4.2 GEOLOGY AND SOILS

The *FORA Reuse Plan Final Environmental Impact Report* (FORA FEIR) identified on a program level less than significant environmental impacts for geology and soils as related to loss of unique soil types, long-term loss of soil fertility, loss of coastal facilities due to coastal erosion, accelerated wind and water erosion, increase landslide susceptibility and sedimentation, and engineering limitations of soils.

Site specific details and project-level information for the EGSP were not known and not analyzed at the time of the FORA FEIR. New information for the currently proposed EGSP include development of a project site plan, project grading plan, and utilities plan; and the preparation of a site-specific geotechnical report containing information on the project site.

This section provides additional analysis of potential impacts not previously analyzed in the FORA FEIR. This section provides information regarding potential geotechnical hazards and impacts resulting from general grading and drainage, including preliminary pavement design. This section is derived from the *Preliminary Geotechnical Exploration East Garrison, Fort Ord Phase I* report prepared in July 2003 by ENGEO Incorporated. A discussion regarding types of foundation systems deemed suitable at the site and subgrade soil treatment for such systems is presented and generally discussed. The geotechnical report is included in Appendix B of this DSEIR.

4.2.1 Environmental Setting

REGIONAL GEOLOGY

Regional geologic mapping by Wagner et al. (2002) indicates that the site is underlain by late Pleistocene older dune sand (Qod) deposits (see Exhibit 4.2-1). Dibblee (1973) similarly maps the site as being underlain by Pleistocene older dune deposits and Plio-Pleistocene Aromas Sand (older dune deposits). Bedding in the region, as mapped by Dibblee, dips to the northeast at inclinations of 3 to 5 degrees.

SITE GEOLOGY

The eastern portion of the site is situated on top of a steeply sloping bluff and the western portion of the site is located at the base of a depression. Elevations range from about 25 feet above mean sea level (msl) at the base of the bluff slope along the eastern boundary to about 225 feet above msl along the western and southwestern boundaries (see Exhibit 4.2-2). The interior portions of the site form three gently sloping plateaus at elevations of roughly 150, 175, and 200 feet above msl within the eastern, southern, and northern areas, respectively. Moderately steep interior slopes that create the elevation differences are located between the plateaus.

SITE SEISMICITY

Exhibit 4.2-3 identifies the regional faults within the project area. The site is not located within a State of California Earthquake Fault Hazard Zone and no active faults are mapped on the site. Faults within the project area include the King City, Rinconada, Palo Colorado, San Andreas, and the Calaveras.

King City Fault

Previously, the King City Fault has been mapped as a concealed and potentially active fault (Kilborne and Mualchin, 1980) that trends in a northwest orientation across the central portion of the site. The King City Fault is associated with the Rinconada Fault system. A published map showing the recent faulting, prepared by Jennings (1994), does not show the King City Fault as active or potentially active. To investigate this feature, several studies were conducted, including a review of aerial photographs, site reconnaissance, literature search, and fault trench excavation. The analysis revealed that the fault is not shown as active on more recent studies and the excavations revealed no indications of faulting in the soil strata. A vegetation lineament coinciding with the mapped fault trace was determined not to be fault related. Therefore, the geologic analysis of the site determined that no evidence exists that the concealed fault crosses the Specific Plan area.

Rinconada Fault

The northward extension of the Rinconada Fault is approximately 0.5 miles to the northeast of the site. The Rinconada Fault is classified as potentially active by Jennings (1994) and the Uniform Building Code (UBC) (1997) includes the Rinconada Fault as an earthquake source with an estimated maximum moment magnitude of 7.3. However, the northern segment of the Rinconada Fault, the Espinosa segment, is not zoned as active by the State of California (Hart et al., 1986) since the fault lacks geomorphic evidence of Holocene displacement. Accordingly, this fault is not considered active within the project development area.

San Andreas Fault

The San Andreas Fault is located approximately 17 miles to the northeast of the site. The maximum earthquake for the region is expected from the San Andreas Fault, the major active fault within the Bay Area. The Uniform Building Code (UBC) (1997) provides an estimated maximum moment magnitude of 7.3 for the San Andreas Fault.

Calaveras Fault

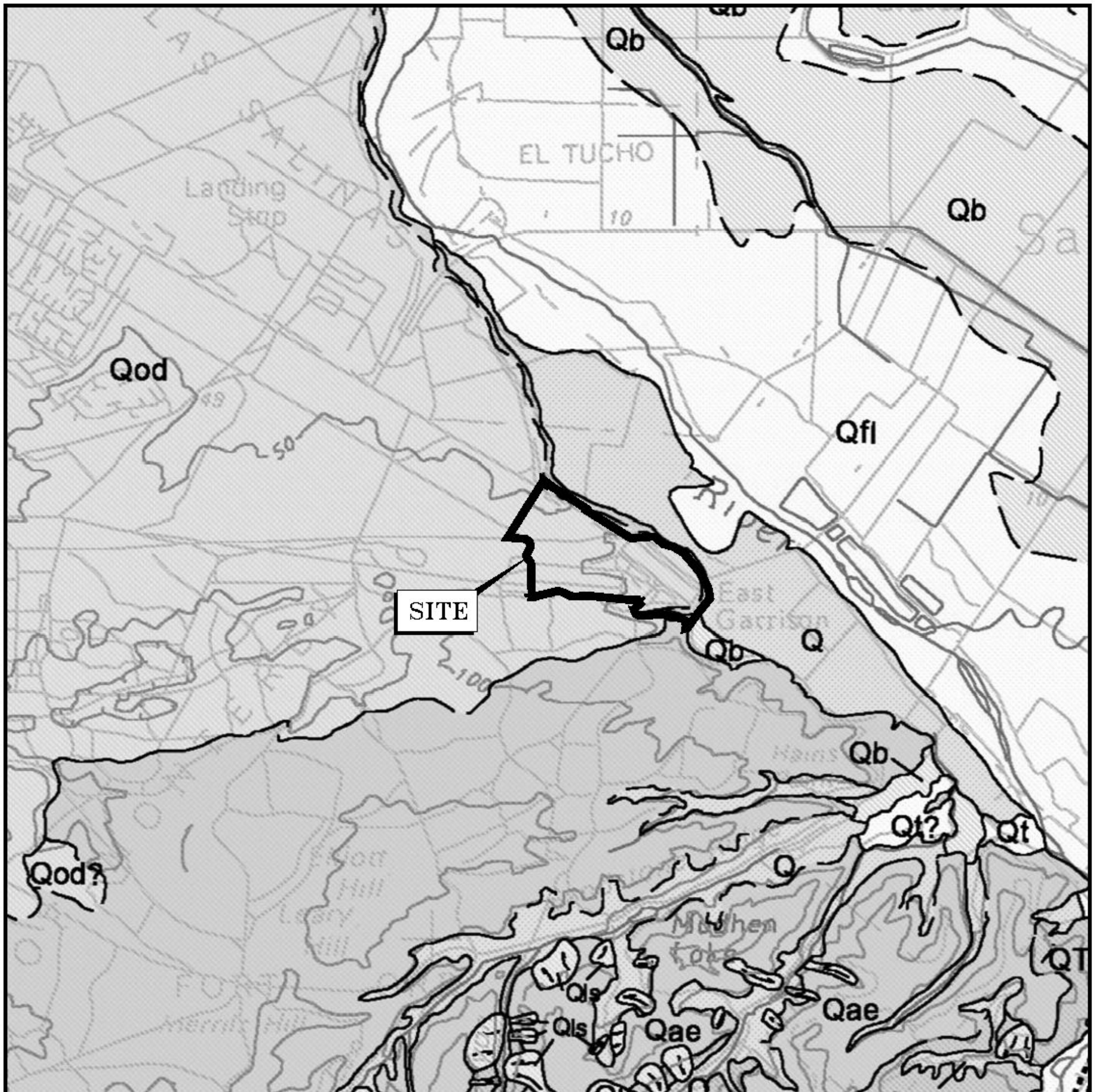
The Calaveras Fault is located approximately 23 miles to the northeast of the project site and is considered a major active fault. The Uniform Building Code (UBC) (1997) provides an estimated maximum moment magnitude of 6.2 for the segment of the Calaveras Fault south of Calaveras Reservoir.

Palo Colorado Fault

The Palo Colorado Fault is located about 15 miles to the southwest and is considered a major active fault. The Uniform Building Code (UBC) (1997) provides an estimated maximum moment magnitude of 7.0 for the Palo Colorado Fault.

LANDSLIDING

A review of published geologic maps did not reveal any landslide activity onsite (Wagner et al. (2002) and Dibblee (1973). However, the lower portion of the natural bluff area to the east has numerous shallow earthflows/slumps, (Figure 2A ([ENGEO, 2003]). The headscarp for two more recent earthflow/slump areas measures as roughly 25 feet below the top of slope elevations, approximately 100 feet wide, and roughly the thickness of the residual soil materials (about 2 to 4 feet). Other shallow earthflow/slump areas are older and well vegetated. Accumulations of landslide debris and slope wash on the lower portion of the bluff probably range up to approximately 10 feet thick. Vegetation on the slope, including thick stands of oak trees, suggests that the accumulation of landslide debris and slope wash is a gradual process that has occurred over a long time.



EXPLANATION

Q	ALLUVIUM
Qfl	FLOOD PLAIN DEPOSITS
Qb	BASIN DEPOSITS
Qod	OLDER DUNE SAND
Qae	AROMAS EOLIAN FACIES

Source: Wagner, et al., 2002 (base map source). ENGEO Incorporated, July 2003.

NORTH

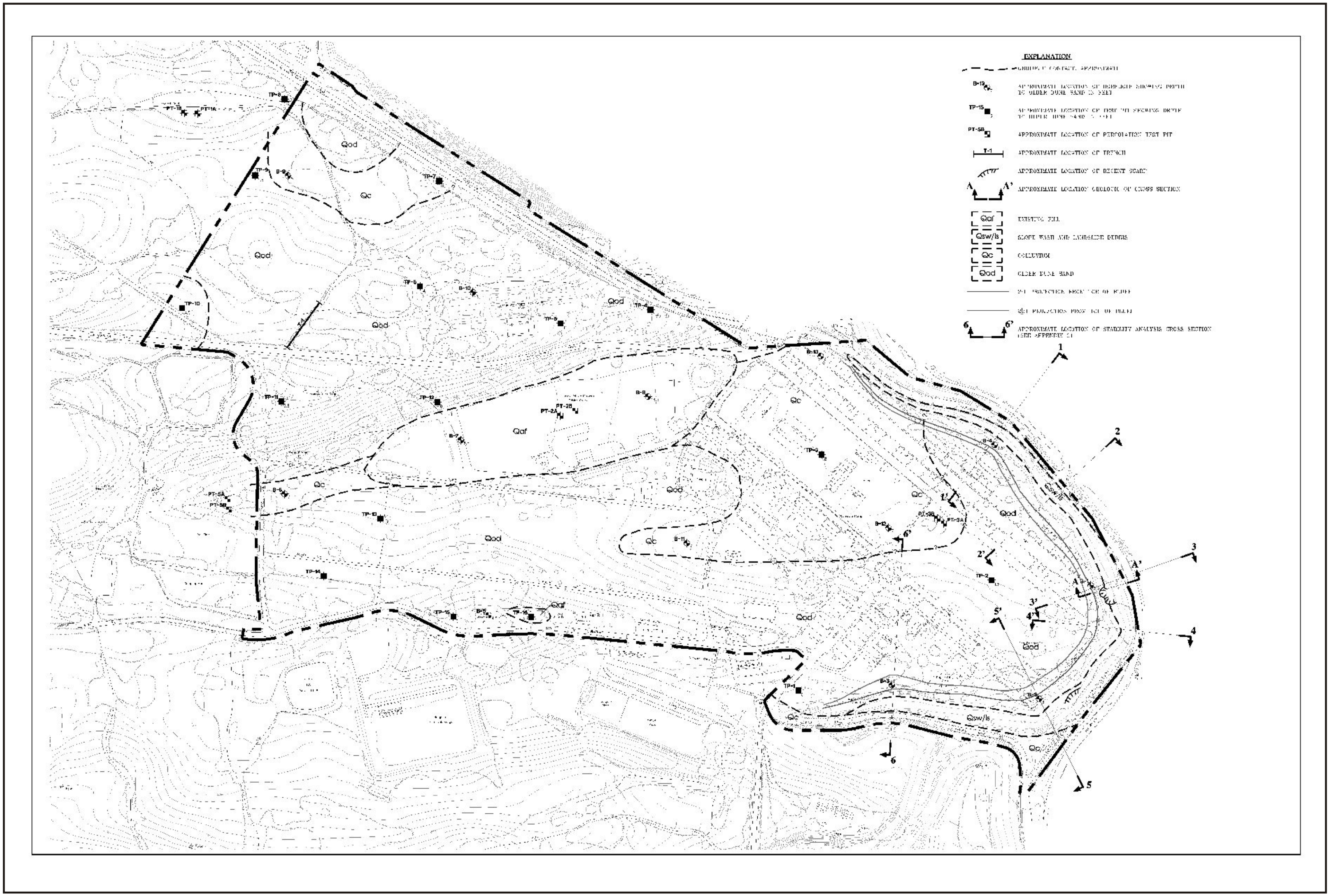
4.275 2,137.5 0 4,275

SCALE IN FEET

Michael Brandman Associates

Exhibit 4.2-1

Regional Geologic Map



Source: Urban Design Associates, March 2003 (base map source). ENGEO Incorporated, July 2003.

NORTH

780 390 0 780

SCALE IN FEET

Michael Brandman Associates

Exhibit 4.2-2
Site Geologic Map

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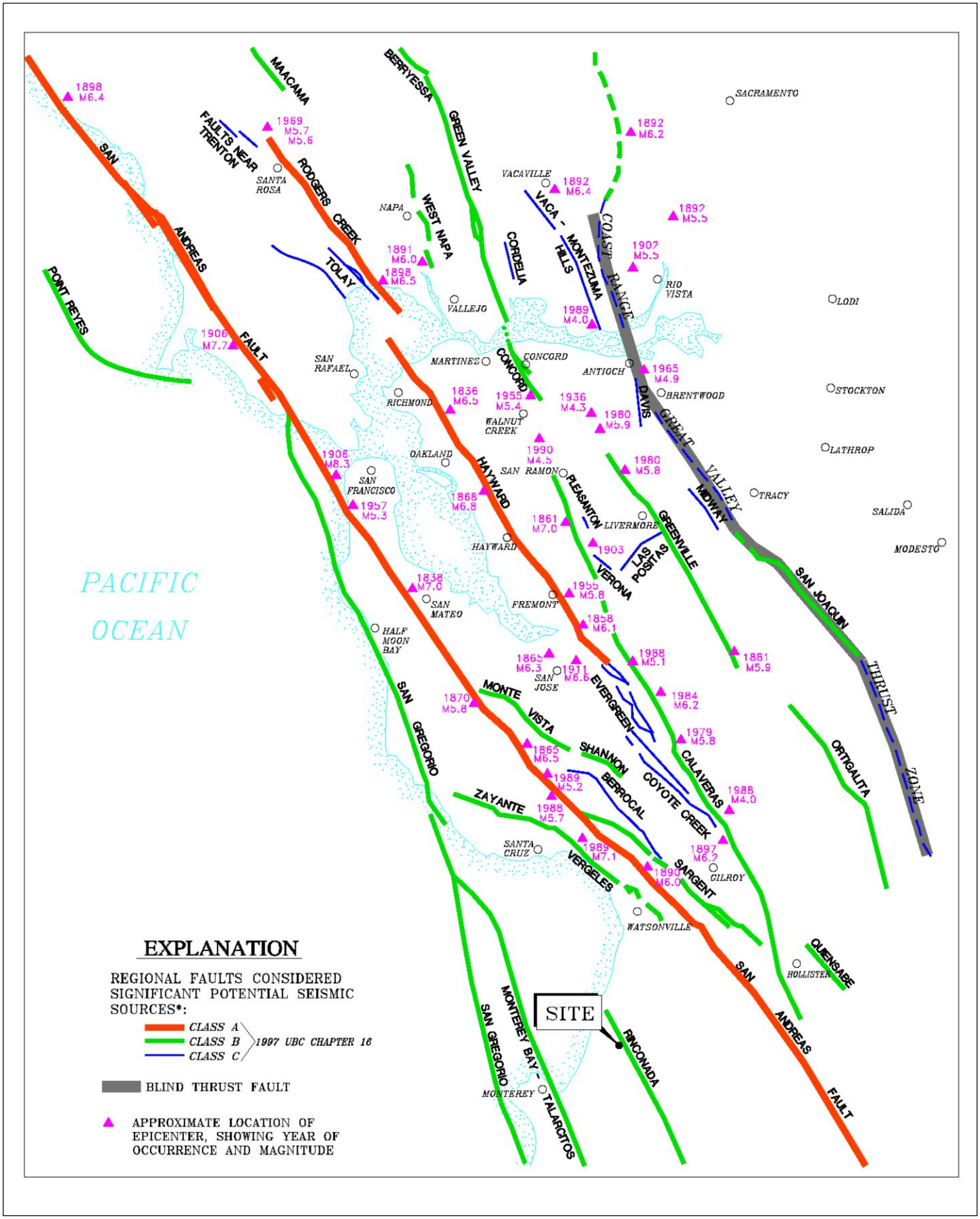


Source: USGS Open File 96-706. ENGEO Incorporated, July 2003.

Michael Brandman Associates

NORTH

NOT TO SCALE

Exhibit 4.2-3
Regional Faulting and Seismicity Map

The existing perimeter bluff along the northeastern and eastern portion of the site is typically inclined at a slope gradient of 1:1 (horizontal:vertical) or flatter, with some localized sections of near-vertical to 0.75:1 inclinations. The bluff slope ranges from 25 feet to 125 feet in height.

Minor recent earthflow/slumps along with some areas of active erosion and evidence of older earthflow/slumps along the lower portion of the bluff slope were noted on portions of the slope at the time of ENGEO's site reconnaissance. Additional erosion and surficial slumps of the bluff slope are anticipated due to the presence of weakly cemented residual soils and dune deposits and the steep inclination of the slope. The bluff along the north and east sides of East Garrison is situated on the south margin of the Salinas River Valley. The bluff formed over a period of several thousand years as streams meandered across the Salinas Valley and eroded the base of the hills along the margin of the valley. The processes that formed the bluff are very different than the processes that can be observed along the Pacific coast where relatively rapid erosion rates occur. Along the Pacific coast, storms and wave action continue to cause erosion and the formation of sea cliffs. Sea cliff retreat can be a relatively rapid geologic process that can average up to one-foot per year in some locations.

Through channel stabilization and flood control measures, streams and rivers no longer meander across the Salinas Valley and, therefore, will no longer erode the East Garrison bluff. Vegetation of the bluff at East Garrison, consisting of oak trees, brush and grasses, suggests that stream erosion along the toe of the bluff has not occurred within a few hundred years. Without stream erosion at the toe of the bluff, the processes of erosion and landsliding along the bluff have slowed substantially allowing vegetation to develop on portions of the slope. Some steep portions of the slope are bare of vegetation and continue to unravel and erode at a slower rate than has occurred in the past.

The bluff on the east side of the site appears to be experiencing the most rapid erosion of the bluffs on the perimeter of the site, although considered very slow in comparison to coastal bluffs. The east facing bluff is also the highest and steepest bluff on the site. The north-facing and south facing bluffs are more highly vegetated and appear to be experiencing erosion at a much slower rate.

SOIL CHARACTERISTICS AND SUBSURFACE STRATIGRAPHY

A geotechnical field exploration was conducted in April 2003, and consisted of drilling 13 borings and excavating 17 test pits distributed across the EGSP area to characterize the project site's subsurface conditions.

The older dune sand deposits onsite were generally found to be capped with a relatively thin layer of residual soil or colluvium. At least 4 areas of pre-existing, undocumented fills were encountered at or near the exploration locations.

Residual Soil

Residual soil develops essentially in-place from weathering of the underlying parent material and older dune sand deposits. The site residual soil is up to 4.5 feet thick and is typically dark-brown to brown silty sand or sand with silt and was generally slightly moist to moist and loose to medium dense. Trace roots are also present in a few locations.

Selected samples of residual soil materials encountered were tested for grain size distribution and yielded a range of 17 to 38 percent passing the No. 200 sieve. One sample was tested for Plasticity Index (PI) and yielded a non-plastic (NP) PI. This is an indication that the residual soils have a low expansion potential.

Colluvium (Qc)

Colluvium materials are accumulated by a combination of processes, including slopewash and soil creep. Above the older dune deposits, colluvium is roughly 7 feet in thickness within some areas of the site. The dark brown silty sand and sand with silt colluvial materials are similar to the residual soil materials, but are found in low-lying swale areas or depressions and were found to be dry to moist, and very loose to medium dense.

Select samples of the colluvial materials were tested for grain size distribution. The representative residual and older soils tested have very-low to low expansion potential.

Existing Fill Materials (Qaf)

A layer of pre-existing undocumented fill is present in two areas over the colluvial materials, and in one area over older dune deposits. The fill ranges in depth from approximately 3.5 feet to 8 feet thick. The fill was likely placed onsite to create the relatively flat area in a depressed/swale area or water tank pad when the military base was active. Based upon blow counts, the fill material is characterized as very loose to medium dense silty sand and sand with silt. Minor roots and trace gravels were also encountered in the fill material.

Several other areas of minor undocumented fill are located around the existing structures. These minor fills were created during minor grading operations to create the relatively flat pads for the military buildings. It is anticipated that the fills are generally 6 feet or less in thickness, but may reach up to 8 feet in some undetermined areas.

These areas of undocumented fill will require over-excavation and recompaction as engineered fill.

Older Dune Sand (Qod)

The older dune sand materials are generally medium-dense to very-dense and slightly-moist to very-moist.

Groundwater

No springs or other manifestations of shallow groundwater were observed during ENGEO’s site reconnaissance. In addition, groundwater was not encountered in the test pits or borings drilled as a part of the geotechnical exploration study. Groundwater levels are expected to vary depending on weather conditions, the time of year, irrigation practices, drainage patterns, and the proposed development.

4.2.2 Project Impacts and Mitigation Measures

IMPACT ANALYSIS AND MITIGATION MEASURES

Thresholds of Significance

The proposed project is considered to have a significant impact due to geology and soils if it would result in one or more of the following:

- 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.

d. Landslides.

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

Methodology

A geologic site assessment was performed by an ENGEO engineering geologist in 2003. The site assessment included map and aerial photography research, a field reconnaissance, laboratory testing, and a literature search. Geological maps and aerial photographs were reviewed for signs of faults, landslides, and liquefaction. The field reconnaissance included a foot survey to observe signs of faulting and geotechnical borings and test pits to assess subsurface conditions, including assessing the depth of groundwater on the project site. Laboratory testing was conducted to determine soil characteristics. The literature search included information related to faulting and other geotechnical hazards in the project area.

Exposure to Seismic Hazards

Impact 4.2-A	**Implementation of the EGSP will result in the development of structures and the introduction of new populations into an area that is subject to seismic hazards, such as ground shaking, densification, landsliding, etc. (Less than Significant After Mitigation)**

Potential seismic hazards, resulting from a nearby moderate to major earthquake may include primary ground rupture, ground shaking, lurching, liquefaction, lateral spreading, and earthquake induced densification and landsliding. Risks from seiches, tsunamis, and inundation, due to embankment failure, are considered low at the site based on the elevated topographic setting and the absence of large reservoirs in the vicinity.

Ground Rupture

The site is not within a State of California Earthquake Fault Hazard Zone and no active faults cross the site. Additionally, as discussed above, no indications of faulting were found in exploratory trenching where Kilborne and Mualchin (1980) map the King City Fault in the central portion of the site. Therefore, based on these findings, the potential for ground rupture at the site is considered low.

Ground Shaking

An earthquake of moderate to high magnitude generated within the Monterey Bay Region could cause considerable ground shaking at the site, similar to that which has occurred in the past. This hazard is not unique to this project and affects all properties in the region.

All structures should be designed using sound engineering judgment and the latest UBC requirements as a minimum. Seismic design provisions of current building codes generally prescribe minimum lateral forces, applied statically to the structure, combined with the gravity forces of dead-and-live loads. The prescribed lateral forces are generally considered substantially smaller than the actual peak forces that would be associated with a major earthquake. Consequently, structures should be able to 1) resist minor earthquakes without damage, 2) resist moderate earthquakes without structural damage but with some nonstructural damage, and 3) resist major earthquakes without collapse but with some structural as well as nonstructural damage. Conformance to the current building code recommendations does not constitute any kind of guarantee that significant structural damage would not occur in the event of a maximum magnitude earthquake; however, it is reasonable to expect that a well-designed and well-constructed structure will not collapse or cause loss of life in a major earthquake (SEAOC, 1996).

Lurching

Ground lurching is a result of the rolling motion imparted to the ground surface during energy released by an earthquake. Such rolling motion can cause ground cracks to form. The potential for the formation of these cracks is considered greater in poorly consolidated colluvial and alluvial deposits or at the contact of surface materials with bedrock. Due to the relatively consistent older dune deposits, lurching is expected to be low to negligible.

Liquefaction

Soil liquefaction is a phenomenon under which saturated, cohesionless, loose soils experience a temporary loss of shear strength when subjected to the cyclic shear stresses caused by earthquake ground shaking. Maps showing liquefaction potential by Dupre and Tinsley (1980) indicate that the site has a low susceptibility for liquefaction.

Near-surface zones of very loose to loose silty sands (residual soils, colluvium, and undocumented fill) were encountered in a few locations on the site. However, groundwater was not encountered in any exploratory locations, which extended up to 71 feet below existing grade. Therefore, based on these findings, in conjunction with general earthwork activities to create a stable foundation soil, soils encountered on site are not susceptible to liquefaction. However to ensure that project structures would not be susceptible to liquefaction, over excavation and construction of engineered fills shall be performed in all areas where there is evidence of loose residual, colluvial, and undocumented fill. Final plans for developable areas will include sub-excavation of near surface materials to encounter firm older dune deposit and placement of engineered materials that are compacted to a minimum specified relative compaction.

Lateral Spreading

Lateral spreading is a failure within weaker soil material that causes the soil mass to move towards a free face or down a gentle slope. Since surficial soils (residual soils, colluvium, and undocumented fill) situated above the older dune deposits will likely be removed as a part of earthwork operations, the potential for lateral spreading is considered low. Therefore, based on these findings, the potential for lateral spreading is considered low.

Seismically Induced Densification

Densification of loose to medium dense sand above and below the groundwater level during earthquake shaking could cause settlement. As previously stated, the liquefaction potential of the onsite soil is considered low; however, there are areas of very-loose to loose surface soils. Therefore, densification induced by earthquake shaking is probable for these areas.

Seismically Induced Landsliding

As for all of the Monterey Bay area, the risk of instability is greater during major earthquakes than during other times. Also, as with most hillside developments, landslides and slope stability are important issues for the project. The relatively flat interior terrain at the site does not appear to be subject to seismically induced landsliding; however, the natural bluff areas and internal slopes to remain could be impacted by landsliding.

Mitigation Measures

4.2-A-1 Appropriate setbacks shall be maintained from the existing top of slope for the perimeter bluff areas as recommended by a licensed geotechnical engineer for permanent improvements and structures. The setback area shall be placed in a conservation easement. Proposed fill slopes shall also be adequately keyed into competent older dune deposits and subdrained.

4.2-A-2 Final plans shall include establishment of setbacks for structures and other improvements from the natural bluff in the eastern portion of the site, based upon slope stability analysis (static and pseudo-static) of existing materials. For interior slopes to remain and proposed new slopes, additional stability analysis shall be performed and stabilizing techniques shall be developed based upon the results of the analysis. This analysis shall be performed by a licensed geotechnical engineer during review of 40-scale grading plans; the final setbacks shall be depicted on the 40-scale grading plans.

Significance After Mitigation

Less than significant.

Landslides and Erosion

Impact 4.2-B **Earth moving activities associated with implementation of the EGSP may result in triggering or accelerating landslides and erosion on the project site. (Less than Significant After Mitigation)**

To estimate the bluff regression from erosion that could occur over the next 75 to 100-year period, ENGEO based their calculations on the estimated erosion rate for the past 62 years (ENGEO, 2003). This is considered a conservative estimate since the rate of erosion of the bluff face after development is expected to be less than the erosion rate that has occurred in the recent past because of the positive drainage aspects of the new site grades. On this basis, bluff regression from raveling and erosion over the next 75 to 100 years is not expected to exceed 6 to 8 feet. Since, improvements and development are proposed in close proximity to the top of the slope, appropriate setbacks for improvements and structures are proposed.

To evaluate the rate that the bluff is regressing from erosion, an aerial photograph taken in 1941 was compared to current conditions. Using the locations of buildings that are common to both the 1941 photograph and the current topographic base map as reference points, the photograph was enlarged to a scale of 1”= 100’. The crest of the steep bluff is clearly visible on the aerial photograph as a line between the grass-covered slope and the bare near-vertical scarp. This line representing the top of the bluff in 1941 is plotted on the current topographic base map (see Exhibit 4.2-4).

The location of the existing crest of the steep bluff was also plotted on the current topographic base map by tape measuring from the existing edge of pavement and from existing power poles (see Exhibit 4.2-4). Comparison of the bluff location in 1941 with the current location indicates that the bluff has regressed no more than about 5 feet over a period of 62 years. This translates to an average estimate rate of regression of about 0.08 feet per year due to stormwater runoff (see Exhibit 4.2-4).

Mitigation Measures

4.2-B-1 Stormwater runoff systems shall be implemented and maintained by the following procedures so that less runoff is directed over the bluff:

- Site grading will be accomplished to direct surface water runoff away from the slope crest and include debris bench catchment areas and subdrainage as appropriate.
- The project engineer shall submit a plan to control stormwater runoff during design phase of the project. This plan shall describe required maintenance by the CSD for the debris bench catchment areas including the removal of soil accumulation from and observation of all subdrain outlets and cleanouts to confirm proper function on an annual basis. During maintenance activities, the need for maintenance including possible regrading, shoring and backfilling shall be assessed. This plan shall be reviewed and approved by the Monterey County Water Resources Agency.

Significance After Mitigation

Less than significant.

Ground or Soil Failure

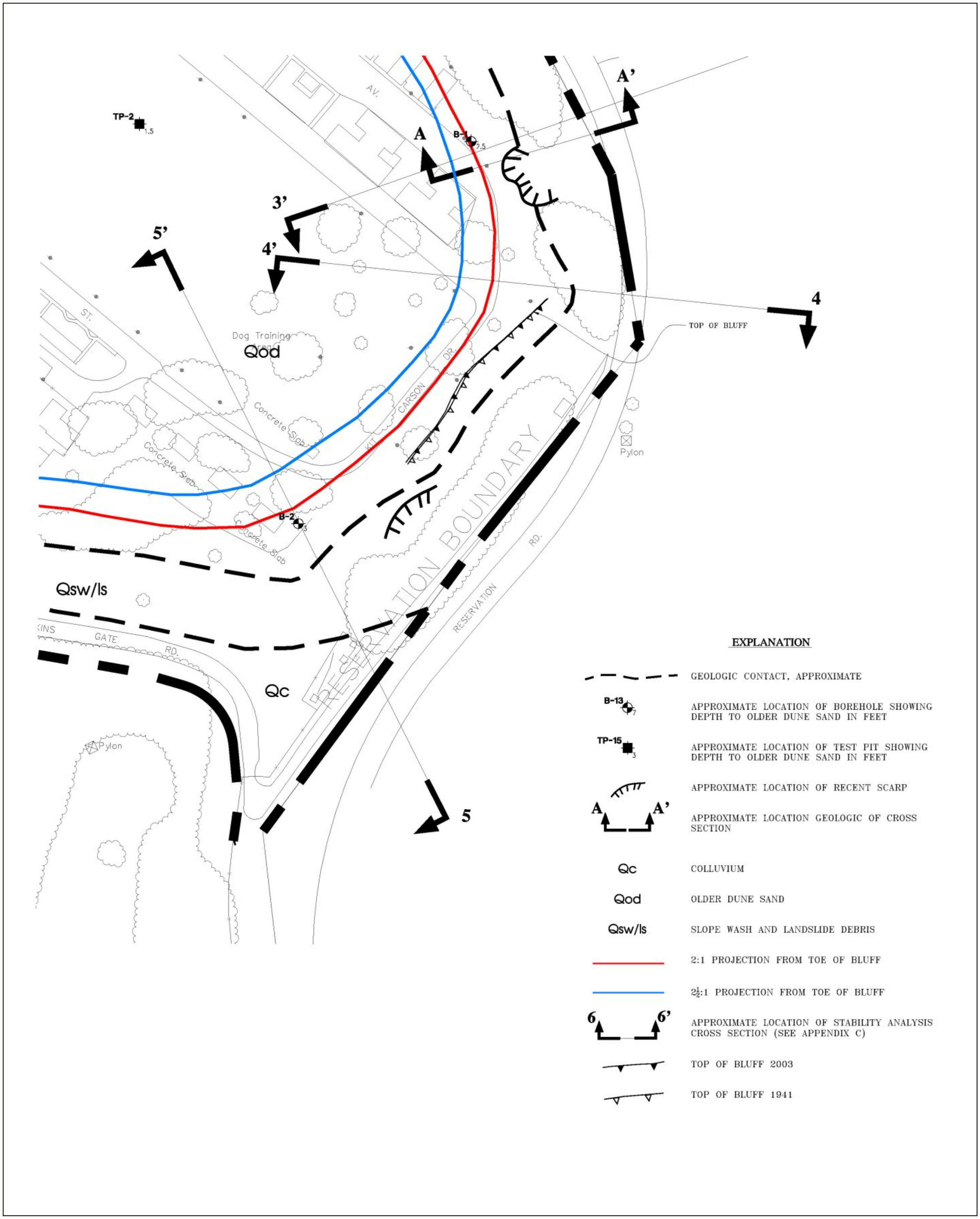
Impact 4.2-C	**Project implementation may result in the damage, endangerment or creation of hazards to people and/or structures as a result of ground or soil failure from existing fill materials, expansive soils, cut and/or fill activities, differential thickness, densification, and compressible materials on the EGSP site. (Less than Significant After Mitigation)**

Existing Fill Materials

Pre-existing fill materials and soft/loose soils present potential hazards to construction. The undocumented fill materials encountered on the site contained trace amounts of organics, and extended to approximately 8 feet below existing grade. The placement and quality of this fill material is unknown, but nearby piles of organic debris and the condition of the surficial material indicates that unsuitable debris could have been placed within the fill material. Given the historic use of the site, there appear to be numerous smaller fill areas associated with building foundations, pipelines, and roadways. This would not lend itself well to receiving additional fill materials during development of the EGSP site.

Mitigation Measures

4.2-C-1 The Geotechnical Engineer shall observe and document all grading activities and shall be informed when import materials are planned for the site. A sample of such material shall be submitted to the Geotechnical Engineer for evaluation prior to being



Source: Urban Design Associates, March 2003 (base map source). ENGEO Incorporated, July 2003.

NORTH

NOT TO SCALE

Michael Brandman Associates

Exhibit 4.2-4
Bluff Regression Map

brought on the site and the import soil shall be in adherence with the guidelines provided in Guide Contract Specifications.

4.2-C-2 A layer of site strippings, topsoil, other organic soil, or other appropriate erosion control measures, no more than 6 inches in thickness, shall be track-walked onto all graded slopes (cut or fill) following rough grading to promote the growth of vegetation on areas outside of building construction envelopes. Subject to approval by the Landscape Architect, organically contaminated soil material may also be utilized in landscape areas located outside the building footprint. These materials shall be stockpiled in an approved area that is unaffected by grading operations until their future use. The location of stockpile areas shall be shown on grading plans for the project.

4.2-C-3 During grading plan development, selective grading schemes shall be developed to reduce the presence of expansive soil within the upper lot areas by placing the highly expansive materials as engineered fill at the base of deeper fills, or by selectively placing such materials outside building areas.

Expansive Soils

Potentially expansive soils are a minor concern on the project within the upper residual soil layer. Although the results of laboratory testing showed that the soils contain very-low to low expansion potentials, some zones of silty or clayey materials may be encountered. Expansive soils shrink and swell as a result of moisture changes. This can cause heaving and cracking of slabs-on-grade, pavements, and structures founded on shallow foundations. Successful construction on expansive soils requires special attention during grading.

Mitigation Measures

4.2-C-4 Building damage due to volume changes associated with expansive soils shall be reduced by deepening the foundations to below the zone of significant moisture fluctuation, or by using structural mat foundations which are designed to resist the deflections associated with the expansive soils. The foundations shall be designed to address this potential deflection. A detailed review of fill thickness shall be performed during the preparation of the final 40-scale grading, and fill performance testing on remolded samples of engineered fill materials shall be provided to the County during grading. Additionally, local sub-excavation of soil material and replacement with engineered fill as directed by the Geotechnical Engineer may be necessary.

Cut-Fill Transition Lots

For the given site conditions and terrain, it is likely that some lots will be traversed by a cut-fill transition. It is anticipated that variations in material properties may occur in the areas of cut-and-fill daylighting. This may cause differential swelling and shrinking of the surface soils under the building foundation, which can be detrimental to shallow foundations and building performance.

Mitigation Measures

4.2-C-5 The upper 12 inches (1 foot) of building pad subgrade soils shall be scarified, mixed, and recompacted as engineered fill. If a highly variable subgrade material is encountered at the time of cutting, the depth of subexcavation may be increased to 24 inches (2 feet) if recommended by a geotechnical engineer. This increase shall depend upon review and approval of grading plans at the time of grading by an engineer or geologist based on the swell potential of the surface materials.

Cut Lots

Lots located entirely in cut may be subjected to differential vertical movement if a significant variation in soil types occurs at the proposed ground surface as a result of grading. This may cause differential swelling/shrinking of the foundation soils, similar to the cut-fill transition zone described above.

Mitigation Measures

4.2-C-6 Graded cut and fill slopes up to 20 feet in height, shall be no steeper than 2:1 (horizontal:vertical). For slopes between 20 and 30 feet in height, a 2.5:1 or flatter slope gradient shall be provided, while for slopes exceeding these height guidelines, a maximum slope gradient of 3:1 shall be provided. If steeper and/or higher slopes are desired, guidelines for geotextile slope reinforcement shall be developed.

4.2-C-7 Cut slopes shall be observed by an Engineering Geologist during grading to determine whether any adverse geologic conditions are encountered on the exposed slope. If adverse conditions are noted, additional recommendations, possibly including slope reconstruction, may be required. Additional recommendations to reduce the need for cut slope reconstruction shall be provided during grading plan development. These supplemental recommendations could include measures such as use of flatter slope gradients, modification of the orientation of the slope face, or provisions for a debris bench.

Differential Thickness

A differential in fill thickness across individual building footprints may occur at the site, pending the final grading layout. Differential building movements may become apparent for a differential fill thickness that exceeds 10 to 15 feet under individual buildings.

Mitigation Measures

4.2-C-8 Differential in fill thickness under individual buildings shall be limited to approximately 10 feet. Local sub-excavation of soil material and replacement with engineered fill may be necessary to achieve this limitation. A detailed review of fill thickness shall be performed during the preparation of the final 40-scale grading, and fill performance testing on remolded samples of engineered fill materials shall be provided during grading.

Densification

Densification of deep fills (over 15 feet in thickness) may be required with implementation of the proposed project. A differential movement under structures is the primary concern. Expansion of the deep fills may result from swelling of the silty components in the fill materials if moisture contents increase due to irrigation or natural conditions, but is expected to be relatively low. Settlement at the site could be generated from the following:

1. Densification of unmitigated residual soils, colluvium, and undocumented fills in the low lying areas where fills will be placed.

2. Compression of the deep fills due to their own weight.

3. Compression of soils beneath foundations due to building loads. For the proposed one- or two story wood-frame residences, settlements due to the building loads are expected to be minor.

Mitigation Measures

4.2-C-9 The exposed soils shall be compacted and moisture conditioned as directed by the Geotechnical Engineer. In general, they shall be kept moist by occasional sprinkling. If the re-moisturizing of silty soils is required, it shall be done through excavation, moisture conditioning, and recompaction.

Compressible Materials

Thicker colluvial materials were encountered within topographic depressions and swale areas on the project site. According to the grading plans for the northern and central portion of the EGSP, some of these areas may receive more than 25 feet of fill to reach finished pad grade. The increased amount of overburden pressure that will be applied on the underlying colluvial materials from the proposed fill could result in settlement of this material if not mitigated during grading of the site.

Mitigation Measures

4.2-C-10 The Geotechnical Engineer shall prepare a remedial grading plan that will depict all the anticipated area of remedial grading, including areas of sub-excavation, keyways, subdrainage, etc. The extent of the localized existing fills shall be evaluated during grading operations, and the existing fills shall be removed and replaced with engineered fill. All soft/compressible materials (such as residual soil, colluvium, and undocumented fill) shall be removed and replaced with engineered fill to provide a more stable base material for the proposed overlying fill. The general depth of removal of unsuitable materials in developable areas may be around 2 to 3 feet in thickness, with isolated identified areas that may require up to an additional 3 to 6 feet of additional sub-excavation to achieve a competent base. Anticipated areas of mitigation for compressible materials that extend beyond common grading activities shall be refined during the 40-scale plan review. Actual depths shall be determined in the field by the Geotechnical Engineer at the time of grading.

Significance After Mitigation

Less than significant.

Slope Stability

Impact 4.2-D **Existing or future fabricated slopes within the project area may be subject to instability, soil creep, and erosion, which could affect development of the EGSP site. (Less than Significant After Mitigation)**

Slope Stability Analysis

A geotechnical concern related to site development is slope stability. To evaluate the stability of the existing slopes and develop proposed mitigation measures, strength testing was performed on samples of the older dune sand material along the bluff area as well on a remolded sample of site materials to determine strength parameters for use in the slope stability analyses. A detailed description of the equipment and techniques employed is contained in the technical report including the laboratory test results.

A slope stability analysis of the existing bluff slope was conducted as part of the study to develop appropriate setback distances. The results of the slope stability analysis indicate that the existing bluff area slope does not have the safety factors to satisfy the standard practice values for static loads and seismic loads for structures located near the bluff top. As a result, the project proposes a bluff setback.

Slopes and Creep
Experience has shown that slopes tend to creep outward causing damage to buildings located in close proximity to the top of slope. Creep is the slow, nearly continuous downhill movement of the soil mantle; this is induced by gravity and may be a potential precursor to landsliding. Creep can result from shrinking and swelling of the soil due to seasonal moisture variations on a slope.

One indicator of soil creep is the presence of shrinkage cracks. When a shrinkage crack annually closes as a result of swelling from absorption of moisture, there can be a downhill component of movement. This movement, induced by gravity, has a progressive effect that can reach a downhill rate of approximately 0.25 inch per year.

There is the potential for the project to result in the adverse soil creep effects on slope areas that are adjacent to residential structures. However, setbacks for non habitable spaces shall adhere to a 2:1 line of projection extending up from the toe of the bluff slope into the site and setbacks for habitable structures shall adhere to a 2.5:1 line of projection extending up from the toe of the bluff slope and this impact would be less than significant.

Cut Slopes
Soil formations within the development area consist of a relatively thin layer (10 feet or less) of residual soils, colluvium, and/or undocumented fill over older dune deposits. Cut slopes made in these areas will be particularly susceptible to erosion.

Soil Erosion and Terraces
In the design of slopes, consideration has to be given to surface drainage and the potential for slope degradation by erosion. Common practice has been to provide benches at regular intervals on steeply graded slopes (steeper than 3:1 horizontal:vertical) that are higher than 30 feet for control of surface drainage. Typical requirements are outlined in the Uniform Building Code.

In 3:1 or flatter slopes, grassed and other vegetation take hold more easily and shallow surface mudflows and debris flows are infrequent as compared to slopes that are steeper than 3:1. The 3:1 graded slopes, particularly, if rounded to match landforms, will have a more natural appearance. Experience has shown that since maintenance and cleaning of ditches is often irregular or non-existent, concentrated overflow can result in localized severe erosion or sloughing.

Mitigation Measures
4.2-D-1 Additional slope stability analysis shall be performed once 40-scale grading plans are developed. The additional analysis will be performed for selected major cut and fill slopes as well as additional slopes along the existing bluff. Remolded samples for additional shear tests shall be performed if deemed appropriate by the Geotechnical Engineer. Based on the slope stability analyses, the required size of keyways and the extent of slide excavation will be determined to obtain a static factor of safety of 1.5 and a seismic factor of safety of 1.1.

4.2-D-2 Geologic review during remedial grading activities shall be performed by the Geotechnical Engineer, and additional mitigation may be required if adverse field conditions are discovered.

4.2-D-3 Techniques such as over-excavation as necessary to create benches during fill placement shall be implemented during grading to address the potential adverse effects of soil creep on slope areas that are adjacent to residential structures.

4.2-D-4 Cut slopes shall be rebuilt as engineered fill if they exceed slope height and gradient recommendations of the geotechnical report. If lots abut open space slopes, especially cut slopes, a debris bench (designated by the Geotechnical Engineer) with a drainage ditch shall be constructed. The need for a debris bench shall be determined by the geotechnical engineer on a case by case basis and will depend on factors such as slope gradient, slope height and geologic conditions. The purpose of this bench is to intercept erosion or slope debris from the uphill area. Access to this bench shall be provided for maintenance purposes.

4.2-D-5 Any graded slopes or localized sections of disturbed or unstable natural slopes shall include erosion control protection by means of jute matting or other synthetic products until mature vegetation occurs.

Significance After Mitigation

Less than significant.

Corrosion

Impact 4.2-E **Onsite soils may have the potential to corrode building materials associated with the development of the EGSP. (Less than Significant After Mitigation)**

Testing for the corrosivity of soils was not conducted as part of ENGEO's Geotechnical Exploration; however, review of documents associated with past geotechnical investigation of the project site and surrounding vicinity, as identified in Appendix B of this DSEIR, suggest that some of the soils in the EGSP project area could have a potential for corrosion to concrete and uncoated steel, which could affect building foundations.

Mitigation Measures

4.2-E-1 Prior to the issuance of building permits, corrosivity tests shall be conducted on subgrade soils following grading and prior to foundation and utility construction. One of the primary purposes for corrosion testing is to establish concrete design parameters for construction, based on the criteria presented in the 1997 Uniform Building Code (UBC). This information is also used to establish cathodic protection requirements for buried steel pipelines. This testing is typically performed after rough grading has been completed. If corrosive soils are found on the project site, concrete mixtures resistant to corrosion shall be used in the construction of the project.

Significance After Mitigation

Less than significant.