APPENDIX D

Final Geotechnical Engineering Services Report

White Slough Wastewater Treatment Facility Tertiary Ponds
Lodi, California

December 16, 2016

Terracon Project No. NA165098

Prepared for:

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Galt, California

Prepared by:

Terracon Consultants, Inc.
Lodi, California

December 16, 2016

Petrologix
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Attn: Daniel Kramer, P.G., C.E.G.

Re: Final Geotechnical Engineering Services Report
White Slough Wastewater Treatment Facility Teriary Ponds
12751 N. Thornton Road
Lodi, California
Terracon Project Number: NA150395

Dear Daniel:

Terracon Consultants, Inc. (Terracon) has completed the final geotechnical engineering services for the above referenced project. This study was performed in general accordance with our proposal number PNA150395 dated October 20, 2015 and revised on November 25, 2015 and March 2, 2016. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of tertiary pond embankments for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Patrick C. Dell, Senior Associate
Geotechnical Engineer 2186
Geotechnical Department Manager

Garret Hubbart, Principal
Geotechnical Engineer 2588
Office Manager

Enclosures
cc: 1 – Client (PDF)
1 – File

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EXECUTIVE SUMMARY

A final geotechnical engineering services report has been prepared for new tertiary ponds to be constructed west of the existing White Slough Wastewater Treatment Facility on Thornton Road in Lodi, San Joaquin County, California. Terracon previously prepared a preliminary geotechnical engineering report for this project dated September 16, 2016. Terracon's preliminary geotechnical engineering scope of work for this project included drilling six (6) borings for subsurface exploration, laboratory testing, preliminary geotechnical engineering analysis, and preparation of a preliminary geotechnical engineering report. Four (4) of the borings were advanced to 21½ feet below the existing ground surface (bgs) and two (2) borings were advanced to 51½ feet bgs. Borings were located at the planned embankments for the ponds. Terracon's final geotechnical engineering scope of work for this project included additional laboratory testing, final geotechnical engineering analysis, and preparation of this report. No additional borings were performed as part of this final report. Additional borings are planned to be performed as part of an addendum to this report for the proposed pump station and pipeline associated with the new tertiary ponds. The recommendations for the pump station and pipeline contained in this report are preliminary only and need to be confirmed with data obtained from the planned additional borings.

Based on the information obtained from our preliminary geotechnical engineering report and final geotechnical engineering analyses and additional laboratory data, the proposed project can proceed as planned provided the final recommendations contained in this report are properly implemented in the planning, initial design work, and pre-construction planning of the project. The following geotechnical considerations were identified:

In general, the upper on-site materials encountered in our borings generally consisted of stiff to very stiff sandy silt and very loose to medium dense silty sand. These upper soils extended to depths of between 4 and 9 feet bgs. An exception to these conditions was encountered in boring B4 where the upper 4 feet consisted of sandy lean clay. The upper soils were underlain by interbedded layers of very soft to hard sandy silt, very loose to dense sand with varying amounts of silt, and very stiff to hard lean clay with sand that extended to the maximum depths explored. For a more detailed description of the soil lithology, see the attached Boring Logs in Appendix A.

Groundwater was encountered in two of the exploratory borings at depths of approximately 5 and 8 feet bgs at the time of the investigation. The borings were not allowed to stay open for an extended period of time for safety purposes, so the groundwater depth should be considered approximate and may fluctuate in the future.

The project site is not mapped for potential liquefaction hazard by the California Geologic Survey (CGS), however saturated cohesionless soils were encountered within the upper 50

feet. A detailed evaluation of liquefaction potential was performed for this project and is summarized in the following report.

A seepage and slope stability analysis of the proposed embankments was performed. The results of these analyses are presented in this report.

Based on the soil conditions encountered in our borings, the tertiary pond embankments may be constructed with material from within the upper 2 feet of the proposed pond locations. Some of the material may need to be blended to meet the project specifications.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of the report limitations.

FINAL GEOTECHNICAL ENGINEERING SERVICES REPORT
WHITE SLOUGH WASTEWATER TREATMENT FACILITY
TERTIARY PONDS
LODI, CALIFORNIA

Terracon Project No. NA165098
December 16, 2016

1.0 INTRODUCTION

This report present the results of our final geotechnical engineering services performed for the proposed tertiary ponds at the White Slough Wastewater Facility on Thornton Road in Lodi, California. Logs of the borings along with a site location map and exploration plan are included in Appendix A of this report.

Our geotechnical engineering scope of work for this project included drilling six (6) borings for subsurface exploration, laboratory testing, geotechnical engineering analysis, and preparation of this report. Four (4) of the borings were advanced to 21½ feet below the existing ground surface (bgs) and two (2) borings were advanced to 51½ feet bgs. All of the borings were drilled at the locations of the planned embankments for the ponds. Additional borings are planned to be performed at the location of the proposed pump station and pipeline that will be included in this project. An addendum will be prepared when those borings are completed. The recommendations for the pump station and pipeline contained in this report are preliminary only and need to be confirmed with data obtained from the planned additional borings.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- groundwater conditions
- foundations and below grade walls
- seepage analysis
- slope stability analysis
- earthwork recommendations
- preliminary recommendations for the design and construction of the pump station and pipeline

2.0 PROJECT INFORMATION

2.1 Project Description

Item	Description
Site layout	See Appendix A, Exhibit A-2: Exploration Plan.
Improvements	Four tertiary treatment ponds are planned west of the existing facility.
Grading	The ponds will be created by excavating about 2 feet of soil from the existing ground surface and utilizing this soil to construct the embankments. The internal pond embankments will be a maximum of 8 feet above the pond bottom. The external pond embankments will be a maximum of 6½ feet above the existing ground surface on the exterior of the embankment and a maximum of 9 feet above the pond bottom. The embankments will have side slopes of 2:1 (2 Horizontal to 1 Vertical) with an embankment crest width of 12 feet. The ponds will provide 2 feet of freeboard above the maximum water surface of the ponds.

2.2 Site Location and Description

Item	Description
Location	12751 N. Thornton Road, Lodi, San Joaquin County, California.
Existing improvements	The pond sites are currently active agricultural fields.
Current ground cover	Agricultural crops.
Existing topography	Relatively flat. There is approximately 2 feet of vertical relief from the east side to the west side of the project. There is about 12 feet of vertical relief from the north side to the south side of the project.

3.0 SUBSURFACE CONDITIONS

3.1 Local Geology

The subject site is located in the center of the middle portion of the Great Valley geomorphic province. A review of the geologic map for this area indicate the soils are composed of Pleistocene age arkosic alluvium of the Modesto formation (Qm).

The site is located in the northern middle portion of the San Joaquin Valley. Approximately 30 miles to the east are the foothills of the Sierra Nevada Province, and approximately 20 miles to the west is the Coast Ranges Province. Tectonic processes involved with the western Coast Ranges are a significant source of seismicity, faulting, and folding.

3.2 Faulting and Seismic Considerations

3.2.1 Seismic Site Class and Parameters

The following table presents the seismic design values and site class as calculated from the USGS U.S. Seismic Design Maps website utilizing ASCE 7-10.

DESCRIPTION	VALUE
2013 California Building Code Site Classification (CBC) [1]	D
Site Latitude	38.09106°
Site Longitude	-121.39622°
S_s Spectral Acceleration for a Short Period	0.881g
S_1 Spectral Acceleration for a 1-Second Period	0.333g
F_a Site Coefficient for a Short Period	1.148
F_v Site Coefficient for a 1-Second Period	1.733
S_{Ms} Maximum Considered Spectral Response Acceleration for a Short Period	1.011g
S_{M1} Maximum Considered Spectral Response Acceleration for a 1-Second Period	0.578g
S_{Ds} Design Spectral Response Acceleration for a Short Period	0.674g
S_{D1} Design Spectral Response Acceleration for a 1-Second Period	0.385g

[1] Note: The 2013 California Building Code (CBC) requires a site soil profile determination extending to a depth of 100 feet for seismic site classification. The current scope does not include the required 100 foot soil profile determination. Borings extended to a maximum depth of 51½ feet, and this seismic site class definition considers that similar soils continue below the maximum depth of the subsurface exploration. Additional exploration to greater depths could be considered to confirm the conditions below the current depth of exploration. Alternatively, a geophysical exploration by us could be utilized in order to attempt to confirm the seismic site class.

3.2.2 Faulting and Estimated Ground Motions

The subject site is located in the California Central Valley Area which is a relatively low to moderately seismically active area. The type and magnitude of seismic hazards affecting the site are dependent on the distance to causative faults, the intensity, and the magnitude of the seismic event. The following table indicates the distance of the fault zones and the associated maximum credible earthquake that can be produced by nearby seismic events, as calculated using the United States Geologic Survey 2008 Interactive Deaggregations program. The Green Valley Connected Characteristic Fault, which is located about 56 kilometers from the site, is considered to have the most significant effect at the site from a design standpoint.

Fault Name	% Contribution	Approximate Distance to Site (kilometers)	Maximum Credible Earthquake (MCE) Magnitude
Green Valley Connected Char	4.11	56.2	6.89
Mount Diablo Thrust D2.1 & D2.4, C	3.28	47.2	6.61

Greenville Connected Char	3.22	44.6	6.89

The USGS Design Maps Detailed Report evaluates the Peak Ground Acceleration (PGA_M) to be 0.368g. Based on the 2008 interactive deaggregations, the PGA at the subject site for a 2% probability of exceedance in 50 years (return period of 2475 years) is expected to be about 0.439g. The site is not located within an Alquist-Priolo Earthquake Fault Zone based on our review of State Fault Hazard Maps.[1]

3.3 Soil Conditions

Based on the results of the borings, subsurface conditions on the project site can be generalized as follows:

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/ Density
1	4 to 7½[1]	Sandy Silt	Very Loose to Medium Dense
2	4 to 9[2]	Silty Sand; Sandy Lean Clay	Very Loose to Medium Dense; Stiff
3	19	Interbedded layers of Sandy Silt, Silty Sand, Poorly Graded Sand with Silt, Clayey Sand, Sandy Lean Clay	Very loose to Dense, Stiff
4	24	Lean Clay with Sand	Very Stiff to Hard
5	51½	Silty Sand, Clayey Sand, Sandy Silt, Silt with Sand	Medium Dense to Dense

1. Encountered in borings B1 and B6.
2. Encountered in borings B2, B3, and B5. Sandy Lean Clay was only encountered in boring B4.

Conditions encountered at each boring location are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in situ, the transition between materials may be gradual. Details for each of the borings can be found on the boring logs in Appendix A of this report.

Laboratory tests consisting of Atterberg limits and No. 200 washes were performed on a number of samples from the borings. In addition, bulk samples collected by Petrologix from within the proposed pond construction area were delivered to our office. The approximate locations of the Petrologix samples are indicated on Plate A-2 of Appendix A. Selected samples from Petrologix were tested for Atterberg limits and No. 200 washes to assist in evaluating the upper 2 feet of

[1] California Department of Conservation Division of Mines and Geology (CDMG), *"Digital Images of Official Maps of Alquist-Priolo Earthquake Fault Zones of California.*

material for use within the pond embankments. The test results from the samples collected from the borings are included on the boring logs. The results of the testing performed on samples from our borings and Petrologix are summarized in Appendix B.

In addition to the bulk samples from Petrologix, we obtained two samples of the near surface soils for Resistance Value (R-value) testing for use in designing pavement sections. The results of the R-value tests are included in Appendix B.

3.4 Groundwater

Groundwater was encountered at depths of 5 and 8 feet bgs in two of our borings at the time the borings were drilled. It is unknown why we did not encounter groundwater in our other borings. A groundwater study by others including additional test borings by us may be warranted in an attempt to determine the depth of groundwater throughout the site. These test holes were not allowed to remain open for an extended period of time; therefore, the measured depth of groundwater should be considered approximate.

We understand Petrologix performed some percolation tests within the proposed tertiary pond areas. For those tests, groundwater was encountered at depths between 3 and 6½ feet bgs.

Groundwater conditions in the future could change due to rainfall, construction activities, irrigation, or other factors. The evaluation of these factors is beyond the scope of this study. Due to potential fluctuation of groundwater depths and the historical groundwater data, a groundwater depth of no less than 3 feet bgs should be utilized for design purposes unless a more detailed groundwater study is performed.

3.5 Liquefaction Potential

Liquefaction is a mode of ground failure that results from the generation of excess pore-water pressures during earthquake ground shaking, causing loss of shear strength. This phenomenon generally occurs in areas of high seismicity, where groundwater is shallow, and loose granular soils. Strong seismic shaking can also cause cyclic softening of saturated relatively non-plastic fine-grained soils. The California Geologic Survey (CGS) has designated certain areas within California as potential liquefaction hazard zones. These are areas considered at a risk of liquefaction-related ground failure during a seismic event, based upon mapped surficial deposits and the likely presence of a relatively shallow water table. This site is not mapped within a designated area of potential liquefaction.

However due to the depth to groundwater and the relatively cohesionless soils encountered in our exploratory borings, two liquefaction analyses were conducted with data from borings B1 and B2 utilizing the SPT correlation procedures set forth by Idriss and Boulanger (2014). We assumed a groundwater depth of 5 feet bgs in our analyses based on recent and historic groundwater

elevations. The analysis method uses correlations based on SPT blow counts recorded at uniform intervals throughout the boring. Based on the analyses, the liquefaction potential is judged to be relatively low. Potential liquefaction-induced settlement was calculated based on the soil conditions encountered in borings B1 and B2. In our opinion, potential settlement from liquefaction is relatively minor and expected to be about 1½ inches total settlement with differential settlement expected to be about ½ this value across the site based on the soil conditions at boring B1. Liquefaction induced settlement based on the soil conditions at boring B2 are expected to be less than ½ inch. Estimates of settlement due to liquefaction are generally expected to vary on the order of a factor of 2. In considering potential liquefaction-induced settlement at this site, we have also considered that the soils are Pleistocene age deposits. Research has indicated that Pleistocene age soils do not typically undergo liquefaction due to aging effects of the deposit.

4.0 FINAL GEOTECHNICAL ENGINEERING ANALYSES

Seepage and slope stability analyses of the proposed pond embankments were performed using computer models. The models were performed utilizing the general criteria from the Urban Levee Design Criteria (ULDC), even though the pond embankments (levees) do not protect an urban area. The ULDC was developed by the California Department of Water Resources (DWR) for application to the design and construction of levees protecting urban environments. However, the ULDC contains some of the most up to date methods and recommendations for the design and construction of levees.

Since the ponds will likely have water in them a majority of the time, we considered the embankments to be “frequently loaded” which the ULDC defines as embankments that “experiences a water surface elevation of 1 foot or higher above the elevation of the landside levee toe at least once a day for more than 36 days per year on average.”

The waterside of the embankment refers to the inside slope of the ponds; the landside refers to the outside slope of the ponds. The proposed pond embankments will have waterside and landside slopes of 2 horizontal to 1 vertical, the crown width will be 12 feet, and the maximum height of the embankment will be about 6½ feet above the existing ground surface and 9 feet above the pond bottoms. It is proposed that the pond embankments be constructed of compacted engineered fill obtained from the upper 2 feet or so of soil from the bottoms of the ponds. The ponds will designed to provide at least 2 feet of freeboard above the design water surface elevation. The maximum amount of head that the ponds will experience will therefore be 4½ feet above the landside toe of the embankment.

For both the seepage and slope stability analyses, we analyzed the embankment for a steady-state seepage condition with water at the design water surface elevation. We used a soil stratigraphy model based on the most conservative soil profile from our field explorations, which was from boring B2. We used presumptive values for the hydraulic conductivity and strength parameters of the compacted embankment and underlying natural soil deposits. These values

were selected based on our experience with similar type soils in the Central Valley and our recent experience with the DWR Urban Levee Evaluation project. We considered a range of values in our analyses.

We have also considered potential settlement of the new pond embankments. Based on the soil conditions encountered in our borings and our experience with similar soils, in our opinion settlement from the new embankments is anticipated to be relatively minor and should occur as the embankments are constructed.

In addition to the pond embankments, a pump station and associated 18-inch diameter inlet/outlet pipeline are also planned to be constructed as part of this project. The pump station will be constructed at the southwest corner of the new ponds. The pipeline will extend from the new pump station east/northeast to the existing treatment facility, as well as under the western pond embankment. The pump station will extend approximately 15 feet below the existing ground surface. The pipeline will be approximately 6 to 8 feet below the existing ground surface.

4.1 Seepage Analysis

We performed a seepage analysis of the proposed tertiary pond embankments using the computer program SEEP/W by Geo-Slope International.

Based on our analysis, seepage through the pond embankments is not likely to result in boils or cause significant stability problems. The exit gradient at the toe of the embankment was calculated to be approximately 0.3. This value is lower than the ULDC criteria at the embankment toe of 0.5. Exit gradients greater than 0.5 indicate a high potential for boils to occur. Therefore, from a steady state seepage perspective, the pond embankments can be constructed as planned, in accordance with the recommendations presented in this report. The results of our seepage analysis are presented in Appendix C.

Some minor seepage through the embankments may occur shortly after construction. However, we anticipate the amount of seepage to be relatively minor and to slow down or stop after a short period of time as silt and other material from the effluent water will tend to seal the inside of the pond embankment. Some seepage may occur through the bottom of the pond but this is not expected to surface in areas adjacent to the ponds. We anticipate seepage through the bottoms of the ponds will migrate vertically downward into the ground.

4.2 Slope Stability Analysis

We performed a slope stability analysis of the proposed tertiary pond embankments using the computer program SLOPE/W by Geo-Slope International.

Based on our analysis, the calculated factor of safety against a slope failure for steady state seepage static conditions is 1.8. This factor of safety is greater than the ULDC recommended factor of safety for levees of 1.5 for static conditions. Therefore, from a slope stability standpoint, the pond embankments can be constructed as planned, in accordance with the recommendations presented in this report. The results of our slope stability analysis are presented in Appendix C.

5.0 RECOMMENDATIONS

5.1 Earthwork

The following presents recommendations for site preparation, excavation, subgrade preparation and placement of engineered fills on the project. The recommendations presented are for the design and construction of the pond embankments and are contingent upon following the recommendations outlined in this section. All grading for the embankments should incorporate the limits of the proposed embankments plus a lateral distance of at least five feet beyond the outside edges of the slopes.

5.1.1 Site Preparation

Strip and remove existing debris, vegetation, and other deleterious materials from the outline of the proposed embankments plus 5 feet beyond the proposed toe of the embankments. Exposed surfaces should be free of mounds and depressions, which could prevent uniform compaction.

The area beneath the proposed embankments should be overexcavated to a depth of 3 feet below the existing ground surface. This may require local dewatering in order to reach the recommended depth and compaction. The exposed subgrade should then be scarified to a depth of 12 inches and compacted to the relative density specified in Section 5.2.1. The overexcavated material should be placed and compacted as engineered fill to the density specified in Section 5.2.1.

5.2 Material Requirements

All engineered fill materials for the proposed embankments from any source should be inorganic soils free of vegetation, debris, and fragments larger than three inches in size.

Imported earth materials for use as engineered fill should be pre-approved by Terracon prior to construction. On-site soils may be used for pond embankment construction, although they may not meet the requirements for the minimum Plasticity Index listed below unless they are mixed with the more clayey soils encountered within the proposed pond locations. Imported soils may also be used as fill material provided they meet the requirements in this section.

The State Reclamation Board has requirements for engineered fill for new levees. These requirements are presented below. These requirements are for levees providing flood protection

and so may be altered somewhat for a project such as this. Imported soils for use as compacted engineered fill material within the proposed embankment areas should conform to materials as indicated as follows:

Gradation	Percent Finer by Weight (ASTM C 136)
3"	100
No. 4 Sieve	80-100
No. 200 Sieve	20 (min)
Liquid Limit	45 (max)
Plasticity Index	8 (min)

5.2.1 Compaction Requirements

Engineered fill should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift. Fill lifts should not exceed twelve inches loose thickness.

All fill placed below and within the pond embankments should be compacted to a minimum of 90 percent relative compaction based on the maximum dry density obtained in the ASTM D1557 test method at a moisture content at least 1 percent above the optimum moisture content.

Since most fill slopes are constructed with a loosely or poorly compacted surface, the fill slopes should be slightly overbuilt and trimmed back to firm, compacted soil.

5.3 Grading and Drainage

All final grades must provide effective drainage away from the pond embankments during and after construction. Water permitted to pond next to the embankments can result in slope stability issues at the toes of the embankments. Stormwater runoff should be directed away from the embankments and be collected and discharged away from the embankments. Also, if water is allowed to pond at the toe of the embankments, it will not be possible to detect water that may be seeping from the embankment. A rigorous maintenance program should be planned to keep vegetation from growing on the sides of the embankment as well as controlling rodents burrowing into the embankments. Care should also be taken to not undercut the toes of the embankments during maintenance operations.

5.4 Earthwork Construction Considerations

It is anticipated that excavations for the proposed construction can be accomplished with conventional earthmoving equipment. Based upon the subsurface conditions determined from the geotechnical exploration, subgrade soils exposed during construction are anticipated to be relatively workable. On-site fine grained soils may pump or become unworkable at high water

contents. As previously mentioned, groundwater is relatively close to the existing ground surface and excavations of the existing ground may encounter difficulty from the high groundwater. The workability of the subgrade may be affected by precipitation, repetitive construction traffic or other factors. If unworkable conditions develop, workability may be improved by scarifying and drying. If the construction schedule does not allow for scarifying and drying by aeration in place, soil stabilization by the addition of chemical agents, such as cement or lime may be required. If soil stabilization is needed, Terracon should be consulted to evaluate the situation as needed.

The pond embankment slopes should be covered with some type of erosion control measure immediately after construction. Erosion control measures can consist of erosion resistant vegetation, jute netting, or rip rap. These should be installed per the manufacturer's specifications. Some minor, relatively shallow erosion should be anticipated and planned for. Routine maintenance will be required on all embankment slopes. Any detected problems should be repaired immediately. It is important that the bottom of all embankments be protected from erosion or undercutting that could jeopardize the integrity of the slope. Substantial slope failure could occur if the bottoms of the slopes are not protected. A rigorous program of reducing the amount of animal burrows should be in place to reduce the potential for seepage-related problems.

The surface soils at the site primarily consist of silty sands and sandy silts which are typically subject to significant wind/water erosion. The project civil engineer, while developing the plans, should plan to limit wind/water erosion during and after construction to a level acceptable to the owner. Rip rap or other erosion control measures should be implemented to reduce the potential for wave damage to the waterside slope of the embankments.

As a minimum, all temporary excavations should be sloped or braced as required by Occupational Safety and Health Administration (OSHA) regulations to provide stability and safe working conditions. The contractor, by his contract, is responsible for designing and constructing stable, temporary excavations (including utility trenches) as required to maintain stability of both the excavation sides and bottom. Excavations should be sloped or shored in the interest of safety following local and federal regulations, including current OSHA excavation and trench safety standards.

Terracon should be retained during the construction phase of the project to observe earthwork and to perform necessary materials tests and observations during subgrade preparation, proof-rolling, placement and compaction of controlled compacted fills, and construction of the embankments to the completed grades.

We recommend that the earthwork portion of this project be completed during extended periods of dry weather if possible. If earthwork is completed during the wet season (typically October through April) it may be necessary to take extra precautionary measures to protect subgrade soils. Wet season earthwork may require additional mitigation measures beyond that which would be

expected during the drier summer and fall months. This could include diversion of surface runoff around exposed soils and draining of ponded water on the site. Once subgrades are established, it may be necessary to protect the exposed subgrade soils from construction traffic.

5.5 Pump Station and Pipeline Design and Construction

The recommendations for the pump station and pipeline contained in this report are preliminary only and need to be confirmed with data obtained from the planned additional borings.

5.5.1 Pump Station Design and Construction

The excavation for the pump station will extend to about 15 to 17 feet below the existing ground surface. Groundwater was encountered at a depth 5 feet bgs in boring B1, the closest boring to the proposed pump station location. Groundwater should be lowered to a depth of at least 3 feet below the bottom of the proposed pump station foundation. If the bottom of the excavation is still unstable after dewatering, then the excavation should be overexcavated another 12 inches, then a geotextile, such as Mirafi RS289i, should be placed in the bottom of the excavation and 12 inches of ¾-inch crushed gravel be placed to stabilize the bottom of the excavation.

The soils encountered in boring B1 consisted of sandy silt soils to a depth of 19 feet bgs. These soils varied in consistency from very soft to stiff. These soils will likely not be stable due to a relatively high moisture content. Since these soils will need to be sloped back to side slopes of between 1½ to 1 (horizontal to vertical) and 2 to 1, this will require a fairly large excavation. In lieu of excavating a “glory hole” to construct the pump station, we anticipate that the excavation will be made with sheet piling to provide stable slopes. The sheet pile should be designed by a contractor familiar with these types of soil and groundwater conditions. The individual contractor(s) is responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the pump station excavation sides and bottom. Excavations should be sloped or shored in the interest of safety following local, and federal regulations, including current OSHA excavation and trench safety standards.

Sheet pile walls should be designed to resist lateral soil pressures of 55 pcf for soils above the water table and 92 pcf for soils below groundwater. This value includes the hydrostatic pressure of groundwater.

In order to resist uplift/buoyant forces from groundwater, we recommend the base of the foundation be extended horizontally to provide uplift resistance. A buoyant unit weight of soil of 60 pounds per cubic foot may be used to calculate the uplift resistance of the soil column above the foundation. The pump station should be designed to withstand buoyant forces assuming a groundwater depth of 3 feet below the existing ground surface.

Backfill around the pump station should be compacted to a minimum of 95 percent relative compaction based on the maximum dry density obtained in the ASTM D1557 test method up to

within 5 feet of the ground surface. The upper 5 feet of backfill should be compacted to a minimum of 90 percent relative compaction based on the maximum dry density obtained in the ASTM D1557 test method. We caution that inadequate compaction of the backfill can result in unacceptable settlement of the backfill which could damage pipes coming into or connected to the pump station.

The pump station foundation may be designed for an allowable bearing pressure of 2,500 pounds per square foot for dead plus live load. This value may be increased by 1/3 to account for wind or seismic forces. Buoyant forces may also be resisted by the friction created from the overburden soil weight against the concrete sides of the pump station or the steel sheet piling. An adhesion friction resistance of 0.40 and 0.35 may be used between the soil and concrete or steel sheet piling, respectively.

Due to the stress relief from excavating 15 feet of soil, the anticipated total settlement of the pump station will be less than ½ inch. This should occur during construction.

Lateral loads on the pump station walls should be designed for the at-rest condition since the walls will not deflect. The at-rest pressure for the soil conditions encountered in boring B-1 is 55 pcf for soils above the water table and 92 pcf for soils below groundwater. This value includes the hydrostatic pressure of groundwater.

5.5.2 18-inch Tertiary Pipeline Design and Construction

An 18-inch diameter pipeline will extend from the new pump station east/northeast to the existing treatment facility as well as extending northwest beneath the west pond embankment. The pipeline will be 6 to 8 feet below the existing ground surface. Since we anticipate groundwater will be encountered at a depth of about 3 to 5 feet bgs, it will be necessary to dewater the excavation to allow construction of the pipeline. Depending on the depth of groundwater encountered in the excavation, it may be possible to control the seepage with only a sump pump. However, if the excavation extends 1 to 2 feet below groundwater, the groundwater will need to be lowered to allow construction of the pipeline. A single stage well point system may be needed. A single stage well point system is where small diameter wells are installed by jetting, driving or boring methods. Once the wells are installed they are connected to a manifold which feeds to a large pump. An experienced dewatering contractor shall review our boring logs and project plans to determine the most suitable method of dewatering. We recommend that the groundwater be lowered to at least 2 feet below the bottom of the excavation. If the bottom of the excavation is unstable, we recommend overexcavating the trench 6 to 12 inches, and placing ¾-inch crushed gravel in the bottom to stabilize the trench bottom. If necessary to further stabilize the bottom of the trench, then a geotextile, such as Mirafi RS289i, should be placed in the bottom of the trench prior to placement of the gravel. The pipe should then be placed and backfilled in accordance with City of Lodi standards. According to the City of Lodi standards, the on-site soils classify as Class 3 Pipe Bedding material.

Since sandy silt and silty sand soils were encountered within the upper 8 feet throughout the project site, it may be necessary to shore the pipeline trench excavation. The individual contractor(s) is responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the trench excavation sides and bottom. Excavations should be sloped or shored in the interest of safety following local, and federal regulations, including current OSHA excavation and trench safety standards.

5.6 Pavements

5.6.1 Design Considerations

Detailed traffic patterns and anticipated loading conditions were not available at the time that this report was prepared. We have provided pavement sections for traffic indices (TI) of 4.0 and 5.0. Two samples of the near surface soils were tested in our laboratory to determine their Resistance Value (R-value). The tests produced results of 10 and 59. The approximate locations of the R-value samples is shown on Plate A-2.

Based on the potential of varying silt content which may alter the R-value, design R-Values of 10 and 50 was used to calculate the Asphalt Concrete (AC) pavement thickness sections. The AC pavement sections were calculated using the Caltrans Highway Design Manual, latest edition, and a 20-year design life. We recommend additional R-value testing of the pavement subgrade soils during the mass grading operations to determine the appropriate pavement section depending on the R-value of the subgrade soil at the finish pavement elevation.

Pavement design methods are intended to provide structural sections with adequate thickness over a particular subgrade such that wheel loads are reduced to a level the subgrade can support.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%;
- The subgrade and pavement surface should have a minimum 2% slope to promote proper surface drainage;
- Install below pavement drainage systems surrounding areas anticipated for frequent wetting;
- Install joint sealant and seal cracks immediately;
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils by embedding curbs a minimum of 6 inches into the native soils;
- Place compacted, low permeability non-expansive backfill against the exterior side of curbs and gutters.

Assuming the pavement subgrades will be prepared as recommended within this report, the following pavement sections should be considered minimums for this project for the traffic indices assumed in the table below. If more specific traffic information becomes available, we should be contacted to reevaluate the pavement calculations.

Minimum AC Pavement Section (inches)					
Traffic Area	**R-value**	**Traffic Index**	**Asphalt Concrete**	**Aggregate Base**	**Total Thickness**
Automobile	10	4.0	2.5	7.0	11.0
Automobile	50	4.0	2.5	4.0	6.5
Maintenance Vehicles	10	5.0	3.0	9.0	12.0
Maintenance Vehicles	50	5.0	3.0	4.0	7.0

All pavement materials should meet the Caltrans Standard Specifications for Highway Construction, latest edition.

Rigid PCC pavements will perform better than AC in areas where short-radii turning and braking are expected (i.e. entrance/exit aprons) due to better resistance to rutting and shoving. In addition, PCC pavement will perform better in areas subject to large or sustained loads. We recommend rigid pavement for the dumpster area to include the area where the trucks will pick up the dumpster. An adequate number of longitudinal and transverse control joints should be placed in the rigid pavement in accordance with ACI and/or AASHTO requirements. Expansion (isolation) joints must be full depth and should only be used to isolate fixed objects abutting or within the paved area.

Graveled access roads for lightweight maintenance vehicles should consist of 12 inches of compacted aggregate base over compacted native subgrade.

5.6.2 Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section.

5.6.3 Pavement Maintenance

The pavement sections provided in this report represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve

the pavement investment. Maintenance consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventive maintenance is usually the first priority when implementing a pavement maintenance program.

5.6.4 Construction Considerations

Additional engineering observation is recommended to determine the type and extent of a cost effective program. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.
Materials and construction of pavements for the project should be in accordance with the requirements and specifications of Caltrans Standard Specifications for Highway Construction, latest edition.

Base course or pavement materials should not be placed when the surface is wet. Surface drainage should be provided away from the edge of paved areas to minimize lateral moisture transmission into the subgrade.

6.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, embankment construction and other earth-related construction phases of the project.

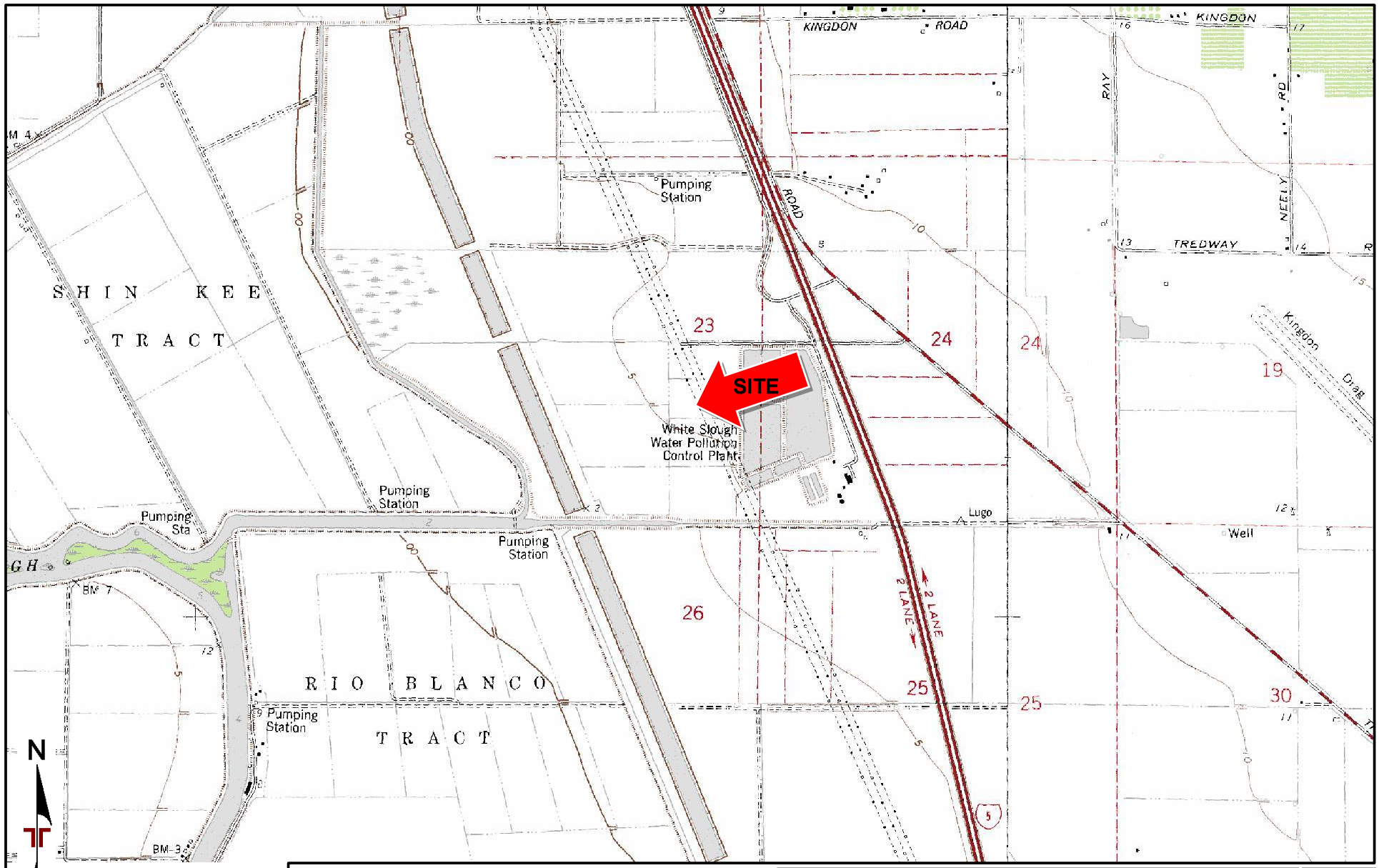
The analysis and recommendations presented in this final report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report and should only be used for planning purposes and should not be used to develop construction documents. This final report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site

safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A
FIELD EXPLORATION



TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY QUADRANGLES INCLUDE: TERMINOUS, CA (1/1/1997) and LODI SOUTH, CA (1/1/1976).

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

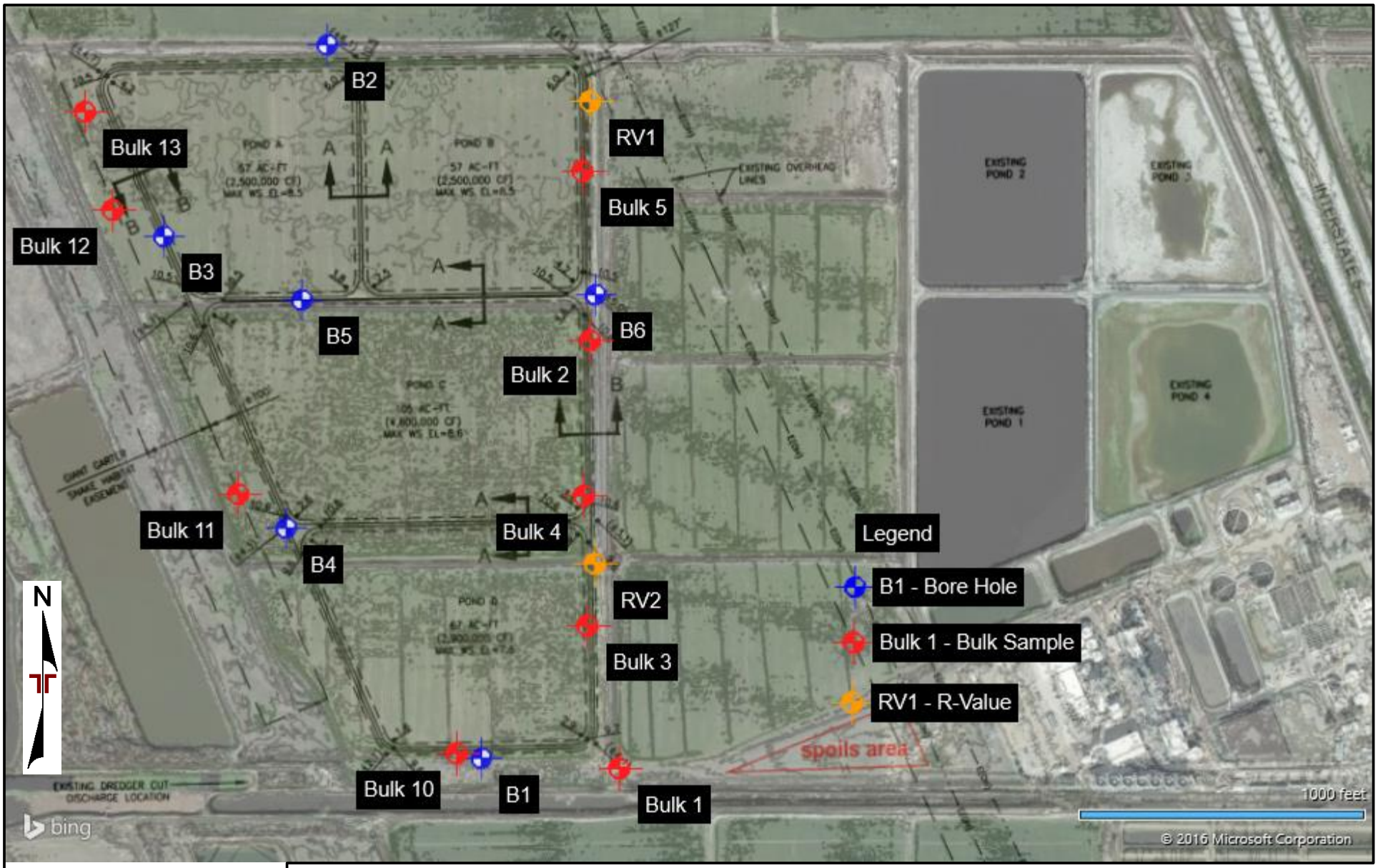
Project Manager: PCD	Project No. NA165098
Drawn by: CBC	Scale: 1"=2,000'
Checked by: PCD	File Name: N/A
Approved by: PCD	Date: Dec. 2016

Terracon
902 Industrial Way
Lodi, CA 95240-3106

SITE LOCATION

White Slough WPCF Storage Expansion Improvement Project
12751 N. Thornton Road
Lodi, CA

Exhibit
A-1



AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: PCD	Project No. NA165098
Drawn by: CBC	Scale: AS SHOWN
Checked by: PCD	File Name: N/A
Approved by: PCD	Date: Dec. 2016

Terracon
902 Industrial Way
Lodi, CA 95240-3106

EXPLORATION PLAN

White Slough WPCF Storage Expansion Improvement Project
12751 N. Thornton Road
Lodi, CA

Exhibit
A-2

Field Exploration Description

The boring locations were laid out in the field by a Terracon representative using a site plan provided by the client and utilizing hand-held GPS equipment. Ground surface elevations indicated on the boring logs were estimated based on Google earth aerial photos. The locations and elevations of the borings should be considered accurate only to the degree implied by the means and methods used to define them.

The borings were drilled with a track-mounted rotary drill rig and a truck-mounted rotary drill rig using continuous flight solid-stem augers to advance the boreholes. Samples of the soil encountered in the borings were obtained using the split-barrel sampling procedures.

In the split-barrel sampling procedure, the number of blows required to advance a standard 2-inch O.D. split-barrel sampler the last 12 inches of the typical total 18-inch penetration by means of a 140-pound hammer with a free fall of 30 inches, is the standard penetration resistance value (SPT-N). This value is used to estimate the in situ relative density of cohesionless soils and consistency of cohesive soils.

The samples were tagged for identification, sealed to reduce moisture loss, and taken to our laboratory for further examination, testing, and classification. Information provided on the boring logs attached to this report includes soil descriptions, consistency evaluations, boring depths, sampling intervals, and groundwater conditions. The borings were backfilled with auger cuttings prior to the drill crew leaving the site.

A field log of each boring was prepared by the field engineer. These logs included visual classifications of the materials encountered during drilling as well as the engineer's interpretation of the subsurface conditions between samples. Final boring logs included with this report represent the engineer's interpretation of the field logs and include modifications based on laboratory observation and tests of the samples.

BORING LOG NO. B1

PROJECT: White Slough Wastewater Treatment Facility
Tertiary Ponds

CLIENT: Petralogix Engineering, Inc
Galt, California

SITE: Thornton Road
Lodi, California

LOCATION See Exhibit A-2

Latitude: 38.08744° Longitude: -121.39494°

Approximate Surface Elev: 1 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description
		SANDY SILT (ML), fine to medium, brown
19.0	-18+/-	brown and gray
24.0	-23+/-	**LEAN CLAY WITH SAND (CL)**, fine to medium, brown
		SILTY SAND (SM), fine to medium, brown
		fine to coarse, brown

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		5-9-14 N=23	14			
5		3-0-1 N=1	17			
10		4-5-8 N=13	15			66
15		5-10-9 N=19	18			
20		12-19-19 N=38	18		30-20-10	
25		4-4-12 N=16	26			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic SPT Hammer

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Borings backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.
Elevations were estimated using Google Earth.

Notes:

WATER LEVEL OBSERVATIONS

While sampling

Terracon
902 Industrial Way
Lodi, CA

Boring Started: 5/16/2016 | Boring Completed: 5/17/2016
Drill Rig: CME-75 | Driller: C. Nix
Project No.: NA165098 | Exhibit: A-4

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL NA165098 WHITE SLOUGH WASTEWATER TREATMENT FACILITY TERTIARY PONDS.GPJ TERRACON2015.GDT 9/16/16

BORING LOG NO. B1

PROJECT: White Slough Wastewater Treatment Facility Tertiary Ponds

CLIENT: Petralogix Engineering, Inc Galt, California

SITE: Thornton Road Lodi, California

LOCATION See Exhibit A-2

Latitude: 38.08744° Longitude: -121.39494°

Approximate Surface Elev: 1 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		SILTY SAND (SM), fine to medium, brown *(continued)*							
			30	X	10-14-13 N=27	16			18
34.0	-33+/-								
		SANDY SILT (ML), fine to medium, gray to yellowish-brown							
			35	X	3-1-2 N=3	37			51
39.0	-38+/-								
		SILTY SAND (SM), fine to coarse, yellowish-brown							
			40	X	12-15-23 N=38	21			
		fine grained, brown	45	X	5-6-9 N=15	20			43
49.0	-48+/-								
		CLAYEY SAND (SC), fine grained, brown	50	X	10-10-16 N=26	17			
51.5	-50.5+/-								
		Boring Terminated at 51.5 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic SPT Hammer

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Borings backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.
Elevations were estimated using Google Earth.

Notes:

WATER LEVEL OBSERVATIONS

While sampling

Terracon
902 Industrial Way
Lodi, CA

Boring Started: 5/16/2016 | Boring Completed: 5/17/2016

Drill Rig: CME-75 | Driller: C. Nix

Project No.: NA165098 | Exhibit: A-4

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL NA165098 WHITE SLOUGH WASTEWATER TREATMENT FACILITY TERTIARY PONDS.GPJ TERRACON2015.GDT 9/16/16

BORING LOG NO. B2

PROJECT: White Slough Wastewater Treatment Facility Tertiary Ponds

CLIENT: Petralogix Engineering, Inc Galt, California

SITE: Thornton Road Lodi, California

LOCATION See Exhibit A-2

Latitude: 38.09429° Longitude: -121.39682°

Approximate Surface Elev: 13 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description
		SILTY SAND (SM), fine to medium, dark brown
		yellowish-brown
9.0	4+/-	
		POORLY GRADED SAND (SP), fine to coarse, brown and orange
14.0	-1+/-	
		CLAYEY SAND (SC), fine to medium, brown, rust mottling
19.0	-6+/-	
		LEAN CLAY WITH SAND (CL), fine grained, brown, rust mottling
24.0	-11+/-	
		SILT WITH SAND (ML), fine grained, yellowish-brown

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	X	4-4-3 N=7	10			
5	X	7-8-10 N=18	14			
10	X	4-4-7 N=11	21			3
15	X	5-7-24 N=31	16			
20	X	6-7-12 N=19	39			64
25	X	6-9-14 N=23	22		45-29-16	

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic SPT Hammer

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Borings backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.
Elevations were estimated using Google Earth.

Notes:

WATER LEVEL OBSERVATIONS

While drilling

Terracon
902 Industrial Way
Lodi, CA

Boring Started: 5/18/2016 | Boring Completed: 5/18/2016

Drill Rig: D-50 track | Driller: C. Nix

Project No.: NA165098 | Exhibit: A-5

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL NA165098 WHITE SLOUGH WASTEWATER TREATMENT FACILITY TERTIARY PONDS.GPJ TERRACON2015.GDT 9/16/16

BORING LOG NO. B2

PROJECT: White Slough Wastewater Treatment Facility Tertiary Ponds

CLIENT: Petralogix Engineering, Inc Galt, California

SITE: Thornton Road Lodi, California

LOCATION See Exhibit A-2

Latitude: 38.09429° Longitude: -121.39682°

Approximate Surface Elev: 13 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILT WITH SAND (ML), fine grained, yellowish-brown *(continued)*								
fine to medium, yellowish-brown, rust mottling		30	X	7-8-12 N=20	34			61
fine to medium, brown to light brown, rust mottling		35	X	6-6-11 N=17	32			
yellowish-brown, rust and black mottling		40	X	5-6-12 N=18	33			76
44.0	-31+/-							
SILTY SAND (SM), fine to medium, yellowish-brown, rust mottling		45	X	8-9-12 N=21	26			44
		50	X	14-14-14 N=28	22			
51.5	-38.5+/-							
Boring Terminated at 51.5 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic SPT Hammer

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Borings backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.
Elevations were estimated using Google Earth.

Notes:

WATER LEVEL OBSERVATIONS

While drilling

Terracon
902 Industrial Way
Lodi, CA

Boring Started: 5/18/2016 | Boring Completed: 5/18/2016

Drill Rig: D-50 track | Driller: C. Nix

Project No.: NA165098 | Exhibit: A-5

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL NA165098 WHITE SLOUGH WASTEWATER TREATMENT FACILITY TERTIARY PONDS.GPJ TERRACON2015.GDT 9/16/16

BORING LOG NO. B3

PROJECT: White Slough Wastewater Treatment Facility
Tertiary Ponds

CLIENT: Petralogix Engineering, Inc
Galt, California

SITE: Thornton Road
Lodi, California

LOCATION See Exhibit A-2

Latitude: 38.09245° Longitude: -121.39881°

Approximate Surface Elev: 7 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description
		SILTY SAND (SM), fine grained, dark brown to brown
		light brown to brown
		rust mottling
14.0	-7+/-	
		SANDY SILT (ML), fine grained, brown, rust and black mottling
21.5	-14.5+/-	
		Boring Terminated at 21.5 Feet

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	X	1-2-6	14	100		48
5	X	3-4-6	23	92		
10	X	11-15-19	27	97		48
15	X	10-14-16	31	85	36-33-3	
20	X	9-6-7	23	98		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic SPT Hammer

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Borings backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.
Elevations were estimated using Google Earth.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
902 Industrial Way
Lodi, CA

Boring Started: 5/17/2016 | Boring Completed: 5/17/2016
Drill Rig: D-50 track | Driller: C. Nix
Project No.: NA165098 | Exhibit: A-6

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL NA165098 WHITE SLOUGH WASTEWATER TREATMENT FACILITY TERTIARY PONDS.GPJ TERRACON2015.GDT 9/16/16

BORING LOG NO. B4

PROJECT: White Slough Wastewater Treatment Facility
Tertiary Ponds

CLIENT: Petralogix Engineering, Inc
Galt, California

SITE: Thornton Road
Lodi, California

LOCATION See Exhibit A-2

Latitude: 38.08965° Longitude: -121.39732°

Approximate Surface Elev: 4 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description
		SANDY LEAN CLAY (CL), fine grained, black
4.0	0+/-	
		SILTY SAND (SM), fine grained, light brown
		fine to medium, dark brown
14.0	-10+/-	
		SANDY SILT (ML), fine to medium, brown, black mottling
19.0	-15+/-	
		POORLY GRADED SAND (SP), fine to medium, brown with gray
21.5	-17.5+/-	
		Boring Terminated at 21.5 Feet

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	X	4-6-6	16	98		
5	X	2-3-7	28	90		48
10	X	4-6-8	27	91		
15	X	6-10-18	30	92	44-32-12	
20	X	4-10-18	26	96		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic SPT Hammer

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Borings backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.
Elevations were estimated using Google Earth.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
902 Industrial Way
Lodi, CA

Boring Started: 5/18/2016 | Boring Completed: 5/18/2016
Drill Rig: D-50 track | Driller: C. Nix
Project No.: NA165098 | Exhibit: A-7

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL NA165098 WHITE SLOUGH WASTEWATER TREATMENT FACILITY TERTIARY PONDS.GPJ TERRACON2015.GDT 9/16/16

BORING LOG NO. B5

PROJECT: White Slough Wastewater Treatment Facility Tertiary Ponds

CLIENT: Petralogix Engineering, Inc Galt, California

SITE: Thornton Road Lodi, California

LOCATION See Exhibit A-2

Latitude: 38.09184° Longitude: -121.39713°

Approximate Surface Elev: 8 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), fine grained, dark brown to brown									
				X	1-3-9	14	117		29
4.0	4+/-								
CLAYEY SAND (SC), fine grained, light brown to brown		5							
				X	20-21-29	23	93		
9.0	-1+/-								
SANDY LEAN CLAY (CL), fine grained, brown and orange		10							
				X	20-8-3	14	112		
14.0	-6+/-								
SANDY SILT (ML), fine grained, yellowish-brown		15							
				X	3-7-10	17	109		51
		20							
				X	6-12-19	17	107		
21.5	-13.5+/-								
Boring Terminated at 21.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic SPT Hammer

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Borings backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.
Elevations were estimated using Google Earth.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
902 Industrial Way
Lodi, CA

Boring Started: 5/18/2016	Boring Completed: 5/18/2016
Drill Rig: D-50 track	Driller: C. Nix
Project No.: NA165098	Exhibit: A-8

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL NA165098 WHITE SLOUGH WASTEWATER TREATMENT FACILITY TERTIARY PONDS.GPJ TERRACON2015.GDT 9/16/16

BORING LOG NO. B6

PROJECT: White Slough Wastewater Treatment Facility Tertiary Ponds

CLIENT: Petralogix Engineering, Inc Galt, California

SITE: Thornton Road Lodi, California

LOCATION See Exhibit A-2

Latitude: 38.09189° Longitude: -121.39355°

Approximate Surface Elev: 7 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		SANDY SILT (ML), fine grained, black to brown							
				X	4-5-7	14	117		56
4.0	3+/-								
		SILTY SAND (SM), fine grained, brown							
			5	X	2-2-3	23	93		
		fine to coarse, brown, rust mottling							
			10	X	4-6-9	14	112		26
			15	X	11-15-18	17	109		
			20	X	11-18-26	17	107		
21.0	-14+/-								
21.5	-14.5+/-	**POORLY GRADED SAND (SP)**, fine to coarse, brown and orange							
		Boring Terminated at 21.5 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic SPT Hammer

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Borings backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.
Elevations were estimated using Google Earth.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
902 Industrial Way
Lodi, CA

Boring Started: 5/18/2016 | Boring Completed: 5/18/2016

Drill Rig: D-50 track | Driller: C. Nix

Project No.: NA165098 | Exhibit: A-9

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL NA165098 WHITE SLOUGH WASTEWATER TREATMENT FACILITY TERTIARY PONDS.GPJ TERRACON2015.GDT 9/16/16

APPENDIX B
LABORATORY TESTING

Laboratory Testing

Soil samples were tested in the laboratory to measure their natural water content and unit weights. A calibrated hand penetrometer was used to estimate the approximate unconfined compressive strength of some samples. The calibrated hand penetrometer has been correlated with unconfined compression tests and provides a better estimate of soil consistency than visual examination alone. The test results are provided on the boring logs included in Appendix A.

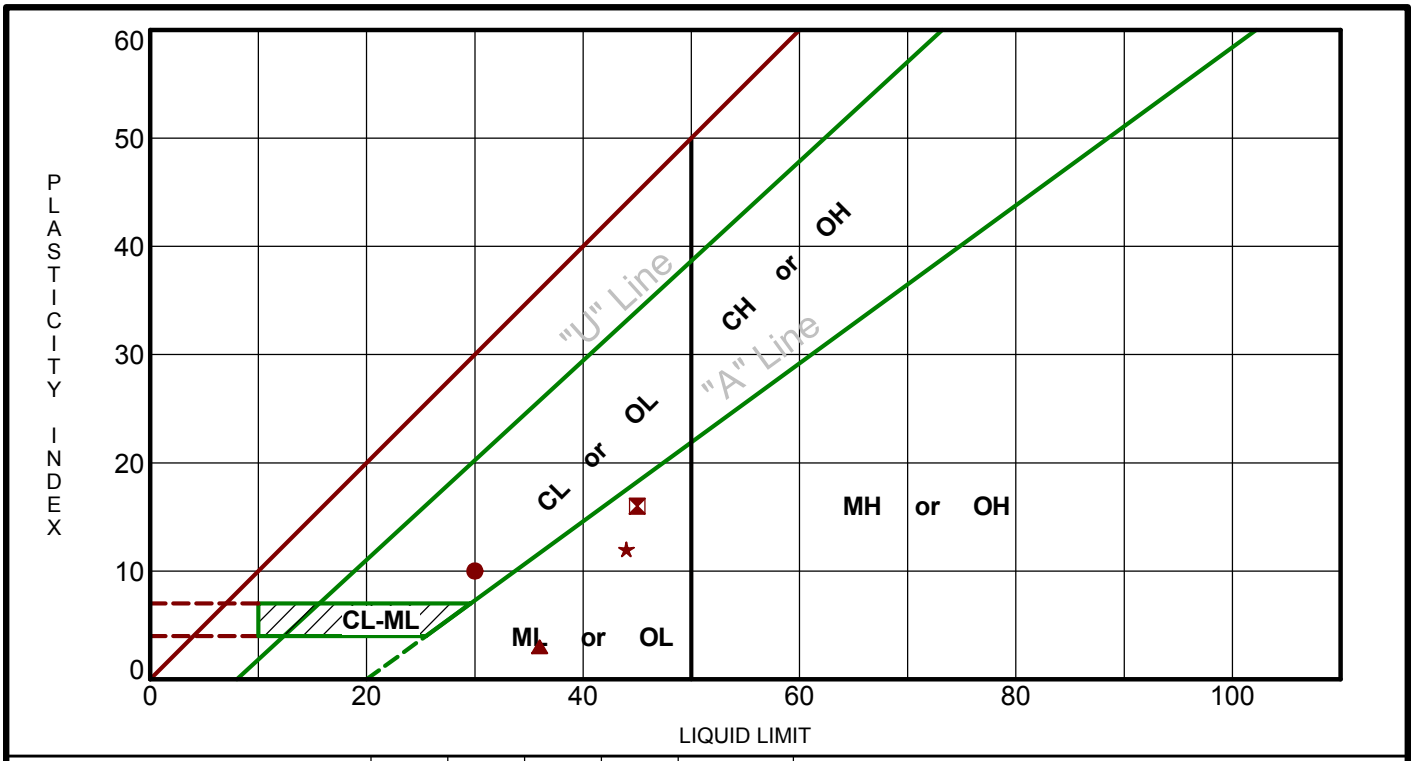
Descriptive classifications of the soils indicated on the boring logs are in accordance with the enclosed General Notes and the Unified Soil Classification System. Also shown are estimated Unified Soil Classification Symbols. A brief description of this classification system is attached to this report. All classification was by visual manual procedures. Selected samples were further classified using the results of Atterberg limits and Wash No. 200 testing. The Atterberg limit test and Wash No. 200 test results are also provided on the boring logs.

Bulk samples obtained by Petrologix from within the proposed pond construction area were delivered to our Lodi laboratory. Selected samples were tested for Atterberg limits and Wash No. 200 testing. A summary of laboratory test results of the Petrologix and Terracon samples is included in this appendix.

Two Resistance Value (R-value) tests were also performed on near surface samples. The R-value test results are also included in this appendix.

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
● B1	20 - 21.5	30	20	10			
⊠ B2	25 - 26.5	45	29	16			
▲ B3	15 - 16.5	36	33	3			
★ B4	15 - 16.5	44	32	12			

PROJECT: White Slough Wastewater Treatment Facility Tertiary Ponds

SITE: Thornton Road Lodi, California

Terracon
902 Industrial Way
Lodi, CA

PROJECT NUMBER: NA165098

CLIENT: Petralogix Engineering, Inc Galt, California

EXHIBIT: B-2

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. ATTERBERG LIMITS NA165098 WHITE SLOUGH WASTEWATER TREATMENT FACILITY TERTIARY PONDS.GPJ TERRACON2015.GDT 9/16/16

Petrologix Samples Test Results

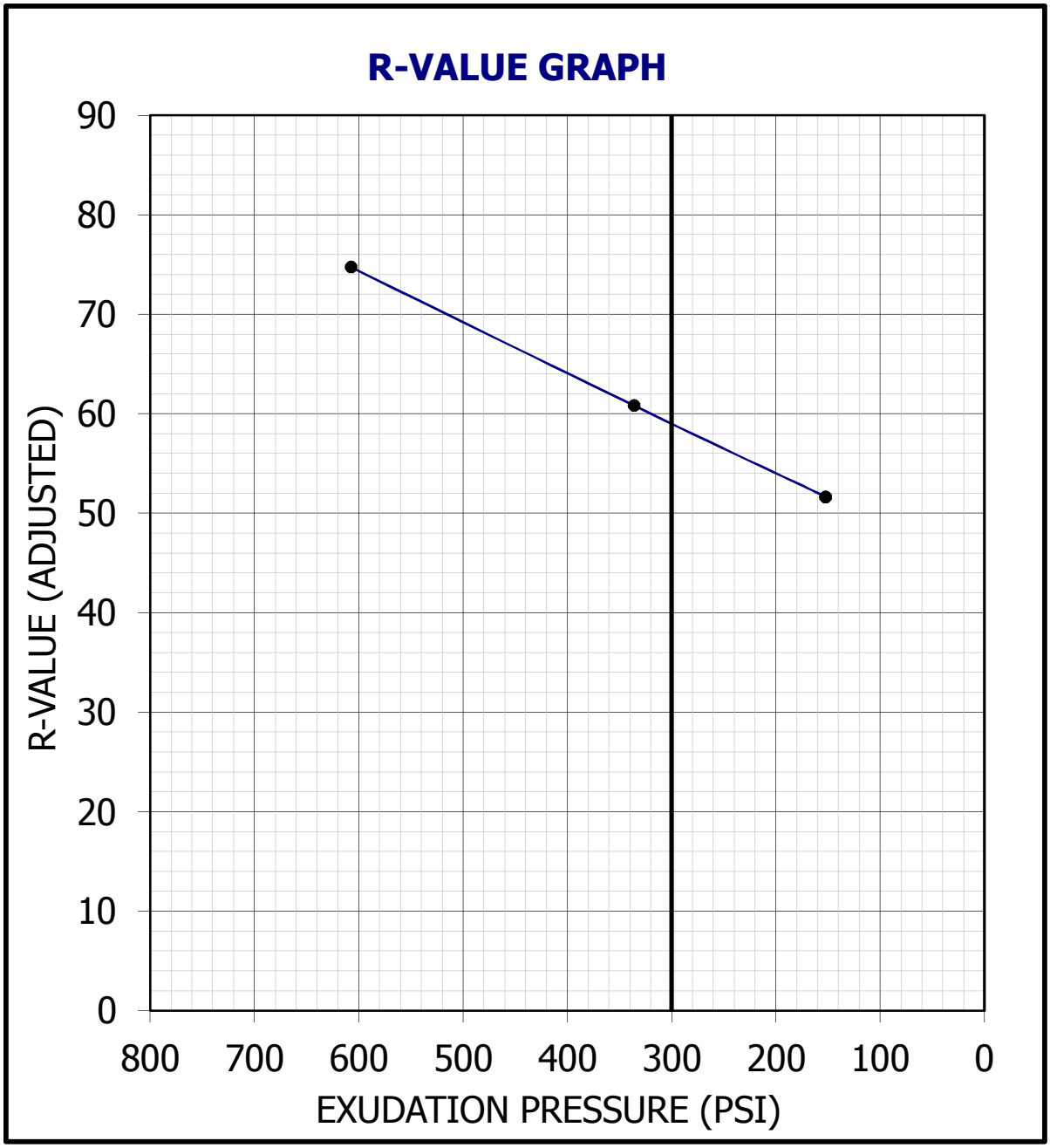
Sample ID	Liquid Limit	Plasticity Index	Passing No. 200
Bulk 1			38
Bulk 2	25	12	61
Bulk 3	34	16	65
Bulk 4	30	13	66
Bulk 5			34
Bulk 10	31	14	60
Bulk 11	30	13	56
Bulk 12	31	12	50
Bulk 13			37

Terracon Samples Test Results

Boring No.	Depth, ft.	Liquid Limit	Plasticity Index	Passing No. 200
B1	10			66
B1	20	30	10	
B1	30			18
B1	35			51
B1	45			43
B2	10			3
B2	20			64
B2	25	45	16	
B2	30			61
B2	40			76
B2	45			44
B3	1			48
B3	10			48
B3	15	36	3	
B4	5			48
B4	15	44	12	
B5	1			29
B5	15			51
B6	1			56
B6	10			26

Exhibit B-3

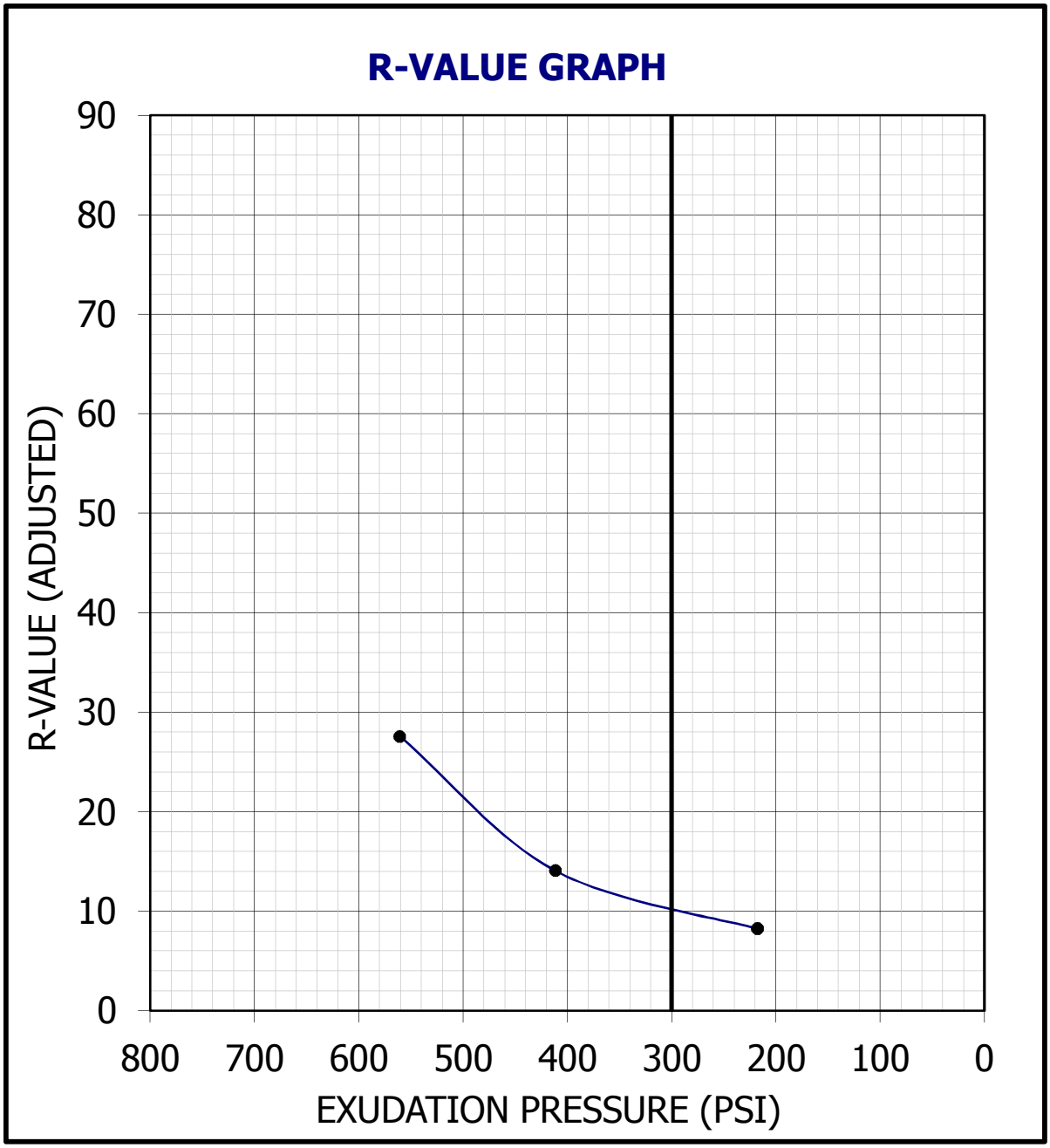
JOB NAME: White Slough WPCF JOB #: NA165098
SAMPLE NUMBER: RV_1



R-VALUE AT 300 PSI EXUDATION PRESSURE: 59

Exhibit B-4

JOB NAME: White Slough WPCF JOB #: NA165098
SAMPLE NUMBER: RV2



R-VALUE AT 300 PSI EXUDATION PRESSURE: 10

Exhibit B-5

APPENDIX C
SUPPORTING DOCUMENTS

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

Auger	Split Spoon
Modified Cal	Macro Core
Ring Sampler	Rock Core
Grab Sample	No Recovery

WATER LEVEL

- Water Initially Encountered
- Water Level After a Specified Period of Time
- Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42
			Hard	> 8,000	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

Exhibit: C-1

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K,L,M,N]
			Liquid limit - not dried			Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K,L,M,P]
			Liquid limit - not dried			Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.

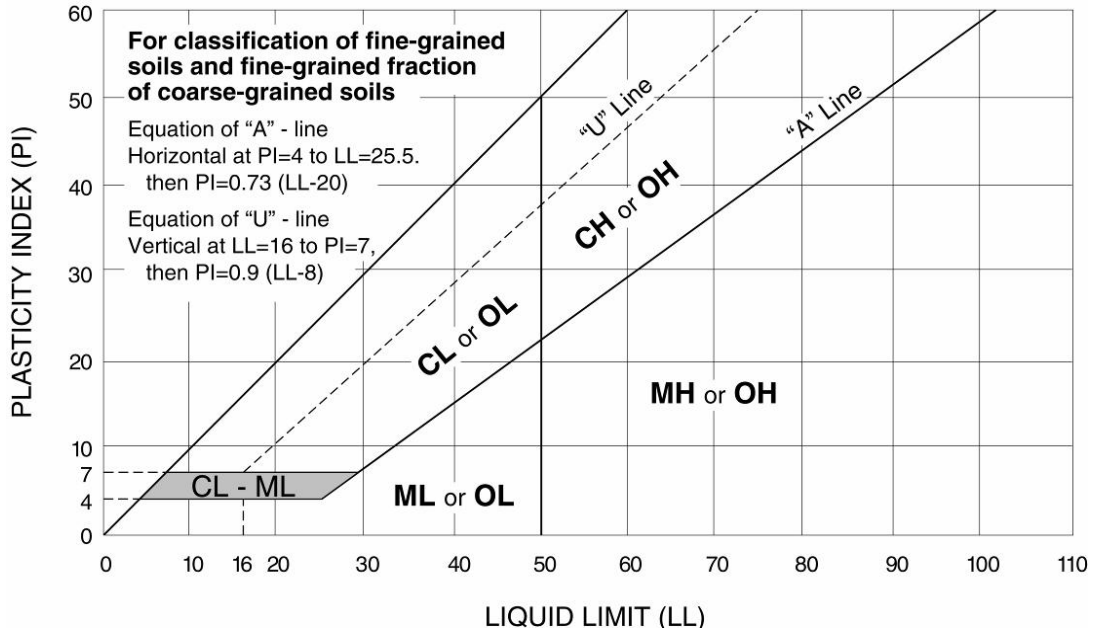


Exhibit: C-2

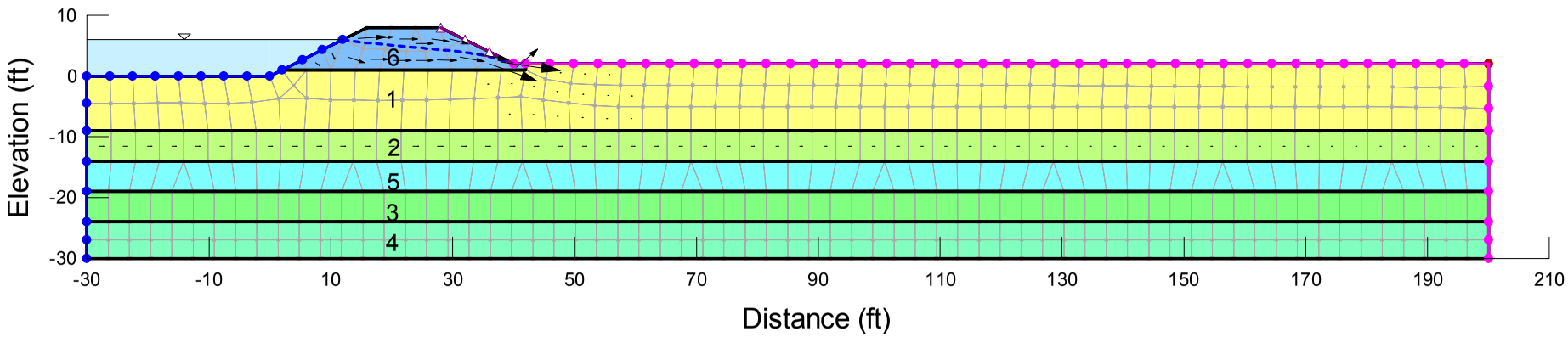
Materials

1 Silty Sand
2 Poorly Graded Sand
3 Lean Clay
4 Silt
5 Clayey Sand
6 Compacted Silty Sand

White Slough Wastewater Treatment Facility Tertiary Ponds

NA165098

Name: Silty Sand Model: Saturated Only Sat Kx: 3e-006 ft/sec
Name: Poorly Graded Sand Model: Saturated Only Sat Kx: 0.0003 ft/sec
Name: Lean Clay Model: Saturated Only Sat Kx: 3e-008 ft/sec
Name: Silt Model: Saturated Only Sat Kx: 3e-007 ft/sec
Name: Clayey Sand Model: Saturated Only Sat Kx: 3e-006 ft/sec
Name: Compacted Silty Sand Model: Saturated Only Sat Kx: 0.0003 ft/sec



Slope Stability Analysis

Materials

1 Silty Sand
2 Poorly Graded Sand
3 Lean Clay
4 Silt
5 Clayey Sand
6 Compacted Silty Sand

Name: Silty Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 25 psf Phi': 32 °
Name: Poorly Graded Sand Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 20 psf Phi': 36 °
Name: Lean Clay Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 500 psf Phi': 0 °
Name: Silt Model: Mohr-Coulomb Unit Weight: 115 pcf Cohesion': 250 psf Phi': 0 °
Name: Clayey Sand Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 75 psf Phi': 32 °
Name: Compacted Silty Sand Model: Mohr-Coulomb Unit Weight: 120 pcf Cohesion': 25 psf Phi': 36 °

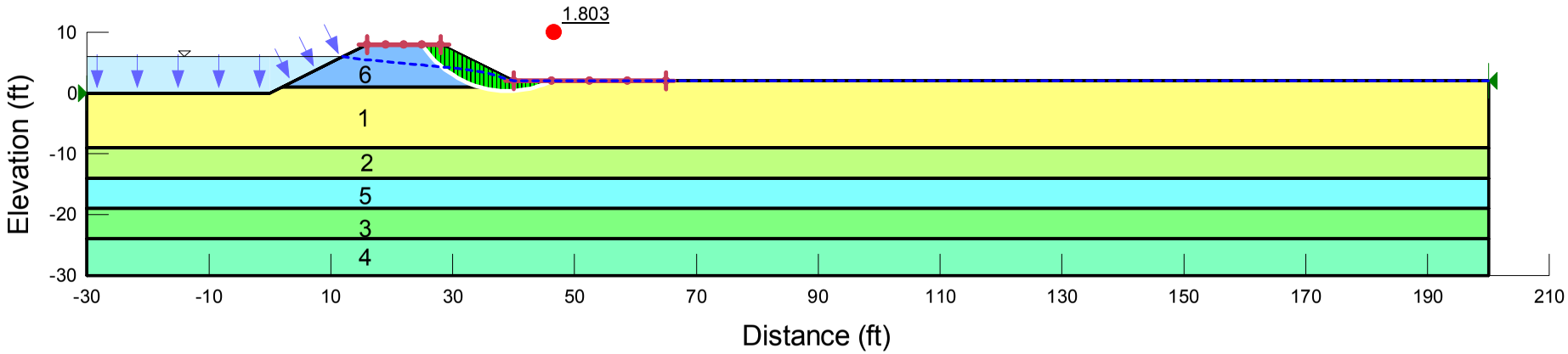


Exhibit C-4

USGS Design Maps Detailed Report

ASCE 7-10 Standard (38.09106°N, 121.39622°W)

Site Class D – "Stiff Soil", Risk Category I/II/III

Section 11.4.1 — Mapped Acceleration Parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_S) and 1.3 (to obtain S_1). Maps in the 2010 ASCE-7 Standard are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 11.4.3.

From Figure 22-1 [1] S_S = 0.881 g

From Figure 22-2 [2] S_1 = 0.333 g

Section 11.4.2 — Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class D, based on the site soil properties in accordance with Chapter 20.

Table 20.3–1 Site Classification

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index PI > 20, • Moisture content w ≥ 40%, and • Undrained shear strength $\bar{s}_u$ < 500 psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft = 0.0479 kN/m

Exhibit C-5

Section 11.4.3 — Site Coefficients and Risk–Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameters

Table 11.4–1: Site Coefficient F_a

Site Class	Mapped MCE_R Spectral Response Acceleration Parameter at Short Period				
	$S_S \leq 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \geq 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_S

For Site Class = D and S_s = 0.881 g, F_a = 1.148

Table 11.4–2: Site Coefficient F_v

Site Class	Mapped MCE_R Spectral Response Acceleration Parameter at 1–s Period				
	$S_1 \leq 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \geq 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_1

For Site Class = D and S_1 = 0.333 g, F_v = 1.733

Exhibit C-5

Equation (11.4–1): $S_{MS} = F_a S_S = 1.148 \times 0.881 = 1.011$ g

Equation (11.4–2): $S_{M1} = F_v S_1 = 1.733 \times 0.333 = 0.578$ g

Section 11.4.4 — Design Spectral Acceleration Parameters

Equation (11.4–3): $S_{DS} = ⅔\ S_{MS} = ⅔ \times 1.011 = 0.674$ g

Equation (11.4–4): $S_{D1} = ⅔\ S_{M1} = ⅔ \times 0.578 = 0.385$ g

Section 11.4.5 — Design Response Spectrum

From Figure 22-12 [3] $T_L = 12$ seconds

Figure 11.4–1: Design Response Spectrum

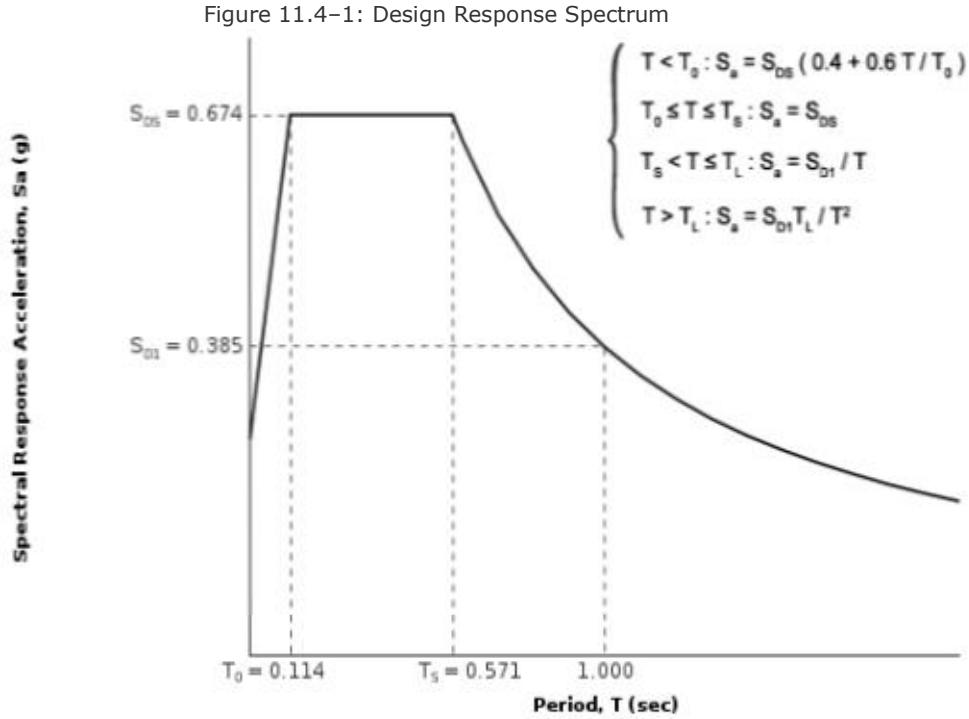


Exhibit C-5

Section 11.4.6 — Risk-Targeted Maximum Considered Earthquake (MCE_R) Response Spectrum

The MCE_R Response Spectrum is determined by multiplying the design response spectrum above by 1.5.

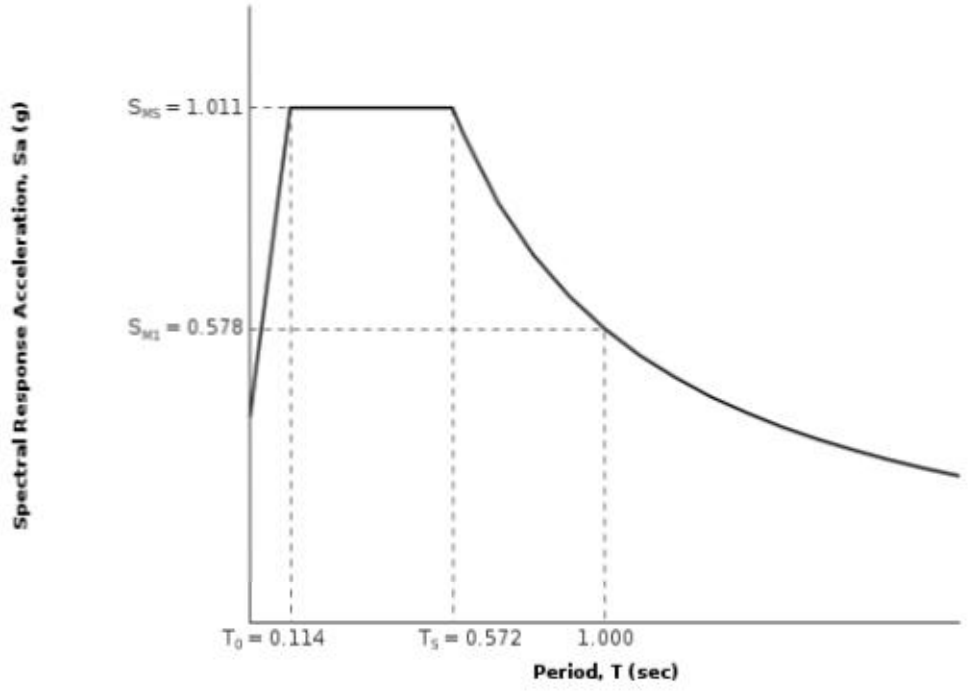


Exhibit C-5

Section 11.8.3 — Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

From Figure 22-7 [4] PGA = 0.309

Equation (11.8–1): $PGA_M = F_{PGA}PGA = 1.191 \times 0.309 = 0.368$ g

Table 11.8–1: Site Coefficient F_{PGA}

Site Class	Mapped MCE Geometric Mean Peak Ground Acceleration, PGA				
	PGA ≤ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA ≥ 0.50
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of PGA

For Site Class = D and PGA = 0.309 g, F_{PGA} = 1.191

Section 21.2.1.1 — Method 1 (from Chapter 21 – Site-Specific Ground Motion Procedures for Seismic Design)

From Figure 22-17 [5] C_{RS} = 1.082

From Figure 22-18 [6] C_{R1} = 1.130

Exhibit C-5

Section 11.6 — Seismic Design Category

Table 11.6-1 Seismic Design Category Based on Short Period Response Acceleration Parameter

VALUE OF S_{DS}	RISK CATEGORY		
	I or II	III	IV
$S_{DS} < 0.167g$	A	A	A
$0.167g \le S_{DS} < 0.33g$	B	B	C
$0.33g \le S_{DS} < 0.50g$	C	C	D
$0.50g \le S_{DS}$	D	D	D

For Risk Category = I and S_{DS} = 0.674 g, Seismic Design Category = D

Table 11.6-2 Seismic Design Category Based on 1-S Period Response Acceleration Parameter

VALUE OF S_{D1}	RISK CATEGORY		
	I or II	III	IV
$S_{D1} < 0.067g$	A	A	A
$0.067g \le S_{D1} < 0.133g$	B	B	C
$0.133g \le S_{D1} < 0.20g$	C	C	D
$0.20g \le S_{D1}$	D	D	D

For Risk Category = I and S_{D1} = 0.385 g, Seismic Design Category = D

Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 11.6-1 or 11.6-2" = D

Note: See Section 11.6 for alternative approaches to calculating Seismic Design Category.

References

1. *Figure 22-1*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-1.pdf
2. *Figure 22-2*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-2.pdf
3. *Figure 22-12*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-12.pdf
4. *Figure 22-7*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-7.pdf
5. *Figure 22-17*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-17.pdf
6. *Figure 22-18*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-18.pdf

Exhibit C-5

*** Deaggregation of Seismic Hazard at One Period of Spectral Accel. ***
*** Data from U.S.G.S. National Seismic Hazards Mapping Project, 2008 version ***
PSHA Deaggregation. %contributions. site: NA165098 long: 121.396 W., lat: 38.091 N.
Vs30(m/s)= 230.0 (some WUS atten. models use Site Class not Vs30).
NSHMP 2007-08 See USGS OFR 2008-1128. dM=0.2 below
Return period: 2475 yrs. Exceedance PGA =0.4027 g. Weight * Computed_Rate_Ex 0.406E-03
#Pr[at least one eq with median motion>=PGA in 50 yrs]=0.00051
#This deaggregation corresponds to Mean Hazard w/all GMPEs

DIST(KM)	MAG(MW)	ALL_EPS	EPSILON>2	1<EPS<2	0<EPS<1	-1<EPS<0	-2<EPS<-1	EPS<-2
6.8	5.05	2.733	0.666	1.641	0.425	0.000	0.000	0.000
13.7	5.05	0.812	0.749	0.063	0.000	0.000	0.000	0.000
7.0	5.20	5.206	1.032	3.014	1.160	0.000	0.000	0.000
13.9	5.20	1.973	1.614	0.359	0.000	0.000	0.000	0.000
22.6	5.21	0.187	0.187	0.000	0.000	0.000	0.000	0.000
7.2	5.40	4.726	0.736	2.515	1.453	0.023	0.000	0.000
14.1	5.40	2.373	1.603	0.770	0.000	0.000	0.000	0.000
23.2	5.41	0.423	0.423	0.000	0.000	0.000	0.000	0.000
7.3	5.60	4.057	0.527	2.014	1.419	0.097	0.000	0.000
14.3	5.60	2.532	1.339	1.193	0.000	0.000	0.000	0.000
23.8	5.60	0.721	0.717	0.004	0.000	0.000	0.000	0.000
34.9	5.62	0.063	0.063	0.000	0.000	0.000	0.000	0.000
7.5	5.80	3.310	0.372	1.594	1.228	0.115	0.000	0.000
14.4	5.80	2.445	1.035	1.397	0.012	0.000	0.000	0.000
24.2	5.80	0.971	0.906	0.065	0.000	0.000	0.000	0.000
35.1	5.81	0.177	0.177	0.000	0.000	0.000	0.000	0.000
7.5	6.01	3.583	0.337	1.758	1.401	0.088	0.000	0.000
14.6	6.01	2.755	0.906	1.756	0.093	0.000	0.000	0.000
24.3	6.00	1.073	0.905	0.167	0.000	0.000	0.000	0.000
34.0	6.02	0.435	0.435	0.000	0.000	0.000	0.000	0.000
43.7	6.01	0.132	0.132	0.000	0.000	0.000	0.000	0.000
8.1	6.20	5.100	0.454	2.552	2.027	0.067	0.000	0.000
16.1	6.20	2.517	0.773	1.650	0.094	0.000	0.000	0.000
25.2	6.20	1.174	0.877	0.297	0.000	0.000	0.000	0.000
34.2	6.20	0.616	0.596	0.019	0.000	0.000	0.000	0.000
44.2	6.22	0.316	0.316	0.000	0.000	0.000	0.000	0.000
53.5	6.21	0.091	0.091	0.000	0.000	0.000	0.000	0.000
8.0	6.40	4.453	0.324	1.882	2.143	0.104	0.000	0.000
15.7	6.40	2.632	0.586	1.832	0.213	0.000	0.000	0.000
25.2	6.40	1.355	0.814	0.541	0.000	0.000	0.000	0.000
34.8	6.40	0.750	0.671	0.079	0.000	0.000	0.000	0.000
44.8	6.47	3.235	2.977	0.258	0.000	0.000	0.000	0.000
55.1	6.45	0.482	0.482	0.000	0.000	0.000	0.000	0.000
63.1	6.43	0.098	0.098	0.000	0.000	0.000	0.000	0.000
74.9	6.46	0.129	0.129	0.000	0.000	0.000	0.000	0.000
6.0	6.60	1.340	0.082	0.484	0.692	0.083	0.000	0.000
14.5	6.60	0.757	0.140	0.523	0.094	0.000	0.000	0.000
24.9	6.60	0.506	0.277	0.229	0.000	0.000	0.000	0.000
35.9	6.60	0.181	0.155	0.026	0.000	0.000	0.000	0.000
44.3	6.60	4.735	4.009	0.726	0.000	0.000	0.000	0.000
55.6	6.59	1.701	1.649	0.051	0.000	0.000	0.000	0.000
62.5	6.60	0.463	0.463	0.000	0.000	0.000	0.000	0.000
75.5	6.63	0.334	0.334	0.000	0.000	0.000	0.000	0.000
80.8	6.58	0.062	0.061	0.000	0.000	0.000	0.000	0.000
6.2	6.80	1.057	0.060	0.358	0.569	0.070	0.000	0.000
14.5	6.80	0.855	0.133	0.568	0.154	0.000	0.000	0.000
24.7	6.80	0.408	0.175	0.233	0.000	0.000	0.000	0.000
34.8	6.80	0.188	0.145	0.043	0.000	0.000	0.000	0.000
44.4	6.76	4.698	3.190	1.508	0.000	0.000	0.000	0.000
55.4	6.76	2.198	1.907	0.291	0.000	0.000	0.000	0.000
62.0	6.77	1.197	1.141	0.055	0.000	0.000	0.000	0.000
75.8	6.79	0.964	0.964	0.000	0.000	0.000	0.000	0.000
81.9	6.79	0.085	0.085	0.000	0.000	0.000	0.000	0.000
6.3	6.95	0.417	0.023	0.136	0.230	0.030	0.000	0.000
14.6	6.95	0.439	0.060	0.279	0.100	0.000	0.000	0.000

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24.1	6.95	0.169	0.060	0.109	0.000	0.000	0.000	0.000
33.3	6.95	0.077	0.051	0.026	0.000	0.000	0.000	0.000
43.8	6.95	2.552	1.453	1.099	0.000	0.000	0.000	0.000
55.4	6.94	0.637	0.506	0.130	0.000	0.000	0.000	0.000
61.9	6.98	1.655	1.330	0.325	0.000	0.000	0.000	0.000
76.0	6.98	0.671	0.660	0.011	0.000	0.000	0.000	0.000
81.8	6.98	0.478	0.478	0.000	0.000	0.000	0.000	0.000
90.9	7.03	0.353	0.352	0.001	0.000	0.000	0.000	0.000
44.0	7.13	0.510	0.237	0.273	0.000	0.000	0.000	0.000
61.9	7.20	0.174	0.121	0.053	0.000	0.000	0.000	0.000
76.3	7.16	0.624	0.546	0.079	0.000	0.000	0.000	0.000
81.3	7.15	0.311	0.299	0.012	0.000	0.000	0.000	0.000
91.0	7.20	0.169	0.168	0.001	0.000	0.000	0.000	0.000
76.2	7.36	0.312	0.235	0.077	0.000	0.000	0.000	0.000
81.9	7.31	0.052	0.045	0.007	0.000	0.000	0.000	0.000
105.0	7.39	0.151	0.151	0.000	0.000	0.000	0.000	0.000
105.9	7.57	0.322	0.322	0.000	0.000	0.000	0.000	0.000
112.9	7.55	0.058	0.058	0.000	0.000	0.000	0.000	0.000
107.5	7.79	0.793	0.789	0.004	0.000	0.000	0.000	0.000
105.5	8.01	1.629	1.372	0.257	0.000	0.000	0.000	0.000
105.0	8.21	0.245	0.189	0.055	0.000	0.000	0.000	0.000
326.3	8.80	0.103	0.103	0.000	0.000	0.000	0.000	0.000
326.3	9.00	0.607	0.607	0.000	0.000	0.000	0.000	0.000
339.2	9.00	0.143	0.143	0.000	0.000	0.000	0.000	0.000
351.6	9.00	0.059	0.059	0.000	0.000	0.000	0.000	0.000
326.3	9.20	0.351	0.262	0.089	0.000	0.000	0.000	0.000
339.2	9.20	0.085	0.075	0.011	0.000	0.000	0.000	0.000

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Summary statistics for above PSHA PGA  deaggregation, R=distance, e=epsilon:
Contribution from this GMPE(%):  100.0
 Mean src-site R=   32.4 km; M= 6.25; eps0=   1.39. Mean calculated for all sources.
Modal src-site R=    7.0 km; M= 5.20; eps0=   0.85 from peak (R,M) bin
 MODE R*=  44.5km; M*= 6.60; EPS.INTERVAL:> 2 sigma      % CONTRIB.=  4.009

Principal sources (faults, subduction, random seismicity having > 3% contribution)
Source Category:                 % contr.  R(km)    M   epsilon0 (mean values).
California B-faults Char           16.31    50.0   6.75    1.97
California B-faults GR              5.18    47.9   6.62    2.08
California A-faults                 9.62    82.0   7.25    2.20
CA Compr. crustal gridded          67.31    13.4   5.89    1.06
Individual fault hazard details if its contribution to mean hazard > 2%:
Fault ID                         % contr.   Rcd(km)  M   epsilon0 Site-to-src azimuth(d)
Mount Diablo Thrust D2.1&D2.4, C    2.93    47.4   6.62    2.02    -136.7
Great Valley 7 Char                 3.26    41.8   6.74    1.87    -164.2
Greenville Connected Char           2.89    44.7   6.90    1.71    -121.2
Green Valley Connected Char         2.73    56.3   6.72    2.09    -112.4
#*********End of deaggregation corresponding to Mean Hazard w/all GMPEs  *********#

******************** Northern California ****************************************
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Exhibit C-6