FUGRO WEST, INC.

PRELIMINARY GEOTECHNICAL REPORT
LOS OSOS WASTEWATER PROJECT
TONINI PROPERTY
3515 TURRI ROAD
SAN LUIS OBISPO COUNTY, CALIFORNIA

Prepared for:
COUNTY OF SAN LUIS OBISPO

January 29, 2009

FUGRO WEST, INC.

660 Clarion Court, Suite A
San Luis Obispo, California 93401
Tel: (805) 542-0797
Fax: (805) 542-9311

January 29, 2009
Project No. 3014.031

County of San Luis Obispo
Department of Public Works, Room 207
County Government Center
San Luis Obispo, CA 93408

Attention: Mr. John Waddell

Subject: Preliminary Geotechnical Report, Los Osos Wastewater Project, Tonini Property, 3515 Turri Road, San Luis Obispo County, California

Dear Mr. Waddell:

Fugro is pleased to submit this Preliminary Geotechnical Report for the Los Osos Wastewater Project in San Luis Obispo County, California. This report was prepared in accordance with the scope of services presented in our proposal dated October 14, 2008, and authorized under the County's Purchase Order No. 25004795, dated October 22, 2008.

The purpose of this report is to provide preliminary geotechnical considerations for the Tonini property at 3515 Turri Road in San Luis Obispo County that is being considered as a possible site for the new wastewater treatment plant, storage ponds, and sprayfield irrigation. This report provides preliminary geotechnical considerations and opinions regarding site geology, soil and groundwater conditions encountered, potential for the site to be impacted by geologic hazards, anticipated site preparation and grading, and foundation support for the proposed structures. We understand this report will likely also provide input to the preparation of an Environmental Impact Report (EIR).

Please contact the undersigned if you have questions regarding this report, or require additional information.

Sincerely,

FUGRO WEST, INC.

Jonathan D. Blanchard, GE 2312
Principal Geotechnical Engineer

Reviewed by:

Lori E. Prentice, C.E.G. 2312
Principal Engineering Geologist

Gresham D. Eckrich
Staff Engineer/Geologist

Copies: 4 – Addressee, 1 PDF

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1. PROJECT AND SITE DESCRIPTION

The work preformed for this study generally consists of a preliminary geotechnical evaluation of the 643-acre Tonini property located at 3515 Turri Road in San Luis Obispo County, California. The site is being considered as a possible location of the new wastewater treatment facility for the Los Osos community that will replace privately-owned individual septic systems (septic tanks and leach lines) that currently serve the residents of Los Osos. The location of the site is shown on Plate 1 - Vicinity Map. The layout of the proposed improvements is shown on Plate 2 – Field Exploration Plan.

1.1 EXISTING SITE

The Tonini property is located approximately ½ mile north of Los Osos Valley Road. The site is currently occupied by ranch buildings, open agricultural fields, and grazing land. The property is bounded by Turri Ranch Road to the south, agricultural fields and the Los Osos Valley drainage (Warden Lake) to the southwest and west, and Turri Road to the north and east.

The topography over the majority of the site and vicinity is characterized by gently rolling hills. A prominent hill top and associated foothills of the Morros are located on the western portion of the property. The eastern portion of the property is generally flat and traversed by a network of south- and east-trending seasonal creeks linked with the Los Osos Valley drainage. Elevations range from about 20 feet near Warden Lake along the southwestern limits of the site to about 541 feet in the northwestern portion of the site. Slope inclinations on the foothills range from about 3½h:1v to 9h:1v.

1.2 PROJECT DESCRIPTION

Proposed improvements at the Tonini site include a wastewater treatment plant, storage ponds, and sprayfields for disposal of treated effluent, as shown on Plate 2. According to Michael Brandman Associates (MBA, 2008), the footprint of the treatment facility and associated ponds will be sited on about 32 acres of generally flat terrain in the south central portion of the property. The sprayfields will occupy the remaining flat terrain and the lower portions of adjacent slopes to about elevation (el.) 280 feet (MSL). A summary description of each project component is presented below:

1.2.1 Wastewater Treatment Plant

According to Carollo (2008), the treatment plant generally will consist of a new wastewater treatment plant designed to accept an estimated peak flow of 1.2-million gallons per day. The facility and appurtenances will occupy about 4 acres, and the components of the facility will depend on the treatment option selected for design. The proposed project will involve secondary treatment using extended aeration basins. The aeration basins are likely to be excavated to depths of 10 to 20 feet below the existing ground surface. Oxidation ditches and some appurtenant treatment facilities likely will involve relatively large, heavily loaded concrete structures and tanks that may be constructed above or below grade. Additional

improvements are likely to include an operations building, offices, septage receiving station, headworks, solids processing, and filter systems. Site improvements could also involve paving for parking and access roads, concrete flatwork, retaining walls, utilities, piping, drainage facilities, and landscaping.

1.2.2 Treatment and Storage Ponds

Partially-mixed facultative ponds may be used as an alternative secondary treatment process and would occupy approximately 20 acres. The proposed project includes approximately 5 to 8 acres of storage intended to hold treated effluent during periods of low disposal capacity (wet season). We understand that treatment and storage ponds likely will be lined earthen reservoirs with an earthen perimeter berm and an interior excavation to provide the required storage. Treatment and storage pond depths have not yet been determined, but will be designed such that the retained height of water and/or capacity of the reservoirs is below the jurisdictional limits of the California Division of Safety of Dams (the ponds will not be considered a dam according to State definitions). Storage ponds will be lined to prevent percolation, protected with riprap, and have 4 feet of free board above the water storage level (MBA, 2008).

1.2.3 Effluent Disposal

According to MBA (2008), on-site effluent disposal will consist of sprayfields that will dispose of up to 842 acre-feet of treated effluent over approximately 175 acres annually. Treated effluent will be disposed of during daytime and dry weather periods by means of evapotranspiration and percolation. Run-off will be collected by a drain constructed at the bottom of sprayfield slopes and reapplied to the sprayfields. We understand irrigation lines will be buried less than two (2) feet below grade. Additional treated wastewater effluent will be transported by a pipe conveyance system to an off-site leachfield.

2. WORK PERFORMED

2.1 PURPOSE

The purpose of this report is to provide preliminary geotechnical considerations and opinions for the proposed wastewater treatment project site. The primary geotechnical considerations evaluated for the project are characterization of the subsurface materials, geologic hazards, anticipated site preparation and grading for support of the improvements, foundation support of structures, and construction considerations. The information provided herein is preliminary and is not intended for design of the project. A design-level geotechnical study will be needed if the project proceeds to design.

2.2 SCOPE

To evaluate the geotechnical considerations for the project, we performed the following scope of work:

- Site visits to observe the general site conditions, a meeting with the Tonini property owner, preparing a Health and Safety Plan, and notifying Underground Service Alert of the field exploration program;
- A review of selected published geologic maps, and geotechnical data available from our in-house files;
- Field exploration consisting of drilling twelve hollow-stem auger borings;
- Laboratory testing of selected samples recovered from the field exploration program; and
- Preparation of this report summarizing the data obtained for the site, and our preliminary conclusions and recommendations regarding;
  - Soil and groundwater conditions encountered;
  - Potential for the site to be impacted by geologic hazards such as seismic shaking, fault rupture, liquefaction, landsliding, or slope instability;
  - Naturally occurring hazards that could impact the design or construction of the project such as erosion, expansive soil, hydro-collapse, naturally occurring asbestos, and radon or hazardous gases;
  - Liquefaction potential and potential impacts to site preparation and structures;
  - Anticipated site preparation and grading;
  - Suitability of on-site soil for use as compacted fill;
  - Suitable foundation types and ranges of presumptive bearing values for the soil conditions encountered; and
  - Excavation considerations such as need for dewatering and excavation characteristics of the materials encountered.

2.3 FIELD EXPLORATION

The drilling subcontractor for the project was J.E.T Drilling of Signal Hill, California. J.E.T used a CME75, truck-mounted drilling rig equipped with 8-inch hollow-stem augers to advance twelve (12) borings within the limits of the proposed improvements. The borings were advanced to depths of approximately 11½ to 50 feet below the existing ground surface. The approximate locations of the borings are shown on Plate 2.

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 SPT sampler was used without liners. The modified California sampler was used with brass liners. The samplers were driven into the materials at the bottom of the drill hole 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. Bulk samples were collected from the drill cuttings retrieved from the auger flights. 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 for moisture content, unit weight, grain size distribution, Atterberg limits, expansion index, and permeability were performed on selected samples recovered from the field exploration program. The tests were performed in general accordance with the applicable standards of ASTM. The results of the tests are presented in Appendix B.

2.5 AERIAL PHOTOGRAPHIC REVIEW AND DATA REVIEW

We reviewed the following site-specific historical aerial photographs to aid in evaluation of the surficial conditions at the site.

Summary of Reviewed Aerial Photographs

Date	Scale	Flight	Frames
11-13-02	1:32,000	GS00999	16 and 17

2.6 PREVIOUS STUDIES

Fugro (2004a, 2004b, 2007, 2008) previously performed geotechnical studies in the project vicinity. Fugro (2004a) addressed the design of the Los Osos Wastewater Project collection system, treatment plant and effluent disposal system. Fugro (2004b) provided a preliminarily evaluation of the subsurface conditions at the adjacent Andres site to identify geotechnical considerations that could impact development of a new treatment facility at that site. Fugro (2007) provided preliminary geotechnical considerations and opinions for the proposed wastewater treatment plant located at the nearby Los Osos Mortuary, Giocamazzi, and Branin properties. Fugro (2008) generally consisted of a preliminary geotechnical evaluation of various sites within Los Osos, Baywood Park and Cuesta-by-the-Sea for components of the wastewater collection and treatment plant system that will provide input to the preparation of the Environmental Impact Report (EIR) currently being prepared for the Los Osos Wastewater Project. Cleath & Associates (2008) conducted a hydrogeologic site reconnaissance to collect data for water quality analyses and preliminarily evaluate geologic hazards.

2.7 GENERAL CONDITIONS

Fugro prepared the conclusions and professional opinions presented in this report in accordance with generally accepted geotechnical engineering principals 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 the County of San Luis Obispo 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 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 preliminary, intended for design-input purposes; they 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 also can 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. 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 (locally the Santa Lucia Mountains) are predominately 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 et al. (1979), is shown on Plate 3 – Regional Geologic Map. The surficial geology in the project vicinity, as mapped by Lettis and Hall (1994), is shown on Plate 5 – Los Osos Fault Zone and Lineaments.

As shown on Plate 3, Franciscan mélange (KJfm) and metavolcanics (KJfmv) underlie the gently rolling hills comprising the majority of the western part of the project site as mapped by Hall et al. (1979). Hall et al. describes the Franciscan metavolcanics as primarily consisting of metamorphosed basalt and diabase (greenstone) with localized, extensively sheared zones. The mélange is characterized by Hall et al. as pervasively sheared greywacke and claystone, with exotic clast inclusions. The mélange typically weathers to a highly expansive soil at the ground surface, and is prone to soil creep, slope instability, and landsliding. Soils formed in place by the decomposition of underlying rock are referred to as residual soils and are included

in the corresponding Franciscan formation. Prominent outcrops of chert and blue schist are mapped within the mélange by Hall et al. (1979).

The terrain in the south and southwestern portions of the property are mapped as queried Paso Robles Formation (Qpr) and dune sand deposits (Qs) by Hall et al. (1979); as shown on Plate 5, Lettis and Hall (1994) mapped these slopes as queried eolian (dune sand) deposits (Qe). Alluvium (Qal) is mapped in the generally flat areas on the eastern portion of the property and within the southwestern limits of the site along Warden Lake. The alluvial sediments are associated with the Los Osos Valley drainage and Warden Lake. Based on our field exploration, the sediments along the southern limits of the property consist of interbedded alluvial deposits, and not the Paso Robles Formation mapped by Hall et al. (1979). Additionally, it is our opinion that the slopes in the southwestern portion of the property are predominantly composed of dune sand deposits. Lettis & Hall (1994) characterize these dune sands as unconsolidated to moderately consolidated, undifferentiated late Pleistocene and Holocene wind blown deposits.

3.2 SUBSURFACE CONDITIONS

The soil and groundwater conditions were characterized for the preliminary study based on the results of the field exploration program. The locations of the explorations are shown on Plate 2.

Logs of the borings are presented in Appendix A. The subsurface conditions encountered consisted of alluvium, colluvium, dune sand deposits, and Franciscan mélange and metavolcanics rocks. A discussion of the geologic units encountered is provided below. Our interpretation of subsurface conditions is based on our boring logs.

Alluvium (Qal). The alluvium encountered likely contained undifferentiated units of floodplain and fluvial sediments deposited along site-traversing creeks of the Los Osos Valley drainage system. Surficial soils disturbed by agricultural practices and/or grazing were encountered in all borings from the ground surface to depths of about 1 to 4½ feet. The alluvium was encountered in all borings except B-102 and B-104 to depths of approximately 3½ to 21½ feet below the existing ground surface. The alluvium encountered has been characterized as a predominantly granular sandy unit (Qal_1) and a cohesive fat clay (CH) unit (Qal_2).

Qal_1. This predominantly granular unit of the alluvium was encountered in B-1, B-4, B-5, and B-101 from the ground surface to depths of approximately 11 to 21½ feet. Borings B-1 and B-4 encountered alluvial sediments to the total depth explored, approximately 21½ feet. The Qal_1 unit consisted predominantly of loose to very dense silty sand (SM), medium dense to dense clayey sand (SC), and medium dense sand (SP) encountered at the base of gentle slopes in the southern portion of the property. The sandy alluvium was interbedded with stiff sandy silt (ML), stiff to hard lean clay (CL), medium stiff lean clay with sand (CL), and stiff to hard sandy clay (CL).

Samples of the Qal_1 unit had dry unit weights ranging between approximately 96 and 113 pounds per cubic foot (pcf) and moisture contents ranging between approximately 4 and 27

percent. A sample of silty sand (SM) from the Qal_1 unit had a permeability of approximately $9x10^{-5}$ centimeters per second (cm/s). Results of laboratory tests are presented in Appendix B.

Qal_2. This finer-grained unit of the alluvium was encountered in B-2, B-3, B-103, B-105, B-106 and B-107 advanced on the property's generally flatter terrain. The Qal_2 unit consisted of medium stiff to hard fat clay (CH) and fat clay with sand (CH) encountered from the ground surface to depths of approximately 3½ to 14 feet.

Samples of the Qal_2 unit had dry unit weights ranging between approximately 93 and 117 pcf and moisture contents ranging between approximately 13 and 26 percent. Samples of the Qal_2 alluvium unit had permeability values ranging between approximately 2.0×10^{-8} to 3.1×10^{-9} cm/s. Two samples of fat clay (CH) obtained from the Qal_2 unit encountered in B-3 had expansion index values of 93 and 105.

Colluvium (Qcol). Colluvium was encountered in B-103 and B-104. The colluvium encountered consisted of very stiff lean clay (CL) and fat clay (CH). We differentiated colluvium from alluvium based on the material's location on or adjacent to slopes and the general heterogeneity of the soil. The colluvium was encountered below alluvium from depths of about 4½ feet to 9 feet in B-103, and from the surface to an approximate depth of 1 foot in B-104.

A sample of fat clay (CH) recovered from the Qcol unit had a dry unit weight of approximately 96 pcf and a moisture content of approximately 10 percent.

Dune Sand Deposits (Qs). Dune sand deposits were encountered in B-102 from the ground surface to the maximum depth explored, approximately 11½ feet. The dune sand deposits consisted of medium dense silty sand (SM). The areal extent of the dune sand deposits, as mapped by Hall et al. (1979), is illustrated on Plate 2. Based on our explorations, it is our opinion the dune sand deposits on the property also extend north of the contact mapped by Hall et al. (1979).

A sample of silty sand (SM) recovered from the Qs unit had a dry unit weight of approximately 99 pcf and a moisture content of approximately 2 percent. A sample of silty sand (SM) recovered from the Qs unit had a permeability of approximately 1×10^{-3} cm/s.

Franciscan Mélange (KJfm). Mélange was encountered in B-104 beneath colluvium from a depth of about 1 foot to the maximum depth explored, approximately 11½ feet. The mélange consisted of stiff to hard residual fat clay (CH) and soft claystone (Rx). The mélange is mapped by Hall et al. (1979) within the northern portion of the site. Based on field observations, the mélange is the predominant formation exposed in areas where geomorphic features indicative of soil creep and landsliding are common.

Franciscan Metavolcanics (KJfmv). Metavolcanics were encountered beneath the alluvium to the maximum depths explored in B-2, B-3, B-5, B-105, B-106 and B-107 up to approximately 50 feet below the ground surface. The metavolcanics were also encountered below colluvium in B-103 from a depth of about 9 feet. The metavolcanics predominantly consisted of residual soils including medium stiff to hard lean clay (CL), stiff to hard clay with

sand (CL), very stiff lean clay with gravel (CL), very stiff fat clay with gravel (CH), hard gravelly lean clay (CL), and clayey gravel (GC); very soft to soft greenstone (Rx) decomposed to clayey gravel with sand (GC) and clayey sand (SC); and bedrock consisting of hard greenstone (Rx).

Samples of residual lean clay (CL) and fat clay with gravel (CH) recovered from the KJfmv unit had dry unit weights of approximately 98 and 100 pcf and moisture contents of approximately 18 and 21 percent, respectively.

3.3 GROUNDWATER

Groundwater was encountered during our October 2008 field exploration program at an approximate depth of 27 feet in B-3. Groundwater was not encountered in any other borings.

Based on published mapping, the Warden Lake area along the southwestern limits of the property can be a marshy environment and has contained surface water in the past. Cleath (2008) noted a linear exposure of mid-slope spring seeps within the dune sand deposits in the southwestern portion of the property (outside the proposed limits of spray irrigation) during a May 2008 site reconnaissance. Variations in surface and groundwater conditions will likely occur as a result of changes in precipitation, irrigation, runoff, and other factors.

3.4 SEISMIC CONDITIONS

3.4.1 Faulting

The majority of the faults within the Coast Ranges province and the Sierra de Salinas belt generally trend north-northwest. The California Geological Survey (CGS 2002) considers major faulting within the project vicinity to be related to the Los Osos fault, the San Luis Range fault zone (a compilation of several named fault strands), the offshore Hosgri fault, the Rinconada fault, and the San Andreas fault. The CGS fault database consists of active and potentially active faults that are considered by the CGS to be capable of affecting regional seismicity in California. Terms used by CGS to describe fault activity are defined below.

Active. Faults that show evidence of displacement during the most recent epoch of geologic time, the Holocene, are classified as active. The Holocene epoch is generally considered to have begun about 11,000 years ago.

Potentially Active. Faults which displace geologic formations of Pleistocene age but show no evidence of movement in the Holocene period can be considered to be potentially active. Pleistocene time is the period between about two million years ago and 11,000 years ago. The exception is that certain Pleistocene faults can be presumed to be inactive based on direct geologic evidence of inactivity during the Holocene time or longer.

Inactive. Faults which show no evidence of movement during the past two million years and show no potential for movement in the future are classified as inactive.

The locations of regional faults in the Central Coast area as mapped by Lettis et al. (2004) are shown on Plate 4 – Regional Fault Map. Fault activity definitions on Plate 4 by Lettis

et al. are not consistent with the California Geological Survey (CGS) activity definitions. Lettis et al. consider faults as 'active' if they exhibit evidence of displacement within the past 500,000 years, whereas the CGS considers faults as 'active' if they exhibit evidence of displacement within the past 11,000 years.

Fugro utilized the fault search routine in FRISKSP (Blake, 2000) to identify active and potentially active mapped faults and fault segments within a 62-mile radius of the project vicinity. The site coordinates (latitude and longitude) for the Tonini property were estimated to be 35.3122° latitude and -120.7782° longitude. Summarized below are eight (8) faults and fault segments that were considered to be the most capable of producing high ground motion within the project vicinity. Additional information is presented in the California Geological Survey (CGS, 2002) fault database.

Summary of Fault Characteristics

Fault	Approximate Distance From Site (mile)	Maximum Moment Magnitude (M_w)	Fault or Fault Segment Length (km)	Slip Rate (mm/yr)
Los Osos	0.9	7.0	44 ± 4	0.5 ± 0.4
San Luis Range (S. Margin)	9.0	7.2	64 ± 6	0.2 ± 0.1
Hosgri	9.9	7.5	169 ± 17	2.5 ± 1.0
Rinconada	13	7.5	190 ± 19	1.0 ± 1.0
Casmalia (Orcutt Frontal Fault)	27	6.5	29 ± 3	0.3 ± 0.2
Lions Head	32	6.6	41 ± 4	0.02 ± 0.02
San Juan	34	7.1	68 ± 7	1.0 ± 1.0
San Andreas (Cholame)	40	7.3	63 ± 6	34 ± 5

Los Osos Fault. The closest mapped active fault to the site is the Los Osos fault zone (CGS, 2002; PG&E, 1988; Lettis & Hall, 1994; Asquith, 1997). The Los Osos fault zone and associated lineament features are shown on Plate 5. Lettis & Hall (1994) describe the Los Osos fault zone as a series of discontinuous, subparallel and en echelon fault traces that extend from the offshore Hosgri fault zone to Lopez Reservoir, a distance of about 35 miles. Lettis & Hall (1994) subdivided the fault zone into four segments: Estero Bay, Irish Hills, Lopez Reservoir, and Newsom Ridge. The Irish Hills segment of the Los Osos fault is about 10 to 12 miles long and extends from the Pacific Ocean near Los Osos eastward to San Luis Creek. This segment of the fault forms the boundary between the Los Osos Valley and the Irish Hills and has documented Holocene offset (PG&E 1988). Portions of the fault east of Los Osos (east of the study area) near the City of San Luis Obispo have been zoned active and are designated as an Alquist-Priolo earthquake fault hazard zone by CGS.

3.4.2 Historical Seismicity

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 March 2008 by the Advanced National Seismic System (ANSS, 2008) and Clark et al. (1994) are presented on Plate 6 - Historical Seismicity Map. Examples of relatively strong ground motion that has reportedly been experienced near the project area are the seismic events of 1830, 1857, 1913, 1916, 1917, 1952, 1966, 1980, and 2003.

The 1830 event is estimated to be an approximately M5 earthquake that occurred from a poorly located source near San Luis Obispo. The effects of the 1830 event were generally observed between the Los Osos and Rinconada faults. The 1857 event (the Fort Tejon earthquake) occurred on the Mojave segment of the San Andreas fault, and reportedly resulted in damage in central and southern California. The 1913 event is estimated to be an approximately M5 earthquake that occurred along the southwestern margin of the San Luis/Pismo block near Arroyo Grande. The 1916 event is estimated to be an approximately M5 earthquake that occurred near Avila, possibly along the Los Osos fault or faults along the southwestern margin of the San Luis/Pismo block. The 1917 event is estimated to be an approximately M5 earthquake that occurred near Lopez Canyon between the Rinconada and West Huasna faults. The 1952 earthquake is estimated to be a M6 earthquake occurring within the Nacimiento Fault Zone. The 1966 event (the Parkfield earthquake) is estimated to be an approximately M6 earthquake that occurred on the San Andreas fault. The 1980 event is estimated to be an approximately M5 earthquake that occurred offshore near Point Sal along the Casmalia fault zone, and near its intersection with the Hosgri fault.

The epicenter of the San Simeon earthquake was located approximately 30 miles north of the project site. 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, as estimated from the ShakeMap, was likely about 0.12g.

4. GEOTECHNICAL ANALYSIS

4.1 SEISMIC HAZARD ANALYSIS

A preliminary probabilistic seismic hazard evaluation for the site was performed using the computer program FRISKSP (Blake, 2000) and the USGS Hazard Calculator program based on the 2007 California Building Code (CBC). The current CBC was adopted by the County in January 2008, and was used to define the seismic hazard exposure for this preliminary evaluation. The CBC seismic design code is referenced to the American Society of Civil Engineers ASCE 7-05 report. The program FRISKSP is based on FRISK (McGuire, 1978) and has been modified for the probabilistic estimations of seismic hazards using three-dimensional earthquake sources.

Our evaluation estimated earthquake effects corresponding to the Maximum Considered Earthquake (MCE). The MCE is defined by the code as an earthquake having a 2 percent chance of being exceeded in 50 years (Statistical Return Period of approximately once every 2,475 years). Design earthquake ground motions for liquefaction and other geotechnical analyses are defined as two-thirds ($^2/_3$) of the corresponding MCE ground motions.

FRISKSP was used to estimate the peak horizontal acceleration using the attenuation relationship proposed by Boore et al. (1997) and assuming an average shear wave velocity of 250 m/s in the upper 100 feet. FRISKSP estimated the MCE would result in a peak horizontal ground acceleration of approximately 0.63g, corresponding to a deaggregated modal M6.7 event on the Los Osos fault.

Based on subsurface conditions encountered at the site, the Soil Profile Type selected for our evaluation was Site Class D, "S_D". This soil profile type corresponds to a stiff soil profile with an average shear wave velocity ranging between 600 and 1,200 feet per second (180 and 360 meters per second), according to the CBC (2007).

4.2 LIQUEFACTION AND SEISMIC SETTLEMENT

Liquefaction is defined as the loss of soil strength due to an increase in soil pore water pressure that results from seismic ground shaking. In order for liquefaction to occur, three general geotechnical conditions need to occur: 1) groundwater is present within the potentially liquefiable material; 2) the soil is granular and meets a specific range of grain sizes; and 3) the soil is in a loose state of low relative density. If those conditions are present and strong ground motion occurs, portions of the soil column could liquefy, depending upon the intensity and duration of the strong ground motion. Seismic settlement can occur in relatively loose sands, similar to soil types that are vulnerable to liquefaction, but can also occur in soils that are unsaturated and above the groundwater table.

The Safety Element of the San Luis Obispo County General Plan (1999) identifies areas where the potential for liquefaction should be evaluated based on mapping of geologic units that may contain soil types susceptible to liquefaction. Within the Los Osos area, the Safety Element identifies geologic units such as beach sand, dune sand, and younger alluvial deposits as having a high potential to contain sediments that may be prone to liquefaction.

Based on our subsurface exploration, the site is predominantly underlain by alluvial, colluvial and residual soils overlying generally shallow bedrock. The stiff to hard fine-grained units of the alluvium (Qal_2) consist mostly of clay and are not considered susceptible to liquefaction. Loose to medium dense sandy alluvium (Qal_1) that may be prone to liquefaction were generally encountered in B-4, B-5 and B-101 above the depth of groundwater and within approximately 4 feet of the ground surface at the base of slopes within the south and southwestern portions of the project area. Potentially liquefiable dune sand deposits (Qs) were also encountered above the depth of groundwater in B-102 along the western limits of the project extent. Our analysis of the liquefaction potential of these units is summarized on Plate 7 - Summary of Liquefaction Potential.

We evaluated the potential for liquefaction to impact the on-site soils encountered by our explorations. For the purpose of our evaluation, we considered a ground motion of approximately 0.42g and an earthquake magnitude of 6.7, corresponding to two-thirds ($^2/_3$) of the MCE and the deaggregated modal earthquake magnitude. The analysis was performed using procedures described in the 1998 NCEER guidelines (Youd and Idriss, 2001) for performing liquefaction analyses using field blow counts and soil type. Field blow counts and soil type at each boring location are shown on the boring logs in Appendix A.

Based on the evaluation, soils susceptible to seismic settlement were encountered predominantly within the shallow alluvial soils and dune sand deposits. A summary of the estimated factor of safety against liquefaction within these potentially liquefiable soils is presented on Plate 7. As summarized on Plate 7, the estimated factors of safety against liquefaction for two blow counts recorded within the sandy alluvium unit (Qal_1) and for one blow count recorded within the dune sand deposits (Qs) are approximately 0.8 and 1.1, and 0.8, respectively. The remainder of the blow counts recorded had estimated factors of safety greater than 1. Liquefaction of these soils would likely occur if the materials were saturated during an earthquake. We anticipate shallow materials susceptible to seismic settlement would be excavated during grading of storage/treatment ponds and construction of critical structures, and be replaced with properly compacted fill having a low potential for liquefaction. Soils susceptible to seismic settlement underlying proposed sprayfield areas, outside the limits of ponds and structures, will likely have minimal impact on the project, and specific mitigation for liquefaction is not needed.

5. GEOLOGIC HAZARDS AND GEOTECHNICAL CONSIDERATIONS

The following sections present a summary of geologic hazards that were evaluated for the project, our opinion regarding the potential for the hazards to impact the project, and preliminary recommendations for mitigation of the hazard, if needed.

5.1 FAULT RUPTURE

Fault rupture is the displacement of the ground surface created by movement along a fault plane during an earthquake. The project vicinity is not located within a designated Alquist-Priolo Earthquake Fault Hazard Zone. The Alquist-Priolo Earthquake Fault Zoning Act identifies areas of known active faults, and the main purpose of the act is to prevent the construction of buildings used for human occupancy on the surface trace of active faults.

Lettis and Hall (1994) mapped a linear drainage trending northwest-southeast between foothills in the southwestern portion of the property as possibly being related to the Los Osos fault zone (LOFZ), as shown on Plate 5. Linear drainages can also be related to differences in material types and erodibility characteristics at geologic contacts. The LOFZ is considered active and a portion of the LOFZ (near the intersection of Los Osos Valley Road and Foothill Boulevard, about 4 miles southeast of the project site) is zoned by the State of California Alquist-Priolo Special Studies Zones Act.

Based on our aerial photograph review, field exploration and site visits, fault-related geomorphic features other than the aforementioned linear drainage are not readily visible within the project limits. In our opinion, the lineation is not fault-related, but rather related to differential weathering and erosion of different geologic materials, and potential for fault rupture to impact the project site is considered low.

5.2 STRONG GROUND MOTION

The potential exists for strong ground motion to affect the project during the design lifetime. Strong ground motion (shaking) can occur in response to local or regional earthquakes. The project site is located within a seismically active area, and has been subjected to earthquake effects in the recent past (such as the 2003 San Simeon Earthquake). The recency of the San Simeon Earthquake does not suggest that the project area is more or less prone to earthquakes, or has a greater frequency of earthquakes, than it did prior to 2003. In general, the primary effects will be those phenomena associated with shaking and/or ground acceleration. Those effects are discussed in subsequent sections of this report regarding liquefaction, seismic settlement, ground lurching, and slope instability.

As discussed in Section 4.1 of this report, the design earthquake for this project is estimated to be a M6.7 event with a corresponding peak ground acceleration of approximately 0.42g. The design earthquake being considered is of similar magnitude to the San Simeon Earthquake; however, the design earthquake would be a near-field event resulting in greater shaking at the project site. Design earthquake ground motions for liquefaction and other geotechnical analyses are defined as two-thirds ($^2/_3$) of the corresponding MCE ground motions. The MCE is defined by the CBC as an earthquake having a 2 percent chance of being exceeded in 50 years (Statistical Return Period of approximately once every 2,475 years).

5.3 LIQUEFACTION, SEISMIC SETTLEMENT, AND LATERAL SPREADS

As discussed in section 4.2 of this report, liquefaction is a loss of soil strength due to a rapid increase in soil pore water pressures due to cyclic loading during a seismic event. 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, collapse, or lateral spreads can occur in loose, soft, or moderately dense and weakly cemented soils, or in association with liquefaction.

Based on the analysis summarized in Section 4.2 and on Plate 7, a majority of the project extent is underlain by fine-grained cohesive alluvium (Qal_2), residual soil and bedrock that has a low potential for liquefaction. Areas within the south and southwestern portion of the project extent are underlain by generally shallow sandy alluvium (Qal_1) or dune sand deposits (Qs) that were encountered above groundwater. We anticipate these soils are likely to be removed during grading within the limits of proposed structures and ponds. Further, we anticipate that any seismic settlement of soils underlying sprayfields would not have an impact on the project.

Fine-grained soil encountered over a majority of the project extent will likely limit the infiltration of irrigation water and limit the potential for liquefaction. However, low lying areas within the southwestern portion of the project extent that are underlain by relatively permeable, potentially liquefiable soils are likely to have an increased potential for liquefaction due to irrigation.

The design of treatment and storage ponds may need to consider the presence of potentially liquefiable near-surface soils comprising perimeter slopes so that proper site preparation and grading can be performed to remove the potentially liquefiable materials maintain slope stability.

5.4 SUBSIDENCE AND COLLAPSE

The site is not in an area where the withdrawal of subsurface fluids is known to have caused ground subsidence. The fine-grained cohesive materials that underlie the majority of the project extent are generally stiff to hard and are not considered significantly susceptible to compression due to lowering of local water levels. Additionally, lowering of local water levels is not anticipated as part of the proposed project. It is our opinion that there is a low potential for subsidence to impact the project.

5.5 LANDSLIDING/SLOPE INSTABILITY

The County of San Luis Obispo has identified the slopes in the northwestern portion of the property as geologic study areas for landslide risk (http://www.sloplanning-maps.org/ed.asp?bhcp=1). Areas of suspected landslide deposits (Qls) and potentially unstable slopes are delineated on Plate 8 – Soil Constraints Map. Based on site visits and our review of aerial photographs, we observed evidence suggestive of slope instability (landslides, debris flows, creep, and erosion) along the eastern-facing slopes in the northwestern portion of the property. These geomorphic features appear to be shallow in nature and can be common within the Franciscan mélange. The on-site mélange is predominantly composed of expansive claystones that are known to be relatively weak and erode rapidly to form shallow slope inclinations without rock outcrops. It is our opinion that sprayfield irrigation systems sited on steeper slopes or areas of potential instability would increase the potential for slope instability. Mitigation for landsliding or slope instability should consist of positioning proposed effluent areas away from suspected landslide features, potentially unstable ground, or slopes steeper than about 20 percent.

5.6 GROUND LURCHING

Ground lurching occurs as the ground is accelerated during a seismic event. As evidenced by the Loma Prieta, Landers, Northridge, and San Simeon earthquakes, the effects of ground lurching can damage facilities and buried pipelines. Ground lurching occurs due to detachment of underlying stratigraphic units, allowing near-surface soil to move differentially from underlying soil. The site is within a seismically active region of Central California that is prone to moderate to large earthquakes. It is therefore our opinion that there is a potential for

ground lurching to impact the site. Ground lurching is generally not a geologic hazard that can be prevented, and therefore is mitigated by implementing preparedness measures.

5.7 EROSION

As described above, erosion was observed on the slopes in the northwestern portion of the property, as shown on Plate 8. Graded cut slopes associated with the site development will be subject to sheet and rill erosion. Erosion of soils can be accelerated where soils are exposed directly to runoff and/or areas of concentrated storm runoff, such as at culvert outlets. Site drainage and landscape improvements can be designed to reduce the potential for soil erosion.

5.8 EXPANSIVE SOILS

Expansive soil generally consists of fine-grained soil of high plasticity (fat clay) that can damage near-surface improvements in response to shrinking and swelling associated with changes in soil moisture content. A majority of the topsoil encountered at the site consists of fat clay (CH). Samples of fat clay (CH) tested for expansion index had a high potential for expansion with expansion index values of 93 and 105. According to the CBC (2007), the soil tested is classified as expansive.

The National Resource Conservation Service (Ernstrom, 1984) maps the highly expansive soils within the limits of the project extent as belonging to the Cropley series. The Cropley series is characterized as having slow to very slow permeability and high shrink-swell potential (Ernstrom, 1984). After swelling, water infiltration is typically low and surface water is more likely to runoff or pond. The design of structure foundations, concrete flatwork, and pavements should be designed with consideration for expansive soil. Expansive soil conditions are typically mitigated by removal and replacement with select fill, increasing the amount of steel reinforcement in foundations and slabs, deepening footings, and/or placing mats of non-expansive soil below structures or pavements.

5.9 NATURALLY OCCURING ASBESTOS

Naturally occurring asbestos (NOA) is common in serpentine rock throughout San Luis Obispo County. The California Air Resources Board has identified serpentine rock as having the potential to contain asbestos. Serpentine rock is typically a constituent of Franciscan Formation mélange, which was encountered in B-104 during our investigation and is mapped on the slopes in the northwestern portion of the site. However, we encountered alluvium and metavolcanic rocks within the limits of proposed ponds and structures, and we do not anticipate extensive grading or excavation in areas potentially underlain by serpentine rock. Therefore, it is our opinion that there is a low potential for NOA to impact the project.

5.10 FLOODING, TSUNAMIS AND INUNDATION

Tsunamis, or long-period sea waves created due to seismic events or submarine landslides, have historically occurred in the project region. Tsunamis can range in height from a

few feet to greater than 50 feet, and can result in run-ups, or bores, extending great distances up streams, rivers, and creeks. As evidenced by recent events around the world, tsunamis can have devastating impacts on coastal areas. According to Kilbourne and Mualchin (1980), the following historical tsunamis have occurred in the project region:

Historical Tsunami Run-up

Year	Estimated Tsunami Generation Location	Estimated Impact Location	Estimated Tsunami Run-up (meters/feet)
1868[1]	Unknown	Morro Bay	Unknown
1878[2]	Unknown	Morro Bay	Unknown
1927	Local	Pismo Beach	1.8 meters/5.9 feet
1946	Aleutian Trench	San Luis Obispo Bay	1.2 - 1.5 meters/3.9 - 4.9 feet
1960	Chile-Peru Trench	Central Coast	>1.0 meters/>3.3 feet
1964	Gulf of Alaska	Central Coast	>1.0 meters/>3.3 feet

[1] Speculative

[2] Reportedly overtopped the sand spit that separates the bay from the ocean (SLO County 1999).

As noted in the above table, tsunamis generated from far-field sources have historically occurred in the project region. A study performed by Houston and Garcia (1978) estimated the 100-year and 500-year tsunami run-ups in the study area based upon far-field source generation locations (such as the Aleutian or Chile-Peru Trenches). On the basis of their study, the estimated tsunami run-up along the Cayucos/Morro Bay coastline is up to approximately 9.5 feet to 24.2 feet for the 100-year and 500-year events, respectively. Those run-ups were calculated using astronomical high tides, and compare well with recorded tsunamis that have occurred in Crescent City and other locations along the California coast. However, according to Kilbourne and Mualchin, the worst case scenario would occur if a tsunami occurred during a meteorological high tide (storm surge), which would add an estimated 15 feet to the run-up values calculated by Houston and Garcia (1978). Thus, with a worst case scenario, the estimated tsunami run-up for the 100-year and 500-year would be approximately 25 and 40 feet, respectively.

Houston and Garcia's (1978) study did not evaluate the tsunami run-up potential generated from local seismic events or local submarine landslides. It is difficult to model the tsunami run-up magnitudes based on local events; however, it is thought that local events can generate tsunamis of equal magnitudes as far-field tsunami sources (Kilbourne and Mualchin 1980).

The project site is located at elevations (el) ranging from approximately el. +20 feet along Warden Lake in the southwest portion of the property to approximately el. +541 feet MSL in the northwestern portion of the site. The County of San Luis Obispo has prepared web-based tsunami inundation maps (http://www.sloplanning-maps.org/ed.asp?bhcp=1) that show areas on the property that may be vulnerable to inundation from tsunamis below about el. +60 feet MSL. Areas vulnerable to inundation are generally in the vicinity of Warden Lake and outside the

limits of the proposed project. Based on estimated tsunami run-up elevations shown on the County website, tsunami run-ups should not be considered a potential hazard to the project.

5.11 HYDROCOLLAPSE POTENTIAL

Hydrocollapse refers to the potential for a soil to consolidate or collapse due to wetting. The site is predominantly underlain by generally stiff fine-grained materials and generally medium dense sandy materials. These materials are not considered susceptible to hydrocollapse. Near-surface expansive clay and disturbed agricultural soil may have a potential to collapse due to wetting; however, these materials are likely to be removed during grading and be replaced with properly compacted soil having a low potential for hydrocollapse. Therefore, it is our opinion that there is a low potential for this hazard to impact the project.

5.12 RADON GASES

Radon gases are generally associated with Mesozoic granitic rocks and derivative Tertiary sedimentary rocks, and Tertiary marine sedimentary rocks. Radon hazards are generally related to an accumulation of radon gases within homes and housing structures. The San Luis Obispo County Safety Element (1999) has identified these geologic formations as having high equivalent uranium (eU) concentrations. These formations have not been mapped or encountered within the project site. We do not anticipate components of the project will be planned for areas potentially containing rocks with high eU concentrations. Therefore, it is our opinion that there is a low potential for this hazard to impact the project.

5.13 SURFACE PERMEABILITY

We understand proposed sprayfields will dispose of up to 842 acre-feet of treated effluent over approximately 175 acres annually by means of evaporation and percolation. As noted in section 5.8 of this report, highly expansive soils mapped within the limits of the project extent belong to the Cropley series. These soils are characterized as having slow to very slow permeability, with reported values ranging from approximately 4.2×10^{-5} to 1.4×10^{-5} cm/s (Ernstrom, 1984). After swelling, water infiltration is typically low and surface water is more likely to runoff or pond. As a measure against excessive runoff, Ernstrom (1984) recommends controlled sprinkler or drip methods of irrigation for the Cropley clay.

Based on our subsurface exploration, we anticipate predominantly clayey alluvium (Qal_2) and residual soils of the Cropley series underlie the northern and eastern portions of the project extent. Samples of fat clay (CH) recovered from the Qal_2 unit had permeabilities ranging from approximately $2x10^{-8}$ to $3x10^{-9}$ cm/s. Relatively permeable dune sand deposits (Qs) and predominantly sandy alluvial deposits (Qal_1) underlie the southern and western portions of the project extent. Samples of silty sand (SM) recovered from the Qs unit and Qal_1 unit had permeabilities of approximately $1x10^{-3}$ to $9x10^{-5}$ cm/s, respectively. Our interpreted contact between relatively impermeable surficial soils (Qal_2) and relatively permeable surficial soils (Qs unit and Qal_1 unit) is shown on Plate 8.

Mitigation of relatively impermeable soils relative to sprayfield operation may consist of periodic scarification and aeration of soils to increase pore spaces within the soil fabric, or temporary shutdown/control of sprayfield discharge to allow prolonged infiltration of effluent.

6. CONCLUSIONS AND RECOMMENDATIONS

We prepared the conclusions and recommendations for this report based on our preliminary geotechnical evaluation of the site conditions and a review of available geotechnical information for other projects located near the project site.

6.1 SUMMARY OF FINDINGS

- The generally flat southern and eastern portions of the site are underlain by alluvial and residual soils consisting of generally stiff fine-grained material and generally medium dense sandy material. Dune sand deposits, and Franciscan metavolcanics and mélange are exposed on hillsides within the site and were encountered at the surface or at generally shallow depths below alluvium and/or colluvium. Alluvium is mapped within the generally flat portions of the site. Groundwater was encountered at a depth of approximately 27 feet below the existing ground surface in B-3. Surface and shallow groundwater likely are present in the vicinity of Warden Lake in the southwest corner of the property.
- Geologic hazards relating to fault rupture, deep-seated landsliding, subsidence, hydrocollapse, tsunami inundation, naturally occurring asbestos, and radon gases are unlikely to impact the project.
- The site is located within a seismically active area, and could be impacted by seismic hazards related to liquefaction and seismic settlement. The site has been subjected to strong ground motions in response to historical earthquakes that have occurred in relatively close proximity to the site. The design of the facility should consider the potential for the site to be subjected to strong ground motion in response to nearby or regional earthquakes. The soil encountered by our explorations is predominantly fine-grained material underlain by Franciscan formational materials that would not be considered susceptible to liquefaction. The loose to medium dense sandy material potentially susceptible to seismic settlement encountered in B-4, B-5, B-101 and B-102 are generally shallow (less than 2 to 3 feet), unsaturated, or underlying proposed sprayfield areas. We anticipate soils susceptible to seismic settlement within the limits of storage/treatment ponds and structures will be removed during grading and construction.
- We expect that typical 1- to 2-story structures, below grade structures, and moderately loaded structures can be supported on shallow foundations supported on compacted fill.
- The design of structure foundations, concrete flatwork, and pavements should be designed with consideration for expansive soil. Expansive soil conditions are typically mitigated by removal and replacement with select non-expansive fill, increasing the

amount of steel reinforcement in foundations and slabs, deepening footings, and/or placing mats of non-expansive soil below structures or pavements.

- Sprayfield design will need to consider the generally slow to very slow permeability of clayey alluvium and residual soil underlying the northern and eastern portions of the project extent. Soils underlying the southern and western portions of the project extent are relatively permeable and generally better suited for percolation of treated wastewater effluent. Our interpreted contact between relatively impermeable surficial soils (Qal_2) and relatively permeable surficial soils (Qs unit and Qal_1 unit) is shown on Plate 8.

6.2 PRELIMINARY SEISMIC DATA

As discussed in Section 4.1 and 5.2 of this report, the design earthquake for this project is estimated to be a M6.7 event with a corresponding peak ground acceleration of approximately 0.42g. The Los Osos fault is the controlling fault for the site, and is mapped approximately 2,000 feet south of the site. The Los Osos fault is classified as a type “B” seismic source by the USGS (Cao et al., 2003). We recommend that the following values be used for zone-based seismic hazard analyses.

Table 1. Parameters for Use in Building Code-Based Seismic Design

California Building Code	Seismic Parameter	Value
Site Coordinates	Latitude, degrees	35.312183
	Longitude, degrees	-120.778203
Section 1613.5.1 Figure 1613.5	Ss , Seismic Factor, Site Class B at 0.2 sec	1.421g
	S_1, Seismic Factor, Site Class B at 1 sec	0.530g
	Site Class	S_D, Stiff soil
Section 1613.5.3 Table 1613.5.3(1)	Fa, Site Coefficient for Site Class D	1.0
Section 1613.5.3 Table 1613.5.3(2)	Fv, Site Coefficient for Site Class D	1.5
Section 1614A	S_{MS}, MCE Spectral Response Acceleration Parameter for Site Class D at 0.2 sec.	1.421g
	S_{M1}, MCE Spectral Response Acceleration Parameter for Site Class D at 1.0 sec.	0.530g
	$S_{DS} = 2/3\ S_{MS}$,	0.947g
	$S_{D1} = 2/3\ S_{M1}$	0.530g

Based on the seismic design parameters calculated by the USGS Hazard Calculator, and per 2007 CBC Section 1613A.5.6, structures of Occupancy Category I, II, III and IV (defined in 2007 CBC Table 1604.5) should be designed according to Seismic Design Category “D”.

6.3 FOUNDATION DESIGN CONSIDERATIONS

Typical 1- to 2-story and moderately loaded structures can likely be supported on shallow foundations bearing in compacted fill. Relatively large or heavy structures located within the south central portion of the site may need to consider total and differential settlement of underlying soil units that may warrant deep foundations bearing on generally shallow bedrock.

Allowable bearing pressures of 2,500 to 3,500 pounds per square foot (psf) can be used for preliminary foundation design. Foundations and floor slabs should be reinforced with consideration for highly expansive soil conditions. Additional exploration testing and analysis will be required as part of the design phase of the project.

6.4 EXPANSIVE SOILS

Tested samples of fat clay (CH) encountered in the Qal_2 unit had expansion index values of 93 and 105. According to the CBC (2007), the soil tested is classified as expansive. It is our opinion the predominantly clayey alluvial soils encountered at the site have a high potential for expansion. Removal or treatment of potentially expansive soils within the limits of proposed structures will need to be considered in foundation design.

6.5 GRADED SLOPES

Graded cut and fill slopes less than 15 feet in height can likely be designed to a slope inclination of 2h:1v or flatter. Retaining structures or reinforced slopes can be provided to allow for steeper slopes, if needed.

6.6 DRAINAGE AND EROSION 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. Irrigated planters and medians should be equipped with drainage or other provisions to help prevent water from infiltrating expansive subgrade soil below structures, pavements, or flatwork. Landscaping and maintenance of slopes should be provided to assist vegetation to be established on slopes, and reduce the potential for erosion. 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.

6.7 EFFLUENT PERCOLATION

Proposed sprayfields will be designed to dispose of wastewater effluent over approximately 175 acres by means of evapotranspiration and percolation. Based on our laboratory testing of surficial alluvium and dune sand deposits, we anticipate predominantly slow percolation rates for soils underlying proposed sprayfield areas, particularly expansive soils within the northern and eastern portions of the project extent. As discussed in section 5.8 of this report, the Cropley soil series is characterized as having slow to very slow permeability and high

shrink-swell potential (Ernstrom, 1984). Expansive soils are likely to swell and become relatively impervious, thereby increasing runoff during prolonged rainfall or irrigation. Mitigation of relatively impermeable soils relative to sprayfield operation may consist of periodic scarification and aeration of soils to increase pore spaces within the soil fabric, or temporary shutdown/control of sprayfield discharge to allow prolonged infiltration of effluent. Additional testing and analysis will be required as part of the design phase of the project.

6.8 CONSTRUCTION CONSIDERATIONS

6.8.1 Site Preparation and Grading

Prior to grading, the site should be cleared and grubbed. Grading for the improvements is likely to consist of excavation of near-surface soils for construction of treatment/storage ponds and over-excavation for building subgrades. Near-surface soils are potentially expansive or may be susceptible to seismic settlement. Site preparation will likely consist of removing the existing soil from areas to receive fill to a depth of about 3 to 5 feet below the existing ground surface. Prior to placing compacted fill, the subgrade in areas to receive fill is typically prepared by scarifying the soil to a depth of approximately 9 inches, moisture conditioning the material, and compacting the subgrade in-place to a specified compaction. Soft or yielding subgrade conditions should be stabilized by placing a mat of dry, compacted fill over the undisturbed subgrade.

6.8.2 Use of On-site Soil

Fill material should be free of organics, oversized rocks, pavements, and other deleterious materials. The clayey on-site materials encountered within the northern and eastern portions of the project limits may not be suitable for fill in building and pavement areas due to potentially expansive soils but may be suitable for use as general fill. If clayey materials are used for building and pavement areas, the overlying improvements will need to be designed with consideration for highly expansive soil conditions. More suitable sandy materials were encountered in the southern and western portions of the project limits. The on-site granular soils likely are not suitable for select material such as backfill for pipelines and base for roadways. On-site soil excavated from below the groundwater table (if encountered) will likely not be suitable for compacted fill as excavated. Aeration or treatment of excavated soils may be needed to reduce the water content of the excavated material and make the material suitable for compaction. The quality of and need for fill material should be considered in the design-level geotechnical study.

6.8.3 Dewatering

Groundwater was encountered at approximately 27 feet below the existing ground surface in B-3. We expect that excavations within the generally flat portions of the site will be above the anticipated depth of groundwater (approximately 27 feet) and would not require dewatering. However, groundwater levels will vary depending on the time of construction, and should be considered in the excavation plans for the project.

6.8.4 Excavation

The existing alluvial and residual soils encountered within the limits of proposed ponds and structures consisted of loose to medium dense sandy soils and medium stiff to hard fine-grained soils that extended to depths ranging from approximately 14 to 21½ feet. These types of soils can likely be excavated using conventional earth-moving equipment and ripping. Excavation of underlying Franciscan metavolcanic rocks or boulders within the Franciscan mélange (mapped on slopes within the sprayfield limits) may require the use of a hoe-ram or similar type of equipment to break hard rocks.

7. CONTINUATION OF SERVICES

The geotechnical considerations in this report are intended for preliminary planning and estimating costs associated with developing the site. The recommendations are preliminary based on our limited geotechnical study. A more comprehensive design-level geotechnical investigation should be completed in support of the final design of the proposed improvements.

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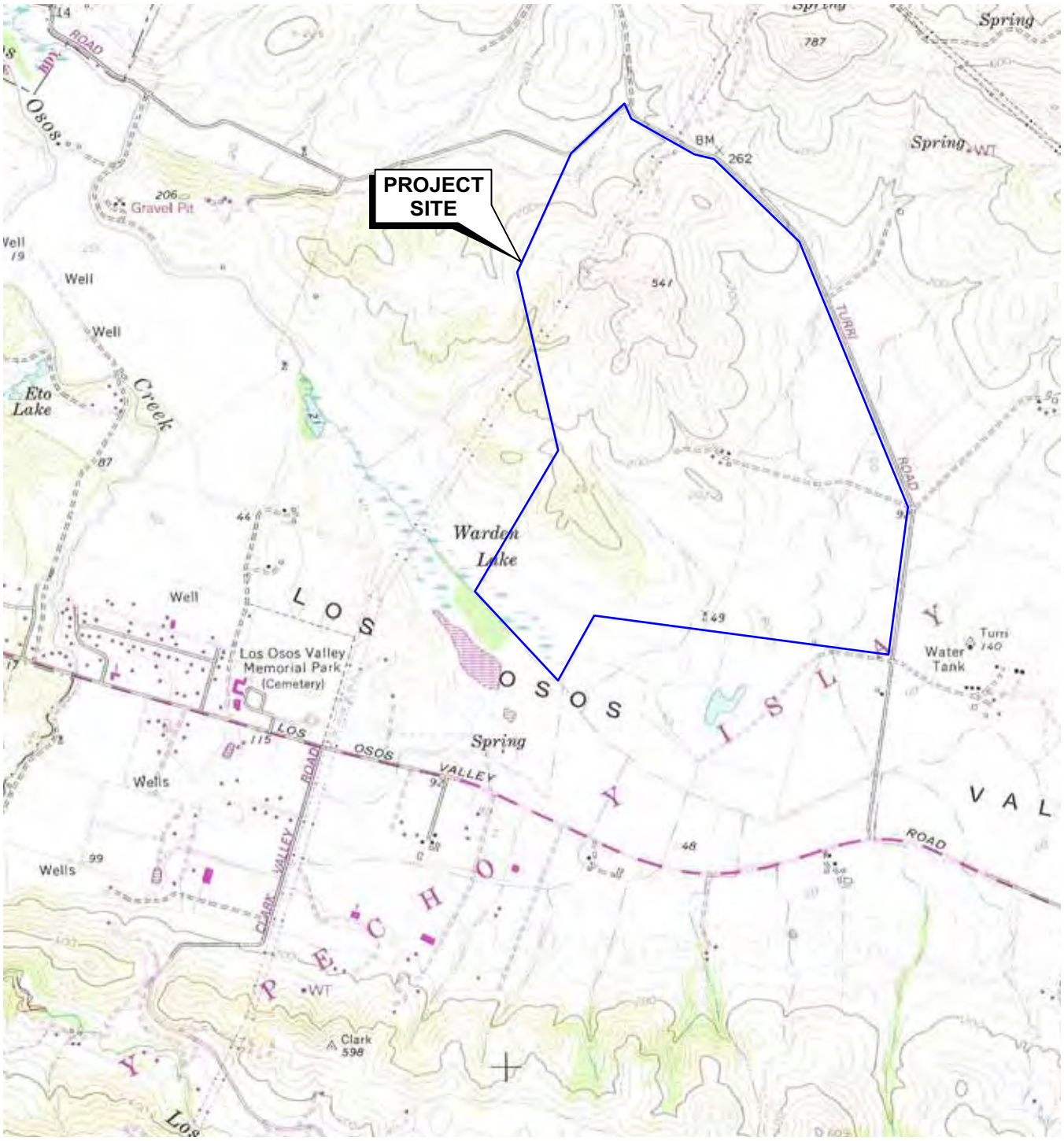
End of Text

PLATES



BASE MAP SOURCE: USGS Morro Bay South 7.5' Quadrangle, revised 1994.

NORTH

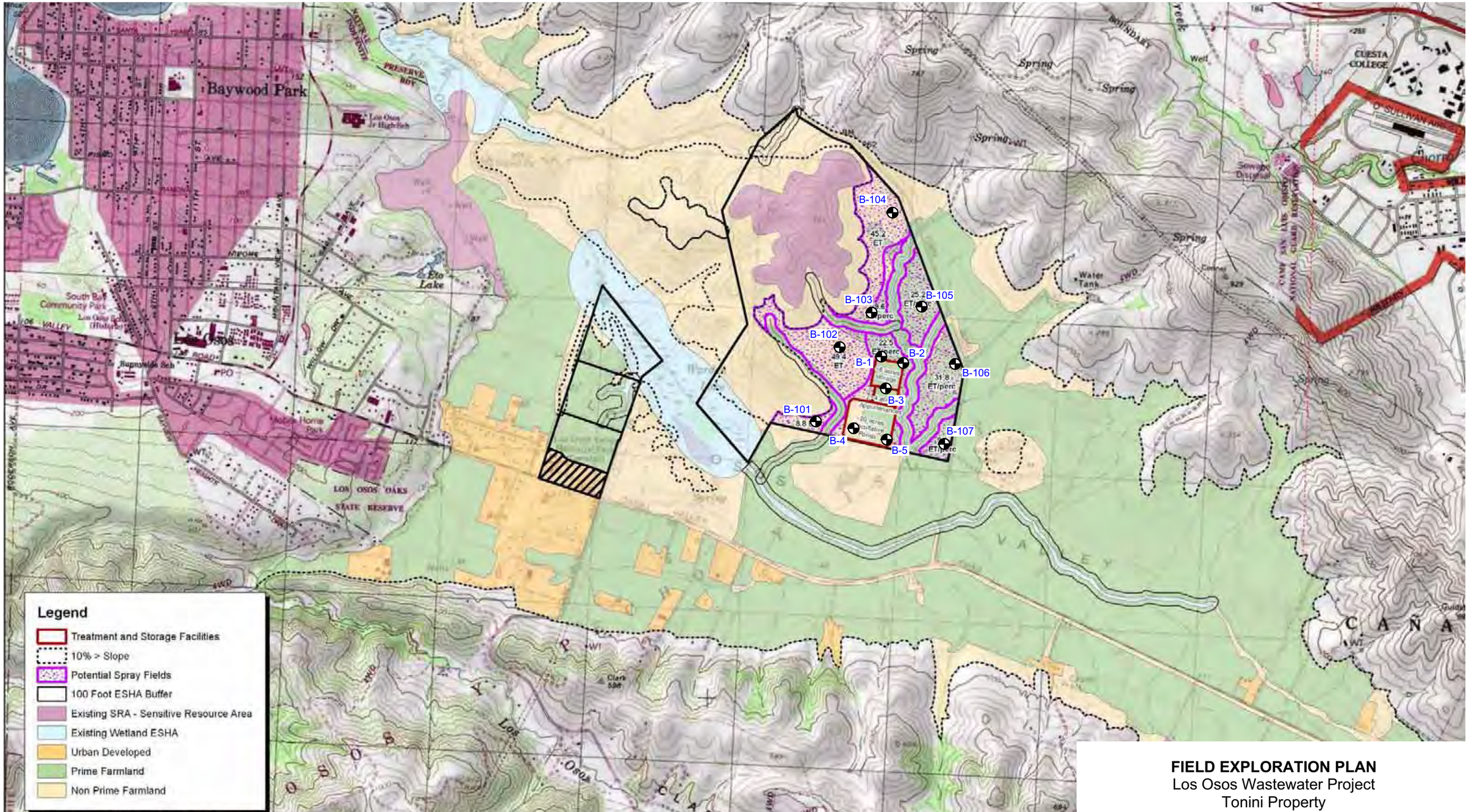
0 1000 2000

FEET

VICINITY MAP

Los Osos Wastewater Project
Tonini Property
San Luis Obispo County, California

PLATE 1



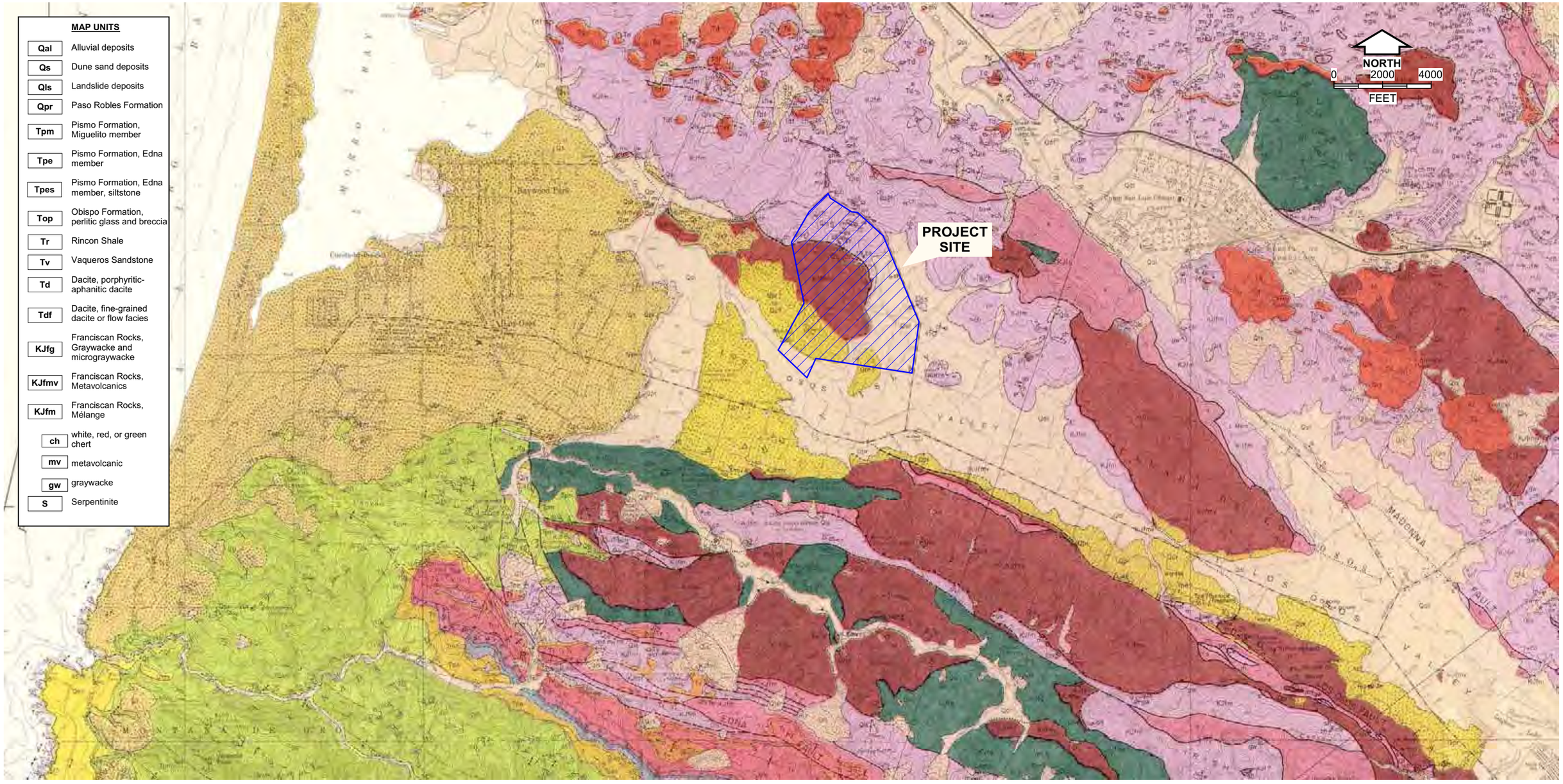
BASE: Exhibit 4, Michael Brandman Associates (10/08)

Exploration (Approximate)

Boring Location and Number
B-103

NORTH
0 1000 2000
FEET

FIELD EXPLORATION PLAN
Los Osos Wastewater Project
Tonini Property
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

Breccia

30 Strike and dip of flow banding

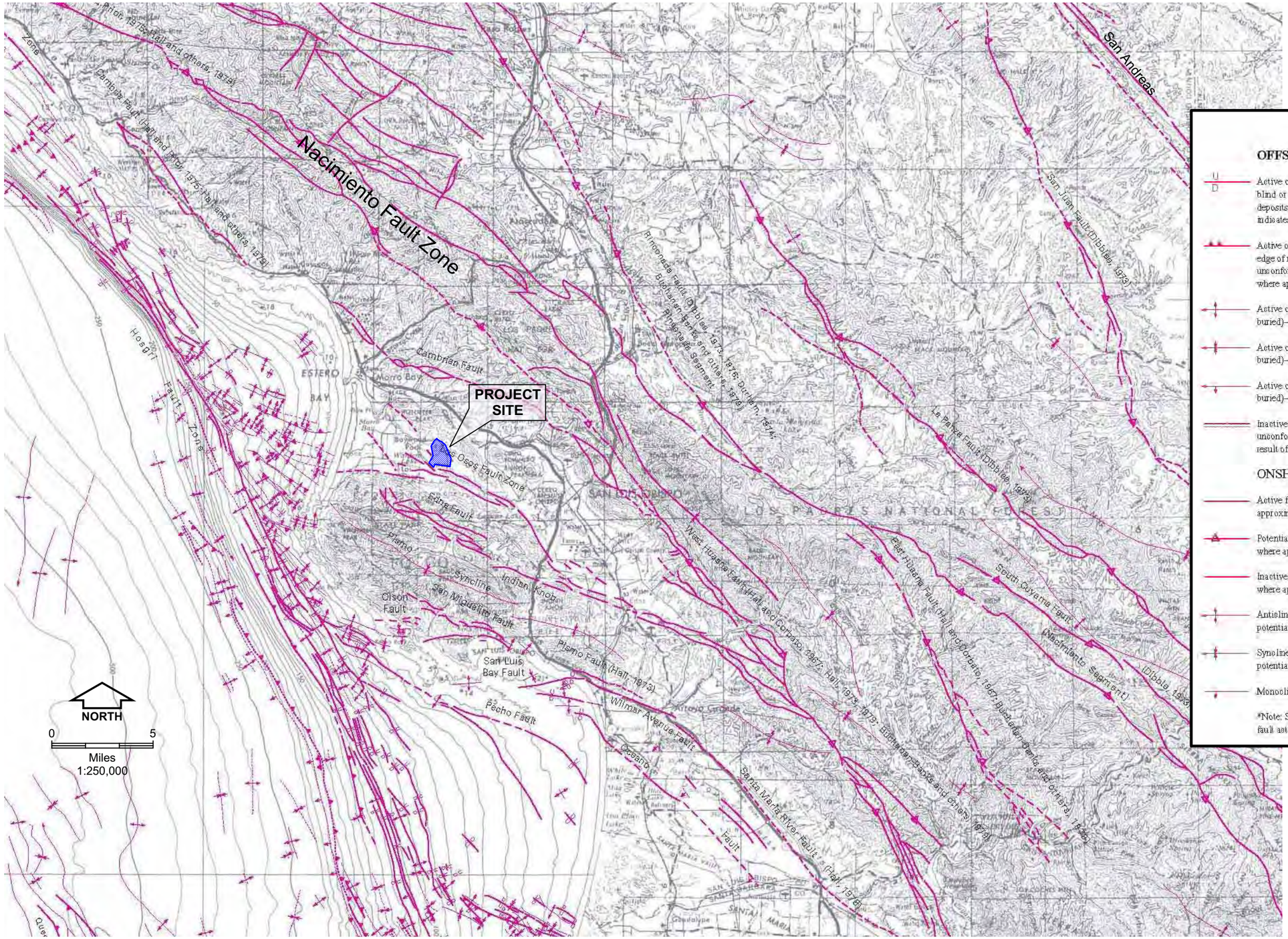
x6193 Megafossil locality - U.C.L.A. locality number

Vollmer Ranch name/property owner

REGIONAL GEOLOGIC MAP
Los Osos Wastewater Project
Tonini Property
San Luis Obispo County, California

PLATE 3

20043394.00\13394.00\geo.ds(1-3)



EXPLANATION

OFFSHORE REGION*

U/D — Active or potentially active high angle fault (sea-floor projection of fault tip where blind or buried)—Deforms early/late Pliocene (2.8–3.4 Ma) unconformity or younger deposits or surfaces; U/D (Up/Down) indicates relative sense of displacement, bar indicates dip direction; dashed where approximately located

Active or potentially active low angle fault (sea-floor projection of fault tip or leading edge of ramp where blind or buried)—Deforms early/late Pliocene (2.8–3.4 Ma) unconformity or younger deposits or surfaces; teeth indicate dip direction; dashed where approximately locate

Active or potentially active anticline axial trace (sea-floor projection where buried)—Arrow indicates direction of plunge; dashed where approximately located

Active or potentially active syncline axial trace (sea-floor projection where buried)—Arrow indicates direction of plunge; dashed where approximately located

Active or potentially active monocline axial trace (sea-floor projection where buried)—Arrow indicates direction of plunge; dashed where approximately located

Inactive fault (bold) or fold (light)—Does not deform early/late Pliocene (2.8–3.4 Ma) unconformity; where this unconformity and (or) younger sediments are absent as a result of erosion, structures are mapped as potentially active

ONSHORE REGION*

Active fault trace—Deforms deposits or surfaces ≤500,000 ka; dashed where approximately located

Potentially active fault trace—May deform deposits or surfaces ≤500,000 ka; dashed where approximately located

Inactive active fault trace—Does not deform deposits or surfaces ≤500,000 ka; dashed where approximately located

Anticline axial trace—Arrow indicates direction of plunge; solid where active or potentially active; dotted where inactive

Syncline axial trace—Arrow indicates direction of plunge; solid where active or potentially active; dotted where inactive

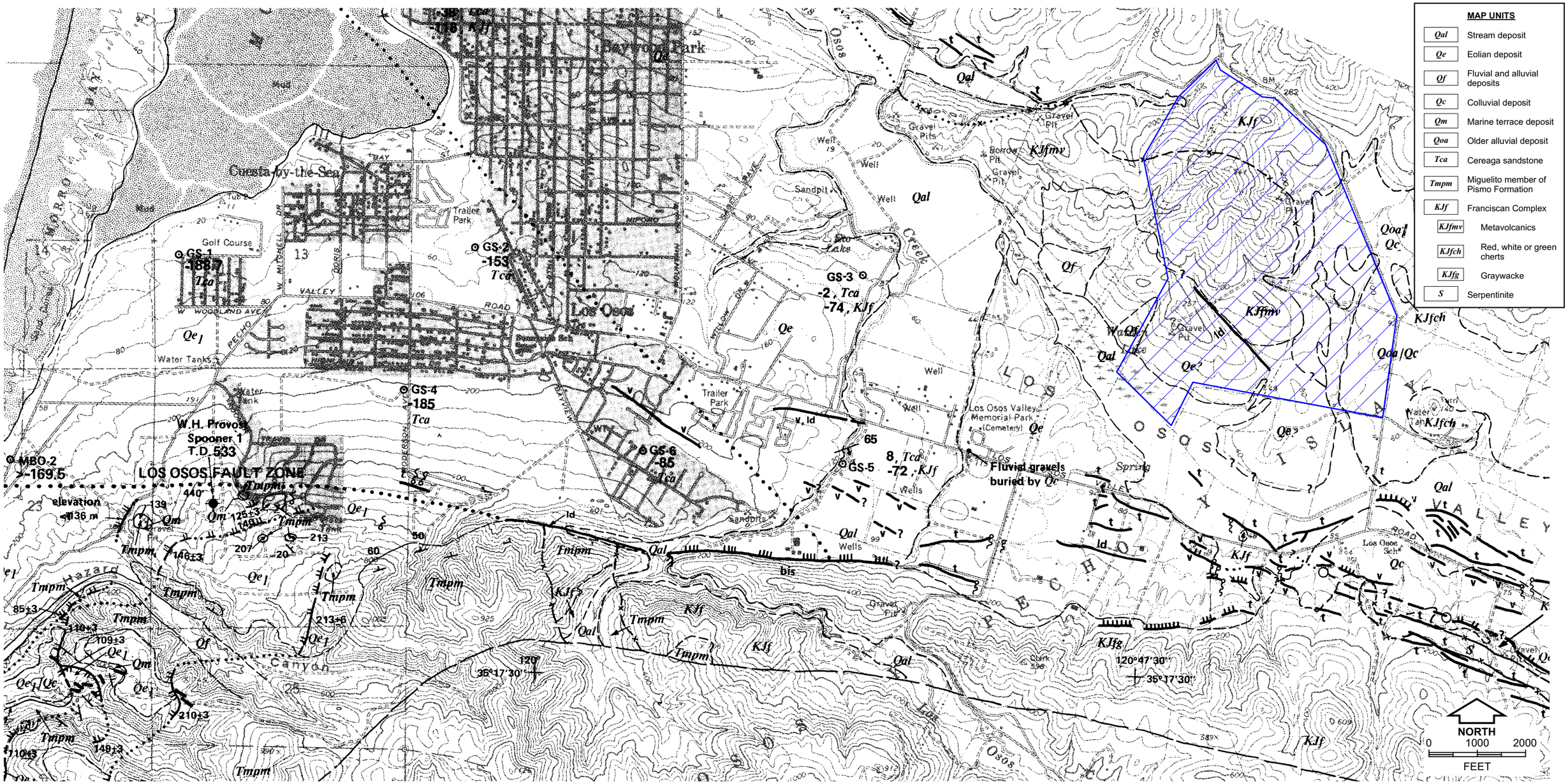
Monocline axial trace—Solid where active or potentially active; dotted where inactive

*Note: See text for discussion of mapping techniques and age criteria used to identify fault activity.

REGIONAL FAULT MAP
Los Osos Wastewater Project
Tonini Property
San Luis Obispo County, California

PLATE 4

BASE MAP: Lettis et al. (2004), Faults and Folds in Onshore and Offsore Regions of South-Central California.



BASE MAP SOURCE: Quaternary Geologic Map of Los Osos Fault Zone, Los Osos Fault Zone, San Luis Obispo County, CA, Plate 5 (Lettis and Hall, 1994).

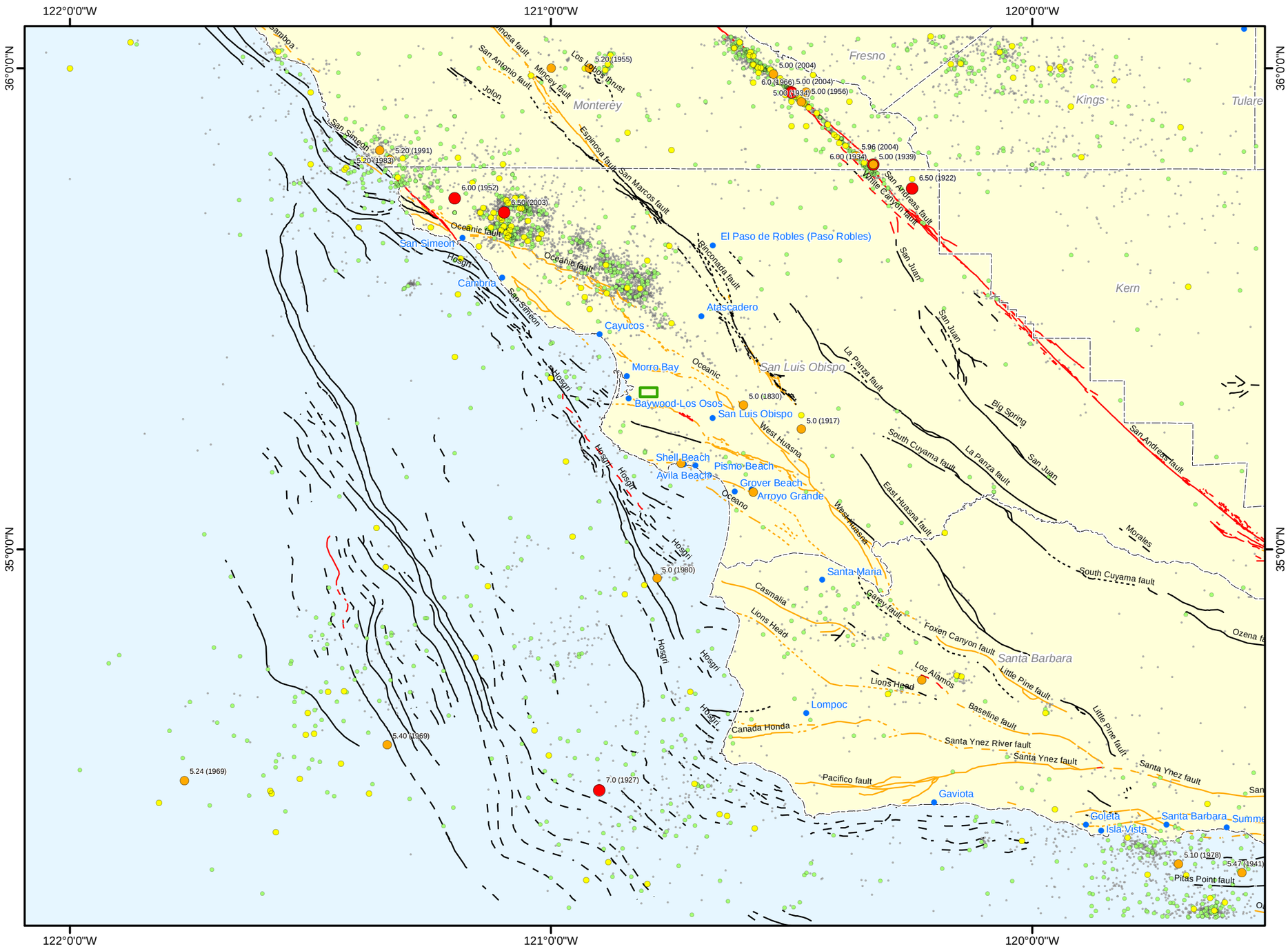
LEGEND

- Fault - Dashed where approximately located; dotted where concealed; U = up/D = down indicates relative sense of displacement; small arrow and number indicate strike and dip of fault exposed in outcrop
- Aerial photo lineament - Or fault-related feature; dashed where less distinct; queried where uncertain; hachures indicate topographic scarp and show direction; ld = linear drainage, tc = tonal contrast, v = vegetation lineament, dd = deflected drainage, bis = break in slope, s = saddle, shb = side hill bench
- Los Osos fault of Hall (1973) - Dashed where approximately located; dotted where concealed
- Edna fault
- Indian Knob fault
- Other faults
- Shoreline angle - Solid where well constrained; double dot dash where concealed; dotted where eroded; altitude shown in meters
- Contact - Dashed where approximately located or inferred; queried where uncertain
- Strike and dip of bedding
- Syncline - Showing trace of axial surfaces and direction of plunge
- Anticline - Showing trace of axial surface and direction of plunge
- Borehole - GS-1 - U.S. Geological Survey (unpublished data, G. Yates, Water Resource Division); MBO-2 - California Department of Water Resources (1972); altitude of subsurface of formations shown in meters
- Borehole - Completed during this study
- Exploratory oil well - Producer, name of well, and depth (meters) are indicated
- Closed depression
- Spring
- Trench location
- Bedrock exposure
- Limit of mapping

LOS OSOS FAULT ZONE AND LINEAMENTS

Los Osos Wastewater Project
Tonini Property
San Luis Obispo County, California

PLATE 5



Legend

Project Vicinity

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 2008, <www.ncedc.org/anss/> (downloaded March 2008)
b) "Seismotectonic framework, coastal central California", Seismotectonics of the Central California Coast Range, Special Paper 292, Geological Society of America, 1994.

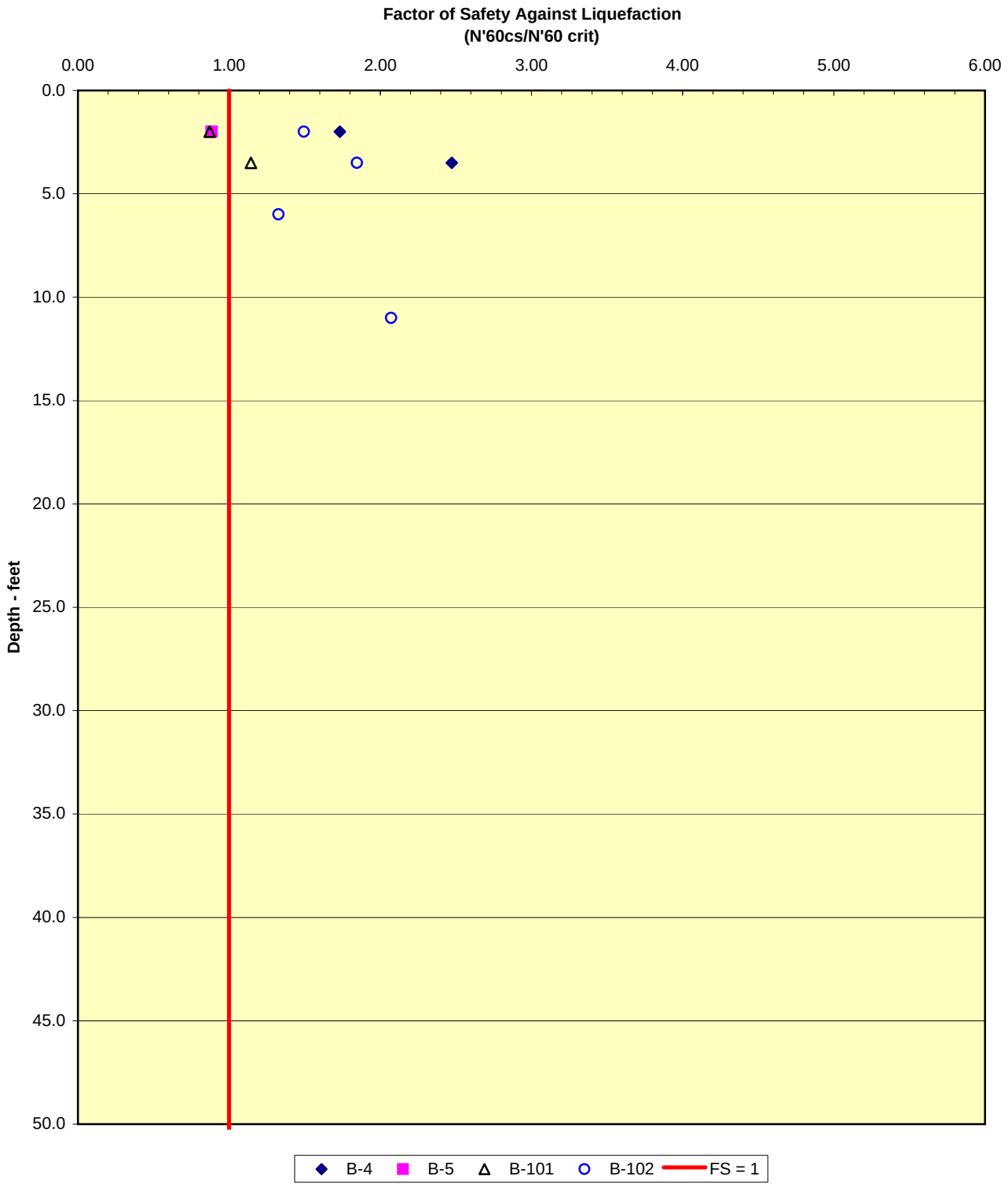
2) Faults:
a) Bryant, 2005
b) Jennings, 1994

N W E S

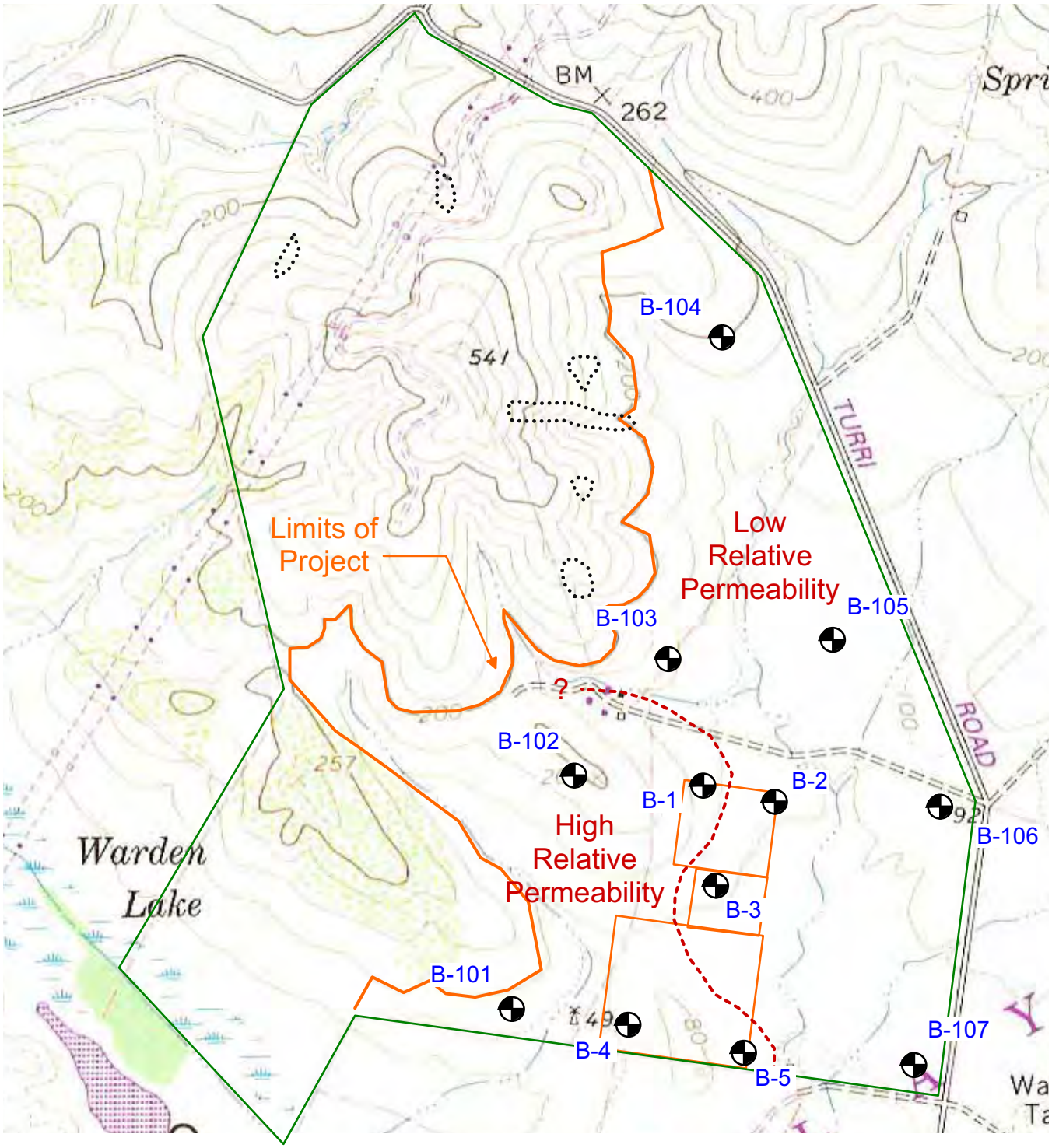
0 7.5 15 30 Miles

HISTORICAL SEISMICITY MAP
Los Osos Wastewater Project
Tonini Property
San Luis Obispo County, California

N:\Projects\3014_SLOcounty\3014-031_LosOsosWWP_Tonini Property\Outputs\Working\mxd\Plate6-Earthquakes.mxd, 11/13/08, vengis



SUMMARY OF LIQUEFACTION POTENTIAL
Los Osos Wastewater Project
Tonini Property
San Luis Obispo County, California



BASE MAP SOURCE: USGS Morro Bay South 7.5' Quadrangle, revised 1994.

LEGEND

Features indicative of potential landsliding or slope instability (landslides, debris flows, creep, and erosion)

Interpreted contact between surficial material with relatively high permeability (Qal_1 and Qs) and surficial material with relatively low permeability (Qal_2)

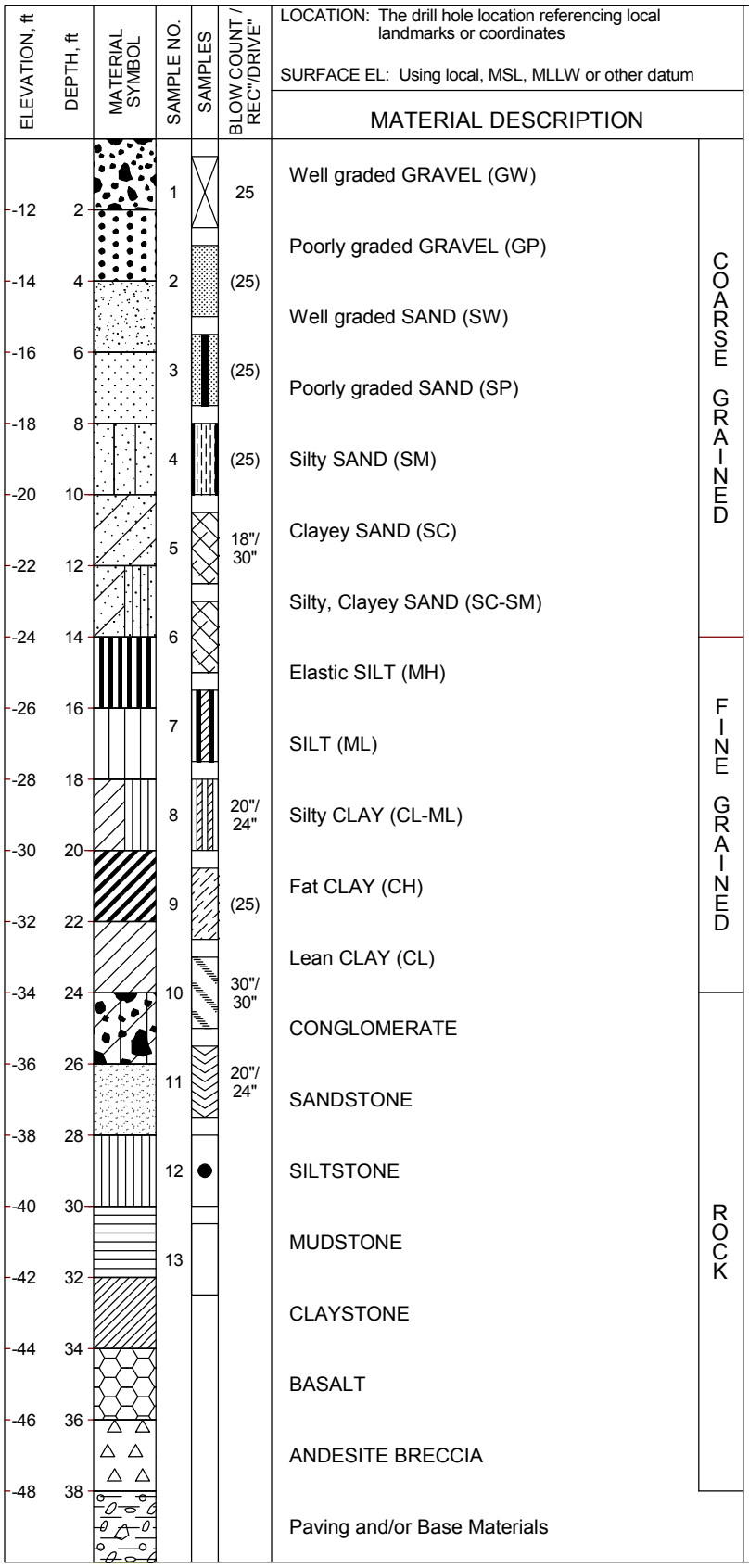
NORTH

0 500 1000
FEET

SOIL CONSTRAINTS MAP
Los Osos Wastewater Project
Tonini Property
San Luis Obispo County, California

PLATE 8

APPENDIX A



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

WEATHERING

FRESH	The rock shows no discoloration, loss of strength, or any other effect due to weathering.
SLIGHTLY WEATHERED	Discoloration or oxidation is limited to surface, or short distance from fractures. Body of rock not weakened with exceptions, such as siltstones and shales.
MODERATELY WEATHERED	Discoloration or oxidation extends from fractures usually throughout. Body of rock is slightly weakened.
INTENSELY WEATHERED	Discoloration or oxidation throughout. Usually can be broken with moderate to heavy manual pressure or by light hammer blow.
DECOMPOSED	The rock is discolored and is entirely changed to soil, but the original fabric of the rock is preserved. The properties of the soil depend upon the composition and structure of the parent rock.

FRACTURE DENSITY

UNFRACTURED	No fractures.
VERY SLIGHTLY FRACTURED	Core recovery mostly in lengths greater than 3 feet.
SLIGHTLY FRACTURED	Core recovery mostly in lengths from 1 to 3 feet with scattered lengths less than 1 foot or greater than 3 feet.
MODERATELY FRACTURED	Core recovery mostly 0.3 to 1.0 foot lengths with most lengths about 0.6 foot.
INTENSELY FRACTURED	Lengths average from 0.1 to 0.3 foot with scattered fragmented intervals. Core recovered mostly in lengths less than 0.3 foot.
VERY INTENSELY FRACTURED	Core recovered mostly as chips and fragments with few scattered short core lengths.

BEDDING THICKNESS

MASSIVE	Greater than 10 feet
VERY THICKLY BEDDED	3 to 10 feet
THICKLY BEDDED	1 to 3 feet
MODERATELY BEDDED	0.3 to 1 feet
THINLY	0.1 to 0.3 feet
VERY THINLY	0.03 to 0.1 feet
LAMINATED	Less than 0.03 feet

ROCK HARDNESS

VERY HARD	The rock cannot be scratched with a knife blade.
HARD	Can be scratched with knife with difficulty. Heavy hammer blow required to break specimen.
MODERATELY HARD	Can be scratched with a knife with light to moderate pressure. Core or fragment breaks with moderate hammer blow.
MODERATELY SOFT	Can be grooved 1/16" deep with knife with moderate to heavy pressure. Core or fragment breaks with light hammer blow or heavy manual pressure.
SOFT	Can be gouged easily by knife. Can be scratched with fingernail. Breaks with light to moderate manual pressure.
VERY SOFT	Can be readily indented, grooved, or gouged with fingernail, or carved with knife. Breaks with light manual pressure.

BEDDING/JOINTING

FRACTURES/FOOT: The number of breaks in the core per foot including drilling-induced breaks, breaks from hammering on the core barrel to remove the core, and breaks from naturally occurring planes of weakness in the rock. It does not include intentional breaks in the core made by the logger to fit the core into the box.
Weak zones such as shear zones with many breaks are defined as contributing +50 fractures per foot to the interval.

NUMBER OF SETS: Refers to the number of fracture/joint sets including bedding.

ORIENTATION: Sketches in plan (box) view after realignment of core or alignment of bedding dips. The degree of inclination indicated numerically represents the actual fracture/jointing dip measured.

FRACTURE/JOINTING ROUGHNESS

STEPPED ROUGH: There are near vertical steps and ridges on the fracture surface.
Large annular asperities, some ridge and high-side angle steps are evident.
SLIGHTLY ROUGH: Asperities are clearly visible and the fracture surface feels abrasive.
SMOOTH: Essentially smooth to touch, may be slickensided.

COMPRESSION-WAVE VELOCITY:

Solid line indicates average values.

MISCELLANEOUS:

Drilling rate varies with pressure on bit.
Core Recovery is the ratio of the length of core recovered in each run to the total length of the core run, in percent.
RQD is the ratio of the sum of the lengths of rock core pieces (4 inches or longer).
Color guide based on Munsell Color System.

TERMS AND DEFINITIONS USED FOR ROCK

LOCATION: Approximately 825' west of creek; approximately 400' south of driveway
N 35 W 121 WGS84

SURFACE EL: 108 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 (Qal1)**							
		1	(16)	Sandy SILT (ML): (Disturbed Agricultural Soil) stiff, brown, dry	117	112	5				p 4.5+
-106	2				130	110	18				
		2	77	Lean CLAY (CL): stiff to hard, brown, moist			11	20			
				Silty SAND (SM): very dense, reddish brown, moist							
-104	4										
		3	(57)	- dense, interbedded with light brown Clayey SAND (SC)	124	111	11				
-102	6										
-100	8										
-98	10	4	26	- medium dense							
-96	12										
-94	14										
		5	(47)	- dense	126	107	18	15			
-92	16										
-90	18										
-88	20	6	42								
-86	22										
-84	24										
-82	26										
-80	28										
-78	30										
-76	32										
-74	34										
-72	36										
-70	38										

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: Cuttings
DRILLING DATE: October 30, 2008

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: 140-lb Automatic Trip
DRILLED BY: JET Drilling
LOGGED BY: G D Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. B-1

Los Osos WWP, Tonini Property
San Luis Obispo County, California

PLATE A-3

LOCATION: Approximately 375' west of creek; approximately 350' south of driveway
N 35 W 121 WGS84

SURFACE EL: 81 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 (Qal2)**							
80			1		(15)	Fat CLAY (CH): (Disturbed Agricultural Soil) very dark brown, moist	125	106	19		77	62	p 4.5+
	2					Fat CLAY (CH): stiff to hard, very dark brown, moist							
78			2		13								
	4					**Franciscan Metavolcanics (KJfmv)**							
76			3		(12)	"Lean CLAY (CL)": (Residual Soil) medium stiff, olive brown, moist, heterogeneous, approximately 5-10% decomposed angular volcanic clasts	116	98	18				
	6												
74													
	8												
72						"Lean CLAY with gravel (CL)": (Residual Soil) very stiff, olive brown, moist, decomposed angular volcanic clasts with oxidation staining							
	10		4		62								
70													
	12												
68													
	14												
66			5		(50/9")	Greenstone (Rx): intensely weathered, very intensely fractured, hard, very dark brown to dark green, moist, oxidation staining							
	16												
64													
	18												
62													
	20		6		ref/5"								
60													
	22												
58													
	24												
56													
	26												
54													
	28												
52													
	30												
50													
	32												
48													
	34												
46													
	36												
44													
	38												
42													

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: 20.5 ft
DEPTH TO WATER: Not Encountered
BACKFILLED WITH: Cuttings
DRILLING DATE: October 30, 2008

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: 140-lb Automatic Trip
DRILLED BY: JET Drilling
LOGGED BY: G D Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. B-2

Los Osos WWP, Tonini Property
San Luis Obispo County, California

PLATE A-4

LOCATION: Approximately 520' west of creek; approximately 1000' south of driveway N 35 W 121 WGS84

SURFACE EL: 79 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 (Qal2)**							
78		1	(18)	Fat CLAY with sand (CH): (Disturbed Agricultural Soil)	130	115	13				p 4.5+
	2			stiff to hard, very dark gray, moist							
76		2	11				17				
	4			Fat CLAY (CH): stiff, reddish brown, moist, black mottling							
74		3	(22)		130	110	19		55	41	
	6										
72											
	8										
70											
	10	4	19	- stiff to hard							p 4.5+
68											
	12										
66											
	14			**Franciscan Metavolcanics (KJfmv)**							
64		5	(44)	"Fat CLAY with gravel (CH)": (Residual Soil) very stiff, reddish brown to light brown, moist, abundant oxidation staining, angular volcanic clasts up to 3/4" diameter	121	100	21				
	16										
62											
	18										
60				Greenstone (Rx): weathered to Clayey GRAVEL with Sand (GC), decomposed, very intensely fractured, very soft, red brown to olive brown, moist							
	20	6	(50)								
58											
	22										
56											
	24										
54		7	11	- wet, approximately 3" seam of green Silty SAND (SM)							
	26										
52											
	28										
50											
	30	8	(50/3")								
48											
	32										
46											
	34										
44		9	50/9"	- very dark gray							
	36										
42											
	38										
40				Greenstone (Rx): moderately weathered, hard, red to							

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: 50.1 ft
DEPTH TO WATER: 27.0 ft
BACKFILLED WITH: Cuttings
DRILLING DATE: October 30, 2008

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: 140-lb Automatic Trip
DRILLED BY: JET Drilling
LOGGED BY: G D Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. B-3

Los Osos WWP, Tonini Property
San Luis Obispo County, California

PLATE A-5a

LOCATION: Approximately 520' west of creek; approximately 1000' south of driveway
N 35 W 121 WGS84

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
			10		(43)	dark grayish brown, moist to wet							
38	42												
36													
	44					Greenstone (Rx): weathered to Clayey GRAVEL with Sand (GC), decomposed, very intensely fractured, very soft, red to dark grayish brown, wet,							
34			11		ref/5"								
	46												
32													
	48												
30						Greenstone (Rx): intensely weathered, hard, dark olive gray, wet							
	50		12		(ref/2.5")								
28													
	52												
26													
	54												
24													
	56												
22													
	58												
20													
	60												
18													
	62												
16													
	64												
14													
	66												
12													
	68												
10													
	70												
8													
	72												
6													
	74												
4													
	76												
2													
	78												
0													

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: 50.1 ft
DEPTH TO WATER: 27.0 ft
BACKFILLED WITH: Cuttings
DRILLING DATE: October 30, 2008

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: 140-lb Automatic Trip
DRILLED BY: JET Drilling
LOGGED BY: G D Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. B-3

Los Osos WWP, Tonini Property
San Luis Obispo County, California

PLATE A-5b

LOCATION: Approximately 1200' west of creek; approximately 120' north of fence line
N 35 W 121 WGS84

SURFACE EL: 60 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 (Qal1)**							
		1	(18)	Silty SAND (SM): (Disturbed Agricultural Soil) medium dense, light brown, dry	118	112	5	32			
-58	2	2	15	- oxidation and black mottling							
-56	4										
		3	(24)	Lean CLAY (CL): very stiff, reddish brown, moist	122	96	27				p 3.8
-54	6										
-52	8										
-50	10	4	43								
				Clayey SAND (SC): dense, yellowish brown, moist, gradational contact with unit above			10	27			
-48	12										
-46	14										
		5	(29)	Poorly-graded SAND (SP): medium dense, light brown, moist							
-44	16			Lean CLAY (CL): very stiff to hard, reddish brown, moist							p 4.3
-42	18										
-40	20	6	23								
-38	22										
-36	24										
-34	26										
-32	28										
-30	30										
-28	32										
-26	34										
-24	36										
-22	38										

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: Cuttings
DRILLING DATE: October 30, 2008

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: 140-lb Automatic Trip
DRILLED BY: JET Drilling
LOGGED BY: G D Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. B-4

Los Osos WWP, Tonini Property
San Luis Obispo County, California

PLATE A-6

LOCATION: Approximately 400' west of creek; approximately 80' north of fence line
N 35 W 121 WGS84

SURFACE EL: 78 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 (Qal1)**							
		1	(10)	Silty SAND (SM): (Disturbed Agricultural Soil) loose, reddish brown, moist	108	104	4	16			
-76	2										
		2	15	Sandy CLAY (CL): stiff, light brown to reddish brown, moist, abundant oxidation mottling							
-74	4										
		3	(26)	- stiff to hard	132	113	16				p 4.5+
-72	6										p 4.0
-70	8										
-68	10	4	21								p 4.5+
				Franciscan Metavolcanics (KJfmv)							p 2.5
-66	12			"Lean CLAY with sand (CL)": (Residual Soil) stiff to hard, reddish brown, moist, black mottling, weathered volcanic clasts							
-64	14										
		5	(26)	**Franciscan Metavolcanics (KJfmv)** Greenstone (Rx): weathered to Clayey SAND (SC), decomposed, soft, pale brown to reddish brown, moist, approximately 5-10% black stringers, pockets of Sandy CLAY (CL)							
-62	16										
-60	18										
-58	20	6	29								
-56	22										
-54	24										
-52	26										
-50	28										
-48	30										
-46	32										
-44	34										
-42	36										
-40	38										

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: Cuttings
DRILLING DATE: October 30, 2008

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: 140-lb Automatic Trip
DRILLED BY: JET Drilling
LOGGED BY: G D Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. B-5

Los Osos WWP, Tonini Property
San Luis Obispo County, California

PLATE A-7

LOCATION: Approximately 300' west of drainage swale; approximately 80' north of fence line
N 35 W 121 WGS84

SURFACE EL: 72 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 (Qal1)							
		1	(9)	Silty SAND (SM): (Disturbed Agricultural Soil) dark reddish brown, moist	116	107	7	20			
-70	2	2	7	Silty SAND (SM): loose, dark reddish brown, moist, oxidation mottling							
-68	4			Lean CLAY with sand (CL): medium stiff, brown, moist							
-66	6	3	(29)	- very stiff, pale brown to reddish brown, oxidation mottling							
-64	8										
-62	10	4	19	Clayey SAND (SC): medium dense, pale brown to reddish brown, moist, black mottling							
-60	12										
-58	14										
-56	16										
-54	18										
-52	20										
-50	22										
-48	24										
-46	26										
-44	28										
-42	30										
-40	32										
-38	34										
-36	36										
-34	38										

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: 11.5 ft
DEPTH TO WATER: Not Encountered
BACKFILLED WITH: Cuttings
DRILLING DATE: October 30, 2008

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: 140-lb Automatic Trip
DRILLED BY: JET Drilling
LOGGED BY: G D Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. B-101

Los Osos WWP, Tonini Property
San Luis Obispo County, California

PLATE A-8

LOCATION: Approximately 1700' west of creek; approximately 900' south of barn
N 35 W 121 WGS84

SURFACE EL: 200 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
			1		(17)	**Dune Sand Deposits (Qs)** Silty SAND (SM): (Disturbed Agricultural Soil) light brown, moist	101	99	2	21			
198	2		2		12	Silty SAND (SM): medium dense, light brown to pale brown, dry							
196	4												
194	6		3		(17)	- reddish brown, moist							
192	8												
190	10		4		20								
188	12												
186	14												
184	16												
182	18												
180	20												
178	22												
176	24												
174	26												
172	28												
170	30												
168	32												
166	34												
164	36												
162	38												

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: 11.5 ft
DEPTH TO WATER: Not Encountered
BACKFILLED WITH: Cuttings
DRILLING DATE: October 30, 2008

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: 140-lb Automatic Trip
DRILLED BY: JET Drilling
LOGGED BY: G D Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. B-102

Los Osos WWP, Tonini Property
San Luis Obispo County, California

PLATE A-9

LOCATION: Approximately 10' east of fence line; approximately 400' north of driveway
N 35 W 121 WGS84

SURFACE EL: 127 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
126			1		(17)	**ALLUVIUM (Qal2)** Fat CLAY (CH): (Disturbed Agricultural Soil) very dark brown, moist	117	93	26		84	63	
	2		2		12	Fat CLAY (CH): stiff, very dark brown to brown, moist							
124													
	4												
122			3		(34)	**COLLUVIUM (Qcol)** Lean CLAY (CL): very stiff, olive brown, moist, non-homogeneous, fissured with oxidized shear planes							
	6												
120													
	8												
118						**Franciscan Metavolcanics (KJfmv)**							
	10		4		47	"Gravelly Lean CLAY (CL)": (Residual Soil) hard, olive brown, moist, moderately weathered angular volcanic clasts with oxidation staining							
116													
	12												
114													
	14												
112													
	16												
110													
	18												
108													
	20												
106													
	22												
104													
	24												
102													
	26												
100													
	28												
98													
	30												
96													
	32												
94													
	34												
92													
	36												
90													
	38												
88													

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: 11.5 ft
DEPTH TO WATER: Not Encountered
BACKFILLED WITH: Cuttings
DRILLING DATE: October 30, 2008

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: 140-lb Automatic Trip
DRILLED BY: JET Drilling
LOGGED BY: G D Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. B-103

Los Osos WWP, Tonini Property
San Luis Obispo County, California

PLATE A-10

LOCATION: Approximately 1500' northeast of gravel pit; approximately 500' west of Turri Road
N 35 W 121 WGS84

SURFACE EL: 220 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
			1		(22)	**COLLUVIUM (Qcol)** Fat CLAY (CH): (Disturbed Agricultural Soil) very dark brown, dry	105	96	10				
218	2		2		32	**Franciscan Melange (KJfm)** "Fat CLAY (CH)": (Residual Soil) stiff to hard, brown to very dark brown, dry							
216	4												
			3		(64)	CLAYSTONE (Rx): "Fat CLAY (CH)" intensely weathered, soft, bluish gray, dry							
214	6												
212	8												
210	10		4		41								
208	12												
206	14												
204	16												
202	18												
200	20												
198	22												
196	24												
194	26												
192	28												
190	30												
188	32												
186	34												
184	36												
182	38												

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: 11.5 ft
DEPTH TO WATER: Not Encountered
BACKFILLED WITH: Cuttings
DRILLING DATE: October 31, 2008

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: 140-lb Automatic Trip
DRILLED BY: JET Drilling
LOGGED BY: G D Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. B-104

Los Osos WWP, Tonini Property
San Luis Obispo County, California

PLATE A-11

LOCATION: Approximately 500' west of Turri Road; approximately 1100' north of driveway
N 35 W 121 WGS84

SURFACE EL: 93 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
92						**ALLUVIUM (Qal2)**							
	2		1		(17)	Fat CLAY (CH): (Disturbed Agricultural Soil) very dark brown, moist	128	108	19		59	47	
90	4		2		12	Fat CLAY (CH): stiff, very dark brown to pale brown, moist, trace angular chert clasts, black mottling - stiff to hard							p 4.5+
88	6		3		(24)	- very stiff, oxidation mottling, black mottling							
86	8												
84	10		4		25	**Franciscan Metavolcanics (KJfmv)** "Lean CLAY with gravel (CL)": (Residual Soil) very stiff, olive brown, moist, oxidized volcanic clasts							
82	12												
80	14												
78	16												
76	18												
74	20												
72	22												
70	24												
68	26												
66	28												
64	30												
62	32												
60	34												
58	36												
56	38												
54													

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: 11.5 ft
DEPTH TO WATER: Not Encountered
BACKFILLED WITH: Cuttings
DRILLING DATE: October 30, 2008

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: 140-lb Automatic Trip
DRILLED BY: JET Drilling
LOGGED BY: G D Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. B-105

Los Osos WWP, Tonini Property
San Luis Obispo County, California

PLATE A-12

LOCATION: Approximately 200' west of Turri Road; approximately 20' south of driveway
N 35 W 121 WGS84

SURFACE EL: 90 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 (Qal2)							
			1		(17)	Fat CLAY (CH): (Disturbed Agricultural Soil) very dark brown, moist	128	110	17				
88	2					Fat CLAY (CH): stiff, very dark brown to olive brown, moist, approximately 5% subangular clasts							
			2		13	- stiff to very stiff, oxidation and black mottling							p 4.5+
86	4												
			3		(31)		139	117	18				
84	6												
82	8												
80	10		4		25	- very stiff to hard							p 3.5
78	12					**Franciscan Metavolcanics (KJfmv)** "Clayey GRAVEL (GC)": (Residual Soil) very dark brown, moist, moderately weathered angular volcanic clasts							
76	14												
74	16												
72	18												
70	20												
68	22												
66	24												
64	26												
62	28												
60	30												
58	32												
56	34												
54	36												
52	38												

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: 11.5 ft
DEPTH TO WATER: Not Encountered
BACKFILLED WITH: Cuttings
DRILLING DATE: October 30, 2008

DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: 140-lb Automatic Trip
DRILLED BY: JET Drilling
LOGGED BY: G D Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. B-106

Los Osos WWP, Tonini Property
San Luis Obispo County, California

PLATE A-13

LOCATION: Approximately 100' west of Turri Road; approximately 175' north of Turri Ranch Road
N 35 W 121 WGS84
SURFACE EL: 63 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 (Qal2)							
62			1		(8)	Fat CLAY (CH): (Disturbed Agricultural Soil) very dark brown, dry	113	96	17		69	52	
	2		2		8	Fat CLAY (CH): medium stiff, very dark brown, dry - medium stiff to hard, moist							p 4.5
60	4												
58			3		(19)	- stiff, dark brown							
	6												
56	8												
54													
	10		4		38	- hard							p 4.5+
52						**Franciscan Metavolcanics (KJfmv)**							
	12					"Lean CLAY (CL)": (Residual Soil) hard, brown to olive brown, moist, non-homogeneous, angular volcanic clasts							
50	14												
48	16												
46	18												
44	20												
42	22												
40	24												
38	26												
36	28												
34	30												
32	32												
30	34												
28	36												
26	38												
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: 11.5 ft
DEPTH TO WATER: Not Encountered
BACKFILLED WITH: Cuttings
DRILLING DATE: October 31, 2008

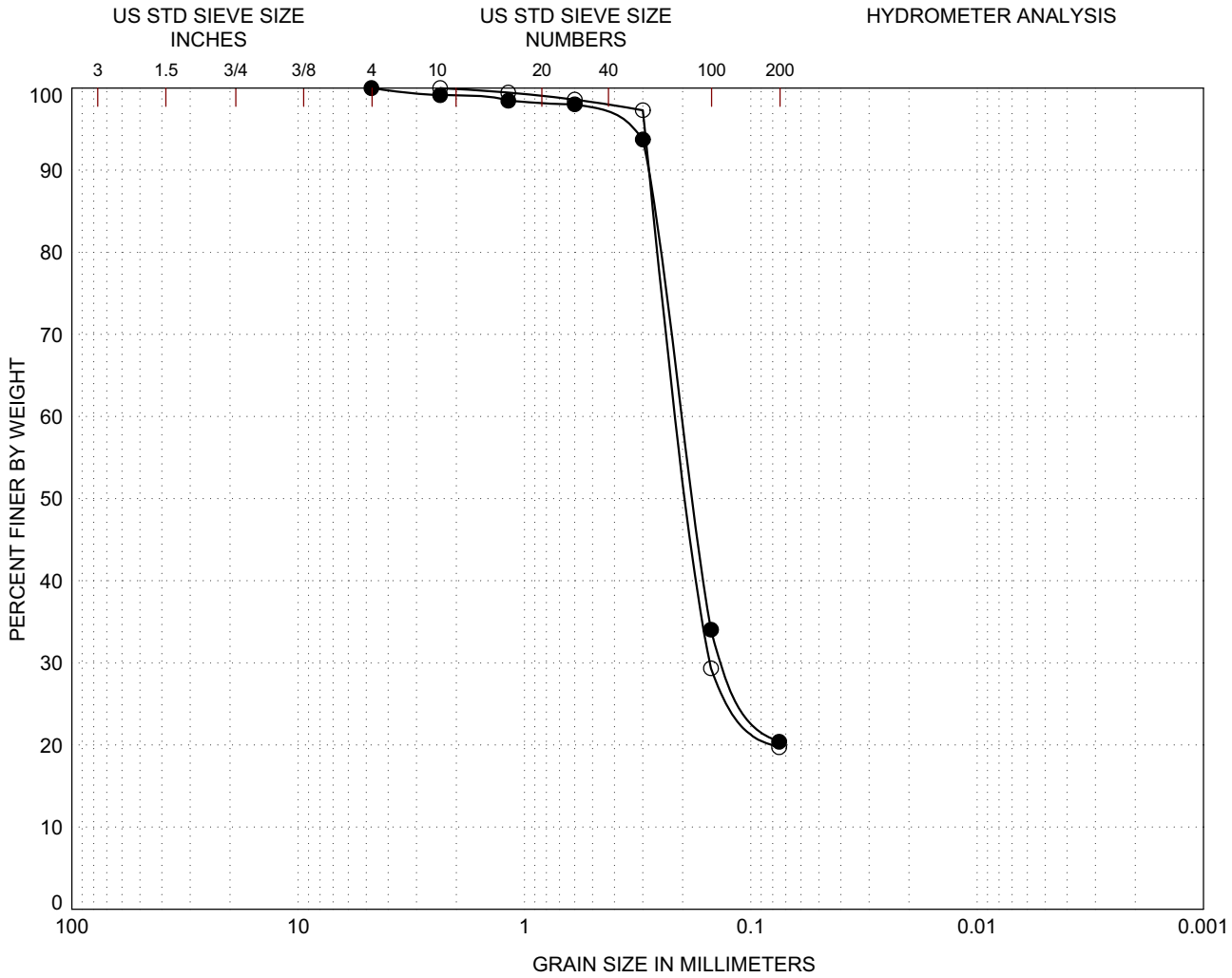
DRILLING METHOD: 8-inch-dia. Hollow Stem Auger
HAMMER TYPE: 140-lb Automatic Trip
DRILLED BY: JET Drilling
LOGGED BY: G D Eckrich
CHECKED BY: J Blanchard

LOG OF BORING NO. B-107

Los Osos WWP, Tonini Property
San Luis Obispo County, California

PLATE A-14

APPENDIX B

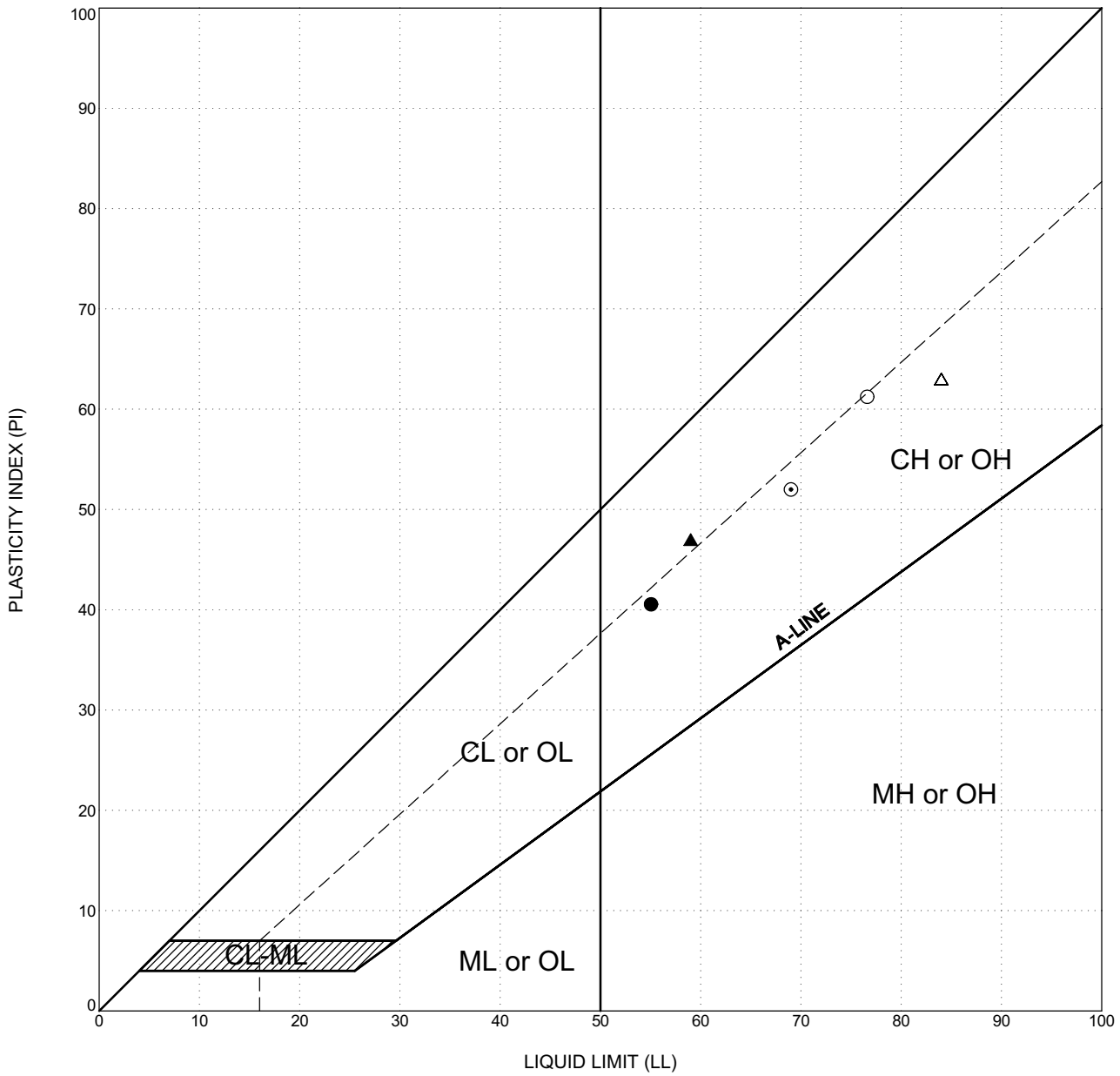


GRAVEL		SAND			SILT or CLAY
Coarse	Fine	Coarse	Medium	Fine	

LEGEND	(location)	(depth,ft)	CLASSIFICATION	Cc	Cu
○	B-1	2.5	Silty SAND (SM)		
●	B-101	1.0	Silty SAND (SM)		

GRAIN SIZE CURVES
Los Osos WWP, Tonini Property
San Luis Obispo County, California

PLATE B-1



LEGEND	location	depth, ft	CLASSIFICATION	ATTERBERG LIMITS TEST RESULTS LIQUID LIMIT(LL)	PLASTIC LIMIT(PL)	PLASTICITY INDEX (PI)
○	B-2	1.0	Fat CLAY (CH)	77	15	62
●	B-3	5.0	Fat CLAY (CH)	55	14	41
△	B-103	1.0	Fat CLAY (CH)	84	21	63
▲	B-105	1.0	Fat CLAY (CH)	59	12	47
⊙	B-107	1.0	Fat CLAY (CH)	69	17	52

PLASTICITY CHART
Los Osos WWP, Tonini Property
San Luis Obispo County, California

PLATE B-2

Drill Hole	Depth (ft)	Soil Type	Initial Dry Density, pcf	Initial Moisture Content	Permeability, cm/s
B-101	1.0	Silty SAND (SM)	105.9	7.5%	8.8×10^{-5}
B-102	1.0	Silty SAND (SM)	67.2	49.6%	1.1×10^{-3}
B-103	1.0	Fat CLAY (CH)	97.4	25.8%	3.1×10^{-9}
B-105	1.0	Fat CLAY (CH)	108.0	19.0%	2.3×10^{-9}
B-106	5.0	Fat CLAY (CH)	112.2	18.0%	2.0×10^{-8}
B-107	1.0	Fat CLAY (CH)	105.8	17.5%	4.4×10^{-8}

Test Method: ASTM D5084, Method A
ASTM D2434 for B-101 at 1.0 foot and B-102 at 1.0 foot

PERMEABILITY TEST RESULTS

Boring, Sample No., and Depth	B-3, Sample A, 0 to 5 feet
Initial Water Content, %	10.6
Initial Dry Unit Weight, pcf	104.5
Assumed Specific Gravity, G_s	2.70
Degree of Saturation, %	46.9
Final Water Content, %	26.1
$EI_{measured}$	109
EI_{50}	**105**
ASTM Expansion Potential	**High**
Description:	**Fat CLAY (CH)**

Boring, Sample No., and Depth	B-3, Samples 1 & 2 1 to 4 feet
Initial Water Content, %	11.2
Initial Dry Unit Weight, pcf	104.2
Assumed Specific Gravity, G_s	2.70
Degree of Saturation, %	48.9
Final Water Content, %	24.9
$EI_{measured}$	94
EI_{50}	**93**
ASTM Expansion Potential	**High**
Description:	**Fat CLAY with SAND (CH)**

EXPANSION INDEX TEST RESULTS
Los Osos WWP, Tonini Property
San Luis Obispo County, California