacted, may contain oversize materials unsuitable for reuse in engineered fills, and may contain unsuitable organic or debris that may preclude their use in engineered fills.

- The closest known major active fault is the Rose Canyon Fault. Specifically, the Spanish Bight Fault, an element of the Rose Canyon Fault, intersects the southwestern boundary of the project. As a result, the western portion of the project area is within both a State of California-designated Earthquake Fault Zone (formerly known as an Alquist-Priolo Special Studies Zone) and a City of San Diego-designated fault zone. Geotechnical constraints related to faulting and seismic events at the project are:

  - *Ground Shaking* – The project has a high potential for strong ground motions due to earthquakes on adjacent and nearby active faults.

  - *Ground Surface Rupture* – Ground surface rupture due to active faulting is possible at the project due to the presence of the Spanish Bight Fault at the southwestern boundary of the project. Additionally, lurching or cracking of the ground surface as a result of nearby seismic events is possible.

  - *Liquefaction* – The soils underlying the project are expected to be subject to dynamic settlement or liquefaction during a seismic event on a nearby fault.

  - *Lateral Spread* – The existing exposed soils are expected to be subject to lateral spread during a seismic event on a nearby fault.

- Groundwater is expected at approximately 3 feet above MLLW level (approximately 9 feet below the proposed ground surface).

- The land to the west and east of the project is not designated as being subject to inundation during a tsunami event (California Geological Survey, 2009). However, the existing shoreline of the lagoon is designated as being at the tsunami inundation line. This line represents the maximum considered tsunami wave runup.

- Based on our review of published geologic literature, aerial photographs, and our site reconnaissance, no landslides or related features underlie or are adjacent the project and the potential for landslides is considered low.

- Based on review of Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM), posted on the County of San Diego, San Diego Geographic Information Source (SanGIS) website (2004), the shore of the lagoon is within the 100-year flood.

- Based on review of dam inundation maps, significant flooding due to dam inundation is not expected to occur at the project.
- Due to the proximity of the project to the marine environment and the anticipated variability of the on-site soils, soils at the project should be treated as highly corrosive.

1. INTRODUCTION

In accordance with your request, Ninyo & Moore has completed an evaluation of geologic and soil conditions for the proposed Shipyard Sediment Alternative project (the project) located in northern portion of San Diego Bay (Figure 1).

Our evaluation is based on geologic reconnaissance, reviews of published and unpublished geologic and geotechnical reports, aerial photographs, in-house data, and our assessment of the potential geologic hazards the project. The purpose of this survey was to estimate the potential for impacts to the project from geologic or soils conditions on or in close proximity to the site, and to discuss measures that might be considered during project design to reduce or mitigate the potential impacts with respect to the development of the proposed project.

2. SCOPE OF SERVICES

Ninyo & Moore's scope of services for this geologic and soils evaluation included the activities listed below:

- Review of readily available regional, local, and site-specific geologic and geotechnical reports.
- Review of readily available background information including topographic, soils, mineral resources, geologic, and seismic and geologic hazard maps, and stereoscopic aerial photographs.
- Performance of a geologic reconnaissance of the site and vicinity.
- Compilation and analysis of the data obtained from our background reviews and site reconnaissance.
- Preparation of this report documenting findings and providing opinions and recommendations regarding possible geologic and soil impacts at the site. The findings were evaluated with respect to questions A through H listed in Section 6, "Geology and Soils" within Appendix G, "Environmental Checklist Form" of the "Guidelines for Implementation of the California Environmental Quality Act (CEQA)."

3. REGULATORY FRAMEWORK

Geologic resources and geotechnical hazards within the proposed project area are governed by the City of San Diego and the State of California. The City's Building Division plans contain conservation and safety elements for the evaluation of geologic hazards. The procedures for construction related earthwork and excavation are established by local grading ordinances developed by the City of San Diego Engineering Department. The site is also governed by the regulations of the California Code of Regulations (CCR) and the 2010 California Building Code (CBC) adopted by the City of San Diego in 2011.

The CBC is promulgated under CCR, Title 24, Parts 1 through 12, also known as the California Building Standards Code, and is administered by the California Building Standards Commission (CBSC). The CBSC is responsible for administering California's building codes.

The Surface Mining and Reclamation Act of 1975 (SMARA) was enacted to promote conservation of the State's mineral resources and to ensure adequate reclamation of lands once they have been mined. Among other provisions, SMARA requires the State Geologist to classify land in California for mineral resource potential. The four categories include: Mineral Resource Zone MRZ-1, areas of no mineral resource significance; MRZ-2, areas of identified mineral resource significance; MRZ-3, areas of undetermined mineral resource significance; and MRZ-4, areas of unknown mineral resource significance. The distinction between these categories is important for land use considerations.

4. SITE DESCRIPTION AND HISTORY

The following sections summarize the sit location, description, and background:

4.1. Site Location

The Convair Lagoon Alternative site consists of approximately 15 acres of water and land located within the San Diego Bay in the City of San Diego, California. The site is bounded by the San Diego Bay to the south; North Harbor Drive, a greenway, and the San Diego International Airport to the north; the United States North Harbor Drive Coast Guard Facility (U.S. Coast Guard Station) to the east; and a rental car parking lot to the west (Figure 1). The site is within the jurisdiction of the San Diego Unified Port District (District) and is located in Planning District 2 (Harbor Island/Lindbergh Field), Planning Subarea 24 (East Basin Industrial) of the 2010 Port Master Plan.

4.2. Site Description

The Convair Lagoon Alternative site is an area of the San Diego Bay that consists of open water, submerged facilities, and land. The land facilities on the Convair Lagoon Alternative site are located along the periphery, with the exception of the southern boundary, which is San Diego Bay. Land facilities include an asphalt paved area along the northern boundary, parallel to North Harbor Drive; a concrete seawall or rip-rap located along the north, east, and west shorelines; and an abandoned concrete sea plane marine ramp located along the southwesterly interface between the land and water. The western and northwestern part of the site is a rental car parking lot.

The submerged facilities on the Convair Lagoon Alternative site include a sand cap, rock berm, and storm drains. The submerged area of the site includes an approximate 7-acre sand cap that was designed to isolate sediment contamination associated with former Teledyne Ryan Aeronautical operations. In addition to the sand cap, submerged facilities on the site include a subsurface rock berm and multiple submerged storm drains. The submerged rock berm transects the site from the northwest corner to the southeast corner in an “L” shape to contain the existing sand cap. On the northern shoreline, a 60-inch diameter storm drain, a 54-inch diameter storm drain, and two 30-inch diameter storm drains outlet into the lagoon. The two 30-inch diameter storm drains, which served the former Teledyne Ryan facility, are abandoned in place. On the western shoreline, three smaller storm drains outlet into the lagoon.

The adjacent surrounding areas consist of a greenway with a bicycle path is located to the north, parallel to North Harbor Drive. Directly west of the site is a rental car parking lot, while to the east is the U.S. Coast Guard Station. The San Diego Bay and a boat anchorage area (Anchorage A-9) are located to the south of the site.

4.3. Background

The surrounding shoreline of Convair Lagoon was previously shallow portions of the San Diego Bay that were filled with dredge sediment. The earliest information regarding dredging and fill operations in the vicinity of the alternative site is from 1921, when the northeastern shoreline of the bay was between present-day Pacific Highway and California Street. In the 1920s and 1930s, the area north of present-day West Laurel Street and North Harbor Drive, encompassing the eastern portion of the present-day San Diego Airport, was filled with material dredged from the bay. A dredging pipeline, (later converted to a 54-inch reinforced concrete storm drain), extended from the northern portion of the filled land, south to the bay, and discharged into the Convair Lagoon. In the mid-1930s, dredging operations filled the area where the U.S. Coast Guard Station is located east and adjacent to the alternative site. By 1939, a concrete pier was constructed above the previously mentioned storm drain on the site. In the early 1940s, dredging operations filled the area west of the site. Convair Lagoon is the unfilled area between the U.S. Coast Guard Station and the filled area to the west of the site. Throughout the years, multiple improvements to the site have been constructed and removed, including additional storm drains and other piers.

On October 17, 1986, the San Diego Regional Water Quality Control Board (San Diego Water Board) Executive Officer issued “Cleanup and Abatement Order No. 86-92 for Teledyne Ryan Aeronautical near Lindbergh Field, San Diego County” for the discharge of polychlorinated biphenyl (PCBs), several trace metals, and volatile organic compounds to the storm drains on Teledyne Ryan Aeronautical property and to the Convair Lagoon portion of the San Diego Bay. Cleanup and Abatement Order (CAO) 86-92, as amended, required Teledyne Ryan Aeronautical to construct a sand cap on the San Diego Bay bottom in Convair Lagoon to isolate the existing sediment contamination within the lagoon from the environment.

In 1996, the PCB contamination in Convair Lagoon was remediated by the Convair Lagoon Capping Project. During the PCB remediation, the existing subsurface rock berm was constructed (Figure 2) and a sand cap was placed behind the rock berm. The majority of the existing sand cap is submerged, although construction of the cap converted approximately 1,400 square feet of an intertidal area to upland.

5. PROJECT DESCRIPTION

The Convair Lagoon Alternative involves the construction of a confined disposal facility (CDF) for the placement of contaminated marine sediment dredged from the Shipyard Sediment Site.

For a detailed project description, please reference the Alternative Description section in the Administrative Draft Program EIR, Shipyard Sediment Remediation Project, San Diego Bay.

6. GEOLOGY

The following sections present our findings relative to regional and site geology, geologic hazards (e.g., landslides or expansive soils), groundwater, faulting and seismicity, and agricultural soils.

6.1. Regional Geologic Setting

The project is situated in the coastal section of the Peninsular Ranges Geomorphic Province. This geomorphic province encompasses an area that extends approximately 900 miles from the Transverse Ranges and the Los Angeles Basin south to the southern tip of Baja California (Norris and Webb, 1990). The province varies in width from approximately 30 to 100 miles. In general, the province consists of rugged mountains underlain by Jurassic-age metavolcanic and metasedimentary rocks, and Cretaceous-age igneous rock of what is known as the southern California batholith. The westernmost portion of the province in San Diego County, which includes the project, consists generally of a dissected coastal plain underlain by Upper Cretaceous-, Tertiary-, and Quaternary-age sediments.

The Peninsular Ranges Province is traversed by a group of sub-parallel faults and fault zones trending roughly northwest. Several of these faults are major active faults. The project area, like much of San Diego, is located near the active Rose Canyon fault zone. The Elsinore, San Jacinto, and San Andreas faults are major active fault systems located northeast of the study area and the Coronado Bank, San Diego Trough, and San Clemente faults are active faults located west of the project. Major tectonic activity associated with these and other faults within this regional tectonic framework consists primarily of right-lateral, strike-slip movement.

6.2. Site Geology

Based on our background review and knowledge of the vicinity, the site is underlain by fill material and bay deposits. These are expected to be underlain by Pleistocene-age old paralic deposits (Figure 3). The fill includes sand fill material placed as part of a capping operation in the 1990s (SAI Engineering, 1996). Recent bay sediments, deposited along the edges of San Diego Bay, are expected to underlie the fill. These materials typically consist of interlayered dark gray, wet to saturated, very loose to loose, silty fine sand and silt, and soft, sandy clay, which are considered compressible under new loading.

6.3. Groundwater

Sources provided by the California Department of Water Resources (DWR) and the California State Water Resources Control Board (SWRCB) were reviewed for information pertaining to groundwater quality and occurrence in the vicinity of the project. Data from groundwater monitoring wells placed at the northern edge of the project for the adjacent Teledyne Ryan project indicate that groundwater is present at approximately mean sea level (Geosyntec, 2010). This corresponds to an elevation of approximately 3 feet above mean lower low water (MLLW). Fluctuations in the groundwater level may occur due to variations in tidal fluctuations, ground surface topography, subsurface geologic conditions and structure, rainfall, irrigation, and other factors.

According to the SWRCB Water Quality Control Plan for the San Diego Basin, the land surrounding the project is located within the Lindbergh Hydrologic Subarea within the San Diego Mesa Hydrologic Area within the Pueblo San Diego Hydrologic Unit. This hydrologic area has been exempted by the Regional Board from the municipal drinking water use designation (SWRCB, revised 2007).

6.4. Faulting and Seismicity

The subject site is considered to be in a seismically active area. The closest known major active fault (i.e., a fault that exhibits evidence of ground displacement within the last 11,000 years) is the Rose Canyon Fault. The Rose Canyon Fault is capable of generating a maximum moment magnitude earthquake of 7.2 (Cao et al., 2003). Figure 4 shows the approximate location of the site with respect to the regional active faults.

As shown on Figures 5 and 6 the western portion of the project is located within a State of California-designated Earthquake Fault Zone (formerly known as an Alquist-Priolo Special Studies Zone) and a City of San Diego designated fault study zone. The element of the Rose Canyon fault intersecting that portion of the site is known as the Spanish Bight Fault strand. It is recognized as active and trends north towards the site through San Diego Bay and intersects the southwestern boundary of the project.

In general, hazards associated with seismic activity include strong ground motion, ground surface rupture, liquefaction, lateral spread, and tsunamis. These hazards are discussed in the following sections.

6.4.1. Strong Ground Motion

The 2010 California Building Code (CBC) (CBSC, 2010) recommends that the design of structures be based on the peak horizontal ground acceleration having a 2 percent probability of exceedance in 50 years which is defined as the Maximum Considered Earthquake (MCE). The statistical return period for PGA_{MCE} is approximately 2,475 years. The Design Earthquake (PGA_{DE}) corresponds to two-thirds of the PGA_{MCE}. The site modified PGA_{MCE} was estimated to be 0.63g using the United States Geological Survey (USGS, 2011) ground motion calculator (web-based) and the corresponding PGA_{DE} for the site is 0.42g.

As noted, the nearest known active fault is the Spanish Bight Fault, an element of the Rose Canyon Fault, which intersects the southwestern boundary of the project. Table 1 below lists principal known active faults that may affect the subject site, the maximum moment magnitude (M_{max}) and the fault types as published for the CGS by Cao et al. (2003). The approximate fault to site distance was calculated by the computer program FRISKSP (Blake, 2001).

Table 1 – Principal Active Faults

Fault	Approximate Distance miles (km)[1]	Maximum Moment Magnitude (M_{max})[1]	Fault Type[2]
Spanish Bight	0 (0)	7.2	B
Rose Canyon	0.7 (1.2)	7.2	B
Coronado Bank	12 (20)	7.6	B
Newport-Inglewood (Offshore)	33 (53)	7.3	B
Elsinore (Julian Segment)	42 (67)	7.1	A
Elsinore (Temecula Segment)	46 (74)	6.8	A
Earthquake Valley	47 (76)	6.5	B
Elsinore (Coyote Mountain Segment)	51 (82)	6.8	A
Palos Verdes	58 (94)	7.3	B

Notes:
[1] Cao, et al., 2003.
[2] California Building Code (CBC), 2010; Cao, et al., 2003.

6.4.2. Ground Surface Rupture

Ground surface rupture due to active faulting is possible at the project due to the presence of the Spanish Bight Fault at the southwestern boundary of the project. Additionally, lurching or cracking of the ground surface as a result of nearby seismic events is possible.

6.4.3. Liquefaction and Seismically Induced Settlement

Liquefaction is the phenomenon in which loosely deposited, saturated granular soils (located below the water table) with clay contents (particles less than 0.005 mm) of less than 15 percent, liquid limit of less than 35 percent, and natural moisture content greater than 90 percent of the liquid limit undergo rapid loss of shear strength due to development of excess pore pressure during strong earthquake-induced ground shaking. Ground shaking of sufficient duration results in the loss of grain-to-grain contact due to rapid rise in pore water pressure, and it eventually causes the soil to behave as a fluid for a short period of time. Liquefaction is known generally to occur in saturated or near-saturated cohesionless soils at depths shallower than approximately 50 feet below grade. Factors known to influence liquefaction potential include composition and thickness of soil layers, grain size, relative density, groundwater level, degree of saturation, and both intensity and duration of ground shaking.

Based on the relatively loose fill material and bay deposits expected to underlie the project, the presence of shallow groundwater, and knowledge from previous evaluations of liquefaction potential near the project (Ninyo & Moore, 2008, 2011), soils underlying the project may be subject to liquefaction and resulting settlement during a nearby seismic event.

6.4.4. Lateral Spread

Lateral spread of the ground surface during an earthquake usually takes place along weak shear zones that have formed within a liquefiable soil layer. Lateral spread has generally been observed to take place in the direction of a free-face (i.e., retaining wall, slope, channel, etc.) but has also been observed to a lesser extent on ground surfaces with gentle slopes. An empirical model developed by Youd, et al. (2002) is typically used to predict the amount of horizontal ground displacement within a site. For sites located in proximity to a free-face, the amount of lateral ground displacement is correlated with the distance of the site from the free-face. Other factors such as earthquake magnitude, distance from the causative fault, thickness of the liquefiable layers, and the fines content and particle sizes of the liquefiable layers also influence the amount of lateral ground displacement.

Based on the proposed topography at the site, and the presence of potentially liquefiable layers in the underlying soil materials, the site is considered to be potentially susceptible to seismically-induced lateral spread.

6.4.5. Tsunamis

Tsunamis are long wavelength seismic sea waves (long compared to ocean depth) generated by the sudden movements of the ocean floor during submarine earthquakes, landslides, or volcanic activity. Based on tsunami inundation maps published by the California Geological Survey (CGS, 2009; Figure 7), the land to the west and east of the project is not designated as a tsunami inundation area. However, the project site was not evaluated as part of the mapping. The tsunami potential may be reevaluated after the project prepares the new land. Presently, the shore of the lagoon is designated as a tsunami line, which represents the maximum considered tsunami runup. The southwestern boundary of the project borders the

San Diego Harbor, which, along with Harbor Island to the west, is designated as a tsunami inundation area by CGS.

6.5. Landsliding

Based on our review of published geologic literature, topographic maps, aerial photographs, and our site reconnaissance, no landslides or related features underlie or are adjacent to the project and the potential for landslides is considered low.

6.6. Flood Hazards

Based on review of Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM), posted on the County of San Diego, San Diego Geographic Information Source (SanGIS) website (2004), the existing shore of the lagoon is within the 100-year flood zone and areas northeast of the project are within the 500-year flood zone. The City of San Diego General Plan (2008) designates the lagoon and the San Diego Harbor southwest of the project within the 100-year flood zone. Based on review of dam inundation maps, significant flooding due to dam inundation is not expected to occur at the project.

6.7. Expansive Soils

Expansive soils generally result from specific clay minerals that have the capacity to shrink or swell in response to changes in moisture content. Based on review of regional geologic maps, geologic reconnaissance, and knowledge of the vicinity, the fill and bay deposits underlying the project site typically consist of silty sand, silt, and sandy clay. Layers of these deposits are considered to have a moderate to high potential for expansion. Although the existing soils at the project may be expansive, much of the material is saturated and dredged and imported fill materials are planned to raise site grade, thus burying these layers. Based on our familiarity with the potential dredge source, granular materials are likely to be placed as fill. Furthermore, import capping materials would likely be specified as granular; therefore, the potential for near-surface expansive soils at the project is low.

6.8. Compressible Soils

Compressible soils, like expansive soils, result from specific clay minerals or loose granular materials that have the capacity to shrink or compress in response to changes in moisture content or new loads. Based on review of regional geologic maps, geologic reconnaissance, and knowledge of the vicinity, the fill and bay deposits underlying the project typically consist of silty sand, silt, and sandy clay, which are considered highly compressible under new loading.

6.9. Corrosive Soils

Caltrans corrosion (2003) criteria define as soils with more than 500 parts per million (ppm) chlorides, more than 0.2 percent sulfates, or a pH less than 5.5. Due to the proximity of the marine environment and the anticipated variability of the on-site soils, site soils should be considered to be corrosive.

6.10. Agricultural Soils

Based on the Soil Survey for the San Diego Area (Bowman, 1973), two different soil series have been noted on the areas surrounding the project. These soil types include Made Land and Urban Land. The soil types and their characteristics are summarized in Table 2. The potential for loss of agricultural soils due to further development of the study area is considered low because the project is near a paved roadway and dredged fill land platforms; the soils in these areas are not in their natural state.

Table 2 – Soil Series Characteristics

Soil Series and Map Symbol	Use	Erosion Potential
Made land (Md)	Building sites	Unknown
Urban land (Ur)	Soil altered by urban works; identification not feasible	Unknown

6.11. Mineral Resources

According to the California Geological Survey Open File Report 96-04 and the City of San Diego General Plan (2008) the project is located in Mineral Resource Zone 1 (MRZ-1).

MRZ-1 is an area where adequate information indicates that no significant mineral deposits are present, or where it is judged that there is little likelihood for their presence.

7. CONCLUSIONS

Based on our review of the referenced background data and our geologic field reconnaissance it is our opinion that geologic and geotechnical considerations at the project include the following:

- The project is underlain by fill material and bay deposits, and underlain at depth by Pleistocene-age old paralic deposits. The fill includes relatively thin material placed as part of a capping operation in the 1990s. Recent bay sediments, deposited along the edges of San Diego Bay, underlie the fill. Geotechnical constraints related to soils at the project are discussed below:
  - *Soft Ground* – Soft ground or loose soils exist underlying the project.
  - *Expansive Soils* – Layers within existing site soils may have a moderate to high potential for expansion. Dredged and imported fill materials are proposed to raise site grade. Based on our familiarity with the potential dredge source (San Diego Bay), granular materials are likely to be placed as fill. Further capping import materials would likely be specified as granular, therefore the potential for near-surface expansive soils at the project is low.
  - *Compressible Soils* – The fill and bay deposits underlying the project typically consist of silty sand, silt, and sandy clay, which are considered compressible under new loading. .
  - *Fill Soils* – Fill soils placed without engineering supervision may be loosely or inadequately compacted, may contain oversize materials unsuitable for reuse in engineered fills, and may contain unsuitable organic or expansive materials and debris that may preclude their re-use in engineered fills.
- The Spanish Bight Fault strand, an element of the Rose Canyon Fault, intersects the southwestern boundary of the project. As a consequence, the western portion of the project is located within a State of California-designated Earthquake Fault Zone (formerly known as an Alquist-Priolo Special Studies Zone) and a City of San Diego designated fault study zone. Geotechnical constraints related to faulting and seismic events at the project are:
  - *Ground Shaking* – The project has a high potential for strong ground motions due to earthquakes on adjacent and nearby active faults.
  - *Ground Surface Rupture* – Ground surface rupture due to active faulting is possible at the project due to the presence of the Spanish Bight Fault strand at the southwestern

boundary of the project. Additionally, lurching or cracking of the ground surface as a result of nearby seismic events is possible.

- *Liquefaction* – The soils underlying the project may be subject to dynamic settlement or liquefaction during a nearby seismic event.
- *Lateral Spread* – The soils underlying the project are considered to be potentially susceptible to seismically-induced lateral spread during a nearby seismic event.

- Groundwater is expected at an elevation of approximately 3 feet above mean lower low water (MLLW) (approximately 9 feet below the proposed ground surface).
- Based on tsunami inundation maps published by the California Geological Survey (2009), the land to the west and east of the project is not designated as a tsunami inundation area. Presently, the shore of the lagoon is designated as being within maximum considered tsunami runup. The southwestern boundary of the project borders the San Diego Harbor, which, along with Harbor Island, is designated as a tsunami inundation area.
- Based on our review of published geologic literature, aerial photographs, and our site reconnaissance, no landslides or related features underlie or are adjacent the project and the potential for landslides is considered low.
- Based on review of FEMA FIRM, posted on the County of San Diego, SanGIS website (2004), the shore of the lagoon is within the 100-year flood zone.
- Based on review of dam inundation maps, significant flooding due to dam inundation is not expected to occur at the project.
- Due to the proximity of the marine environment and the anticipated variability of the on-site soils, the soils at the project should be considered as highly corrosive.

8. RECOMMENDATIONS

Based on the geologic and geotechnical considerations at the project presented in the previous section, our general recommendations for the project development are presented below. These recommendations assume that a geotechnical evaluation will be conducted and specific recommendations provided at that time for the actual proposed development.

- Hydrocollapse – Proposed fill materials within and overlying the zone of fluctuating groundwater may be subject to hydrocollapse. A recommendation to mitigate this condition could typically include removal and/or replacement of soils as engineered compacted fill. The extent of removals cannot be determined without further investigation.

- Soft Ground – Soils in areas with soft ground or loose soils in the area of the proposed project may be subject to settlement or may provide weak bearing conditions for support of proposed barriers and fills. A recommendation to mitigate this condition could typically include removal and/or replacement of soils as engineered fill. The extent of removals cannot be determined without further investigation.

- Expansive Soils – Expansive soils may exist at the project. However, they are likely to remain saturated and be buried under proposed fill, thus mitigating the potentials for expansion. The presence of expansive soils would not preclude the proposed construction. If expansive soils exist on site, the following recommendations may be implemented during construction to address this condition: the soils could remain in deeper fill areas or the soils could be excavated and removed from the site.

- Compressible Soils – Compressible soils may lead to settlement of the proposed project and potential instability for overlying slopes. The following recommendations may be implemented during construction to address this condition: the soils could be excavated and removed from the site; they could be treated to mitigate their potential for compression, or the materials could be surcharged through the benefit of proposed fills.

- Ground Shaking – Although there is a high potential for ground shaking at the project during a nearby seismic event, this would not preclude the proposed construction. Engineering measures to mitigate the effects of ground shaking are anticipated to be included in future development.

- Liquefaction – Although soils underlying the project may be subject to liquefaction or static settlement during a nearby seismic event, this would not preclude the proposed construction. The following recommendations may be implemented during construction to mitigate this condition: removal and replacement of soils susceptible to liquefaction, densification of these soils through geotechnical engineering methods (e.g., stone columns, compaction grouting, or deep, dynamic compaction), or selecting an engineering foundation design to accommodate the expected effects of liquefaction.

- Shallow groundwater – Shoring and dewatering may be required for the proposed construction (i.e., trenching) where shallow groundwater is present.

- Flooding – Although portions of the project are in flood hazard areas, potential flooding of the site would not preclude the proposed construction.

- Corrosive Soils – Due to the proximity of the marine environment and the anticipated variability of the on-site soils, the soils at the project should be treated as highly corrosive. A corrosion engineer should be retained to assist in the design of improvements in contact with the soil should further development propose such features.

9. IMPACT ANALYSIS

Based upon the results of our Geology and Soils Evaluation, our opinions, and recommendations are provided in the following sections.

9.1. Significance Thresholds

In evaluating the significance of potential environmental concerns in a particular study area, the criteria to consider, as they relate to geologic and soil conditions, are presented in the CEQA Guidelines. In accordance with the scope of work, the findings of this study were evaluated with respect to Questions A through E of Section 6 "Geology and Soils" with in Appendix G of the CEQA Guidelines (2009).

9.2. Project Impacts and Significance

Based on the above criteria and the results of the evaluation, the potential impact by geologic and soil conditions at the project have been identified, and are discussed below.

A. Would the project expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:

i. 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 known fault?

Ground surface rupture due to active faulting is possible at the project due to the presence of the Spanish Bight Fault strand. As noted, the Spanish Bight Fault intersects the southwestern boundary of the project. Additionally, lurching or cracking of the ground surface as a result of nearby seismic events is possible. This risk should be evaluated by a geotechnical evaluation performed for the specific development of the project once development use and details are known.

ii. Strong seismic ground shaking?

The project has a high potential for strong ground motions due to earthquakes on nearby active faults.

iii. Seismic related ground failure, including liquefaction?

Based on the relatively loose fill material and bay deposits underlying the project, the presence of shallow groundwater, and knowledge from previous evaluations of liquefaction near the project, soils underlying the project may be subject to liquefaction or static settlement during a nearby seismic event.

iv. Landslides?

Based on our review of published geologic literature, aerial photographs, and our site reconnaissance, no landslides or related features underlie or are adjacent to the project and the potential for landslides is considered low.

B. Would the project result in substantial soil erosion or the loss of topsoil?

The potential for substantial soil erosion or loss of topsoil due to the proposed project improvements is considered low. Additionally, the capping fill material and compaction would generally be recommended to be placed to reduce the potential for soil erosion.

C. Would the project be located on 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?

The soils underlying the project may be subject to liquefaction, lateral spreading, and settlement due to subsidence, hydrocollapse, or consolidation of soft soils. A geotechnical evaluation would provide mitigation measures for the project.

D. Would the 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?

Soils with a moderate to high potential for expansion may be present at the site. However, these materials are expected to be mitigated during construction of the project by remaining saturated at relatively deep depths.

10. LIMITATIONS

The field evaluation and geotechnical analyses presented in this report have been conducted in accordance with current engineering practice and the standard of care exercised by reputable geotechnical consultants performing similar tasks in this area. No warranty, implied or expressed, is made regarding the conclusions, recommendations, and professional opinions expressed in this report. Variations may exist and conditions not observed or described in this report may be encountered. Our preliminary conclusions and recommendations area based on an analysis of the observed conditions and the referenced background information.

The purpose of this study was to evaluate geologic and geotechnical conditions within the project and to provide a geotechnical reconnaissance report to assist in the preparation of environmental impact documents for the project. A comprehensive geotechnical evaluation, including subsurface exploration and laboratory testing, should be performed prior to design and construction of structural improvements.

11. REFERENCES

AMEC Earth & Environmental, Inc., 2002, Historical Review of Lindbergh Field, San Diego International Airport: dated June 14.

Blake, T.F., 2001, FRISKSP (Version 4.00) A Computer Program for the Probabilistic Estimation of Peak Acceleration and Uniform Hazard Spectra Using 3-D Faults as Earthquake Sources.

Boore, D.M., Joyner, W.B., and Fumal, T.E., 1997, Equations for Estimating Horizontal Response Spectra and Peak Acceleration from Western North American Earthquakes: A Summary of Recent Work, Seismological Research Letters, Vol. 68, No. 1, pp. 128-153.

Bowman, R.H., 1973, Soil Survey of San Diego Area, California, United States Department of Agriculture, Soil Conservation Service, Washington, DC.

California Building Standards Commission, 2010, California Building Code, Title 24, Part 2, Volumes 1 and 2.

California Department of Transportation (Caltrans), 2003, Corrosion Guidelines (Version 1.0), Division of Engineering and Testing Services, Corrosion Technology Branch: dated September.

California Environmental Quality Act (CEQA), 2009, Title 14. California Code of Regulations http://ceres.ca.gov/topic/env_law/ceqa/guidelines/.

California Geological Survey, 1963, Geology and Mineral Resources of San Diego County, California.

California Geological Survey, 1996, Open File Report 96-04, Update of Mineral Land Classification: Aggregate Materials in the Western San Diego County Production - Consumption Region.

California Geological Survey, 1999, Seismic Shaking Hazard Maps of California: Map Sheet 48.

California Geological Survey, 2009, Tsunami Inundation Map for Emergency Planning, State of California, County of San Diego, Point Loma Quadrangle, Scale 1:24,000.

California State Water Resources Control Board, 2011, GeoTracker Website: www.geotracker.swrcb.ca.gov: accessed in April.

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: dated June.

City of San Diego, 1978, Topographic Survey (Orthotopographic), Sheet 202-1707, scale 1:24,000.

City of San Diego, 2008, Seismic Safety Study, Sheets 16, and 17, Scale 1:9,600.

City of San Diego, 2008, General Plan: dated March 10.

County of San Diego, 2004, San Diego Geographic Information Source (SanGIS) website: http://www.sangis.org/SangisInteractive/viewer/viewer.asp.

Geosyntec, 2010, Groundwater Monitoring Report, Third Quarter, 2701 North Harbor Drive, San Diego, California: dated October.

Google, Inc., 2011, www.googleearth.com.

Harden, D.R., 1998, California Geology: Prentice Hall, Inc.

Innovative Mapping Solutions, 2009, Mapping San Diego website: http://mappingsandiego.com.

Jennings, C.W., and Bryant, W.A., 2010, Fault Activity Map of California and Adjacent Areas: California Geological Survey, California Geologic Data Map Series, Map No. 6, Scale 1:750,000.

Kennedy, M.P. and Tan S.S., 2008, Geologic Map of the San Diego 30' x 60' Quadrangle, California, Scale 1:100,000.

Ninyo & Moore, In-house proprietary information.

Ninyo & Moore, 2008, Geotechnical Evaluation, Gate 1A Reconfiguration (CIP # 104065), San Diego International Airport, San Diego, California: dated February 7.

Ninyo & Moore, 2010, Geotechnical Evaluation, City of San Diego, Harbor Drive and Lindbergh Field, Water Line Replacement Project, San Diego, California: dated September 13.

Ninyo & Moore, 2011, Geotechnical Evaluation, CIP 104056 - Expand Terminal 2, East Facilities, Service Connector Bridge, and Canopy Addition, San Diego International Airport, San Diego, California: dated March 11.

Norris, R. M. and Webb, R. W., 1990, Geology of California, Second Edition: John Wiley & Sons, Inc.

State of California, 2003, Earthquake Fault Zones, Point Loma Quadrangle, Revised Official Map, Scale 1:24,000.

State Water Resources Control Board (SWRCB), 1994, Water Quality Control Plan for the San Diego Basin (9), with amendments effective prior to April 25, 2007: dated September 8.

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

United States Geological Survey, 1967 (Photorevised 1975), Point Loma Quadrangle, California, San Diego County, 7.5-Minute Series (Topographic): Scale 1:24,000.

United States Geological Survey, 2011, Earthquake Ground Motion Parameter Java Application, Java Ground Motion Parameter Calculator – Version 5.1.0; http://earthquake.usgs.gov/ research/hazmaps/design/.

Youd, T.L., et. al, 2001, Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of

Soils, Journal of Geotechnical and Geoenvironmental Engineering: American Society of Civil Engineering 124(10), pp. 817-833.

Youd, T.L., Hansen, C.M., and Bartlett, S.F., 2002, Revised Multilinear Regression Equations for Prediction of Lateral Spread Displacement: Journal of Geotechnical and Geoenvironmental Engineering, Vol. 128, No. 12, pp. 1007-1017.

AERIAL PHOTOGRAPHS				
Source	**Date**	**Flight**	**Numbers**	**Scale**
USDA	March 31, 1953	AXN 3M	214 & 215	1:20,000

SOURCE: 2008 Thomas Guide for San Diego County, Street Guide and Directory; Map © Rand McNally, R.L.07-S-129

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE

SCALE IN FEET

0 1,200 2,400 4,800

S:\ArcGIS\Projects\100000_SD\106000-106999\106997\002\106997002_sl.mxd 5/31/2011 2:51:51 PM JDL

Ninyo & Moore	SITE LOCATION	FIGURE
PROJECT NO. 106997002	DATE 5/11	SHIPYARD SEDIMENT ALTERNATIVE CONVAIR LAGOON SAN DIEGO, CALIFORNIA	1

SOURCE: SOURCE: Aerial Imagery - Photo Date: August, 2010; (c) Google Earth, 2011

LEGEND

PROJECT AREA

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

SCALE IN FEET

0 100 200 400

Ninyo & Moore

PROJECT NO.	DATE
106997002	5/11

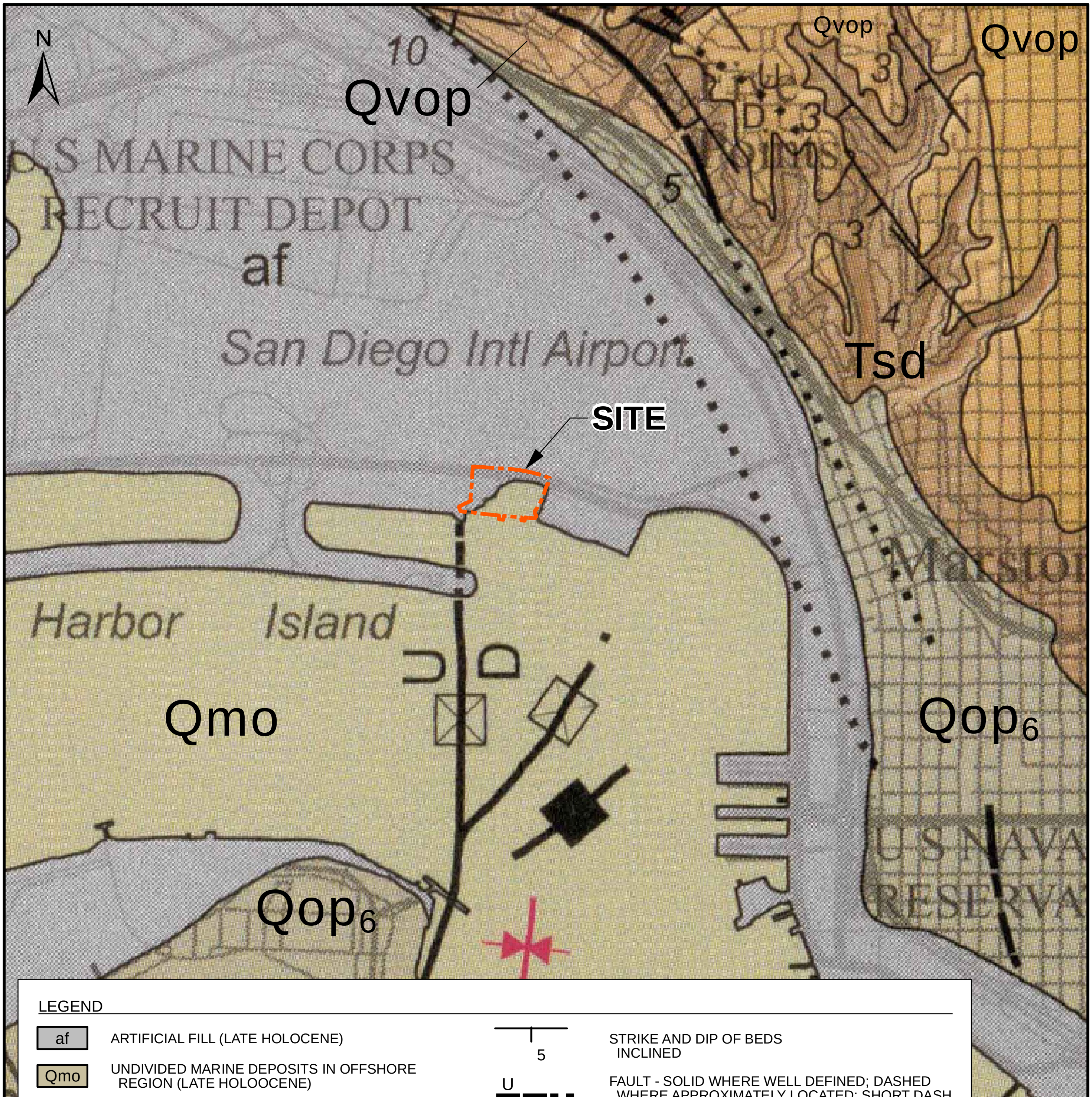
SITE AND VICINITY

SHIPYARD SEDIMENT ALTERNATIVE
CONVAIR LAGOON
SAN DIEGO, CALIFORNIA

FIGURE

2

S:\ArcGIS\Projects\100000_SD\106000-106999\106997\002\106997002_sv.mxd 5/31/2011 2:50:46 PM JDL



LEGEND

af	ARTIFICIAL FILL (LATE HOLOCENE)
Qmo	UNDIVIDED MARINE DEPOSITS IN OFFSHORE REGION (LATE HOLOOCENE)
Qop_6	OLD PARALIC DEPOSITS, (LATE TO MIDDLE PLEISTOCENE)
Qvop	VERY OLD PARALIC DEPOSITS, UNDIVIDED (MIDDLE TO EARLY PLEISTOCENE)
Tsd	SAN DIEGO FORMATION (EARLY PLEISTOCENE AND LATE PLIOCENE) - MARINE SANDSTONE

5	STRIKE AND DIP OF BEDS INCLINED
U / D	FAULT - SOLID WHERE WELL DEFINED; DASHED WHERE APPROXIMATELY LOCATED; SHORT DASH WHERE INFERRED; DOTTED WHERE CONCEALED
	CUTS STRATA OF HOLOCENE AGE
	CUTS STRATA OF LATE QUATERNARY AGE
	SYNCLINE - SOLID WHERE WELL DEFINED; SHORT WHERE INFERRED

SOURCE: KENNEDY, M.P., AND TAN, S.S., 2008, GEOLOGIC MAP OF THE SAN DIEGO 30' X 60' QUADRANGLE, CALIFORNIA.

NOTES: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE

SCALE IN FEET

0 1,000 2,000 4,000

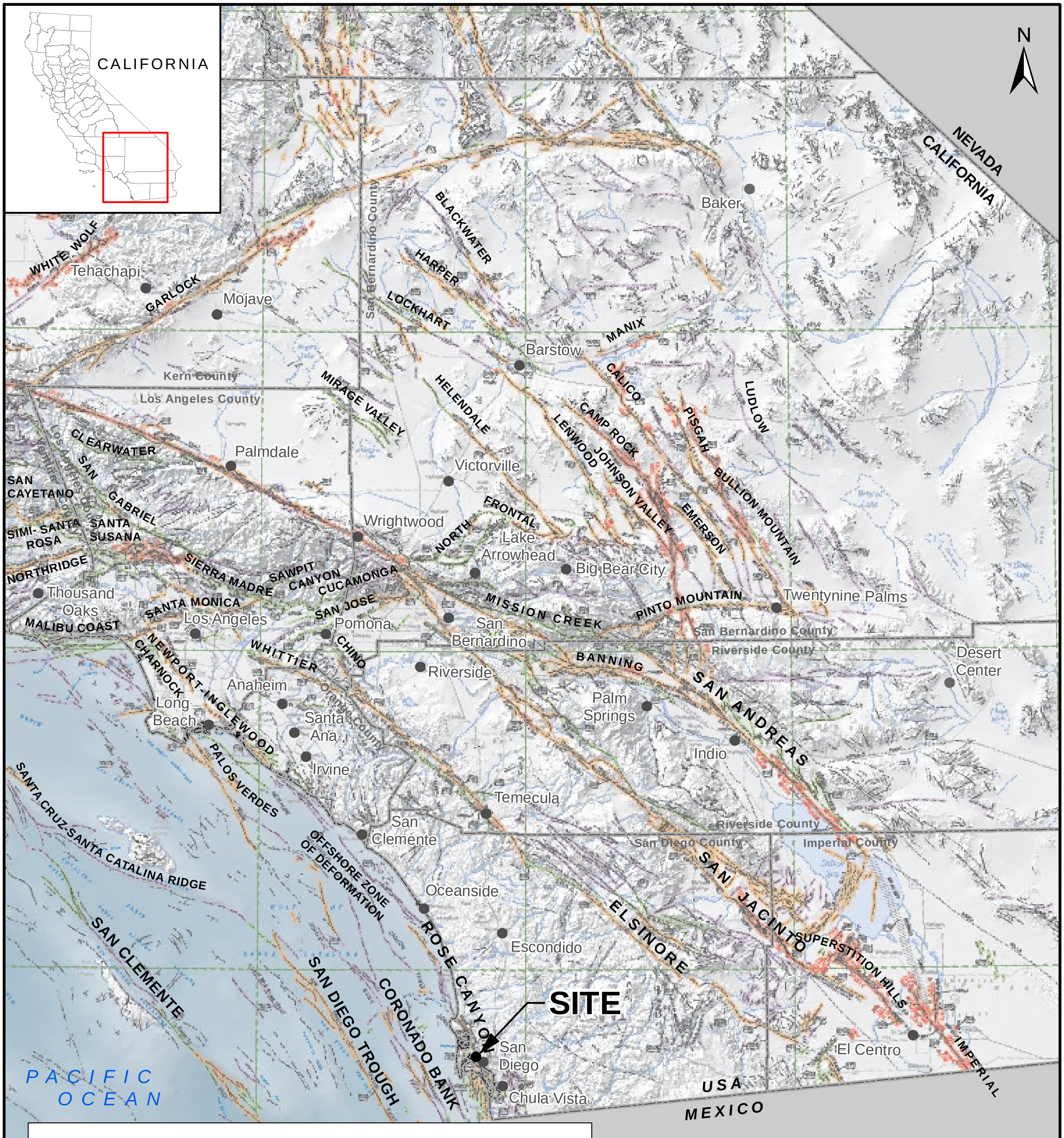
Ninyo & Moore

GEOLOGY

FIGURE 3

PROJECT NO.	DATE
106997002	4/11

SHIPYARD SEDIMENT ALTERNATIVE
CONVAIR LAGOON
SAN DIEGO, CALIFORNIA



LEGEND

CALIFORNIA FAULT ACTIVITY

- HISTORICALLY ACTIVE
- HOLOCENE ACTIVE
- LATE QUATERNARY (POTENTIALLY ACTIVE)
- QUATERNARY (POTENTIALLY ACTIVE)
- STATE/COUNTY BOUNDARY

SOURCE: Fault Activity Map of California, 2010, Jennings, C.W., and Bryant, W.A., California Geological Survey.

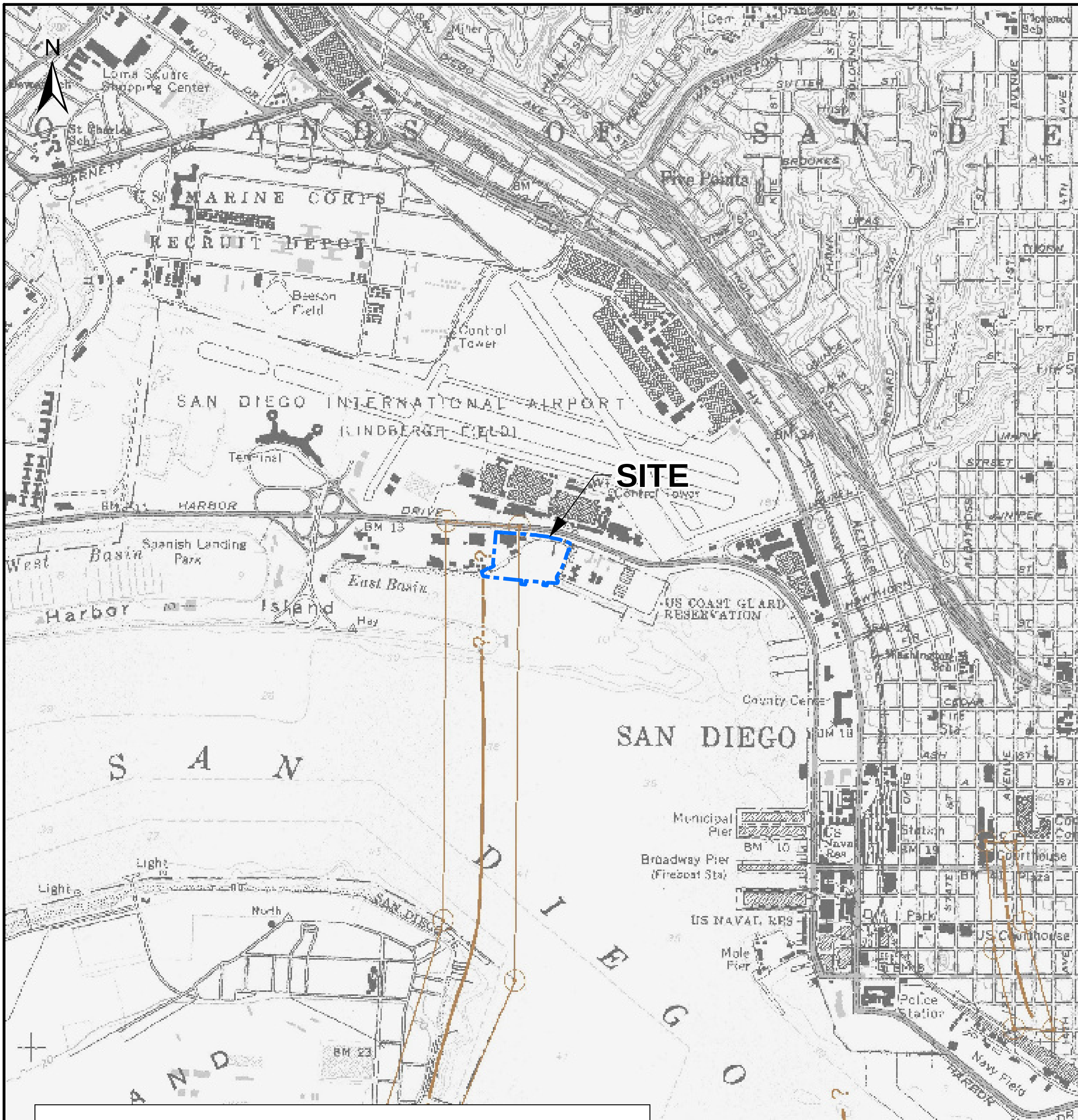
APPROXIMATE SCALE

0 30 60 MILES

NOTES: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE

S:\ArcGIS\Projects\100000_SD\106000-106999\106997\002\106997002_fl.mxd 4/5/2011 4:58:13 PM JDL

Ninyo & Moore		FAULT LOCATIONS	FIGURE
PROJECT NO.	DATE	SHIPYARD SEDIMENT ALTERNATIVE CONVAIR LAGOON SAN DIEGO, CALIFORNIA	4
106997002	5/11		



LEGEND

ACTIVE FAULTS
LONG DASH WHERE APPROXIMATELY LOCATED, SHORT DASH WHERE INFERRED, DOTTED WHERE CONCEALED; QUERY INIDICATES ADDITIONAL UNCERTAINTY.

THESE ARE DELINEATED AS STRAIGHT-LINE SEGMENTS THAT CONNECT ENCIRCLED TURNING POINTS SO AS TO DEFINE EARTHQUAKE FAULT ZONE SEGMENTS.

SOURCE: BASE - STATE OF CALIFORNIA EARTHQUAKE FAULT ZONES, POINT LOMA QUADRANGLE, DATED 2003.

SCALE IN FEET

0 1,000 2,000 4,000

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

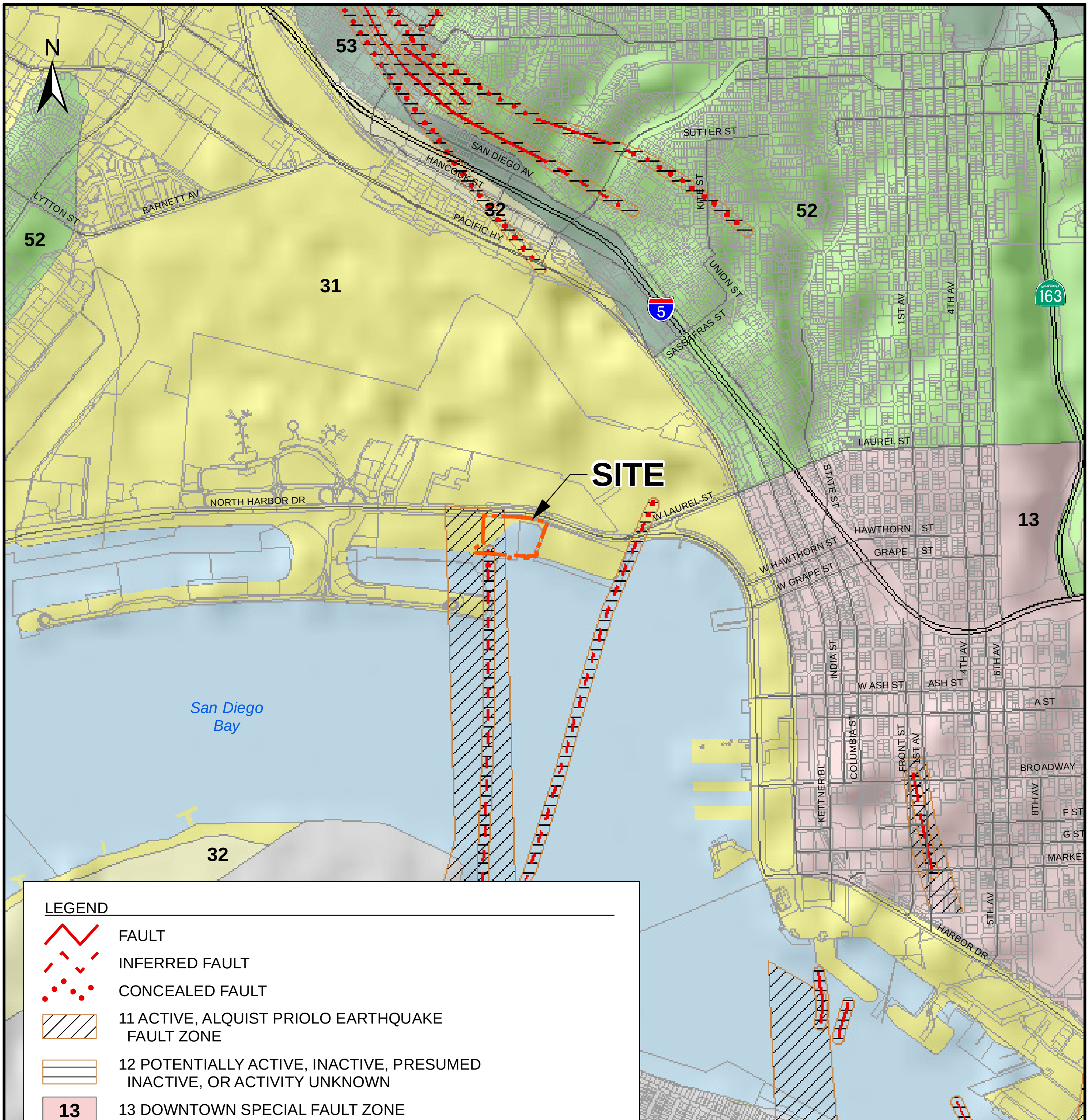
Ninyo & Moore

EARTHQUAKE FAULT ZONES

PROJECT NO.	DATE
106997002	5/11

SHIPYARD SEDIMENT ALTERNATIVE
CONVAIR LAGOON
SAN DIEGO, CALIFORNIA

FIGURE
5



LEGEND

- FAULT
- INFERRED FAULT
- CONCEALED FAULT
- 11 ACTIVE, ALQUIST PRIOLO EARTHQUAKE FAULT ZONE
- 12 POTENTIALLY ACTIVE, INACTIVE, PRESUMED INACTIVE, OR ACTIVITY UNKNOWN
- 13 — 13 DOWNTOWN SPECIAL FAULT ZONE
- 31 — 31 HIGH LIQUEFACTION POTENTIAL - SHALLOW GROUNDWATER MAJOR DRAINAGES, HYDRAULIC FILLS
- 32 — 32 LOW LIQUEFACTION POTENTIAL - FLUCTUATING GROUNDWATER MINOR DRAINAGES
- 52 — 52 OTHER LEVEL AREAS, GENTLY SLOPING TO STEEP TERRAIN, FAVORABLE GEOLOGIC STRUCTURE, LOW RISK
- 53 — 53 LEVEL OR SLOPING TERRAIN, UNFAVORABLE GEOLOGIC STRUCTURE, LOW TO MODERATE RISK

SOURCE: City of San Diego Seismic Safety Study Geologic Hazards and Faults, SanGIS, 2008

SCALE IN FEET

0 1,200 2,400 4,800

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

Ninyo & Moore

PROJECT NO.	DATE
106997002	5/11

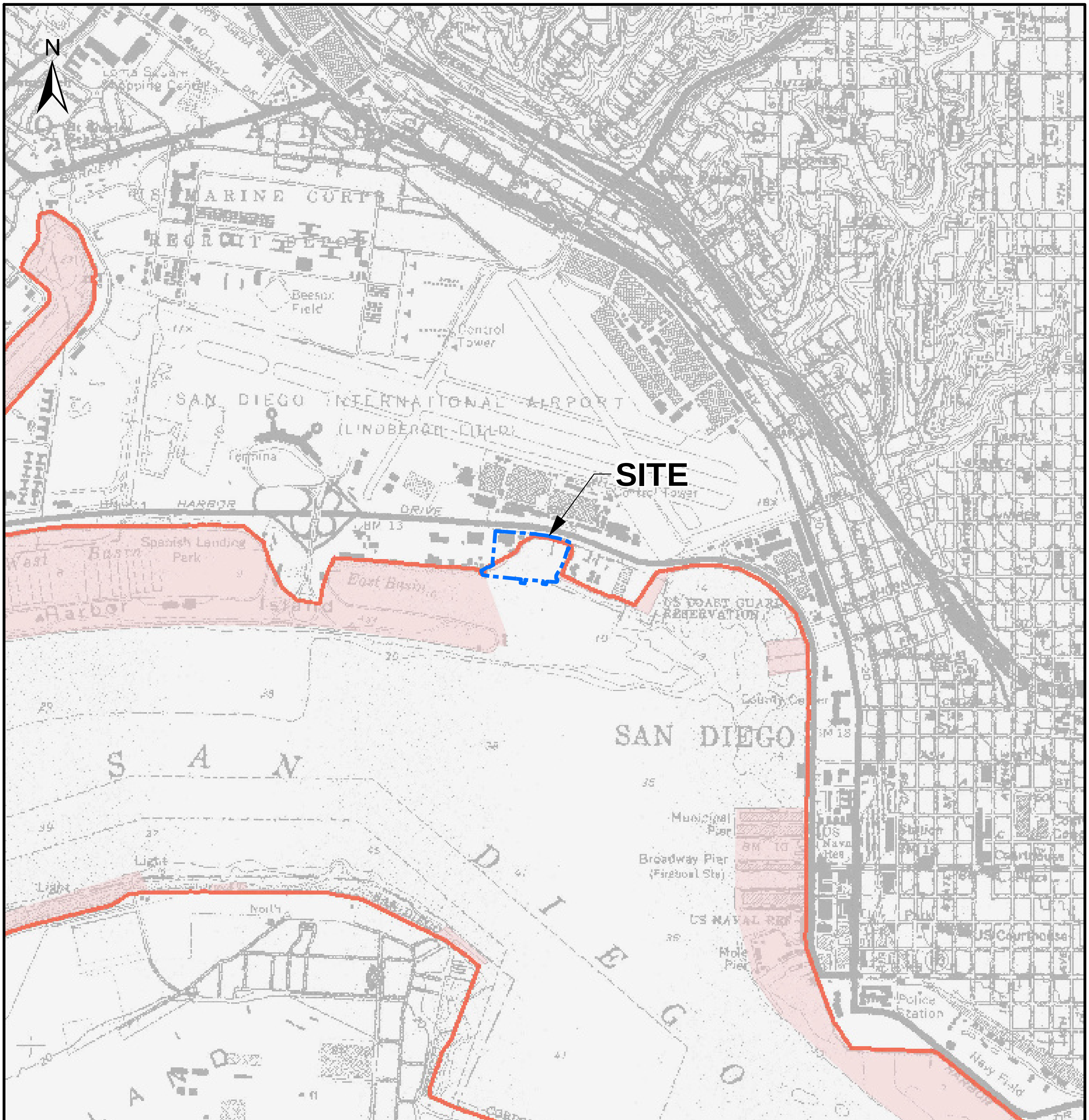
GEOLOGIC HAZARDS

SHIPYARD SEDIMENT ALTERNATIVE
CONVAIR LAGOON
SAN DIEGO, CALIFORNIA

FIGURE

6

S:\ArcGIS\Projects\100000_SD\106000-106999\106997\002\106997002_geo_haz_P.mxd 5/31/2011 2:55:51 PM JDL



SOURCE: Base - TSUNAMI MAP FOR EMERGENCY PLANNING; State of California - County of San Diego, USGS 7.5 Minute Topographic Quadrangle - Point Loma, CA - June 1, 2009.

LEGEND

TSUNAMI INUNDATION LINE

TSUNAMI INUNDATION AREA

SCALE IN FEET

0 1,000 2,000 4,000

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

Ninyo & Moore		TSUNAMI INUNDATION	FIGURE
PROJECT NO.	DATE	SHIPYARD SEDIMENT ALTERNATIVE CONVAIR LAGOON SAN DIEGO, CALIFORNIA	7
106997002	5/11		

S:\ArcGIS\Projects\100000_SD\106000-106999\106997\002\106997002_tsu.mxd 5/31/2011 2:57:15 PM JDL