Appendix M
Geology and Seismicity Update

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Project No.
8506.000.002

June 13, 2012

Subject: Great Park Neighborhoods - TTOD
Irvine, California

PROJECT GEOLOGY AND SEISMICITY UPDATE TO SUPPORT THE 2012 MODIFIED PROJECT IN THE SECOND SUPPLEMENTAL ENVIRONMENTAL IMPACT REPORT (2012 SSEIR)

The purpose of this letter is to provide geotechnical opinions for the description of site conditions, impacts and mitigation measures presented in the Geology and Seismicity section of the 2011 Certified EIR as it relates to the 2012 Modified Project (existing PAs 30 and 51). The information and conclusions presented herein are an update to Geology and Seismicity section of the 2003 FEIR and Addenda, and 2011 Certified EIR in support of the Second Supplemental Environmental Impact Report (SSEIR) planned for the Project.

This document provides an updated assessment of the Geology and Seismicity Chapters of the 2011 Certified EIR with a comparison to the most current available geologic publications and site-specific geotechnical reports for the project.

2012 MODIFIED PROJECT DESCRIPTION

The term "Proposed Project Site" (2012 Modified Project) refers to and encompasses; (1) the Heritage Fields Development, also known as the Great Park Neighborhoods, consisting of nine existing Development Districts[1]; (2) an 11-acre parcel currently owned by the Transportation Corridor Agencies (TCA) located adjacent to the SR-133 Freeway between Trabuco Road and Irvine Boulevard (the "TCA Property"); (3) Lot D, Lot E, and Lot F as depicted on 2nd Amended Vesting Tentative Tract Map 17008 currently zoned 3.2 Transit Oriented Development within Districts 2 and 3 (together, the "City Parcels"); and (4) 132 acres owned by the City, referred to as the Wildlife Corridor, together with a portion of the Great Park known as the "Sports Park District," all of which are located within the areas designated as Existing “Planning Area (PA) 30” and Existing “PA 51” in the City's General Plan, northeast of the freeway junction of Interstate 5 (I-5) and Interstate 405 (I-405), within the City.

Existing PA 51 is generally bounded by the Eastern Transportation Corridor to the west, the Foothill Transportation Corridor to the north, the Southern California Regional Rail Authority (“SCRRA”) rail lines to the south, and Irvine Boulevard and the stormwater channel near Alton Parkway to the north. Existing PA 51 abuts Existing PA 30 and PA 32 to the south, PA 35 (Irvine Spectrum 2) and the City of Lake Forest to the east, and PAs 9 and 40 to the west. Existing PA 30 is generally bounded by I-5 to the south, the SCRRA rail lines to the north, and the Irvine Spectrum to the east and west (Irvine Spectrum 2- PA 35 and Irvine Spectrum 3 – PA 32).

[1] Development District 9 will be merged into Development District 6 as part of the 2012 Modified Project, reducing the number of Development Districts to eight.

The 2012 Modified Project changes the 2011 Approved Project as follows:

- Combines Existing PAs 30 and 51, and the approximately 11 acres between the current western boundary of Existing PA 51 and SR-133 between Trabuco Road and Irvine Boulevard currently owned by Transportation Corridor Agency (TCA), into a single PA, Combined PA 51.

- Rezones property in Districts 2, 3, and 6 from 3.2 Transit Oriented Development, 4.3 Vehicle Related Commercial, and 5.4 B General Industrial to 8.1 Trails and Transit Oriented Development.

- Rezones 13 acres in District 6 (formerly District 9) from its current 1.1 Agriculture zoning to 1.4 Preservation.

- Rezones the City Parcels from 3.2 Transit Oriented Development to 8.1 Trails and Transit Oriented District.

- Relocates the 132-acre Wildlife Corridor within District 5 adjacent to the Borrego Canyon Wash.

- Zones the approximately 11 acres between the current western boundary of Existing PA 51 and SR-133 between Trabuco Road and Irvine Boulevard, currently owned by TCA to 8.1 TTOD.

- Amends the Master Plan of Arterial Highways to eliminate the extension of Rockfield Boulevard from the eastern project boundary to Marine Way once the Orange County Transportation Authority (OCTA) has approved this proposed amendment to the countywide Master Plan of Arterial Highways.

- Amends the General Plan and Zoning Ordinance to allow the following:

    - 3,412 multi-use residential units within Combined PA 51, in addition to the 4,894 units already allocated in Districts 1 North, 1 South, 4, 7, and 8.

    - Modify non-residential uses to allow:
        - 3,364,000 square feet of Medical and Science

        - 1,318,200 square feet of Multi-Use. The Modified Project includes an option to convert up to 535,000 square feet of the proposed Multi-Use intensity to residential intensity for up to an additional 889 dwelling units within District 6 and Lot 48 of 2nd Amended VTTM 17008, subject to a vehicle trip limit.

        - 220,000 square feet of Community Commercial

- Grants, pursuant to State law, up to 1,194 additional DB units (35% of 3,412) plus any additional Density Bonus (DB) units associated with the optional conversion and granted pursuant to State law.

- Encourages Accessory Retail within Combined PA 51, as defined in the City of Irvine Zoning Code.

The 2012 Modified Project consists of 4,606 dwelling units (3,412 base units and 1,194 DB units). The 2012 Modified Project also includes the option to convert up to 535,000 square feet of Multi-Use to up to 889 base units and 311 DB units, granted pursuant to State law. These are in addition to the already approved 4,894 dwelling units.

The 2012 Modified Project includes two options for the "Main Street" development along Trabuco Road east of "O" Street. Option 1, which was studied in the 2011 Certified EIR, includes Community Commercial and Multi-Use north of Trabuco Road with Residential south of Trabuco in District 1 South. Option 2 will study Residential north of Trabuco Road with Community Commercial, Multi-Use, and Residential south of Trabuco Road in District 1 South. Both options will include a 2,600-student high school in District 5. The 2012 Modified Project also proposes to Modify Objective B-1 to identify locations where LOS E is acceptable.

The 2012 Modified Project also includes implementation of recreational facilities in the previously approved Sports Park District of the Orange County Great Park (Great Park).

The 2012 Modified Project incorporates the Mitigation Measures recommended by the 2011 Certified EIR and adopted by the City in the Mitigation Monitoring and Reporting Program. It also incorporates the Project Design Features described below.

UPDATED GEOTECHNICAL STUDIES

The following studies incorporate relevant work completed since 2003 to Great Park Neighborhoods - TTOD:

Consultant	Report Type	Report Area	Reference
ENGEO	Geotechnical Baseline Report	PA 51, PA 30	ENGEO 2010a
ENGEO	Tentative Map Report	District 4	ENGEO 2010b
ENGEO	Tentative Map Report	District 8	ENGEO 2010c
ENGEO	Tentative Map Report	District 1 North	ENGEO 2011a
ENGEO	Tentative Map Report	District 1 South	ENGEO 2011b
ENGEO	Tentative Map Report	District 7	ENGEO 2011c
ENGEO	Geotechnical Exploration	TCA Property	ENGEO 2011TCA

These geotechnical reports include or reference over 200 borings, over 50 CPT soundings, and over 180 test pits; laboratory testing of soil samples recovered from the borings and test pits; and geotechnical analyses to evaluate expected ground shaking levels, vertical and lateral ground displacement due to liquefaction and settlement of native soils and existing fills, shrink/swell potential of expansive soils, seepage, and slope stability.

THRESHOLDS OF SIGNIFICANCE, IMPACT, AND MITIGATION

The 2012 SSEIR describes applicable thresholds of significance, environmental impact, significance of the impact, and mitigation measures for the project to bring the impact to less than significant. From a Soil and Geology standpoint, the thresholds of significance for geologic hazards incorporated into the 2011 Approved Project and comparison with the 2012 Modified Project are summarized below:

Threshold A (1): Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:

1. *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.*

2. *Strong seismic ground shaking.*

3. *Seismic-related ground failure, including liquefaction.*

    1. The 2011 Certified EIR concluded that the risk of surface rupture is extremely low since there are no known active or potentially active faults crossing through or projecting into the project area based on a review the City of Irvine General Plan, Figure D-1. The 2011 TCA study for the roughly 11-acre site located between the current western boundary of Existing Planning Area 51 and SR-133 between Trabuco Road and Irvine Boulevard also reported that no known active or potential active faults cross the site. The applicable technical references for this conclusion are the State of California Special Publication 42 (Bryant and Hart, 2007) and the Fault Activity Map of California (Jennings and Bryant, 2010). Based on this information, the impact of surface rupture on the project remains less than significant and is no additional impact when comparing the 2011 Approved Project to the 2012 Modified Project, including the 11-acre site and relocation of the Wildlife Corridor.

    2. The 2011 Certified EIR concluded that the risk of strong seismic ground shaking in the planning area is high, consistent with seismic shaking hazards throughout Southern California, thereby, yielding significant impact (Impacts GS-1 and GS-2). The 2011 TCA study for the added 11-acre site (TCA) also reported the risk for strong seismic shaking. Mitigation Measures GS-1 and GS-2 state that the development should be designed in accordance with future geotechnical reports and the latest applicable building codes. These mitigation measures remain appropriate and the conclusion should be that following the implementation of MM GS-1 and GS-2, the impact of strong seismic ground shaking will be reduced to less than significant for the 2011 Approved Project. In addition, there is no additional impact when comparing the 2011 Approved Project to the 2012 Modified Project, including the 11-acre site and relocation of the Wildlife Corridor.

    3. The 2011 Certified EIR concluded that the risk of seismic-related ground failure, including liquefaction, is low and that no significant impact is anticipated, based on reference to the City of Irvine General Plan, Figure D-3, which identifies the site as being in Seismic Response Areas SRA 2 through SRA 4, in which the hazard of liquefaction is considered to

be remote. This conclusion was not consistent with the published literature available at that time (2000, SHZ Report 047), but appropriately noted that liquefaction hazards would be further evaluated in future studies as described below and incorporated into the 2011 Certified EIR for the 2011 Approved Project.

In 2000, the State of California published the Seismic Hazards map (Seismic Hazard Zone Report 047) for the El Toro Quadrangle pursuant to the requirements of the California Public Resources Code, Section 2690-2699.6 (Seismic Hazards Mapping Act). This map identifies areas of suspected liquefaction and seismic slope hazards within Districts 7 and 8 of Existing PA 51, within the large proposed habitat preserve parcel at the northeast corner of Existing PA 51, and within Existing PA 30 (see Figure 1 of this letter). Geotechnical studies between 2000 and 2010 also confirmed the presence of locally liquefiable soils in District 7 and in PA-30, but did not encounter conditions susceptible to liquefaction in District 8. For historic high groundwater conditions within District 7 and Existing PA 30, total seismically induced settlements were estimated between negligible to approximately 2½ inches, considering a design groundwater level at around 20 feet below existing grades. The hazard of lateral spreading was estimated to be low (ENGEO, 2010a) based on existing information provided.

The subsequent 2011 ENGEO geotechnical study within the roughly 11-acre site located between the current western boundary of Existing Planning Area 51 and SR-133 between Trabuco Road and Irvine Boulevard also concluded the potential for relatively minor settlements and lateral spreading due to liquefaction if hydrostatic conditions in proximity to the top of cut slope are not controlled.

The level of liquefaction hazard identified to date at the project should be considered potentially significant in proposed development areas. Appropriate mitigation measures to address liquefaction could include:

- Avoiding placing structures and improvements in susceptible areas
- Designing foundations and improvements for differential movements
- Low permeability linings or cut off barriers for potential water features
- Removal and replacement of liquefiable soils
- Deep dynamic compaction (DDC)
- Rapid impact compaction (RIC)
- Compaction with vibratory probes
- Compaction piles

The selection of a given method should be based on the proposed development/improvement type and local ground conditions. However, with the implementation of one or more of these methods, the potential impacts of liquefaction can be reduced to a less than significant level.

The Seismic Hazards Map (2000) for the El Toro Quadrangle also identified potential earthquake-induced landslide hazards in District 7 and in the northeast corner of Existing PA 51. In District 7, these hazards will be reduced to less than significant levels by implementation of corrective grading in the form of cut slope stability fills. In the northeast corner of Existing PA51, these hazards do not pose a risk to development.

The 2011 Certified EIR indicated that by implementing Mitigation Measure GS-2, the impact of liquefaction, lateral spreading and landsliding will be reduced to less than significant for the 2011 Approved Project. Therefore, no additional impacts related to soil instability are associated with the 2012 Modified Project, including the 11-acre site and relocation of the Wildlife Corridor, as compared to the 2011 Approved Project.

Threshold B (2): Result in substantial soil erosion or the loss of topsoil.

The 2011 Certified EIR concluded that the risk of erosion due to construction activities and post-construction conditions was a significant impact, defined as Impact GS-5. The 2011TCA study for the roughly 11-acre site located between the current western boundary of Existing Planning Area 51 and SR-133 between Trabuco Road and Irvine Boulevard also recognizes that there is a potential for soil erosion or loss of topsoil attributed to construction and post-construction conditions.

The 2011 Certified EIR concluded that this impact will be reduced to less than significant by incorporating Mitigation Measures GS-2 and GS-4. No additional impacts are associated with the 2012 Modified Project, including the 11-acre site and relocation of the Wildlife Corridor, as compared to the 2011 Approved Project.

Threshold C (3): Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the proposed project, and potentially result in onsite or offsite landslide, lateral spreading, subsidence, liquefaction, or collapse.

The 2011 Certified EIR concluded that these risks were not present in Existing PA 51 or Existing PA 30. As noted in Threshold B-3 above and as described in the 2011 Certified EIR; however, local landslide hazards are present in District 7 and outlying portions of Existing PA 51. In addition, the 2011 ENGEO geotechnical study within the roughly 11-acre site located between the current western boundary of Existing Planning Area 51 and SR-133 between Trabuco Road and Irvine Boulevard also concluded the potential for landsliding. Geotechnical corrective grading proposed in ENGEO (20010a, 2010f) for District 7 and ENGEO (2011TCA) will mitigate these hazards to less than significant levels in development areas through MM GS-2. Therefore, no additional impacts related to landsliding are associated with the 2012 Modified Project, including the 11-acre site and relocation of the Wildlife Corridor, as compared to the 2011 Approved Project.

As described in the 2011 Certified EIR, lateral spreading hazards do not appear to be present for the majority of PA-30 and Existing PA 51 based on the level of geotechnical explorations to date along select drainage corridors. Based on a 2011 study for the roughly 11-acre site located between the current western boundary of Existing Planning Area 51 and SR-133 between Trabuco Road and Irvine Boulevard, lateral spreading is a potential hazard if hydrostatic conditions in proximity to the top of cut slope are not controlled. Lateral spreading hazards at the 11-acre site and site-wide would be reduced to less than significant levels by implementation of Mitigation Measure GS-2 from the 2011 Certified EIR through design and corrective grading in Existing PA 30 and Existing PA 51. Therefore, no additional impacts related to lateral spreading are associated with the 2012 Modified Project, including the 11-acre site and relocation of the Wildlife Corridor, as compared to the 2011 Approved Project.

As described in the 2011 Certified EIR, potential liquefaction hazards exist in District 7 of Existing PA 51, and portions of Existing PA 30. In addition, based on the 2011 study for the roughly 11-acre site located between the current western boundary of Existing Planning Area 51 and SR-133 between Trabuco Road and Irvine Boulevard, liquefaction is a potential hazard if hydrostatic conditions in proximity to the top of cut slope are not controlled. Liquefaction hazards would be reduced to less than significant levels by implementation of Mitigation Measure GS-2 from the 2011 Certified EIR through design and corrective grading in Existing PA 30 and Existing PA 51. Therefore, no additional impacts related to liquefaction hazards are associated with the 2012 Modified Project, including the 11-acre site and relocation of the Wildlife Corridor, as compared to the 2011 Approved Project.

As described in the 2011 Certified EIR, potential subsidence hazards are present in the existing undocumented fill area under the former officers housing area of District 7 and in various locations in Existing PA 51, Existing PA 30 where there are less extensive undocumented fills or compressible surface soils. In addition, based on the 2011 study at the roughly 11-acre site located between the current western boundary of Existing Planning Area 51 and SR-133 between Trabuco Road and Irvine Boulevard, similar conditions were encountered. The 2003 OCGP EIR and 2011 Certified EIR for the 2011 Approved Project indicated subsidence hazards will be mitigated to less than significant levels by implementation of corrective grading recommendations for subexcavation and replacement of unsuitable soils as well as by implementation of Mitigation Measure GS-2. Therefore, no additional impacts related to subsidence hazards are associated with the 2012 Modified Project, including the 11-acre site and relocation of the Wildlife Corridor, as compared to the 2011 Approved Project.

Threshold D (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.

The 2011 Certified EIR concluded that this was a significant impact (presented as Impact GS-3 and duplicated as Impact GS-6). Mitigation for this impact is presented as part of Mitigation Measure GS-2, which requires future geotechnical reports to provide appropriate expansive soil design measures. Mitigation measures that reduce expansive soil impacts to less than significant levels have been described in ENGEO (2010a-2010f, and 2011TCA). Therefore, no additional impacts related to expansive soils are associated with the 2012 Modified Project, including the 11-acre site and relocation of the Wildlife Corridor, as compared to the 2011 Approved Project.

Threshold E (5): Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems, where sewers are not available for the disposal of wastewater.

The 2011 Certified EIR concluded that this was a less than significant impact since the project will rely of municipal sewers. The 2012 Modified Project will also rely on municipal sewers; therefore, no additional impacts are associated with the 2012 Modified Project, including the 11-acre site and relocation of the Wildlife Corridor, as compared to the 2011 Approved Project.

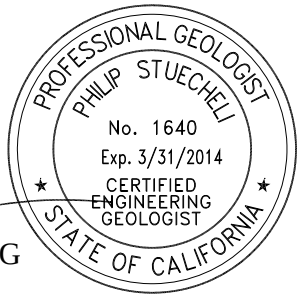
CONCLUSIONS

The mitigation measures incorporated into the 2011 Certified EIR provide the means to reduce geology and seismicity impacts to less than significant levels, mainly through the provisions of Mitigation Measures GS-2 that require future geotechnical studies to define and provide mitigation recommendations for geotechnical hazards.

Subsequent geotechnical studies have largely fulfilled the requirements of MM GS-2 by more accurately defining geology and seismicity hazards. Implementation of the recommendations in ENGEO (2010a-c, 2011a-c, and 2011TCA) will result in no additional impacts between the 2011 Approved Project and the 2012 Modified Project and will reduce the CEQA impacts to less-than-significant levels.

Sincerely,

ENGEO Incorporated



Jonathan Boland, GE
jb/pjs/jam/jf:sseir

Philip J. Stuecheli, CEG

Julia A. Moriarty, GE

Attachments: List of References
Figure 1 – Seismic Hazard Zone Map

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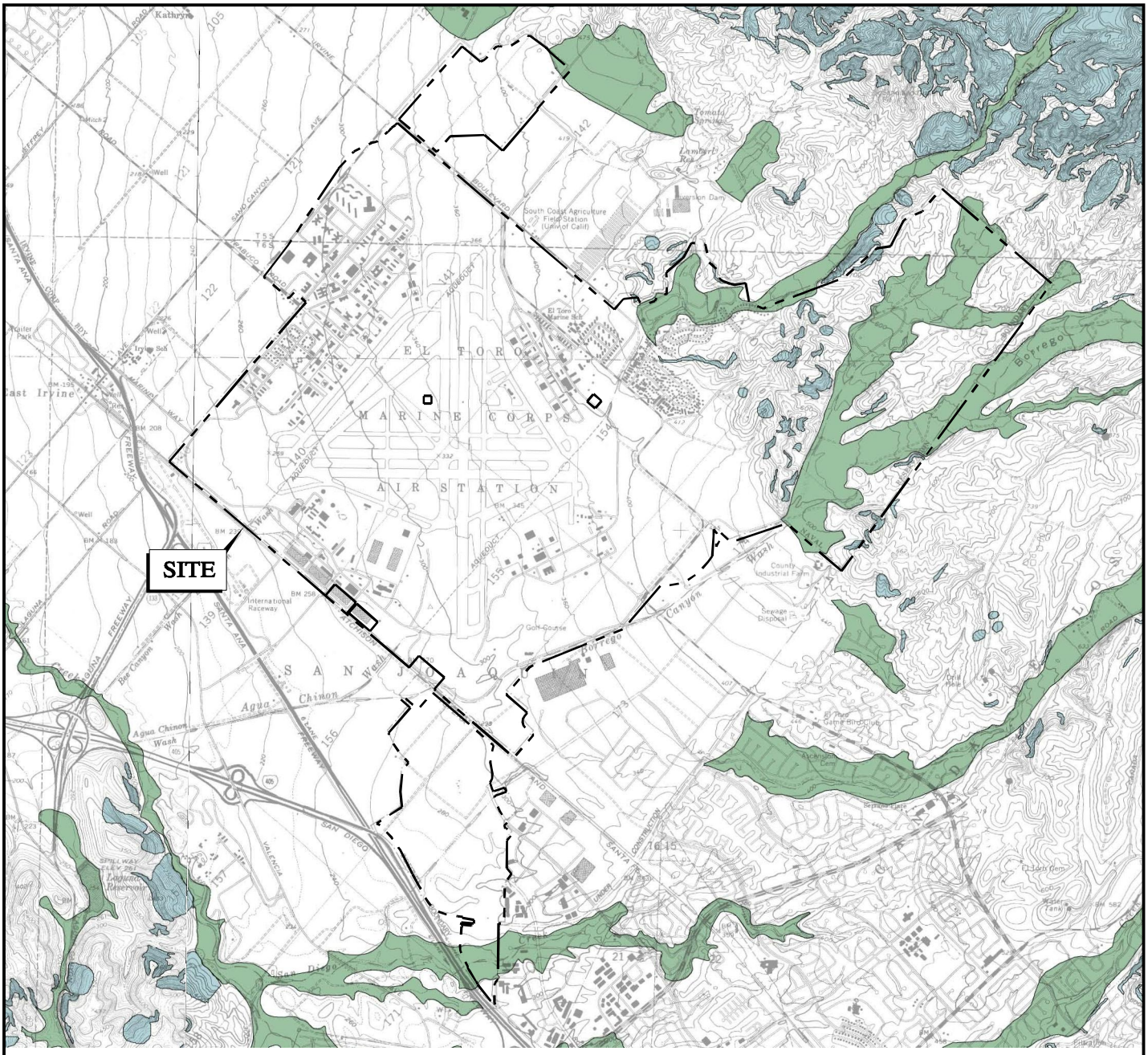

EXPLANATION

LIQUEFACTION

AREAS WHERE HISTORIC OCCURRENCE OF LIQUEFACTION, OR LOCAL GEOLOGICAL, GEOTECHNICAL AND GROUNDWATER CONDITIONS INDICATE A POTENTIAL FOR PERMANENT GROUND DISPLACEMENTS SUCH THAT MITIGATION AS DEFINED IN PUBLIC RESOURCES CODE SECTION 2693(c) WOULD BE REQUIRED

EARTHQUAKE-INDUCED LANDSLIDES

AREAS WHERE PREVIOUS OCCURRENCE OF LANDSLIDE MOVEMENT, OR LOCAL TOPOGRAPHIC, GEOLOGICAL, GEOTECHNICAL AND SUBSURFACE WATER CONDITIONS INDICATE A POTENTIAL FOR PERMANENT GROUND DISPLACEMENTS SUCH THAT MITIGATION AS DEFINED IN PUBLIC RESOURCES CODE SECTION 2693(c) WOULD BE REQUIRED

BASE MAP SOURCE: CALIFORNIA DEPARTMENT OF CONSERVATION, DIVISION OF MINES AND GEOLOGY

ENGEO Expect Excellence

SEISMIC HAZARD ZONE MAP

GREAT PARK NEIGHBORHOODS - 8.1 TRAILS AND TOD DISTRICT

IRVINE, CALIFORNIA

PROJECT NO.: 8506.000.002			FIGURE NO. 1
SCALE: AS SHOWN			
DRAWN BY: DLB	CHECKED BY: JAM		

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ORIGINAL FIGURE PRINTED IN COLOR