EIR APPENDICES

Appendix E – Geological and Geotechnical Report

Pacific Geotechnical Consultants. *EIR Level Geotechnical Investigation and Geologic Feasibility Evaluation Update*. Proposed Santana Ranch, Fairview Road, San Benito County, California. February 2007.

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February 26, 2007
Project 2132EG

Northeast Fairview Property Owners
c/o Pacific Rim Planning Group
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Subject: EIR Level Geotechnical Investigation and Geologic Feasibility Evaluation Update, Proposed Santana Ranch, Fairview Road, San Benito County, California

This report presents the results of our Environmental Impact Report (EIR) level Geotechnical Investigation and Geologic Feasibility Evaluation Update for the planned Santana Ranch project on Fairview Road, in San Benito County, east of the city of Hollister, California. The approximate boundaries of the property are shown on the Geologic Index Map (Figure 1).

In 1997, Pacific Geotechnical Engineering performed a Geologic Feasibility Evaluation for the project site and prepared a report dated May 16, 1997. We understand San Benito County is requesting a Geotechnical Investigation report as part of the project completeness process.

1. PROJECT DESCRIPTION

Santana Ranch (formerly known as Northeast Fairview Specific Plan project) consists of approximately 292 acres bordering the east side of Fairview Road, east of Hollister, in San Benito County, California. The project extends about 1,300 feet north of Hillcrest Road, about 950 feet south of Sunnyslope Road, and about 2,600 feet east of Fairview Road. The development will include residential units, commercial development, a school, roadway improvements and an off-site wastewater treatment plant. The site of the proposed wastewater treatment plant is located northeastern of the property (See Figure 2).

2. OBJECTIVE AND SCOPE OF SERVICES

The objective of this study was to update and supplement the geologic information presented in our 1997 geologic feasibility evaluation report and to provide preliminary geotechnical information in support of the EIR process. To accomplish this objective, we performed the following scope of work.

1. Research and review of geologic literature of the property, including geologic maps, seismic shaking maps, and seismically-induced liquefaction potential maps. The peak ground acceleration value was updated based on the current California Geological Survey seismic model.

2. Marking locations of our drill holes in the field and notifying Underground Service Alert of our exploration schedule (as required by law).

3. Performance of a geologic field reconnaissance to determine if geologic conditions or processes, such as landsliding, debris flow, etc., may affect the planned development.

4. Sampling and classification of subsurface earth materials by means of 8 exploratory drill holes up to 15 feet deep. In each drill hole, penetration testing and soil sampling were performed at about 5-foot depth intervals. The holes were backfilled with soil cuttings.

5. Laboratory testing of selected soil samples from our field exploration to evaluate pertinent engineering properties of the samples.

6. Analysis of information from our field investigation, laboratory testing, and geologic literature review.

7. Preparation of this report summarizing our findings, conclusions, and recommendations.

3. FINDINGS

3.1 Terrain

The subject property is bounded on the west by Fairview Road, and on the north, east and south by open range land; there are two ranch houses that boarder the property to the north. A Pacific Gas and Electric (PG&E) pipeline traverses the northeastern portion of the property (See Figure 2).

Elevations at the property range from about 500 feet above sea level along a portion of the southeastern property boundary, to 350 feet above sea level in the extreme northwest corner of the site. The property is situated within variably sloping terrain, generally characterized by north-south trending ridges and valleys. A broad, 200 to 500 foot wide ridge trends through the central portion of the property. Hillside areas adjacent to the west side of this ridge slope gently at inclinations that range from about 2 to 12 degrees. Along the east side of this ridge, hillside terrain slopes at inclinations that range from about 5 to 14 degrees and locally up to about 18 degrees. Hillside inclinations along the flanks of a ridge situated in the southeastern portion of the property range from about 5 to 13 degrees. Overall, the hillsides are characterized by smooth, well rounded, gentle to moderate slopes. The valley areas between the ridge crests are characterized by gently sloping terrain with smooth, even slope transitions from the hillside terrain. See Site Map, Figure 2, for a topographical portrayal of site terrain.

The steepest ground slope inclinations on the property are located adjacent to the eastern property boundary, along the flanks of a roughly west-east trending tributary of Santa Ana Creek (See Figure 2). In this area, slope inclinations range from about 20 to 30 degrees and locally up to about 40 degrees.

3.2 Drainage and Vegetation

Drainage at the property occurs primarily by natural, overland sheet-flow. In the central portion of the property, drainage is concentrated along a seasonal stream valley that flows northward through the site. We did not observe erosion or down-cutting of adjacent slopes as might be expected in an active drainage channel. Consequently, it appears that most of the rainfall at the property infiltrates the ground surface and eventually becomes part of the ground water regime. We did not observe evidence of springs or seeps at the property during our work on this project.

At its nearest point, the Santa Ana Creek is about 300 feet east of the northeastern portion of the property. A small tributary of Santa Ana Creek extends about 200 feet into the northeastern portion of the property. Flow within the tributary channel is seasonal, and erosion and down-cutting are occurring locally. The location of Santa Ana Creek and the tributary relative to the subject property can be seen on our Geologic Index Map (Figure 1) and our Site Map (Figure 2).

Most of the site is used for dry-land farming. During our site reconnaissance, we observed that most of the site was being plowed and seeded. There is an orchard that spans almost the width (west to east) of the property (See Figure 2). The northern edge of the orchard is about 800 feet south of the northern property boundary; most of the orchard is about 450 feet wide, tapering to about 300 feet wide to the east. The area of the proposed wastewater treatment plant is used as rangeland; it is primarily open grassland.

3.3 Earth Materials

Regional geologic mapping of the area has been performed by Dibblee (2006), Rosenberg (1998), and by Majmundar (1994). Majmundar shows the property as underlain by Quaternary age older alluvial deposits. Dibblee shows the property as underlain by the intermediate level terrace in a set of three dissected, late Pleistocene age alluvial terrace deposits. Rosenberg shows the property as underlain by Pleistocene alluvial fan deposits; he describes these deposits as moderately consolidated, moderately to poorly sorted gravel, sand, and silt, capped by maximally developed soils. Our observations of the earth materials at the property, as described below, are consistent with Rosenberg's description of alluvial fan deposits.

In our investigation we advanced eight exploratory drill holes to a depth of about 15 feet (see Figure 2 for drill hole locations). We encountered two earth material units in these drill holes: colluvium and alluvial fan deposits. Colluvium mantles the alluvial fan deposits on the property to a depth of 2 to 5 feet; the average thickness of colluvium is about 3 feet. Colluvium at the site is variably brown, dark brown, dark yellowish brown, and dark grayish brown, fat clay to fat clay with sand.

Alluvial fan deposits at the site are variable and consist mostly of clay to clayey sand with minor intervals of silt to silty sand, poorly sorted sand, and sandy clay with gravel. The color of these deposits vary between light olive brown, light to dark yellowish brown, brown, and grayish brown. The fine-grained alluvial fan materials are stiff to hard; the coarse-grained materials are medium dense to very dense.

3.4 Groundwater and Liquefaction

Rosenberg (1998) compiled a map of historical high ground water levels for the Hollister area. This map shows that the property is located in an area where the historical high groundwater level is greater than 50 feet below the ground surface. No groundwater was encountered in any of our exploratory drill holes which were about 15 feet in depth.

Rosenberg (1998) also developed a map on which he presents his interpretation of liquefaction susceptibility for the Hollister area. The property is in an area of very low liquefaction susceptibility, in which sediments "are very unlikely to liquefy even in a nearby major earthquake" (Rosenberg, 1998).

3.5 Landsliding

No landslide or landslide related features have been mapped at the subject property by Majmundar (1994), Rosenberg (1998), or Dibblee (2006). During our reconnaissance, we did not observe any evidence of landslides or debris flows.

Regional mapping by Majmundar included a Landslide Susceptibility Map that includes the property. For this map, Majmundar developed four Areas of Relative Landslide Susceptibility. These areas are defined, in order of increasing landslide susceptibility, in the following manner:

Area 1 - Least Susceptible
Area 2 - Marginally Susceptible
Area 3 - Generally Susceptible
Area 4 - Most Susceptible.

A detailed description of these Landslide Susceptibility Areas is provided in the Appendix of this report. Establishment of these areas is based on both objective and subjective data and was "prepared to aid in general land-use planning." The map "is not intended, nor suitable, for evaluation of individual sites." The map does, however, provide a regional perspective of conditions that could potentially impact future development of the property.

Majmundar's Landslide Susceptibility mapping is shown on our Site Map (Figure 2). Although we find significant discrepancies with some parts of his mapping, we are in agreement with most of his work. In general the southwestern half of the property was accurately categorized by Majmundar as being in the Least Susceptible or Marginally Susceptible Landslide Areas (zones #1 and #2). The northeastern half of the property was categorized as being within the Generally Susceptible Landslide Area (zone #3), with a very small area along the Santa Ana Creek tributary as being within the Most Susceptible Landslide Area (zone #4). It is out opinion that these areas are not as susceptible to landsliding as indicated on Majmundar's map.

3.6 Faulting

While numerous faults are known to exist in the Hollister area, only the San Andreas, Quien Sabe, Calaveras, and small segments of the Tres Pinos faults are locally classified by the California Geological Survey as being active or potentially active (CGS, 2002). The San Andreas fault passes through the Gabilan Mountains about 6 miles to the southwest. The Quien Sabe fault crosses the edge of the Hollister Valley at the base of the Diablo Range about 3 miles to the northeast. The Tres Pinos fault crosses the southern edge of the Hollister Valley; with several splays trending out into the valley, the closest being about 2 miles southeast of the site.

The Calaveras fault zone trends northwestward through the City of Hollister and is the nearest active or potentially active fault to the property. The Calaveras fault is located about 2.3 miles southwest of the property. The Calaveras fault consists of three major sections along its 98-mile (158 km) length between Paicines and Concord. The southernmost section, which is closest to the property, extends northwest about 15 miles (24 km) long from where it intersects with the Paicines fault, about 4.3 miles south of Hollister (Kelson, 2001). The slip rate on this section of the Calaveras fault is estimated to be 15±2 mm/year. Structures and pavements built across the southern section of the Calaveras fault have been visibly deformed along the trend of a west facing topographic scarp.

3.7 Seismicity

The property is in an area of high seismicity. Earthquakes strong enough to cause damage occur frequently in the Hollister area. Between the years 1800 and 1961, at least 19 earthquakes caused damage in the City of Hollister (Rogers, 1980). Since 1961, three additional earthquakes have caused significant damage in Hollister: the "Coyote Lake" earthquake of 1979, the "Morgan Hill" earthquake of 1984, and the "Loma Prieta" earthquake of 1989.

The southern section of the Calaveras fault is capable of generating a M (moment magnitude) 6.7 earthquake (WGCEP, 2003). The 1984 Morgan Hill earthquake (M6.2) occurred on the central section of the Calaveras fault on an epicenter located about 38 miles northwest of the property. The 1979 Coyote Lake earthquake (M 5.9) also occurred on the central section of the

Calaveras fault on an epicenter located about 20 miles northwest of the property. The largest historical earthquake associated with the southern section of the Calaverals fault was the 1974 Busch Ranch earthquake (M5.1); this earthquake was centered about 3.7 miles northwest of the property.

The California Geological Survey (1996) divided the Calaveras fault into a northern and southern section; the estimated earthquake recurrence interval for the southern section of the fault is 33 years and estimated earthquake recurrence interval for the northern section is 146 years. The probability of large earthquakes has been estimated by the Working Group on California Earthquake Probabilities (WGCEP, 1996, 1999, and 2003). Current estimates (WGCEP, 2003) are that there is a 62% probability of a large magnitude (6.7 or greater) earthquake in the San Francisco Bay area as a whole in the 30-year period ending in 2032. The estimate of a large magnitude earthquake occurring on the San Andreas fault alone is 21%; on the Calaveras fault alone, 11% (entire fault, not individual sections); and on the Hayward fault alone, 27%.

Based on a statewide probabilistic model (California Division of Mines and Geology, 2002) that collectively incorporates the probabilities of earthquakes on individual faults, the peak ground acceleration with a 10% chance of exceedance in 50 years at the site was estimated to range from 0.66g to 0.69g (CGS Probabilistic Seismic Hazards Ground Motion Web Page, firm rock or soft rock site; Longitude 121.3546W & Latitude 36.8475N to Longitude 121.3631W & Latitude 36.8369N).

4. ANALYSIS, DISCUSSION, AND CONCLUSIONS

From an engineering geology and geotechnical engineering viewpoint, it is feasible to develop the property into a residential community with supporting infrastructures provided the geologic and geotechnical issues are addressed in the subsequent phases of the project. The various geologic and geotechnical conditions for consideration are discussed below, together with their general mitigation measures.

Because details of the project have not been finalized, our discussion and guidelines presented below should only be considered as general and preliminary. As details of the project become available, the potential impact of the various geologic and geotechnical conditions on the project should be refined. Design and construction of the project should be only based on design-level geologic and geotechnical studies.

4.1 Geologic Considerations

4.1.1 Landsliding

About half of the property is in an area that is classified by the California Geological Survey as either "least susceptible" to landsliding or "marginally susceptible" to landsliding. Most of the rest of the property is in an area that is classified as "generally susceptible" to landsliding, with a very minor portion classified as "most susceptible." Our site-specific geologic study strongly suggests that this susceptibility mapping is conservative. We did not observe any evidence of landslides on the property during our site reconnaissance, nor have any other regional geologic studies identified any discrete landslide bodies on the property. It is our opinion that the overall landslide hazard should be considered to be acceptably low. We judge that given appropriate care in siting of proposed improvements on the variably sloping terrain, potential slope stability problems can either be avoided in project design or be mitigated by appropriate geotechnical design.

The wastewater treatment facility is shown to be sited in terrain classified by CGS as being "most susceptible" to landsliding. We suggest that during subsequent phases of project design, consideration be made for locating sensitive structures onto gently sloping terrain and that grading be kept to a minimum. It would be appropriate for additional geologic and geotechnical analysis to be an iterative part of those planning studies

4.1.2 Faulting

No active or potentially active faults are known to cross the property; therefore, it is reasonably to conclude that the risk of fault rupture through the property is low.

4.1.3 Seismicity

The property is in an area of high seismicity. Based on general knowledge of the regional seismicity, it should be anticipated that the improvements will be subject to high intensity ground shaking during their design life. The proposed improvements should be designed according to recommendations by qualified design professionals, applicable building codes and experience of the design professionals.

4.1.4 Liquefaction

Based on our review of the available geologic literature and subsurface information from our preliminary subsurface exploration, it is our opinion the potential for liquefaction at the property is low. Our opinion is based on the nature of the subsurface material encountered in our drill holes and the regional data suggesting that depth to groundwater at the property is deeper than 50 feet.

4.1.5 Seismically-induced Settlement

Seismic densification is the densification of unsaturated, loose granular soils due to strong vibration such as that resulting from earthquake shaking. Granular soils and loose fills above groundwater may be subject to such phenomenon.

The subsurface soils encountered in our drill holes consist of medium dense to dense sand and gravel layers. These materials generally have low susceptibility to seismically-induced settlement.

Engineered fills for construction of the project should be placed and compacted to the recommendations of the design-level geotechnical reports to reduce the potential of seismically-induced settlements.

4.1.6 Lateral Spreading

The property is not located in the immediately vicinity of any major creek channel, rivers, lakes or bodies of water. The risk of lateral spreading as a result of a seismic event is judged to be low.

4.2 Geotechnical Considerations

Geotechnical conditions which potentially can impact development of the site are discussed below. General mitigation measures are also presented.

4.2.1 Expansive Soils

The surficial layer of soil encountered in our drill holes consists of fat clay of high plasticity, which corresponds to high expansion potential. Expansive soils have the ability to undergo volume changes (shrink or swell) due to variations in moisture content. Changes in soil moisture content can result from rainfall, landscape irrigation, perched groundwater, drought or other factors. Changes in soil moisture may result in unacceptable settlement or heave of structures, concrete slabs or pavements supported on the expansive soil.

The following methods can help reduce the potential impact of expansive soils on the building foundations and concrete slabs-on-grade: 1) moisture conditioning of the fat clay; 2) extending the foundations deeper than usual; 3) placement of a layer of "non-expansive" fill under concrete slabs-on-grade; 4) maintaining surface drainage away from the foundations and slabs; and 5) maintaining relatively uniform soil moisture content year-round through controlled irrigation. These methods can help reduce the adverse effects of expansive soils, but will not eliminate them completely. Some differential ground movements due to expansive soils are unavoidable and maintenance and repair of such areas should be anticipated. "Non-expansive" fill would be on the order of 18 to 30 inches.

In lieu of using imported soil as "non-expansive" fill, it may be possible to lime treat the on-site fat clay to reduce its expansive potential. If lime treatment is to be considered as an option, laboratory testing should be performed to evaluate its feasibility, and the type and percentage of lime that would be required to reduce the expansion potential of the soil. It is likely that either high calcium or dolomitic quicklime could be used, but the percentage of lime would vary.

4.2.2 Compressive Soils

The subsurface soils encountered in our drill holes consists of stiff clays and medium dense to dense sands and gravels. These soils generally have low compressibility for the relatively light structures anticipated for this project.

4.2.3 Collapsible Soils

The subsurface soils encountered in our drill holes consists of stiff clays and medium dense to dense sands and gravels. These soils generally are not considered collapsible.

4.2.4 Disturbed Surface Soils

The upper approximately 1 to 2 feet of site soil have been disturbed by plowing and disking. In areas to receive improvements, the disturbed soils should be over-excavated and replaced as engineered fill. Soil surfaces exposed by over-excavation should be scarified, moisture-conditioned and compacted as engineered fill prior to further construction activities.

4.2.5 Variable Foundation and Subgrade Materials

Site grading will expose different materials with varying properties. Where buildings will be constructed on cut and fill pads, it may be desirable to over-excavate the cut portion of the pads and to compact the material together with the fill portion to create a more uniform support under the buildings. The depth and extend of such over-excavation should be determined during the design-level geotechnical investigation when information on cut grading and building type and loads are available.

4.3 General Geotechnical Guidelines for Project Planning

4.3.1 Earthwork and Grading

Earthwork and grading for this project will involve cuts and fills of variable thickness and in different earth materials. It is anticipated that cuts can generally be made with conventional earth moving equipment and the need for blasting for excavation is unlikely.

Requirements for compaction will vary for the different earth materials. Expansive soils, such as fat clay encountered on the site, should be compacted at a controlled range (typically between the mid 80s and the low 90s percent relative compaction) at a moisture content typically at least 3 to 5 percent above the laboratory optimum water content. Over compaction of fat clay is undesirable.

Soils with low expansive potential should be compacted to the recommendations of the design-level geotechnical investigations. Typically, such soils are compacted to a minimum of 90 percent relative compaction. If such soils are used in deep fills, in support of heavy structures, in settlement sensitive environments, or at pavement subgrades, a higher relative compaction would be warranted. Pavement subgrades are typically compacted to a minimum of 95 percent relative compaction based on ASTM Test Method D1557, latest edition.

If necessary, final cut and fill slopes should be constructed at inclinations no steeper than 2:1 (horizontal:vertical) in materials of low expansive potential and 3:1 (h:v) in the fat clays. Slopes should be protected from erosion with erosion-resistant vegetation or other appropriate means. The final slope inclinations should be determined during the design-level geotechnical studies.

4.3.2 Building Foundations

Selection of the appropriate foundation types will depend on many factors, including building type and loads, foundation bearing material, proximity to cut and fill slopes, allowable settlements, etc. For preliminary planning purposes, the following foundation types may be considered: conventional footings, pier and grade beam foundations, post-tensioned slabs and mat slabs.

Conventional footings should only be used in areas where no expansive soils are within 3 feet of the foundations. In areas of expansive soils, pier and grade beam foundations are considered more appropriate.

4.3.3 Concrete Slabs-on-grade

Concrete slabs-on-grade in expansive soil areas should be constructed on a layer of "non-expansive" fill. For planning purposes, the thickness of the "non-expansive" fill may be assumed to range between 18 and 24 inches. For slabs that are more sensitive to movements and cracking, a thicker "non-expansive" fill section should be considered.

Where concrete slabs are constructed on soils of low expansive potential, such as the alluvial fan deposits, no "non-expansive" fill is required.

4.3.4 Vehicle Pavements

Vehicle pavements for the project are anticipated to include on-site streets, residential driveways, access drives and parking for various developments. The pavement supporting capability will vary from very low for the fat clay to moderate or moderate high for the silty sands. During the subsequent design phases of the project, R-value tests may be performed on bulk samples of soils collected from the site at various locations and elevations. The measured R-values may be used for calculations of the required pavement sections for the various loading conditions.

5. LIMITATIONS

In preparing the findings and professional opinions presented in this report, we have endeavored to follow generally accepted principles and practices of the engineering geologic and geotechnical engineering professions in the area and at the time our services were provided. No warranty, express or implied, is provided.

Subsurface exploration is necessarily confined to selected locations. Conditions may, and often do, vary between these locations. Should conditions different from those assumed in this report be encountered during project development, additional exploration, testing, and analysis may be required.

Should persons concerned with this project observe geotechnical features or conditions at the site or surrounding areas which are different from those described in this report, those observations should be reported immediately to Pacific Geotechnical Engineering for evaluation.

It is important for project performance that the recommendations given in this report are made known to the design professionals involved with the project, that they be incorporated into project drawings and documents, and that the recommendations be carried out during construction by the contractor and subcontractors. It is not the responsibility of Pacific Geotechnical Engineering to perform this task.

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Attachments: References
Explanation to Landslide Susceptability Map
Figure 1 – Geologic Index Map
Figure 2 – Site Map
Key to Soil Classification (Fine and Coarse Grained Soils, 2 sheets)
Logs of Exploratory Drill Hole DH-1 through DH-8

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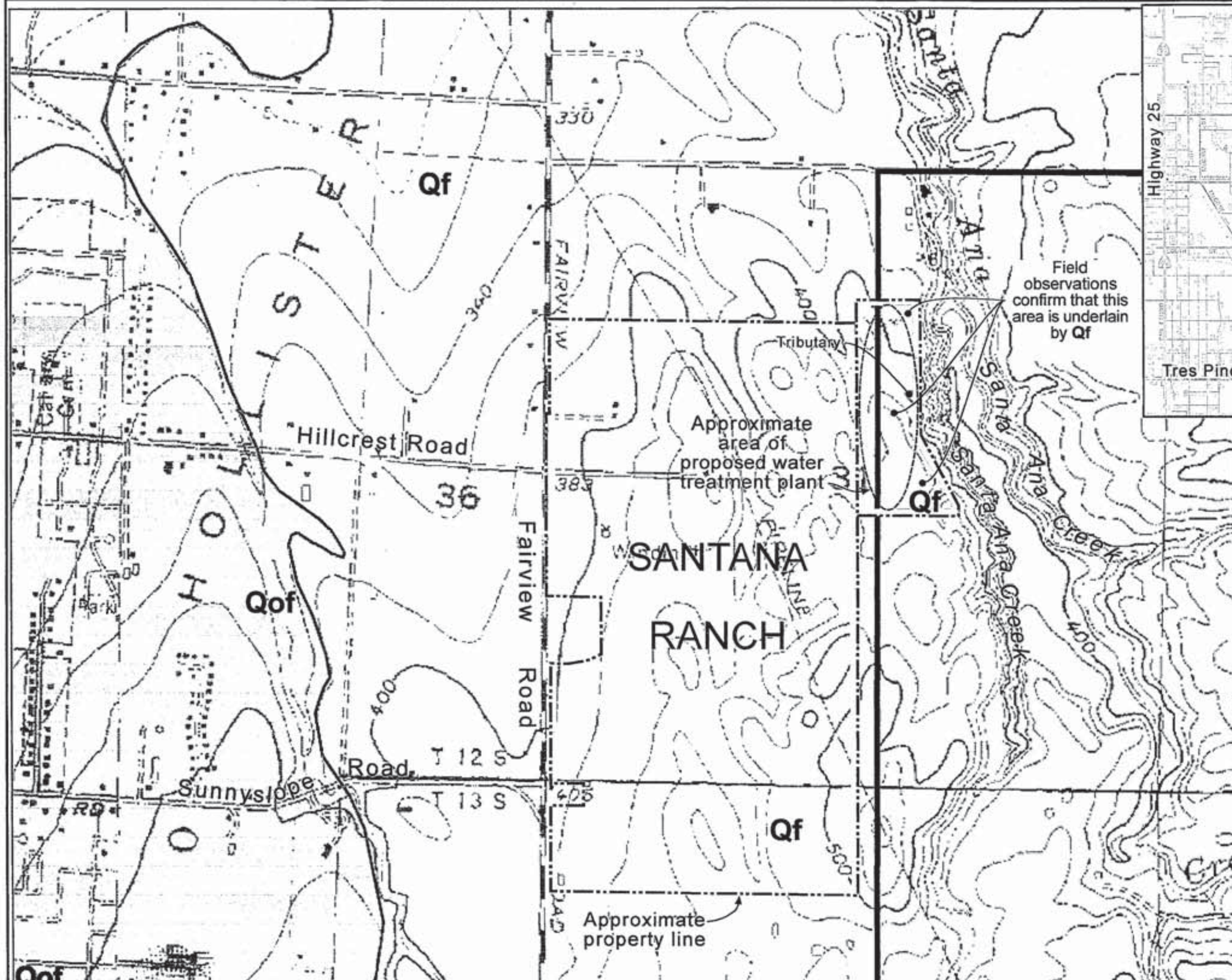
EXPLANATION TO
LANDSLIDE SUSCEPTIBILITY MAP
(Majmundar, 1994)

Area 1 - Least Susceptible Landslide Areas. Landslides and other features related to slope instability are very rare to non-existent within this area. Included within this area are topographically low-lying valley bottoms and alluviated floodplains. Part of the area may be underlain by material that lacks the strength to support steep slopes (such as unconsolidated alluvium) but occupies a relatively stable position due to the flatness of the slope (lacks potential energy). Land within Area 1 will probably remain relatively stable unless the topography is radically modified.

Area 2 - Marginally Susceptible Area. This area includes gentle to moderate slopes underlain by relatively competent material or colluvium that is considered unlikely to remobilize under natural conditions. Also includes ridgetops and spur crests that are underlain by relatively competent material but flanked by steep, potentially unstable slopes. The stability of slopes within Area 2 may change radically in response to modification of the adjacent terrain.

Area 3 - Generally Susceptible Area. Slopes within this area are at or near their stability limits due to a combination of weaker materials and steeper slopes. Although most slopes within Area 3 do not currently contain landslide deposits, the materials that underlie them can be expected to fail, locally, when modified because they are close to their stability limit.

Area 4 - Most Susceptible Area. This area is characterized by steep slopes and includes most landslides in upslope areas, whether apparently active at present or not, and slopes upon which there is substantial evidence of downslope creep of surface materials. Slopes within Area 4 should be considered naturally unstable, subject to failure even in the absence of the activities of man.



VICINITY MAP - no scale

EXPLANATION

EARTH MATERIALS

Qof	Older flood-plain deposits (Pleistocene) - Poorly consolidated, moderately sorted gravel, sand and silt with Monterey Shale fragments. Capped by maximally developed soils
Qf	Alluvial fan deposits (Pleistocene) - Moderately consolidated, moderately to poorly sorted gravel, sand and silt. Capped by maximally developed soils

MAP SYMBOLS

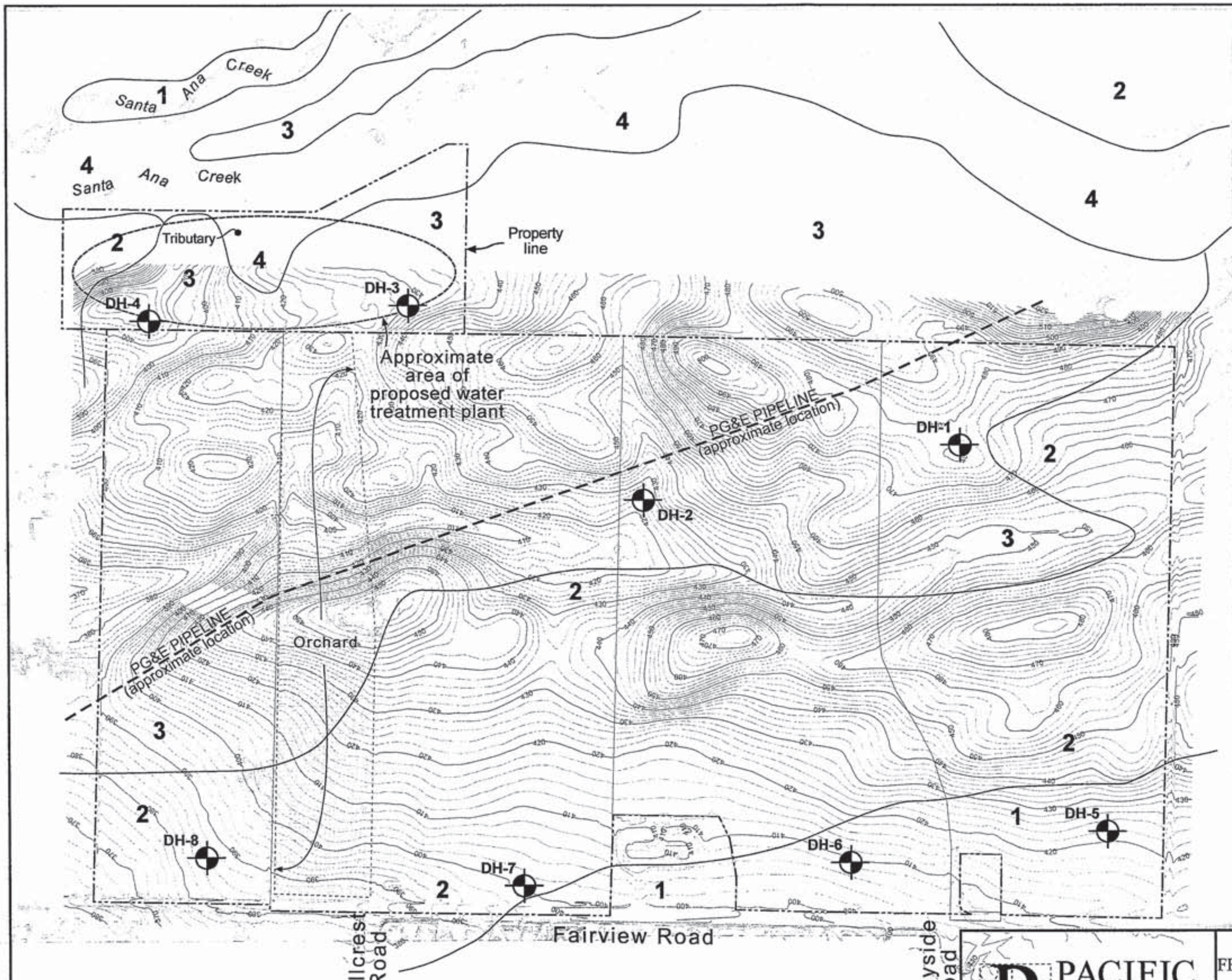
——— Contact, approximately located

N

0 1000 ft

BASE MAP: "Quaternary Geologic Map, Liquefaction Susceptibilty of the Hollister Area, San Benito County, California" by Lewis Rosenberg (1998).

PACIFIC GEOTECHNICAL ENGINEERING	DATE FEBRUARY 2007	GEOLOGIC INDEX MAP	FIGURE 1
	APPROVED	SANTANA RANCH FAIRVIEW ROAD HOLLISTER, CALIFORNIA	PROJECT 2132E



EXPLANATION

LANDSLIDE SUSCEPTIBILITY (Majmundar, 1994)

- **1** Least Susceptible Landslide Area
- **2** Marginally Susceptible Landslide Area
- **3** Generally Susceptible Landslide Area
- **4** Most Susceptible Landslide Area

See report Appendix for detailed description of landslide susceptibilty areas

MAP SYMBOLS

DH-8 Exploratory drill hole

NOTES:

1. BASE MAP: "Santana Ranch" by Ruggeri, Jensen, Azar & Associates, dated November 28, 2006.
2. Boundaries of Landslide Susceptibility Areas are taken directly from Majmundar (1994).

PACIFIC GEOTECHNICAL ENGINEERING	DATE FEBRUARY 2007	SITE MAP	FIGURE 2
	APPROVED	SANTANA RANCH FAIRVIEW ROAD HOLLISTER, CALIFORNIA	PROJECT 2132E

KEY TO SOIL CLASSIFICATION - FINE GRAINED SOILS

(50% OR MORE IS SMALLER THAN NO. 200 SIEVE SIZE)

(modified from ASTM D2487 to include fine grained soils with intermediate plasticity)

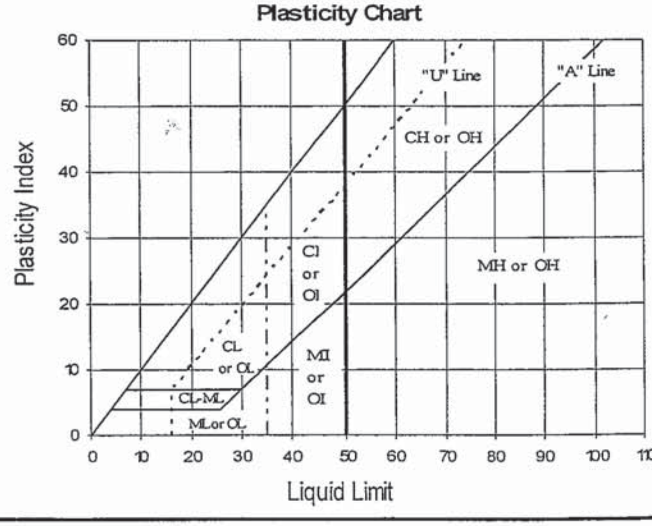
MAJOR DIVISIONS			GROUP SYMBOLS	GROUP NAMES
SILTS AND CLAYS (Liquid Limit less than 35) Low Plasticity	Inorganic	PI < 4 or plots below "A" line	ML	Silt, Silt with Sand or Gravel, Sandy or Gravelly Silt, Sandy or Gravelly Silt with Sand or Gravel
	Inorganic	PI > 7 or plots on or above "A" line	CL	Lean Clay, Lean Clay with Sand or Gravel, Sandy or Gravelly Lean Clay, Sandy or Gravelly Lean Clay with Sand or Gravel
	Inorganic	PI between 4 and 7	CL-ML	Silty Clay, Silty Clay with Sand or Gravel, Sandy or Gravelly Silty Clay, Sandy or Gravelly Silty Clay with Sand or Gravel
	Organic	See footnote 3	OL	Organic Silt (below "A" Line) or Organic Clay (on or above "A" Line) [1,2]
SILTS AND CLAYS (35 ≤ Liquid Limit < 50) Intermediate Plasticity	Inorganic	PI < 4 or plots below "A" line	MI	Silt, Silt with Sand or Gravel, Sandy or Gravelly Silt, Sandy or Gravelly Silt with Sand or Gravel
	Inorganic	PI > 7 or plots on or above "A" line	CI	Clay, Clay with Sand or Gravel, Sandy or Gravelly Clay, Sandy or Gravelly Clay with Sand or Gravel
	Organic	See footnote 3	OI	Organic Silt (below "A" Line) or Organic Clay (on or above "A" Line) [1,2]
SILTS AND CLAYS (Liquid Limit 50 or greater) High Plasticity	Inorganic	PI plots below "A" line	MH	Elastic Silt, Elastic Silt with Sand or Gravel, Sandy or Gravelly Elastic Silt, Sandy or Gravelly Elastic Silt with Sand or Gravel
	Inorganic	PI plots on or above "A" line	CH	Fat Clay, Fat Clay with Sand or Gravel, Sandy or Gravelly Fat Clay, Sandy or Gravelly Fat Clay with Sand or Gravel
	Organic	See note 3 below	OH	Organic Silt (below "A" Line) or Organic Clay (on or above "A" Line) [1,2]

1. If soil contains 15% to 29% plus No. 200 material, include "with sand" or "with gravel" to group name, whichever is predominant.
2. If soil contains ≥30% plus No. 200 material, include "sandy" or "gravelly" to group name, whichever is predominant. If soil contains ≥15% of sand or gravel sized material, add "with sand" or "with gravel" to group name.
3. Ratio of liquid limit of oven dried sample to liquid limit of not dried sample is less than 0.75.

CONSISTENCY	UNCONFINED SHEAR STRENGTH (KSF)	STANDARD PENETRATION (BLOWS/FOOT)
VERY SOFT	< 0.25	< 2
SOFT	0.25 – 0.5	2 – 4
FIRM	0.5 – 1.0	5 – 8
STIFF	1.0 – 2.0	9 – 15
VERY STIFF	2.0 – 4.0	16 – 30
HARD	> 4.0	> 30

MOISTURE	CRITERIA
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp, but no visible water
Wet	Visible free water, usually soil is below the water table

Plasticity Chart



PACIFIC GEOTECHNICAL ENGINEERING

KEY TO SOIL CLASSIFICATION – COARSE GRAINED SOILS

(MORE THAN 50% IS LARGER THAN NO. 200 SIEVE SIZE)

(modified from ASTM D2487 to include fines with intermediate plasticity)

MAJOR DIVISIONS			GROUP SYMBOLS	GROUP NAMES[1]
GRAVELS (more than 50% of coarse fraction is larger than No. 4 sieve size)	Gravels with less than 5% fines	$Cu \geq 4$ and $1 \leq Cc \leq 3$	GW	Well Graded Gravel, Well Graded Gravel with Sand
		$Cu < 4$ and/or $1 > Cc > 3$	GP	Poorly Graded Gravel, Poorly Graded Gravel with Sand
	Gravels with 5% to 12% fines	ML, MI or MH fines	GW-GM	Well Graded Gravel with Silt, Well Graded Gravel with Silt and Sand
			GP-GM	Poorly Graded Gravel with Silt, Poorly Graded Gravel with Silt and Sand
		CL, CI or CH fines	GW-GC	Well Graded Gravel with Clay, Well Graded Gravel with Clay and Sand
			GP-GC	Poorly Graded Gravel with Clay, Poorly Graded Gravel with Clay and Sand
	Gravels with more than 12% fines	ML, MI or MH fines	GM	Silty Gravel, Silty Gravel with Sand
		CL, CI or CH fines	GC	Clayey Gravel, Clayey Gravel with Sand
		CL-ML fines	GC-GM	Silty Clayey Gravel; Silty, Clayey Gravel with Sand
SANDS (50% or more of coarse fraction is smaller than No. 4 sieve size)	Sands with less than 5% fines	$Cu \geq 6$ and $1 \leq Cc \leq 3$	SW	Well Graded Sand, Well Graded Sand with Gravel
		$Cu < 6$ and/or $1 > Cc > 3$	SP	Poorly Graded Sand, Poorly Graded Sand with Gravel
	Sands with 5% to 12% fines	ML, MI or MH fines	SW-SM	Well Graded Sand with Silt, Well Graded Sand with Silt and Gravel
			SP-SM	Poorly Graded Sand with Silt, Poorly Graded Sand with Silt and Gravel
		CL, CI or CH fines	SW-SC	Well Graded Sand with Clay, Well Graded Sand with Clay and Gravel
			SP-SC	Poorly Graded Sand with Clay, Poorly Graded Sand with Clay and Gravel
	Sands with more than 12% fines	ML, MI or MH fines	SM	Silty Sand, Silty Sand with Gravel
		CL, CI or CH fines	SC	Clayey Sand, Clayey Sand with Gravel
		CL-ML fines	SC-SM	Silty, Clayey Sand; Silty, Clayey Sand with Gravel

US STANDARD SIEVES 3 Inch ¾ Inch No. 4 No. 10 No. 40 No. 200

	COARSE	FINE	COARSE	MEDIUM	FINE	
COBBLES & BOULDERS	GRAVELS		SANDS			SILTS AND CLAYS

RELATIVE DENSITY (SANDS AND GRAVELS)	STANDARD PENETRATION (BLOWS/FOOT)
Very Loose	0 - 4
Loose	5 – 10
Medium Dense	11 – 30
Dense	31 - 50
Very Dense	50+

1. Add "with sand" to group name if material contains 15% or greater of sand-sized particle. Add "with gravel" to group name if material contains 15% or greater of gravel-sized particle.

MOISTURE	CRITERIA
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp, but no visible water
Wet	Visible free water, usually soi is below the water table

PACIFIC GEOTECHNICAL ENGINEERING

DATE: 12/21/2007	LOG OF EXPLORATORY DRILL HOLE	DH- 1

PROJECT NAME: Santana Ranch — **PROJECT NUMBER:** 2135E

DRILL RIG: Mobile B53, 140# downhole hammer, wire winch — **LOGGED BY:** CSS

HOLE DIAMETER: 8" hollow stem auger — **HOLE ELEVATION:** -----

SAMPLER:
D = 3" OD, 2½" ID Split-spoon
X = 2½" OD, 2" ID Split-spoon
I = Standard Penetrometer (2" OD SPT)
S = Slough in sample

GROUND WATER DEPTH: Initial: --- Final: ---

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
COLLUVIUM, FAT CLAY WITH SAND: very dark grayish brown (10YR 3/2), dry to moist, stiff, disked surface, mostly fine to medium sand	CH	1										
		2										
ALLUVIAL FAN DEPOSITS, SILTY SAND: light olive brown (2.5Y 5/3), dry to moist, medium dense, fine sand	SM	3	S D D	20		37		7	NP	95		
		4										
		5										
		6	S D D	51				13		97		
		7										
		8										
		9	S D D	36								
color change to olive brown (2.5Y 4/3) moist to wet		10										
		11										
		12										
LEAN CLAY: light olive brown (2.5Y 5/4), moist to wet, very stiff	CL	13										
		14	S D D	39								
BOTTOM OF HOLE @ 15 FEET NO GROUNDWATER ENCOUNTERED		15										
		16										
		17										
		18										
		19										
		20										

DATE: 12/21/2007

LOG OF EXPLORATORY DRILL HOLE

DH- 2

PROJECT NAME: Santana Ranch **PROJECT NUMBER:** 2135E

DRILL RIG: Mobile B53, 140# downhole hammer, wire winch **LOGGED BY:** CSS

HOLE DIAMETER: 8" hollow stem auger **HOLE ELEVATION:** -----

SAMPLER:
D = 3" OD, 2½" ID Split-spoon
X = 2½" OD, 2" ID Split-spoon
I = Standard Penetrometer (2" OD SPT)
S = Slough in sample

GROUND WATER DEPTH: Initial: --- Final: ---

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
COLLUVIUM, FAT CLAY WITH SAND: very dark grayish brown (10YR 3/2), moist, very stiff to hard, disked surface, mostly fine to medium sand	CH	1	S									
		2	DD	26	4.5+			15		111		
sandstone fragments 1/2" diameter		3										
		4	S									
		5	DD	61	4.5+							
ALLUVIAL FAN DEPOSITS, CLAYEY SAND: yellowish brown (10YR 5/4) to light olive brown (2.5Y 5/3), moist, dense, fine sand, minor veins & blebs of caliche	SC	6										
		7										
		8										
		9	S									
		10	DD	75				9		111		
		11										
		12										
		13										
		14	S									
		15	II	47								
BOTTOM OF HOLE @ 15 FEET NO GROUNDWATER ENCOUNTERED		16										
		17										
		18										
		19										
		20										

DATE: 12/21/2007	LOG OF EXPLORATORY DRILL HOLE	DH- 3

PROJECT NAME: Santana Ranch **PROJECT NUMBER:** 2135E

DRILL RIG: Mobile B53, 140# downhole hammer, wire winch **LOGGED BY:** CSS

HOLE DIAMETER: 8" hollow stem auger **HOLE ELEVATION:** -----

SAMPLER:
D = 3" OD, 2½" ID Split-spoon
X = 2½" OD, 2" ID Split-spoon
I = Standard Penetrometer (2" OD SPT)
S = Slough in sample

GROUND WATER DEPTH: Initial: --- Final: ---

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
COLLUVIUM, FAT CLAY: brown (10YR 4/3), moist, very stiff to hard	CH	1										
		2										
		3	S D D	36	4.0 4.5+			15		109		
ALLUVIAL FAN DEPOSITS, SILTY SAND to SILT/LEAN CLAY WITH SAND: dark yellowish brown (10YR 4/6), moist, medium dense sand to hard clay, fine sand	SM/ ML/ CL	4										
		5										
		6	S D D	49								
		7										
		8										
		9	S D D	54								
		10										
		11										
		12										
		13										
		14	S I I	22				15				
BOTTOM OF HOLE @ 15 FEET NO GROUNDWATER ENCOUNTERED		15										
		16										
		17										
		18										
		19										
		20										

DATE: 12/21/2007	LOG OF EXPLORATORY DRILL HOLE	DH- 4

PROJECT NAME: Santana Ranch **PROJECT NUMBER:** 2135E

DRILL RIG: Mobile B53, 140# downhole hammer, wire winch **LOGGED BY:** CSS

HOLE DIAMETER: 8" hollow stem auger **HOLE ELEVATION:** -----

SAMPLER:
D = 3" OD, 2½" ID Split-spoon
X = 2½" OD, 2" ID Split-spoon
I = Standard Penetrometer (2" OD SPT)
S = Slough in sample

GROUND WATER DEPTH: Initial: --- Final: ---

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
COLLUVIUM, FAT CLAY WITH SAND: dark brown (10YR 3/3), dry to moist, very stiff to hard, mostly fine sand	CH	1	S D D	29	4.5+		52	15	32	114		
		2										
		3										
		4	S D D	19								
ALLUVIAL FAN DEPOSITS, CLAYEY SAND to SANDY LEAN CLAY: dark yellowish brown (10YR 4/6), moist, medium dense sand to very stiff clay, fine sand	SC/ CL	5										
		6										
		7										
		8										
		9	S D D	24								
		10										
		11										
CLAYEY SAND to POORLY GRADED SAND: brown (10YR 4/3), moist, medium dense, fine to medium sand	SC-SP	12										
		13										
		14	S D D	33		11		6		109		
BOTTOM OF HOLE @ 15 FEET NO GROUNDWATER ENCOUNTERED		15										
		16										
		17										
		18										
		19										
		20										

DATE: 12/21/2007	LOG OF EXPLORATORY DRILL HOLE	DH- 5

PROJECT NAME: Santana Ranch **PROJECT NUMBER:** 2135E

DRILL RIG: Mobile B53, 140# downhole hammer, wire winch **LOGGED BY:** CSS

HOLE DIAMETER: 8" hollow stem auger **HOLE ELEVATION:** -----

SAMPLER:
D = 3" OD, 2½" ID Split-spoon
X = 2½" OD, 2" ID Split-spoon
I = Standard Penetrometer (2" OD SPT)
S = Slough in sample

GROUND WATER DEPTH: Initial: --- Final: ---

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
COLLUVIUM, FAT CLAY WITH SAND: dark yellowish brown (10YR 4/6), dry to moist, very stiff to hard, fine to medium sand	CH	1										
		2										
		3	S									
ALLUVIAL FAN DEPOSITS, SILTY SAND to LEAN CLAY WITH SAND: dark yellow brown (10YR 4/6), dry to moist, medium dense sand to hard clay, fine sand	SM/CL	4	D D	75	4.5+							
		5	S									
		6	I I	26								
		7										
		8										
CLAYEY SAND WITH GRAVEL to CLAYEY GRAVEL WITH SAND: grayish brown (10YR 5/2) to dark yellowish brown (10YR 3/6), moist, dense, fine to coarse sand, fine to coarse subrounded to subangular gravel	SC/GC	9	S									
		10	D D	75				5		121		
		11										
		12										
		13										
		14	S I									
		15	I									
BOTTOM OF HOLE @ 15 FEET NO GROUNDWATER ENCOUNTERED		16										
		17										
		18										
		19										
		20										

DATE: 7/13/2006	LOG OF EXPLORATORY DRILL HOLE	DH- 6

PROJECT NAME: Santana Ranch **PROJECT NUMBER:** 2135E

DRILL RIG: Mobile B53, 140# downhole hammer, wire winch **LOGGED BY:** CSS

HOLE DIAMETER: 8" hollow stem auger **HOLE ELEVATION:** -----

SAMPLER:
D = 3" OD, 2½" ID Split-spoon
X = 2½" OD, 2" ID Split-spoon
I = Standard Penetrometer (2" OD SPT)
S = Slough in sample

GROUND WATER DEPTH: Initial: --- Final: ---

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
COLLUVIUM, FAT CLAY WITH SAND: brown (10YR 4/3), moist, very stiff to hard, mostly fine sand	CH	1	S D D	25			57	19	36	107		
		2										
1 foot transition with sandstone clasts		3										
ALLUVIAL FAN DEPOSITS, CLAYEY SAND to SANDY LEAN CLAY: dark yellowish brown (10YR 4/4), dry to moist, dense sand to hard clay, fine sand	SC/ CL	4	S D D	70				17		87		
		5										
CLAYEY SAND to CLAYEY SAND WITH GRAVEL: dark yellowish brown (10YR 4/6) to brown (10YR 4/3), dry to moist, dense, fine to medium sand and subrounded gravel, minor cobbles	SC	6										
		7										
		8										
		9	S I I	50				4				
		10										
		11										
		12										
		13										
		14	S D D	57								
BOTTOM OF HOLE @ 15 FEET NO GROUNDWATER ENCOUNTERED		15										
		16										
		17										
		18										
		19										
		20										

DATE: 7/13/2006	LOG OF EXPLORATORY DRILL HOLE	DH- 7

PROJECT NAME: Santana Ranch **PROJECT NUMBER:** 2135E

DRILL RIG: Mobile B53, 140# downhole hammer, wire winch **LOGGED BY:** CSS

HOLE DIAMETER: 8" hollow stem auger **HOLE ELEVATION:** -----

SAMPLER:
D = 3" OD, 2½" ID Split-spoon
X = 2½" OD, 2" ID Split-spoon
I = Standard Penetrometer (2" OD SPT)
S = Slough in sample

GROUND WATER DEPTH: Initial: --- Final: ---

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
COLLUVIUM, FAT CLAY WITH SAND: very dark grayish brown (10YR 3/2), moist, very stiff to hard, mostly fine sand	CH	1	SDD	25	4.5+			9		98		
		2										
gradational contact												
ALLUVIAL FAN DEPOSITS, CLAYEY SAND to SANDY CLAY: brown (10YR 4/3), moist, dense sand to hard clay, fine sand	SC/CL	3										
		4	SDD	66								
		5										
		6										
		7										
		8										
		9	SII	32				13				
		10										
		11										
CLAY: brown (10YR 4/3), moist, hard, minor fine sand	CI	12										
		13										
		14	SDD	70								
BOTTOM OF HOLE @ 15 FEET NO GROUNDWATER ENCOUNTERED		15										
		16										
		17										
		18										
		19										
		20										

DATE: 7/13/2006	LOG OF EXPLORATORY DRILL HOLE	DH- 8

PROJECT NAME: Santana Ranch — PROJECT NUMBER: 2135E

DRILL RIG: Mobile B53, 140# downhole hammer, wire winch — LOGGED BY: CSS

HOLE DIAMETER: 8" hollow stem auger — HOLE ELEVATION: -----

SAMPLER:
D = 3" OD, 2½" ID Split-spoon
X = 2½" OD, 2" ID Split-spoon
I = Standard Penetrometer (2" OD SPT)
S = Slough in sample

GROUND WATER DEPTH: Initial: --- Final: ---

DESCRIPTION OF EARTH MATERIALS	SOIL TYPE	DEPTH (ft)	SAMPLE	BLOWS PER FOOT	POCKET PEN (tsf)	% PASSING #200 SIEVE	LIQUID LIMIT	WATER CONTENT	PLASTICITY INDEX	DRY DENSITY (pcf)	FAILURE STRAIN (%)	UNCONFINED COMPRESSIVE STRENGTH (psf)
COLLUVIUM, FAT CLAY WITH SAND: dark yellowish brown (10YR 4/2), moist, very stiff to hard, fine sand	CH	1										
		2										
		3	S									
CLAYEY SAND: dark yellowish brown (10YR 4/4), dry to moist, medium dense, fine sand	SC		D	37	4.5+							
		4	D					11		96		
		5	S									
		6	D D	32								
		7										
		8										
		9	S									
		10	D D	20								
		11										
SANDY CLAY: dark yellowish brown (10YR 4/4), moist, hard, fine sand	CL/ CI	12										
		13										
		14	S									
			I I	42				15				
BOTTOM OF HOLE @ 15 FEET NO GROUNDWATER ENCOUNTERED		15										
		16										
		17										
		18										
		19										
		20										

PACIFIC GEOTECHNICAL ENGINEERING