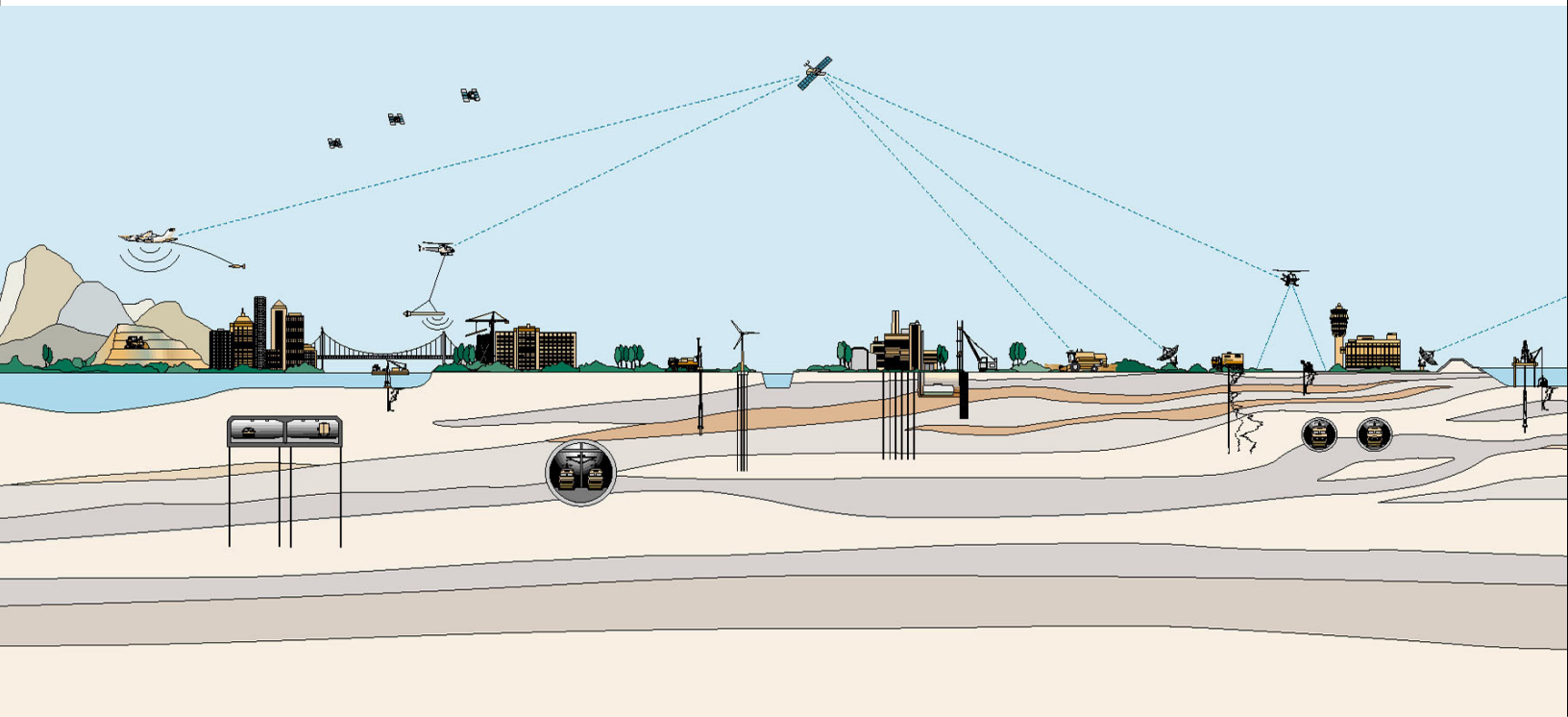
FUGRO CONSULTANTS, INC.

GEOTECHNICAL REPORT
LOS OSOS WATER RECYCLING FACILITY
LOS OSOS VALLEY ROAD AT CLARK VALLEY ROAD
SAN LUIS OBISPO COUNTY, CALIFORNIA

Prepared for:
Carollo Engineers, Inc.

May 23, 2013
Project No. 04.6212.0178



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May 23, 2013
Project No. 04.6212.0178

Carollo Engineers
1218 3rd Ave., Suite 1600
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Attention: Mr. Karl Hadler

Subject: Geotechnical Report, Los Osos Water Recycling Facility Design, Los Osos Valley Road at Clark Valley Road, San Luis Obispo County, California

Dear Mr. Hadler:

Fugro is pleased to submit this Geotechnical Report for the design of the Los Osos Water Recycling Facility. The purpose of this report is to provide geotechnical recommendations for the design of the water recycling facility. This report was prepared in accordance with Task Order Nos. 1 and 2 to our subconsultant agreement with Carollo Engineers dated November 8, 2012.

This report provides geotechnical recommendations for site preparation and grading, foundation design, above- and below-grade structures, seismic data, pipeline and utility trenches, pavement design, and construction considerations. Field and laboratory data obtained from the geotechnical evaluation are presented in this report. The environmental assessment and tests for agricultural soils will be submitted separately.

We appreciate the opportunity to provide our services on this project. Please contact the undersigned if you have questions regarding this report, or require additional information.

Sincerely,

FUGRO CONSULTANTS, INC.

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Copies: 4 – addressee (1 pdf)

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1.0 SITE AND PROJECT DESCRIPTION

The project will generally consist of the design of a new wastewater treatment and water recycling facility for the community of Los Osos, California. The site for the new recycling facility is located east of Los Osos about ¼-mile north of the intersection of Clark Valley Road with Los Osos Valley Road. The location of the site relative to nearby streets and geographic landmarks is shown on Plate 1, Vicinity Map. The layout of the site is shown on Plate 2, Field Exploration Plan.

1.1 EXISTING SITE

The site is located on undeveloped property that is located approximately 1.5 miles east of Los Osos, and about 1,500 feet north of the intersection of Clark Valley Road with Los Osos Valley Road. The site is approximately 14 acres that has been used mainly as farmland. The site is bordered on all sides by undeveloped parcels. There is a single family home to the west of the site. The Los Osos Valley Memorial Park Cemetery is located to the south.

The site is generally composed of gently rolling terrain with two predominant drainages that trend northeast through the middle and west end of the site (see Plate 2). The site had been disked at the time of our December 2012 field exploration program, and was covered with low grasses and weeds. The drainages deepen to approximately 6 to 8 feet and become incised toward the north end of site, and then confluence beyond the project limits to the north. The combined drainage flows north into Warden Lake and the drainage of the Los Osos Creek approximately 700 feet beyond the limits of the site. The ground surface descends approximately 50 feet beyond the north end of the site and along the drainages (Carollo 2013). Willows and wet ground conditions are present near the base of the slope. The ground to the south and west of the site is generally flat.

The existing ground surface ranges from approximately elevation (el.) 92 feet along the south boundary of the site to el. 65 feet along the invert of the drainages and on the existing slopes that pass through the north end of the site. The slope of the ground surface steepens to approximately 12 percent along the northern limits of the site.

1.2 PROJECT UNDERSTANDING

The project will generally consist of constructing a new 1.2-million-gallon per day (MGD) wastewater treatment and water recycling facility at the site. The layout of the proposed improvements is shown on Plate 2. The site will be mass-graded to a finished grade of approximately el. 86 to 90feet. The south end of the plant will be predominantly in cut and the north end of the plant will be predominantly on fill. Finished grades will have up to approximately 3 feet of cut and up to approximately 16 feet of fill. Carollo (2013) has identified that the facility will include the following:

- Administration, Dewatering, Maintenance and Electrical buildings will be provided. The buildings will have slab on grade floors and range in height from approximately 26 to 32 feet with steel and/or masonry framing.

- The headworks with screening and septage receiving station will be located at the west of the new plant within invert elevation of 87.5 feet, near finished pad grade. The invert of overflow and meter vault portions of the headworks will be 4 to 7 feet below finished grades.
- The oxidation ditches will be provided near the center of the new plant. The structure will consist of two parallel units that are approximately 100 feet wide and 250 feet long combined. The ditches are to be constructed of reinforced concrete on a mat foundation. The invert of the structure is el. 76 feet, approximately 12 feet below the finished pad grade. The invert at the east and west ends of the structure will be founded approximately 2 to 12 feet below the existing ground surface. The center of the structure traverses one of the natural drainages that passes through the site, with the invert founded between approximately 1 foot above and 4 feet below existing site grades along the drainage.
- Two secondary clarifiers will be sited east of the oxidations ditches. The clarifiers will be approximately 60-foot diameter with the bottom of clarifiers extending to approximately 20 to 21 feet below finished grade, and the center wells extending to approximately 21 to 22 feet below finished grade.
- A partially below-grade ML splitter box will be founded approximately 9 feet below existing grade and rising to approximately 11½ feet above existing grades.
- The odor control units will be founded on a structural slab on grade with two media silos extending to approximately 19 feet above the slab.
- The filter influent pump station will be located in the southeast portion of the site just east of the administration building. The invert of the pump station vault is el. 71.25 feet, and will be founded approximately 16 feet below the existing ground surface. The pumps will be founded on a structural slab on grade adjacent to the vault.
- The tertiary filters and chemical facilities will be founded on structural slabs with a roof covering and be either fully or partially enclosed. The UV facility will be a concrete water bearing structure that is founded 5 feet below finished grade. These facilities will house pumps, tanks, and appurtenant electrical and mechanical equipment and piping.
- The Sludge Storage Tanks will be a partially buried structure, with the top of footing at el. 76 feet, or 10 feet below finished grade. The top of the structure will be at el. 95 feet. The structures will be reinforced concrete with various piping, pumping and drainage provisions.
- The invert of the effluent pump station will be el. 65 feet, and will be founded less than 30 feet below the existing ground surface. The effluent pumps will draw from recycled water storage ponds that will be provided along the west and north sides of the plant. The pumps for the effluent pump station will be founded on structural slabs at finished grade.

- A 30-foot diameter welded steel tank with a ring wall footing and founded on a gravel mat will be provided near the northeast corner of the site. The tank will have a water storage depth of approximately 20 feet.
- Two recycled water storage ponds and one stormwater detention pond will be situated along the north and west perimeters of the plant. The storage ponds will have a capacity of approximately 32 acre-feet with a maximum water surface at el. 83 feet. The detention pond will be up to about 15 feet deep and have a capacity of about 2 acre feet. The bottom of the storage ponds will be at approximately el. 70 feet, and range from approximately 4 to 20 feet below existing ground surface. The ponds will be lined with an HDPE liner. A reinforced concrete wall will be constructed to separate Ponds 1 and 2. A gravel surface access road will be provided along the pond's perimeter. A perimeter berm up to approximately 16 feet in height will be needed to support the northeast portion of the pond.
- Two sections of segmental masonry unit (SMU) retaining walls are proposed along the perimeter berm exterior slope. The northwestern wall will be up to about 5½ feet in height and approximately 156 feet in length; the northern wall will be up to about 8 feet in height and approximately 234 feet in length.
- An approximately 150-foot long SMU retaining wall measuring up to 16 feet in height is proposed along the northeastern slope of the treatment plant.
- The access road and utilities to the plant will be approximately 1,500 feet long extending north from the intersection of Los Osos Valley Road and Clark Valley Road. The road will be paved with asphalt concrete.
- Access roads and parking areas will be paved with asphalt concrete throughout the plant. Walkway, building aprons, and covered parking and loading areas will be constructed of concrete slabs on grade.
- Appurtenant improvements are expected to consist of buried and above grade utilities and piping, canopy structures, irrigated landscaping, and drainage.

2.0 WORK PERFORMED

2.1 PURPOSE

The purpose of this report is to provide geotechnical recommendations for the design of the new wastewater treatment plant and water recycling facility. The main geotechnical considerations that we evaluated for the project are characterization of the soil and groundwater conditions encountered, site preparation and grading, seismic hazards, foundation support for the design of the treatment plant and water recycling facility improvements, design and construction of below grade structures, the stability of the slope for the storage ponds, and roadway design and buried pipes.

2.2 SCOPE OF WORK

As a basis for providing the geotechnical recommendations presented in this report, we have performed the following scope of work:

- Visited the site to observe the general site conditions, mark drill hole locations, and coordinate site access with the County and our drilling subcontractor;
- Reviewed selected published geologic maps, historical aerial photographs, and geotechnical data from our previous studies;
- Prepared a Health and Safety Plan for the field work, obtained well permits for selected drill holes from the County, and notified Underground Service Alert to clear the marked drill hole locations for the field exploration program;
- Drilled twenty-one (21) borings at the wastewater treatment and water recycling facility site to depths ranging from approximately 8 to 75 feet below the ground surface;
- Performed laboratory tests on selected samples obtained from the borings for classification and characterization of various geotechnical properties;
- Collected near-surface samples from selected borings, transported the samples to a state certified laboratory for analytical testing of agricultural soils, and prepared a letter describing the procedures, testing, and results; and
- Prepared this report summarizing the data obtained for the site and our opinions and recommendations regarding:
    - Soil and groundwater conditions encountered;
    - Geologic and seismic setting;
    - Potential for geologic hazards to impact the project (such as seismic shaking, faulting, liquefaction, and seismic settlement);
    - Seismic data for use with the 2010 California Building Code and AWWA Standards;
    - Site-specific response spectra extrapolated to a period of 15 seconds;
    - Site preparation and grading for improvement areas;
    - Suggested material specifications for fill and backfill materials;
    - Suitability of the soils encountered for use as fill or backfill material;
    - Fill placement and compaction;
    - Site preparations and grading for the plant, ponds, and access roads;
    - Design of shallow spread footing, mat, and structural slab foundations (bearing pressures, subgrade modulus, foundation widths and depths, and estimated settlement);
    - Friction coefficient and passive pressure for resisting lateral loads;
    - Resistance to uplift pressures for buried structures;
    - Lateral earth pressures (static and dynamic) for retaining wall design and subsurface structures;

- Considerations for expansive soil conditions;
- Design of slabs-on-grade;
- Bedding, pipe zone and trench backfill materials and compaction requirements for the pipelines and utilities;
- Surface drainage;
- Pavement recommendations for parking lots and access roads based on traffic indices (TI) provided to us (and according to Caltrans design methods);
- Corrosion data for the design of subsurface structures and pipes; and
- Construction considerations regarding groundwater, temporary slopes, shoring, and excavations.

2.3 FIELD EXPLORATION

The field exploration for this project consisted of advancing nineteen (19) borings during the period of December 17 to 21, 2012, and drilling two hand auger borings on January 23, 2013. The logs for the borings are presented in Appendix A. The approximate locations of the explorations are shown on Plate 2. The drilling subcontractor for the project was S/G Drilling Company of Lompoc, California. BP General Excavating of Los Osos, California supported the drilling by compacting routes to the drill holes using a sheepsfoot compactor and providing a bulldozer to assist the drill rigs in crossing the muddy ground. S/G mainly used a CME85 truck-mounted drill rig equipped with 8-inch-diameter hollow-stem augers to advance the borings to depths of approximately 20 to 75 feet below the ground surface. A second CME75 drill rig was used to complete the drilling for DH-2 and DH-6, but broke down and had to leave the site. Tracking with and use of the bulldozer was necessary to move between holes as the ground surface was wet from rain and was slick, which allowed little traction to develop.

The borings were sampled using a 2-inch outside diameter standard penetration test (SPT) split-spoon sampler and a 3-inch outside diameter modified California split-spoon sampler. The modified California sampler was equipped with 1-inch high brass rings. The SPT sampler was used without liners. The samplers were driven into the materials at the bottom of the drill holes at selected intervals using a 140-pound automatic trip hammer with a 30-inch drop. The blow count (N-value) is the number of blows from the hammer that were needed to drive the sampler 1 foot after the sampler had been seated at least 6 inches into the material at the bottom of the hole.

The hand auger borings were drilled by a field geologist from Fugro who used a 4-inch hand auger to advance the borings to depths of approximately 8½ to 10 feet. The borings were logged in the field and sampled using a 3-inch outside diameter sampler with a 6-inch long split barrel. The sampler was driven into the material at the bottom of the hole using a 5-pound slide hammer. The borings were backfilled with native fill upon completion of the drilling.

Handheld pocket penetrometer tests were performed on the trimmed ends of selected samples in the field to estimate the undrained shear strength of cohesive soils. Bulk samples were collected from the drill cuttings retrieved from the auger flights. The recovered samples

were sealed in plastic bags, set in protective containers, labeled and transported to the laboratory.

We obtained well permits for the borings that were deeper than 25 feet. Those borings were backfilled with cement-sand slurry to seal the boreholes. Shallower borings were backfilled with native fill materials. The sample intervals, N-values, a description of the subsurface conditions encountered and other field and laboratory data are presented on the logs of the borings in Appendix A.

2.4 LABORATORY TESTING

Laboratory tests were performed on selected soil samples retrieved from the borings. The laboratory testing program for this project included tests for moisture content and unit weight, grain size distribution, plasticity (Atterberg limits), compaction (Proctor), direct shear strength, consolidated undrained (CU) triaxial compressive strength, unconsolidated undrained (UU) triaxial compressive strength, consolidation, flex-wall permeability, expansion index, R-value and corrosion. Corrosion tests were performed on selected samples by Cooper Testing Laboratory of Palo Alto, California. The tests were performed in general accordance with the applicable standards of ASTM. The results of the tests are presented in Appendix B and on the boring logs in Appendix A. Analytical tests used to assess agricultural soils were performed by Oilfield and Environmental Compliance of Santa Maria, California.

2.5 LIME TREATED SOIL EVALUATION

Additional laboratory testing was performed to evaluate the use of lime to stabilize expansive clay soils encountered at the site. Tests to estimate the minimum lime content needed to stabilize the soil and provide a pH of 12.4 were performed (the Eades and Grim Test). The estimated minimum lime content was then used to prepare composite samples of clay from the site with lime treatment and to perform additional tests for one-dimensional expansion, and compressive strength. The results of the testing are included with the other laboratory test results in Appendix B (Plates B-12 through B-14). Based on review of the results by Fugro and Carollo, using lime treated soils as structure backfill or for pavement subgrades is not recommended for this project.

2.6 HISTORICAL AERIAL PHOTOGRAPH AND TOPOGRAPHIC MAP REVIEW

We reviewed selected historical aerial photographs dated between 1937 and 2006 that were obtained from Environmental Data Resources (EDR 2012). The EDR historical aerial photographs are included in Appendix C. The following is a summary of the photographs reviewed as part of the preliminary study.

Table 1. Summary of Historical Aerial Photograph Review

Date	Scale	Source	Key observations
1937	1" = 500'	Army	Site is generally rural and vacant with boundaries similar to what exists today. The residence to the west of the site is present. There is also a residence to the north on the adjacent property. There is no development or cemetery between the site and Los Osos Valley Road. The natural drainages that pass through the existing site are present and appear to be at about the same location as they are now. A series of buildings, barns or pens are present to the east of the residence and along the drainage that is near the northern border of the plant site and proposed ponds. The drainage to the northeast of the site has little vegetation. Warden Lake appears full with a water surface near el. 30 feet based on a comparison to ground elevations estimated using Google Earth.
1949	1" = 500'	Park	Similar to 1937 photo except the pens and buildings along the drainage have been removed along the northern boundary of the existing site. A barn and smaller structure are still present near the house. The water surface of Warden Lake appears higher than in 1937, near el. 35 feet.
1956	1" = 500'	Hycon	Similar to 1949 photo. The water surface of Warden Lake appears lower than in 1949, near el. 28 feet, and contains considerable vegetation along the shorelines. A stand of possible willows is present along the drainage just north of the site that is about 200 feet long.
1969	1" = 500'	Western	Similar to 1949 photo. The water surface of Warden Lake appears lower than in 1956, near el. 26 feet (similar to existing), and contains considerable vegetation throughout the lake. Two roads or ditches have been graded into the lake near the mouth of the drainage that drains from the site, and about 250 feet to the east. The stand of willows noted in the 1956 photo has been removed and the drainage and adjacent slopes appear to have been graded. Roads have been graded toward the west end of the present-day cemetery south of the site, but it is not evident whether or not any grave sites have been made. There is evidence of possible row crops being planted on a portion of the parcel immediately south of the site.
1978	1" = 500'	Pacific Air	Similar to 1969 photo. Warden Lake appears dry. The existing power transmission lines appear to be present on the parcel to the east (Andre site). The cemetery boundaries are evident and western portion of the cemetery appears to be occupied.
1989	1" = 500'	USGS	The site appears to be used for dry farming. The parcel to the south is fallow. There appears to be a developed house lot on the parcel to the east (Andre site). The cemetery appears to be built out. Willows appear to have grown up for about 150 feet along the drainage to north of the site. Warden Lake appears dry; however, there appears that an offstream reservoir was graded along the south shore of the former lake about 1,200 feet upstream of the site.
1994 color	1" = 500'	EDR	Similar to 1989 photo. Willows extend for about 300 to 400 feet along the drainage to north of the site. Warden Lake appears dry.
2005	1" = 500'	EDR	Similar to existing site condition. Parcels to south and onsite appear to have been cultivated for row crops. Water is present in the offstream reservoir portion of Warden Lake about 1,200 feet upstream of the site.
2006	1" = 500'	EDR	Similar to 2005 photo.

2.7 PREVIOUS STUDIES

We reviewed previous geotechnical and geologic reports prepared for the site and vicinity for this project. The following reports contained boring or geotechnical information that was used to assist in characterizing the subsurface conditions at the site:

- Fugro (2011) prepared a geotechnical report for the design of a conveyance system to move water from the sewer collection system to the new plant and to deliver recycled water from the plant back into the community of Los Osos. The field program included drilling borings along Los Osos Valley Road and a boring (DH-501 on Plate 2) at the intersection with Clark Valley Road.
- Fugro (2007) prepared a preliminary geotechnical report for the Los Osos Mortuary (the parcel to the south of the current site), Giacomazzi (the current site) and Branin (the parcel to the north of the current site) properties as input to the environmental documents and preliminary engineering studies. The study focused on the potential for the site to be impacted by geologic hazards and the geotechnical considerations for the development of a new treatment plant on those sites. The study included advancing 7 CPT soundings (C-1 to C-7 in blue on Plate 2) and 4 hand augers (HA-1 to HA-4 on Plate 2), mostly on the Giacomazzi property.
- Fugro (2004) prepared a technical memorandum for the Andre site (the parcel to the east of the current site) as input to the environmental documents and preliminary engineering studies. The study focused on the potential for the site to be impacted by geologic hazards and the geotechnical considerations for the development of a new treatment plant on those sites. The study included advancing 7 CPT soundings (C-1 to C-7 in green on Plate 2) on the Andre property.

The approximate locations of the referenced borings and CPT soundings are shown on Plate 2. Logs of the borings and CPT soundings are included in Appendix D.

2.8 GENERAL CONDITIONS

Fugro prepared the conclusions and professional opinions presented in this report in accordance with generally accepted geotechnical engineering principles and practices at the time and location this report was prepared. This statement is in lieu of all warranties, expressed or implied.

This report has been prepared for Carollo and their authorized agents only. It may not contain sufficient information for the purposes of other parties or other uses. If any changes are made in the project or site conditions as described in this report, the conclusions and recommendations contained in this report should not be considered valid unless Fugro reviews the changes and modifies and approves, in writing, the conclusions and recommendations of this report. The report and drawings contained in this report are not intended to act as construction drawings or specifications.

Soil and rock deposits will vary in type, strength, and other geotechnical properties between points of observation and exploration. Additionally, groundwater and soil moisture conditions can also vary seasonally or for other reasons. Therefore, we do not and cannot have complete knowledge of the subsurface conditions underlying the site. The conclusions and recommendations presented in this report are based upon the findings at the points of exploration, and interpolation and extrapolation of information between and beyond the points of

observation, and are subject to confirmation based on the conditions revealed during construction.

The scope of services did not include any environmental assessments for the presence or absence of hazardous/toxic materials in the soil, surface water, groundwater, or atmosphere. Any statements or absence of statements in this report or data presented herein regarding odors, unusual or suspicious items, or conditions observed are strictly for descriptive purposes and are not intended to convey engineering judgment regarding potential hazardous/toxic assessment.

3.0 SITE CONDITIONS

3.1 GEOLOGIC SETTING

The project is located in the Los Osos Valley that is part of the Coast Ranges geologic and geomorphic province. That province consists of north-northwest-trending sedimentary, volcanic, and igneous rocks extending from the Transverse ranges to the south, into northern California. Rocks of the Coast Ranges province are predominantly of Jurassic and Cretaceous age; however, some pre-Jurassic, along with Paleocene-age to Recent rocks are present. The surficial geology in the project vicinity, as mapped by Hall (1979), is shown on Plate 3.

The site is located on a terrace that is dissected by Los Osos Creek to the north. As shown on Plate 3, the surface geology is queried as possibly belonging to the Paso Robles Formation. As encountered in our explorations, the surficial sediments appear to be clayey alluvial terrace deposits and are not consistent with the type section and apparent age of the Paso Robles Formation. The sediments are underlain by sandy alluvium, possibly intermixed with eolian sands, which are exposed on the hill side in the bottom of the drainages north of the site. These units are described as Qal_1, Qal_2 and Qal_3 in the subsequent sections of this report. Recent alluvium (Qa) overlies these sediments to the north of the site and in the vicinity of Warden Lake. A deeper unit of marine or estuarine blue clay was encountered beneath the alluvium in DH-11, which was terminated within that unit. The hillsides north and south of the site are generally composed of claystone and metavolcanic Franciscan rocks (KJfm). The Franciscan rocks are the basement rock in the site vicinity and likely underlie sediments that fill the Los Osos Valley in the vicinity of the site at some depth beneath the site.

3.2 SUBSURFACE CONDITIONS

The subsurface conditions encountered at the site are described below. The locations of the explorations are shown on Plate 2. Logs of the borings are presented in Appendix A. Supplemental subsurface information from previous studies are presented in Appendix D. Subsurface profiles showing a summary of the generalized subsurface conditions encountered are shown on Plates 4a to 4d, taken in the east-west direction, and on Plates 5a and 5b, taken in the north-south direction.

Alluvium (Qal). Alluvium was encountered at the ground surface in each boring performed for this study. The borings were terminated within the alluvium at depths ranging from approximately 8½ to 50 feet below the existing ground surface, with the exception of DH-

11 which was advanced to a depth of 76 feet and encountered a marine clay unit beneath the alluvium. The alluvium encountered in the borings consisted of three predominant units (Qal_1 through Qal_3) as described below:

Qal_1. This unit consisted of a moderately desiccated surficial alluvium encountered in each of the borings. As shown on the subsurface profiles, the unit is interpreted to follow the profile of the ground surface and to range in thickness from approximately 6 to 17 feet thick. The upper 1 to 3 feet of the unit appears to be softer and has likely been disturbed by previous farming and cultivating activities at the site. The unit was generally thinner where encountered along the existing drainages and lower elevations of the site, and was thicker where encountered in the higher elevations of the site. This unit of alluvium generally consisted of very stiff to hard lean to fat clay (CL/CH) with varying amounts of sand and gravel, and occasionally grading to clayey sand (SC). Pieces and lenses of angular gravel are common at the ground surface and at various depths within the unit. The hardness of the clay is attributed to ongoing desiccation and weathering of the surficial clay units.

Qal_2. This unit of alluvium was encountered below the Qal_1 unit in each of the borings. The unit is similar in color and material type to Qal_1, but is differentiated as generally being softer and less weathered than the surficial unit. As shown on the profiles, the thickness of the unit is estimated to range from approximately 4 to 12 feet and to always be concealed beneath the Qal_1 where the alluvium is exposed at the ground surface. The unit generally consisted of stiff to very stiff clay (CL/CH) with varying amounts of sand and gravel, and occasionally grading to clayey sand. Only DH-13 was terminated within Qal_2 at a depth of 21.5 feet. The unit was underlain by the Qal_3 in each of the remaining borings.

Qal_3. This unit of the alluvium was encountered below the Qal_2 unit. Deeper borings were typically terminated within this unit at depths of up to approximately 50 feet below the ground surface. DH-11 was advanced to a depth of 76 feet and appears to have penetrated the base of the unit at approximately 73 feet below the ground surface. The unit generally consisted of dense to very dense silty sand (SM), clayey sand (SC) and sand (SP) with varying amounts of silt, clay, and gravel. The sand was commonly stained and mottled. The alluvium was underlain by marine clay at 73 feet below the ground surface in DH-11.

Marine Clay (Qm). A layer of marine clay, or possible older estuarine deposits, was encountered in DH-11 at a depth of approximately 73 feet. The unit was interpreted to be marine because of its distinct blue gray color. The unit generally consisted of very stiff fat clay (CH) as was encountered to the maximum depth explored, about 76 feet below the existing ground surface.

A summary of selected geotechnical properties for each of the units encountered is presented below:

Table 2. Summary of Selected Geotechnical Properties

Geologic Unit	Soil	Range of Dry Unit Weights (pcf)	Range of Moisture Contents (%)	Plasticity (Atterberg Limits) LL = Liquid Limit PI = Plasticity Index	SPT Field N_{60}-Value	Undrained Shear Strength (ksf).
Qal_1	Very stiff to hard CLAY (CL/CH) with varying sand gravel	105-119	7-19	LL 8-33, PI 27-48	14-65	2.6-8.9uu 2.3 – 4.5+ p
Qal_2	Stiff to Very Stiff CLAY (CL/CH) and clayey SAND (SC)	87-117	18-33	LL 32-68, PI 15-48	8-35	1.9-3uu 1.5 – 4.5+ p
Qal_3	Dense to very dense silty SAND (SM), clayey SAND (SC) and SAND with silt (SP-SM)	102-111	5-26	–	34 - >100	–
Qm	Very stiff CLAY (CH)	70	52	–	17	2.5-3p

3.3 GROUNDWATER CONDITIONS

Groundwater was encountered in selected borings at depths ranging from approximately 21 to 42 feet below the existing ground surface during our December 2012 field exploration program. The depth to groundwater corresponds to a groundwater elevation ranging between el. 46 and 50 feet. The groundwater elevation is similar to those measured in CPT soundings advanced during a May 2007 (Fugro 2007) preliminary geotechnical study of the site. CPT sounding C-2, advanced on the mortuary property approximately 1000 feet southwest of the site, encountered groundwater at approximately 34 feet below the ground surface (elevation 74 feet), and may be associated with the perched groundwater encountered. Springs and wet ground conditions were observed along the drainage beyond the northeast corner of the site near el. 45 feet. The drainage flows to Warden Lake, located about 300 feet further downstream of the site to the north. A summary of the groundwater levels observed in the 2012 and 2007 explorations are summarized below:

Table 3. Summary of Groundwater Levels Encountered

Boring	Ground Elevation feet	Depth below Ground feet	Groundwater Elevation feet	Date Observed (m/d/y)	Notes
1	86	39.7	46.3	12/20/2012	
2	77	29	48	12/18/2012	
3	87	42.2	44.8	12/20/2012	
4	85	35	50	12/20/2012	
5	70.5	–	–	–	Not encountered to 8’
6	70	21.5	48.5	12/19/2012	
7	88.5	–	–	12/21/2012	Not encountered to 23'
8	86	–	–	–	Not encountered to 10’
9	82.5	33.7	48.8	12/19/2012	

[1] Undrained shear strength at estimated using the handheld field pocket penetrometer performed on the trimmed ends of selected

Boring	Ground Elevation feet	Depth below Ground feet	Groundwater Elevation feet	Date Observed (m/d/y)	Notes
10	80	32.5	47.5	12/19/2012	
11	85	35	50	12/21/2012	
12	76	–	–	12/19/2012	Not encountered to 21'
13	89	–	–	12/17/2012	Not encountered to 21'
14	73.5	–	–	12/18/2012	Not encountered to 21'
15	87	39.3	47.7	12/17/2012	
16	79	32.5	46.5	12/18/2012	
17	87	–	–	12/17/2012	Not encountered to 25'
18	80	–	–	12/18/2012	Not encountered to 21'
19	74	26.5	47.5	12/18/2012	
20	79	–	–	12/18/2012	Not encountered to 21'
21	74	–	–	12/18/2012	Not encountered to 25'
C-1	105	–	–	5/8/2007	Not encountered to 34'
C-2	108	34	74	5/8/2007	
C-3	85	37	48	5/8/2007	Caved to 7'. Pore pressure reading.
C-4	82	35	47	5/8/2007	
C-5	90	41.5	48.5	5/8/2007	
C-6	90	45	45	5/8/2007	Caved to 36.5'. Pore pressure reading.

Variations in soil moisture and groundwater conditions will likely occur as a result of irrigation, pumping from local groundwater, changes in precipitation, runoff, and other factors.

4.0 GEOTECHNICAL EVALUATION AND ANALYSES

4.1 SEISMICITY AND STRONG GROUND MOTION

4.1.1 Seismic Setting

The project is located within a seismically active region of Central California. Historical records indicate that the area has been subject to various seismic events over the last 183 years (PG&E, 1988). A summary of Magnitude 2 and greater seismic events recorded from 1933 through May 2012 by the Council of the National Seismic System (CNSS) is presented on Plate 6. The map shows data from recorded and historical earthquakes. Within the past 100 years the region has been impacted by various earthquakes of M5.0 or greater. The regional seismicity is mainly controlled by tectonic movements occurring between the San Andreas Fault that is mapped along the easterly border of San Luis Obispo County, and offshore faults mainly associated with the Hosgri Fault zone. A series of predominantly northwest trending faults of various lengths and types between the two major fault zones have generated earthquakes ranging in magnitude from about 5.0 to 6.5.

A relatively recent earthquake significant to the region was the M6.5 2003 San Simeon Earthquake that occurred approximately 25 miles north of the site. The earthquake caused

damage in the coastal areas of the county and near Paso Robles. Liquefaction and lateral spreading was observed along the shorelines of Los Osos and Baywood Park following the earthquake (Fugro 2004). A ShakeMap for the site developed by the California Integrated Seismic Network (CISN 2003) shows that the project site likely experienced moderate ground motion during the earthquake. The peak horizontal ground acceleration at the project site estimated from the ShakeMap was likely about 0.15g.

4.1.2 Faulting

The site is not within a designated Earthquake Fault Zone based on State mapping (California Geologic Survey 2007) and review of the USGS Quaternary Fault mapping (2013). The closest mapped fault to the site is the Los Osos Fault. A portion of the Los Osos fault zone is zoned under the Alquist-Priolo Earthquake Fault Zoning Act. The zoned portion of the fault is mapped near the intersection of Foothill and Los Osos Valley Roads, approximately 5 miles east of the site. The fault generally follows the trend of Los Osos Valley Road and at its closest point is mapped as a series of fault splays essentially on Los Osos Valley Road approximately 1,500 feet south of the site. The main trace of the fault is mapped along the base of the Irish Hills, approximately 1 mile south of the site. Based on the mapping, the potential for fault rupture at the site is considered low, and no special mitigation or setback from active faults is recommended for this project to address fault rupture hazards.

4.1.3 Site-Specific Ground Motions

A site-specific seismic hazard analysis was performed in accordance with Chapter 21 of ASCE 7-05 for use with the California Building Code (CBC 2010). The peak ground acceleration was estimated for a 2 percent probability of occurrence in 50 years using the USGS 2008 online deaggregation tool and adjusted in accordance with Chapter 21 of ASCE 7-05. The input to developing response spectra is based on an estimation of the maximum considered earthquake (MCE). The MCE is defined by comparing a probabilistic MCE, deterministic MCE and lower boundary spectral ordinate values. The soil profile was approximated to have an average site shear wave velocity of 310 meters per second for the upper 100 feet.

Probabilistic Ground Motions. Probabilistic seismic hazard parameters were estimated using the USGS 2008 Interactive website. The USGS website provides probabilistic estimations of seismic hazards using three-dimensional earthquake sources. MCE-modified spectral accelerations were estimated as having a 2 percent chance of being exceeded in 50 years, or a return period of about 2,475 years. The estimated peak ground acceleration for the site was approximately 0.55g, likely generated from a M6.8 earthquake on the Los Osos Fault. The probabilistic MCE spectral accelerations are calculated using equally-weighted averages of three (3) attenuation relationships: Boore and Atkinson (2008), Campbell and Bozorgnia (2008), and Chiou and Youngs (2008).

Deterministic Ground Motions. Based on a deterministic comparison of faults within the project vicinity, the Los Osos fault has the potential to generate the highest spectral accelerations at the site. The median deterministic spectrum was estimated for a maximum

magnitude M7.0 earthquake occurring on the Los Osos Fault. The deterministic spectrum was calculated using the same equally-weighted averages of attenuation relationships mentioned above and Abrahamson and Silva (2008). In accordance with ASCE (2005) and CBC 2010, 150 percent of the deterministic spectrum was compared to a deterministic lower limit, and the greater spectral accelerations are included in the deterministic MCE spectrum.

Site-Specific Design Response Spectra. The site-specific design response spectrum corresponds to 2/3 of the estimated MCE spectrum in accordance with the CBC 2010 (Chapter 21 of ASCE 7-05). The spectra on Plate 7b were scaled using the procedure recommended by Abrahamson et al. (2003). Empirical attenuation relationships allow for the estimation of response spectral ordinates for periods up to 10 seconds. For tank design, spectral ordinates have been extrapolated to higher sloshing periods of up to 15 seconds. The spectral values beyond a 10 second period were extrapolated assuming constant spectral displacement. The site-specific MCE design response spectrum described in this report takes into account the variation of near-surface stratigraphy at the project site. Therefore, the spectrum is applicable directly at the foundation level.

4.2 LIQUEFACTION AND SEISMIC SETTLEMENT

Liquefaction is a loss of soil strength due to a rapid increase in pore water pressures due to cyclic loading during a seismic event. Procedures used to evaluate liquefaction hazards are described in the 1997 NCEER guidelines (Youd and Idriss, 2001). Liquefaction commonly occurs in loose to medium dense sandy soil that is below the groundwater table at the time of an earthquake. The potential and severity of liquefaction will depend on the intensity and duration of the strong ground motion. Seismically induced settlement can occur in association with liquefaction and in soils not prone to liquefaction which are loose or medium dense and weakly cemented. Settlement, lateral spread, collapse, and loss of bearing support are common manifestations of liquefaction. Predominant geologic units at the site are stiff to hard clay (Qal_1 and Qal_2) and dense to very dense sand (Qal_3). Occasional blow counts suggesting medium dense soils were encountered at various depths below the groundwater table, but the blow counts were discounted for liquefaction analyses and occurred when the borehole hole “sanded in” because of disturbance caused by the auguring. The site soils are generally not considered prone to liquefaction or seismic settlement because the soils are either cohesive clay soils or are dense and not considered vulnerable to liquefaction.

4.3 SLOPE STABILITY

Slope stability analyses were performed as a basis for providing recommendations for Segmental Masonry Unit (SMU) walls using the computer program SLIDE (Rocscience 2010). SMU walls are proposed along the exterior slopes of the recycled water storage ponds and along the northeastern slope of the plant. The walls were modeled for retaining wall heights ranging from a maximum 5.5 feet to 18 feet to estimate the minimum spacing, strength and embedment of geosynthetic reinforcements that would be needed to provide a stable wall configuration for various wall heights. The face of the walls were assumed to be interlocking masonry blocks at a batter of approximately 1h:6v.

The existing and final grades shown on Carollo (2013) plans and sketches were used to estimate ground surface profiles of the graded and natural slopes. Slope stability analyses were performed for static loading conditions. The slopes were evaluated with respect to the stability criteria discussed below. The results from the analyses are presented in Appendix E.

Criteria. Slope stability criteria were selected in accordance with County of San Luis Obispo (2005) and California Geological Survey (CGS) Guidelines for Evaluating and Mitigating Seismic Hazards (CGS 2008). For the purpose of evaluating analytical results, slopes are considered stable when the estimated factor of safety is at least 1.5 under static loading conditions. A factor of safety of 1.0 represents the theoretical boundary below which a slope is no longer stable and experiences failure. Factors of safety greater than 1.0 are theoretically stable; however, a factor of safety of at least 1.5 is typically used to define stable slope conditions in practice to help account for uncertainties associated with characterizing subsurface conditions and limitations associated with the geotechnical analyses used to evaluate slope stability.

Methods. The slope stability analyses were performed using the computer program SLIDE (Rocscience 2010). SLIDE was used to estimate factors of safety for slope stability under static and pseudostatic loading conditions. SLIDE requires the user to input the surface and subsurface profile boundaries; soil properties including unit weight (γ), friction angle (ϕ) and cohesion (c); groundwater levels; and the analysis method to be used. The following describes specific methods that were used to evaluate slope stability for the alternatives being considered for this study.

Selection of Shear Strength Parameters. Effective shear strength parameters (ϕ and c) were selected for slope stability analyses based on laboratory direct shear and consolidated undrained triaxial tests performed on driven ring and remolded samples obtained from the field exploration program. The strength of stiff clay soils (Units Qal_1 and Qal_2) were estimated from using the post-peak limiting strength estimated from direct shear tests. The strength of sandy soils (Qal_3) was estimated using the peak strength from direct shear and triaxial tests. Lower bound strength values were selected for SMU wall material and geosynthetic reinforcement (geotextile) based on a review of various manufacturers' literature. The shear strength parameters assigned to soil layers, SMU walls and geosynthetic reinforcement are shown on the slope stability plots in Appendix E.

Geosynthetic Reinforcement. Placement of geogrid reinforcement to improve slope stability was considered in the analyses. The vertical limits, strength, and lengths of geosynthetic reinforcement were specified by the user. The analyses were used to estimate the configuration of the reinforcement that was needed to provide a factor of safety of at least 1.5 for various slope heights and checked using the screening criteria for pseudostatic loads.

Groundwater Considerations. Groundwater was encountered between elevation 46 and 50 feet at the site. The groundwater surface used in the analyses was estimated based on the depth to groundwater encountered in the borings, and extending that surface to a location where springs were observed within an existing natural drainage northeast of the ponds. The groundwater table is below the depths evaluated in our slope stability analyses.

Earthquake. Pseudostatic loading was used as a screening level analysis to help evaluate whether or not a slope may be vulnerable to movement or deformation in response to earthquake loads. As discussed in this report, the design earthquake is estimated to be a M6.9 earthquake resulting in a peak ground acceleration of approximately 0.55g at the site. Horizontal pseudostatic coefficients of 0.28 and 0.21 were estimated using procedures presented in CGS (2008) for the design earthquake and threshold slope displacements of approximately 2 inches and 6 inches, respectively.

Results. The results of our slope stability analyses for generalized profiles of the proposed SMU walls are presented graphically in Appendix E. Minimum geosynthetic reinforcement parameters (lengths and tensile strengths) for various slope heights are based on wall configurations estimated to be stable under static loading conditions, with a minimum factor of safety of 1.5. The estimated factor of safety for the pseudostatic screening analysis exceeds 1, suggesting that the seismic displacement of the finished slope should not exceed 2 inches for the design earthquake. Because the strength of the compacted clay fill that will be used to construct the pond berms and buildings is less than that of the SMU wall's granular backfill considered in the analysis, the estimated length of the reinforcement was relatively long to provide stability considered static and seismic screening analyses.

The embankment slopes and those excavated in cut will likely be composed of clay soils. The clay is considered to be expansive, and graded slopes steeper than about 2.5h:1v that are not adequately vegetated or covered would likely be vulnerable to surficial instability during periods of wet weather. Landscaping and lining of the interior slope of the ponds should help to limit the potential for surficial instability and for water to infiltrate the planned 2:1 interior slopes of the ponds. Vegetation suitable for clay soils should be selected that will be relatively deep rooted and help to stabilize the exterior slopes of the pond and in other areas of the plant site as discussed in this report.

4.4 SEEPAGE EVALUATION

Seepage analyses were performed for generalized sections of the proposed recycled water storage pond divider wall and SMU walls along the pond perimeter berm with the numerical modeling program within SLIDE (Rocscience, 2010). Analyses were performed for steady-state seepage conditions corresponding to the water surface elevations provided by Carollo Engineers (2013). The plans show that the bottom of the pond is near elevation 70 feet with a surface water elevation of 83 feet. The divider wall will be founded on an 11½ -foot wide footing with a shear/cut off key beneath the footing.

The purpose of our seepage analyses was to evaluate the potential effects of foundation underseepage on the pond divider wall and perimeter berm exterior slopes if the impermeable pond liner failed and allowed leakage of pond water. We understand leakage mitigation and/or detection measures are not included in the design of the recycled water storage ponds.

Foundation underseepage refers to hydraulic flow beneath the impermeable liner as a result of the higher water level (high gradient) in the pond infiltrating the pond subgrade or

perimeter berm, and flowing beneath the divider wall or perimeter berm to a lower water level (low gradient).

Criteria. The factor of safety for underseepage is defined as the critical gradient (i_{cr}) divided by the exit gradient (i_e). The critical gradient is defined as the effective unit weight (the difference between the saturated unit weight of soil at the landside toe and the unit weight of water) divided by the unit weight of water. The exit gradient is a measure of upward seepage force defined as the difference in hydraulic head at the top and bottom of a landside soil stratum, divided by the thickness of the soil stratum. Critical seepage conditions exist when the exit gradient equals the critical gradient. If the exit gradient exceeds the critical gradient, piping of the subsurface can erode foundation materials and potentially destabilize the wall foundation or embankment.

Typical performance criteria specify that underseepage conditions are acceptable if the exit gradient is 0.5 or less, which would provide a factor of safety against underseepage-related failures of at least about 1.5 for a soil with a minimum submerged unit weight of 110 pcf. For our analysis of the pond divider wall, we considered a minimum factor of safety of about 5 or 6 to further reduce the potential for underseepage failure, as the consequences of piping could severely impact the stability of the wall foundation.

Steady-state Analyses. Steady-state seepage is defined by a stabilized water surface elevation in the pond and stabilized seepage flow paths below and through the pond subgrade or perimeter berm. As input to the seepage analyses, hydraulic conductivity values were selected based on a comparison of laboratory hydraulic conductivity test results and correlated hydraulic conductivity values estimated by the CRS testing performed for this study. Permeability values are assigned by inputting the saturated permeability in the horizontal direction and inputting the vertical to horizontal permeability ratio (k_v/k_h). Estimated k_v/k_h ratios and additional material properties are presented with the results of our seepage and stability analyses in Appendix E.

4.4.1 Results of Seepage Analyses

The results of our seepage analyses for the proposed recycled water storage pond divider wall and perimeter berm exterior slopes are presented graphically in Appendix E and discussed as follows:.

Pond Divider Wall. The analysis considered the potential for steady seepage conditions to develop beneath the divider wall that could be associated with leakage or damage to the pond liner while one side of the pond was full while the other side was drained for maintenance. The analysis considered whether or not excessive underseepage from the adjacent pond might result in localized erosion (boils or heaving) of the drained pond subgrade and destabilize the pond divider wall foundation. We estimated the factors of safety corresponding to steady state seepage conditions for the design water level in the full side of pond. Considering the recommended minimum 3-foot depth of the shear key below the pond divider wall footing, which acts as a seepage barrier, the estimated factor of safety against under seepage is at least 6 and no further mitigation for seepage below the wall is recommended.

Exterior Slope of the Perimeter Berm. The ponds will be lined which should limit the potential for seepage to develop through the berm; however, we evaluated the influence that seepage through the berm could have if the liner was damaged or significant leakage occurred. Based on the results of our seepage analysis, the perimeter berm slopes would likely be susceptible to instability if underseepage and/or steady state seepage conditions developed and could daylight on the slope through the berm. Instability of the slope from seepage could be manifested as heaving or sloughing of the slope face, or internal or localized erosion of the slope material. We have recommended that the exterior slopes be periodically observed for evidence of seepage such as: seeps, wet spots or green vegetation observed during periods of dry weather. Sustained through-seepage could lead to piping, which typically consists of tunnel-like voids that can form within undermine the stability of slope when uncontrolled seepage daylights on the face of an exterior slope. Therefore, we have recommended in the subsequent sections of this report that the liner be periodically inspected and that any liner damage observed be repaired prior to refilling the pond, in order to minimize the potential for perimeter berm slope instability.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF FINDINGS

The following is a general summary of the findings and key recommendations of this report. Detailed recommendations for the design of the improvements are provided in the sections of the report that follow.

- The site is underlain by alluvial deposits that are generally composed of a sequence of very stiff to hard clay, stiff clay, and dense to very dense sand as shown on the subsurface profiles (See Plates 4a through 4d, 5a and 5b). Twenty one (21) borings were drilled at the site to explore the subsurface conditions to depths of up to 76 feet below the ground surface. The ground surface has been disturbed by past agricultural activities at the site to depths of about 1 to 3 feet. The soils encountered within the anticipated depths of excavation are predominantly stiff to hard clay soil.
- The earthwork for the project is likely to produce considerable export, and it would typically be desired to reuse as much of the excavated on-site soil as fill and backfill material wherever it is suitable to do so. The samples of the clay that were tested were moderately to highly expansive. Expansive clay soil is generally not considered suitable for reuse as select material for pipe bedding, pipe zone material, or as backfill for retaining walls or buried structures. We have recommended that imported granular materials be used for non-expansive fill below floor slabs, within the pipe zone, and backfill for retaining walls and buried structures.
- The design of foundations and slabs will need to consider potentially expansive subgrade conditions and the use of imported granular material as fill that is non-expansive to help reduce the affects of expansive soils on foundations and slabs. The clay soils tested were only moderately improved when treated with lime. The optimum lime content was estimated to be about 5 percent, and the samples tested still exhibited some swell potential when tested in one-dimensional expansion. The

control sample swelled by approximately 10 percent when flooded with water, while the lime treated specimen swelled by approximately 1.5 percent. The lime treated soil was therefore *not* considered suitable for use as non-expansive backfill behind retaining walls or buried structures. However, the limited use of lime during construction could be used by the contractor to assist in reducing the moisture content of clay fill or subgrade soils. The use of lime by the contractor would only be to assist with compaction or stabilizing the subgrade, if necessary, and based on the soil moisture and weather conditions at the time of construction.

- Groundwater was generally encountered below el. 50 feet, at depths ranging from approximately 22 to 46 below the ground surface. The anticipated depths of excavation are generally above the groundwater levels encountered in our explorations and should not require dewatering.
- The site is located within a seismically active area and should be designed to current code standards and practices. The soils encountered at the site are not considered vulnerable to liquefaction, seismic settlement, or strength loss in response to the design earthquake and no special geotechnical recommendations to mitigate those hazards are needed for design.
- The proposed buildings and above grade structures can be supported on spread footings or mat foundations. The design of foundations, slabs and pavements will need to consider potentially expansive subgrade conditions.
- The ponds will likely also be excavated in clay, and may encounter dense silty sand below the clay in some areas. The ponds will be bottomed above the groundwater table, and the slope can be lined and designed using slope inclinations of 2h:1v or flatter as planned.
- The onsite soils can likely be excavated with typical heavy construction equipment. Excavations should be properly dewatered in advance of the excavation, and be sloped or shored per OSHA guidelines. The design of temporary slopes and shoring systems should consider the presence of existing structures and include provisions to protect existing structures that must remain in operation during construction.

5.2 SEISMIC CONSIDERATIONS

5.2.1 Seismic Data

Structures should be designed to resist the lateral forces generated by earthquake shaking in accordance with the building code and accepted design practice. This section presents seismic design parameters for use with the 2010 California Building Code (CBC) and ASCE 7-05. The site coordinates and USGS interactive web page (V3.0.1 last updated 2012-07-12) were used to obtain the seismic design criteria. The average shear wave velocity within the upper 100 feet of the site is estimated to be approximately 310 to 335 meters per second, corresponding to a Site D, Stiff Soil Site. The California Building Code proposes a building occupancy category of “III” for wastewater treatment facilities. The peak ground acceleration

was estimated for a 2 percent probability of occurrence in 50 years using the USGS 2008 online deaggregation tool.

The CBC also allows any structure to be designed considering a site-specific ground motion hazard analysis. The following presents our site-specific ground motion hazard analysis for the site. The Seismic Data estimated from the site-specific ground motion hazard analysis performed in accordance with Chapter 21 of ASCE 7-05 are generally less than the mapped parameters specified by the seismic design procedure outlined in Chapter 11 of ASCE 7-05. According to Section 11.4.7 of ASCE 7-05, the site-specific ground motion procedures set forth in Chapter 21 are permitted to be used to estimate ground motions for any structure. Therefore, the lower parameters tabulated below and adjusted in accordance with Chapter 21 may be used for any site structure in lieu of the higher parameters tabulated below and based on Chapter 11. The peak ground acceleration was estimated for a 2 percent probability of occurrence in 50 years using the USGS 2008 online deaggregation tool and adjusted in accordance with Chapter 21 of ASCE 7-05. Based on these criteria, the seismic data for use with code-based designs are:

Table 4. Seismic Data

California Building Code (2010)	Seismic Parameter	Mapped Values per Chapter 11	Site Specific Values per Chapter 21
Site Coordinates	Latitude, degrees	35.3082	35.3082
	Longitude, degrees	-120.8005	-120.8005
Section 1613.5.1 Figure 1613.5	Ss, Seismic Factor, Site Class B at 0.2 sec	1.450g	1.450g
	S_1 Seismic Factor, Site Class B at 1 sec	0.543g	0.543g
	Site Class	S_D Stiff Soil	S_D Stiff Soil
Section 1613.5.3 Table 1613.5.3(1)	Fa, Site Coefficient for Site Class	1.000	1.000
Section 1613.5.3 Table 1613.5.3(2)	Fv, Site Coefficient for Site Class	1.500	1.500
Section 1614A	S_{MS}, Site Specific Response Parameter for Site Class at 0.2 sec	1.450	1.200g
	S_{M1}, Site Specific Response Parameter for Site Class D at 1 sec	0.814	0.652g
	$S_{DS} = 2/3\ S_{MS1}$	0.967	0.800g
	$S_{D1} = 2/3\ S_{M1}$	0.543	0.434g
–	Peak Ground Acceleration (2% probability in 50 years)	0.55g	0.55g
–	Likely Magnitude (M)	6.8	6.8
ASCE-7-05 Figure 22-15	Long-Period Transition Period (T_L)	8.0 sec	8.0 sec

5.2.2 Design Response Spectra

A ground motion hazard analysis was performed to develop design response spectra for use with the 2010 California Building Code (CBC). The design response spectrum, at 5 percent damping and associated design acceleration parameters are presented on Plate 7a. The adjusted design response spectrum for damping ratios of 0.5, 2 and 5 percent is presented on Plate 7b. The design spectrum corresponds to 2/3 of the estimated MCE in accordance with the 2010 CBC (Chapter 21 of ASCE 7-05). Empirical attenuation relationships such as the one developed by Abrahamson and Silva (2008) allow for the estimation of response spectral ordinates for periods up to 10 seconds For tank design, spectral ordinates are extrapolated to higher sloshing periods of up to 15 seconds. The spectral values beyond a 10 second period were extrapolated assuming constant spectral displacement.

5.3 GRADING - GENERAL

Fill placement and grading operations should be performed according to the grading recommendations of this report. We recommend that, unless otherwise noted, fill and backfill materials be compacted to at least 90 percent relative compaction, as determined by the latest approved edition of ASTM Test Method D1557, unless a higher degree of compaction is otherwise recommended. Fill and backfill materials placed in pavement areas should be compacted to at least 95 percent relative compaction. Cut and fill slopes, if needed, should be graded to inclinations of 2h:1v or flatter.

5.3.1 Suggested Material Specifications

The following materials are referenced in various sections of this report. Additional recommendations for placement of trench backfill materials, and other components of the project, are presented in the sections that follow.

Aggregate Base (AB) shall be Class 2 conforming to Section 26-1.02A, "Class 2 Aggregate Base," of the Standard Specifications. Class 3 aggregate base that incorporates reclaimed material can be used as aggregate base, provided the Class 3 material meets the gradation and quality requirements for the Class 2 material.

Asphalt concrete (AC) shall be Type A conforming to Section 39, “Asphalt Concrete,” of the Standard Specifications. Asphalt binder shall be grade PG 64-10.

Capillary break beneath the vapor barrier shall consist of clean, angular, crushed gravel conforming to ASTM C33, Grade 67.

Coarse Sand (placed below floor slabs) shall consist of imported material conforming to ASTM C-33 fine aggregate, and have no more than 3 percent of the material passing the U.S. Standard No. 200 sieve.

Compacted fill material (general) shall consist of imported or on-site material free of organics, oversize rock (greater than 3 inches), trash, debris, corrosive, and other deleterious materials. Imported fill shall be reviewed by the geotechnical engineer prior to being brought to

the site; however, imported fill materials shall comply with all specifications for the material as placed at the site. Fill materials shall comply with all specified material requirements for the area where the material is being placed. Imported fill materials placed in building areas shall have an Expansion Index of less than 20. Fill material placed within 3 feet of finished grade in pavement areas shall meet the design R-value for that area.

Subgrade stabilization material shall consist of 1-½ inch by ¾ inch crushed rock conforming to Caltrans Section 90-1.02C (4) (b), Coarse Aggregate Grading.

Drainage material shall conform to Caltrans Standard Specifications for Class 2 permeable material, Section 68-2.02F. ASTM C-33 No. 8 coarse aggregate (pea gravel) can be used in lieu of Class 2 permeable material provided the materials are enclosed in a filter fabric. As an alternative, prefabricated geocomposite drainage panels can be placed behind retaining walls as recommended in this report.

Geogrid Reinforcement used for reinforcing Segmental Masonry Unit (SMU) walls shall provide at least the minimum strength and be anchored to the block facing in a manner that will not reduce the strength of the reinforcement material. Reinforcement shall have at least the long term design strength (LTDS) shown on the plans in the machine direction as determined by the Geosynthetic Research Institute Test Method GG4 and required by the plans. Geogrid shall be a regular network of integrally connected polymer tensile elements with aperture geometry sufficient to permit significant mechanical interlock with the surrounding soil. Geogrid shall obtain pullout resistance from the soil by a combination of shearing on the plane surfaces parallel to the direction of shearing and soil bearing on transverse grid surfaces normal to the direction of grid movement.

Geogrid shall meet the following requirements:

1. Geogrid shall have an open area between 50 and 90 percent.

2. At the long term design strength in the machine direction, the maximum strain shall not exceed 5 percent.

3. Geogrid shall be resistant to naturally occurring alkaline and acidic soil conditions and to attack by bacteria.

4. Geogrid shall be stabilized with at least 1 percent carbon black to be resistant to the effects of long-term exposure to ultra-violet rays.

Geosynthetic Reinforced Slope (GRS) Backfill shall consist of imported material that is free of organics, oversized rocks (greater than 3 inches) trash, debris, corrosive and other deleterious material. Imported fill shall be reviewed by the geotechnical engineer prior to being brought to the site; however, imported fill materials shall comply with all specifications for material placed at the site. On-site soil or imported materials to be used as the compacted fill shall be non-expansive soil have at least 75 percent material passing the U.S. Standard No. 4 sieve, no more than 5 percent passing the U.S. Standard No. 200 sieve.

Geotextile for separation (filter fabric) shall consist of geotextile that conforms to the requirements outlined in the Caltrans Standard Specifications for Filter Fabric-underdrains, Section 88-1.02B, Class C.

Geotextile for subgrade stabilization shall conform to the requirements outlined in Caltrans Standard Specifications for Rock Slope Protection Fabric, Section 88-1.02I, Class 8.

Geocomposite drain shall consist of a manufactured plastic core not less than ¼-inch thick with both sides covered with a layer of filter fabric that will provide a continuous drainage void in the horizontal and vertical directions. Geocomposite drain placed behind retaining walls shall have an impermeable backing. Geocomposite drain to be embedded in the ground shall be double-sided with filter fabric covering both sides of the drainage void.

The drain shall produce a flow rate through the drainage void of at least 10 gallons per minute per foot of width at a hydraulic gradient of 1.0 under a maximum externally applied pressure of 2,000 psf. The core materials and filter fabric shall be capable of maintaining the drainage void for the entire height of the geocomposite drain. Filter fabric shall be integrally bonded to the core materials with the drainage void. Core material manufactured from impermeable plastic sheets having non-connecting corrugations shall not be permitted.

The fabric shall overlap a minimum of 6 inches at all joints and wrap around the exterior edges of the drain a minimum of 6 inches beyond the edge. If additional fabric is needed to provide overlaps at joints and to wrap around the edges of core material, the added fabric shall overlap the fabric on the geocomposite drain at least 6 inches and be attached thereto.

Should the fabric on the geocomposite drain be torn or punctured: 1) the damaged section shall be replaced completely if damage is done to the core material, or 2) if the core material is not damaged than the repair can be performed by placing a piece of fabric that is large enough to cover the damaged area and provide a 1-foot overlap.

Non-expansive fill shall consist of imported granular material conforming to Caltrans Standard Specifications for Structure Backfill, Section 19-3.02B, having a sand equivalent greater than 20 and an expansion index of 0.

Pipe zone material shall consist of imported soil having a sand equivalent (SE per ASTM 2419) of at least 30 and conforming to Section 19-3.02E (2), Sand Bedding, of the Caltrans Standard Specifications.

Pipe bedding material shall consist of imported material having a sand equivalent of at least 30, and conforming to Section 19-3.02E (2), Sand Bedding, of the Caltrans Standard Specifications.

Pipe bedding material - gravel for trench bottom stabilization shall consist of material conforming to ASTM C33 No. 8 Coarse Aggregate (pea gravel) or any one of the gradings per Caltrans Section 90-1.02C (4) (b), Coarse Aggregate Grading.

Retaining wall backfill material shall consist of either imported material conforming to Caltrans Standard Specifications for Structure Backfill, Section 19-3.02B or approved onsite sandy soil having a sand equivalent greater than 20.

Trench backfill shall consist of compacted fill or material conforming to the material requirement for the area where the trench backfill is placed. If not otherwise specified, Trench Backfill shall meet the requirements for Compacted Fill.

Vapor Barrier installation procedures, including over-laps, seams, and sealing at penetrations or service openings, shall conform to ASTM E 1643-98, modified as appropriate based on written recommendations from the vapor barrier manufacturer. Vapor barrier shall conform to Class A material per Table 1 of ASTM E 1745-97 with the following modifications:

- The permeability rating per ASTM E 96 shall be no greater than 0.01 perms; and
- The puncture resistance per ASTM 1709 shall be no less than 2,400 grams.

A sample specification is available from http://www.stegoindustries.com/specifications, for the Option 3 Vapor Barrier (non-proprietary) case.

5.3.2 Use of On-site Soils

Soils encountered within the anticipated depth of excavation for the proposed structures were mainly classified as lean to fat clay (CL/CH) with varying amounts of sand and gravel. The clay is considered to be highly expansive and will be sensitive to changes in moisture content and be difficult to compact. The site also became muddy and slick during periods of rainfall in December 2012. The on-site clay can be used as general compacted fill provided any structures or improvements supported on the fill are designed with consideration for expansive soil conditions. The moisture content of the soil encountered within the depths of excavation was variable, but was commonly above the optimum needed for compaction. Processing or drying of the material could be needed to dry the soil to a moisture content suitable for compaction.

5.3.3 Use of Soils Excavated from Los Osos Collection System Project

The Fugro (2004b, 2011) studies for the design of the collection system encountered predominantly dune sand deposits composed mostly of silty sand and sand that are likely suitable for use as imported granular soil. Soils classified as silty sand, sand and sand with silt (SM, SP, SP-SM) would likely be considered suitable for use as retaining wall backfill, backfill for below grade structures, and non-expansive fill below floor slabs as described in this report. Imported soils should meet the requirements for the area where the material is being placed, and should be tested for conformance with the project specifications as they are delivered to the project site during construction. The contractor should be responsible for segregating the soils from unsuitable soil, processing of the material to make it suitable for compaction, and importing material to the site that complies with the specified requirements for the material being placed.

5.3.4 Clearing and Grubbing

Prior to commencing grading operations in building, roadway, and other improvement areas, soil containing debris, organics, pavement, uncompacted fill, or other unsuitable materials, should be removed. Demolition areas should be cleared of old foundations, slabs, buried pipes, abandoned utilities, and soils disturbed during the demolition process. Depressions or disturbed areas left from the removal of such material should be replaced with compacted fill.

5.3.5 Fill Placement

Fill derived from on-site clay soils is likely to be highly expansive. Fill should be placed and compacted to at least the minimum relative compaction recommended in this report. The moisture content of the fill should be suitable to achieve the recommended compaction and generally be compacted at approximately 2 percent above the optimum. Each layer should be spread evenly and should be thoroughly blade-mixed during the spreading to provide relative uniformity of material within each layer. Jetting and ponding of water to assist with compaction should not be permitted for fill placement. Soft or yielding materials should be removed and be replaced with properly compacted fill material prior to placing the next layer.

Scattered gravel and rocks are common within the near surface soil. Rock, cobble and other oversized material, greater than 3 inches in diameter, should be removed from the fill material being placed. Rocks should not be nested and voids should be filled with compacted material.

When the moisture content of the fill material is below that sufficient to achieve the recommended compaction, water should be added to the fill. While water is being added, the fill should be bladed and mixed to provide relatively uniform moisture content throughout the material. When the moisture content of the fill material is excessive, the fill material should be aerated by blading or other methods to dry the material to a moisture content suitable for compaction. Grading work could begin in the potentially wet winter months, and drying soils by disking and aerating can be difficult in the Los Osos vicinity due to coastal fog that commonly occurs in the summer months. Adding lime to the soil to reduce the moisture of the soil to make it suitable for compaction may be necessary if the soil cannot be dried due to weather or fog conditions. If used, the contractor should submit a description of their work plan for using lime for review. The work plan should include the type and manufacturer of the lime to be used, storage requirements, quality control procedures, and mixing and compaction requirements.

Fill should be spread in lifts that will allow the soil to be compacted to the specified compaction with the equipment being used, generally no thicker than approximately 8 inches prior to being compacted. Fill and backfill materials may need to be placed in thinner lifts to achieve the recommended compaction with the equipment being used.

A summary of our recommended grading for fill placed on sloping ground is shown on Plate 8. Where fill materials are to be placed on slopes steeper than 5h:1v, the fill should be keyed and benched into the slope. The base of the fill should initiate from a base key at the toe

of the slope. The base key should be excavated at least 3 feet below the existing ground surface or into relatively stiff material. The width of the base key should be at least 10 feet and be sloped at 2 percent into the hillside. Any loose or disturbed material should be removed prior to placing the fill. Excavation above the base key should be performed such that at least the upper 3 feet of the existing soil is removed and the fill is keyed into firm material beyond the limits of the excavation. Subsequent benches should be keyed into stiff subgrade soil beyond the limits of the excavation. Excavated soil that is suitable for use as fill can be incorporated into the compacted fill as the excavation and fill placement progresses.

5.3.6 Compaction

Fill placement and grading operations should be performed according to the grading recommendations of this report. Relative compaction should be assessed based on the latest approved edition of ASTM D1557. Gravel, crushed rock, and drainage materials that cannot be tested per ASTM D1557 should be compacted with at least 4 coverages with a vibratory plate or by track walking with construction equipment for each 2 feet of material that is placed. We recommend that fill material placed in various locations be compacted to the minimum relative compaction presented in the following table:

Table 5. Recommended Relative Compaction

Location	Recommended Minimum Relative Compaction
General	90 % U.O.N.
Utility trench bedding and pipe zone, and backfill materials	90 % U.O.N.
Backfill in non-pavement areas	90 % U.O.N.
Fill or backfill placed within 3 feet of finished grade in pavement areas	95 %
Asphalt concrete, aggregate base or subbase	95 %
Untreated on-site soil placed in building and foundation areas and areas within 5 feet horizontally of the building or structure footprint	90 %
Lime treated subgrade below pavement or slab-on-grade	95 %
Retaining wall, buried tank, clarifier, basin, or basement backfill	90% U.O.N.

U.O.N. = unless otherwise noted

5.4 SITE PREPARATION AND GRADING

5.4.1 Treatment Plant Site Mass Grading and Building Areas

A summary of our recommendations for the mass grading of the treatment plant, building areas and above grade structures is presented on Plate 9. The existing soil encountered within the plant site generally consisted of clay soil that is moderately to highly expansive. It appears that the ground surface has been disturbed by past agricultural activities to depths of approximately 1 to 3 feet. The proposed plant construction will consist of various buildings, access roads, pump stations, and treatment facilities that will be constructed on compacted fill

placed over gently sloping ground. We recommend that the site be mass graded to provide uniform support for structures, piping and roadways. The larger structures (oxidation ditches, vaults, and pump stations) extending more than about 5 feet below existing site grades can be addressed separately and should not control the depth of removal and excavation limits for the overall mass grading of the plant site.

Prior to placing fill, the site should be cleared and grubbed and the existing soil should be removed to a depth of at least 3 feet below existing site grades. The excavation should remove the disturbed soil and expose stiff to hard clay subgrade soil. The horizontal limits of the excavation should include any areas to receive fill and extend at least 5 feet outside the footprint of any structures. The bottom of the excavation should be deepened where needed to provide at least 1 foot of compacted fill below any structure foundations The subgrade and existing channels should then be prepared according to the following sections of this report. Compacted fill can then be placed to finished grades according to the recommendations of this report. The upper 2 feet of the fill below interior floor slabs and the exterior perimeter slab/walkway should consist of non-expansive granular fill conforming to the recommendations of this report. The exterior perimeter footing should extend below the mat of non-expansive fill.

Existing Drainage Channels. Special grading should be performed to address the northeast trending drainages that currently pass through the proposed treatment plant and pond sites. The drainages are incised channels that deepen to the north with steep and eroded banks. The drainages should be excavated to remove any loose, unstable or eroded soil from the channel. The excavation should extend to at least 1 foot below the bottom of the existing channel, and the side slopes of the drainage should be excavated back to 4h:1v or flatter. A summary of our grading recommendations for building and above grade structures is presented on Plate 10.

Subgrade Preparation and Fill Placement. Once the excavation is complete, the bottom of the excavation should be scarified to a depth of 9 inches, moisture conditioned, and compacted in-place to at least the recommended compaction. Soils encountered near the finished subgrade were at a moisture content in excess of the optimum moisture at some drill hole locations. When the moisture content of the subgrade is excessive, the subgrade should be ripped, plowed, disked or otherwise aerated to dry the subgrade to lower the moisture content of the subgrade prior to compaction. Because no springs or groundwater appear to be present at the anticipated depths of excavation, the soil exposed at the bottom of the excavation should be conducive to drying.

If the work is done during the wet season or when there is extensive coastal fog, the contractor may elect to use lime stabilization of the subgrade to assist in reducing the moisture content of the soil to achieve compaction. The contractor should provide a submittal describing their proposed excavation plan, the proposed lime content, application and mixing procedures to control the soil moisture content prior to beginning work. The lime content of the subgrade when used in association with moisture control should not exceed 5 percent of the dry weight of the soil being treated. Once compaction of the subgrade is complete, fill materials can then be placed to finished grade according to the recommendations of this report.

5.4.2 Below Grade Structures

Below grade structures are those structures that will bear more than 5 feet below the existing ground surface or below the anticipated depths of excavation for the mass grading. A summary of our grading recommendations for below grade structures is presented on Plate 11. In general, below grade structures can be supported on a mat of aggregate base placed on the undisturbed subgrade material. The subgrade for below grade structures should be excavated with backhoe type equipment to reduce the potential for disturbance to the subgrade, and vehicles and rubber tired equipment should not be allowed to operate on the subgrade. Backfill material for below grade structures will consist of imported granular backfill conforming to the recommendations of this report.

At least 6 inches of aggregate base should then be spread over the subgrade in a single lift, and be compacted to 90 percent relative compaction. The aggregate base is intended to protect the subgrade from excessive drying and shrinkage once exposed, provide a working mat for construction. If construction traffic (i.e. concrete trucks) will operate on the subgrade the contractor may need to provide additional gravel, steel plates, reinforce the base with geogrid to provide additional support for construction vehicles.

The oxidation ditches are likely to straddle both the mass graded area along the north side of the structure, the existing drainage that passes through the middle of the treatment plant site, and extend up to 14 feet below existing grade at other locations. The excavation for the oxidation ditches should include the minimum depths of removal discussed above for the mass grading. The subgrade for the oxidation ditch structure may therefore consist of a combination of undisturbed subgrade soils and compacted fill. A mat of at least 12 inches of aggregate base should be provided beneath the structure and be placed either on the undisturbed subgrade or compacted fill material where the base of the structure is above the depth of the excavation needed for the mass grading. The foundation support for the oxidation ditches will likely be non-uniform as result of the proposed grading, the proposed layout of the plant, and the orientation of the natural drainage that passes beneath the structure location. The foundation support conditions for the structure are further discussed in the foundation design sections of this report.

5.4.3 Site Retaining Walls

Retaining walls, such as proposed at the outlet structures for the ponds should be supported on a mat of compacted fill. A detail summarizing our grading and backfill recommendations for retaining wall areas is presented on Plate 12. The existing soil should be removed to at least 1 foot below the wall footing or 3 feet below the existing ground surface, whichever is deeper. Once the excavation is completed, the bottom of the excavation should be scarified to a depth of 9 inches, moisture conditioned, and compacted in-place to at least the recommended compaction. Compacted fill and backfill can then be placed according to the recommendations of this report.

5.4.4 Pond 1 and 2 Divider Wall

The footing for the divider wall between Ponds 1 and 2 should be supported on undisturbed clay alluvium. If desired, sand-cement slurry (a mud mat) can be placed on the undisturbed subgrade at the bottom of the footing excavation to provide a working mat for construction of the footing. The north and south ends of the wall are planned as stepped-footings bearing level below the 2h:1v fill and cut slopes on the pond interior. Site preparation and excavation beyond the proposed depths and widths of the stepped footings is not recommended. Foundation material, which is anticipated to consist of expansive clayey alluvium and fill, should be protected from water infiltration during and after construction.

5.4.5 Subgrade Conditions and Variations

The geotechnical engineer should review the bottom of all excavations prior to placing fill materials to evaluate whether or not loose or unsuitable materials have been removed, and that the base of the excavation is suitable for placing compacted fill. The project specifications should provide for review of the excavation by the geotechnical engineer, and for increasing the depth of the excavation to remove additional loose soil or other unsuitable materials.

5.5 FOUNDATION DESIGN

5.5.1 Spread Footings

The proposed structures can be supported on spread footing foundations bearing in compacted fill materials prepared in accordance with the recommendations of this report. Spread footings should be designed using a maximum allowable bearing pressure of 2,500 pounds per square foot. Continuous footings should be designed with a width of at least 1 foot. Isolated pad footings should be designed with a least dimension of 1.5 feet. Spread footings should be embedded at least 2.5 feet below the lowest adjacent exterior grade or 1.5 feet below the finished slab elevation, whichever is deeper. The maximum allowable bearing pressure may be increased by 250 pounds per square foot for each additional foot of embedment or width above the recommended minimums to a maximum of 3,500 psf. The allowable bearing pressure is recommended for footings on level ground or where the footing is setback at least 10 feet horizontally from the face of an adjacent slope.

The maximum allowable bearing pressure can be increased by one-third when considering short-term wind or seismic loads. For retaining wall or eccentrically loaded footings, the toe pressure can exceed the recommended maximum allowable bearing pressure provided the resultant force acts within the middle third of the footing.

The grading and foundations recommendations presented in are intended to reduce the impact of expansive soils on foundations; however, those impacts cannot be eliminated and the design should consider the potential for differential movements as discussed in this report (Section 5.5.3). Foundations should be reinforced to anticipate highly expansive soil conditions. Reinforcing of foundations should be designed by the structural engineer based on loading conditions.

5.5.2 Mat Foundation Design

Mat foundations can be designed using the subgrade modulii presented in the table below. The modulus of subgrade reaction was estimated from settlement analysis of a mat foundation or structurally loaded slab having an average contact pressure of no more than 2,000 psf. The contact pressure at the bottom of the mat foundation should be estimated relative to the existing ground surface and include any increases resulting from fill being placed adjacent to the structure.

The existing and final overburden pressure at the bottom of the mat can be estimated using a soil unit weight of 125 pcf. The use of the overburden pressure to estimate the change in pressure at the bottom of the mat foundation is particularly important for the oxidation ditches where the northern-middle portion of the new ditch will be founded near or above existing site grades and the east, west and south ends of the ditch will be founded up to about 14 feet below existing site grades. We expect that the foundation support and resulting settlement of the mat will be differential because of the variable ground surface profile across the footprint of the new ditches. The estimated settlement of the oxidation ditches is discussed in more detail in the following section.

Mat foundations can be designed using modulus of subgrade reaction values as shown in the following table:

Table 6. Modulus of Subgrade Reaction Values

Structure	Modulus of Subgrade Reaction (lb/in^3)
Oxidation ditches where bottom of ditch is less than 5 feet below existing grade	11
Secondary Clarifiers or Pump Station Vaults embedded to at least 12 feet below finished pad	20
Structural slabs or equipment mats with thickened edges (such as UV disinfection, Odor Control or Tertiary Filters)	15

5.5.3 Settlement Considerations

Treatment Plant and Building Areas. Foundations and flat work will be prone to settlement and heaving due to the presence of expansive soils. The design of foundations should generally consider the potential for differential movement (up or down) resulting from static foundation loads to be approximately 1-inch total and approximately 1/2-inch differential in 30 feet for foundation elements designed according to the recommendations of this report.

As discussed in the previous section of this report, the foundation support for the oxidation ditches will be particularly non-uniform because the bottom of the structure will range from near or above existing site grades to 14 feet below existing site grades. We estimate that the total settlement of the ditches at the maximum contact pressure of 2,000 psf would range from approximately ½ to 1-1/2 inches between the ends of the ditches and the north-center wall

of the ditch. The maximum angular distortion associated with the estimated differential settlement of the foundation soils is approximately ¾ inches in about 30 feet. If the foundation can be designed to tolerate the estimated distortion, no further mitigation for settlement is recommended. The factors that will influence the amount of settlement are the ground conditions, the net change in stress applied by the structure and adjacent fill relative to existing grade and overburden pressures, the stiffness of the foundation, and the sequence of construction.

The recommended modulus values presented in the previous section of this report can be used to check the differential movement of the foundation associated with changes in the contact pressure below the mat, the adjacent overburden stress, and localized load conditions on the mat while considering the stiffness of the structure. The predominantly clay soil encountered below the foundation level is moderately compressible, but is unsaturated and should consolidate relatively rapidly in response to foundation loads. If the estimated settlement or differential movement of the mat is considered excessive, Fugro should provide additional recommendations to modify the foundation support or provide surcharge recommendations to help limit the estimated settlement.

Perimeter Berm. We estimate that the total settlement of the perimeter berm at the maximum height of 16 feet will be approximately 2 inches, and the estimated angular distortion associated with differential settlement would be approximately 1 inch in about 30 feet. As, noted above, the predominantly clay soil encountered below the foundation level is moderately compressible, but is unsaturated and should consolidate relatively rapidly in response to foundation loads. Preloading the soil by constructing the berm first and then excavating for the perimeter wall footings after the initial placement of the fill would help to limit the potential for differential settlement to impact the pond divider wall.

5.5.4 Resistance to Lateral Loads

Resistance to lateral loading can be provided by sliding friction acting on the base of spread footings or slabs combined with passive pressure acting on the sides of foundations or grade beams. The values assume that the foundations will be embedded in a compacted clay subgrade. We recommend that a coefficient of friction of 0.27 be used to estimate the sliding resistance along the bottoms of footings or slabs bearing in compacted soil. We recommend that a net passive resistance of 275 pcf, equivalent fluid weight, plus a uniform pressure of 400 psf be used to estimate the lateral resistance acting on the sides of footings or grade beams above the groundwater table. The passive resistance is recommended for footings on level ground or where the top of the footing is setback at least 10 feet horizontally from the face of an adjacent slope.

Where foundations will be located below water, a net passive resistance of 140 pcf, equivalent fluid weight, plus the same uniform pressure of 400 psf can used to estimate the lateral resistance acting on the sides of footings or grade beams. Passive resistance should not be used for the upper one foot of soil that is not constrained at the ground surface by slab-on-grade or pavement. A one-third increase in the passive value can be used when considering short-term wind or seismic loads.

5.5.5 Resistance to Uplift Loads

As discussed in Section 3.3 of this report, groundwater has been encountered below el. 50 feet at the site. Structures within the plant are generally expected to be above the groundwater table. Emptying a tank structure reduces its total mass and decreases its ability to withstand buoyant forces acting upward on the tank. The design of below grade structures whose foundations may extend into soils below the groundwater table or flood levels should consider buoyant forces that may act upward on the structure and cause uplift. Pressure relief valves can also be installed in the walls of below grade structures to help reduce uplift forces.

If needed, uplift forces due to buoyancy can be resisted by the buoyant dead weight of the structure and by friction acting between the exterior walls of the structure and the surrounding soil. The maximum allowable frictional resistance between the soil and the buried concrete structure can be estimated as 0.2 times the effective overburden stress. The effective overburden stress, in psf, can be estimated using an effective buoyant unit weight of 60 pcf for submerged soil times the depth in feet. If filter fabric will be placed between the wall backfill and the ground in close proximity to the structure, the uplift resistance due to friction should be neglected.

5.6 DESIGN OF RETAINING AND BURIED WALLS

Retaining walls and the walls of buried structures should be designed to resist lateral earth pressures considering the backfill, drainage and wall loading conditions. Foundations for retaining walls should be designed according to the recommendations of this report and be supported on compacted fill prepared according to the recommendations of this report. A summary of grading recommendations for retaining walls is presented on Plate12. Based on discussions with Carollo, the on-site clay soil is not considered suitable for use as retaining wall backfill because the material is potentially expansive, the wall would need to be designed for relatively high earth pressures, and the clay backfill would be more prone to post-construction settlement behind the structure. Backfill material for retaining walls and below grade structures should therefore consist of well-drained Retaining Wall Backfill material conforming to the suggested material specifications of this report. The recommended backfill material should be granular and free draining, and an outlet or weepholes should be provided such that water does not have potential to accumulate within the backfill. We recommend the following equivalent fluid weights for use in estimating the lateral earth pressures that will act on the retaining wall for level backslope conditions behind the wall:

Table 7. Lateral Earth Pressures for Retaining Walls with Imported Sand Backfill

Wall Loading Condition	Wall and Backfill Drainage Condition	Wall Backfill Material	Lateral Earth Pressure Condition	Equivalent Fluid Weight (pcf)
Unbraced cantilever wall with level backslope and wall is free to rotate	Drained	Imported, free draining, granular soil	Active	35

Wall Loading Condition	Wall and Backfill Drainage Condition	Wall Backfill Material	Lateral Earth Pressure Condition	Equivalent Fluid Weight (pcf)
Unbraced: Undrained with level backslope and wall is free to rotate	Undrained	Imported, free draining, granular soil	Active	80
Braced: Drained with level backslope and wall is not free to rotate	Drained	Imported, free draining, granular soil	At-rest	60
Braced: Undrained with level backslope and wall is not free to rotate	Undrained	Imported, free draining, granular soil	At-Rest	90

Surcharges. The recommended equivalent fluid weights for retaining walls and buried structures do not account for surcharge loads acting on the backfill. The surcharge from foundation loads can be neglected provided adjacent footings are setback behind a 1h:1v line projected upward from the base of the wall. The lateral earth pressure from uniform surcharge loads can be estimated as 0.3 times the stress being applied at the ground surface. Traffic surcharges can be estimated as an additional 2 feet of soil cover, equal to a uniform pressure of 72 pounds per square foot. Fugro should provide additional recommendations if foundation loads act within the 1h:1v line or other surcharges to retaining walls are anticipated.

Wall Drainage. For drained backfill conditions, drainage should be provided behind retaining walls to reduce the potential for the buildup of hydrostatic pressures. Retaining Wall Backfill Material should be placed between the wall and a 1h:1v backslope projected up from the heel of the retaining wall footing or edge of buried structures.

Walls designed for drained loading conditions should be designed with collector pipes to assist in the removal of water from the backfill, and to prevent the buildup of hydrostatic pressures behind the wall. A continuous layer of granular drainage material consisting of either 1-foot of Drainage Material or Geocomposite Drain panels should be provided along the backside of walls. The drainage material should be terminated 2 feet below the finished grade of the wall backfill, and be topped with on-site soil. Alternatively, where access roads or walkways are to be constructed behind the wall, the structural section can be placed directly over the retaining wall backfill material. Retaining Wall Backfill and Drainage Materials should conform to the materials recommendations of this report.

5.6.1 Dynamic Earth Pressures

Dynamic earth pressures were estimated based on current seismic loading criteria using a reduction factor of 0.5 and the estimated peak horizontal ground acceleration of 0.55g. The seismic increment of active earth pressure for non-braced walls that are free to rotate can be approximated as a uniform pressure of 15H (lateral pressure in pounds per square foot and the wall height (H) in feet). Active earth pressure conditions can be assumed where the top of the wall can rotate at least 0.001 times the wall height, H. The dynamic increment should be increased to 20H for non-yielding walls. If submerged backfill conditions are anticipated, Fugro should provide additional recommendations for dynamic water pressures.

5.7 POND DIVIDER WALL DESIGN

Footings for the proposed divider wall foundation should be supported on undisturbed stiff to hard clay alluvium along the majority of the wall length and compacted fill at the north end of the wall. A detail summarizing our grading recommendations for the divider wall foundation is presented on Plate 13 – Summary of Grading Recommendations for Pond Divider Wall.

The footing should be at least 3 feet wide and be embedded to at least 1.5 feet below the bottom of the pond. The "shear key" for the divider wall should be embedded to a minimum depth of 3 feet below the bottom of the footing to provide cutoff for seepage. The footing can be design using a maximum allowable bearing pressure of 2,500 psf. The bearing pressure can be increased by one-third when considering seismic or other transient loads. The footing can be designed to resist lateral loads according to the recommendations presented in Section 5.5.4 of this report.

The allowable bearing pressure is recommended for footings on level ground or where footings are setback at least 10 feet horizontally from the face of an adjacent slope. The wall footing should be stepped where the footings will be constructed on the slopes of the pond. The bottom of the footing should be level and be deepened (to about 5 feet below finished grade) as needed to provide at least a 10-foot horizontal setback between the bottom edge of the footing and the face of the interior slope of the pond

5.8 SEGMENTAL MASONRY UNIT WALL DESIGN

Segmental Masonry Unit (SMU) will be used to support portions of the exterior slope of the ponds and the northern edge of the plant. Grading for the berm and treatment plant should be performed according to the site preparation and grading recommendations of this report. A typical detail summarizing our recommendations for the design for geosynthetic reinforced SMU walls is presented on Plate14 – Geosynthetic Reinforced Segmental Masonry Unit Walls. The SMU wall should consist of a facing composed of interlocking stacked masonry block, granular backfill, geogrid reinforcing within the backfill, and provisions for drainage. Plate 14 provides our recommended reinforcing for wall heights ranging from 5.5 to 18 feet, and a wall face designed to an inclination of 1h:6v.

Submittal Requirements. Prior to delivering materials for the SMU wall to the site, the contractor should provide a submittal for the wall detailing their work for the construction, the types of materials that will be used, and supporting data needed to show compliance with the specifications and recommendations of this report. Proprietary wall systems that have been reviewed by the ICC for conformance with the building code may be submitted as an equivalent wall system, and should be reviewed by the design engineer and the geotechnical professional prior to being accepted for the project. Proprietary wall systems should provide similar means of retention of the earth slope, and satisfy slope stability requirements discussed in this report.

Foundation Support. The base of SMU Wall and facing should be embedded a minimum of 2 feet below finished grade at the base of the wall. The bottom front edge of the wall should be setback at least 5 feet horizontally from the face of the adjacent exterior slope of

the pond and any natural descending slope. The base of the excavation should consist of compacted fill placed in accordance with the recommendations of this report. If the base of the wall is founded below the base of the fill, the subgrade should be scarified to a depth of 9 inches, moisture conditioned, and compacted in-place to at least 90 percent relative compaction. Prior to placing the geogrid, the geotechnical professional should review the subgrade and soil conditions exposed by construction to evaluate whether or not they appear suitable for placement of fill and reinforcement. A layer of compacted drainage material conforming to the Suggested Material Specifications of this report should then be placed over the compacted material.

The design of the temporary slope is the responsibility of the contractor. However, we recommend that the temporary slope behind the geosynthetic reinforced slope be constructed no steeper than 1h:1v to allow for placement of the geogrid and granular backfill. The contractor should evaluate and design a suitable inclination for the temporary slope with consideration of the construction and worker safety in accordance with OSHA and other applicable requirements.

Drainage. A layer of drainage material should be placed below the wall as shown on Plate 14. The purpose of the drain is to reduce the potential for water to accumulate within the SMU wall backfill and provide an outlet for any water that is collected. A perforated collector pipe should be placed at the base of the drainage material. Where open graded gravel is used as drainage material, the gravel should be fully encased in a filter fabric. The drain should outlet to a solid pipe. The pipe should discharge beyond the slope face. Splash blocks or rock should be provided at the pipe outlet to protect against erosion. Drainage materials should conform to the Suggested Material Specifications in this report.

Facing Elements: SMU block for the facing should have sufficient interlocking strength, shear pins, or a keyway that can resist a lateral earth pressure of at least 200 psf. The lateral earth pressure should be applied between the vertical spacing of the reinforcements. The blocks should be stackable and provide a finished wall face that is at least 1h:6v or steeper. The block for the facing should be placed level. A 6-inch layer of sand or gravel can be placed below the facing to serve as a leveling pad for the block. Where open-graded gravel is used for the leveling pad, a filter fabric should be placed between the gravel and any soil or wall backfill. Geosynthetic reinforcement should be placed within the wall backfill and connected to the SMU wall facing in accordance with the manufacturer's specifications, and provide a connection with strength that is equal to or exceeds the strength of the reinforcement itself.

SMU Wall Backfill. Fill for construction of the geosynthetic reinforced SMU wall should consist of imported granular backfill complying with the GRS Backfill recommended in the Suggested Materials Specifications of this report. Fill material should be placed according to the recommendations of this report and be compacted to at least 90 percent relative compaction, except where placed in roadway or foundation areas where the upper 3 feet of the fill should be compacted to at least 95 percent compaction. During placement and compaction of the backfill material, at least 6-inches of fill, measured vertically, should be maintained between the geosynthetic reinforcement and construction equipment. Equipment or vehicles should not be permitted to operate or drive directly on the geosynthetic reinforcement, unless

specifically permitted with supporting data supplied by the manufacturer. The contractor should submit the materials and methods to be used for construction of the SMU wall for review by the geotechnical professional in advance of construction.

Geosynthetic Reinforcement. Geosynthetic reinforcement should consist of geogrid material conforming to the strength and material requirements recommended in the Suggest Materials Specifications of this report. The length and spacing of the reinforcement for the various wall heights considered was estimated from slope stability analyses as discussed in Section 4.3 of this report. The reinforcement should be placed level within the backfill, and to the minimum vertical intervals and embedment lengths shown on Plate 14 for the wall height being considered. The geogrid layout should be selected for the maximum wall height along the wall. The same geogrid material, spacing and layout should then be used throughout the length of the wall regardless of the wall height.

Reinforcement Placement. The first layer of reinforcement should be placed on the compacted subgrade below the wall. Subsequent reinforcements should be placed as the fill placement progresses at intervals not exceeding the allowable vertical spacing shown on Plate 14. Geosynthetic reinforcement should be placed level. Reinforcement should be laid such that the working tensile strength of the material is oriented perpendicular to the finished face of the SMU wall. The geogrid should be laid level, smooth and without wrinkles. Spliced and sewn joints should not be used in the direction of the working tensile stress, unless it is demonstrated that the connection meets the same strength requirements for long-term design strength as the intact reinforcement material.

5.9 SLAB-ON-GRADE

Concrete slab-on-grade in building areas should be supported on compacted fill prepared according to the grading recommendations of this report (Section 5.4) and material conforming to the Suggested Material Specifications of this report (Section 5.3.1). The soils encountered in building areas include clay soil having a high potential for expansion. We recommend that the upper 12 inches of the subgrade be compacted to at least 90 percent relative compaction below walkways and other minor flat work that will not be subject to vehicle traffic. Concrete pavements should be designed according to the recommendations of Section 5.10.2 of this report.

Recommendations for the design of slab-on-grade or slab-on-ground construction are presented below for use with ACI 302.2R-06, “Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials,” published in 2006. The performance of flooring is complicated as described by ACI and depends on many factors including sub-slab relative humidity, concrete materials and water-cement ratio, internal relative humidity, and construction aspects, such as curing, length of drying, environmental conditions, pH, etc. Our recommendations are not intended to resolve every issue regarding moisture vapor penetration through on-grade concrete slabs. The architect and design engineer should review ACI 302.2R-06 for background on moisture vapor penetration through concrete slabs and issues regarding protection from delamination of flooring, blistering, staining, mold growth and other problems related to performance of moisture-sensitive flooring. Since 1999, water-based flooring adhesives have

replaced solvent-based adhesives because of restrictions by the EPA, which has lead to an increase in moisture-related problems.

Slab Design Considerations. The thickness of floor slabs not subject to vehicle traffic should be designed by the structural engineer and have a thickness of at least 4 inches. Slab reinforcement, control and expansion joints should be provided as needed to control shrinkage and slab cracking in accordance with ACI, Portland Cement Association, or other applicable design guidelines. The structural engineer should provide steel reinforcement requirements for the floor slab; however, we recommend that floor slabs be reinforced with at least No. 3 rebar spaced at no more than 18 inches each way and above the mid-depth of the slab. The contractor should provide means to maintain the location of reinforcement during construction and concrete placement. The architect and design engineer should select the desired concrete properties based on the concrete slab-on-grade performance requirements.

Vapor Barrier. A vapor barrier should be provided below interior floor slabs, especially those with coverings. The barrier is intended to reduce vapor moisture migration from the subgrade up through the slab. The vapor barrier for rough, unfinished concrete floors can be omitted when permitted by the architect or design engineer. Vapor barrier material can be placed directly on capillary break material. Vapor barrier should conform to the Suggested Material Specifications of this report.

Granular Fill Above Vapor Barrier. ACI 302.2R-06 (2006) presents advantages and disadvantages for placement of a granular fill cushion/protection layer above the vapor barrier. Issues include cushion disturbance during reinforcement placement and construction activities, concrete slab performance during curing (e.g., curling and shrinkage), and the cushion layer providing a source of moisture, as well as other factors described in ACI 302.2R-06 (see Figure 7.1 for guidance). If used, granular fill placed above the vapor barrier should be between 2 and 3 inches thick and conform to the suggested materials specifications of this report for Coarse Sand (placed below floor slabs). The material should have enough moisture to be compactable and easy to trim, but still dry enough at the time of concrete placement to act as a blotter. The material should be proof-rolled or compacted with a vibratory plate such that construction equipment can pass over the material without undue disturbance.

Capillary Break below Vapor Barrier. The capillary break, beneath the vapor barrier, should consist of 4 inches of material conforming to the Suggested Material Specifications of this report and be placed on compacted fill prepared according to the recommendations of this report. The gravel should be lightly vibrated with three to four passes of a base-plate compactor or smooth-wheel vibratory roller.

Exterior Flatwork. Exterior concrete flatwork and slab-on-grade (such as walk ways and patios) should be at least 4 inches thick. Flatwork can be underlain with at least 4 inches of aggregate base to help limit erosion and mud-jacking from beneath joints or edges in the slab. Expansion joints, control joints and/or reinforcement of slabs should be provided according to ACI, Portland Cement Association or other applicable design standards to control cracking.

Mold. Mold can occur in buildings and is a concern for owners and occupants. The growth and development of mold in buildings can be nurtured by moisture either from sources inside or outside the structure. Assessment of mold development potential is beyond the scope of geotechnical services for this study. The recommendations presented herein are not intended to mitigate mold potential and will not eliminate the risk of future mold problems, unless by coincidence.

5.10 PAVEMENT DESIGN

Structural sections were estimated for asphalt concrete and Portland cement concrete pavements based on an R-value of 5 for the subgrade soils encountered at the site and a range of traffic indices (TI) up to 8. Fill placement and grading should be performed according to recommendations of this report. In general, the upper 12 inches of the subgrade in pavement areas should be compacted to at least 95 percent relative compaction. Where pavement is constructed on fill, the upper 3 feet of the fill as-measured below finished grade should be compacted to at least 95 percent relative compaction. Where wet or yielding subgrade conditions are encountered, the subgrade should be stabilized to a firm and unyielding condition prior to placing aggregate base.

5.10.1 Asphalt Concrete Pavements

The following structural section thicknesses for asphalt concrete pavements were estimated using methods presented in the Caltrans Highway Design Manual. Structural section recommendations for flexible 2-layer pavements, asphalt concrete (AC) over aggregate base (AB) are provided in the table below.

Table 8. Asphalt Concrete Pavement Recommendations

Traffic Index	Structural Section Thickness on Compacted Clay Subgrade (inches)
≤5	3” AC over 12”AB(1)
6	3” AC over 14”AB
7	4” AC over 16” AB
8	5” AC over 18” AB
1. At least 12 inches of AB is recommended for potentially expansive subgrade	

Maintenance of asphalt concrete pavements should consist of periodic fog or slurry seals to reduce the potential for weathering. Deflection surveys can be performed to evaluate the structural capacity of pavements and the need for future overlays.

5.10.2 Portland Cement Concrete Pavements

The following structural sections for Portland cement concrete pavements were estimated using the Portland Cement Association (PCA) design method. The thicknesses were estimated for 3,000-psi strength Portland cement concrete and for various levels of the average daily truck traffic (ADTT). Portland cement concrete pavements should be designed with control joints, expansion joints, and load transfer provisions in according to PCA or other applicable guidelines.

Table 9. Portland Cement Concrete Pavement Recommendations

ADTT	Structural Section Thickness on Compacted Clay Subgrade (inches)
≤ 10	6.5" PCC over 6" AB
≤ 100	7" PCC over 6" AB
≤ 500	7.5" PCC over 6" AB

5.11 POND DESIGN

5.11.1 Site Preparation Grading for Ponds

Perimeter Berm. The new ponds will be constructed predominantly below the existing site grade with a perimeter berm extending up to about 16 feet above existing site grades. The interior and exterior slopes of the berm should be designed to 2h:1v or flatter. Prior to placing fill for the berm, the existing soil should be removed to at least 3 feet below the existing ground surface over the entire footprint of the berm. The geotechnical engineer should review the subgrade and excavation limits prior to placing fill to evaluate whether or not there are zones of loose soil or other unsuitable material present below the berm or if additional excavation is needed.

Once the excavation is completed, the bottom of the excavation should be scarified to a depth of 9 inches, moisture conditioned, and compacted in-place to at least 90 percent relative compaction. Compacted fill can then be placed to finished grades according to the recommendations of this report. The fill should be placed beyond the finished grade of the berm and then be cut back to reveal compacted soil at the slope face. Particular care should be taken during fill placement that the limits of the compacted fill is placed beyond the catch point between the fill for the perimeter berm and the lower portion of the berm slope that will be made in cut. A summary of our grading recommendations for the perimeter berm slopes is presented on Plate 15.

Interior and Cut Slope. Below the fill, the pond slopes can be excavated in cut and should be excavated to 2h:1v or flatter. The cut will likely be in stiff to hard clay; however, layers of clayey sand, angular clasts of gravel, and sandy clay were also commonly

encountered in the drill holes. Care should taken that the cut portion of the slope is graded smoothly to finished grade during the initial cut to reduce the need to further grade or place fill on the slope. The surface of the cut should then be compacted and graded as-needed to provide a smooth surface to place the liner. Large or angular rocks protruding from the slope face should be removed and filled with sand. Smaller rocks, less than about 2 inches, can be rammed into the subgrade and covered with soil. The slope surface should be smooth, without abrupt changes in grade, windrows, pockets, or depression that could adversely impact the pond liner. The slope face should be protected from desiccation or rutting, and be compacted to at least 90 percent relative compaction.

During removal of the existing materials, the bottom of the excavation should be reviewed by the geotechnical engineer to evaluate whether or not there are zones of loose soil or other unsuitable material present below the existing ponds. If zones of loose, disturbed or other unsuitable materials are encountered, we recommend that the zones be removed and replaced with compacted fill. The project specifications should provide for variations in the limits of existing fill, and for deeper depths of excavations and replacement with compacted fill, if needed.

The subgrade on the slope and bottom of the ponds upon which the liner will be placed should be smooth, dry and free from sharp rocks, roots, vegetation, and other foreign material. In general, the liner should be installed according to the manufacturer's recommendations. The subgrade should be raked and rolled to provide relatively uniform support for the liner. A geotextile underlayment (nonwoven geotextile having a weight of at least 8 ounces per square yard) can be provided below the liner to provide cushioning for the liner and for drainage of leakage water.

5.11.2 Monitoring of Exterior Slope

As previously discussed in this report the ponds will be lined; however, if the liner were damaged or significant leakage were to occur through liner the exterior slopes of the pond could be susceptible to instability as a result of underseepage and/or seepage daylighting on the slope. Any damage to the liner that may occur during emptying or maintenance of the pond should be repaired before refilling the pond. The exterior slopes of the pond should be periodically reviewed to check for evidence of seepage through the berm. Evidence of seepage could be manifested as seeps daylighting on the slope, areas of wet soil or green vegetation noted during periods of dry weather, or heaving, bulging or cracking of the fill slope particularly near toe of the slope of the exterior slope. Regular inspection of the perimeter berm exterior slopes for evidence of seepage or instability should be included in the operations program for the plant.

5.12 DESIGN OF UTILITY TRENCHES AND PIPELINES

5.12.1 Trench Design

Material requirements for bedding material, pipe zone material and trench backfill are described in Section 5.3.1. A typical detail for the design of the pipe trenches is shown on Plate 16.

Foundation Support. The trench bottom should be prepared to provide suitable foundation support for the pipe and compaction of the backfill. Where the bottom of the trench is relatively stable, bedding material can be placed directly on the undisturbed subgrade. Where wet or yielding soils are encountered at the bottom of the trench, subgrade stabilization with gravel bedding material should be provided prior to placing the pipe.

Dewatering (if needed) should be provided in advance of excavation. Subgrade stabilization should consist of removing the trench subgrade to 12 inches below the bottom of the trench, and replacing the material with gravel bedding conforming to the suggested materials specifications of this report. The gravel can be substituted for sand bedding material when subgrade stabilization is provided. The geotechnical professional should review the trench subgrade during construction to evaluate the foundation support conditions for the pipe and the need to stabilize the subgrade. Gravel bedding materials should be encased in a filter fabric for separation and the project specifications should allow the gravel thickness to be varied or omitted depending on the conditions encountered.

Pipe Bedding. Utility pipes should be placed on properly prepared bedding. Bedding is select fill material placed between the trench subgrade and the bottom of the pipe. At least 6 inches of bedding material should be provided below the pipe. Bedding can typically consist of sand bedding where the exposed trench subgrade is relatively firm, stable and above the groundwater table. Gravel bedding can be used in lieu of sand bedding to assist in stabilizing the subgrade, as described above.

Pipe Zone Material. Pipe zone material is select fill material placed between the top of the bedding and at least 6 inches above the top of the pipe, and to at least 12 inches beyond the spring line of the pipe. Compaction within the pipe zone should be performed such that the pipe is fully supported during compaction, and such that excessive deformation or damage to the pipe does not occur. Compaction above the spring line or top of the pipe should not be performed until the fill placed below that elevation has been properly compacted.

Trench Backfill. Trench backfill is fill material placed above the pipe zone to the finished grade or the base of other specified backfill materials (such as the pavement structural section). Trench backfill can consist of either on-site or imported fill material that complies with the recommendations of this report, and any other requirements for the area where the trench backfill is being placed.

5.12.2 Deflection of Flexible Pipes

The initial vertical deflection of flexible pipe can be estimated using the Reclamation Equation (Howard 1996). Flexible pipes are typically steel, HDPE, PVC or other material that will respond relatively elastically to loading. Pipe deflection tolerances may be set by the pipe manufacturer or by the designer with consideration for the pipe material or the type of joint between lengths of pipe. The deflection of the pipe is controlled by the weight of the soil prism above the pipe, a modulus of soil reaction that reflects the pipe backfill and in-situ soil type at the springline (E'), and the stiffness of the pipe.

The vertical (prism) load on the pipe is estimated as the soil unit weight times the depth of the backfill above the top of the pipe times the outside width of the pipe (γhB). A soil unit weight of 125 pounds per cubic foot can be used to estimate the vertical load for compacted trench backfill material.

Howard (1996, 2006) provides guidelines for estimating the modulus of soil reaction, E', for various soil types and pipe backfill conditions that can be used to estimate the initial average vertical deflection of the pipe. For the backfill recommendations presented in this report, an E' value of 1,500 psi can be used to estimate the vertical deflection of flexible pipes:

5.12.3 Load on Rigid Pipes

The load on rigid pipes can be estimated using procedures presented in the American Concrete Pipe Association (ACPA 2011) design manual for pipes in stalled in trenches. Rigid pipes are typically Reinforced Concrete (RCP) or other material having limited flexibility. The pipe should be able to support the weight of soil above the pipe. Because the cover thickness over the pipe will be low, the load on the pipe can be conservatively estimated as the prism load acting over the width of the pipe.

For use with ACPA guidelines, we estimate that the soil load on a rigid pipe in a trench with vertical sides can be estimated as 4,000 pounds per foot of pipe for a cover thickness of up to 5 feet and installed according to the recommendations of this report. The soil load on a rigid pipe in a trench with sloping sides can be estimated as 7,300 pounds per foot of pipe for a cover thickness of up to 5 feet and installed according to the recommendations of this report. The estimate loads should be increased by 500 pounds and 1,000 pounds per foot of pipe for each foot of additional cover over 5 feet for trenches with vertical and sloping sidewalls, respectively. The pipe should be able to resist the soil load with a factor of safety of at least 1.5.

5.12.4 Thrust Resistance

Where pressurized portions of the pipeline change direction abruptly, resistance to thrust forces can be provided by mobilizing frictional resistance between the pipe and surrounding soil, and by the use of a thrust block, or by a combination of the two.

We understand that pressurized pipelines could be designed to resist thrust using restrained joints in conjunction with mobilized pipeline/soil resistance. A coefficient of lateral

earth pressure, K_o, value of 0.7 can be used in conjunction with a coefficient of friction (between the pipe and granular backfill) of 0.35 for concrete pipe, mortar coated or ductile iron pipe, and 0.20 for PVC or plastic pipe. The friction should be neglected if DIP is encased with polyethylene sheeting. The recommended values assume that granular pipe zone materials will be placed adjacent to the pipe, as recommended in this report.

Thrust blocks can be designed to resist lateral forces based on the passive resistance acting on the bearing side of the block, and the estimated frictional resistance acting along the base of the block. Thrust blocks should be designed with a minimum cover of 3 feet below finish grade. The passive pressures and friction coefficient presented in the previous section of the report are considered to be applicable for the design of thrust blocks along the pipeline route.

5.13 CONSIDERATIONS FOR FOUNDATIONS AND UTILITIES

Conflicts commonly arise when utility lines or pipelines outside the structure footprint are located in close proximity to the structure. Generally, where a pipeline and backfill are located above a 1h:1v line projected downward from the outside edge of a footing there is no conflict.

The proximity of foundations and utilities in relation to one another should consider: 1) the potential for the support of the foundation to be compromised by the presence of the utility trench backfill, and 2) the potential for the foundation to exert loads on the pipeline for which the pipe is not designed. Utility and service lines extending inside the structure footprint should be placed above the bearing level of the foundation. Utility lines that penetrate the building or structure perimeter should go through a footing stem wall or grade beam. The footing should be stepped down to encase the penetration below the structure within the footing stem wall. The details of the penetration and steps should be as recommended by the structural engineer. Pipelines placed beneath hydraulic structures and tanks should be placed according to the recommendations of this report.

These considerations regarding utilities and foundations are general. Poorly compacted backfill in pipeline trenches can result in settlement or impacts to adjacent structures that would normally not occur. Gravel bedding and granular backfill materials can serve as conduits that allow groundwater to infiltrate areas where it would not normally flow. The locations of existing and new utilities relative to foundations and grading should be considered in the foundations, structural, and grading plans for the project.

5.14 CORROSION CONSIDERATIONS

Corrosivity testing was performed on selected samples obtained from the field exploration program by Cooper Testing Labs of Palo Alto, California. The results of the testing are presented in Appendix B. The corrosion tests were performed in accordance with ASTM test methods.

Saturated resistivity values ranged between 798 and 10,472 ohm-cm. pH values ranged between 6.8 and 8.2. Chloride content ranged between 4 and 141 parts per million (ppm) and soluble sulfate content was less than 11 and 106 ppm for the samples tested.

The samples tested do not represent a corrosive environment toward concrete in accordance with ACI 318. Per tables 4.2.1 and 4.3.1 in ACI 318, the sulfate and chloride content of the soil tested is considered to be negligible sulfate and chloride exposure, and no cement type restrictions are required. Type II cement can be used for concrete that will be in contact with on-site soils. The design engineer should also consider the impacts that the effluent, gases and treatment processes may have on the design of concrete structures and concrete mixes.

Most metals are subject to corrosion associated with oxidation. Metals should be designed with appropriate losses for corrosion, coatings, or cathodic protection as needed. If needed, a corrosion engineer should be consulted to provide recommendations for test points, cathodic protection or coatings that may be needed for design.

5.15 NATURALLY OCCURRING ASBESTOS

The soils encountered within the anticipated depths of excavation for the improvements generally consist of alluvial clay or sand soil deposits. Franciscan Mélange and serpentine bedrock are known to potentially contain naturally occurring asbestos (NOA), and were not encountered at the site. Excavations for the proposed structures are expected to be within the alluvial sediment. It is therefore our opinion that there is a low potential for NOA to impact the project, and that special mitigation to address NOA should not be needed.

5.16 DRAINAGE CONSIDERATIONS

Drainage should be provided such that surface water does not run over slopes or pond on pavements, slabs, or adjacent to foundations. Downspouts should be provided to collect roof drainage and direct the water to drainage pipes or areas away from the building. Concentrated flows and runoff should not be permitted to discharge on slopes. Down drains, solid pipes, or lined ditches should be provided to carry water to the base of slopes. Energy dissipation and erosion control devices should be provided at the outlet of drainage pipes and in areas of concentrated flow and runoff to reduce the potential for erosion. Landscaping and maintenance of slopes should be provided to assist vegetation to establish on slopes and reduce the potential for erosion.

Graded slopes, such as along the pond exterior will be constructed of expansive clay embankment fill. The graded slopes if left exposed without suitable vegetation will have a propensity to shrink and swell, loose strength, and become prone to surficial slope instability or erosion. Suitable vegetation should be provided on the graded slopes that will protect the slopes from erosion, and provide roots that will help to stabilize the soil to a depth of 2 to 3 feet.

The soils at the site are potentially expansive. Landscape improvements within the plant should consider the presence of expansive soils and include provisions to reduce the potential

for irrigation water to saturate the subgrade or infiltrate below pavement or structural improvements. Planters should be equipped with subdrain systems to collect any excess irrigation water and to direct the collected water to a suitable location for disposal.

5.17 CONSTRUCTION CONSIDERATIONS

5.17.1 Excavation

Soils encountered within the anticipated depth of excavation consisted mainly of stiff to hard material with layers of clayey sand, angular gravel clasts and sandy clay. These types of soils can likely be excavated with typical heavy construction equipment in good working order. The soils and ground surface at the site will be prone to swelling and becoming soft and slick during periods of rainfall and if excessively watered as part of dust control and compaction operations.

5.17.2 Groundwater Conditions

Groundwater conditions are discussed in Section 3.3 of this report. Groundwater was generally encountered below el. 50 feet at the site. Therefore special dewatering is not expected for the construction of the plant and pond improvements. Where needed, dewatering should result in lowering the groundwater below the depth of excavation prior to beginning the excavation such that water does not seep through sidewalls of the excavation, and is sufficiently below the excavation to allow for stabilization of the subgrade and proper compaction of fill material. The contractor should be responsible for both designing and maintaining the dewatering system for construction. Gravel fully encased in a filter fabric can be placed over the base of excavations to help stabilize wet subgrade conditions and provide a working mat for construction.

A qualified registered professional should prepare the dewatering plan for the project. The dewatering plan should be submitted for review by the geotechnical professional prior to beginning excavations below the groundwater table. Dewatering facilities, such as sump pits, wells, and well points should be designed with filters such that sand and fine-grained materials are not removed from the soil during dewatering operations. Dewatering facilities should be installed prior to beginning excavation, and time should be allowed for lowering of the groundwater table before beginning excavation. Shoring systems, such as sheet piling, should be embedded adequately below the base of the excavation to cutoff groundwater and help stabilize the base of the excavation.

5.17.3 Temporary Slopes

Within the anticipated depths of excavation, the soil is anticipated to consist of predominantly stiff to hard clay with varying amounts of sand and gravel. The soils should not be considered capable of maintaining a stable vertical slope. Temporary slopes should be braced or sloped according to the requirements of OSHA. The contractor should be responsible for job site safety, and for the design of temporary slopes or shoring. Based on review of OSHA guidelines and the soil conditions encountered, temporary construction slopes will likely need to

be sloped to inclinations of 1h:1v (horizontal to vertical) or flatter for trench depths of up to 20 feet and consider Type B soil conditions. Slopes or shoring systems supporting excavations more than 20 feet deep should be designed by a qualified professional engineer. Slopes should not be considered stable if seepage can daylight on the slope or groundwater is expected within the planned depths of excavation. If excavations need to extend below the groundwater table, dewatering should be provided in advance of the excavation to avoid the potential for groundwater to daylight on the slope.

5.17.4 Shoring

Shoring systems to support temporary slopes typically consist of trench shields, sheet pilings, or braced excavations designed to support the anticipated soil conditions and depth of excavation. As discussed above, the soils encountered at the site would be classified as clay with varying amounts of sand and gravel, conforming to Type B conditions.

"Dragging a shield" is a common method of providing worker safety during trenching and pipe construction. However, unless specific provisions exist to emplace the shield tight against the sidewalls, a shield provides no support for the trench sidewalls and should not be considered as an appropriate shoring system in pavement areas or adjacent to settlement sensitive structures.

According to OSHA, the lateral earth pressure acting on trench shoring can be estimated as a uniform soil pressure plus a surcharge for traffic loading.

For the Type B soil conditions, OSHA recommends that the active earth pressure acting on trench shoring be estimated as:

σ_a = 45H + 72 psf for soil being retained above the water table

σ_a = 22H + u + 72 psf for soil being retained below the water table

where:

"σ_a" is the uniform, active earth pressure acting on the shoring, in pounds per square foot (psf) with a level backslope

"H" is the height of the soil that is being retained in feet

"u" is the water pressure that increases at 62.4z, with z = depth in feet

"72 psf" is the traffic surcharge

Excavated material should generally be stockpiled away from excavations, or the shoring systems should be designed for the additional surcharge from the stockpiled material. The stock piled materials, or other surcharges, can be assumed to not influence the design of the shoring systems where the materials are located beyond a 1h:1v line projected upward from the bottom edge of the trench.

5.17.5 Adjacent Structures and Utilities

The contractor should be responsible for the design of shoring systems such that the construction will not result in settlement or instability of adjacent structures, private property, or existing roadway improvements that will not be replaced as part of the project. In general,

surcharge loads from existing structures can be neglected if the structure is behind a 1h:1v line projected upwards from the nearest bottom edge of a shored trench excavation. If excavations are made within the zone of influence of adjacent structures or foundations, the contractor should design the slope or shoring system for the additional surcharge load.

The design of temporary slopes and shoring should also consider support of adjacent utilities and pipelines, and be constructed to prevent sloughing of trench backfill, pipe zone, and bedding materials from adjacent utilities into the new excavation. Particular attention should be made to pressurized lines that may rely on the lateral support of the ground to constrain the pipeline against movement.

6.0 CONTINUATION OF SERVICES

The geotechnical evaluation consists of an ongoing process involving the planning, design, and construction phases of the project. To provide this continued service, we recommend that the geotechnical engineer be provided the opportunity to review the project plans and specifications, and observe portions of the construction.

6.1 REVIEW OF PLANS AND SPECIFICATIONS

The geotechnical engineer should review the foundation and grading plans for the project. The purpose of the review is to evaluate if the plans and specifications were prepared in general accordance with the recommendations of this report.

6.2 GEOTECHNICAL OBSERVATION AND TESTING

Field exploration and site reconnaissance provides only a limited view of the geotechnical conditions of the site. Substantially more information will be revealed during the excavation, grading and ground improvement phases of the construction. Subsurface conditions, excavations and fill placement should be observed by the geotechnical professional during construction to evaluate if the materials encountered during construction are consistent with those assumed for this report.

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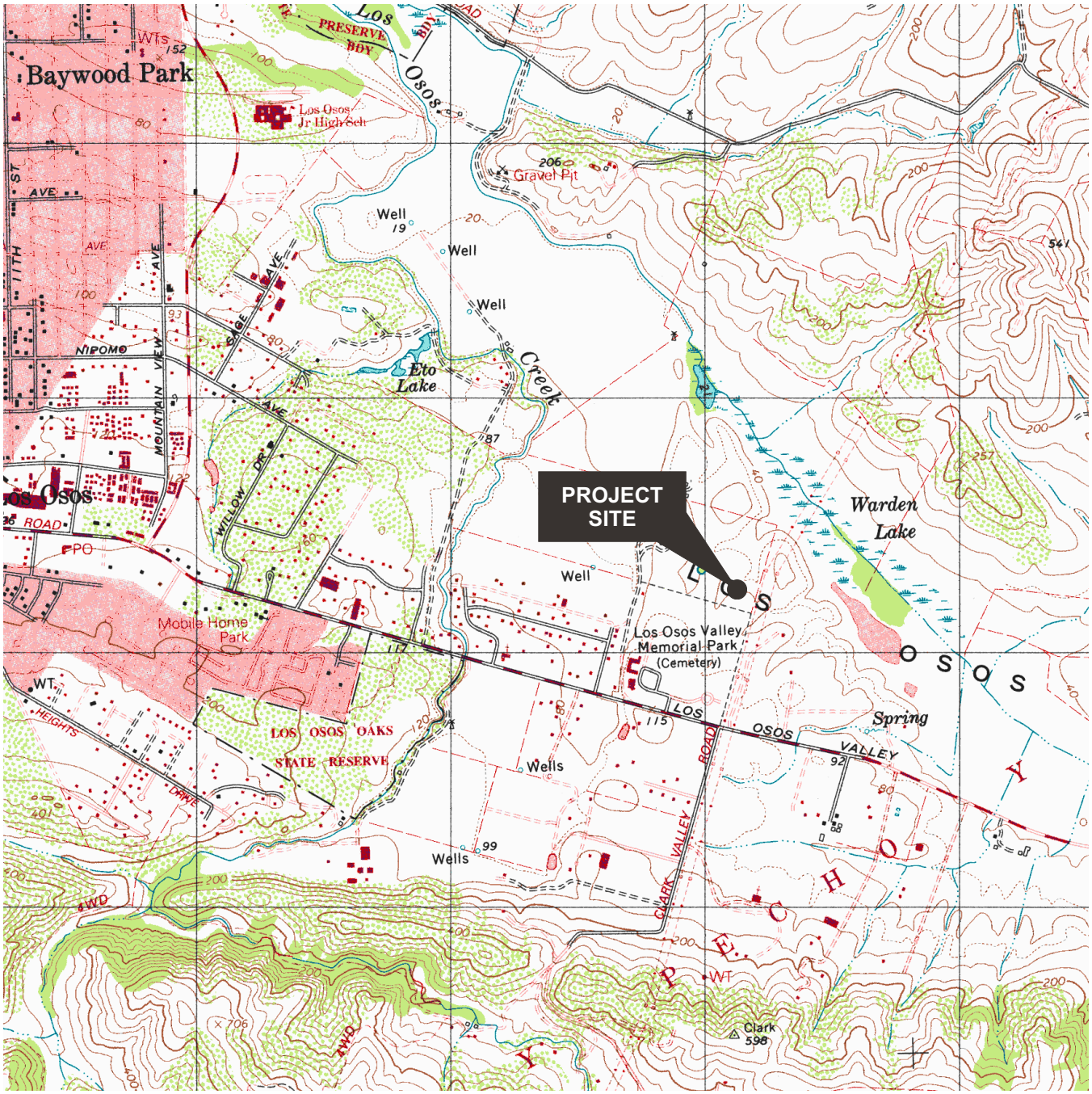
PLATES

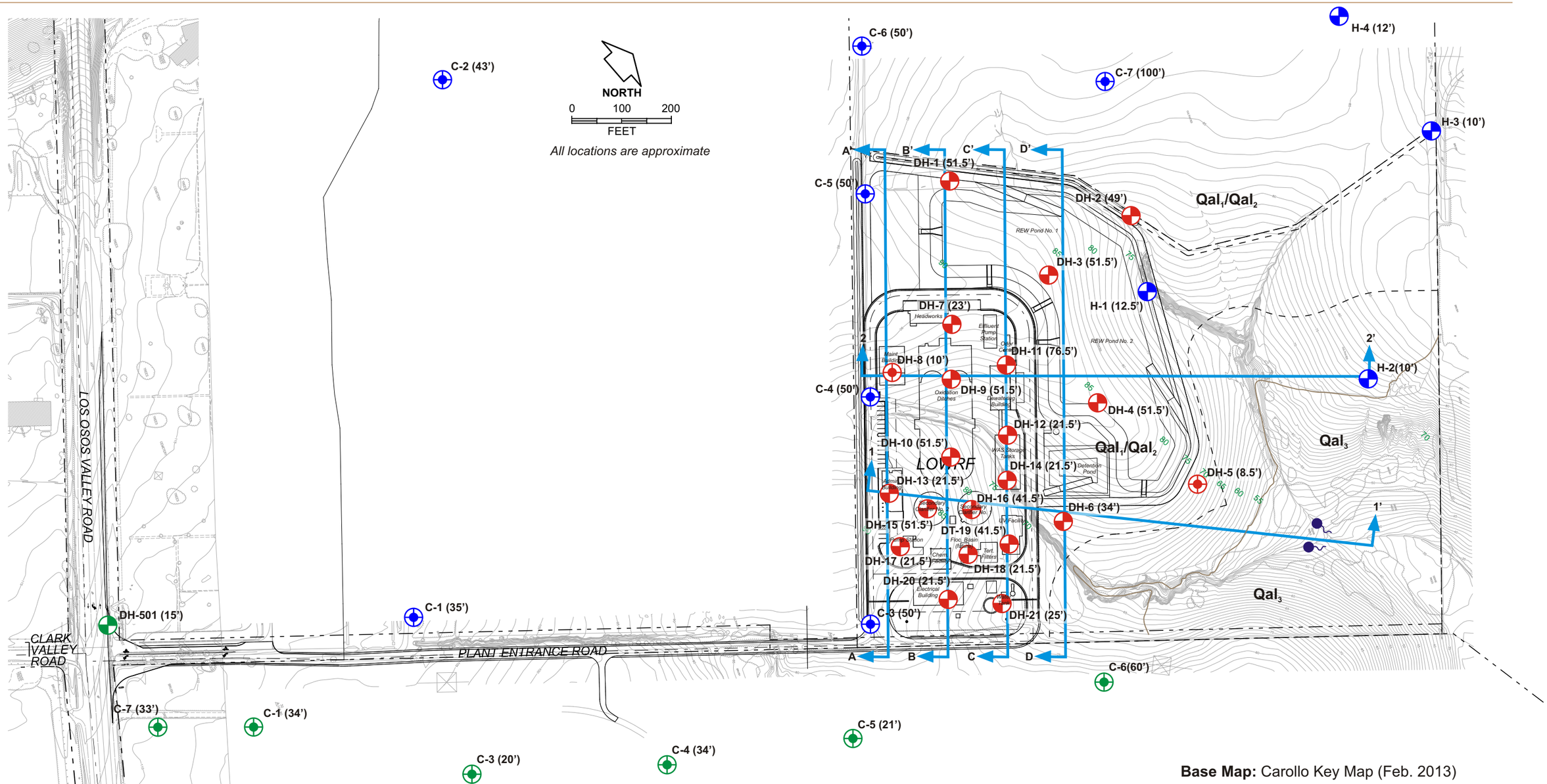


BASE MAP SOURCE: USGS 7.5' Morro Bay South 1998 Quadrangle

NORTH

0 1000 2000
FEET

VICINITY MAP
Los Osos Water Recycling Facility
San Luis Obispo County, California

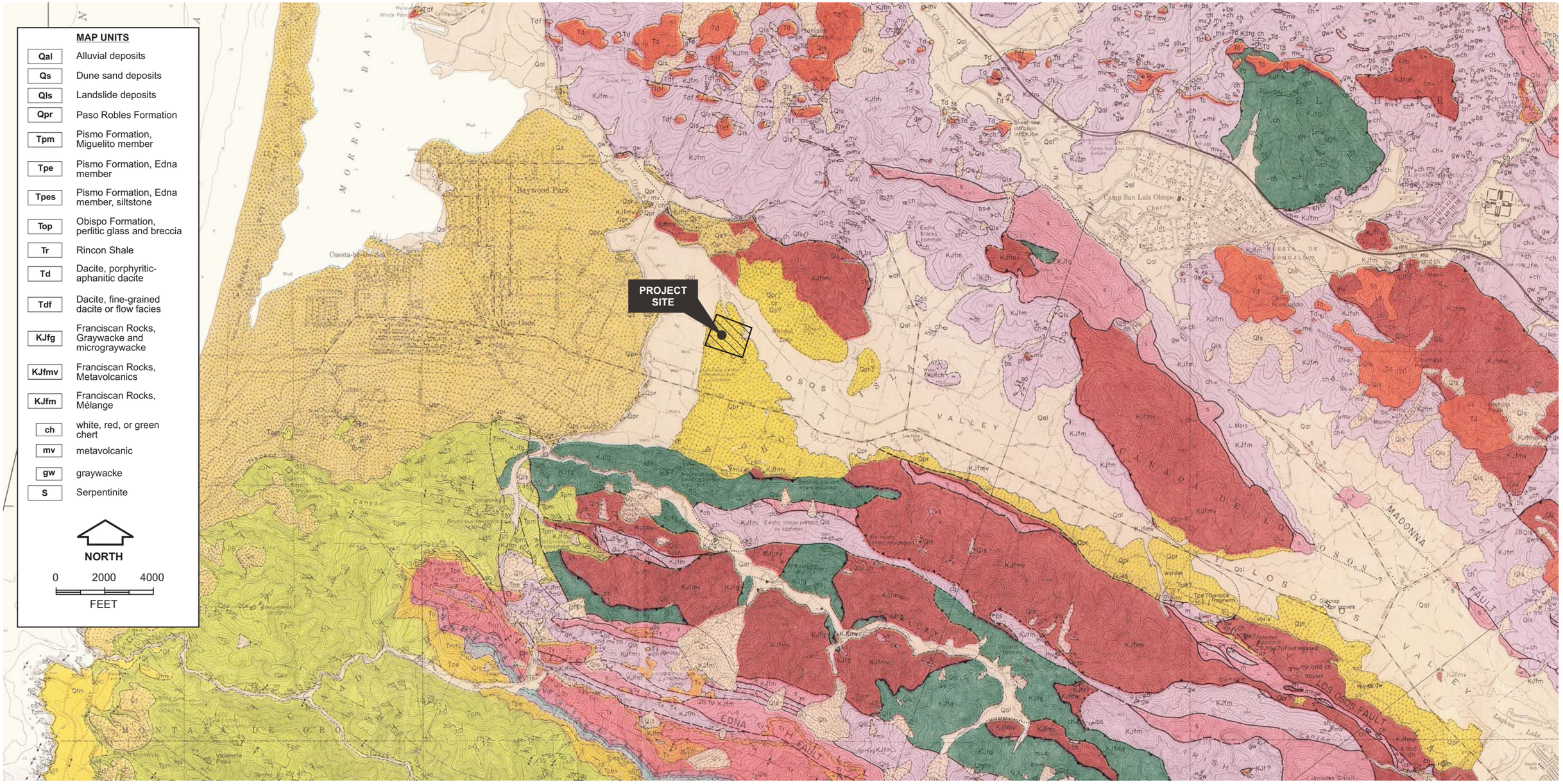


Base Map: Carollo Key Map (Feb. 2013)

LEGEND

C-1	Fugro (2007) cone penetration test (CPT) location
H-2	Fugro (2007) hand auger boring location
C-3	Fugro (2004) CPT location
DH-401	Fugro (2011) hollow stem auger boring location
DH-5	Fugro (2012) boring location with depth noted
DH-6	Fugro (2013) hand auger location with depth noted
A A'	Subsurface profile, see Plates 4a - 4d
Qal_1/Qal_2	Units of clayey Alluvium
Qal_3	Units of sandy Alluvium
	Spring observed 12/20/2012
	Contact between geologic units

FIELD EXPLORATION PLAN
Los Osos Water Recycling Facility
San Luis Obispo County, California



BASE MAP SOURCE: Geologic Map of the the San Luis Obispo-San Simeon Region, USGS Misc. Investigations Series Map I-1097, Sheet 3 of 3 (Hall, et al., 1979).

LEGEND

Contact - Dashed where approximately located or inferred; queried where doubtful; dotted where concealed

High-angle fault - Dashed where approximately located or inferred; dotted where concealed and inferred; queried where uncertain. Arrows show relative direction of movement on cross sections when known; queried where uncertain.

Thrust or reverse fault - Dashed where approximately located or inferred, dotted where concealed and inferred; queried where concealed or doubtful. Sawteeth on upper plate. Dip of fault plane between 30° and 80°

Photo lineament - Queried where uncertain

Synform - Trace of axis at surface. Dashed where approximately located. Flanks coverate downward in folds and in rocks whose stratigraphic sequence is unknown.

Antiform - Trace of axis at surface. Dashed where approximately located. Flanks diverge downward in folds and in rocks whose stratigraphic sequence is unknown.

Strike and dip of beds uncertain

Marker beds

Conglomerate or gravel bed

Sandstone

Siltstone or diatomaceous

Siltstone

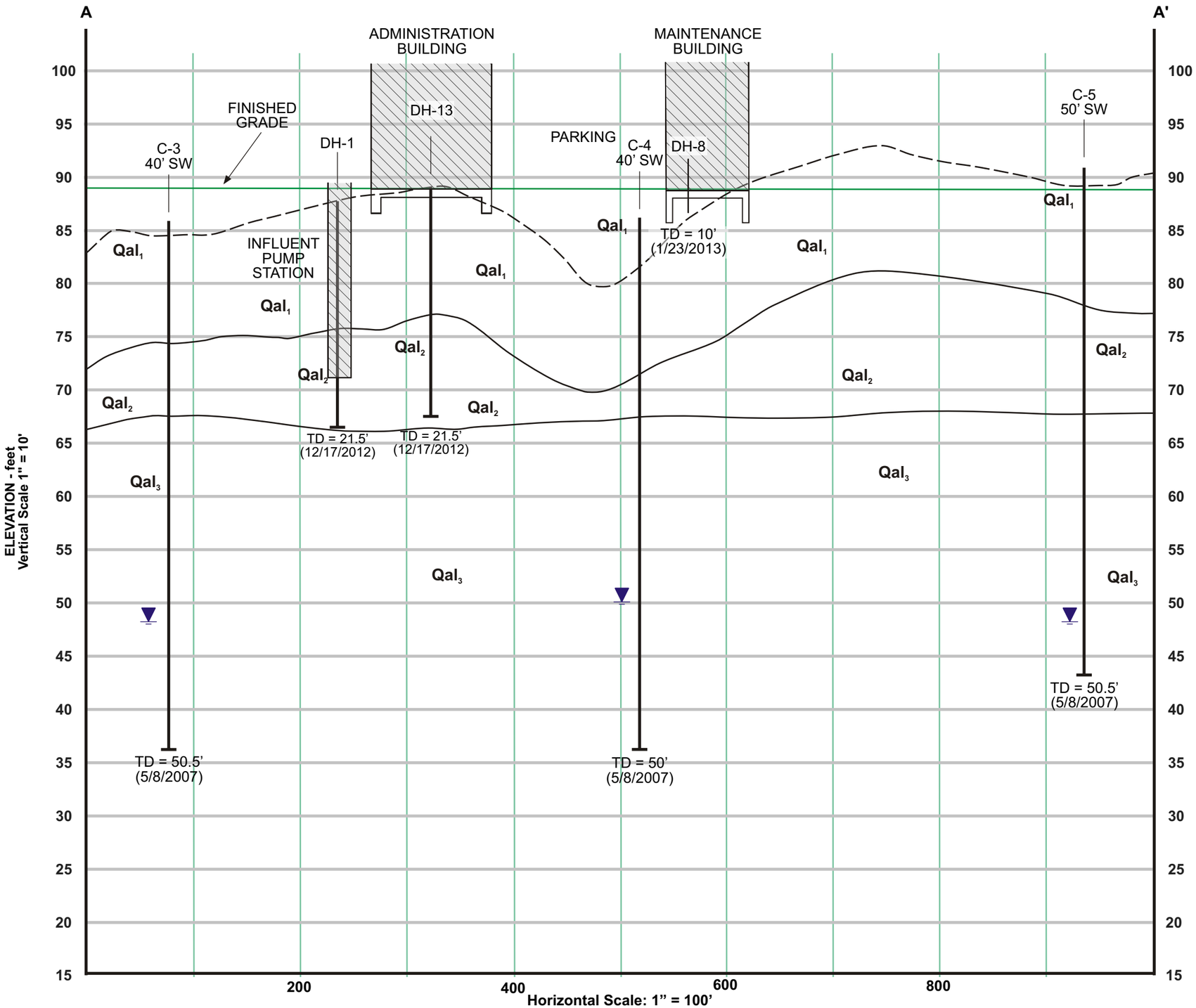
Tuff

30 Strike and dip of flow banding

x6193 Megafossil locality - U.C.L.A. locality number

Vollmer Ranch name/property owner

REGIONAL GEOLOGIC MAP
Los Osos Water Recycling Facility
San Luis Obispo County, California



LEGEND

Qal_1	Alluvium: Desiccated very stiff to hard clay
Qal_2	Alluvium: Stiff to very stiff clay
Qal_3	Alluvium: Dense to very dense silty sand

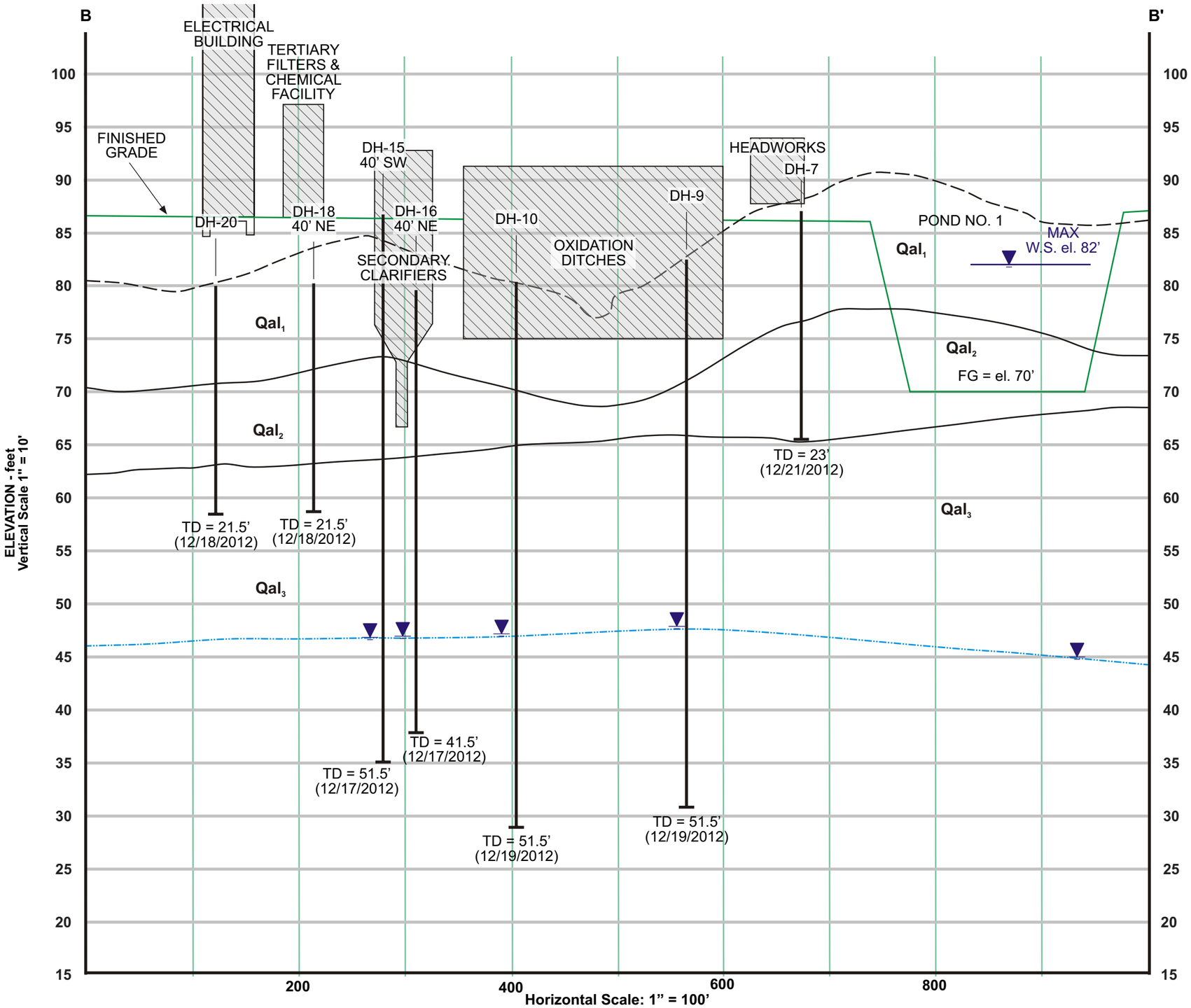
See text and logs for additional description and data concerning subsurface conditions.

— — -	Existing ground surface
———	Finished grade
———	Interpolated subsurface boundary
-·-·-	Interpreted groundwater surface
DH-1 130' SE	Boring number with offset and direction from section line when applicable
▼	Approximate groundwater elevation encountered in boring with interpreted elevation between boring location
≈	Wet soil or seepage
┴	Approximate depth interval of boring with sample blow counts (N-values) noted per Appendix A
TD = 25' (6/17/10)	Total depth and completion date of boring

Subsurface profile is interpolated between points of exploration and will vary from that shown.

All locations and information are approximate.

SUBSURFACE PROFILE A - A'
Los Osos Water Recycling Facility
San Luis Obispo County, California



LEGEND

Qal_1	Alluvium: Desiccated very stiff to hard clay
Qal_2	Alluvium: Stiff to very stiff clay
Qal_3	Alluvium: Dense to very dense silty sand

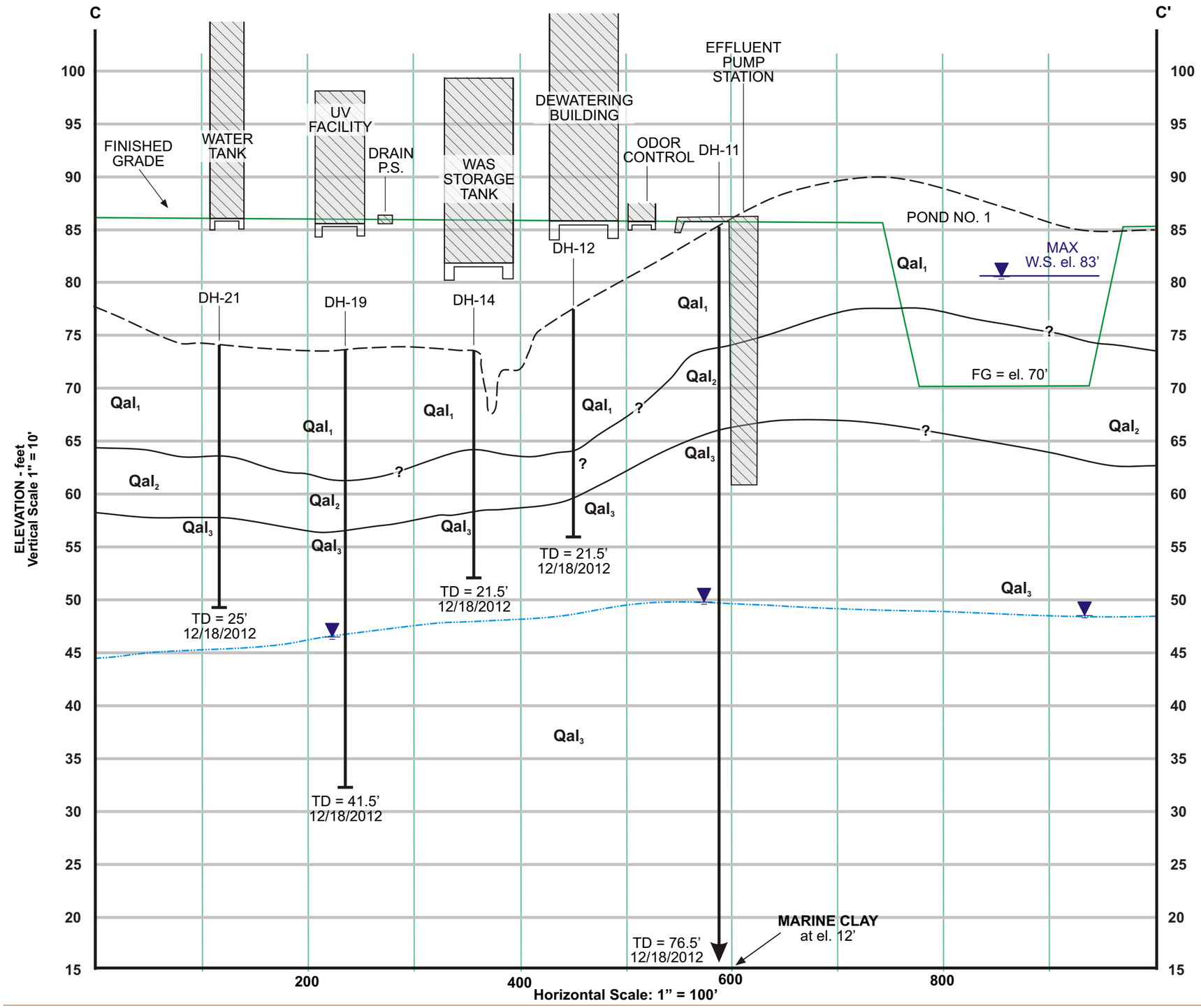
See text and logs for additional description and data concerning subsurface conditions.

— — -	Existing ground surface
———	Finished grade
———	Interpolated subsurface boundary
-·-·-	Interpreted groundwater surface
DH-1 130' SE	Boring number with offset and direction from section line when applicable
▼	Approximate groundwater elevation encountered in boring with interpreted elevation between boring location
∿	Wet soil or seepage
|	Approximate depth interval of boring with sample blow counts (N-values) noted per Appendix A
TD = 25' (6/17/10)	Total depth and completion date of boring

Subsurface profile is interpolated between points of exploration and will vary from that shown.

All locations and information are approximate.

SUBSURFACE PROFILE B - B'
Los Osos Water Recycling Facility
San Luis Obispo County, California



LEGEND

Qal_1	Alluvium: Desiccated very stiff to hard clay
Qal_2	Alluvium: Stiff to very stiff clay
Qal_3	Alluvium: Dense to very dense silty sand
Marine Clay	Very stiff blue clay

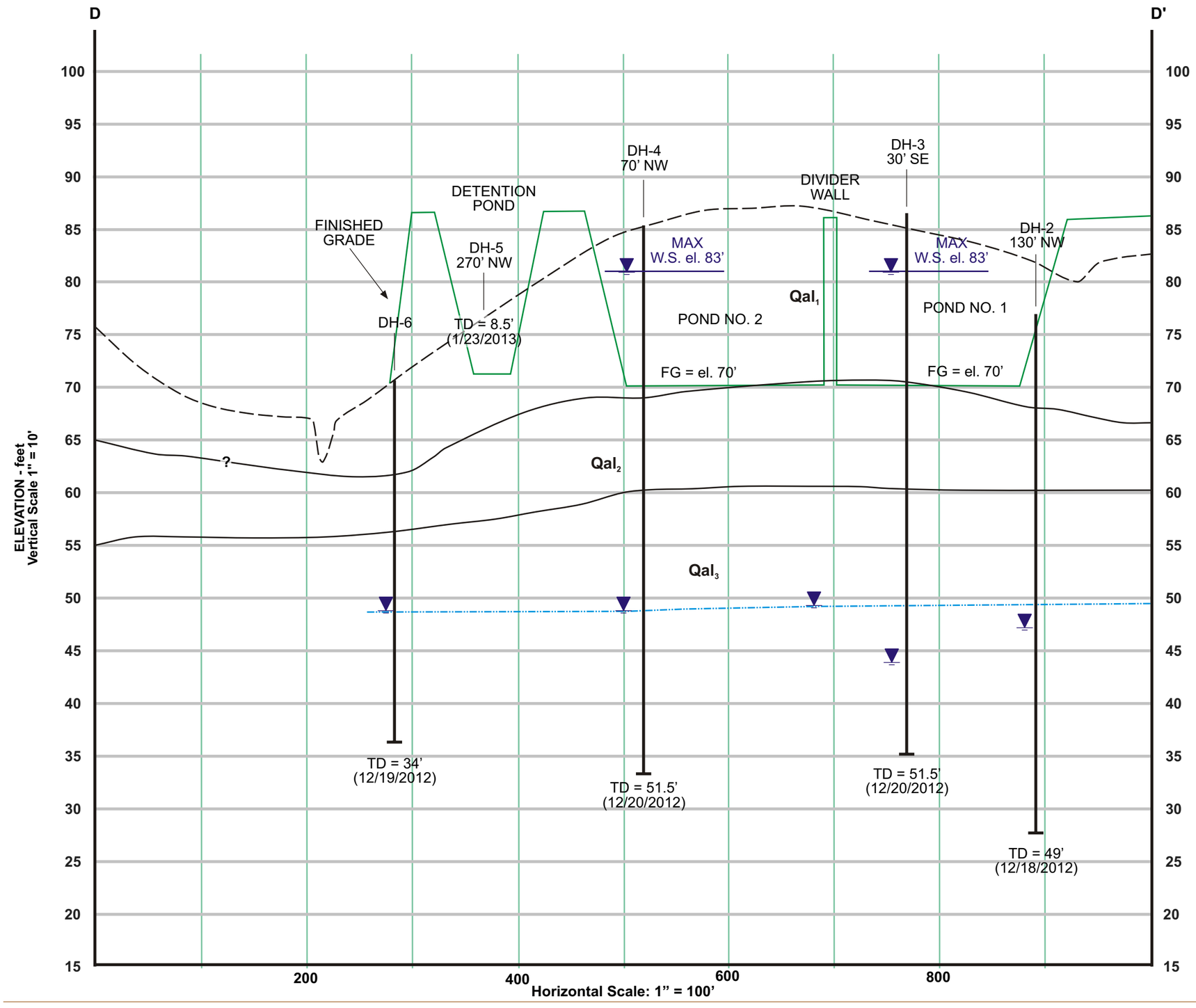
See text and logs for additional description and data concerning subsurface conditions.

- Existing ground surface
- Finished grade
- Interpolated subsurface boundary
- Interpreted groundwater surface
- DH-1 130' SE — Boring number with offset and direction from section line when applicable
- Approximate groundwater elevation encountered in boring with interpreted elevation between boring location
- Wet soil or seepage
- Approximate depth interval of boring with sample blow counts (N-values) noted per Appendix A
- TD = 25' (6/17/10) — Total depth and completion date of boring

Subsurface profile is interpolated between points of exploration and will vary from that shown.

All locations and information are approximate.

SUBSURFACE PROFILE C - C'
Los Osos Water Recycling Facility
San Luis Obispo County, California



LEGEND

Qal_1	Alluvium: Desiccated very stiff to hard clay
Qal_2	Alluvium: Stiff to very stiff clay
Qal_3	Alluvium: Dense to very dense silty sand

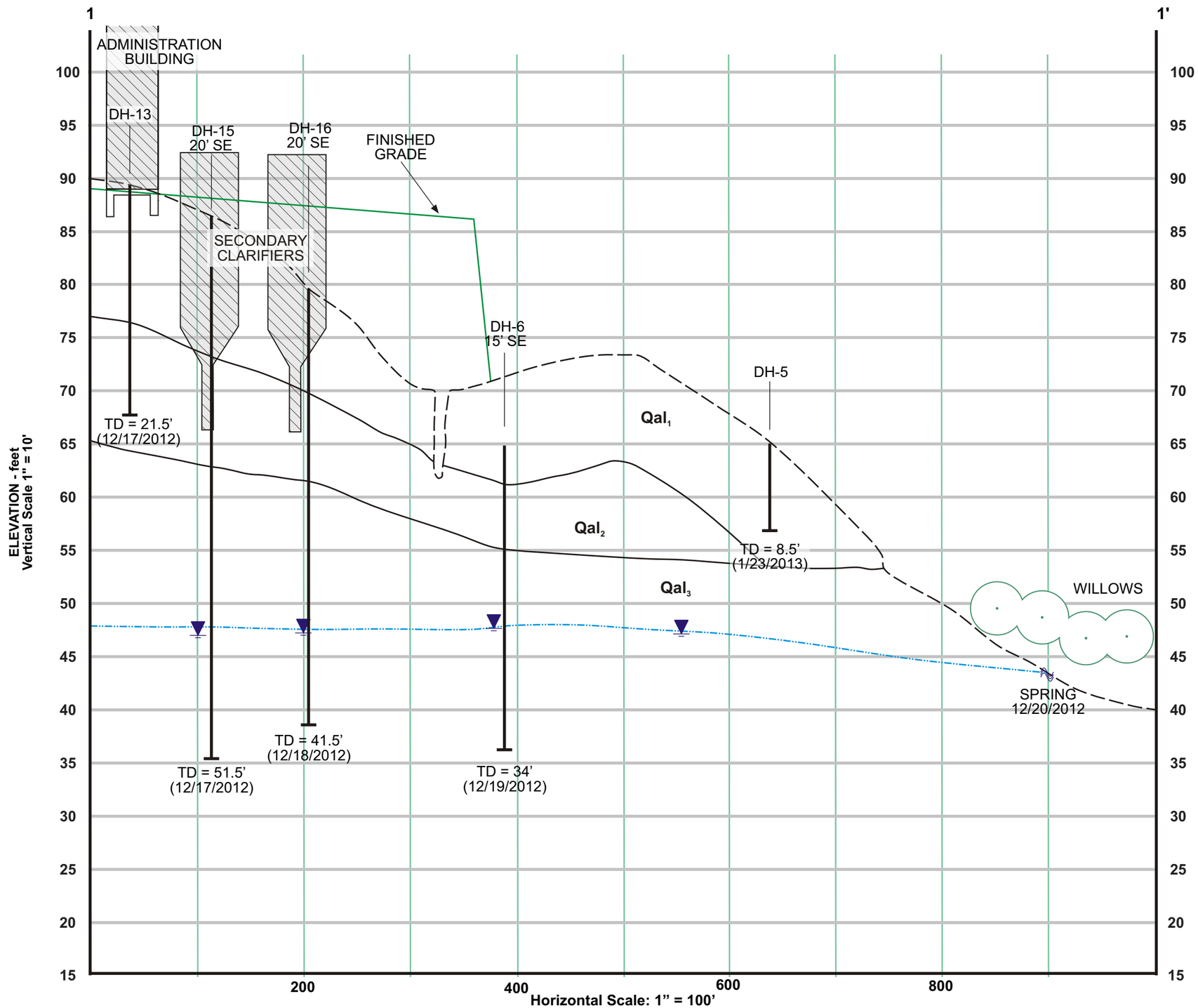
See text and logs for additional description and data concerning subsurface conditions.

— — -	Existing ground surface
———	Finished grade
———	Interpolated subsurface boundary
-·-·-	Interpreted groundwater surface
DH-1 130' SE	Boring number with offset and direction from section line when applicable
▼	Approximate groundwater elevation encountered in boring with interpreted elevation between boring location
∿	Wet soil or seepage
|	Approximate depth interval of boring with sample blow counts (N-values) noted per Appendix A
TD = 25' (6/17/10)	Total depth and completion date of boring

Subsurface profile is interpolated between points of exploration and will vary from that shown.

All locations and information are approximate.

SUBSURFACE PROFILE D - D'
Los Osos Water Recycling Facility
San Luis Obispo County, California



LEGEND

Qal_1	Alluvium: Desiccated very stiff to hard clay
Qal_2	Alluvium: Stiff to very stiff clay
Qal_3	Alluvium: Dense to very dense silty sand

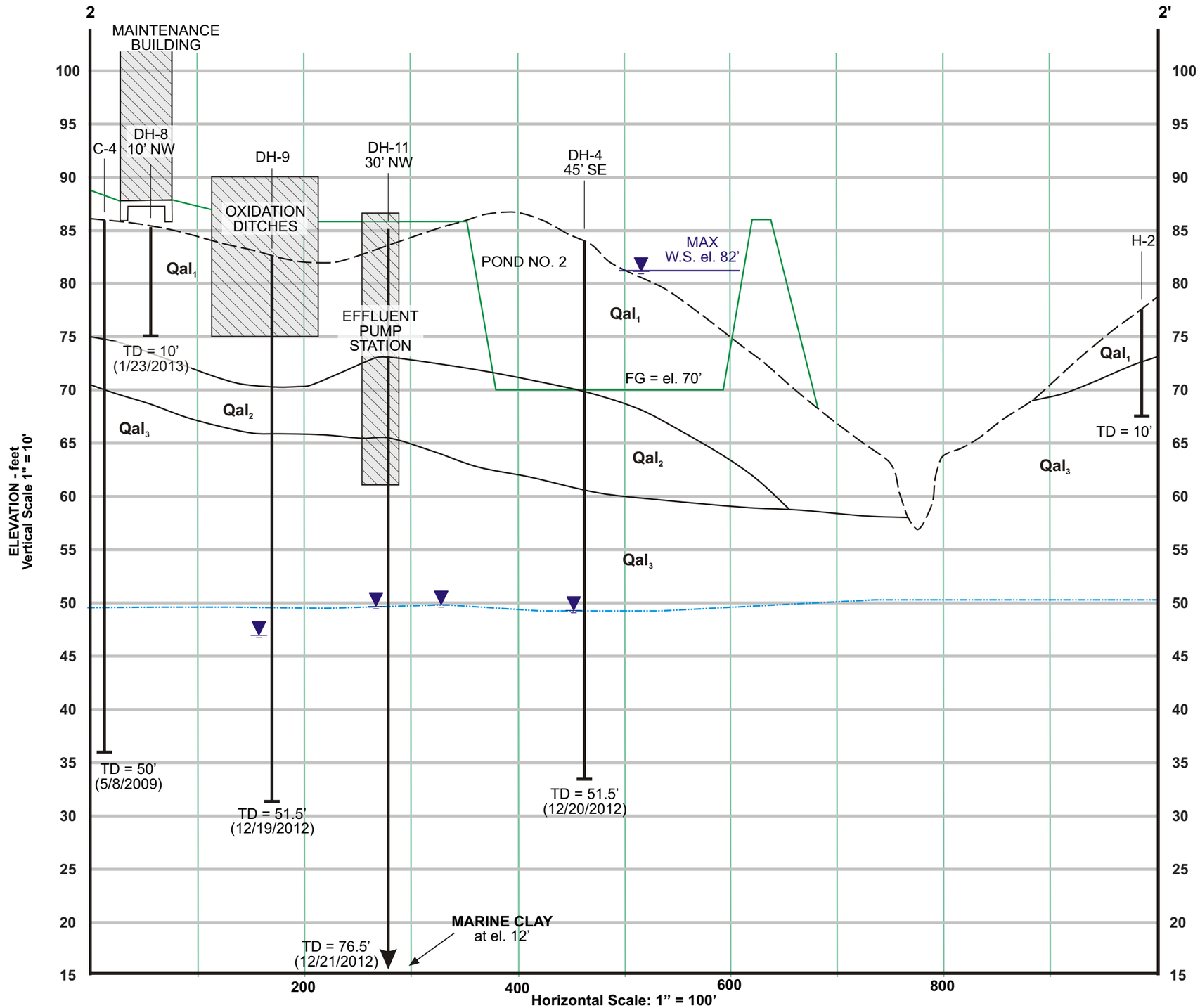
See text and logs for additional description and data concerning subsurface conditions.

— — -	Existing ground surface
———	Finished grade
———	Interpolated subsurface boundary
-·-·-	Interpreted groundwater surface
DH-1 130' SE	Boring number with offset and direction from section line when applicable
▼	Approximate groundwater elevation encountered in boring with interpreted elevation between boring location
∿	Wet soil or seepage
|	Approximate depth interval of boring with sample blow counts (N-values) noted per Appendix A
TD = 25' (6/17/10)	Total depth and completion date of boring

Subsurface profile is interpolated between points of exploration and will vary from that shown.

All locations and information are approximate.

SUBSURFACE PROFILE 1 - 1'
Los Osos Water Recycling Facility
San Luis Obispo County, California



LEGEND

Qal_1	Alluvium: Desiccated very stiff to hard clay
Qal_2	Alluvium: Stiff to very stiff clay
Qal_3	Alluvium: Dense to very dense silty sand
Marine Clay	Very stiff blue clay

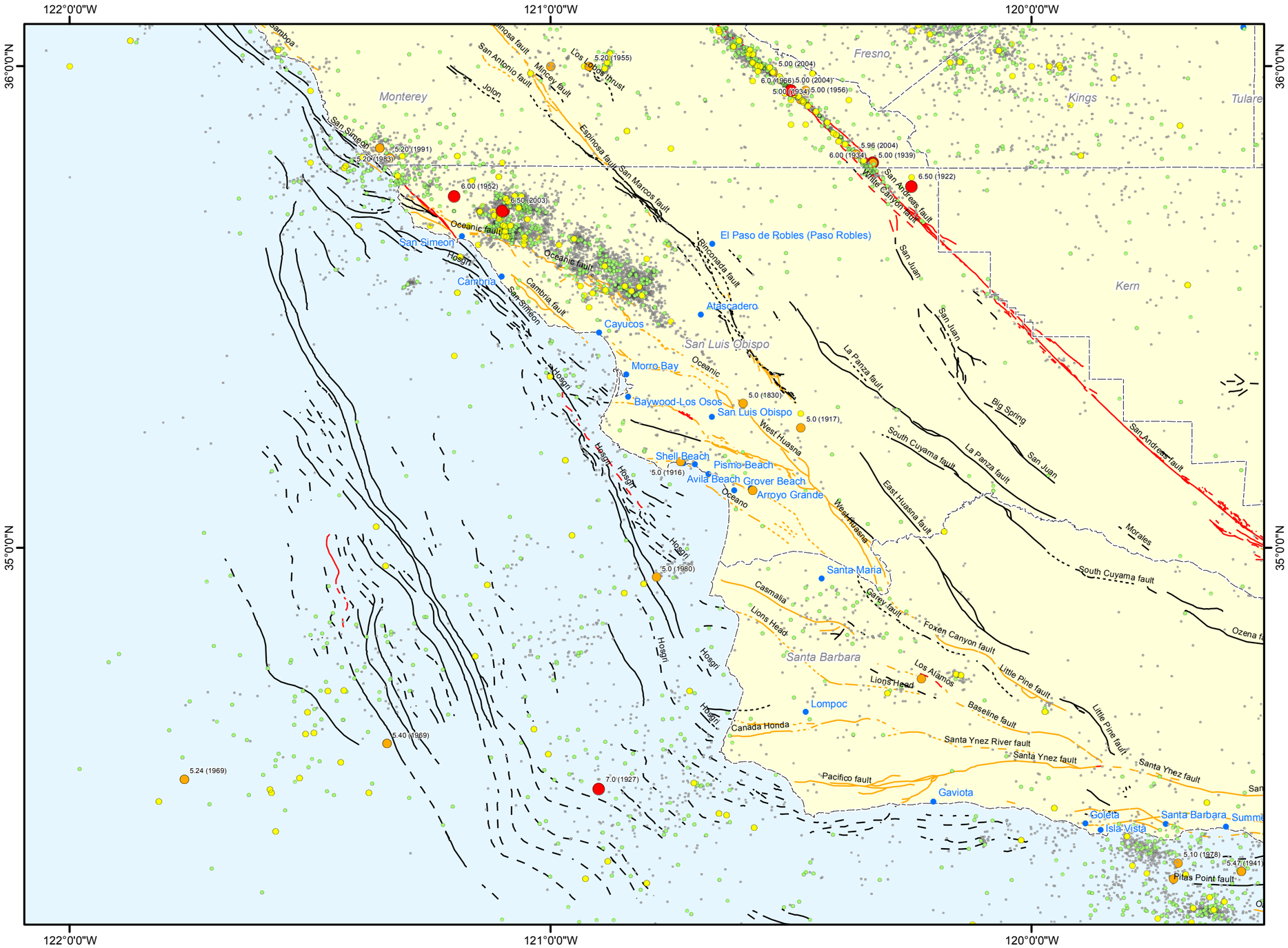
See text and logs for additional description and data concerning subsurface conditions.

— — -	Existing ground surface
———	Finished grade
———	Interpolated subsurface boundary
-·-·-	Interpreted groundwater surface
DH-1 130' SE	Boring number with offset and direction from section line when applicable
▼	Approximate groundwater elevation encountered in boring with interpreted elevation between boring location
∿	Wet soil or seepage
|	Approximate depth interval of boring with sample blow counts (N-values) noted per Appendix A
TD = 25' (6/17/10)	Total depth and completion date of boring

Subsurface profile is interpolated between points of exploration and will vary from that shown.

All locations and information are approximate.

SUBSURFACE PROFILE 2 - 2'
Los Osos Water Recycling Facility
San Luis Obispo County, California



Legend

Earthquake Magnitude
Magnitudes equal to and greater than 5 are labeled.

- 2.0 - 2.9
- 3.0 - 3.9
- 4.0 - 4.9
- 5.0 - 5.9
- >6.0

Faults (dashed where inferred, dotted where concealed)

- Active Fault
- Potentially Active Fault
- Inactive Fault

Source:

1) Earthquake Data:
   Earthquake epicenters from:
   a) ANSS Composite Catalog Search, 1933 to 2012, <www.ncedc.org/anss/> (downloaded May 2012)
   b) "Seismotectonic framework, coastal central California", Seismotectonics of the Central California Coast Range, Special Paper 292, Geological Society of America, 1994.

2) Faults:
   a) Bryant, 2005
   b) Jennings, 1994

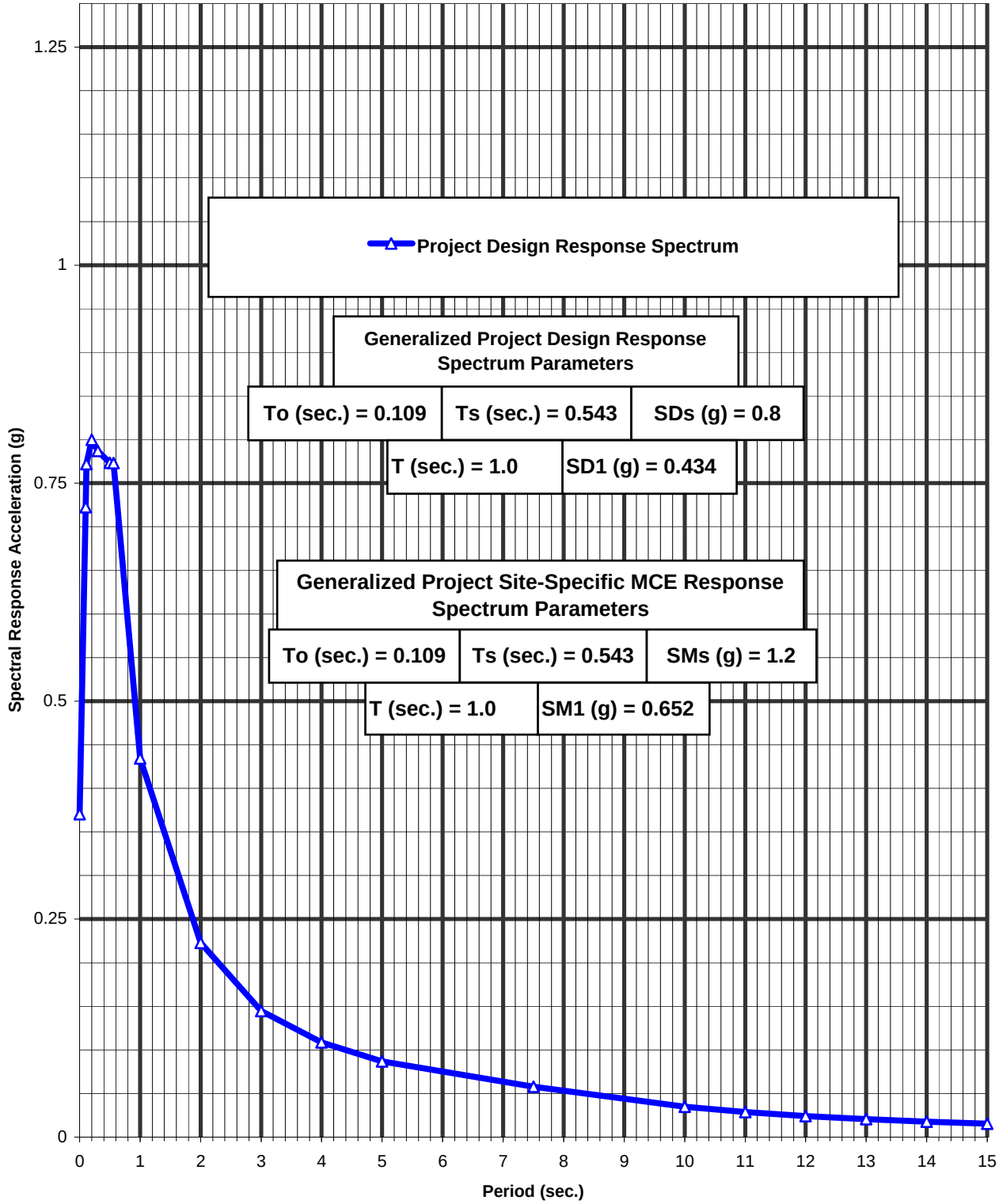
N

0 7.5 15 30 Miles

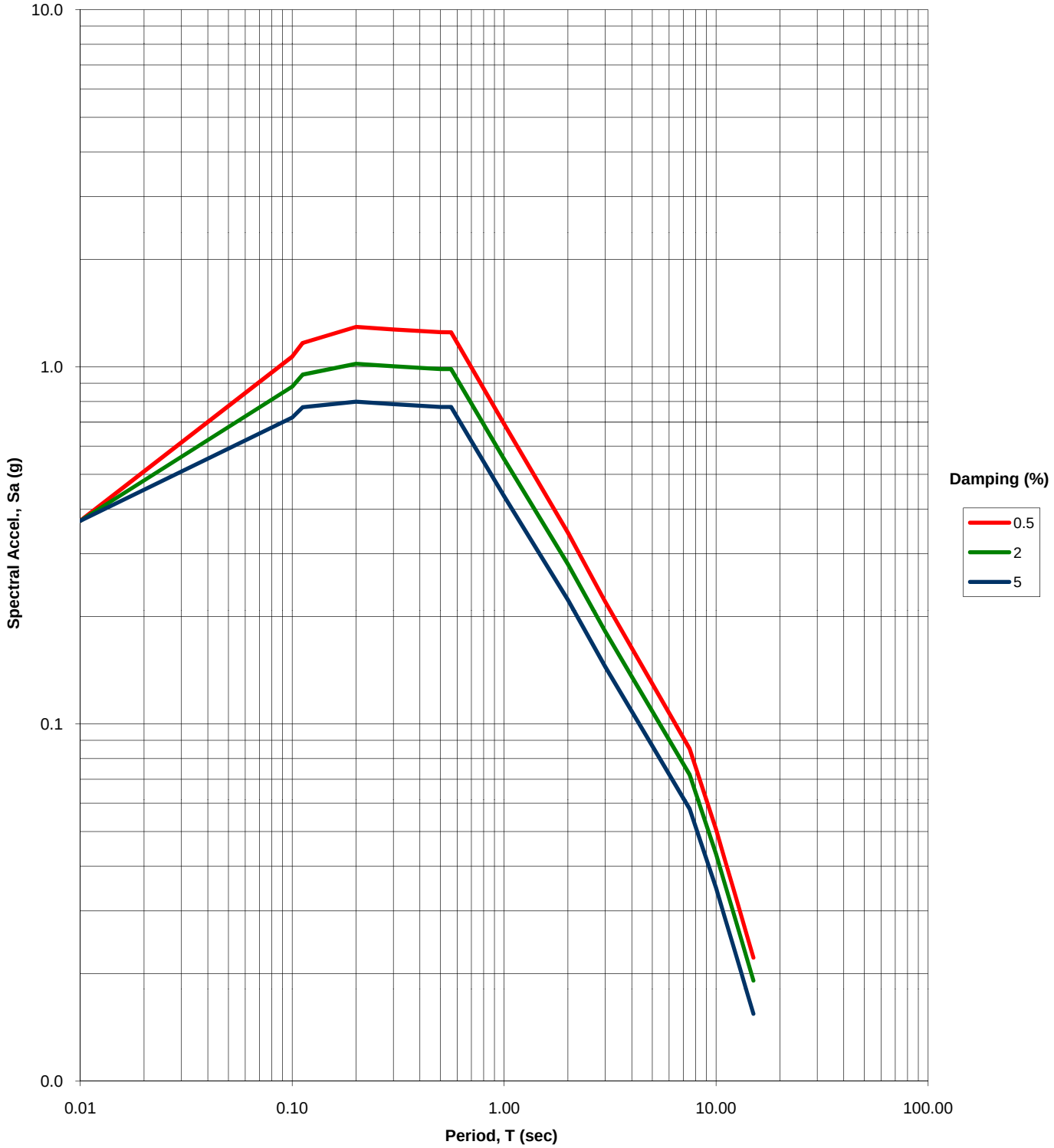
HISTORICAL SEISMICITY MAP
Los Osos Water Recycling Facility
San Luis Obispo County, California

N:\Projects\04_2012\04_6212_0178_CarolloEngineers\Outputs\2013_01_25_Report\mxd\Plate-06_Seismicity.mxd, 01/18/13, dpollard

5% Damping
(Project Design and Site-Specific Response Spectra Plotted up to maximum period with spectral value)

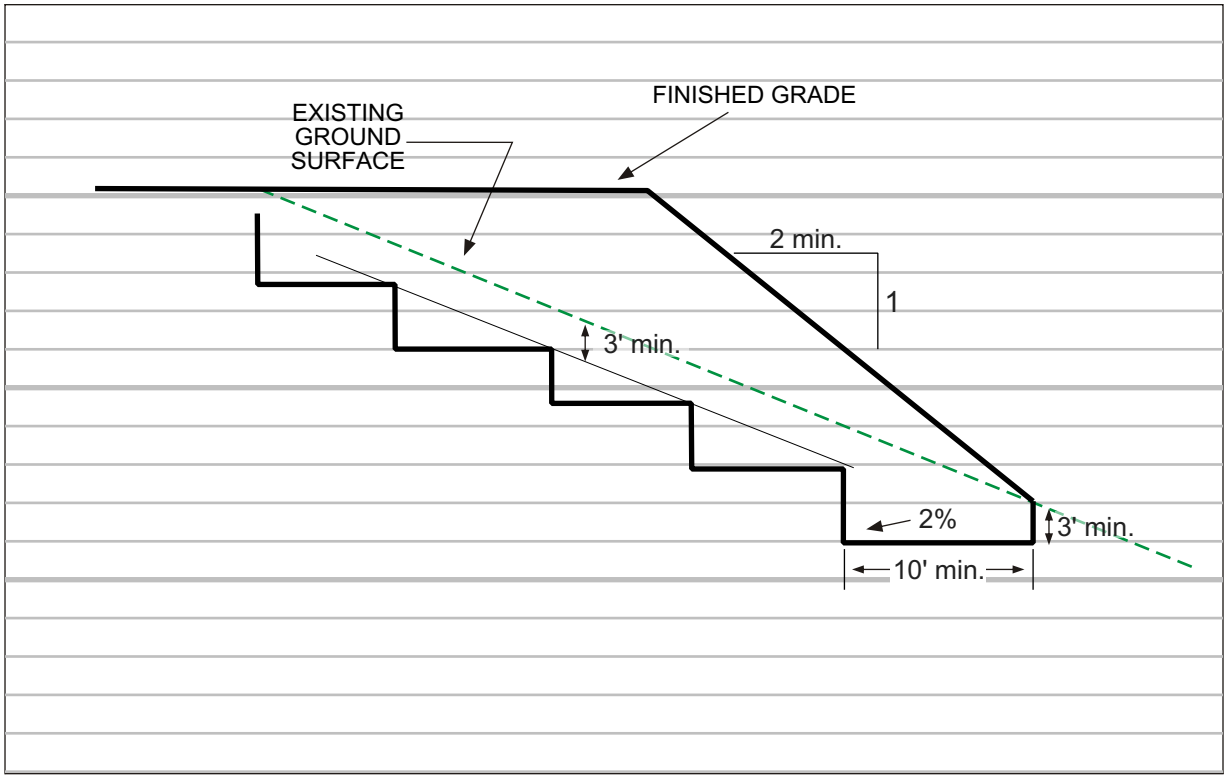


SUMMARY OF RESPONSE SPECTRA
Los Osos Water Recycling Facility
San Luis Obispo County, California



PROJECT DESIGN RESPONSE SPECTRA
Los Osos Water Recycling Facility
San Luis Obispo County, California

PLATE 7b

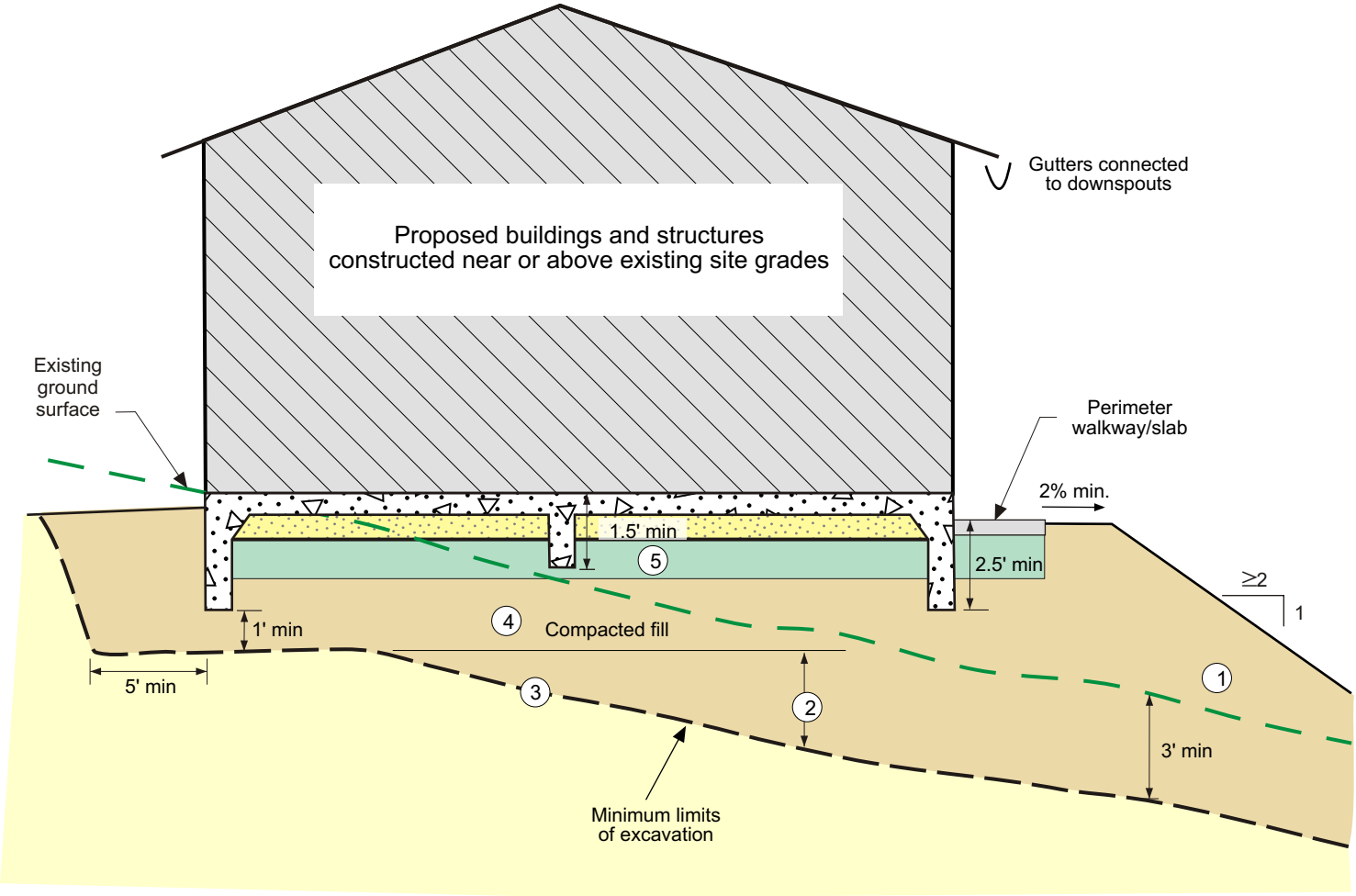


TYPICAL SECTION
NOT TO SCALE

Notes:

1. Remove existing soil to minimum depth of 3 feet below existing ground surface in areas to recieve fill.
2. Excavate initial base key to at least 3 feet below the toe of the proposed slope, and slope bench at least 2 percent into the existing hillside.
3. Key and bench fill into the existing hillside such that at least the upper 3 feet of the existing soil is removed.
4. Compact embankment fill to at least 90 percent relative compaction, and at least 95 percent relative compaction where fill is placed within 3 feet of finished grade in pavement areas.

SUMMARY OF GRADING RECOMMENDATIONS
FOR KEYING AND BENCHING
Los Osos Water Recycling Facility
San Luis Obispo County, California



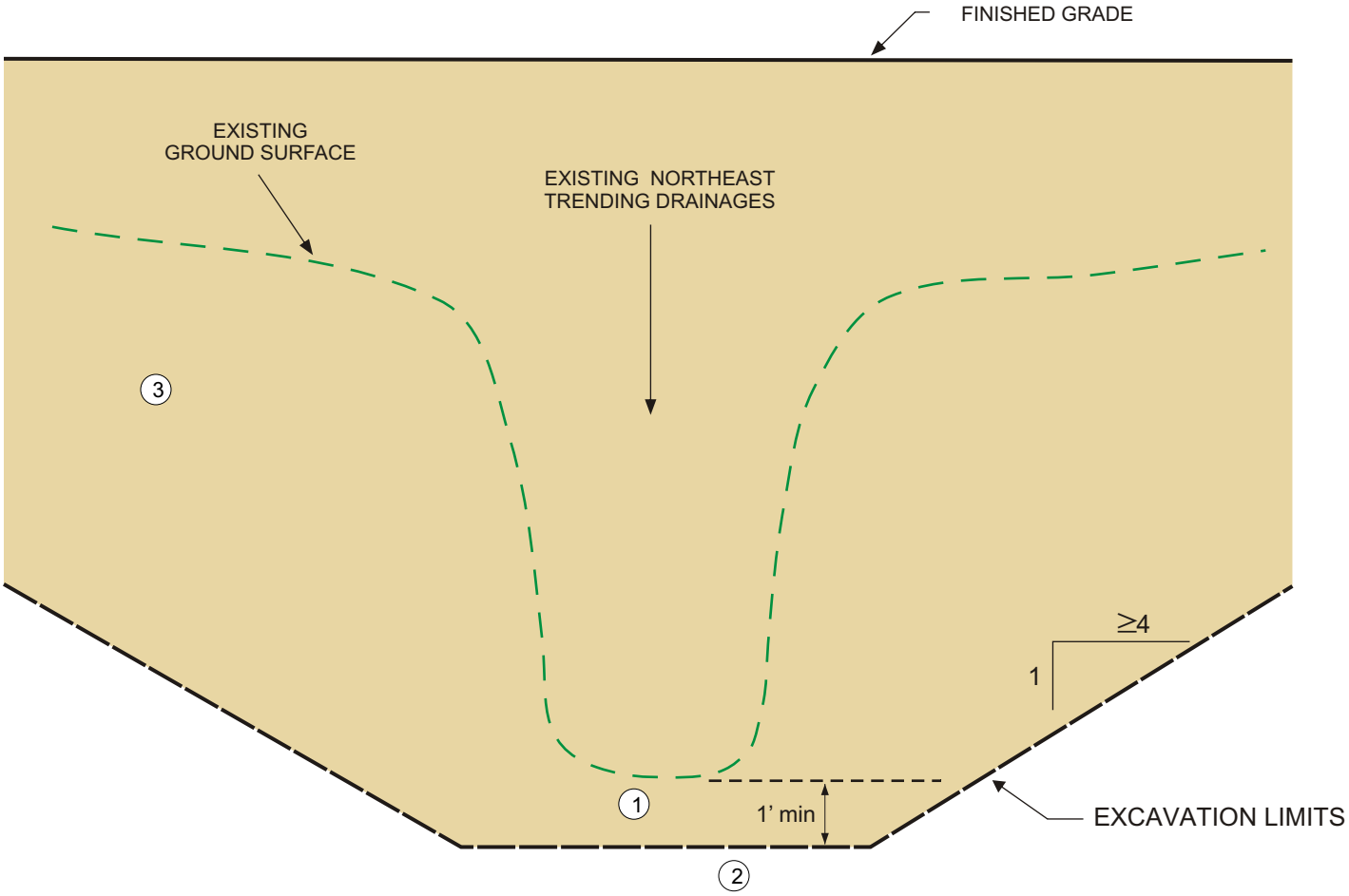
Notes:

1. Remove existing soil to at least 3 feet below existing grade in areas to receive fill and to expose stiff to hard alluvium as discussed in the report. The excavation limits should extend at least five feet outside the footprint of any structure.
2. Deepen excavation when needed to limit the difference in the fill thickness below the building to less than 2 feet. Provide at least 1 foot of compacted fill below the footings.
3. Subgrade is clay and sensitive to changes in moisture. Scarify soil to depth of 9 inches and compact to 90 percent relative compaction.
4. Moisture condition clay fill to above optimum. Place compacted fill to at least 90 percent relative compaction according to the recommendations in this report.
5. Provide at least 2 feet of non-expansive fill below interior floor slabs and exterior perimeter slabs.

See report for additional recommendations and information.

SUMMARY OF GRADING RECOMMENDATIONS FOR BUILDING AND ABOVE GRADE STRUCTURES

Los Osos Water Recycling Facility
San Luis Obispo County, California



TYPICAL SECTION
NOT TO SCALE

Notes:

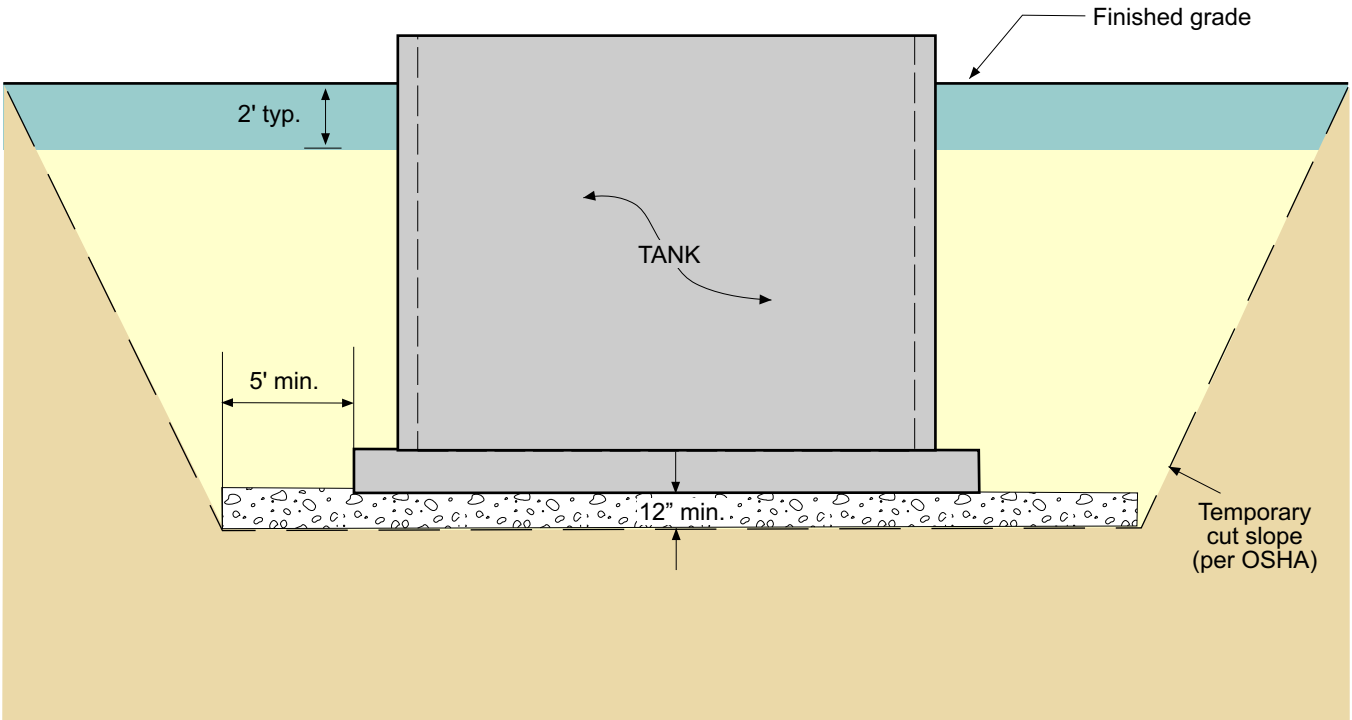
1. Remove existing soil to at least 1 foot below drainage invert and beyond sidewalls to expose stiff to hard alluvium, and excavate sides of the drainage to 4:1 or flatter.

2. Subgrade is clay and sensitive to changes in moisture. Scarify soil to depth of 9 inches and compact to 90 percent relative compaction.

3. Place compacted fill to at least 90 percent relative compaction according to the recommendations in this report.

See report for additional recommendations and information.

SUMMARY OF GRADING RECOMMENDATIONS
FOR FILL PLACEMENT IN DRAINAGES
Los Osos Water Recycling Facility
San Luis Obispo County, California



LEGEND

Aggregate base compacted to at least 90 percent relative compaction. Contractor should reinforce or provide additional material as-needed to support construction traffic depending on their means and methods.

Retaining wall backfill composed of either imported structure backfill, lime treated on-site soil or on-site clay soil compacted to at least 90% relative compaction. Backfill type is dependent on the material type that is consistent with the structural design of the walls.

Soil cover: On-site clayey material compacted to 90% relative compaction, pavement section or slab (see text for discussion).

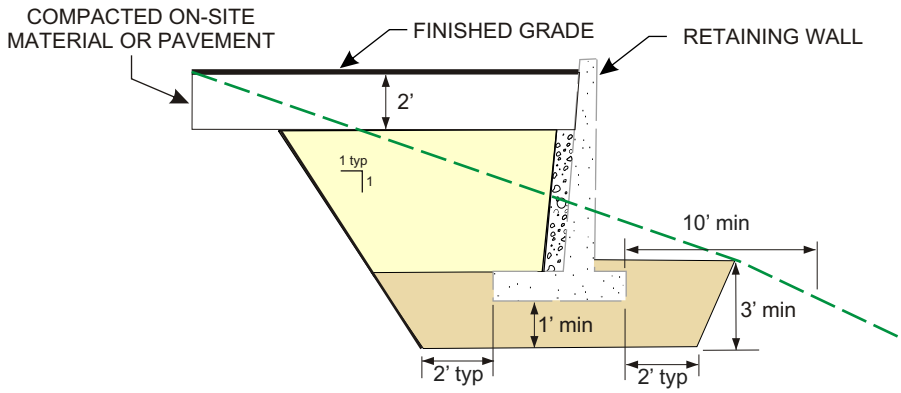
Undisturbed clayey Alluvium. Scarify and recompact upper 9 inches to 90% relative compaction.

1. Drainage should be provided behind walls if granular backfill is used to collect and outlet infiltrating water.

2. Compaction within 4 feet of the structure should be limited with consideration of the curing and strength of the wall as the material is being placed. Hand equipment or small walk-behind compactors that will not damage should be used, as-needed.

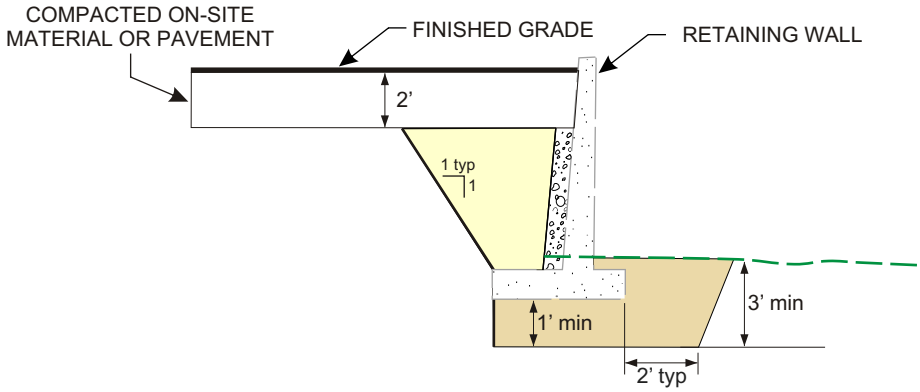
3. See text for additional recommendations and grading.

SUMMARY OF GRADING RECOMMENDATIONS
FOR BELOW GRADE STRUCTURES
Los Osos Water Recycling Facility
San Luis Obispo County, California



TYPICAL SECTIONS
NOT TO SCALE

CUT SLOPE



FILL SLOPE

LEGEND

Footing to bear in compacted fill placed during mass grading or to limits shown

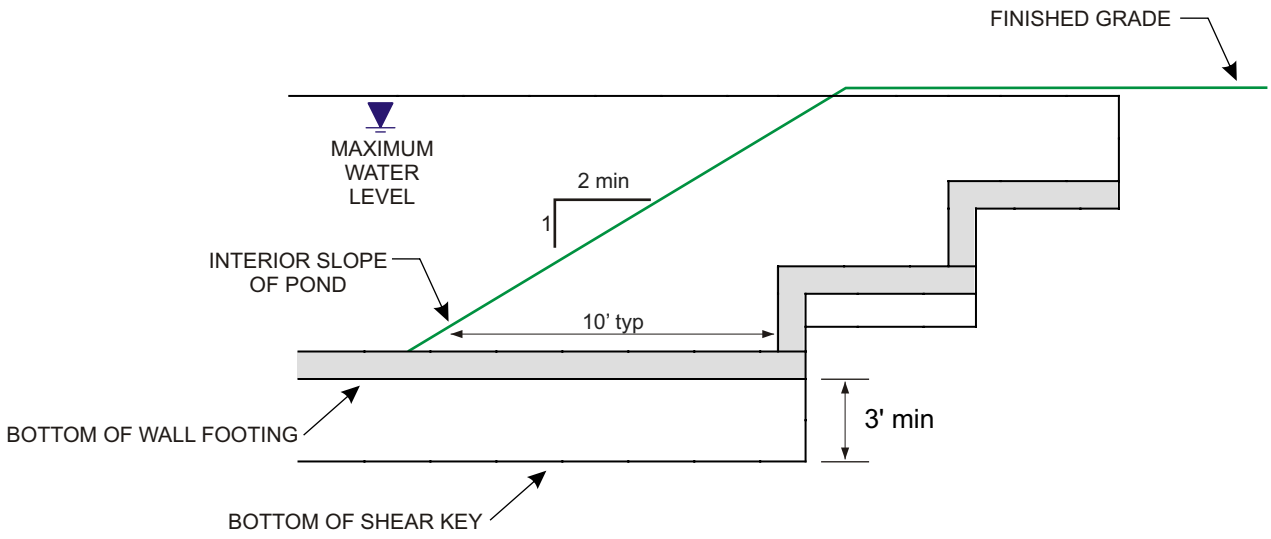
Retaining wall backfill material (see text for material specifications)

Drainage material or geocomposite drain with weep holes or collector pipe: Terminate top of drainage material at base of pavement section or 2 feet below grade in non-pavement areas and cover with compacted on-site soil

Existing ground surface

Grading recommendations for support of retaining walls vary.
See text for recommended grading limits and compaction requirements.

SUMMARY OF GRADING RECOMMENDATIONS
FOR RETAINING WALLS
Los Osos Water Recycling Facility
San Luis Obispo County, California



Notes:

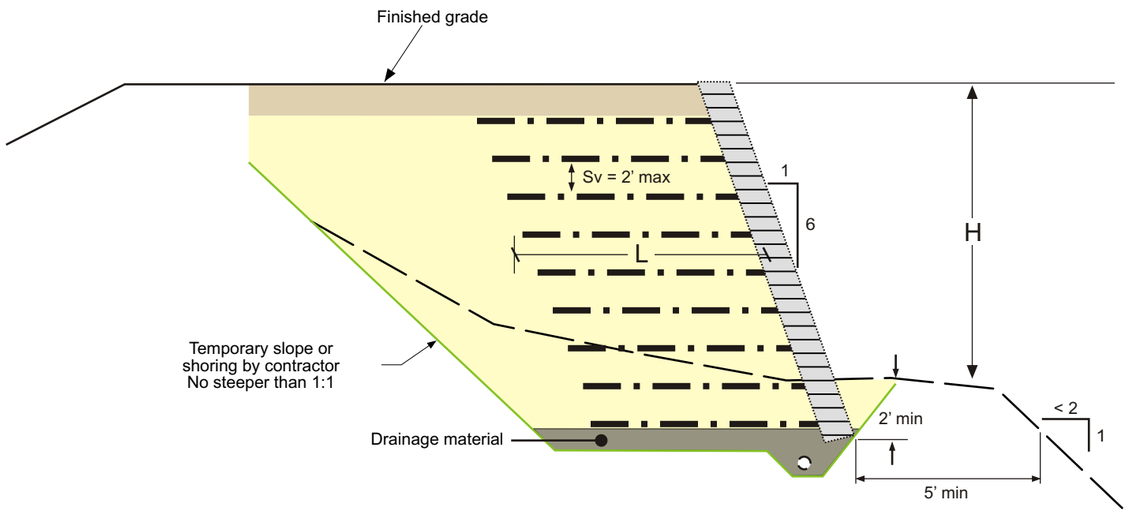
1. Wall footing should be excavated into undisturbed stiff clay alluvium or compacted fill for the perimeter berm.

2. Wall footing should be embedded at least 1.5 feet below finished grade and be set back at least 10 feet horizontally from adjacent slopes.

3. Cutoff wall below the footing should extend to at least 3 feet below the bottom of the wall footing.

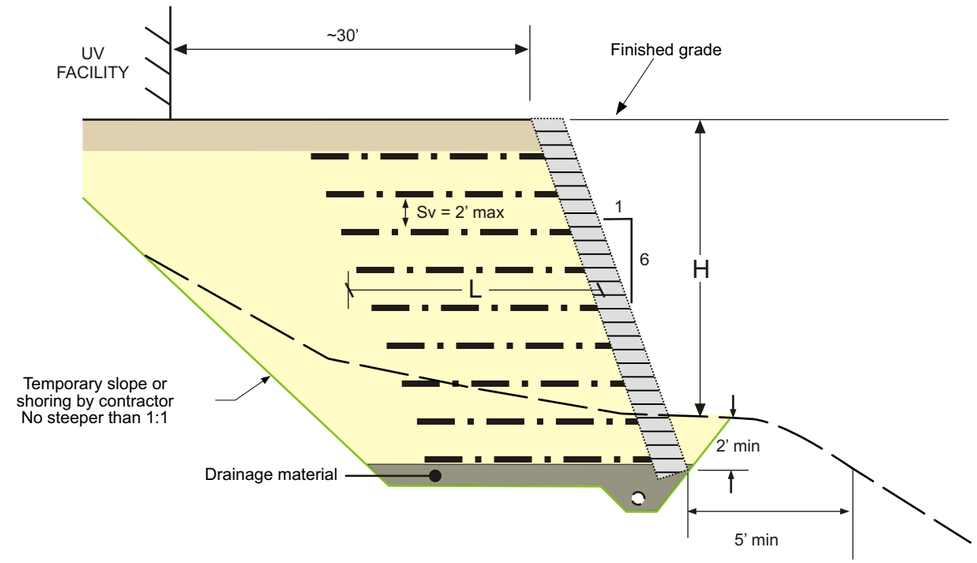
See report for additional recommendations and information.

SUMMARY OF GRADING RECOMMENDATIONS FOR POND DIVIDER WALL
Los Osos Water Recycling Facility
San Luis Obispo County, California



Slope Height H – Feet	Minimum Length L – Feet	Long Term Design Strength LTDS – lbs/ft
10 max	15	1300
8 max	12	1300
5.5 max	8	1300

Typical 1:6 SMU Wall for Pond Exterior Perimeter Berm



Slope Height H – Feet	Minimum Length L – Feet	Long Term Design Strength LTDS – lbs/ft
18 max	31	3000
16 max	27	2300
11 max	18	1300

Typical 1:6 SMU Wall for Building Pad

LEGEND

Primary geogrid reinforcement having minimum strength (LTDS) and length (L) for slope height (H)

Segmental masonry unit (SMU) retaining wall

Non-expansive, non-plastic compacted fill having sand equivalent greater than 30

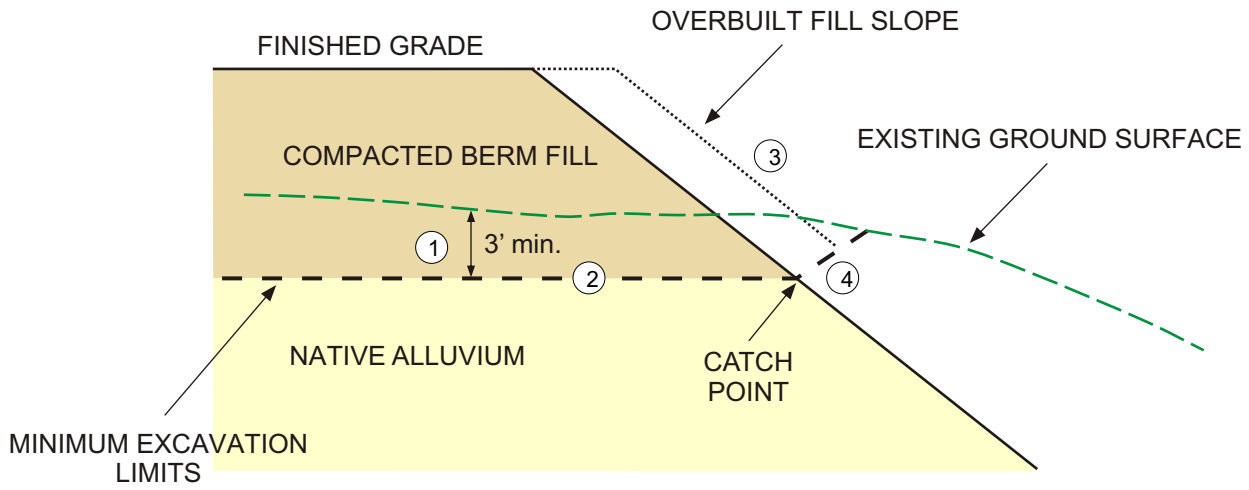
Drainage material encased in filter fabric and outlet down gradient

Notes:

1. Length should be selected based on maximum slope height (H) and should not be varied for differing slope heights within that location.

2. Wall should be founded on compacted material per recommendations of this report.

GEOSYNTHETIC REINFORCED
SEGMENTAL MASONRY UNIT RETAINING WALL
Variable Height
Los Osos Water Recycling Facility
San Luis Obispo County, California



TYPICAL SECTION
NOT TO SCALE

Notes:

1. Remove existing soil to at least 3 feet below existing grade to expose stiff to hard alluvium as discussed in the report.

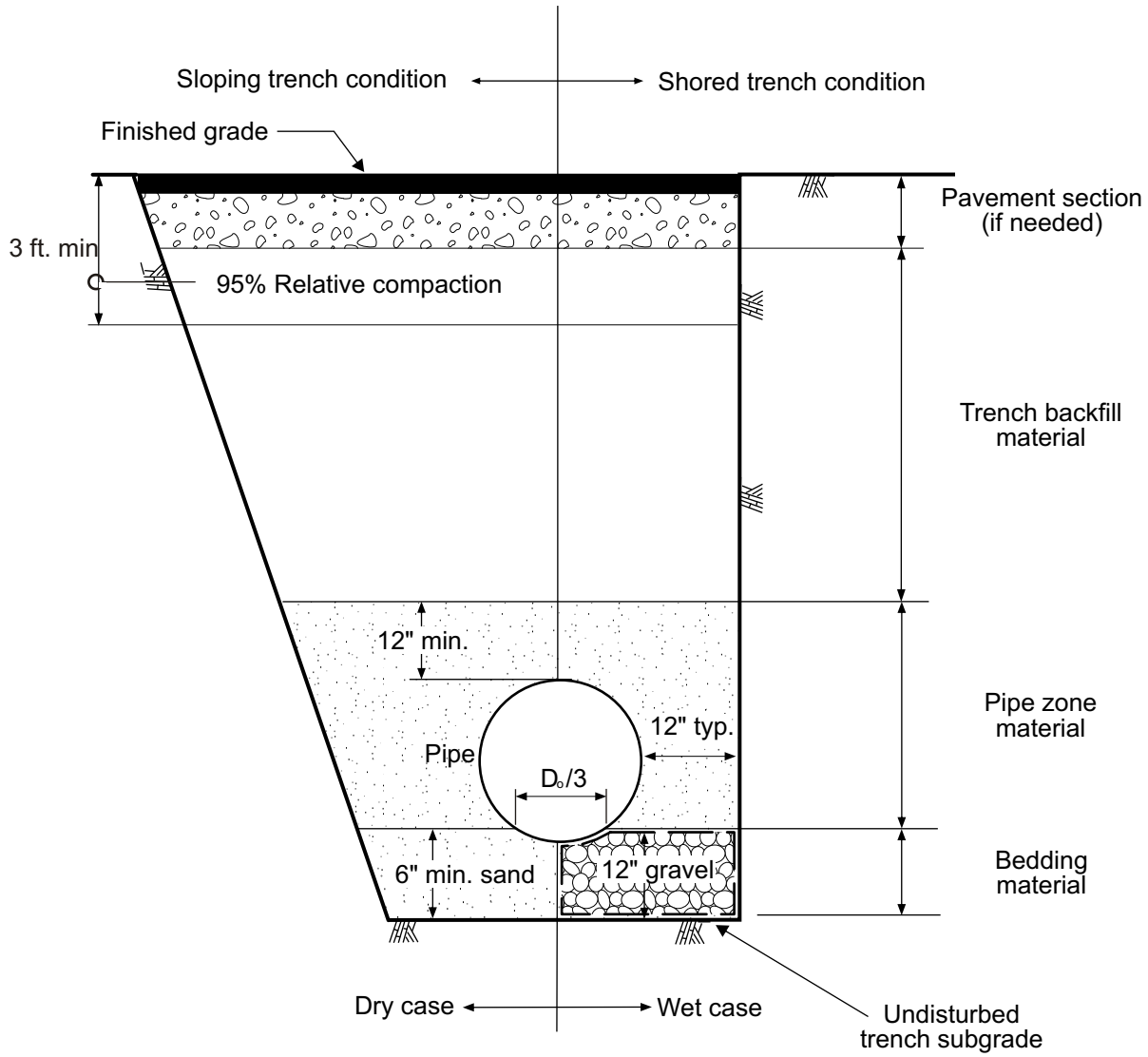
2. Subgrade is clay and sensitive to changes in moisture. Scarify soil to depth of 9" and compact to 90 percent relative compaction.

3. The fill should be placed beyond the finished grade of the berm and then be cut back to reveal compacted soil at the slope face.

4. Particular care should be taken during fill placement that the limits of the excavation and compacted fill extendsbeyond the catch point between the fill for the perimeter berm and the lower portion of the berm slope that will be made in cut.

See report for additional recommendations and information.

SUMMARY OF GRADING RECOMMENDATIONS
FOR PERIMETER BERM SLOPES
Los Osos Water Recycling Facility
San Luis Obispo, California



NOT TO SCALE

See text for description of trench materials and compaction requirements.

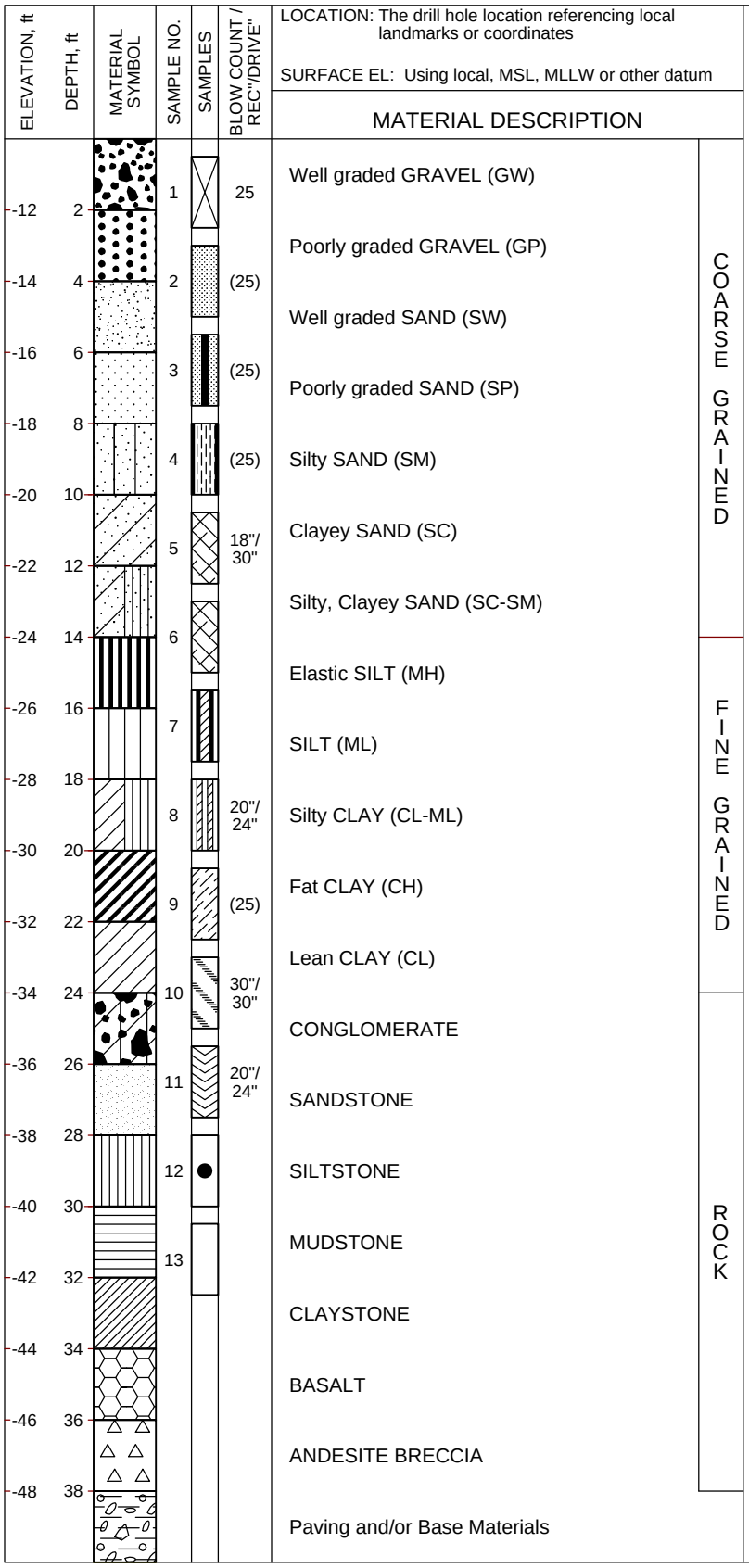
Where wet or yielding soil conditions are encountered at the bottom of the trench excavation, the subgrade should be stabilized prior to placing bedding according to the recommendations of the report.

Do = Pipe Diameter

— — — Geotextile encasement around open-graded gravel

SCHEMATIC TRENCH DETAIL
Los Osos Water Recycling Facility
San Luis Obispo County, California

APPENDIX A



General Notes

Soil Texture Symbol

Sloped line in symbol column indicates transitional boundary

Samplers and sampler dimensions
(unless otherwise noted in report text) are as follows:

Symbol for:

1	SPT Sampler, driven 1-3/8" ID, 2" OD
2	CA Liner Sampler, driven 2-3/8" ID, 3" OD
3	CA Liner Sampler, disturbed 2-3/8" ID, 3" OD
4	Thin-walled Tube, pushed 2-7/8" ID, 3" OD
5	Bulk Bag Sample (from cuttings)
6	CA Liner Sampler, Bagged
7	Hand Auger Sample
8	CME Core Sample
9	Pitcher Sample
10	Lexan Sample
11	Vibracore Sample
12	No Sample Recovered
13	Sonic Soil Core Sample

Sampler Driving Resistance

Number of blows with 140 lb. hammer, falling 30" to drive sampler 1 ft. after seating sampler 6"; for example,

Blows/ft	Description
25	25 blows drove sampler 12" after initial 6" of seating
86/11"	After driving sampler the initial 6" of seating, 36 blows drove sampler through the second 6" interval, and 50 blows drove the sampler 5" into the third interval
50/6"	50 blows drove sampler 6" after initial 6" of seating
Ref/3"	50 blows drove sampler 3" during initial 6" seating interval

Blow counts for California Liner Sampler shown in ( )

Length of sample symbol approximates recovery length

Classification of Soils per ASTM D2487 or D2488

Geologic Formation noted in bold font at the top of interpreted interval

Strength Legend

Q = Unconfined Compression
u = Unconsolidated Undrained Triaxial
t = Torvane
p = Pocket Penetrometer
m = Miniature Vane

Water Level Symbols

- Initial or perched water level
- Final ground water level
- Seepages encountered

Rock Quality Designation (RQD) is the sum of recovered core pieces greater than 4 inches divided by the length of the cored interval.

KEY TO TERMS & SYMBOLS USED ON LOGS

PLATE A-1

LOCATION: Proposed Pond No. 1 near southwest corner of site
N 35.30863 W 120.80198

SURFACE EL: 86 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	SAMPLE NO.	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
				ALLUVIUM (Qal) Lean CLAY (CL): stiff to hard, dark brown, moist							
		A 1	(18)		120	106	12				p 4.5+
84	2										
				- grades to lean CLAY with sand (CL), light brown to reddish brown, mottled, pinhole voids, fine to medium sand							
82	4										
		2	17								
80	6			- very stiff to hard							p 4.5 p 3.8 p 4.5+
78	8										
76	10	3	(33)								
				- brown to reddish brown, mottled							p 4.5+
74	12										
				Lean CLAY (CL): stiff to very stiff, yellowish brown, moist, manganese stains and gray mottles							
72	14										
		4	(24)		123	97	27				
70	16										p 1.5 p 2.5 p 2.0
68	18			Sandy Lean CLAY (CL): hard, light brown, fine sand, gradational contact with unit below							
66	20	5A 5B	35								
				Clayey SAND (SC): dense, light yellowish brown, moist							p 4.5+
64	22										
62	24										
		6	(41)	Sandy lean CLAY (CL): very stiff to hard, light yellowish brown to reddish brown, moist, fine sand	126	107	18	35			
60	26										p 4.5+

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 51.5 ft
DEPTH TO WATER: 39.7 ft
BACKFILLED WITH: 3-sack slurry
DRILLING DATE: December 20, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-1

Los Osos Water Recycling Facility
San Luis Obispo County, California

PLATE A-2a

LOCATION: Proposed Pond No. 1 near southwest corner of site
N 35.30863 W 120.80198

SURFACE EL: 86 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
58	28											
56	30	7		34	Poorly graded SAND with silt (SP-SM): dense, moderate yellowish brown to reddish brown, moist, fine sand							
54	32											
52	34											
50	36	8		(91/9")	- very dense, moderate yellowish brown							
48	38											
46	40	9		40				26	7			
44	42				- dense, wet							
42	44				Silty SAND (SM): dense to very dense, yellowish brown, wet							
40	46	10		49	- flow sand in auger, less than 6 inches							
38	48											
36	50	11		56	- very dense, approximately ¼" thick lense of dark reddish brown silty SAND (SM) - light yellowish brown							
34	52											

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 51.5 ft
DEPTH TO WATER: 39.7 ft
BACKFILLED WITH: 3-sack slurry
DRILLING DATE: December 20, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-1

Los Osos Water Recycling Facility
San Luis Obispo County, California

PLATE A-2b

LOCATION: Proposed Pond No. 1 near northwest corner of site
N 35.30951 W 120.80141

SURFACE EL: 77 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
			A			**ALLUVIUM (Qal)**							
76						Lean CLAY with sand (CL): soft, dark brown, moist, trace angular gravel, faint oxide staining - very stiff to hard							
	2		1		(37)								p 4.5+
74													
	4		2		(44)								
72													p 4.5+
	6					Clayey SAND (SC): medium dense, dark brown, moist							
70													
	8												
68			3		17								
	10					Lean CLAY (CL): very stiff, brown, moist, black staining along fine fractures							p 3.5
66													
	12												
64						- brown mottled with gray, moist							
	14		4		(17)		121	95	27		34	17	
62													p 2.8
	16												
60													
	18												
58			5		52								
	20					Silty SAND (SM): very dense, gray brown, moist, fine grained							
56													
	22												
54													
	24		6		(76)		114	106	8	13			
52													
	26												

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 49.0 ft
DEPTH TO WATER: 29.0 ft
BACKFILLED WITH: 3-sack slurry
DRILLING DATE: December 18, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: B Fagundes
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-2

Los Osos Water Recycling Facility
San Luis Obispo County, California

PLATE A-3a

LOCATION: Proposed Pond No. 1 near northwest corner of site
N 35.30951 W 120.80141

SURFACE EL: 77 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
50						Poorly graded SAND with silt (SP-SM): dense, yellowish brown, wet							
	28												
48			7		46								
	30					- dense, brown, wet							
46													
	32												
44													
	34		8		(97/10")		128	105	21	6			
42						- very dense							
	36												
40						Silty SAND (SM): yellowish brown, wet							
	38												
38			B			- flow sand, unable to sample, water added by driller, approximately 3' flow sand in auger				17			
	40												
36													
	42												
34													
	44												
32						- unable to sample due to flow sand, driller out of water, approximately 3' flow sand in auger							
	46		9		--	- SPT sample pushed through flow sand in auger							
30													
	48												
28													
	50												
26													
	52												
24													

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 49.0 ft
DEPTH TO WATER: 29.0 ft
BACKFILLED WITH: 3-sack slurry
DRILLING DATE: December 18, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: B Fagundes
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-2

Los Osos Water Recycling Facility
San Luis Obispo County, California

PLATE A-3b

LOCATION: Proposed Pond. No. 1
N 35.30893 W 120.80122

SURFACE EL: 87 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
						ALLUVIUM (Qal)							
86			1A 1B		8	Lean CLAY (CL): medium stiff to hard, brown, moist, rootlets							p 2.5 p 2.3
	2					Sandy lean CLAY with gravel (CL): medium stiff to hard, reddish brown matrix, moist, heterogenous, fine to coarse sand, fine gravel, rounded to well rounded							p 4.5+
84	4												
82			2		(51)	Lean CLAY (CL): hard, brown to dark brown, moist, black staining, carbonate filled linear cavities	132	113	17				
	6												p 4.5+
80	8												
78	10		3		22								
76						- grades to lean clay with SAND (CL), very stiff							
	12												
74	14												
72			4		(35)		121	98	23	86	46	27	u 3.0
	16					- very stiff to hard, light gray to reddish brown, moist, mottled, black staining, dark red lineations, pockets of sand							p 4.5+
70	18					Fat CLAY (CH): stiff to very stiff, dark yellowish brown, moist							
68	20		5 A		13						64	48	
66													p 3.5
	22												p 3.5
64	24												
62			6		(87/8")	Silty SAND (SM): very dense, light yellowish brown to reddish brown, moist, fine sand							
	26												

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 51.5 ft
DEPTH TO WATER: 42.2 ft
BACKFILLED WITH: 3-sack slurry
DRILLING DATE: December 20, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-3

Los Osos Water Recycling Facility
San Luis Obispo County, California

PLATE A-4a

LOCATION: Proposed Pond. No. 1
N 35.30893 W 120.80122

SURFACE EL: 87 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
60													
	28												
58													
	30		7		24				13	19			
56						- medium dense, light yellowish brown							
	32												
54													
	34												
52			8		(85/11")								
	36					- very dense, light yellowish brown to reddish brown							
50													
	38												
48													
	40		9		68								
46						- reddish brown							
	42												
44													
	44												
42			10		(50/6")								
	46												
40													
	48												
38													
	50		11		34								
36						- dense, light flow sand							
	52												
34													

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 51.5 ft
DEPTH TO WATER: 42.2 ft
BACKFILLED WITH: 3-sack slurry
DRILLING DATE: December 20, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-3

Los Osos Water Recycling Facility
San Luis Obispo County, California

PLATE A-4b

LOCATION: Proposed Pond No. 2 on north side of site
N 35.30904 W 120.80013

SURFACE EL: 85 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
						ALLUVIUM (Qal)							
						Sandy Lean CLAY (CL): stiff to hard, brown, moist, fine to rounded coarse sand							
84			A										
	2		1A		11								p 3.0
													p 2.5
82			1B										p 4.5
	4												
80			2		(38)		132	115	15		32	18	
	6					- hard, black staining, with well rounded chert and friable sandstone gravel up to 1"							p 4.5+
78													
	8												
76													
	10		3		22	Clayey SAND (SC): medium dense, brown, moist, fine sand							
			B										
74													
	12												
72													
	14												
70			4		34	Fat CLAY (CH): very stiff to hard, light gray brown, moist, mottled reddish brown							
	16												p 4.5
68													
	18												
66													
	20		5		19				30	99	56	34	p 4.3
64													p 4.5
	22												
62													
	24					Silty SAND (SM): very dense, light yellowish brown, moist, oxidation staining, fine sand							
60			6		(50/6")								
	26												

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 51.5 ft
DEPTH TO WATER: 35.0 ft
BACKFILLED WITH: 3-sack slurry
DRILLING DATE: December 20, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-4

Los Osos Water Recycling Facility
San Luis Obispo County, California

PLATE A-5a

LOCATION: Proposed Pond No. 2 on north side of site
N 35.30904 W 120.80013

SURFACE EL: 85 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
58													
	28												
56													
	30		7		33								
54						- dense							
	32												
52													
	34												
50			8		(89/11")		124	106	18				
	36					- very dense, reddish brown, wet							
48													
	38												
46													
	40		9		56								
44						- dark reddish brown lenses approximately 1/16" thick at ¼" to 2" intervals							
	42												
42													
	44												
40			10		63								
	46												
38													
	48												
36													
	50		11		89/11"								
34													
	52												
32													

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 51.5 ft
DEPTH TO WATER: 35.0 ft
BACKFILLED WITH: 3-sack slurry
DRILLING DATE: December 20, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-4

Los Osos Water Recycling Facility
San Luis Obispo County, California

PLATE A-5b

LOCATION: Proposed Pond No. 2 at northeast corner of site
N 35.30927 W 120.79965

SURFACE EL: 70.5 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
70						**ALLUVIUM (Qal)**							
						Fat CLAY (CH): medium stiff, dark brown, moist							
						- light brown, trace fine to medium sand							
68	2		1		(--)	- soft to hard							
						Lean CLAY with sand (CL): hard, light brown to dark reddish brown, moist, fine sand, blocky, block mottling							p 2.3 p 3.3
66	4												
						- abundantly blocky and mottling							
64	6												
62	8					- light brown, increase in sand content, oxidation mottling							
						Clayey SAND (SC): light brown to light yellowish brown, moist, fine sand							
60	10												
58	12												
56	14												
54	16												
52	18												
50	20												
48	22												
46	24												
44	26												

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 8.5 ft
DEPTH TO WATER: Not Encountered
BACKFILLED WITH: Native Fill
DRILLING DATE: January 23, 2013

DRILLING METHOD: Hand Auger
HAMMER TYPE: 5-lb Slide
DRILLED BY: Fugro Consultants
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-5

Los Osos Water Recycling Facility
San Luis Obispo County, California

LOCATION: Proposed detention pond
N 35.30866 W 120.79958

SURFACE EL: 70 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	SAMPLE NO.	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
				ALLUVIUM (Qal)							
		1	15	Sandy lean CLAY with gravel (CL): medium stiff, dark gray, moist, angular to subrounded gravel							
68	2			- stiff, mottled gray brown with brown, faint orange oxide staining							
		2	(36)		128	114	13				u 5.0
66	4			Sandy Fat CLAY (CH): very stiff to hard, dark gray, increased sand content, increased orange oxide staining							p 4.5+
		3 A	(41)								
64	6										p 4.5+
62	8										
		4	17	- very stiff, brown, black staining along fine fractures, reduced gravel content							
60	10										
58	12										
56	14	5	(40)	Clayey SAND (SC): dense, gray brown, moist, fine grained							
54	16										
		B		Silty SAND (SM): dense, orange brown, moist, fine grained							
52	18										
		6	32								
50	20										
48	22										
46	24	7	(66)	Poorly graded SAND with silt (SP-SM): dense, yellowish brown, wet							
					129	106	22	5			
44	26										

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 34.0 ft
DEPTH TO WATER: 21.5 ft
BACKFILLED WITH: 3-sack slurry
DRILLING DATE: December 19, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: B Fagundes
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-6

Los Osos Water Recycling Facility
San Luis Obispo County, California

PLATE A-7a

LOCATION: Proposed detention pond
N 35.30866 W 120.79958

SURFACE EL: 70 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
42	28												
			8		33								
40	30												
38	32												
						- Approximately 3' flow sands in auger. Auger broke. Terminated hole at 34'.							
36	34												
34	36												
32	38												
30	40												
28	42												
26	44												
24	46												
22	48												
20	50												
18	52												

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 34.0 ft
DEPTH TO WATER: 21.5 ft
BACKFILLED WITH: 3-sack slurry
DRILLING DATE: December 19, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: B Fagundes
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-6

Los Osos Water Recycling Facility
San Luis Obispo County, California

PLATE A-7b

LOCATION: Proposed headworks at west end of plant site

SURFACE EL: 88.5 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	SAMPLE NO.	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
88				**ALLUVIUM (Qal)**							
		A		Lean CLAY (CL): stiff to hard, dark brown, moist, fine to coarse sand, rootlets, black staining							
86	2		(18)								
84	4	1	(22)		128	107	19				p 3.3
		2	(71)	- fine to coarse sand, rounded fine gravel							p 4.5
82	6			- hard, abundant black staining							
80	8			Sandy Fat CLAY (CH): very stiff to hard, light yellowish brown, moist, mottled reddish brown, fine to medium sand							
78	10	3	(40)		124	105	18				u 2.6
											p 4.5+
76	12			Lean CLAY (CL): stiff to hard, brown to reddish brown, moist, fine sand							
74	14										
		4	13								
72	16										p 2.8
											p 3.5
											p 2.5
70	18										
68	20	5	13								
											p 3.5
		6	(44)		131	113	16				p 3.3
66	22										p 3.0
				Sandy Lean CLAY (CL): stiff to very stiff, light yellowish brown, moist, oxidation staining, fine to coarse sand							p 1.5
64	24										p 2.8
											p 3.0
62	26										

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 23.0 ft
DEPTH TO WATER: Not Encountered
BACKFILLED WITH: Native Fill
DRILLING DATE: December 21, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-7

Los Osos Water Recycling Facility
San Luis Obispo County, California

LOCATION: Proposed maintenance building at southwest corner of plant site
N 35.30796 W 120.80092

SURFACE EL: 86 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
						ALLUVIUM (Qal) Lean CLAY (CL): medium stiff, brown, moist, trace sand, trace fine subangular gravel							
84	2					- hard - light brown							
						Sandy Lean CLAY (CL): hard, light brown to reddish brown, moist, fine to medium sand, trace black mottling, trace subrounded fine gravel							
82	4					Clayey SAND (SC): light brown to reddish brown, moist, fine sand, gradational contact with unit below							
80	6		1		(--)	Sandy Lean CLAY (CL): hard, light brown, moist, fine sand, oxidation mottling							
78	8					- stiff, light brown to brown, trace subangular gravel							p 3.3 p 3.5
76	10					- sandy lean CLAY with gravel (CL), brown matrix, fine to coarse subrounded to rounded graywacke and serpentinite gravel							
74	12												
72	14												
70	16												
68	18												
66	20												
64	22												
62	24												
60	26												

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 10.0 ft
DEPTH TO WATER: Not Encountered
BACKFILLED WITH: Native Fill
DRILLING DATE: January 23, 2013

DRILLING METHOD: Hand Auger
HAMMER TYPE: 5-lb Slide
DRILLED BY: Fugro Consultants
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-8

Los Osos Water Recycling Facility
San Luis Obispo County, California

LOCATION: West end of proposed oxidation ditch at west end of plant site
N 35.30866 W 120.8007

SURFACE EL: 82.5 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	SAMPLE NO.	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
82		A		**ALLUVIUM (Qal)** Sandy Lean CLAY (CL): very stiff to hard, brown, moist, fine to coarse sand					39	26	
80	2	1	(28)		128	112	14				p 3.5
78	4										p 4.5+
76	6										
74	8	2	(38)	- fine to medium sand, black staining	131	111	18				p 4.5+
72	10	3	(23)	Clayey SAND (SC): medium dense, yellowish brown, moist, fine to coarse sand, trace well rounded gravel up to ¾", pinhole size secondary porosity	123	101	22				
70	12										
68	14										
66	16	4	13	Lean CLAY (CL): very stiff, light brown, moist, mottled reddish brown, blocky texture							p 3.8 p 4.0
64	18			Silty SAND (SM): very dense, light yellowish brown to reddish brown, moist, fine sand							
62	20	5	(50/6")								
60	22										
58	24										
56	26	6	34	- dense, light gray brown, large orange stains and mottles							

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 51.5 ft
DEPTH TO WATER: 33.7 ft
BACKFILLED WITH: 3-sack slurry
DRILLING DATE: December 19, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-9

Los Osos Water Recycling Facility
San Luis Obispo County, California

PLATE A-10a

LOCATION: West end of proposed oxidation ditch at west end of plant site
N 35.30866 W 120.8007

SURFACE EL: 82.5 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
54	28												
52	30		7		(76)		113	107	6				
						- very dense, reddish brown							
50	32												
						Poorly graded SAND with silt (SP-SM): dense, dark yellowish brown, wet							
48	34												
			8		35				24	8			
46	36												
44	38												
42	40		9		(67)								
						- light brown							
40	42												
38	44												
			10		50/6"								
36	46					- very dense							
34	48												
32	50		11		71								
30	52												

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 51.5 ft
DEPTH TO WATER: 33.7 ft
BACKFILLED WITH: 3-sack slurry
DRILLING DATE: December 19, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-9

Los Osos Water Recycling Facility
San Luis Obispo County, California

PLATE A-10b

LOCATION: East end of proposed oxidation ditch

SURFACE EL: 80 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	SAMPLE NO.	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
		A		**ALLUVIUM (Qal)** Sandy lean CLAY with gravel (CL): very stiff to hard, reddish brown matrix, moist, fine to coarse sand, rounded to well rounded sandstone and chert gravel up to ½"			10				
78	2	1A 1B	(40)								
				Clayey SAND (SC): medium dense, brown, moist, homogenous, fine to medium sand							p 4.5+
76	4										
		2	17								
74	6			Lean CLAY (CL): very stiff, light gray, moist, oxidation staining							
72	8										
70	10	3	(25)	Clayey SAND (SC): medium dense, brown to reddish brown matrix, moist, fine to coarse sand, trace rounded to well rounded gravel up to 1"	124	104	19	29			
											p 4.3
68	12										
66	14			Lean CLAY (CL): stiff to hard, light gray brown, moist, black staining, faint mottling, with layers of clayey SAND (SC)							p 3.8
		4	15								p 4.0
64	16										
				Silty SAND (SM): very dense, light yellowish brown, moist, oxidation staining, fine sand							
62	18										
60	20	5	(91)		120	110	9				
58	22										
56	24										
		6	34				12	17			
54	26			- dense							

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 51.5 ft
DEPTH TO WATER: 32.5 ft
BACKFILLED WITH: 3-sack slurry
DRILLING DATE: December 19, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-10

Los Osos Water Recycling Facility
San Luis Obispo County, California

PLATE A-11a

LOCATION: East end of proposed oxidation ditch

SURFACE EL: 80 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	SAMPLE NO.	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
52	28										
50	30	7	(64)								
				- reddish brown to light yellowish brown							
48	32										
46	34			Poorly graded SAND with silt (SP-SM): very dense, reddish brown, wet							
		8	(82/10")		125	102	23	6			
44	36										
42	38										
40	40	9	47								
				- dense							
38	42										
36	44										
		10	53								
34	46			- very dense, interbedded layers of brown to reddish brown silty SAND (SM)							
32	48										
30	50	11	68								
				- light brown to brown, layers of brown and bright reddish brown silty SAND (SM) and sand with SILT (SP-SM)							
28	52										

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 51.5 ft
DEPTH TO WATER: 32.5 ft
BACKFILLED WITH: 3-sack slurry
DRILLING DATE: December 19, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-10

Los Osos Water Recycling Facility
San Luis Obispo County, California

PLATE A-11b

LOCATION: Proposed effluent pump station at northwest corner of plant site

SURFACE EL: 85 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	SAMPLE NO.	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
				ALLUVIUM (Qal)							
84		1A	17	Lean CLAY (CL): stiff to hard, brown to dark brown, moist, trace fine rounded gravel, black staining							p 3.8
	2	1B									
82		A 2	(55)	- hard, brown, moist, fine to coarse rounded to well rounded sand, fine chert and sandstone gravel	133	114	17				p 2.8 p 4.5+
	4										
80		3	(56)	Clayey SAND (SC): medium dense, brown, moist, fine sand							
	6										p 4.5+
78											
	8										
76											
	10	4	21				21	65			
74											
	12										
72											
	14										
70		5	(26)								
	16										p 3.5
68											p 3.3
	18										
66				Silty SAND (SM): dense, light yellowish brown, moist, trace faint oxidation staining							
	20	6	46								
64											
	22										
62											
	24										
60		7	(82/11")								
	26			- very dense							

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 76.5 ft
DEPTH TO WATER: 35.0 ft
BACKFILLED WITH: 3-sack slurry
DRILLING DATE: December 21, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-11

Los Osos Water Recycling Facility
San Luis Obispo County, California

PLATE A-12a

LOCATION: Proposed effluent pump station at northwest corner of plant site

SURFACE EL: 85 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
58													
	28												
56													
	30		8		45								
54						- dense, reddish brown							
	32												
52													
	34												
50			9		(89)		123	103	19				
	36					- very dense							
48													
	38												
46													
	40		10		(50/5")								
44						- moderate yellowish brown, wet							
	42												
42													
	44												
40			11		56								
	46					- dense, ¼" layer of gray fat CLAY (CH) strata, oxidation staining at unit contacts							
38													
	48												
36						Poorly graded SAND with silt (SP-SM): dense, reddish brown, wet							
	50		12		42								
34													
	52												
32													

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 76.5 ft
DEPTH TO WATER: 35.0 ft
BACKFILLED WITH: 3-sack slurry
DRILLING DATE: December 21, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-11

Los Osos Water Recycling Facility
San Luis Obispo County, California

PLATE A-12b

LOCATION: Proposed effluent pump station at northwest corner of plant site

SURFACE EL: 85 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
	54												
-30			13		38				26	7			
	56					- moderate yellowish brown							
-28													
	58					Silty SAND (SM): medium dense, yellowish brown, wet, oxidation horizons at ¼" to 2" intervals, approximately 5" thick strata of lean CLAY with sand (CL), hard, gray to light brown, oxidation staining							
-26													
	60		14A		25	- auger stuck due to flow sands, possibly disturbed			25	48			
-24			14B										
	62												p 3.3
-22													
	64												
-20			15		70								
	66					- very dense							
-18													
	68												
-16													
	70		16		(72/10")								
-14						- very dense, bluish gray, fine to medium sand							
	72												
-12						Fat CLAY (CH): very stiff, dark bluish gray, wet, possible marine CLAY							
	74												
-10			17A		(26)		107	70	52				
	76		17B										p 3.0
-8													p 2.5
	78												
-6													

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 76.5 ft
DEPTH TO WATER: 35.0 ft
BACKFILLED WITH: 3-sack slurry
DRILLING DATE: December 21, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-11

Los Osos Water Recycling Facility
San Luis Obispo County, California

PLATE A-12c

LOCATION: Proposed dewatering building at north end of plant site
N 35.30848 W 120.8001

SURFACE EL: 76 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	SAMPLE NO.	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
		A		**ALLUVIUM (Qal)**							
				Lean CLAY with sand (CL): very stiff to hard, light gray to reddish brown, moist, fine to medium sand, mottled, black staining, trace subangular gravel up to ¾"							
74	2	1	(31)		127	113	13				
											p 4.5+
72	4										
				Fat CLAY (CH): very stiff to hard, brown, moist, black staining, trace fine to coarse sand							
		2	(37)		135	117	15				u 5.9
70	6										p 4.5+
68	8										
66	10	3	(28)								
				- faint reddish brown oxidation mottling							p 4.5
64	12										p 4.0
62	14										
		4	36								
60	16			Silty SAND (SM): dense, light yellowish brown to reddish brown, moist, fine sand							
58	18										
56	20	5	(85)		122	109	12	20			
				- intermixed with clayey SAND (SC), very dense, light yellowish brown							
54	22										
52	24										
50	26										

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 21.5 ft
DEPTH TO WATER: Not Encountered
BACKFILLED WITH: Native Fill
DRILLING DATE: December 19, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-12

Los Osos Water Recycling Facility
San Luis Obispo County, California

LOCATION: Proposed admin building on south side of plant site
N 35.30785 W 120.8005

SURFACE EL: 89 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
			A			**ALLUVIUM (Qal)**					40	27	
88						Sandy Lean CLAY (CL): very stiff to hard, brown, moist, fine sand, pockets of yellowish brown lean CLAY (CL) with greater sand content							
	2		1		(24)		128	110	17				p 4.5+
86						- gray, pinhole voids, rootlets							
	4												
84			2		(90/11")	- reddish brown, faint mottling							
	6												p 4.5+
82													
	8												
80													
	10					Sandy Lean CLAY with gravel (CL): very stiff, reddish brown matrix, moist, rounded to well grounded graywacke gravel up to 2", fine to coarse sand							
78			3A 3B		(38)		131	117	12	23			
	12												
76													
	14												
74						Lean CLAY (CL): very stiff to hard, gray to light gray, moist, subrounded friable oxidized sandstone gravel up to ¾"							
	16		4		17								p 4.3
72													p 3.3
	18												
70													
	20		5		(20)								
68						- abundant oxidation mottling, manganese nodules							p 2.3
	22												
66													
	24												
64													
	26												

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 21.5 ft
DEPTH TO WATER: Not Encountered
BACKFILLED WITH: Native Fill
DRILLING DATE: December 17, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-13

Los Osos Water Recycling Facility
San Luis Obispo County, California

LOCATION: Proposed WAS storage tanks on north side of plant site
N 35.30834 W 120.79986

SURFACE EL: 73.5 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
						ALLUVIUM (Qal)							
			1		(19)	Lean CLAY (CL): stiff to hard, dark brown, moist, fine sand	119	108	10				p 3.8 p 4.5+
72	2												
70	4												
			2		(35)	- very stiff to hard, light brown, oxidation mottling, black staining	130	112	16				
68	6												p 4.5+
66	8												
64	10		3		11	- stiff to hard, light gray, mottled							p 3.5 p 2.5
62	12												
60	14												
			4		(83)	Silty SAND (SM): very dense, light yellowish brown, moist	115	108	6				
58	16												
56	18												
54	20		5		66								
52	22					- reddish brown							
50	24												
48	26												

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 21.5 ft
DEPTH TO WATER: Not Encountered
BACKFILLED WITH: Native Fill
DRILLING DATE: December 18, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-14

Los Osos Water Recycling Facility
San Luis Obispo County, California

LOCATION: Proposed Secondary Clarifier No. 2
N 35.30803 W 120.79993

SURFACE EL: 87 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
			A			**ALLUVIUM (Qal)**							
86						Lean CLAY (CL): very stiff to hard, brown, moist, trace fine sand, secondary porosity and rootlets							
	2		1		(25)		126	109	15				p 4.5+
84													
	4												
82			2		(73)		133	119	13				p 4.5+ u 8.9
	6					- reddish brown, friable sandstone gravel up to ¾"							
80													
	8												
78													
	10		3		(52)	Clayey SAND with gravel (SC): dense, reddish brown matrix, moist, rounded to well rounded chert gravel up to 1"							
76													
	12												
74													
	14												
72			4		9	Fat CLAY (CH): stiff to very stiff, light brown, moist, fine sand, black staining							
	16												p 1.8
70													
	18												
68													
	20		5		(20)		115	87	32		66	41	p 2.3 p 3.8
66						- stiff to hard, mottled							
	22												
64						Silty SAND (SM): dense, light yellowish brown, moist							
	24												
62			6		45								
	26												

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 51.5 ft
DEPTH TO WATER: 39.3 ft
BACKFILLED WITH: 3-sack slurry
DRILLING DATE: December 17, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-15

Los Osos Water Recycling Facility
San Luis Obispo County, California

PLATE A-16a

LOCATION: Proposed Secondary Clarifier No. 2
N 35.30803 W 120.79993

SURFACE EL: 87 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
60													
	28												
58													
	30		7		(68)		125	111	12	19			
56						- very dense, 6" interbed of reddish brown clayey SAND (SC)							
	32												
54													
	34												
52			8		42								
	36					- dense, reddish brown							
50													
	38												
48													
	40		9		(74)								
46						- very dense, wet							
	42												
44													
	44												
42			10		56								
	46												
40													
	48												
38													
	50		11		(73/11")		131	109	20				
36													
	52												
34													

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 51.5 ft
DEPTH TO WATER: 39.3 ft
BACKFILLED WITH: 3-sack slurry
DRILLING DATE: December 17, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-15

Los Osos Water Recycling Facility
San Luis Obispo County, California

PLATE A-16b

LOCATION: Proposed Secondary Clarifier No. 1 on north side of plant site
N 35.3083 W 120.79987

SURFACE EL: 79 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
		A			**ALLUVIUM (Qal)** Lean CLAY (CL): very stiff to hard, brown, moist							
78												
	2	1A 1B 1C		24	- increase in sand content							p 3.8
76												
	4				Clayey SAND with gravel (SC): dense, brown to light brown matrix, moist, fine to coarse sand, rounded gravel up to 1"							
74		2		(51)								
	6				Clayey SAND (SC): dense, brown to reddish brown, moist							
72												
	8											
70												
	10	3		8	Fat CLAY (CH): medium stiff to stiff, brown, moist							
68												p 2.3
	12											p 1.8
66												
	14											
64		4		(26)		121	96	27		66	46	
	16				- very stiff, mottled, black staining							p 4.5+
62					- light yellowish brown, increase in fine sand content							p 4.5+
	18											
60												
	20	5		38	Silty SAND (SM): dense, light yellowish brown, moist, trace oxidation staining							
58												
	22											
56												
	24											
54		6		(45)		120	107	12	15			
	26											

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 41.5 ft
DEPTH TO WATER: 32.5 ft
BACKFILLED WITH: 3-sack slurry
DRILLING DATE: December 18, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-16

Los Osos Water Recycling Facility
San Luis Obispo County, California

PLATE A-17a

LOCATION: Proposed Secondary Clarifier No. 1 on north side of plant site
N 35.3083 W 120.79987

SURFACE EL: 79 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
52													
	28												
50													
	30		7		35								
48						- dense, reddish brown							
	32												
46													
	34												
44			8		(80/11")								
	36					- very dense, brown to reddish brown, wet							
42													
	38												
40													
	40		9		28								
38						- medium dense							
	42												
36													
	44												
34													
	46												
32													
	48												
30													
	50												
28													
	52												
26													

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 41.5 ft
DEPTH TO WATER: 32.5 ft
BACKFILLED WITH: 3-sack slurry
DRILLING DATE: December 18, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-16

Los Osos Water Recycling Facility
San Luis Obispo County, California

PLATE A-17b

LOCATION: Proposed filter pump station near southeast corner of plant site
N 35.30784 W 120.79976

SURFACE EL: 87 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
			A			**ALLUVIUM (Qal)** Fat CLAY (CH): stiff, brown, moist, trace fine sand							
86													
	2		1		11								
84													
	4												
82			2		(80)	Lean CLAY (CL): hard, moderate yellowish brown, moist, abundant black staining, trace fine sand, trace angular fine gravel, pinhole voids	125	109	15				
	6												p 4.5+
80													
	8												
78													
	10		3		37	Clayey SAND with gravel (SC): dense, reddish brown matrix, moist, fine to medium rounded to well rounded graywacke gravel, serpentinite clasts							
76													
	12												
74													
	14												
72													
	16		4A 4B		(20)	Lean CLAY (CL): stiff to very stiff, light brown, moist	123	101	23				u 1.9 p 3.5
70						Lean CLAY with sand (CL): stiff to very stiff, brown, moist, fine sand							p 2.0
	18												
68													
	20		5A 5B		19	Lean CLAY (CL): very stiff, light brown to gray, moist, mottled							
66						Lean CLAY with sand (CL): very stiff to hard, gray, moist, fine sand							p 2.8
	22												p 4.0
64													
	24												
62													
	26												

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 21.5 ft
DEPTH TO WATER: Not Encountered
BACKFILLED WITH: Native Fill
DRILLING DATE: December 17, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-17

Los Osos Water Recycling Facility
San Luis Obispo County, California

LOCATION: Proposed tertiary filters at east end of plant site
N 35.30782 W 120.79971

SURFACE EL: 80 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	SAMPLE NO.	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
		A		**ALLUVIUM (Qal)** Lean CLAY (CL): hard, light brown to reddish brown, moist, mottled, trace fine sand							
78	2	1	(55)		131	113	16				p 4.5+
76	4										
74	6	2	(49)	Clayey SAND (SC): dense, light yellowish to reddish brown matrix, moist, fine to coarse sand, trace rounded to well rounded sandstone and chert gravel, black staining	123	106	16	33	27	8	p 4.5+
72	8										
70	10	3	(29)	Lean CLAY (CL): very stiff, light brown to reddish brown, moist, trace fine sand	121	102	19		32	15	p 2.3
68	12										p 3.3
66	14										
64	16	4	15	- light gray, blocky texture							p 3.8 p 3.5
62	18			Silty SAND (SM): very dense, light yellowish brown, moist, fine sand, faint oxidation staining							
60	20	5	(87/11")								
58	22										
56	24										
54	26										

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 21.5 ft
DEPTH TO WATER: Not Encountered
BACKFILLED WITH: Native Fill
DRILLING DATE: December 18, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-18

Los Osos Water Recycling Facility
San Luis Obispo County, California

LOCATION: Proposed UV facility near northeast corner of plant site
N 35.30874 W 120.79977

SURFACE EL: 74 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	SAMPLE NO.	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
				ALLUVIUM (Qal)					48	33	
		A	21	Lean CLAY (CL): soft, dark brown, moist							
		1A 1B		Sandy lean CLAY (CL): very stiff to hard, brown mottled with dark brown, orange oxide staining, sandstone and chert fragments							
72	2										
		2	(34)								p 4.5+
70	4										
		3	20	Fat CLAY (CH): hard, brown, moist, trace subangular gravel, trace carbon specks							
68	6										
66	8										
64	10	4	(23)		116	87	33		68	44	p 4.5+
				- mottled							p 3.5
62	12										
60	14										
		5	33	Silty SAND (SM): dense, reddish brown to light yellowish brown, moist, fine sand							
58	16										
56	18										
54	20	6	(35)								
				- medium dense, oxidation staining							
52	22										
50	24										
		7	(73)								
48	26			- dense							

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 41.5 ft
DEPTH TO WATER: 26.5 ft
BACKFILLED WITH: 3-sack slurry
DRILLING DATE: December 18, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-19

Los Osos Water Recycling Facility
San Luis Obispo County, California

PLATE A-20a

LOCATION: Proposed UV facility near northeast corner of plant site
N 35.30874 W 120.79977

SURFACE EL: 74 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
						- wet							
-46	28												
-44	30		8		58								
						very dense, reddish brown							
-42	32												
-40	34												
			9		(84/10")								
-38	36												
-36	38												
-34	40		10		39	- driller notes flow sands less than 6"							
-32	42												
-30	44												
-28	46												
-26	48												
-24	50												
-22	52												

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 41.5 ft
DEPTH TO WATER: 26.5 ft
BACKFILLED WITH: 3-sack slurry
DRILLING DATE: December 18, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-19

Los Osos Water Recycling Facility
San Luis Obispo County, California

PLATE A-20b

LOCATION: Proposed electrical building at east end of plant site

SURFACE EL: 79 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
			A			**ALLUVIUM (Qal)** Sandy lean CLAY (CL): hard, dark brown, moist, fine sand							
78													
	2		1		(25)		116	108	7	51			p 4.5+
76													
	4												
74			2		(37)	Lean CLAY (CL): hard, light brown to reddish brown, moist, mottled, black staining							
	6												p 4.5+
72													
	8												
70													
	10		3		15								
68						- grades from lean CLAY with sand (CL) to lean CLAY (CL), very stiff, fine to coarse sand							p 3.8
	12												p 3.3
66													
	14												
64			4		(26)								
	16					- dark brown to light gray, faintly mottled							p 4.3
62													p 4.5+
	18					Silty SAND (SM): dense, light yellowish brown, moist, fine sand							
60													
	20		5		40				8	21			
58													
	22												
56													
	24												
54													
	26												

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 21.5 ft
DEPTH TO WATER: Not Encountered
BACKFILLED WITH: Native Fill
DRILLING DATE: December 18, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-20

Los Osos Water Recycling Facility
San Luis Obispo County, California

LOCATION: Proposed water tank at northeast corner of plant site
N 35.3083 W 120.79919

SURFACE EL: 74 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	SAMPLE NO.	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
				ALLUVIUM (Qal)							
				Lean CLAY with sand (CL): medium stiff to hard, moist, oxidation mottling, rootlets, fine sand							
		A									
72	2	1	(12)		128	114	12				p 4.5+
				Lean CLAY with sand (CL): hard, light brown to gray, faint mottling							
70	4										
		2	(33)					72			
68	6										p 4.5+
66	8										
64	10	3	13								
				- very stiff, oxidation staining, blocky texture							p 3.8
62	12										p 3.8
				Silty SAND (SM): very dense, light yellowish brown, moist, fine sand							
60	14										
		4	(93/11")		115	110	5				
58	16										
56	18										
54	20	5	39				11				
				- dense, grades to reddish brown							
52	22										
		6	(89/11")								
50	24			- very dense							
48	26										

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 25.0 ft
DEPTH TO WATER: Not Encountered
BACKFILLED WITH: Native Fill
DRILLING DATE: December 18, 2012

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: G Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-21

Los Osos Water Recycling Facility
San Luis Obispo County, California

APPENDIX B

DRILL HOLE	DEPTH, ft	SAMPLE NUMBER	MATERIAL DESCRIPTION	UWW pcf	UDW pcf	MC %	FINES %	ATTERBERG LIMITS		COMPACTION TEST		SPECIFIC GRAVITY	SAND EQUIVALENT (SE)	CORROSIVITY TESTS				R-VALUE	EXPANSION INDEX	PERMEABILITY (cm/s)			
								LL	PI	MAX DD pcf	OPT MC %			R	pH	Cl	So_4 (ppm)						
Composite	0.0	Comp.	Sandy Lean CLAY (CL)							117.7	13.3												
DH-1	1.5	1	Lean CLAY (CL)	120	106	12																	
DH-1	15.0	4	Lean CLAY (CL)	123	97	27																	
DH-1	25.0	6	Sandy Lean CLAY (CL)	126	107	18	35																
DH-1	40.0	9	Poorly graded SAND with silt (SP-SM)			26	7																
DH-2	14.0	4	Lean CLAY with sand (CL)	121	95	27		34	17														
DH-2	24.0	6	Clayey SAND (SC)	114	106	8	13																
DH-2	34.0	8	Poorly graded SAND with silt (SP-SM)	128	105	21	6																
DH-2	39.0	B	Silty SAND (SM)				17			122.9	10.0												
DH-3	5.0	2	Lean CLAY (CL)	132	113	17																	
DH-3	15.0	4	Lean CLAY (CL)	121	98	23	86	46	27														
DH-3	20.0	A	Fat CLAY (CH)					64	48	114.6	17.0								121				
DH-3	30.0	7	Silty SAND (SM)			13	19																
DH-3	45.0	10	Poorly graded SAND with silt (SP-SM)	125	101	24	6													1.2E-3			
DH-4	1.0	A	Fat CLAY (CH)											798	7.80	141	106		105				
DH-4	5.0	2	Sandy Lean CLAY (CL)	132	115	15		32	18														
DH-4	20.0	5	Fat CLAY (CH)			30	99	56	34														
DH-4	35.0	8	Poorly graded SAND with silt (SP-SM)	124	105	18	8													1.3E-3			
DH-6	3.0	2	Sandy Fat CLAY (CH)	128	114	13																	
DH-6	25.0	7	Poorly graded SAND with silt (SP-SM)	129	106	22	5																
DH-7	3.5	1	Lean CLAY (CL)	128	107	19																	
DH-7	10.0	3	Sandy Fat CLAY (CH)	124	105	18																	
DH-7	21.5	6	Sandy Lean CLAY (CL)	131	113	16																	
DH-9	0.0	A	Sandy Lean CLAY (CL)					39	26	124.3	11.4								58				
DH-9	2.0	1	Sandy Lean CLAY (CL)	128	112	14																	
DH-9	7.0	2	Sandy Lean CLAY (CL)	131	111	18																	
DH-9	10.0	3	Clayey SAND (SC)	123	101	22																	
DH-9	30.0	7	Silty SAND (SM)	113	107	6																	
DH-9	35.0	8	Poorly graded SAND with silt (SP-SM)			24	8																
DH-10	1.5	1	Sandy Lean CLAY (CL)			10																	

SUMMARY OF LABORATORY TEST RESULTS

Los Osos Water Recycling Facility
San Luis Obispo County, California

LAB SUMMARY SLO (WITHOUT STRENGTH DATA) _ F:\FUGRO SLO GEOTECH DOCUMENTS\GINTIGINT PROJECTS\04.6212.0178.GPJ_ 4/2/13 10:44 AM-cab

DRILL HOLE	DEPTH, ft	SAMPLE NUMBER	MATERIAL DESCRIPTION	UWW pcf	UDW pcf	MC %	FINES %	ATTERBERG LIMITS		COMPACTION TEST		SPECIFIC GRAVITY	SAND EQUIVALENT (SE)	CORROSIVITY TESTS				R-VALUE	EXPANSION INDEX	PERMEABILITY (cm/s)			
								LL	PI	MAX DD pcf	OPT MC %			R	pH	Cl	So_4 (ppm)						
DH-10	5.0	2	Clayey SAND (SC)											2663	7.50	15	20						
DH-10	10.0	3	Clayey SAND (SC)	124	104	19	29																
DH-10	15.0	4	Lean CLAY (CL)											1306	8.20	16	30						
DH-10	20.0	5	Silty SAND (SM)	120	110	9								10472	8.20	4	11						
DH-10	25.0	6	Silty SAND (SM)			12	17																
DH-10	35.0	8	Poorly graded SAND with silt (SP-SM)	125	102	23	6																
DH-11	2.5	2	Lean CLAY (CL)	133	114	17																	
DH-11	10.0	4	Clayey SAND (SC)			21	65																
DH-11	35.0	9	Silty SAND (SM)	123	103	19																	
DH-11	40.0	10	Poorly graded SAND with silt (SP-SM)	127	104	21	10													1.0E-3			
DH-11	55.0	13	Poorly graded SAND with silt (SP-SM)			26	7																
DH-11	60.0	14	Silty SAND (SM)			25	48																
DH-11	75.0	17	Fat CLAY (CH)	107	70	52																	
DH-12	1.5	1	Lean CLAY (CL)	127	113	13																	
DH-12	5.0	2	Fat CLAY (CH)	135	117	15																	
DH-12	20.0	5	Clayey SAND (SC)	122	109	12	20																
DH-13	0.0	A	Sandy Lean CLAY (CL)					40	27	119.2	13.3			1049	7.30	9	106		84				
DH-13	1.5	1	Fat CLAY (CH)	128	110	17																	
DH-13	10.5	3A	Sandy Lean CLAY with gravel (CL)	131	117	12	23																
DH-14	1.0	1	Lean CLAY (CL)	119	108	10																	
DH-14	5.0	2	Lean CLAY (CL)	130	112	16																	
DH-14	15.0	4	Silty SAND (SM)	115	108	6																	
DH-15	1.5	1	Lean CLAY (CL)	126	109	15																	
DH-15	5.0	2	Lean CLAY (CL)	133	119	13																	
DH-15	20.0	5	Fat CLAY (CH)	115	87	32		66	41														
DH-15	30.0	7	Clayey SAND (SC)	125	111	12	19																
DH-15	50.0	11	Silty SAND (SM)	131	109	20																	
DH-16	15.0	4	Fat CLAY (CH)	121	96	27		66	46														
DH-16	25.0	6	Silty SAND (SM)	120	107	12	15																
DH-17	0.0	A	Fat CLAY (CH)															13					

SUMMARY OF LABORATORY TEST RESULTS

Los Osos Water Recycling Facility
San Luis Obispo County, California

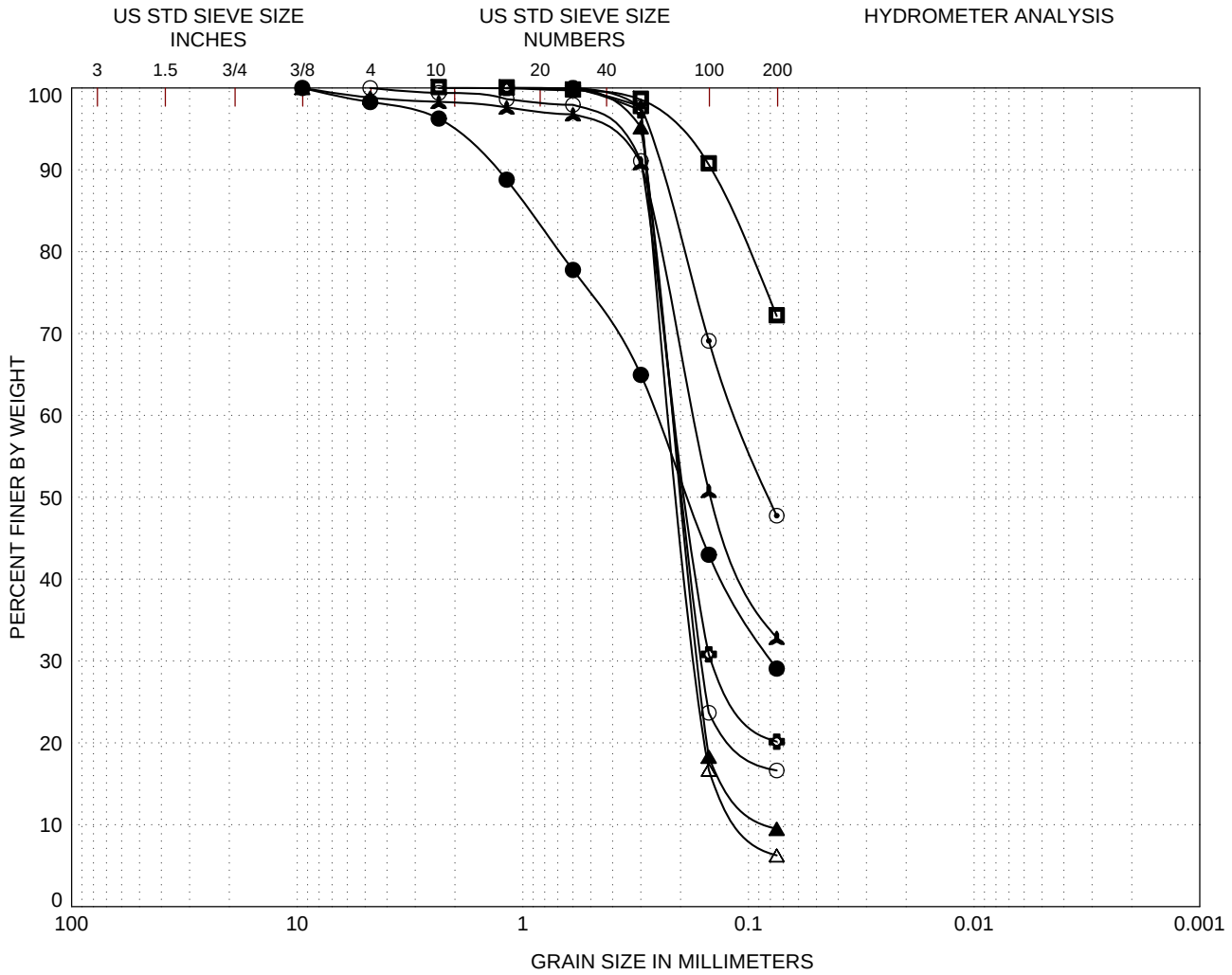
LAB SUMMARY SLO (WITHOUT STRENGTH DATA) _ F:\FUGRO SLO GEOTECH DOCUMENTS\GINTIGINT PROJECTS\04.6212.0178.GPJ_ 4/2/13 10:44 AM cab

DRILL HOLE	DEPTH, ft	SAMPLE NUMBER	MATERIAL DESCRIPTION	UWW pcf	UDW pcf	MC %	FINES %	ATTERBERG LIMITS		COMPACTION TEST		SPECIFIC GRAVITY	SAND EQUIVALENT (SE)	CORROSIVITY TESTS				R-VALUE	EXPANSION INDEX	PERMEABILITY (cm/s)			
								LL	PI	MAX DD pcf	OPT MC %			R	pH	Cl	So_4 (ppm)						
DH-17	5.0	2	Sandy Lean CLAY (CL)	125	109	15																	
DH-17	15.5	4A	Lean CLAY (CL)	123	101	23																	
DH-18	1.5	1	Lean CLAY (CL)	131	113	16																	
DH-18	5.0	2	Clayey SAND (SC)	123	106	16	33	27	8										46				
DH-18	10.0	3	Lean CLAY (CL)	121	102	19		32	15														
DH-19	0.0	A	Sandy Lean CLAY (CL)					48	33	122.3	12.9			1464	7.80	32	55		117				
DH-19	10.0	4	Fat CLAY (CH)	116	87	33		68	44														
DH-20	0.0	A	Sandy Lean CLAY (CL)											3640	6.80	16	38		34				
DH-20	1.5	1	Lean CLAY (CL)	116	108	7	51																
DH-20	20.0	5	Silty SAND (SM)			8	21																
DH-21	1.5	1	Lean CLAY (CL)	128	114	12																	
DH-21	5.0	2	Fat CLAY with sand (CH)				72																
DH-21	15.0	4	Silty SAND (SM)	115	110	5																	
DH-21	20.0	5	Silty SAND (SM)			11																	

SUMMARY OF LABORATORY TEST RESULTS

Los Osos Water Recycling Facility
San Luis Obispo County, California

LAB SUMMARY SLO (WITHOUT STRENGTH DATA) _ F:\FUGRO SLO GEOTECH DOCUMENTS\GINTIGINT PROJECTS\04.6212.0178.GPJ_ 4/2/13 10:44 AM-cab

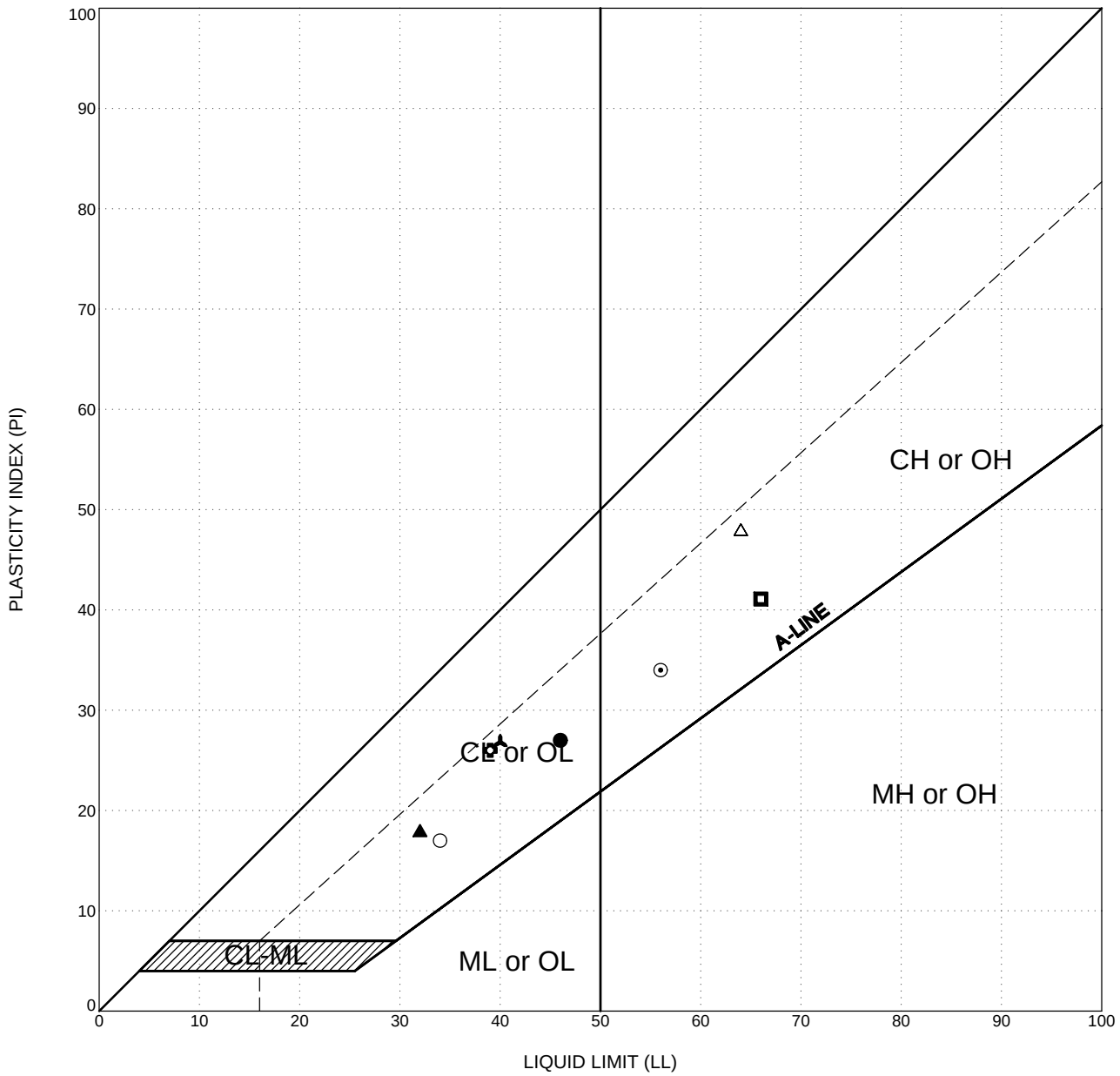


GRAVEL		SAND			SILT or CLAY
Coarse	Fine	Coarse	Medium	Fine	

LEGEND	(location)	(depth,ft)	CLASSIFICATION	Cc	Cu
○	DH-2	39.0	Silty SAND (SM)		
●	DH-10	10.0	Clayey SAND (SC)		
△	DH-10	35.0	Poorly graded SAND with silt (SP-SM)	1.4	2.3
▲	DH-11	40.0	Poorly graded SAND with silt (SP-SM)	1.6	2.8
⊙	DH-11	60.0	Silty SAND (SM)		
✿	DH-12	20.0	Clayey SAND (SC)		
⅄	DH-18	5.0	Clayey SAND (SC)		
◘	DH-21	5.0	Fat CLAY with sand (CH)		

GRAIN SIZE CURVES
Los Osos Water Recycling Facility
San Luis Obispo County, California

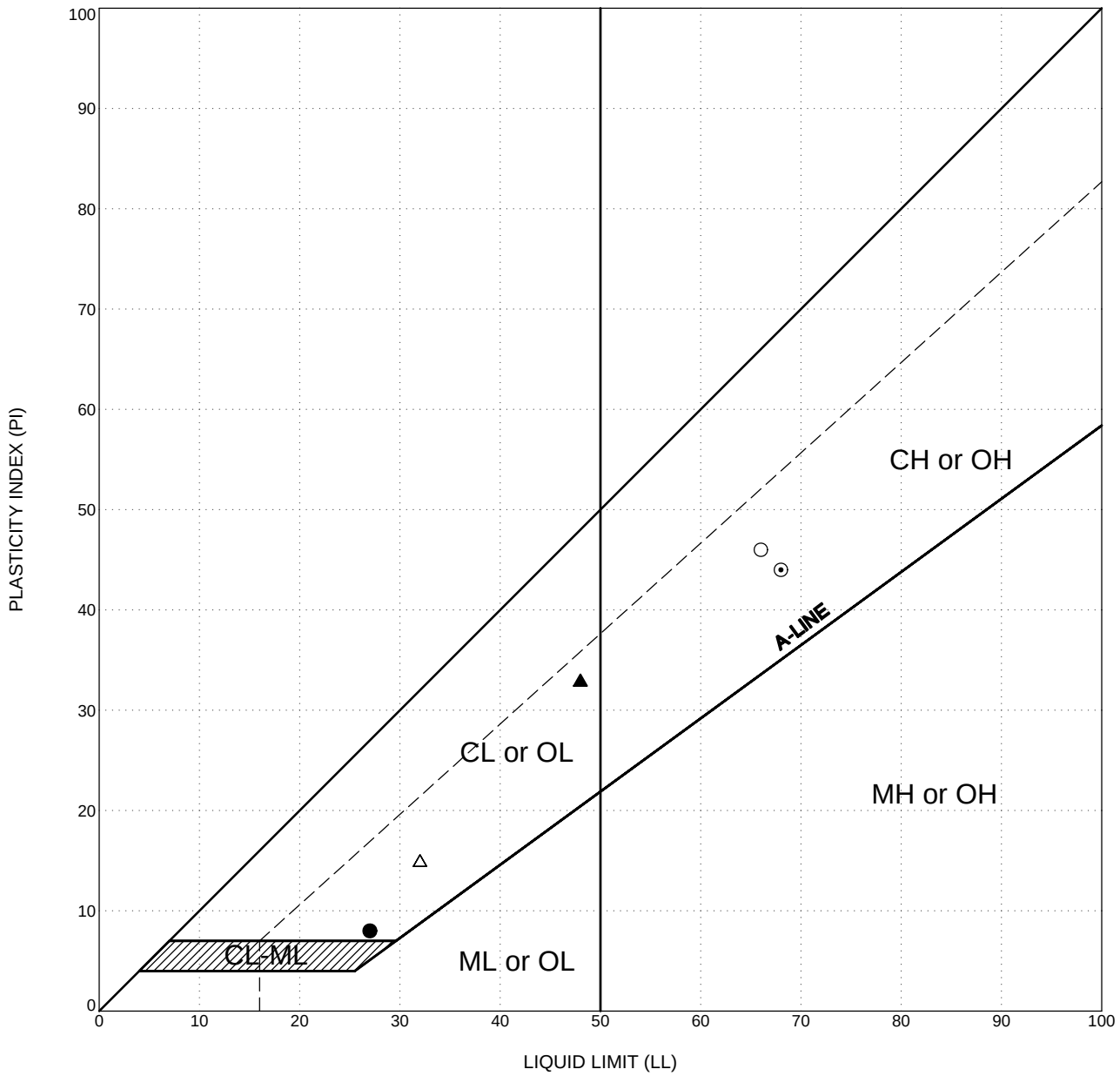
PLATE B-2



LEGEND	location	depth, ft	CLASSIFICATION	ATTERBERG LIMITS TEST RESULTS LIQUID LIMIT(LL)	PLASTIC LIMIT(PL)	PLASTICITY INDEX (PI)
○	DH-2	14.0	Lean CLAY with sand (CL)	34	17	17
●	DH-3	15.0	Lean CLAY (CL)	46	19	27
△	DH-3	20.0	Fat CLAY (CH)	64	16	48
▲	DH-4	5.0	Sandy Lean CLAY (CL)	32	14	18
⊙	DH-4	20.0	Fat CLAY (CH)	56	22	34
✿	DH-9	0.0	Sandy Lean CLAY (CL)	39	13	26
⅄	DH-13	0.0	Sandy Lean CLAY (CL)	40	13	27
◘	DH-15	20.0	Fat CLAY (CH)	66	25	41

PLASTICITY CHART
Los Osos Water Recycling Facility
San Luis Obispo County, California

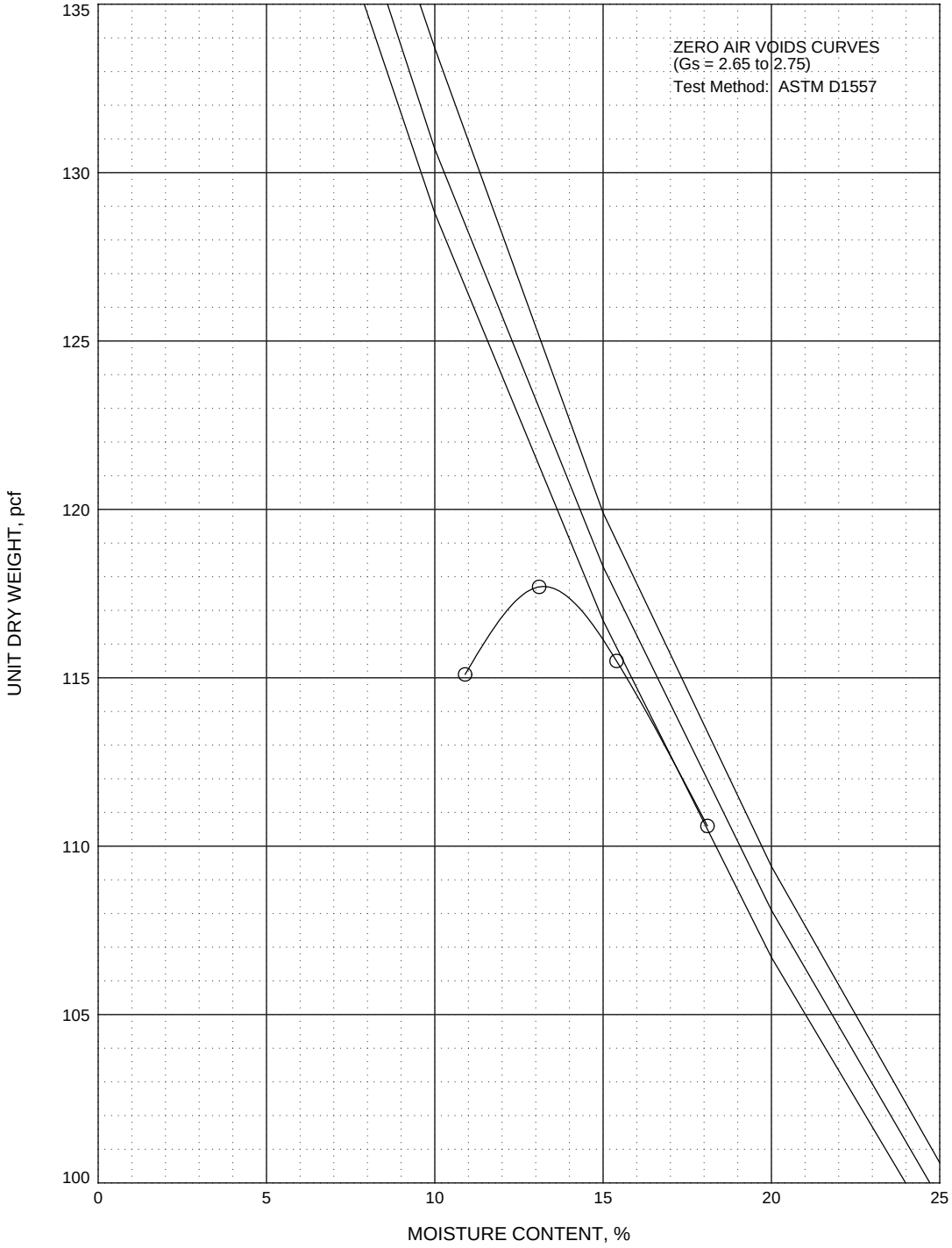
PLATE B-3a



LEGEND	location	depth, ft	CLASSIFICATION	ATTERBERG LIMITS TEST RESULTS LIQUID LIMIT(LL)	PLASTIC LIMIT(PL)	PLASTICITY INDEX (PI)
○	DH-16	15.0	Fat CLAY (CH)	66	20	46
●	DH-18	5.0	Clayey SAND (SC)	27	19	8
△	DH-18	10.0	Lean CLAY (CL)	32	17	15
▲	DH-19	0.0	Sandy Lean CLAY (CL)	48	15	33
⊙	DH-19	10.0	Fat CLAY (CH)	68	24	44

PLASTICITY CHART
Los Osos Water Recycling Facility
San Luis Obispo County, California

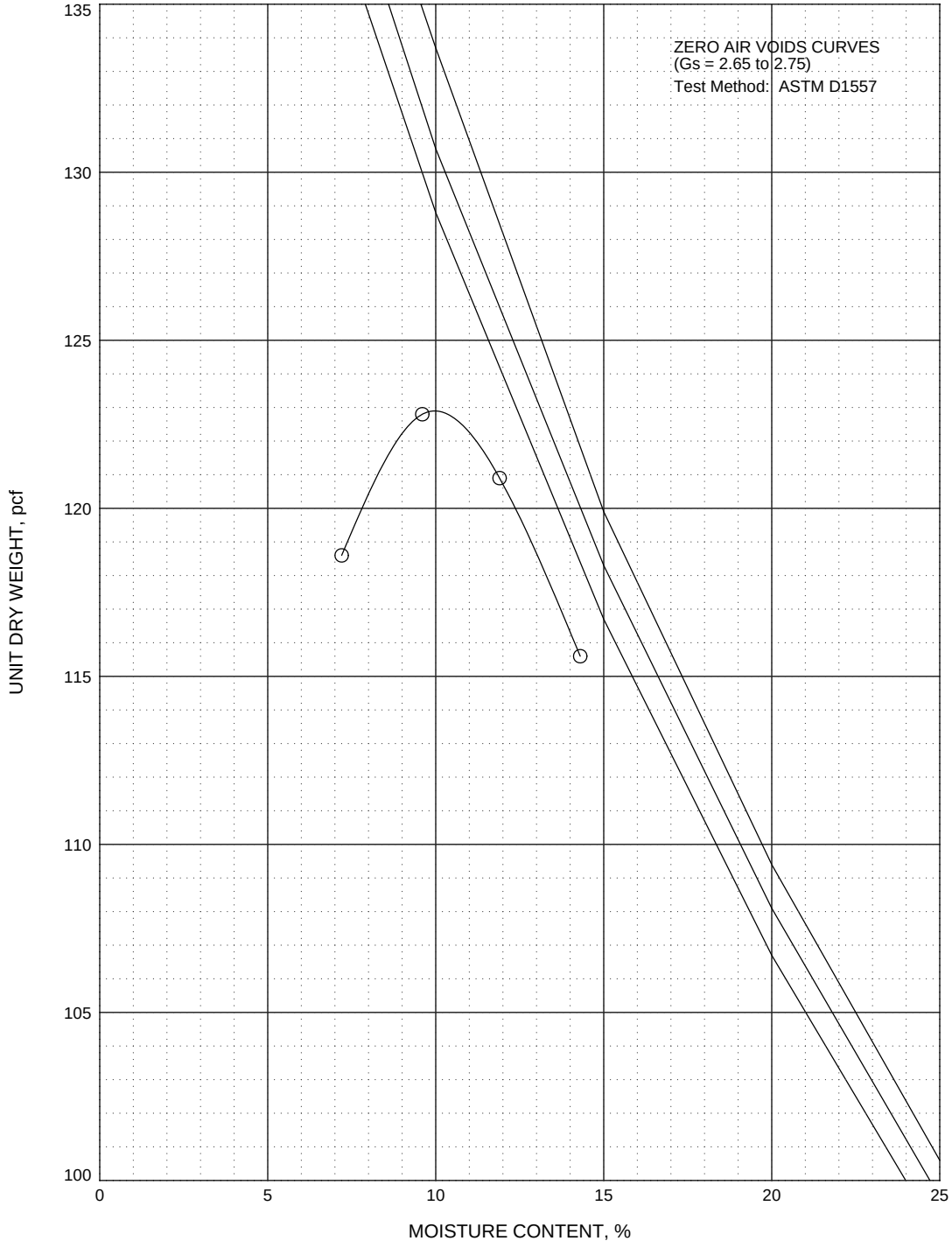
PLATE B-3b



LEGEND (location)	depth, ft	CLASSIFICATION	MAXIMUM UNIT DRY WEIGHT, pcf	OPTIMUM WATER CONTENT, %
○ Composite	0.0	Sandy Lean CLAY (CL)	117.7	13.3

COMPACTION TEST RESULTS
Los Osos Water Recycling Facility
San Luis Obispo County, California

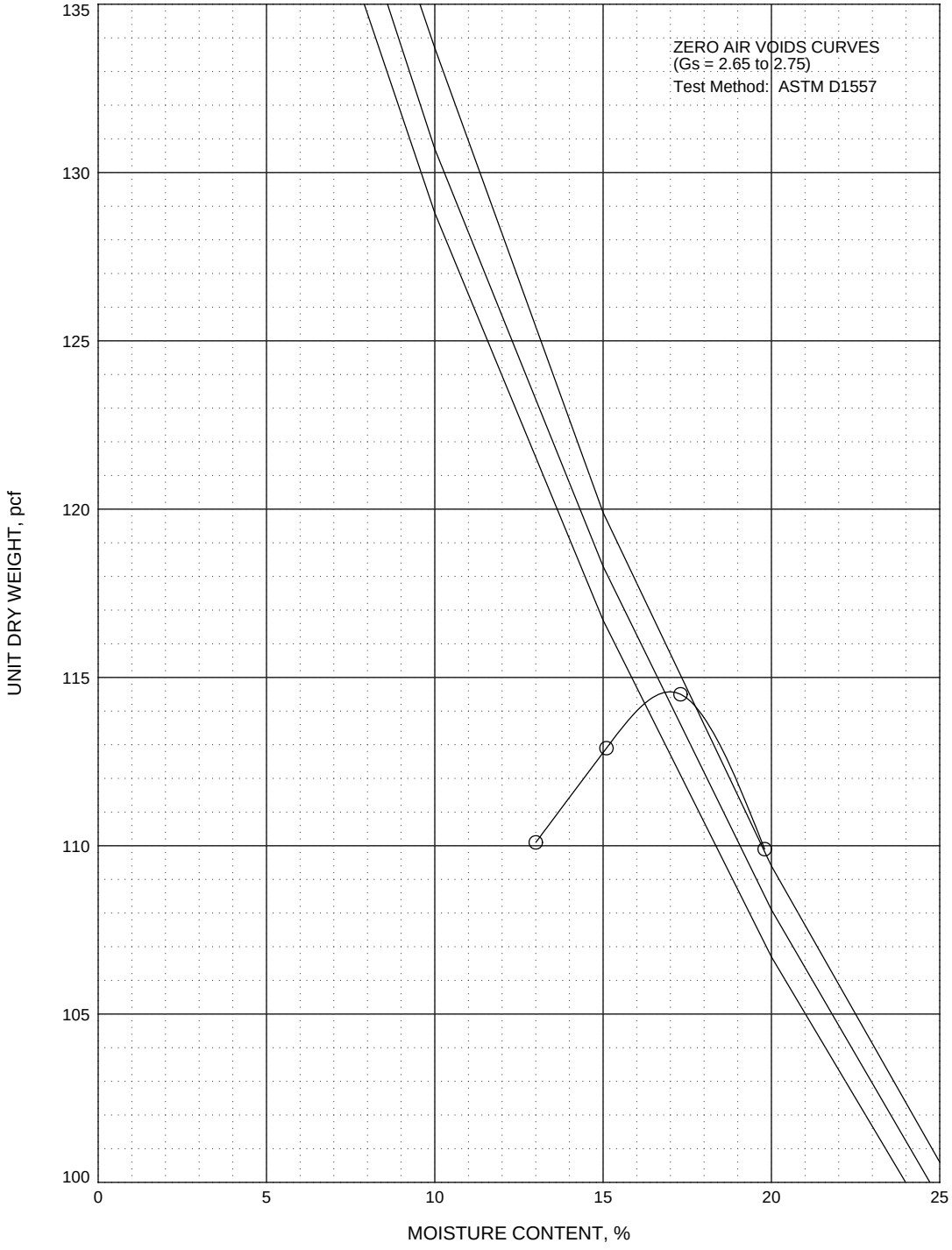
PLATE B-4a



LEGEND	(location)	depth, ft	CLASSIFICATION	MAXIMUM UNIT DRY WEIGHT, pcf	OPTIMUM WATER CONTENT, %
○	DH-2	39.0	Silty SAND (SM)	122.9	10.0

COMPACTION TEST RESULTS
Los Osos Water Recycling Facility
San Luis Obispo County, California

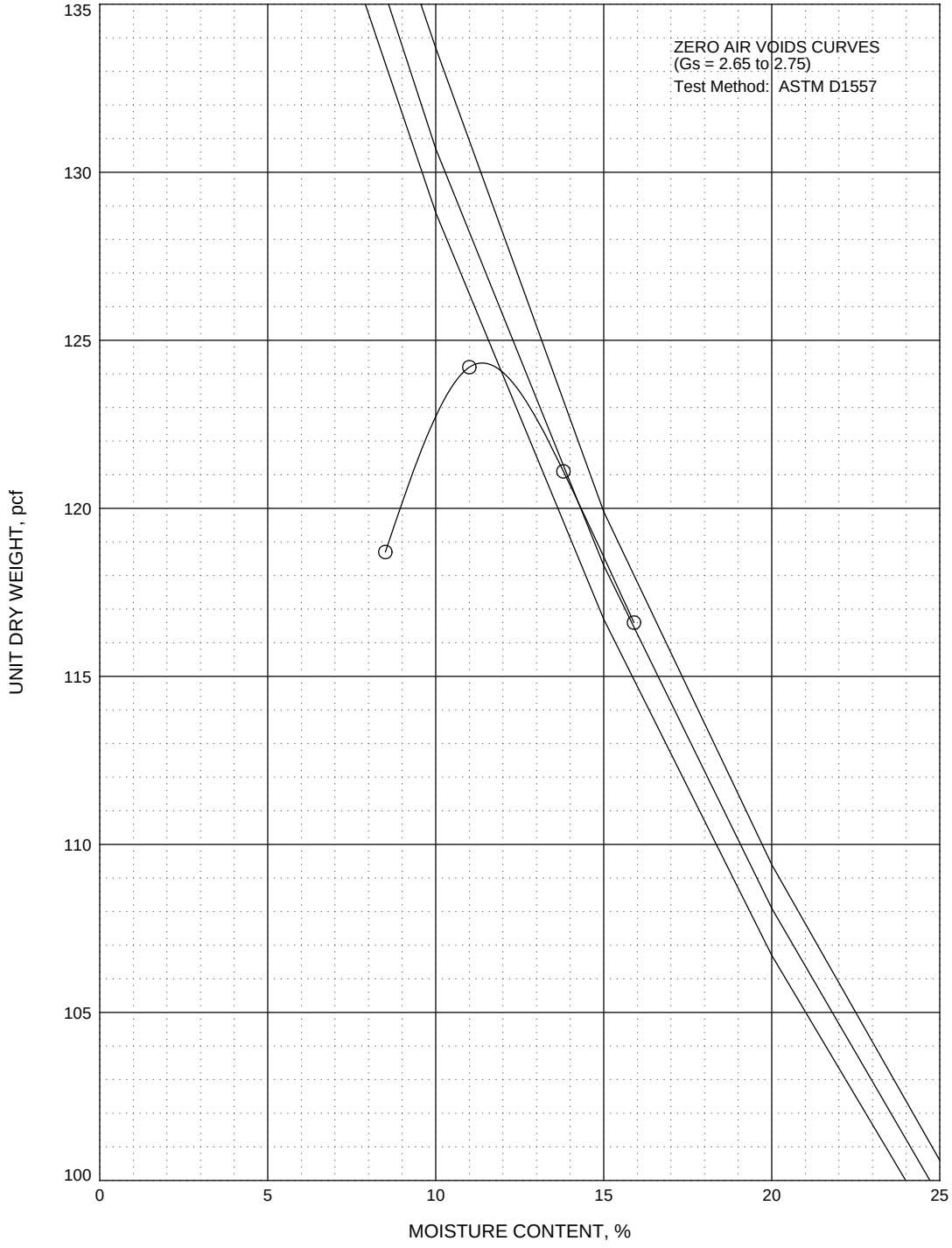
PLATE B-4b



LEGEND (location)	depth, ft	CLASSIFICATION	MAXIMUM UNIT DRY WEIGHT, pcf	OPTIMUM WATER CONTENT, %
○ DH-3	20.0	Fat CLAY (CH)	114.6	17.0

COMPACTION TEST RESULTS
Los Osos Water Recycling Facility
San Luis Obispo County, California

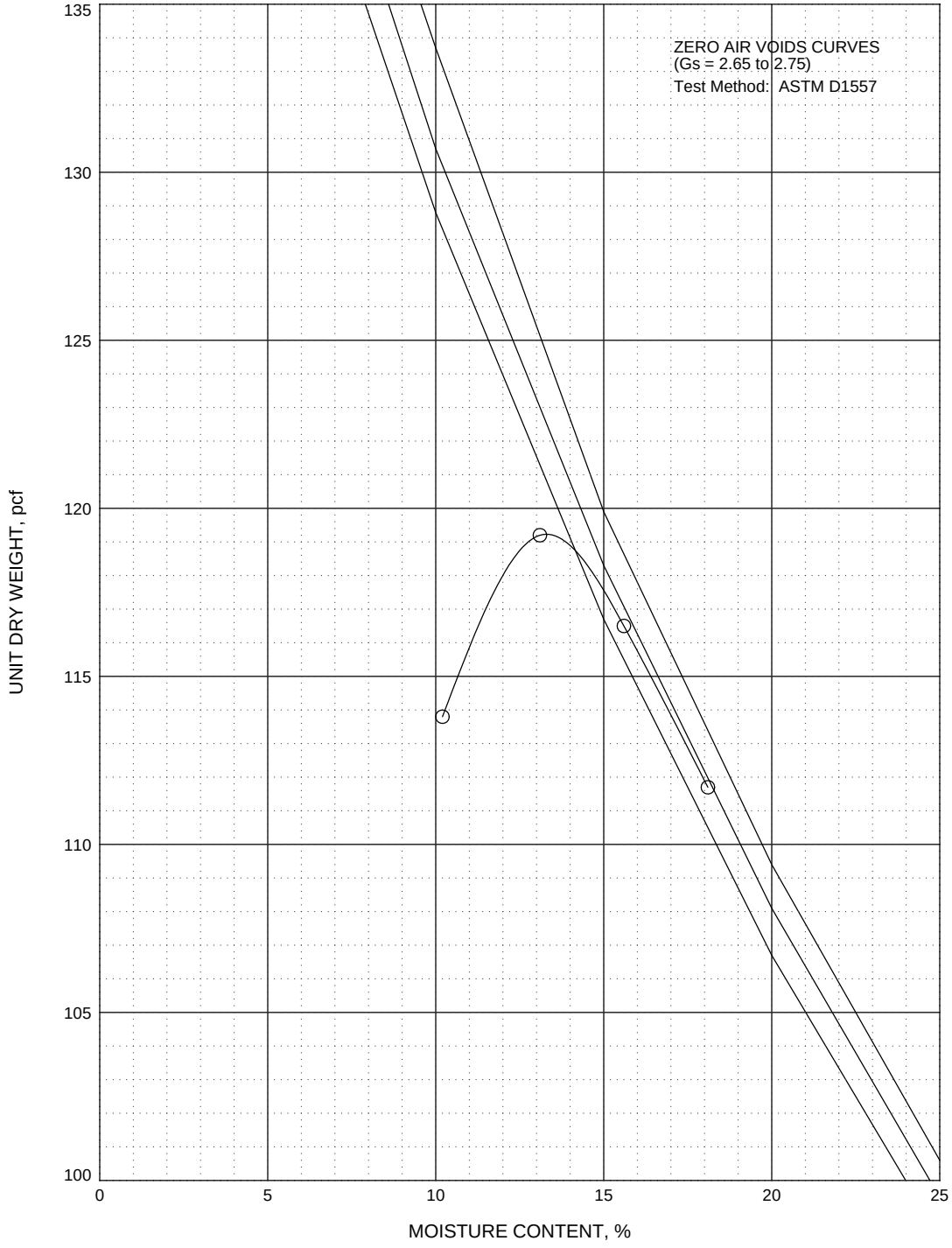
PLATE B-4c



LEGEND	(location)	depth, ft	CLASSIFICATION	MAXIMUM UNIT DRY WEIGHT, pcf	OPTIMUM WATER CONTENT, %
○	DH-9	0.0	Sandy Lean CLAY (CL)	124.3	11.4

COMPACTION TEST RESULTS
Los Osos Water Recycling Facility
San Luis Obispo County, California

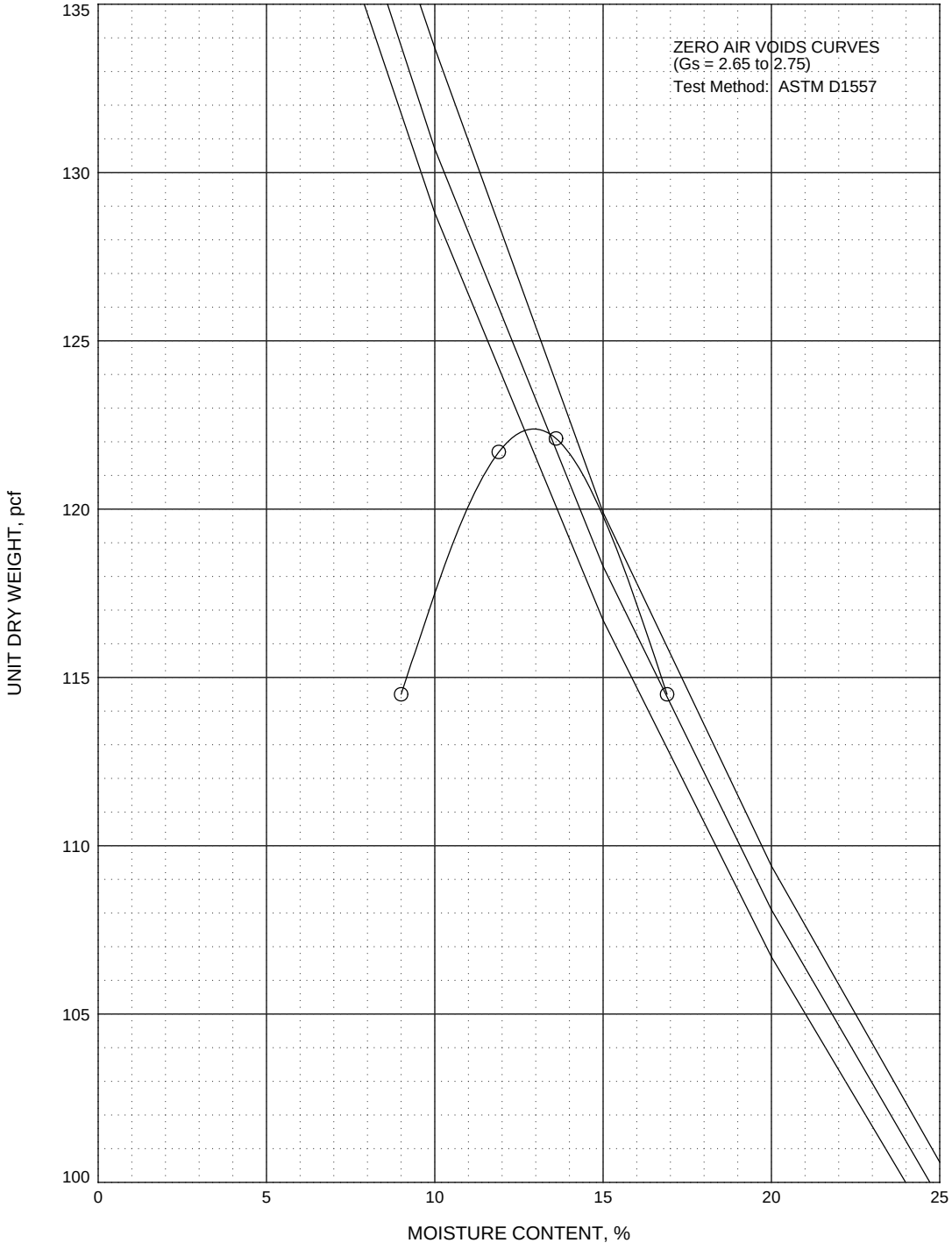
PLATE B-4d



LEGEND	(location)	depth, ft	CLASSIFICATION	MAXIMUM UNIT DRY WEIGHT, pcf	OPTIMUM WATER CONTENT, %
○	DH-13	0.0	Sandy Lean CLAY (CL)	119.2	13.3

COMPACTION TEST RESULTS
Los Osos Water Recycling Facility
San Luis Obispo County, California

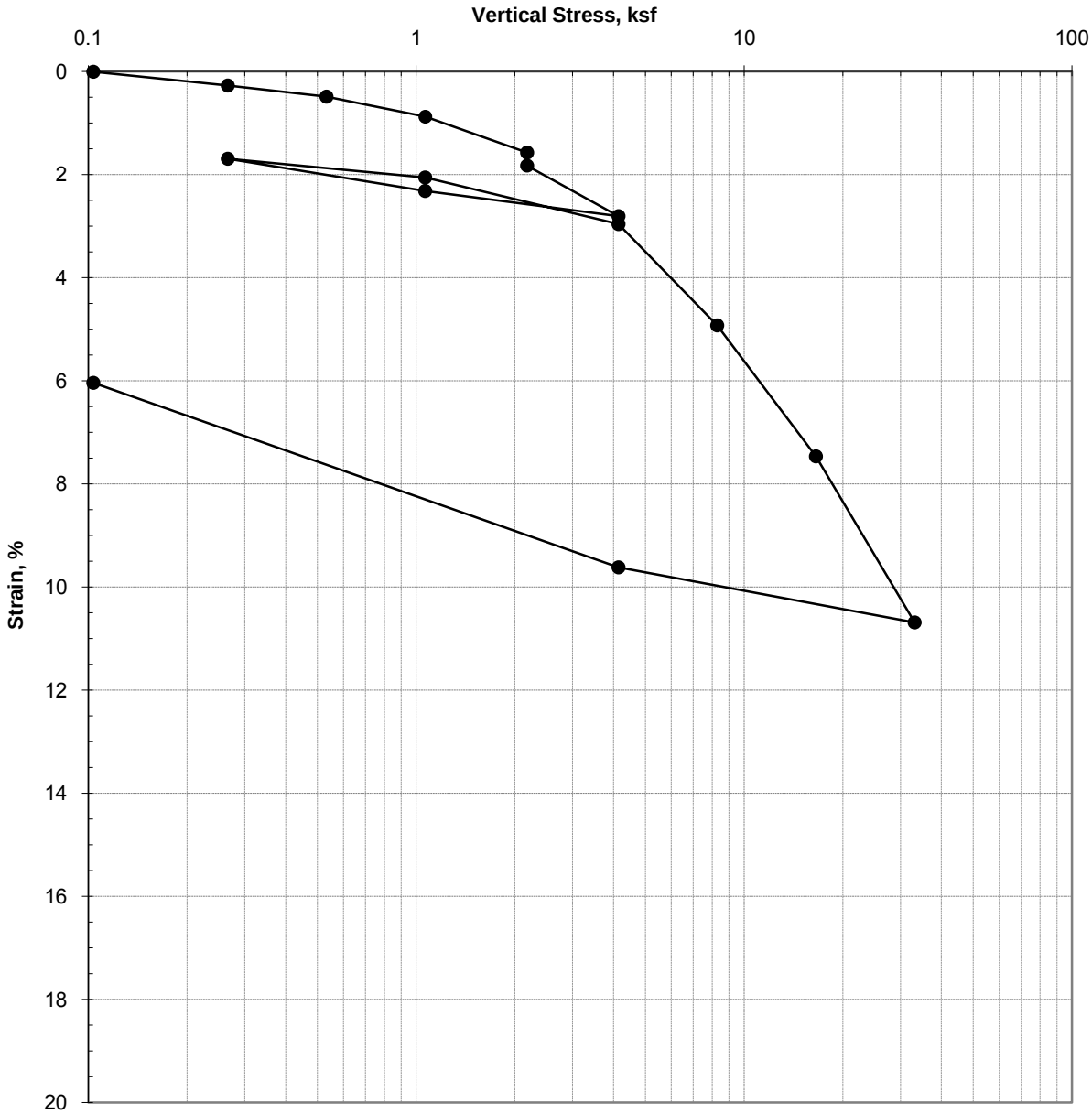
PLATE B-4e



LEGEND	(location)	depth, ft	CLASSIFICATION	MAXIMUM UNIT DRY WEIGHT, pcf	OPTIMUM WATER CONTENT, %
○	DH-19	0.0	Sandy Lean CLAY (CL)	122.3	12.9

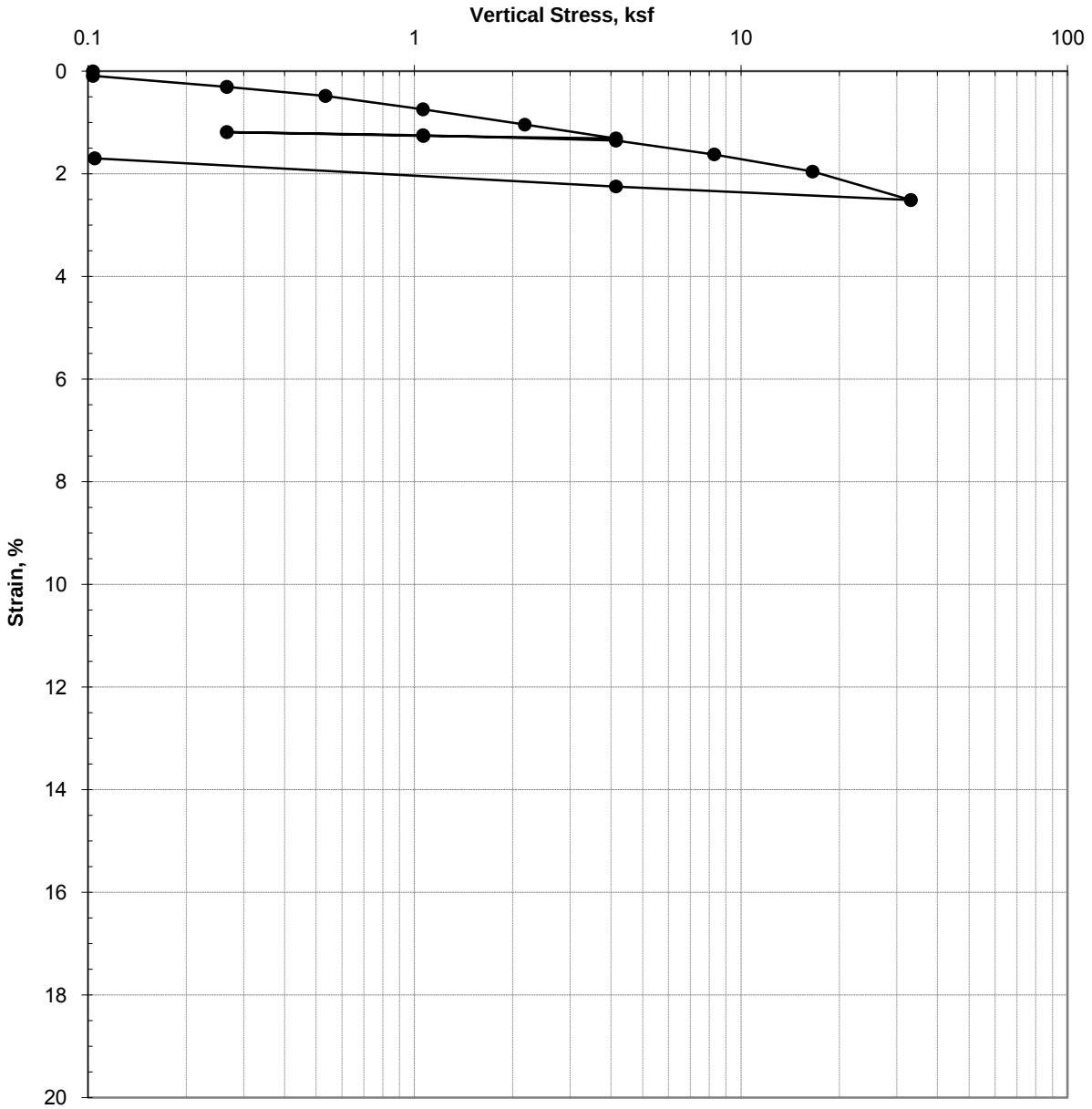
COMPACTION TEST RESULTS
Los Osos Water Recycling Facility
San Luis Obispo County, California

PLATE B-4f



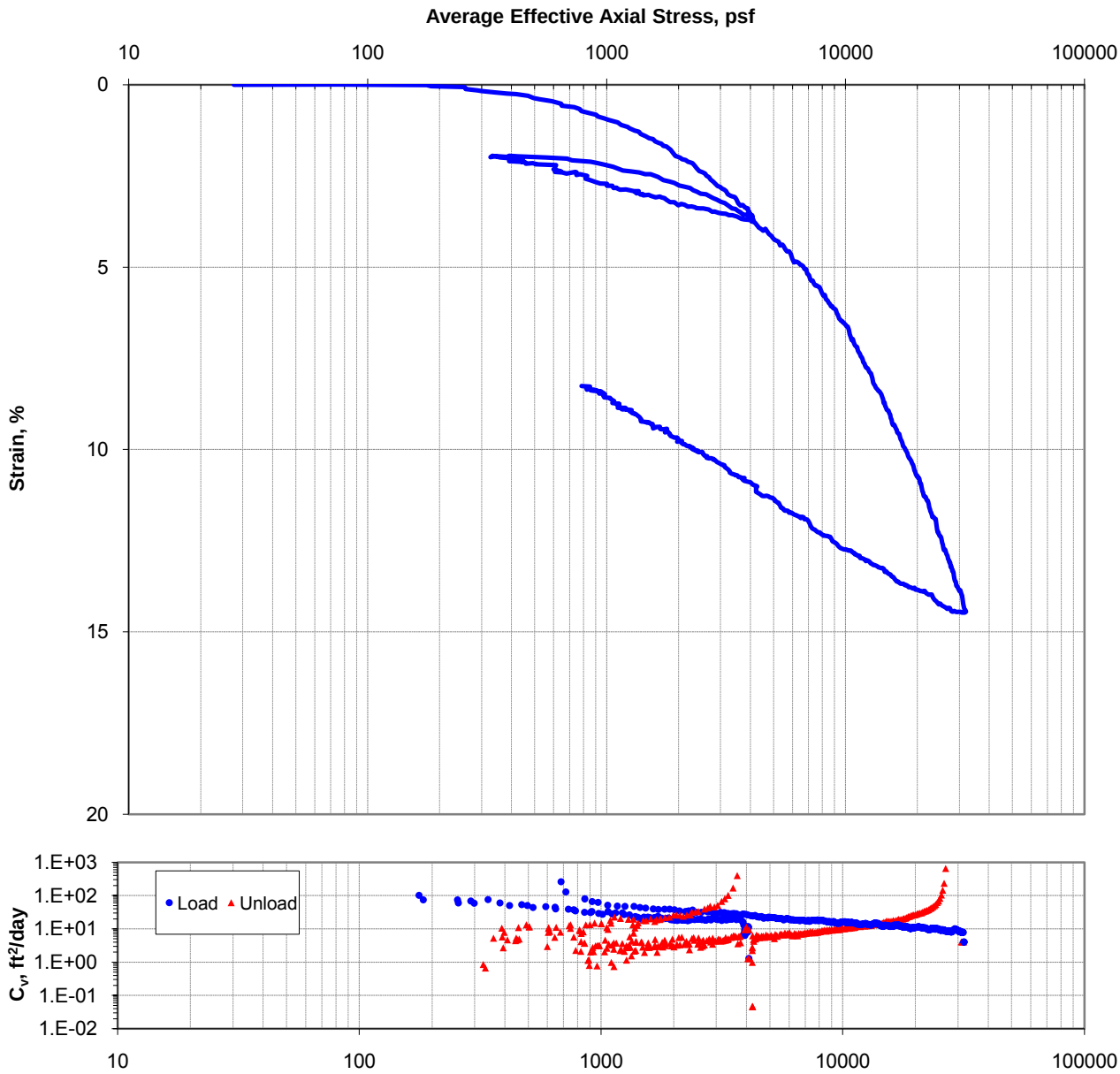
SAMPLE ID	Boring, Sample #, Depth	DH-09 , #3 , 10.0 ft		SUMMARY	Preconsolidation Pressure, ksf	---
	USCS Classification:	Clayey SAND (SC): yellowish brown, moist			Inundation Increment, ksf	2.18
					Liquid Limit	---
PROPERTIES		Initial	Final		Plastic Limit	---
					Plasticity Index	---
	Water Content, %	22.0%	20.9%		Passing #200	---
	Dry Unit Weight, pcf	100.9	107.3		Estimated Gs	2.69
	Saturation, %	89%	100%	REMARKS	Test Method: D2435	
	Voids Ratio	0.67	0.56			
	Diameter, in	2.42	2.42			
	Height, in	1.00	0.94			

CONSOLIDATION TEST RESULTS
Los Osos Water Recycling Facility
San Luis Obispo County, California



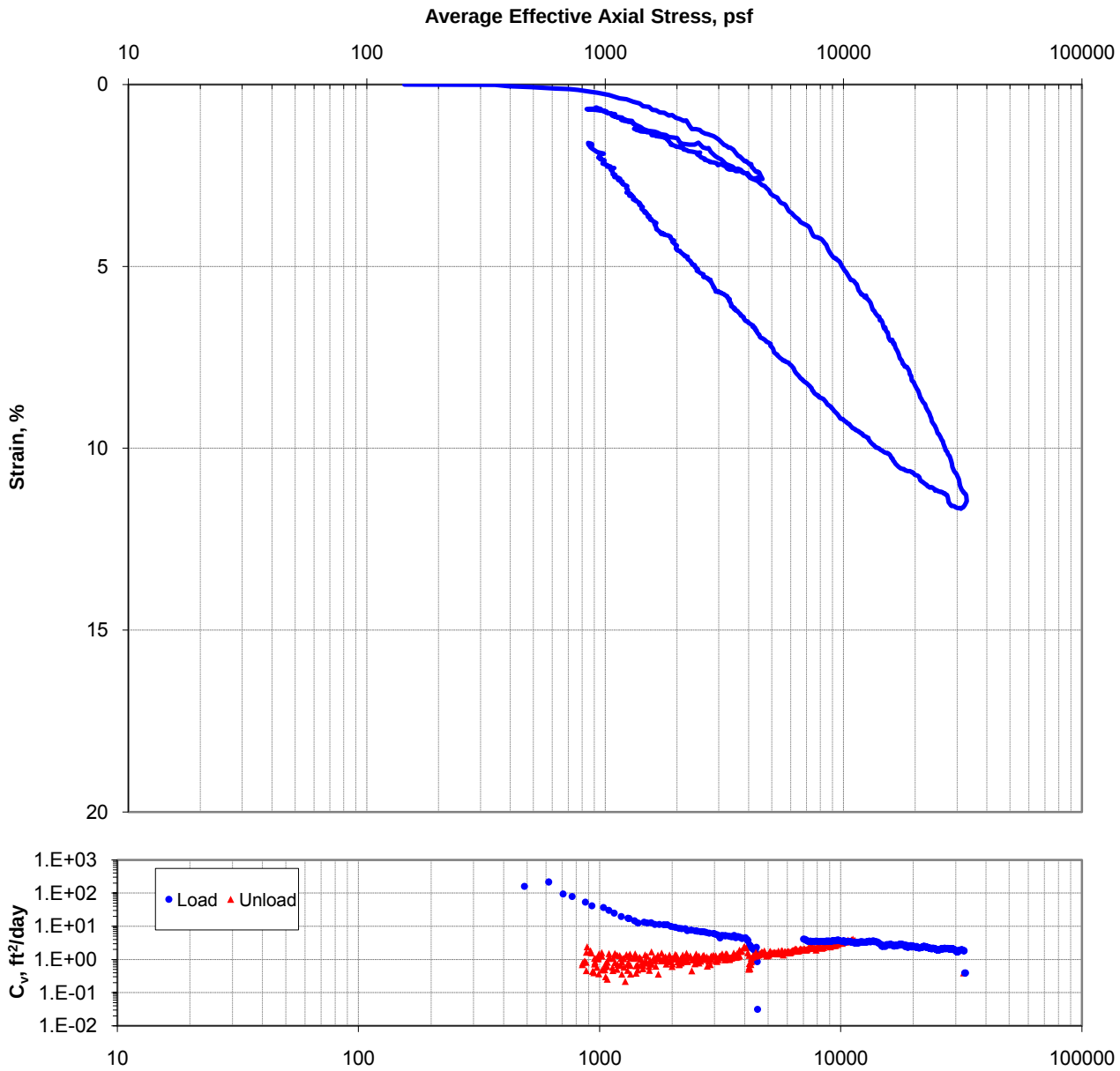
SAMPLE ID	Boring, Sample #, Depth	DH-10 , #8 , 35.0 ft		SUMMARY	Preconsolidation Pressure, ksf	---
	USCS Classification:	Poorly-graded SAND with silt (SP-SM): yellow, wet, fine sand			Inundation Increment, ksf	0.10
					Liquid Limit	---
PROPERTIES		Initial	Final		Plastic Limit	---
					Plasticity Index	---
	Water Content, %	22.9%	22.4%		Passing #200	6.0%
	Dry Unit Weight, pcf	101.9	103.6		Estimated Gs	2.65
	Saturation, %	97%	100%	REMARKS	Test Method: D2435	
	Voids Ratio	0.62	0.60			
	Diameter, in	2.42	2.42			
	Height, in	1.00	0.98			

CONSOLIDATION TEST RESULTS
Los Osos Water Recycling Facility
San Luis Obispo County, California



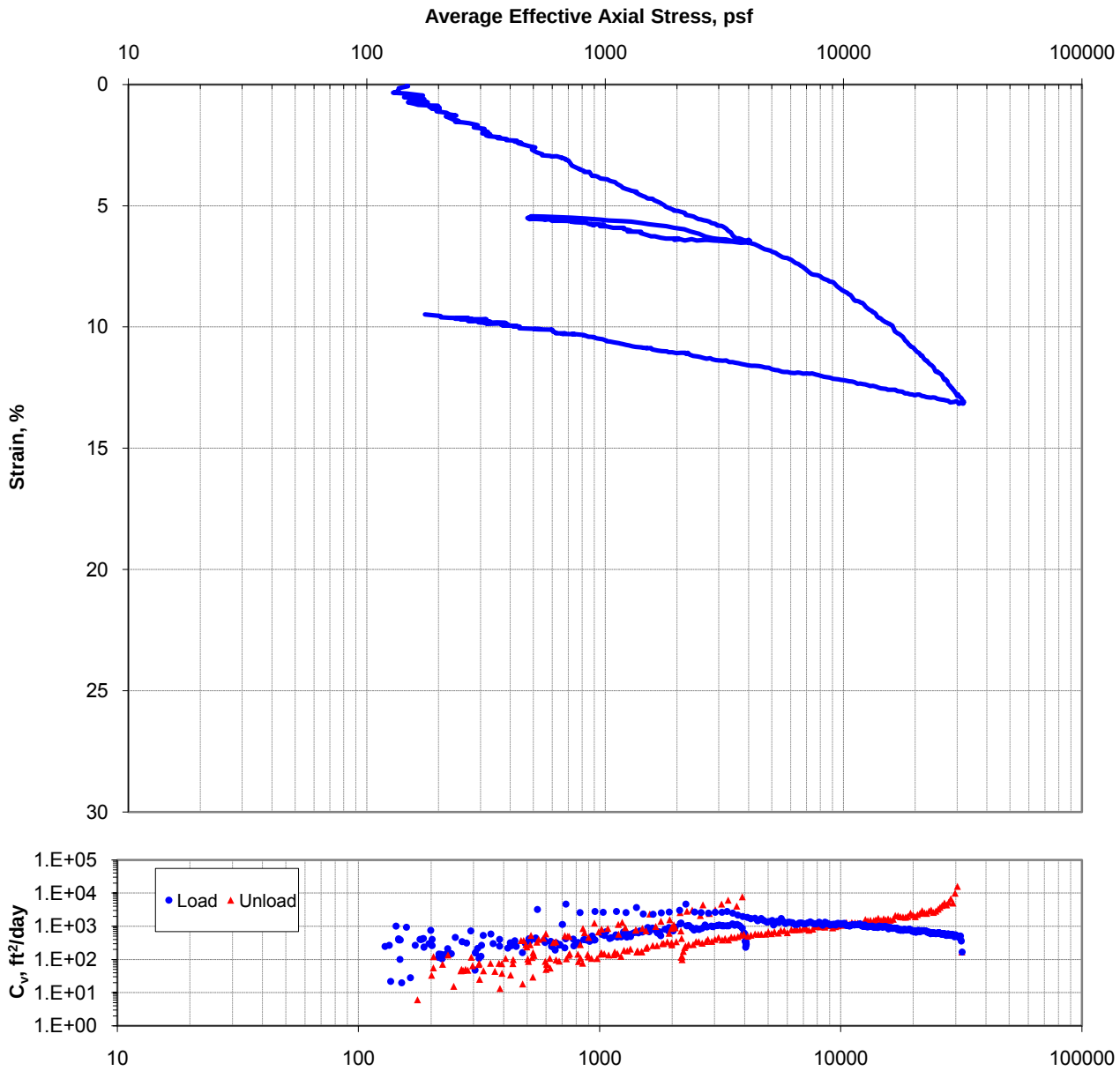
SAMPLE ID	Boring, Sample #, Depth	DH-15 , #5 , 20.0 ft		SUMMARY	Strain Rate, %/hr	0.3
	USCS Classification:	Fat CLAY (CH): dark grayish brown mottled w/dark yellowish brown & black, FeO2 stains, moist			Liquid Limit, %	66
					Plastic Limit, %	25
					Plasticity Index, %	41
PROPERTIES		Initial	Final		Passing #200	---
	Water Content, %	32.4%	31.1%		Estimated Gs	2.75
	Dry Unit Weight, pcf	87.2	92.3			
	Saturation, %	92%	100%	REMARKS	Test Method: D4186	
	Void Ratio	0.97	0.86			
	Diameter, in	2.00	2.00			
	Height, in	0.74	0.70			

CONSOLIDATION TEST RESULTS
Los Osos Water Recycling Facility
San Luis Obispo County, California



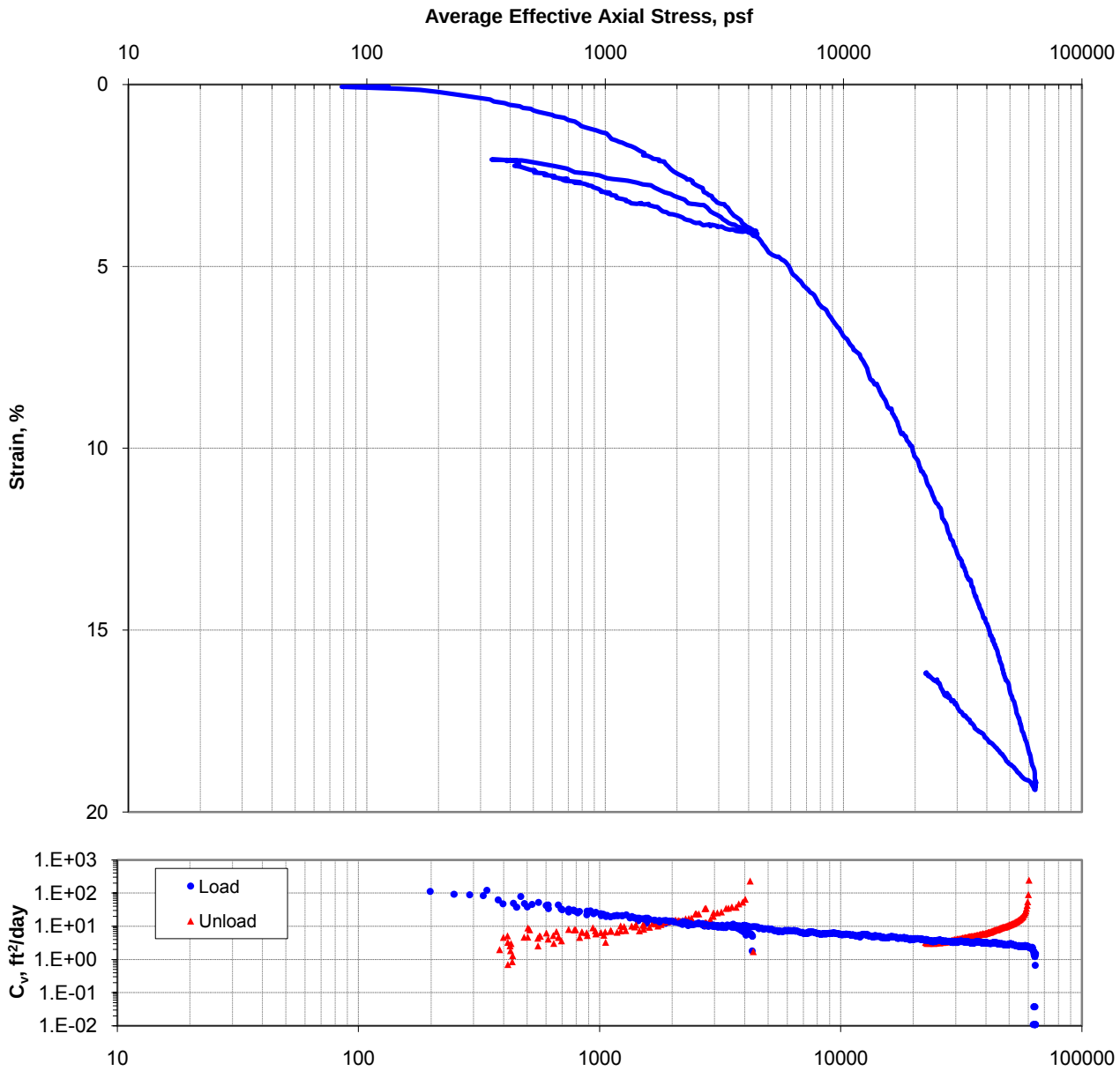
SAMPLE ID	Boring, Sample #, Depth	DH-16 , #4 , 15.0 ft		SUMMARY	Strain Rate, %/hr	0.4
	USCS Classification:	Fat CLAY (CH): olive, moist, black inclusions			Liquid Limit, %	66
					Plastic Limit, %	20
					Plasticity Index, %	46
PROPERTIES		Initial	Final		Passing #200	---
	Water Content, %	26.6%	28.7%		Estimated Gs	2.75
	Dry Unit Weight, pcf	95.7	92.7			
	Saturation, %	92%	93%	REMARKS	Test Method: D4186	
	Void Ratio	0.79	0.85			
	Diameter, in	2.00	2.00			
	Height, in	0.74	0.77			

CONSOLIDATION TEST RESULTS
Los Osos Water Recycling Facility
San Luis Obispo County, California



SAMPLE ID	Boring, Sample #, Depth	DH-18 , #3 , 10.0 ft		SUMMARY	Strain Rate, %/hr	0.8
	USCS Classification:	Clayey SAND (SC): yellowish brown, moist			Liquid Limit, %	32
					Plastic Limit, %	17
					Plasticity Index, %	15
PROPERTIES		Initial	Final		Passing #200	---
	Water Content, %	18.7%	20.3%		Estimated Gs	2.75
	Dry Unit Weight, pcf	102.1	109.9			
	Saturation, %	75%	99%	REMARKS	Test Method: D4186	
	Void Ratio	0.68	0.56			
	Diameter, in	2.00	2.00			
	Height, in	0.74	0.69			

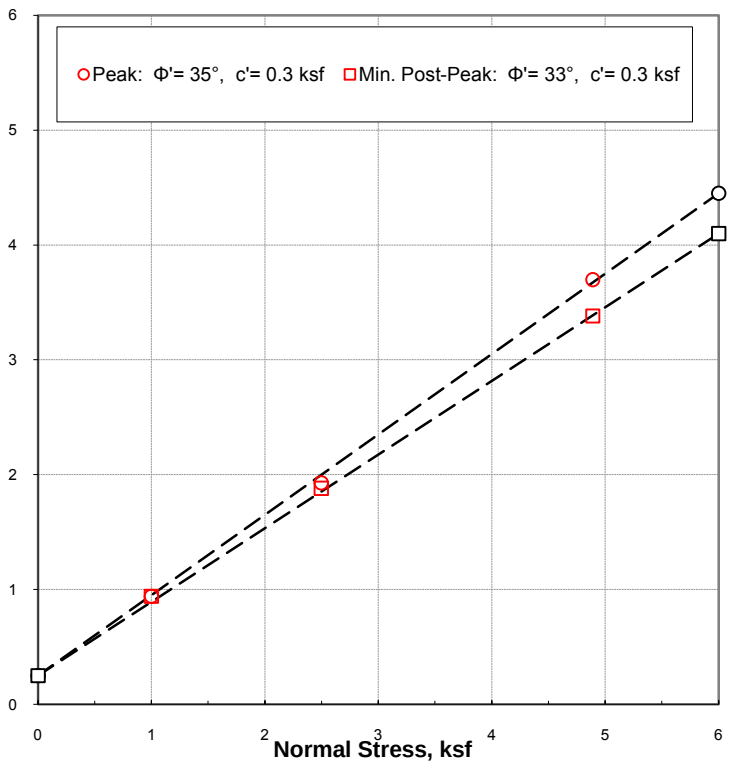
CONSOLIDATION TEST RESULTS
Los Osos Water Recycling Facility
San Luis Obispo County, California

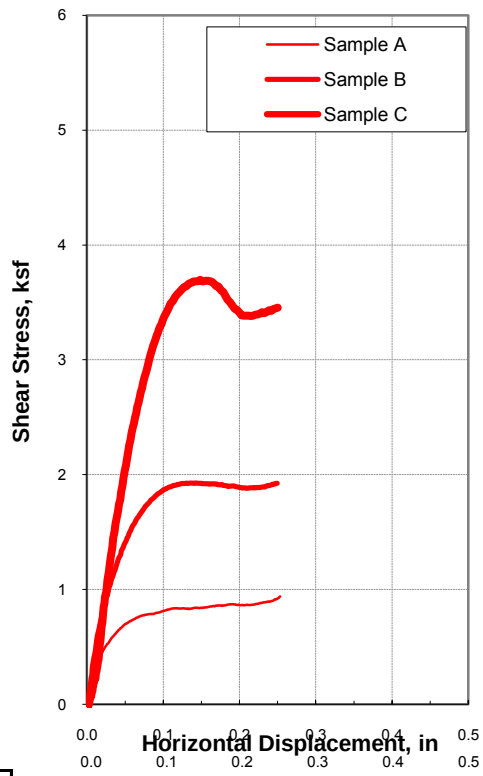


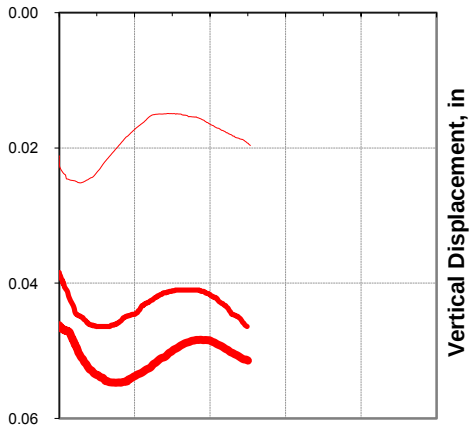
SAMPLE ID	Boring, Sample #, Depth	DH-19 , #4 , 10.0 ft	
	USCS Classification:	Fat CLAY (CH): grayish brown, moist	
PROPERTIES		Initial	Final
	Water Content, %	33.2%	29.9%
	Dry Unit Weight, pcf	86.8	103.6
	Saturation, %	93%	125%
	Void Ratio	0.98	0.66
	Diameter, in	2.00	2.00
	Height, in	0.75	0.62

SUMMARY	Strain Rate, %/hr	0.3
	Liquid Limit, %	68
	Plastic Limit, %	24
	Plasticity Index, %	44
	Passing #200	---
	Estimated Gs	2.75
REMARKS	Test Method: D4186	

CONSOLIDATION TEST RESULTS
Los Osos Water Recycling Facility
San Luis Obispo County, California







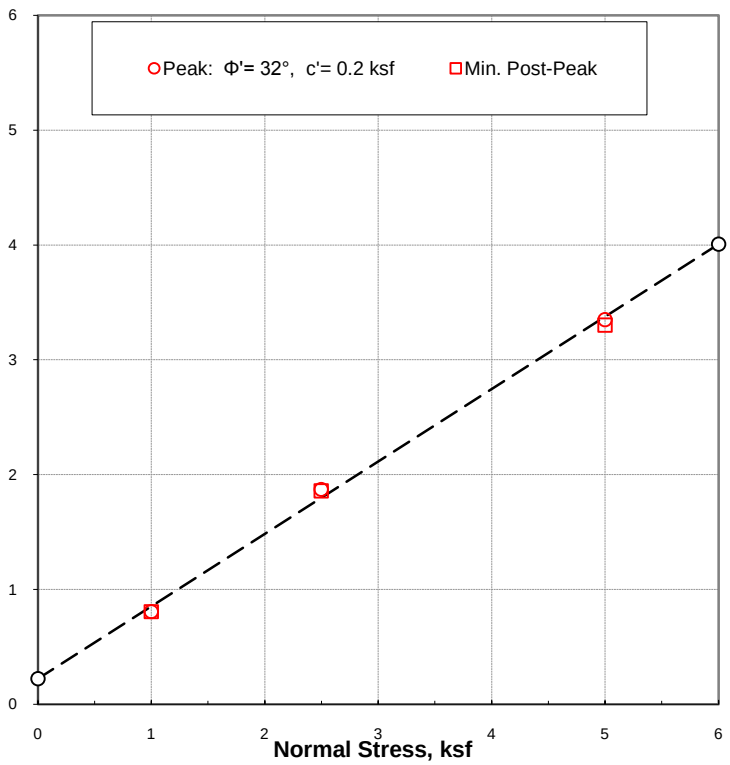
SAMPLE ID	Boring Number:	DH-02			
	Sample Number:	6			
	Sample Depth:	24.0 ft			
	USCS Classification:	Clayey SAND (SC): light brownish gray, moist			
INITIAL	Specimen	A	B	C	D
	Water Content, %	7.5%	7.5%	7.5%	
	Dry Unit Weight, pcf	102.5	100.6	101.8	
	Saturation, %	33%	31%	32%	
	Void Ratio	0.61	0.64	0.62	
	Diameter, in	2.42	2.42	2.42	
	Height, in	1.00	1.00	1.00	
FINAL	Water Content, %	20.3%	21.2%	19.7%	
	Dry Unit Weight, pcf	106.5	106.0	107.8	
	Void Ratio	0.55	0.56	0.53	
TEST SUMMARY	Displacement at Peak, in	0.25	0.14	0.15	
	Displacement Rate, in/min	0.001	0.001	0.001	
	Normal Stress, ksf	1.0	2.5	4.9	
	Peak Shear Stress, ksf	0.94	1.93	3.70	
	Min. Post-Peak Stress, ksf	0.94	1.88	3.38	
REMARKS	Test Method: ASTM D3080				

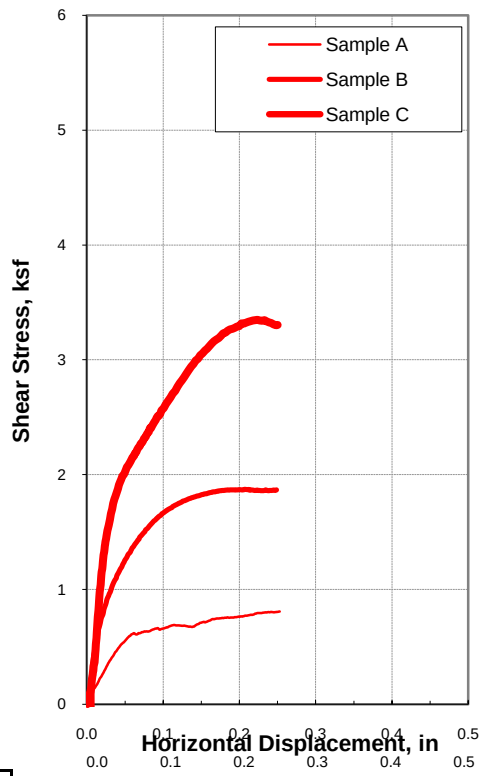
CLASSIFICATION

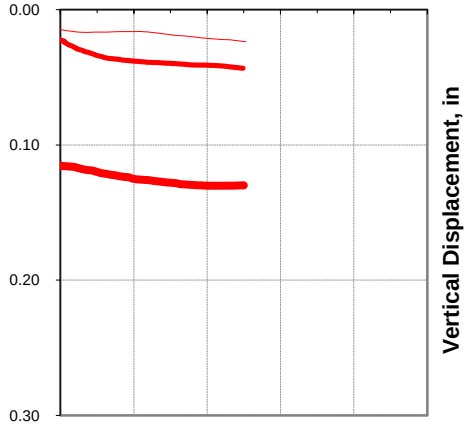
Sieve Size	% Passing
3/8-in. (9.5mm)	---
#4 (4.75mm)	---
#16 (1.18mm)	---
#30 (0.6mm)	---
#100 (0.150mm)	---
#200 (0.075mm)	13

Atterberg Limits	
Liquid Limit, %	---
Plastic Limit, %	---
Plasticity Index, %	---
Estimated Gs	2.65
k_{avg} 20ºC, cm/sec	---

DIRECT SHEAR TEST RESULTS
Los Osos Water Recycling Facility
San Luis Obispo County, California







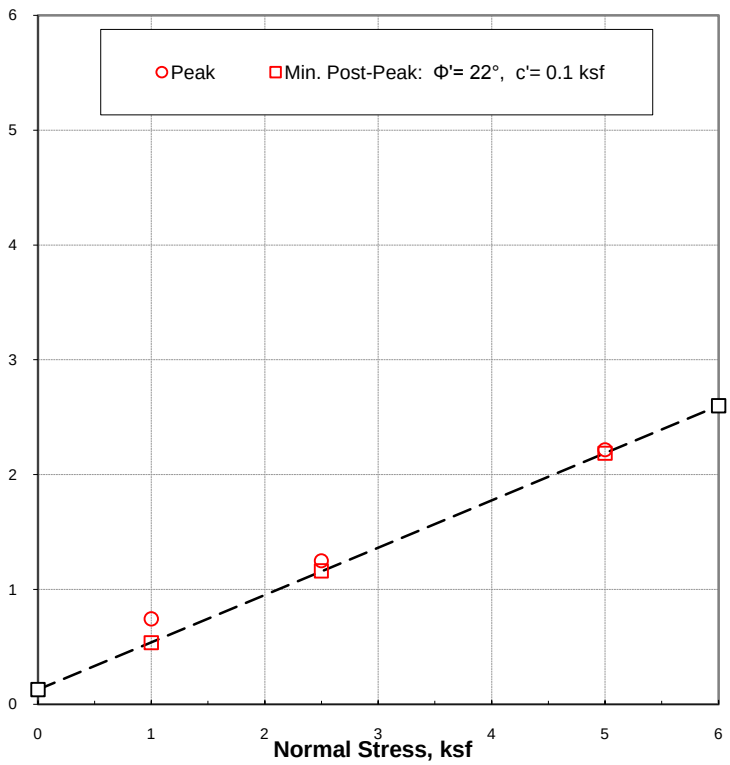
SAMPLE ID	Boring Number:	DH-02			
	Sample Number:	B			
	Sample Depth:	39.0 ft			
	USCS Classification:	Silty SAND (SM): yellowish brown, moist			
INITIAL	Specimen	A	B	C	D
	Water Content, %	11.9%	11.9%	11.9%	
	Dry Unit Weight, pcf	110.9	111.1	110.9	
	Saturation, %	64%	64%	64%	
	Void Ratio	0.49	0.49	0.49	
	Diameter, in	2.41	2.41	2.41	
	Height, in	1.00	1.00	1.00	
FINAL	Water Content, %	17.3%	16.8%	15.5%	
	Dry Unit Weight, pcf	112.4	113.4	116.7	
	Void Ratio	0.47	0.46	0.42	
TEST SUMMARY	Displacement at Peak, in	0.25	0.21	0.22	
	Displacement Rate, in/min	0.001	0.001	0.001	
	Normal Stress, ksf	1.0	2.5	5.0	
	Peak Shear Stress, ksf	0.81	1.87	3.35	
	Min. Post-Peak Stress, ksf	0.81	1.86	3.30	
REMARKS	Test Method: ASTM D3080				

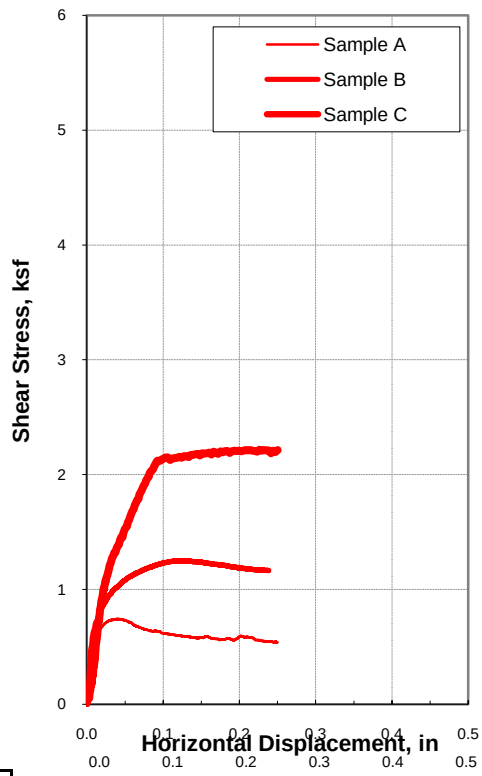
CLASSIFICATION

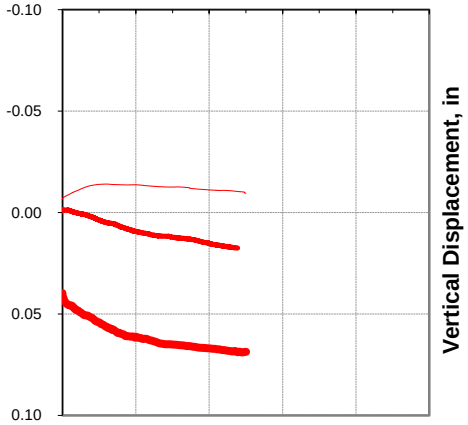
Sieve Size	% Passing
3/8-in. (9.5mm)	100
#4 (4.75mm)	100
#16 (1.18mm)	99
#30 (0.6mm)	98
#100 (0.150mm)	24
#200 (0.075mm)	17

Atterberg Limits	
Liquid Limit, %	---
Plastic Limit, %	---
Plasticity Index, %	---
Estimated Gs	2.65
k_{avg} 20ºC, cm/sec	---

DIRECT SHEAR TEST RESULTS
Los Osos Water Recycling Facility
San Luis Obispo County, California







SAMPLE ID	Boring Number:	DH-03			
	Sample Number:	A			
	Sample Depth:	20.0 ft			
	USCS Classification:	Fat CLAY (CH): brown, moist			
INITIAL	Specimen	A	B	C	D
	Water Content, %	18.7%	18.7%	18.7%	
	Dry Unit Weight, pcf	103.4	103.3	103.3	
	Saturation, %	83%	83%	82%	
	Void Ratio	0.60	0.60	0.60	
	Diameter, in	2.41	2.41	2.41	
	Height, in	1.00	1.00	1.00	
FINAL	Water Content, %	27.7%	26.4%	24.7%	
	Dry Unit Weight, pcf	95.3	96.9	102.0	
	Void Ratio	0.74	0.71	0.62	
TEST SUMMARY	Displacement at Peak, in	0.04	0.12	0.23	
	Displacement Rate, in/min	0.0001	0.0001	0.0001	
	Normal Stress, ksf	1.0	2.5	5.0	
	Peak Shear Stress, ksf	0.74	1.25	2.22	
	Min. Post-Peak Stress, ksf	0.54	1.16	2.19	
	Swell Pressure, ksf	2.25	2.86	1.41	
REMARKS	Test Method: ASTM D3080				

CLASSIFICATION

Sieve Size	% Passing
3/8-in. (9.5mm)	---
#4 (4.75mm)	---
#16 (1.18mm)	---
#30 (0.6mm)	---
#100 (0.150mm)	---
#200 (0.075mm)	---

Atterberg Limits	
Liquid Limit, %	64
Plastic Limit, %	16
Plasticity Index, %	48
Estimated Gs	2.65
k_{avg} 20ºC, cm/sec	---

DIRECT SHEAR TEST RESULTS
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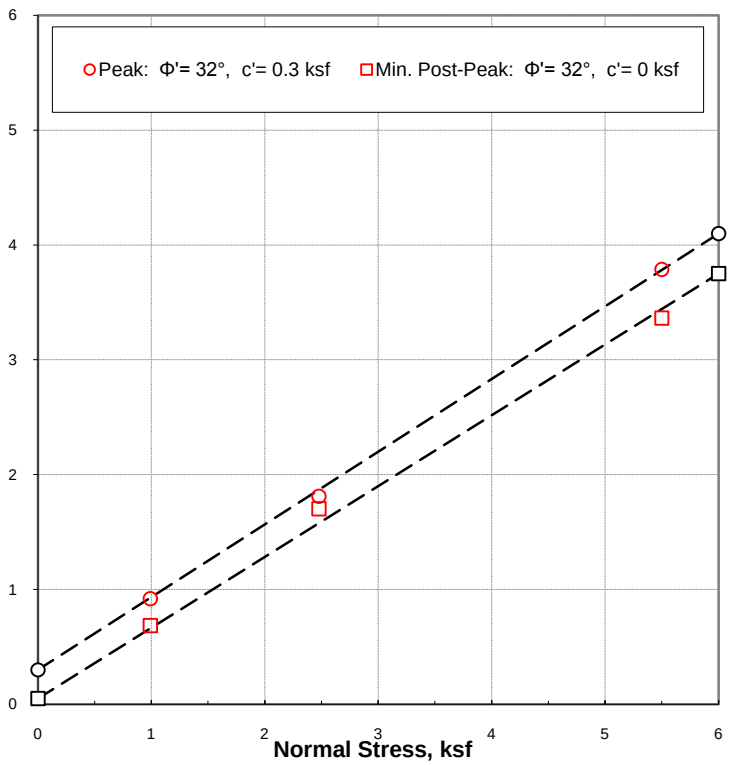

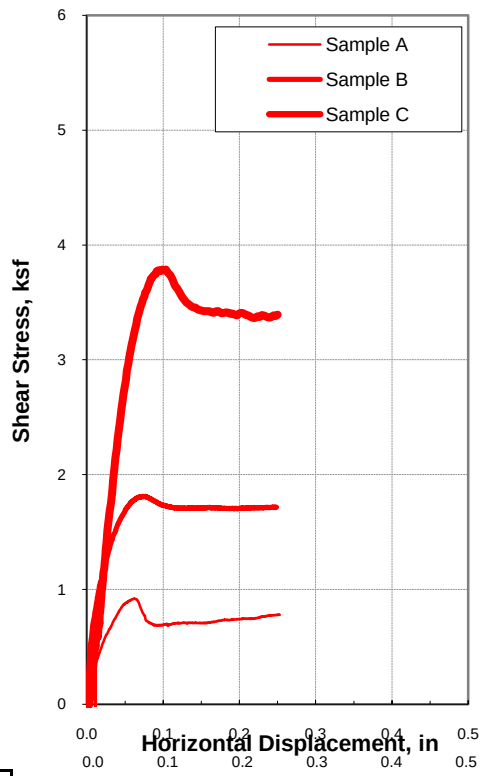

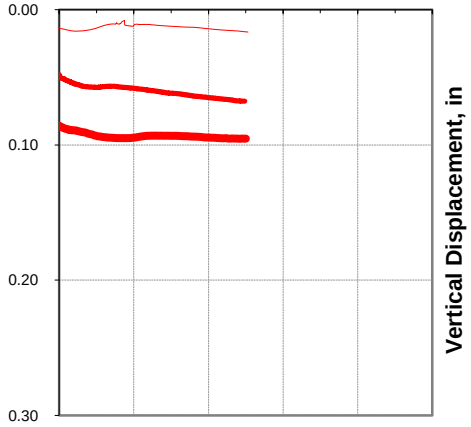

SAMPLE ID	Boring Number:	DH-04			
	Sample Number:	2			
	Sample Depth:	5.0 ft			
	USCS Classification:	Sandy lean CLAY (CL): dark yellowish brown, moist			
INITIAL	Specimen	A	B	C	D
	Water Content, %	14.6%	14.6%	14.6%	
	Dry Unit Weight, pcf	115.3	114.8	114.4	
	Saturation, %	84%	83%	82%	
	Void Ratio	0.47	0.48	0.48	
	Diameter, in	2.42	2.42	2.42	
	Height, in	0.99	1.00	0.99	
FINAL	Water Content, %	18.4%	18.3%	17.1%	
	Dry Unit Weight, pcf	111.9	112.5	116.0	
	Void Ratio	0.52	0.51	0.46	
TEST SUMMARY	Displacement at Peak, in	0.06	0.07	0.10	
	Displacement Rate, in/min	0.0002	0.0002	0.0002	
	Normal Stress, ksf	1.0	2.5	5.5	
	Peak Shear Stress, ksf	0.92	1.81	3.79	
	Min. Post-Peak Stress, ksf	0.69	1.70	3.36	
REMARKS	Test Method: ASTM D3080				

CLASSIFICATION

Sieve Size	% Passing
3/8-in. (9.5mm)	---
#4 (4.75mm)	---
#16 (1.18mm)	---
#30 (0.6mm)	---
#100 (0.150mm)	---
#200 (0.075mm)	---

Atterberg Limits	
Liquid Limit, %	32
Plastic Limit, %	14
Plasticity Index, %	18
Estimated Gs	2.72
k_{avg} 20ºC, cm/sec	---

DIRECT SHEAR TEST RESULTS
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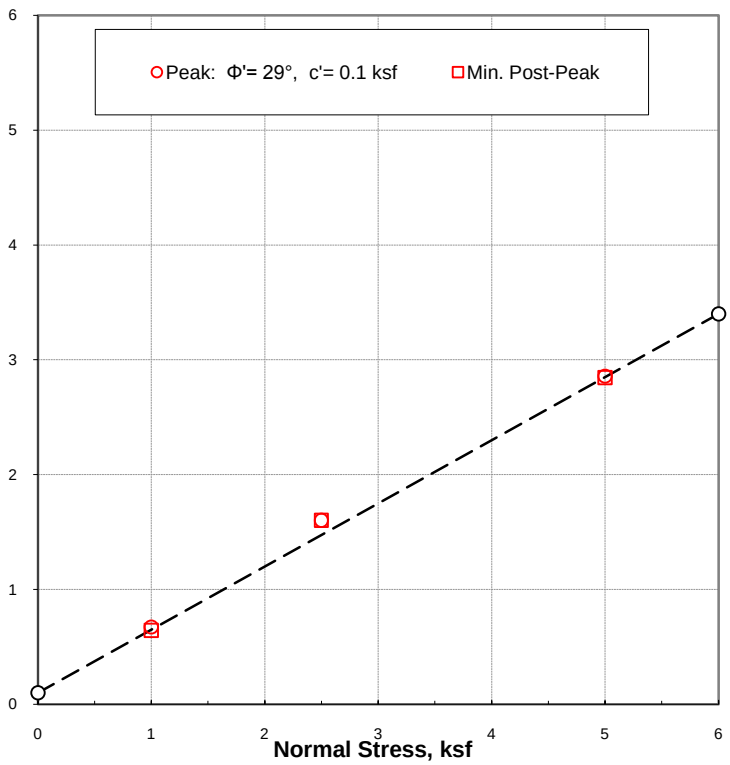

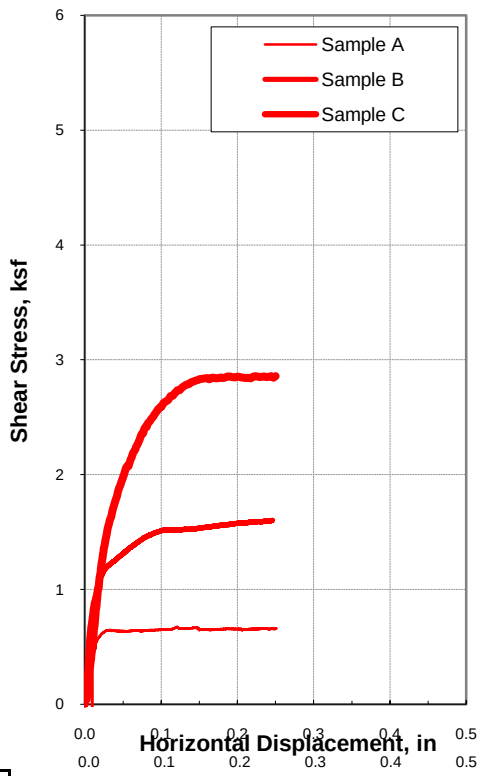

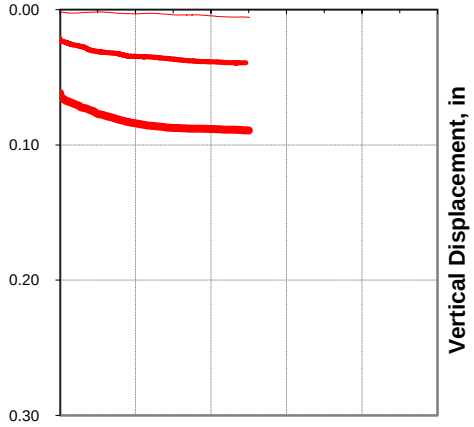

SAMPLE ID	Boring Number:	DH-09			
	Sample Number:	A			
	Sample Depth:	0.0 ft			
	USCS Classification:	Sandy lean CLAY (CL): brown, moist			
INITIAL	Specimen	A	B	C	D
	Water Content, %	13.8%	13.8%	13.8%	
	Dry Unit Weight, pcf	112.2	112.2	112.1	
	Saturation, %	75%	75%	75%	
	Void Ratio	0.50	0.50	0.50	
	Diameter, in	2.41	2.41	2.41	
	Height, in	1.00	1.00	1.00	
FINAL	Water Content, %	19.7%	18.2%	16.9%	
	Dry Unit Weight, pcf	106.5	110.4	114.9	
	Void Ratio	0.58	0.52	0.46	
TEST SUMMARY	Displacement at Peak, in	0.12	0.24	0.24	
	Displacement Rate, in/min	0.0001	0.0001	0.0001	
	Normal Stress, ksf	1.0	2.5	5.0	
	Peak Shear Stress, ksf	0.67	1.60	2.86	
	Min. Post-Peak Stress, ksf	0.64	1.60	2.84	
	Swell Pressure, ksf	0.74	0.97	0.59	
REMARKS	Test Method: ASTM D3080				

CLASSIFICATION

Sieve Size	% Passing
3/8-in. (9.5mm)	---
#4 (4.75mm)	---
#16 (1.18mm)	---
#30 (0.6mm)	---
#100 (0.150mm)	---
#200 (0.075mm)	---

Atterberg Limits	
Liquid Limit, %	39
Plastic Limit, %	13
Plasticity Index, %	26
Estimated Gs	2.69
k_{avg} 20ºC, cm/sec	---

DIRECT SHEAR TEST RESULTS
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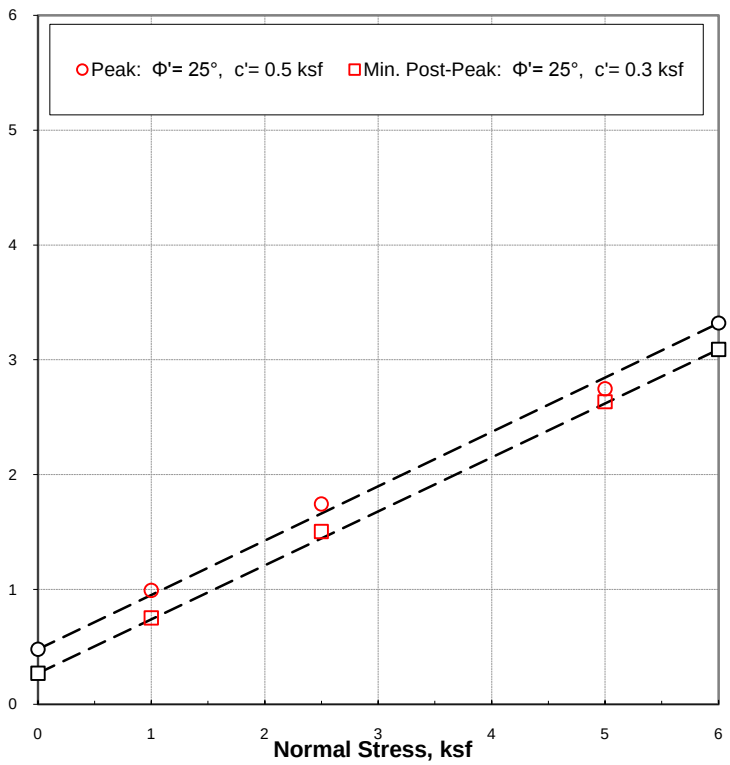
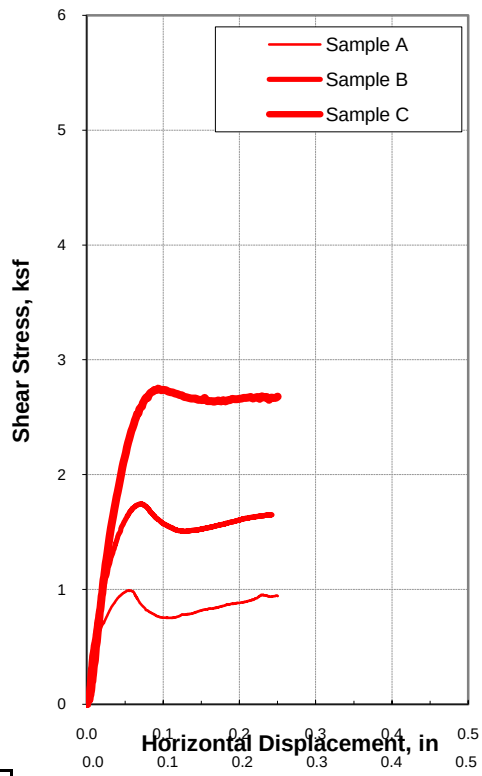
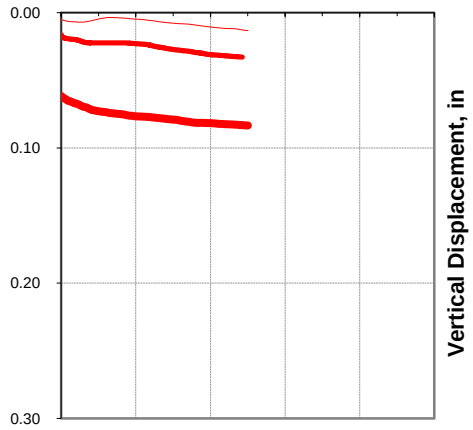


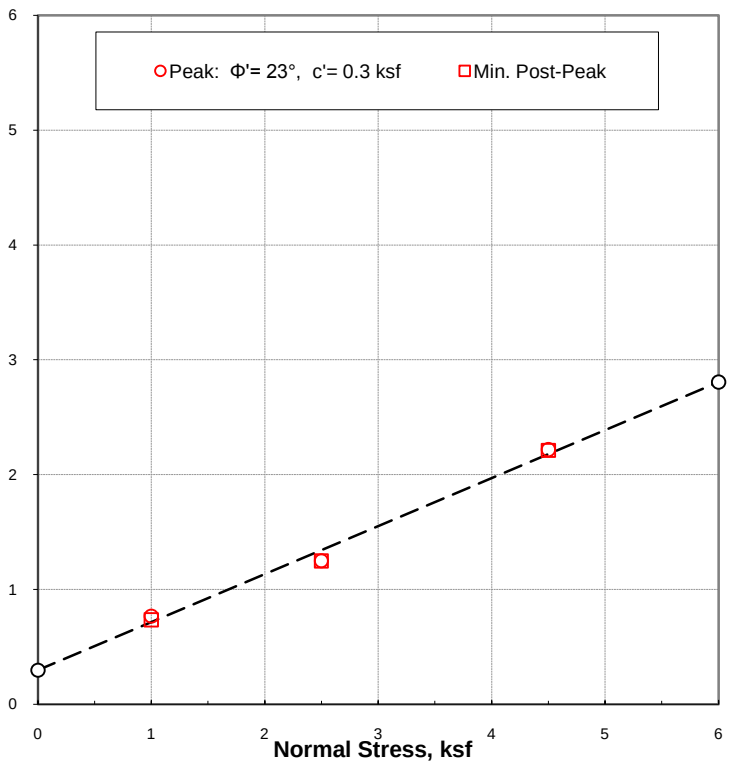


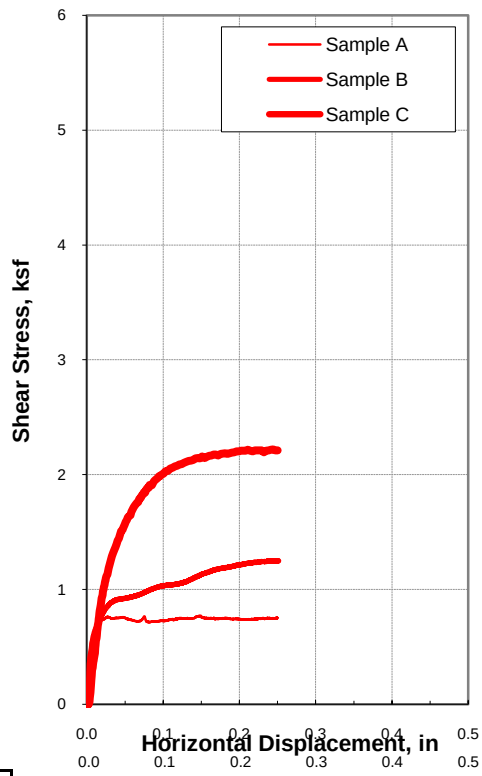


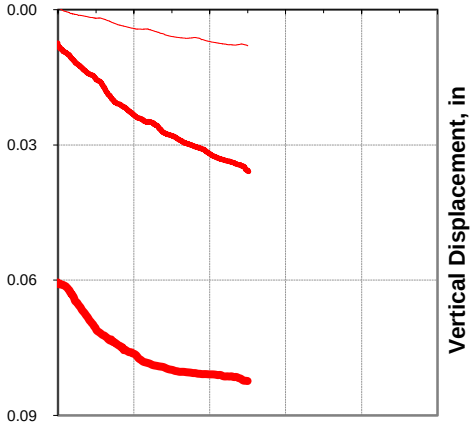
SAMPLE ID	Boring Number:	DH-09			
	Sample Number:	2			
	Sample Depth:	7.0 ft			
	USCS Classification:	Fat CLAY (CH): very dark grayish brown w/black & FeO2 mottling, moist			
INITIAL	Specimen	A	B	C	D
	Water Content, %	18.2%	18.2%	18.2%	
	Dry Unit Weight, pcf	110.6	111.1	111.6	
	Saturation, %	97%	99%	100%	
	Void Ratio	0.50	0.49	0.48	
	Diameter, in	2.41	2.41	2.41	
	Height, in	1.00	1.00	1.00	
FINAL	Water Content, %	21.5%	20.1%	19.4%	
	Dry Unit Weight, pcf	105.2	107.5	108.6	
	Void Ratio	0.57	0.54	0.52	
TEST SUMMARY	Displacement at Peak, in	0.05	0.07	0.09	
	Displacement Rate, in/min	0.0002	0.0002	0.0002	
	Normal Stress, ksf	1.0	2.5	5.0	
	Peak Shear Stress, ksf	0.99	1.74	2.75	
	Min. Post-Peak Stress, ksf	0.75	1.51	2.63	
	Swell Pressure, ksf	0.59	0.58	0.36	
REMARKS	Test Method: ASTM D3080				

CLASSIFICATION	Sieve Size	% Passing
	3/8-in. (9.5mm)	---
	#4 (4.75mm)	---
	#16 (1.18mm)	---
	#30 (0.6mm)	---
	#100 (0.150mm)	---
	#200 (0.075mm)	---
	Atterberg Limits	
	Liquid Limit, %	---
	Plastic Limit, %	---
	Plasticity Index, %	---
	Estimated Gs	2.65
	k_{avg} 20ºC, cm/sec	---

DIRECT SHEAR TEST RESULTS
Los Osos Water Recycling Facility
San Luis Obispo County, California







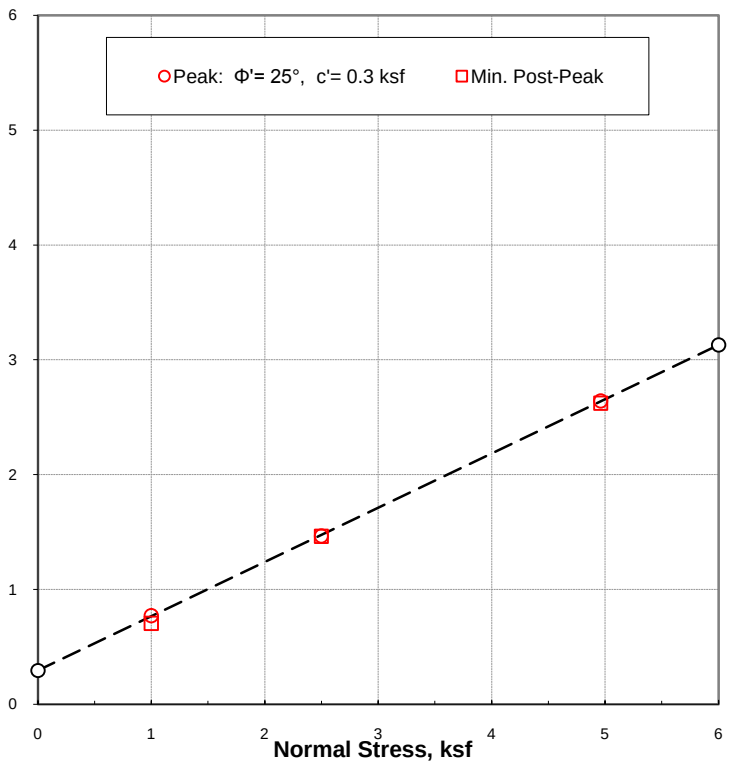
SAMPLE ID	Boring Number:	DH-13			
	Sample Number:	A			
	Sample Depth:	0.0 ft			
	USCS Classification:	Sandy lean CLAY (CL): brown, moist			
INITIAL	Specimen	A	B	C	D
	Water Content, %	15.6%	15.6%	15.6%	
	Dry Unit Weight, pcf	107.5	107.5	107.5	
	Saturation, %	77%	77%	77%	
	Void Ratio	0.54	0.54	0.54	
	Diameter, in	2.41	2.41	2.41	
	Height, in	1.00	1.00	1.00	
FINAL	Water Content, %	22.7%	21.3%	19.9%	
	Dry Unit Weight, pcf	100.9	103.9	107.5	
	Void Ratio	0.64	0.59	0.54	
TEST SUMMARY	Displacement at Peak, in	0.15	0.25	0.24	
	Displacement Rate, in/min	0.0001	0.0001	0.0001	
	Normal Stress, ksf	1.0	2.5	4.5	
	Peak Shear Stress, ksf	0.77	1.25	2.22	
	Min. Post-Peak Stress, ksf	0.74	1.25	2.21	
	Swell Pressure, ksf	1.19	1.52	0.79	
REMARKS	Test Method: ASTM D3080				

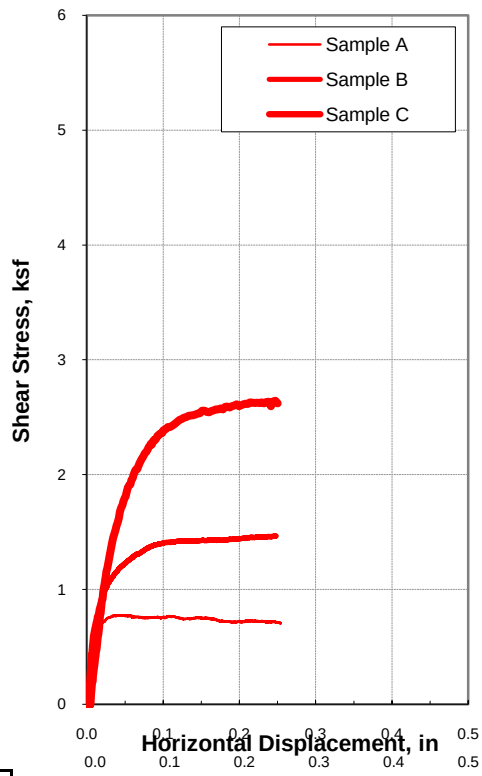
CLASSIFICATION

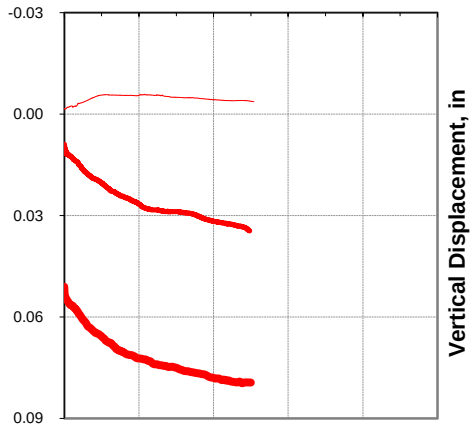
Sieve Size	% Passing
3/8-in. (9.5mm)	---
#4 (4.75mm)	---
#16 (1.18mm)	---
#30 (0.6mm)	---
#100 (0.150mm)	---
#200 (0.075mm)	---

Atterberg Limits	
Liquid Limit, %	40
Plastic Limit, %	13
Plasticity Index, %	27
Estimated Gs	2.65
k_{avg} 20ºC, cm/sec	---

DIRECT SHEAR TEST RESULTS
Los Osos Water Recycling Facility
San Luis Obispo County, California



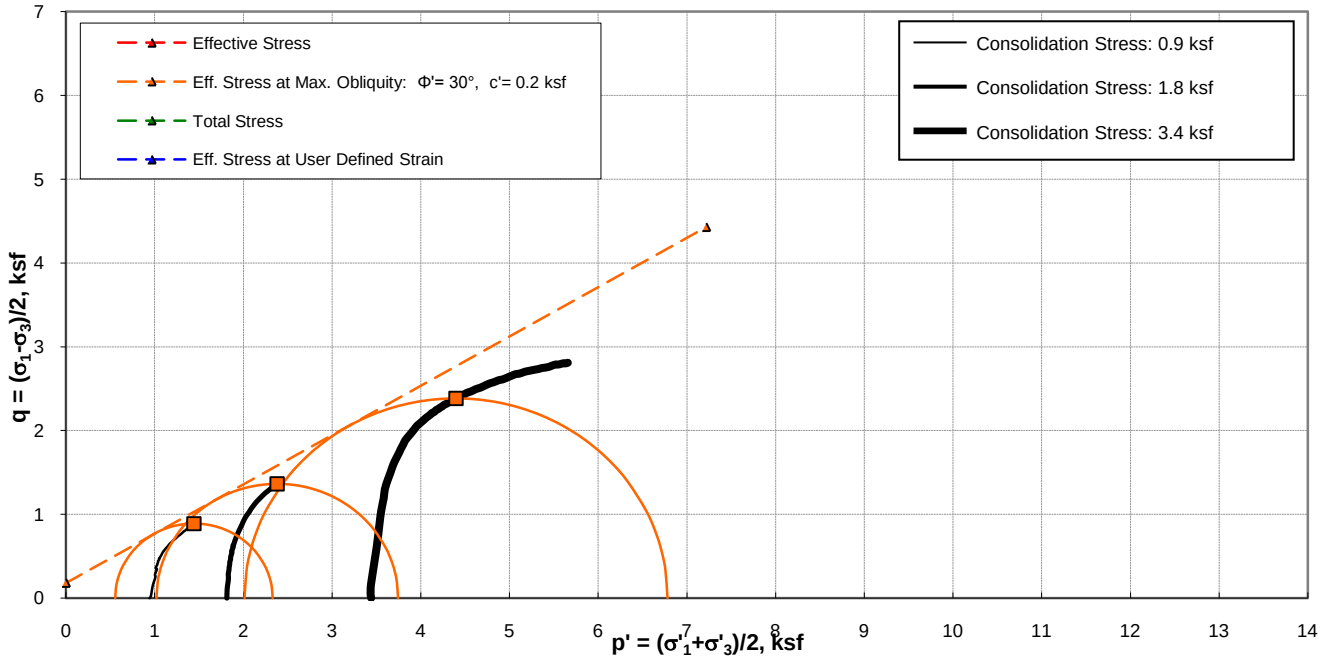




SAMPLE ID	Boring Number:	DH-19			
	Sample Number:	A			
	Sample Depth:	0.0 ft			
	USCS Classification:	Sandy lean CLAY (CL): dark yellowish brown, moist			
INITIAL	Specimen	A	B	C	D
	Water Content, %	16.9%	16.9%	16.9%	
	Dry Unit Weight, pcf	110.0	110.0	110.0	
	Saturation, %	89%	89%	89%	
	Void Ratio	0.50	0.50	0.50	
	Diameter, in	2.41	2.41	2.41	
	Height, in	1.00	1.00	1.00	
FINAL	Water Content, %	22.2%	20.9%	19.7%	
	Dry Unit Weight, pcf	104.5	106.4	109.4	
	Void Ratio	0.58	0.55	0.51	
TEST SUMMARY	Displacement at Peak, in	0.04	0.25	0.25	
	Displacement Rate, in/min	0.0001	0.0001	0.0001	
	Normal Stress, ksf	1.0	2.5	5.0	
	Peak Shear Stress, ksf	0.77	1.47	2.64	
	Min. Post-Peak Stress, ksf	0.70	1.46	2.62	
	Swell Pressure, ksf	1.16	1.17	0.83	
REMARKS	Test Method: ASTM D3080				

CLASSIFICATION	Sieve Size	% Passing
	3/8-in. (9.5mm)	---
	#4 (4.75mm)	---
	#16 (1.18mm)	---
	#30 (0.6mm)	---
	#100 (0.150mm)	---
	#200 (0.075mm)	---
	Atterberg Limits	
	Liquid Limit, %	48
	Plastic Limit, %	15
	Plasticity Index, %	33
	Estimated Gs	2.65
	k_{avg} 20ºC, cm/sec	---

DIRECT SHEAR TEST RESULTS
Los Osos Water Recycling Facility
San Luis Obispo County, California



SAMPLE ID		
Boring Number	DH-01	
Sample Number	4	
Specimen Depth	15.0 ft	
USCS Classification	Lean CLAY (CL): yellowish brown, moist	

INITIAL	Trial ID	A	B	C
	Water Content, %	27.0%	27.9%	27.2%
	Dry Unit Weight, pcf	96.9	95.7	96.8
	Saturation, %	100%	100%	100%
	Void Ratio	0.73	0.75	0.73
	Diameter, in	2.42	2.46	2.47
	Height, in	4.87	4.78	4.69
PRE-SHEAR	Water Content, %	27.9%	27.2%	26.1%
	Dry Unit Weight, pcf	95.7	96.8	98.5
	Saturation, %	100%	100%	100%
	Void Ratio	0.75	0.73	0.70

REMARKS: Test Method: ASTM 4767 (modified for staged testing)

CLASSIFICATION	Trial ID	A	B	C
	Liquid Limit	---	---	---
	Plastic Limit	---	---	---
	Plastic Index	---	---	---
	Passing #4 (4.75 mm)	---	---	---
	Passing #200 (0.075 mm)	---	---	---
	Estimated Gs	2.68	2.68	2.68

TEST SUMMARY	Trial ID	A	B	C
	B-Parameter	0.99	0.99	0.99
	t_{50}, minutes	8.3	16.1	18.5
	Strain Rate, %/min	0.05	0.05	0.05
	Cell Pressure, ksf	11.0	12.0	13.6
	Back Pressure, ksf	10.2	10.2	10.2
	Consolidation Stress, ksf	0.9	1.8	3.4
	Deviator Stress @ Failure, ksf	1.8	2.7	4.7
	Axial Strain @ Failure, %	2.4	4.2	7.1
	σ'_{1F}, ksf	2.3	3.7	6.7
	σ'_{3F}, ksf	0.6	1.0	2.0
	Tested By:	JC	JC	JC
	Date Tested:	1/2/13	1/3/13	1/10/13

CONSOLIDATED, UNDRAINED TRIAXIAL TEST RESULTS

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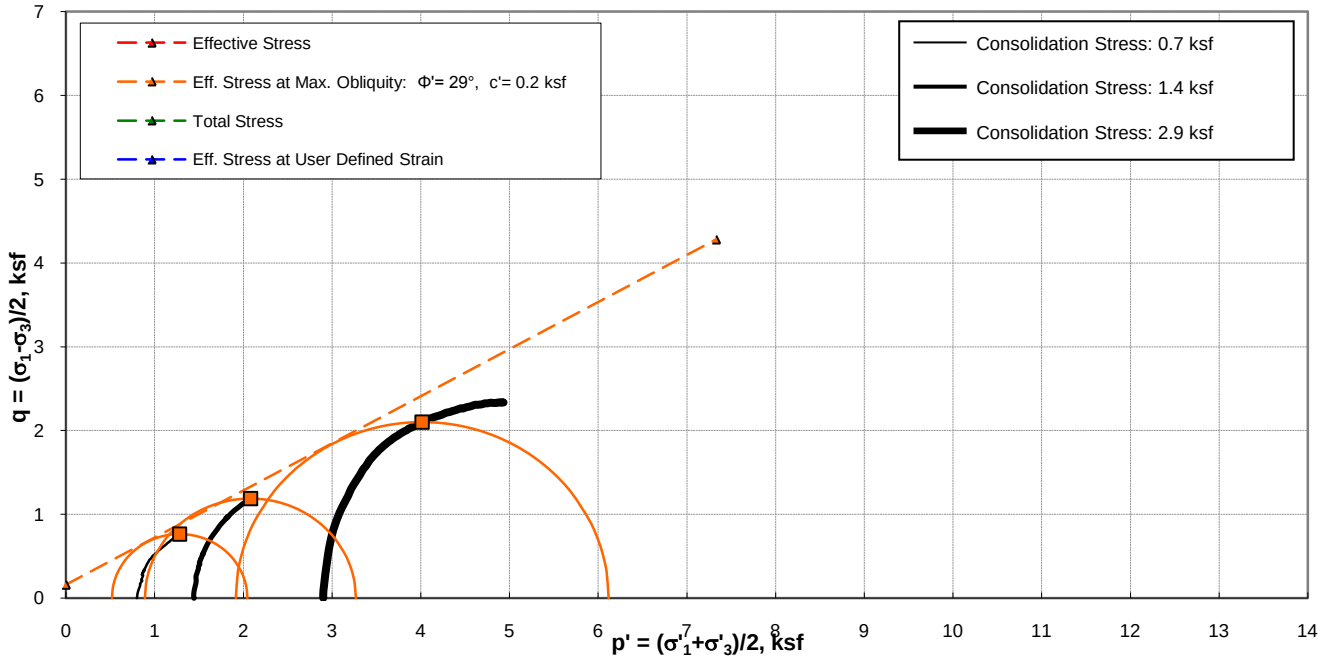


SAMPLE ID		
Boring Number	DH-02	
Sample Number	4	
Specimen Depth	14.0 ft	
USCS Classification	Lean CLAY with sand (CL): yellowish brown, moist	

INITIAL	Trial ID	A	B	C
	Water Content, %	27.1%	29.1%	28.4%
	Dry Unit Weight, pcf	95.4	93.4	94.3
	Saturation, %	98%	100%	100%
	Void Ratio	0.73	0.77	0.75
	Diameter, in	2.43	2.48	2.49
	Height, in	4.88	4.78	4.67
PRE-SHEAR	Water Content, %	29.1%	28.4%	27.3%
	Dry Unit Weight, pcf	93.4	94.3	96.0
	Saturation, %	100%	100%	100%
	Void Ratio	0.77	0.75	0.72

REMARKS: Test Method: ASTM 4767 (modified for staged testing)

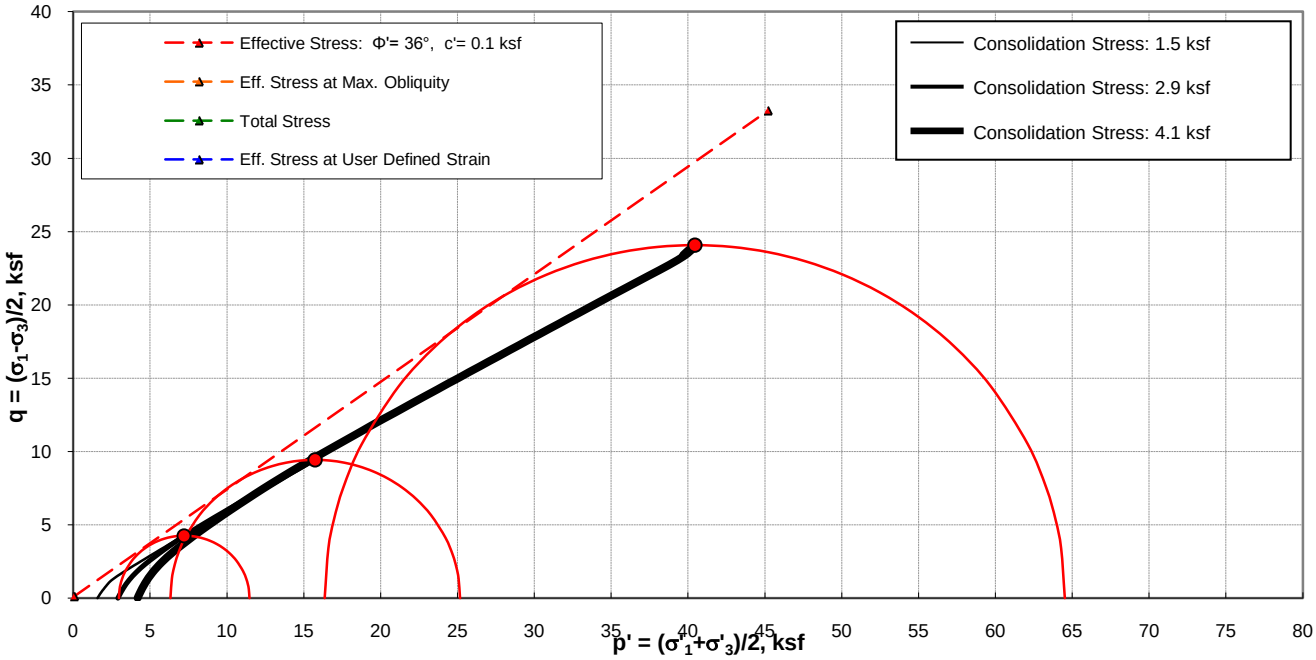
CLASSIFICATION	Trial ID	A	B	C
	Liquid Limit	34	---	---
	Plastic Limit	17	---	---
	Plastic Index	17	---	---
	Passing #4 (4.75 mm)	---	---	---
	Passing #200 (0.075 mm)	---	---	---
	Estimated Gs	2.65	2.65	2.65

TEST SUMMARY	Trial ID	A	B	C
	B-Parameter	0.97	0.97	0.97
	t_{50}, minutes	8.8	N/A	13.3
	Strain Rate, %/min	0.05	0.05	0.05
	Cell Pressure, ksf	10.9	11.7	13.1
	Back Pressure, ksf	10.2	10.3	10.3
	Consolidation Stress, ksf	0.7	1.4	2.9
	Deviator Stress @ Failure, ksf	1.5	2.3	4.1
	Axial Strain @ Failure, %	2.4	4.1	7.5
	σ'_{1F}, ksf	2.0	3.2	6.1
	σ'_{3F}, ksf	0.5	0.9	1.9
	Tested By:	JC	JC	JC
	Date Tested:	1/2/13	1/3/13	1/4/13

CONSOLIDATED, UNDRAINED TRIAXIAL TEST RESULTS

Los Osos Water Recycling Facility

San Luis Obispo County, California



SAMPLE ID	
Boring Number	DH-06
Sample Number	7
Specimen Depth	25.0 ft
USCS Classification	Poorly-graded SAND with silt (SP-SM): yellow, wet

INITIAL	Trial ID	A	B	C
	Water Content, %	21.9%	21.0%	20.8%
	Dry Unit Weight, pcf	106.0	107.4	107.8
	Saturation, %	100%	100%	100%
	Void Ratio	0.59	0.57	0.56
	Diameter, in	2.42	2.43	2.44
	Height, in	5.00	4.89	4.82
PRE-SHEAR	Water Content, %	21.0%	20.8%	20.7%
	Dry Unit Weight, pcf	107.4	107.8	108.0
	Saturation, %	100%	100%	100%
	Void Ratio	0.57	0.56	0.56

REMARKS: Test Method: ASTM 4767 (modified for staged testing)

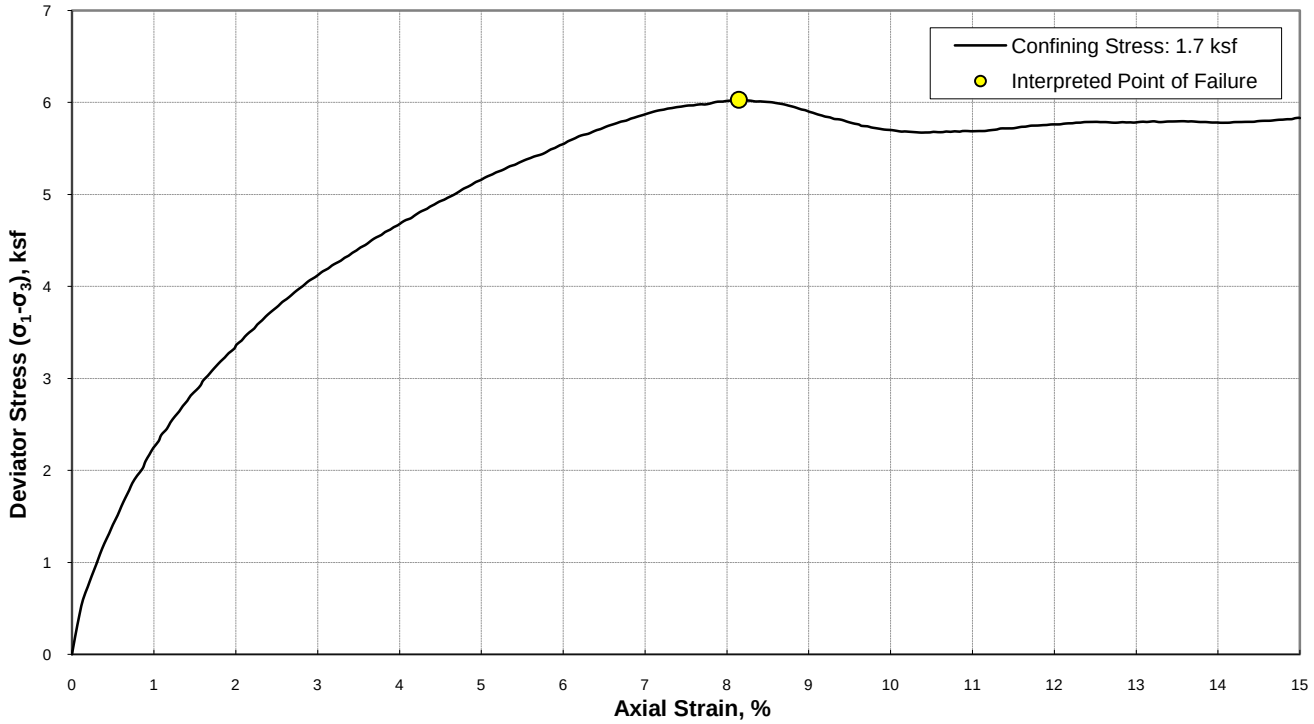
CLASSIFICATION	Trial ID	A	B	C
	Liquid Limit	---	---	---
	Plastic Limit	---	---	---
	Plastic Index	---	---	---
	Passing #4 (4.75 mm)	---	---	---
	Passing #200 (0.075 mm)	5.0%	---	---
	Estimated Gs	2.70	2.70	2.70

TEST SUMMARY	Trial ID	A	B	C
	B-Parameter	0.96	0.96	0.96
	t_{50}, minutes	N/A	N/A	N/A
	Strain Rate, %/min	0.48	0.48	0.48
	Cell Pressure, ksf	11.9	13.3	14.6
	Back Pressure, ksf	10.4	10.4	10.5
	Consolidation Stress, ksf	1.5	2.9	4.1
	Deviator Stress @ Failure, ksf	8.4	18.6	47.6
	Axial Strain @ Failure, %	2.5	4.3	10.1
	σ'_{1F}, ksf	11.4	24.9	63.9
	σ'_{3F}, ksf	3.0	6.3	16.4
	Tested By:	JC	JC	0
	Date Tested:	1/2/13	1/2/13	1/0/00

CONSOLIDATED, UNDRAINED TRIAXIAL TEST RESULTS

Los Osos Water Recycling Facility

San Luis Obispo County, California



SAMPLE ID

Boring Number:	DH-03
Sample Number:	4
Sample Depth:	15.0 ft
USCS Classification:	Lean CLAY (CL): dark yellowish brown, moist

SAMPLE PROPERTIES

Water Content, %	23.4%
Dry Unit Weight, pcf	97.9
Saturation, %	90%
Void Ratio	0.69
Diameter, in	2.41
Height, in	4.88

SAMPLE IMAGES

CLASSIFICATION

Sieve Size	% Passing
3/8-in. (9.5mm)	---
#4 (4.75mm)	---
#16 (1.18mm)	---
#30 (0.6mm)	---
#100 (0.150mm)	---
#200 (0.075mm)	86

Other Parameters	
Liquid Limit	46
Plastic Limit	19
Plasticity Index	27
Estimated Gs	2.65
S_u from T_v, ksf	---
S_u from PP, ksf	---

TEST SUMMARY

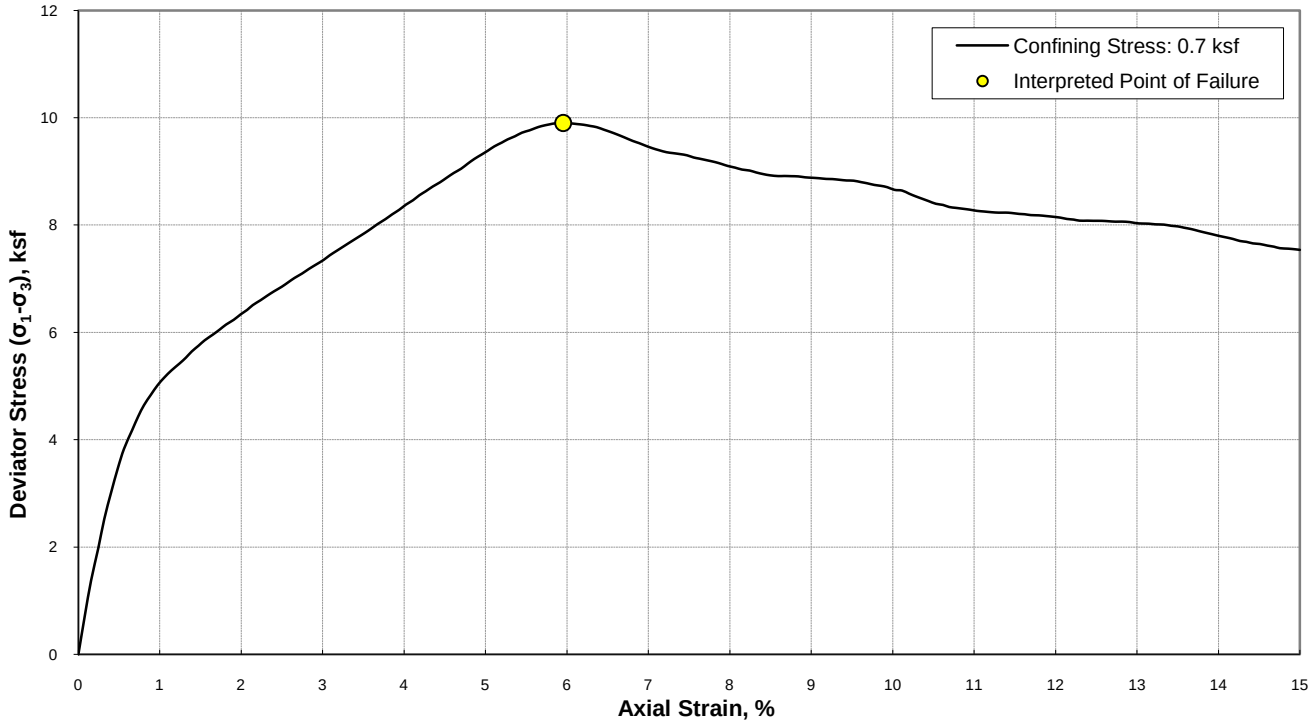
Maximum Deviator Stress, ksf	6.0
Undrained Shear Strength, ksf	3.0
Axial Strain at Failure, %	8.1
Strain Rate, %/min	0.3
Cell Pressure, ksf	1.7
Tested By:	JC
Date Tested:	1/3/13

REMARKS

Test Method: ASTM 2850

UNCONSOLIDATED, UNDRAINED TRIAXIAL TEST RESULTS

Los Osos Water Recycling Facility
San Luis Obispo County, California



SAMPLE ID

Boring Number:	DH-06
Sample Number:	2
Sample Depth:	3.0 ft
USCS Classification:	Sandy fat CLAY (CH): brown mottled w/yellow, dark gray, & very dark brown, moist

SAMPLE PROPERTIES

Water Content, %	13.2%
Dry Unit Weight, pcf	113.5
Saturation, %	77%
Void Ratio	0.46
Diameter, in	2.40
Height, in	4.88

SAMPLE IMAGES

CLASSIFICATION

Sieve Size	% Passing	Other Parameters	
3/8-in. (9.5mm)	---	Liquid Limit	---
#4 (4.75mm)	---	Plastic Limit	---
#16 (1.18mm)	---	Plasticity Index	---
#30 (0.6mm)	---	Estimated Gs	2.65
#100 (0.150mm)	---	S_u from T_v, ksf	---
#200 (0.075mm)	---	S_u from PP, ksf	---

TEST SUMMARY

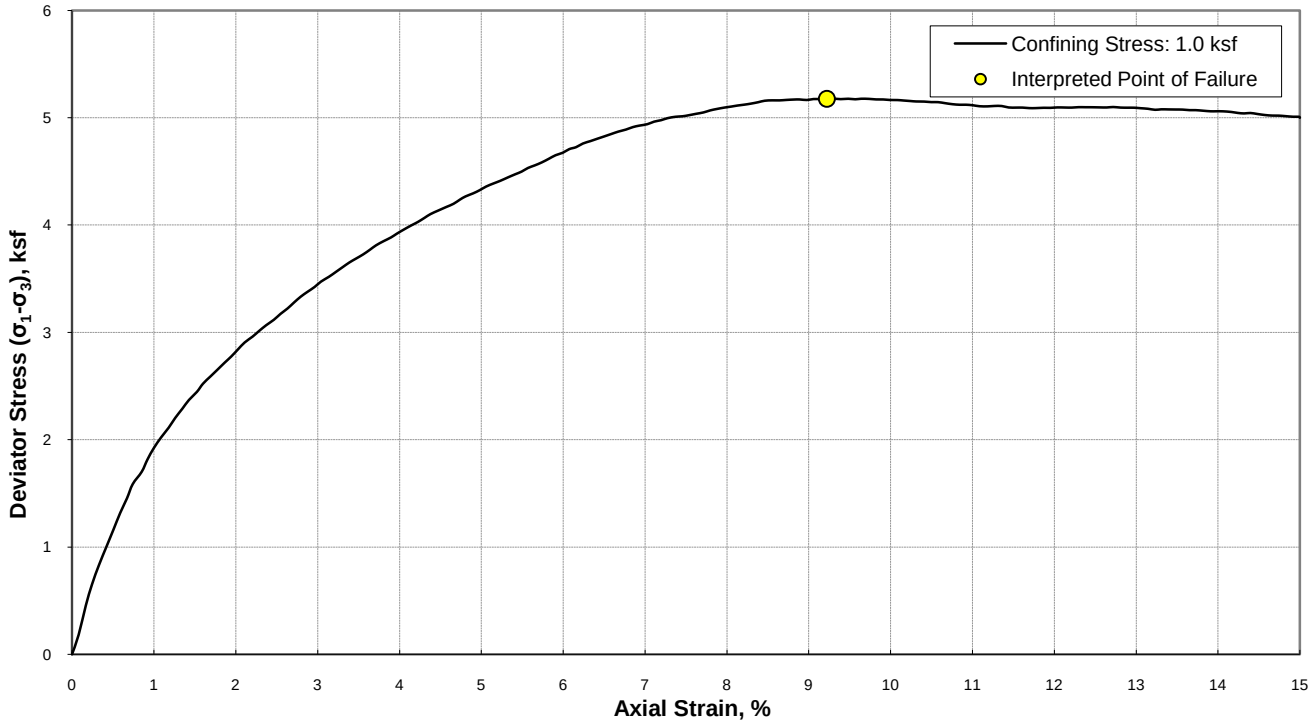
Maximum Deviator Stress, ksf	9.9
Undrained Shear Strength, ksf	5.0
Axial Strain at Failure, %	6.0
Strain Rate, %/min	0.5
Cell Pressure, ksf	0.7
Tested By:	JC
Date Tested:	12/28/12

REMARKS

Test Method: ASTM 2850

UNCONSOLIDATED, UNDRAINED TRIAXIAL TEST RESULTS

Los Osos Water Recycling Facility
San Luis Obispo County, California



SAMPLE ID

Boring Number:	DH-07
Sample Number:	3
Sample Depth:	10.0 ft
USCS Classification:	Sandy fat CLAY (CH): dark yellowish brown, moist

SAMPLE PROPERTIES

Water Content, %	18.3%
Dry Unit Weight, pcf	104.9
Saturation, %	84%
Void Ratio	0.58
Diameter, in	2.42
Height, in	4.88

SAMPLE IMAGES

CLASSIFICATION

Sieve Size	% Passing	Other Parameters	
3/8-in. (9.5mm)	---	Liquid Limit	---
#4 (4.75mm)	---	Plastic Limit	---
#16 (1.18mm)	---	Plasticity Index	---
#30 (0.6mm)	---	Estimated Gs	2.65
#100 (0.150mm)	---	S_u from T_v, ksf	---
#200 (0.075mm)	---	S_u from PP, ksf	---

TEST SUMMARY

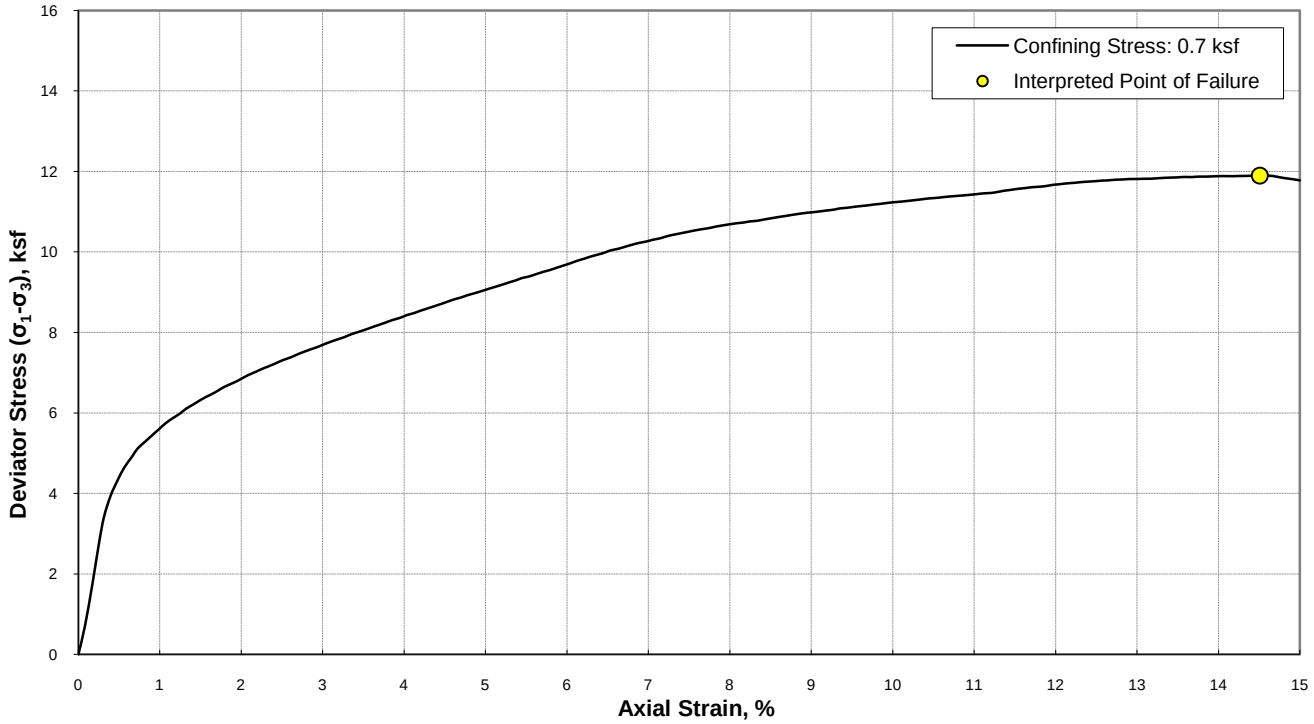
Maximum Deviator Stress, ksf	5.2
Undrained Shear Strength, ksf	2.6
Axial Strain at Failure, %	9.2
Strain Rate, %/min	0.5
Cell Pressure, ksf	1.0
Tested By:	JC
Date Tested:	1/7/13

REMARKS

Test Method: ASTM 2850

UNCONSOLIDATED, UNDRAINED TRIAXIAL TEST RESULTS

Los Osos Water Recycling Facility
San Luis Obispo County, California



SAMPLE ID

Boring Number:	DH-12
Sample Number:	2
Sample Depth:	5.0 ft
USCS Classification:	Fat CLAY (CH): yellowish brown mottled w/olive brown, moist

SAMPLE PROPERTIES

Water Content, %	15.4%
Dry Unit Weight, pcf	117.4
Saturation, %	100%
Void Ratio	0.41
Diameter, in	2.39
Height, in	4.88

SAMPLE IMAGES

CLASSIFICATION

Sieve Size	% Passing	Other Parameters	
3/8-in. (9.5mm)	---	Liquid Limit	---
#4 (4.75mm)	---	Plastic Limit	---
#16 (1.18mm)	---	Plasticity Index	---
#30 (0.6mm)	---	Estimated Gs	2.65
#100 (0.150mm)	---	S_u from T_v, ksf	---
#200 (0.075mm)	---	S_u from PP, ksf	---

TEST SUMMARY

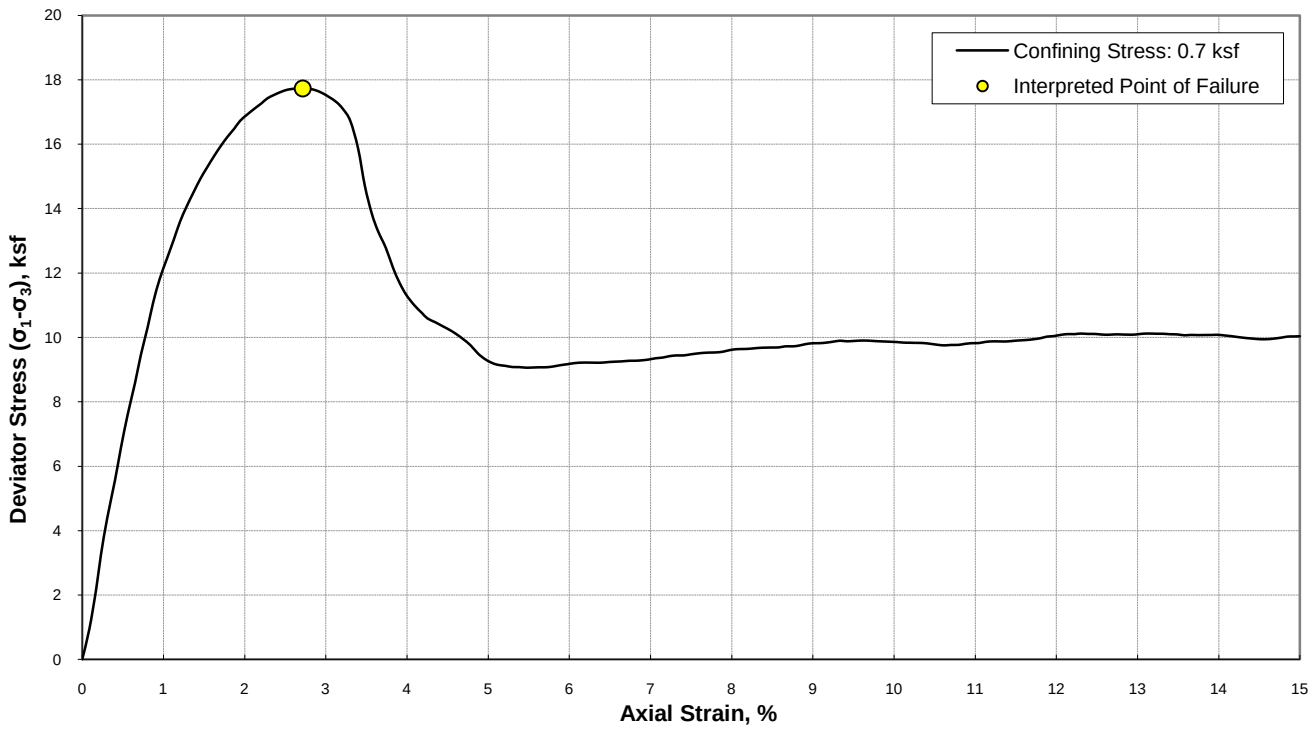
Maximum Deviator Stress, ksf	11.9
Undrained Shear Strength, ksf	5.9
Axial Strain at Failure, %	14.5
Strain Rate, %/min	0.5
Cell Pressure, ksf	0.7
Tested By:	JC
Date Tested:	12/28/12

REMARKS

Test Method: ASTM 2850

UNCONSOLIDATED, UNDRAINED TRIAXIAL TEST RESULTS

Los Osos Water Recycling Facility
San Luis Obispo County, California



SAMPLE ID

Boring Number:	DH-15
Sample Number:	2
Sample Depth:	5.0 ft
USCS Classification:	Sandy fat CLAY (CH): dark yellowish brown, moist

SAMPLE PROPERTIES

Water Content, %	12.6%
Dry Unit Weight, pcf	118.5
Saturation, %	85%
Void Ratio	0.40
Diameter, in	2.42
Height, in	5.01

SAMPLE IMAGES

CLASSIFICATION

Sieve Size	% Passing	Other Parameters	
3/8-in. (9.5mm)	---	Liquid Limit	---
#4 (4.75mm)	---	Plastic Limit	---
#16 (1.18mm)	---	Plasticity Index	---
#30 (0.6mm)	---	Estimated Gs	2.65
#100 (0.150mm)	---	S_u from T_v, ksf	---
#200 (0.075mm)	---	S_u from PP, ksf	---

TEST SUMMARY

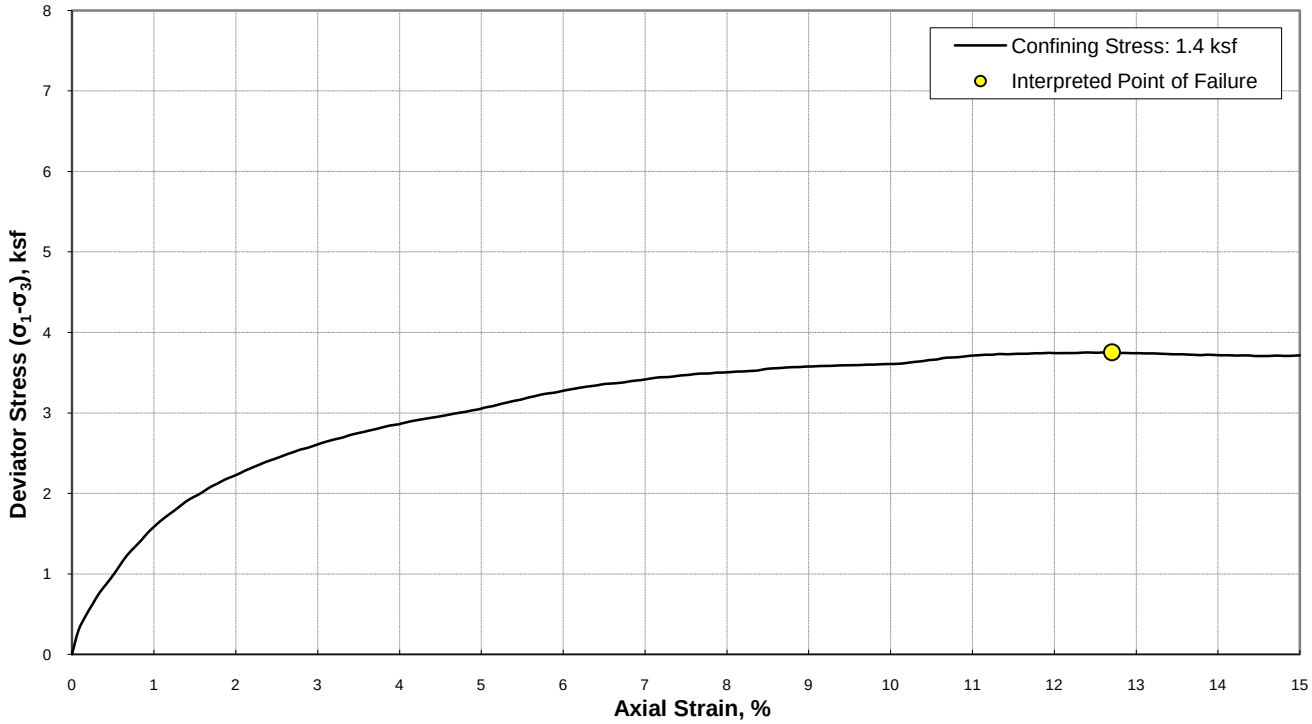
Maximum Deviator Stress, ksf	17.7
Undrained Shear Strength, ksf	8.9
Axial Strain at Failure, %	2.7
Strain Rate, %/min	0.5
Cell Pressure, ksf	0.7
Tested By:	JC
Date Tested:	1/2/13

REMARKS

Test Method: ASTM 2850

UNCONSOLIDATED, UNDRAINED TRIAXIAL TEST RESULTS

Los Osos Water Recycling Facility
San Luis Obispo County, California



SAMPLE ID

Boring Number:	DH-17
Sample Number:	4A
Sample Depth:	15.5 ft
USCS Classification:	Fat CLAY with sand (CH): dark olive brown, moist, layer interface at mid-height to well-graded clayey sand

SAMPLE PROPERTIES

Water Content, %	22.5%
Dry Unit Weight, pcf	100.7
Saturation, %	93%
Void Ratio	0.64
Diameter, in	2.42
Height, in	4.88

SAMPLE IMAGES

CLASSIFICATION

Sieve Size	% Passing	Other Parameters	
3/8-in. (9.5mm)	---	Liquid Limit	---
#4 (4.75mm)	---	Plastic Limit	---
#16 (1.18mm)	---	Plasticity Index	---
#30 (0.6mm)	---	Estimated Gs	2.65
#100 (0.150mm)	---	S_u from T_v, ksf	---
#200 (0.075mm)	---	S_u from PP, ksf	---

TEST SUMMARY

Maximum Deviator Stress, ksf	3.8
Undrained Shear Strength, ksf	1.9
Axial Strain at Failure, %	12.7
Strain Rate, %/min	0.5
Cell Pressure, ksf	1.4
Tested By:	JC
Date Tested:	1/4/13

REMARKS

Test Method: ASTM 2850

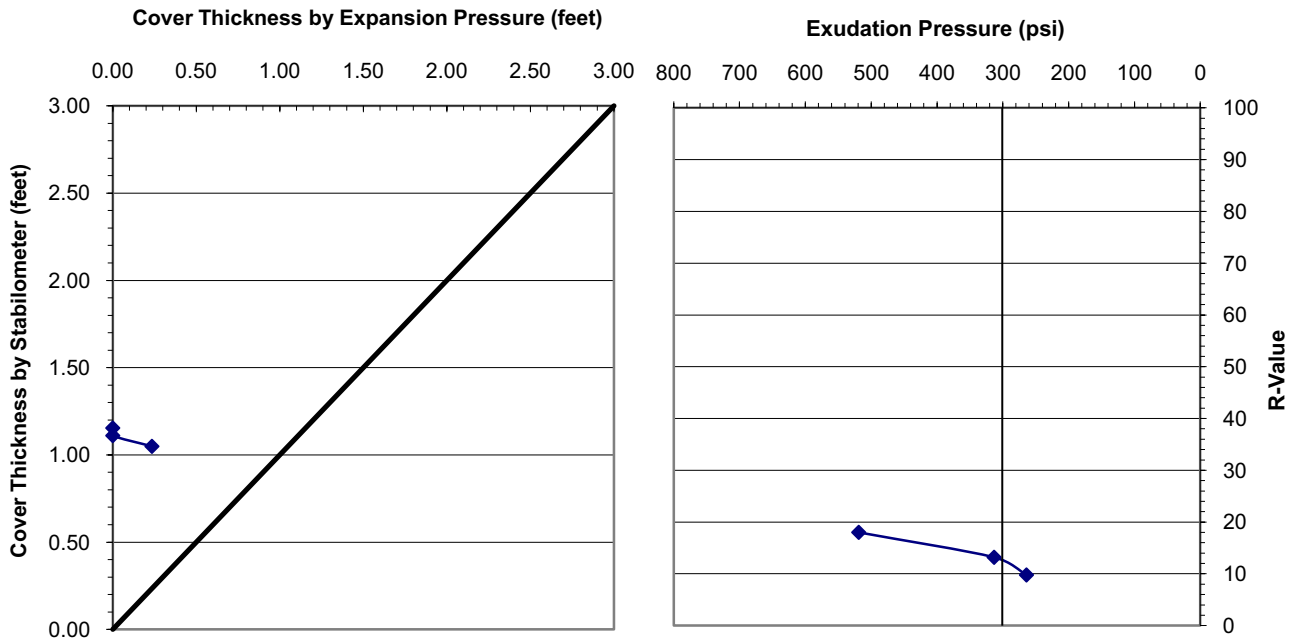
UNCONSOLIDATED, UNDRAINED TRIAXIAL TEST RESULTS

Los Osos Water Recycling Facility
San Luis Obispo County, California

Boring No.	DH-3	DH-4	DH-9	DH-13
Sample No.	**A**	**A**	**A**	**A**
Depth (feet)	**20-25**	**1-6**	**0-5**	**0-5**
Initial Water Content, %	14.1	13.0	10.4	15.0
Initial Dry Unit Weight, pcf	94.1	97.6	107.5	92.0
Degree of Saturation, %	48.2	48.2	49.7	48.7
Final Water Content, %	34.9	31.	23.0	31.0
$EI_{measured}$	121	105	58	84
EI_{50}	**121**	**105**	**58**	**84**
ASTM Expansion Potential	**High**	**High**	**Medium**	**Medium**
Description:	**Fat Clay (CH)**	**Sandy Lean CLAY (CL)**	**Sandy Lean CLAY (CL)**	**Sandy Lean CLAY (CL)**

Boring No.	DH-18	DH-19	DH-20
Sample No.	**2**	**A**	**A**
Depth (feet)	**5**	**20-25**	**0-5**
Initial Water Content, %	11.2	10	10.9
Initial Dry Unit Weight, pcf	104.1	107.5	104.9
Degree of Saturation, %	48.9	48.1	48.6
Final Water Content, %	23.8	27.0	20.3
$EI_{measured}$	46	120	34
EI_{50}	**46**	**117**	**34**
ASTM Expansion Potential	**Low**	**High**	**Low**
Description:	**Clayey SAND (SC)**	**Sandy lean Clay (CL)**	**Sandy lean CLAY (CL)**

EXPANSION INDEX TEST RESULTS
Los Osos Water Recycling Facility
San Luis Obispo County, California



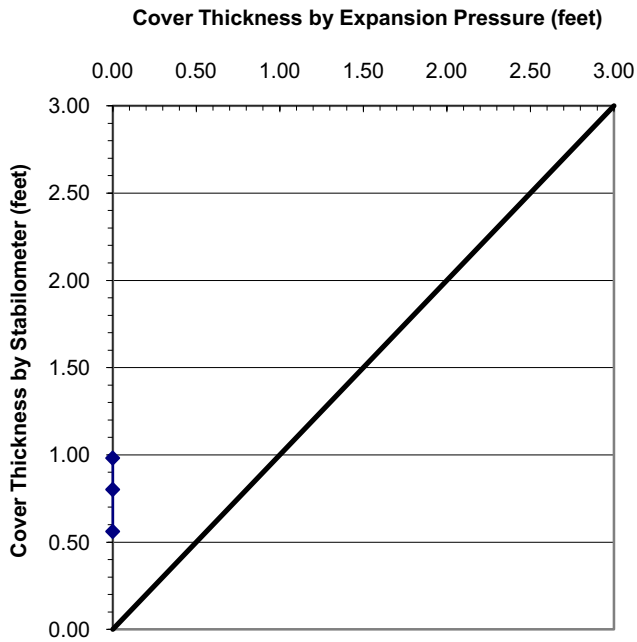
Sample No. A **Depth:** 0.0' - 5.0'
Description: Dark Yellowish Brown Sandy Lean CLAY (CL)
Date Tested: 1/4/2013
Test Method: ASTM D2844, CT301
Initial Moisture Content: 11.1%

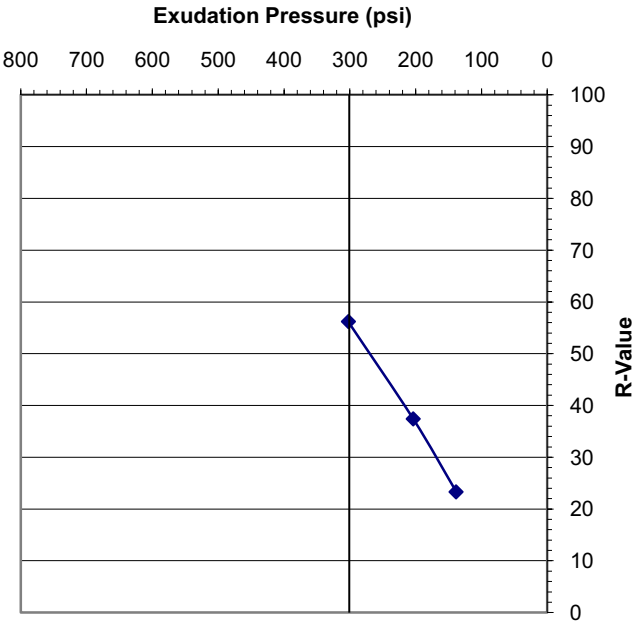
Dry Unit Weight (pcf)	Water Content (%)	Exudation Pressure (psi)	Expansion Pressure (psf)	R-Value
102.0	19.2	264	0	10
104.4	18.2	313	0	13
108.0	16.5	519	31	18

R-value at Exudation Pressure of 300 psi: **12.5**
R-value by Expansion Pressure: TI = 4 **N/A**

Remarks: R-value by stabilometer controls.

R-VALUE TEST RESULTS
Los Osos Water Recycling Facility
San Luis Obispo County, California





Sample No. A **Depth:** 20.0' - 25.0'
Description: Fat CLAY w/ 5% Dolomitic Lime (CH)
Date Tested: 4/5/2013
Test Method: ASTM D2844, CT301
Initial Moisture Content: 22.6%

Dry Unit Weight (pcf)	Water Content (%)	Exudation Pressure (psi)	Expansion Pressure (psf)	R-Value
96.0	27.4	138	0	23
97.6	26.2	204	0	37
100.1	24.6	302	0	56

R-value at Exudation Pressure of 300 psi: **55.5**
R-value by Expansion Pressure: TI = 4 **N/A**

Remarks: R-value by stabilometer controls.

R-VALUE TEST RESULTS
Los Osos Water Recycling Facility
San Luis Obispo County, California

SAMPLE ID

Boring Number	DH-3
Sample Number	10
Sample Depth, ft	45.0
Classification	Poorly-graded SAND with silt (SP-SM): red yellow, wet, fine sand

SAMPLE PROPERTIES

	Intial	Final
Mass, g	451.47	451.86
Water Content, %	23.6%	23.7%
Dry Unit Weight, pcf	100.8	100.8
Saturation, %	100%	100%
Void Ratio	0.62	0.62
Diameter, in	2.42	2.42
Height, in	3.00	3.00
Area, in^2	4.60	4.60
Volume, in^3	13.80	13.80

CLASSIFICATION

Sieve Size	% Passing
3/8-in. (9.5mm)	---
#4 (4.75mm)	---
#16 (1.18mm)	---
#30 (0.6mm)	---
#100 (0.150mm)	---
#200 (0.075mm)	6.1

Other Parameters	
Liquid Limit	---
Plastic Limit	---
Plasticity Index	---
Estimated Gs	2.62

TEST SUMMARY

k_{avg} 20ºC, cm/s	1.2E-03
Sample Type	MCA
Permeant	Deaired Tap-Water
Pipette Area, cm^2	0.971
Tested By	JC

REMARKS

Test Method: ASTM D5084 (Method C)
Estimated Gs provides final saturation of 100%.

PERMEATION DATA

Trial	Date	Time, sec	$Temp_{Avg}$, ºC	σ', ksf	μ, ksf	i_o	i_f	k_t, cm/s
1	1/28/13	220	22.5	4.3	10.1	0.4	0.1	1.3E-03
2	1/28/13	222	22.5	4.3	10.1	0.4	0.1	1.3E-03
3	1/28/13	221	22.5	4.3	10.1	0.4	0.1	1.3E-03
4	1/28/13	219	22.5	4.3	10.1	0.4	0.1	1.3E-03
5								
6								

SAMPLE IMAGES

HYDRAULIC CONDUCTIVITY
Los Osos Water Recycling Facility
San Luis Obispo County, California

SAMPLE ID

Boring Number	DH-4
Sample Number	8
Sample Depth, ft	35.0
Classification	Poorly-graded SAND with silt (SP-SM): yellow, moist, fine sand

SAMPLE PROPERTIES

	Intial	Final
Mass, g	447.36	458.06
Water Content, %	18.4%	21.2%
Dry Unit Weight, pcf	104.3	104.9
Saturation, %	85%	100%
Void Ratio	0.57	0.56
Diameter, in	2.42	2.42
Height, in	3.00	3.00
Area, in^2	4.60	4.58
Volume, in^3	13.80	13.72

CLASSIFICATION

Sieve Size	% Passing
3/8-in. (9.5mm)	---
#4 (4.75mm)	---
#16 (1.18mm)	---
#30 (0.6mm)	---
#100 (0.150mm)	---
#200 (0.075mm)	7.5

Other Parameters	
Liquid Limit	---
Plastic Limit	---
Plasticity Index	---
Estimated Gs	2.62

TEST SUMMARY

k_{avg} 20ºC, cm/s	1.3E-03
Sample Type	MCA
Permeant	Deaired Tap-Water
Pipette Area, cm^2	0.971
Tested By	JC

REMARKS

Test Method: ASTM D5084 (Method C)
Estimated Gs provides final saturation of 100%.

PERMEATION DATA

Trial	Date	Time, sec	$Temp_{Avg}$, ºC	σ', ksf	μ, ksf	i_o	i_f	k_t, cm/s
1	1/28/13	216	20.2	4.3	10.1	0.4	0.1	1.3E-03
2	1/28/13	209	20.2	4.3	10.1	0.4	0.1	1.4E-03
3	1/28/13	204	20.2	4.3	10.1	0.4	0.1	1.4E-03
4	1/28/13	207	20.2	4.3	10.1	0.4	0.1	1.4E-03
5								
6								

SAMPLE IMAGES

HYDRAULIC CONDUCTIVITY
Los Osos Water Recycling Facility
San Luis Obispo County, California

SAMPLE ID

Boring Number	DH-11
Sample Number	10
Sample Depth, ft	40.0
Classification	Poorly-graded SAND with silt (SP-SM): yellow, wet, fine sand

SAMPLE PROPERTIES

	Intial	Final
Mass, g	466.46	463.94
Water Content, %	21.3%	20.7%
Dry Unit Weight, pcf	104.4	106.1
Saturation, %	99%	100%
Void Ratio	0.57	0.54
Diameter, in	2.42	2.42
Height, in	3.05	3.00
Area, in^2	4.60	4.60
Volume, in^3	14.03	13.80

CLASSIFICATION

Sieve Size	% Passing
3/8-in. (9.5mm)	100
#4 (4.75mm)	100
#30 (0.60mm)	100
#50 (0.3mm)	95
#100 (0.150mm)	18
#200 (0.075mm)	9.5

Other Parameters	
Liquid Limit	---
Plastic Limit	---
Plasticity Index	---
Estimated Gs	2.62

TEST SUMMARY

k_{avg} 20ºC, cm/s	1.0E-03
Sample Type	MCA
Permeant	Deaired Tap-Water
Pipette Area, cm^2	0.971
Tested By	JC

REMARKS

Test Method: ASTM D5084 (Method C)
Estimated Gs provides final saturation of 100%.

PERMEATION DATA

Trial	Date	Time, sec	$Temp_{Avg}$, ºC	σ', ksf	μ, ksf	i_o	i_f	k_t, cm/s
1	1/28/13	278	18.7	2.3	10.1	0.4	0.1	1.0E-03
2	1/28/13	285	18.7	2.3	10.1	0.4	0.1	9.9E-04
3	1/28/13	277	18.7	2.3	10.1	0.4	0.1	1.0E-03
4	1/28/13	273	18.7	2.3	10.1	0.4	0.1	1.0E-03
5								
6								

SAMPLE IMAGES

HYDRAULIC CONDUCTIVITY
Los Osos Water Recycling Facility
San Luis Obispo County, California

SAMPLE ID

Boring Number	DH-12
Sample Number	3
Sample Depth, ft	10.0
Classification	Fat CLAY (CH): olive brown, moist, mottled w/pale brown & dark gray, FeO2 staining

SAMPLE PROPERTIES

	Intial	Final
Mass, g	142.24	145.57
Water Content, %	31.4%	34.5%
Dry Unit Weight, pcf	92.4	88.7
Saturation, %	100%	100%
Void Ratio	0.87	0.95
Diameter, in	2.40	2.42
Height, in	0.99	1.01
Area, in^2	4.51	4.60
Volume, in^3	4.46	4.65

CLASSIFICATION

Sieve Size	% Passing
3/8-in. (9.5mm)	---
#4 (4.75mm)	---
#16 (1.18mm)	---
#30 (0.6mm)	---
#100 (0.150mm)	---
#200 (0.075mm)	---

Other Parameters	
Liquid Limit	82
Plastic Limit	23
Plasticity Index	59
Estimated Gs	2.77

TEST SUMMARY

k_{avg} 20ºC, cm/s	1.3E-09
Sample Type	MCA
Permeant	Deaired Tap-Water
Pipette Area, cm^2	0.0314
Annulus Area, cm^2	0.7671
Tested By	JC

REMARKS

Test Method: ASTM D5084 (Method F)

Estimated Gs provides final saturation of 100%.

PERMEATION DATA

Trial	Date	Time, sec	$Temp_{Avg}$, ºC	σ', ksf	μ, ksf	i_o	i_f	k_t, cm/s
1	4/17/13	28997	19.4	2.3	11.5	28.0	22.9	1.4E-09
2	4/17/13	46328	19.6	2.3	11.5	28.0	22.4	1.0E-09
3	4/18/13	11868	18.9	2.3	11.5	28.0	26.0	1.3E-09
4								
5								
6								

SAMPLE IMAGES

HYDRAULIC CONDUCTIVITY

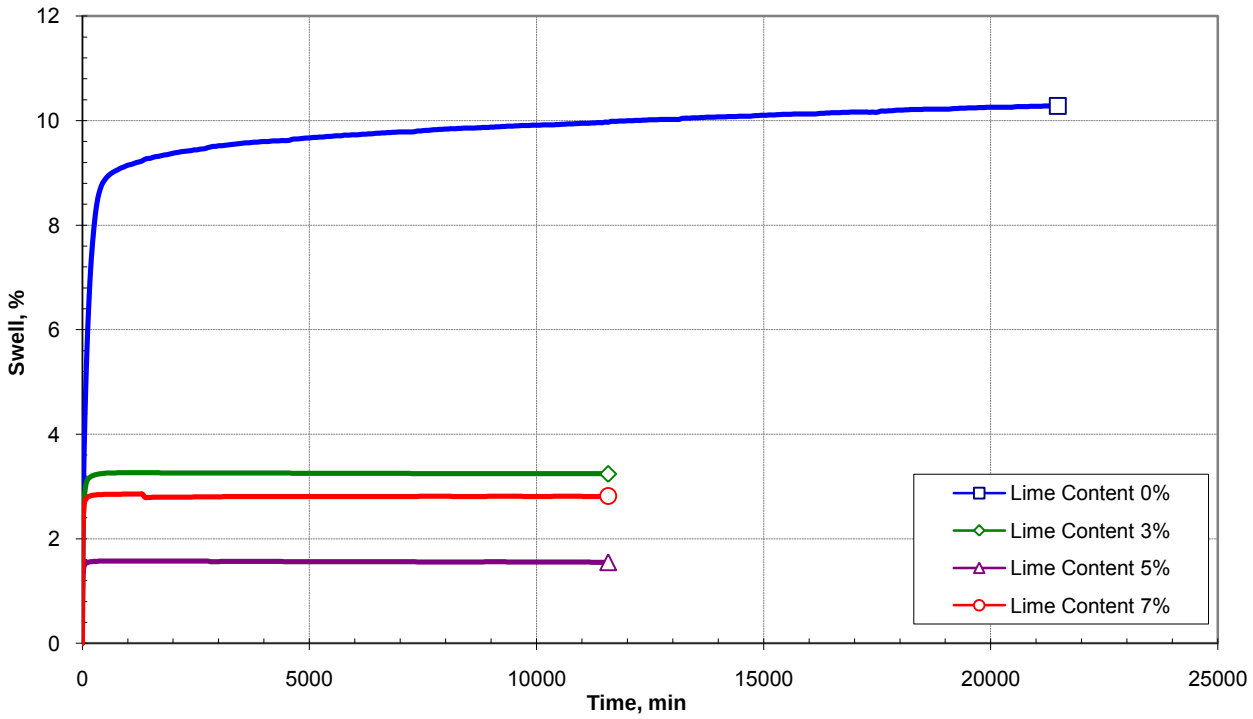
Los Osos Water Recycling Facility

San Luis Obispo County, California

Boring No.	**DH-3**	**DH-4**	**DH-19**
Sample No.	**A**	**A**	**A**
Depth (feet)	**20-25**	**1-5**	**0-5**
Air-dried Moisture	8.1	5.2	7.2
Lime Added:	**pH**	**pH**	**pH**
+2%	11.6	12.2	12.1
+3%	11.9	12.2	12.2
+4%	12.1	12.4	12.3
+5%	12.3	12.4	12.4
+6%	12.4	12.4	12.4
Saturated Solution	12.4	12.4	12.4
Minimum Lime Content, %	**6**	**4**	**5**
Soil Description	**Sandy Fat CLAY (CH)**	**Sandy Fat CLAY (CH)**	**Sandy Lean CLAY (CL)**
Additive	**Dolomitic Quick Lime**	**Dolomitic Quick Lime**	**Dolomitic Quick Lime**
Remarks	**EI = 121**	**EI = 105**	**EI = 117**

Test Method: ASTM D6276 (based on Eades and Grim Test)

pH FOR SOIL-LIME STABILIZATION TEST RESULTS
Los Osos Water Recycling Facility
San Luis Obispo County, California



	Lime Content	0%	3%	5%	7%
SAMPLE ID	Boring Number	Composite	---	---	---
	Sample Number	---	---	---	---
	Depth, ft	---	---	---	---
	USCS Classification	Fat CLAY (CH)	---	---	---
SAMPLE PROPERTIES			INITIAL		
	Dry Unit Weight, pcf	111.0	111.2	110.8	109.1
	Moisture Content, %	13.7%	15.7%	14.5%	13.1%
			AIR-DRIED		
	Dry Unit Weight, pcf	114.5	113.9	112.7	110.1
	Moisture Content, %	9.7%	10.3%	9.2%	8.5%
			FINAL		
	Dry Unit Weight, pcf	103.1	110.3	110.2	106.4
	Moisture Content, %	21.9%	18.3%	18.2%	18.8%
INDEX	Liquid Limit	---	---	---	---
	Plastic Limit	---	---	---	---
	Plasticity Index	---	---	---	---
	Passing #200	---	---	---	---
REMARKS	Test Method: D4546-B				

ONE-DIMENSIONAL EXPANSION
Los Osos Water Recycling Facility
Los Osos, California

Boring No.	–	
Sample No.	Composite Clay Sample	
Depth (feet)	–	
Specimen	1	2
Test Date	3/29/13	3/29/13
Age when tested (days)	28	28
Diameter x Height, inches	4.00 x 4.56	4.0 x 4.6
Initial Dry Unit Weight, pcf	106.0	106.8
Initial Moisture Content, %	20.2	20.2
Final Dry Unit Weight, pcf	107.7	108
Final Water Content, %	18.9	19
Crushing Load	2860	2890
Compressive Strength (psi)	**225**	**230**
Soil Description	**Fat CLAY (CH)**	
Additive	**5% Dolomitic Quick Lime**	

Test Method: ASTM D5102 B

COMPRESSIVE STRENGTH TEST RESULTS
Los Osos Water Recycling Facility
San Luis Obispo County, California

Corrosivity Test Summary

CTL # 446-163 **Date:** 1/14/2013 **Tested By:** PJ **Checked:** PJ
Client: Fugro Consultants **Project:** Los Osos Water Recycling Facility **Proj. No:** 04.6212.0178
Remarks:

Sample Location or ID			Resistivity @ 15.5 °C (Ohm-cm)			Chloride	Sulfate		pH	ORP	Moisture	Soil Visual Description
Boring	Sample, No.	Depth, ft.	As Rec.	Minimum	Saturated	mg/kg	mg/kg	%		(Redox)	At Test	
						Dry Wt.	Dry Wt.	Dry Wt.		mv	%	
			ASTM G57	Cal 643	ASTM G57	Cal 422-mod.	Cal 417-mod.	Cal 417-mod.	Cal 643	SM 2580B	ASTM D2216	
DH-4	A	1-5	-	798	-	141	106	0.0106	7.8	-	18.0	Brown CLAY
DH-10	2	5	-	2663	-	15	20	0.0020	7.5	-	24.4	Brown Clayey SAND
DH-10	4	15	-	1306	-	16	30	0.0030	8.2	-	21.5	Mottled Brown CLAY
DH-10	5	20	-	10472	-	4	11	0.0011	8.2	-	8.7	Pale Brown SAND w/ Clay
DH-13	A	0-4	-	1049	-	9	106	0.0106	7.3	-	16.5	Brown CLAY
DH-19	A	0-5	-	1464	-	32	55	0.0055	7.8	-	15.9	Brown Sandy CLAY
DH-20	A	0-5	-	3640	-	16	38	0.0038	6.8	-	12.1	Reddish Brown Clayey SAND

CORROSION TEST RESULTS
Los Osos Water Recycling Facility
San Luis Obispo County, California

APPENDIX C

Los Osos Water Recycling Facility
Los Osos, CA 93402

Inquiry Number: 3475901.1
December 18, 2012

The EDR Aerial Photo Decade Package

EDR® Environmental Data Resources Inc

440 Wheelers Farms Road
Milford, CT 06461
800.352.0050
www.edrnet.com

EDR Aerial Photo Decade Package

Environmental Data Resources, Inc. (EDR) Aerial Photo Decade Package is a screening tool designed to assist environmental professionals in evaluating potential liability on a target property resulting from past activities. EDR's professional researchers provide digitally reproduced historical aerial photographs, and when available, provide one photo per decade.

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Date EDR Searched Historical Sources:

Aerial Photography December 18, 2012

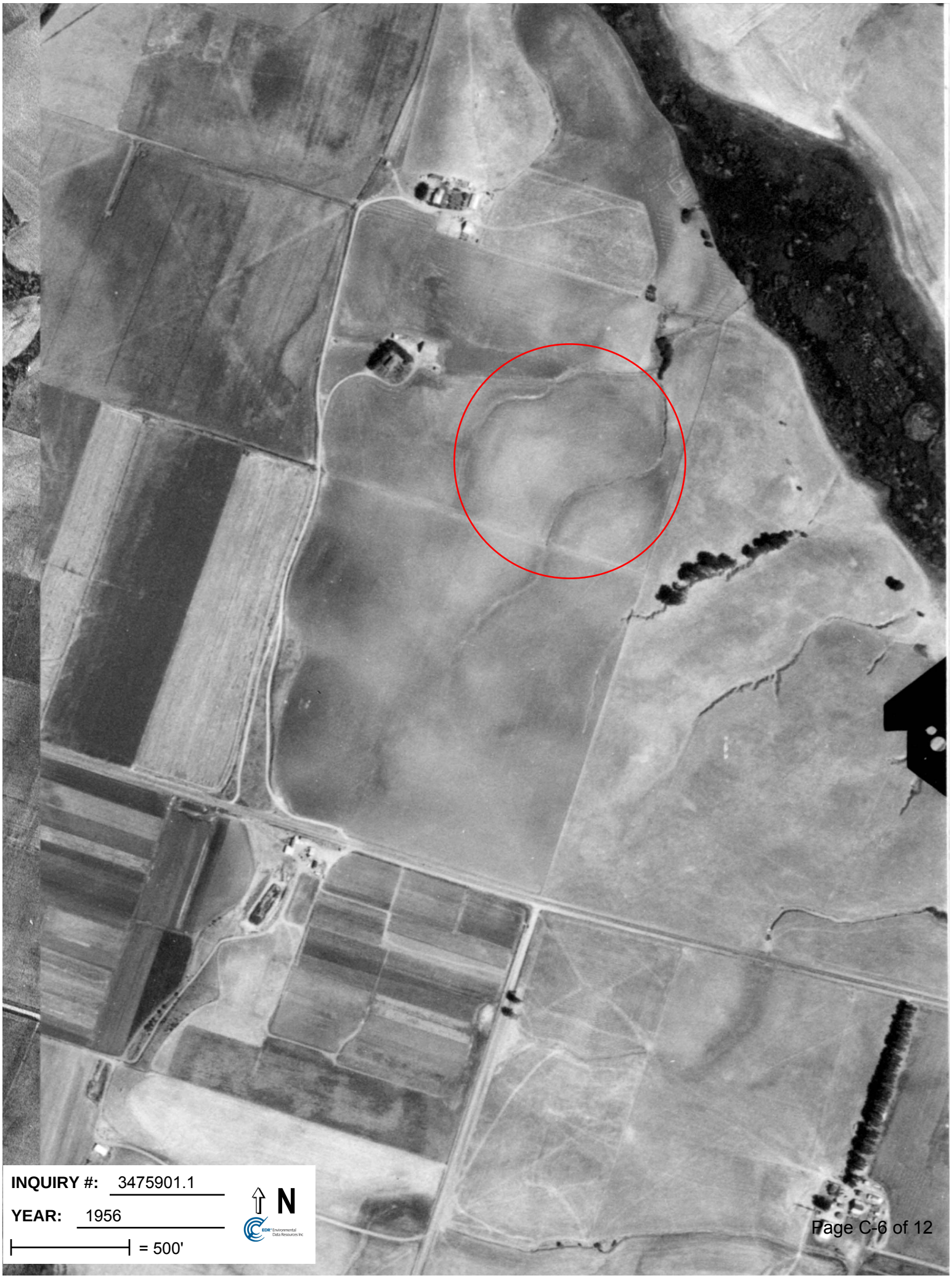
Target Property:

Los Osos, CA 93402

Year	***Scale***	***Details***	***Source***
1937	Aerial Photograph. Scale: 1"=500'	Flight Year: 1937	Army
1949	Aerial Photograph. Scale: 1"=500'	Flight Year: 1949	Park
1956	Aerial Photograph. Scale: 1"=500'	Flight Year: 1956	Hycon
1969	Aerial Photograph. Scale: 1"=500'	Flight Year: 1969	Western
1978	Aerial Photograph. Scale: 1"=500'	Flight Year: 1978	Pacific Air
1989	Aerial Photograph. Scale: 1"=500'	Flight Year: 1989	USGS
1994	Aerial Photograph. Scale: 1"=500'	/Composite DOQQ - acquisition dates: 1994	EDR
2005	Aerial Photograph. Scale: 1"=500'	Flight Year: 2005	EDR
2006	Aerial Photograph. Scale: 1"=500'	Flight Year: 2006	EDR

INQUIRY #: 3475901.1
YEAR: 1937
= 500'
N
EDR Environmental Data Resources Inc

INQUIRY #: 3475901.1
YEAR: 1949
= 500'
N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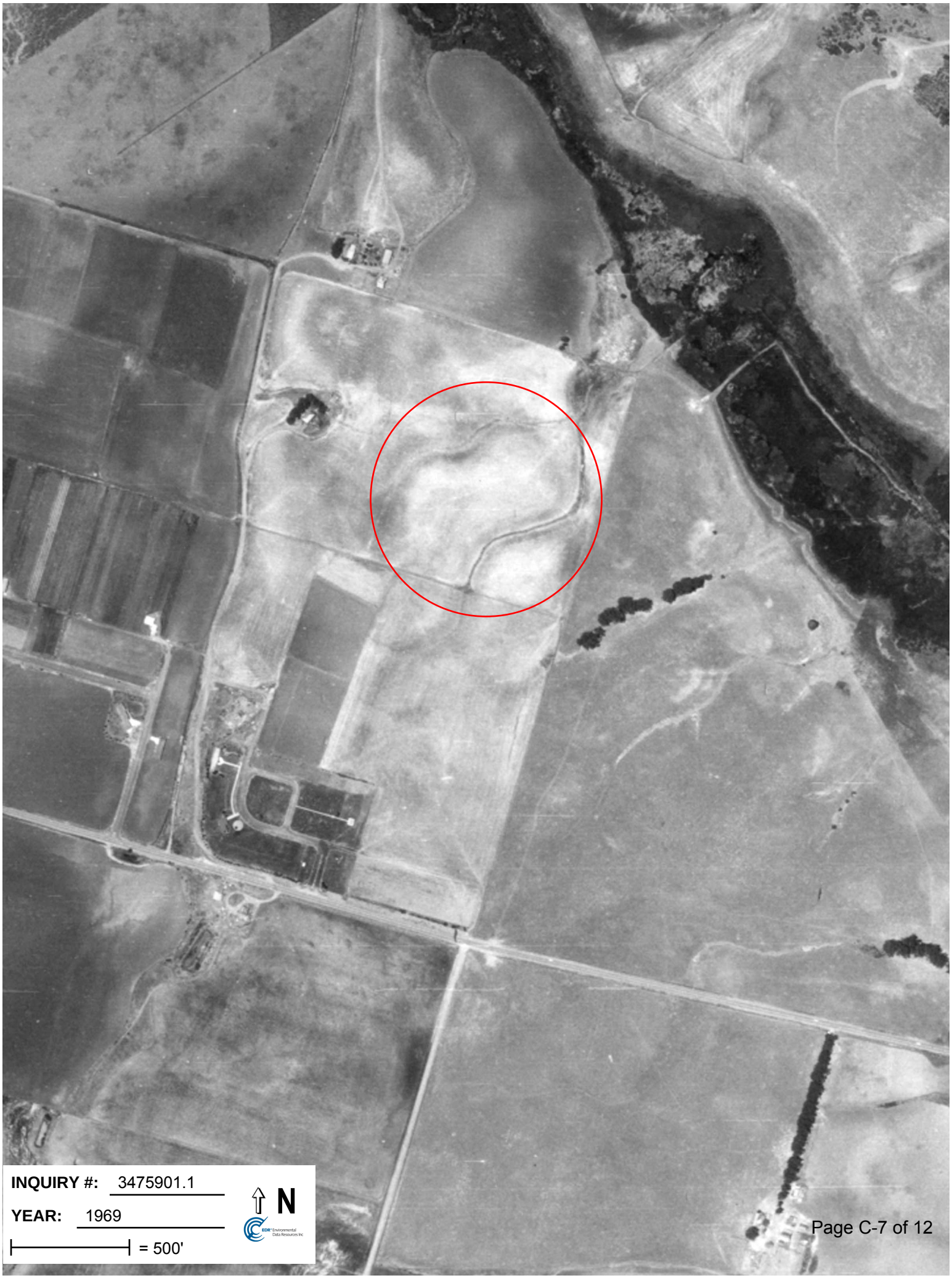
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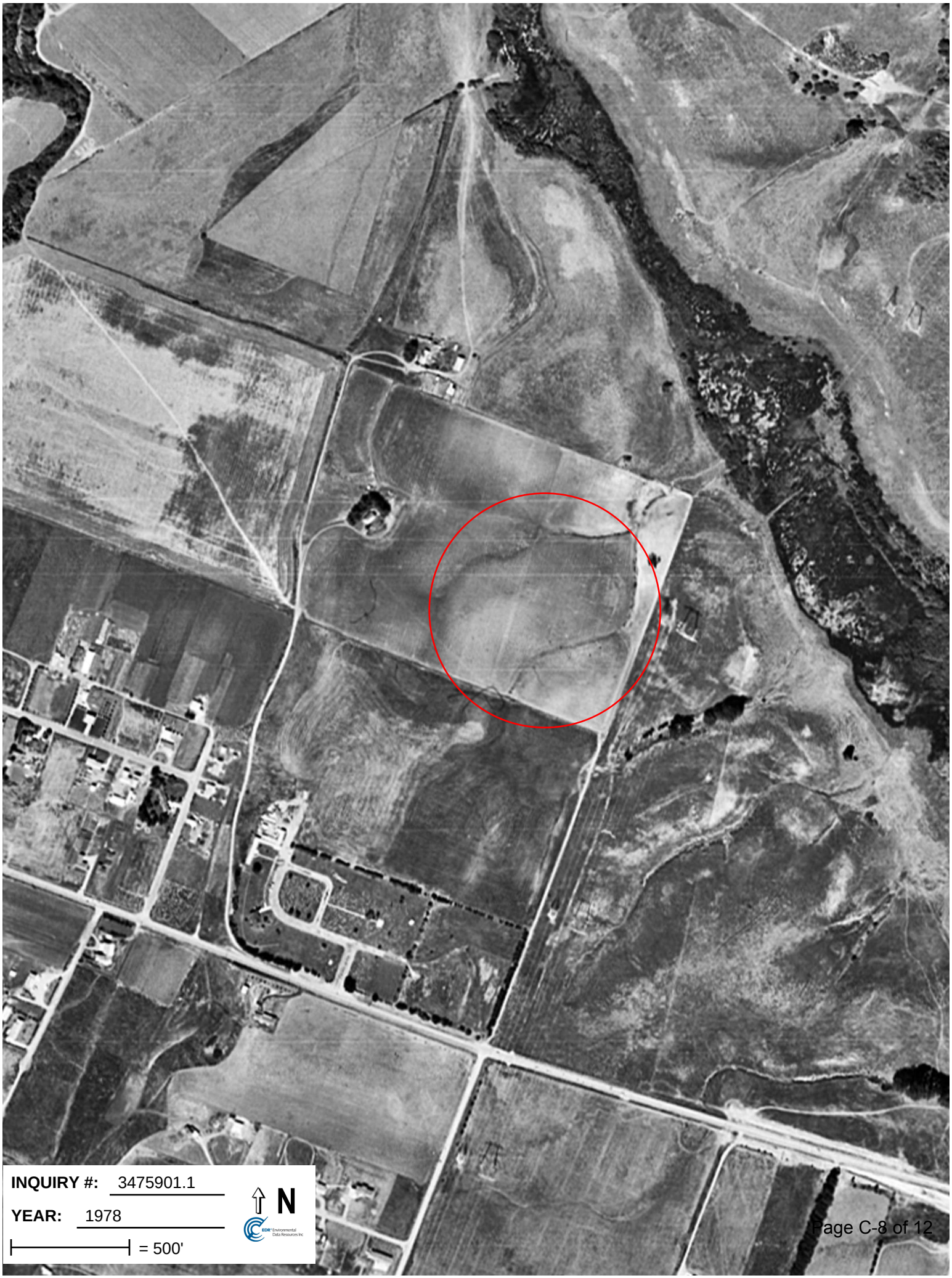
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YEAR: 1978
= 500'
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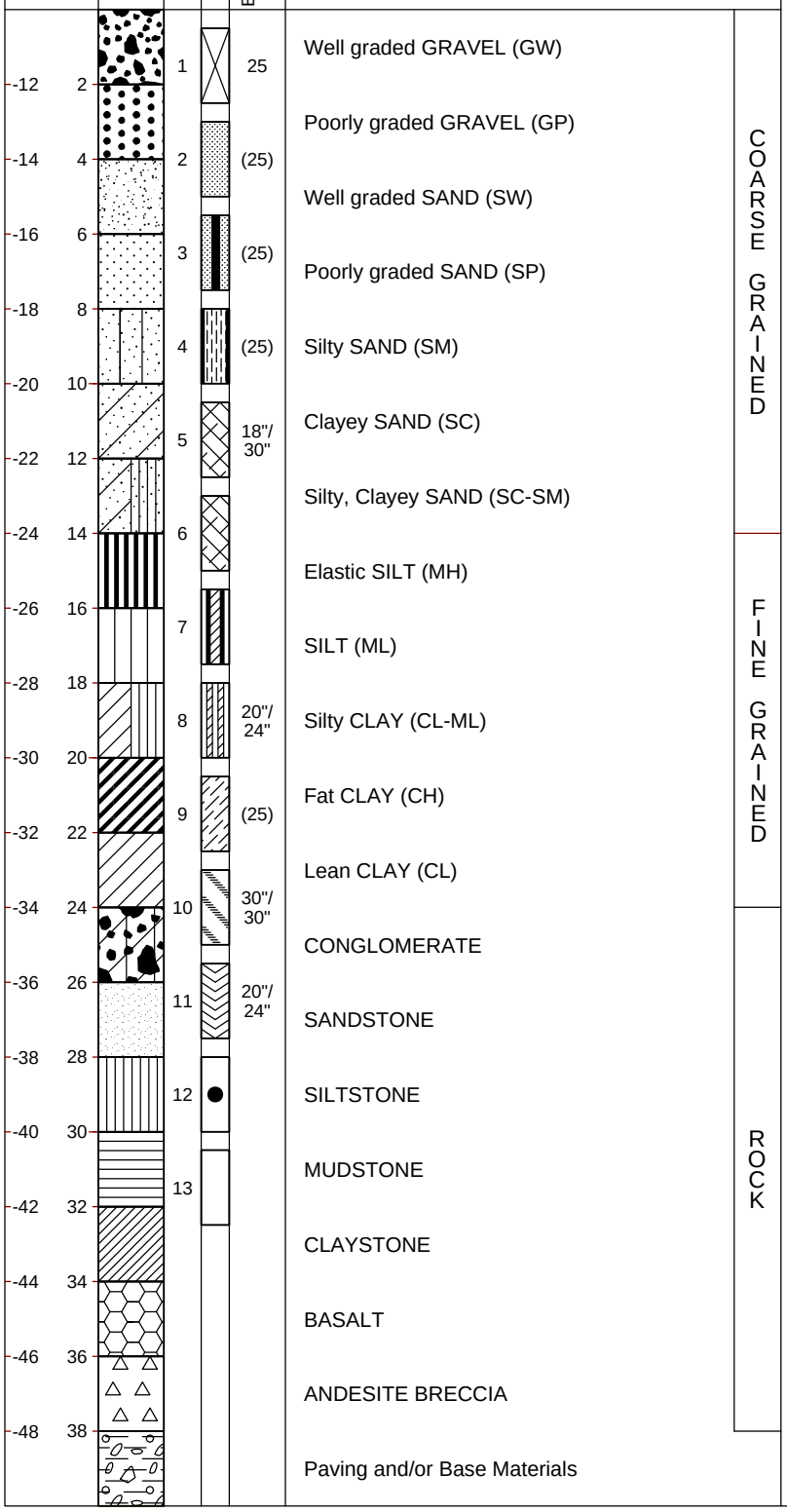
YEAR: 1989
= 500'
N

INQUIRY #: 3475901.1
YEAR: 1994
= 500'
N

INQUIRY #: 3475901.1
YEAR: 2005
= 500'
N

INQUIRY #: 3475901.1
YEAR: 2006
= 500'
N

APPENDIX D



LOCATION: The drill hole location referencing local landmarks or coordinates

SURFACE EL: Using local, MSL, MLLW or other datum

MATERIAL DESCRIPTION

Well graded GRAVEL (GW)	COARSE GRAINED
Poorly graded GRAVEL (GP)	COARSE GRAINED
Well graded SAND (SW)	COARSE GRAINED
Poorly graded SAND (SP)	COARSE GRAINED
Silty SAND (SM)	COARSE GRAINED
Clayey SAND (SC)	COARSE GRAINED
Silty, Clayey SAND (SC-SM)	COARSE GRAINED
Elastic SILT (MH)	FINE GRAINED
SILT (ML)	FINE GRAINED
Silty CLAY (CL-ML)	FINE GRAINED
Fat CLAY (CH)	FINE GRAINED
Lean CLAY (CL)	FINE GRAINED
CONGLOMERATE	ROCK
SANDSTONE	ROCK
SILTSTONE	ROCK
MUDSTONE	ROCK
CLAYSTONE	ROCK
BASALT	ROCK
ANDESITE BRECCIA	ROCK
Paving and/or Base Materials	

General Notes

Soil Texture Symbol

Sloped line in symbol column indicates transitional boundary

Samplers and sampler dimensions
(unless otherwise noted in report text) are as follows:

Symbol for:

1	SPT Sampler, driven 1-3/8" ID, 2" OD
2	CA Liner Sampler, driven 2-3/8" ID, 3" OD
3	CA Liner Sampler, disturbed 2-3/8" ID, 3" OD
4	Thin-walled Tube, pushed 2-7/8" ID, 3" OD
5	Bulk Bag Sample (from cuttings)
6	CA Liner Sampler, Bagged
7	Hand Auger Sample
8	CME Core Sample
9	Pitcher Sample
10	Lexan Sample
11	Vibracore Sample
12	No Sample Recovered
13	Sonic Soil Core Sample

Sampler Driving Resistance

Number of blows with 140 lb. hammer, falling 30" to drive sampler 1 ft. after seating sampler 6"; for example,

Blows/ft	Description
25	25 blows drove sampler 12" after initial 6" of seating
86/11"	After driving sampler the initial 6" of seating, 36 blows drove sampler through the second 6" interval, and 50 blows drove the sampler 5" into the third interval
50/6"	50 blows drove sampler 6" after initial 6" of seating
Ref/3"	50 blows drove sampler 3" during initial 6" seating interval

Blow counts for California Liner Sampler shown in ( )

Length of sample symbol approximates recovery length

Classification of Soils per ASTM D2487 or D2488

Geologic Formation noted in bold font at the top of interpreted interval

Strength Legend

Q = Unconfined Compression
u = Unconsolidated Undrained Triaxial
t = Torvane
p = Pocket Penetrometer
m = Miniature Vane

Water Level Symbols

- Initial or perched water level
- Final ground water level
- Seepages encountered

Rock Quality Designation (RQD) is the sum of recovered core pieces greater than 4 inches divided by the length of the cored interval.

KEY TO TERMS & SYMBOLS USED ON LOGS

PLATE A-1

LOCATION: Westbound shoulder of Los Osos Valley Road, 40' west of Clark Valley Road

SURFACE EL: 113 ft +/- (rel. NAVD88 datum)

ELEVATION, ft	DEPTH, ft	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
					8" of asphalt concrete							
					15" of base material, yellowish brown gravelly SAND (SP)							
	2	1		(14)				12	34			
					SAND DUNE DEPOSITS (Qos) Silty, Clayey SAND (SC-SM): loose, grayish brown, moist, mottled, minor gravel to 1/2", pockets of lean CLAY (CL) with sand							
	4	2 3		(52)	Clayey SAND (SC): dense, dark yellowish brown with gray and orange mottles, moist	134	117	14	33			
	10	4		25	- light brown to moderate brown, orange staining throughout							
	14	5		(71)		131	114	15	19			

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 15.5 ft
DEPTH TO WATER: Not Encountered
BACKFILLED WITH: Sand cement slurry
DRILLING DATE: June 20, 2011

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: Automatic Trip
DRILLED BY: S/G Drilling Company
LOGGED BY: T Nicely
CHECKED BY: J Blanchard

LOG OF BORING NO. DH-501

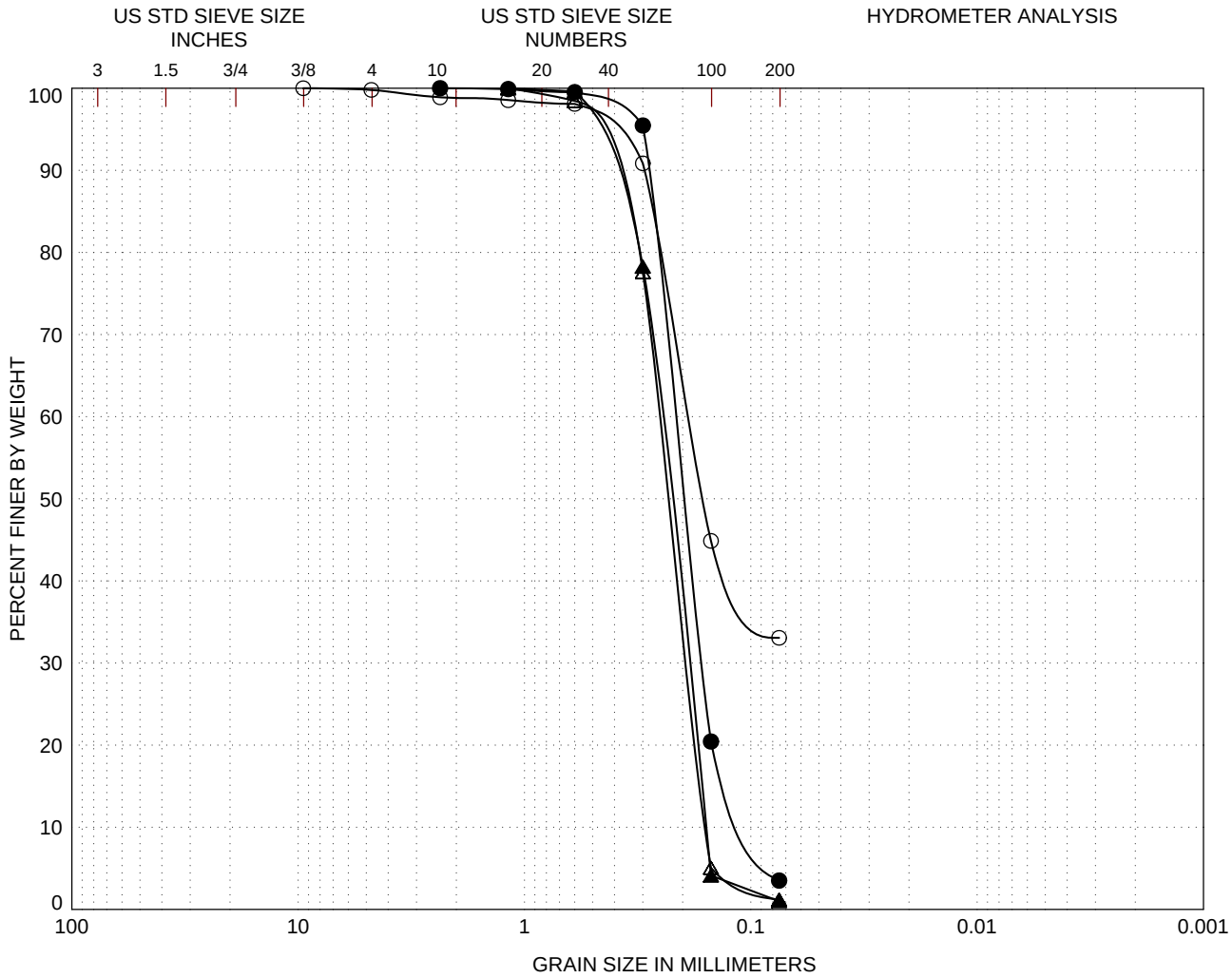
Los Osos Wastewater Collection System
Los Osos, California

PLATE A-2

DRILL HOLE	DEPTH, ft	SAMPLE NUMBER	MATERIAL DESCRIPTION	UWW pcf	UDW pcf	MC %	FINES %	ATTERBERG LIMITS		COMPACTION TEST		DIRECT SHEAR		COMPRESSIVE STRENGTH TESTS		CORROSIVITY TESTS				R-VALUE	EXPANSION INDEX	SAND EQUIVALENT (SE)	SPECIFIC GRAVITY
								LL	PI	MAX DD pcf	OPT MC %	C ksf	PHI deg	Qu, ksf	S_u (Cell Prs.) ksf	R	pH	Cl	So_4 (ppm)				
DH-501	1.5	1	Clayey SAND (SC)			12	34																
DH-501	3.5	2	Clayey SAND (SC)																	18			
DH-501	4.0	3	Clayey SAND (SC)	134	117	14	33															14	
DH-501	14.0	5	Clayey SAND (SC)	131	114	15	19																
DH-502	1.0	6	Clayey SAND (SC)	127	115	17						0.5	35										
DH-502	2.5	7	Clayey SAND (SC)													2082	8.10	30	15.5				
DH-502	4.0	8	Clayey SAND (SC)	134	117	14	21															17	
DH-502	10.0	9	Fat CLAY (CH)	128	113	13																	
DH-502	14.0	10	Clayey SAND (SC)	124	108	15																	
DH-503	1.5	11	Lean CLAY with sand (CL)	130	112	16		35	20														
DH-503	3.0	12	Lean CLAY (CL)											1.9	1.0 (0.4)	1658	7.80	13	26	10			
DH-503	4.0	13	Clayey SAND with gravel (SC)	112	105	7								3.2	1.6 (0.9)								
DH-503	14.0	15	Sandy Lean CLAY (CL)	125	102	23	57																
DH-504	1.5	32	Sandy Lean CLAY (CL)	129	116	11																	
DH-504	3.0	33	Sandy Lean CLAY (CL)							126.7	9.9			1.3	0.7 (0.4)								
DH-504	4.0	34	Clayey SAND (SC)	112	97	16		27	11														
DH-504	9.0	35	Lean CLAY with sand (CL)																				
DH-504	14.0	36	Lean CLAY with sand (CL)	125	102	23		30	14							1971	7.70	22	47				
DH-504	24.0	38	Poorly graded SAND with silt (SP-SM)	124	102	22																	
DH-504	34.0	40	Poorly graded GRAVEL with clay (GP-GC)	146	131	12																	
DH-504	39.0	41	Poorly graded SAND with silt (SP-SM)				6																
DH-505	1.5	27	Poorly graded SAND with silt (SP-SM)	105	101	4	9															24	
DH-505	4.0	29	Poorly graded SAND (SP)	103	100	3	4															49	
DH-506	2.0	17	Poorly graded SAND (SP)	105	101	4																	
DH-506	4.0	18	Poorly graded SAND (SP)				1															76	
DH-506	14.0	21	Poorly graded SAND (SP)	120	114	6	2																
DH-506	24.0	23	Poorly graded SAND (SP)				1																
DH-506	34.0	25	Poorly graded SAND (SP)	116	107	8																	

SUMMARY OF LABORATORY TEST RESULTS

Los Osos Wastewater Collection System
Los Osos, California

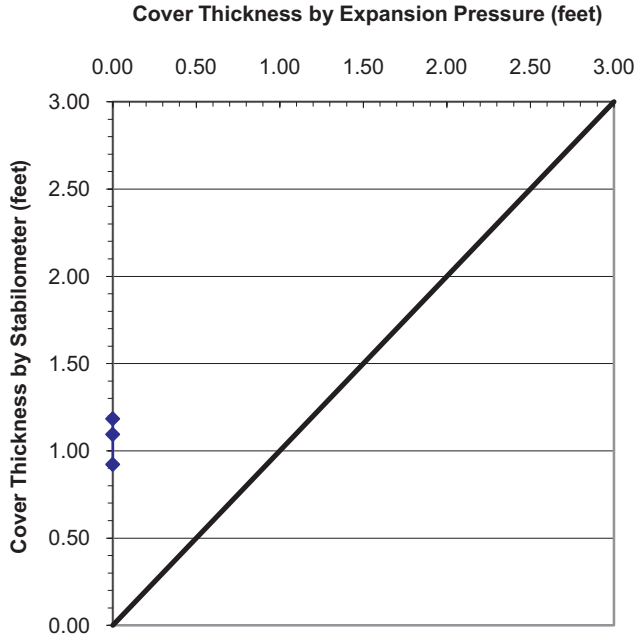


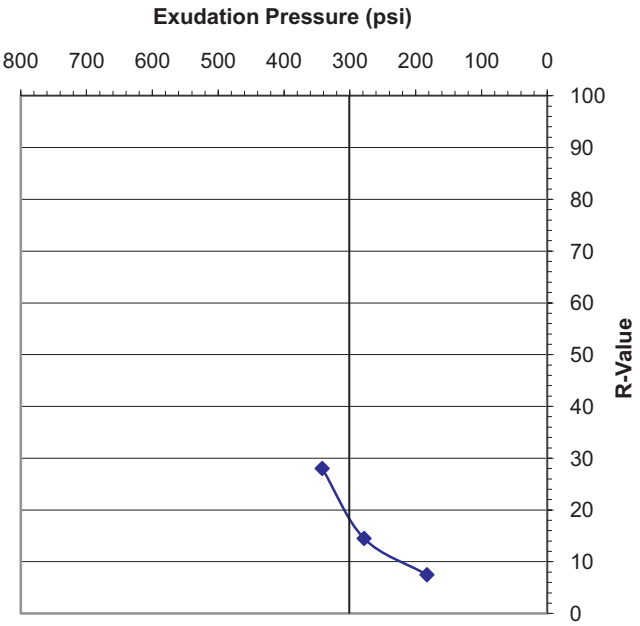
GRAVEL		SAND			SILT or CLAY
Coarse	Fine	Coarse	Medium	Fine	

LEGEND	(location)	(depth,ft)	CLASSIFICATION	Cc	Cu
○	DH-501	4.0	Clayey SAND (SC)		
●	DH-505	4.0	Poorly graded SAND (SP)	1.3	2.2
△	DH-506	4.0	Poorly graded SAND (SP)	0.9	1.6
▲	DH-506	24.0	Poorly graded SAND (SP)	0.9	1.6

GRAIN SIZE CURVES
Los Osos Wastewater Collection System
Los Osos, California

PLATE B-2





Sample No. DH-501 #2 **Depth:** 3'-5'
Description: Brown clayey SAND (SC)
Date Tested: 6/30/2011
Test Method: ASTM D2844, CT301
Initial Moisture Content: 11.2%

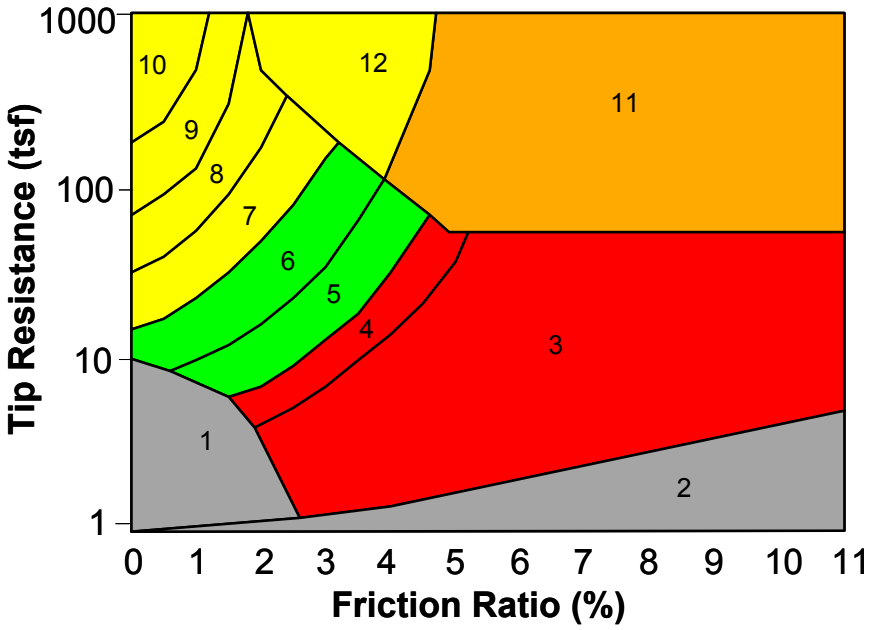
Dry Unit Weight (pcf)	Water Content (%)	Exudation Pressure (psi)	Expansion Pressure (psf)	R-Value
118.7	13.4	183	0	8
123.3	12.2	278	0	15
124.6	11.2	342	0	28

R-value at Exudation Pressure of 300 psi: **18**
R-value by Expansion Pressure: TI = 4 **N/A**

Remarks: R-value by stabilometer controls.

R-VALUE TEST RESULTS
Los Osos Wastewater Collection System
Los Osos, California

PLATE B-6a



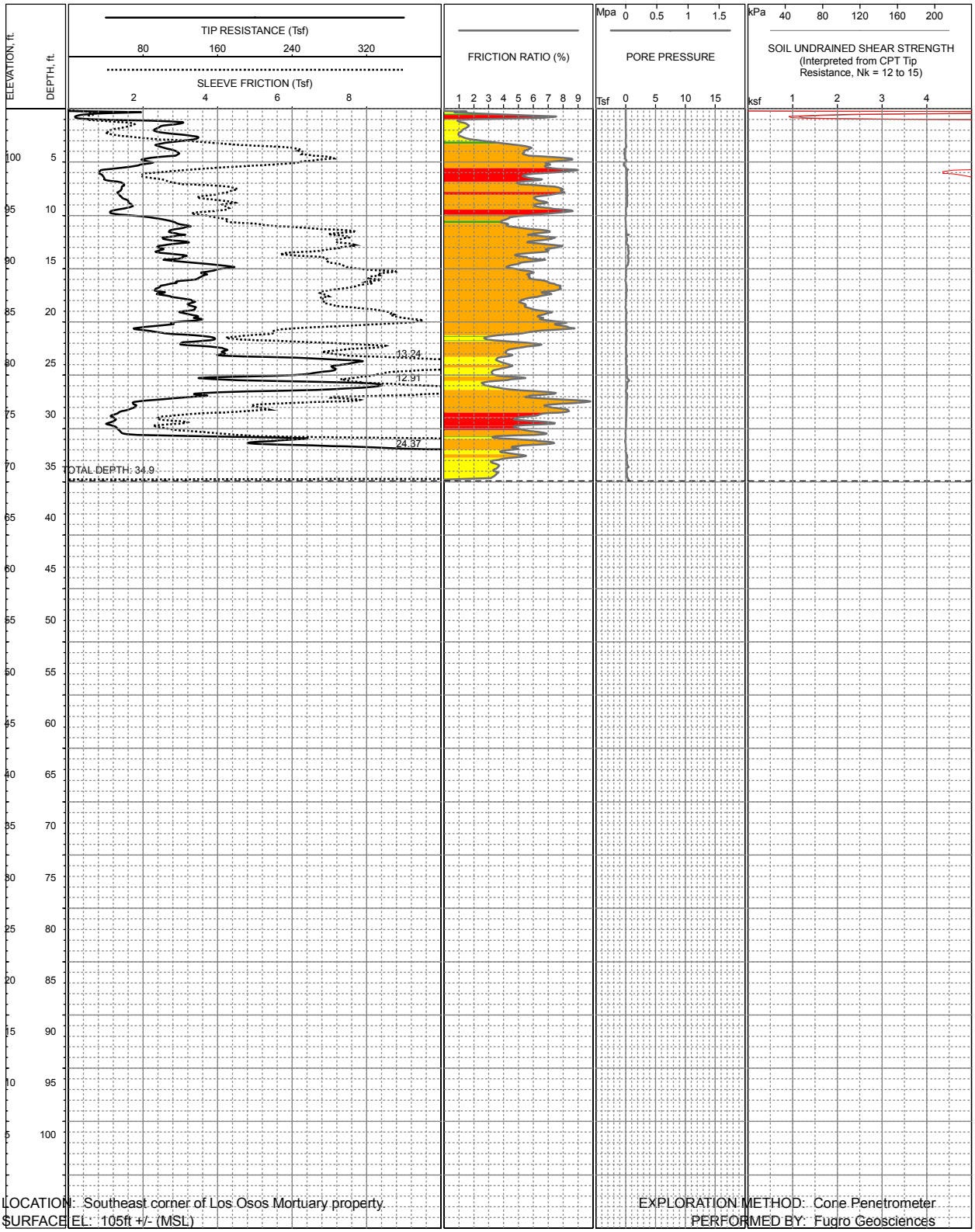
Zone	Soil Behavior Type	U.S.C.S.
1	Sensitive Fine-grained	OL-CH
2	Organic Material	OL-OH
3	Clay	CH
4	Silty Clay to Clay	CL-CH
5	Clayey Silt to Silty Clay	MH-CL
6	Sandy Silt to Clayey Silt	ML-MH
7	Silty Sand to Sandy Silt	SM-ML
8	Sand to Silty Sand	SM-SP
9	Sand	SW-SP
10	Gravelly Sand to Sand	SW-GW
11	Very Stiff Fine-grained *	CH-CL
12	Sand to Clayey Sand *	SC-SM

*overconsolidated or cemented

CPT CORRELATION CHART
(Robertson and Campanella, 1984)

N:\Projects\3014_SLOcounty\3014-026_LosOsosWastewater\Outputs\Working\mxd\CPT\CPTkey.mxd, 06/11/07, CDean

KEY TO CPT LOGS
Los Osos Wasterwater Project
San Luis Obispo County, California



LOCATION: Southeast corner of Los Osos Mortuary property.
SURFACE EL: 105ft +/- (MSL)
COMPLETION DEPTH: 34.9ft
TESTDATE: 5/8/2007

EXPLORATION METHOD: Cone Penetrometer
PERFORMED BY: Fugro Geosciences
REVIEWED BY: J Blanchard

LOG OF C-1

Los Osos Wastewater Project
San Luis Obispo County, California

PLATE A-2

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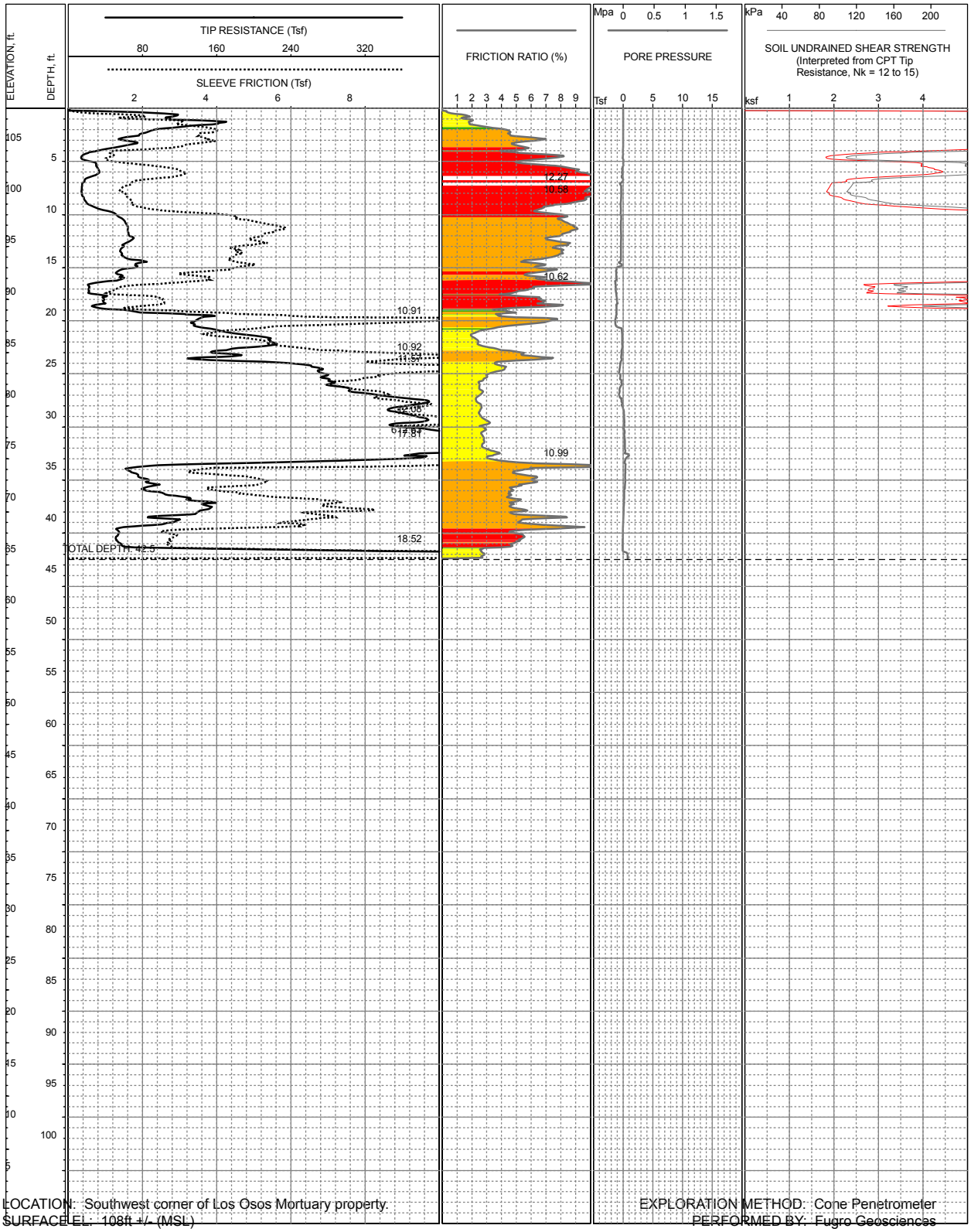

LOCATION: Southwest corner of Los Osos Mortuary property.
SURFACE EL: 108ft +/- (MSL)
COMPLETION DEPTH: 42.5ft
TESTDATE: 5/8/2007

EXPLORATION METHOD: Cone Penetrometer
PERFORMED BY: Fugro Geosciences
REVIEWED BY: J Blanchard

LOG OF C-2

Los Osos Wastewater Project
San Luis Obispo County, California

PLATE A-3

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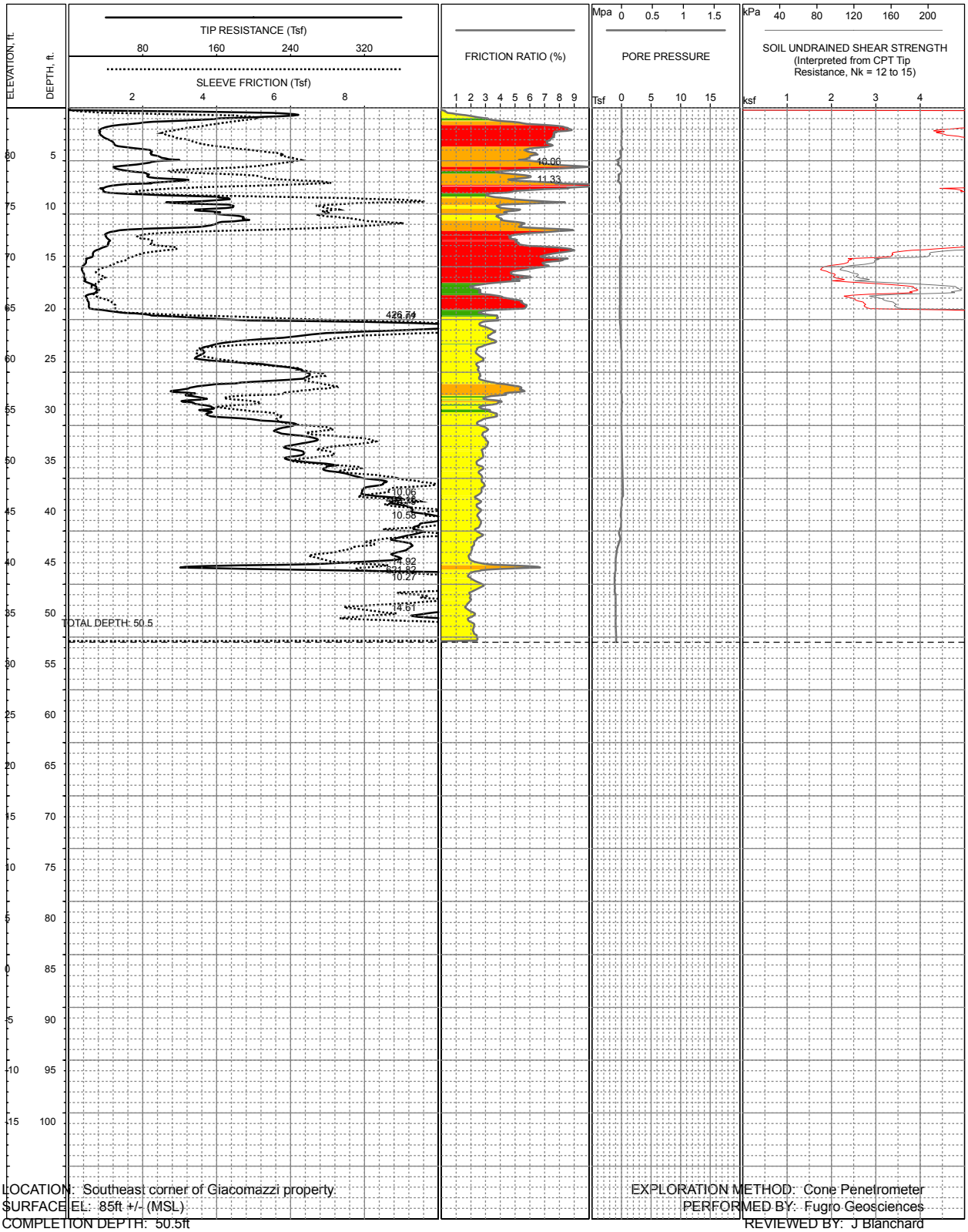


LOCATION: Southeast corner of Giacomazzi property.
SURFACE EL: 85ft +/- (MSL)
COMPLETION DEPTH: 50.5ft
TESTDATE: 5/8/2007

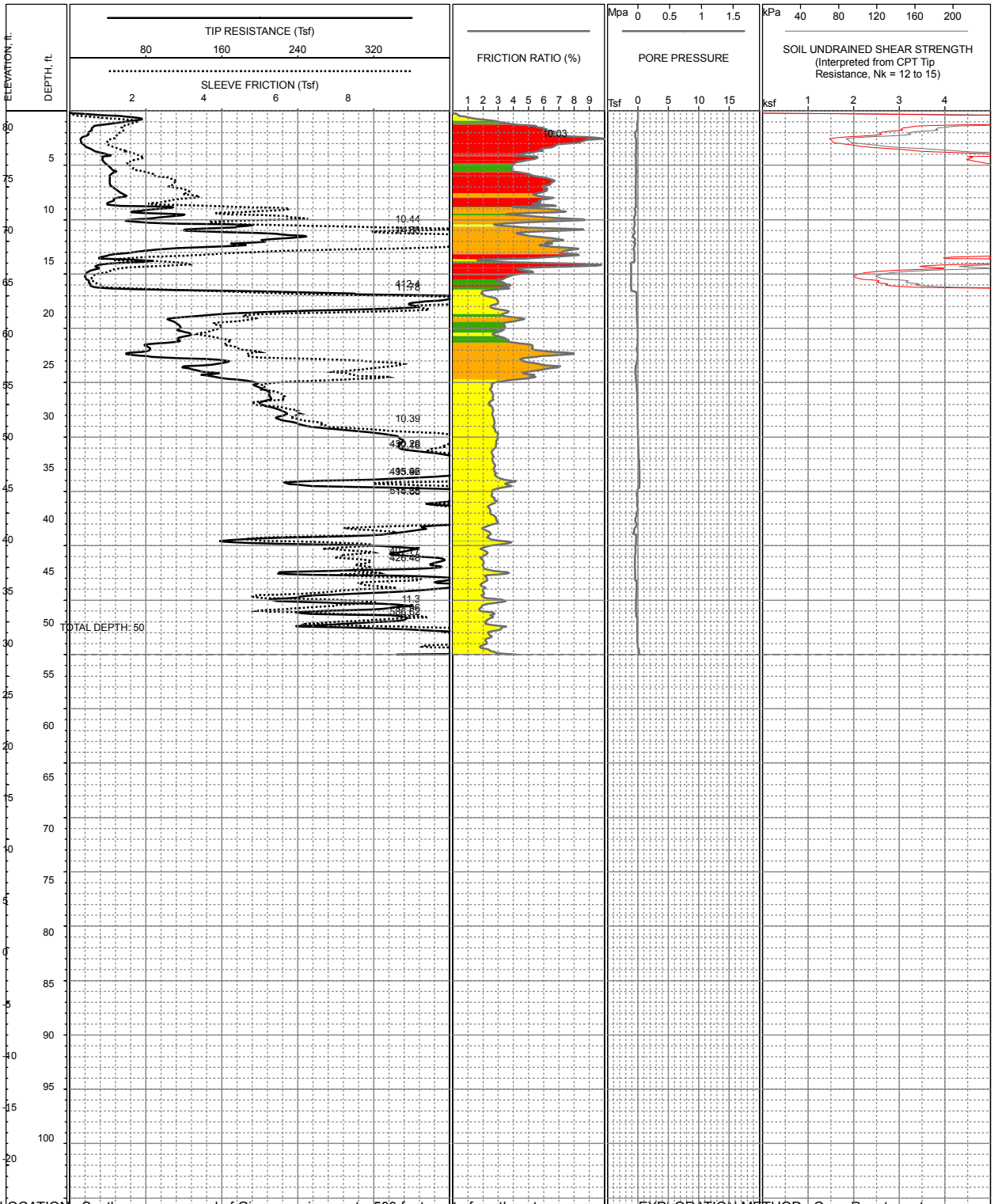
EXPLORATION METHOD: Cone Penetrometer
PERFORMED BY: Fugro Geosciences
REVIEWED BY: J Blanchard

LOG OF C-3

Los Osos Wastewater Project

San Luis Obispo County, California

PLATE A-4



LOCATION: Southern access road of Giacomazzi property, 500 feet west of southeast corner.
SURFACE EL: 82ft +/- (MSL)
COMPLETION DEPTH: 50ft
TESTDATE: 5/8/2007

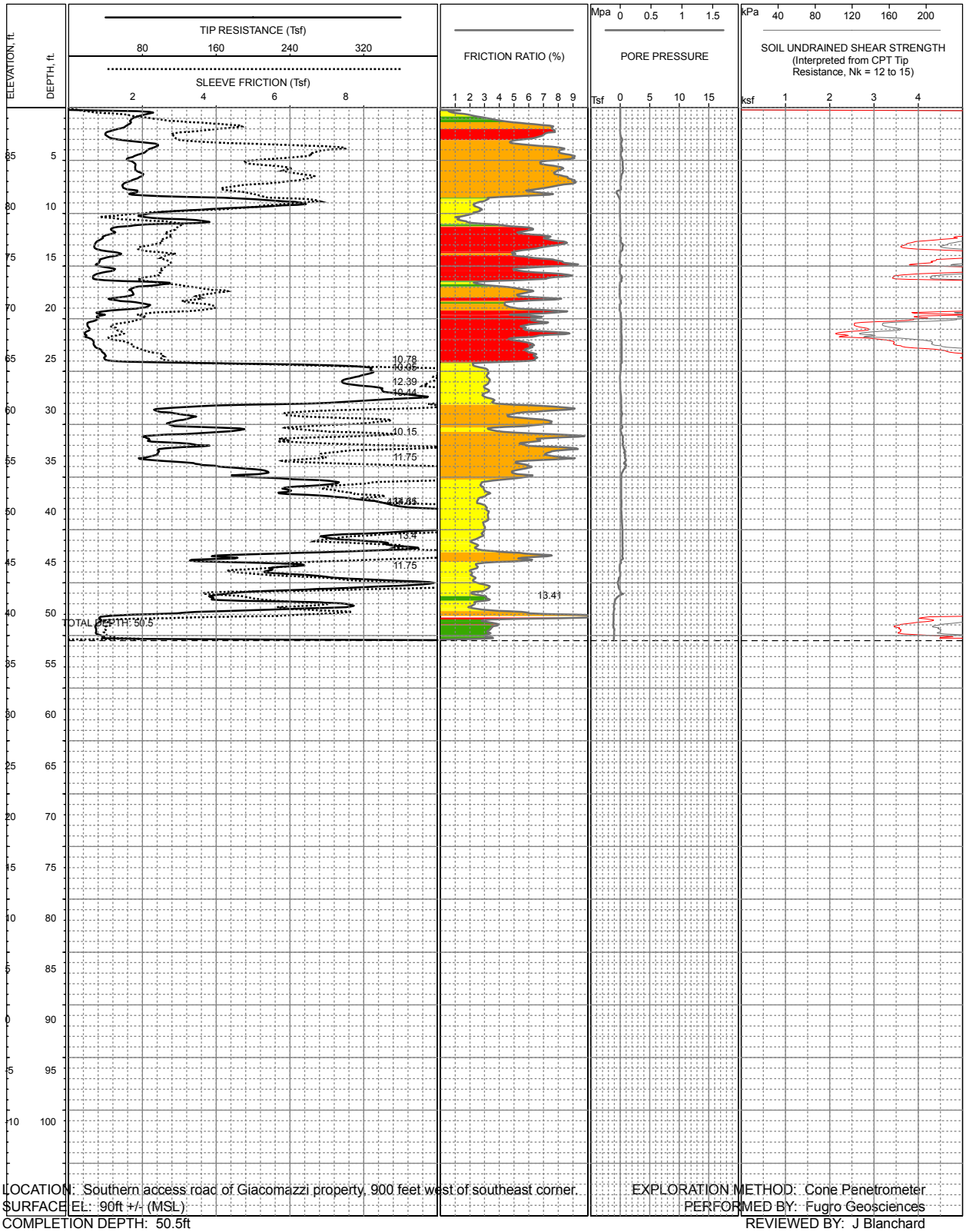
EXPLORATION METHOD: Cone Penetrometer
PERFORMED BY: Fugro Geosciences
REVIEWED BY: J Blanchard

LOG OF C-4

Los Osos Wastewater Project
San Luis Obispo County, California

PLATE A-5

N:\Projects\3014_SLOcounty\3014-026_LosOsosWastewater\Outputs\Working\mxd\CPT\CPTLogs.mxd, 31/05/07 11:51, CDean



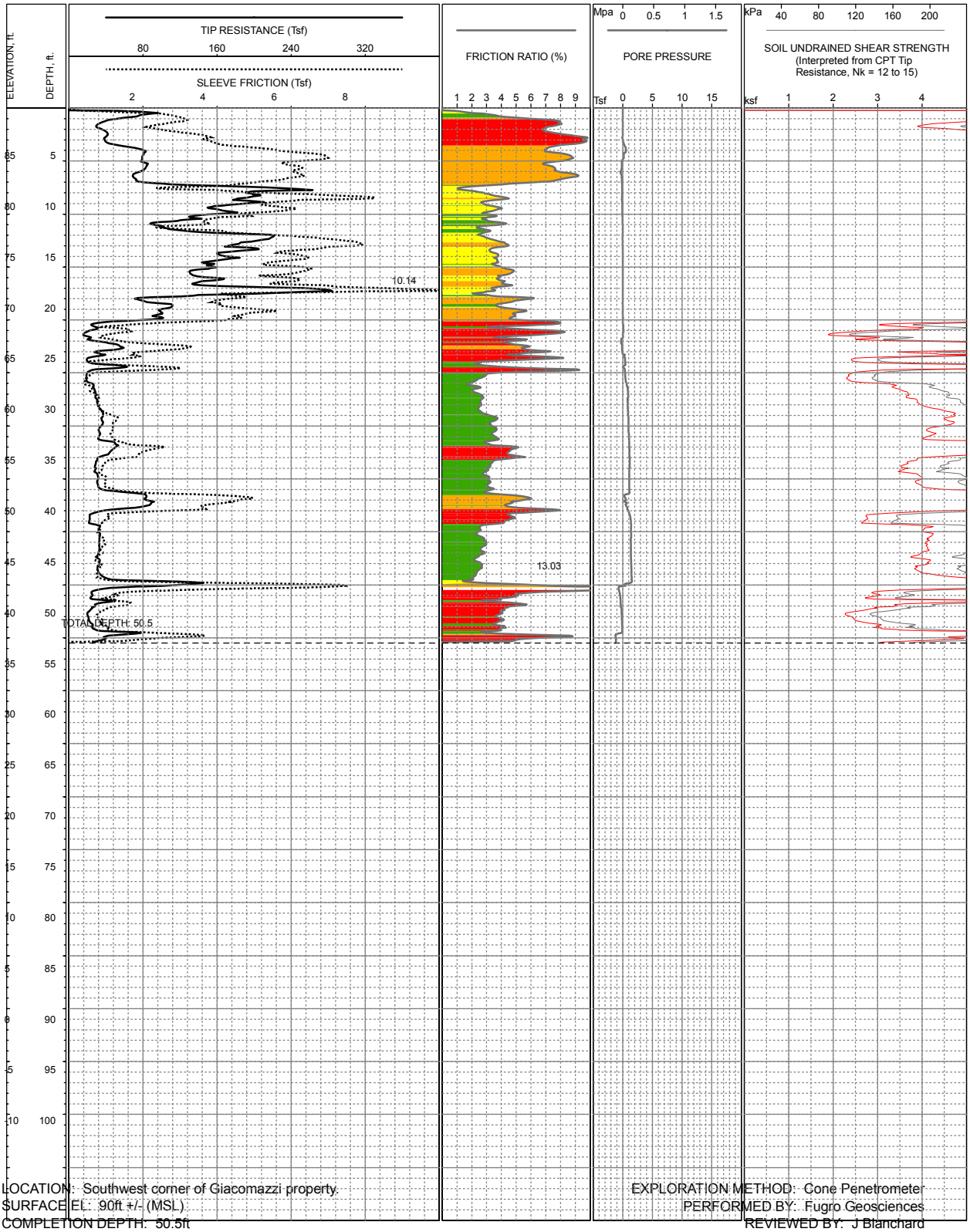
LOCATION: Southern access road of Giacomazzi property, 900 feet west of southeast corner.
SURFACE EL: 90ft +/- (MSL)
COMPLETION DEPTH: 50.5ft
TESTDATE: 5/8/2007

EXPLORATION METHOD: Cone Penetrometer
PERFORMED BY: Fugro Geosciences
REVIEWED BY: J Blanchard

LOG OF C-5

Los Osos Wastewater Project
San Luis Obispo County, California

PLATE A-6



LOCATION: Southwest corner of Giacomazzi property.
SURFACE EL: 90ft +/- (MSL)
COMPLETION DEPTH: 50.5ft
TESTDATE: 5/8/2007

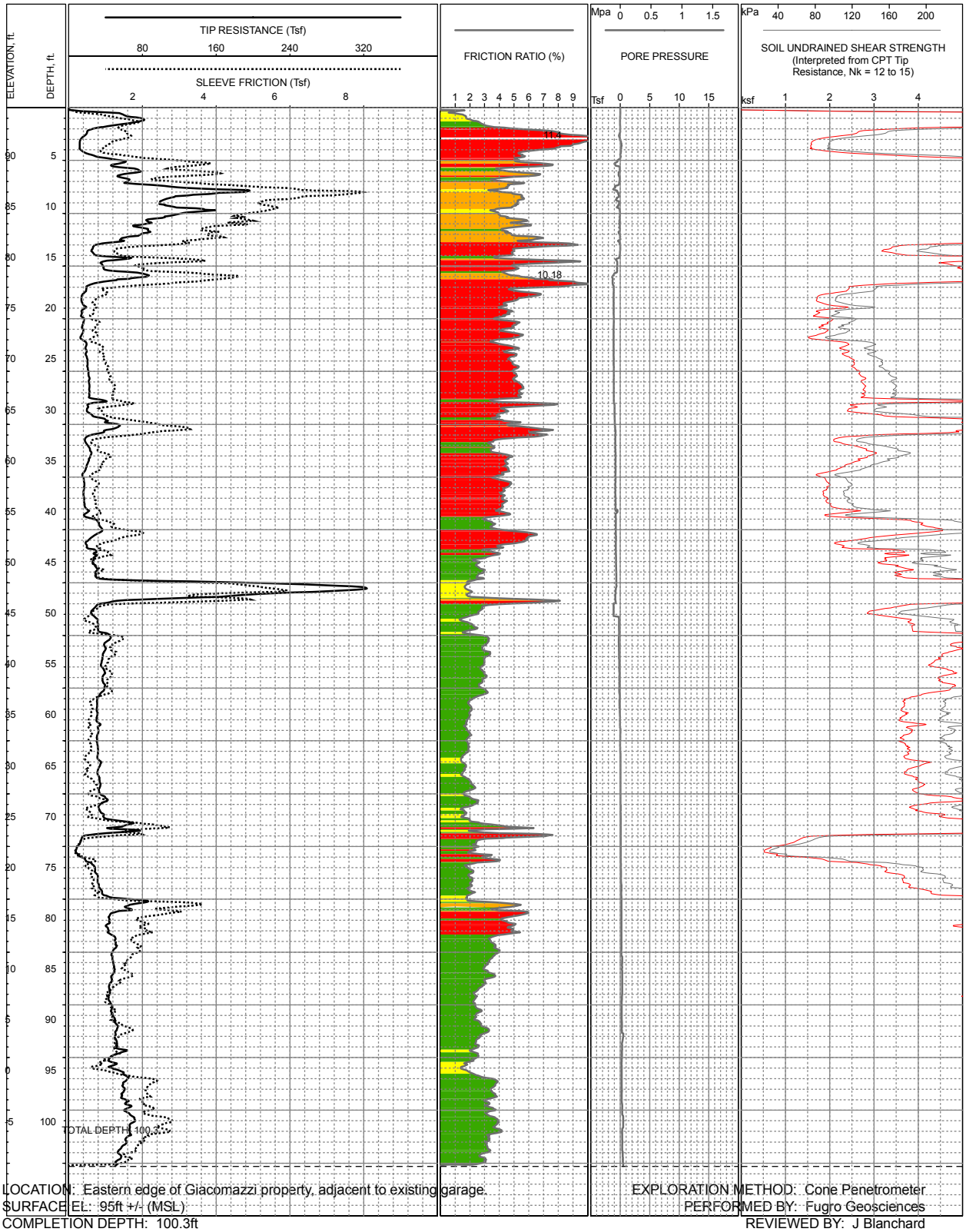
EXPLORATION METHOD: Cone Penetrometer
PERFORMED BY: Fugro Geosciences
REVIEWED BY: J Blanchard

LOG OF C-6

Los Osos Wastewater Project
San Luis Obispo County, California

PLATE A-7

N:\Projects\3014_SLOcounty\3014-026_LosOsosWastewater\Outputs\Working\mxd\CPT\CPT_Logs.mxd,31,0,0,0,0,152,0,0,0,0



LOCATION: Eastern edge of Giacomazzi property, adjacent to existing garage.
SURFACE EL: 95ft +/- (MSL)
COMPLETION DEPTH: 100.3ft
TESTDATE: 5/8/2007

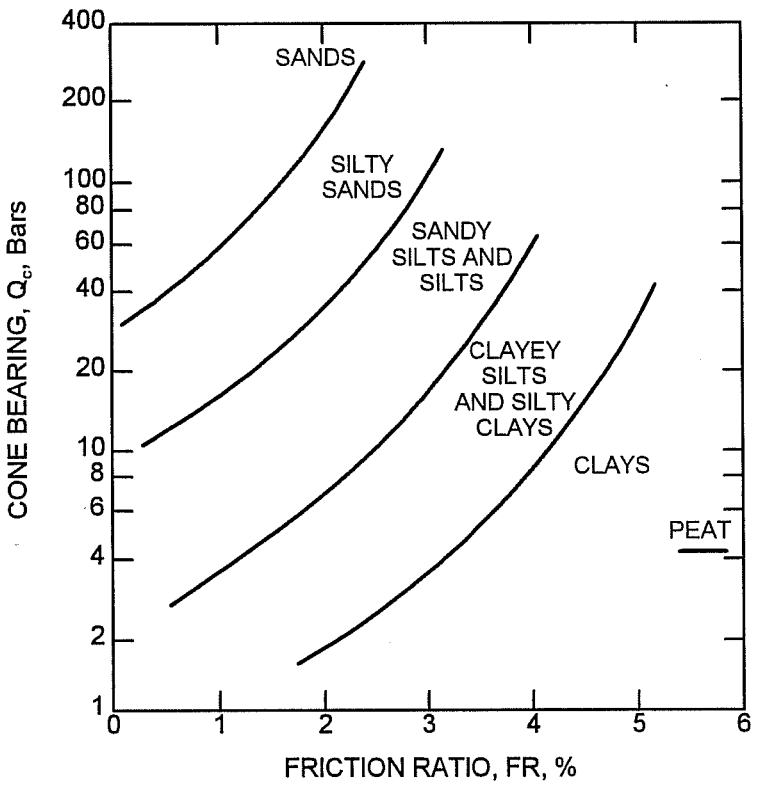
EXPLORATION METHOD: Cone Penetrometer
PERFORMED BY: Fugro Geosciences
REVIEWED BY: J Blanchard

LOG OF C-7

Los Osos Wastewater Project
San Luis Obispo County, California

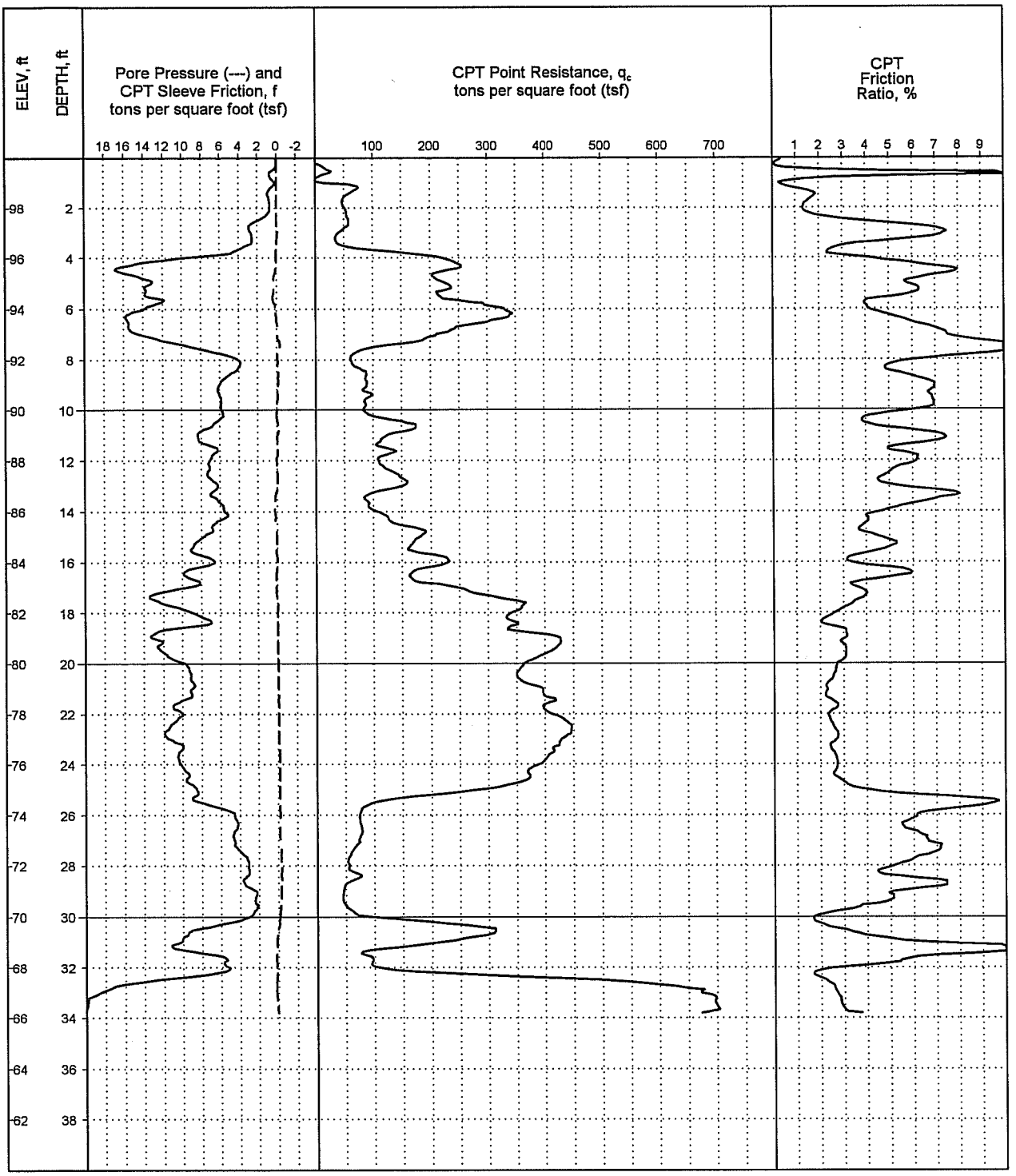
PLATE A-8

1 BAR = 100 KPA = 1.02 KG/CM^2



CAMPANELLA AND ROBERTSON CLASSIFICATION CHART

SOIL CLASSIFICATION CHART FOR CPT LOGS
Andre Site, Los Osos Wastewater Project
San Luis Obispo County, California

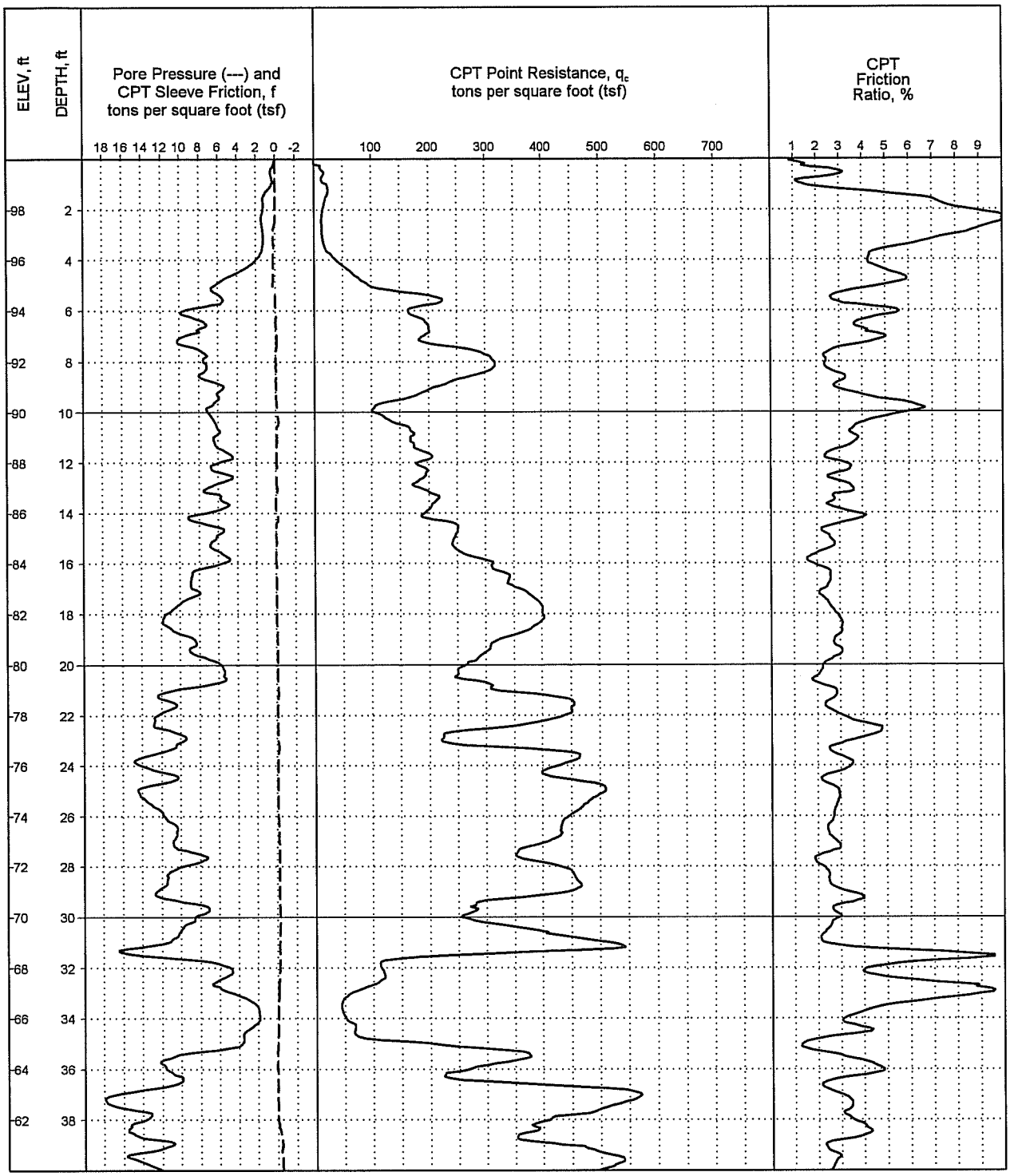


LOCATION: 200 ft north of LOVR.
SURFACE EL: 100 ft +/- (rel. MSL datum)
COMPLETION DEPTH: 33.8 ft
EXPLORATION DATE: June 15, 2004
DEPTH TO WATER: Not Encountered

EXPLORATION METHOD: Cone Penetrometer
PERFORMED BY: Fugro Geosciences
REVIEWED BY: JDBlanchard

LOG OF CPT NO: C-1

Andre Site, Los Osos Wastewater Project
San Luis Obispo County, California

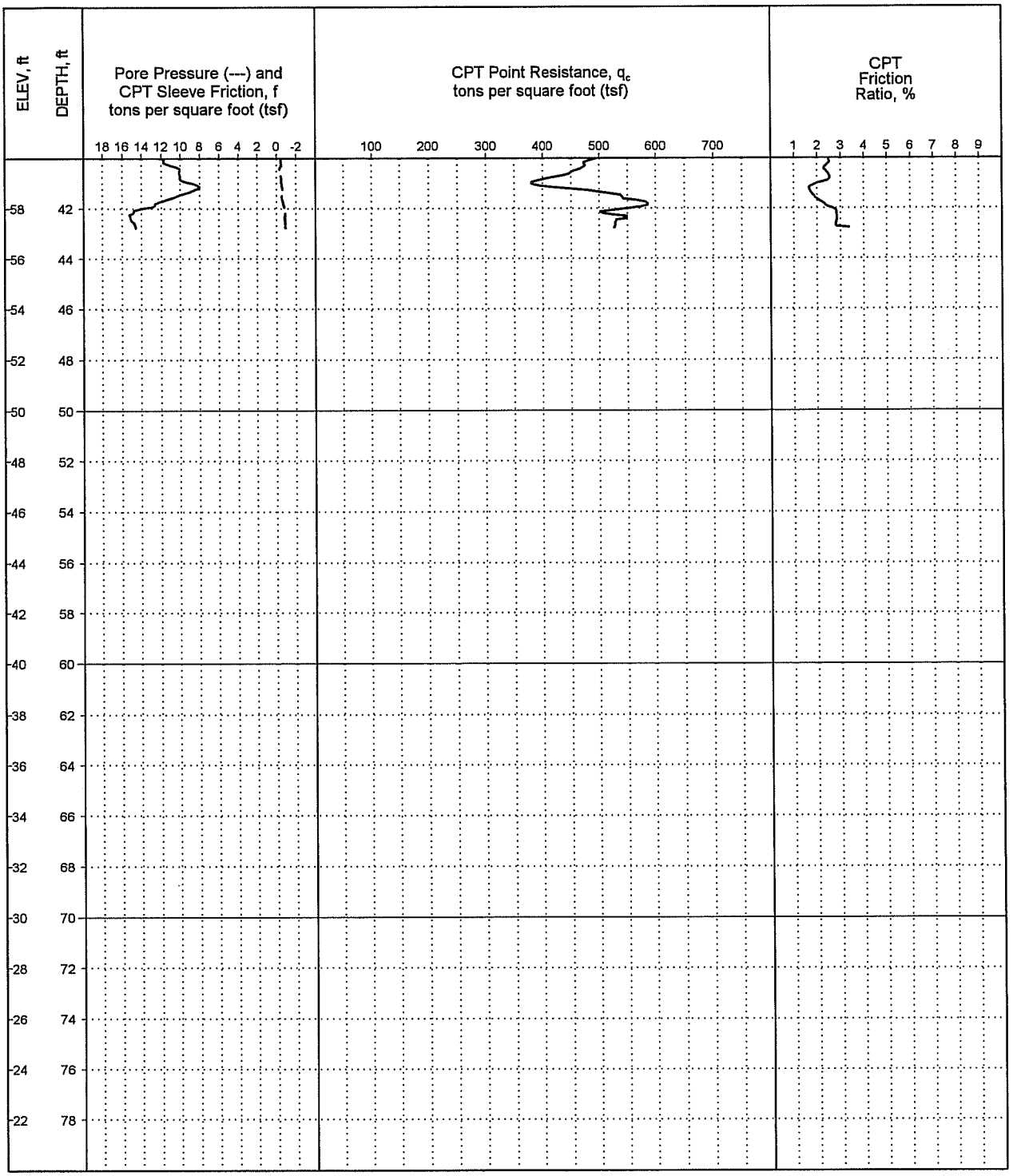


LOCATION: 450 ft north of LOVR.
SURFACE EL: 100 ft +/- (rel. MSL datum)
COMPLETION DEPTH: 42.8 ft
EXPLORATION DATE: June 15, 2004
DEPTH TO WATER: Not Encountered

EXPLORATION METHOD: Hollow Stem Auger
PERFORMED BY: Fugro Geosciences
REVIEWED BY: JDBlanchard

LOG OF CPT NO: C-2A

Andre Site, Los Osos Wastewater Project
San Luis Obispo County, California

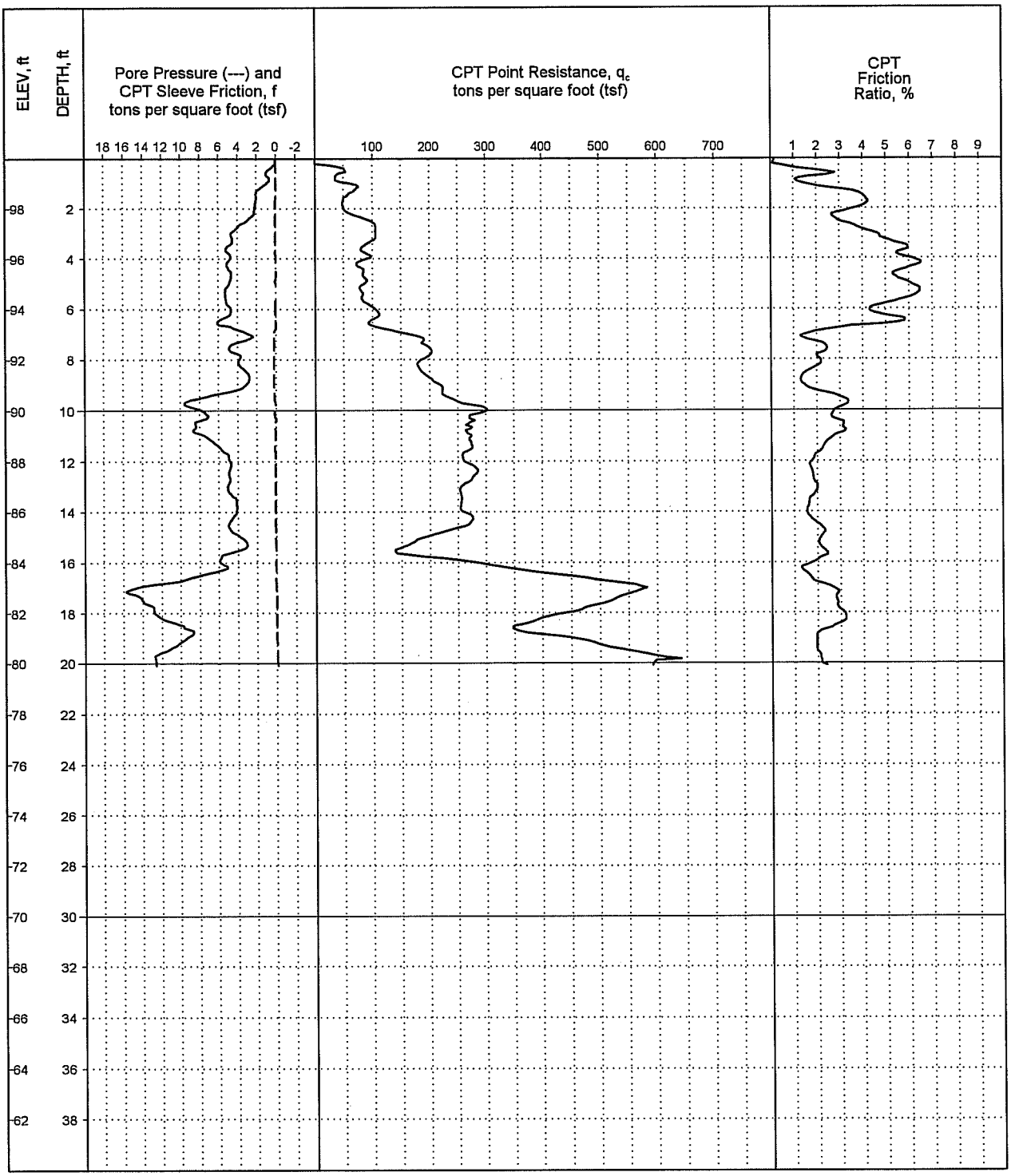


LOCATION: 450 ft north of LOVR.
SURFACE EL: 100 ft +/- (rel. MSL datum)
COMPLETION DEPTH: 42.8 ft
EXPLORATION DATE: June 15, 2004
DEPTH TO WATER: Not Encountered

EXPLORATION METHOD: Hollow Stem Auger
PERFORMED BY: Fugro Geosciences
REVIEWED BY: JDBlanchard

LOG OF CPT NO: C-2A

Andre Site, Los Osos Wastewater Project
San Luis Obispo County, California

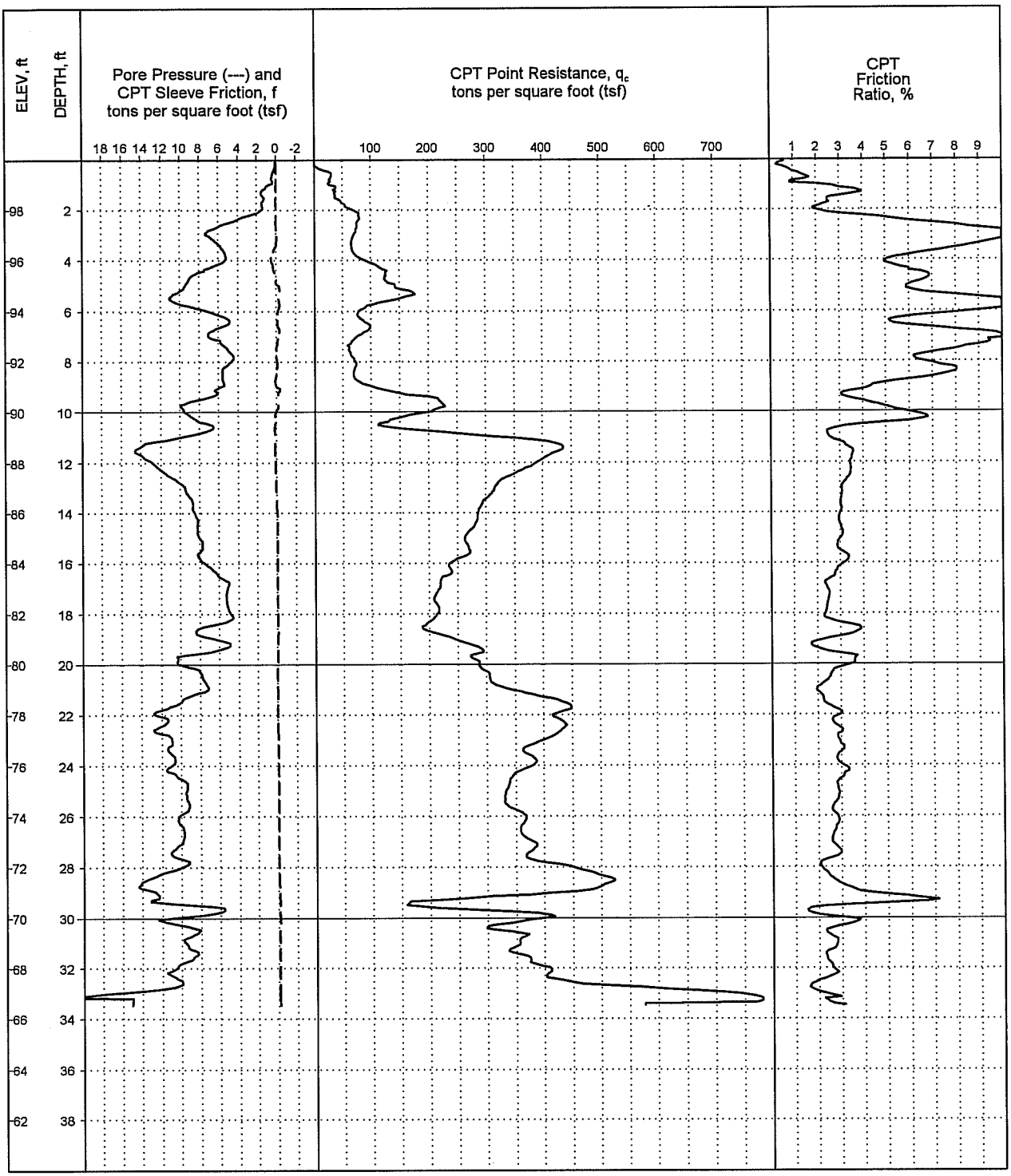


LOCATION: 850 ft north of LOVR.
SURFACE EL: 100 ft +/- (rel. MSL datum)
COMPLETION DEPTH: 20.1 ft
EXPLORATION DATE: June 15, 2004
DEPTH TO WATER: Not Encountered

EXPLORATION METHOD: Hollow Stem Auger
PERFORMED BY: Fugro Geosciences
REVIEWED BY: JDBlanchard

LOG OF CPT NO: C-3

Andre Site, Los Osos Wastewater Project
San Luis Obispo County, California

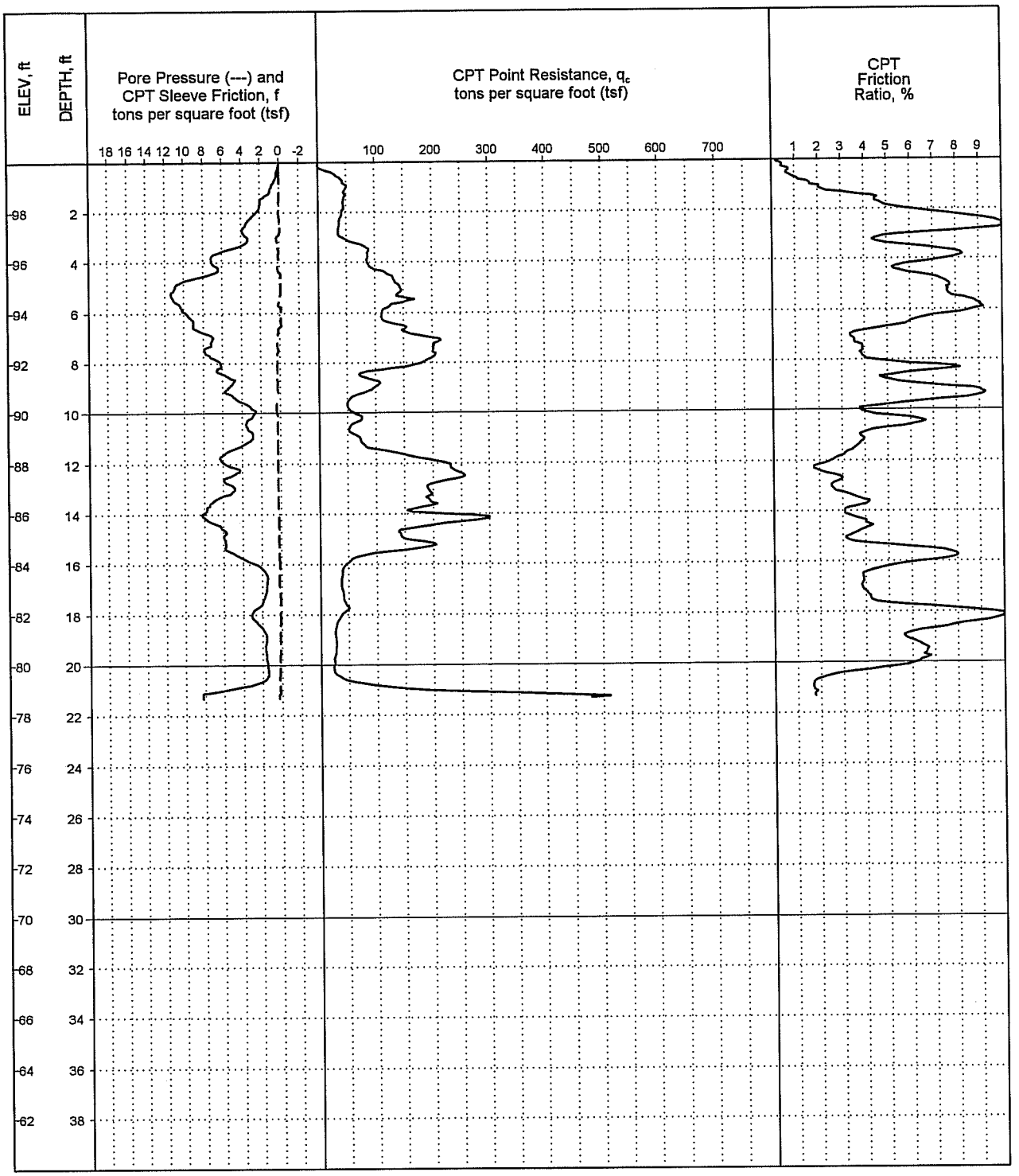


LOCATION: 1200 ft north of LOVR.
SURFACE EL: 100 ft +/- (rel. MSL datum)
COMPLETION DEPTH: 33.5 ft
EXPLORATION DATE: June 15, 2004
DEPTH TO WATER: Not Encountered

EXPLORATION METHOD: Hollow Stem Auger
PERFORMED BY: Fugro Geosciences
REVIEWED BY: JDBlanchard

LOG OF CPT NO: C-4

Andre Site, Los Osos Wastewater Project
San Luis Obispo County, California



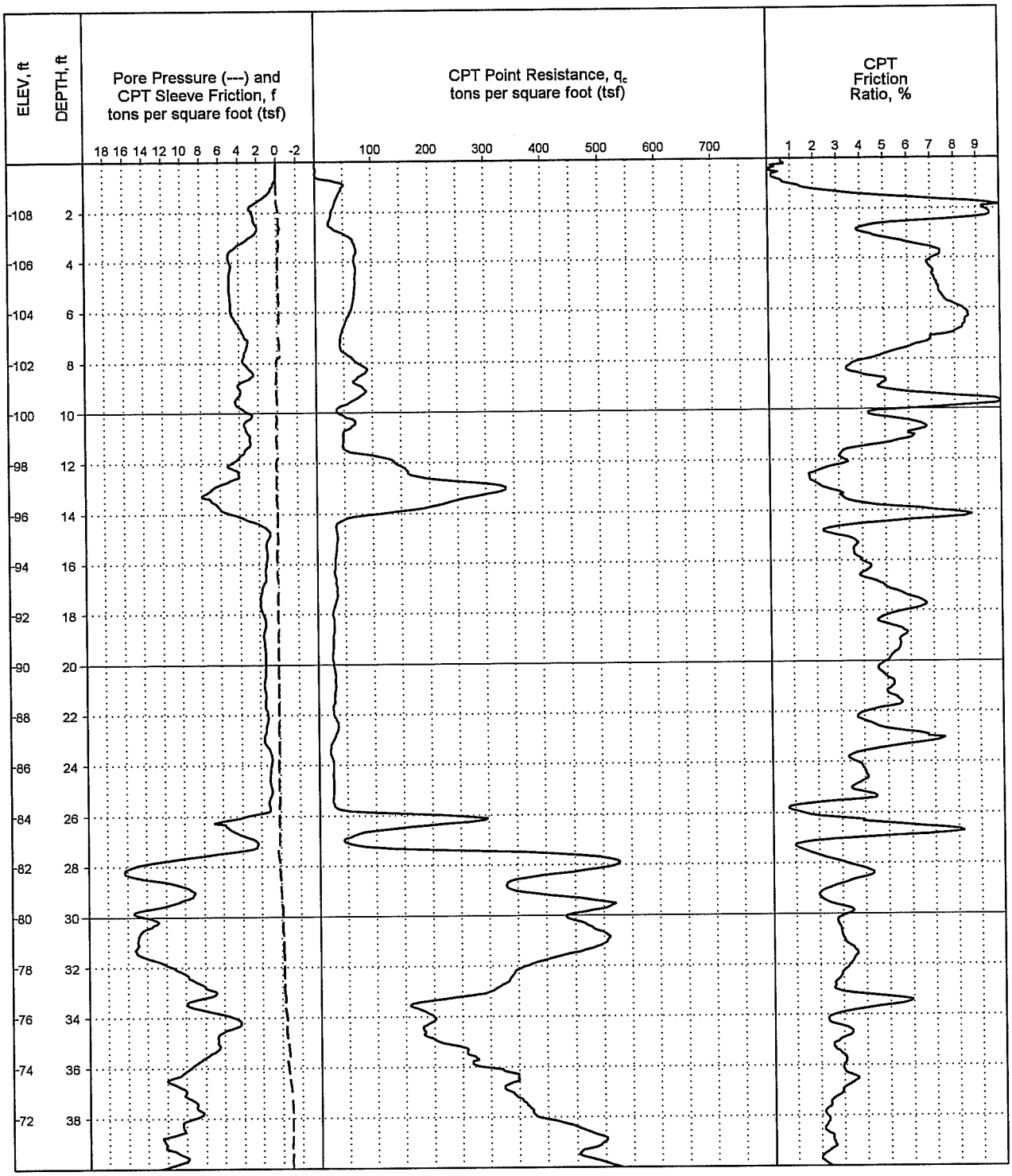
LOCATION: 1500 ft north of LOVR.
SURFACE EL: 100 ft +/- (rel. MSL datum)
COMPLETION DEPTH: 21.3 ft
EXPLORATION DATE: June 15, 2004
DEPTH TO WATER: Not Encountered

EXPLORATION METHOD: Hollow Stem Auger
PERFORMED BY: Fugro Geosciences
REVIEWED BY: JDBlanchard

LOG OF CPT NO: C-5

Andre Site, Los Osos Wastewater Project
San Luis Obispo County, California

PLATE A-6



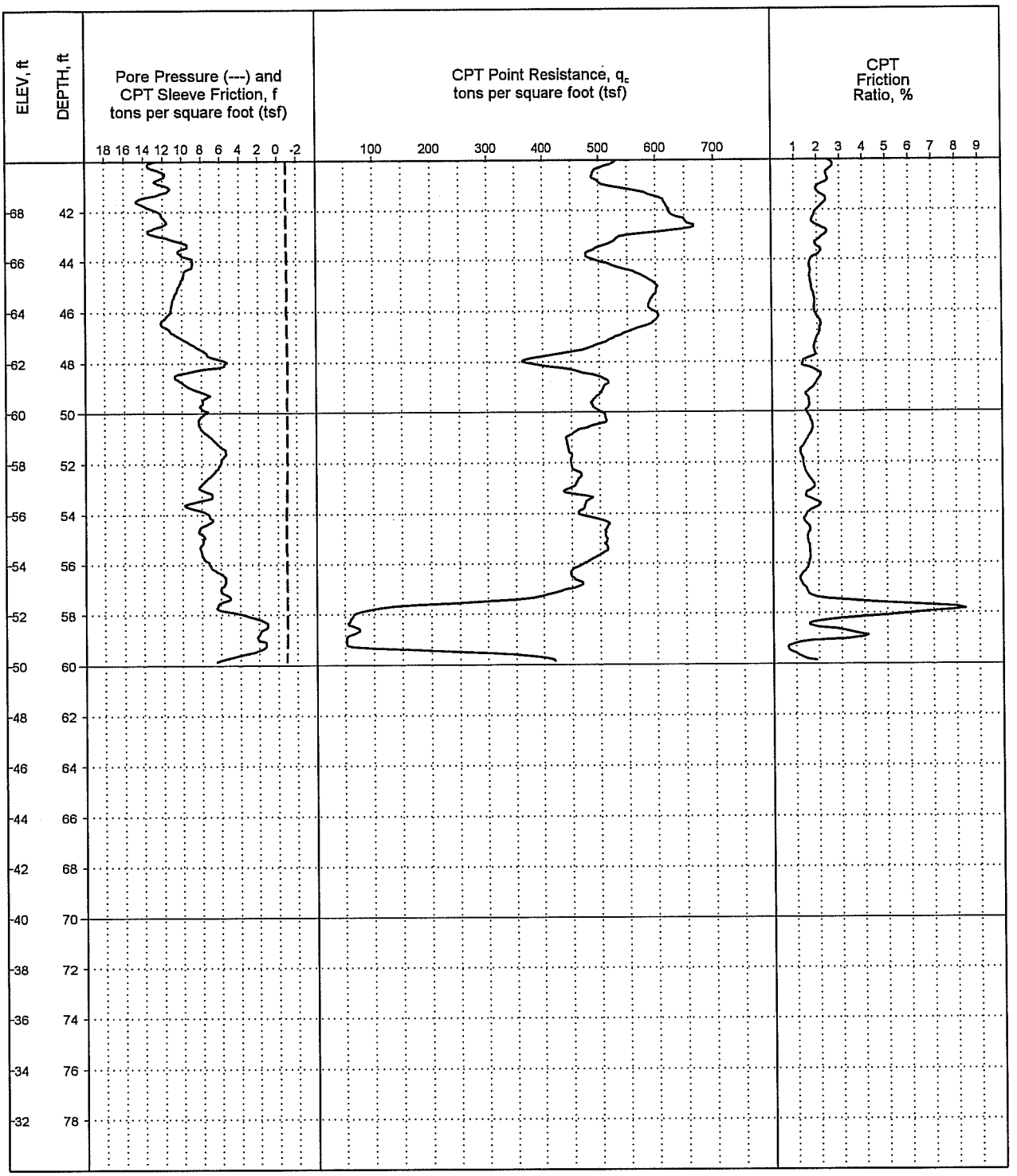
LOCATION: 2100 ft north of LOVR.
SURFACE EL: 110 ft +/- (rel. MSL datum)
COMPLETION DEPTH: 59.8 ft
EXPLORATION DATE: June 15, 2004
DEPTH TO WATER: Not Encountered

EXPLORATION METHOD: Hollow Stem Auger
PERFORMED BY: Fugro Geosciences
REVIEWED BY: JDBlanchard

LOG OF CPT NO: C-6

Andre Site, Los Osos Wastewater Project
San Luis Obispo County, California

PLATE A-7a

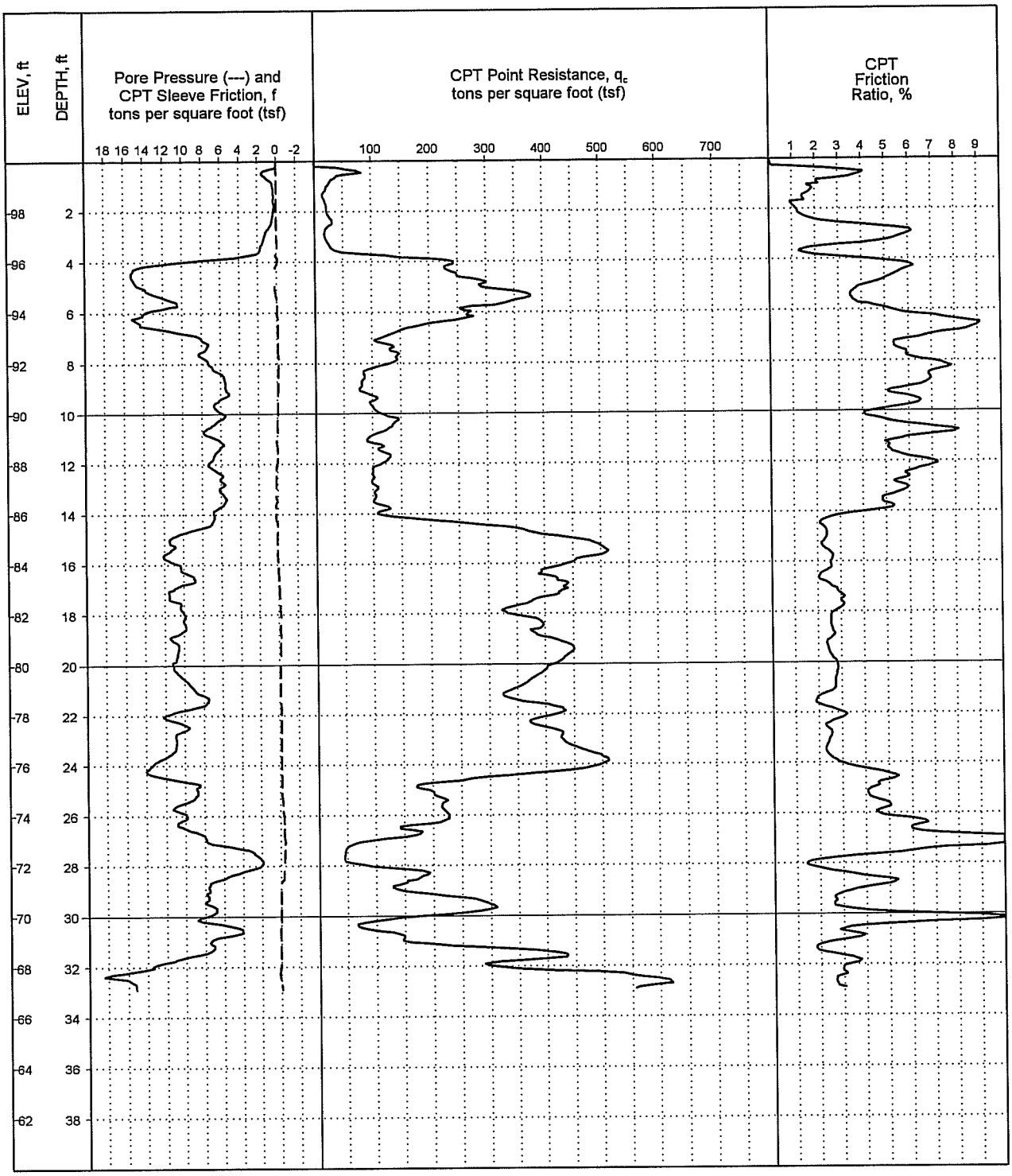


LOCATION: 2100 ft north of LOVR.
SURFACE EL: 110 ft +/- (rel. MSL datum)
COMPLETION DEPTH: 59.8 ft
EXPLORATION DATE: June 15, 2004
DEPTH TO WATER: Not Encountered

EXPLORATION METHOD: Hollow Stem Auger
PERFORMED BY: Fugro Geosciences
REVIEWED BY: JDBlanchard

LOG OF CPT NO: C-6

Andre Site, Los Osos Wastewater Project
San Luis Obispo County, California



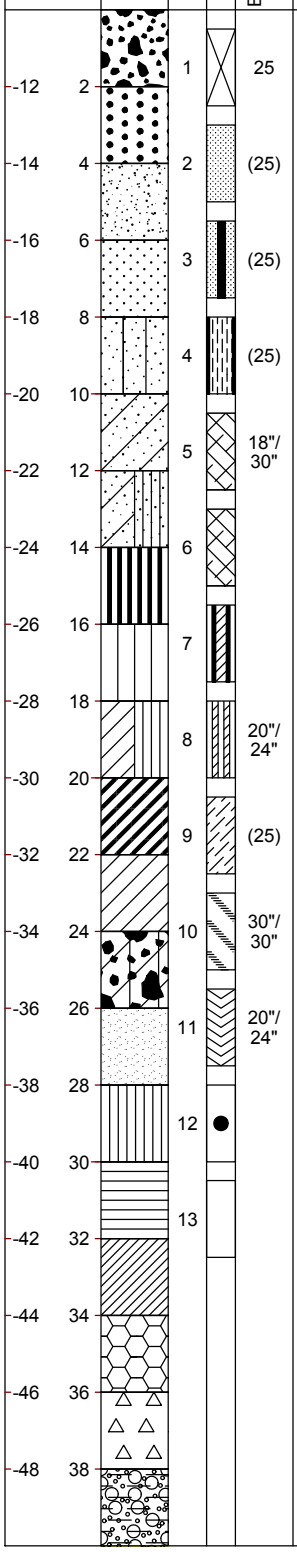
LOCATION: 50 ft north of LOVR.
SURFACE EL: 100 ft +/- (rel. MSL datum)
COMPLETION DEPTH: 32.9 ft
EXPLORATION DATE: June 15, 2004
DEPTH TO WATER: Not Encountered

EXPLORATION METHOD: Hollow Stem Auger
PERFORMED BY: Fugro Geosciences
REVIEWED BY: JDBlanchard

LOG OF CPT NO: C-7

Andre Site, Los Osos Wastewater Project
San Luis Obispo County, California

PLATE A-8



LOCATION: The drill hole location referencing local landmarks or coordinates

SURFACE EL: Using local, MSL, MLLW or other datum

MATERIAL DESCRIPTION

Well graded GRAVEL (GW)	COARSE GRAINED
Poorly graded GRAVEL (GP)	COARSE GRAINED
Well graded SAND (SW)	COARSE GRAINED
Poorly graded SAND (SP)	COARSE GRAINED
Silty SAND (SM)	COARSE GRAINED
Clayey SAND (SC)	COARSE GRAINED
Silty, Clayey SAND (SC-SM)	COARSE GRAINED
Elastic SILT (MH)	FINE GRAINED
SILT (ML)	FINE GRAINED
Silty CLAY (CL-ML)	FINE GRAINED
Fat CLAY (CH)	FINE GRAINED
Lean CLAY (CL)	FINE GRAINED
CONGLOMERATE	ROCK
SANDSTONE	ROCK
SILTSTONE	ROCK
MUDSTONE	ROCK
CLAYSTONE	ROCK
BASALT	ROCK
ANDESITE BRECCIA	ROCK
Paving and/or Base Materials	

General Notes

Soil Texture Symbol

Sloped line in symbol column indicates transitional boundary

Samplers and sampler dimensions
(unless otherwise noted in report text) are as follows:

Symbol for:

1	SPT Sampler, driven 1-3/8" ID, 2" OD
2	CA Liner Sampler, driven 2-3/8" ID, 3" OD
3	CA Liner Sampler, disturbed 2-3/8" ID, 3" OD
4	Thin-walled Tube, pushed 2-7/8" ID, 3" OD
5	Bulk Bag Sample (from cuttings)
6	CA Liner Sampler, Bagged
7	Hand Auger Sample
8	CME Core Sample
9	Pitcher Sample
10	Lexan Sample
11	Vibracore Sample
12	No Sample Recovered
13	Sonic Soil Core Sample

Sampler Driving Resistance

Number of blows with 140 lb. hammer, falling 30" to drive sampler 1 ft. after seating sampler 6"; for example,

Blows/ft	Description
25	25 blows drove sampler 12" after initial 6" of seating
86/11"	After driving sampler the initial 6" of seating, 36 blows drove sampler through the second 6" interval, and 50 blows drove the sampler 5" into the third interval
50/6"	50 blows drove sampler 6" after initial 6" of seating
Ref/3"	50 blows drove sampler 3" during initial 6" seating interval

Blow counts for California Liner Sampler shown in ( )

Length of sample symbol approximates recovery length

Classification of Soils per ASTM D2487 or D2488

Geologic Formation noted in bold font at the top of interpreted interval

Strength Legend

Q = Unconfined Compression
u = Unconsolidated Undrained Triaxial
t = Torvane
p = Pocket Penetrometer
m = Miniature Vane

Water Level Symbols

- Initial or perched water level
- Final ground water level
- Seepages encountered

Rock Quality Designation (RQD) is the sum of recovered core pieces greater than 4 inches divided by the length of the cored interval.

KEY TO TERMS & SYMBOLS USED ON LOGS

PLATE B-1

LOCATION: Giacomazzi property, near center of property.

SURFACE EL: 70 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
						PASO ROBLES FORMATION (Qtp) Topsoil: Sandy Fat CLAY (CH): firm, brown, dry							
						- moist							
68	2					- grades to Clayey SAND (SC): medium dense, brown, moist							
						Lean CLAY (CL): stiff, red-brown, moist							
66	4												
						Lean CLAY with sand (CL): stiff, red-brown, moist							
						Lean CLAY (CL): stiff to very stiff, red-brown, moist							
64	6												
						Clayey SAND (SC): medium dense, brown, moist							
62	8					Lean CLAY with sand (CL): very stiff, red-brown, moist, iron oxide staining							
60	10												
58	12												
56	14												

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 12.5 ft
DEPTH TO WATER: Not Encountered
BACKFILLED WITH: Cuttings
DRILLING DATE: May 8, 2007

DRILLING METHOD: 3-inch-dia. Hand Auger
HAMMER TYPE:
DRILLED BY: Fugro West, Inc.
LOGGED BY: CLovato
CHECKED BY: C Lovato

LOG OF NO. H-1
Los Osos Wastewater Project
San Luis Obispo County, California

PLATE B-2

LOCATION: Giacomazzi property, northeast corner, 145 feet south of property line.

SURFACE EL: 80 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
						PASO ROBLES FORMATION (Qtp) Topsoil: Sandy fat CLAY (CH): firm, brown, dry							
						- moist, very stiff							
78	2												p 4.5+
						- with pockets of light brown clayey sand, fine to medium grain size							
						Clayey SAND (SC): medium dense to dense, light yellowish brown with light gray mottling, moist, iron oxide staining							
76	4					Poorly-graded SAND with clay (SP-SC): very dense, light yellowish brown, moist, iron oxide staining with occasional chert gravel to 1" diameter (red-brown, iron oxide stained)							
74	6												
72	8												
70	10												
68	12												
66	14												

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 10.0 ft
DEPTH TO WATER: Not Encountered
BACKFILLED WITH: Cuttings
DRILLING DATE: May 8, 2007

DRILLING METHOD: 3-inch-dia. Hand Auger
HAMMER TYPE:
DRILLED BY: Fugro West, Inc.
LOGGED BY: CLovato
CHECKED BY: C Lovato

LOG OF NO. H-2

Los Osos Wastewater Project
San Luis Obispo County, California

PLATE B-3

LOCATION: Giacomazzi property, northern property line.

SURFACE EL: 80 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
						PASO ROBLES FORMATION (Qtp) Topsoil: Clayey SAND (SC): medium dense, brown, moist							
-78	2					Sandy lean CLAY (CL): firm, light brown with gray and red-brown mottling, moist							
						- stiff, gray							
-76	4												
													p 3.0
						- very stiff, red-brown							
-74	6												
-72	8												
-70	10												
-68	12												
-66	14												

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

COMPLETION DEPTH: 10.0 ft
DEPTH TO WATER: Not Encountered
BACKFILLED WITH: Cuttings
DRILLING DATE: May 8, 2007

DRILLING METHOD: 3-inch-dia. Hand Auger
HAMMER TYPE:
DRILLED BY: Fugro West, Inc.
LOGGED BY: CLovato
CHECKED BY: C Lovato

LOG OF NO. H-3
Los Osos Wastewater Project
San Luis Obispo County, California

PLATE B-4

LOCATION: Giacomazzi property, western property line.

SURFACE EL: 82 ft +/- (rel. MSL datum)

ELEVATION, ft	DEPTH, ft	MATERIAL SYMBOL	SAMPLE NO.	SAMPLERS	SAMPLER BLOW COUNT	MATERIAL DESCRIPTION	UNIT WET WEIGHT, pcf	UNIT DRY WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, S_u, ksf
						PASO ROBLES FORMATION (Qtp) Topsoil: Sandy lean CLAY (CL): firm, dark brown, moist							
						Lean CLAY with sand (CL): stiff, brown, with dark brown mottling, moist							
80	2					- dark brown, with gypsum							
						- brown							
78	4					- very stiff							
76	6												
74	8												
						Clayey SAND with gravel (SC): dense, red-brown, moist							
72	10					- grades to sandy CLAY (CL)/Clayey SAND (SC)							
70	12												
68	14												

The log and data presented are a simplification of actual conditions encountered at the time of drilling at the drilled location. Subsurface conditions may differ at other locations and with the passage of time.

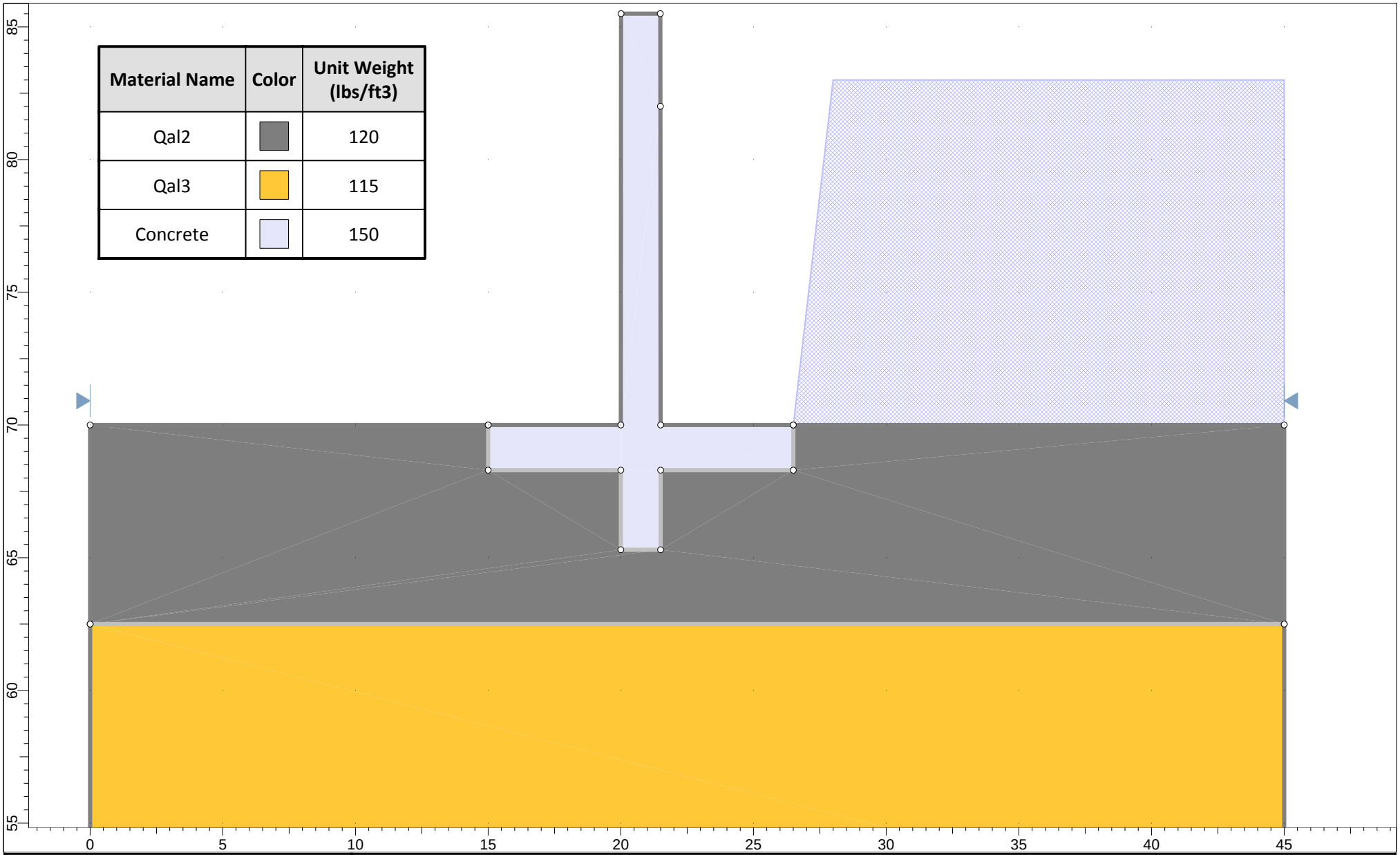
COMPLETION DEPTH: 12.0 ft
DEPTH TO WATER: Not Encountered
BACKFILLED WITH: Cuttings
DRILLING DATE: May 8, 2007

DRILLING METHOD: 3-inch-dia. Hand Auger
HAMMER TYPE:
DRILLED BY: Fugro West, Inc.
LOGGED BY: JHollenback
CHECKED BY: C Lovato

LOG OF NO. H-4
Los Osos Wastewater Project
San Luis Obispo County, California

PLATE B-5

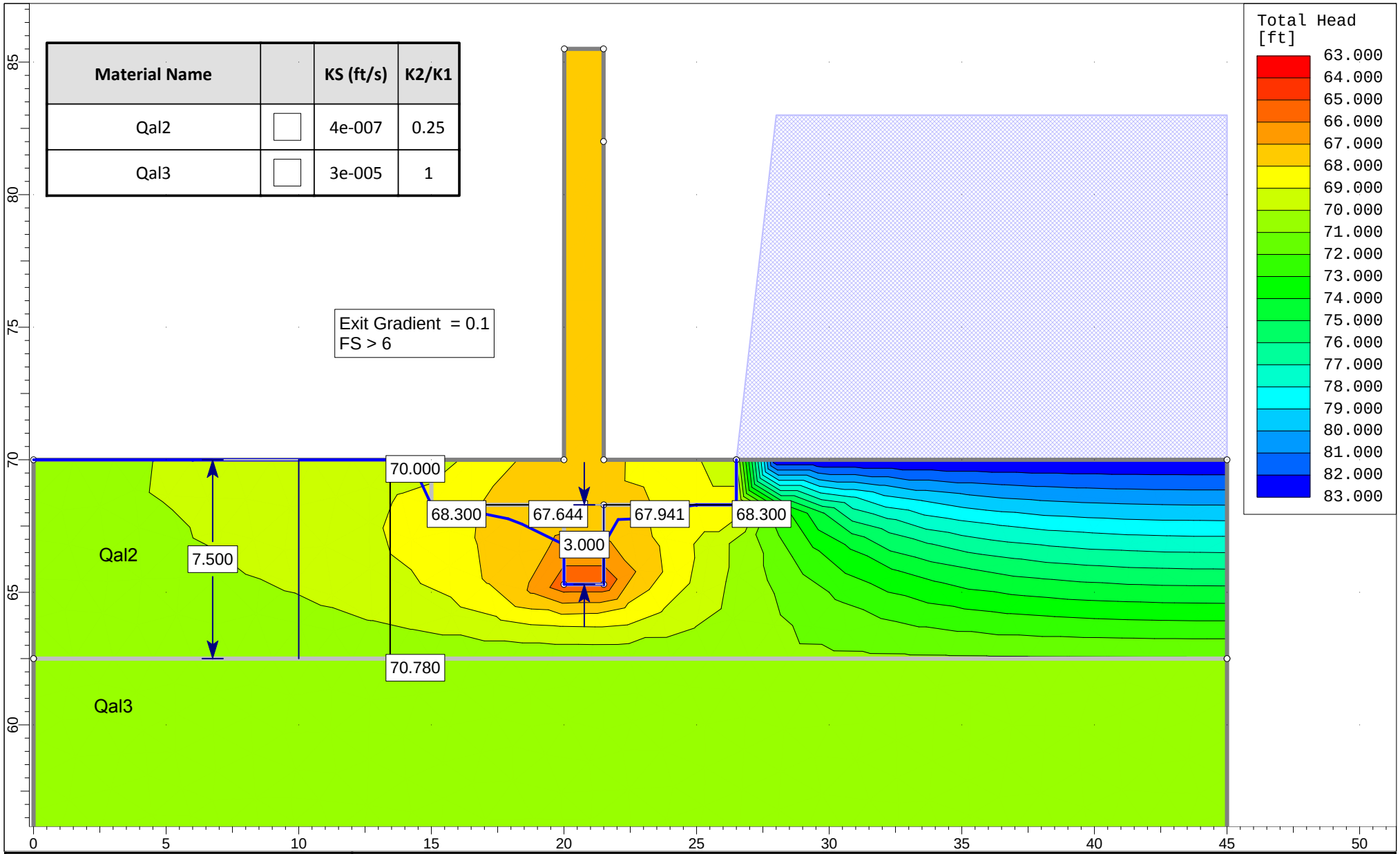
APPENDIX E



Material Name	Color	Unit Weight (lbs/ft3)
Qal2		120
Qal3		115
Concrete		150

Project	Los Osos Water Recycling Facility		
Analysis Description	Retention Pond Divider Wall		
Drawn By	GDE	Scale 1:60	Company Fugro Consultants
Date	4/17/2013, 12:17:23 PM		File Name Pond Divider Wall_Imperm. Concrete.slim

SLIDE 6.020

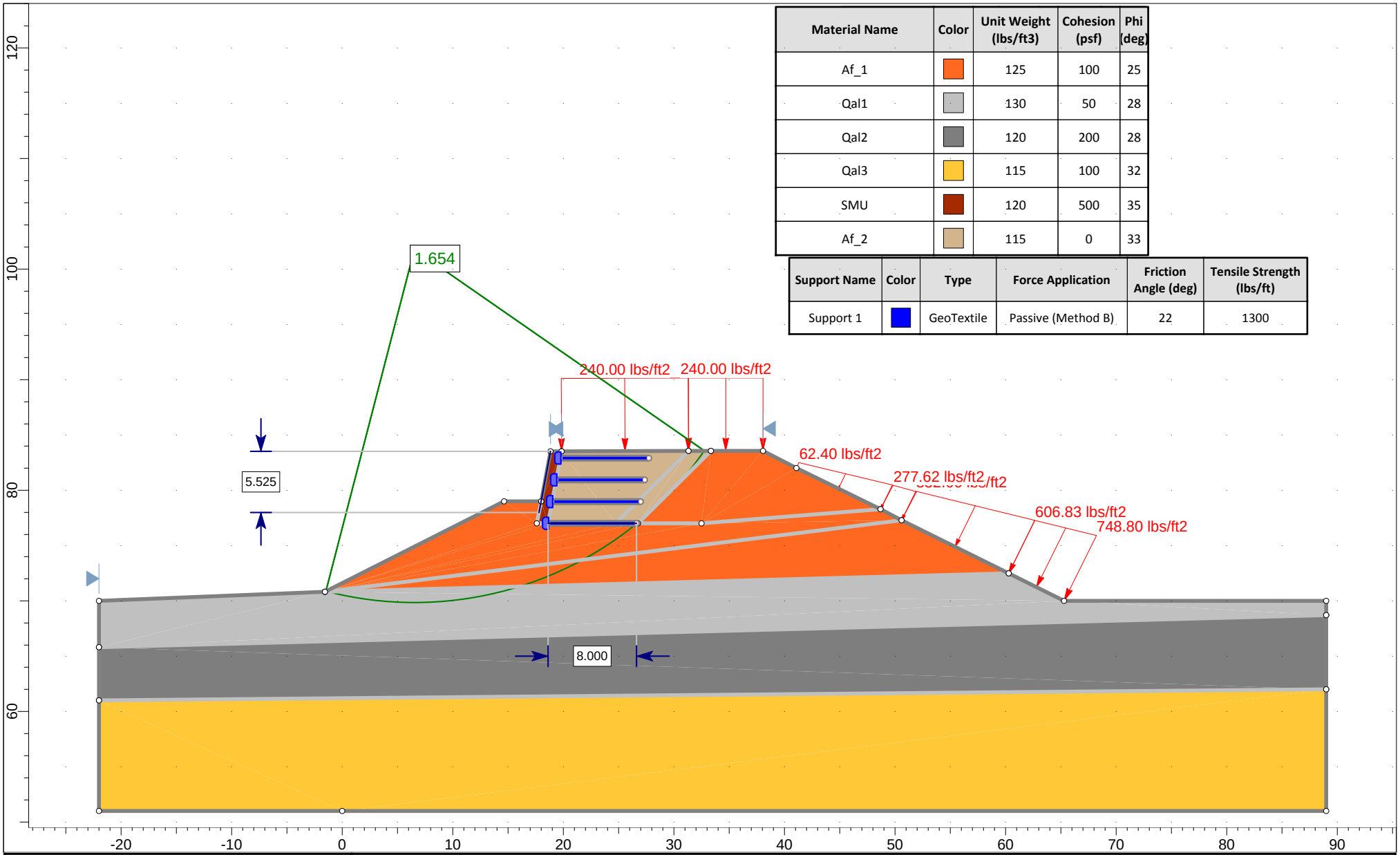


Project	Los Osos Water Recycling Facility		
Analysis Description	Retention Pond Divider Wall		
Drawn By: GDE	Scale: 1:60	Company: Fugro Consultants	
Date: 4/17/2013, 12:17:23 PM		File Name: Pond Divider Wall_Imperm. Concrete.slim	

SLIDEINTERPRET 6.020

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Af_1		125	100	25
Qal1		130	50	28
Qal2		120	200	28
Qal3		115	100	32
SMU		120	500	35
Af_2		115	0	33

Support Name	Color	Type	Force Application	Friction Angle (deg)	Tensile Strength (lbs/ft)
Support 1		GeoTextile	Passive (Method B)	22	1300

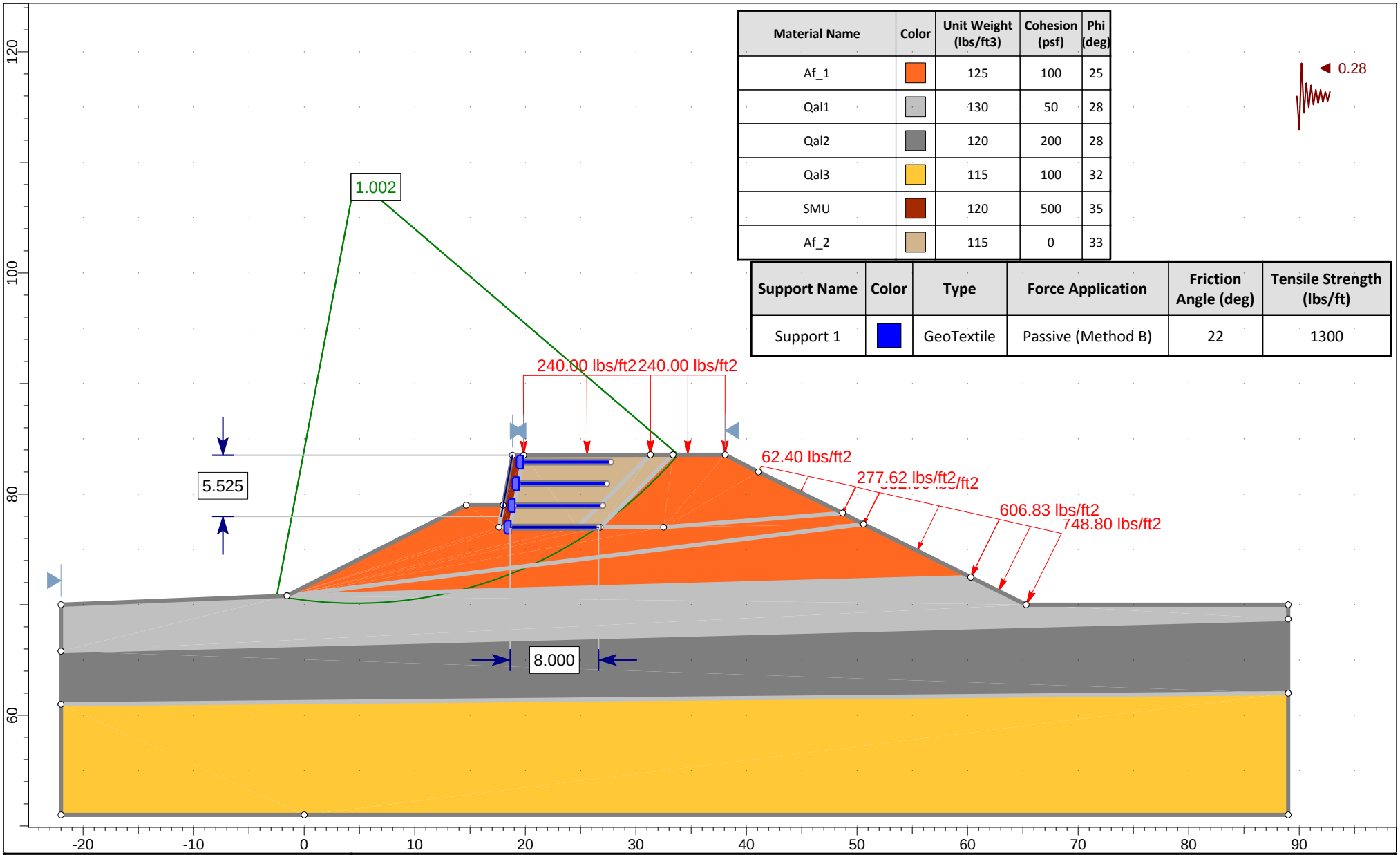


Project	Los Osos Water Recycling Facility		
Analysis Description	Retention Pond_5.5 ft SMU Wall_Exterior_DRY_Static		
Drawn By	GDE	Scale 1:144	Company Fugro Consultants
Date	4/15/2013, 3:51:14 PM		File Name SMU Wall_5.5ft_Config1.slim

SLIDEINTERPRET 6.020

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Af_1		125	100	25
Qal1		130	50	28
Qal2		120	200	28
Qal3		115	100	32
SMU		120	500	35
Af_2		115	0	33

Support Name	Color	Type	Force Application	Friction Angle (deg)	Tensile Strength (lbs/ft)
Support 1		GeoTextile	Passive (Method B)	22	1300

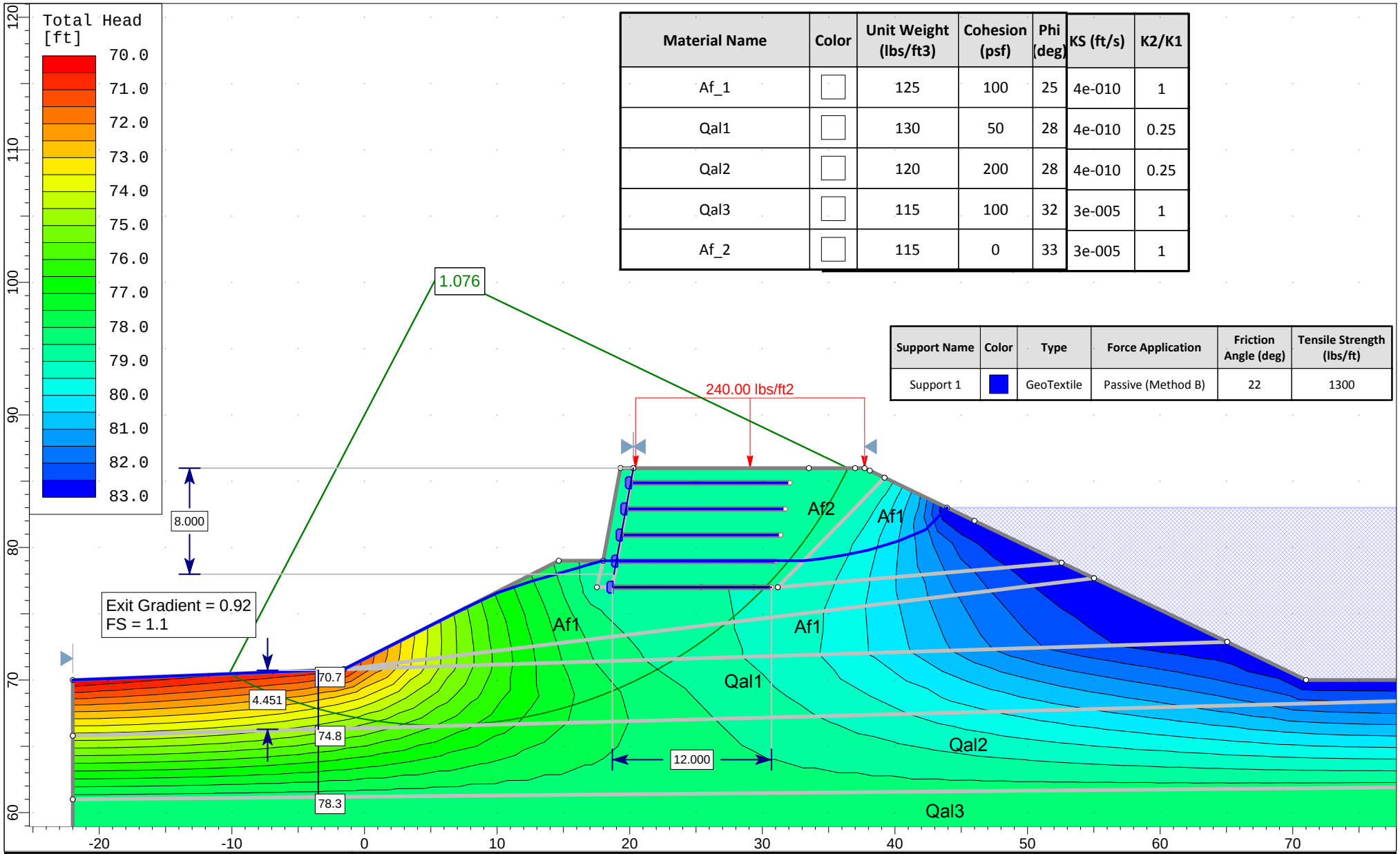


Project	Los Osos Water Recycling Facility		
Analysis Description	Retention Pond_5.5 ft SMU Wall_Exterior_DRY_Pseudostatic		
Drawn By: GDE	Scale: 1:144	Company: Fugro Consultants	
Date: 4/15/2013, 3:51:14 PM		File Name: SMU Wall_5.5ft_Config1.slim	

SLIDEINTERPRET 6.020

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)	KS (ft/s)	K2/K1
Af_1		125	100	25	4e-010	1
Qal1		130	50	28	4e-010	0.25
Qal2		120	200	28	4e-010	0.25
Qal3		115	100	32	3e-005	1
Af_2		115	0	33	3e-005	1

Support Name	Color	Type	Force Application	Friction Angle (deg)	Tensile Strength (lbs/ft)
Support 1		GeoTextile	Passive (Method B)	22	1300



Project	Los Osos Water Recycling Facility		
Analysis Description	Retention Pond_8 ft SMU Wall_Exterior_Steady State Seepage		
Drawn By	GDE	Scale 1:120	Company Fugro Consultants
Date	4/15/2013, 3:51:14 PM		File Name SMU Wall_8ft_Config1_Seepage.slim

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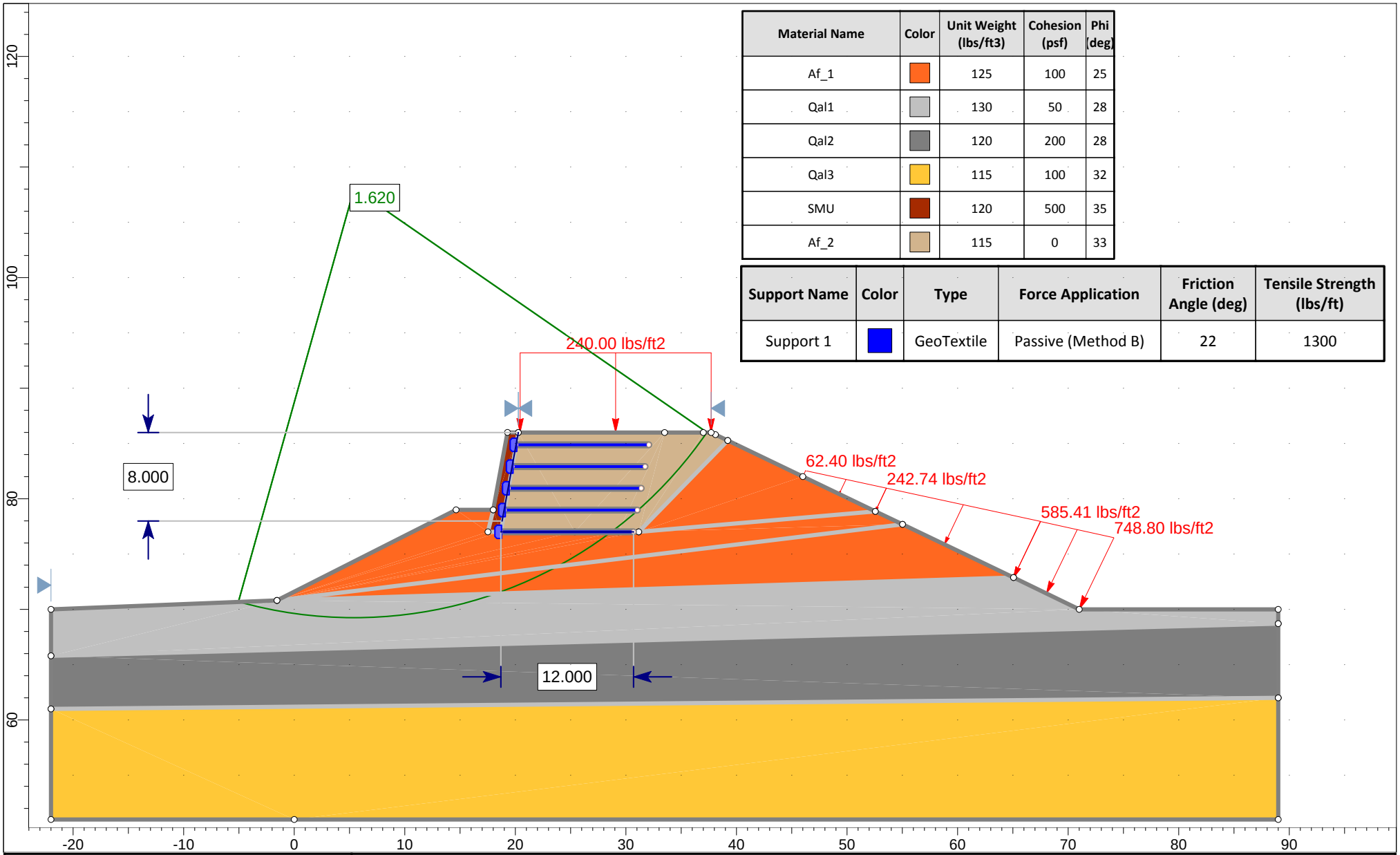
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Af_1		125	100	25
Qal1		130	50	28
Qal2		120	200	28
Qal3		115	100	32
SMU		120	500	35
Af_2		115	0	33

Support Name	Color	Type	Force Application	Friction Angle (deg)	Tensile Strength (lbs/ft)
Support 1		GeoTextile	Passive (Method B)	22	1300

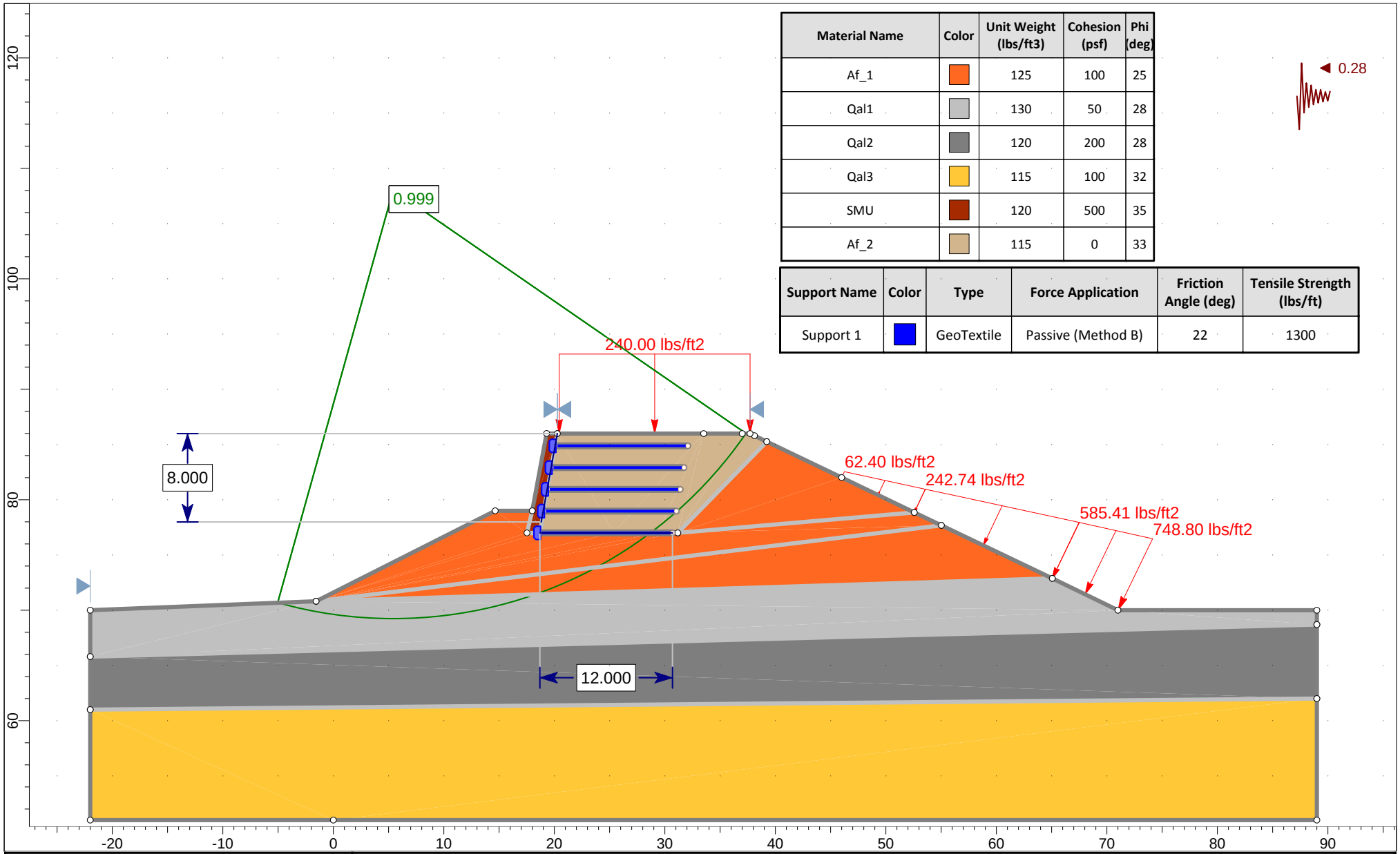


Project	Los Osos Water Recycling Facility		
Analysis Description	Retention Pond_8 ft SMU Wall_Exterior_Dry_Static		
Drawn By: GDE	Scale: 1:144	Company: Fugro Consultants	
Date: 4/15/2013, 3:51:14 PM		File Name: SMU Wall_8ft_Config1.slim	

SLIDEINTERPRET 6.020

Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Af_1		125	100	25
Qal1		130	50	28
Qal2		120	200	28
Qal3		115	100	32
SMU		120	500	35
Af_2		115	0	33

Support Name	Color	Type	Force Application	Friction Angle (deg)	Tensile Strength (lbs/ft)
Support 1		GeoTextile	Passive (Method B)	22	1300

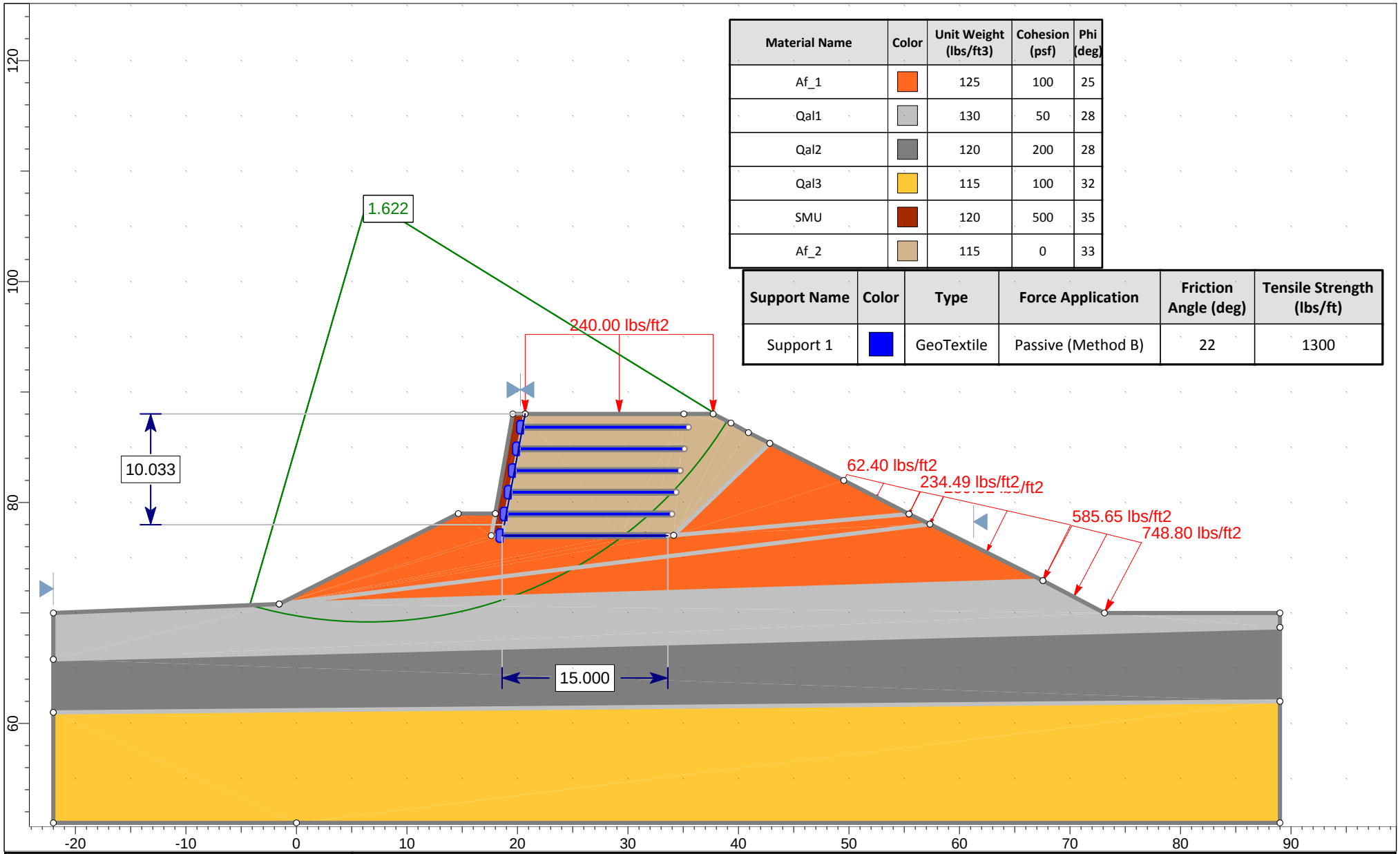


Project	Los Osos Water Recycling Facility		
Analysis Description	Retention Pond_8 ft SMU Wall_Exterior_Dry_Pseudostatic		
Drawn By	GDE	Scale 1:144	Company Fugro Consultants
Date	4/15/2013, 3:51:14 PM		File Name SMU Wall_8ft_Config1.slim

SLIDEINTERPRET 6.020

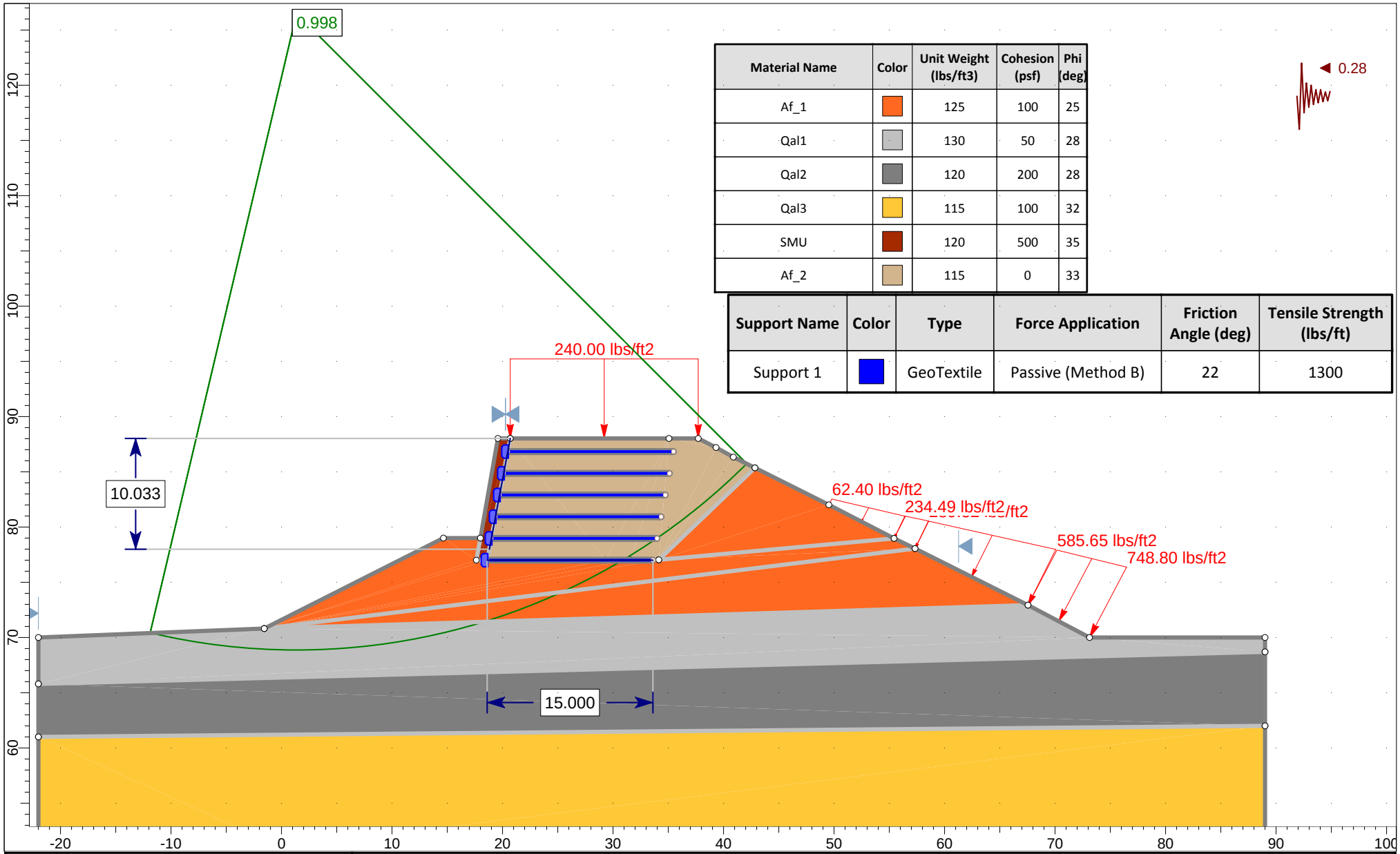
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Af_1		125	100	25
Qal1		130	50	28
Qal2		120	200	28
Qal3		115	100	32
SMU		120	500	35
Af_2		115	0	33

Support Name	Color	Type	Force Application	Friction Angle (deg)	Tensile Strength (lbs/ft)
Support 1		GeoTextile	Passive (Method B)	22	1300



Project	Los Osos Water Recycling Facility		
Analysis Description	Retention Pond_10 ft SMU Wall_Exterior_DRY_Static		
Drawn By: GDE	Scale: 1:144	Company: Fugro Consultants	
Date: 4/15/2013, 3:51:14 PM		File Name: SMU Wall_10ft_Config1.slim	

SLIDEINTERPRET 6.020

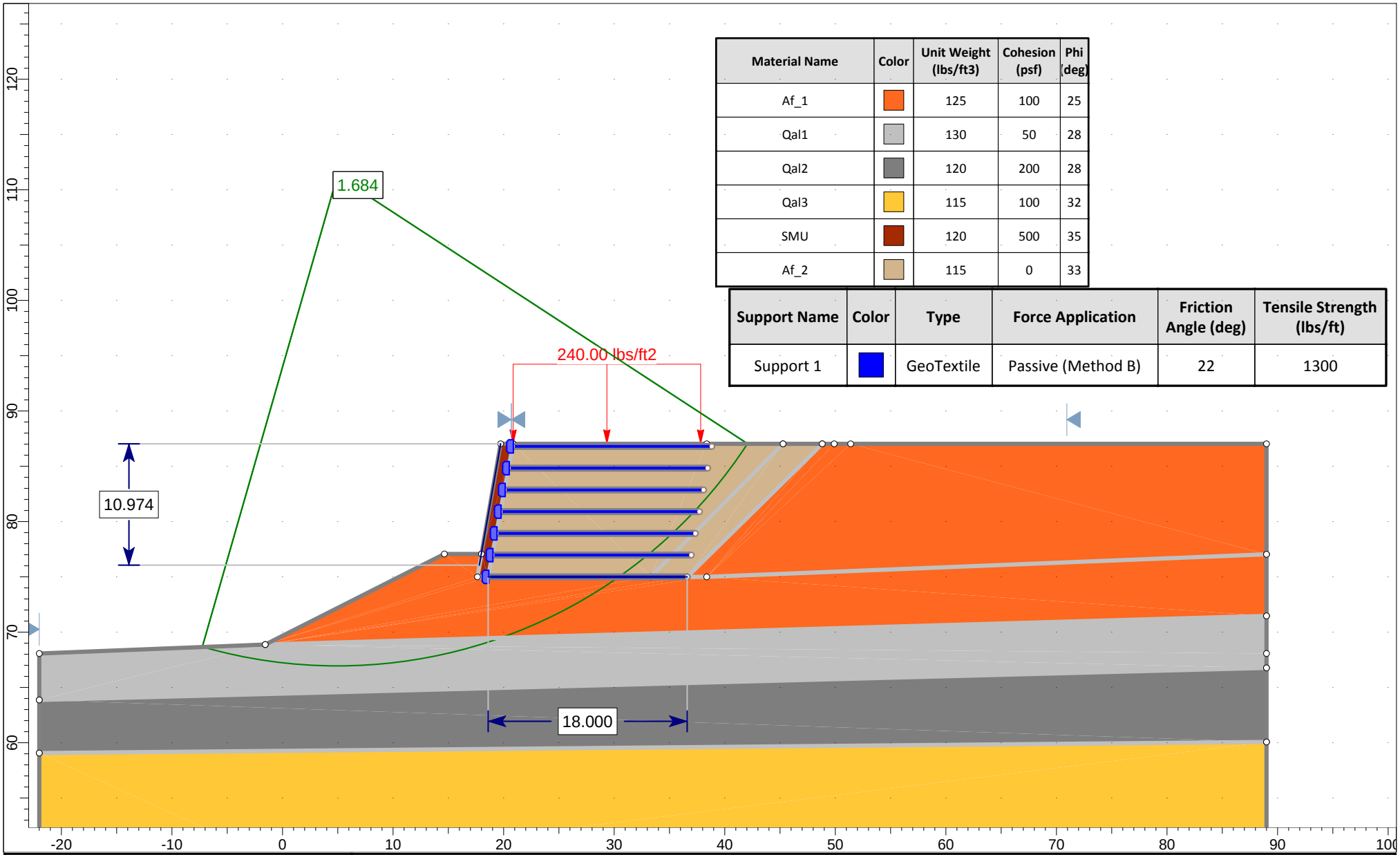


Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Af_1		125	100	25
Qal1		130	50	28
Qal2		120	200	28
Qal3		115	100	32
SMU		120	500	35
Af_2		115	0	33

Support Name	Color	Type	Force Application	Friction Angle (deg)	Tensile Strength (lbs/ft)
Support 1		GeoTextile	Passive (Method B)	22	1300

Project	Los Osos Water Recycling Facility		
Analysis Description	Retention Pond_10 ft SMU Wall_Exterior_DRY_Pseudostatic		
Drawn By	GDE	Scale 1:144	Company Fugro Consultants
Date	4/15/2013, 3:51:14 PM		File Name SMU Wall_10ft_Config1.slim

SLIDEINTERPRET 6.020

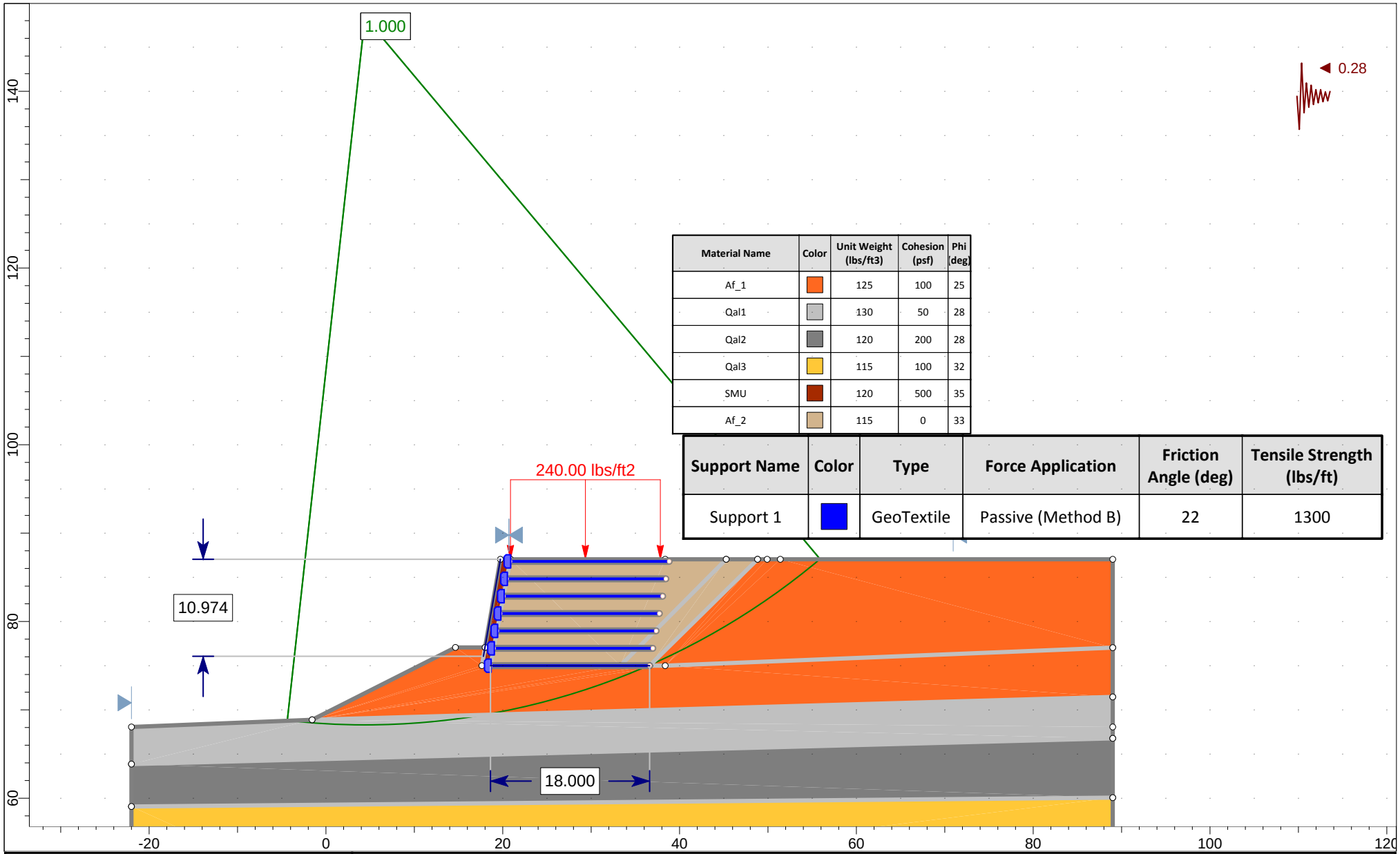


Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Af_1		125	100	25
Qal1		130	50	28
Qal2		120	200	28
Qal3		115	100	32
SMU		120	500	35
Af_2		115	0	33

Support Name	Color	Type	Force Application	Friction Angle (deg)	Tensile Strength (lbs/ft)
Support 1		GeoTextile	Passive (Method B)	22	1300

SLIDEINTERPRET 6.020

Project	Los Osos Water Recycling Facility		
Analysis Description	Retention Pond_11 ft SMU Wall_Building Pad_Static		
Drawn By	GDE	*Scale* 1:144	*Company* Fugro Consultants
Date	4/15/2013, 3:51:14 PM		*File Name* SMU Wall_11ft_Config1.slim



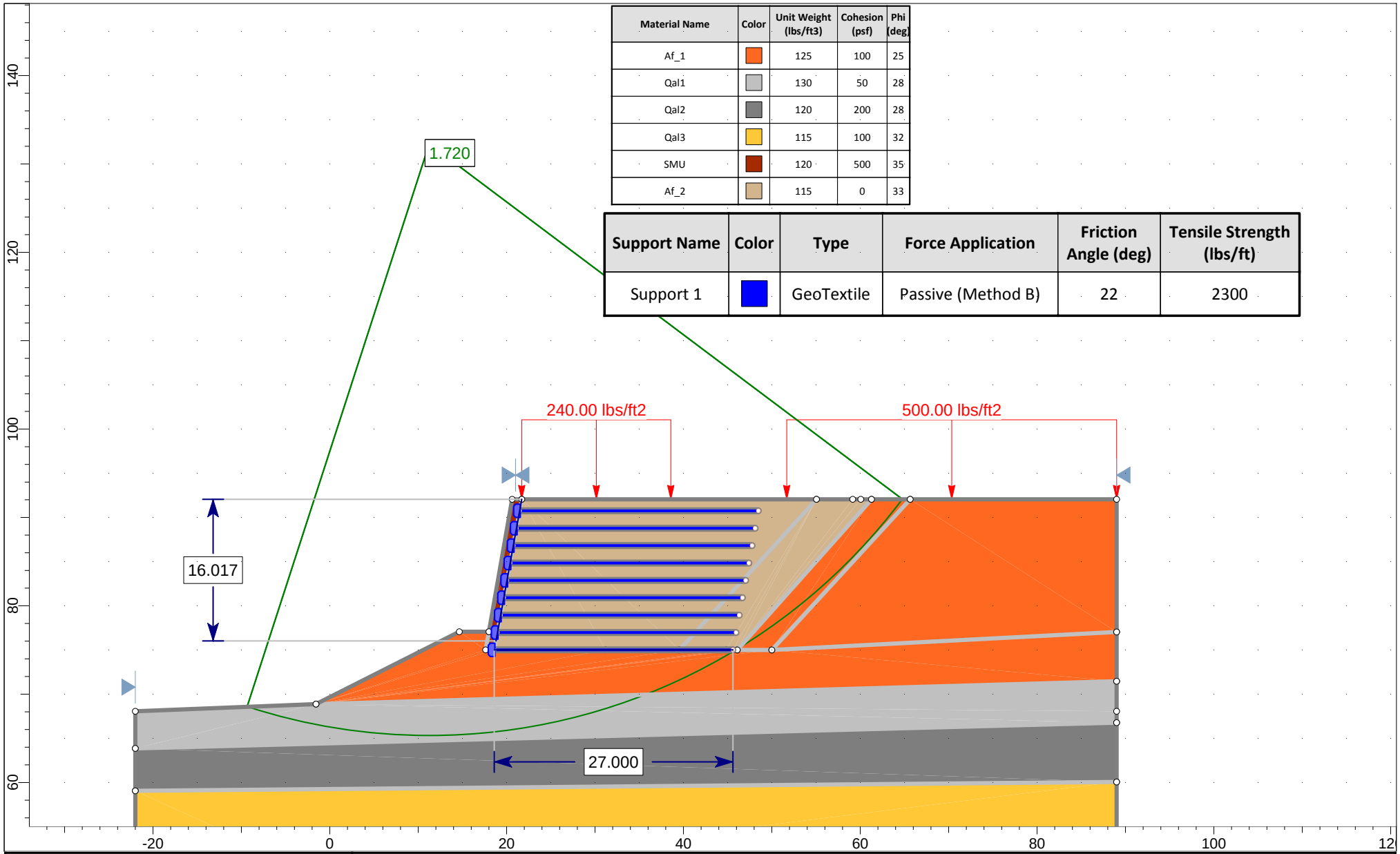
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Af_1		125	100	25
Qal1		130	50	28
Qal2		120	200	28
Qal3		115	100	32
SMU		120	500	35
Af_2		115	0	33

Support Name	Color	Type	Force Application	Friction Angle (deg)	Tensile Strength (lbs/ft)
Support 1		GeoTextile	Passive (Method B)	22	1300

SLIDEINTERPRET 6.020	*Project*	Los Osos Water Recycling Facility	
	Analysis Description	Retention Pond_11 ft SMU Wall_Building Pad_Pseudostatic	
	Drawn By GDE	*Scale* 1:180	*Company* Fugro Consultants
	Date 4/15/2013, 3:51:14 PM		*File Name* SMU Wall_11ft_Config1.slim

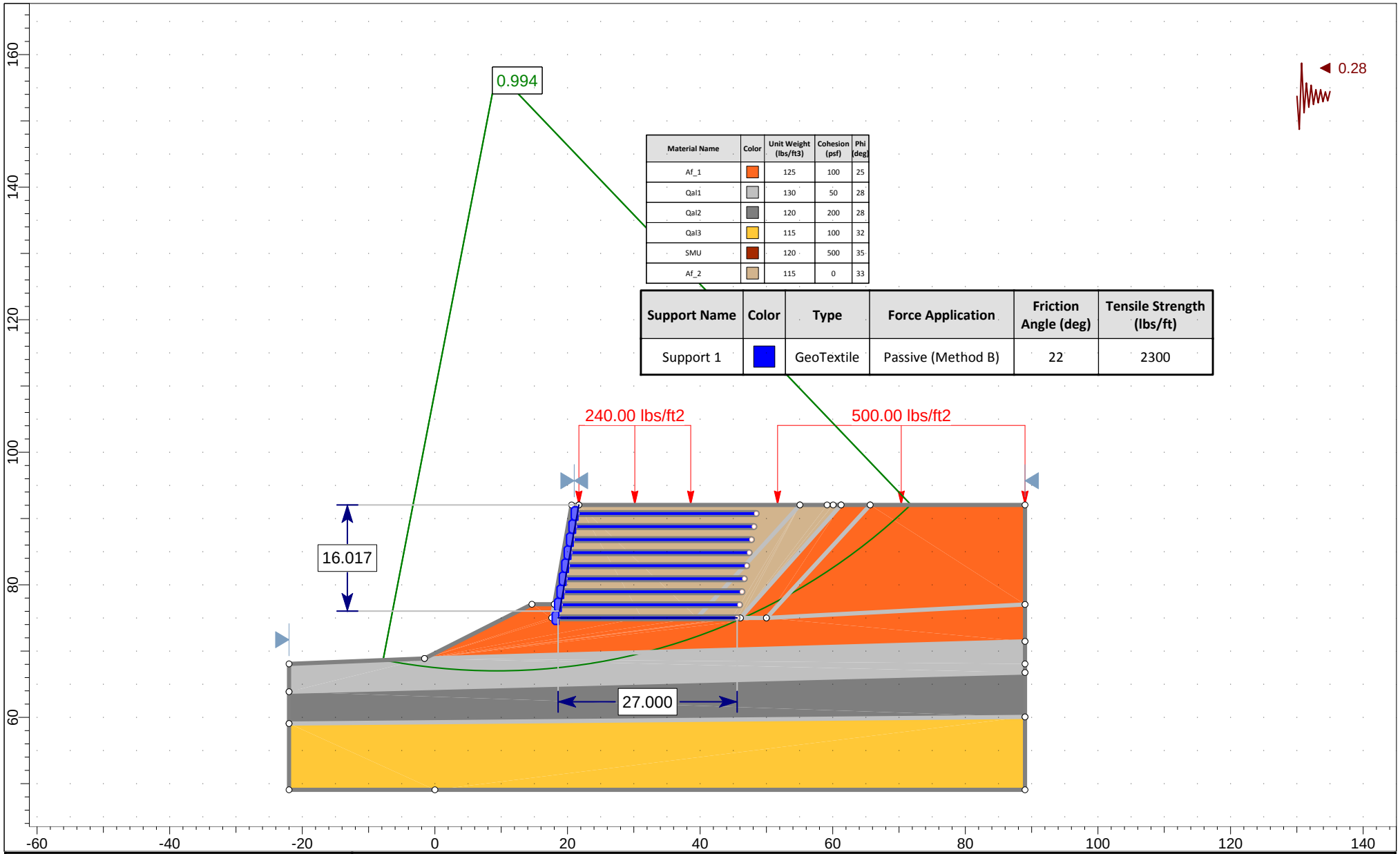
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Af_1		125	100	25
Qal1		130	50	28
Qal2		120	200	28
Qal3		115	100	32
SMU		120	500	35
Af_2		115	0	33

Support Name	Color	Type	Force Application	Friction Angle (deg)	Tensile Strength (lbs/ft)
Support 1		GeoTextile	Passive (Method B)	22	2300



Project	Los Osos Water Recycling Facility		
Analysis Description	Retention Pond_16 ft SMU Wall_Building Pad_Static		
Drawn By: GDE	Scale: 1:180	Company: Fugro Consultants	
Date: 4/15/2013, 3:51:14 PM		File Name: SMU Wall_16ft_Config1.slim	

SLIDEINTERPRET 6.020

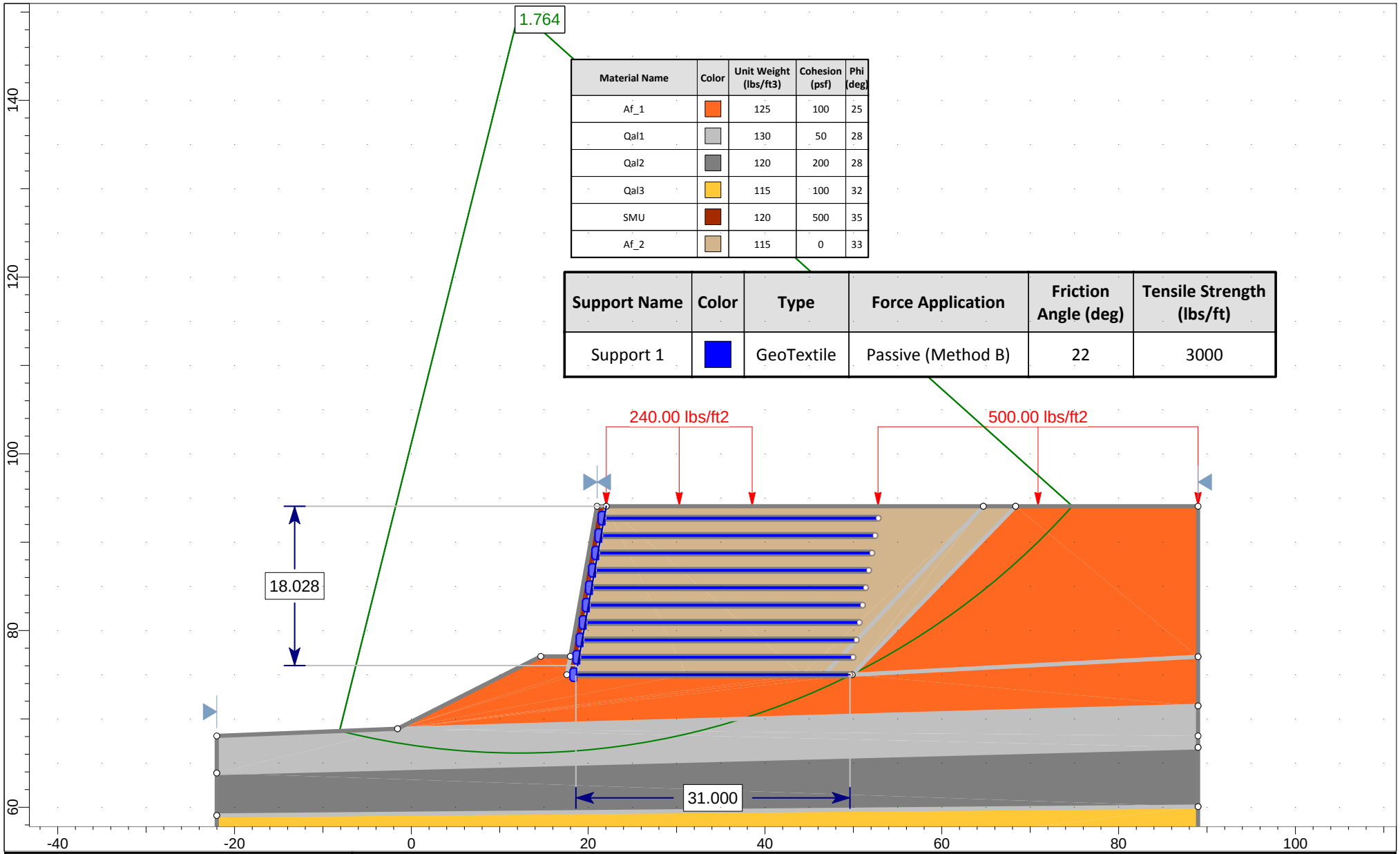


Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Af_1		125	100	25
Qal1		130	50	28
Qal2		120	200	28
Qal3		115	100	32
SMU		120	500	35
Af_2		115	0	33

Support Name	Color	Type	Force Application	Friction Angle (deg)	Tensile Strength (lbs/ft)
Support 1		GeoTextile	Passive (Method B)	22	2300

SLIDEINTERPRET 6.020

Project	Los Osos Water Recycling Facility		
Analysis Description	Retention Pond_16 ft SMU Wall_Building Pad_Pseudostatic		
Drawn By	GDE	*Scale* 1:240	*Company* Fugro Consultants
Date	4/15/2013, 3:51:14 PM		*File Name* SMU Wall_16ft_Config1.slim

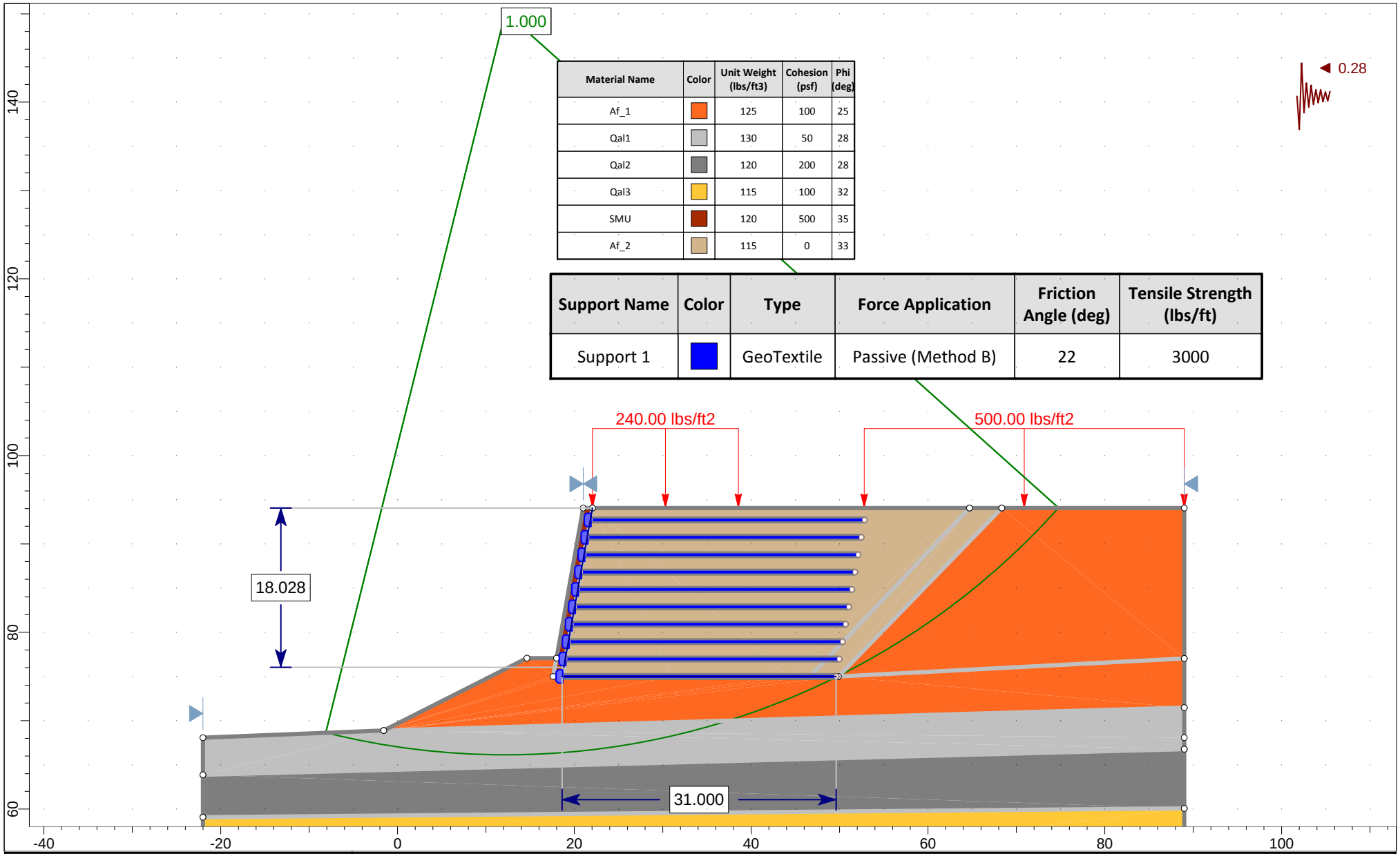


Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Af_1		125	100	25
Qal1		130	50	28
Qal2		120	200	28
Qal3		115	100	32
SMU		120	500	35
Af_2		115	0	33

Support Name	Color	Type	Force Application	Friction Angle (deg)	Tensile Strength (lbs/ft)
Support 1		GeoTextile	Passive (Method B)	22	3000

Project	Los Osos Water Recycling Facility		
Analysis Description	Retention Pond_18 ft SMU Wall_Building Pad_Static		
Drawn By	GDE	Scale 1:180	Company Fugro Consultants
Date	4/15/2013, 3:51:14 PM		File Name SMU Wall_18ft_Config1.slim

SLIDEINTERPRET 6.020



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Af_1		125	100	25
Qal1		130	50	28
Qal2		120	200	28
Qal3		115	100	32
SMU		120	500	35
Af_2		115	0	33

Support Name	Color	Type	Force Application	Friction Angle (deg)	Tensile Strength (lbs/ft)
Support 1		GeoTextile	Passive (Method B)	22	3000

SLIDEINTERPRET 6.020

Project	Los Osos Water Recycling Facility		
Analysis Description	Retention Pond_18 ft SMU Wall_Building Pad_Pseudostatic		
Drawn By	GDE	*Scale* 1:180	*Company* Fugro Consultants
Date	4/15/2013, 3:51:14 PM		*File Name* SMU Wall_18ft_Config1.slim