# APPENDIX D

***Geotechnical Study***

KLEINFELDER
Bright People. Right Solutions.

May 11, 2015
Project No. 20155150.001A

**Merlone Geier Partners**
3580 Carmel Mountain Road
San Diego, California 90744

Attention: Mr. Stephen W. Moss

**Subject: Geotechnical Study**
**Proposed Five Lagunas Redevelopment**
**24155 Laguna Hills Mall**
**Laguna Hills, California**

Dear Mr. Moss:

Kleinfelder is pleased to present this draft report summarizing our geotechnical study for the proposed redevelopment of the Five Lagunas mall located in Laguna Hills, California. The purpose of our geotechnical study was to evaluate subsurface soil conditions beneath the site and to provide geotechnical recommendations for design and construction. The conclusions and recommendations presented in this report are subject to the limitations presented in Section 6. An information sheet from the Geoprofessional Business Association (GBA) follows the Table of Contents and provides important information about this geotechnical engineering report

We appreciate the opportunity to provide geotechnical engineering services to you on this project. If you have any questions regarding this report or if we can be of further service, please contact the undersigned at (949) 727-4466.

Respectfully submitted,

**KLEINFELDER**

REGISTERED PROFESSIONAL ENGINEER MARIUSZ P. SIERADZKI No. GE 2864 GEOTECHNICAL STATE OF CALIFORNIA

Mariusz P. Sieradzki, PhD, PE, GE
Senior Principal Geotechnical Engineer

Brian E. Crystal, PE, GE
Senior Project Manager

REGISTERED PROFESSIONAL ENGINEER BRIAN E. CRYSTAL GE 2639 EXP. 6/30/16 GEOTECHNICAL STATE OF CALIFORNIA

MPS:BEC:mm

# GEOTECHNICAL STUDY
# PROPOSED FIVE LAGUNAS REDEVELOPMENT
# 24155 LAGUNA HILLS MALL
# LAGUNA HILLS, CALIFORNIA

**MAY 11, 2015**

A Report Prepared for:

Mr. Stephen W. Moss
**Merlone Geier Partners**
3580 Carmel Mountain Road
San Diego, California 90744

**GEOTECHNICAL STUDY**
**PROPOSED FIVE LAGUNAS REDEVELOPMENT**
**24155 LAGUNA HILLS MALL**
**LAGUNA HILLS, CALIFORNIA**


Prepared by:

Mariusz P. Sieradzki, PhD, PE, GE
Senior Principal Geotechnical Engineer


Reviewed by:

Brian E. Crystal, PE, GE
Senior Project Manager

**KLEINFELDER**
2 Ada, Suite 250
Irvine, California 92618
Phone: 949-727-4466
Fax: 949-727-9242

May 11, 2015
Kleinfelder Project No. 20155150.001A

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

**Section** **Page**



**TABLES**

## TABLE OF CONTENTS (Continued)

**FIGURES**



**APPENDICES**

# Important Information about Your

# Geotechnical-Engineering Report

*Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.*

*While you cannot eliminate all such risks, you can manage them. The following information is provided to help.*

## Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

## Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

## A Geotechnical-Engineering Report Is Based on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

## Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical-engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

## Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

## A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

## A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical-engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

## Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

## Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

## Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

## Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

## Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold-prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical-engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold-prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

## Rely, on Your GBA-Member Geotechncial Engineer for Additional Assistance

Membership in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk confrontaton techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your GBA-member geotechnical engineer for more information.

GEOPROFESSIONAL BUSINESS ASSOCIATION

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@geoprofessional.org www.geoprofessional.org

# 1 INTRODUCTION

This report presents the results of our geotechnical study for the proposed redevelopment of the Five Lagunas Mall located in Laguna Hills, California. The location of the project site is presented on Figure 1, Site Map. The purpose of our geotechnical study was to evaluate subsurface soil conditions beneath the site and to provide geotechnical recommendations for design and construction. The scope of our services was presented in our proposal titled, "Revised Proposal for Geotechnical Study, Proposed Five Lagunas Redevelopment, 24155 Laguna Hills Mall, Laguna Hills, California," dated March 2, 2015.

Our report includes a description of the work performed, a discussion of the geotechnical conditions observed at the site, and recommendations developed from our engineering analyses of field and laboratory data. An information sheet prepared by GBA (Geoprofessional Business Association) is also included. We recommend that all individuals utilizing this report read the limitations (Section 6.0) along with the attached GBA document.

## 1.1 PROJECT DESCRIPTION

Kleinfelder understands Merlone Geier Partners (Merlone Geier) plans to redevelop the existing Laguna Hills Mall located at 24155 Laguna Hills Mall in Laguna Hills, California. The project is located south of El Toro Road, east of Calle De La Louisa, west of Avenida De La Carlota, and north of Calle De Los Caballeros. The proposed redevelopment (Five Lagunas) will consist of: 1) demolishing the eastern portion of the mall and replacing it with two- to three-level structures for new majors, shops, outdoor shopping plaza, fitness center, and a theater; 2) constructing new building pads and new shop buildings in parking areas surrounding the main mall structure; 3) constructing a new six-level parking structure in the southwestern portion of the mall; 4) constructing a mixed-use (major retail, residential apartment housing, and a five-level parking structure) on the southeastern portion of the mall; 5) construction two five-level residential apartment complexes and six-level parking structures with one subterranean level in the southern portion of the mall; and 7) associated parking lot and site improvements.

Architectural and structural details are not currently available for the project; however, based on past experience, column loads for the two- to three-level mall structures with the theater could be up to 800 kips (450 to 500 kips dead load and 300 to 350 live load). Further, the maximum column loads for the parking structures are anticipated to be on the order of 1,200 and 600 kips for interior and exterior columns, respectively. Structural loading for the building pads and shops will be relatively light with columns load up to 75 kips and wall loads up 2 to 3 kips per lineal foot. We anticipate the finished grade of the new building areas will generally match the existing grades, with less than 3 feet of cut or fill.

In addition to the redevelopment project, we understand that some surface settlement has occurred in the storm drain easement between the existing Sears building and the mall, and Merlone Geier desires to assess the cause(s) of the settlement.

## 1.2 SCOPE OF SERVICES

The scope of our geotechnical study consisted of a literature review, subsurface explorations, geotechnical laboratory testing, engineering evaluation and analysis, and preparation of this report. A description of our scope of services performed for the geotechnical portion of the project follows.

**Task 1 – Background Data Review.** We reviewed readily-available published and unpublished geologic literature in our files and the files of public agencies, including results of our previous geotechnical investigation at the site (Kleinfelder, 2012) and selected publications prepared by the California Geological Survey (formerly known as the California Division of Mines and Geology) and the US Geological Survey. We also reviewed readily available seismic and faulting information, including data for designated earthquake fault zones as well as our in-house database of faulting in the general site vicinity.

**Task 2 – Field Exploration.** Subsurface conditions at the site were explored by drilling of 24 borings and advancing 26 cone penetration tests (CPTs). The field exploration includes 12 borings and 6 CPTs that were drilled/ advanced during a previous investigation by Kleinfelder in 2012.

Borings were drilled to depths between approximately 20 and 100 feet beneath ground surface (bgs) using truck-mounted rotary wash drilling equipment. The CPTs were advanced to depths between approximately 50 and 80 feet bgs. In addition, two hand auger borings to approximately 4 feet deep were advanced to assess the cause(s) of the settlement in the storm drain easement between the existing Sears building and the mall. The approximate location of the borings and CPTs are presented on Figure 2, Field Exploration Map.

Prior to commencement of the fieldwork, various geophysical techniques were used at the boring and CPT locations to identify potential conflicts with subsurface structures. The boring and CPT locations were also cleared for buried utilities through Underground Service Alert (USA). A Kleinfelder staff engineer supervised the field operations and logged the borings. Selected bulk and drive samples were retrieved from the borings, sealed and transported to our laboratory for further evaluation. The number of blows necessary to drive both Standard Penetration Test (SPT) and modified-California samplers were recorded. A description of the field exploration, boring logs, and CPT report, including a Graphics Key, Soil Description Key, and Rock Description Key, are presented in Appendix A.

**Task 3 – Laboratory Testing.** Laboratory testing was performed on representative bulk and drive samples to substantiate field classifications and to provide engineering parameters for geotechnical design. Laboratory testing consisted of in-situ moisture content and dry unit weight, dry density, wash sieve (% passing #200 sieve), Atterberg limits, direct shear, unconsolidated undrained (UU) triaxial shear, consolidation, R-value, expansion index, and corrosivity (pH, electrical resistivity, water-soluble sulfates, and water-soluble chlorides). A summary of the testing performed and the results are presented in Appendix B.

**Task 4 – Geotechnical Analyses.** Field and laboratory data were analyzed in conjunction with the assumed finished grades, structures layout, and structural loads to provide geotechnical recommendations for design and construction. We evaluated feasible foundation systems including constructability and compatibility constraints with the existing buildings, lateral earth pressures for retaining structures, floor slab support, pavement design, and earthwork. The potential for liquefaction and seismically-induced settlement was also evaluated. In addition, seismic parameters based on the 2013 *California Building Code* (CBC) are presented.

**Task 5 – Report Preparation.** This report summarizes the work performed, data acquired, and our findings, conclusions, and geotechnical recommendations for the design and construction of the proposed facility. Our report includes the following items:

- Vicinity map and site plan showing the approximate field exploration locations;
- Logs of borings and CPTs (Appendix A);
- Results of laboratory tests (Appendix B);
- Discussion of general site conditions;
- Discussion of general subsurface conditions as encountered in our field explorations;
- Discussion of geologic and seismic hazards;
- Evaluation of the liquefaction potential;
- Recommendations for site preparation, earthwork, fill placement, and compaction criteria;
- Recommendations for pile design (e.g., axial capacities, minimum embedment depths) and installation for various sizes of driven piles and drilled piers, including a discussion of potential site constraints (e.g., pile refusal);

- Recommendations for shallow foundation design including allowable bearing pressures, embedment depths, friction coefficient, and compatibility constrains under various loading conditions;
- Recommendations for ground improvement (the actual ground improvement design will be performed by the ground improvement contractor);
- Anticipated total and differential static and dynamic settlements for the structural loading provided;
- Recommendations for design of retaining structures and walls below grade, including active and restrained lateral earth pressures and applicable surcharge loads;
- Recommendations for floor slab and slab-on-grade support;
- Recommendations for flexible and rigid pavement structural sections for various Traffic Indices, pavement subgrade preparation, pavement drainage, and pavement maintenance;
- Recommendations for seismic design parameters in accordance with the 2013 CBC;
- Preliminary evaluation of the corrosion potential of the on-site soils and their effects on concrete and buried utilities; and
- An assessment of potential cause(s) of the settlement in the storm drain easement between the existing Sears building and the mall and provide recommendations for repair.

# 2 SITE CONDITIONS

## 2.1 SITE DESCRIPTION

The project site is located within the existing Laguna Hills Mall and is located south of El Toro Road, east of Calle De La Louisa, west of Avenida De La Carlota, and north of Calle De Los Caballeros. The existing mall structure and anchor stores are located in the central portion of the site. The remainder of the site is currently used as a parking lot and is paved with asphalt concrete.

Based on a June 2012 ATLA survey prepared by RA Smith National, topography of the developed site is relatively flat with elevations varying from approximately 345 feet to 358 feet (datum not noted).

## 2.2 SURFACE WATER CONDITIONS

Site drainage is currently by sheet flow from the currently developed facility into on-site catch basins and storm drains, or onto the adjacent bordering streets and into the local storm-drain system.

# 3 GEOLOGY

## 3.1 GEOLOGIC SETTING

The project area is located in southern Orange County along the western flank of the Peninsular Ranges Geomorphic Province of southern California (Norris and Webb, 1990). The Peninsular Ranges are a series of northwest-southeast trending mountain ranges separated by similarly trending valleys. These mountains and valleys are sub-parallel to the major faults of the area. The Peninsular Ranges Province is bounded on the east by the Colorado Desert Province and on the north by the Transverse Ranges Province. The Peninsular Ranges extend southward beyond the U.S. - Mexican border into Baja California (CGS, 2002).

The project is located along an alluvial plain of the San Joaquin Hills bordering the Irvine Basin. Uplift of the San Joaquin Hills is believed to be a result of shortening of the crust perpendicular to the southern Newport-Inglewood Fault Zone (Grant et al., 1999, 2002, 2004). Based on the geologic mapping and dating of terraces in the area (Barrie et al., 1992; Vedder et. al, 1957), this uplift is believed to have begun in the early Pleistocene and the hills became a positive topographic feature above sea level approximately 1.3 million years ago.

## 3.2 SUBSURFACE CONDITIONS

Subsurface conditions at the site generally consist of artificial fill underlain by alluvial deposits which, in turn, are underlain by siltstone bedrock of the Capistrano Formation. A discussion of the subsurface materials encountered is presented in the following sections. Descriptions of the deposits are provided in our boring logs and CPTs presented in Appendix A.

### 3.2.1 Artificial Fill

Artificial fill associated with previous grading of the site was encountered in the borings drilled at the site. The fill encountered consisted primarily of sandy clay and clayey sand and occasionally silty clay, sandy silt, and silty sand. As observed in our borings, fill was encountered up to a depth of approximately 8½ feet bgs. Deeper fills may be present at the site, such as at utility trench locations. In-situ moisture contents of the fill tested ranged between 12 to 65 percent. The fill soils with higher moisture contents (above 40 to 45 percent) may contain pieces of the Capistrano Formation, which contains diatomaceous facies.

### 3.2.2 Alluvium

Alluvial soils were observed to underlie the fill and were encountered to a depth of 50 to 60 feet bgs. The alluvial soils consisted primarily of alternating layers of soft to stiff sandy clay and loose to dense clayey sand with thin layers of clayey and sandy silt and silty sand.

### 3.2.3 Capistrano Formation

The early Pliocene-age (3.6 to 5.3 million years old) Capistrano Formation underlies the alluvial soils at the project site. This formation is also exposed in the foothills south of the project. The Capistrano Formation unconformably overlies the Monterey Formation (Edgington, 1974). The CPTs penetrating below this depth also encountered increased penetration resistance at similar depths, interpreted as penetration of the Capistrano Formation bedrock.

The Capistrano Formation consists of two lithofacies, the turbidite facies and the siltstone facies. The turbidite facies was not encountered in our borings. The siltstone facies is comprised of layers of siltstone, mudstone, silty and diatomaceous shale, with occasional lenses and interbeds of fine to medium grained to conglomeratic, poorly bedded, weakly cemented sandstone (Morton et al., 1974; Morton, 2004). The diatomaceous facies exhibit low densities and high moisture contents. Gypsum also commonly occurs as veins or “stringers” in the Capistrano Formation. In environments where gypsum occurs as a secondary mineral, groundwater usually contains high concentration of dissolved sulfates.

Soils derived from Capistrano Formation (siltstone facies) are dark gray to grayish brown and are typically comprised of clayey to silty sand, or sandy to clayey silt. These soils are weak and have a high potential for expansion and settlement when subjected to changes in moisture content (Audell and Baghoomian, 1995). For the same reasons, materials derived from Capistrano Formation are typically unsuitable for fill. The Capistrano Formation is susceptible to slope failures. In our experience throughout the area, the fine-grained lithologies of the Capistrano Formation, soils derived from them, and/or groundwater that has permeated them tend to have high concentrations of dissolved sulfate that renders them potentially corrosive to concrete and steel reinforcing.

## 3.3 GROUNDWATER

During our subsurface exploration, groundwater was encountered in the borings generally between depths of approximately 9 and 20 feet. The water level readings in the borings were taken during our field investigation. Depths to ground levels recorded on the boring logs are subject to many variables and may not be indicative of long-term equilibrium conditions. Historic high groundwater levels are mapped approximately 10 feet below the natural ground surface (CGS, 2001a).

Fluctuations of the groundwater level, localized zones of perched water, and increased soil moisture content should be anticipated during and following the rainy season. Irrigation of landscaped areas on or adjacent to the site can also cause a fluctuation of local groundwater levels.

## 3.4 FAULTING

We have reviewed the Probabilistic Seismic Hazard Maps published by the USGS and CGS (Petersen et al., 1996 and 2008; Cao et al., 2003) to assess the expected maximum magnitude earthquake to be generated on the Newport Inglewood-Rose Canyon Fault Zone and the San Joaquin Hills Blind Thrust Fault. The project is located about 14.0 kilometers (8.7 miles) northeast of the Newport-Inglewood-Rose Canyon Fault Zone. This fault is considered capable of generating a maximum credible earthquake of magnitude 6.8. The exact location of the San Joaquin Hills Blind Thrust Fault is unknown. The project is located upon the hanging wall of the San Joaquin Hills Blind Thrust Fault. Based on the information available at this time, the rupture plane of this fault is believed to be as deep as 2 kilometers (1.2 miles) beneath the ground surface and this fault is capable of generating a maximum credible earthquake of magnitude 6.6 (Cao et al., 2003).

Under the current understanding of regional seismology and tectonics, the largest maximum earthquake to impact the project may be generated by the Newport-Inglewood-Rose Canyon Fault Zone having an estimated maximum magnitude of M6.8.

## 3.5 ASSESSMENT OF POTENTIAL GEOLOGIC HAZARDS

### 3.5.1 Fault-Rupture Hazard

The site is not located within a currently delineated State of California Alquist-Priolo Earthquake Fault Zone (Bryant and Hart, 2007). The San Joaquin Hills Blind Thrust Fault is believed to be located approximately 2 kilometers beneath the ground surface. However, due to the nature of this fault, the potential for ground surface rupture is considered nil. No other known active faults have been identified on the site, thus, the potential for future surface fault rupture at the site is considered to be “low.” While fault rupture would most likely occur along previously established fault traces, future fault rupture could occur at other locations.

#### 3.5.2 Flood Hazard

Flooding occurs as a result of several factors in developed areas. These factors are rainfall rates that exceed an area's ability to absorb or control the runoff; impounded water retained behind a flood control structure (upstream-inundation); failure of a flood control structure (inundation); and tsunami.

The site is considered a Zone X site, which is an area that is determined to be outside the 0.2% annual chance floodplain, by FEMA (2006). The site is not designated by Orange County (2011) as being within the Prado Dam inundation hazard zone. Due to the site's elevated inland location and the lack of any local impounded bodies of water, we do not consider that tsunami or seiches represent potential hazards to the site.

#### 3.5.3 Landsliding

Landslides and other forms of mass wasting, including mud flows, debris flows, and soil slips occur as soil moves downslope under the influence of gravity. Landslides are frequently triggered by intense rainfall or seismic shaking. Because the site is located in a relatively flat area, we do not consider landslides or other forms of natural slope instability to represent a significant hazard to the project. The site is not within a State designated hazard zone for landslides (CGS, 2001b).

#### 3.5.4 Liquefaction

The term liquefaction describes a phenomenon in which saturated, cohesionless soils temporarily lose shear strength (liquefy) due to increased pore water pressures induced by strong, cyclic ground motions during an earthquake. Structures founded on or above potentially liquefiable soils may experience bearing capacity failures due to the temporary loss of foundation support, vertical settlements (both total and differential), and/or undergo lateral spreading. The factors known to influence liquefaction potential include soil type, relative density, grain size, confining pressure, depth to groundwater, and the intensity and duration of the seismic ground shaking. Liquefaction is most prevalent in loose to medium dense, silty, sandy, and gravelly soils below the groundwater table.

The site is within a State of California Hazard Zone for Liquefaction (CGS, 2001b). A liquefaction evaluation was performed as part of our geotechnical study. Because of the depth to groundwater and the soil types encountered during our investigation, the potential for liquefaction at the site exists in layers of medium dense sandy silt and silty sand. A description of our liquefaction analyses is provided in Section 4.2.2.

#### 3.5.5 Expansive Soils

Expansive soils are characterized by their ability to undergo significant volume changes (shrink or swell) due to variations in moisture content. Changes in soil moisture content can result from precipitation, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors and may result in unacceptable settlement or heave of structures or concrete slabs supported on grade.

The existing fill and upper younger alluvial soils (upper 10 feet) consist generally of lean clay. Expansion index testing of clay soils indicates that the potential for expansion is medium. Moisture conditioning recommendations are presented in Section 4.5 to reduce the expansion potential of the clayey soils.

#### 3.5.6 Subsidence

The site is not located in an area of known ground subsidence due to the withdrawal of subsurface fluids. Accordingly, the potential for subsidence occurring at the site due to the withdrawal of oil, gas, or water is considered remote.

# 4 CONCLUSIONS AND RECOMMENDATIONS

## 4.1 GENERAL

Based on the results of our field exploration, laboratory testing, and engineering analyses conducted during this study, it is our professional opinion that the proposed project is geotechnically feasible, provided the recommendations presented in this report are incorporated into the project design and construction. The primary geotechnical constraints for site development are the presence of undocumented artificial fill and the compressibility of the alluvial soils.

Based on the anticipated soil conditions, coupled with the anticipated high structural loads imposed by the proposed multi-level structures (the two- to three-level mall structures, parking structures, and mixed-use structures), we recommend that these multi-level structures (including any attached new retail space) be supported on a pile foundation system (driven or drilled piles). The floor slabs for these structures may be supported at grade on engineered fill following removal of undocumented fill if static and seismically-induced settlement of approximately 1 inch and up to 4 inches, respectively, is tolerable. If it is not tolerable, the slabs could be tied into the pile caps and heavily reinforced to mitigate abrupt differential settlement, or they may be structurally supported (suspended slab). As an alternative to piles, the proposed multi-level structures may be supported on a shallow foundation system on ground improved by deep soil mixing. The floor slabs may be supported at grade provided the ground improvement program considers the estimated static and seismically-induced settlement.

The proposed light, one-story structures (new shops and building pads) may be supported on a conventional shallow foundation system once remedial grading is performed; however, because of the potential for seismically-induced settlement, footings may need to be tied together with grade beams. Further discussion of the foundation support options is presented in Section 4.4.

The following opinions, conclusions, and recommendations are based on the properties of the materials encountered in the borings/CPTs, the results of the laboratory-testing program, and our engineering analyses performed. Our recommendations regarding the geotechnical aspects of the design and construction of the project are presented in the following sections. If the design grades are substantially different than what was assumed in our analyses or the proposed improvements configuration changes, our recommendations may have to be modified accordingly.

## 4.2 SEISMIC DESIGN CONSIDERATIONS

### 4.2.1 2013 CBC Seismic Design Parameters

According to ACSE/SEI 7-10 (2010), which is incorporated into the 2013 CBC by reference, sites subject to liquefaction, as discussed below, should be classified as Site Class F, which requires a site response analysis. However, ACSE/SEI 7-10 states that for a short period (less than ½ second) structure on liquefiable soils, Site Class D or E may be used instead of Site Class F to estimate design seismic loading on the structure. The selection of Site Class D or E is based on the assessment of the site soil profile assuming no liquefaction. We have assumed that the period of the structures will be less than ½ second. The assumption that the structures have a period of less than ½ second should be verified by the project structural engineer.

Based on information obtained from the investigation, published geologic literature and maps, and on our interpretation of the 2013 California Building Code (CBC) criteria, it is our opinion that the project site may be classified as Site Class E, Soft Clay Soil, according to Section 1613.3.2 of 2013 CBC and Table 20.3-1 of ASCE/SEI 7-10 (2010).

The Risk-Targeted Maximum Considered Earthquake ($MCE_R$) mapped spectral accelerations for 0.2 seconds and 1 second periods ($S_s$ and $S_1$) were estimated using Section 1613.3 of the 2013 CBC and the U.S. Geological Survey (USGS) web based application (available at http://geohazards.usgs.gov/designmaps/us/application.php). The mapped acceleration values and associated soil amplification factors ($F_a$ and $F_v$) based on the 2013 CBC and corresponding site modified spectral accelerations ($S_{MS}$ and $S_{M1}$) and design spectral accelerations ($S_{DS}$ and $S_{D1}$) are presented in Table 1 and in Appendix C – Calculations.

**Table 1**
**2013 CBC Seismic Design Parameters**

| Design Parameter | Recommended Value |
|---|---|
| Site Class | E |
| $S_s$ (g) | 1.474 |
| $S_1$ (g) | 0.549 |
| $F_a$ | 0.9 |
| $F_v$ | 2.4 |
| $S_{MS}$ (g) | 1.327 |
| $S_{M1}$ (g) | 1.317 |
| $S_{DS}$ (g) | 0.885 |
| $S_{D1}$ (g) | 0.878 |
| $PGA_M$ (g) | 0.507 |

#### 4.2.2 Liquefaction and Seismic Settlement

To assess the potential for liquefaction of subsurface soils at the site, we used the liquefaction analysis procedures outlined in Youd et.al. (2001), Seed et.al (2003), and Idriss and Boulanger (2004 and 2008). For estimating the resulting ground settlements, we used the methods proposed by Tokimatsu and Seed (1987), Cetin et.al (2009), and Idriss and Boulanger (2008), respectively. These methods utilize corrected standard penetration test (SPT) blow counts to estimate the amount of volumetric compaction or settlement during an earthquake.

According to the State of California (CGS, 2001a), the historical high depth to groundwater beneath the site has been mapped at about 10 feet below grade. During our subsurface exploration, groundwater was encountered in the borings between depths of approximately 9 and 20 feet below the existing ground. A groundwater depth of 10 feet below the existing grade was used in our analyses.

As recommended in Section 1803.5.12 of 2013 CBC, the peak ground acceleration (PGA) used in the liquefaction analysis was estimated in accordance with Section 11.8.3 of ASCE 7-10. A $PGA_M$ of 0.51g with an earthquake magnitude of 6.8 was used as the design-level seismic event in our liquefaction analysis, which is defined as an earthquake event with 2 percent probability of being exceeded in 50 years (return period of about 2,475 years) according to the 2013 CBC and ASCE/SEI 7-10.

We evaluated the liquefaction potential at the site using the CPT and SPT data. Based on the CPT and SPT data and our engineering analyses, it is our opinion that layers of loose and medium dense sandy silt, silty sand, and sand below the groundwater are subject to liquefaction in the event of a major earthquake occurring on a nearby fault. Based on our analyses, calculated average liquefaction-induced settlements from the three liquefaction analysis procedures varied between approximately 1 to 14 inches (6 inches overall average) based on CPT data and approximately 0 to 4½ inches (2 inches overall average) based on SPT data. However, the boring and laboratory data indicate some liquefiable layers identified by CPT-based procedures are cohesive sandy clay or clayey sand soil and are not considered liquefiable. Accordingly, we consider the SPT-based methods more reliable. It is, therefore, our engineering judgment that the anticipated liquefaction-induced settlements due to strong ground shaking during a design-level seismic event will be on the order of 1 to 3 inches for the northern/western portion of the site (the area of the new shops and building pads) and approximately 0 to 4 inches for the southern/eastern portion of the site (the area of the multi-level structures). Differential settlement is generally assumed to be between ½ and ¾ of the total settlement. The results of our liquefaction analyses are presented in Appendix C. Although the potential for localized liquefaction cannot be ruled out, the potential for larger-scale widespread liquefaction affecting the proposed structures is considered low. In addition, if localized sandy layers were to liquefy, the resulting minor settlements should not induce downdrag loads and affect a pile foundation system, because the layers are isolated and not continuous. Shallow foundations may need to be tied together with grade beams.

## 4.3 DESIGN GROUNDWATER ELEVATION

During our subsurface exploration, groundwater was encountered in the borings generally between depths of approximately 9 and 20 feet. The water level readings in the borings were taken during our field investigation. Depths to ground levels recorded on the boring logs are subject to many variables and may not be indicative of long-term equilibrium conditions. Historic high groundwater levels in the general area have been mapped approximately 10 feet below the natural ground surface (CGS, 2001a).

Based on current groundwater depths and high groundwater levels, a groundwater depth of 8 feet below current grades for each structure should be assumed for design. Design ground elevations can be provided once the grading plans have been prepared and the finished floor elevations of the structures have been established. We recommend that all subterranean walls and floor slabs that extend to and below a depth of 8 feet below current grades be designed for hydrostatic pressures and be waterproofed, as appropriate.

## 4.4 FOUNDATIONS

### 4.4.1 General

Based on the results of our field exploration, laboratory testing, and geotechnical analyses, we recommend that the proposed five- and six-level parking structures, five- level residential apartment complexes, any two- to three-level major retail structures (including any attached new retail space) be supported on a pile foundation system (driven or drilled piles). As an alternative to piles, these multi- level structures may be supported on shallow foundation system on ground improved by deep soil mixing.

The proposed new, lightly loaded one-story structures (new shops and building pads) may be supported on a conventional shallow foundation system (spread footings) supported on engineered fill designed to accommodate the estimated static and seismically-induced differential settlement. Based on past experience, we anticipate that these structures will be able to tolerate the estimated seismic settlement (i.e., the buildings will not collapse creating a life safety issue). It should be noted that the design intent of the 2013 California Building Code (CBC) during a design-level seismic event is life safety, not serviceability of the building after an earthquake. If the total settlements (both static and seismic) are in excess of tolerable levels for shallow foundations, these structures should be supported on a pile foundations or shallow foundations on improved ground, as recommended above.

### 4.4.2 Deep Foundations (Multi-Level Structures)

The multi-level structures may be supported on either driven or drilled piles. Driven piles are preferred due to the shallow groundwater conditions and the potential for caving during drilling. However, noise and vibrations associated with pile driving operations may be a concern. Design and construction recommendations for 14-inch and 16-inch-square precast pre-stressed concrete driven piles and for 30-inch-diameter cast-in-drilled-hole (CIDH) piles are presented in the following sections. Other pile systems such, as auger-cast displacement, Tubex, or Fundex piles may be considered. If these alternative pile foundation systems are desired, further evaluation will be required.

Noise and vibrations associated with pile driving operations may be a concern. Pre-drilling and the use of noise blankets may help to reduce noise and vibrations associated with pile driving.

If CIDH piles are used, special precautions will need to be taken while constructing the CIDH piles due to shallow groundwater conditions. The performance of CIDH piles is strongly dependent on construction methods and procedures. Construction methods that create large zones of disturbance around the drilled shafts can lead to lower than expected side friction due to excessive stress relief around the shaft length. Because CIDH piles will be constructed in granular (sandy) and soft clay soils below groundwater, caving of the pile shafts should be anticipated and will need to be prevented. Polymer slurry or a combination of temporary casing and polymer slurry may be required to stabilize the sides of CIDH pile shafts.

Driven Pile Foundations

The proposed multi-level structures may be supported on driven piles designed and constructed as recommended in the report. Design parameters for 14-inch and 16-inch-square precast pre-stressed concrete driven piles are presented below.

*Axial Capacity*

A summary of the recommended axial pile capacities for 14-inch and 16-inch-square precast pre-stressed concrete driven piles are presented in Tables 2 and 3.

**Table 2**
**Summary of Recommended Axial Pile Capacities**
**14-inch-square Precast Pre-stressed Concrete Driven Pile**

| Building Level | Assumed Bottom of Pile Cap Elev. (ft.) | Design Pile Length (ft.) | Design Tip Elev. (ft.) | Allowable Axial Capacity[1] (kips) | |
|---|---|---|---|---|---|
| | | | | Compressio n | Tension |
| ground | 350 | 75 | 275 | 146 | 82 |
| basement | 335 | 60 | 275 | 135 | 74 |

***Notes:*** *[1] A one-third increase may be used when considering wind or seismic loads.*

**Table 3**
**Summary of Recommended Axial Pile Capacities**
**16-inch-square Precast Pre-stressed Concrete Driven Pile**

| Building Level | Assumed Bottom of Pile Cap Elev. (ft.) | Design Pile Length (ft.) | Design Tip Elev. (ft.) | Allowable Axial Capacity[1] (kips) | |
|---|---|---|---|---|---|
| | | | | Compression | Tension |
| ground | 350 | 75 | 275 | 171 | 93 |
| basement | 335 | 60 | 275 | 159 | 85 |

**Notes:** [1] *A one-third increase may be used when considering wind or seismic loads.*

Piles in groups should be spaced at least 3 pile widths on centers. If the piles are so spaced, no reduction in the axial capacities of the piles need be considered due to group action. If closer spacing of piles is desired, additional evaluation will be required.

*Settlement*

The settlement of the proposed structure due to the assumed dead and live loads, supported on driven piles in the manner recommended, is estimated to be less than ½ inch, excluding elastic compression of the piles. Differential settlement between adjacent columns is estimated to be less than ¼ inch. Differential settlement of similarly loaded columns under static and seismic conditions is expected to be less than 50 percent of the total settlement, or about ½ inch. Settlement of the surrounding ground should be anticipated to be up to 4 inches due to liquefaction in the event of a moderate to large earthquake on a nearby fault. This settlement should be considered when designing access points and utility connections to the structure.

*Lateral Loads*

Lateral loads may be resisted by bending of the piles and the passive resistance of the soils against the pile cap. The lateral capacity of the piles will depend on the permissible deflection and the degree of fixity at the top of the pile. The capacities presented are based on the strength of the soils encountered in our field explorations. The lateral pile capacity analyses considered both static and dynamic loading conditions. The pile sections should be checked to verify the structural capacity of the piles. The lateral capacities for 14- and 16-inch-square precast, pre-stressed, concrete piles for the free- and fixed-head, with a 28-day compressive strength of at least 6,000 pounds per square inch (psi) are presented in Tables 4 and 5. The values before "/" in the table are for the ground-level piles and the values after "/" are for basement-level piles. The calculated lateral capacity curves (deflection vs. depth, shear vs. depth, and moment vs. depth) are presented in Appendix C.

**Table 4**
**Summary of Lateral Pile Capacities**
**14-inch-square Precast Pre-stressed Concrete Driven Pile**

| Pile Head Condition | Free | Fixed [2] |
|---|---|---|
| **Pile Head Deflection** | ½-inch | |
| **Lateral Capacity [1] (kips)** | 16.2/11.4 | 32.0/21.9 |
| **Flexural Depth [3] (feet)** | 10.5/14.0 | 17.0/19.0 |
| **Maximum Moment (kip-in)** | 736/514 | -1,764/-1,327 |
| **Depth to Max. Moment from Bottom of Pile Cap (feet)** | 6.5/7.5 | 0/0 |

***Notes:*** *[1] Above lateral capacities are for a single pile.*
*[2] For the fixed-head condition, the transfer moment capacity of the pile head will control the maximum lateral capacity.*
*[3] First point of zero deflection.*

**Table 5**
**Summary of Lateral Pile Capacities**
**16-inch-square Precast Pre-stressed Concrete Driven Pile**

| Pile Head Condition | Free | Fixed [2] |
|---|---|---|
| **Pile Head Deflection** | ½-inch | |
| **Lateral Capacity [1] (kips)** | 16.9/12.1 | 33.5/23.3 |
| **Flexural Depth [3] (feet)** | 10.5/13.5 | 17.0/19.0 |
| **Maximum Moment (kip-in)** | 756/538 | -1,818/-1,385 |
| **Depth to Max. Moment from Bottom of Pile Cap (feet)** | 6.5/7.5 | 0/0 |

***Notes:*** *[1] Above lateral capacities are for a single pile.*
*[2] For the fixed-head condition, the transfer moment capacity of the pile head will control the maximum lateral capacity.*
*[3] First point of zero deflection.*

The estimated lateral capacities presented above are for single piles and do not consider a reduction for group action. Piles in groups may be considered to act individually when the center-to-center spacing is greater than 3 pile widths in the direction normal to loading and 8 piles widths in the direction parallel to loading. Group action reduction factors are based on the pile configuration and spacing. The reduction factors can be provided once the group configuration and pile spacing are known. However, for preliminary design purposes, Table 6 presents the lateral load reduction factors to be applied for various pile spacing for in-line loading based on Table 10.7.2-4.1 of the California Amendments to AASHTO LRFD Bridge Design Specifications (Caltrans, 2014). For spacing in between those provided below, a linear interpolation may be utilized to calculate the reduction factor.

**Table 6**
**Lateral Load Reduction Factors**

| Center-to-center Pile Spacing for In-line Loading | Ratio of Load Resistance of Piles in Group to Single Pile | | |
|---|---|---|---|
| | Row 1 | Row 2 | Row 3 |
| 7D | 1.0 | 1.0 | 0.90 |
| 5D | 1.0 | 0.85 | 0.70 |
| 3D | 0.75 | 0.55 | 0.40 |

***Note:*** *D = diameter or width of the pile*

For lateral resistance of pile caps, we recommend an allowable passive fluid pressure of 250 pounds per square foot (psf) per foot of depth. Allowable passive earth pressures should not exceed 2,500 psf. No frictional resistance should be assumed between the slab and the subgrade soils if the slab will be structurally supported (i.e., suspended slab). If pile deflection is about 2 percent of embedment depth of the pile cap it is considered fully compatible, and the passive resistance of the pile cap and lateral capacity of the piles may be combined without reduction. If deflection is less than 2 percent embedment depth of the pile cap, passive resistance (equivalent fluid pressure) should be reduced/adjust accordingly (linearly).

*Installation*

Piles in groups should be driven from the interior of the group outward. Piles should be checked for alignment and plumbness. The amount of acceptable misalignment of a pile is approximately 2 to 3 inches from the exact location, and it is usually acceptable to be out of plumb 1 percent of the depth of the pile. Pre-drilling of the pile locations may be performed to aid in pile installation. Dense sand layers should be anticipated below a depth of approximately 50 to 60 feet bgs. The allowable depth and diameter of the pre-drilling should be evaluated by Kleinfelder during the indicator pile program. Excessive pre-drilling can reduce pile capacity, especially lateral capacity. Caving and raveling of the pre-drill excavations should be anticipated. The auger for pre-drilling should have a cross-sectional area no larger than 80 percent of the cross-sectional area of the pile.

We recommend that at least 30 indicator piles (6 piles for each large multi-level structure) be driven to evaluate the required pile lengths and the efficiency of driving systems before production piles are cast and/or ordered. These piles should be distributed evenly across the building site with some of the piles located adjacent to the boring and CPT locations. Provisions should be made to restrike (or retap) the indicator piles at least 48 hours after the initial driving. The restrikes will be used to evaluate the soil set-up/freeze effect on the piles. The indicator piles should be ordered 10 feet longer than the design length to allow for instrumentation and possible variations in the subsurface materials. We can provide proposed locations of indicator piles after the pile foundation plan is finalized. The indicator piles should not be used as production piles.

Dynamic measurements during the indicator pile program using a Pile Driving Analyzer (PDA) are recommended on all indicator piles to develop blow count criteria required to obtain the design capacities, as well as to evaluate the induced stresses on the piles and the allowable depth of pre-drilling. The pile hammer should develop sufficient energy to drive piles at a penetration rate of not less than 1/8-inch per blow at the design load. A pile hammer delivering a minimum energy of 60,000 foot-pounds, the equivalent of Delmag Diesel D32 or Model SC50 Hydrohammer, are recommended. The final driving criteria should incorporate the results of the indicator pile program recommended above. Prior to the indicator pile program, the contractor should provide details of the pile driving system (i.e. hammer, cushion blocks, etc.) to be used for our evaluation.

Due to the location of the hospital and residential development in the vicinity of the project site, some noise mitigation measures such as a hanging noise shield around the hammer and/or a temporary perimeter sound wall may be required during pile driving operations. Selection of the hammer will have a significant effect with respect to the noise level and the type of noise mitigation system. In general, hydraulic hammers are much less noisy compared to the diesel hammers. The pile driving contractor should be responsible for developing and implementing proper noise mitigation measures at the site.

CIDH Piles

The proposed multi-level structures may be supported on 30-inch-diameter CIDH piles designed and constructed as recommended here.

*Axial Capacity*

A summary of the recommended axial pile capacities for 30-inch-diameter CIDH piles are presented in Table 7.

**Table 7**
**Summary of Recommended Axial Pile Capacities**
**30-inch-diameter CIDH Piles**

| Building Level | Assumed Bottom of Pile Cap Elev. (ft.) | Design Pile Length (ft.) | Design Tip Elev. (ft.) | Allowable Axial Capacity [1,2] (kips) | |
|---|---|---|---|---|---|
| | | | | Compression | Tension |
| ground | 350 | 75 | 275 | 168 | 112 |
| basement | 335 | 60 | 275 | 153 | 1022 |

***Note:*** [1] *End bearing is neglected.*
[2] *A one-third increase may be used when considering wind or seismic loads.*

Piles in groups should be spaced at least 3 pile widths on centers. If the piles are so spaced, no reduction in the axial capacities of the piles need be considered due to group action. If closer spacing of piles is desired, additional evaluation will be required.

*Settlement*

The settlement of the proposed structures due to dead and live loads, supported on CIDH piles in the manner recommended, is estimated to be less than ½ inch, excluding elastic compression of the piles. Differential settlement between adjacent columns is estimated to be less than ¼ inch. Differential settlement of similarly loaded columns under static and seismic conditions is expected to be less that 50 percent of the total settlement, or about ½ inch. Settlement of the surrounding ground should be anticipated to up to 4 inches due to liquefaction in the event of a moderate to large earthquake on a nearby fault. This settlement should be considered when designing access points and utility connections to the structure.

*Lateral Loads*

Lateral loads may be resisted by the piles and the passive resistance of the soils against the pile cap. The lateral capacity of the piles will depend on the permissible deflection and the degree of fixity at the top of the pile. The capacities presented are based on the strength of the soils encountered in our field explorations. The lateral pile capacity analyses considered both static and dynamic loading conditions. The pile sections should be checked to verify the structural capacity of the piles. The lateral capacities of free- and fixed-head, CIDH piles with a 28-day compressive strength of at least 4,000 pounds per square inch (psi) are presented in Table 8. The values before "/" in the table are for the ground-level piles, and the values after "/" are for basement-level piles. The lateral capacity curves (deflection vs. depth, shear vs. depth, and moment vs. depth) are presented in Appendix C.

**Table 8**
**Summary of Lateral Pile Capacities**
**30-inch-diameter CIDH Piles**

| Pile Head Condition | Free | Fixed [2] |
|---|---|---|
| **Pile Head Deflection** | ½-inch | |
| **Lateral Capacity [1] (kips)** | 41.0/30.6 | 73.1/59.2 |
| **Flexural Depth [3] (feet)** | 19.5/21.5 | 30.5/30.0 |
| **Maximum Moment (kip-in)** | 2,551/2,178 | -6,178/-5,631 |
| **Depth to Max. Moment from Bottom of Pile Cap (ft.)** | 9.5/12.0 | 0/0 |

***Notes:*** [1] *Above lateral capacities are for a single pile.*
[2] *For the fixed-head condition, the transfer moment capacity of the pile head will control the maximum lateral capacity.*
[3] *First point of zero deflection.*

Lateral load reduction factors to be applied for various pile spacing for in-line loading are presented in Table 6. Design recommendations for lateral resistance of pile caps are presented with the recommendations for driven piles.

*Installation*

Performance of CIDH piles is heavily dependent on construction methods and procedures. Construction methods that create large zones of disturbance around the drilled shafts can lead to lower than expected skin friction due to excessive stress relief around the shaft length. The pile foundations should be constructed only by qualified contractors experienced in this type of construction, and under strict construction monitoring and quality control. The piling contractors should carefully review the boring logs and perform their own assessment of potential construction difficulties.

The CIDH piles will be constructed partly in granular (sandy) soils below groundwater; therefore, caving of the pile shafts should be anticipated and will need to be prevented. Polymer slurry or a combination of temporary casing and polymer slurry may be required to stabilize the sides of CIDH pile shafts. The use of alternative excavation methods must be subject to review by the geotechnical engineer for compatibility with the design assumptions.

The concrete for the CIDH piles should be placed using a down-hole tremie, or similar provision, such that the falling concrete does not strike the sides of the shaft. Once concrete pumping is initiated, a minimum head of 5 feet of concrete above the bottom of the tremie should be established and maintained throughout the concrete placement to prevent contamination of the concrete (soil inclusions). If steel casing is used, the casing should be removed slowly, and the minimum concrete head maintained, to prevent soil caving and “necking” of the pile as the concrete is placed. Concrete should be placed in newly excavated pile shafts as soon as practical. The pile excavation should not be allowed to remain open for more than 12 hours. The concrete must be capable of propagating between the reinforcing bars to come in contact with the soil and avoid arching during extraction of the casing. The reinforcing cage should be placed carefully in the hole in a manner such that the soil is not disturbed.

Maintenance of the full design cross-section for the entire pile length is a concern when casing is extracted during pile casting. Sometimes the suction created by pulling the casing allows soil intrusion into the shaft resulting in reduced pile cross-section. Due to this concern, post-construction evaluation of the piles using non-destructive testing should be considered. All piles should be subjected to Gamma-Gamma testing. Plastic tubing should be installed in all the piles in the event defective piles are detected so the remainder of the piles supporting that column can be evaluated. The structural engineer should detail the number and location of inspection tubes for CIDH piles.

#### 4.4.3 Shallow Foundations on Improved Ground

Ground Improvement Design

As an alternative to piles, the proposed multi-level structures may be supported on a shallow foundation system utilizing a properly designed ground improvement program. The ground improvement program will need to consider the compressibility of the on-site soils. Based on past experience with similar soil conditions, deep soil mixing (DSM) is considered a cost effective ground improvement option.

DSM is the mechanical blending of the in-situ soil with cementious materials using a hollow auger and paddle arrangement. Soil-mixing rigs may have a single auger (about 2 to 12 feet in diameter) or several smaller-diameter augers (usually 2 to 8 augers). As the augers are advanced into the soil, grout is pumped through the stems and injected into the soil at the tips. After the design depth has been reached, the augers are withdrawn while mixing process continues. The soil-mixing process results in a fairly uniform soil-cement column. DSM solidifies “columns” of soil in the treated area and the resulting soil-cement matrix helps to redistribute the stresses in the soil, thus, reducing the settlement of the ground surface. In addition, the soil-cement columns can be used as a load-bearing element to reduce static settlement.

The actual design of a soil-mixing program should be performed by a design-build contractor specializing and experienced with this ground improvement method. The contractor should provide material requirements, column spacing, replacement ratios, and other design information. However, we recommend that DSM columns be laid out in a grid pattern consisting of cells/panels in lieu of discrete column locations. Also, the (DSM) column size used to construct the cells/panels should be limited to a maximum of 6 feet in diameter.

The ground improvement program should be designed to limit static and seismic settlement (total and differential) to within acceptable levels (typically about 1 to 1½ inches total and ½ inch differential over 40 feet). Additionally, the ground improvement program should consider the impact to the surrounding roads and underground utilities.

The proposed ground improvement program should be reviewed by the geotechnical engineer and installed under their observation. The ground improvement design will likely be an iterative process between the ground improvement contractor and the owner’s design team. It should be noted that ground improvement programs are typically design-build projects, and the specialty contractors are ultimately responsible for the performance of their designs.

Shallow Foundation Design

The design allowable bearing pressure is typically provided by the ground improvement contractor, as it will depend on the achievable strength the soil-cement mixtures and the layout and size of the columns. Based on past experience, shallow footings on ground improved by DSM are typically designed for net allowable bearing pressures of 4,000 to 5,000 pounds per square foot (psf) for dead plus sustained live loads. However, based on recent discussions with a ground improvement specialty contractor, allowable bearing pressures of up to 12,000 psf may be achieved depending on the cement content, soil type and column layout. For preliminary design purposes, we recommend a net allowable bearing pressure of 5,000 psf be used.

The design allowable bearing pressure will also need to consider the compressibility of the soil prior to ground improvement. We estimate that, for the existing unimproved site soils, static settlement would be on the order of 5 and 6 inches for shallow foundations with soil pressures of 4,000 and 5,000 psf, respectively, for a column load of 800 kips at the current ground level and 10 to 12 inches for a column load of 1,200 kips at a subterranean parking level.

All footings should be established at a depth of at least 24 inches below the lowest adjacent grade or finished slab grade, whichever is deeper. The footing dimensions and reinforcement should be designed by the structural engineer.

Lateral load resistance may be derived from passive resistance along the vertical sides of the footings, friction acting at the base of the footing, or a combination of the two. An allowable passive earth pressure of 250 psf per foot of depth may be used for design. Allowable passive earth pressure values should not exceed 2,500 psf. An allowable coefficient of friction value of 0.30 between the base of the footings and the engineered fill soils can be used for sliding resistance using the dead load forces. Friction and passive resistance may be combined without reduction. We recommend that the first foot of soil cover be neglected in the passive resistance calculations if the ground surface is not protected from erosion or disturbance by a slab, pavement, or in some similar manner.

#### 4.4.4 Spread Footing Foundations for Lightly Loaded Structures

The proposed new relatively lightly loaded one-story structures and minor structures, such as site walls and equipment pads, which are structurally separate from multi-level structures may be supported on shallow spread footings founded on engineered fill. However, due to the potential for seismically-induced settlement, footings may need to be tied together with grade beams. The need for additional foundation reinforcement due to seismically-induced settlements should be determined by the structural engineer.

Allowable Bearing Pressure

Footings supported on at least 4 feet of engineered fill, as recommended in Section 4.6.2, may be designed for a net allowable bearing pressure of 1,500 psf for dead plus sustained live loads. A one-third increase in the bearing value can be used for wind or seismic loads. All footings should be established at a depth of at least 24 inches below the lowest adjacent grade. The footing dimension and reinforcement should be designed by the structural engineer.

Estimated Settlements

We estimate that total static settlement for footings designed in accordance with the recommendations presented above should be on the order of 1 to 1½ inch or less, depending on the size of the footing and applied load. Differential settlement of similarly loaded columns under static conditions should be less that 50 percent of the total settlement, or about ½ to ¾ inch over 40 feet. Seismic settlement of the surrounding ground in the area of the new shops and building pads is estimated to be up to 3 inches due to liquefaction in the event of a moderate to large earthquake on a nearby fault. Differential seismic settlement is estimated to be on the order of 1 to 1 ½ inches over a distance of 50 feet.

Lateral Resistance

Lateral load resistance may be derived from passive resistance along the vertical sides of the footings, friction acting at the base of the footings, or a combination of the two. An allowable passive earth pressure of 250 psf per foot of depth may be used for design. Allowable passive earth pressure values should not exceed 2,500 psf. An allowable coefficient of friction value of 0.30 between the base of the footings, or slabs founded on grade, and the engineered fill soils can be used for sliding resistance using the dead load forces. Friction and passive resistance may be combined without reduction. We recommend that the first foot of soil cover be neglected in the passive resistance calculations if the ground surface is not protected from erosion or disturbance by a slab, pavement, or in some similar manner.

## 4.5 BUILDING SLABS-ON-GRADE

For one-story structures, the estimated post-construction static settlement of slab-on-grade floors is less than 1 inch and differential settlement of less than ¼ inch assuming that structural loads are uniformly distributed over the entire structure footprint area and that there are no heavy, concentrated loads on the slabs.

For unimproved site soils, we estimate approximately 1 inch of static settlement from the floor slab loads for the proposed multi-level structures and up to 4 inches of seismic settlement. If the estimated settlements are tolerable, the slabs for the proposed structure may be supported at grade on engineered fill. If the risk is not tolerable, the slabs could be tied into the pile caps and heavily reinforced to mitigate abrupt differential settlement, or they may be structurally supported (suspended slab). The reinforcement requirements for a heavily-reinforced or suspended slab should be determined by the structural engineer. The decision as to which option to select will likely be dictated at least partially by economics, and should be made by the owner in consultation with the design team.

The choice of floor slab type should also consider the serviceability of the slab. For residential structures (such as the proposed apartments on this project) there is typically less tolerance of cracks or movements of floor slabs than for typical commercial buildings. For these residential structures, this consideration may make slabs-on-grade (which are more prone to cracking and movements) less attractive than structural slabs.

If the proposed multi-level structures are supported on a shallow foundation system on ground improved by Deep Soil Mixing, the floor slabs may be supported at grade provided the ground improvement program considers the estimated static and seismically-induced settlement.

For slabs supported on grade, we recommend a minimum nominal slab thickness of 5 inches and a minimum slab reinforcement of No. 3 bars spaced at 18 inches on centers in both directions. The structural engineer should specify additional reinforcement that may be required for other specific loading conditions. A modulus of subgrade reaction of 50 pounds per cubic inch (pci) may be used for design of slabs supported on engineered fill.

Prior to casting floor slabs, the moisture content of clayey soils should be maintained to at least 2 percent above optimum. In the event that subgrade soils are allowed to dry out, the exposed subgrade should be presoaked to about 85 percent of saturation (130 percent of optimum moisture content) to a depth of 12 inches.

Subsurface moisture and moisture vapor naturally migrate upward through the soil and, where the soil is covered by a building or pavement, this subsurface moisture will collect. Based on the soil conditions observed during our field explorations and the depth to groundwater, we recommend that a moisture vapor retarder be installed beneath the new building floor slab. The moisture vapor retarder product should meet the performance standards of an ASTM E1745, Class A material, and be properly installed in accordance with ACI publication 302.1. The vapor retarder should be at least 10 mils thick and be properly lapped and sealed. The joints between the sheets and the openings for utility piping should be lapped and taped. The sheeting should also be lapped into the sides of the footing trenches a minimum of 6 inches. Any puncture of the vapor retarder should be repaired prior to casting concrete.

Normally, a thin layer of clean sand (about two inches thick) is placed on the sheeting to facilitate concrete curing and to decrease the likelihood of slab curling. The final decision for the need and thickness of sand above the vapor barrier is the purview of the slab designer/structural engineer. The moisture vapor retarder is intended only to reduce moisture vapor transmission from the soil beneath the concrete and will not provide a waterproof or vapor proof barrier or reduce vapor transmission from sources above the retarder.

It should be noted that this system, although currently the industry standard, may not be completely effective in preventing moisture transmission through the floor slab and related floor covering problems. These systems typically will not necessarily assure that floor slab moisture transmission rates will meet floor-covering manufacturer standards and that indoor humidity levels will be appropriate to inhibit mold growth. The design and construction of such systems are totally dependent on the proposed use and design of the proposed building and all elements of building design and function should be considered in the slab-on-grade floor design. Building design and construction may have a greater role in perceived moisture problems since sealed buildings/rooms or inadequate ventilation may produce excessive moisture in a building and affect indoor air quality.

Various factors such as surface grades, adjacent planters, the quality of slab concrete (water-cement ratio) and the permeability of the on-site soils affect slab moisture and can influence performance. In many cases, floor moisture problems are the result of water-cement ratio, improper curing of floor slabs, improper application of flooring adhesives, or a combination of these factors. Studies have shown that concrete water-cement ratios lower than 0.5 and proper slab curing can significantly reduce the potential for vapor transmission through floor slabs. We recommend contacting a flooring consultant experienced in the area of concrete slab-on-grade floors for specific recommendations regarding your proposed flooring applications.

Special precautions must be taken during the placement and curing of all concrete slabs. Excessive slump (high water-cement ratio) of the concrete and/or improper curing procedures used during either hot or cold weather conditions could lead to excessive shrinkage, cracking or curling of the slabs. High water-cement ratio and/or improper curing also greatly increase the water vapor permeability of concrete. We recommend that all concrete placement and curing operations be performed in accordance with the American Concrete Institute (ACI) Manual.

## 4.6 EARTHWORK

### 4.6.1 General

Site preparation and earthwork operations should be performed in accordance with applicable codes, safety regulations, and other local, state, or federal specifications, and the recommendations included in this report. References to maximum unit weights are established in accordance with the latest version of ASTM Standard Test Method D1557. The earthwork operations should be observed and tested by a representative of Kleinfelder.

There is a potential for unacceptable ground movements if existing fill materials are not overexcavated and replaced with structural fill. Although the building structures will be designed to avoid the potential for undesirable structural movements, there is a risk of distress to exterior project improvements. These include, but are not limited to, exterior flatwork such as concrete pads, dock aprons, sidewalks, curb and gutter, concrete pavers, light and flag poles, and above and below ground utilities. To reduce the potential for volume changes of the existing fill soils which may result in undesirable movement, we recommend that the fill soils be overexcavated and replaced with structural fill below any exterior item where such movement would not be acceptable. Placing a geogrid over the existing fill could also be considered to reduce the risk of differential settlements within the existing fill; however, this would not be as effective as overexcavation and replacement.

The potential maintenance as well as tripping hazards along sidewalks and pavements should be considered when evaluating leaving the existing fill soils in-place without remediation. Such tripping hazards are often of greater concern for sidewalks and pavements at residential structures, such as the apartments included in this project. Therefore, greater consideration should be given to removal of the existing fill below pavement and sidewalk areas near the proposed residential structures.

### 4.6.2 Site Preparation

Abandoned utilities, foundations, and other existing improvements within the proposed improvement areas should be removed and the excavation(s) backfilled with engineered fill. Debris produced by demolition operations, including wood, metal, piping, plastics, etc., should be separated and disposed of off-site. Existing utility pipelines or conduits that extend beyond the limits of the proposed construction and are to be abandoned in place, should be plugged with non-shrinking cement grout to prevent migration of soil and/or water. Demolition, disposal, and grading operations should be observed and tested by a representative of the geotechnical engineer. Areas to receive fill should be stripped of all dry, loose, or soft earth materials and undocumented fill materials to the satisfaction of Kleinfelder.

- Buildings supported on Piles with a Structural Slab: Building pads should be overexcavated to a depth of at least 2 feet below the bottom of the floor slab and the soil replaced as engineered fill. The overexcavation should extend a horizontal distance of at least 5 feet outside the building pad, if possible.
- Buildings supported on Piles with a Slab-On-Grade Floor: In order to provide uniform support, we recommend the existing soils be overexcavated to a depth of at least 3 feet below the bottom of floor slab and replaced as engineered fill. If fill soils are encountered at the base of the overexcavation, the overexcavation should continue until the fill is removed. Artificial fill depths encountered during our field exploration typically ranged between approximately 3 to 8 feet bgs. Deeper fills should be expected to be present at the site, especially at utility trench locations. The overexcavation should extend horizontally beyond the limits of the structure pads a distance equal to the thickness of fill below the bottom of the slabs or 3 feet, whichever is greater, if practicable.
- Buildings supported on Improved Ground: After ground improvement is performed, the upper few feet of the existing soils will be disturbed and some remedial grading will be required. In addition, there may be bulking of the upper soils from the ground improvement process. We recommend that the improvement area be overexcavated to a depth of at least 3 feet below the pre-improved grade or to at least 1 foot below the bottom of the footings, whichever is deeper. Depending on the amount of disturbance, the overexcavation may have to be deepened. This overexcavation should extend the

full width of the improved area or at least of 5 feet outside the building pad, whichever is greater.

Based on past experience, the ground improvement process may result in "wicking" of moisture up into the near-surface soils, thereby increasing the moisture content, especially in clayey and silty soils. Furthermore, the Deep Soil Mixing process will also saturate the surface soils. Subgrade stabilization may be necessary. If necessary, the material should be processed and stabilized an additional 12 to 18 inches using lime/cement treatment. Alternatively, an additional material may be removed and an 18-inch-thick crushed rock blanket underlain by Mirafi 500X fabric, or equivalent, could be placed to stabilize the subgrade. To limit disturbance, track-mounted equipment should be used for the excavation, and the subgrade compacted with a non-vibratory rollers.

- Lightly Loaded Structures supported on Shallow Foundations with a Slab-On-Grade Floor: In order to provide uniform support for the new one-story building pads and minor structures, we recommend the pads be overexcavated to a depth of at least 4 feet below the bottom of footings or the depth of existing undocumented artificial fill, whichever is greater, and the soil replaced with engineered fill. Undocumented artificial fill depths encountered during our field exploration typically ranged between approximately 3 to 8 feet bgs. Deeper undocumented artificial fills should be expected to be present at the site, especially at utility trench locations. The overexcavation should extend horizontally beyond the limits of the pad a distance equal to the thickness of undocumented artificial fill below the bottom of the proposed foundations or 5 feet, whichever is greater, if possible.
- Non-Structural Areas: For non-structural areas, such as pavements, sidewalks and other flatwork, etc., we recommend that the existing soils be overexcavated a minimum of 18 inches below existing grade or finished subgrade, whichever is greater, and be replaced as engineered fill. Depending on the observed condition of the existing soils, deeper overexcavation may be required in some areas. The overexcavation should extend beyond the proposed improvements a horizontal distance of at least 2 feet.

Once the area has been stripped of dry/loose soil and debris, the exposed subgrade should be proof-rolled with heavy construction equipment (e.g. loader or smooth-drum roller) to disclose areas of soft and yielding material. Where soft and yielding material is observed, it should be overexcavated and replaced as structural fill. After proof-rolling and/or prior to placement of fill, the subgrade should be scarified to a depth of 6 to 8 inches, moisture conditioned to at least 2 percent above optimum, and compacted to at least 90 percent of the maximum dry unit weight.

### 4.6.3 Fill Material

The on-site soils, minus debris, organic matter, or other deleterious materials, may be used in the site fills. Rock or other soil fragments greater than 4 inches in size should not be used in the fills.

Fill soils should be compacted to at least 90 percent of the maximum dry unit weight (ASTM D1557). The upper 12 inches below pavements should be compacted to at least 95 percent. Fill should be placed in loose horizontal lifts not more than 8 inches thick (loose measurement). The moisture content of the fill should be maintained at least 2 percent above optimum during compaction. Due to the elevated moisture content of the soil encountered in the borings, processing (moisture reduction) of these materials will likely be required prior to placement as engineered fill. Processing (moisture reduction) of these materials will likely be required prior to placement as engineered fill. Utility trench backfill should be mechanically compacted. Flooding should not be permitted.

The moisture content of the engineered fill is considered very important, and therefore, both relative compaction and moisture content should be used to evaluate compaction acceptance. If both criteria are not within the specified tolerances, the fill should not be accepted, and the contractor should rework the material until the fill is placed within the specified tolerances.

Import materials, if required, should have an expansion index of less than 20 with no more than 30 percent of the particles passing the No. 200 sieve and no particles greater than 4 inches in maximum dimension. The maximum expansion index for imported soils may be modified by the project geotechnical engineer depending on its proposed use. Imported fill should be documented to be free of hazardous materials, including petroleum or petroleum byproducts, chemicals, and harmful minerals. Kleinfelder should evaluate the proposed imported materials prior to their transportation and use on site.

### 4.6.4 Excavation Characteristics and Wet Soils

Elevated moisture contents (in excess of 30 percent) were observed in the upper soils encountered in the borings. In addition, wet soils are anticipated in currently landscaped areas and are typically encountered in utility trenches. Groundwater was also encountered as shallow as approximately 9 feet bgs. Additionally, based on past experience, the ground improvement process may result in "wicking" of moisture up into the near-surface soils, thereby increasing the moisture content, especially in clayey and silty soils. Furthermore, the soil mixing process (if used at this site) will also saturate the surface soils. Pumping subgrade conditions mostly likely will be encountered during site grading activities, and areas of the bottom of the overexcavation may need to be stabilized with geotextiles and crushed rock and/or cement/lime treatment. The bottom of the overexcavation may also be difficult to compact using conventional methods of fill placement and compaction. Soil excavation near groundwater will require the use of track-mounted equipment. Excessive disturbance of the subgrade will require additional removals. The contractor should consider the moisture conditions when selecting equipment for earthwork and compaction. During seasonal rains, handling of saturated soils may pose problems in equipment access and cleanup, and we suggest the materials be allowed to dry out, if possible, prior to excavation.

#### 4.6.5 Unstable Subgrade Conditions

As discussed above, unstable subgrade conditions are anticipated. These conditions could seriously impede grading by causing an unstable subgrade condition. Typical remedial measures include the following:

- Drying: Drying unstable subgrade involves disking or ripping wet subgrade to a depth of approximately 18 to 24 inches and allowing the exposed soil to dry. Multiple passes of the equipment (likely on a daily basis) will be needed because as the surface of the soil dries, a crust forms that reduces further evaporation. Frequent disking will help prevent the formation of a crust and will promote drying. This process could take several days to several weeks depending on the depth of ripping, the number of passes, and the weather. Given the current depth of groundwater, drying of the subgrade soils for subterranean level excavations would not likely be achievable.
- Removal and Replacement with Crushed Rock and Geotextile Fabric: Unstable subgrade could be over-excavated 12 to 24 inches below existing grade and replaced with ¾- or 1-inch crushed rock underlain by geotextile fabric. The geotextile fabric should consist of a woven geotextile, such as Mirafi 600X or equivalent. The final depth of removal will depend upon the conditions observed in the field once over-excavation begins. The geotextile fabric should be placed in accordance with the manufacturer's recommendations.
- Soil Treatment: Unstable subgrades could be stabilized by mixing the upper 12 to 18 inches of the subgrade with Portland cement, Class C fly ash, or lime. For estimating purposes, an application rate of 10 to 12 percent Class C fly ash, 3 to 4 percent for high calcium quick lime, or 4 to 5 percent Portland cement may be used. Final application rates should be determined in the field at the time of construction in consultation with the

geotechnical engineer. Chemical treatment should be performed by a specialty contractor experienced in this work and should be performed in accordance with Caltrans Standard Specifications. Since treatment uses the on-site soil, the expense of importing material can be avoided. Chemically treated areas may have a high pH level (pH over 10) that will need to be removed from landscape areas.

#### 4.6.6 Temporary Excavations

All excavations must comply with applicable local, state, and federal safety regulations. The responsibility for excavation safety and stability of temporary construction slopes lies solely with the contractor. We are providing this information below solely as a service to our client. Under no circumstances should this information provided be interpreted to mean that Kleinfelder is assuming responsibility for final engineering of excavations or shoring, construction site safety, or the contractors' activities; such responsibility is not being implied and should not be inferred.

Slopes of temporary cuts should be determined by the contractor. Minor sloughing and/or raveling should be anticipated as they dry out. If signs of slope instability are observed, the inclination should be decreased until stability of the slope is obtained. In addition, at the first signs of slope instability, a geotechnical engineer should be contacted. Where space for sloped embankments is not available, shoring will be necessary. Shoring and/or underpinning of existing improvements that are to remain may be required to perform the demolition and overexcavation. Excavations within a 1.5:1 plane extending downward from a horizontal distance of 2 feet beyond the bottom outer edge of existing improvements should not be attempted without bracing and/or underpinning the improvements. Generalized temporary shoring recommendations are provided in the following section. Personnel from a geotechnical engineer should observe the excavations so that modifications can be made to the excavations, as necessary, based on variations in the encountered soil conditions. All applicable excavation safety requirements and regulations, including OSHA requirements, should be met.

Where sloped excavations are used, tops of the slopes should be barricaded so that vehicles and storage loads do not encroach within a distance equal to the depth of the excavation. Greater setback may be necessary when considering heavy vehicles, such as concrete trucks and cranes. The contractor's geotechnical consultant should be advised of such heavy vehicle loadings so that specific setback requirements can be established. If temporary construction slopes are to be maintained during the rainy season, berms are recommended along the tops of the slopes to reduce runoff that may enter the excavation and erode the slope faces.

Temporary, shallow excavations with vertical side slopes less than 4 feet high should generally be stable, although sloughing may be encountered. Vertical excavations greater than 4 feet high should not be attempted without appropriate shoring to prevent local instability. All trench excavations should be braced and shored in accordance with good construction practice and all applicable safety ordinances and codes. The contractor is responsible for the structural design and safety of the temporary shoring system, and we recommend that this design be submitted to Kleinfelder for review. For preliminary planning purposes, the on-site soils may be considered Type C, as defined using the current OSHA soil classification. Final determination of the excavation soil type is the responsibility of the contractor's competent person.

Stockpiled (excavated) materials should be placed no closer to the edge of an excavation than a distance equal to the depth of the excavation, but no closer than 4 feet. All trench excavations should be made in accordance with OSHA requirements.

#### 4.6.7 Temporary Shoring

General

Temporary shoring may be required in areas adjacent to existing structures or improvements where excavations cannot be adequately sloped. Temporary shoring may consist of a turn-key shoring system, soldier piles and lagging, or other system. General recommendations for design of temporary shoring are presented below.

The shoring design must be provided by a civil engineer registered in the State of California and experienced in the design and construction of shoring under similar conditions. Once the final excavation and shoring plans are complete, the plans and design should be reviewed by Kleinfelder for conformance with the design intent and geotechnical recommendations provided herein.

Lateral Pressures

For the design of cantilevered shoring, an equivalent fluid pressure of 40 pounds pounds per cubic foot (pcf) may be used for level backfill. Where the surface of the retained earth slopes up away from the shoring, a greater pressure should be used. Design data can be developed for additional cases when the design conditions are established.

In addition to the recommended earth pressure, any surcharge (live, including traffic, or dead load) located within a 1:1 plane drawn upward from the base of the shored excavation should be added to the lateral earth pressures. The lateral contribution of a uniform surcharge load located immediately behind the wall may be calculated by multiplying the surcharge by 0.40 for the level backfill condition. Lateral load contributions of surcharges located at a distance behind the shored wall may be provided once the load configurations and layouts are known. As a minimum, a 2-foot equivalent soil surcharge (250 psf) is recommended to account for nominal construction loads (not including cranes or other heavy equipment). It should be noted that the above pressures do not include hydrostatic pressure and assume groundwater will not be encountered in the excavation, or dewatering will be used to lower the ground water table below the bottom of the excavation.

Design of Soldier Piles

All soldier piles should extend to a sufficient depth below the excavation bottom to provide the required lateral resistance. We recommend the required embedment depths be calculated based on the principles of force and moment equilibrium. For this method, the allowable passive pressure against soldier piles that extend below the level of excavation may be assumed to be a uniform pressure of 1,000 psf due to the presence of soft clay below the excavation. To account for arching, the passive resistance may be assumed to act over a width 1.5 times the width of the embedded portion of the pile, provided adjacent piles are spaced at least 2.0 pile diameters, center-to-center.

Drilling of the soldier pile shafts could be accomplished using conventional heavy-duty drilling equipment. The piles may be constructed partly below groundwater and, therefore, caving of the pile shafts should be anticipated and will need to be prevented. Polymer slurry or temporary steel casing may be required to stabilize the sides of the pile shaft. Concrete for piles should be placed immediately after the drilling of the hole is complete. The concrete should be pumped to the bottom of the drilled shaft using a tremie. Once concrete pumping is initiated, a minimum head of 5 feet of concrete above the bottom of the tremie should be established and maintained throughout the concrete placement to prevent contamination of the concrete by soil inclusions. If steel casing is used, the casing should be removed as the concrete is placed.

To develop full lateral resistance, provisions should be taken to assure firm contact between the soldier piles and undisturbed materials. The concrete placed in the soldier pile excavations may be a lean-mix concrete. However, the concrete used in that portion of the soldier pile that is below the planned excavated level should provide sufficient strength to adequately transfer the imposed loads to the surrounding materials.

Lagging

Continuous treated timber lagging should be used between the soldier piles. The lagging should be installed as the excavation proceeds. If treated timber is used, the lagging may remain in place after backfilling. The lagging should be designed for the recommended earth pressure but limited to a maximum value of 400 psf.

Some caving and running of the upper soils should be anticipated. To reduce the potential for loss of ground and settlement of the soil behind the wall, the contractor should backfill any space between the lagging and the cut slope with clean sand or sand-cement slurry after installation.

Deflection

Shoring adjacent to existing structures or improvements should be designed and constructed to reduce potential movement. The shoring system designer should evaluate potential deflections in their design.

Monitoring

Some deflection of the shored excavation should be anticipated during the planned excavation. We recommend the project civil engineer perform a survey of all existing utilities and structures adjacent to the shored excavation. The purpose of this survey would be to evaluate the ability of existing utility lines or improvements to withstand horizontal movements associated with a shored excavation and to establish the baseline condition in case of unfounded claims of damage. If existing improvements are not capable of withstanding anticipated lateral movements, alternative shoring systems may be required.

Horizontal and vertical movements of the shoring system should be monitored by a licensed surveyor. The construction monitoring and performance of the shoring system are ultimately the contractor's responsibility. However, at a minimum, we recommend that the top of shoring be surveyed prior to excavation and that the top and bottom of the soldier beams be surveyed on a weekly basis until the shoring is not needed. Surveying should consist of measuring movements in vertical and two perpendicular horizontal directions.

#### 4.6.8 Trench Backfill

Pipe bedding and pipe zone material should consist of sand or similar granular material having a minimum sand equivalent value of 30. The sand should be placed in a zone that extends a minimum of 4 inches below and 10 inches above the pipe for the full trench width. The bedding material should be compacted to at least 90 percent of the maximum dry density or to the satisfaction of the project geotechnical engineer's representative observing the compaction of the bedding material. Bedding material should consist of sand, gravel, crushed aggregate, or select native free-draining granular material with a maximum particle size of ¾ inch and a sand equivalent of at least 30. Bedding materials and placement should also conform to the pipe manufacturer's specifications.

Trench backfill above bedding and pipe zone materials may consist of approved, on-site or import soils placed in lifts no greater than 8 inches loose thickness and compacted to at least 90 percent of the maximum dry density based on ASTM Test Method D1557. Mechanical compaction is recommended; ponding or jetting should be avoided, especially in areas supporting structural loads or beneath concrete slabs supported on grade, pavements, or other improvements.

### 4.7 GROUNDWATER IMPACTS DURING EARTHWORK

Excavations of up to approximately 16 to 18 feet below existing grades are anticipated to construct the subterranean parking levels. Groundwater is anticipated to be above the excavation bottom. Groundwater was encountered as shallow as approximately 9 feet below current grades.

Temporary dewatering will likely be required at the time of construction. Dewatering of excavations may be limited to using localized sumps and trenches for nuisance water if the bottom of excavation is above the groundwater level at the time of construction. However, if groundwater inflows are significant, we recommend implementing a well-point or educator pump dewatering system. The following are considerations with respect to dewatering proposed excavations:

- The contractor should retain an experienced engineer for design of a dewatering system. The dewatering system should be installed by a contractor specializing in dewatering under similar soil conditions. It has been our experience that improperly designed or constructed dewatering systems can significantly impact project schedule, cost, and adjacent structures.
- Sump pumping during construction should be anticipated to remove groundwater that bypasses the dewatering system. Gravel filled trenches and sump pits should be lined with filter fabric (Mirafi 140N or equivalent) to reduce the potential of pumping out fines.

Turbid (cloudy to muddy) discharge water should be anticipated and additional measures for settlement of solids may be required.

- A dewatering monitoring program should include routine monitoring for suspended solids and treatment facilities to ensure compliance with regulatory criteria. Permitting and monitoring of the discharged water will be required. Contaminated water will be required to be captured and treated to agency requirements prior to discharging into public system from the pumping system.
- Soils exposed at the base of the excavation may be wet and could be disturbed by heavy construction equipment. We recommend that heavy equipment be kept off the lower 3 feet of the excavation. The excavation should be performed with a “toothless” bucket to reduce disturbance of the subgrade. All disturbed soils at the subgrade level should be replaced with removed and replaced with compacted fill or a 2-sack, sand-cement slurry.

## 4.8 SETTLEMENT ALONG STORM DRAIN EASEMENT

Based on the results of our field investigation and our experience with general soil conditions within the project site, very moist, unstable, and soft saturated clays/silts are present within the near-surface fill layer including trench backfill and bedding where settlement has been observed along the existing storm drain easement located between Sears building and the mall. In our opinion, the cause of the distress appears to be poorly compacted fill that has consolidated over time, causing the observed settlement. In addition, it has been our past experience that there may not be proper pipe bedding below older utilities.

To mitigate poor subgrade conditions above the existing storm drain and to reduce the potential for future settlement, we recommend excavating upper 4 feet of fill in the distressed area and replace it with granular fill, as defined in Section 4.6, compacted to at least 95 percent (ASTM D1557). In lieu of the granular fill material, a 2 sack sand-cement slurry may be considered for backfill.

## 4.9 EXTERIOR FLATWORK

Prior to casting exterior flatwork, the subgrade soils should be moisture conditioned and recompacted or overexcavated, as recommended in Section 4.6. The moisture content of the subgrade soils should be maintained at least 2 percent above optimum prior to the placement of any flatwork. In the event that these subgrade soils are allowed to dry out, the exposed subgrade should be moisture conditioned to about 85 percent of saturation (130 percent of optimum moisture content) to a depth of 12 inches.

Moisture conditioning to the full 12-inch depth should be verified by the geotechnical engineer's representative. Careful control of the water/cement ratio should be performed to avoid shrinkage cracking due to excess water or poor concrete finishing or curing. Unreinforced slabs should not be built in areas where further saturation may occur following construction.

Exterior concrete slabs for pedestrian traffic or landscape should be at least 4 inches thick. Weakened plane joints should be located at intervals of about 6 feet.

As described in Section 4.6.1 of this report, there is a risk of unacceptable slab movements if constructed above existing fill soils. To limit the risk of damage to the exterior slabs and the creation of tripping hazards, we recommend that the subgrade below any exterior slab-on-grade that is placed over any existing fill be covered with a geogrid placed between the subgrade and the crushed rock base material. This geogrid would spread differential settlement caused by uneven settlement of the existing fill and provide a more stable, stronger subgrade for the slab.

All concrete slabs should be designed to minimize cracking as a result of shrinkage. Cracking or slab movement are often of greater concern for exterior flat work at residential structures, such as the apartments included in this project. Therefore, greater consideration should be given structural details for exterior flatwork in areas near the proposed residential structures. Any reinforcement should be installed at mid-height in the slab or as required by the structural design. The concrete section and reinforcement should be designed by a structural engineer.

Special precautions must be taken during the placement and curing of all concrete slabs. Excessive slump of the concrete and/or improper curing procedures used during either hot or cold weather conditions could lead to excessive shrinkage, cracking, or curling in the slabs. We recommend that all concrete design, placement, and curing operations be performed in accordance with the most current American Concrete Institute (ACI) Manual.

## 4.10 PAVEMENT SECTIONS

### 4.10.1 Asphalt Concrete

The required pavement structural sections will depend on the expected wheel loads, volume of traffic, and subgrade soils. We have provided asphalt concrete pavement sections in Table 9 for assumed traffic indices based on the assumed traffic use. The traffic indices should be verified by the civil engineer.

Positive drainage of the paved areas should be provided since moisture infiltration into the subgrade may decrease the life of pavements. Curbing located adjacent to paved areas should be founded in the subgrade, not the aggregate base, in order to provide a cutoff, which reduces water infiltration into the base course.

**Table 9**
**Preliminary Asphalt Concrete Pavement Sections**
**(Design R-Value = 15)**

| Traffic Use | Assumed Traffic Index (TI) | Asphalt Concrete (inches) | Aggregate Base (inches) |
|---|---|---|---|
| Light Traffic, Parking | 5.0 | 3.5 | 7.0 |
| Medium Traffic, Driveways | 6.0 | 4.0 | 9.5 |
| Heavy Traffic, Fire Lanes | 7.0 | 4.0 | 13.0 |

* Table values were rounded up to the nearest 1/2 inch.

The pavement sections presented above were established using the design criteria of the State of California, Department of Transportation, a design R-value of 15, and the noted Traffic Indices. The pavement sections are based on a theoretical design life of 20 years.

4.10.2 Portland Cement Concrete Pavement

Table 10 presents Portland cement concrete (PCC) pavement sections for various traffic indices. As noted above, the traffic indices should be reviewed by the project owner, architect, and/or civil engineer to evaluate their suitability for this project.

**Table 10**
**PCC Pavement Sections**
**(Design R-Value = 15)**

| Traffic Use | Traffic Index (TI) | PCC (inches) | Aggregate Base (inches) |
|---|---|---|---|
| Light Traffic, Parking | 5.0 | 7.0 | 6.0 |
| Medium Traffic, Driveways | 6.0 | 7.5 | 6.0 |
| Heavy Traffic, Fire Lanes | 7.0 | 8.0 | 6.0 |

* Table values were rounded up to the nearest 1/2 inch.

The PCC pavement sections were based on the design procedures from the Portland Cement Association and the recommended subgrade conditions. The design assumes that the PCC will have a 28-day flexural strength (modulus of rupture determined by the third-point method) of at least 550 pounds per square inch (psi) (approximate compressive strength of 4,000 psi). A design modulus of subgrade reaction (k value) of 80 pci was assumed for the top of the compacted subgrade. It was also assumed that aggregate interlock would be developed at the control joints. The pavement sections are based on a theoretical design life of 20 years.

#### 4.10.3 Construction Considerations

The pavement sections provided above are contingent on the following recommendations being implemented during construction.

- The subgrade for pavements should be prepared as recommended in Section 4.6.
- Subgrade soils should be in a stable, non-pumping condition at the time the aggregate base materials are placed and compacted.
- Aggregate base materials should be compacted to at least 95 percent relative compaction (ASTM D1557).
- Adequate drainage (both surface and subsurface) should be provided such that the subgrade soils and aggregate base materials are not allowed to become wet.
- Aggregate base materials should meet current Caltrans specifications for Class 2 aggregate base. Alternatively, the aggregate base course could meet the specifications for untreated base materials (crushed aggregate base or crushed miscellaneous base) as defined in Section 200-2 of the current edition of the Standard Specifications for Public Works Construction (Greenbook).
- Asphalt paving materials and placement methods should meet current Caltrans specifications for asphalt concrete or Section 400 of the current edition of the Standard Specifications for Public Works Construction (Greenbook).

Pavement sections provided above are based on the soil conditions encountered during our field investigation, our assumptions regarding final site grades, and limited laboratory testing.

#### 4.10.4 Pavement Maintenance

Pavements, particularly with clayey subgrades, may undergo movement due to changes in subgrade moisture content. This movement tends to accelerate pavement deterioration. A crack sealing program should be performed annually to slow pavement deterioration. Any areas where surface water stands on the surface should be remediated. Over time as cracking becomes more pronounced, a slurry seal coat should be applied. Pavement deterioration is often of greater concern at residential structures, such as the apartments included in this project, and it can create tripping hazards. Therefore, it is especially important that the owner implement a program of pavement maintenance in these areas.

### 4.11 SITE DRAINAGE

Foundation, pavement, and slab performance depends greatly on proper irrigation and how well runoff water drains from the site. This drainage should be maintained both during construction and over the entire life of the project. The ground surface around structures should be graded such that water drains rapidly away from structures without ponding. The surface gradient needed to do this depends on the landscaping type. In general, landscape area within 10 feet of buildings should slope away at gradients of at least 5 percent, per Section 1804.3 of 2013 CBC.

We recommend that landscape planters either not be located adjacent to buildings and pavement areas or be properly drained to area drains. Drought resistant plants and minimum watering are recommended for planters immediately adjacent to structures. No raised planters should be installed immediately adjacent to structures unless they are damp-proofed and have a drainpipe connected to an area drain outlet. Planters should be built such that water exiting from them will not seep into the foundation areas or beneath slabs and pavement. In addition, waterproofing the slab and walls should be considered. Roof water should be directed to fall on hardscape areas sloping to an area drain, or roof gutters and downspouts should be installed and routed to area drains. In any event, maintenance personnel should be instructed to limit irrigation to the minimum actually necessary to properly sustain landscaping plants. Should excessive irrigation, waterline breaks or unusually high rainfall occur, saturated zones and “perched” groundwater may develop. Consequently, the site should be graded so that water drains away readily without saturating the foundation or landscaped areas. Potential sources of water such as water pipes, drains, and the like should be frequently examined for signs of leakage or damage. Any such leakage or damage should be promptly repaired. Wet utilities should also be designed to be watertight.

## 4.12 STORM WATER MANAGEMENT

We have evaluated the potential for storm water infiltration/percolation into the subgrade soils at the subject project site. Pursuant to the current standard of practice, an infiltration evaluation is a two-step process. The first step is to characterize the site to assess whether infiltration is feasible. If infiltration is feasible, then infiltration testing is needed to provide a design infiltration rate (step two).

Based on visual soil classification and laboratory testing of the soil samples collected during our field exploration, the onsite soils in the upper 10 to 20 feet below the existing ground surface at the site are comprised primarily of clay. Furthermore, groundwater was observed as shallow as approximately 9 feet below the existing grade during our exploration. Given the low infiltration capacity of the on-site soils and shallow depth of groundwater, we recommend alternatives to infiltration Best Management Practices (BMPs), such as bio-filtration/bio-retention systems (bio-swales and planter boxes), be implemented at the project site.

If bio-filtration/bio-retention systems are employed, we recommend that the BMPs be built such that water exiting from them will not seep into the foundation areas or beneath slabs and pavement. If planters are located within 10 feet of buildings or building foundations, or adjacent to slabs and pavements, then some means of diverting water away from the building, building foundation soils, or soils that support slabs and pavements would be required, such as lining the planters.

## 4.13 RETAINING STRUCTURES

Design earth pressures for retaining structures (retaining walls or walls below grade) depend primarily on the allowable wall movement, wall inclination, type of backfill material, backfill slopes, surcharges, and drainage. The on-site fine-grained soils (clays) have a medium to high expansion potential. These materials may be used as backfill if the risk of some damage to retaining wall from soil expansion is considered acceptable. If the risk is considered unacceptable, the backfill extending behind the wall a horizontal distance of at least one-half the height of the wall replaced with import material, as defined in Section 4.6.3. If a drainage system is not installed, the wall should be designed to resist hydrostatic pressure in addition to the earth pressure. Determination of whether the active or at-rest condition is appropriate for design will depend on the flexibility of the walls. Walls that are free to rotate at least 0.01 radians (deflection at the top of the wall of at least 0.01 x H, where H is the unbalanced wall height) may be designed for the active condition. Walls that are not capable of this movement should be assumed rigid and designed for the at-rest condition. The recommended active and at-rest earth pressures and passive resistance values are provided in Tables 11 and 12.

**Table 11**
**Lateral Earth Pressures for Retaining Structures**
**(Fine-Grained / On-Site Backfill)**

| Wall movement | Backfill Condition | Equivalent Fluid Pressure (pcf) |
|---|---|---|
| Free to Deflect (active condition) | Level | 50 * |
| Restrained (at-rest condition) | | 70 * |

***Notes:*** * *The fine-grained soil backfill should be moisture conditioned to at least 2 percent above optimum at the time of compaction.*

**Table 12**
**Lateral Earth Pressures for Retaining Structures**
**(Imported Backfill)**

| Wall movement | Backfill Condition | Equivalent Fluid Pressure (pcf) |
|---|---|---|
| Free to Deflect (active condition) | Level | 40 |
| Restrained (at-rest condition) | | 60 |

In addition to the above lateral earth pressures, walls below grade should be designed to support an incremental seismic lateral pressure of 11H (psf), applied as a triangular pressure distribution (not inverted) with a maximum pressure at the bottom of the wall and H is the height of the wall. This seismic load is a directly calculated value and should be used as is. When designing for seismic loads, the seismic lateral earth pressure should be combined with the active earth pressure. If designing for static loading, only the at-rest lateral earth pressure should be used.

The above lateral earth pressures do not include the effects of surcharges (e.g., traffic, footings), compaction, or truck-induced wall pressures. Any surcharge (live, including traffic, or dead load) located within a 1H:1V plane drawn upward from the base of the wall should be added to the lateral earth pressures. The lateral contribution of a uniform surcharge load located immediately behind walls may be calculated by multiplying the surcharge by 0.40 for cantilevered walls and 0.60 for restrained walls with fine-grained backfill. For coarse-grained import backfill, the lateral contribution of a uniform surcharge loads may be calculated by multiplying the surcharge by 0.33 for cantilevered walls and 0.50 for restrained walls. Walls adjacent to areas subject to vehicular traffic should be designed for a 2-foot equivalent soil surcharge (240 psf). Lateral load contributions from other surcharges located behind walls may be provided once the load configurations and layouts are known.

Walls below grade should be properly waterproofed and have drainage system that extends to a depth of 8 feet below grade to collect surface water. We have assumed that remainder of the wall will designed for full hydrostatic pressure. Adequate drainage for above-grade retaining walls is essential to provide a free-drained backfill condition so that there is no hydrostatic buildup behind the walls. Above-grade retaining walls should also be appropriately waterproofed to reduce the potential for staining. Except for the upper 2 feet, the backfill immediately behind walls (minimum horizontal distance of 2 feet measured perpendicular to the wall) should consist of free-draining ¾-inch crushed rock wrapped with filter fabric. The upper 2 feet of cover backfill should consist of relatively impervious material. A 4-inch-diameter perforated PVC pipe, placed perforations down at the bottom of the rock layer leading to a suitable gravity outlet, should be installed at the base of the walls.

As an alternative to the gravel drain noted above, a manufactured drain panel may be used in addition to normal waterproofing. This system generally consists of a prefabricated drain panel lined with filter fabric. At the wall base, we recommend that a gravel drain be installed to collect and discharge drainage to a suitable outlet. The drain should consist of a 4-inch-diameter perforated PVC pipe, placed perforations down at the bottom of approximately 3 cubic feet of clean gravel per foot of wall length. The gravel drain should be wrapped in filter fabric (Mirafi 140N or equivalent). The pipe should be sloped to drain to a suitable outlet and cleanouts should be provided at appropriate intervals. If drainage behind the wall is omitted, the wall should be designed for full hydrostatic pressure. The design of any drain panel system should be submitted to Kleinfelder for review to check that our recommendations have been properly incorporated into the design. Installation of the drainage system should be reviewed and documented by a Kleinfelder representative.

### 4.14 SOIL CORROSION

Kleinfelder has completed laboratory testing to provide data regarding corrosivity of onsite soils. Our scope of services does not include corrosion engineering and, therefore, a detailed analysis of the corrosion test results is not included in this report. A qualified corrosion engineer should be retained to review the test results and design protective systems that may be required. Kleinfelder may be able to provide those services.

Laboratory soluble chloride concentration, soluble sulfate concentration, pH, and electrical resistivity tests were performed for soil samples obtained from the borings. The results of the tests are attached and are summarized in Table 13. If fill materials will be imported to the project site, similar corrosion potential laboratory testing should be completed on the imported material..

**Table 13**
**Corrosion Test Results**

| Boring | Depth (ft.) | Minimum Resistivity (ohm-cm) | pH | Soluble Sulfate Content (ppm) | Soluble Chloride Content (ppm) |
|---|---|---|---|---|---|
| B-5 | 2 – 2½ | 898 | 7.8 | 407 | 48 |
| B-8 | 2 – 2½ | 726 | 8.0 | 459 | 102 |
| KB-12 | 7½ | 730 | 7.7 | 1,999 | 113 |
| KCPT-5 | 3 - 5 | 812 | 8.0 | 520 | 33 |

Ferrous metal and concrete elements in contact with soil, whether part of a foundation or part of the supported structure, are subject to degradation due to corrosion or chemical attack. Therefore, buried ferrous metal and concrete elements should be designed to resist corrosion and degradation based on accepted practices. Based on the Caltrans "Corrosion Guidelines" version 2, November 2012, the results of the soil resistivity tests indicate a high potential for corrosion. We recommend that a corrosion engineer be consulted to recommend appropriate protective measures.

The degradation of concrete or cement grout can be caused by chemical agents in the soil or groundwater that react with concrete to either dissolve the cement paste or precipitate larger compounds within the concrete, causing cracking and flaking. The concentration of water-soluble sulfates in the soils is a good indicator of the potential for chemical attack of concrete or cement grout. The American Concrete Institute (ACI) in their publication *Guide to Durable Concrete* (ACI 201.2R-08) provides guidelines for this assessment. The tests had sulfate concentration ranging from 407 to 1,999 parts per million (ppm) (1,999 ppm = 0.1999%). The results of these sulfate tests indicate the potential for deterioration of concrete is moderate to mild; use of Type II cement should be considered. We recommend that a corrosion engineer be consulted to recommend appropriate protective measures.

Concrete and the reinforcing steel within it are at risk of corrosion when exposed to water-soluble chloride in the soil or groundwater. Chloride tests indicated that the samples had a measureable concentration. The project structural engineer should review this data to determine if remedial measures are necessary for the concrete reinforcing steel.

# 5 ADDITIONAL SERVICES

## 5.1 PLANS AND SPECIFICATIONS REVIEW

We recommend that Kleinfelder perform a general review of the project plans and specifications before they are finalized to verify that our geotechnical recommendations have been properly interpreted and implemented during design. If we are not accorded the privilege of performing this review, we can assume no responsibility for misinterpretation of our recommendations.

## 5.2 CONSTRUCTION OBSERVATION AND TESTING

The construction process is an integral design component with respect to the geotechnical aspects of a project. Because geotechnical engineering is an inexact science due to the variability of natural processes, and because we sample only a limited portion of the soils affecting the performance of the proposed improvements, unanticipated or changed conditions can be encountered during grading. Proper geotechnical observation and testing during construction are imperative to allow the geotechnical engineer the opportunity to verify assumptions made during the design process. Therefore, we recommend that Kleinfelder be retained during the construction of the proposed improvements to observe compliance with the design concepts and geotechnical recommendations, and to allow design changes in the event that subsurface conditions or methods of construction differ from those assumed while completing this study.

Our services are typically needed at the following stages of construction:

- after demolition;
- during grading;
- during the installation of temporary construction shoring and dewatering;
- after the overexcavation, but prior to scarification;
- during utility trench backfill;
- during base placement and site paving;
- during the installation of pile foundations; and
- after excavation for spread foundations.

## 6 LIMITATIONS

This geotechnical study has been prepared for the exclusive use of Merlone Geier Partners and their agents for specific application to the proposed Five Lagunas Redevelopment located at 24155 Laguna Hills Mall in Laguna Hills, California. We have prepared this report in substantial accordance with the generally accepted geotechnical engineering practice as it exists in the site area at the time of our study. No warranty is expressed or implied.

The scope of services was limited to a background data review and the field exploration described in Section 1.2. It should be recognized that definition and evaluation of subsurface conditions are difficult. Judgments leading to conclusions and recommendations are generally made with incomplete knowledge of the subsurface conditions present due to the limitations of data from field studies. The conclusions of this assessment are based on our field exploration and laboratory testing programs, and engineering analyses.

Kleinfelder offers various levels of investigative and engineering services to suit the varying needs of different clients. Although risk can never be eliminated, more detailed and extensive studies yield more information, which may help understand and manage the level of risk. Since detailed study and analysis involves greater expense, our clients participate in determining levels of service, which provide information for their purposes at acceptable levels of risk. The client and key members of the design team should discuss the issues addressed in this report with Kleinfelder, so that the issues are understood and applied in a manner consistent with the owner's budget, tolerance of risk and expectations for future performance and maintenance.

Recommendations contained in this report are based on our field observations and subsurface explorations, limited laboratory tests, and our present knowledge of the proposed construction. It is possible that soil or groundwater conditions could vary between or beyond the points explored. If soil or groundwater conditions are encountered during construction that differ from those described herein, the client is responsible for ensuring that Kleinfelder is notified immediately so that we may reevaluate the recommendations of this report. If the scope of the proposed construction, including the locations of the improvements, changes from that described in this report, the conclusions and recommendations contained in this report are not considered valid until the changes are reviewed, and the conclusions of this report are modified or approved in writing, by Kleinfelder.

Our geotechnical scope of services for this subsurface exploration and geotechnical report did not include environmental assessments or evaluations regarding the presence or absence of wetlands or hazardous substances in the soil, surface water, or groundwater at this site.

Kleinfelder cannot be responsible for interpretation by others of this report or the conditions encountered in the field. Kleinfelder must be retained so that all geotechnical aspects of construction will be monitored on a full-time basis by a representative from Kleinfelder, including site preparation, preparation of foundations, and placement of engineered fill and trench backfill. These services provide Kleinfelder the opportunity to observe the actual soil and groundwater conditions encountered during construction and to evaluate the applicability of the recommendations presented in this report to the site conditions. If Kleinfelder is not retained to provide these services, we will cease to be the engineer of record for this project and will assume no responsibility for any potential claim during or after construction on this project. If changed site conditions affect the recommendations presented herein, Kleinfelder must also be retained to perform a supplemental evaluation and to issue a revision to our original report.

Kleinfelder's services and documents on this project are intended solely for the design and construction of residential rental units under the ownership and control of a single owner, Merlone Geier Partners. If the project is changed to any other purpose or use whatsoever, including, but not limited to, subdivision of the project into individual units for sale, Kleinfelder shall have no liability and shall be released from all obligations and responsibility for the project. Further, in such event, any and all of the Client's rights, license, and/or ownership interest in the documents prepared by Kleinfelder shall be void. The Client shall be expressly prohibited from making any further use of the documents prepared by Kleinfelder for any purpose, including, but not limited to, the conversion of this project to another purpose. The Client acknowledges the risks inherent in condominium and other owner-occupied residential projects and that these risks and exposures were not contemplated in Kleinfelder's fee for the project as originally contemplated. The Client agrees, to the fullest extent permitted by law, to indemnify and hold harmless Kleinfelder, its officers, directors, employees, and subconsultants against all damages, liabilities, or costs, including reasonable attorneys' fees and defense costs, arising out of on any way connected with any change, conversion, or alternative use of the Project.

This report, and any future addenda or reports regarding this site, may be made available to bidders to supply them with only the data contained in the report regarding subsurface conditions and laboratory test results at the point and time noted. Bidders may not rely on interpretations, opinion, recommendations, or conclusions contained in the report. Because of the limited nature of any subsurface study, the contractor may encounter conditions during construction which differ from those presented in this report. In such event, the contractor should promptly notify the owner so that Kleinfelder's geotechnical engineer can be contacted to confirm those conditions. We recommend the contractor describe the nature and extent of the differing conditions in writing and that the construction contract include provisions for dealing with differing conditions. Contingency funds should be reserved for potential problems during earthwork and foundation construction.

This report may be used only by the client and only for the purposes stated, within a reasonable time from its issuance, but in no event later than one year from the date of the report. Land use, site conditions (both on site and off site) or other factors may change over time, and additional work may be required with the passage of time. Any party, other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of this report and the nature of the new project, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party and the client agrees to defend, indemnify, and hold harmless Kleinfelder from any claims or liability associated with such unauthorized use or non-compliance.

# 7 REFERENCES

American Concrete Institute (ACI), 2011, Building Code Requirements for Structural Concrete (ACI 318-11) and Commentary.

American Society of Civil Engineers (ASCE), 2010, Minimum Design Load for Buildings and Other Structures (ASCE/SEI 7-10).

Atwater, T., 1998, Plate Tectonic History of Southern California with Emphasis on the Western Transverse Ranges and Santa Rosa Island, in Weigand, P.W., ed., Contributions to the Geology of the Northern Channel Islands, Southern California: American Association of Petroleum Geologists, Pacific Section, MP 45, pp. 1-8.

Audell, H.S., and Baghoomian, H., 1995, Homeowner-induced geologic impact to residential structures that overlie the Capistrano Formation, Orange County, California: Environmental & Engineering Geoscience, Volume I, No. 1, pp. 89-93.

Barrie, D., Totnall, T., and Gath, E., 1992, Neotectonic Uplift and Ages of Pleistocene Marine Terraces, San Joaquin Hills, Orange County, California. in Heath, E.G., and W.L. Lewis, eds., 1992, The Regressive Pleistocene Shoreline, Coastal Southern California: South Coast Geological Society, Annual Field Trip Guidebook Number 20.

Bryant, W.A. and Hart, E.W., 2007, Fault-Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zones Maps: California Geological Survey Special Publication 42, 42p.

California Department of Transportation (Caltrans), 2003, Corrosion Guidelines, Version 1.0, available at http://www.dot.ca.gov/hq/esc/ttsb/corrosion/Index.htm.

California Department of Transportation (Caltrans), 2014, California Amendments to AASHTO LRFD Bridge Design Specifications-Sixth Edition.

California Geological Survey (CGS), 2001a, Seismic Hazard Zone Report for the San Juan Capistrano 7.5-Minute Quadrangle, Orange County California, SHZR 053, revised 2006.

California Geological Survey (CGS), 2001b, Seismic Hazard Zones Map, San Juan Capistrano Quadrangle, Orange County, California, scale 1:24,000.

California Geological Survey (CGS), 2002, California Geomorphic Provinces, Note 36, 4p.

Cao, T., Bryant, W.A., Rowshandel, B., Branum, D., and Wills, C.J., 2003, The Revised 2002 California Probabilistic Seismic Hazard Maps, California Geological Survey, available at http://www.conservation.ca.gov/.

Cetin, K.O., Bilge, H. T., Wu, J., Kammerer, A. M., and Seed, R. B., 2009, Probabilistic Models for Cyclic Straining of Saturated Clean Sand, ASCE J.Geotech.Eng, 135 (3), p. 371–386.

Federal Emergency Management Agency (FEMA), 2009, Flood Insurance Rate Maps (FIRM), Panel 06059C0427, FEMA Map Service Center, accessible at http://msc.fema.gov.

Grant, L.B., Mueller, K.J., Gath, E.M., Cheng, H., Edwards, R.L., Munro, R., and Kennedy, G.L., 1999, Late Quaternary uplift and earthquake potential of the San Joaquin Hills, southern Los Angeles Basin, California: Geological Society of America Geology, Volume 27, No. 11, pp. 1031-1034.

Grant, L.B., Ballenger, L.J., and Runnerstrom, E.E., 2002, Coastal uplift of the San Joaquin Hills, southern Los Angeles Basin, California, by a large earthquake since A.D. 1635: Bulletin of the Seismological Society of America, Volume 92, No. 2, pp. 590-599.

Grant, L.B. and Shearer, P.M., 2004, Activity of the offshore Newport-Inglewood-Rose Canyon Fault Zone, coastal southern California, from relocated microseismicity: Bulletin of the Seismological Society of America, Volume 94, No. 2, pp. 747-752.

Idriss, I.M., and Boulanger, R.W., 2004, “Semi–empirical Procedures for Evaluating Liquefaction Potential During Earthquakes”, Proceedings of the 11th SDEE and 3rd ICEGE, University of California, Berkeley, January 2004, plenary session, p. 32–56.

Idriss, I. M. and Boulanger, R.W., 2008, Soil Liquefaction During Earthquakes. Earthquake Engineering Research Institute, MNO - 12, Oakland, California.

International Code Council, Inc., 2013 California Building Code.

Jennings, Charles W., 1994, Fault Activity Map of California and Adjacent Areas with Locations of Recent Volcanic Eruptions, California Division of Mines and Geology Map.

Morton, P.K., Edgington, W.J., and Fife, D.L., 1974, Geology and Engineering Geologic Aspects of the San Juan Capistrano Quadrangle, Orange County California: California Division of Mines and Geology (CDMG), Special Report No. 112, 64p.

Morton, D.M., 2004, Preliminary Geologic Map of the Santa Ana 30'x 60' Quadrangle, Southern California: U.S. Geological Survey Open File Report 99-172, Scale 1:100,000.

Moss, R. E. S., Seed, R.B., Kayen, R.E., Steward, J.P., and Kiureghian, A.D., 2006, CPT-Based Probabilistic Assessment of Seismic Soil Liquefaction Initiation, PEER 2005/15, Richmond, California.

Norris, R.M., and Webb, R.W., 1990, Geology of California, Second Edition, John Wiley & Sons, Inc. Pub.

National Association of Corrosion Engineers (NACE), 2006, "Corrosion Basics, An Introduction, 2nd Edition" National Association of Corrosion Engineers.

Orange County, 2011, County of Orange General Plan, OC Public Works, Board of Supervisors Resolution 11-044, dated March 22, 2011, Maps and Figures, IX-9.

Portland Cement Association, 1988, Design and Control of Concrete Mixtures, Portland Cement Association, Skokie, Illinois.

Pridmore, C.L., 2001, Liquefaction zones in the San Juan Capistrano 7.5-Minute Quadrangle, Orange County, California in Seismic Hazard Zone Report for the San Juan Capistrano 7.5-minute Quadrangle, Orange County, California: California Geological Survey Seismic Hazard Zone Report 053, pp. 3-18.

R.A. Smith National, 2012, ATLA/ACSM Survey, Laguna Hills Mall, Laguna Hill, CA, dated June 7, 2012.

Seed, R. B., Cetin, K. O., Moss, R. E. S., Kammerer, A., Wu, J., Pestana, J., Riemer, M., Sancio, R. B., Bray, J. D., Kayen, R. E., and Faris, A. (2003). Recent Advances in Soil Liquefaction Engineering: a Unified and Consistent Framework, Keynote Presentation, 26th Annual ASCE Los Angeles Geotechnical Spring Seminar, Long Beach, CA.

Tokimatsu, K., and Seed, H. B., 1987, Evaluation of settlements in sands due to earthquake shaking, J. Geotechnical Eng., ASCE 113(GT8), 861–78.

U.S. Geological Survey (USGS) and California Geological Survey (CGS), 2006, Quaternary Fault and Fold Database for the United States, accessed July 24, 2012: http://earthquake.usgs.gov/hazards/qfaults/google.php

United States Geological Survey (USGS), 1968, San Juan Capistrano Quadrangle, Orange County, California, 7.5-Minute Series Topographic Map, scale 1:24,000, photorevised 1981.

United States Geological Survey (USGS), 1968, El Toro Quadrangle, Orange County, California, 7.5-Minute Series Topographic Map, scale 1:24,000, photorevised 1982.

Vedder, J.G., 1975, Revised geologic map, structure sections and well table, San Joaquin Hills-San Juan Capistrano area, California: U.S. Geological Survey Open File Report 75-552.

Vedder, J.G., Yerkes, R.F., and Schoellhamer, J.E., 1957, Geologic map of the San Joaquin Hills-San Juan Capistrano Area, Orange County, California, USGS Oil and Gas Investigations Map OM 193, Scale 1:24,000.

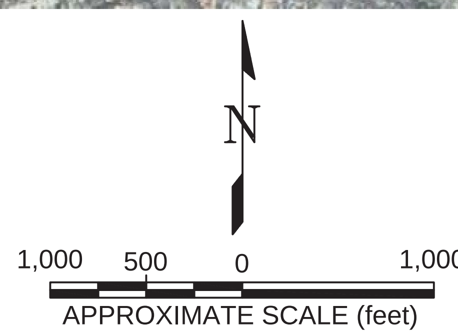
Wilson, R.I., Perez, F.G., Barrows, A.G., McCrink, T.P., and Tan, S.S., 2001, Earthquake-induced landslide zones in the San Juan Capistrano 7.5-minute Quadrangle, Orange County, California, in Seismic Hazard Zone Report for the San Juan Capistrano 7.5-minute Quadrangle, Orange County, California: California Geological Survey Seismic Hazard Zone Report 053, pp. 19-36.

Youd, T. Leslie and Idriss, Izzat M., 1997, Proceeding of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils, National Center for Earthquake Engineering Research, Technical Report NCEER-97-0022.

Youd, et.al, 2001, “Liquefaction Resistance of Soils: Summary report of NCEER 1996 and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils,” Journal of Geotechnical and Geoenvironmental Engineering, October 2001, pp.817-833.

# FIGURES


SOURCE: U.S.G.S. NATIONAL MAP VIEWER, IMAGE DATE 2012.




The information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

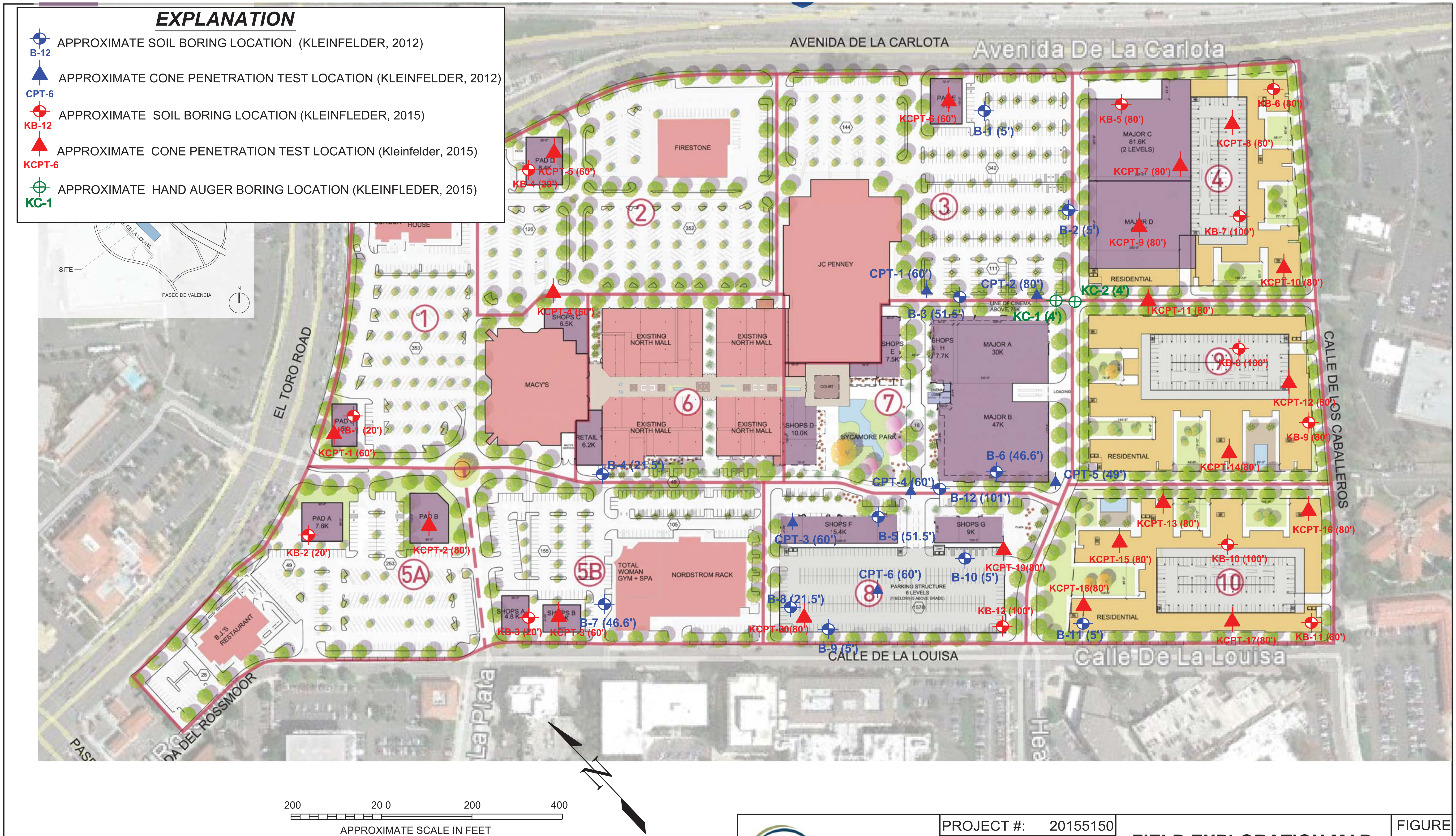
| | |
|---|---|
| PROJECT: | 20155150 |
| DRAWN: | 04/2015 |
| DRAWN BY: | DMF |
| CHECKED BY: | SK |
| FILE NAME: 20155150_F1.dwg | |

SITE MAP

GEOTECHNICAL STUDY
PROPOSED FIVE LAGUNAS REDEVELOPMENT
24155 LAGUNA HILLS MALL
LAGUNA HILLS, CALIFORNIA

FIGURE
1

PLOTTED: 01 May 2015, 11:07am, dfahrney
LAYOUT: 1
CAD FILE: L:\2015\CADD\20155150\
Images: LAGUNA-HILLS-MALL.PNG
ATTACHED IMAGES:
ATTACHED XREFS:
LONG BEACH, CA




KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

| | |
|---|---|
| PROJECT #: | 20155150 |
| DRAWN BY: | SK |
| DATE DRAWN: | 4/29/15 |
| CHECKED BY: | MS |
| DATE CHECKED: | 4/29/15 |

**FIELD EXPLORATION MAP**

GEOTECHNICAL STUDY
PROPOSED FIVE LAGUNAS REDEVELOPMENT
24155 LAGUNA HILLS MALL
LAGUNA HILLS, CALIFORNIA

FIGURE 2

# APPENDIX A
## Field Explorations

## APPENDIX A
## FIELD EXPLORATIONS

### GENERAL

Our field exploration program consisted of drilling 24 borings and advancing 26 cone penetration tests (CPTs), including 12 borings and 6 CPTs that were drilled/ advanced during a previous investigation by Kleinfelder in 2012.

Borings were drilled to depths between approximately 5 and 100 feet beneath ground surface (bgs) using truck-mounted rotary wash drilling equipment. The CPTs were advanced to depths between approximately 50 and 80 feet bgs. In addition, two hand auger borings to approximately 4 feet deep were advanced to assess the cause(s) of the settlement in the storm drain easement between the existing Sears building and mall. The borings were drilled by CalPac Drilling of Calimesa and SoCal Drilling of La Habra, California with a truck-mounted, drilling rig equipped with an auto-hammer (Mobile B61). The CPTs were advanced by Kehoe Testing and Engineering of Huntington Beach, California with a truck-mounted rig. The approximate locations of the borings and CPTs are presented on Figure 2.

Prior to commencement of the fieldwork, various geophysical techniques were used at the boring location in order to identify potential conflicts with subsurface structures. The boring location was also cleared for buried utilities through Underground Service Alert (USA).

### BORINGS

The Logs of Borings are presented in this appendix. Keys to the symbols and classifications used on the logs are presented as Figures A-1, A-2, and A-3. The Logs of Boring describes the earth materials encountered, samples obtained and show field and laboratory tests performed. The logs also show the location, boring number, drilling date, and the name of the drilling subcontractor. The boring was logged by a Kleinfelder engineer using the Unified Soil Classification System. The boundaries between soil types shown on the logs are approximate because the transition between different soil layers may be gradual. Bulk and drive samples of selected earth materials were obtained from the borings.

A modified-California sampler was used to obtain drive samples of the soil encountered. This sampler consists of a 3-inch O.D., 2.4-inch I.D. split barrel shaft that is pushed or driven a total of 18-inches into the soil at the bottom of the boring. The soil was retained in six 1-inch brass rings for laboratory testing. An additional 2 inches of soil from each drive remained in the cutting shoe and was usually discarded after visually classifying the soil. The sampler was driven using a 140-pound hammer falling 30 inches. The total number of blows required to drive the sampler the final 12 inches is termed blow count and is recorded on the Log of Boring.

Samples were also obtained using a Standard Penetration Sampler (SPT). This sampler consists of a 2-inch O.D., 1-inch I.D. split barrel shaft that is advanced into the soils at the bottom of the drill hole a total of 18 inches. The sampler was driven using a 140-pound hammer falling 30 inches. The total number of hammer blows required to drive the sampler the final 12 inches is termed the blow count (N) and is recorded on the Log of Boring. The procedures we employed in the field are generally consistent with those described in ASTM Standard Test Method D1586.

## CONE PENETRATION TESTS

The CPTs were advanced by Kehoe Testing and Engineering of Huntington Beach, California with a truck-mounted rig. The CPT involves pushing a conical-shaped probe into a soil deposit and recording the resistance of the soil to penetration. Test equipment consists of a cone assembly, a series of hollow sounding rods, a hydraulic frame to push the cone and rods into the soil, an electronic data processing unit, and a truck to transport the test equipment and provide thrust resistance.

The cone penetrometer consists of a conical tip with a 60-degree apex angles and a cylindrical friction sleeve. The interior of the device is instrumented with strain gauges allowing simultaneous measurements of cone penetration resistance and sleeve friction during testing. Electric signals from the strain gauges are transmitted by cable through the hollow sounding rods to a data processing unit. The cone assembly used on this project had a cross-sectional area of 15-square centimeters and a friction sleeve surface area of 225 square centimeters. Plots of the tip resistance (tip bearing) and friction ratio for each CPT performed during this investigation are provided in this Appendix.

CPT data can be used to derive several significant soil parameters related to foundation design and performance. The end bearing resistance of the cone tip (generally referred to as the tip resistance) is an indicator of both in-situ bearing capacity and compressibility. Indirectly, tip resistance can also be an indicator of soil type, since a fine-grained soil typically has a lower tip resistance than a coarse-grained soil.

The sleeve friction resistance is an indirect indicator of in-situ shear strength. In addition, the friction ratio (expressed as a percentage), is an indicator of soil behavior types. Sands typically have low friction ratios (0 to 2½ percent) while clays have higher friction ratios (typically more than 4 percent).

The combination of CPT data defining soil behavior type and penetration resistance allows rapid interpretation of subsurface stratigraphy. A general classification of soil strata can be obtained from the data using the CPT Classification Chart provided in the attached CPT report in this Appendix. Since the CPT provides near-continuous information throughout the stratigraphy penetrated, it is possible to identify thin soil units that could go undetected in selectively sampled boring.

## SAMPLE/SAMPLER TYPE GRAPHICS

- BAG SAMPLE
- CALIFORNIA SAMPLER (3 in. (76.2 mm.) outer diameter)
- CORE SAMPLER
- GRAB SAMPLE
- STANDARD PENETRATION SPLIT SPOON SAMPLER (2 in. (50.8 mm.) outer diameter and 1-3/8 in. (34.9 mm.) inner diameter)

## GROUND WATER GRAPHICS

- WATER LEVEL (level where first observed)
- WATER LEVEL (level after exploration completion)
- WATER LEVEL (additional levels after exploration)
- OBSERVED SEEPAGE

## NOTES

- The report and graphics key are an integral part of these logs. All data and interpretations in this log are subject to the explanations and limitations stated in the report.
- Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual or differ from those shown.
- No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
- Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
- In general, Unified Soil Classification System designations presented on the logs were based on visual classification in the field and were modified where appropriate based on gradation and index property testing.
- Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing the No. 200 sieve require dual USCS symbols, ie., GW-GM, GP-GM, GW-GC, GP-GC, GC-GM, SW-SM, SP-SM, SW-SC, SP-SC, SC-SM.
- If sampler is not able to be driven at least 6 inches then 50/X indicates number of blows required to drive the identified sampler X inches with a 140 pound hammer falling 30 inches.

## UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

| Major Division | Subdivision | Fines | Gradation | Symbol | Description |
|---|---|---|---|---|---|
| COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve) | GRAVELS (More than half of coarse fraction is larger than the #4 sieve) | CLEAN GRAVEL WITH <5% FINES | $Cu \geq 4$ and $1 \leq Cc \leq 3$ | GW | WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES |
| | | | $Cu < 4$ and/ or $1 > Cc > 3$ | GP | POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES |
| | | GRAVELS WITH 5% TO 12% FINES | $Cu \geq 4$ and $1 \leq Cc \leq 3$ | GW-GM | WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES |
| | | | | GW-GC | WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES |
| | | | $Cu < 4$ and/ or $1 > Cc > 3$ | GP-GM | POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES |
| | | | | GP-GC | POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES |
| | | GRAVELS WITH > 12% FINES | | GM | SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES |
| | | | | GC | CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES |
| | | | | GC-GM | CLAYEY GRAVELS, GRAVEL-SAND-CLAY-SILT MIXTURES |
| | SANDS (More than half of coarse fraction is smaller than the #4 sieve) | CLEAN SANDS WITH <5% FINES | $Cu \geq 6$ and $1 \leq Cc \leq 3$ | SW | WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES |
| | | | $Cu < 6$ and/ or $1 > Cc > 3$ | SP | POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES |
| | | SANDS WITH 5% TO 12% FINES | $Cu \geq 6$ and $1 \leq Cc \leq 3$ | SW-SM | WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES |
| | | | | SW-SC | WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES |
| | | | $Cu < 6$ and/ or $1 > Cc > 3$ | SP-SM | POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES |
| | | | | SP-SC | POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES |
| | | SANDS WITH > 12% FINES | | SM | SILTY SANDS, SAND-GRAVEL-SILT MIXTURES |
| | | | | SC | CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES |
| | | | | SC-SM | CLAYEY SANDS, SAND-SILT-CLAY MIXTURES |

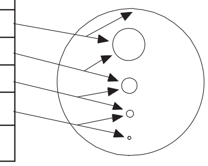
| Major Division | Subdivision | Symbol | Description |
|---|---|---|---|
| FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve) | SILTS AND CLAYS (Liquid Limit less than 50) | ML | INORGANIC SILTS AND VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, SILTS WITH SLIGHT PLASTICITY |
| | | CL | INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS |
| | | CL-ML | INORGANIC CLAYS-SILTS OF LOW PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS |
| | | OL | ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY |
| | SILTS AND CLAYS (Liquid Limit greater than 50) | MH | INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT |
| | | CH | INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS |
| | | OH | ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY |

KLEINFELDER
Bright People. Right Solutions.

| | | |
|---|---|---|
| PROJECT NO.: 20155150 | GRAPHICS KEY | FIGURE |
| DRAWN BY: | | |
| CHECKED BY: | Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | A-1 |
| DATE: | | |
| REVISED: - | | |

## GRAIN SIZE

| DESCRIPTION | | SIEVE SIZE | GRAIN SIZE | APPROXIMATE SIZE |
|---|---|---|---|---|
| Boulders | | >12 in. (304.8 mm.) | >12 in. (304.8 mm.) | Larger than basketball-sized |
| Cobbles | | 3 - 12 in. (76.2 - 304.8 mm.) | 3 - 12 in. (76.2 - 304.8 mm.) | Fist-sized to basketball-sized |
| Gravel | coarse | 3/4 -3 in. (19 - 76.2 mm.) | 3/4 -3 in. (19 - 76.2 mm.) | Thumb-sized to fist-sized |
| | fine | #4 - 3/4 in. (#4 - 19 mm.) | 0.19 - 0.75 in. (4.8 - 19 mm.) | Pea-sized to thumb-sized |
| Sand | coarse | #10 - #4 | 0.079 - 0.19 in. (2 - 4.9 mm.) | Rock salt-sized to pea-sized |
| | medium | #40 - #10 | 0.017 - 0.079 in. (0.43 - 2 mm.) | Sugar-sized to rock salt-sized |
| | fine | #200 - #10 | 0.0029 - 0.017 in. (0.07 - 0.43 mm.) | Flour-sized to sugar-sized |
| Fines | | Passing #200 | <0.0029 in. (<0.07 mm.) | Flour-sized and smaller |

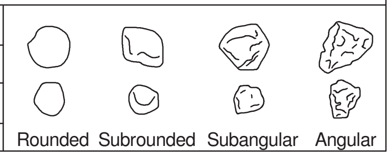


## Munsell Color

| NAME | ABBR |
|---|---|
| Red | R |
| Yellow Red | YR |
| Yellow | Y |
| Green Yellow | GY |
| Green | G |
| Blue Green | BG |
| Blue | B |
| Purple Blue | PB |
| Purple | P |
| Red Purple | RP |
| Black | N |

## ANGULARITY

| DESCRIPTION | CRITERIA |
|---|---|
| Angular | Particles have sharp edges and relatively plane sides with unpolished surfaces |
| Subangular | Particles are similar to angular description but have rounded edges |
| Subrounded | Particles have nearly plane sides but have well-rounded corners and edges |
| Rounded | Particles have smoothly curved sides and no edges |




## Particles Present

| Amount | Percentage |
|---|---|
| trace | <5 |
| few | 5-10 |
| little | 15-25 |
| some | 30-45 |
| and | 50 |
| mostly | 50-100 |

## PLASTICITY

| DESCRIPTION | LL | FIELD TEST |
|---|---|---|
| Non-plastic | NP | A 1/8-in. (3 mm.) thread cannot be rolled at any water content. |
| Low (L) | < 30 | The thread can barely be rolled and the lump or thread cannot be formed when drier than the plastic limit. |
| Medium (M) | 30 - 50 | The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump or thread crumbles when drier than the plastic limit |
| High (H) | > 50 | It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump or thread can be formed without crumbling when drier than the plastic limit |

## MOISTURE CONTENT

| DESCRIPTION | FIELD TEST |
|---|---|
| Dry | Absence of moisture, dusty, dry to the touch |
| Moist | Damp but no visible water |
| Wet | Visible free water, usually soil is below water table |

## REACTION WITH HYDROCHLORIC ACID

| DESCRIPTION | FIELD TEST |
|---|---|
| None | No visible reaction |
| Weak | Some reaction, with bubbles forming slowly |
| Strong | Violent reaction, with bubbles forming immediately |

## APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

| APPARENT DENSITY | $SPT-N_{60}$ (# blows/ft) | MODIFIED CA SAMPLER (# blows/ft) | CALIFORNIA SAMPLER (# blows/ft) | RELATIVE DENSITY (%) |
|---|---|---|---|---|
| Very Loose | <4 | <4 | <5 | 0 - 15 |
| Loose | 4 - 10 | 5 - 12 | 5 - 15 | 15 - 35 |
| Medium Dense | 10 - 30 | 12 - 35 | 15 - 40 | 35 - 65 |
| Dense | 30 - 50 | 35 - 60 | 40 - 70 | 65 - 85 |
| Very Dense | >50 | >60 | >70 | 85 - 100 |

NOTE: AFTER TERZAGHI AND PECK, 1948

## CONSISTENCY - FINE-GRAINED SOIL

| CONSISTENCY | UNCONFINED COMPRESSIVE STRENGTH ($q_u$)(psf) | CRITERIA |
|---|---|---|
| Very Soft | < 1000 | Thumb will penetrate soil more than 1 in. (25 mm.) |
| Soft | 1000 - 2000 | Thumb will penetrate soil about 1 in. (25 mm.) |
| Firm | 2000 - 4000 | Thumb will indent soil about 1/4-in. (6 mm.) |
| Hard | 4000 - 8000 | Thumb will not indent soil but readily indented with thumbnail |
| Very Hard | > 8000 | Thumbnail will not indent soil |

## STRUCTURE

| DESCRIPTION | CRITERIA |
|---|---|
| Stratified | Alternating layers of varying material or color with layers at least 1/4-in. thick, note thickness |
| Laminated | Alternating layers of varying material or color with the layer less than 1/4-in. thick, note thickness |
| Fissured | Breaks along definite planes of fracture with little resistance to fracturing |
| Slickensided | Fracture planes appear polished or glossy, sometimes striated |
| Blocky | Cohesive soil that can be broken down into small angular lumps which resist further breakdown |
| Lensed | Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness |
| Homogeneous | Same color and appearance throughout |

## CEMENTATION

| DESCRIPTION | FIELD TEST |
|---|---|
| Weakly | Crumbles or breaks with handling or slight finger pressure |
| Moderately | Crumbles or breaks with considerable finger pressure |
| Strongly | Will not crumble or break with finger pressure |

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20155150
DRAWN BY:
CHECKED BY:
DATE:
REVISED: -

SOIL DESCRIPTION KEY

Five Lagunas Redevelopment
24155 Laguna Hills Mall
Laguna Hills, CA

FIGURE
A-2

## INFILLING TYPE

| NAME | ABBR | NAME | ABBR |
|---|---|---|---|
| Albite | Al | Muscovite | Mus |
| Apatite | Ap | None | No |
| Biotite | Bi | Pyrite | Py |
| Clay | Cl | Quartz | Qz |
| Calcite | Ca | Sand | Sd |
| Chlorite | Ch | Sericite | Ser |
| Epidote | Ep | Silt | Si |
| Iron Oxide | Fe | Talc | Ta |
| Manganese | Mn | Unknown | Uk |

## BEDDING CHARACTERISTICS

| TERM | Thickness (in.) | Thickness (mm.) |
|---|---|---|
| Very Thick Bedded | > 36 | > 915 |
| Thick Bedded | 12 - 36 | 305 - 915 |
| Moderately Bedded | 4 - 12 | 102 - 305 |
| Thin Bedded | 1 - 4 | 25 - 102 |
| Very Thin Bedded | 0.4 - 1 | 10 - 25 |
| Laminated | 0.1 - 0.4 | 2.5 - 10 |
| Thinly Laminated | < 0.1 | < 2.5 |

Bedding Planes — Planes dividing the individual layers, beds, or stratigraphy of rocks.
Joint — Fracture in rock, generally more or less vertical or traverse to bedding.
Seam — Applies to bedding plane with unspecified degree of weather.

## DENSITY/SPACING OF DISCONTINUITIES

| DESCRIPTION | SPACING CRITERIA |
|---|---|
| Unfractured | > 6 ft. (> 1.83 meters) |
| Slightly Fractured | 2 - 6 ft. (.061 - 1.83 meters) |
| Moderately Fractured | 8 in - 2 ft. (203.20 - 609.60 mm.) |
| Highly Fractured | 2 - 8 in. (50.80 - 203.30 mm.) |
| Intensely Fractured | < 2 in. (< 50.80 mm.) |

## APERTURE

| DESCRIPTION | CRITERIA [in.(mm.)] |
|---|---|
| Tight | < 0.04 (< 1) |
| Open | 0.04 - 0.20 (1 - 5) |
| Wide | > 0.20 (> 5) |

## ADDITIONAL TEXTURAL ADJECTIVES

| DESCRIPTION | RECOGNITION |
|---|---|
| Pit (Pitted) | Pinhole to 0.03 ft. (3/8 in.) (>1 to 10 mm.) openings |
| Vug (Vuggy) | Small openings (usually lined with crystals) ranging in diameter from 0.03 ft. (3/8 in.) to 0.33 ft. (4 in.) (10 to 100 mm.) |
| Cavity | An opening larger than 0.33 ft. (4 in.) (100 mm.), size descriptions are required, and adjectives such as small, large, etc., may be used |
| Honeycombed | If numerous enough that only thin walls separate individual pits or vugs, this term further describes the preceding nomenclature to indicate cell-like form |
| Vesicle (Vesicular) | Small openings in volcanic rocks of variable shape and size formed by entrapped gas bubbles during solidification |

## DISCONTINUITY TYPE

| DESCRIPTION |
|---|
| Fault |
| Joint |
| Shear |
| Foliation |
| Vein |
| Bedding |

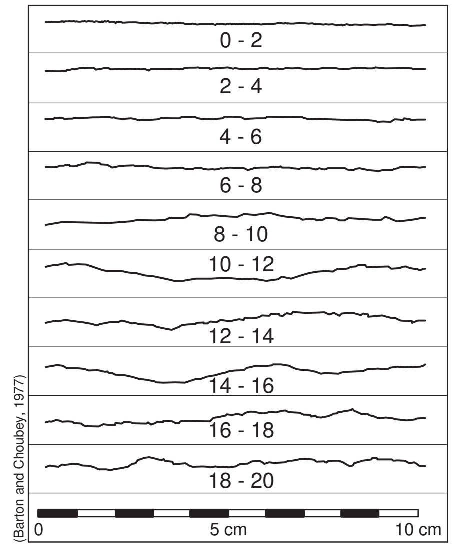
## INFILLING AMOUNT

| DESCRIPTION |
|---|
| Surface Stain |
| Spotty |
| Partially Filled |
| Filled |
| None |

## ROCK QUALITY DESIGNATION (RQD)

| DESCRIPTION | RQD (%) |
|---|---|
| Very Poor | 0 - 25 |
| Poor | 25 - 50 |
| Fair | 50 - 75 |
| Good | 75 - 90 |
| Excellent | 90 - 100 |

## JOINT ROUGHNESS COEFFICIENT (JRC)




RQD — Rock-quality designation (RQD) Rough measure of the degree of jointing or fracture in a rock mass, measured as a percentage of the drill core in lengths of 10 cm. or more.

## DEGREES OF WEATHERING

| DESCRIPTION | CRITERIA |
|---|---|
| Unweathered | No evidence of chemical/mechanical alternation; rings with hammer blow. |
| Slightly Weathered | Slight discoloration on surface; slight alteration along discontinuities; <10% rock volume altered. |
| Moderately Weathered | Discoloring evident; surface pitted and alteration penetration well below surface; Weathering "halos" evident; 10-50% rock altered. |
| Highly Weathered | Entire mass discolored; Alteration pervading most rock, some slight weathering pockets; some minerals may be leached out. |
| Decomposed | Rock reduced to soil with relict rock texture/structure; Generally molded and crumbled by hand. |

## RELATIVE HARDNESS / STRENGTH DESCRIPTIONS

| GRADE | | UCS (MPa) | FIELD TEST |
|---|---|---|---|
| R0 | Extremely Weak | 0.25 - 1.0 | Indented by thumbnail |
| R1 | Very Weak | 1.0 - 5.0 | Crumbles under firm blows of geological hammer, can be peeled by a pocket knife |
| R2 | Weak | 5.0 - 25 | Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer |
| R3 | Medium Strong | 25 - 50 | Cannot be scraped or peeled with a pocket knife, specimen can be fractured with a single firm blow of a geological hammer |
| R4 | Strong | 50 - 100 | Specimen requires more than one blow of geological hammer to fracture it |
| R5 | Very Strong | 100 - 250 | Specimen requires many blows of geological hammer to fracture it |
| R6 | Extremely Strong | > 250 | Specimen can only be chipped with a geological hammer |

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20155150
DRAWN BY:
CHECKED BY:
DATE:
REVISED: -

ROCK DESCRIPTION KEY

Five Lagunas Redevelopment
24155 Laguna Hills Mall
Laguna Hills, CA

FIGURE
A-3

| | | | | | |
|---|---|---|---|---|---|
| **Date Begin - End:** | 3/27/2015 | **Drilling Co.-Lic.#:** | Socal Drilling - #864735 | | **BORING LOG KB-1** |
| **Logged By:** | D. Castle | **Drill Crew:** | Randy & Marc | | |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Mayhew 1000 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Mud Rotary | **Hammer Efficiency:** | 80% |
| **Weather:** | Sunny | **Bore Diameter:** | 6 in. O.D. | **Hammer Cal. Date:** | 2/04/2015 |

FIELD EXPLORATION

Latitude: 33.61267° N
Longitude: 117.70976° W
Approximate Ground Surface Elevation (ft.): 356.40
Surface Condition: Asphalt

LABORATORY RESULTS

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **ASPHALT**: 5" | | | | | | | | | | | |
| | | | **BASE COURSE**: 6" | | | | | | | | | | | |
| 355 | | | **FILL** **Silty CLAY (CL-ML)**: low plasticity, gray to bluish gray, moist, soft | | | | | | | | | | | |
| | 5 | | **ALLUVIUM** **Sandy CLAY (CL)**: low plasticity, mottled bluish gray and greenish gray, moist, soft | | BC=2 3 1 | 12" | | 33.2 | | | | | | |
| 350 | | | | | | | | | | | | | | |
| | | | | | BC=2 5 6 | 13" | | | | | | | | |
| | 10 | | | | BC=2 2 3 | 12" | | 25.5 | | | | | | |
| 345 | | | | | | | | | | | | | | |
| | | | mottled gray with brown, firm, few fine to coarse grained subangular to subrounded gravel | | BC=8 20 15 | 15" | | 15.7 | 118.0 | | | | | |
| | 15 | | | | BC=3 6 6 | 16" | | | | | | | | |
| 340 | | | | | | | | | | | | | | |
| | 20 | | | | BC=2 2 4 | NR | | | | | | | | |
| 335 | | | | | | | | | | | | | | |
| | 25 | | | | | | | | | | | | | |
| 330 | | | | | | | | | | | | | | |

The boring was terminated at approximately 21.5 ft. below ground surface. The exploration was backfilled with bentonite on March 27, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:
Boring was hand augered to 5' prior to drilling.
Boring was backfilled with betonite chips and patched with cold patch AC.
The exploration location and elevation are approximate and were estimated by Kleinfelder.

| | | | |
|---|---|---|---|
| KLEINFELDER Bright People. Right Solutions. | PROJECT NO.: 20155150 | BORING LOG KB-1 | BORING |
| | DRAWN BY: DC | | |
| | CHECKED BY: MS | Five Lagunas Redevelopment 24155 Laguna Hills Mall Laguna Hills, CA | KB-1 |
| | DATE: 4/29/2015 | | |
| | REVISED: - | | PAGE: 1 of 1 |

# BORING LOG KB-2

| | | | | | |
|---|---|---|---|---|---|
| **Date Begin - End:** | 3/27/2015 | **Drilling Co.-Lic.#:** | Socal Drilling - #864735 | | |
| **Logged By:** | D. Castle | **Drill Crew:** | Randy & Marc | | |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Mayhew 1000 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Mud Rotary | **Hammer Efficiency:** | 80% |
| **Weather:** | Sunny | **Bore Diameter:** | 6 in. O.D. | **Hammer Cal. Date:** | 2/04/2015 |

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.61234° N
Longitude: 117.71063° W
Approximate Ground Surface Elevation (ft.): 356.00
Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | **ASPHALT**: 4" | | | | | | | | | | | |
| 355 | | **BASE COURSE**: 6" | | | | | | | | | | | |
| | | __FILL__<br>**Sandy CLAY (CL)**: low to medium plasticity, light brownish gray, moist, firm | | | | | | | | | | | |
| | 5 | | | BC=2 9 16 | 18" | | 12.8 | 119.0 | | | | | |
| 350 | | __ALLUVIUM__<br>**Sandy CLAY (CL)**: low to medium plasticity, dark bluish gray, moist, firm | | | | | | | | | | | |
| | | | | BC=3 7 5 | 8" | | 15.8 | | | | | | |
| | 10 | | | BC=6 7 8 | 15" | | | | | | | | |
| 345 | | | | | | | | | | | | | |
| | | **Silty SAND (SM)**: dark bluish gray, moist, loose to medium dense, mostly fine to medium grained subrounded sand, few medium to coarse grained sand | | BC=5 6 6 | 14" | | 17.1 | | | | | | |
| | 15 | **Sandy SILT (ML)**: non-plastic, pale olive and tan, moist, firm, some fine grained sand, trace medium grained sand | | BC=7 12 16 | 18" | | | | | | | | |
| 340 | | | | | | | | | | | | | |
| | 20 | **Silty SAND (SM)**: yellowish brown, moist, dense, mostly fine to medium grained subrounded sand, few coarse grained sand | | BC=5 12 20 | 14" | | | | | | | | |
| 335 | | | | | | | | | | | | | |
| | 25 | | | | | | | | | | | | |
| 330 | | | | | | | | | | | | | |

The boring was terminated at approximately 21.5 ft. below ground surface. The exploration was backfilled with bentonite on March 27, 2015.

__GROUNDWATER LEVEL INFORMATION:__
Groundwater was not encountered during drilling or after completion.
__GENERAL NOTES:__
Boring was hand augered to 5' prior to drilling.
Boring was backfilled with betonite chips and patched with cold patch AC.
The exploration location and elevation are approximate and were estimated by Kleinfelder.

KLEINFELDER
Bright People. Right Solutions.

| | | | |
|---|---|---|---|
| PROJECT NO.: | 20155150 | BORING LOG KB-2 | BORING |
| DRAWN BY: | DC | | |
| CHECKED BY: | MS | Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | KB-2 |
| DATE: | 4/29/2015 | | |
| REVISED: | - | | PAGE: 1 of 1 |

| | | | |
|---|---|---|---|
| **Date Begin - End:** 3/25/2015 | **Drilling Co.-Lic.#:** Socal Drilling - #864735 | | **BORING LOG KB-3** |
| **Logged By:** D. Castle | **Drill Crew:** Randy & Marc | | |
| **Hor.-Vert. Datum:** Not Available | **Drilling Equipment:** Mayhew 1000 | **Hammer Type - Drop:** 140 lb. Auto - 30 in. | |
| **Plunge:** -90 degrees | **Drilling Method:** Mud Rotary | **Hammer Efficiency:** 80% | |
| **Weather:** Sunny | **Bore Diameter:** 6 in. O.D. | **Hammer Cal. Date:** 2/04/2015 | |

Latitude: 33.61111° N
Longitude: 117.70995° W
Approximate Ground Surface Elevation (ft.): 347.50
Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Lithologic Description (FIELD EXPLORATION) | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol (LABORATORY RESULTS) | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **ASPHALT**: 4" | | | | | | | | | | | |
| | | **BASE COURSE**: 6" | | | | | | | | | | | |
| 345 | | **FILL** **Silty CLAY (CL-ML)**: reddish brown | | | | | | | | | | | |
| | 5 | **ALLUVIUM** **Sandy CLAY (CL)**: reddish brown, moist, firm, trace fine subangular gravel | | BC=5 8 10 | 3" | | 12.3 | 120.0 | | | | | |
| 340 | | | | | | | | | | | | | |
| | 10 | **Clayey SAND (SC)**: yellowish brown, moist, loose, trace subangular to subrounded fine gravel | | BC=4 5 5 | 14" | | 32.1 | | | | | | |
| 335 | | **Sandy CLAY (CL)**: olive mottled yellowish brown, moist, firm, piece of cobble in top of sample | | BC=6 8 12 | 12" | | 38.5 | 79.0 | | | | | |
| | 15 | **CLAY with Sand (CL)**: olive brown, moist, firm | | BC=2 2 3 | 11" | | 48.8 | | | | | | |
| 330 | | | | | | | | | | | | | |
| | 20 | **Silty SAND (SM)**: reddish orange, wet, medium dense | | BC=7 14 22 | 18" | | | | | | | | |
| 325 | | | | | | | | | | | | | |
| | 25 | | | | | | | | | | | | |
| 320 | | | | | | | | | | | | | |

The boring was terminated at approximately 21.5 ft. below ground surface. The exploration was backfilled with bentonite on March 25, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 17 ft. below ground surface at the end of drilling.
GENERAL NOTES:
Boring was hand augered to 5' prior to drilling.
Boring was backfilled with betonite chips and patched with cold patch AC.
The exploration location and elevation are approximate and were estimated by Kleinfelder.

| | | | |
|---|---|---|---|
| KLEINFELDER Bright People. Right Solutions. | PROJECT NO.: 20155150 | BORING LOG KB-3 | BORING |
| | DRAWN BY: DC | | KB-3 |
| | CHECKED BY: MS | Five Lagunas Redevelopment 24155 Laguna Hills Mall Laguna Hills, CA | |
| | DATE: 4/29/2015 | | |
| | REVISED: - | | PAGE: 1 of 1 |

| | | | | | |
|---|---|---|---|---|---|
| **Date Begin - End:** | 4/02/2015 | **Drilling Co.-Lic.#:** | Socal Drilling - #864735 | | **BORING LOG KB-4** |
| **Logged By:** | D. Castle | **Drill Crew:** | Randy & Marc | | |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Mayhew 1000 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Mud Rotary | **Hammer Efficiency:** | 80% |
| **Weather:** | Cloudy | **Bore Diameter:** | 6 in. O.D. | **Hammer Cal. Date:** | 2/04/2015 |

FIELD EXPLORATION — Latitude: 33.61304° N; Longitude: 117.70764° W; Approximate Ground Surface Elevation (ft.): 356.00; Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | **ASPHALT**: 4" | | | | | | | | | | | |
| 355 | | | **BASE COURSE**: 8" | | | | | | | | | | | |
| | | | **FILL**<br>**SILT (ML)**: pale olive, moist to wet, soft | | | | | | | | | | | |
| 350 | 5 | | | | BC=2 3 3 | 10" | | 61.1 | | | | | | |
| | | | **ALLUVIUM**<br>**SILT (ML)**: gray with pale olive, moist, firm, mica present | | BC=4 7 11 | 18" | | | | | | | | |
| 345 | 10 | | | | BC=3 5 7 | 18" | | | | | | | | |
| | ▼ (13) | | **Sandy CLAY (CL)**: light brownish gray, wet, soft | | BC=8 20 15 | 16" | | | | | | | | |
| 340 | 15 | | | | BC=2 3 4 | 18" | | 47.5 | | | | | | |
| 335 | 20 | | **SILT (ML)**: pale olive, wet, firm to hard | | BC=4 9 15 | 16" | | | | | | | | |

The boring was terminated at approximately 21.5 ft. below ground surface. The exploration was backfilled with bentonite on April 02, 2015.

GROUNDWATER LEVEL INFORMATION:
▼ Groundwater was observed at approximately 13 ft. below ground surface at the end of drilling.

GENERAL NOTES:
Boring was hand augered to 5' prior to drilling.
Boring was backfilled with betonite chips and patched with cold patch AC.
The exploration location and elevation are approximate and were estimated by Kleinfelder.



KLEINFELDER
Bright People. Right Solutions.

| | | | |
|---|---|---|---|
| PROJECT NO.: 20155150 | BORING LOG KB-4 | | BORING |
| DRAWN BY: DC | | | |
| CHECKED BY: MS | Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | | KB-4 |
| DATE: 4/29/2015 | | | |
| REVISED: - | | | PAGE: 1 of 1 |

| Date Begin - End: | 4/02/2015 | Drilling Co.-Lic.#: | Socal Drilling - #864735 | | **BORING LOG KB-5** |
|---|---|---|---|---|---|
| **Logged By:** | D. Castle | **Drill Crew:** | Randy & Marc | | |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Mayhew 1000 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Mud Rotary | **Hammer Efficiency:** | 80% |
| **Weather:** | Cloudy | **Bore Diameter:** | 6 in. O.D. | **Hammer Cal. Date:** | 2/04/2015 |

FIELD EXPLORATION: Latitude: 33.61081° N; Longitude: 117.70425° W; Approximate Ground Surface Elevation (ft.): 356.70; Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **ASPHALT**: 4" | | | | | | | | | | | |
| | | **BASE COURSE**: 6" | | | | | | | | | | | |
| 355 | | **FILL** **Sandy CLAY (CL)**: light brownish gray, moist | | | | | | | | | | | |
| | 5 | firm to hard | | BC=6 12 17 | 8" | | 21.6 | | | | | | |
| 350 | | | | | | | | | | | | | |
| | | **ALLUVIUM** **SILT (ML)**: bluish gray mottled with reddish orange, moist, firm | | BC=6 12 19 | 16" | | 31.1 | 93.0 | | | | | |
| | 10 | | | BC=7 11 14 | 14" | | | | | | | | |
| 345 | | | | | | | | | | | | | |
| | | | | BC=7 16 19 | 16" | | | | | | | | |
| | 15 | **CLAY (CH)**: gray, moist, firm, small pocket of mottled reddish brown | | BC=4 8 11 | 16" | | 32.7 | | | | 59 | 33 | |
| 340 | | | | | | | | | | | | | |
| | 20 ▼ | **SILT (ML)**: gray mottled with orange, wet, firm | | BC=11 18 20 | 17" | | | | | | | | |
| 335 | | | | | | | | | | | | | |
| | 25 | | | BC=6 11 14 | 18" | | | | | | | | |
| 330 | | | | | | | | | | | | | |

| KLEINFELDER Bright People. Right Solutions. | PROJECT NO.: 20155150 | BORING LOG KB-5 | BORING |
|---|---|---|---|
| | DRAWN BY: DC | | |
| | CHECKED BY: MS | Five Lagunas Redevelopment 24155 Laguna Hills Mall Laguna Hills, CA | KB-5 |
| | DATE: 4/29/2015 | | |
| | REVISED: - | | PAGE: 1 of 3 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Date Begin - End:** | 4/02/2015 | **Drilling Co.-Lic.#:** | Socal Drilling - #864735 | | | **BORING LOG KB-5** | |
| **Logged By:** | D. Castle | **Drill Crew:** | Randy & Marc | | | | |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Mayhew 1000 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. | | |
| **Plunge:** | -90 degrees | **Drilling Method:** | Mud Rotary | **Hammer Efficiency:** | 80% | | |
| **Weather:** | Cloudy | **Bore Diameter:** | 6 in. O.D. | **Hammer Cal. Date:** | 2/04/2015 | | |

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.61081° N
Longitude: 117.70425° W
Approximate Ground Surface Elevation (ft.): 356.70
Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **SILT (ML)**: gray mottled with orange, wet, firm hard | | BC=14 19 30 | 16" | | 26.3 | 95.0 | | | | | |
| 325 | | | **Sandy CLAY (CL)**: gray, wet, firm | | | | | | | | | | | |
| | 35 | | | | BC=9 14 17 | 18" | | 27.3 | | | | 48 | 22 | |
| 320 | | | | | | | | | | | | | | |
| | 40 | | | | BC=19 27 30 | 16" | | | | | | | | |
| 315 | | | greenish black, trace fine sand | | | | | | | | | | | |
| | 45 | | **SILTSTONE**: greenish black, fine grained, decomposed, extremely weak R0, laminated, sea shells present | | BC=8 14 18 | 18" | | 30.7 | | | | | | |
| 310 | | | | | | | | | | | | | | |
| | 50 | | | | BC=18 26 32 | 17" | | | | | | | | |
| 305 | | | | | | | | | | | | | | |
| | 55 | | | | BC=12 18 20 | 18" | | | | | | | | |
| 300 | | | | | | | | | | | | | | |

KLEINFELDER
Bright People. Right Solutions.

| | |
|---|---|
| PROJECT NO.: | 20155150 |
| DRAWN BY: | DC |
| CHECKED BY: | MS |
| DATE: | 4/29/2015 |
| REVISED: | - |

BORING LOG KB-5

Five Lagunas Redevelopment
24155 Laguna Hills Mall
Laguna Hills, CA

BORING

KB-5



KLEINFELDER - 2 Ada, Suite 250 | Irvine, CA 92618 | PH: 949.727.4466 | FAX: 949.727.9242 | www.kleinfelder.com

| | | | | | |
|---|---|---|---|---|---|
| **Date Begin - End:** | 4/02/2015 | **Drilling Co.-Lic.#:** | Socal Drilling - #864735 | | **BORING LOG KB-5** |
| **Logged By:** | D. Castle | **Drill Crew:** | Randy & Marc | | |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Mayhew 1000 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Mud Rotary | **Hammer Efficiency:** | 80% |
| **Weather:** | Cloudy | **Bore Diameter:** | 6 in. O.D. | **Hammer Cal. Date:** | 2/04/2015 |

FIELD EXPLORATION — Latitude: 33.61081° N; Longitude: 117.70425° W; Approximate Ground Surface Elevation (ft.): 356.70; Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **SILTSTONE**: greenish black, fine grained, decomposed, extremely weak R0, laminated, sea shells present | | BC=15 22 27 | 18" | | | | | | | | |
| 295 | | | | | | | | | | | | | | |
| | 65 | | strongly cemented at tip | | BC=9 15 35 | 18" | | | | | | | | |
| 290 | | | | | | | | | | | | | | driller nots 6" cemented layer |
| | 70 | | | | BC=12 13 15 | 18" | | | | | | | | |
| 285 | | | | | | | | | | | | | | |
| | 75 | | | | BC=9 15 17 | 18" | | | | | | | | |
| 280 | | | | | | | | | | | | | | |
| | 80 | | becomes fine to medium grained | | BC=14 50/2" | 14" | | | | | | | | |
| 275 | | | | | | | | | | | | | | |
| | 85 | | | | | | | | | | | | | |
| 270 | | | | | | | | | | | | | | |

The boring was terminated at approximately 80.5 ft. below ground surface. The exploration was backfilled with bentonite on April 02, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 20 ft. below ground surface at the end of drilling.
GENERAL NOTES:
Boring was hand augered to 5' prior to drilling.
Boring was backfilled with betonite chips and patched with cold patch AC.
The exploration location and elevation are approximate and were estimated by Kleinfelder.

| | | | | | |
|---|---|---|---|---|---|
| **Date Begin - End:** | 4/01/2015 | **Drilling Co.-Lic.#:** | Socal Drilling - #864735 | | **BORING LOG KB-6** |
| **Logged By:** | D. Castle | **Drill Crew:** | Randy & Marc | | |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Mayhew 1000 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Mud Rotary | **Hammer Efficiency:** | 80% |
| **Weather:** | Cloudy | **Bore Diameter:** | 6 in. O.D. | **Hammer Cal. Date:** | 2/04/2015 |

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.61024° N
Longitude: 117.70338° W
Approximate Ground Surface Elevation (ft.): 357.80
Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **ASPHALT**: 3" | | | | | | | | | | | |
| | | **BASE COURSE**: 7" | | | | | | | | | | | |
| 355 | | **FILL**<br>**Silty SAND (SM)**: non-plastic, brown, moist, fine to medium grained sand | | | | | | | | | | | |
| | 5 | **ALLUVIUM**<br>**SILT with Sand (ML)**: brown, moist, firm, fine to medium grained subrounded sand | | BC=4 5 5 | 10" | | 13.7 | | | | | | |
| 350 | | **Silty SAND (SP)**: brown to yellowish brown, moist, medium dense | | BC=6 9 12 | 10" | | 2.2 | 108.0 | | | | | |
| | 10 | | | BC=3 5 6 | 11" | | | | | 15 | | | |
| 345 | | @ 12.5 becomes brown and loose | | BC=4 4 2 | 7" | | | | | | | | |
| | 15 | wet, medium dense, mostly medium to coarse grained subrounded sand, trace fine sand | | BC=5 7 10 | 10" | | | | | | | | |
| 340 | | | | | | | | | | | | | |
| | 20 | yellowish brown to brown, mostly coarse grained, some medium grained, few to trace fine grained sand | | BC=6 11 12 | 13" | | 16.3 | 108.0 | | | | | |
| 335 | | | | | | | | | | | | | |
| | 25 | **Sandy CLAY (CL)**: low plasticity, bluish gray to gray, wet, firm, pockets of orange oxide veins < 0.5" thick | | BC=7 7 8 | 14" | | | | | | 40 | 16 | |
| 330 | | | | | | | | | | | | | |

| | | | |
|---|---|---|---|
| KLEINFELDER Bright People. Right Solutions. | PROJECT NO.: 20155150<br>DRAWN BY: DC<br>CHECKED BY: MS<br>DATE: 4/29/2015<br>REVISED: - | BORING LOG KB-6<br>Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | BORING<br>KB-6<br>PAGE: 1 of 3 |

| Date Begin - End: | 4/01/2015 | Drilling Co.-Lic.#: | Socal Drilling - #864735 | | **BORING LOG KB-6** |
|---|---|---|---|---|---|
| **Logged By:** | D. Castle | **Drill Crew:** | Randy & Marc | | |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Mayhew 1000 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Mud Rotary | **Hammer Efficiency:** | 80% |
| **Weather:** | Cloudy | **Bore Diameter:** | 6 in. O.D. | **Hammer Cal. Date:** | 2/04/2015 |

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.61024° N
Longitude: 117.70338° W
Approximate Ground Surface Elevation (ft.): 357.80
Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | BC=11 16 22 | 16" | | | | | | | | |
| 325 | | | | | | | | | | | | | | |
| | 35 | | | | BC=8 12 15 | 18" | | | | | | | | |
| 320 | | | | | | | | | | | | | | |
| | 40 | | | | BC=16 28 32 | 18" | | | | | | | | UU Triaxial |
| 315 | | | | | | | | | | | | | | |
| | 45 | | | | BC=9 15 19 | 17" | | | | | | | | |
| 310 | | | **SILTSTONE**: greenish black, fine grained, decomposed, extremely weak R0, laminated | | | | | | | | | | | |
| | 50 | | | | BC=14 30 37 | 18" | | | | | | | | |
| 305 | | | | | | | | | | | | | | |
| | 55 | | | | BC=11 22 29 | 18" | | | | | | | | |
| 300 | | | | | | | | | | | | | | |



KLEINFELDER
Bright People. Right Solutions.

| PROJECT NO.: | 20155150 | BORING LOG KB-6 | BORING |
|---|---|---|---|
| DRAWN BY: | DC | | |
| CHECKED BY: | MS | Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | KB-6 |
| DATE: | 4/29/2015 | | |
| REVISED: | - | | PAGE: 2 of 3 |

| | | | | | |
|---|---|---|---|---|---|
| **Date Begin - End:** | 4/01/2015 | **Drilling Co.-Lic.#:** | Socal Drilling - #864735 | | **BORING LOG KB-6** |
| **Logged By:** | D. Castle | **Drill Crew:** | Randy & Marc | | |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Mayhew 1000 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Mud Rotary | **Hammer Efficiency:** | 80% |
| **Weather:** | Cloudy | **Bore Diameter:** | 6 in. O.D. | **Hammer Cal. Date:** | 2/04/2015 |

FIELD EXPLORATION: Latitude: 33.61024° N; Longitude: 117.70338° W; Approximate Ground Surface Elevation (ft.): 357.80; Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **SILTSTONE**: greenish black, fine grained, decomposed, extremely weak R0, laminated | | BC=16 30 36 | 18" | | | | | | | | |
| 295 | | | | | | | | | | | | | | |
| | 65 | | | | BC=14 22 26 | 18" | | | | | | | | |
| 290 | | | | | | | | | | | | | | |
| | 70 | | | | BC=18 52/6" | 18" | | | | | | | | |
| 285 | | | | | | | | | | | | | | |
| | 75 | | | | BC=17 18 22 | 18" | | | | | | | | |
| 280 | | | | | | | | | | | | | | |
| | 80 | | | | BC=21 32 37 | 16" | | | | | | | | |
| 275 | | | | | | | | | | | | | | |
| | 85 | | | | | | | | | | | | | |
| 270 | | | | | | | | | | | | | | |

The boring was terminated at approximately 81.5 ft. below ground surface. The exploration was backfilled with bentonite on April 01, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 14 ft. below ground surface at the end of drilling.

GENERAL NOTES:
Boring was hand augered to 5' prior to drilling.
Boring was backfilled with betonite chips and patched with cold patch AC.
The exploration location and elevation are approximate and were estimated by Kleinfelder.



KLEINFELDER
Bright People. Right Solutions.

| | | | |
|---|---|---|---|
| PROJECT NO.: 20155150 | BORING LOG KB-6 | BORING |
| DRAWN BY: DC | | |
| CHECKED BY: MS | Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | KB-6 |
| DATE: 4/29/2015 | | |
| REVISED: - | | PAGE: 3 of 3 |

**BORING LOG KB-7**

| | | | | | |
|---|---|---|---|---|---|
| **Date Begin - End:** | 3/31/2015 - 4/01/2015 | **Drilling Co.-Lic.#:** | Socal Drilling - #864735 | | |
| **Logged By:** | D. Castle | **Drill Crew:** | Randy & Marc | | |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Mayhew 1000 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Mud Rotary | **Hammer Efficiency:** | 80% |
| **Weather:** | Sunny | **Bore Diameter:** | 6 in. O.D. | **Hammer Cal. Date:** | 2/04/2015 |

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.60987° N
Longitude: 117.70417° W
Approximate Ground Surface Elevation (ft.): 353.30
Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **ASPHALT**: 3" | | | | | | | | | | | |
| | | **BASE COURSE**: 8" | | | | | | | | | | | |
| | | **FILL** **SILT (ML)**: brown, moist | | | | | | | | | | | |
| 350 | | | | | | | | | | | | | |
| | 5 | firm | | BC=3 4 5 | 18" | | 16.4 | | | | | | |
| | | dark brown | | BC=4 6 9 | 18" | | 20.6 | 104.0 | | | | | |
| 345 | | **ALLUVIUM** **Sandy CLAY (CL)**: mottled pale olive with brown, moist, firm, trace mica in top of sample, orange oxide veins | | | | | | | | | | | |
| | 10 | | | BC=3 4 5 | 13" | | | | | | 41 | 18 | |
| 340 | | | | BC=3 12 15 | 16" | | 17.6 | 105.0 | | | | | |
| | 15 | wet (▼) | | BC=7 7 8 | 16" | | | | | | | | |
| 335 | | | | | | | | | | | | | |
| | 20 | | | BC=7 8 11 | 17" | | | | | | | | |
| | | **Silty CLAY (CL-ML)**: low to medium plasticity, mottled olive and light brownish gray, wet, soft to firm | | | | | | | | | | | |
| 330 | | | | | | | | | | | | | |
| | 25 | | | BC=4 7 12 | 15" | | 31.2 | | | | | | |
| | | **SILT (ML)**: greenish black to black, wet, hard, looks like siltstone | | | | | | | | | | | |
| 325 | | | | | | | | | | | | | |

KLEINFELDER
Bright People. Right Solutions.

| | |
|---|---|
| PROJECT NO.: | 20155150 |
| DRAWN BY: | DC |
| CHECKED BY: | MS |
| DATE: | 4/29/2015 |
| REVISED: | - |

BORING LOG KB-7

Five Lagunas Redevelopment
24155 Laguna Hills Mall
Laguna Hills, CA

BORING
KB-7



KLEINFELDER - 2 Ada, Suite 250 | Irvine, CA 92618 | PH: 949.727.4466 | FAX: 949.727.9242 | www.kleinfelder.com

| Date Begin - End: | 3/31/2015 - 4/01/2015 | Drilling Co.-Lic.#: | Socal Drilling - #864735 | | BORING LOG KB-7 |
|---|---|---|---|---|---|
| Logged By: | D. Castle | Drill Crew: | Randy & Marc | | |
| Hor.-Vert. Datum: | Not Available | Drilling Equipment: | Mayhew 1000 | Hammer Type - Drop: | 140 lb. Auto - 30 in. |
| Plunge: | -90 degrees | Drilling Method: | Mud Rotary | Hammer Efficiency: | 80% |
| Weather: | Sunny | Bore Diameter: | 6 in. O.D. | Hammer Cal. Date: | 2/04/2015 |

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.60987° N
Longitude: 117.70417° W
Approximate Ground Surface Elevation (ft.): 353.30
Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **SILT (ML)**: greenish black to black, wet, hard, looks like siltstone | | BC=14 28 35 | 16" | | | | | | | | |
| 320 | | | | | | | | | | | | | | |
| | 35 | | | | BC=35 18 20 | 18" | | 26.5 | | | | | | |
| 315 | | | | | | | | | | | | | | |
| | 40 | | greenish gray | | BC=25 50/5" | 18" | | | | | | | | |
| 310 | | | | | | | | | | | | | | |
| | 45 | | | | BC=6 10 12 | 18" | | | | | | | | |
| 305 | | | | | | | | | | | | | | |
| | | | **SILTSTONE**: greenish gray to greenish black, fine grained, decomposed, extremely weak R0, laminated | | | | | | | | | | | |
| | 50 | | | | BC=11 23 26 | 16" | | 29.7 | 90.0 | | | | | |
| 300 | | | | | | | | | | | | | | |
| | 55 | | trace seashells | | BC=12 18 20 | 18" | | 28.9 | | | | | | |
| 295 | | | | | | | | | | | | | | |

| Date Begin - End: | 3/31/2015 - 4/01/2015 | Drilling Co.-Lic.#: | Socal Drilling - #864735 | | BORING LOG KB-7 |
|---|---|---|---|---|---|
| Logged By: | D. Castle | Drill Crew: | Randy & Marc | | |
| Hor.-Vert. Datum: | Not Available | Drilling Equipment: | Mayhew 1000 | Hammer Type - Drop: | 140 lb. Auto - 30 in. |
| Plunge: | -90 degrees | Drilling Method: | Mud Rotary | Hammer Efficiency: | 80% |
| Weather: | Sunny | Bore Diameter: | 6 in. O.D. | Hammer Cal. Date: | 2/04/2015 |

FIELD EXPLORATION — Latitude: 33.60987° N; Longitude: 117.70417° W; Approximate Ground Surface Elevation (ft.): 353.30; Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **SILTSTONE**: greenish gray to greenish black, fine grained, decomposed, extremely weak R0, laminated | | BC=29 50/5" | 18" | | | | | | | | |
| 290 | | | | | | | | | | | | | | |
| | 65 | | | | BC=7 12 14 | 18" | | | | | | | | |
| 285 | | | | | | | | | | | | | | |
| | 70 | | | | BC=15 23 28 | 18" | | | | | | | | |
| 280 | | | | | | | | | | | | | | |
| | 75 | | | | BC=11 14 17 | 12" | | | | | | | | |
| 275 | | | | | | | | | | | | | | |
| | 80 | | | | BC=29 55 | 12" | | | | | | | | |
| 270 | | | | | | | | | | | | | | |
| | 85 | | | | BC=14 22 25 | 18" | | | | | | | | |
| 265 | | | | | | | | | | | | | | |

LABORATORY RESULTS

| | | | | | |
|---|---|---|---|---|---|
| **Date Begin - End:** | 3/31/2015 - 4/01/2015 | **Drilling Co.-Lic.#:** | Socal Drilling - #864735 | | **BORING LOG KB-7** |
| **Logged By:** | D. Castle | **Drill Crew:** | Randy & Marc | | |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Mayhew 1000 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Mud Rotary | **Hammer Efficiency:** | 80% |
| **Weather:** | Sunny | **Bore Diameter:** | 6 in. O.D. | **Hammer Cal. Date:** | 2/04/2015 |

FIELD EXPLORATION — Latitude: 33.60987° N; Longitude: 117.70417° W; Approximate Ground Surface Elevation (ft.): 353.30; Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | × × | **SILTSTONE**: greenish gray to greenish black, fine grained, decomposed, extremely weak R0, laminated | | BC=27 50/5" | 18" | | | | | | | | |
| 260 | | | | | | | | | | | | | | |
| | 95 | | | | BC=14 22 26 | 18" | | | | | | | | |
| 255 | | | | | | | | | | | | | | |
| | 100 | | | | BC=30 50/4" | 18" | | | | | | | | |
| 250 | | | | | | | | | | | | | | |
| | 105 | | | | | | | | | | | | | |
| 245 | | | | | | | | | | | | | | |
| | 110 | | | | | | | | | | | | | |
| 240 | | | | | | | | | | | | | | |
| | 115 | | | | | | | | | | | | | |
| 235 | | | | | | | | | | | | | | |

The boring was terminated at approximately 101 ft. below ground surface. The exploration was backfilled with bentonite on April 01, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 16 ft. below ground surface at the end of drilling.
GENERAL NOTES:
Boring was hand augered to 5' prior to drilling.
Boring was backfilled with betonite chips and patched with cold patch AC.
The exploration location and elevation are approximate and were estimated by Kleinfelder.

| | | | |
|---|---|---|---|
| KLEINFELDER Bright People. Right Solutions. | PROJECT NO.: 20155150 | BORING LOG KB-7 | BORING |
| | DRAWN BY: DC | | |
| | CHECKED BY: MS | Five Lagunas Redevelopment 24155 Laguna Hills Mall Laguna Hills, CA | KB-7 |
| | DATE: 4/29/2015 | | |
| | REVISED: - | | PAGE: 4 of 4 |

| | | | | | |
|---|---|---|---|---|---|
| **Date Begin - End:** | 3/30/2015 | **Drilling Co.-Lic.#:** | Socal Drilling - #864735 | | **BORING LOG KB-8** |
| **Logged By:** | D. Castle | **Drill Crew:** | Randy & Marc | | |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Mayhew 1000 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Mud Rotary | **Hammer Efficiency:** | 80% |
| **Weather:** | Sunny | **Bore Diameter:** | 6 in. O.D. | **Hammer Cal. Date:** | 2/04/2015 |

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.60928° N
Longitude: 117.70488° W
Approximate Ground Surface Elevation (ft.): 349.50
Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **ASPHALT**: 5" | | | | | | | | | | | |
| | | | **BASE COURSE**: 5" | | | | | | | | | | | |
| | | | **FILL** **Sandy CLAY (CL)**: reddish brown, moist, fine grained sand | | | | | | | | | | | |
| 345 | 5 | | soft to firm | | BC=2 3 4 | 9" | | 18.4 | 106.0 | | | | | |
| | | | **ALLUVIUM** **Sandy CLAY (CL)**: reddish brown, moist, very soft, little fine sand, mica present in top of sample | | BC=Push Push Push | 16" | | 25.2 | | | | | | |
| 340 | 10 | | | | BC=Push Push Push | 17" | | | | | | | | Consol |
| | | | wet | | BC=Push Push Push | 18" | | 20.0 | | | | | | |
| 335 | 15 | | | | BC=Push Push Push | 14" | | 20.0 | 104.0 | | | | | |
| 330 | 20 | | | | BC=Push Push Push | 17" | | 27.4 | | | | 35 | 17 | |
| 325 | 25 | | | | BC=Push Push Push | 18" | | | | | | | | |
| 320 | | | | | | | | | | | | | | |

KLEINFELDER
Bright People. Right Solutions.

| | | | |
|---|---|---|---|
| PROJECT NO.: | 20155150 | BORING LOG KB-8 | BORING |
| DRAWN BY: | DC | | KB-8 |
| CHECKED BY: | MS | Five Lagunas Redevelopment 24155 Laguna Hills Mall Laguna Hills, CA | |
| DATE: | 4/29/2015 | | |
| REVISED: | - | | PAGE: 1 of 4 |

| Date Begin - End: | 3/30/2015 | Drilling Co.-Lic.#: | Socal Drilling - #864735 | | BORING LOG KB-8 |
|---|---|---|---|---|---|
| Logged By: | D. Castle | Drill Crew: | Randy & Marc | | |
| Hor.-Vert. Datum: | Not Available | Drilling Equipment: | Mayhew 1000 | Hammer Type - Drop: | 140 lb. Auto - 30 in. |
| Plunge: | -90 degrees | Drilling Method: | Mud Rotary | Hammer Efficiency: | 80% |
| Weather: | Sunny | Bore Diameter: | 6 in. O.D. | Hammer Cal. Date: | 2/04/2015 |

FIELD EXPLORATION — Latitude: 33.60928° N; Longitude: 117.70488° W; Approximate Ground Surface Elevation (ft.): 349.50; Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Sandy CLAY (CL)**: brown to dark brown, wet, firm | | BC=3 6 6 | 18" | | | | | | | | |
| | | | **SILT with Sand (ML)**: brown to dark brown, wet, firm | | | | | | | | | | | |
| 315 | 35 | | | | BC=4 9 14 | 17" | | | | | | | | |
| 310 | 40 | | | | BC=4 8 19 | 18" | | | | | | | | |
| 305 | 45 | | | | BC=22 40 50/5" | 100% | | | | | | | | |
| 300 | 50 | | | | BC=14 23 26 | 18" | | 39.3 | | | | 50 | 18 | |
| 295 | 55 | | **SILTSTONE**: greenish black to gray, fine grained, decomposed, extremely weak R0, laminated | | BC=24 56 | 12" | | | | | | | | |
| 290 | | | | | | | | | | | | | | |

| | | | |
|---|---|---|---|
| KLEINFELDER Bright People. Right Solutions. | PROJECT NO.: 20155150<br>DRAWN BY: DC<br>CHECKED BY: MS<br>DATE: 4/29/2015<br>REVISED: - | BORING LOG KB-8<br><br>Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | BORING<br>KB-8<br>PAGE: 2 of 4 |

| Date Begin - End: | 3/30/2015 | Drilling Co.-Lic.#: | Socal Drilling - #864735 | | BORING LOG KB-8 |
|---|---|---|---|---|---|
| Logged By: | D. Castle | Drill Crew: | Randy & Marc | | |
| Hor.-Vert. Datum: | Not Available | Drilling Equipment: | Mayhew 1000 | Hammer Type - Drop: | 140 lb. Auto - 30 in. |
| Plunge: | -90 degrees | Drilling Method: | Mud Rotary | Hammer Efficiency: | 80% |
| Weather: | Sunny | Bore Diameter: | 6 in. O.D. | Hammer Cal. Date: | 2/04/2015 |

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.60928° N
Longitude: 117.70488° W
Approximate Ground Surface Elevation (ft.): 349.50
Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | BC=14 24 27 | 18" | | | | | | | | |
| 285 | 65 | | | | BC=25 53 | 12" | | | | | | | | |
| 280 | 70 | | | | BC=7 12 16 | 15" | | | | | | | | |
| 275 | 75 | | | | BC=16 32 38 | 15" | | | | | | | | |
| 270 | 80 | | | | BC=12 25 28 | 15" | | | | | | | | |
| 265 | 85 | | | | BC=27 50/5" | 18" | | | | | | | | |
| 260 | | | | | | | | | | | | | | |

KLEINFELDER
Bright People. Right Solutions.

| PROJECT NO.: | 20155150 | BORING LOG KB-8 | BORING |
|---|---|---|---|
| DRAWN BY: | DC | | KB-8 |
| CHECKED BY: | MS | Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | |
| DATE: | 4/29/2015 | | |
| REVISED: | - | | PAGE: 3 of 4 |

| | | | | | |
|---|---|---|---|---|---|
| **Date Begin - End:** | 3/30/2015 | **Drilling Co.-Lic.#:** | Socal Drilling - #864735 | | **BORING LOG KB-8** |
| **Logged By:** | D. Castle | **Drill Crew:** | Randy & Marc | | |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Mayhew 1000 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Mud Rotary | **Hammer Efficiency:** | 80% |
| **Weather:** | Sunny | **Bore Diameter:** | 6 in. O.D. | **Hammer Cal. Date:** | 2/04/2015 |

FIELD EXPLORATION — LABORATORY RESULTS

Latitude: 33.60928° N
Longitude: 117.70488° W
Approximate Ground Surface Elevation (ft.): 349.50
Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | BC=10 22 24 | 18" | | | | | | | | |
| 255 | 95 | | | | BC=14 25 28 | 18" | | | | | | | | |
| 250 | 100 | | | | BC=16 24 28 | 18" | | | | | | | | |
| 245 | 105 | | | | | | | | | | | | | |
| 240 | 110 | | | | | | | | | | | | | |
| 235 | 115 | | | | | | | | | | | | | |
| 230 | | | | | | | | | | | | | | |

The boring was terminated at approximately 101.5 ft. below ground surface. The exploration was backfilled with bentonite on March 30, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 12 ft. below ground surface at the end of drilling.
GENERAL NOTES:
Boring was hand augered to 5' prior to drilling.
Boring was backfilled with betonite chips and patched with cold patch AC.
The exploration location and elevation are approximate and were estimated by Kleinfelder.

| | | |
|---|---|---|
| PROJECT NO.: 20155150 | BORING LOG KB-8 | BORING |
| DRAWN BY: DC | | |
| CHECKED BY: MS | Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | KB-8 |
| DATE: 4/29/2015 | | |
| REVISED: - | | PAGE: 4 of 4 |

KLEINFELDER
Bright People. Right Solutions.

| Date Begin - End: | 3/30/2015 | Drilling Co.-Lic.#: | Socal Drilling - #864735 | | **BORING LOG KB-9** |
|---|---|---|---|---|---|
| **Logged By:** | D. Castle | **Drill Crew:** | Randy & Marc | | |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Mayhew 1000 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Mud Rotary | **Hammer Efficiency:** | 80% |
| **Weather:** | Cloudy | **Bore Diameter:** | 6 in. O.D. | **Hammer Cal. Date:** | 2/04/2015 |

FIELD EXPLORATION: Latitude: 33.60861° N; Longitude: 117.70485° W; Approximate Ground Surface Elevation (ft.): 348.00; Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **ASPHALT**: 3" | | | | | | | | | | | |
| | | | **BASE COURSE**: 8" | | | | | | | | | | | |
| 345 | | | **FILL** **Silty SAND (SM)**: olive brown to brown, moist, loose, fine sand, trace fine subangular to angular gravel | | | | | | | | | | | |
| | 5 | | | | BC=2 3 2 | 5" | | 16.6 | | | | | | |
| 340 | | | **ALLUVIUM** **Sandy CLAY**: reddish brown to dark reddish brown, moist to wet, very soft, mostly fine grained sand, few medium grained sand | | BC=2 2 2 | 13" | | 20.7 | 98.0 | | | | | |
| | 10 | | | | BC=Push Push Push | 17" | | | | | | | | |
| 335 | | | wet, firm | | BC=3 7 10 | 15" | | 15.3 | 112.0 | | | | | |
| | 15 | | | | BC=4 7 9 | 4" | | | | | | | | |
| 330 | | | | | | | | | | | | | | @17.5' drill chatter |
| | 20 | | **SAND with Gravel (SP)**: brown, wet, medium dense to dense, mostly medium grained sand, few to some fine grained sand | | BC=21 25 31 | 14" | | | | | | | | |
| 325 | | | | | | | | | | | | | | @22.5' drill chatter persists |
| | 25 | | **Sandy CLAY (CL)**: light brownish gray, wet, firm, fine grained sand, few fine angular to subangular gravel | | BC=9 8 10 | 16" | | | | | | | | |
| 320 | | | | | | | | | | | | | | |

| | | | |
|---|---|---|---|
| KLEINFELDER Bright People. Right Solutions. | PROJECT NO.: 20155150 | BORING LOG KB-9 | BORING |
| | DRAWN BY: DC | | |
| | CHECKED BY: MS | Five Lagunas Redevelopment 24155 Laguna Hills Mall Laguna Hills, CA | KB-9 |
| | DATE: 4/29/2015 | | |
| | REVISED: - | | PAGE: 1 of 3 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Date Begin - End:** | 3/30/2015 | **Drilling Co.-Lic.#:** | Socal Drilling - #864735 | | | **BORING LOG KB-9** |
| **Logged By:** | D. Castle | **Drill Crew:** | Randy & Marc | | | |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Mayhew 1000 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. | |
| **Plunge:** | -90 degrees | **Drilling Method:** | Mud Rotary | **Hammer Efficiency:** | 80% | |
| **Weather:** | Cloudy | **Bore Diameter:** | 6 in. O.D. | **Hammer Cal. Date:** | 2/04/2015 | |

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.60861° N
Longitude: 117.70485° W
Approximate Ground Surface Elevation (ft.): 348.00
Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Poorly-graded SAND with Gravel (SP)**: yellow and yellowish brown, wet, very dense, mostly coarse grained subrounded to subangular sand, few medium grained sand, trace fine grained sand, trace fine to coarse subrounded to subangular gravel | | BC=26 50/5" | 11" | | | | | | | | |
| 315 | | | | | | | | | | | | | | |
| | 35 | | **Sandy CLAY (CL)**: bluish gray to gray, wet, firm, sample disturbed, split by rock in nose of sampler, trace coarse subangular gravel | | BC=5 9 11 | 18" | | | | | | | | |
| 310 | | | | | | | | | | | | | | |
| | 40 | | | | BC=30 50/5" | 9" | | | | | | | | |
| 305 | | | | | | | | | | | | | | |
| | 45 | | hard | | BC=10 17 19 | 18" | | | | | | | | |
| | | | **SILTSTONE**: greenish black, fine grained, decomposed, extremely weak R0 | | | | | | | | | | | |
| 300 | | | | | | | | | | | | | | |
| | 50 | | | | BC=19 42 50/5" | 15" | | | | | | | | |
| 295 | | | | | | | | | | | | | | |
| | 55 | | | | BC=6 10 17 | 18" | | | | | | | | |
| 290 | | | | | | | | | | | | | | |

| Date Begin - End: | 3/30/2015 | Drilling Co.-Lic.#: | Socal Drilling - #864735 | | **BORING LOG KB-9** |
|---|---|---|---|---|---|
| **Logged By:** | D. Castle | **Drill Crew:** | Randy & Marc | | |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Mayhew 1000 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Mud Rotary | **Hammer Efficiency:** | 80% |
| **Weather:** | Cloudy | **Bore Diameter:** | 6 in. O.D. | **Hammer Cal. Date:** | 2/04/2015 |

FIELD EXPLORATION: Latitude: 33.60861° N; Longitude: 117.70485° W; Approximate Ground Surface Elevation (ft.): 348.00; Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **SILTSTONE**: greenish black, fine grained, decomposed, extremely weak R0 | | BC=29 50/5" | 11" | | | | | | | | |
| 285 | | | | | | | | | | | | | | |
| | 65 | | | | BC=16 30 50/5" | 17" | | | | | | | | |
| 280 | | | | | | | | | | | | | | |
| | 70 | | | | BC=14 33 50/5" | 15" | | 33.9 | 91.0 | | | | | |
| 275 | | | | | | | | | | | | | | |
| | 75 | | | | BC=18 26 30 | 18" | | | | | | | | |
| 270 | | | | | | | | | | | | | | |
| | 80 | | | | BC=35 50/4" | 10" | | | | | | | | |
| 265 | | | | | | | | | | | | | | |
| | 85 | | | | | | | | | | | | | |
| 260 | | | | | | | | | | | | | | |

The boring was terminated at approximately 81 ft. below ground surface. The exploration was backfilled with bentonite on March 30, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 12 ft. below ground surface at the end of drilling.
GENERAL NOTES:
Boring was hand augered to 5' prior to drilling.
Boring was backfilled with betonite chips and patched with cold patch AC.
The exploration location and elevation are approximate and were estimated by Kleinfelder.

| KLEINFELDER Bright People. Right Solutions. | PROJECT NO.: 20155150 | BORING LOG KB-9 | BORING |
|---|---|---|---|
| | DRAWN BY: DC | | |
| | CHECKED BY: MS | Five Lagunas Redevelopment 24155 Laguna Hills Mall Laguna Hills, CA | KB-9 |
| | DATE: 4/29/2015 | | |
| | REVISED: - | | PAGE: 3 of 3 |

| | | | | | |
|---|---|---|---|---|---|
| **Date Begin - End:** | 3/26/2015 | **Drilling Co.-Lic.#:** | Socal Drilling - #864735 | | **BORING LOG KB-10** |
| **Logged By:** | D. Castle | **Drill Crew:** | Randy & Marc | | |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Mayhew 1000 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Mud Rotary | **Hammer Efficiency:** | 80% |
| **Weather:** | Sunny | **Bore Diameter:** | 6 in. O.D. | **Hammer Cal. Date:** | 2/04/2015 |

FIELD EXPLORATION

Latitude: 33.60848° N
Longitude: 117.70581° W
Approximate Ground Surface Elevation (ft.): 346.50
Surface Condition: Asphalt

LABORATORY RESULTS

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **ASPHALT**: 6" | | | | | | | | | | | |
| | | | **BASE COURSE**: 6" | | | | | | | | | | | |
| 345 | | | **FILL**<br>**Silty SAND (SM)**: brown, moist, fine grained | | | | | | | | | | | |
| | 5 | | **ALLUVIUM**<br>**Sandy CLAY (CL)**: brown to dark brown, moist, soft, caliche present | | BC=1 1 1 | 9" | CL | 22.6 | | | 52 | 33 | 14 | |
| 340 | | | | | | | | | | | | | | |
| | | | | | BC=1 2 2 | 18" | | | | | | | | |
| | 10 | | | | BC=Push Push Push | 4" | | | | | | | | |
| 335 ▼ | | | | | | | | | | | | | | |
| | | | **Silty SAND (SM)**: dark brown, wet, loose, mostly fine grained sand, some medium grained subrounded sand | | BC=1 2 3 | 14" | | | | | | | | |
| | 15 | | | | BC=Push Push Push | 8" | | | | | | | | |
| 330 | | | | | | | | | | | | | | |
| | 20 | | **Sandy CLAY (CL)**: brown, wet, soft | | BC=1 1 2 | 14" | | | | | | | | UU Triaxial |
| 325 | | | | | | | | | | | | | | |
| | 25 | | | | BC=1 2 3 | 10" | | | | | | | | |
| 320 | | | | | | | | | | | | | | |

| Date Begin - End: | 3/26/2015 | Drilling Co.-Lic.#: | Socal Drilling - #864735 | | **BORING LOG KB-10** |
|---|---|---|---|---|---|
| **Logged By:** | D. Castle | **Drill Crew:** | Randy & Marc | | |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Mayhew 1000 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Mud Rotary | **Hammer Efficiency:** | 80% |
| **Weather:** | Sunny | **Bore Diameter:** | 6 in. O.D. | **Hammer Cal. Date:** | 2/04/2015 |

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.60848° N
Longitude: 117.70581° W
Approximate Ground Surface Elevation (ft.): 346.50
Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 315 | | | olive brown, firm | | BC=1 5 5 | 17" | | | | | | | | |
| 310 | 35 | | soft | | BC=1 2 2 | 13" | | | | | | | | |
| 305 | 40 | | firm | | BC=2 4 10 | 16" | | | | | | | | |
| 300 | 45 | | **Silty CLAY (CL-ML)**: olive brown, wet, medium dense, mostly fine sand, some medium grained subrounded sand | | BC=5 6 11 | 10" | | 24.3 | | | | 25 | 4 | |
| 295 | 50 | | **GRAVEL (GP)**: no recovery | | BC=12 18 20 | NR | | | | | | | | @49.75' Drill chatter, driller notes gravel layer |
| 290 | 55 | | dense | | BC=16 23 21 | 2" | | | | | | | | |
| | | | | | | | | | | | | | | @57' Heavy drill chatter, driller notes bedrock |

| KLEINFELDER Bright People. Right Solutions. | PROJECT NO.: 20155150 | BORING LOG KB-10 | BORING |
|---|---|---|---|
| | DRAWN BY: DC | | |
| | CHECKED BY: MS | Five Lagunas Redevelopment 24155 Laguna Hills Mall Laguna Hills, CA | KB-10 |
| | DATE: 4/29/2015 | | |
| | REVISED: - | | PAGE: 2 of 4 |

| Date Begin - End: | 3/26/2015 | Drilling Co.-Lic.#: | Socal Drilling - #864735 | | **BORING LOG KB-10** |
|---|---|---|---|---|---|
| **Logged By:** | D. Castle | **Drill Crew:** | Randy & Marc | | |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Mayhew 1000 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Mud Rotary | **Hammer Efficiency:** | 80% |
| **Weather:** | Sunny | **Bore Diameter:** | 6 in. O.D. | **Hammer Cal. Date:** | 2/04/2015 |

FIELD EXPLORATION — Latitude: 33.60848° N; Longitude: 117.70581° W; Approximate Ground Surface Elevation (ft.): 346.50; Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 285 | | | **SILTSTONE**: greenish black mottled with black, sample disturbed | | BC=11 25 20 | 6" | | | | | | | | |
| 280 | 65 | | greenish black, fine grained, decomposed, extremely weak R0, laminated | | BC=18 14 29 | 18" | | | | | | | | |
| 275 | 70 | | greenish black to olive gray | | BC=7 10 12 | 18" | | | | | | | | |
| 270 | 75 | | gray<br>greenish black to black, vein of gray in sample | | BC=19 31 35 | 18" | | | | | | | | Consol |
| 265 | 80 | | no veins of gray | | BC=12 14 19 | 18" | | | | | | | | |
| 260 | 85 | | | | BC=31 37 42 | 17" | | | | | | | | |

| | | |
|---|---|---|
| KLEINFELDER Bright People. Right Solutions. | PROJECT NO.: 20155150<br>DRAWN BY: DC<br>CHECKED BY: MS<br>DATE: 4/29/2015<br>REVISED: - | BORING LOG KB-10<br>Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA |
| | | BORING KB-10 |

PLOTTED: 05/01/2015 11:31 AM BY: skuo

| | | | | | |
|---|---|---|---|---|---|
| **Date Begin - End:** | 3/26/2015 | **Drilling Co.-Lic.#:** | Socal Drilling - #864735 | | **BORING LOG KB-10** |
| **Logged By:** | D. Castle | **Drill Crew:** | Randy & Marc | | |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Mayhew 1000 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Mud Rotary | **Hammer Efficiency:** | 80% |
| **Weather:** | Sunny | **Bore Diameter:** | 6 in. O.D. | **Hammer Cal. Date:** | 2/04/2015 |

Latitude: 33.60848° N
Longitude: 117.70581° W
Approximate Ground Surface Elevation (ft.): 346.50
Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | FIELD EXPLORATION | | | | LABORATORY RESULTS | | | | | | | |
| 255 | | | no veins, tiny yellow seashells present | | BC=9 18 28 | 18" | | | | | | | | |
| 250 | 95 | | sample got stuck in the ground | | BC=17 35 50/5" | 17" | | | | | | | | |
| 245 | 100 | | vein of gray in sample, tiny seashells present | | BC=5 16 28 | 18" | | | | | | | | |
| 240 | 105 | | | | | | | | | | | | | |
| 235 | 110 | | | | | | | | | | | | | |
| 230 | 115 | | | | | | | | | | | | | |

The boring was terminated at approximately 101.5 ft. below ground surface. The exploration was backfilled with bentonite on March 26, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 11.5 ft. below ground surface at the end of drilling.

GENERAL NOTES:
Boring was hand augered to 5' prior to drilling.
Boring was backfilled with betonite chips and patched with cold patch AC.
The exploration location and elevation are approximate and were estimated by Kleinfelder.

gINT FILE: U:\bcrystal\projects - Active\20155150.001a - Mgp #635 Five Lagunas\gint\20155150 Gint.gpj
gINT TEMPLATE: PROJECTWISE: KLF_STANDARD_GINT_LIBRARY_2015.GLB [KLF_BORING/TEST PIT SOIL LOG]

KLEINFELDER
Bright People. Right Solutions.

| | | | |
|---|---|---|---|
| PROJECT NO.: 20155150 | BORING LOG KB-10 | BORING |
| DRAWN BY: DC | | |
| CHECKED BY: MS | Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | KB-10 |
| DATE: 4/29/2015 | | |
| REVISED: - | | PAGE: 4 of 4 |

PLOTTED: 05/01/2015 11:31 AM BY: skuo

| | | | | | |
|---|---|---|---|---|---|
| **Date Begin - End:** | 3/26/2015 - 3/27/2015 | **Drilling Co.-Lic.#:** | Socal Drilling - #864735 | | **BORING LOG KB-11** |
| **Logged By:** | D. Castle | **Drill Crew:** | Randy & Marc | | |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Mayhew 1000 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Mud Rotary | **Hammer Efficiency:** | 80% |
| **Weather:** | Sunny | **Bore Diameter:** | 6 in. O.D. | **Hammer Cal. Date:** | 2/04/2015 |

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.60780° N
Longitude: 117.70586° W
Approximate Ground Surface Elevation (ft.): 345.70
Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **ASPHALT**: 5" | | | | | | | | | | | |
| 345 | | **BASE COURSE**: 6" | | | | | | | | | | | |
| | | **FILL**<br>**Sandy SILT (ML)**: brown to dark brown, moist, firm | | | | | | | | | | | |
| 340 | 5 | | | BC=1 3 5 | 9" | | 16.9 | 106.0 | | | | | |
| | | **Silty SAND (SM)**: reddish brown to brown, moist, loose, fine to medium grained subangular to subrounded sand | | | | | | | | | | | |
| | | **ALLUVIUM**<br>**Silty CLAY (CL-ML)**: reddish brown to brown, moist, very soft, fine to medium grained subangular to subrounded sand | | BC=Push Push Push | 14" | | 19.6 | | | | | | |
| 335 | 10 | | | BC=2 3 5 | 9" | | 10.1 | 118.0 | | | | | |
| | | ▼ wet | | BC=1 1 1 | 15" | | | | | | | | |
| 330 | 15 | | | BC=3 9 12 | 14" | | | | | | | | |
| 325 | 20 | | | BC=2 2 4 | 12" | | | | | | 27 | 5 | |
| 320 | 25 | **Poorly-graded SAND with Gravel (SP)**: yellowish brown, wet, medium dense, mostly medium grained subangular sand, fine to medium subangular gravel, trace fines | | BC=11 16 19 | 10" | | | | | | | | |
| | | **Sandy SILT (ML)**: brown to olive brown, wet, firm | | | | | | | | | | | |

gINT FILE: U:\bcrystal\projects - Active\20155150.001a - Mgp #635 Five Lagunas\gint\20155150 Gint.gpj
gINT TEMPLATE: PROJECTWISE: KLF_STANDARD_GINT_LIBRARY_2015.GLB [KLF_BORING/TEST PIT SOIL LOG]

| Date Begin - End: | 3/26/2015 - 3/27/2015 | Drilling Co.-Lic.#: | Socal Drilling - #864735 | | **BORING LOG KB-11** |
|---|---|---|---|---|---|
| Logged By: | D. Castle | Drill Crew: | Randy & Marc | | |
| Hor.-Vert. Datum: | Not Available | Drilling Equipment: | Mayhew 1000 | Hammer Type - Drop: | 140 lb. Auto - 30 in. |
| Plunge: | -90 degrees | Drilling Method: | Mud Rotary | Hammer Efficiency: | 80% |
| Weather: | Sunny | Bore Diameter: | 6 in. O.D. | Hammer Cal. Date: | 2/04/2015 |

FIELD EXPLORATION — Latitude: 33.60780° N; Longitude: 117.70586° W; Approximate Ground Surface Elevation (ft.): 345.70; Surface Condition: Asphalt

LABORATORY RESULTS

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 315 | | | **Sandy SILT (ML)**: brown to olive brown, wet, firm | | BC=5 10 14 | 14" | | | | | | | | |
| 310 | 35 | | | | BC=10 19 25 | 17" | | | | | | | | |
| 305 | 40 | | **Poorly-graded SAND with Gravel (SP)**: brown, wet, very dense, mostly coarse to medium grained subangular sand, some fine to coarse subangular gravel | | BC=17 35 42 | 14" | | | | | | | | |
| 300 | 45 | | **Sandy SILT (ML)**: greenish gray to gray, wet, hard | | BC=11 19 26 | 18" | | | | | | | | UU Triaxial |
| 295 | 50 | | | | BC=14 30 36 | 18" | ML | 28.2 | | | 52 | NP | NP | |
| 290 | 55 | | **SILTSTONE**: greenish black, fine grained, decomposed, extremely weak R0, laminated | | BC=16 27 34 | 15" | | | | | | | | |

KLEINFELDER
Bright People. Right Solutions.

| PROJECT NO.: | 20155150 | BORING LOG KB-11 | BORING |
|---|---|---|---|
| DRAWN BY: | DC | | KB-11 |
| CHECKED BY: | MS | Five Lagunas Redevelopment 24155 Laguna Hills Mall Laguna Hills, CA | |
| DATE: | 4/29/2015 | | |
| REVISED: | - | | PAGE: 2 of 3 |

| Date Begin - End: | 3/26/2015 - 3/27/2015 | Drilling Co.-Lic.#: | Socal Drilling - #864735 | | BORING LOG KB-11 |
|---|---|---|---|---|---|
| Logged By: | D. Castle | Drill Crew: | Randy & Marc | | |
| Hor.-Vert. Datum: | Not Available | Drilling Equipment: | Mayhew 1000 | Hammer Type - Drop: | 140 lb. Auto - 30 in. |
| Plunge: | -90 degrees | Drilling Method: | Mud Rotary | Hammer Efficiency: | 80% |
| Weather: | Sunny | Bore Diameter: | 6 in. O.D. | Hammer Cal. Date: | 2/04/2015 |

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.60780° N
Longitude: 117.70586° W
Approximate Ground Surface Elevation (ft.): 345.70
Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 285 | | | **SILTSTONE**: greenish black, fine grained, decomposed, extremely weak R0, laminated seashells throughout | | BC=4 9 14 | 18" | | | | | | | | |
| 280 | 65 | | greenish black to black | | BC=18 43 50/4.5" | 17" | | | | | | | | |
| 275 | 70 | | | | BC=9 25 19 | 18" | | | | | | | | |
| 270 | 75 | | no seashells, trace fine to medium subrounded gravel | | BC=21 35 50/5" | 17" | | | | | | | | |
| 265 | 80 | | some fine subrounded gravel | | BC=7 16 19 | 18" | | | | | | | | |
| 260 | 85 | | | | | | | | | | | | | |

The boring was terminated at approximately 81.5 ft. below ground surface. The exploration was backfilled with bentonite on March 27, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 13 ft. below ground surface at the end of drilling.
GENERAL NOTES:
Boring was hand augered to 5' prior to drilling.
Boring was backfilled with betonite chips and patched with cold patch AC.
The exploration location and elevation are approximate and were estimated by Kleinfelder.

| | | | | | |
|---|---|---|---|---|---|
| **Date Begin - End:** | 3/25/2015 | **Drilling Co.-Lic.#:** | Socal Drilling - #864735 | | **BORING LOG KB-12** |
| **Logged By:** | D. Castle | **Drill Crew:** | Randy & Marc | | |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Mayhew 1000 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Mud Rotary | **Hammer Efficiency:** | 80% |
| **Weather:** | Sunny | **Bore Diameter:** | 6 in. O.D. | **Hammer Cal. Date:** | 2/04/2015 |

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.60908° N
Longitude: 117.70743° W
Approximate Ground Surface Elevation (ft.): 345.00
Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **ASPHALT**: 4" | | | | | | | | | | | |
| | | | **BASE COURSE**: 6" | | | | | | | | | | | |
| | | | **FILL**<br>**Sandy CLAY**: olive, moist, soft | | | | | | | | | | | |
| 340 | 5 | | | | BC=2 2 3 | 12" | | 24.4 | | | | | | |
| | | | **ALLUVIUM**<br>**Silty CLAY (CL-ML)**: olive gray, moist, soft | | BC=1 3 3 | 12" | | 19.2 | 102.0 | | | | | |
| 335 | 10 | | no caliche | | BC=Push Push Push | 18" | | | | | | | | |
| ▼ | | | | | BC=Push 1 2 | 18" | | | | | | | | |
| 330 | 15 | | wet, very soft | | BC=Push Push Push | 16" | | | | | | | | |
| 325 | 20 | | | | BC=Push Push Push | 18" | | | | | | | | Consol |
| 320 | 25 | | | | BC=Push Push Push | 16" | | | | | | | | |

| | | | |
|---|---|---|---|
| KLEINFELDER Bright People. Right Solutions. | PROJECT NO.: 20155150<br>DRAWN BY: DC<br>CHECKED BY: MS<br>DATE: 4/29/2015<br>REVISED: - | BORING LOG KB-12<br>Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | BORING<br>KB-12<br>PAGE: 1 of 4 |

| Date Begin - End: | 3/25/2015 | Drilling Co.-Lic.#: | Socal Drilling - #864735 | | **BORING LOG KB-12** |
|---|---|---|---|---|---|
| **Logged By:** | D. Castle | **Drill Crew:** | Randy & Marc | | |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Mayhew 1000 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Mud Rotary | **Hammer Efficiency:** | 80% |
| **Weather:** | Sunny | **Bore Diameter:** | 6 in. O.D. | **Hammer Cal. Date:** | 2/04/2015 |

FIELD EXPLORATION — Latitude: 33.60908° N; Longitude: 117.70743° W; Approximate Ground Surface Elevation (ft.): 345.00; Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Silty SAND (SM)**: olive to olive brown, wet, loose, mostly fine grained sand, trace medium grained angular sand | | BC=1 3 6 | 18" | | | | | | | | |
| 310 | 35 | | | | BC=4 4 5 | 12" | | | | | | | | |
| 305 | 40 | | **Poorly-graded SAND (SP)**: yellowish brown, wet, medium dense, mostly medium grained subangular sand, some coarse grained subangular sand, some fine grained sand, trace to little silt | | BC=14 21 25 | 18" | | | | | | | | |
| 300 | 45 | | trace fine angular gravel, sand coarsens | | BC=10 14 10 | 12" | | | | | | | | |
| | | | **Sandy SILT (ML)**: mottled yellowish brown and light grayish brown, wet, firm, fine grained sand | | | | | | | | | | | |
| 295 | 50 | | | | BC=2 7 15 | 18" | | | | | | | | |
| 290 | 55 | | light brownish gray to gray, wet, firm | | BC=2 3 6 | 18" | | | | | | | | |

| Date Begin - End: | 3/25/2015 | Drilling Co.-Lic.#: | Socal Drilling - #864735 | | **BORING LOG KB-12** |
|---|---|---|---|---|---|
| Logged By: | D. Castle | Drill Crew: | Randy & Marc | | |
| Hor.-Vert. Datum: | Not Available | Drilling Equipment: | Mayhew 1000 | Hammer Type - Drop: | 140 lb. Auto - 30 in. |
| Plunge: | -90 degrees | Drilling Method: | Mud Rotary | Hammer Efficiency: | 80% |
| Weather: | Sunny | Bore Diameter: | 6 in. O.D. | Hammer Cal. Date: | 2/04/2015 |

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.60908° N
Longitude: 117.70743° W
Approximate Ground Surface Elevation (ft.): 345.00
Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **SILTSTONE**: mottled greenish black and bluish gray, decomposed, extremely weak R0, laminated <1" layers, micaceous | | BC=14 32 41 | 15" | | | | | | | | |
| 280 | 65 | | dark olive brown, trace mica | | BC=9 16 25 | 18" | | | | | | | | |
| 275 | 70 | | mottled greenish black and bluish gray, micaceous | | BC=14 29 32 | 16" | | | | | | | | |
| 270 | 75 | | greenish black, less mica | | BC=11 18 26 | 18" | | | | | | | | CORR |
| 265 | 80 | | | | BC=20 29 31 | 16" | | | | | | | | UU Triaxial |
| 260 | 85 | | seam of white coarse grained angular sand 0.25" thick, bluish gray areas present 0.5" x 0.75" | | BC=7 11 16 | 18" | | | | | | | | |



KLEINFELDER
Bright People. Right Solutions.

| PROJECT NO.: | 20155150 | BORING LOG KB-12 | BORING |
|---|---|---|---|
| DRAWN BY: | DC | | |
| CHECKED BY: | MS | Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | KB-12 |
| DATE: | 4/29/2015 | | |
| REVISED: | - | | PAGE: 3 of 4 |

| Date Begin - End: | 3/25/2015 | Drilling Co.-Lic.#: | Socal Drilling - #864735 | | **BORING LOG KB-12** |
|---|---|---|---|---|---|
| **Logged By:** | D. Castle | **Drill Crew:** | Randy & Marc | | |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Mayhew 1000 | **Hammer Type - Drop:** | 140 lb. Auto - 30 in. |
| **Plunge:** | -90 degrees | **Drilling Method:** | Mud Rotary | **Hammer Efficiency:** | 80% |
| **Weather:** | Sunny | **Bore Diameter:** | 6 in. O.D. | **Hammer Cal. Date:** | 2/04/2015 |

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 33.60908° N
Longitude: 117.70743° W
Approximate Ground Surface Elevation (ft.): 345.00
Surface Condition: Asphalt

| Approximate Elevation (feet) | Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | × × | no sand seam, no bluish gray areas | | BC=23 40 46 | 15" | | | | | | | | |
| 250 | 95 | × × | 0.5" thick bluish black seams in middle of sample | | BC=8 14 15 | 16" | | | | | | | | |
| 245 | 100 | × × | no seams | | BC=17 36 50/5" | 17" | | | | | | | | |
| 240 | 105 | | | | | | | | | | | | | |
| 235 | 110 | | | | | | | | | | | | | |
| 230 | 115 | | | | | | | | | | | | | |

The boring was terminated at approximately 101.5 ft. below ground surface. The exploration was backfilled with bentonite on March 25, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 12 ft. below ground surface at the end of drilling.
GENERAL NOTES:
Boring was hand augered to 5' prior to drilling.
Boring was backfilled with betonite chips and patched with cold patch AC.
The exploration location and elevation are approximate and were estimated by Kleinfelder.

| KLEINFELDER Bright People. Right Solutions. | PROJECT NO.: 20155150 | BORING LOG KB-12 | BORING |
|---|---|---|---|
| | DRAWN BY: DC | | |
| | CHECKED BY: MS | Five Lagunas Redevelopment 24155 Laguna Hills Mall Laguna Hills, CA | KB-12 |
| | DATE: 4/29/2015 | | |
| | REVISED: - | | PAGE: 4 of 4 |

| | | | |
|---|---|---|---|
| **Date Begin - End:** | 4/02/2015 | **Drilling Company:** | Strive Concrete Cutting |
| **Logged By:** | D. Castle | **Drill Crew:** | Nathan |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Hand Auger |
| **Plunge:** | -90 degrees | **Drilling Method:** | Hand Auger |
| **Weather:** | Sunny | **Auger Diameter:** | 7 in. O.D. |

**BORING LOG KC-1**

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: ° N
Longitude: ° W
Surface Condition: Concrete

| Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **CONCRETE**: 6.5" | | | | | | | | | | | |
| | | **BASE COURSE**: 8" | | | | | | | | | | | |
| | | <u>FILL</u> **Sandy SILT (ML)**: brown, moist, soft | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | | |

The pavement coring was terminated at approximately 4 ft. below ground surface. The exploration was backfilled with excavated material on April 02, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.
GENERAL NOTES:
Core was taken as a sample.
Hand augered to 4'.
Backfilled with excavated materials and patched with quickrete.



KLEINFELDER
Bright People. Right Solutions.

| | | | | |
|---|---|---|---|---|
| PROJECT NO.: | 20155150 | BORING LOG KC-1 | BORING |
| DRAWN BY: | DC | | KC-1 |
| CHECKED BY: | MS | Five Lagunas Redevelopment 24155 Laguna Hills Mall Laguna Hills, CA | |
| DATE: | 4/29/2015 | | |
| REVISED: | - | | PAGE: 1 of 1 |

| | | | |
|---|---|---|---|
| **Date Begin - End:** | 4/02/2015 | **Drilling Company:** | Strive Concrete Cutting |
| **Logged By:** | D. Castle | **Drill Crew:** | Nathan |
| **Hor.-Vert. Datum:** | Not Available | **Drilling Equipment:** | Hand Auger |
| **Plunge:** | -90 degrees | **Drilling Method:** | Hand Auger |
| **Weather:** | Sunny | **Auger Diameter:** | 7 in. O.D. |

**BORING LOG KC-2**

Latitude: ° N
Longitude: ° W
Surface Condition: Concrete

| Depth (feet) | Graphical Log | Lithologic Description | Sample Type | Blow Counts(BC)= Uncorr. Blows/6 in. | Recovery (NR=No Recovery) | USCS Symbol | Water Content (%) | Dry Unit Wt. (pcf) | Passing #4 (%) | Passing #200 (%) | Liquid Limit | Plasticity Index (NP=NonPlastic) | Additional Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **CONCRETE**: 7" | | | | | | | | | | | |
| | | **BASE COURSE**: 8" | | | | | | | | | | | |
| | | **FILL** **CLAY (CL)**: greenish black to black, moist, soft | | | | | 18.5 | | | | 36 | 18 | |

FIELD EXPLORATION / LABORATORY RESULTS

The pavement coring was terminated at approximately 4 ft. below ground surface. The exploration was backfilled with excavated material on April 02, 2015.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.
GENERAL NOTES:
Core was taken as a sample.
Hand augered to 4'.
Backfilled with excavated materials and patched with quickrete.

Depth scale: 5, 10, 15

| | | |
|---|---|---|
| PROJECT NO.: 20155150 | BORING LOG KC-2 | BORING |
| DRAWN BY: DC | | KC-2 |
| CHECKED BY: MS | Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | |
| DATE: 4/29/2015 | | |
| REVISED: - | | PAGE: 1 of 1 |

KLEINFELDER
Bright People. Right Solutions.

| | | | |
|---|---|---|---|
| **Date Begin - End:** | 7/2/12 | **Drill Company:** | Cal Pac |
| **Logged By:** | K Sarwold | **Drill Crew:** | Travis and Leo |
| **Hor.-Vert. Datum:** | Not Available | **Drill Equipment:** | Mobile B-61 |
| **Angle from Vert.:** | 0 degrees | **Exploration Method:** | Hand Auger |
| **Weather:** | Sunny, 70º | **Auger Diameter:** | 4 inches |

**BORING LOG B-1**

| Depth (feet) | Graphical Log | FIELD EXPLORATION: No Coordinates Available / No Elevation Available / Surface Condition: Asphalt Pavement | Sample Type | Blow Counts(BC)= Uncorr. blows/6 in | Recovery | LABORATORY RESULTS: USCS Symbol | Moisture Content (%) | Dry Density (pcf) | Passing No.4 Sieve (%) | Passing #200 Sieve (%) | Liquid Limit (NV=No Value) | Plasticity Index (NP=No Plasticity) | Other Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Asphalt:** 4-inch Asphalt over 7-foot Base | | | | | | | | | | | |
| | | **Alluvium:** **Sandy CLAY**: yellowish brown and olive brown, dry to moist, fine sand | | | 48" | | | | | | | | |
| | | | | | 6" | CL | 18.5 | | | | | | |
| | | @ 3 ft. olive brown, increase in moisture, biotitic, trace coarse sand | | | | | | | | | | | |
| 5 | | @ 4 ft. moisture increase | | | 6" | | 18.4 | | | | | | |

The boring was terminated at approximately 5.5 feet below ground surface. Boring was backfilled with auger cuttings and patched at surface with Quikset concrete and black dye on July 02, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:

10

15

20

25

30

| | | |
|---|---|---|
| PROJECT NO. 20155150 | BORING LOG B-1 | BORING |
| DRAWN BY: SK | | B-1 |
| CHECKED BY: JM | Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | |
| DATE: 8/30/2012 | | |
| REVISED: 8/31/2012 | | PAGE: 1 of 1 |

KLEINFELDER
Bright People. Right Solutions.

| | | | |
|---|---|---|---|
| **Date Begin - End:** | 7/2/12 | **Drill Company:** | Cal Pac |
| **Logged By:** | K Sarwold | **Drill Crew:** | Travis and Leo |
| **Hor.-Vert. Datum:** | Not Available | **Drill Equipment:** | Mobile B-61 |
| **Angle from Vert.:** | 0 degrees | **Exploration Method:** | Hand Auger |
| **Weather:** | Sunny, 70º | **Auger Diameter:** | 4 inches |

**BORING LOG B-2**

| Depth (feet) | Graphical Log | FIELD EXPLORATION: No Coordinates Available<br>No Elevation Available<br>Surface Condition: Asphalt Pavement | Sample Type | Blow Counts(BC)= Uncorr. blows/6 in | Recovery | LABORATORY RESULTS: USCS Symbol | Moisture Content (%) | Dry Density (pcf) | Passing No.4 Sieve (%) | Passing #200 Sieve (%) | Liquid Limit (NV=No Value) | Plasticity Index (NP=No Plasticity) | Other Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Asphalt:** 4-inch Asphalt over 10-inch Base | | | | | | | | | | | |
| | | **Alluvium:** **Sandy CLAY**: yellowish brown, moist, fine to medium sand, trace coarse sand, biotitic | | | 48" | CL | | | | | | | |
| | | | | | 6" | | 15.4 | | | | | | |
| 5 | | | | | 6" | | 19.2 | | | | | | |

The boring was terminated at approximately 5.5 feet below ground surface. Boring was backfilled with auger cuttings and patched at surface with Quikset concrete and black dye on July 02, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.
GENERAL NOTES:

Depth scale: 5, 10, 15, 20, 25, 30

gINT FILE: U:\gint_projects\oracle Project Numbers\128062 - Laguna Hills Mall\Laguna Data.gpj U:KLF_STANDARD_GINT_LIBRARY_BETA_R2.GLB [KLF_BORING/TEST PIT LOG]

KLEINFELDER
Bright People. Right Solutions.

| | | | |
|---|---|---|---|
| PROJECT NO. 20155150 | BORING LOG B-2 | BORING |
| DRAWN BY: SK | | |
| CHECKED BY: JM | Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | B-2 |
| DATE: 8/30/2012 | | |
| REVISED: 8/31/2012 | | PAGE: 1 of 1 |

| | | | | | |
|---|---|---|---|---|---|
| **Date Begin - End:** | 7/3/12 | **Drill Company:** | Cal Pac | | **BORING LOG B-3** |
| **Logged By:** | K Sarwold | **Drill Crew:** | Travis and Leo | | |
| **Hor.-Vert. Datum:** | Not Available | **Drill Equipment:** | Mobile B-61 | **Hammer Type - Drop:** | 140 lb. Automatic - 30" |
| **Angle from Vert.:** | 0 degrees | **Exploration Method:** | Hollow Stem Auger | | |
| **Weather:** | Sunny, 70º | **Auger Diameter:** | 8 inches | | |

| Depth (feet) | FIELD EXPLORATION: Description (No Coordinates Available; No Elevation Available; Surface Condition: Asphalt Pavement) | Blow Counts(BC)= Uncorr. blows/6 in | Recovery | LABORATORY RESULTS: USCS Symbol | Moisture Content (%) | Dry Density (pcf) | Passing No.4 Sieve (%) | Passing #200 Sieve (%) | Liquid Limit (NV=No Value) | Plasticity Index (NP=No Plasticity) | Other Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Asphalt:** 4-inch Asphalt over 7-inch Base | | | | | | | | | | |
| | **Fill:** **Clayey SAND with gravel**: yellowish brown, olive brown, and pale olive, dry to moist | | 48" | SC | | | | | | | |
| | | | 6" | | 31.6 | | | | | | |
| | **CLAY**: pale olive gray with light brownish gray, dry to moist | | | | | | | | | | |
| 5 | **Alluvium:** **Sandy CLAY**: olive brown, moist, fine to coarse grained sand, some brown inclusions | BC=3 5 5 | 12" | | 11.6 | 114 | | | 27 | 9 | |
| | Consistent coloring - olive brown | | | | | | | | | | |
| | **Sandy CLAY**: olive brown, moist to wet, fine grained sand, trace medium sand | BC=1 1 1 | 18" | SC/CL | 24.8 | | | | | | |
| 10 | **Sandy CLAY**: olive brown, moist, fine to medium sand, biotitic | BC=0 0 1 | 12" | | 22.1 | 105 | | | | | |
| | **Sandy CLAY**: olive yellow with light brownish gray inclusions, wet, fine to medium sand | | | | | | | | | | |
| 15 | | BC=0 0 1 | 18" | SC/CL | 21.1 | | 100 | 51 | | | |
| | **Sandy CLAY**: olive yellow, wet, fine sand, trace medium sand | | | CL | | | | | | | |
| 20 | | BC=1 1 2 | 12" | | 22.4 | 102 | | | | | |
| | **Clayey SAND**: olive yellow, wet, in fine to medium sand | | | SC | | | | | | | |
| 25 | Fine to coarse sand, ~25% clay, biotitic, very loose @ 25 ft. 8 inches , 6-inch layer of fine to medium sand, ~40% clay | BC=0 1 1 | 18" | | | | | | | | |
| | **Silty SAND**: wet, loose, fine to medium sand, ~25% clay, top 2 rings disturbed | | | | | | | | | | |
| 30 | | BC=2 4 4 | 10" | SM | 16.8 | 110 | 100 | 23 | NV | NP | |
| | **Clayey SAND**: olive yellow, wet, fine to medium sand | | | | | | | | | | |



KLEINFELDER
Bright People. Right Solutions.

| | | | |
|---|---|---|---|
| PROJECT NO. 20155150 | BORING LOG B-3 | BORING |
| DRAWN BY: SK | | B-3 |
| CHECKED BY: JM | Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | |
| DATE: 8/30/2012 | | |
| REVISED: 8/31/2012 | | PAGE: 1 of 2 |

| Date Begin - End: | 7/3/12 | Drill Company: | Cal Pac | BORING LOG B-3 |
|---|---|---|---|---|
| Logged By: | K Sarwold | Drill Crew: | Travis and Leo | |
| Hor.-Vert. Datum: | Not Available | Drill Equipment: | Mobile B-61 | Hammer Type - Drop: 140 lb. Automatic - 30" |
| Angle from Vert.: | 0 degrees | Exploration Method: | Hollow Stem Auger | |
| Weather: | Sunny, 70º | Auger Diameter: | 8 inches | |

| Depth (feet) | Graphical Log | FIELD EXPLORATION<br>No Coordinates Available<br>No Elevation Available<br>Surface Condition: Asphalt Pavement | Sample Type | Blow Counts(BC)= Uncorr. blows/6 in | Recovery | USCS Symbol | Moisture Content (%) | Dry Density (pcf) | Passing No.4 Sieve (%) | Passing #200 Sieve (%) | Liquid Limit (NV=No Value) | Plasticity Index (NP=No Plasticity) | Other Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Clayey SAND**: olive yellow, wet, fine to medium sand<br>Olive yellow, wet, @ 36 ft. ~20% clay, loose, fine to coarse sand | | BC=2 3 5 | 18" | SC | | | | | | | |
| 40 | | Olive yellow, loose | | BC=3 3 4 | 12" | | | | | | | | |
| | | Fine to coarse sand | | | | | | | | | | | |
| 45 | | | | BC=5 5 12 | 18" | | | | | | | | |
| 50 | | Dense | | BC=4 11 34 | 12" | | | | | | | | |
| 55 | | | | | | | | | | | | | |
| 60 | | | | | | | | | | | | | |
| 65 | | | | | | | | | | | | | |

The boring was terminated at approximately 51.5 feet below ground surface. Boring was backfilled with bentonite grout and patched at surface with Quikset concrete and black dye on July 03, 2012.

GROUNDWATER LEVEL INFORMATION:

Groundwater was observed at approximately 9 ft. below ground surface after drilling completion.

Groundwater was observed at approximately 13 ft. below ground surface during drilling.

GENERAL NOTES:



| KLEINFELDER Bright People. Right Solutions. | PROJECT NO. 20155150 | BORING LOG B-3 | BORING |
|---|---|---|---|
| | DRAWN BY: SK | | B-3 |
| | CHECKED BY: JM | Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | |
| | DATE: 8/30/2012 | | |
| | REVISED: 8/31/2012 | | PAGE: 2 of 2 |

| | | | | | |
|---|---|---|---|---|---|
| **Date Begin - End:** | 7/3/12 | **Drill Company:** | Cal Pac | | **BORING LOG B-4** |
| **Logged By:** | K Sarwold | **Drill Crew:** | Travis and Leo | | |
| **Hor.-Vert. Datum:** | Not Available | **Drill Equipment:** | Mobile B-61 | **Hammer Type - Drop:** | 140 lb. Automatic - 30" |
| **Angle from Vert.:** | 0 degrees | **Exploration Method:** | Hollow Stem Auger | | |
| **Weather:** | Sunny, 70º | **Auger Diameter:** | 8 inches | | |

FIELD EXPLORATION — No Coordinates Available; No Elevation Available; Surface Condition: Asphalt Pavement

| Depth (feet) | Graphical Log | Description | Sample Type | Blow Counts(BC)= Uncorr. blows/6 in | Recovery | USCS Symbol | Moisture Content (%) | Dry Density (pcf) | Passing No.4 Sieve (%) | Passing #200 Sieve (%) | Liquid Limit (NV=No Value) | Plasticity Index (NP=No Plasticity) | Other Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Asphalt:** 5-inch Asphalt over 3-inch Base | | | 48" | CL | | | | | | | |
| | | **Fill:** **CLAY**: olive brown to gray, mottled with oxide stains and pink reddish brown, moist, fine to coarse sand | | | 6" | | | | | | | | |
| | | **Clayey SAND with gravel**: light brownish gray to olive, moist, fine to coarse sand, fine to coarse gravel, ~35% fines | | | | SC | | | | | | | |
| | | | | | | CL | 28.5 | | | | | | |
| | | | | | | CL | | | | | | | |
| 5 | | @ 3 ft. color change to yellow brown, with sandy clay nodules | | BC=3 5 5 | 18" | CL | 13.4 | 109 | | | | | |
| | | **Sandy CLAY**: gray, moist, fine to medium sand | | | | SM | | | | | | | |
| | | **Alluvium:** **Sandy CLAY**: olive brown, moist, fine to medium sand | | BC=1 1 2 | 18" | CL | | | | | | | |
| 10 | | **Silty SAND**: olive yellow to olive brown, moist, fine to medium sand | | BC=2 4 4 | 18" | | 22.7 | | | | | | |
| | | **CLAY with sand**: olive to olive yellow, moist, fine sand with pockets of clayey sand, few medium sand | | | | | | | | | | | |
| | | **Sandy CLAY**: gray, moist, fine sand | | | | CL | | | | | | | |
| 15 | | | | BC=0 0 1 | 18" | | | | | | | | |
| 20 | | **Fat CLAY with silt**: olive to olive yellow, moist, trace fine sand, some sand nodules, no odor | | BC=2 2 2 | 18" | CH | 42.5 | | | | | | |

The boring was terminated at approximately 21.5 feet below ground surface. Boring was backfilled with bentonite grout and patched at surface with Quikset concrete and black dye on July 03, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 12 ft. below ground surface after drilling completion.
GENERAL NOTES:

25

30

| | | | | |
|---|---|---|---|---|
| KLEINFELDER Bright People. Right Solutions. | PROJECT NO. 20155150 | BORING LOG B-4 | | BORING |
| | DRAWN BY: SK | | | |
| | CHECKED BY: JM | Five Lagunas Redevelopment 24155 Laguna Hills Mall Laguna Hills, CA | | B-4 |
| | DATE: 8/30/2012 | | | |
| | REVISED: 8/31/2012 | | | PAGE: 1 of 1 |

| | | | | | |
|---|---|---|---|---|---|
| **Date Begin - End:** | 7/2/12 | **Drill Company:** | Cal Pac | | **BORING LOG B-5** |
| **Logged By:** | K Sarwold | **Drill Crew:** | Travis and Leo | | |
| **Hor.-Vert. Datum:** | Not Available | **Drill Equipment:** | Mobile B-61 | **Hammer Type - Drop:** | 140 lb. Automatic - 30" |
| **Angle from Vert.:** | 0 degrees | **Exploration Method:** | Hollow Stem Auger | | |
| **Weather:** | Sunny, 70º | **Auger Diameter:** | 8 inches | | |

FIELD EXPLORATION / LABORATORY RESULTS

No Coordinates Available
No Elevation Available
Surface Condition: Asphalt Pavement

| Depth (feet) | Graphical Log | Description | Sample Type | Blow Counts(BC)= Uncorr. blows/6 in | Recovery | USCS Symbol | Moisture Content (%) | Dry Density (pcf) | Passing No.4 Sieve (%) | Passing #200 Sieve (%) | Liquid Limit (NV=No Value) | Plasticity Index (NP=No Plasticity) | Other Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Asphalt:** 8-inch Asphalt over 3-inch Base | | | | | | | | | | | |
| | | **Fill:** **Sandy CLAY**: mottled brown gray, light brownish gray, moist, calcified fragments, trace wood pieces | | | 48" | CL | | | | | | | |
| | | | | | 6" | | 23.2 | | | | | | |
| | | **Clayey SAND**: light brownish gray, moist, fine to coarse sand | | | | SC | | | | | | | |
| 5 | | **Clayey SILT with sand**: olive yellow to pale olive, moist, fine to medium sand | | BC=3 4 7 | 18" | ML | 64.4 | 55 | | | | | |
| | | @ 6 ft. Sandy clayey SILT, fine to coarse sand, oxide stains | | | | CL | | | | | | | |
| | | | | BC=2 2 4 | 18" | | 17.4 | | | | | | |
| 10 | | **Alluvium:** **Sandy CLAY**: gray, dry to moist, white specks/strings transition inside sample ~ 6 ft. 3 inches<br>Dry, fine to medium sand<br>Fine sand, calcium stringer<br>@ 11.1 ft. olive yellow, moist, fine sand<br>Fine to medium sand, moist, yellow brown to brown | | BC=4 7 8 | 18" | | 19.9 | | | | | | |
| 15 | | Yellow brown to olive brown, pinholes, biotitic, consistent coloring | | BC=0 1 3 | 18" | CL | 25.4 | | | | | | |
| 20 | | Light brownish gray, wet, soft to firm, trace fine sand | | BC=3 4 4 | 18" | CL | 23.1 | 101 | | | | | |
| 25 | | **Clayey SILT**: olive yellow to yellow brown layers of clayey silt | | BC=1 1 2 | 18" | ML | | | | | 33 | 9 | |
| | | **Clayey SAND**: olive yellow to yellow brown, moist, fine to medium sand, biotitic | | | | SC | | | | | | | |
| 30 | | | | BC=3 7 7 | 18" | | 17.7 | 112 | | | | | |
| | | | | | | CL-CH | | | | | | | |



KLEINFELDER
Bright People. Right Solutions.

| | | | |
|---|---|---|---|
| PROJECT NO. | 20155150 | BORING LOG B-5 | BORING |
| DRAWN BY: | SK | | B-5 |
| CHECKED BY: | JM | Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | |
| DATE: | 8/30/2012 | | |
| REVISED: | 8/31/2012 | | PAGE: 1 of 2 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Date Begin - End:** | 7/2/12 | **Drill Company:** | Cal Pac | | | **BORING LOG B-5** |
| **Logged By:** | K Sarwold | **Drill Crew:** | Travis and Leo | | | |
| **Hor.-Vert. Datum:** | Not Available | **Drill Equipment:** | Mobile B-61 | **Hammer Type - Drop:** | 140 lb. Automatic - 30" | |
| **Angle from Vert.:** | 0 degrees | **Exploration Method:** | Hollow Stem Auger | | | |
| **Weather:** | Sunny, 70º | **Auger Diameter:** | 8 inches | | | |

| FIELD EXPLORATION | | | | | | LABORATORY RESULTS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth (feet) | Graphical Log | No Coordinates Available<br>No Elevation Available<br>Surface Condition: Asphalt Pavement | Sample Type | Blow Counts(BC)= Uncorr. blows/6 in | Recovery | USCS Symbol | Moisture Content (%) | Dry Density (pcf) | Passing No.4 Sieve (%) | Passing #200 Sieve (%) | Liquid Limit (NV=No Value) | Plasticity Index (NP=No Plasticity) | Other Tests/ Remarks |
| | | **CLAY with sand**: olive yellow with reddish yellow and yellow cementation, wet, soft, fine to medium sand | | BC=0 1 1 | 18" | | | | | | | | |
| 40 | | Mottled light brownish gray, olive and dark brown, soft to firm | | BC=2 3 3 | 18" | CL-CH | 73.8 | 60 | | | | | |
| 45 | | With black staining | | BC=0 1 1 | 18" | | | | | | | | |
| 50 | | **CLAY**: mottled yellow brown, black light brownish gray, wet, trace fine to medium sand | | BC=2 5 8 | 18" | CL | | | | | | | |
| 55 | | | | | | | | | | | | | |
| 60 | | | | | | | | | | | | | |
| 65 | | | | | | | | | | | | | |

The boring was terminated at approximately 51.5 feet below ground surface. Boring was backfilled with bentonite grout and patched at surface with Quikset concrete and black dye on July 02, 2012.

GROUNDWATER LEVEL INFORMATION:
▽ Groundwater was observed at approximately 20 ft. below ground surface during drilling.
▼ Groundwater was observed at approximately 14 ft. below ground surface at the end of drilling.
GENERAL NOTES:

gINT FILE: U:\gint_projects\oracle Project Numbers\128062 - Laguna Hills Mall\laguna Data.gpj U:KLF_STANDARD_GINT_LIBRARY_BETA_R2.GLB [KLF_BORING/TEST PIT LOG]

| | | | | |
|---|---|---|---|---|
| KLEINFELDER<br>Bright People. Right Solutions. | PROJECT NO. 20155150 | BORING LOG B-5 | | BORING |
| | DRAWN BY: SK | | | |
| | CHECKED BY: JM | Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | | B-5 |
| | DATE: 8/30/2012 | | | |
| | REVISED: 8/31/2012 | | | PAGE: 2 of 2 |

| | | | | | |
|---|---|---|---|---|---|
| **Date Begin - End:** | 7/2/12 | **Drill Company:** | Cal Pac | | **BORING LOG B-6** |
| **Logged By:** | K Sarwold | **Drill Crew:** | Travis and Leo | | |
| **Hor.-Vert. Datum:** | Not Available | **Drill Equipment:** | Mobile B-61 | **Hammer Type - Drop:** | 140 lb. Automatic - 30" |
| **Angle from Vert.:** | 0 degrees | **Exploration Method:** | Hollow Stem Auger | | |
| **Weather:** | Sunny, 70º | **Auger Diameter:** | 8 inches | | |

No Coordinates Available
No Elevation Available
Surface Condition: Asphalt Pavement

| Depth (feet) | FIELD EXPLORATION: Description | Sample Type | Blow Counts(BC)= Uncorr. blows/6 in | Recovery | LABORATORY RESULTS: USCS Symbol | Moisture Content (%) | Dry Density (pcf) | Passing No.4 Sieve (%) | Passing #200 Sieve (%) | Liquid Limit (NV=No Value) | Plasticity Index (NP=No Plasticity) | Other Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Asphalt:** 4-inch Ashphalt, no Base | | | | CL | | | | | | | |
| | | | | 48" | | | | | | | | |
| | **Fill:** **Sandy CLAY**: mottled brown light brownish gray and gray with yellowish brown, rootlets | | | 6" | | 21.1 | | | | | | |
| | **Alluvium:** **CLAY with sand**: yellow to light brownish gray, moist, fine to medium sand | | | | CL | | | | | | | |
| | | | | | CL | | | | | | | |
| 5 | @ 4 ft. oxide stains, gravel sized calcified pieces | | BC=2 3 4 | 18" | CL | 21.4 | | | | | | |
| | **Sandy CLAY**: gray with white specks, moist, soft to firm, fine to medium sand | | | | CL | | | | | | | |
| | Moist, mottled light brownish gray, gray, olive brown, few oxide stains | | BC=3 5 12 | 18" | | 66.5 | 57 | | | | | |
| | @ 5.5 ft. very mottled light brownish gray, gray, yellow with olive yellow cementation and calcium carbonate | | | | CL | | | | | | | |
| 10 | | | | | CL | | | | | | | |
| | **Sandy CLAY**: olive brown to gray, moist, with white specks/strings consistent coloring, predominantly fine sand, trace medium sand | | BC=2 4 5 | 18" | | | | | | | | |
| 15 | | | BC=2 3 4 | 18" | | 25.6 | 100 | | | | | |
| | **CLAY**: olive brown to yellow brown, moist to wet, biotitic, fine sand, trace medium sand | | | | CL | | | | | | | |
| ▽ | | | | | | | | | | | | |
| 20 | **Sandy CLAY**: olive yellow, wet, soft, fine to medium sand | | BC=0 0 2 | 18" | CL | 19.2 | | | | | | |
| | **Clayey SAND**: olive yellow, wet, fine to medium sand | | | | SC | | | | | | | |
| 25 | | | BC=0 0 1 | 18" | | 26.8 | 99 | | | | | |
| | **CLAY**: olive yellow, wet, soft, fine sand, contracted inside rings | | | | CL | | | | | | | |
| | **Clayey SAND**: olive yellow, wet, fine to medium sand, trace coarse sand | | | | SC | | | | | | | |
| 30 | | | BC=1 2 4 | 18" | SM | 16.4 | 100 | 100 | 36 | | | |

| | | | |
|---|---|---|---|
| KLEINFELDER Bright People. Right Solutions. | PROJECT NO. 20155150 | BORING LOG B-6 | BORING |
| | DRAWN BY: SK | | B-6 |
| | CHECKED BY: JM | Five Lagunas Redevelopment 24155 Laguna Hills Mall Laguna Hills, CA | |
| | DATE: 8/30/2012 | | |
| | REVISED: 8/31/2012 | | PAGE: 1 of 2 |

| | | | |
|---|---|---|---|
| **Date Begin - End:** | 7/2/12 | **Drill Company:** | Cal Pac |
| **Logged By:** | K Sarwold | **Drill Crew:** | Travis and Leo |
| **Hor.-Vert. Datum:** | Not Available | **Drill Equipment:** | Mobile B-61 |
| **Angle from Vert.:** | 0 degrees | **Exploration Method:** | Hollow Stem Auger |
| **Weather:** | Sunny, 70º | **Auger Diameter:** | 8 inches |

**BORING LOG B-6**

**Hammer Type - Drop:** 140 lb. Automatic - 30"

| Depth (feet) | Graphical Log | FIELD EXPLORATION: No Coordinates Available, No Elevation Available, Surface Condition: Asphalt Pavement | Sample Type | Blow Counts(BC)= Uncorr. blows/6 in | Recovery | LABORATORY RESULTS: USCS Symbol | Moisture Content (%) | Dry Density (pcf) | Passing No.4 Sieve (%) | Passing #200 Sieve (%) | Liquid Limit (NV=No Value) | Plasticity Index (NP=No Plasticity) | Other Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Clayey SAND**: olive yellow, wet, fine to medium sand, trace coarse sand | | BC=7 13 19 | 18" | | 11.9 | | | | | | |
| | | **Sandy CLAY**: olive yellow, wet, fine to medium sand, some coarse sand | | | | CL | | | | | | | |
| 40 | | | | BC=0 1 2 | 18" | SM | 20.2 | | 100 | 41 | | | |
| 45 | | | | | | | | | | | | | |
| 50 | | | | | | | | | | | | | |
| 55 | | | | | | | | | | | | | |
| 60 | | | | | | | | | | | | | |
| 65 | | | | | | | | | | | | | |

The boring was terminated at approximately 46.5 feet below ground surface. Boring was backfilled with bentonite grout and patched at surface with Quikset concrete and black dye on July 02, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 19 ft. below ground surface during drilling.
GENERAL NOTES:
Used bucket of water to help extract samplers @ 46 ft.Do not use moisture test in lab. 3 ft. sand heaving inside auger



| | | | |
|---|---|---|---|
| PROJECT NO. | 20155150 | BORING LOG B-6 | BORING |
| DRAWN BY: | SK | | B-6 |
| CHECKED BY: | JM | Five Lagunas Redevelopment, 24155 Laguna Hills Mall, Laguna Hills, CA | |
| DATE: | 8/30/2012 | | |
| REVISED: | 8/31/2012 | | PAGE: 2 of 2 |

KLEINFELDER
Bright People. Right Solutions.

| | | | | | |
|---|---|---|---|---|---|
| **Date Begin - End:** | 7/2/12 | **Drill Company:** | Cal Pac | | **BORING LOG B-7** |
| **Logged By:** | K Sarwold | **Drill Crew:** | Travis and Leo | | |
| **Hor.-Vert. Datum:** | Not Available | **Drill Equipment:** | Mobile B-61 | **Hammer Type - Drop:** | 140 lb. Automatic - 30" |
| **Angle from Vert.:** | 0 degrees | **Exploration Method:** | Hollow Stem Auger | | |
| **Weather:** | Sunny, 70º | **Auger Diameter:** | 8 inches | | |

FIELD EXPLORATION / LABORATORY RESULTS

No Coordinates Available
No Elevation Available
Surface Condition: Asphalt Pavement

| Depth (feet) | Description | Blow Counts(BC)= Uncorr. blows/6 in | Recovery | USCS Symbol | Moisture Content (%) | Dry Density (pcf) | Passing No.4 Sieve (%) | Passing #200 Sieve (%) | Liquid Limit (NV=No Value) | Plasticity Index (NP=No Plasticity) | Other Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | **Asphalt:** 4-inch Asphalt over 5-inch Base | | | | | | | | | | |
| 1 | **Fill:** **Sandy CLAY**: olive brown with yellow cementation, moist, fine to coarse sand, fine gravel. | | 48" | CL | | | | | | | |
| 2 | | | 6" | | 30.1 | | | | | | |
| 3 | rootlets at 2.5 ft<br>Yellow to pale olive, dry to moist | | | CL | | | | | | | |
| 5 | | BC=1 2 2 | 18" | | 65.3 | | | | | | |
| 8 | **Alluvium:** **CLAY**: dry, moderate to highly cemented, oxide stains, trace fine to medium sand | BC=7 9 8 | 18" | CL | 49.0 | 66 | | | | | |
| 10 (▼) | Increase in moisture | BC=2 4 7 | 18" | | 78.2 | | | | | | |
| 15 | **CLAY with silt**: light brownish gray to pale olive, moist, trace organic material, trace medium sand with silt, some weakly cemented pieces | BC=3 5 9 | 18" | CL | 91.0 | 47 | | | | | |
| 20 | Decrease in moisture, pockets of gray clay | BC=2 3 6 | 18" | CL | | | | | | | |
| 23.5 | **Clayey SILT**: light brownish gray, dry to moist, firm to hard, claystone? | | | ML | | | | | | | |
| 25 | | BC=4 7 10 | 18" | | 81.6 | 45 | | | | | |
| 30 | | BC=3 4 7 | 18" | | | | | | | | |
| 31 | **SILT with clay and sand**: light brownish gray to pale olive, moist, fine sand | | | ML | | | | | | | |



KLEINFELDER
Bright People. Right Solutions.

| | | | |
|---|---|---|---|
| PROJECT NO. 20155150 | BORING LOG B-7 | BORING |
| DRAWN BY: SK | | |
| CHECKED BY: JM | Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | B-7 |
| DATE: 8/30/2012 | | |
| REVISED: 8/31/2012 | | PAGE: 1 of 2 |

| | | | | | |
|---|---|---|---|---|---|
| **Date Begin - End:** | 7/2/12 | **Drill Company:** | Cal Pac | | **BORING LOG B-7** |
| **Logged By:** | K Sarwold | **Drill Crew:** | Travis and Leo | | |
| **Hor.-Vert. Datum:** | Not Available | **Drill Equipment:** | Mobile B-61 | **Hammer Type - Drop:** | 140 lb. Automatic - 30" |
| **Angle from Vert.:** | 0 degrees | **Exploration Method:** | Hollow Stem Auger | | |
| **Weather:** | Sunny, 70º | **Auger Diameter:** | 8 inches | | |

| Depth (feet) | Graphical Log | FIELD EXPLORATION<br>No Coordinates Available<br>No Elevation Available<br>Surface Condition: Asphalt Pavement | Sample Type | Blow Counts(BC)= Uncorr. blows/6 in | Recovery | LABORATORY RESULTS<br>USCS Symbol | Moisture Content (%) | Dry Density (pcf) | Passing No.4 Sieve (%) | Passing #200 Sieve (%) | Liquid Limit (NV=No Value) | Plasticity Index (NP=No Plasticity) | Other Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Light brownish gray to pale olive, moist, trace coarse sand, sampler was wet | | BC=4 7 9 | 18" | | 81.7 | 50 | | | | | |
| 40 | | 4 inches of wet, highly cemented pieces at 40'<br>Some pink and reddish yellow inclusions and oxides with fine sand, some gray laminations | | BC=4 4 4 | 18" | ML | | | | | | | |
| 45 | | | | BC=5 7 10 | 18" | | | | | | | | |

The boring was terminated at approximately 46.5 feet below ground surface. Boring was backfilled with bentonite grout and patched at surface with Quikset concrete and black dye on July 02, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 10 ft. below ground surface at the end of drilling.
GENERAL NOTES:
Encountered PVC pipe at 2.5 ft., moved over 2 ft.; moved hole two times

50

55

60

65

| | | | |
|---|---|---|---|
| KLEINFELDER Bright People. Right Solutions. | PROJECT NO. 20155150 | BORING LOG B-7 | BORING |
| | DRAWN BY: SK | | |
| | CHECKED BY: JM | Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | B-7 |
| | DATE: 8/30/2012 | | |
| | REVISED: 8/31/2012 | | PAGE: 2 of 2 |

| | | | | |
|---|---|---|---|---|
| **Date Begin - End:** | 7/2/12 | **Drill Company:** | Cal Pac | **BORING LOG B-8** |
| **Logged By:** | K Sarwold | **Drill Crew:** | Travis and Leo | |
| **Hor.-Vert. Datum:** | Not Available | **Drill Equipment:** | Mobile B-61 | **Hammer Type - Drop:** 140 lb. Automatic - 30" |
| **Angle from Vert.:** | 0 degrees | **Exploration Method:** | Hollow Stem Auger | |
| **Weather:** | Sunny, 70° | **Auger Diameter:** | 8 inches | |

No Coordinates Available
No Elevation Available
Surface Condition: Asphalt Pavement

| Depth (feet) | Description (FIELD EXPLORATION) | Blow Counts(BC)= Uncorr. blows/6 in | Recovery | USCS Symbol | Moisture Content (%) | Dry Density (pcf) | Passing No.4 Sieve (%) | Passing #200 Sieve (%) | Liquid Limit (NV=No Value) | Plasticity Index (NP=No Plasticity) | Other Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | **Asphalt:** 5-inch Asphalt over 6-inch Base | | | | | | | | | | |
| 1 | **Fill:** **Sandy CLAY**: mottled light brownish gray, gray, yellow, moist, fine to coarse sand | | 48" | CL | 21.8 | | | | | | |
| 2 | | | 6" | CL | | | | | | | |
| 2.5 | @ 2.5 ft. yellow, dry, increase in coarse sand | | | CL | | | | | | | |
| 4 | **Alluvium:** **Sandy CLAY**: olive brown, dry, fine to medium sand | | | SC | | | | | | | |
| 5 | **Sandy Clay To Clayey Sand**: olive yellow, moist, fine sand wih calcium stringers | BC=1 2 2 | 18" | | 16.3 | | | | | | |
| 7 | **Sandy CLAY**: olive brown, moist, fine to medium sand | | | CL | | | | | | | |
| 7.5 | | BC=2 3 4 | 18" | | 22.3 | 19 | | | | | |
| 10 | | BC=1 1 2 | 18" | | | | | | | | |
| 11 | **Silty CLAY**: olive yellow, moist to wet, trace coarse sand | | | CL | | | | | | | |
| 13.5 | **Sandy SILT**: olive yellow, moist to wet, biotitic, fine sand | | | ML | | | | | | | |
| 15 | | BC=2 2 2 | 18" | | 31.6 | 88 | | | | | |
| 18.5 | **Silty CLAY**: olive yellow to yellow brown, moist to wet, trace to few fine sand | | | CL | | | | | | | |
| 20 | | BC=1 1 1 | 18" | | | | | | | | |

The boring was terminated at approximately 21.5 feet below ground surface. Boring was backfilled with bentonite grout and patched at surface with Quikset concrete and black dye on July 02, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 11 ft. below ground surface at the end of drilling.
GENERAL NOTES:

| | | | |
|---|---|---|---|
| PROJECT NO. | 20155150 | BORING LOG B-8 | BORING |
| DRAWN BY: | SK | | B-8 |
| CHECKED BY: | JM | Five Lagunas Redevelopment 24155 Laguna Hills Mall Laguna Hills, CA | |
| DATE: | 8/30/2012 | | |
| REVISED: | 8/31/2012 | | PAGE: 1 of 1 |

KLEINFELDER Bright People. Right Solutions.

KLEINFELDER - 2 Ada, Suite 250 | Irvine, CA 92618 | PH: 949-727-4466 | FAX: 949-727-9242 | www.kleinfelder.com

| | | | |
|---|---|---|---|
| **Date Begin - End:** | 7/2/12 | **Drill Company:** | Cal Pac |
| **Logged By:** | K Sarwold | **Drill Crew:** | Travis and Leo |
| **Hor.-Vert. Datum:** | Not Available | **Drill Equipment:** | Mobile B-61 |
| **Angle from Vert.:** | 0 degrees | **Exploration Method:** | Hand Auger |
| **Weather:** | Sunny, 70º | **Auger Diameter:** | 4 inches |

**BORING LOG B-9**

| Depth (feet) | Graphical Log | FIELD EXPLORATION: No Coordinates Available / No Elevation Available / Surface Condition: Asphalt Pavement | Sample Type | Blow Counts(BC)= Uncorr. blows/6 in | Recovery | USCS Symbol | Moisture Content (%) | Dry Density (pcf) | Passing No.4 Sieve (%) | Passing #200 Sieve (%) | Liquid Limit (NV=No Value) | Plasticity Index (NP=No Plasticity) | Other Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Asphalt:** 4-inch Asphalt over 6-inch Base | | | | | | | | | | | |
| | | **Fill:** **Clayey SAND**: yellowish brown, moist, fine to coarse sand | | | 48" | SC | | | | | | | |
| | | | | | 6" | CL | 61.9 | | | | | | |
| | | **CLAY**: light brownish gray to yellow, moist to wet, weakly cemented | | | | CL | | | | | | | |
| 5 | | **Alluvium:** **CLAY**: olive brown, dry to moist, some fine sand @ 4ft gray, moist | | | 6" | | 15.9 | | | | | | |

The boring was terminated at approximately 5.5 feet below ground surface. Boring was backfilled with auger cuttings and patched at surface with Quikset concrete and black dye on July 02, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.
GENERAL NOTES:

Depth scale: 5, 10, 15, 20, 25, 30

gINT FILE: U:\gint_projects\oracle Project Numbers\128062 - Laguna Hills Mall\laguna Data.gpj U:KLF_STANDARD_GINT_LIBRARY_BETA_R2.GLB [KLF_BORING/TEST PIT LOG]

KLEINFELDER
Bright People. Right Solutions.

| | |
|---|---|
| PROJECT NO. | 20155150 |
| DRAWN BY: | SK |
| CHECKED BY: | JM |
| DATE: | 8/30/2012 |
| REVISED: | 8/31/2012 |

BORING LOG B-9

Five Lagunas Redevelopment
24155 Laguna Hills Mall
Laguna Hills, CA

BORING
B-9



KLEINFELDER - 2 Ada, Suite 250 | Irvine, CA 92618 | PH: 949-727-4466 | FAX: 949-727-9242 | www.kleinfelder.com

| | | | | |
|---|---|---|---|---|
| **Date Begin - End:** | 7/2/12 | **Drill Company:** | Cal Pac | **BORING LOG B-10** |
| **Logged By:** | K Sarwold | **Drill Crew:** | Travis and Leo | |
| **Hor.-Vert. Datum:** | Not Available | **Drill Equipment:** | Mobile B-61 | |
| **Angle from Vert.:** | 0 degrees | **Exploration Method:** | Hand Auger | |
| **Weather:** | Sunny, 70º | **Auger Diameter:** | 4 inches | |

| Depth (feet) | Graphical Log | FIELD EXPLORATION<br>No Coordinates Available<br>No Elevation Available<br>Surface Condition: Asphalt Pavement | Sample Type | Blow Counts(BC)= Uncorr. blows/6 in | Recovery | LABORATORY RESULTS<br>USCS Symbol | Moisture Content (%) | Dry Density (pcf) | Passing No.4 Sieve (%) | Passing #200 Sieve (%) | Liquid Limit (NV=No Value) | Plasticity Index (NP=No Plasticity) | Other Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Asphalt:**<br>3-inch Asphalt over 5-inch Base | | | | | | | | | | | |
| | | **Fill:**<br>**Sandy CLAY**: mottled olive brown, light brownish gray | | | 48" | CL | | | | | | | |
| | | | | | 6" | CL | 35.9 | | | | | | |
| | | **CLAY with sand**: light brownish gray to yellow oxide stains, fine sand with cemented or dry pieces | | | | CL | | | | | | | |
| 5 | | @ 3 ft. dry | | | | | | | | | | | |
| | | @ 4 ft. dark reddish brown weakly cemented pieces | | | 6" | | 46.2 | | | | | | |
| | | **Alluvium:**<br>**Sandy CLAY**: olive brown to gray, dry to moist, with white specks, fine sand | | | | | | | | | | | |

The boring was terminated at approximately 5.5 feet below ground surface. Boring was backfilled with auger cuttings and patched at surface with Quikset concrete and black dye on July 02, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.
GENERAL NOTES:

Depth scale: 5, 10, 15, 20, 25, 30

gINT FILE: U:\gint_projects\oracle Project Numbers\128062 - Laguna Hills Mall\laguna Data.gpj U:KLF_STANDARD_GINT_LIBRARY_BETA_R2.GLB [KLF_BORING/TEST PIT LOG]

| | | | |
|---|---|---|---|
| KLEINFELDER Bright People. Right Solutions. | PROJECT NO. 20155150<br>DRAWN BY: SK<br>CHECKED BY: JM<br>DATE: 8/30/2012<br>REVISED: 8/31/2012 | BORING LOG B-10<br>Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | BORING<br>B-10<br>PAGE: 1 of 1 |

| | | | |
|---|---|---|---|
| **Date Begin - End:** | 7/2/12 | **Drill Company:** | Cal Pac |
| **Logged By:** | K Sarwold | **Drill Crew:** | Travis and Leo |
| **Hor.-Vert. Datum:** | Not Available | **Drill Equipment:** | Mobile B-61 |
| **Angle from Vert.:** | 0 degrees | **Exploration Method:** | Hand Auger |
| **Weather:** | Sunny, 70º | **Auger Diameter:** | 4 inches |

**BORING LOG B-11**

| Depth (feet) | Graphical Log | FIELD EXPLORATION<br>No Coordinates Available<br>No Elevation Available<br>Surface Condition: Asphalt Pavement | Sample Type | Blow Counts(BC)= Uncorr. blows/6 in | Recovery | LABORATORY RESULTS<br>USCS Symbol | Moisture Content (%) | Dry Density (pcf) | Passing No.4 Sieve (%) | Passing #200 Sieve (%) | Liquid Limit (NV=No Value) | Plasticity Index (NP=No Plasticity) | Other Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Asphalt:**<br>4-inch Asphalt over 8-inch Base | | | | | | | | | | | |
| | | **FIll:**<br>**Sandy CLAY**: light brownish gray and yellow, moist, fine to medium sand | | | 48" | CL | | | | | | | |
| | | | | | 6" | CL | 15.2 | | | | | | |
| | | **Alluvium:**<br>**Sandy CLAY**: gray, moist, fine sand, white speckles<br>@ 3 ft. mottled with olive brown<br>@ 3.5 ft. olive brown, moist, biotitic<br>@ 4 ft. yellowish brown, with white stringers | | | | | | | | | | | |
| 5 | | | | | 6" | | 21.7 | | | | | | |

The boring was terminated at approximately 5.5 feet below ground surface. Boring was backfilled with auger cuttings and patched at surface with Quikset concrete and black dye on July 02, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:

Depth scale: 5, 10, 15, 20, 25, 30

gINT FILE: U:\gint_projects\oracle Project Numbers\128062 - Laguna Hills Mall\laguna Data.gpj U:KLF_STANDARD_GINT_LIBRARY_BETA_R2.GLB [KLF_BORING/TEST PIT LOG]

KLEINFELDER
Bright People. Right Solutions.

| | | | |
|---|---|---|---|
| PROJECT NO. 20155150 | BORING LOG B-11 | BORING |
| DRAWN BY: SK | | |
| CHECKED BY: JM | Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | B-11 |
| DATE: 8/30/2012 | | |
| REVISED: 8/31/2012 | | PAGE: 1 of 1 |

| | | | |
|---|---|---|---|
| **Date Begin - End:** | 7/25/12 | **Drill Company:** | Cal Pac |
| **Logged By:** | K Sarwold | **Drill Crew:** | Elliott and Leo |
| **Hor.-Vert. Datum:** | Not Available | **Drill Equipment:** | Mobile B-61 |
| **Angle from Vert.:** | 0 degrees | **Exploration Method:** | Mud Rotary |
| **Weather:** | Sunny, 70º | **Auger Diameter:** | 6 inches |

**BORING LOG B-12**

**Hammer Type - Drop:** 140 lb. Automatic - 30"

| Depth (feet) | FIELD EXPLORATION: No Coordinates Available / No Elevation Available / Surface Condition: Asphalt Pavement | Sample Type | Blow Counts(BC)= Uncorr. blows/6 in | Recovery | LABORATORY RESULTS: USCS Symbol | Moisture Content (%) | Dry Density (pcf) | Passing No.4 Sieve (%) | Passing #200 Sieve (%) | Liquid Limit (NV=No Value) | Plasticity Index (NP=No Plasticity) | Other Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Asphalt:** 11-inch Asphalt over 6-inch Base | | | | | | | | | | | |
| | **Fill:** **Sandy CLAY**: mottled olive brown and olive gray, dry to moist, fine sand, trace medium sand | | | 48" | CL | 12.4 | 124 | | | | | |
| 5 | **Silty CLAY**: yellow to pale olive, dry to moist, fine to medium sand | | | | CL | 21.6 | 105 | | | | | |
| | **Alluvium:** **Fat CLAY with sand**: olive gray to greenish black, fine to coarse sand, trace fine gravel, rootlets | | | | CH | 31.0 | 94 | | | | | |
| 10 | **Sandy SILT**: brown, moist, medium stiff to stiff, fine sand | | BC=3 5 6 | 12" | ML | 26.5 | 97 | | | | | |
| 15 | **CLAY**: brown to yellow brown, moist, trace medium sand, white powder inclusions (gypsum, carbonate) | | BC=2 3 4 | 12" | CL | 22.9 | 103 | | | | | |
| ▽ 20 | **Clayey SILT**: olive yellow mottled with light brownish gray, moist to wet, trace medium to coarse sand increase in clay at bottom of sample ~ silty clay | | BC=3 3 3 | 12" | ML | 14.4 | 117 | | | | | |
| 25 | **Silty CLAY**: olive yellow, wet, trace fine to medium sand, trace dark reddish brown magnesium oxide stains | | BC=2 2 3 | 12" | CL | 13.1 | 119 | | | | | |
| 30 | **Clayey SAND**: olive yellow, wet, very loose, fine sand, micaceous | | BC=5 2 1 | 12" | SC | | | | | | | |
| | **Sandy CLAY**: olive yellow, wet, fine sand, trace medium sand | | | | CL | 13.9 | 121 | | | | | |



KLEINFELDER
Bright People. Right Solutions.

| | |
|---|---|
| PROJECT NO. | 20155150 |
| DRAWN BY: | SK |
| CHECKED BY: | JM |
| DATE: | 8/30/2012 |
| REVISED: | 8/31/2012 |

BORING LOG B-12

Five Lagunas Redevelopment
24155 Laguna Hills Mall
Laguna Hills, CA

BORING
B-12



KLEINFELDER - 2 Ada, Suite 250 | Irvine, CA 92618 | PH: 949-727-4466 | FAX: 949-727-9242 | www.kleinfelder.com

| Date Begin - End: | 7/25/12 | Drill Company: | Cal Pac | BORING LOG B-12 |
|---|---|---|---|---|
| Logged By: | K Sarwold | Drill Crew: | Elliott and Leo | |
| Hor.-Vert. Datum: | Not Available | Drill Equipment: | Mobile B-61 | Hammer Type - Drop: 140 lb. Automatic - 30" |
| Angle from Vert.: | 0 degrees | Exploration Method: | Mud Rotary | |
| Weather: | Sunny, 70º | Auger Diameter: | 6 inches | |

| Depth (feet) | Graphical Log | FIELD EXPLORATION<br>No Coordinates Available<br>No Elevation Available<br>Surface Condition: Asphalt Pavement | Sample Type | Blow Counts(BC)= Uncorr. blows/6 in | Recovery | LABORATORY RESULTS<br>USCS Symbol | Moisture Content (%) | Dry Density (pcf) | Passing No.4 Sieve (%) | Passing #200 Sieve (%) | Liquid Limit (NV=No Value) | Plasticity Index (NP=No Plasticity) | Other Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Clayey SAND**: olive yellow, wet, medium dense, poorly graded, SR-SA | | BC=4 9 15 | 12" | SC | 83.2 | 50 | | | | | |
| 40 | | Well graded, dense | | BC=15 24 32 | 12" | | 66.9 | 58 | | | | | |
| | | Olive yellow with light brownish gray and yellow inclusions, wet, loose, fine to coarse sand, increase in clay content | | | | | 65.9 | 58 | | | | | |
| | | Light brownish gray, medium dense, fine to medium sand | | | | | 63.1 | 59 | | | | | |
| 45 | | | | BC=8 3 3 | 12" | | | | | | | | |
| 50 | | | | BC=13 16 20 | 12" | | | | | | | | |
| | | **CLAY with sand**: olive brown with yellow and light brownish gray, moist to dry, fine sand | | | | CL | 79.3 | 49 | | | | | |
| 55 | | | | BC=7 5 7 | 12" | | | | | | | | |
| | | **SILTSTONE**: greenish black and bluish gray fissile, moist, micaceous with yellow specks, -seashell-tubular, hollow, float in water | | | | | 64.4 | 59 | | | | | |
| 60 | | | | BC=8 13 19 | 12" | | | | | | | | |
| 65 | | Same, no bluish gray specks | | BC=10 16 24 | 12" | | 85.0 | 49 | | | | | |

gINT FILE: U:\gint_projects\oracle Project Numbers\128062 - Laguna Hills Mall\laguna Data.gpj U:KLF_STANDARD_GINT_LIBRARY_BETA_R2.GLB [KLF_BORING/TEST PIT LOG]

KLEINFELDER
Bright People. Right Solutions.

| PROJECT NO. | 20155150 |
|---|---|
| DRAWN BY: | SK |
| CHECKED BY: | JM |
| DATE: | 8/30/2012 |
| REVISED: | 8/31/2012 |

BORING LOG B-12

Five Lagunas Redevelopment
24155 Laguna Hills Mall
Laguna Hills, CA

BORING
B-12

| | | | | | |
|---|---|---|---|---|---|
| **Date Begin - End:** | 7/25/12 | **Drill Company:** | Cal Pac | | **BORING LOG B-12** |
| **Logged By:** | K Sarwold | **Drill Crew:** | Elliott and Leo | | |
| **Hor.-Vert. Datum:** | Not Available | **Drill Equipment:** | Mobile B-61 | **Hammer Type - Drop:** | 140 lb. Automatic - 30" |
| **Angle from Vert.:** | 0 degrees | **Exploration Method:** | Mud Rotary | | |
| **Weather:** | Sunny, 70º | **Auger Diameter:** | 6 inches | | |

FIELD EXPLORATION | LABORATORY RESULTS

No Coordinates Available
No Elevation Available
Surface Condition: Asphalt Pavement

| Depth (feet) | Graphical Log | Description | Sample Type | Blow Counts(BC)= Uncorr. blows/6 in | Recovery | USCS Symbol | Moisture Content (%) | Dry Density (pcf) | Passing No.4 Sieve (%) | Passing #200 Sieve (%) | Liquid Limit (NV=No Value) | Plasticity Index (NP=No Plasticity) | Other Tests/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **SILTSTONE**: greenish black and bluish gray fissile, moist, micaceous with yellow specks, -seashell-tubular, hollow, float in water<br>Seashell up to 0.5 inch | | BC=27 24 36 | 12" | | | | | | | | |
| 75 | | Half-inch seam of bluish gray, micaceous | | BC=17 36 48 | 12" | | | | | | | | |
| 80 | | Trace yellowish grown inclusions | | BC=14 23 42 | 12" | | | | | | | | |
| 85 | | | | | | | | | | | | | |
| 90 | | 1/8-inch to 1/4-inch seam of bluish gray | | BC=16 32 44 | 12" | | | | | | | | |
| 95 | | | | | | | | | | | | | |
| 100 | | Few shells, specks, olive gray | | BC=24 50 | 12" | | | | | | | | |

The boring was terminated at approximately 101 feet below ground surface. Boring was backfilled with cement-bentonite grout and cap with Quikset and black dye on July 25, 2012.

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 20 ft. below ground surface during drilling.
GENERAL NOTES:
Driller notes gravel at 28 feet depth

| | | | |
|---|---|---|---|
| KLEINFELDER Bright People. Right Solutions. | PROJECT NO. 20155150<br>DRAWN BY: SK<br>CHECKED BY: JM<br>DATE: 8/30/2012<br>REVISED: 8/31/2012 | BORING LOG B-12<br><br>Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | BORING<br>B-12<br>PAGE: 3 of 3 |

# SUMMARY

# OF

# CONE PENETRATION TEST DATA

Project:

**Five Lagunas Redevelopment**
**24155 Laguna Hills Mall**
**Laguna Hills, CA**
**March 25-27, 2015**

Prepared for:


**Mr. Steven Kuo**
**Kleinfelder, Inc.**
**2 Ada, Ste 250**
**Irvine, CA 92618**
**Office (949) 727-4466 / Fax (949) 727-9242**


Prepared by:


KTE

**KEHOE TESTING & ENGINEERING**

5415 Industrial Drive
Huntington Beach, CA 92649-1518
Office (714) 901-7270 / Fax (714) 901-7289
www.kehoetesting.com

# TABLE OF CONTENTS

# SUMMARY

# OF

# CONE PENETRATION TEST DATA

## 1. INTRODUCTION

This report presents the results of a Cone Penetration Test (CPT) program carried out for the Five Lagunas Redevelopment project located at 24155 Laguna Hills Mall in Laguna Hills, California. The work was performed by Kehoe Testing & Engineering (KTE) on March 25-27, 2015. The scope of work was performed as directed by Kleinfelder, Inc. personnel.

## 2. SUMMARY OF FIELD WORK

The fieldwork consisted of performing CPT soundings at 20 locations to determine the soil lithology. Groundwater measurements and hole collapse depths provided in **TABLE 2.1** are for information only. The readings indicate the apparent depth to which the hole is open and the apparent water level (if encountered) in the CPT probe hole at the time of measurement upon completion of the CPT. KTE does not warranty the accuracy of the measurements and the reported water levels may not represent the true or stabilized groundwater levels.

| LOCATION | DEPTH OF CPT (ft) | COMMENTS/NOTES: |
|---|---|---|
| **KCPT-1** | 60 | Hole open to 5.0 ft (dry) |
| **KCPT-2** | 80 | Groundwater @ 10.0 ft |
| **KCPT-3** | 60 | Groundwater @ 13.0 ft |
| **KCPT-4** | 59 | Refusal, hole open to 7.0 ft (dry) |
| **KCPT-5** | 60 | Groundwater @ 11.0 ft |
| **KCPT-6** | 33 | Refusal, hole open to 1.0 ft (dry) |
| **KCPT-7** | 50 | Refusal, hole open to 4.0 ft (dry) |
| **KCPT-8** | 64 | Refusal, hole open to 10.0 ft (dry) |
| **KCPT-9** | 75 | Refusal, hole open to 9.0 ft (dry) |
| **KCPT-10** | 80 | Groundwater @ 12.0 ft |
| **KCPT-11** | 80 | Groundwater @ 13.0 ft |

| LOCATION | DEPTH OF CPT (ft) | COMMENTS/NOTES: |
|---|---|---|
| **KCPT-12** | 74 | Refusal, groundwater @ 12.0 ft |
| **KCPT-13** | 59 | Refusal, groundwater @ 13.0 ft |
| **KCPT-14** | 60 | Refusal, groundwater @ 12.0 ft |
| **KCPT-15** | 77 | Refusal, groundwater @ 12.5 ft |
| **KCPT-16** | 80 | Groundwater @ 11.0 ft |
| **KCPT-17** | 80 | Hole open to 2.0 ft (dry) |
| **KCPT-18** | 80 | Groundwater @ 13.0 ft |
| **KCPT-19** | 80 | Groundwater @ 13.0 ft |
| **KCPT-20** | 80 | Groundwater @ 12.0 ft |

**TABLE 2.1 - Summary of CPT Soundings**

## 3. FIELD EQUIPMENT & PROCEDURES

The CPT soundings were carried out by **KTE** using an integrated electronic cone system manufactured by Vertek. The CPT soundings were performed in accordance with ASTM standards (D5778). The cone penetrometers were pushed using a 30-ton CPT rig. The cone used during the program was a 15 cm^2 cone and recorded the following parameters at approximately 2.5 cm depth intervals:

- Cone Resistance (qc)
- Sleeve Friction (fs)
- Dynamic Pore Pressure (u)
- Inclination
- Penetration Speed

The above parameters were recorded and viewed in real time using a laptop computer. Data is stored at the KTE office for future analysis and reference. A complete set of baseline readings was taken prior to each sounding to determine temperature shifts and any zero load offsets. Monitoring base line readings ensures that the cone electronics are operating properly.

## 4. CONE PENETRATION TEST DATA & INTERPRETATION

The Cone Penetration Test data is presented in graphical form in the attached Appendix. These plots were generated using the CPeT-IT program. Penetration depths are referenced to ground surface. The soil classification on the CPT plots is derived from the attached CPT Classification Chart (Robertson) and presents major soil lithologic changes. The stratigraphic interpretation is based on relationships between cone resistance (qc), sleeve friction (fs), and penetration pore pressure (u). The friction ratio (Rf), which is sleeve friction divided by cone resistance, is a calculated parameter that is used along with cone resistance to infer soil behavior type. Generally, cohesive soils (clays) have high friction ratios, low cone resistance and generate excess pore water pressures. Cohesionless soils (sands) have lower friction ratios, high cone bearing and generate little (or negative) excess pore water pressures.

Tables of basic CPT output from the interpretation program CPeT-IT are provided for CPT data averaged over one foot intervals in the Appendix. Spreadsheet files of the averaged basic CPT output and averaged estimated geotechnical parameters are also included for use in further geotechnical analysis. We recommend a geotechnical engineer review the assumed input parameters and the calculated output from the CPeT-IT program. A summary of the equations used for the tabulated parameters is provided in the Appendix.

It should be noted that it is not always possible to clearly identify a soil type based on qc, fs and u. In these situations, experience, judgement and an assessment of the pore pressure data should be used to infer the soil behavior type.

If you have any questions regarding this information, please do not hesitate to call our office at (714) 901-7270.

Sincerely,

**KEHOE TESTING & ENGINEERING**

Richard W. Koester, Jr.
General Manager

04/03/15-kk-5751

# APPENDIX

**Kehoe Testing and Engineering**
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

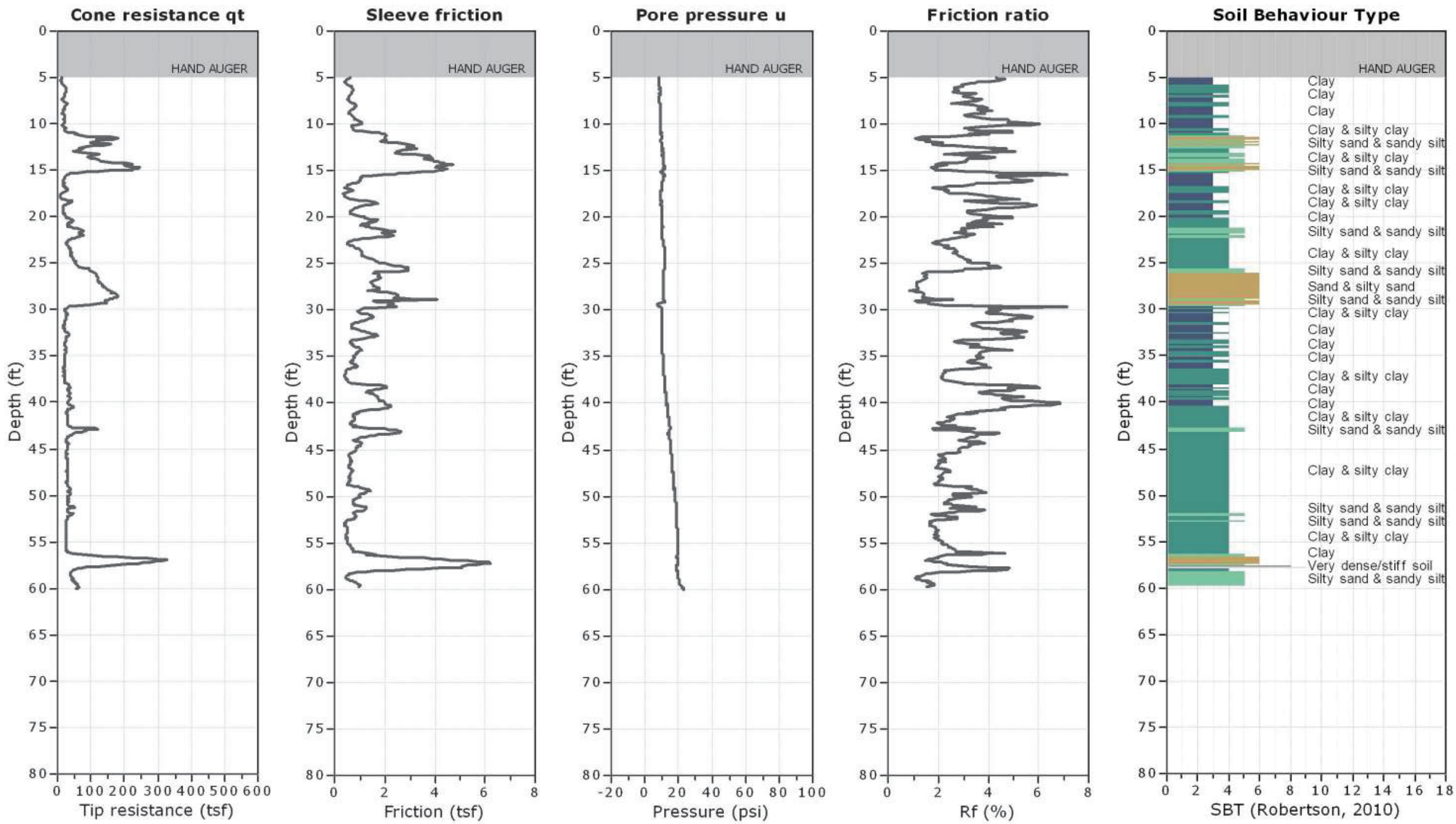
**CPT: KCPT-1**

Total depth: 60.08 ft, Date: 3/27/2015

Cone Type: Vertek

**Project:** **Kleinfelder, Inc.\ Five Lagunas Redevelopment**

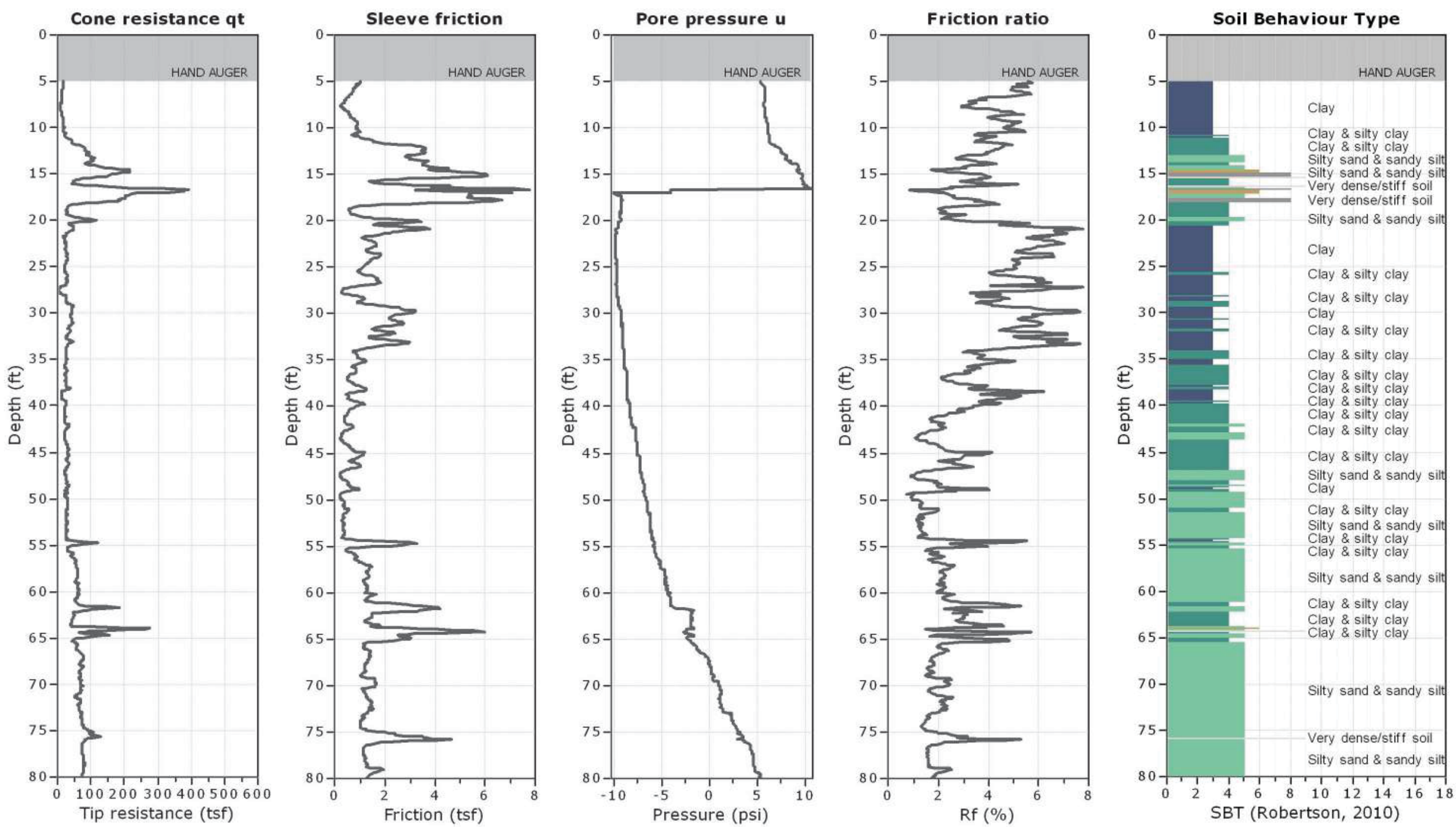
**Location:** **24155 Laguna Hills Mall Laguan Hills, CA**



**Kehoe Testing and Engineering**
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

**CPT: KCPT-2**
Total depth: 80.68 ft, Date: 3/27/2015
Cone Type: Vertek

**Project:** **Kleinfelder, Inc.\ Five Lagunas Redevelopment**
**Location:** **24155 Laguna Hills Mall Laguan Hills, CA**




CPeT-IT v.1.7.6.42 - CPTU data presentation & interpretation software - Report created on: 3/30/2015, 2:44:36 PM
Project file: C:\KleinfelderLagunaHills3-15\CPeT Data\Plot Data\Plots w-ha.cpt

Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

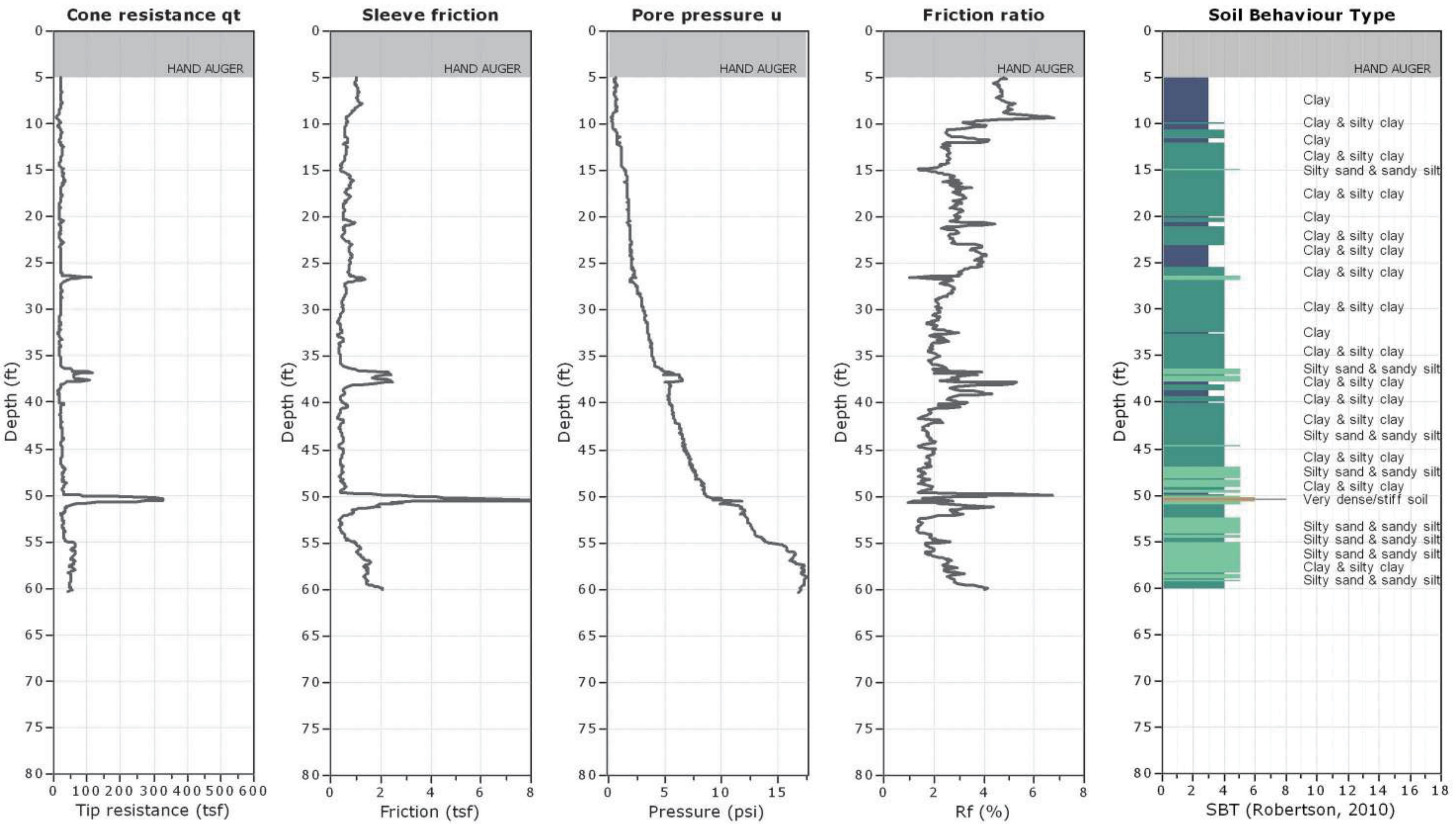
**CPT: KCPT-3**

**Project:** Kleinfelder, Inc.\ Five Lagunas Redevelopment

**Location:** 24155 Laguna Hills Mall Laguan Hills, CA

Total depth: 60.37 ft, Date: 3/25/2015

Cone Type: Vertek



Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

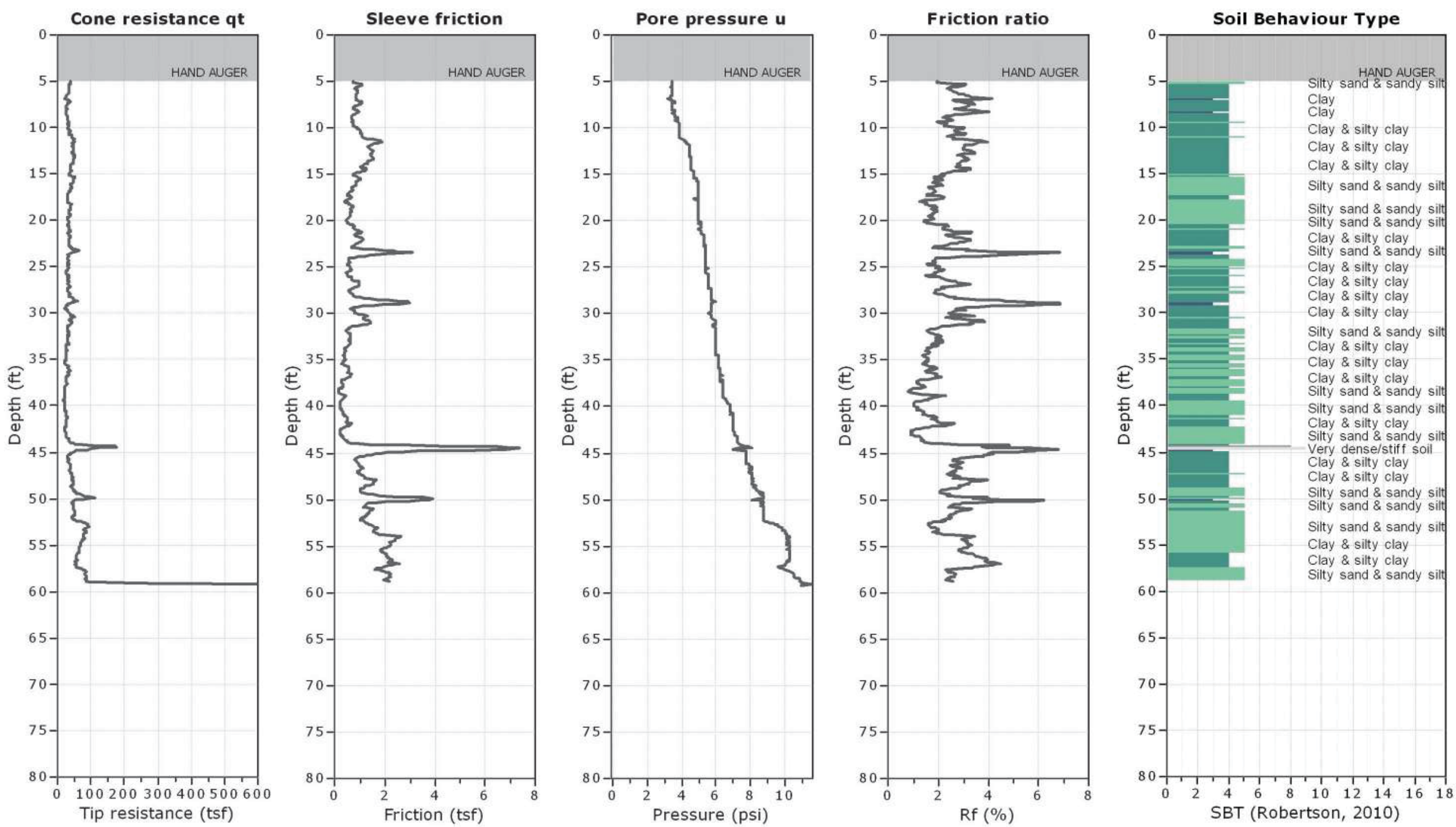
**CPT: KCPT-4**

Total depth: 59.19 ft, Date: 3/27/2015

Cone Type: Vertek

**Project:** Kleinfelder, Inc.\ Five Lagunas Redevelopment

**Location:** 24155 Laguna Hills Mall Laguan Hills, CA






Project file: C:\KleinfelderLagunaHills3-15\CPeT Data\Plot Data\Plots w-ha.cpt

**Kehoe Testing and Engineering**
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

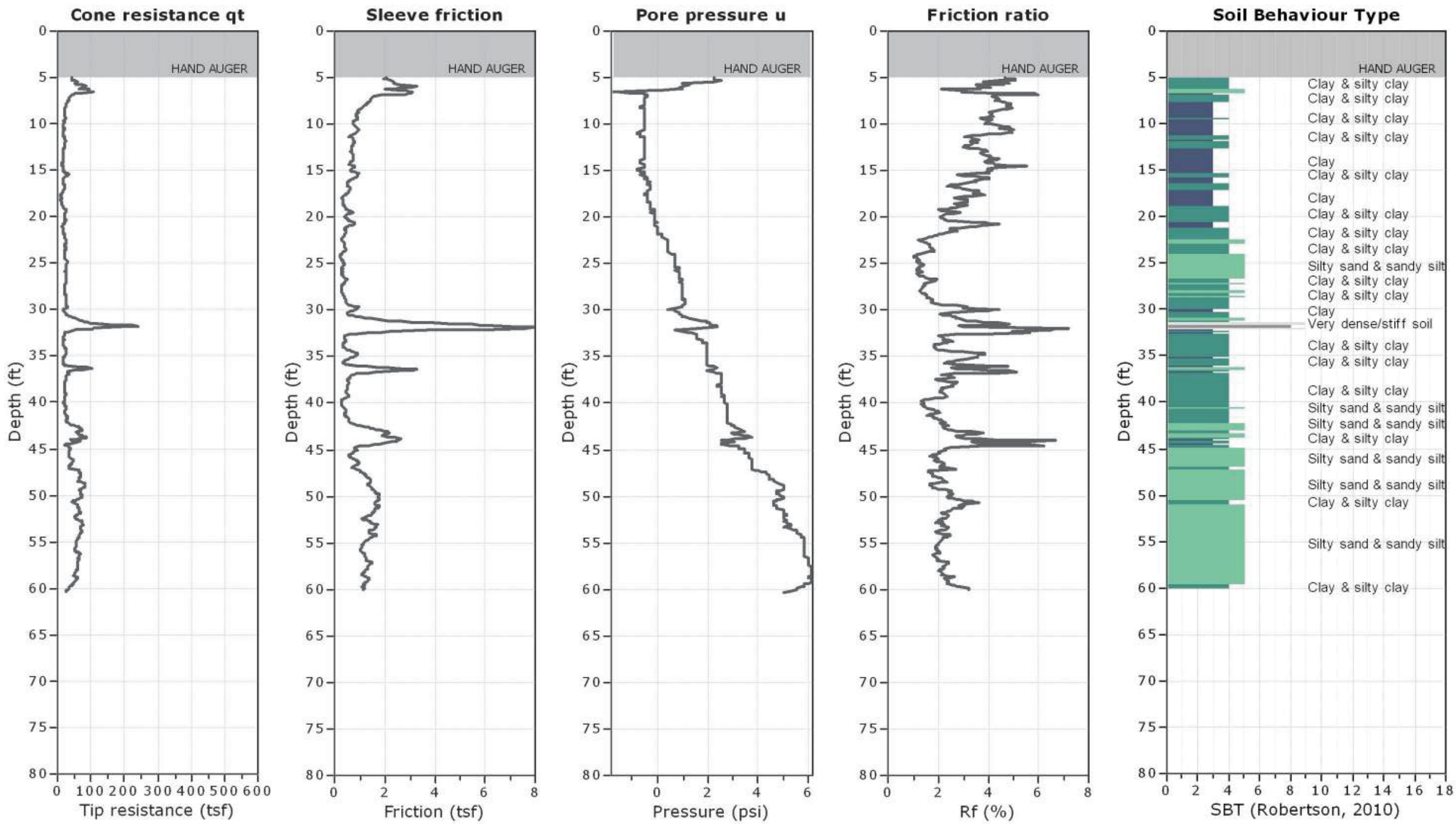
**CPT: KCPT-5**

Total depth: 60.41 ft, Date: 3/27/2015

Cone Type: Vertek

**Project:** **Kleinfelder, Inc.\ Five Lagunas Redevelopment**

**Location:** **24155 Laguna Hills Mall Laguan Hills, CA**



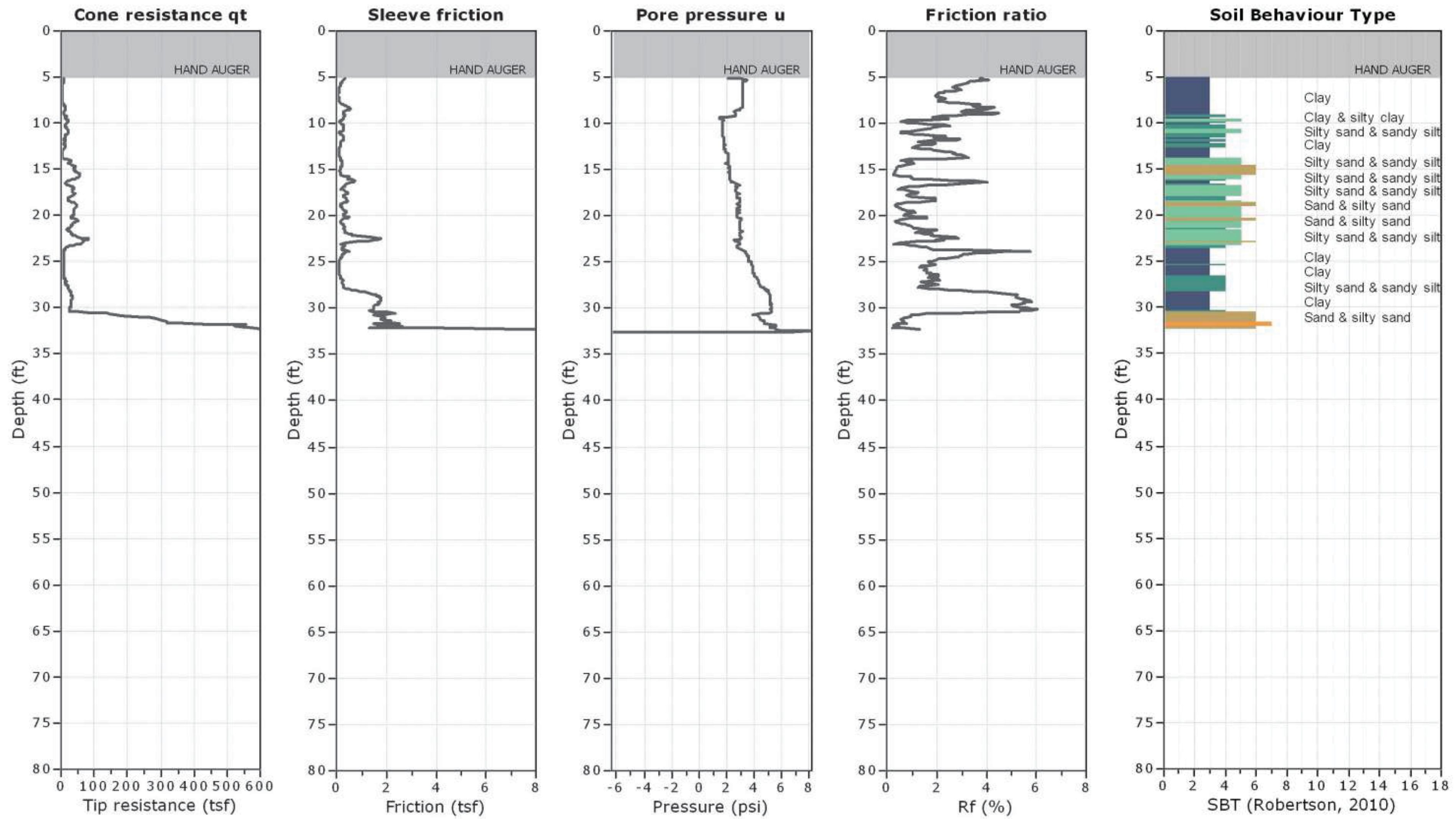

CPeT-IT v.1.7.6.42 - CPTU data presentation & interpretation software - Report created on: 3/30/2015, 2:38:39 PM

Project file: C:\KleinfelderLagunaHills3-15\CPeT Data\Plot Data\Plots w-ha.cpt

**Kehoe Testing and Engineering**
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

**CPT: KCPT-6**
Total depth: 32.67 ft, Date: 3/27/2015
Cone Type: Vertek

**Project:** **Kleinfelder, Inc.\ Five Lagunas Redevelopment**
**Location:** **24155 Laguna Hills Mall Laguan Hills, CA**



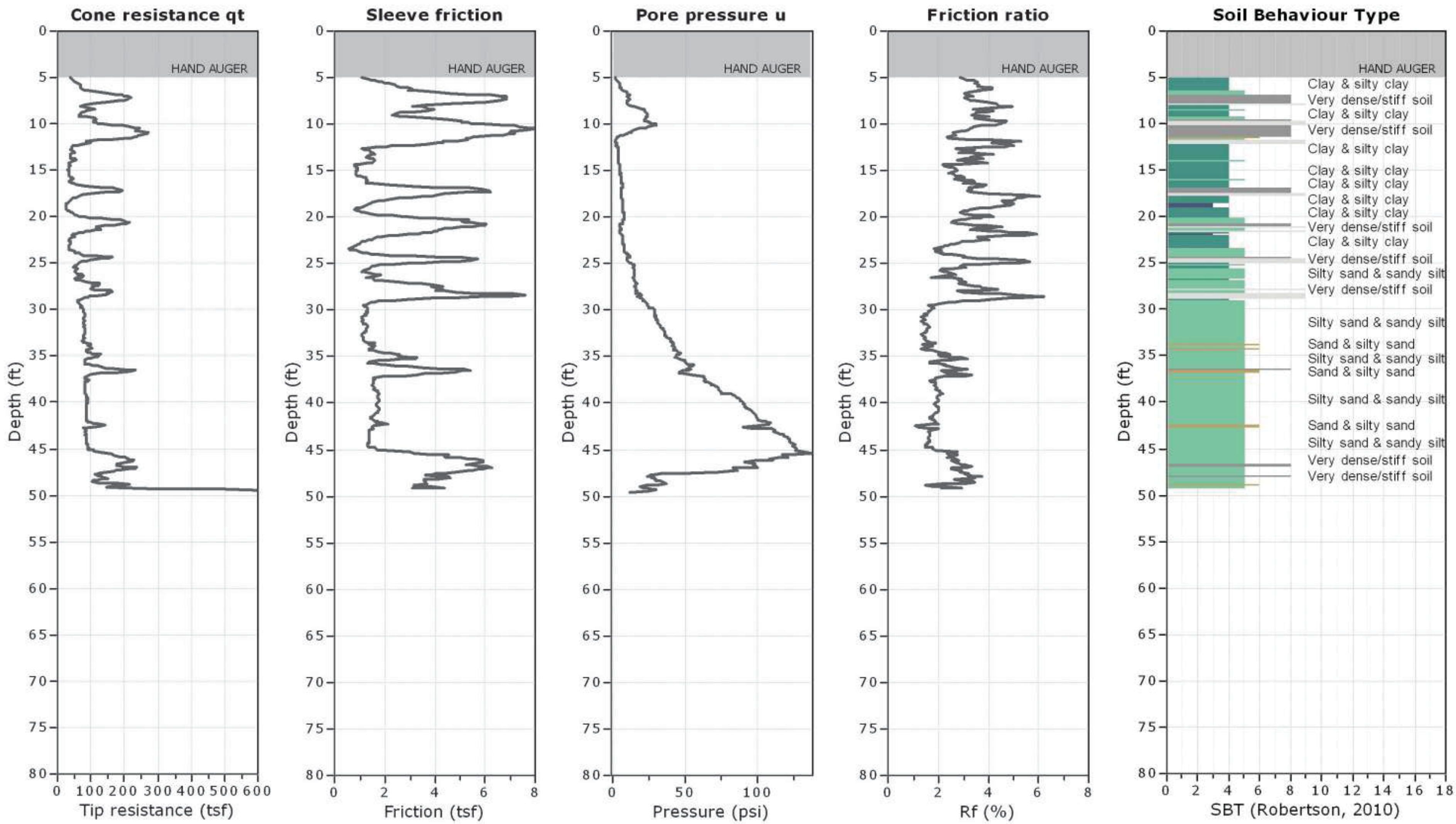
**Kehoe Testing and Engineering**
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

**CPT: KCPT-7**

**Project:** **Kleinfelder, Inc.\ Five Lagunas Redevelopment**

**Location:** **24155 Laguna Hills Mall Laguan Hills, CA**

Total depth: 49.52 ft, Date: 3/27/2015
Cone Type: Vertek



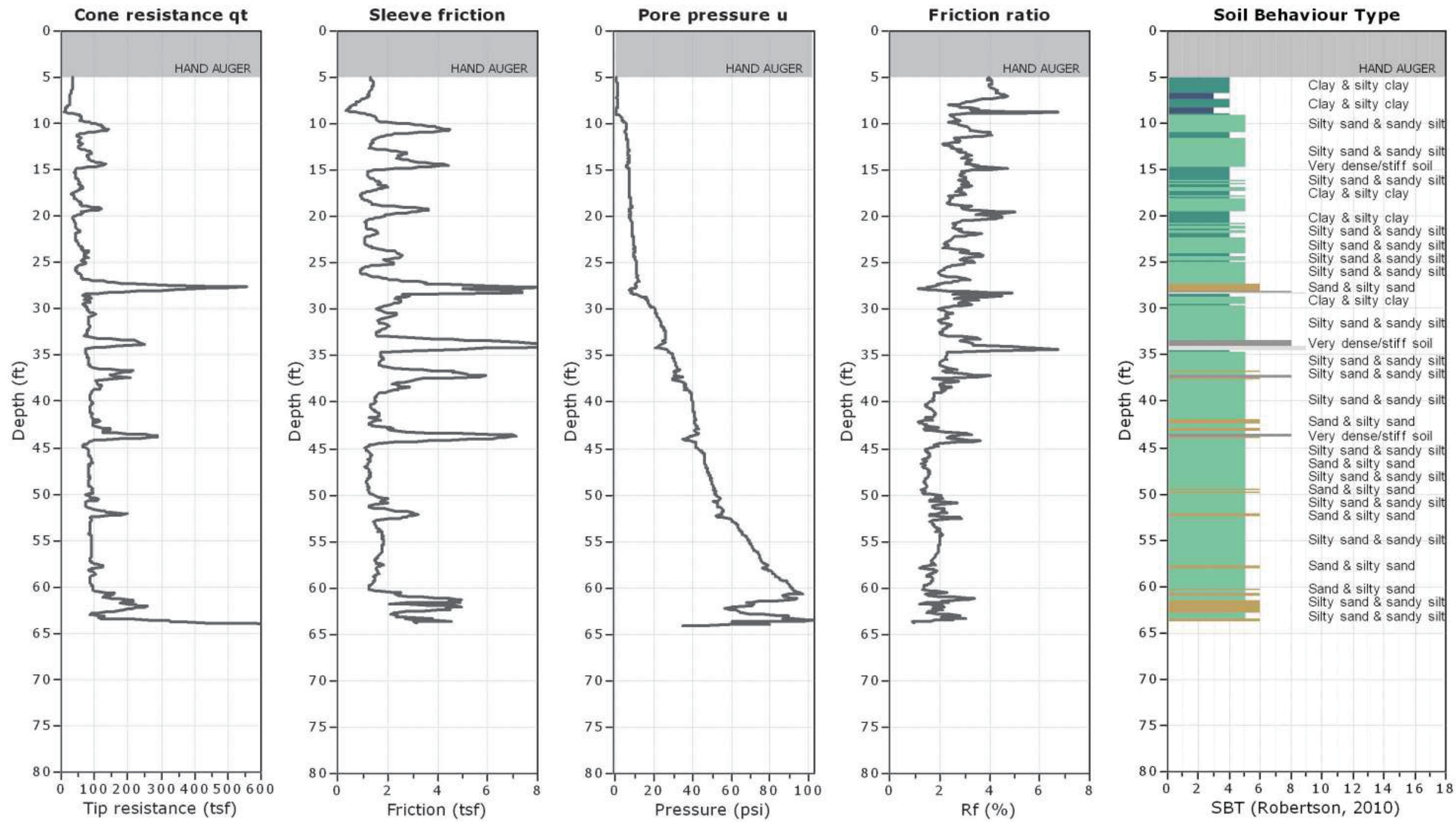
Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

**CPT: KCPT-8**

**Project:** Kleinfelder, Inc.\ Five Lagunas Redevelopment

**Location:** 24155 Laguna Hills Mall Laguan Hills, CA

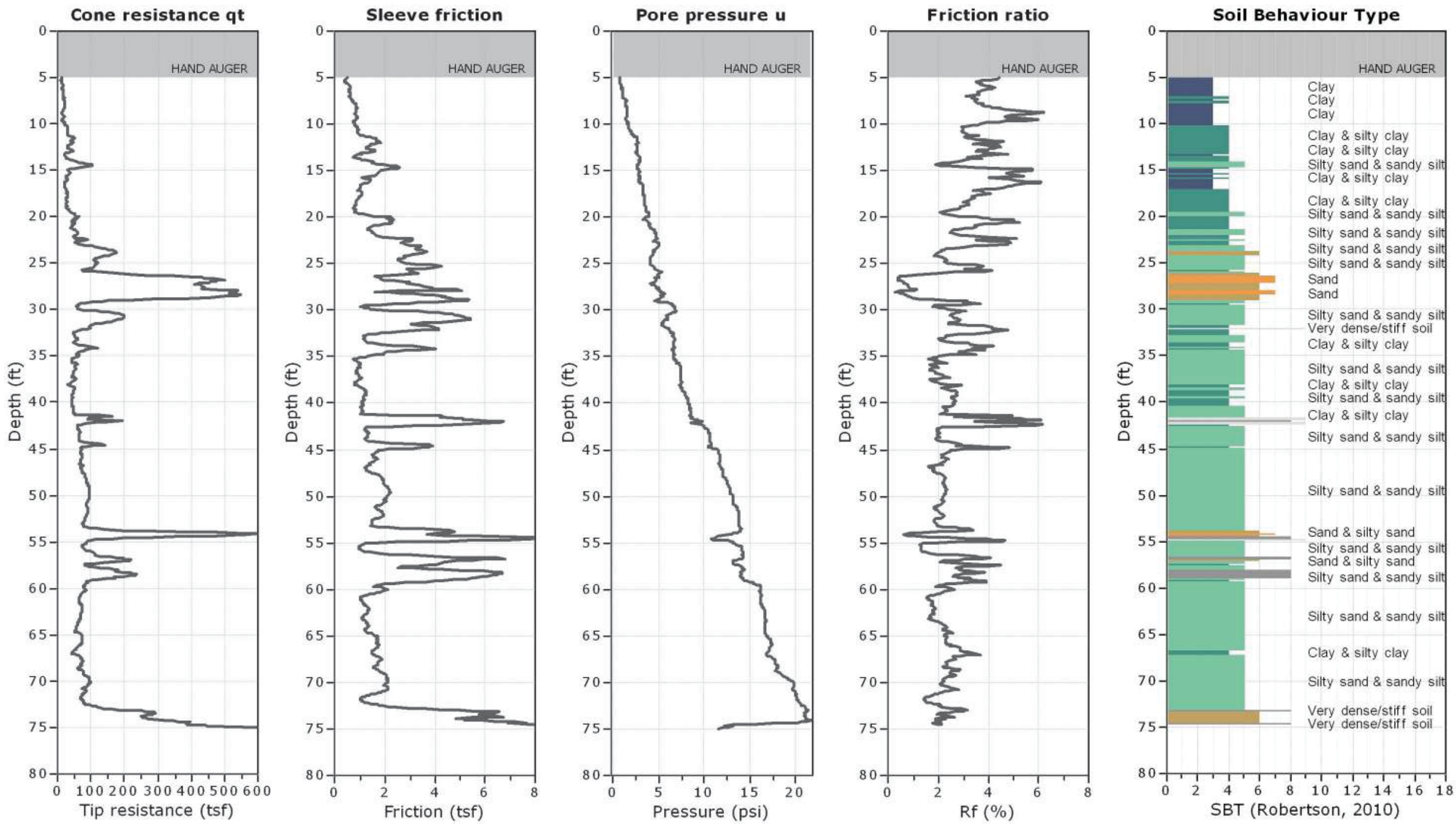
Total depth: 64.13 ft, Date: 3/26/2015
Cone Type: Vertek



**Kehoe Testing and Engineering**
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

**Project:** **Kleinfelder, Inc.\ Five Lagunas Redevelopment**
**Location:** **24155 Laguna Hills Mall Laguan Hills, CA**

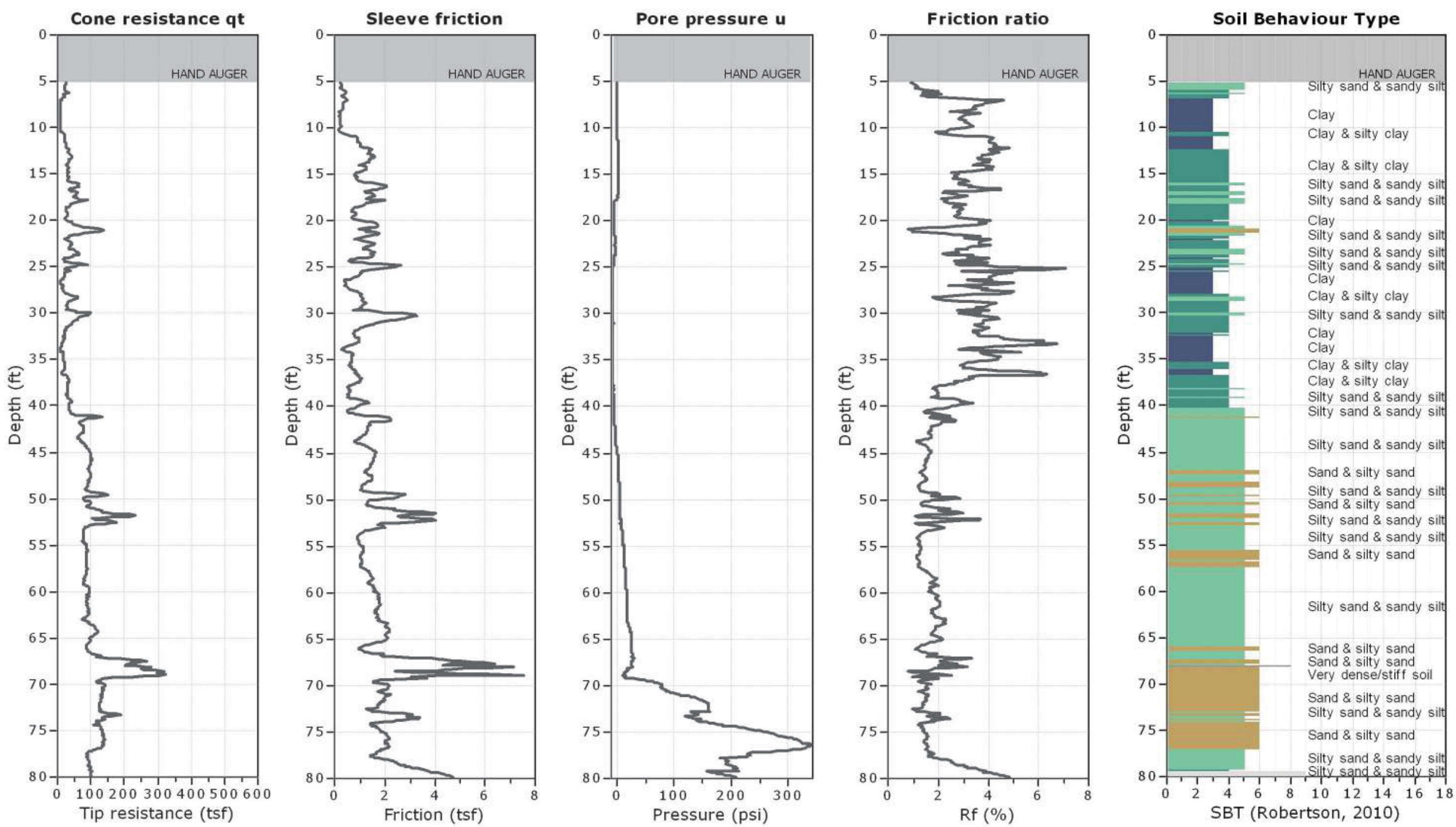
**CPT: KCPT-9**
Total depth: 74.98 ft, Date: 3/27/2015
Cone Type: Vertek



Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

**CPT: KCPT-10**
Total depth: 80.23 ft, Date: 3/25/2015
Cone Type: Vertek

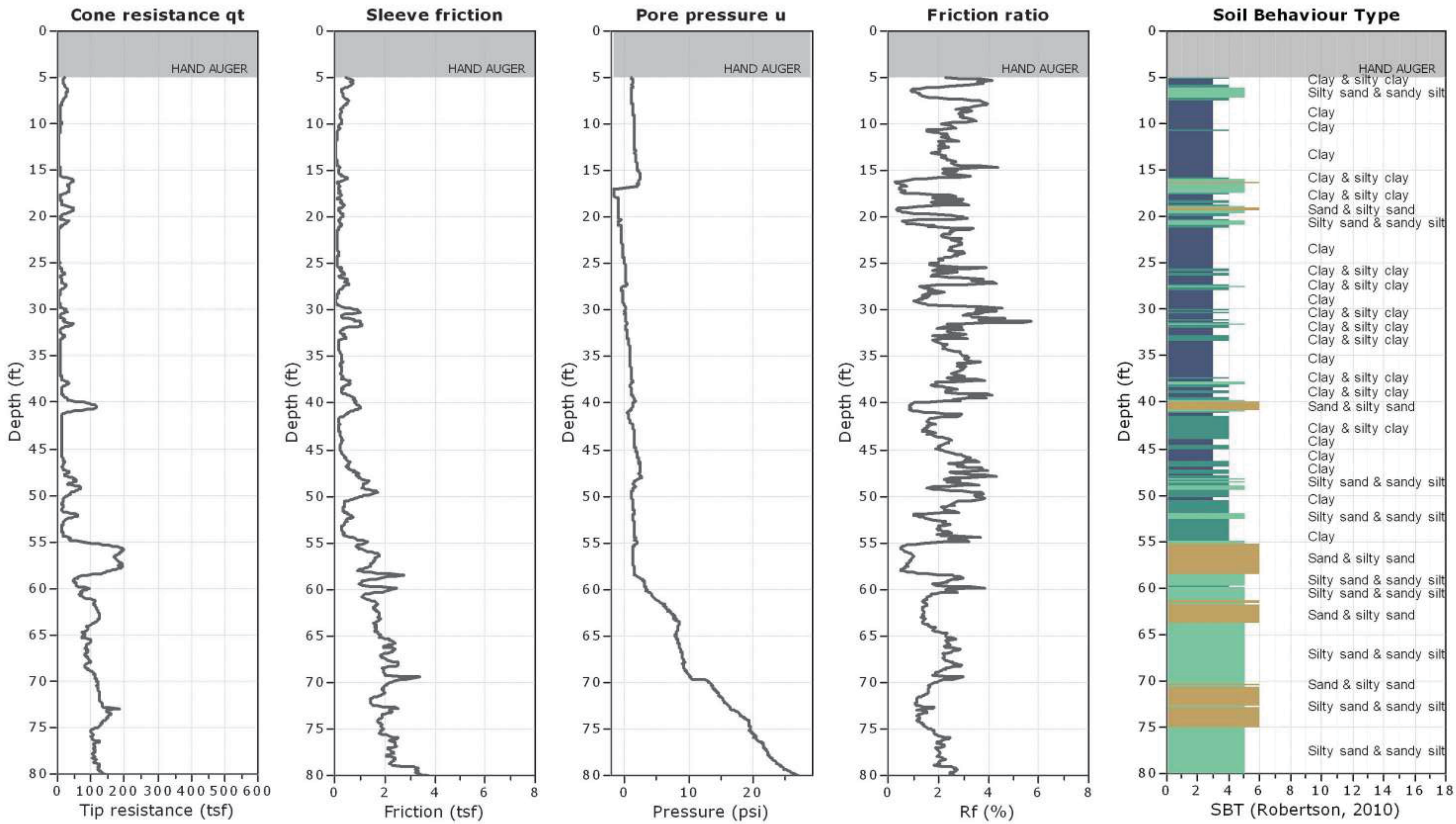
**Project:** Kleinfelder, Inc.\ Five Lagunas Redevelopment
**Location:** 24155 Laguna Hills Mall Laguan Hills, CA



**Kehoe Testing and Engineering**
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

**CPT: KCPT-11**
Total depth: 80.52 ft, Date: 3/26/2015
Cone Type: Vertek

**Project:** **Kleinfelder, Inc.\ Five Lagunas Redevelopment**
**Location:** **24155 Laguna Hills Mall Laguan Hills, CA**



**Kehoe Testing and Engineering**
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

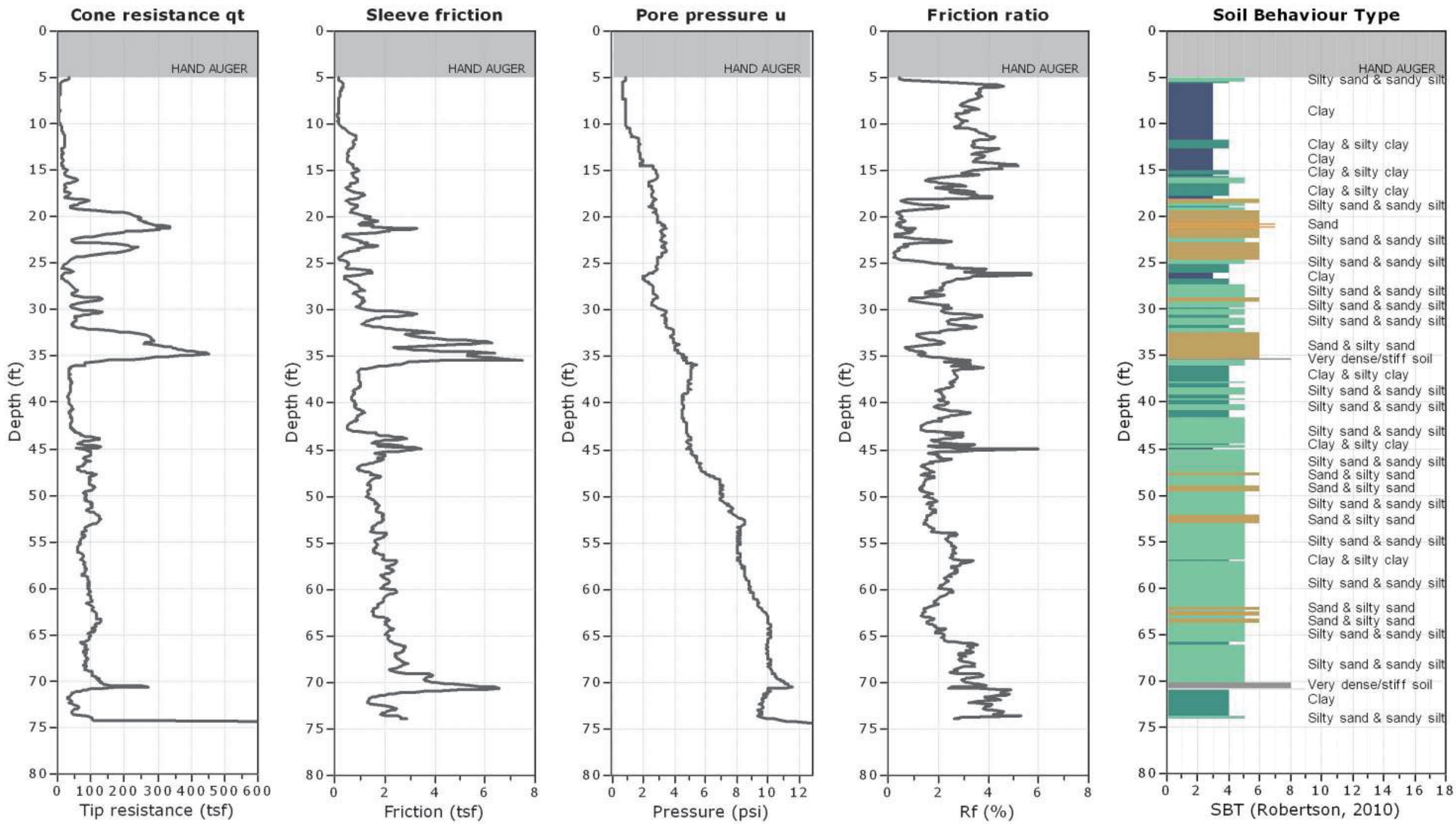
**CPT: KCPT-12**

Total depth: 74.34 ft, Date: 3/25/2015

Cone Type: Vertek

**Project:** **Kleinfelder, Inc.\ Five Lagunas Redevelopment**

**Location:** **24155 Laguna Hills Mall Laguan Hills, CA**

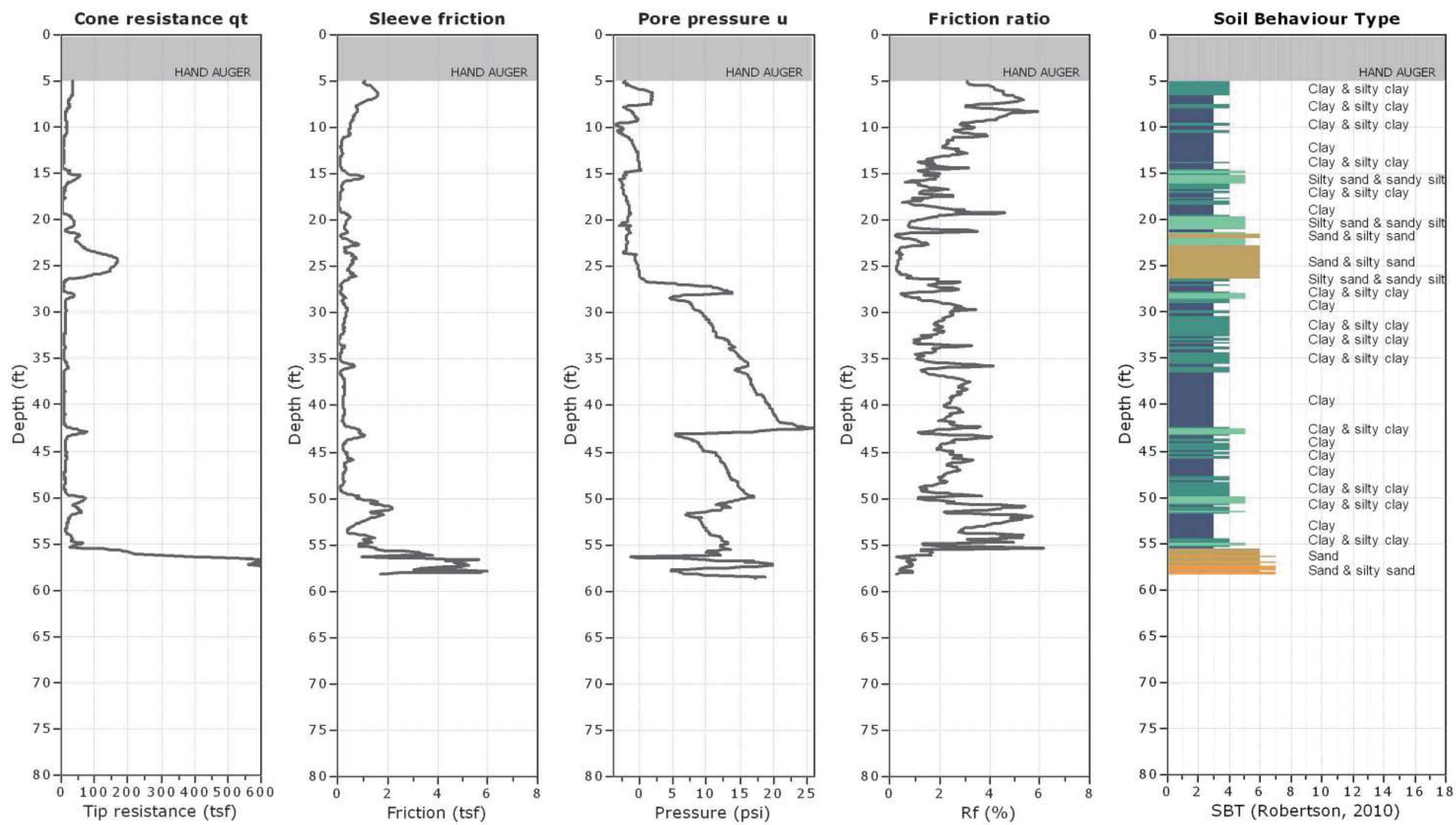


**Kehoe Testing and Engineering**
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

**CPT: KCPT-13**

**Project:** **Kleinfelder, Inc.\ Five Lagunas Redevelopment**
**Location:** **24155 Laguna Hills Mall Laguan Hills, CA**

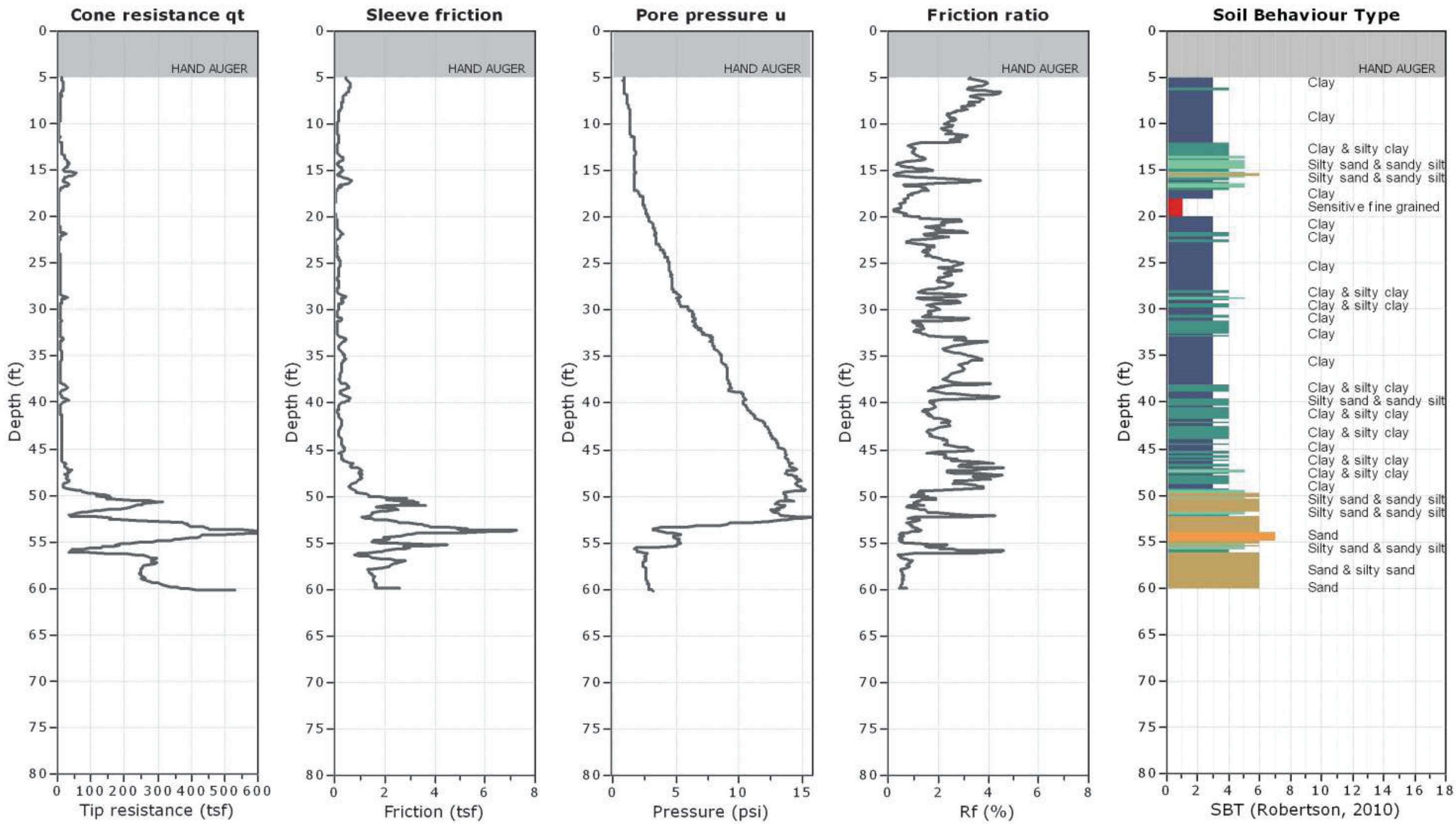
Total depth: 58.60 ft, Date: 3/26/2015
Cone Type: Vertek



**Kehoe Testing and Engineering**
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

**CPT: KCPT-14**
Total depth: 60.26 ft, Date: 3/26/2015
Cone Type: Vertek

**Project:** **Kleinfelder, Inc.\ Five Lagunas Redevelopment**
**Location:** **24155 Laguna Hills Mall Laguan Hills, CA**



Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

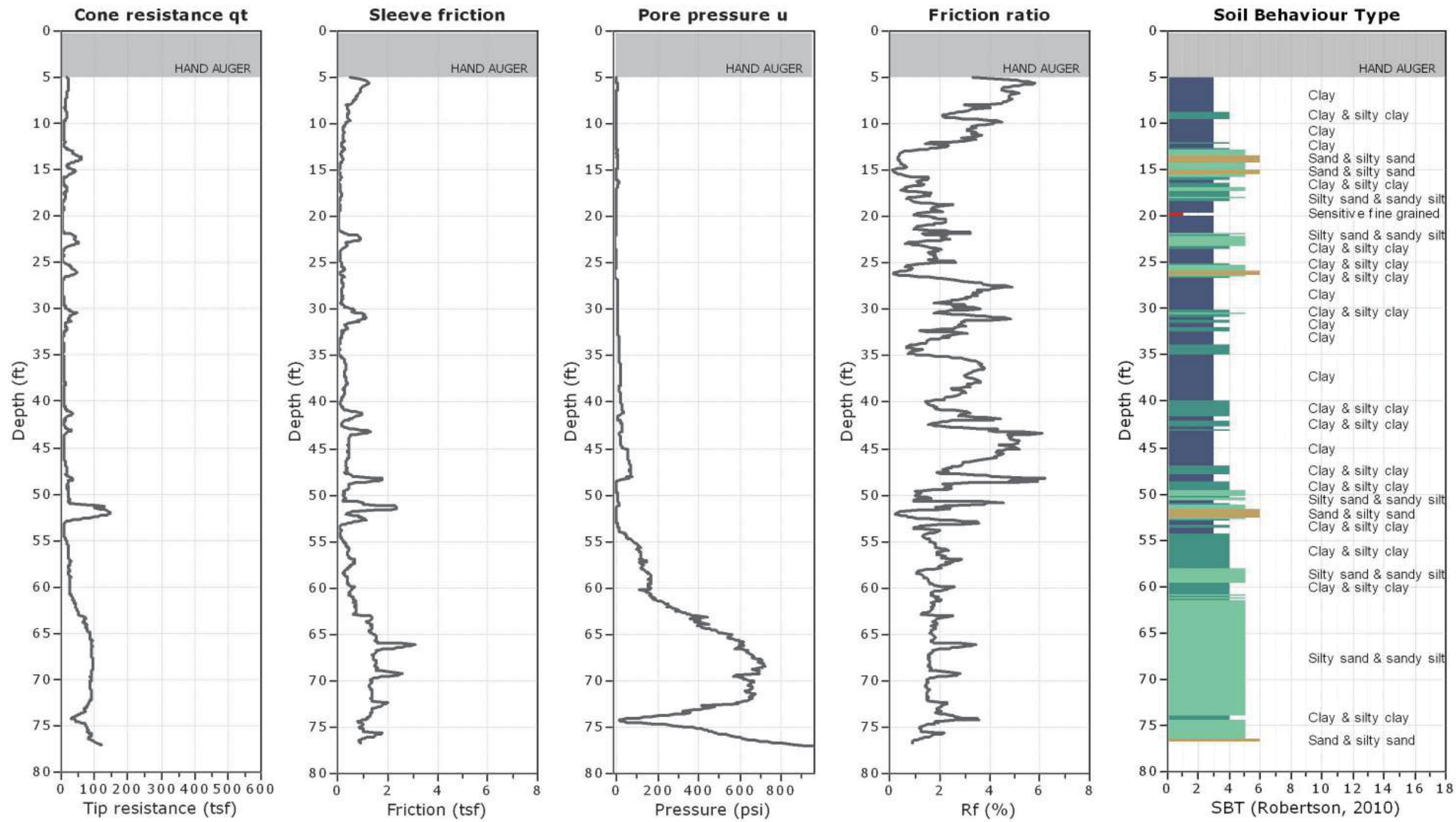
**CPT: KCPT-15**

**Project:** Kleinfelder, Inc.\ Five Lagunas Redevelopment

**Location:** 24155 Laguna Hills Mall Laguan Hills, CA

Total depth: 77.08 ft, Date: 3/26/2015

Cone Type: Vertek



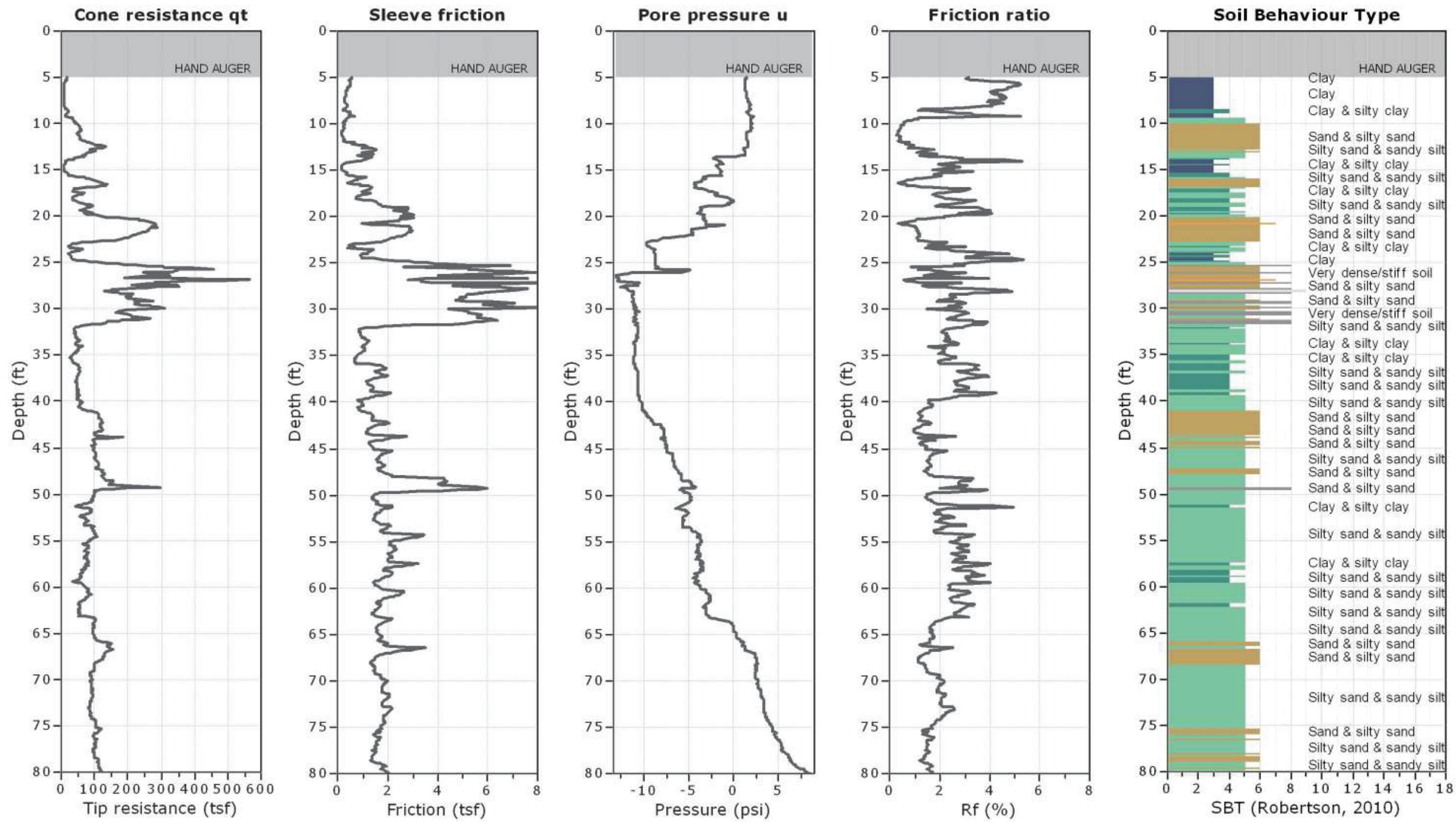

CPeT-IT v.1.7.6.42 - CPTU data presentation & interpretation software - Report created on: 3/30/2015, 2:32:36 PM

Project file: C:\KleinfelderLagunaHills3-15\CPeT Data\Plot Data\Plots w-ha.cpt

**Kehoe Testing and Engineering**
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

**CPT: KCPT-16**
Total depth: 80.49 ft, Date: 3/26/2015
Cone Type: Vertek

**Project:** **Kleinfelder, Inc.\ Five Lagunas Redevelopment**
**Location:** **24155 Laguna Hills Mall Laguan Hills, CA**

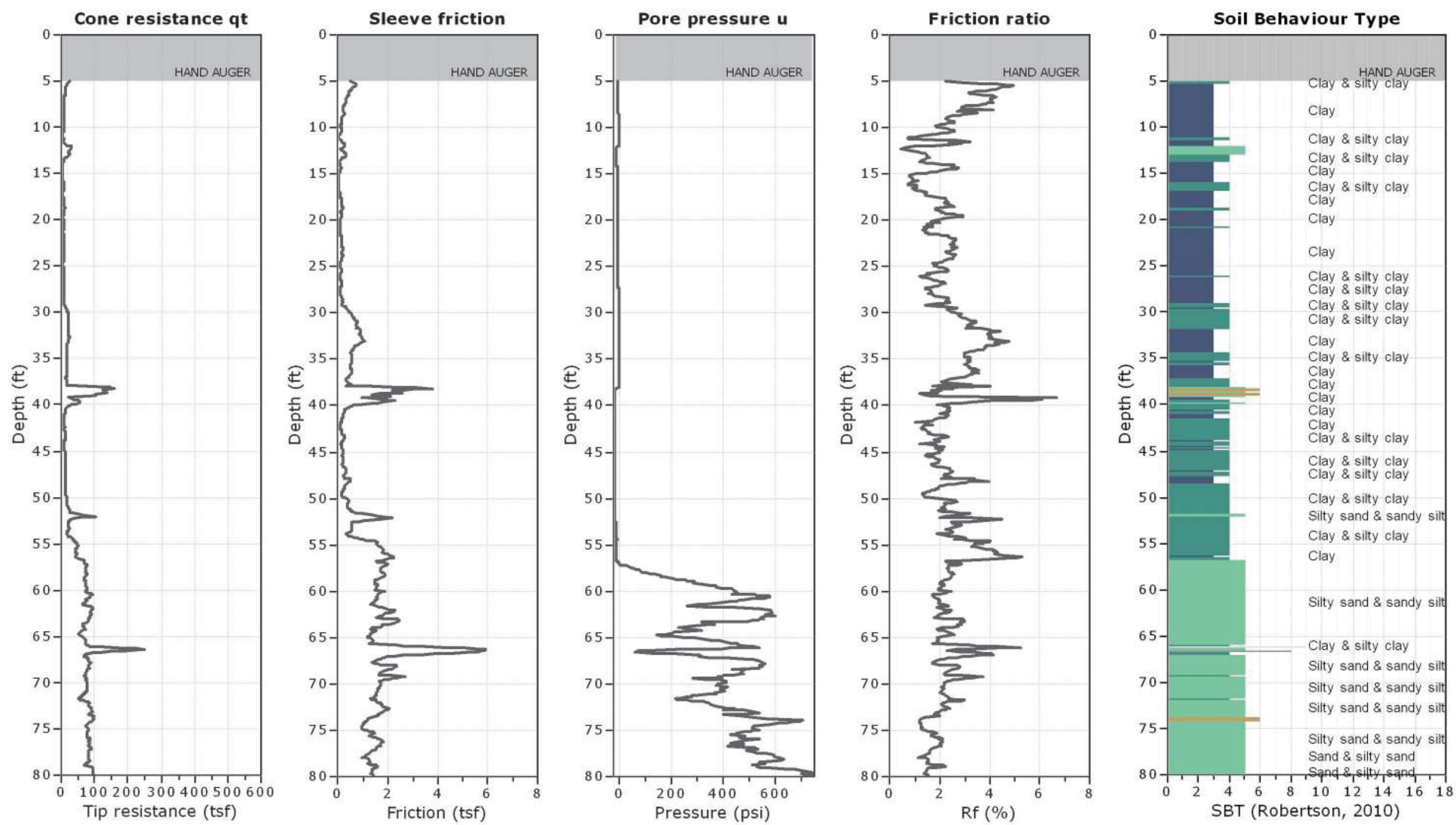



CPeT-IT v.1.7.6.42 - CPTU data presentation & interpretation software - Report created on: 3/30/2015, 2:32:01 PM
Project file: C:\KleinfelderLagunaHills3-15\CPeT Data\Plot Data\Plots w-ha.cpt

**Kehoe Testing and Engineering**
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

**CPT: KCPT-17**
Total depth: 80.39 ft, Date: 3/26/2015
Cone Type: Vertek

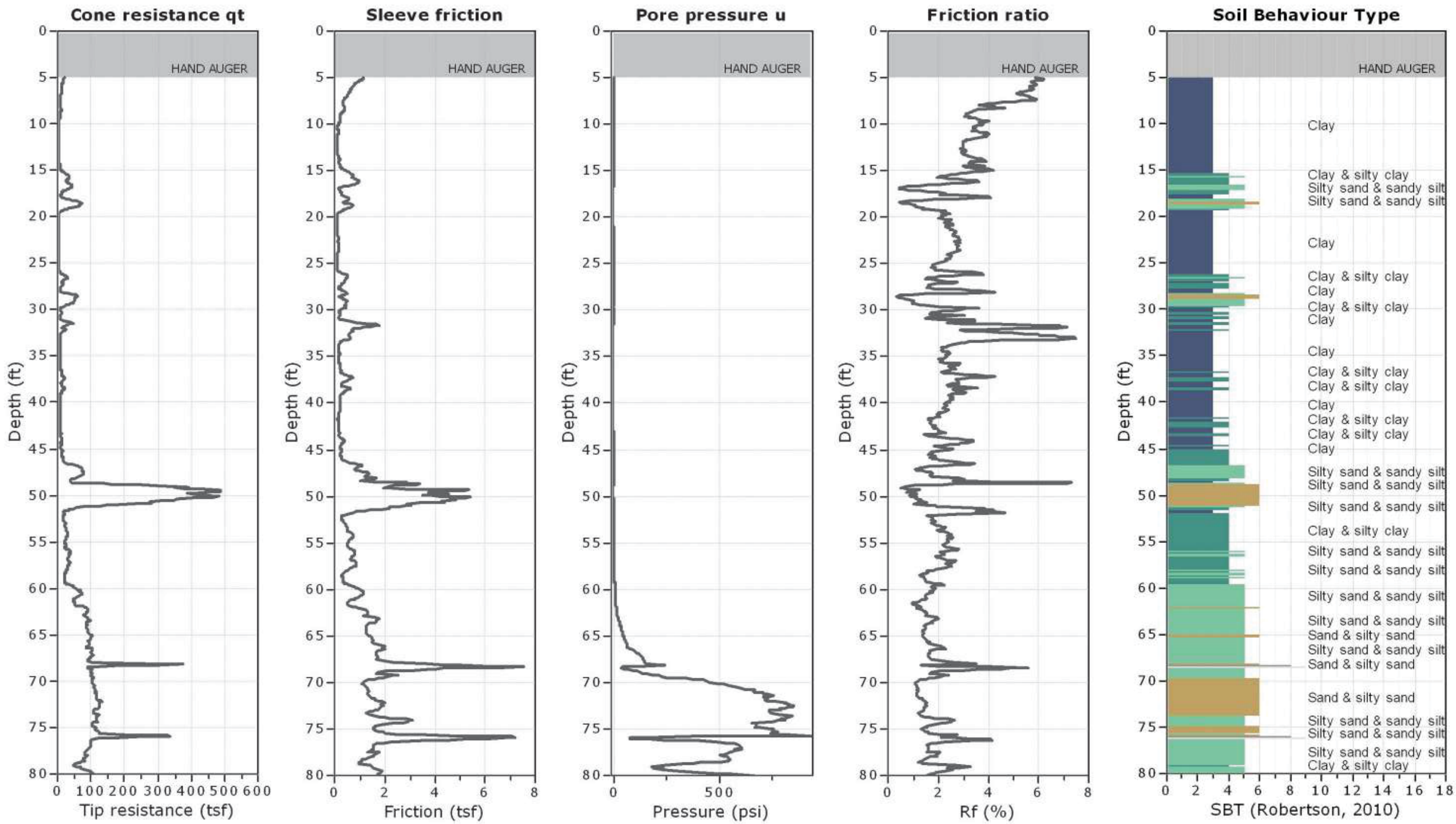
**Project:** **Kleinfelder, Inc.\ Five Lagunas Redevelopment**
**Location:** **24155 Laguna Hills Mall Laguan Hills, CA**



**Kehoe Testing and Engineering**
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

**CPT: KCPT-18**
Total depth: 80.66 ft, Date: 3/25/2015
Cone Type: Vertek

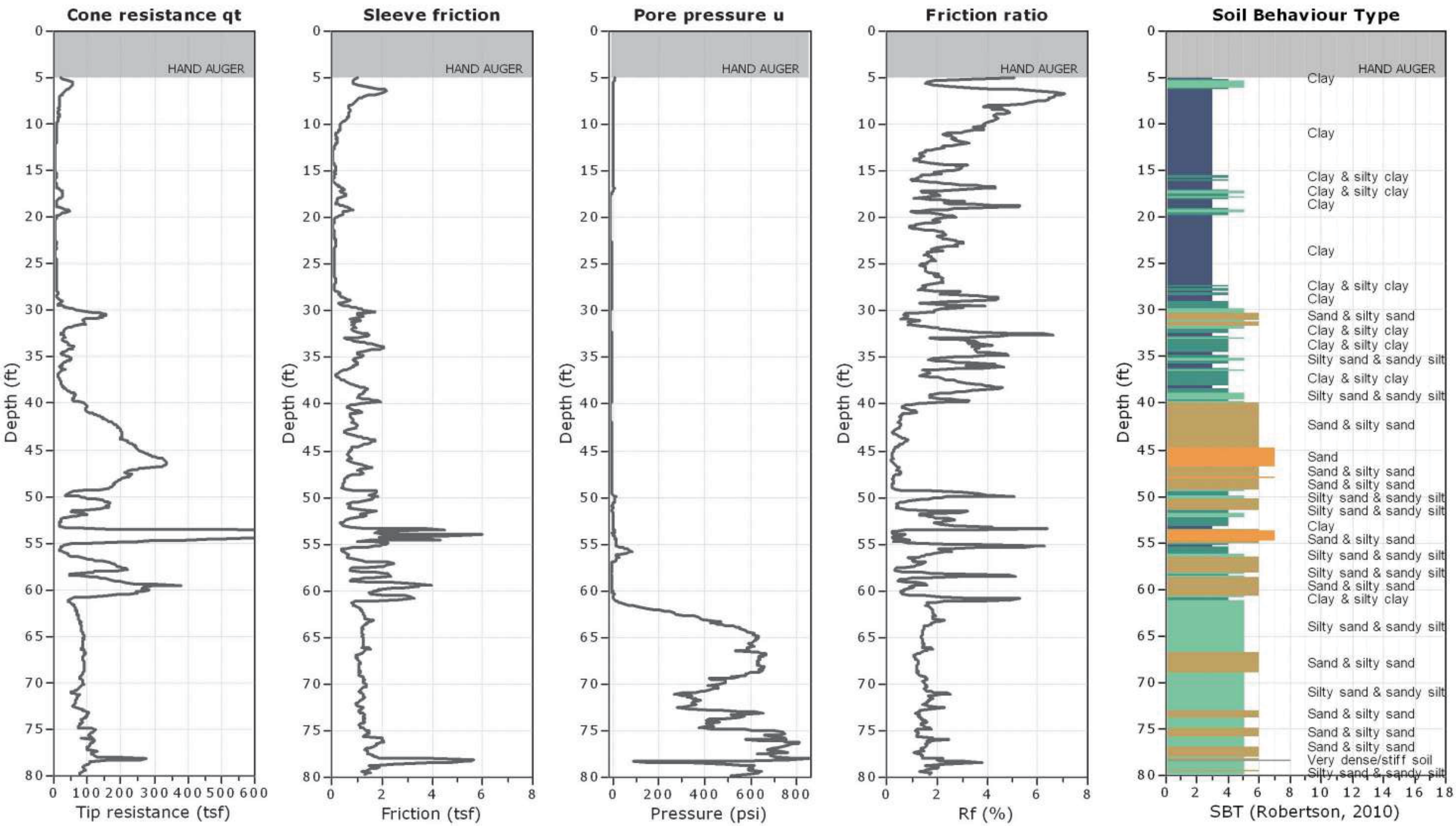
**Project:** **Kleinfelder, Inc.\ Five Lagunas Redevelopment**
**Location:** **24155 Laguna Hills Mall Laguan Hills, CA**



Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

**Project:** Kleinfelder, Inc.\ Five Lagunas Redevelopment
**Location:** 24155 Laguna Hills Mall Laguan Hills, CA

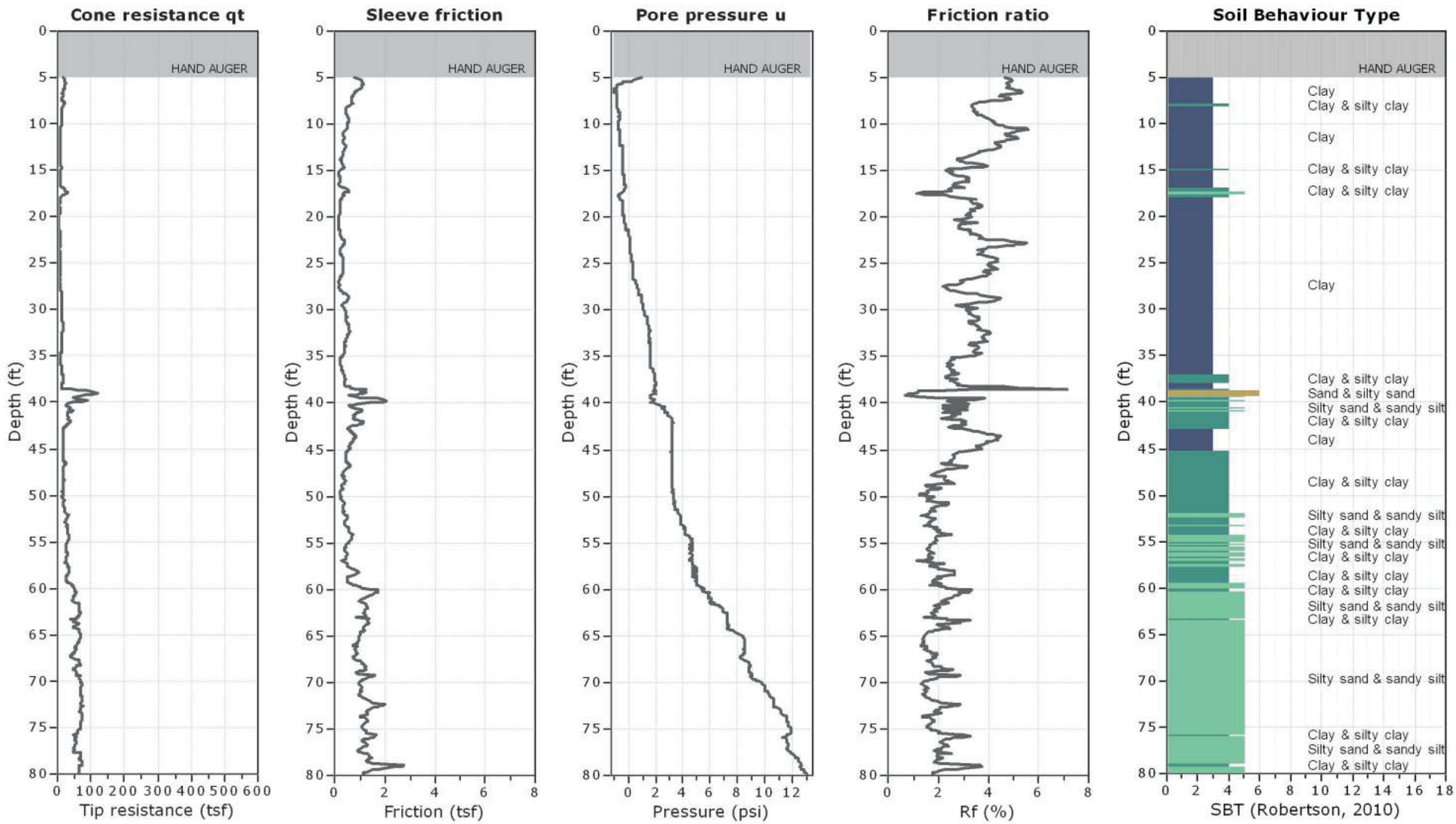
**CPT: KCPT-19**
Total depth: 80.11 ft, Date: 3/25/2015
Cone Type: Vertek



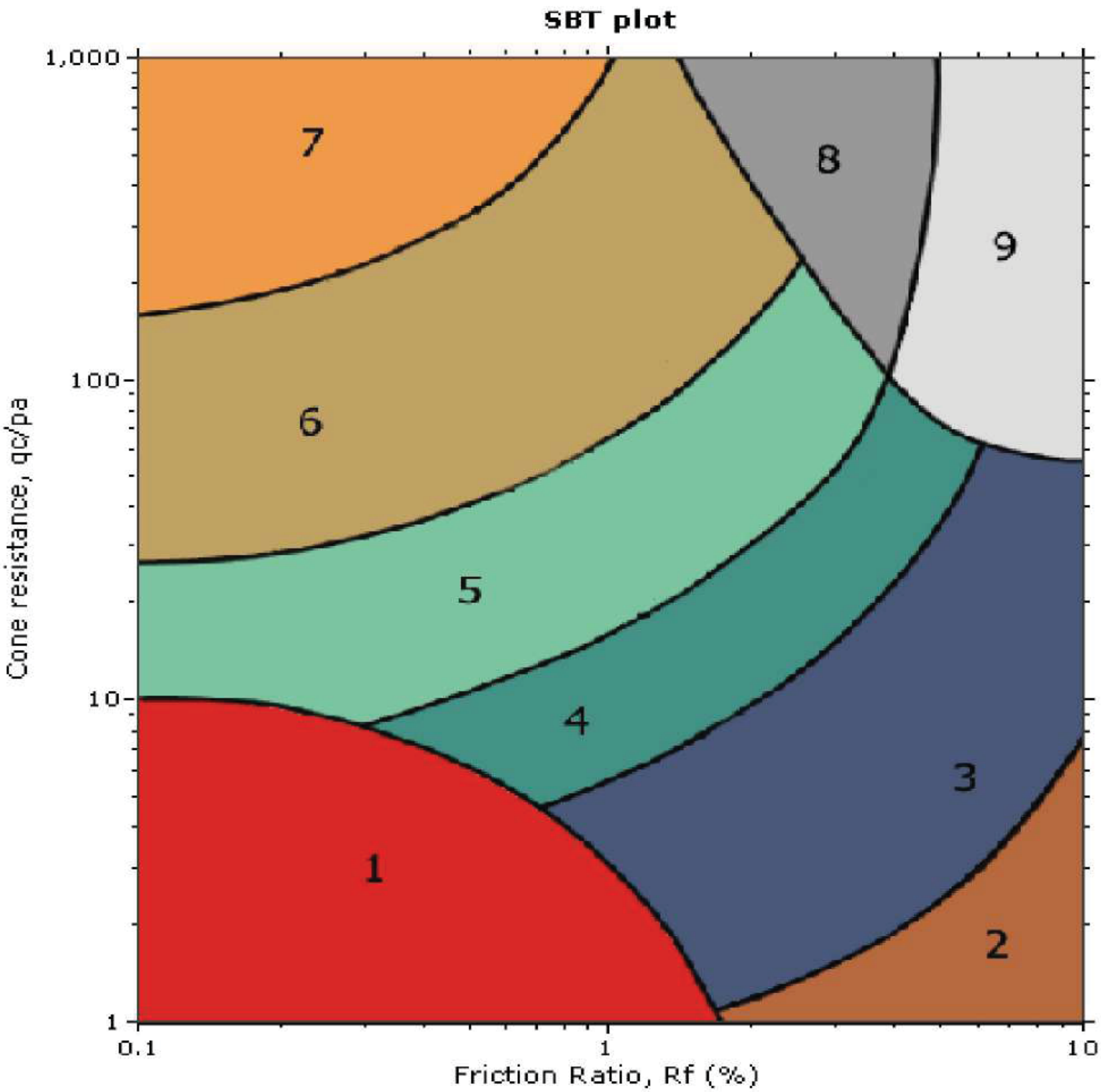
**Kehoe Testing and Engineering**
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

**Project:** **Kleinfelder, Inc.\ Five Lagunas Redevelopment**
**Location:** **24155 Laguna Hills Mall Laguan Hills, CA**

**CPT: KCPT-20**
Total depth: 80.66 ft, Date: 3/25/2015
Cone Type: Vertek



**Kehoe Testing and Engineering**
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com




**SBT legend**

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

Kleinfelder 2012

CPT Exploration

# SUMMARY

# OF

# CONE PENETRATION TEST DATA

Project:

**Laguna Hills Mall**
**24155 Laguna Hills Mall**
**Laguna Hills, CA**
**June 28, 2012**

Prepared for:

**Mr. Brian Crystal**
**Kleinfelder, Inc.**
**2 Ada, Ste 250**
**Irvine, CA 92618**
**Office (949) 727-4466 / Fax (949) 727-9242**

Prepared by:

KTE

**KEHOE TESTING & ENGINEERING**
5415 Industrial Drive
Huntington Beach, CA 92649-1518
Office (714) 901-7270 / Fax (714) 901-7289

# TABLE OF CONTENTS

# SUMMARY

# OF

# CONE PENETRATION TEST DATA

## 1. INTRODUCTION

This report presents the results of a Cone Penetration Test (CPT) program carried out for the Laguna Hills Mall project located at 24155 Laguna Hills Mall in Laguna Hills, California. The work was performed by Kehoe Testing & Engineering (KTE) on June 28, 2012. The scope of work was performed as directed by Kleinfelder, Inc. personnel.

## 2. SUMMARY OF FIELD WORK

The fieldwork consisted of performing CPT soundings at six locations to determine the soil lithology. Groundwater measurements and hole collapse depths provided in **TABLE 2.1** are for information only. The readings indicate the apparent depth to which the hole is open and the apparent water level (if encountered) in the CPT probe hole at the time of measurement upon completion of the CPT. KTE does not warranty the accuracy of the measurements and the reported water levels may not represent the true or stabilized groundwater levels.

| LOCATION | DEPTH OF CPT (ft) | COMMENTS/NOTES: |
|---|---|---|
| **CPT-1** | 60 | Hole open to 5 ft (dry) |
| **CPT-2** | 80 | Hole open to 6 ft (dry) |
| **CPT-3** | 60 | Hole open to 6 ft (dry) |
| **CPT-4** | 60 | Hole open to 5 ft (dry) |
| **CPT-5** | 49 | Refusal, hole open to 5 ft (dry) |
| **CPT-6** | 60 | Hole open to 5 ft (dry) |

**TABLE 2.1 - Summary of CPT Soundings**

## 3. FIELD EQUIPMENT & PROCEDURES

The CPT soundings were carried out by **KTE** using an integrated electronic cone system manufactured by Vertek. The CPT soundings were performed in accordance with ASTM standards (D5778). The cone penetrometers were pushed using a 30-ton CPT rig. The cone used during the program was a 15 cm^2 cone and recorded the following parameters at approximately 2.5 cm depth intervals:

- Cone Resistance (qc)
- Sleeve Friction (fs)
- Dynamic Pore Pressure (u)
- Inclination
- Penetration Speed
- Pore Pressure Dissipation (at selected depths)

The above parameters were recorded and viewed in real time using a portable computer and stored on a diskette for future analysis and reference. A complete set of baseline readings was taken prior to each sounding to determine temperature shifts and any zero load offsets. Monitoring base line readings ensures that the cone electronics are operating properly.

## 4. CONE PENETRATION TEST DATA & INTERPRETATION

The Cone Penetration Test data is presented in graphical form in the attached Appendix. Penetration depths are referenced to ground surface. The soil classification on the CPT plots is derived from the CPT Classification Chart (Robertson, 1986) and presents major soil lithologic changes. The stratigraphic interpretation is based on relationships between cone resistance (qc), sleeve friction (fs), and penetration pore pressure (u). The friction ratio (Rf), which is sleeve friction divided by cone resistance, is a calculated parameter that is used to infer soil behavior type. Generally, cohesive soils (clays) have high friction ratios, low cone resistance and generate excess pore water pressures. Cohesionless soils (sands) have lower friction ratios, high cone bearing and generate little (or negative) excess pore water pressures.

Output from the interpretation program CPTINT provides averaged CPT data over one-foot intervals. The CPTINT output includes Soil Classification Zones, SPT N Values and Undrained Shear Strength (Su). A summary of the equations used for the tabulated parameters is provided in the CPTINT Correlation Table in the Appendix.

The interpretation of soils encountered on this project was carried out using correlations developed by Robertson et al, 1986. It should be noted that it is not always possible to clearly identify a soil type based on qc, fs and u. In these situations, experience, judgment and an assessment of the pore pressure data should be used to infer the soil behavior type.

If you have any questions regarding this information, please do not hesitate to call our office at (714) 901-7270.

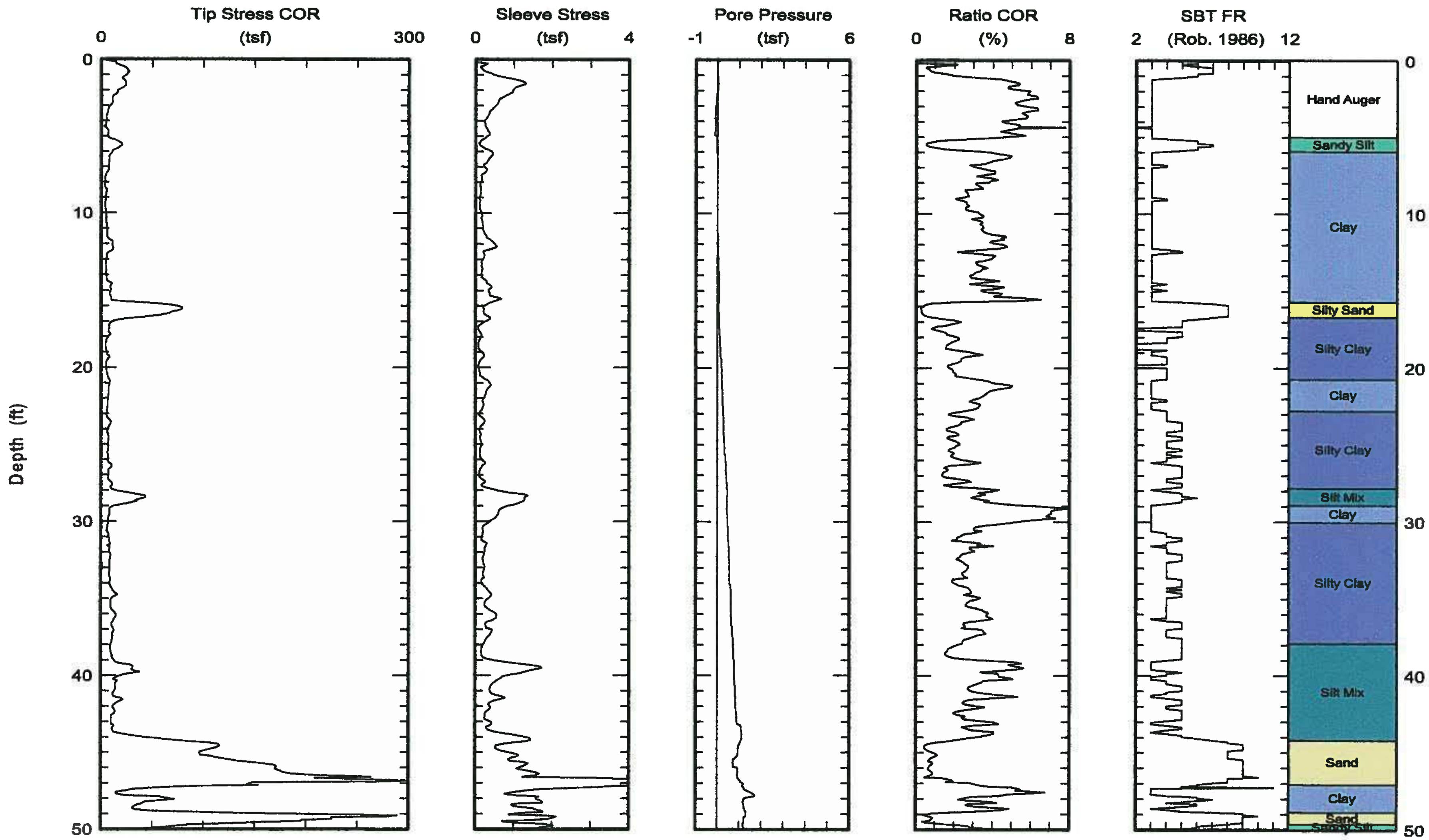
Sincerely,

**KEHOE TESTING & ENGINEERING**

Richard W. Koester, Jr.
General Manager

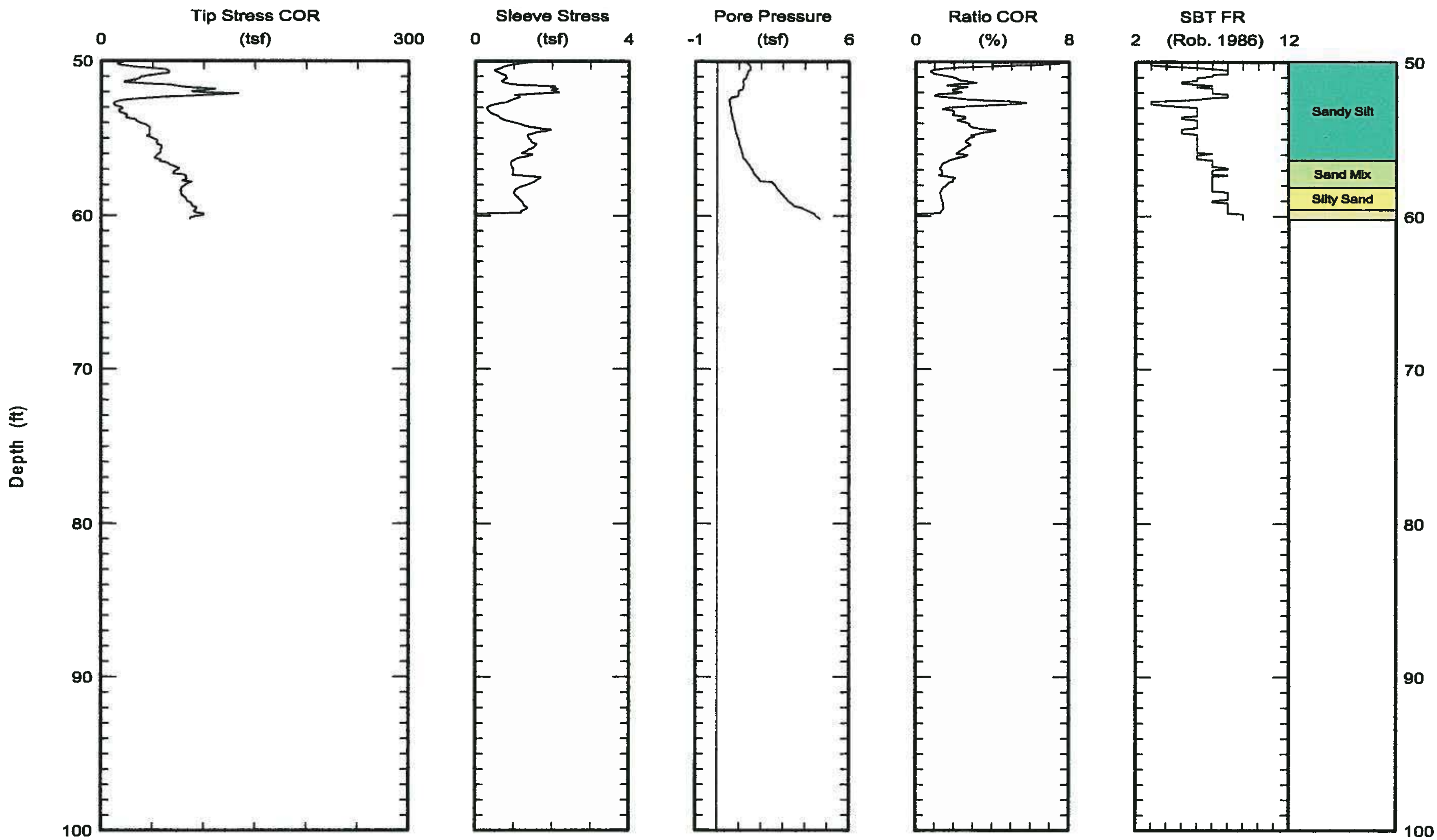
07/11/12-at-2846

| Kehoe Testing & Engineering<br>Office: (714) 901-7270<br>Fax: (714) 901-7289<br>rich@kehoetesting.com<br>www.kehoetesting.com | CPT Data<br>30 ton rig | Date: 28/Jun/2012<br>Test ID: CPT-1<br>Project: LagunaHills |
|---|---|---|
| | Customer: Kleinfelder, Inc.<br>Job Site: Laguna Hills Mall | |



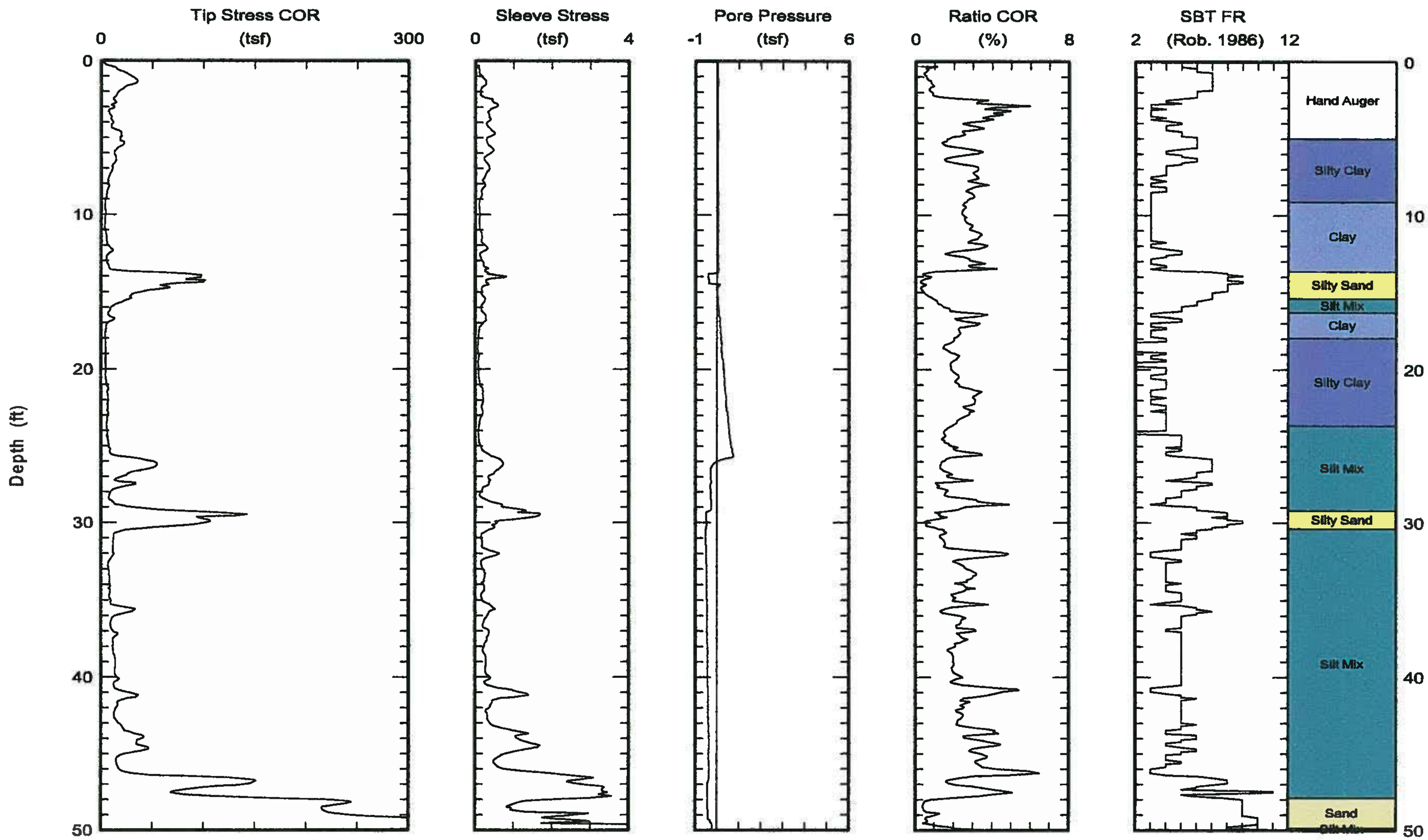

Maximum depth: 60.20 (ft)

| | | |
|---|---|---|
| Kehoe Testing & Engineering<br>Office: (714) 901-7270<br>Fax: (714) 901-7289<br>rich@kehoetesting.com<br>www.kehoetesting.com | CPT Data<br>30 ton rig | Date: 28/Jun/2012<br>Test ID: CPT-1<br>Project: LagunaHills |
| | Customer: Kleinfelder, Inc.<br>Job Site: Laguna Hills Mall | |



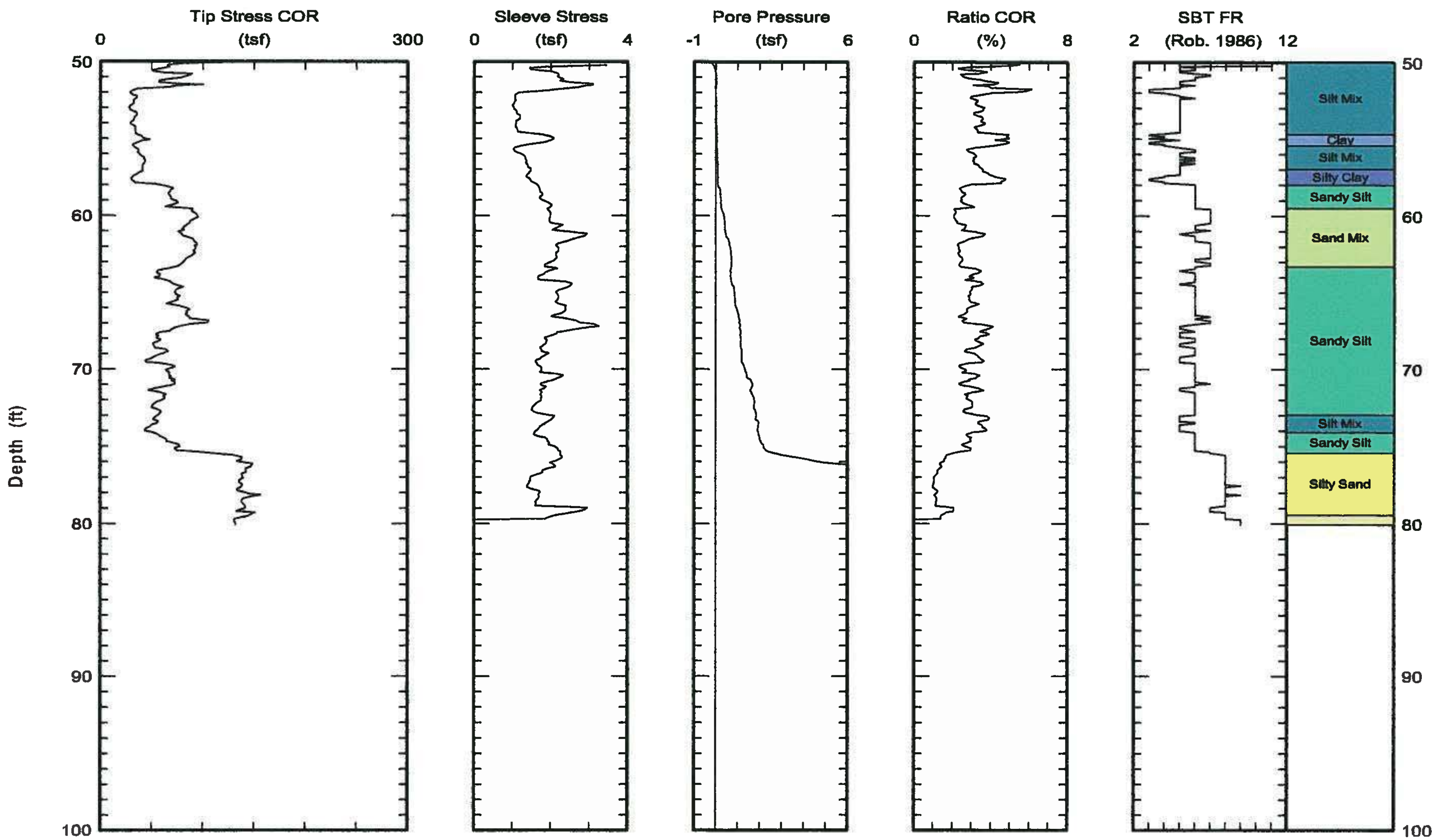

Maximum depth: 60.20 (ft)

| | | |
|---|---|---|
| Kehoe Testing & Engineering<br>Office: (714) 901-7270<br>Fax: (714) 901-7289<br>rich@kehoetesting.com<br>www.kehoetesting.com | CPT Data<br>30 ton rig | Date: 28/Jun/2012<br>Test ID: CPT-2<br>Project: LagunaHills |
| | Customer: Kleinfelder, Inc.<br>Job Site: Laguna Hills Mall | |



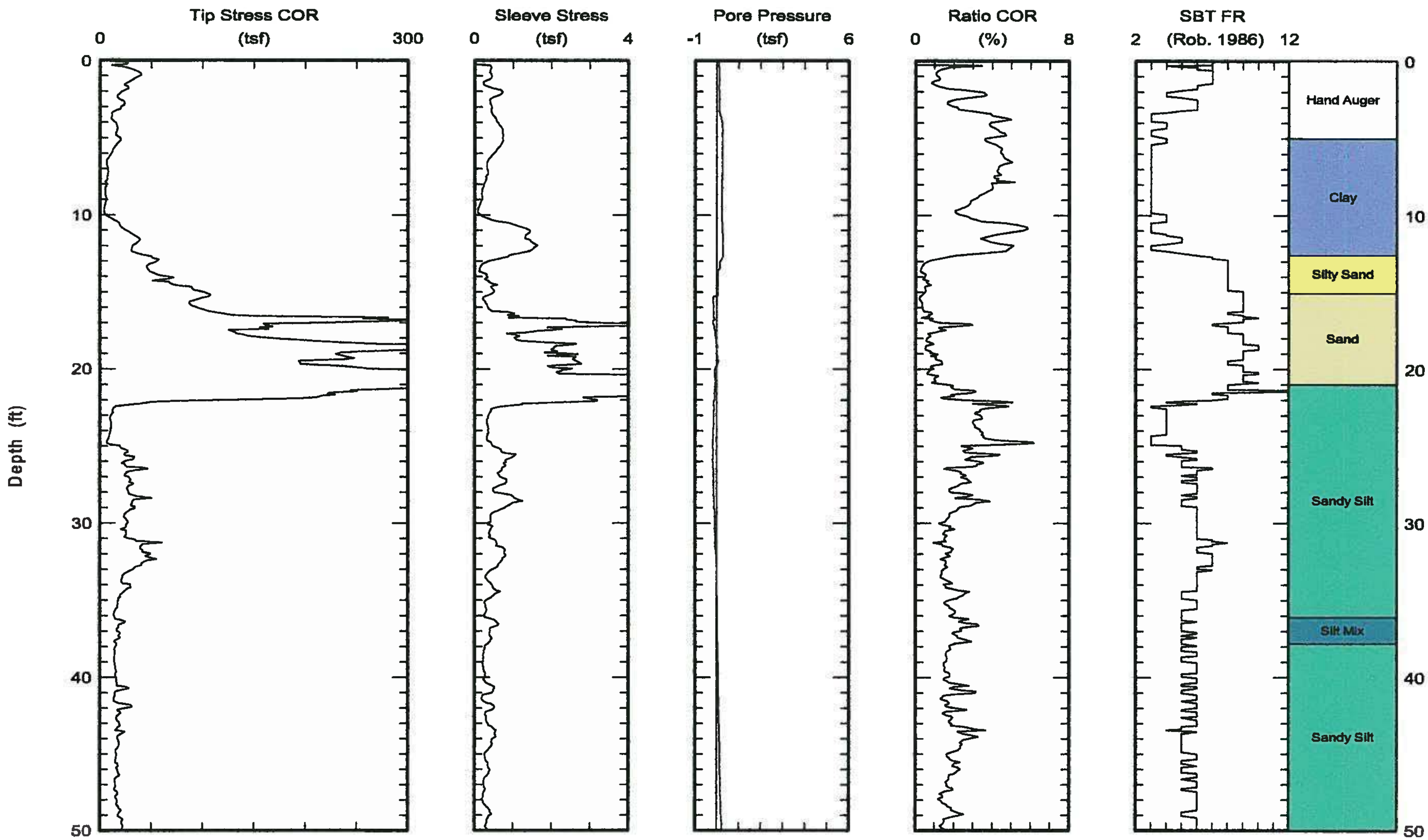

Maximum depth: 80.09 (ft)

| | | |
|---|---|---|
| Kehoe Testing & Engineering<br>Office: (714) 901-7270<br>Fax: (714) 901-7289<br>rich@kehoetesting.com<br>www.kehoetesting.com | CPT Data<br>30 ton rig | Date: 28/Jun/2012<br>Test ID: CPT-2<br>Project: LagunaHills |
| | Customer: Kleinfelder, Inc.<br>Job Site: Laguna Hills Mall | |



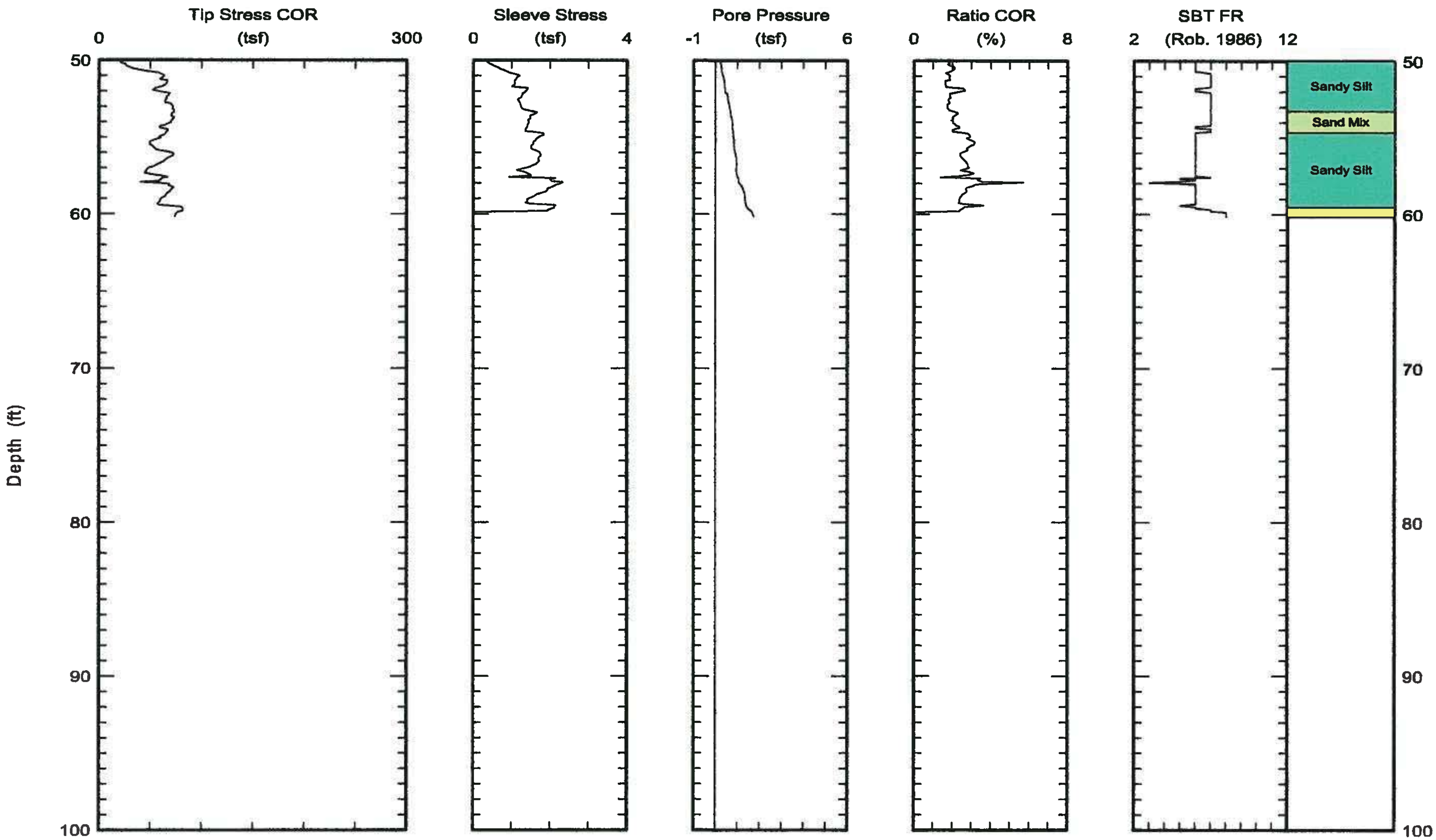

Maximum depth: 80.09 (ft)

| Kehoe Testing & Engineering<br>Office: (714) 901-7270<br>Fax: (714) 901-7289<br>rich@kehoetesting.com<br>www.kehoetesting.com | CPT Data<br>30 ton rig | Date: 28/Jun/2012<br>Test ID: CPT-3<br>Project: LagunaHills |
|---|---|---|
| | Customer: Kleinfelder, Inc.<br>Job Site: Laguna Hills Mall | |



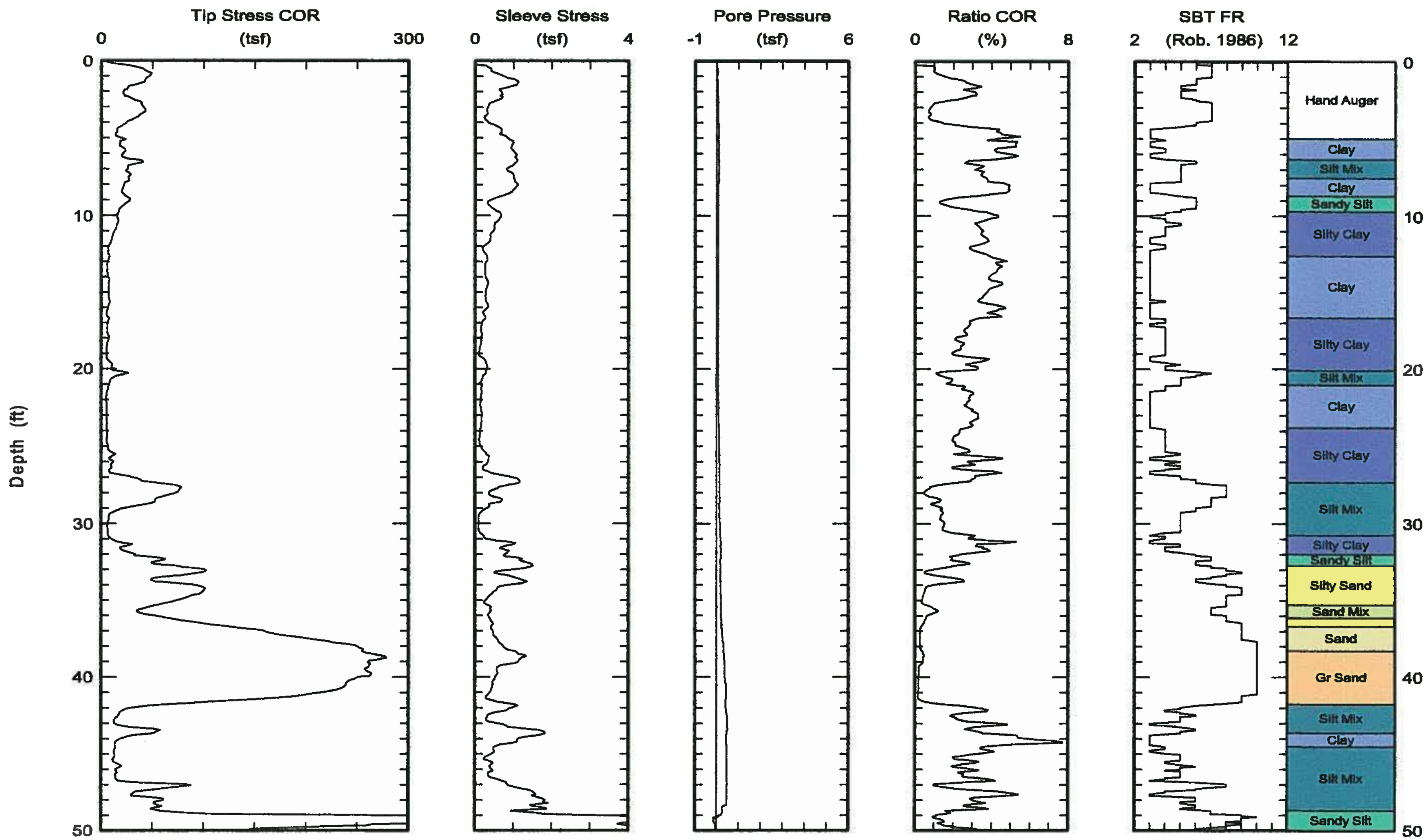

Maximum depth: 60.18 (ft)

| | | |
|---|---|---|
| Kehoe Testing & Engineering<br>Office: (714) 901-7270<br>Fax: (714) 901-7289<br>rich@kehoetesting.com<br>www.kehoetesting.com | CPT Data<br>30 ton rig | Date: 28/Jun/2012<br>Test ID: CPT-3<br>Project: LagunaHills |
| | Customer: Kleinfelder, Inc.<br>Job Site: Laguna Hills Mall | |



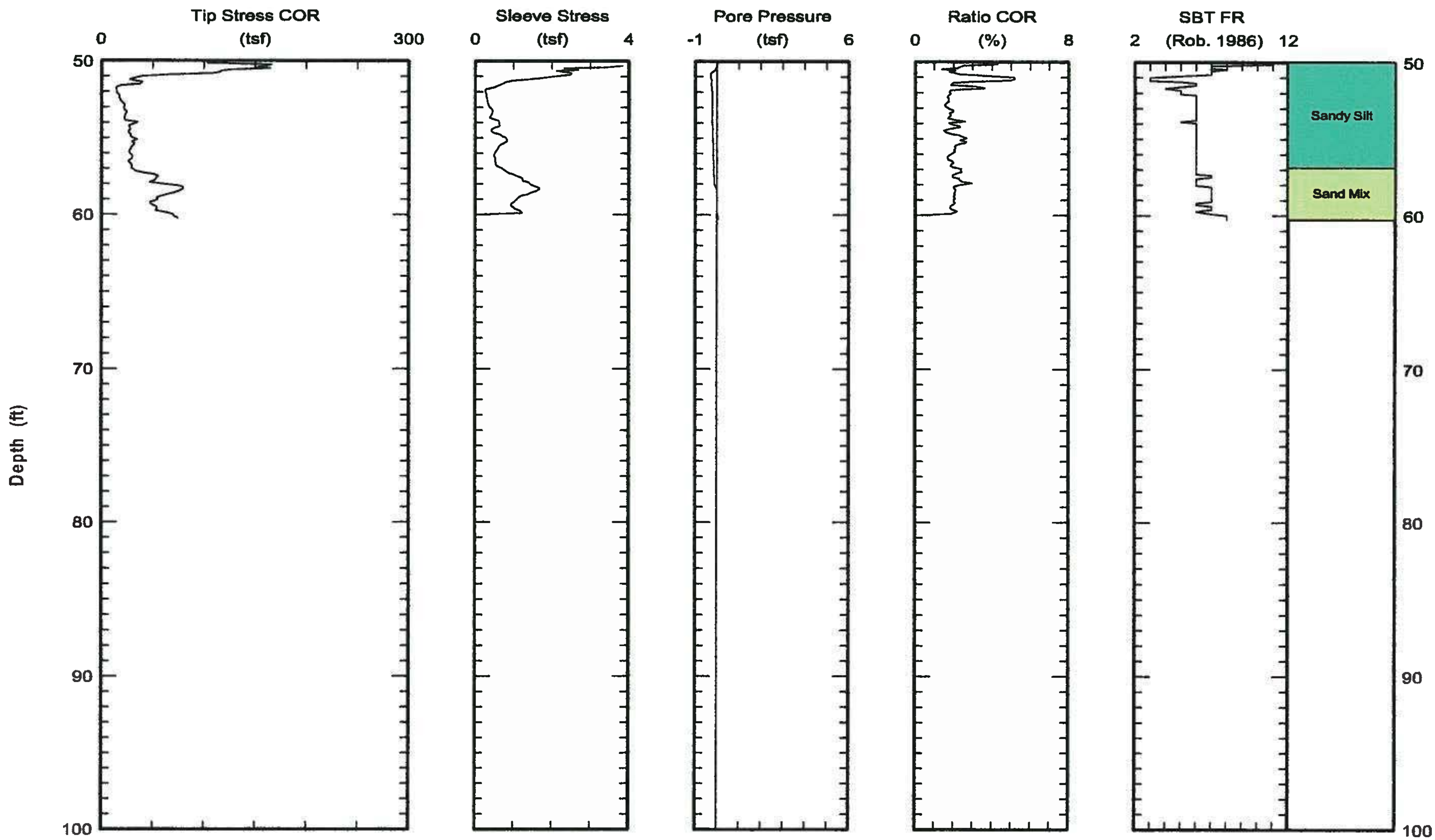

Maximum depth: 60.18 (ft)

| | | |
|---|---|---|
| Kehoe Testing & Engineering<br>Office: (714) 901-7270<br>Fax: (714) 901-7289<br>rich@kehoetesting.com<br>www.kehoetesting.com | CPT Data<br>30 ton rig | Date: 28/Jun/2012<br>Test ID: CPT-4<br>Project: LagunaHills |
| | Customer: Kleinfelder, Inc.<br>Job Site: Laguna Hills Mall | |




Maximum depth: 60.29 (ft)

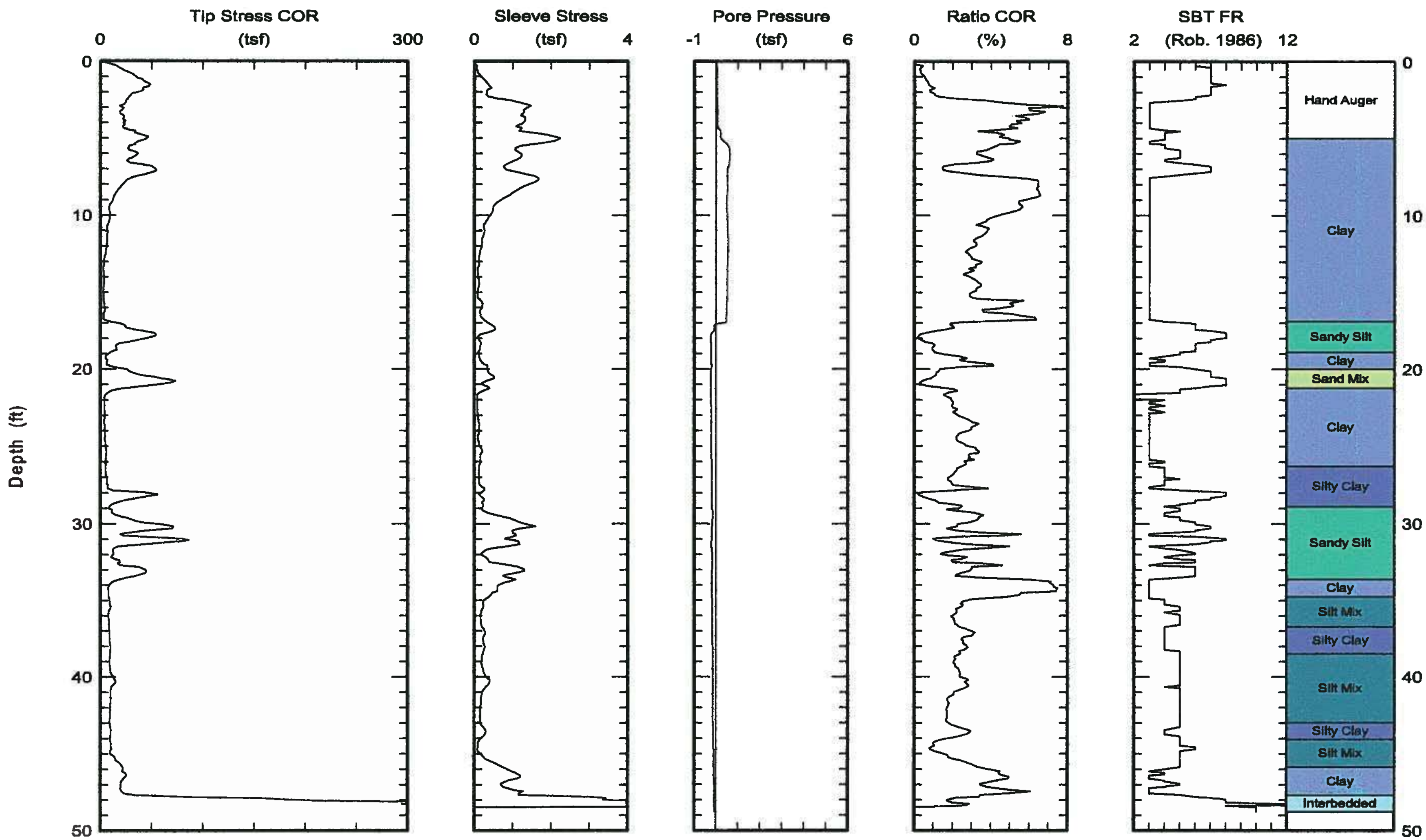
| Kehoe Testing & Engineering<br>Office: (714) 901-7270<br>Fax: (714) 901-7289<br>rich@kehoetesting.com<br>www.kehoetesting.com | CPT Data<br>30 ton rig | Date: 28/Jun/2012<br>Test ID: CPT-4<br>Project: LagunaHills |
|---|---|---|
| | Customer: Kleinfelder, Inc.<br>Job Site: Laguna Hills Mall | |




Maximum depth: 60.29 (ft)

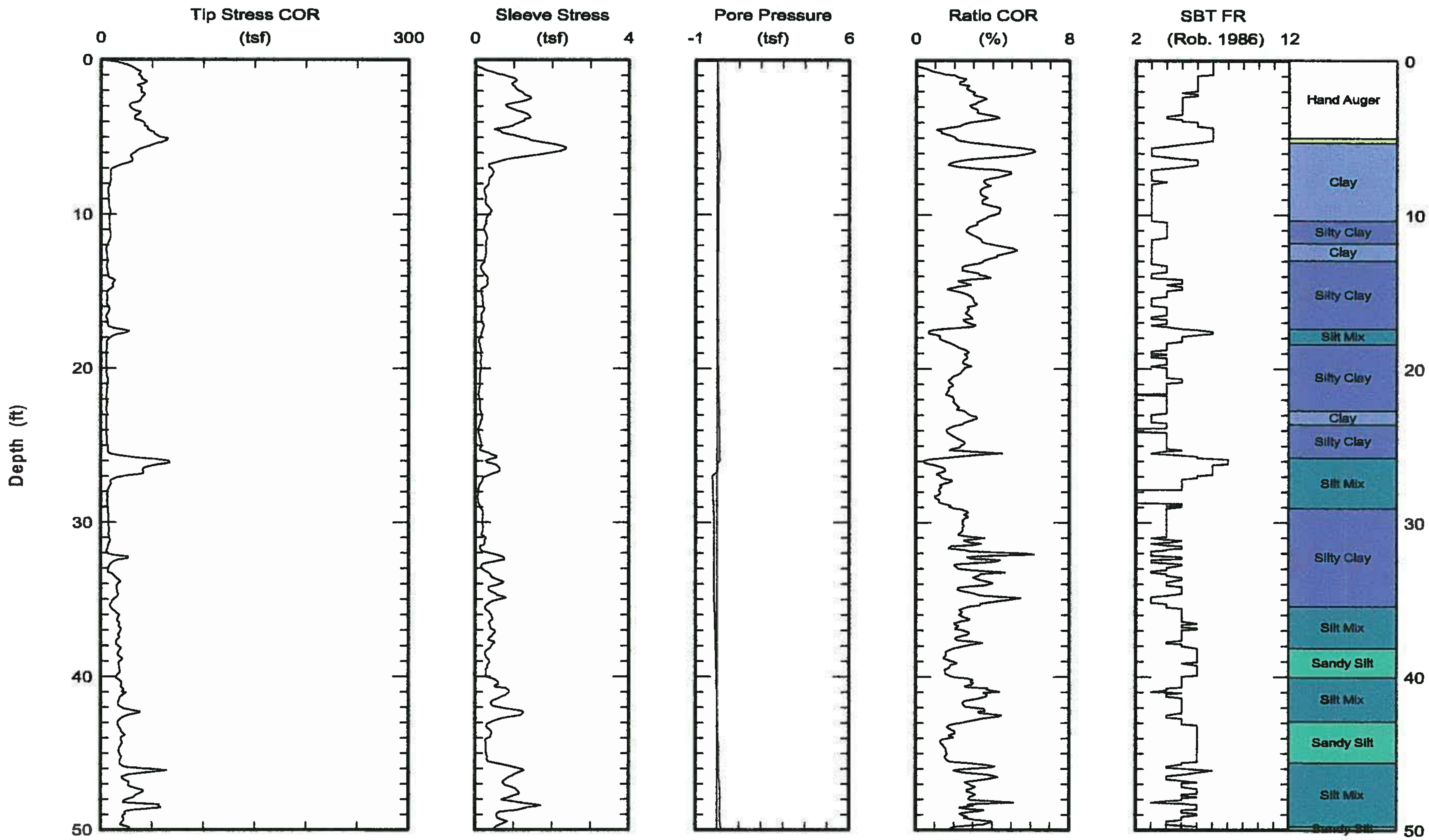
Page 2 of 2

| | | |
|---|---|---|
| Kehoe Testing & Engineering<br>Office: (714) 901-7270<br>Fax: (714) 901-7289<br>rich@kehoetesting.com<br>www.kehoetesting.com | CPT Data<br>30 ton rig | Date: 28/Jun/2012<br>Test ID: CPT-5<br>Project: LagunaHills |
| | Customer: Kleinfelder, Inc.<br>Job Site: Laguna Hills Mall | |



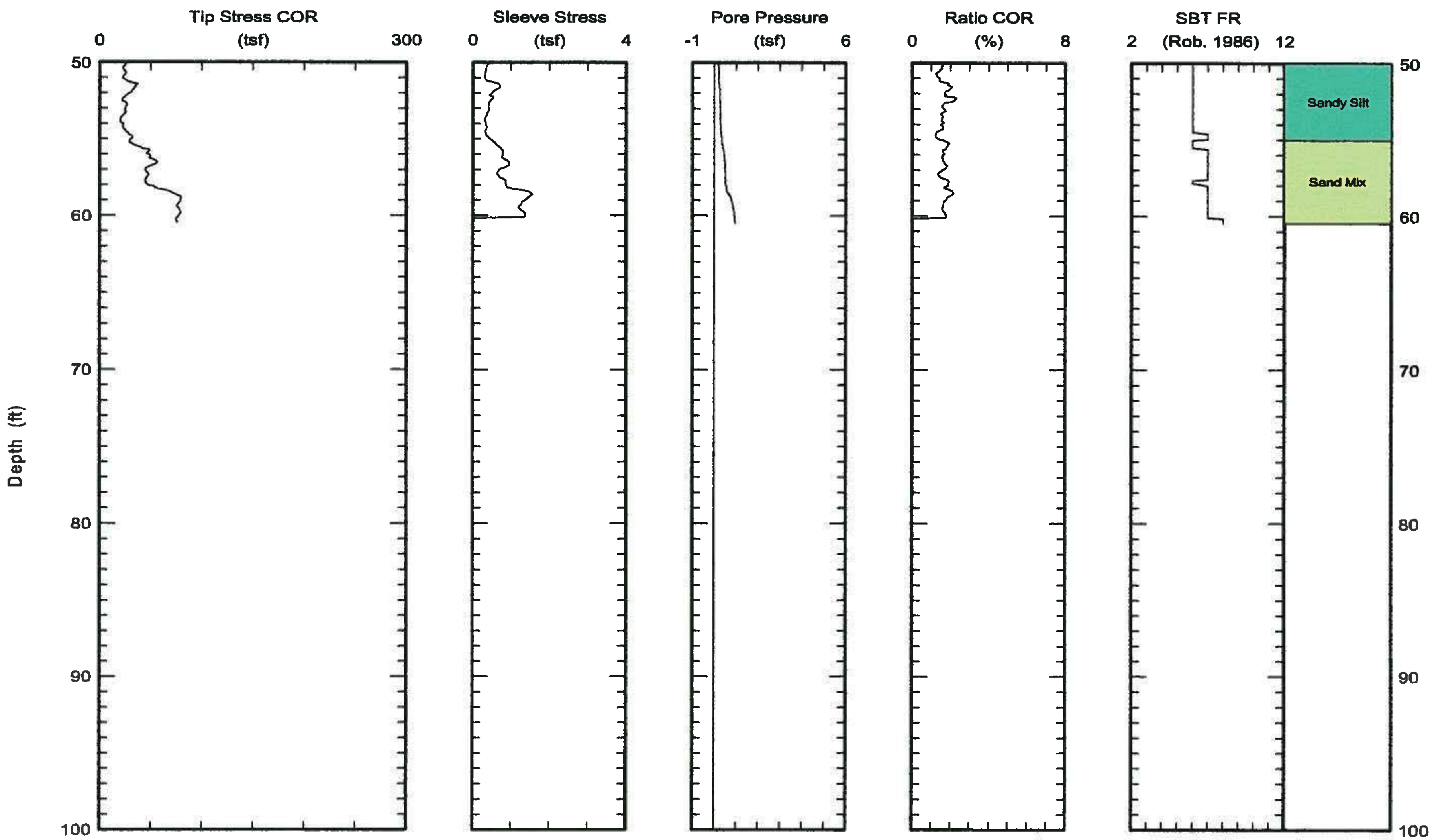

Maximum depth: 48.78 (ft)

| Kehoe Testing & Engineering<br>Office: (714) 901-7270<br>Fax: (714) 901-7289<br>rich@kehoetesting.com<br>www.kehoetesting.com | CPT Data<br>30 ton rig | Date: 28/Jun/2012<br>Test ID: CPT-6<br>Project: LagunaHills |
|---|---|---|
| | Customer: Kleinfelder, Inc.<br>Job Site: Laguna Hills Mall | |




Maximum depth: 60.47 (ft)

| Kehoe Testing & Engineering<br>Office: (714) 901-7270<br>Fax: (714) 901-7289<br>rich@kehoetesting.com<br>www.kehoetesting.com | CPT Data<br>30 ton rig | Date: 28/Jun/2012<br>Test ID: CPT-6<br>Project: LagunaHills |
|---|---|---|
| | Customer: Kleinfelder, Inc.<br>Job Site: Laguna Hills Mall | |



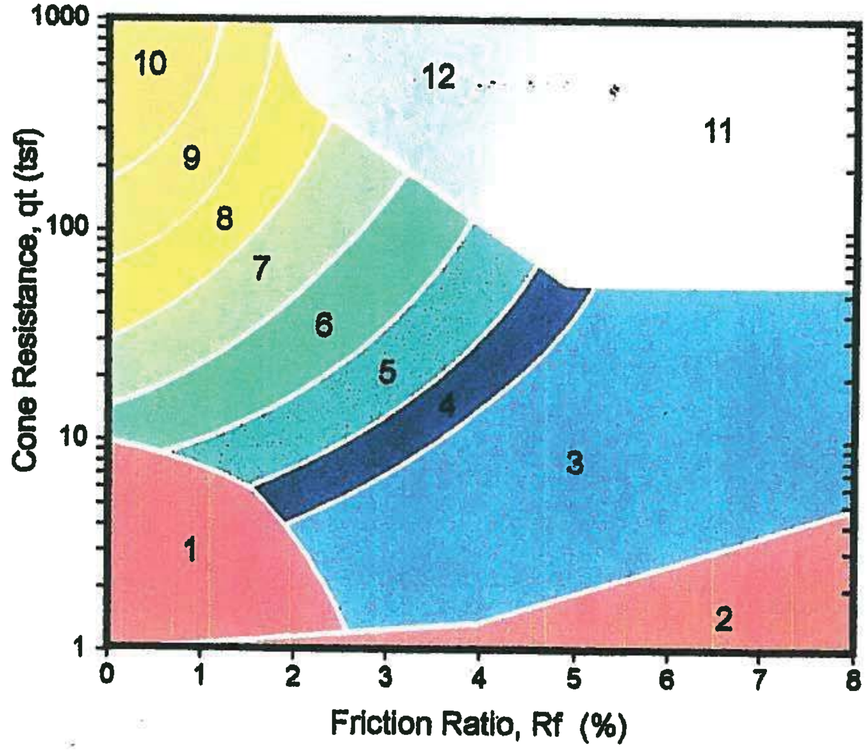

Maximum depth: 60.47 (ft)

Page 2 of 2

KEHOE TESTING & ENGINEERING

# CPT Classification Chart

(after Robertson and Campanella, 1988)




| Zone | $q_t$ / N | Soil Behavior Type | UCSCS |
|---|---|---|---|
| 1 | 2 | sensitive fine grained | OL-OH |
| 2 | 1 | organic material | Pt-OH |
| 3 | 1 | clay | CH |
| 4 | 1.5 | silty clay to clay | CL-CH |
| 5 | 2 | clayey silt to silty clay | ML-CL |
| 6 | 2.5 | sandy silt to clayey silt | MH-ML |
| 7 | 3 | silty sand to sandy silt | SM-ML |
| 8 | 4 | sand to silty sand | SP-SM |
| 9 | 5 | sand | SP |
| 10 | 6 | gravelly sand to sand | SW-SP |
| 11 | 1 | very stiff fine grained * | CL-MH |
| 12 | 2 | sand to clayey sand * | SP-SC |

* overconsolidated or cemented

# APPENDIX B
# Laboratory Testing

# APPENDIX B
# LABORATORY TESTING

## GENERAL

Laboratory tests were performed on selected samples as an aid in classifying the soils and to evaluate physical properties of the soils that may affect foundation design and construction procedures. The tests were performed in general conformance with the current ASTM or California Department of Transportation (Caltrans) standards. A description of the laboratory-testing program is presented below.

## MOISTURE AND UNIT WEIGHT

Moisture content and dry unit weight tests were performed on selected samples recovered from the boring. Moisture contents were determined in general accordance with ASTM Test Method D 2216; dry unit weight was calculated using the entire weight of the samples collected. Results of these tests are presented on the boring logs in Appendix A.

## WASH SIEVE

The percent passing the No. 200 sieve of selected soil samples was performed by wash sieving in accordance with ASTM Standard Test Method D1140. The results of the tests are presented on the boring logs in Appendix A.

## ATTERBERG LIMITS

Three Atterberg limits test were performed on soil samples to aid in classification and to evaluate the plasticity characteristics of the materials. The testing was performed in general accordance with ASTM Standard Test Method D4318. The result of these tests are presented on the boring logs in Appendix A.

## DIRECT SHEAR TEST

One select sample was subject to direct shear testing in order to evaluate the shear strength of the in-situ soils in accordance with ASTM Standard Test Method D3080. The tests were performed by AP Engineering and Testing, Inc. in Pomona, California. The results are attached to this appendix.

## UNCONSOLIDATED UNDRAINED TRIAXIAL TEST

Unconsolidated undrained triaxial shear testing was performed on several relatively undisturbed samples to assess the undrained strength properties and stress-strain relations for soils. The test was performed in accordance with ASTM Standard Test Method D2850. The tests were performed by AP Engineering and Testing, Inc. in Pomona, California. The results are attached to this appendix.

## CONSOLIDATION TESTS

Three consolidation tests were performed on selected undisturbed samples in accordance with ASTM D2435. The tests were performed on 1.0-inch-high, 2.41-inch diameter samples. After trimming the ends, the sample was placed in the consolidometer and an initial reading was recorded. The sample was saturated during loading, and thereafter, the sample was incrementally loaded and. The test results are attached.

## R-VALUE TESTS

One resistance value (R-value) test was performed on bulk soil samples obtained within the proposed parking areas to evaluate pavement support characteristics of the near-surface onsite soils. R-value tests were performed in accordance with Caltrans Standard Test Method 301. The test results are attached.

## EXPANSION INDEX

Expansion index testing was performed on one bulk sample of the near-surface soils to evaluate its expansion characteristics. The test was performed in accordance with ASTM 4829. The test results are presented on Table B-1, Expansion Index Test Results. The report provides recommendations for remediating the risk of the shrink/swell potential of these soils.

**Table B-1**
**Expansion Index Test Results**

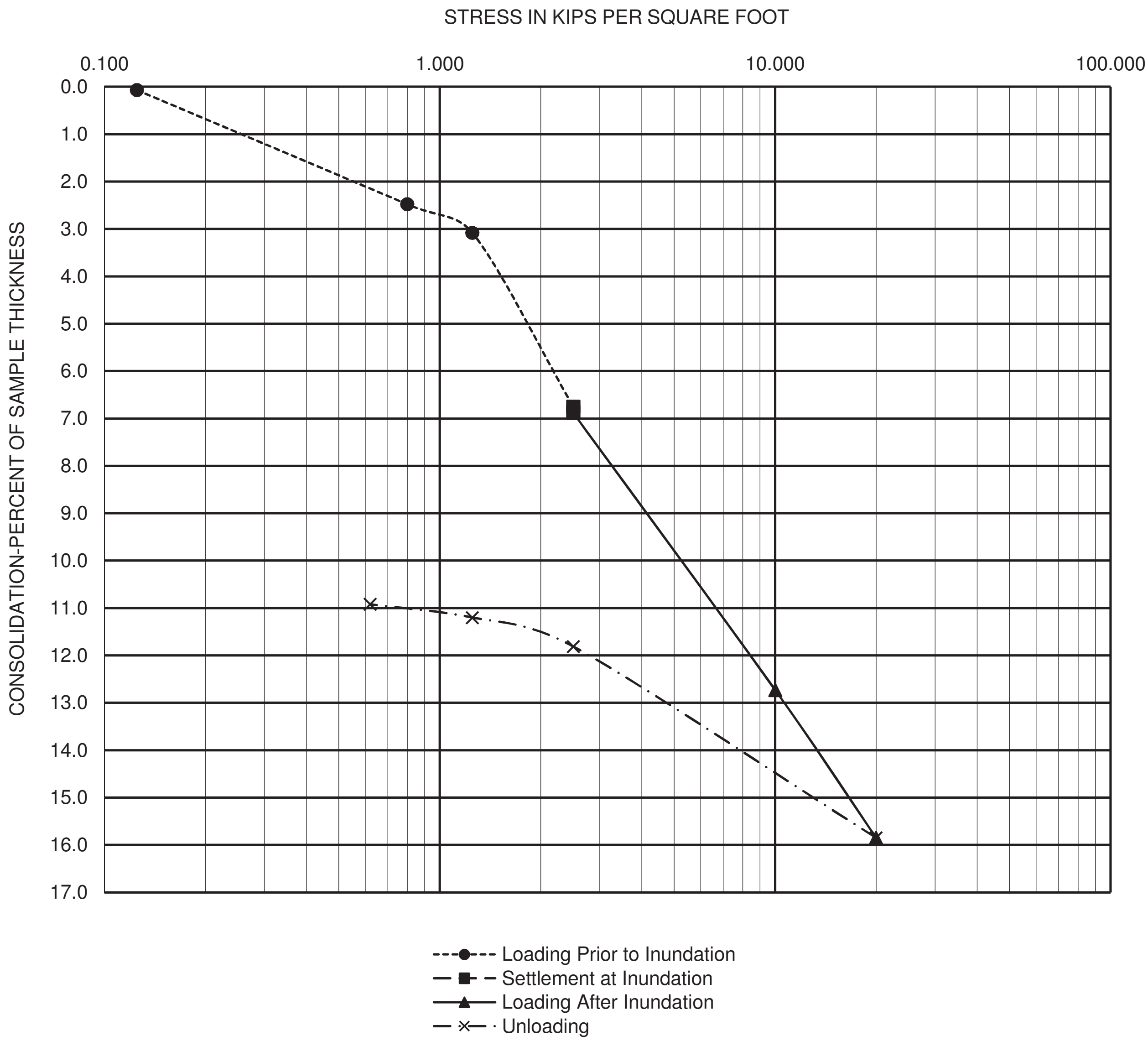
| Boring | Depth (ft.) | Expansion Index | Severity of Problem |
|---|---|---|---|
| B-5 | 1 – 5 | 62 | Medium |

## SOIL CORROSIVITY TESTS

A series of chemical tests were performed on selected samples of the near-surface soils to estimate pH and minimum resistivity, soluble chlorides, and soluble sulfates, respectively. The tests were performed by AP Engineering and Testing of Pomona, California. Test results may be used by a qualified corrosion engineer to evaluate the general corrosion potential with respect to construction materials. The results of the tests are presented in Table 13 of Section 4.14 of the report and are attached to this appendix.

# APPENDIX B

## Laboratory Testing




| SAMPLE IDENTIFICATION | | | SOIL CLASSIFICATION |
|---|---|---|---|
| BORING NO. | SAMPLE NO. | DEPTH (ft.) | |
| KB-8 | 3 | 10 | Reddish Brown Sandy CLAY (CL) |

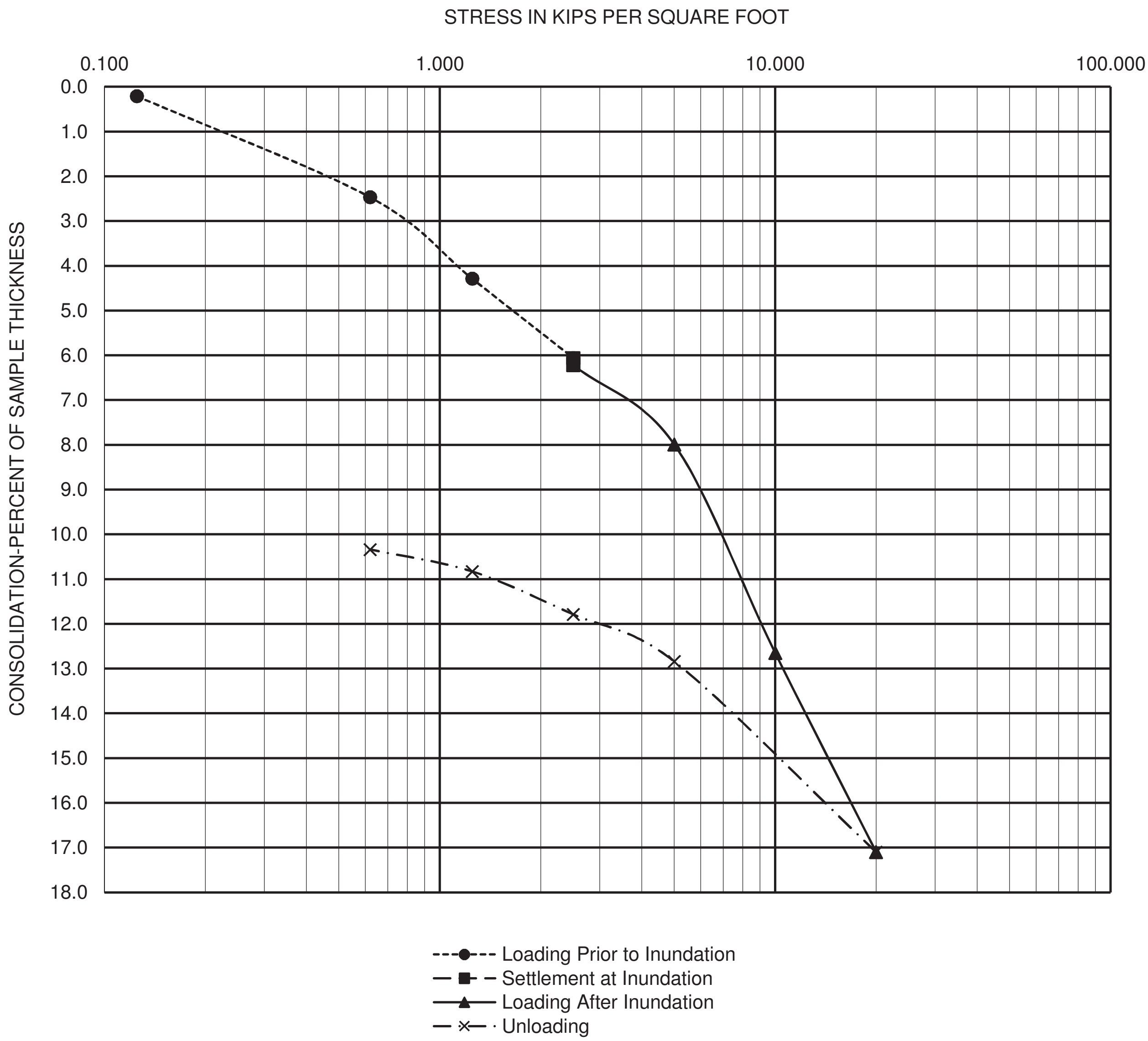
**INITIAL MOISTURE (%):** 23.7

**INITIAL DRY DENSITY (PCF):** 93.5

**FINAL MOISTURE(%):** 23.4

Testing performed in general accordance with ASTM D2435/D2435M - 11

| KLEINFELDER Bright People. Right Solutions. | PROJECT NO.:20155150<br>TESTED BY: ELF<br>DATE: 4/21/15<br>CHECKED BY:<br>DATE: | CONSOLIDATION TEST<br><br>Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | PLATE<br><br>B-1 |
|---|---|---|---|




| SAMPLE IDENTIFICATION | | | SOIL CLASSIFICATION |
|---|---|---|---|
| **BORING NO.** | **SAMPLE NO.** | **DEPTH (ft.)** | |
| KB-10 | 17 | 75 | SILT with Clay (CL) |

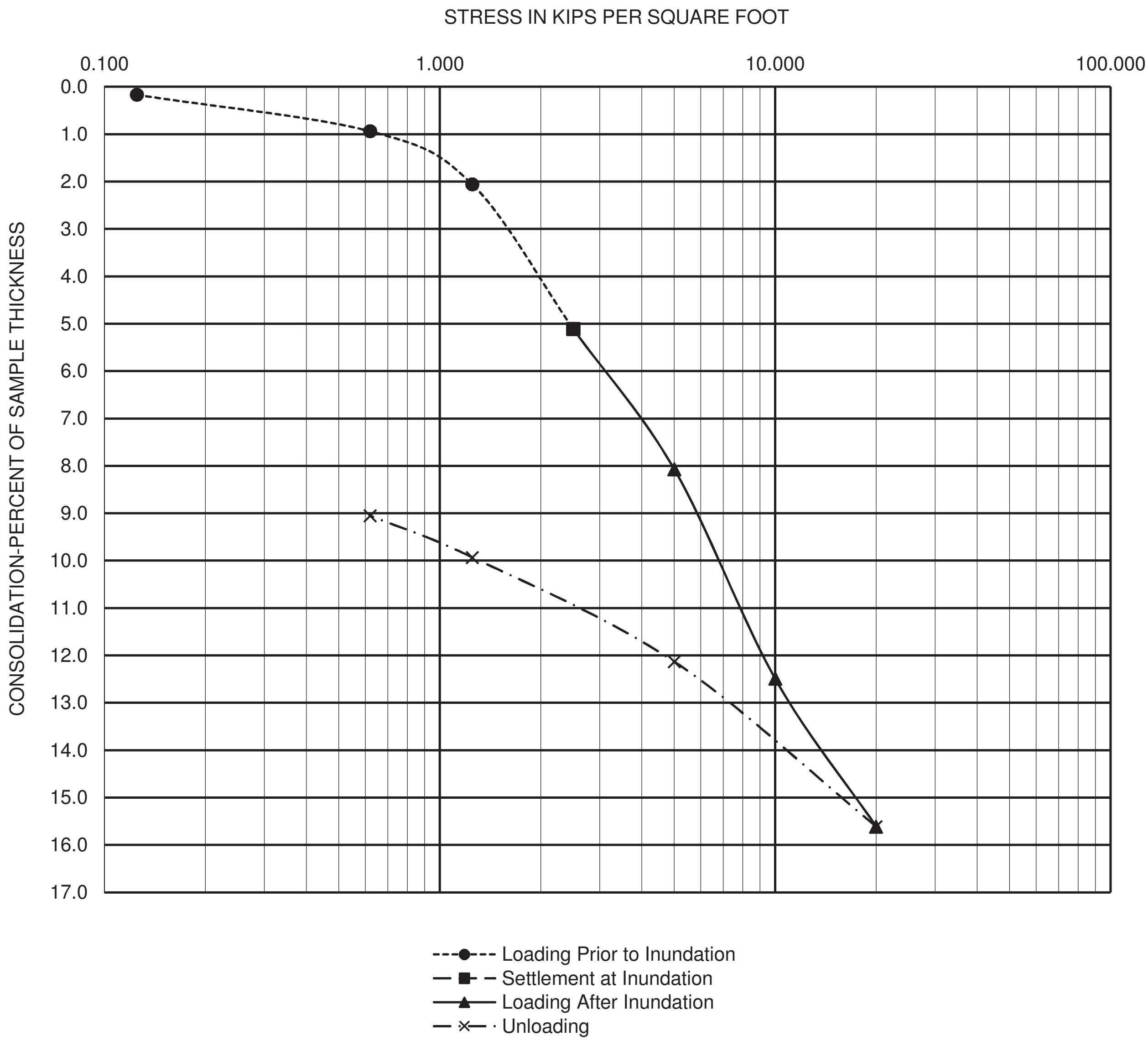
**INITIAL MOISTURE (%):** 22.5

**INITIAL DRY DENSITY (PCF):** 97.2

**FINAL MOISTURE(%):** 22.1

Testing performed in general accordance with ASTM D2435/D2435M - 11

| KLEINFELDER Bright People. Right Solutions. | PROJECT NO.:20155150<br>TESTED BY: ELF<br>DATE: 4/21/15<br>CHECKED BY:<br>DATE: | CONSOLIDATION TEST<br><br>Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | PLATE<br><br>B-2 |
|---|---|---|---|




| SAMPLE IDENTIFICATION | | | SOIL CLASSIFICATION |
|---|---|---|---|
| BORING NO. | SAMPLE NO. | DEPTH (ft.) | |
| KB-12 | 3 | 20 | CLAY with Silt (CL) |

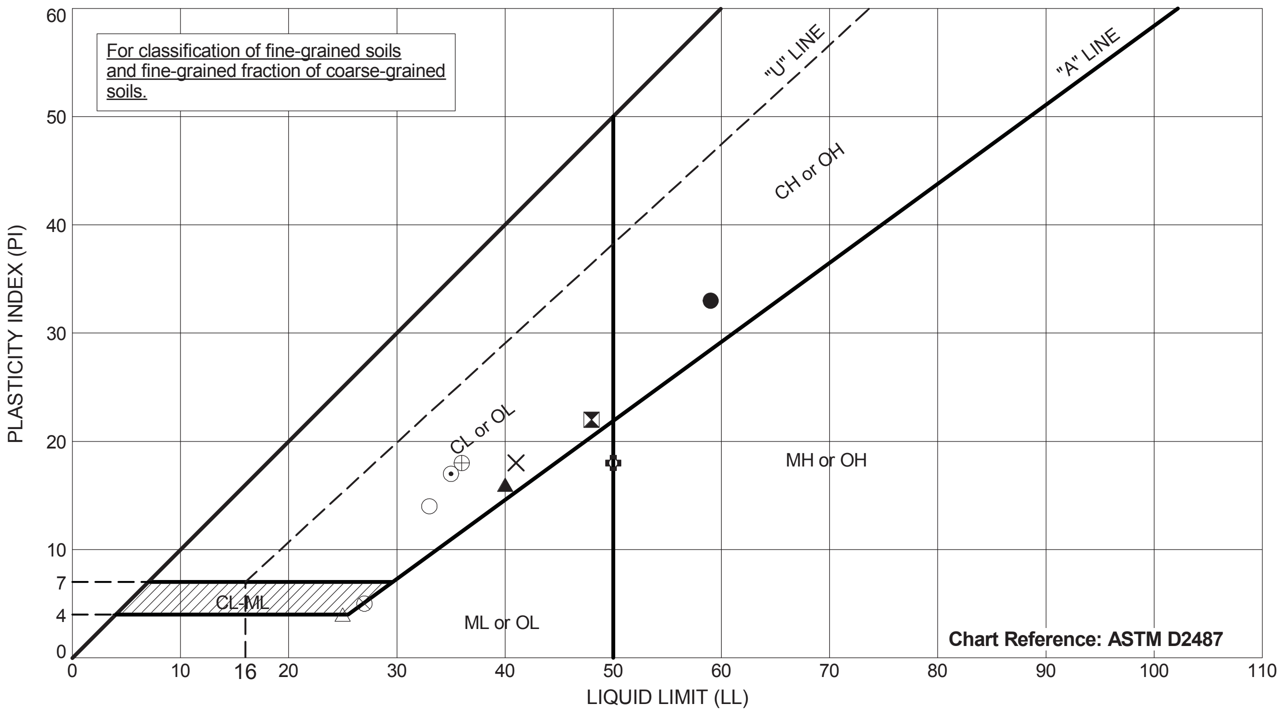
**INITIAL MOISTURE (%):** 21.2

**INITIAL DRY DENSITY (PCF):** 98.2

**FINAL MOISTURE(%):** 20.9

Testing performed in general accordance with ASTM D2435/D2435M - 11

| KLEINFELDER Bright People. Right Solutions. | PROJECT NO.:20155150<br>TESTED BY: ELF<br>DATE: 4/21/15<br>CHECKED BY:<br>DATE: | CONSOLIDATION TEST<br><br>Five Lagunas Redevelopment<br>24155 Laguna Hills Mall<br>Laguna Hills, CA | PLATE<br><br>B-3 |
|---|---|---|---|




| Exploration ID | Depth (ft.) | Sample Description | Passing #200 | LL | PL | PI |
|---|---|---|---|---|---|---|
| ● KB-5 | 15 | FAT CLAY (CH) | NM | 59 | 26 | 33 |
| ⧗ KB-5 | 35 | SANDY LEAN CLAY (CL) | NM | 48 | 26 | 22 |
| ▲ KB-6 | 25 | SANDY LEAN CLAY (CL) | NM | 40 | 24 | 16 |
| × KB-7 | 10 | SANDY LEAN CLAY (CL) | NM | 41 | 23 | 18 |
| ⊙ KB-8 | 20 | SANDY LEAN CLAY (CL) | NM | 35 | 18 | 17 |
| ✪ KB-8 | 50 | SILT (ML) | NM | 50 | 32 | 18 |
| ○ KB-10 | 5 | SANDY LEAN CLAY (CL) | 52 | 33 | 19 | 14 |
| △ KB-10 | 45 | SILTY CLAY (CL-ML) | NM | 25 | 21 | 4 |
| ⊗ KB-11 | 20 | SILTY CLAY (CL-ML) | NM | 27 | 22 | 5 |
| ⊕ KC-2 | 2 | LEAN CLAY (CL) | NM | 36 | 18 | 18 |

Testing perfomed in general accordance with ASTM D4318.
NP = Nonplastic
NM = Not Measured

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20155150
DRAWN BY: DC
CHECKED BY: MS
DATE: 4/29/2015
REVISED: -

ATTERBERG LIMITS

Five Lagunas Redevelopment
24155 Laguna Hills Mall
Laguna Hills, CA

PLATE
B-4

AP Engineering and Testing, Inc.
MBE • DBE • SBE
www.aplaboratory.com
2607 Pomona Boulevard
Pomona, CA 91768
T 909.869.6316 • F 909.869.6318

# CORROSION TEST RESULTS

Client Name: Kleinfelder
Project Name: 5 Lagunas
Project No.: 20155150

AP Job No.: 15-0445
Date 04/24/15

| Boring No. | Sample No. | Depth (feet) | Soil Type | Minimum Resistivity (ohm-cm) | pH | Sulfate Content (ppm) | Chloride Content (ppm) |
|---|---|---|---|---|---|---|---|
| KB-12 | 17 | 75 | CL-ML | 730 | 7.7 | 1999 | 113 |
| KCPT-5 | - | 3-5 | CL | 812 | 8.0 | 520 | 33 |

NOTES:
Resistivity Test and pH: California Test Method 643
Sulfate Content : California Test Method 417
Chloride Content : California Test Method 422
ND = Not Detectable
NA = Not Sufficient Sample
NR = Not Requested

PLATE
B-5

AP Engineering and Testing, Inc.
MBE • DBE • SBE
www.aplaboratory.com
2607 Pomona Boulevard
Pomona, CA 91768
T 909.869.6316 • F 909.869.6318

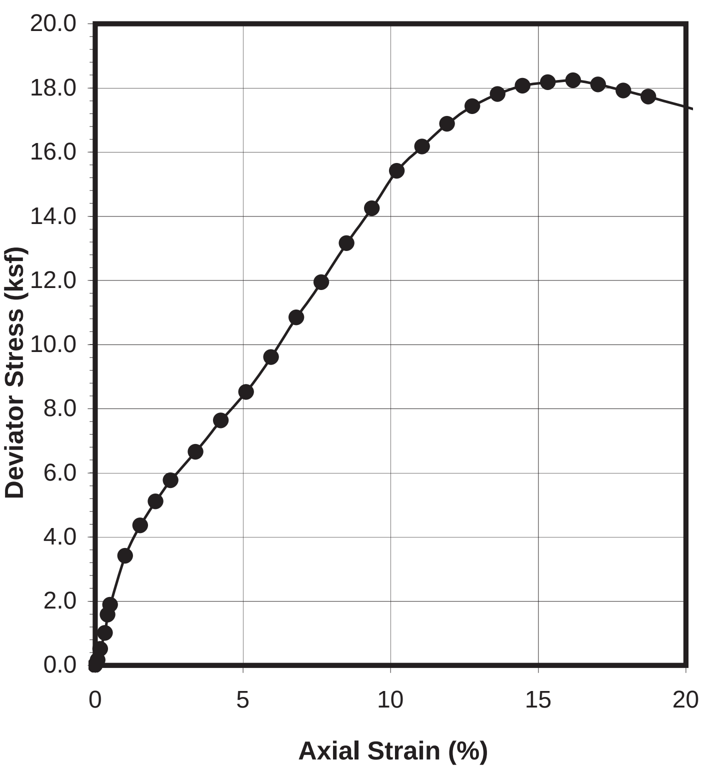
# UNCONSOLIDATED UNDRAINED TRIAXIAL TEST (UU,Q)
## ASTM D 2850

| | | | | | |
|---|---|---|---|---|---|
| Client Name: | Kleinfelder | Tested By: | ST | Date: | 04/24/15 |
| Project Name: | 5 Lagunas | Checked by: | AP | Date: | 04/28/15 |
| Project No.: | 20155150 | | | | |
| Boring No.: | KB-6 | | | | |
| Sample No.: | 10 | Depth (feet): | 40 | | |
| Soil Description | Silty Clay | Sample Type: | Mod. Cal. | | |

| | | | |
|---|---|---|---|
| Sample Diameter (inch): | 2.408 | Wet Unit Weight (pcf): | 122.7 |
| Sample Hieght (inch): | 5.871 | Dry Unit Weight (pcf): | 98.4 |
| Sample Weight (gms): | 861.89 | Moisture Content (%): | 24.8 |
| Wt. Wet Soil+Container(gms) | 1007.83 | Void Ratio for Gs=2.7: | 0.71 |
| Wt. Dry Soil+Container(gms) | 837.05 | % Saturation: | 93.8 |
| Wt. Container (gms) | 147.24 | | |

## TEST DATA

| | |
|---|---|
| Cell Pressure (ksf): | 4.88 |
| Back Pressure (ksf): | 0.0 |
| Eff. Confining Pressure (ksf): | 4.88 |
| Shear Rate (%/min): | 0.3 |
| Maximum Deviator Stress (ksf): | 18.23 |
| Ultimate Deviator Stress (ksf): | 17.28 |
| Ultimate Undrained Shear Strength (ksf): | 8.64 |
| Axial Strain @ Maximum Stress (%) | 16.18 |




| Load (lbs) | Def. (inch) | Area (sq.in) | Deviator Stress (ksf) | Axial Strain (%) |
|---|---|---|---|---|
| 0 | 0.000 | 4.55 | 0.00 | 0.00 |
| 5 | 0.005 | 4.56 | 0.16 | 0.09 |
| 16 | 0.010 | 4.56 | 0.51 | 0.17 |
| 32 | 0.020 | 4.57 | 1.01 | 0.34 |
| 50 | 0.025 | 4.57 | 1.57 | 0.43 |
| 60 | 0.030 | 4.58 | 1.89 | 0.51 |
| 109 | 0.060 | 4.60 | 3.41 | 1.02 |
| 140 | 0.090 | 4.63 | 4.36 | 1.53 |
| 165 | 0.120 | 4.65 | 5.11 | 2.04 |
| 187 | 0.150 | 4.67 | 5.76 | 2.55 |
| 218 | 0.200 | 4.71 | 6.66 | 3.41 |
| 252 | 0.250 | 4.76 | 7.63 | 4.26 |
| 284 | 0.300 | 4.80 | 8.52 | 5.11 |
| 323 | 0.350 | 4.84 | 9.60 | 5.96 |
| 368 | 0.400 | 4.89 | 10.84 | 6.81 |
| 409 | 0.450 | 4.93 | 11.94 | 7.66 |
| 455 | 0.500 | 4.98 | 13.16 | 8.52 |
| 497 | 0.550 | 5.02 | 14.24 | 9.37 |
| 543 | 0.600 | 5.07 | 15.41 | 10.22 |
| 575 | 0.650 | 5.12 | 16.17 | 11.07 |
| 606 | 0.700 | 5.17 | 16.88 | 11.92 |
| 632 | 0.750 | 5.22 | 17.43 | 12.77 |
| 652 | 0.800 | 5.27 | 17.81 | 13.63 |
| 668 | 0.850 | 5.33 | 18.06 | 14.48 |
| 679 | 0.900 | 5.38 | 18.18 | 15.33 |
| 688 | 0.950 | 5.43 | 18.23 | 16.18 |
| 690 | 1.000 | 5.49 | 18.10 | 17.03 |
| 690 | 1.050 | 5.55 | 17.92 | 17.88 |
| 690 | 1.100 | 5.60 | 17.73 | 18.74 |
| 687 | 1.200 | 5.72 | 17.28 | 20.44 |

PLATE

B-6

AP Engineering and Testing, Inc.
MBE • DBE • SBE
www.aplaboratory.com
2607 Pomona Boulevard
Pomona, CA 91768
T 909.869.6316 • F 909.869.6318

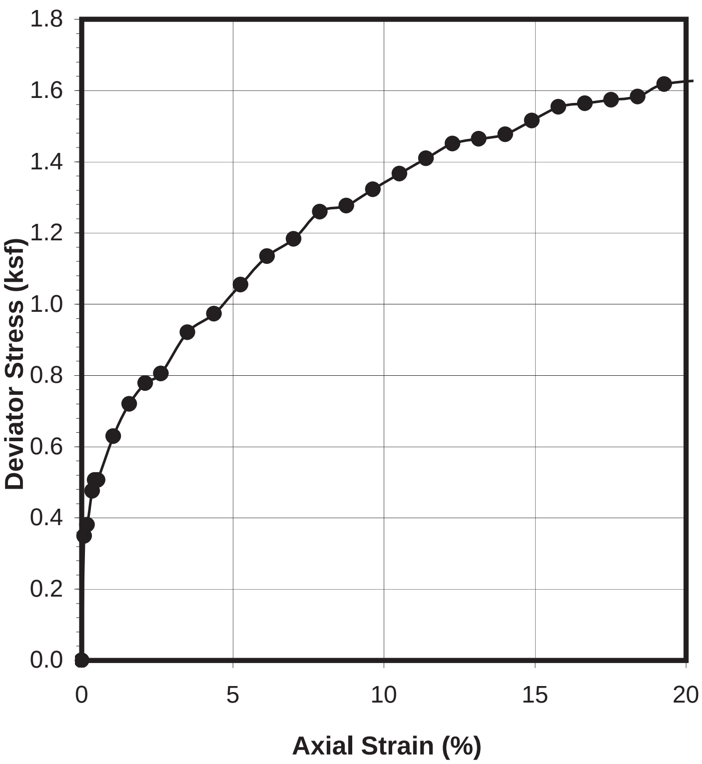
# UNCONSOLIDATED UNDRAINED TRIAXIAL TEST (UU,Q)
## ASTM D 2850

| | | | |
|---|---|---|---|
| Client Name: | Kleinfelder | Tested By: | ST |
| | | Date: | 04/24/15 |
| Project Name: | 5 Lagunas | Checked by: | AP |
| | | Date: | 04/28/15 |
| Project No.: | 20155150 | | |
| Boring No.: | KB-10 | | |
| Sample No.: | 6 | Depth (feet): | 20 |
| Soil Description | Sandy Clay | Sample Type: | Mod. Cal. |

| | | | |
|---|---|---|---|
| Sample Diameter (inch): | 2.401 | Wet Unit Weight (pcf): | 120.6 |
| Sample Hieght (inch): | 5.705 | Dry Unit Weight (pcf): | 90.7 |
| Sample Weight (gms): | 818.44 | Moisture Content (%): | 32.9 |
| Wt. Wet Soil+Container(gms) | 957.35 | Void Ratio for Gs=2.7: | 0.86 |
| Wt. Dry Soil+Container(gms) | 755.03 | % Saturation: | 103.8 |
| Wt. Container (gms) | 140.63 | | |

## TEST DATA

| | |
|---|---|
| Cell Pressure (ksf): | 2.39 |
| Back Pressure (ksf): | 0.0 |
| Eff. Confining Pressure (ksf): | 2.39 |
| Shear Rate (%/min): | 0.3 |
| Maximum Deviator Stress (ksf): | 1.63 |
| Ultimate Deviator Stress (ksf): | 1.63 |
| Ultimate Undrained Shear Strength (ksf): | 0.82 |
| Axial Strain @ Maximum Stress (%) | 21.03 |




| Load (lbs) | Def. (inch) | Area (sq.in) | Deviator Stress (ksf) | Axial Strain (%) |
|---|---|---|---|---|
| 0 | 0.000 | 4.53 | 0.00 | 0.00 |
| 11 | 0.005 | 4.53 | 0.35 | 0.09 |
| 12 | 0.010 | 4.54 | 0.38 | 0.18 |
| 15 | 0.020 | 4.54 | 0.48 | 0.35 |
| 16 | 0.025 | 4.55 | 0.51 | 0.44 |
| 16 | 0.030 | 4.55 | 0.51 | 0.53 |
| 20 | 0.060 | 4.58 | 0.63 | 1.05 |
| 23 | 0.090 | 4.60 | 0.72 | 1.58 |
| 25 | 0.120 | 4.62 | 0.78 | 2.10 |
| 26 | 0.150 | 4.65 | 0.81 | 2.63 |
| 30 | 0.200 | 4.69 | 0.92 | 3.51 |
| 32 | 0.250 | 4.74 | 0.97 | 4.38 |
| 35 | 0.300 | 4.78 | 1.05 | 5.26 |
| 38 | 0.350 | 4.82 | 1.13 | 6.13 |
| 40 | 0.400 | 4.87 | 1.18 | 7.01 |
| 43 | 0.450 | 4.92 | 1.26 | 7.89 |
| 44 | 0.500 | 4.96 | 1.28 | 8.76 |
| 46 | 0.550 | 5.01 | 1.32 | 9.64 |
| 48 | 0.600 | 5.06 | 1.37 | 10.52 |
| 50 | 0.650 | 5.11 | 1.41 | 11.39 |
| 52 | 0.700 | 5.16 | 1.45 | 12.27 |
| 53 | 0.750 | 5.21 | 1.46 | 13.15 |
| 54 | 0.800 | 5.27 | 1.48 | 14.02 |
| 56 | 0.850 | 5.32 | 1.52 | 14.90 |
| 58 | 0.900 | 5.38 | 1.55 | 15.78 |
| 59 | 0.950 | 5.43 | 1.56 | 16.65 |
| 60 | 1.000 | 5.49 | 1.57 | 17.53 |
| 61 | 1.050 | 5.55 | 1.58 | 18.40 |
| 63 | 1.100 | 5.61 | 1.62 | 19.28 |
| 65 | 1.200 | 5.73 | 1.63 | 21.03 |

AP Engineering and Testing, Inc.
MBE • DBE • SBE
www.aplaboratory.com
2607 Pomona Boulevard
Pomona, CA 91768
T 909.869.6316 • F 909.869.6318

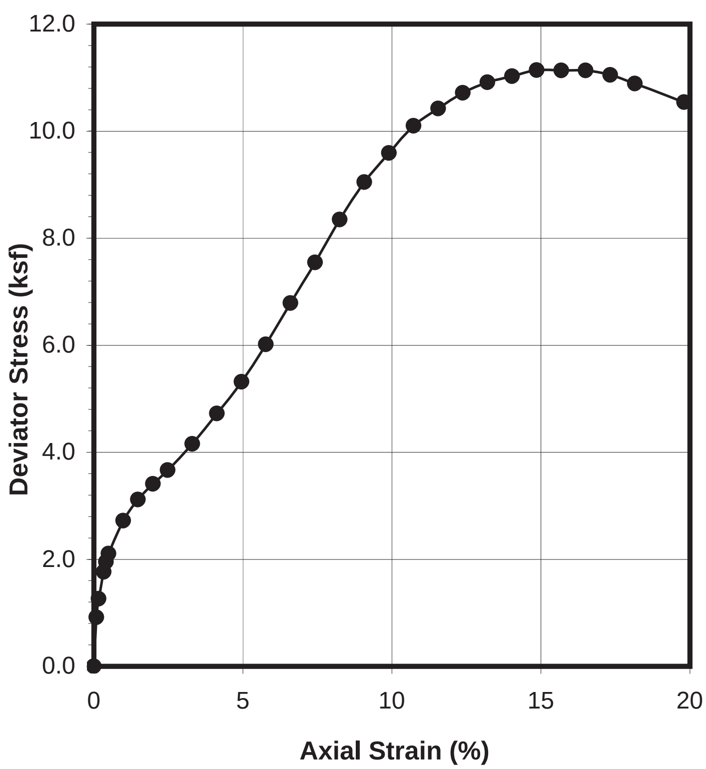
# UNCONSOLIDATED UNDRAINED TRIAXIAL TEST (UU,Q)
## ASTM D 2850

| | | | | | |
|---|---|---|---|---|---|
| Client Name: | Kleinfelder | Tested By: | ST | Date: | 04/24/15 |
| Project Name: | 5 Lagunas | Checked by: | AP | Date: | 04/28/15 |
| Project No.: | 20155150 | | | | |
| Boring No.: | KB-11 | | | | |
| Sample No.: | 11 | Depth (feet): | 45 | | |
| Soil Description | Silty Clay | Sample Type: | Mod. Cal. | | |

| | | | |
|---|---|---|---|
| Sample Diameter (inch): | 2.409 | Wet Unit Weight (pcf): | 114.4 |
| Sample Hieght (inch): | 6.058 | Dry Unit Weight (pcf): | 84.6 |
| Sample Weight (gms): | 830.01 | Moisture Content (%): | 35.3 |
| Wt. Wet Soil+Container(gms) | 979.60 | Void Ratio for Gs=2.7: | 0.99 |
| Wt. Dry Soil+Container(gms) | 763.53 | % Saturation: | 96.0 |
| Wt. Container (gms) | 150.81 | | |

## TEST DATA

| | |
|---|---|
| Cell Pressure (ksf): | 5.13 |
| Back Pressure (ksf): | 0.0 |
| Eff. Confining Pressure (ksf): | 5.13 |
| Shear Rate (%/min): | 0.3 |
| Maximum Deviator Stress (ksf): | 11.14 |
| Ultimate Deviator Stress (ksf): | 10.54 |
| Ultimate Undrained Shear Strength (ksf): | 5.27 |
| Axial Strain @ Maximum Stress (%) | 14.86 |




| Load (lbs) | Def. (inch) | Area (sq.in) | Deviator Stress (ksf) | Axial Strain (%) |
|---|---|---|---|---|
| 0 | 0.000 | 4.56 | 0.00 | 0.00 |
| 29 | 0.005 | 4.56 | 0.92 | 0.08 |
| 40 | 0.010 | 4.57 | 1.26 | 0.17 |
| 56 | 0.020 | 4.57 | 1.76 | 0.33 |
| 62 | 0.025 | 4.58 | 1.95 | 0.41 |
| 67 | 0.030 | 4.58 | 2.11 | 0.50 |
| 87 | 0.060 | 4.60 | 2.72 | 0.99 |
| 100 | 0.090 | 4.63 | 3.11 | 1.49 |
| 110 | 0.120 | 4.65 | 3.41 | 1.98 |
| 119 | 0.150 | 4.67 | 3.67 | 2.48 |
| 136 | 0.200 | 4.71 | 4.15 | 3.30 |
| 156 | 0.250 | 4.75 | 4.73 | 4.13 |
| 177 | 0.300 | 4.80 | 5.32 | 4.95 |
| 202 | 0.350 | 4.84 | 6.01 | 5.78 |
| 230 | 0.400 | 4.88 | 6.79 | 6.60 |
| 258 | 0.450 | 4.92 | 7.55 | 7.43 |
| 288 | 0.500 | 4.97 | 8.35 | 8.25 |
| 315 | 0.550 | 5.01 | 9.05 | 9.08 |
| 337 | 0.600 | 5.06 | 9.59 | 9.90 |
| 358 | 0.650 | 5.11 | 10.10 | 10.73 |
| 373 | 0.700 | 5.15 | 10.42 | 11.55 |
| 387 | 0.750 | 5.20 | 10.71 | 12.38 |
| 398 | 0.800 | 5.25 | 10.91 | 13.21 |
| 406 | 0.850 | 5.30 | 11.03 | 14.03 |
| 414 | 0.900 | 5.35 | 11.14 | 14.86 |
| 418 | 0.950 | 5.41 | 11.14 | 15.68 |
| 422 | 1.000 | 5.46 | 11.13 | 16.51 |
| 423 | 1.050 | 5.51 | 11.05 | 17.33 |
| 421 | 1.100 | 5.57 | 10.89 | 18.16 |
| 416 | 1.200 | 5.68 | 10.54 | 19.81 |

PLATE

B-8

AP Engineering and Testing, Inc.
MBE • DBE • SBE
www.aplaboratory.com
2607 Pomona Boulevard
Pomona, CA 91768
T 909.869.6316 • F 909.869.6318

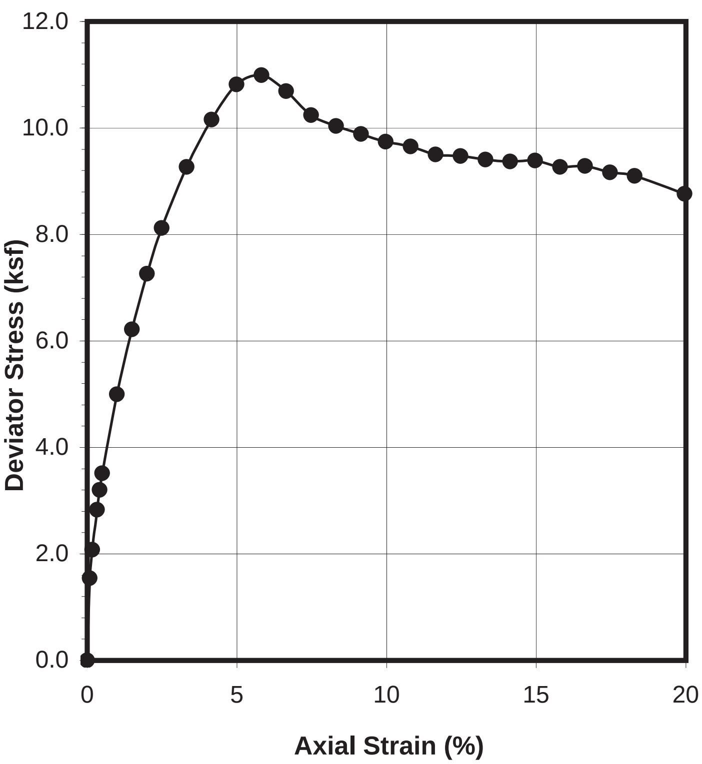
# UNCONSOLIDATED UNDRAINED TRIAXIAL TEST (UU,Q)
## ASTM D 2850

| | | | | | |
|---|---|---|---|---|---|
| Client Name: | Kleinfelder | Tested By: | ST | Date: | 04/24/15 |
| Project Name: | 5 Lagunas | Checked by: | AP | Date: | 04/28/15 |
| Project No.: | 20155150 | | | | |
| Boring No.: | KB-12 | | | | |
| Sample No.: | 18 | Depth (feet): | 80 | | |
| Soil Description | Clay | Sample Type: | Mod. Cal. | | |

| | | | |
|---|---|---|---|
| Sample Diameter (inch): | 2.411 | Wet Unit Weight (pcf): | 97.2 |
| Sample Hieght (inch): | 6.013 | Dry Unit Weight (pcf): | 58.8 |
| Sample Weight (gms): | 700.55 | Moisture Content (%): | 65.1 |
| Wt. Wet Soil+Container(gms) | 844.86 | Void Ratio for Gs=2.7: | 1.86 |
| Wt. Dry Soil+Container(gms) | 570.75 | % Saturation: | 94.3 |
| Wt. Container (gms) | 149.71 | | |

## TEST DATA

| | |
|---|---|
| Cell Pressure (ksf): | 7.75 |
| Back Pressure (ksf): | 0.0 |
| Eff. Confining Pressure (ksf): | 7.75 |
| Shear Rate (%/min): | 0.3 |
| Maximum Deviator Stress (ksf): | 10.99 |
| Ultimate Deviator Stress (ksf): | 8.76 |
| Ultimate Undrained Shear Strength (ksf): | 4.38 |
| Axial Strain @ Maximum Stress (%) | 5.82 |




| Load (lbs) | Def. (inch) | Area (sq.in) | Deviator Stress (ksf) | Axial Strain (%) |
|---|---|---|---|---|
| 0 | 0.000 | 4.57 | 0.00 | 0.00 |
| 49 | 0.005 | 4.57 | 1.54 | 0.08 |
| 66 | 0.010 | 4.57 | 2.08 | 0.17 |
| 90 | 0.020 | 4.58 | 2.83 | 0.33 |
| 102 | 0.025 | 4.58 | 3.20 | 0.42 |
| 112 | 0.030 | 4.59 | 3.51 | 0.50 |
| 160 | 0.060 | 4.61 | 5.00 | 1.00 |
| 200 | 0.090 | 4.63 | 6.21 | 1.50 |
| 235 | 0.120 | 4.66 | 7.26 | 2.00 |
| 264 | 0.150 | 4.68 | 8.12 | 2.49 |
| 304 | 0.200 | 4.72 | 9.27 | 3.33 |
| 336 | 0.250 | 4.76 | 10.16 | 4.16 |
| 361 | 0.300 | 4.81 | 10.82 | 4.99 |
| 370 | 0.350 | 4.85 | 10.99 | 5.82 |
| 363 | 0.400 | 4.89 | 10.69 | 6.65 |
| 351 | 0.450 | 4.93 | 10.24 | 7.48 |
| 347 | 0.500 | 4.98 | 10.03 | 8.32 |
| 345 | 0.550 | 5.03 | 9.89 | 9.15 |
| 343 | 0.600 | 5.07 | 9.74 | 9.98 |
| 343 | 0.650 | 5.12 | 9.65 | 10.81 |
| 341 | 0.700 | 5.17 | 9.50 | 11.64 |
| 343 | 0.750 | 5.22 | 9.47 | 12.47 |
| 344 | 0.800 | 5.27 | 9.41 | 13.30 |
| 346 | 0.850 | 5.32 | 9.37 | 14.14 |
| 350 | 0.900 | 5.37 | 9.39 | 14.97 |
| 349 | 0.950 | 5.42 | 9.27 | 15.80 |
| 353 | 1.000 | 5.48 | 9.28 | 16.63 |
| 352 | 1.050 | 5.53 | 9.16 | 17.46 |
| 353 | 1.100 | 5.59 | 9.10 | 18.29 |
| 347 | 1.200 | 5.70 | 8.76 | 19.96 |

PLATE

B-9

# Kleinfelder 2012

# Laboratory Testing

## APPENDIX B
## LABORATORY TESTING

### GENERAL

Laboratory tests were performed on selected samples as an aid in classifying the soils and to evaluate physical properties of the soils that may affect foundation design and construction procedures. The tests were performed in general conformance with the current ASTM or California Department of Transportation (Caltrans) standards. A description of the laboratory-testing program is presented below.

### MOISTURE AND UNIT WEIGHT

Moisture content and dry unit weight tests were performed on selected samples recovered from the boring. Moisture contents were determined in general accordance with ASTM Test Method D 2216; dry unit weight was calculated using the entire weight of the samples collected. Results of these tests are presented on the boring logs in Appendix A.

### WASH SIEVE

The percent passing the No. 200 sieve of selected soil samples was performed by wash sieving in accordance with ASTM Standard Test Method D1140. The results of the tests are presented on the boring logs in Appendix A.

### ATTERBERG LIMITS

Three Atterberg limits test were performed on soil samples to aid in classification and to evaluate the plasticity characteristics of the materials. The testing was performed in general accordance with ASTM Test Method D4318. The result of the test is presented on the Log of Boring in Appendix A.

### DIRECT SHEAR TEST

One select sample was subject to direct shear testing in order to evaluate the shear strength of the in-situ soils in accordance with ASTM Standard Test Method D3080. The tests were performed by AP Engineering and Testing, Inc. in Pomona, California. The results are attached to this appendix.

## UNCONSOLIDATED UNDRAINED TRIAXIAL TEST

Unconsolidated Undrained Triaxial testing was performed on eight relatively undisturbed samples to assess the undrained strength properties and stress-strain relations for soils. The test was performed in accordance with ASTM Standard Test Method D2850. The tests were performed by AP Engineering and Testing, Inc. in Pomona, California. The results are attached to this appendix.

## CONSOLIDATION TESTS

Three consolidation tests were performed on selected undisturbed samples in accordance with ASTM D2435. The tests were performed on 1.0-inch-high, 2.41-inch diameter samples. After trimming the ends, the sample was placed in the consolidometer and an initial reading was recorded. The sample was saturated during loading, and thereafter, the sample was incrementally loaded and. The test results are attached.

## R-VALUE TESTS

One resistance value (R-value) test was performed on bulk soil samples obtained within the proposed parking areas to evaluate pavement support characteristics of the near-surface onsite soils. R-value tests were performed in accordance with Caltrans Standard Test Method 301. The test results are attached.

## EXPANSION INDEX

Expansion index testing was performed on one bulk sample of the near-surface soils to evaluate its expansion characteristics. The test was performed in accordance with ASTM 4829. The test results are presented on Table B-1, Expansion Index Test Results.

**Table B-1**
**Expansion Index Test Results**

| Boring | Depth (ft) | Expansion Index | Severity of Problem |
|---|---|---|---|
| B-5 | 1 – 5 | 62 | Medium |

## SOIL CORROSIVITY TESTS

A series of chemical tests were performed on a selected sample of the near-surface soils to estimate pH, resistivity and sulfate and chloride contents. The sample was tested for pH and minimum resistivity, soluble chlorides, and soluble sulfates, respectively. The tests were performed by AP Engineering and Testing of Pomona, California. Test results may be used by a qualified corrosion engineer to evaluate the general corrosion potential with respect to construction materials. The results of the tests are presented in Table 11 of Section 4.10 of the report and attached to this appendix.

AP Engineering & Testing, Inc.

# DIRECT SHEAR TEST DATA
# ASTM D 3080

Project Name: Laguna Hills Mall-Simon Property Group | Tested By KM | Date: 08/01/12

Boring No.: B-12 | Checked By AP | Date: 08/06/12

Sample No.: 7 Depth (ft): 36.0-36.5

Description: Silty Sand, fine to coarse grained

Sample Type: Mod. Cal.

Test Condition: Inundated

| | |
|---|---|
| Sample Diameter (in) | 2.415 |
| Sample Height (in) | 1.00 |
| Total Soil+Ring Weight(g) | 617.99 |
| Total Ring Weight (g) | 134.29 |
| Wet Density (pcf) | 134.09 |
| Dry Density (pcf) | 117.21 |

| Moisture Determination | Before Test | After Test |
|---|---|---|
| Cont. Weight (g) | 50.06 | 148.49 |
| Wet Soil+Cont. (g) | 198.12 | 621.99 |
| Dry Soil+Cont. (g) | 179.49 | 556.74 |
| Moisture Content (%) | 14.4 | 16.0 |
| Degree Saturation | 88.7 | 102.9 |

**METHOD OF SHEARING**

☒ Regular Shearing

☐ Residual Shearing 5 Passes

Shear Rate (in/min): **0.002**

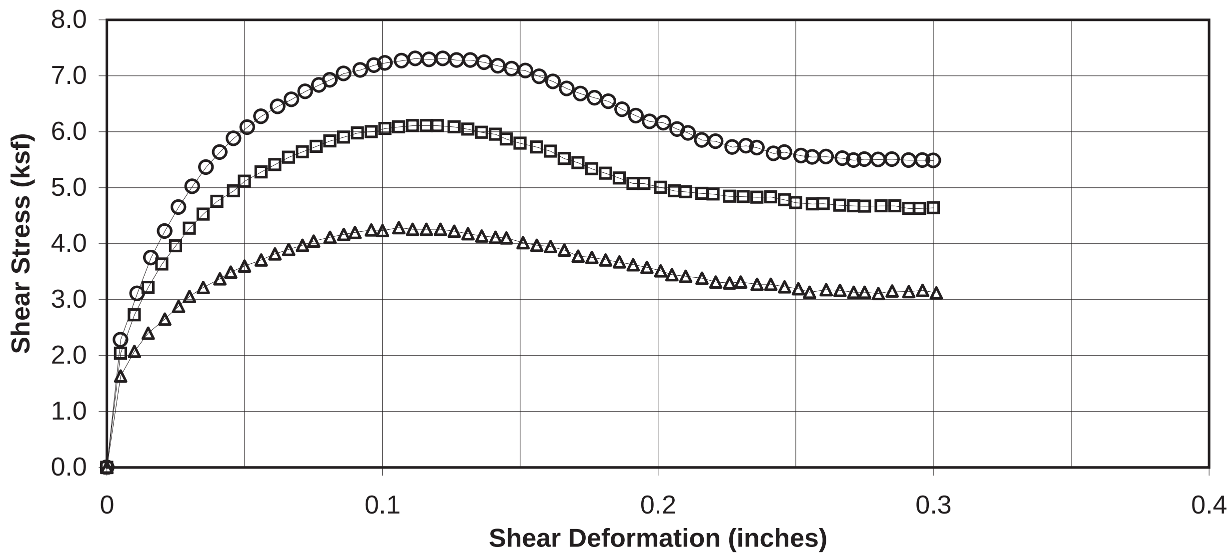
Shear Distance (in): **0.3**

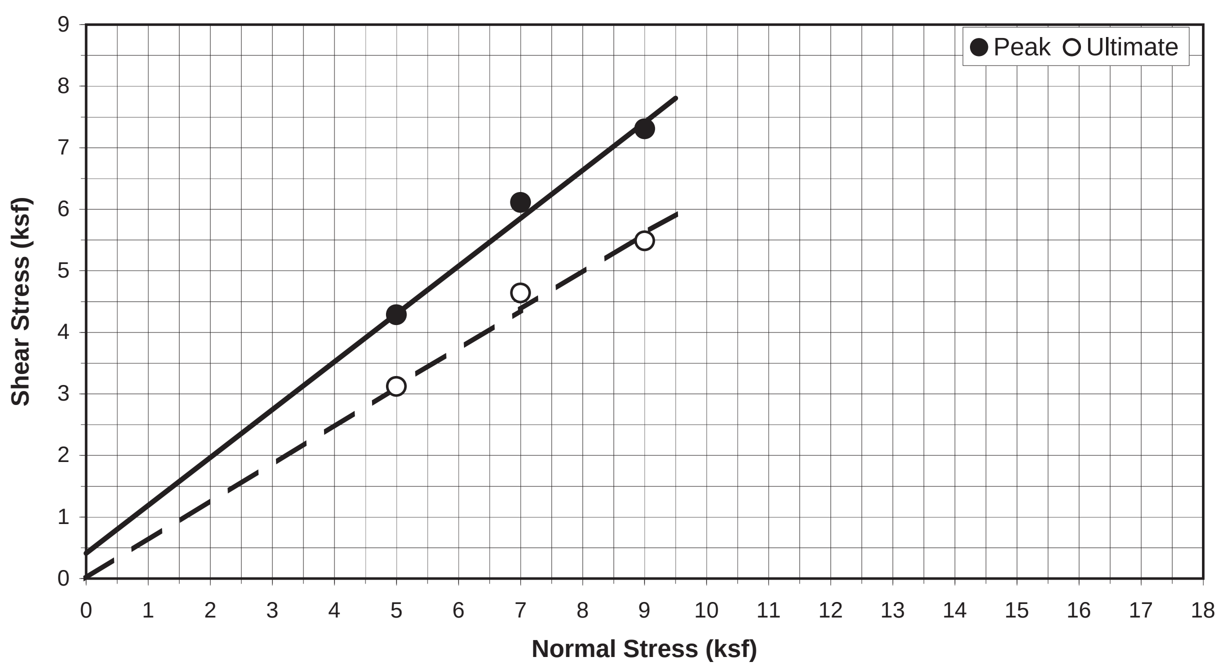
| Sample Number | Sample + Ring Wt. | Ring Wt. | Normal Load (ksf) | Max. Shear Reading (psf) | Ultimate Shear Reading (psf) | Remarks |
|---|---|---|---|---|---|---|
| **1** | **207.87** | **45.09** | **5.0** | **4284** | **3120** | |
| **2** | **205.94** | **44.92** | **7.0** | **6108** | **4639** | |
| **3** | **204.18** | **44.28** | **9.0** | **7305** | **5484** | |
| | | | | | | |

AP Engineering & Testing, Inc.

# DIRECT SHEAR TEST RESULTS
## ASTM D 3080

| | | | | |
|---|---|---|---|---|
| Project Name: | Laguna Hills Mall-Simon Property Group | Initial Dry Density: | 117.2 | pcf |
| Boring No.: | B-12 | Moisture Content (before): | 14.4 | % |
| Sample No.: | 7 | Moisture Content (after): | 16.0 | % |
| Depth (ft): | 36.0-36.5 | | | |
| Sample Type: | Mod. Cal. | | | |
| Soil Description: | Silty Sand, fine to coarse grained | | | |
| Test Condition: | Inundated | | | |




| Strength Parameters | Peak | Ultimate |
|---|---|---|
| Cohesion (psf): | 400 | 0 |
| Friction Angle: | 38 ° | 32 ° |

AP Engineering & Testing, Inc.

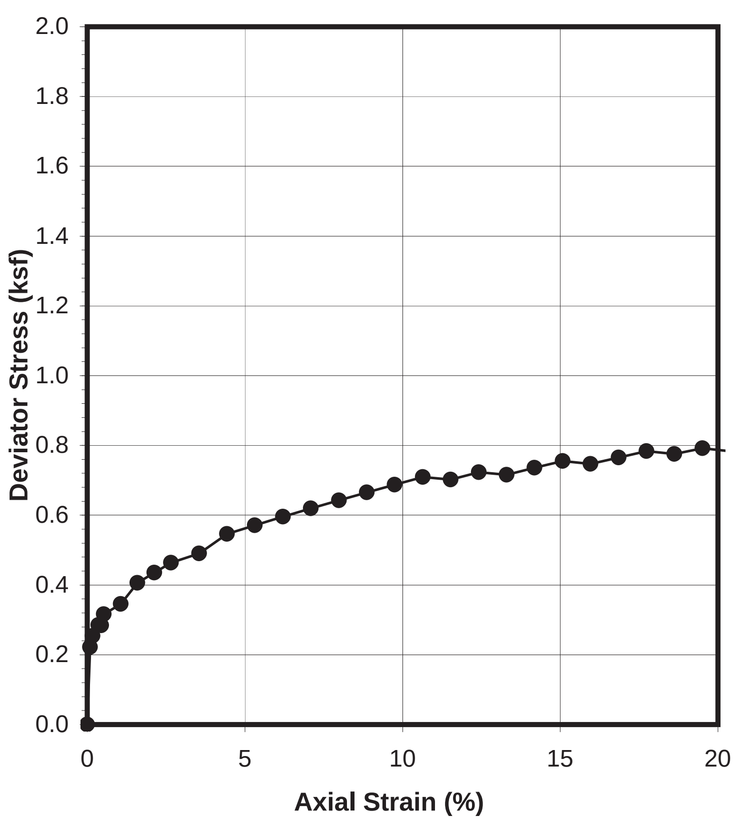
# UNCONSOLIDATED UNDRAINED TRIAXIAL TEST (UU,Q)
## ASTM D 2850

| | | | | | |
|---|---|---|---|---|---|
| Client Name: | Kleinfelder | Tested By: | ST | Date: | 07/18/12 |
| Project Name: | Laguna Hills Mall - Simon Property Group | Checked by: | AP | Date: | 07/27/12 |
| Project No.: | 128062 | | | | |
| Boring No.: | B-3 | | | | |
| Sample No.: | 5 | Depth (feet): | 11 | | |
| Soil Description | Sandy Lean Clay | Sample Type: | Mod. Cal. | | |

| | | | |
|---|---|---|---|
| Sample Diameter (inch): | 2.403 | Wet Unit Weight (pcf): | 128.2 |
| Sample Hieght (inch): | 5.638 | Dry Unit Weight (pcf): | 105.0 |
| Sample Weight (gms): | 860.89 | Moisture Content (%): | 22.1 |
| Wt. Wet Soil+Container(gms) | 509.86 | Void Ratio for Gs=2.7: | 0.60 |
| Wt. Dry Soil+Container(gms) | 444.79 | % Saturation: | 98.6 |
| Wt. Container (gms) | 149.99 | | |

## TEST DATA

| | |
|---|---|
| Cell Pressure (ksf): | 1.50 |
| Back Pressure (ksf): | 0.0 |
| Eff. Confining Pressure (ksf): | 1.50 |
| Shear Rate (%/min): | 0.3 |
| Maximum Deviator Stress (ksf): | 0.79 |
| Ultimate Deviator Stress (ksf): | 0.77 |
| Ultimate Undrained Shear Strength (ksf): | 0.39 |
| Axial Strain @ Maximum Stress (%) | 19.51 |




| Load (lbs) | Def. (inch) | Area (sq.in) | Deviator Stress (ksf) | Axial Strain (%) |
|---|---|---|---|---|
| 0 | 0.000 | 4.54 | 0.00 | 0.00 |
| 7 | 0.005 | 4.54 | 0.22 | 0.09 |
| 8 | 0.010 | 4.54 | 0.25 | 0.18 |
| 9 | 0.020 | 4.55 | 0.28 | 0.35 |
| 9 | 0.025 | 4.56 | 0.28 | 0.44 |
| 10 | 0.030 | 4.56 | 0.32 | 0.53 |
| 11 | 0.060 | 4.58 | 0.35 | 1.06 |
| 13 | 0.090 | 4.61 | 0.41 | 1.60 |
| 14 | 0.120 | 4.63 | 0.44 | 2.13 |
| 15 | 0.150 | 4.66 | 0.46 | 2.66 |
| 16 | 0.200 | 4.70 | 0.49 | 3.55 |
| 18 | 0.250 | 4.75 | 0.55 | 4.43 |
| 19 | 0.300 | 4.79 | 0.57 | 5.32 |
| 20 | 0.350 | 4.84 | 0.60 | 6.21 |
| 21 | 0.400 | 4.88 | 0.62 | 7.09 |
| 22 | 0.450 | 4.93 | 0.64 | 7.98 |
| 23 | 0.500 | 4.98 | 0.67 | 8.87 |
| 24 | 0.550 | 5.03 | 0.69 | 9.76 |
| 25 | 0.600 | 5.08 | 0.71 | 10.64 |
| 25 | 0.650 | 5.13 | 0.70 | 11.53 |
| 26 | 0.700 | 5.18 | 0.72 | 12.42 |
| 26 | 0.750 | 5.23 | 0.72 | 13.30 |
| 27 | 0.800 | 5.29 | 0.74 | 14.19 |
| 28 | 0.850 | 5.34 | 0.76 | 15.08 |
| 28 | 0.900 | 5.40 | 0.75 | 15.96 |
| 29 | 0.950 | 5.45 | 0.77 | 16.85 |
| 30 | 1.000 | 5.51 | 0.78 | 17.74 |
| 30 | 1.050 | 5.57 | 0.78 | 18.62 |
| 31 | 1.100 | 5.63 | 0.79 | 19.51 |
| 31 | 1.200 | 5.76 | 0.77 | 21.28 |

AP Engineering & Testing, Inc.

# UNCONSOLIDATED UNDRAINED TRIAXIAL TEST (UU,Q)
## ASTM D 2850

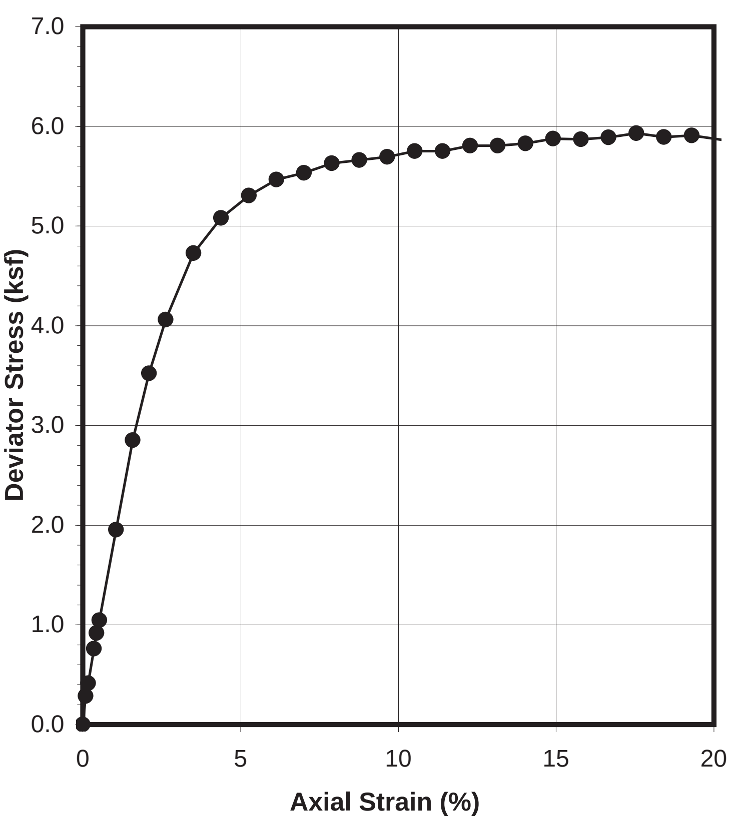
| | | | | |
|---|---|---|---|---|
| Client Name: | Kleinfelder | Tested By: | ST | Date: 07/20/12 |
| Project Name: | Laguna Hills Mall - Simon Property Group | Checked by: | AP | Date: 07/27/12 |
| Project No.: | 128062 | | | |
| Boring No.: | B-3 | | | |
| Sample No.: | 11 | Depth (feet): 41 | | |
| Soil Description | Clayey Sand | Sample Type: | Mod. Cal. | |

| | |
|---|---|
| Sample Diameter (inch): | 2.400 |
| Sample Hieght (inch): | 5.701 |
| Sample Weight (gms): | 907.90 |
| Wt. Wet Soil+Container(gms) | 609.63 |
| Wt. Dry Soil+Container(gms) | 552.82 |
| Wt. Container (gms) | 149.71 |

| | |
|---|---|
| Wet Unit Weight (pcf): | 134.0 |
| Dry Unit Weight (pcf): | 117.5 |
| Moisture Content (%): | 14.1 |
| Void Ratio for Gs=2.7: | 0.43 |
| % Saturation: | 87.6 |

## TEST DATA

| | |
|---|---|
| Cell Pressure (ksf): | 5.00 |
| Back Pressure (ksf): | 0.0 |
| Eff. Confining Pressure (ksf): | 5.00 |
| Shear Rate (%/min): | 0.3 |
| Maximum Deviator Stress (ksf): | 5.93 |
| Ultimate Deviator Stress (ksf): | 5.83 |
| Ultimate Undrained Shear Strength (ksf): | 2.92 |
| Axial Strain @ Maximum Stress (%) | 17.54 |




| Load (lbs) | Def. (inch) | Area (sq.in) | Deviator Stress (ksf) | Axial Strain (%) |
|---|---|---|---|---|
| 0 | 0.000 | 4.52 | 0.00 | 0.00 |
| 9 | 0.005 | 4.53 | 0.29 | 0.09 |
| 13 | 0.010 | 4.53 | 0.41 | 0.18 |
| 24 | 0.020 | 4.54 | 0.76 | 0.35 |
| 29 | 0.025 | 4.54 | 0.92 | 0.44 |
| 33 | 0.030 | 4.55 | 1.04 | 0.53 |
| 62 | 0.060 | 4.57 | 1.95 | 1.05 |
| 91 | 0.090 | 4.60 | 2.85 | 1.58 |
| 113 | 0.120 | 4.62 | 3.52 | 2.10 |
| 131 | 0.150 | 4.65 | 4.06 | 2.63 |
| 154 | 0.200 | 4.69 | 4.73 | 3.51 |
| 167 | 0.250 | 4.73 | 5.08 | 4.39 |
| 176 | 0.300 | 4.78 | 5.31 | 5.26 |
| 183 | 0.350 | 4.82 | 5.47 | 6.14 |
| 187 | 0.400 | 4.87 | 5.53 | 7.02 |
| 192 | 0.450 | 4.91 | 5.63 | 7.89 |
| 195 | 0.500 | 4.96 | 5.66 | 8.77 |
| 198 | 0.550 | 5.01 | 5.69 | 9.65 |
| 202 | 0.600 | 5.06 | 5.75 | 10.52 |
| 204 | 0.650 | 5.11 | 5.75 | 11.40 |
| 208 | 0.700 | 5.16 | 5.81 | 12.28 |
| 210 | 0.750 | 5.21 | 5.81 | 13.16 |
| 213 | 0.800 | 5.26 | 5.83 | 14.03 |
| 217 | 0.850 | 5.32 | 5.88 | 14.91 |
| 219 | 0.900 | 5.37 | 5.87 | 15.79 |
| 222 | 0.950 | 5.43 | 5.89 | 16.66 |
| 226 | 1.000 | 5.49 | 5.93 | 17.54 |
| 227 | 1.050 | 5.55 | 5.89 | 18.42 |
| 230 | 1.100 | 5.61 | 5.91 | 19.29 |
| 232 | 1.200 | 5.73 | 5.83 | 21.05 |

AP Engineering & Testing, Inc.

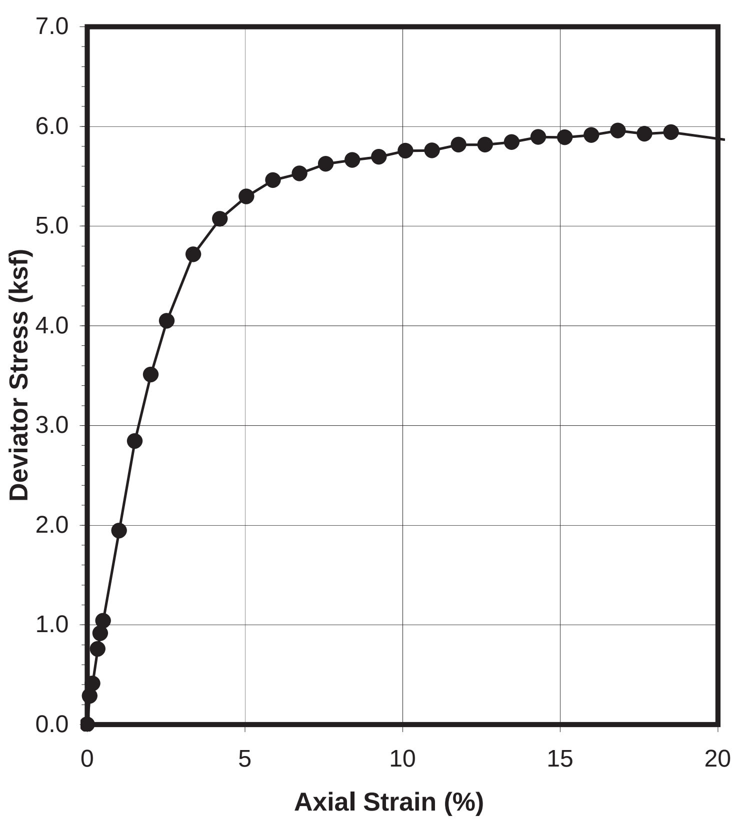
# UNCONSOLIDATED UNDRAINED TRIAXIAL TEST (UU,Q)
## ASTM D 2850

| | | | |
|---|---|---|---|
| Client Name: | Kleinfelder | Tested By: | ST Date: 07/20/12 |
| Project Name: | Laguna Hills Mall - Simon Property Group | Checked by: | AP Date: 07/27/12 |
| Project No.: | 128062 | | |
| Boring No.: | B-6 | | |
| Sample No.: | 4 Depth (feet): 8.5 | | |
| Soil Description | Sandy Clay | Sample Type: | Mod. Cal. |

| | | | |
|---|---|---|---|
| Sample Diameter (inch): | 2.405 | Wet Unit Weight (pcf): | 95.4 |
| Sample Hieght (inch): | 5.941 | Dry Unit Weight (pcf): | 57.3 |
| Sample Weight (gms): | 676.40 | Moisture Content (%): | 66.5 |
| Wt. Wet Soil+Container(gms) | 507.90 | Void Ratio for Gs=2.7: | 1.94 |
| Wt. Dry Soil+Container(gms) | 364.51 | % Saturation: | 92.6 |
| Wt. Container (gms) | 148.88 | | |

## TEST DATA

| | |
|---|---|
| Cell Pressure (ksf): | 1.00 |
| Back Pressure (ksf): | 0.0 |
| Eff. Confining Pressure (ksf): | 1.00 |
| Shear Rate (%/min): | 0.3 |
| Maximum Deviator Stress (ksf): | 5.96 |
| Ultimate Deviator Stress (ksf): | 5.87 |
| Ultimate Undrained Shear Strength (ksf): | 2.93 |
| Axial Strain @ Maximum Stress (%) | 16.83 |




| Load (lbs) | Def. (inch) | Area (sq.in) | Deviator Stress (ksf) | Axial Strain (%) |
|---|---|---|---|---|
| 0 | 0.000 | 4.54 | 0.00 | 0.00 |
| 9 | 0.005 | 4.55 | 0.29 | 0.08 |
| 13 | 0.010 | 4.55 | 0.41 | 0.17 |
| 24 | 0.020 | 4.56 | 0.76 | 0.34 |
| 29 | 0.025 | 4.56 | 0.92 | 0.42 |
| 33 | 0.030 | 4.57 | 1.04 | 0.50 |
| 62 | 0.060 | 4.59 | 1.95 | 1.01 |
| 91 | 0.090 | 4.61 | 2.84 | 1.51 |
| 113 | 0.120 | 4.64 | 3.51 | 2.02 |
| 131 | 0.150 | 4.66 | 4.05 | 2.52 |
| 154 | 0.200 | 4.70 | 4.72 | 3.37 |
| 167 | 0.250 | 4.74 | 5.07 | 4.21 |
| 176 | 0.300 | 4.78 | 5.30 | 5.05 |
| 183 | 0.350 | 4.83 | 5.46 | 5.89 |
| 187 | 0.400 | 4.87 | 5.53 | 6.73 |
| 192 | 0.450 | 4.92 | 5.63 | 7.57 |
| 195 | 0.500 | 4.96 | 5.66 | 8.42 |
| 198 | 0.550 | 5.01 | 5.70 | 9.26 |
| 202 | 0.600 | 5.05 | 5.76 | 10.10 |
| 204 | 0.650 | 5.10 | 5.76 | 10.94 |
| 208 | 0.700 | 5.15 | 5.82 | 11.78 |
| 210 | 0.750 | 5.20 | 5.82 | 12.62 |
| 213 | 0.800 | 5.25 | 5.84 | 13.47 |
| 217 | 0.850 | 5.30 | 5.89 | 14.31 |
| 219 | 0.900 | 5.35 | 5.89 | 15.15 |
| 222 | 0.950 | 5.41 | 5.91 | 15.99 |
| 226 | 1.000 | 5.46 | 5.96 | 16.83 |
| 227 | 1.050 | 5.52 | 5.92 | 17.67 |
| 230 | 1.100 | 5.58 | 5.94 | 18.52 |
| 232 | 1.200 | 5.69 | 5.87 | 20.20 |

AP Engineering & Testing, Inc.

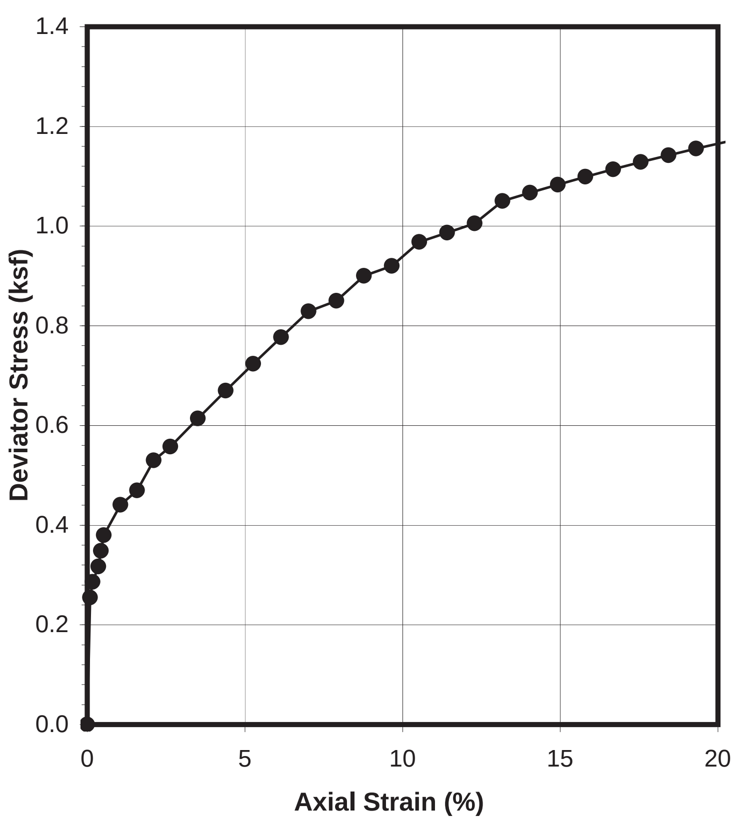
# UNCONSOLIDATED UNDRAINED TRIAXIAL TEST (UU,Q)
## ASTM D 2850

| | | | |
|---|---|---|---|
| Client Name: | Kleinfelder | Tested By: | ST Date: 07/20/12 |
| Project Name: | Laguna Hills Mall - Simon Property Group | Checked by: | AP Date: 07/27/12 |
| Project No.: | 128062 | | |
| Boring No.: | B-6 | | |
| Sample No.: | 6 Depth (feet): 16 | | |
| Soil Description | Sandy Clay | Sample Type: | Mod. Cal. |

| | | | |
|---|---|---|---|
| Sample Diameter (inch): | 2.400 | Wet Unit Weight (pcf): | 125.2 |
| Sample Hieght (inch): | 5.696 | Dry Unit Weight (pcf): | 99.7 |
| Sample Weight (gms): | 847.71 | Moisture Content (%): | 25.6 |
| Wt. Wet Soil+Container(gms) | 523.85 | Void Ratio for Gs=2.7: | 0.69 |
| Wt. Dry Soil+Container(gms) | 447.42 | % Saturation: | 100.2 |
| Wt. Container (gms) | 148.53 | | |

## TEST DATA

| | |
|---|---|
| Cell Pressure (ksf): | 2.00 |
| Back Pressure (ksf): | 0.0 |
| Eff. Confining Pressure (ksf): | 2.00 |
| Shear Rate (%/min): | 0.3 |
| Maximum Deviator Stress (ksf): | 1.18 |
| Ultimate Deviator Stress (ksf): | 1.18 |
| Ultimate Undrained Shear Strength (ksf): | 0.59 |
| Axial Strain @ Maximum Stress (%) | 21.07 |




| Load (lbs) | Def. (inch) | Area (sq.in) | Deviator Stress (ksf) | Axial Strain (%) |
|---|---|---|---|---|
| 0 | 0.000 | 4.52 | 0.00 | 0.00 |
| 8 | 0.005 | 4.53 | 0.25 | 0.09 |
| 9 | 0.010 | 4.53 | 0.29 | 0.18 |
| 10 | 0.020 | 4.54 | 0.32 | 0.35 |
| 11 | 0.025 | 4.54 | 0.35 | 0.44 |
| 12 | 0.030 | 4.55 | 0.38 | 0.53 |
| 14 | 0.060 | 4.57 | 0.44 | 1.05 |
| 15 | 0.090 | 4.60 | 0.47 | 1.58 |
| 17 | 0.120 | 4.62 | 0.53 | 2.11 |
| 18 | 0.150 | 4.65 | 0.56 | 2.63 |
| 20 | 0.200 | 4.69 | 0.61 | 3.51 |
| 22 | 0.250 | 4.73 | 0.67 | 4.39 |
| 24 | 0.300 | 4.78 | 0.72 | 5.27 |
| 26 | 0.350 | 4.82 | 0.78 | 6.14 |
| 28 | 0.400 | 4.87 | 0.83 | 7.02 |
| 29 | 0.450 | 4.91 | 0.85 | 7.90 |
| 31 | 0.500 | 4.96 | 0.90 | 8.78 |
| 32 | 0.550 | 5.01 | 0.92 | 9.66 |
| 34 | 0.600 | 5.06 | 0.97 | 10.53 |
| 35 | 0.650 | 5.11 | 0.99 | 11.41 |
| 36 | 0.700 | 5.16 | 1.01 | 12.29 |
| 38 | 0.750 | 5.21 | 1.05 | 13.17 |
| 39 | 0.800 | 5.26 | 1.07 | 14.04 |
| 40 | 0.850 | 5.32 | 1.08 | 14.92 |
| 41 | 0.900 | 5.37 | 1.10 | 15.80 |
| 42 | 0.950 | 5.43 | 1.11 | 16.68 |
| 43 | 1.000 | 5.49 | 1.13 | 17.56 |
| 44 | 1.050 | 5.55 | 1.14 | 18.43 |
| 45 | 1.100 | 5.61 | 1.16 | 19.31 |
| 47 | 1.200 | 5.73 | 1.18 | 21.07 |

AP Engineering & Testing, Inc.

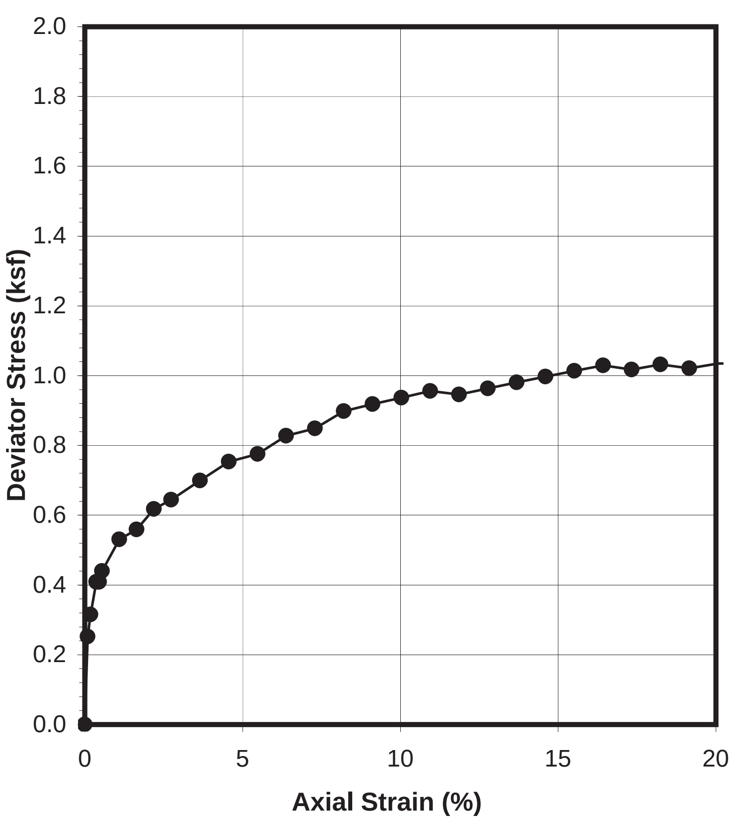
# UNCONSOLIDATED UNDRAINED TRIAXIAL TEST (UU,Q)
## ASTM D 2850

| | | | | | |
|---|---|---|---|---|---|
| Client Name: | Kleinfelder | Tested By: | ST | Date: | 07/23/12 |
| Project Name: | Laguna Hills Mall - Simon Property Group | Checked by: | AP | Date: | 07/27/12 |
| Project No.: | 128062 | | | | |
| Boring No.: | B-6 | | | | |
| Sample No.: | 8 | Depth (feet): | 26 | | |
| Soil Description | Sandy Clay | Sample Type: | Mod. Cal. | | |

| | | | |
|---|---|---|---|
| Sample Diameter (inch): | 2.410 | Wet Unit Weight (pcf): | 125.3 |
| Sample Hieght (inch): | 5.480 | Dry Unit Weight (pcf): | 98.8 |
| Sample Weight (gms): | 822.71 | Moisture Content (%): | 26.8 |
| Wt. Wet Soil+Container(gms) | 494.05 | Void Ratio for Gs=2.7: | 0.71 |
| Wt. Dry Soil+Container(gms) | 420.65 | % Saturation: | 102.7 |
| Wt. Container (gms) | 146.85 | | |

## TEST DATA

| | |
|---|---|
| Cell Pressure (ksf): | 3.00 |
| Back Pressure (ksf): | 0.0 |
| Eff. Confining Pressure (ksf): | 3.00 |
| Shear Rate (%/min): | 0.3 |
| Maximum Deviator Stress (ksf): | 1.04 |
| Ultimate Deviator Stress (ksf): | 1.04 |
| Ultimate Undrained Shear Strength (ksf): | 0.52 |
| Axial Strain @ Maximum Stress (%) | 21.90 |




| Load (lbs) | Def. (inch) | Area (sq.in) | Deviator Stress (ksf) | Axial Strain (%) |
|---|---|---|---|---|
| 0 | 0.000 | 4.56 | 0.00 | 0.00 |
| 8 | 0.005 | 4.57 | 0.25 | 0.09 |
| 10 | 0.010 | 4.57 | 0.32 | 0.18 |
| 13 | 0.020 | 4.58 | 0.41 | 0.36 |
| 13 | 0.025 | 4.58 | 0.41 | 0.46 |
| 14 | 0.030 | 4.59 | 0.44 | 0.55 |
| 17 | 0.060 | 4.61 | 0.53 | 1.09 |
| 18 | 0.090 | 4.64 | 0.56 | 1.64 |
| 20 | 0.120 | 4.66 | 0.62 | 2.19 |
| 21 | 0.150 | 4.69 | 0.64 | 2.74 |
| 23 | 0.200 | 4.73 | 0.70 | 3.65 |
| 25 | 0.250 | 4.78 | 0.75 | 4.56 |
| 26 | 0.300 | 4.83 | 0.78 | 5.47 |
| 28 | 0.350 | 4.87 | 0.83 | 6.39 |
| 29 | 0.400 | 4.92 | 0.85 | 7.30 |
| 31 | 0.450 | 4.97 | 0.90 | 8.21 |
| 32 | 0.500 | 5.02 | 0.92 | 9.12 |
| 33 | 0.550 | 5.07 | 0.94 | 10.04 |
| 34 | 0.600 | 5.12 | 0.96 | 10.95 |
| 34 | 0.650 | 5.18 | 0.95 | 11.86 |
| 35 | 0.700 | 5.23 | 0.96 | 12.77 |
| 36 | 0.750 | 5.28 | 0.98 | 13.69 |
| 37 | 0.800 | 5.34 | 1.00 | 14.60 |
| 38 | 0.850 | 5.40 | 1.01 | 15.51 |
| 39 | 0.900 | 5.46 | 1.03 | 16.42 |
| 39 | 0.950 | 5.52 | 1.02 | 17.34 |
| 40 | 1.000 | 5.58 | 1.03 | 18.25 |
| 40 | 1.050 | 5.64 | 1.02 | 19.16 |
| 41 | 1.100 | 5.71 | 1.03 | 20.07 |
| 42 | 1.200 | 5.84 | 1.04 | 21.90 |

AP Engineering & Testing, Inc.

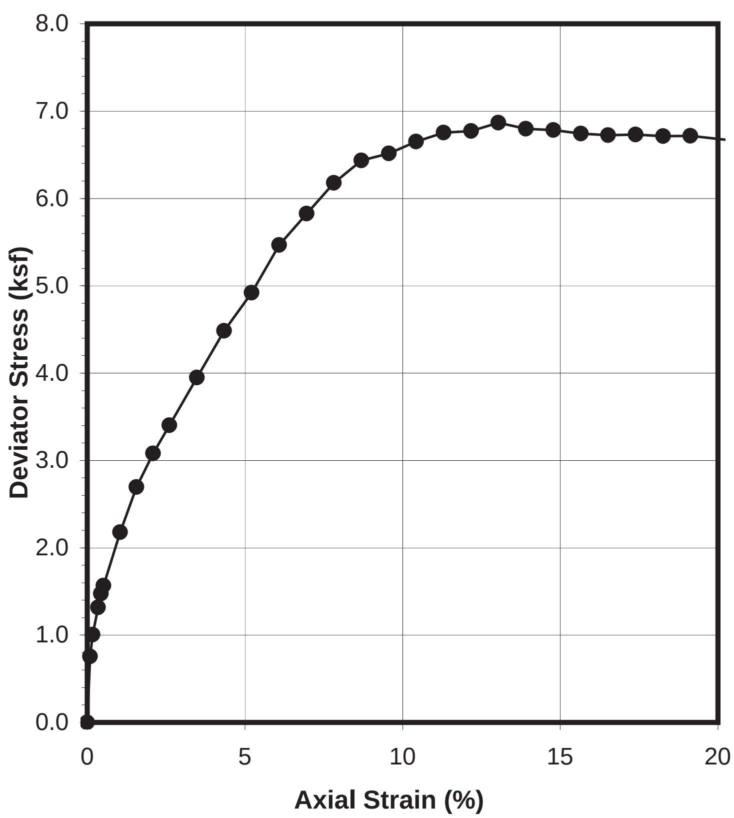
# UNCONSOLIDATED UNDRAINED TRIAXIAL TEST (UU,Q)
## ASTM D 2850

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Client Name: | Kleinfelder | | | Tested By: | ST | Date: | 07/31/12 |
| Project Name: | Laguna Hills Mall - Simon Property Group | | | Checked by: | AP | Date: | 08/08/12 |
| Project No.: | 128062 | | | | | | |
| Boring No.: | B-12 | | | | | | |
| Sample No.: | 12 | Depth (feet): | 61.0-61.5 | | | | |
| Soil Description | Clay | | | Sample Type: | Mod. Cal. | | |

| | | | |
|---|---|---|---|
| Sample Diameter (inch): | 2.414 | Wet Unit Weight (pcf): | 96.8 |
| Sample Hieght (inch): | 5.750 | Dry Unit Weight (pcf): | 58.0 |
| Sample Weight (gms): | 669.41 | Moisture Content (%): | 66.9 |
| Wt. Wet Soil+Container(gms) | 430.80 | Void Ratio for Gs=2.7: | 1.90 |
| Wt. Dry Soil+Container(gms) | 319.90 | % Saturation: | 94.9 |
| Wt. Container (gms) | 154.24 | | |

## TEST DATA

| | |
|---|---|
| Cell Pressure (ksf): | 6.00 |
| Back Pressure (ksf): | 0.0 |
| Eff. Confining Pressure (ksf): | 6.00 |
| Shear Rate (%/min): | 0.3 |
| Maximum Deviator Stress (ksf): | 6.87 |
| Ultimate Deviator Stress (ksf): | 6.65 |
| Ultimate Undrained Shear Strength (ksf): | 3.32 |
| Axial Strain @ Maximum Stress (%) | 13.04 |




| Load (lbs) | Def. (inch) | Area (sq.in) | Deviator Stress (ksf) | Axial Strain (%) |
|---|---|---|---|---|
| 0 | 0.000 | 4.58 | 0.00 | 0.00 |
| 24 | 0.005 | 4.58 | 0.75 | 0.09 |
| 32 | 0.010 | 4.58 | 1.01 | 0.17 |
| 42 | 0.020 | 4.59 | 1.32 | 0.35 |
| 47 | 0.025 | 4.60 | 1.47 | 0.43 |
| 50 | 0.030 | 4.60 | 1.56 | 0.52 |
| 70 | 0.060 | 4.63 | 2.18 | 1.04 |
| 87 | 0.090 | 4.65 | 2.69 | 1.57 |
| 100 | 0.120 | 4.67 | 3.08 | 2.09 |
| 111 | 0.150 | 4.70 | 3.40 | 2.61 |
| 130 | 0.200 | 4.74 | 3.95 | 3.48 |
| 149 | 0.250 | 4.78 | 4.48 | 4.35 |
| 165 | 0.300 | 4.83 | 4.92 | 5.22 |
| 185 | 0.350 | 4.87 | 5.47 | 6.09 |
| 199 | 0.400 | 4.92 | 5.83 | 6.96 |
| 213 | 0.450 | 4.97 | 6.18 | 7.83 |
| 224 | 0.500 | 5.01 | 6.43 | 8.70 |
| 229 | 0.550 | 5.06 | 6.52 | 9.57 |
| 236 | 0.600 | 5.11 | 6.65 | 10.43 |
| 242 | 0.650 | 5.16 | 6.75 | 11.30 |
| 245 | 0.700 | 5.21 | 6.77 | 12.17 |
| 251 | 0.750 | 5.26 | 6.87 | 13.04 |
| 251 | 0.800 | 5.32 | 6.80 | 13.91 |
| 253 | 0.850 | 5.37 | 6.78 | 14.78 |
| 254 | 0.900 | 5.43 | 6.74 | 15.65 |
| 256 | 0.950 | 5.48 | 6.72 | 16.52 |
| 259 | 1.000 | 5.54 | 6.73 | 17.39 |
| 261 | 1.050 | 5.60 | 6.71 | 18.26 |
| 264 | 1.100 | 5.66 | 6.72 | 19.13 |
| 267 | 1.200 | 5.78 | 6.65 | 20.87 |

AP Engineering & Testing, Inc.

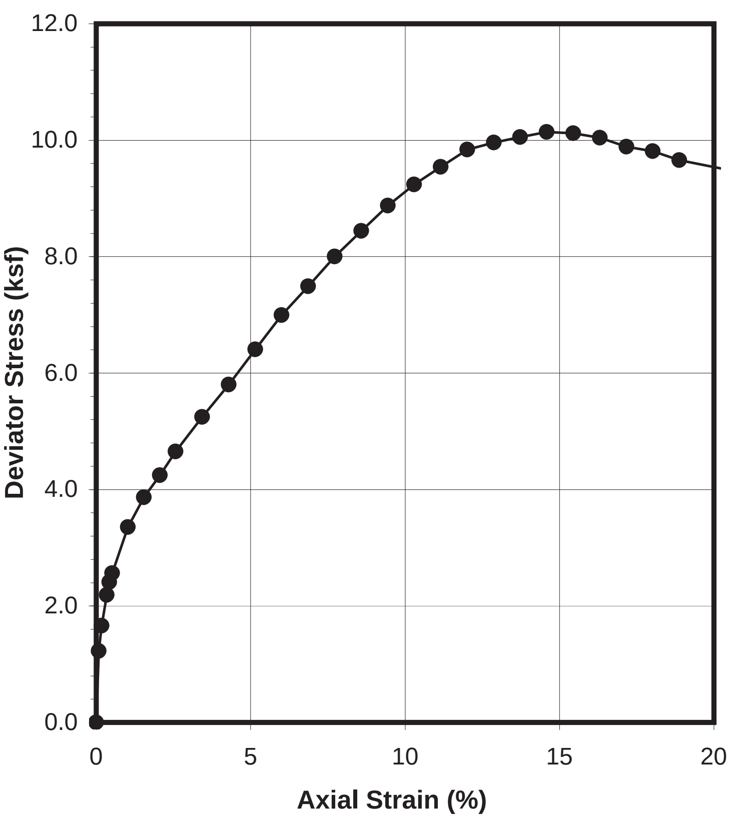
# UNCONSOLIDATED UNDRAINED TRIAXIAL TEST (UU,Q)
## ASTM D 2850

| | | | | | |
|---|---|---|---|---|---|
| Client Name: | Kleinfelder | Tested By: | ST | Date: | 07/31/12 |
| Project Name: | Laguna Hills Mall - Simon Property Group | Checked by: | AP | Date: | 08/08/12 |
| Project No.: | 128062 | | | | |
| Boring No.: | B-12 | | | | |
| Sample No.: | 14 | Depth (feet): | 71.0-71.5 | | |
| Soil Description | Clay | Sample Type: | Mod. Cal. | | |

| | | | |
|---|---|---|---|
| Sample Diameter (inch): | 2.416 | Wet Unit Weight (pcf): | 96.4 |
| Sample Hieght (inch): | 5.826 | Dry Unit Weight (pcf): | 59.1 |
| Sample Weight (gms): | 676.60 | Moisture Content (%): | 63.1 |
| Wt. Wet Soil+Container(gms) | 413.53 | Void Ratio for Gs=2.7: | 1.85 |
| Wt. Dry Soil+Container(gms) | 310.46 | % Saturation: | 92.2 |
| Wt. Container (gms) | 147.23 | | |

## TEST DATA

| | |
|---|---|
| Cell Pressure (ksf): | 7.00 |
| Back Pressure (ksf): | 0.0 |
| Eff. Confining Pressure (ksf): | 7.00 |
| Shear Rate (%/min): | 0.3 |
| Maximum Deviator Stress (ksf): | 10.14 |
| Ultimate Deviator Stress (ksf): | 9.48 |
| Ultimate Undrained Shear Strength (ksf): | 4.74 |
| Axial Strain @ Maximum Stress (%) | 14.59 |




| Load (lbs) | Def. (inch) | Area (sq.in) | Deviator Stress (ksf) | Axial Strain (%) |
|---|---|---|---|---|
| 0 | 0.000 | 4.58 | 0.00 | 0.00 |
| 39 | 0.005 | 4.59 | 1.22 | 0.09 |
| 53 | 0.010 | 4.59 | 1.66 | 0.17 |
| 70 | 0.020 | 4.60 | 2.19 | 0.34 |
| 77 | 0.025 | 4.60 | 2.41 | 0.43 |
| 82 | 0.030 | 4.61 | 2.56 | 0.51 |
| 108 | 0.060 | 4.63 | 3.36 | 1.03 |
| 125 | 0.090 | 4.66 | 3.87 | 1.54 |
| 138 | 0.120 | 4.68 | 4.25 | 2.06 |
| 152 | 0.150 | 4.71 | 4.65 | 2.57 |
| 173 | 0.200 | 4.75 | 5.25 | 3.43 |
| 193 | 0.250 | 4.79 | 5.80 | 4.29 |
| 215 | 0.300 | 4.83 | 6.41 | 5.15 |
| 237 | 0.350 | 4.88 | 7.00 | 6.01 |
| 256 | 0.400 | 4.92 | 7.49 | 6.87 |
| 276 | 0.450 | 4.97 | 8.00 | 7.72 |
| 294 | 0.500 | 5.01 | 8.44 | 8.58 |
| 312 | 0.550 | 5.06 | 8.87 | 9.44 |
| 328 | 0.600 | 5.11 | 9.24 | 10.30 |
| 342 | 0.650 | 5.16 | 9.54 | 11.16 |
| 356 | 0.700 | 5.21 | 9.84 | 12.02 |
| 364 | 0.750 | 5.26 | 9.96 | 12.87 |
| 371 | 0.800 | 5.31 | 10.05 | 13.73 |
| 378 | 0.850 | 5.37 | 10.14 | 14.59 |
| 381 | 0.900 | 5.42 | 10.12 | 15.45 |
| 382 | 0.950 | 5.48 | 10.04 | 16.31 |
| 380 | 1.000 | 5.53 | 9.89 | 17.16 |
| 381 | 1.050 | 5.59 | 9.81 | 18.02 |
| 379 | 1.100 | 5.65 | 9.66 | 18.88 |
| 380 | 1.200 | 5.77 | 9.48 | 20.60 |

AP Engineering & Testing, Inc.

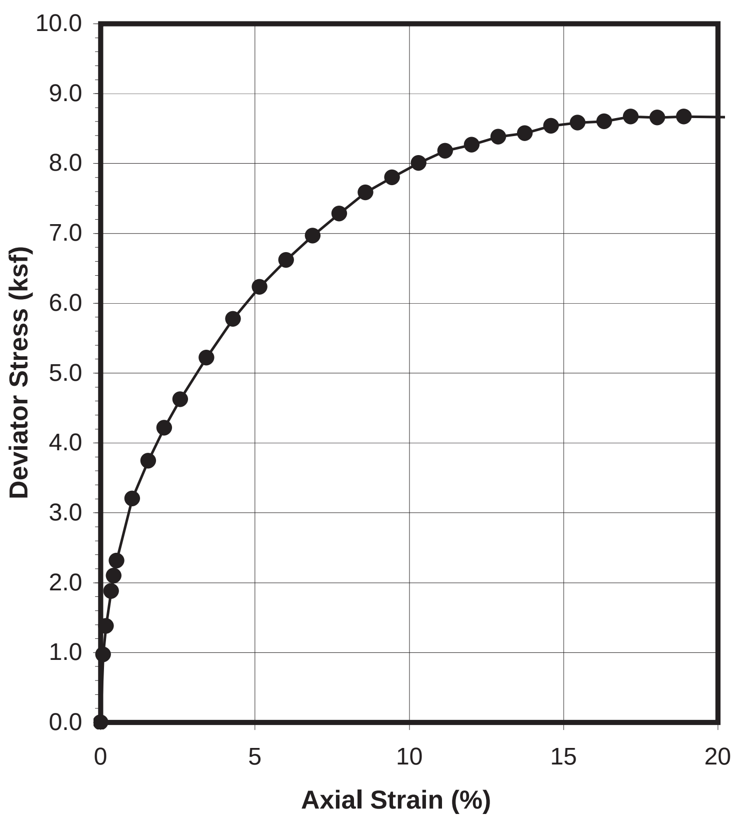
# UNCONSOLIDATED UNDRAINED TRIAXIAL TEST (UU,Q)
## ASTM D 2850

| | | | | | |
|---|---|---|---|---|---|
| Client Name: | Kleinfelder | Tested By: | ST | Date: | 07/31/12 |
| Project Name: | Laguna Hills Mall - Simon Property Group | Checked by: | AP | Date: | 08/08/12 |
| Project No.: | 128062 | | | | |
| Boring No.: | B-12 | | | | |
| Sample No.: | 16 | Depth (feet): | 81.0-81.5 | | |
| Soil Description | Clay | Sample Type: | Mod. Cal. | | |

| | | | |
|---|---|---|---|
| Sample Diameter (inch): | 2.415 | Wet Unit Weight (pcf): | 97.1 |
| Sample Hieght (inch): | 5.821 | Dry Unit Weight (pcf): | 59.0 |
| Sample Weight (gms): | 679.72 | Moisture Content (%): | 64.6 |
| Wt. Wet Soil+Container(gms) | 540.43 | Void Ratio for Gs=2.7: | 1.86 |
| Wt. Dry Soil+Container(gms) | 387.55 | % Saturation: | 93.9 |
| Wt. Container (gms) | 150.84 | | |

## TEST DATA

| | |
|---|---|
| Cell Pressure (ksf): | 8.00 |
| Back Pressure (ksf): | 0.0 |
| Eff. Confining Pressure (ksf): | 8.00 |
| Shear Rate (%/min): | 0.3 |
| Maximum Deviator Stress (ksf): | 8.67 |
| Ultimate Deviator Stress (ksf): | 8.66 |
| Ultimate Undrained Shear Strength (ksf): | 4.33 |
| Axial Strain @ Maximum Stress (%) | 17.18 |



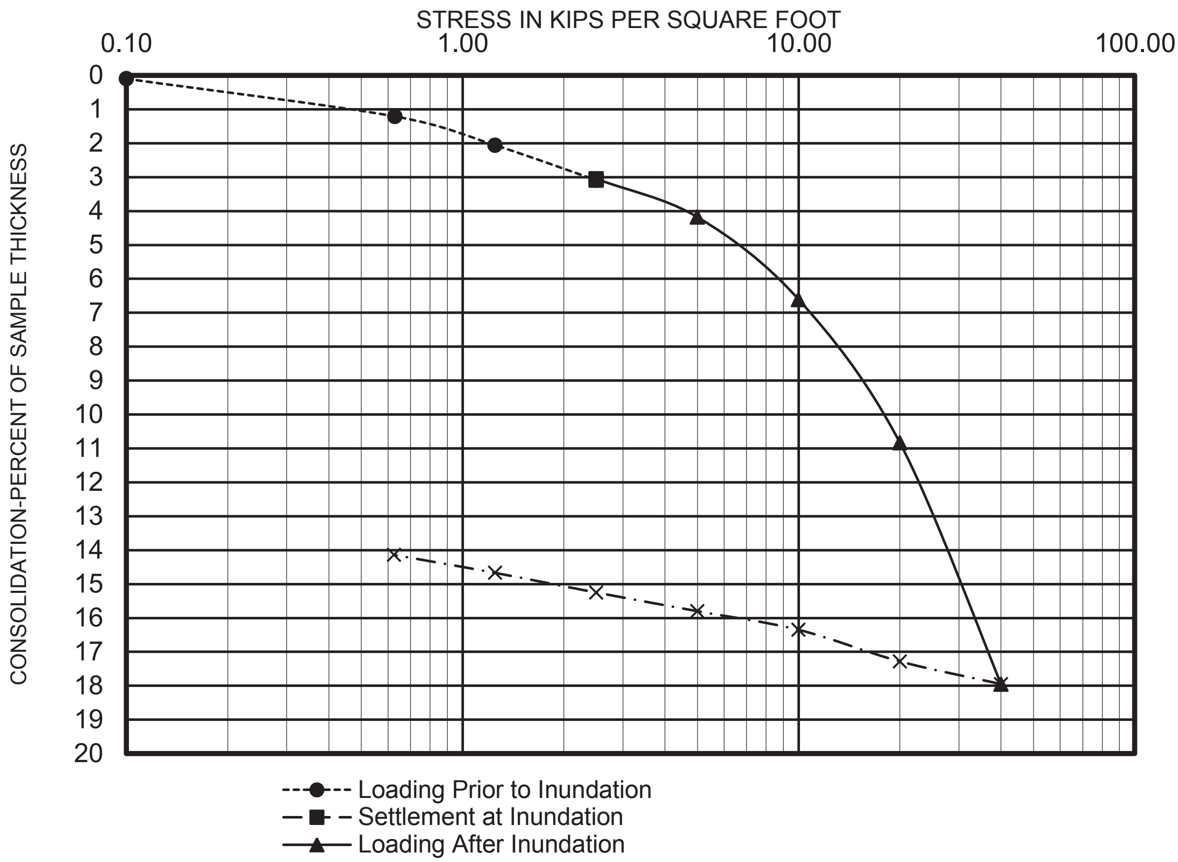

| Load (lbs) | Def. (inch) | Area (sq.in) | Deviator Stress (ksf) | Axial Strain (%) |
|---|---|---|---|---|
| 0 | 0.000 | 4.58 | 0.00 | 0.00 |
| 31 | 0.005 | 4.58 | 0.97 | 0.09 |
| 44 | 0.010 | 4.59 | 1.38 | 0.17 |
| 60 | 0.020 | 4.60 | 1.88 | 0.34 |
| 67 | 0.025 | 4.60 | 2.10 | 0.43 |
| 74 | 0.030 | 4.60 | 2.31 | 0.52 |
| 103 | 0.060 | 4.63 | 3.20 | 1.03 |
| 121 | 0.090 | 4.65 | 3.75 | 1.55 |
| 137 | 0.120 | 4.68 | 4.22 | 2.06 |
| 151 | 0.150 | 4.70 | 4.62 | 2.58 |
| 172 | 0.200 | 4.74 | 5.22 | 3.44 |
| 192 | 0.250 | 4.79 | 5.78 | 4.29 |
| 209 | 0.300 | 4.83 | 6.23 | 5.15 |
| 224 | 0.350 | 4.87 | 6.62 | 6.01 |
| 238 | 0.400 | 4.92 | 6.97 | 6.87 |
| 251 | 0.450 | 4.96 | 7.28 | 7.73 |
| 264 | 0.500 | 5.01 | 7.59 | 8.59 |
| 274 | 0.550 | 5.06 | 7.80 | 9.45 |
| 284 | 0.600 | 5.11 | 8.01 | 10.31 |
| 293 | 0.650 | 5.16 | 8.18 | 11.17 |
| 299 | 0.700 | 5.21 | 8.27 | 12.03 |
| 306 | 0.750 | 5.26 | 8.38 | 12.88 |
| 311 | 0.800 | 5.31 | 8.43 | 13.74 |
| 318 | 0.850 | 5.36 | 8.54 | 14.60 |
| 323 | 0.900 | 5.42 | 8.58 | 15.46 |
| 327 | 0.950 | 5.47 | 8.60 | 16.32 |
| 333 | 1.000 | 5.53 | 8.67 | 17.18 |
| 336 | 1.050 | 5.59 | 8.66 | 18.04 |
| 340 | 1.100 | 5.65 | 8.67 | 18.90 |
| 347 | 1.200 | 5.77 | 8.66 | 20.62 |

620 W. 16th St., Unit F
Long Beach, CA 90813
Phone: (562) 432-1696 Fax: (562) 432-1796

## ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS - ASTM D 2435

| | | | |
|---|---|---|---|
| Report To: | | Report Date: | 7/30/2012 |
| | Simon Property Group, Inc. | Project No.: | 128062 |
| | 225 West Washington Street | Project: | Laguna Hills Mall |
| | Indianapolis, IN 46204 | Task: | 1 |

## TEST RESULTS




| SAMPLE IDENTIFICATION | | | SOIL CLASSIFICATION | USCS TOTAL SAMPLE |
|---|---|---|---|---|
| BORING NO. | SAMPLE NO. | DEPTH (ft) | | |
| B-5 | 3 | 6.0 | Silt | ML |

| | |
|---|---|
| **INITIAL MOISTURE (%):** | 64.4 |
| **INITIAL DRY DENSITY (pcf):** | 55.4 |
| **FINAL MOISTURE(%):** | 54.3 |

Reviewed on 7/31/2012 by: ______________________

Eric Finley
Laboratory Manager

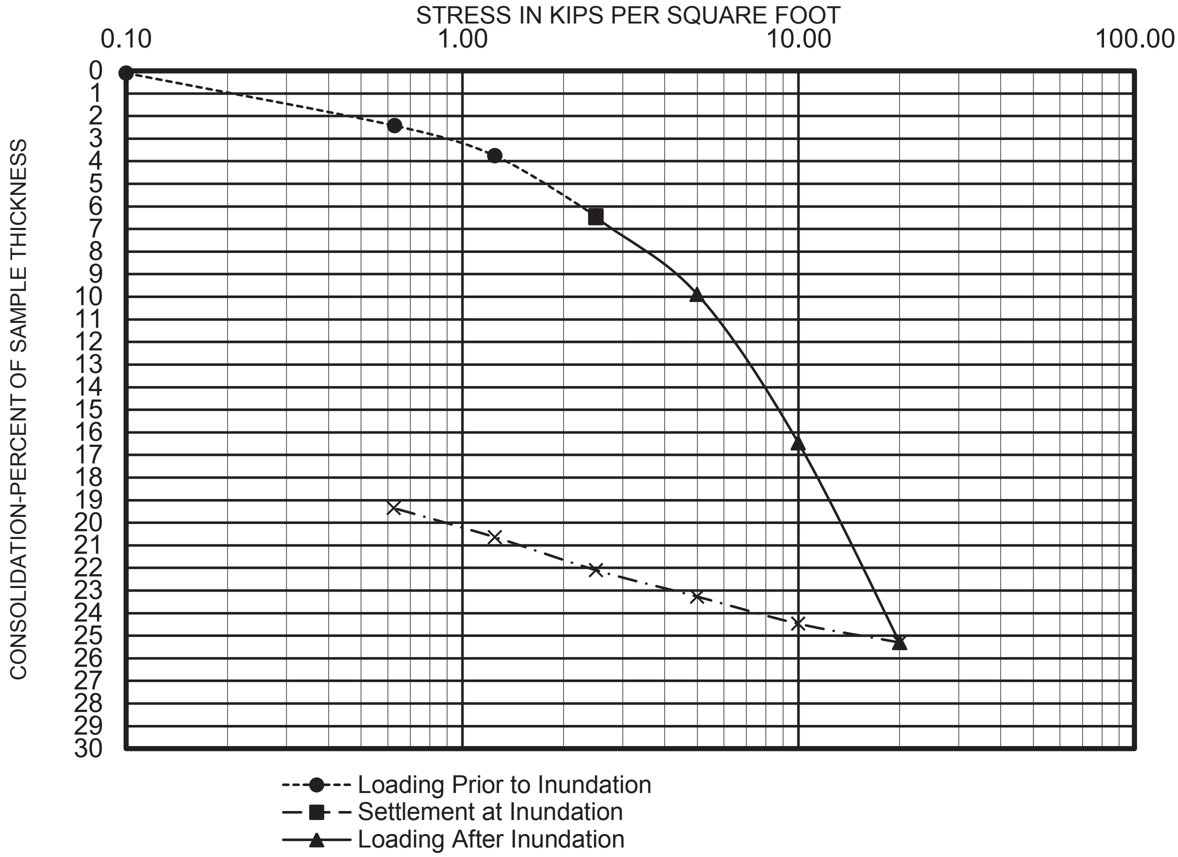
620 W. 16th St., Unit F
Long Beach, CA 90813
Phone: (562) 432-1696  Fax: (562) 432-1796

## ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS - ASTM D 2435

Report To:
Simon Property Group, Inc.
225 West Washington Street
Indianapolis, IN 46204

Report Date: 7/30/2012
Project No.: 128062
Project: Laguna Hills Mall
Task: 1

## TEST RESULTS




| SAMPLE IDENTIFICATION | | | SOIL CLASSIFICATION | USCS TOTAL SAMPLE |
|---|---|---|---|---|
| BORING NO. | SAMPLE NO. | DEPTH (ft) | | |
| B-5 | 11 | 41 | Silt | ML |

**INITIAL MOISTURE (%):** 73.8
**INITIAL DRY DENSITY (pcf):** 60.2
**FINAL MOISTURE(%):** 59.6

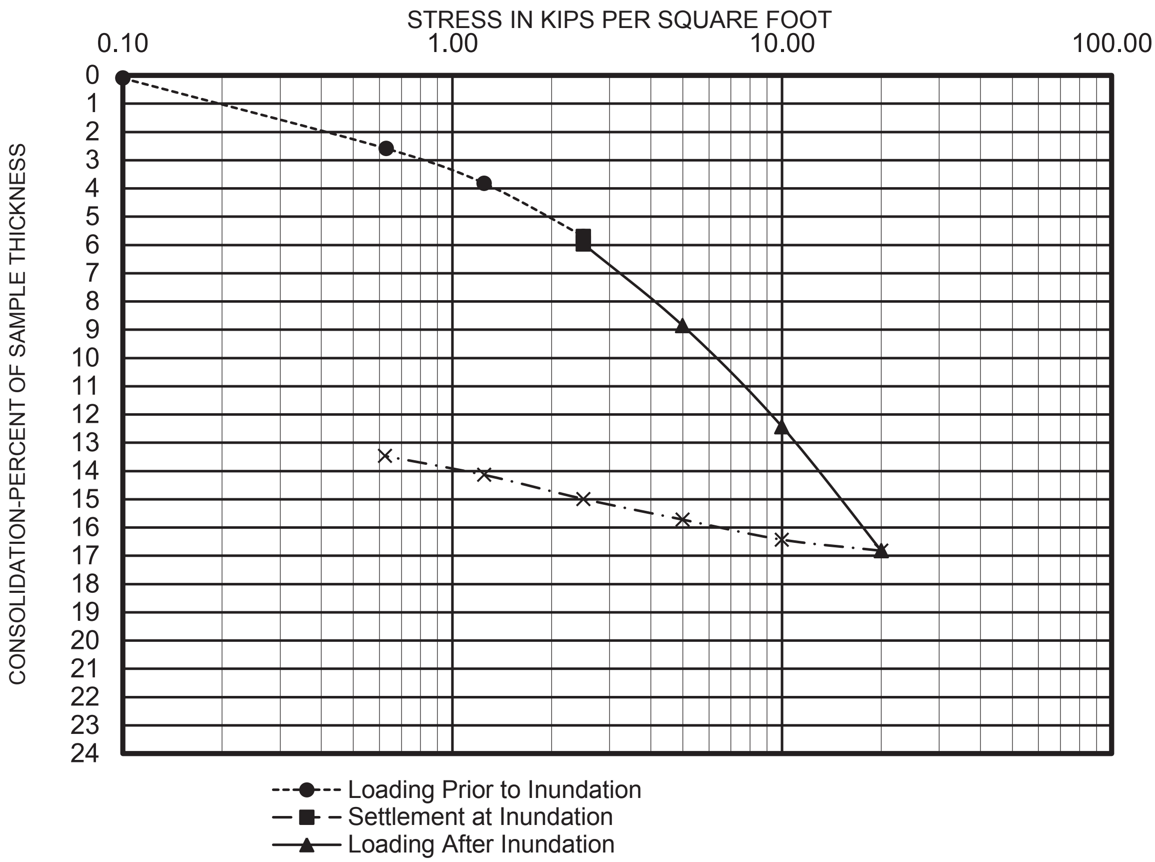
Reviewed on 7/31/2012 by: ____________________
Eric Finley
Laboratory Manager

KLEINFELDER
Bright People. Right Solutions.
620 W. 16th St., Unit F
Long Beach, CA 90813
Phone: (562) 432-1696 Fax: (562) 432-1796

## ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS - ASTM D 2435

| | | | |
|---|---|---|---|
| Report To: | | Report Date: | 8/7/2012 |
| | Simon Property Group, Inc. | Project No.: | 128062 |
| | 225 West Washington Street | Project: | Laguna Hills Mall |
| | Indianapolis, IN 46204 | Task: | 1 |

## TEST RESULTS




| SAMPLE IDENTIFICATION | | | SOIL CLASSIFICATION | USCS TOTAL SAMPLE |
|---|---|---|---|---|
| BORING NO. | SAMPLE NO. | DEPTH (ft) | | |
| B-12 | 4 | 21-21.5 | Clay | CL |

**INITIAL MOISTURE (%):** 31.0
**INITIAL DRY DENSITY (pcf):** 93.6
**FINAL MOISTURE(%):** 25.1

Reviewed on 8/9/2012 by:
Eric Finley
Laboratory Manager

KLEINFELDER
Bright People. Right Solutions.

620 W. 16th St., Unit F
Long Beach, CA 90813
Phone: (562) 432-1696 Fax: (562) 432-1796

# Resistance (R-Value) and Expansion Pressure of Compacted Soils

**Report To:**

Simon Property Group, Inc.
Curt Tappendorf, PE
225 W. Washington Street
Indianapolis, IN 46204

**Report Date:** 8/31/2012
**Project No.:** 128062
**Project:** CSM Simon Laguna Hills, CA GEO
**Task:** 001 Geotech Study

## TEST RESULTS

**Sample Number:** LB_12_9_237
**Date Sampled:** 7/13/2012
**Material Description:** Sandy Clay
**Specific Location:** B-1/1@1

| Briquette No. | A | B | C |
|---|---|---|---|
| Dry Unit Weight (pcf) | 118.8 | 120.1 | 121.7 |
| Expansion Pressure (psf) | | | |
| Exudation Pressure (psi) | 431 | 294 | 183 |
| Moisture at Time of Test (%) | 12.6 | 13.1 | 14.5 |
| Resistance Value | 24 | 18 | 12 |
| **R-VALUE AT 300 PSI EXUDATION PRESSURE:** | | | **18** |

Remarks:

Reviewed on 8/31/2012 by: ______________________

Eric Finley
Senior Technician

AP Engineering & Testing, Inc.

# CORROSION TEST RESULTS

Client Name: Kleinfelder
Project Name: Laguna Hills Mall - Simon Property Group
Project No.: 128062

AP Job No.: 12-0710
Date 07/18/12

| Boring No. | Sample No. | Depth (feet) | Soil Type | Minimum Resistivity (ohm-cm) | pH | Sulfate Content (ppm) | Chloride Content (ppm) |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| B-5 | 2 | 2 | CL | 898 | 7.8 | 407 | 48 |
| B-8 | 2 | 2 | CL | 726 | 8.0 | 459 | 102 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

NOTES: Resistivity Test and pH: California Test Method 643
Sulfate Content : California Test Method 417
Chloride Content : California Test Method 422
ND = Not Detectable
NA = Not Sufficient Sample
NR = Not Requested

2607 Pomona Boulevard, Pomona, CA 91768
Tel. (909) 869-6316 Fax. (909)869-6318

# APPENDIX C
# Calculations

# Liquefaction

| PROJECT | Five Lagunas | PROJECT NO. | 20155150 | REVIEWED BY | MS | DATE | 04/29/15 |
|---|---|---|---|---|---|---|---|
| SUBJECT | Liquefaction Analysis | | | PERFORMED BY | YZ | DATE | 04/29/15 |

**PURPOSE:**

Evaluate the liquefaction-induced seismic settlement based on CPT and SPT data for Laguna Hills Mall Project. The site is located in a state designated liquefaction hazard zone, and the historical ground water depth is shallow.

**REQUIREMENTS:**

1. Minimum Factor of safety for liquefaction triggering and settlement = 1.1 and 1.3 respectively
2. Seismic Design Parameters based on 2013 CBC

**GIVEN/ASSUMPTIONS:**

1. Approximate Site Coordinates: Latitude 33.610 deg and Longitude -117.706 deg
2. CPTs and Boring Logs our field exploration
3. Design ground water depth = 10 feet, based on historical high GW depth per CGS map
4. Existing and finish ground surface elevation assumed to be approximately the same
5. Maximum analysis depths are limited to 60 feet.

**CALCULATIONS:**

1. Based on the UU tests results, the average undrained shear strength (Su) of the upper 30 m is less than 1,000 psf. Per 2013 CBC, the site can be classified as Class E.

2. Per 2013 CBC, $PGA_M$ should be used for liquefaction analysis if a site-specific seismic hazard study was not performed. We calculated $PGA_M$ (0.51g) based on ASCE-7-10 (with March 2013 errata) using the USGS online tool (http://earthquake.usgs.gov/designmaps/us/application.php).

3. Design earthquake magnitude Mw =6.9 is based on the seismic hazard de-aggregation using the USGS online tool (http://geohazards.usgs.gov/deaggint/2008/). This event is associated with San Joaquin Hills Fault. The site is about 2 miles to the rupture plane of this fault.

4. We performed simplified liquefaction analyses based on both CPT data and boring SPT data. We used three different semi-empirical procedures for both CPT-based and SPT-based liquefaction triggering and liquefaction-induced settlement analyses. We also estimated dry seismic settlements for sands above design groundwater table based on SPT data. Though the SPT-based analyses were performed on borings deeper than 50 feet, the analyzed depths were generally terminated at the top of bedrock (primarily siltstone), which is cemented and not considered as liquefiable. The calculations were performed using Kleinfelder's in-house spreadsheets. The following table summarizes calculated settlement based on these analyses.

KLEINFELDER
Bright People. Right Solutions.

| PROJECT | Five Lagunas | PROJECT NO. | 20155150 | REVIEWED BY | MS | DATE | 04/29/15 |
|---|---|---|---|---|---|---|---|
| SUBJECT | Liquefaction Analysis | | | PERFORMED BY | YZ | DATE | 04/29/15 |

**Table 1. Summary of Liquefaction-induced and Dry Seismic Settlement**

| Boring/ CPT ID | Total/Analysis Depth (feet) | Liquefaction-Induced Settlement (inch) | | | | Dry Seismic Compaction (inch) |
|---|---|---|---|---|---|---|
| | | Cetin, Moss Seed 03,04 and 06 | IB04,06&08 | Youd2001 | Average of 3 Methods | |
| KCPT-1 | 60/60 | 5.3 | 5.1 | 1 | 3.8 | - |
| KCPT-2 | 80/60 | 3.7 | 3.2 | 0.6 | 2.5 | - |
| KCPT-3 | 60/60 | 3.6 | 4.4 | 1.3 | 3.1 | - |
| KCPT-4 | 59/59 | 10.7 | 12.2 | 5.3 | 9.4 | - |
| KCPT-5 | 32/32 | 7.1 | 8.9 | 2.6 | 6.2 | - |
| KCPT-6 | 49/49 | 4.5 | 5.5 | 2.7 | 4.2 | - |
| KCPT-7 | 64/60 | 12 | 11.4 | 4.8 | 9.4 | - |
| KCPT-8 | 75/60 | 18.1 | 17.3 | 7.8 | 14.4 | - |
| KCPT-9 | 80/60 | 13.3 | 13.5 | 5.4 | 10.7 | - |
| KCPT-10 | 80/60 | 11.5 | 12.1 | 5.2 | 9.6 | - |
| KCPT-11 | 80/60 | 3.4 | 4.8 | 1.6 | 3.3 | - |
| KCPT-12 | 80/60 | 11.9 | 12.3 | 6.1 | 10.1 | - |
| KCPT-13 | 58/58 | 4.1 | 4.7 | 2.5 | 3.8 | - |
| KCPT-14 | 60/60 | 2.4 | 3.1 | 1.5 | 2.3 | - |
| KCPT-15 | 77/60 | 3.5 | 4.2 | 2.4 | 3.4 | - |
| KCPT-16 | 80/60 | 13 | 12.9 | 5.9 | 10.6 | - |
| KCPT-17 | 80/60 | 2.4 | 2.7 | 1.5 | 2.2 | - |
| KCPT-18 | 80/60 | 2.6 | 3 | 1.5 | 2.4 | - |
| KCPT-19 | 80/60 | 5.4 | 6.2 | 2.7 | 4.8 | - |
| KCPT-20 | 80/60 | 0.7 | 0.8 | 0.4 | 0.6 | - |
| KB-5 | 81/45 | 0 | 0 | 0 | 0.0 | 0 |
| KB-6 | 81/35 | 1.9 | 1.7 | 1.3 | 1.6 | 0.1 |
| KB-7 | 101/43 | 0 | 0 | 0 | 0.0 | 0 |
| KB-8 | 101.5/45 | 1.6 | 2.6 | 1.8 | 2.0 | 0 |
| KB-9 | 81/45 | 1.1 | 1.1 | 0.8 | 1.0 | 1.8 |
| KB-10 | 101.5/57 | 3.9 | 5.2 | 4.3 | 4.5 | 0 |
| KB-11 | 81.5/55 | 2.9 | 3.3 | 2.2 | 2.8 | 0.1 |
| KB-12 | 101.5/59 | 2.8 | 5.5 | 3.7 | 4.0 | 0 |
| CPT-1 | 60 | 3.79 | 4.7 | 1.85 | 3.4 | - |
| CPT-2 | 60 | 3.45 | 4.1 | 1.38 | 3.0 | - |
| CPT-3 | 60 | 6.44 | 7.6 | 2.56 | 5.5 | - |
| CPT-4 | 60 | 4.78 | 5.7 | 2.21 | 4.2 | - |
| CPT-5 | 48 | 2.18 | 2.7 | 0.97 | 2.0 | - |
| CPT-6 | 60 | 2.14 | 2.8 | 1.16 | 2.0 | - |
| B-3 | 50 | 1.2 | 1.69 | 1.25 | 1.4 | - |
| B-5 | 50 | 0 | 1.66 | 1.13 | 0.9 | - |
| B-7 | 50 | 0 | 0 | 0 | 0.0 | - |
| B-12 | 50 | 0.98 | 1.32 | 0.79 | 1.0 | - |

**CONNCLUSIONS:**

| PROJECT | Five Lagunas | PROJECT NO. | 20155150 | REVIEWED BY | MS | DATE | 04/29/15 |
|---|---|---|---|---|---|---|---|
| SUBJECT | Liquefaction Analysis | | | PERFORMED BY | YZ | DATE | 04/29/15 |

We evaluated the liquefaction potential at the site using the CPT and SPT data. Based on the CPT and SPT data and our engineering analyses, it is our opinion that layers of loose and medium dense sandy silt, silty sand, and sand below the groundwater are subject to liquefaction in the event of a major earthquake occurring on a nearby fault. Based on our analyses, calculated average liquefaction-induced settlements from the three liquefaction analysis procedures varied between approximately 1 to 14 inches (6 inches overall average) based on CPT data and approximately 0 to 4½ inches (2 inches overall average) based on SPT data. However, the boring and laboratory data indicate some liquefiable layers identified by CPT-based procedures are cohesive sandy clay or clayey sand soil and are not considered liquefiable. Accordingly, we consider the SPT-based methods more reliable. It is, therefore, our engineering judgment that the anticipated liquefaction-induced settlements due to strong ground shaking during a design-level seismic event will be on the order of 1 to 3 inches for the northern/western portion of the site (the area of the new shops and building pads) and approximately 0 to 4 inches for the southern/eastern portion of the site (the area of the multi-level structures). Differential settlement is generally assumed to be between ½ and ¾ of the total settlement. The results of our liquefaction analyses are attached. Although the potential for localized liquefaction cannot be ruled out, the potential for larger-scale widespread liquefaction affecting the proposed structures is considered low. In addition, if localized sandy layers were to liquefy, the resulting minor settlements should not induce downdrag loads and affect a pile foundation system, because the layers are isolated and not continuous. Shallow foundations may need to be tied together with grade beams.

**ATTACHMENTS:**

1. CPT-based liquefaction analysis output plots
2. SPT-based liquefaction analysis output plots

**REFERENCE:**


1. ASCE 7-10, (2010), "Minimum Design Loads for Buildings and Other Structures".

2. California Building Code, 2013.

3. Cetin K. O. , Seed R. B. et al. (2004) "Standard Penetration Test-Based Probabilistic and Deterministic Assessment of Seismic Soil Liquefaction Potential" Journal: Journal of Geotechnical and Geoenvironmental Engineering, vol. 130, No. 12, 2004

4. Idriss and Boulanger (2004), "Semi-Empirical Procedures For Evaluating Liquefaction Potential During Earthquakes", Proceedings of the 11the SDEE and 3rd ICEGE, University of California, Berkeley, January 2004, Plenary Session, p. 32 - 56.

5. Idriss and Boulanger (2008), "Soil Liquefaction During Earthquakes", Earthquake Engineering Research Institute, MNO - 12, Oakland, California.

6. Moss R. E. S. , Seed R. B. , Cetin K. O. , Der Kiureghian A. , Kayen R. E. , Stewart J. P. (2006) " CPT-Based Probabilistic and Deterministic Assessment of in Situ Seismic Soil Liquefaction Potential", Journal of Geotechnical and Geoenvironmental Engineering, Vol. 132, No. 8, 2006

KLEINFELDER
Bright People. Right Solutions.

| PROJECT | Five Lagunas | PROJECT NO. | 20155150 | REVIEWED BY | MS | DATE | 04/29/15 |
|---|---|---|---|---|---|---|---|
| SUBJECT | Liquefaction Analysis | | | PERFORMED BY | YZ | DATE | 04/29/15 |


7. Ross W. Boulanger and I. M. Idriss (2006), “Liquefaction Susceptibility Criteria for Silts and Clays”, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 132, No. 11, 2006.

8. Seed, R. B. et al (2003), "Recent Advances in Soil Liquefaction Engineering: a Unified and Consistent Framework." Keynote Presentation, 26th Annual ASCE Los Angeles Geotechnical Spring Seminar, Long Beach, CA.

9. Tokimatsu, K., and Seed, H. B., 1987, Evaluation of settlements in sands due to earthquake shaking, J. Geotechnical Eng., ASCE 113(GT8), 861–78.

10. Youd et al. (2001), "Liquefaction Resistance Of Soils: Summary Report From The 1996 NCEER And 1998 NCEER/NSF Workshops On Evaluation Of Liquefaction Resistance Of Soils", ASCE Journal of Geotechnical and Geoenvironmental Engineering, Vol. 132, No.8, 2001

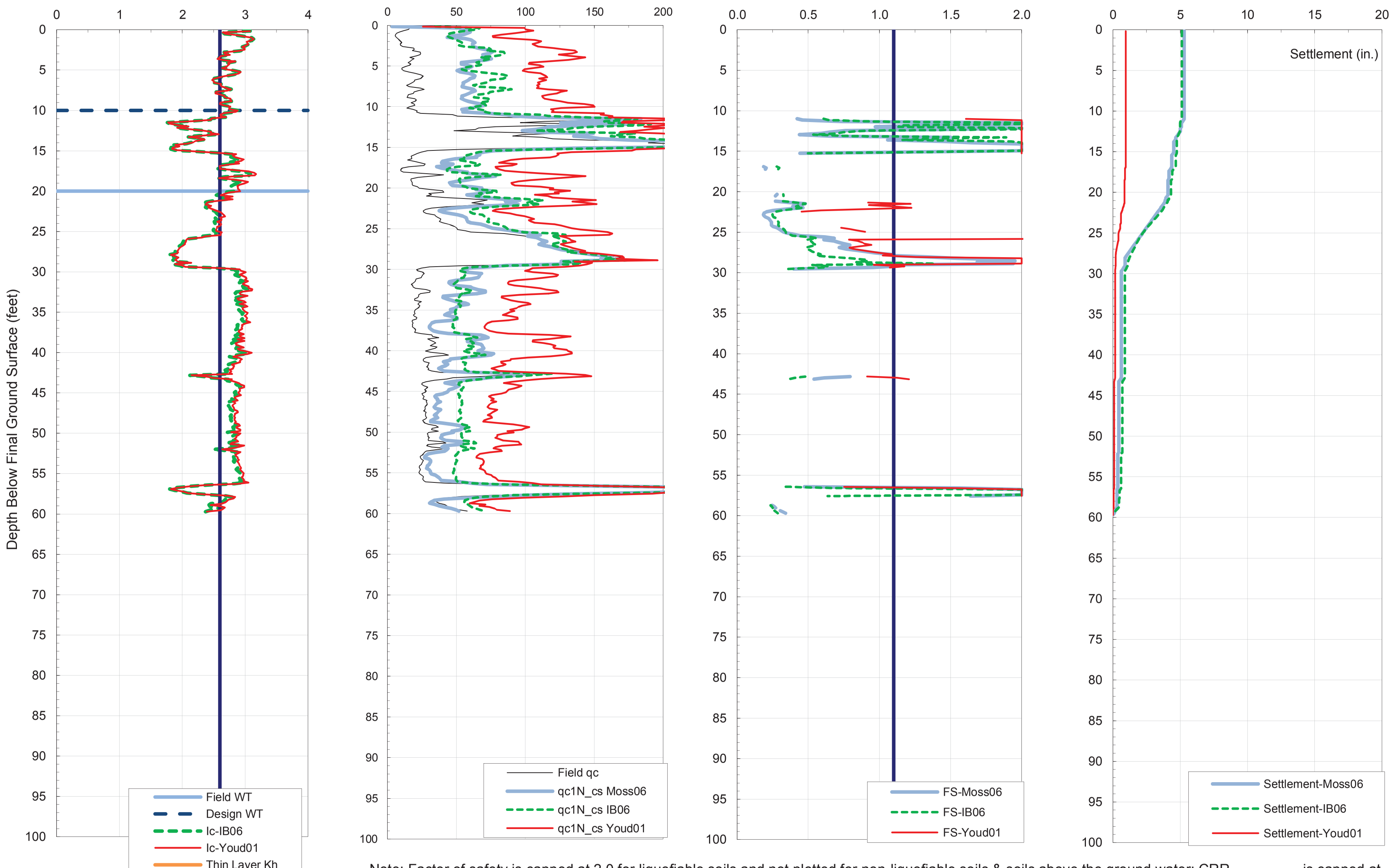
CPT ID: **KCPT-1**

$M_w$= **6.8**
PGA= **0.51g**

Field Ground Water Depth (ft)= **20.0 ft**
Design Ground Water Depth (ft)= **10.0 ft**

Existing Ground Elevation= **357.0 ft**
Final Ground Elevation= **357.0 ft**

Ana. by: Y. Zhou
Checked by:




Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5,\ \sigma v'=\ 1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

KLEINFELDER
Bright People. Right Solutions.

**Project Name:** **Laguna Hills Mall**
**Project No.:** **20155150**
**Project Location:** **Laguna Hills, CA**

# LIQUEFACTION ANALYSIS

Date 4/27/2015

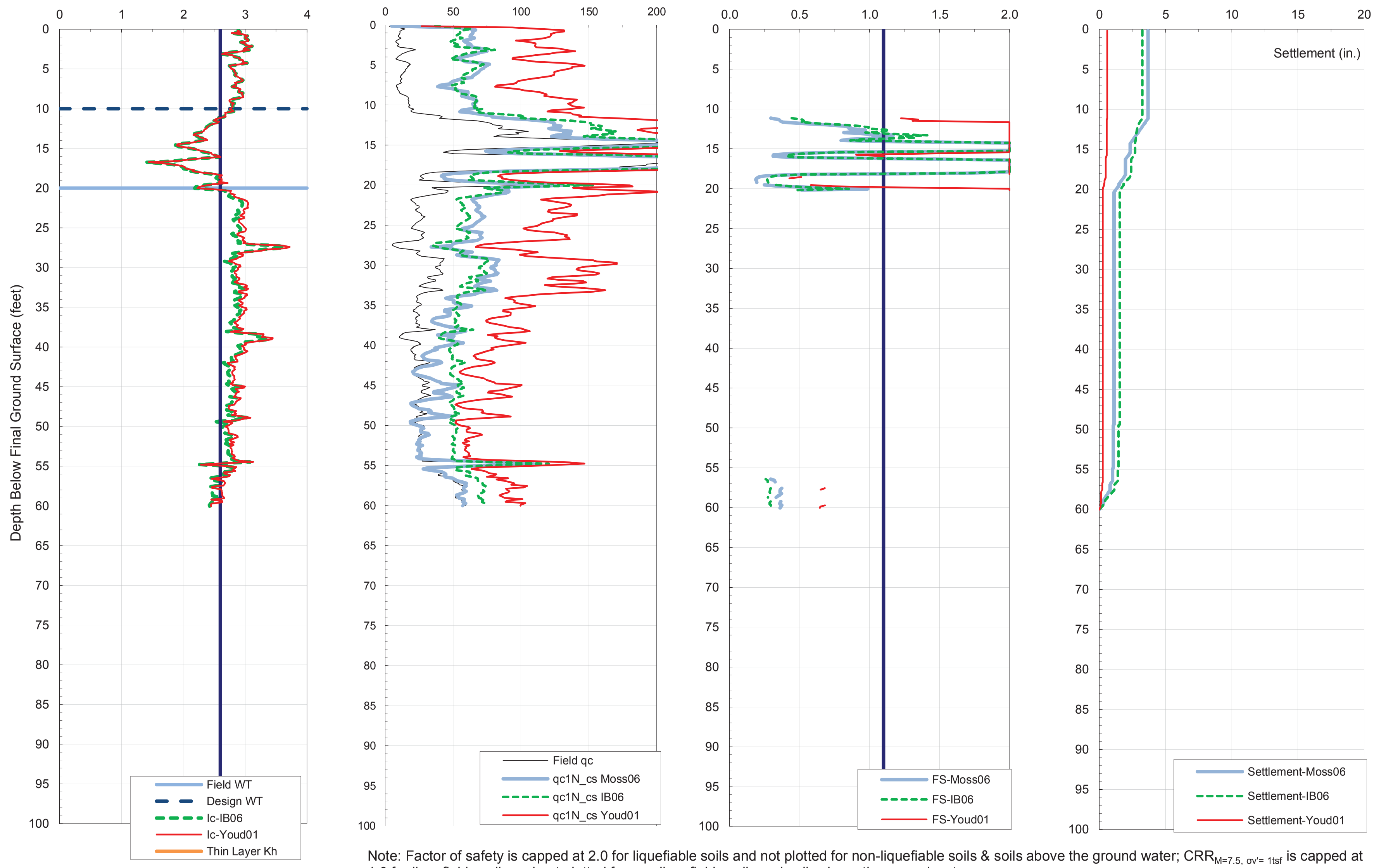
CPT ID: **KCPT-2**

$M_w$= **6.8**
PGA= **0.51g**

Field Ground Water Depth (ft)= **20.0 ft**
Design Ground Water Depth (ft)= **10.0 ft**

Existing Ground Elevation= **352.0 ft**
Final Ground Elevation= **352.0 ft**

Ana. by: Y. Zhou
Checked by:




Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5,\ \sigma v'=1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

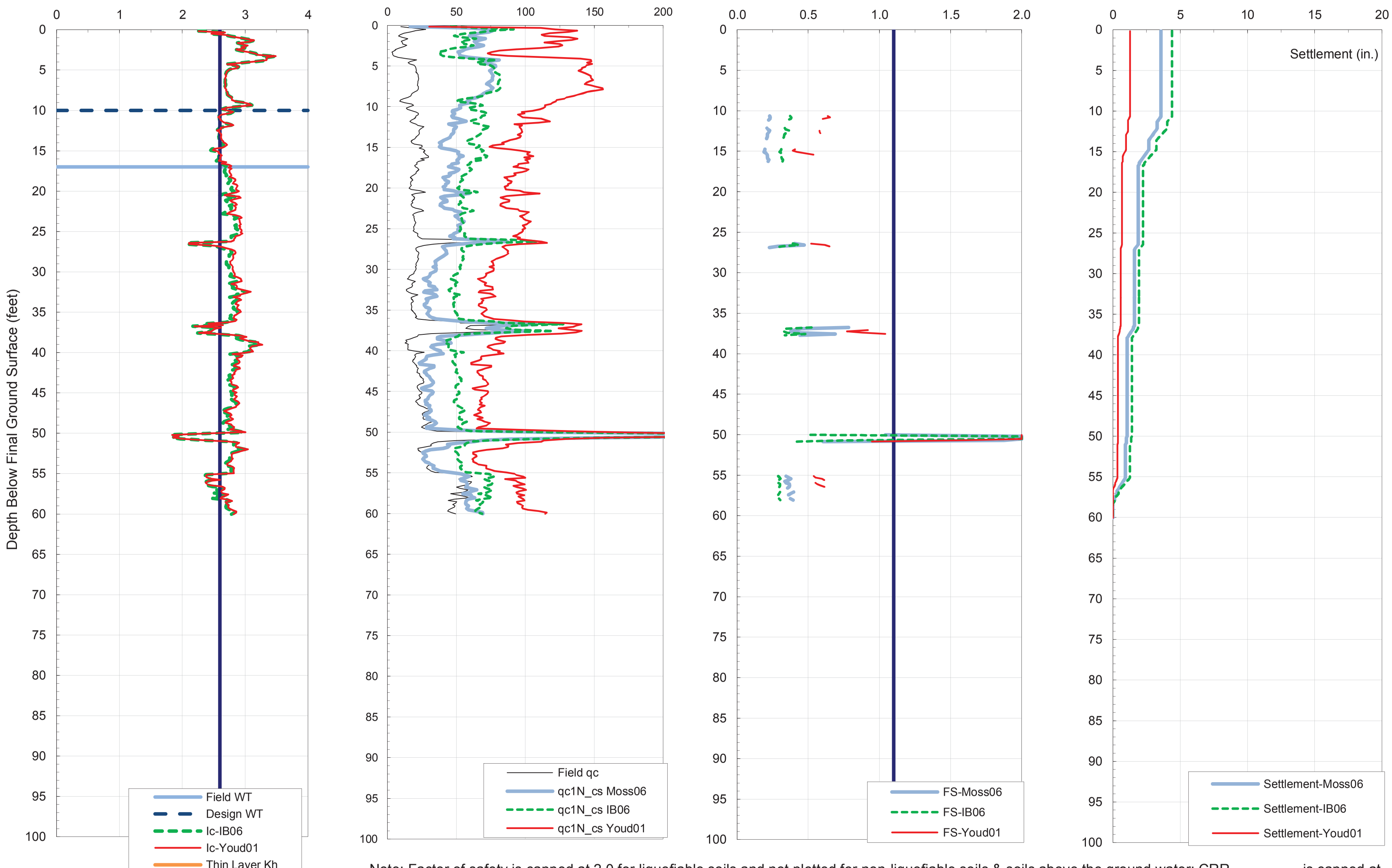
KLEINFELDER
Bright People. Right Solutions.

**Project Name:** **Laguna Hills Mall**
**Project No.:** **20155150**
**Project Location:** **Laguna Hills, CA**

## LIQUEFACTION ANALYSIS

Date 4/27/2015

| | | | | | |
|---|---|---|---|---|---|
| CPT ID: | **KCPT-3** | $M_w$= **6.8** | Field Ground Water Depth (ft)= **17.0 ft** | Existing Ground Elevation= **347.0 ft** | Ana. by: Y. Zhou |
| | | PGA= **0.51g** | Design Ground Water Depth (ft)= **10.0 ft** | Final Ground Elevation= **347.0 ft** | Checked by: |




Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5,\ \sigma v'=1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

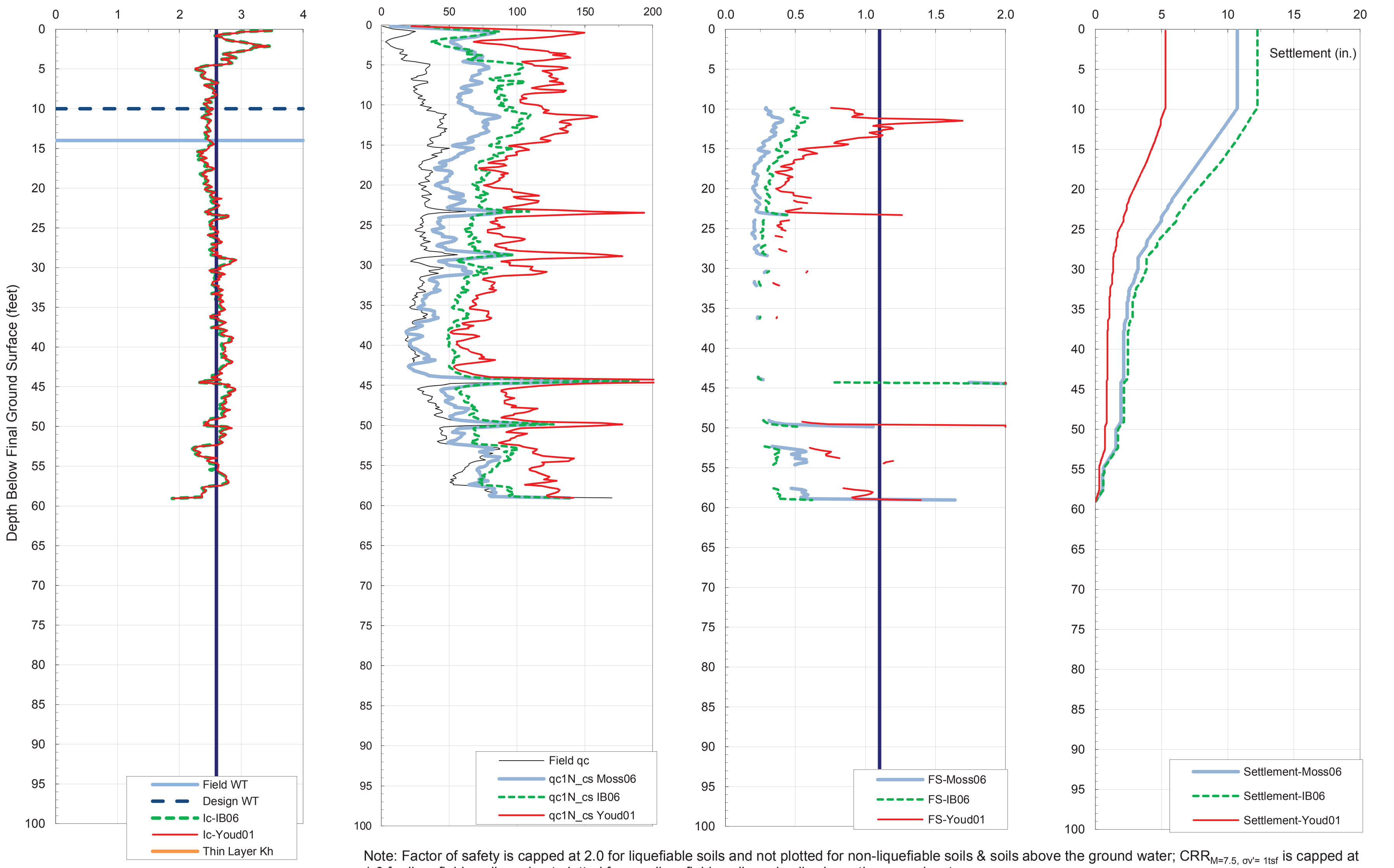
KLEINFELDER
Bright People. Right Solutions.

**Project Name:** **Laguna Hills Mall**
**Project No.:** **20155150**
**Project Location:** **Laguna Hills, CA**

## LIQUEFACTION ANALYSIS

Date 4/27/2015

| | | | | | |
|---|---|---|---|---|---|
| CPT ID: **KCPT-4** | $M_w$= **6.8** | Field Ground Water Depth (ft)= **14.0 ft** | Existing Ground Elevation= **351.0 ft** | Ana. by: | Y. Zhou |
| | PGA= **0.51g** | Design Ground Water Depth (ft)= **10.0 ft** | Final Ground Elevation= **351.0 ft** | Checked by: | |




Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5,\ \sigma v'=1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

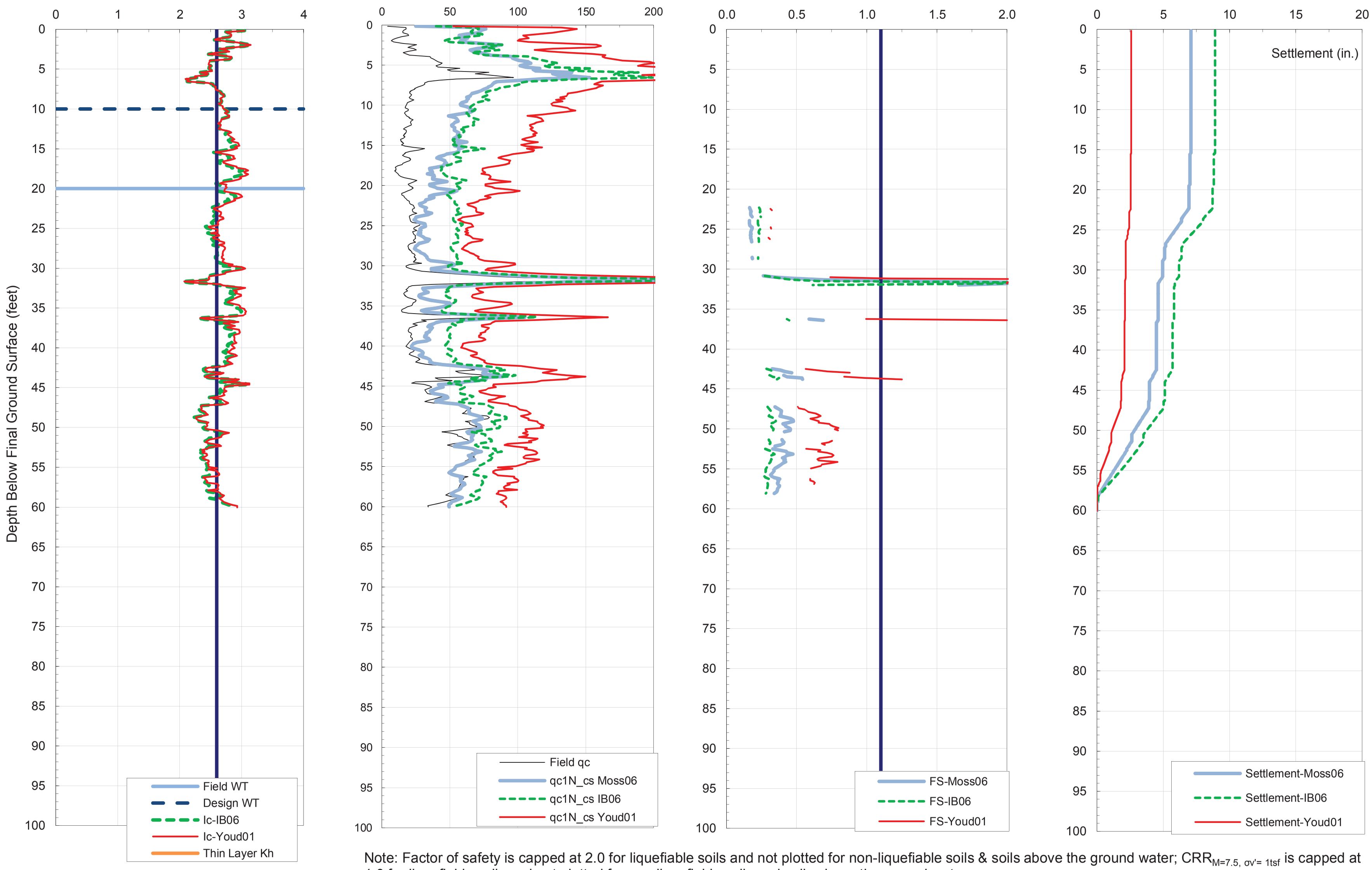
KLEINFELDER
Bright People. Right Solutions.

**Project Name:** **Laguna Hills Mall**
**Project No.:** **20155150**
**Project Location:** **Laguna Hills, CA**

## LIQUEFACTION ANALYSIS

Date 4/27/2015

| CPT ID: | KCPT-5 | $M_w$= 6.8 | Field Ground Water Depth (ft)= **20.0 ft** | Existing Ground Elevation= **357.0 ft** | Ana. by: Y. Zhou |
| --- | --- | --- | --- | --- | --- |
| | | PGA= **0.51g** | Design Ground Water Depth (ft)= **10.0 ft** | Final Ground Elevation= **357.0 ft** | Checked by: |




Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5,\ \sigma v'=1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

KLEINFELDER
Bright People. Right Solutions.

**Project Name:** **Laguna Hills Mall**
**Project No.:** **20155150**
**Project Location:** **Laguna Hills, CA**

## LIQUEFACTION ANALYSIS

Date 4/27/2015

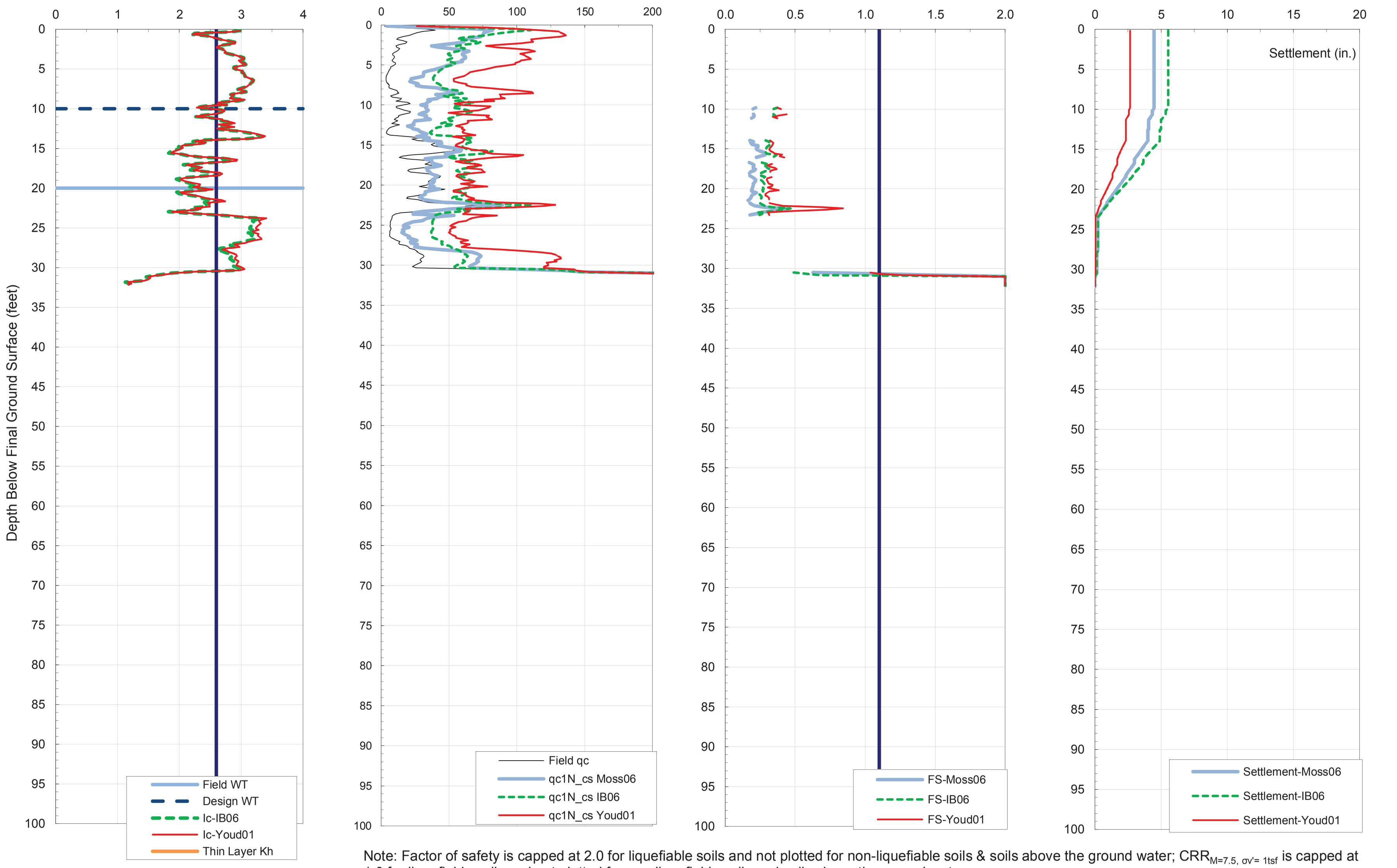
CPT ID: **KCPT-6**

$M_w$= **6.8** PGA= **0.51g**

Field Ground Water Depth (ft)= **20.0 ft**
Design Ground Water Depth (ft)= **10.0 ft**

Existing Ground Elevation= **356.0 ft**
Final Ground Elevation= **356.0 ft**

Ana. by: Y. Zhou
Checked by:




Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5,\ \sigma v'=1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

KLEINFELDER
Bright People. Right Solutions.

**Project Name:** **Laguna Hills Mall**
**Project No.:** **20155150**
**Project Location:** **Laguna Hills, CA**

## LIQUEFACTION ANALYSIS

Date 4/27/2015

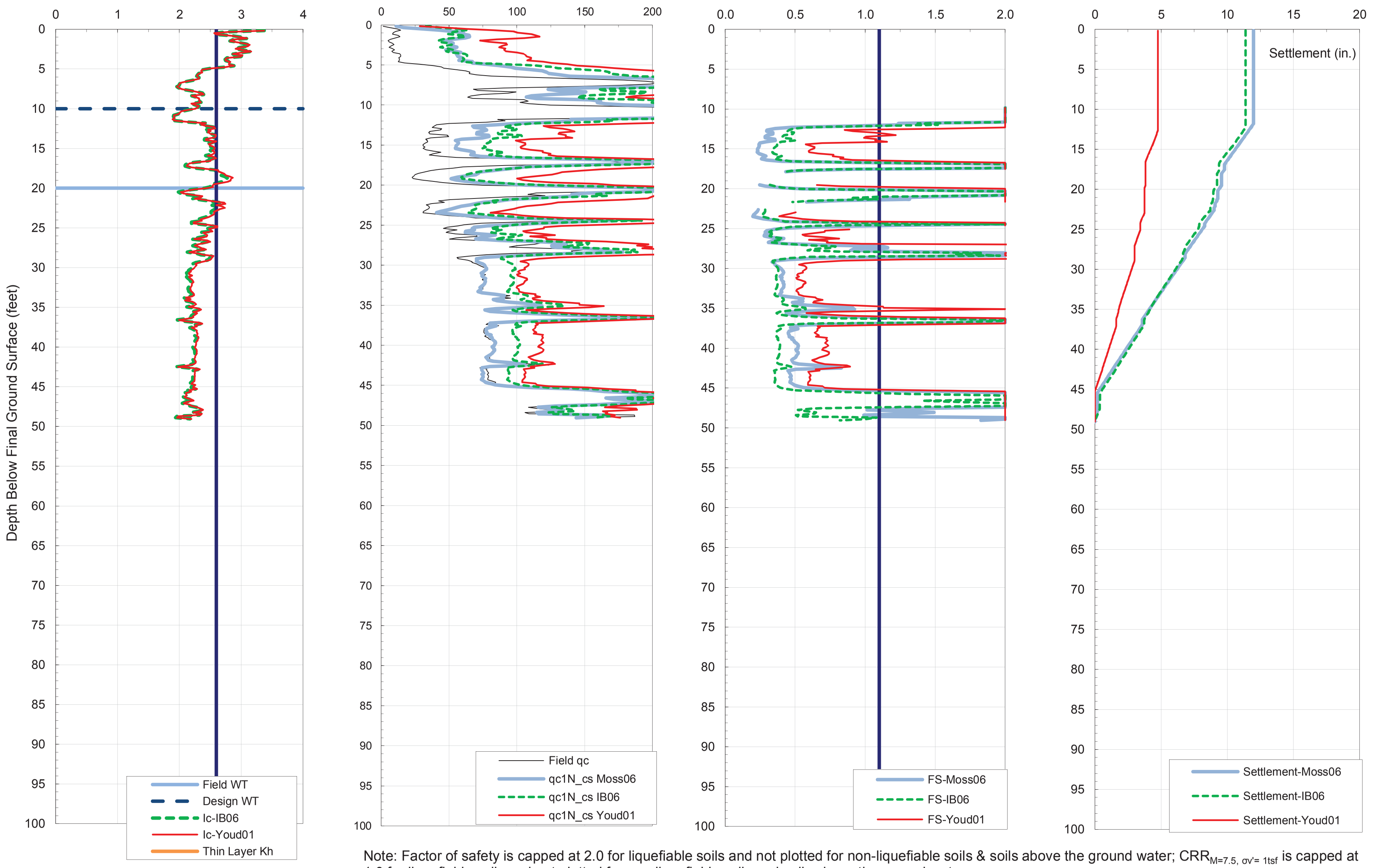
CPT ID: **KCPT-7**

$M_w$= **6.8** PGA= **0.51g**

Field Ground Water Depth (ft)= **20.0 ft**
Design Ground Water Depth (ft)= **10.0 ft**

Existing Ground Elevation= **354.0 ft**
Final Ground Elevation= **354.0 ft**

Ana. by: Y. Zhou
Checked by:




Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5,\ \sigma v'=1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

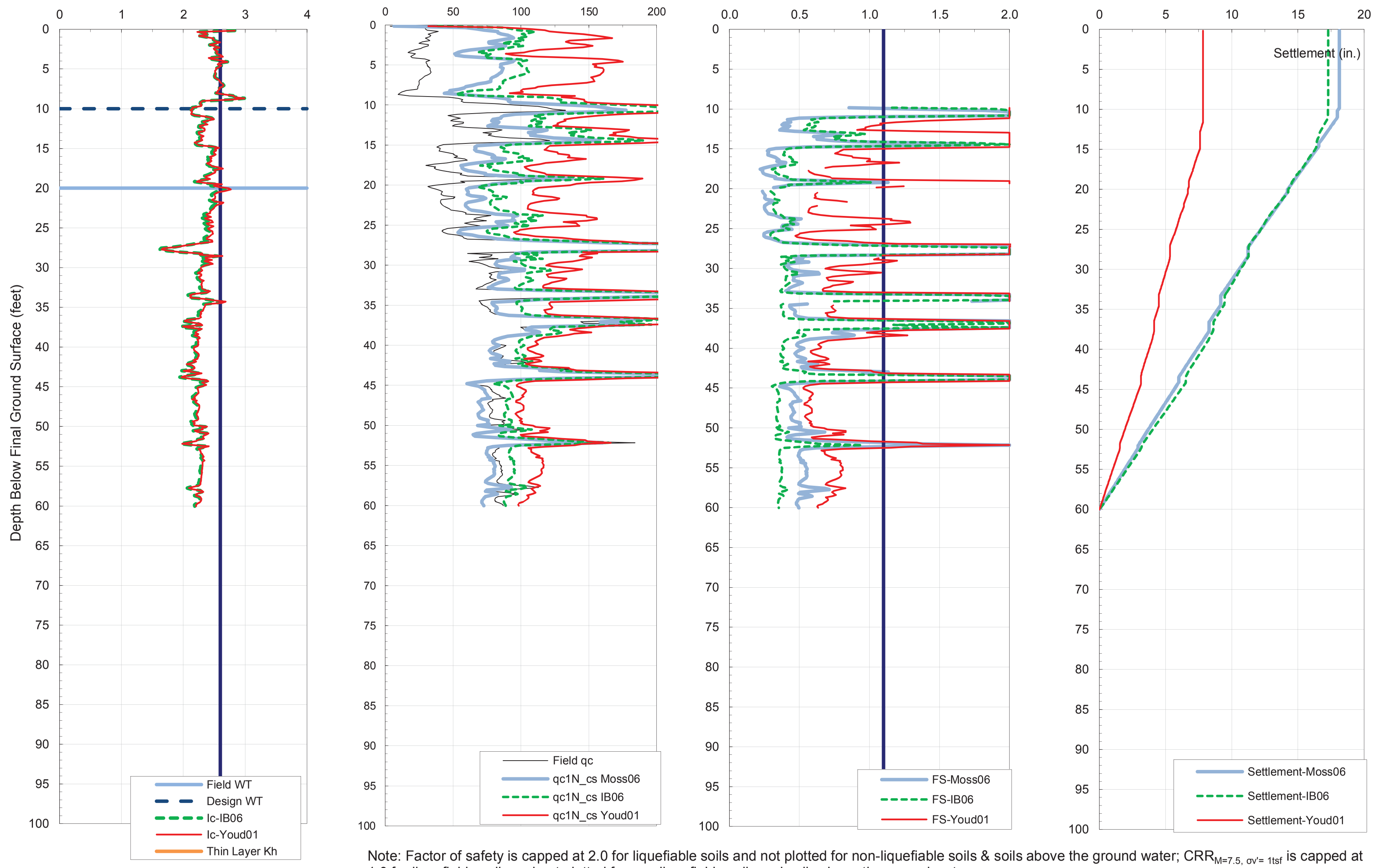
KLEINFELDER
Bright People. Right Solutions.

**Project Name:** **Laguna Hills Mall**
**Project No.:** **20155150**
**Project Location:** **Laguna Hills, CA**

# LIQUEFACTION ANALYSIS

Date 4/27/2015

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CPT ID: | **KCPT-8** | $M_w$= | **6.8** | Field Ground Water Depth (ft)= **20.0 ft** | Existing Ground Elevation= **357.0 ft** | Ana. by: | Y. Zhou |
| | | PGA= | **0.51g** | Design Ground Water Depth (ft)= **10.0 ft** | Final Ground Elevation= **357.0 ft** | Checked by: | |




Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5, \sigma v'=1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

KLEINFELDER
Bright People. Right Solutions.

**Project Name:** **Laguna Hills Mall**
**Project No.:** **20155150**
**Project Location:** **Laguna Hills, CA**

## LIQUEFACTION ANALYSIS

Date 4/27/2015

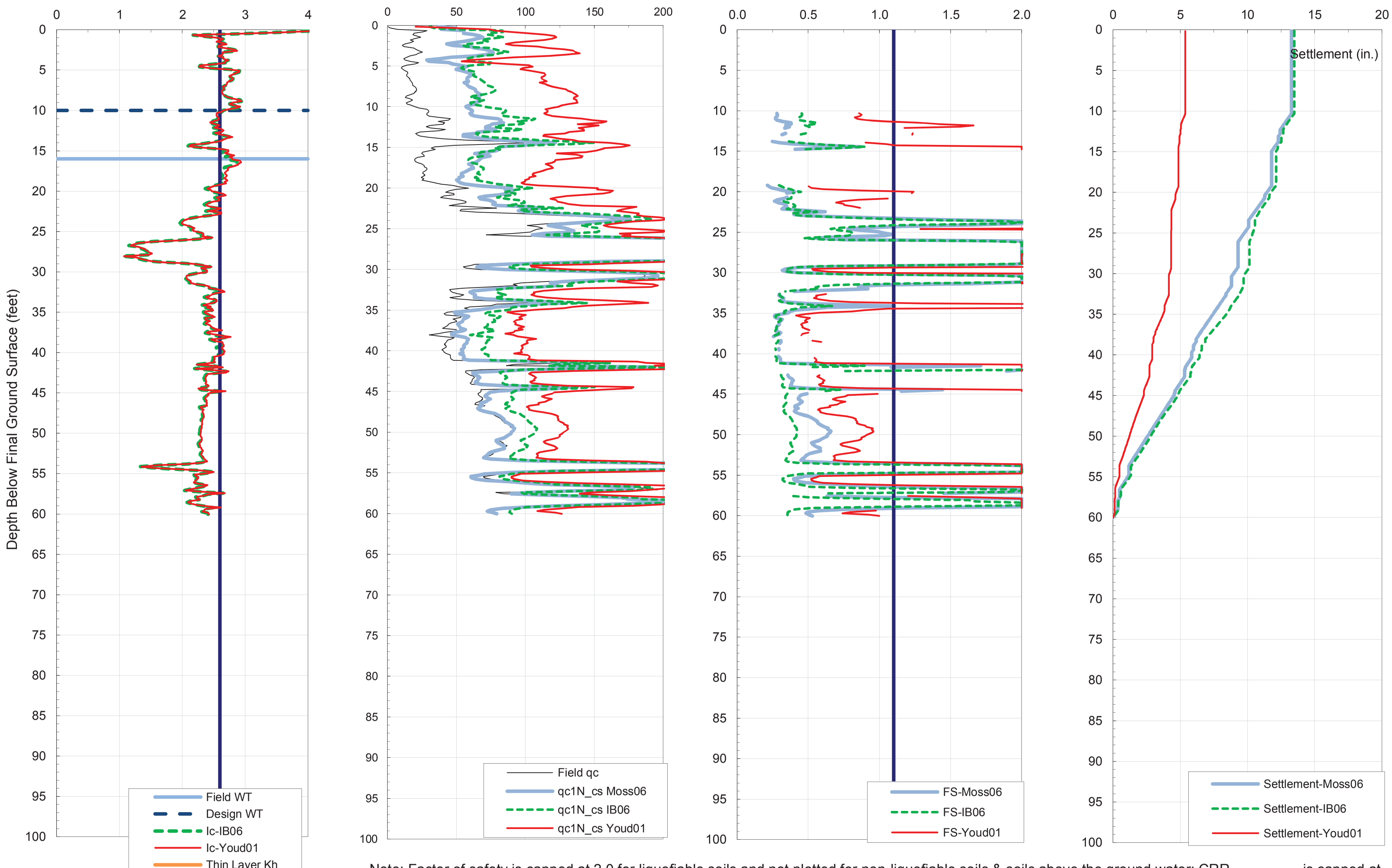
CPT ID: **KCPT-9**

$M_w$= **6.8**
PGA= **0.51g**

Field Ground Water Depth (ft)= **16.0 ft**
Design Ground Water Depth (ft)= **10.0 ft**

Existing Ground Elevation= **352.0 ft**
Final Ground Elevation= **352.0 ft**

Ana. by: Y. Zhou
Checked by:




Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5,\ \sigma v'=1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

KLEINFELDER
Bright People. Right Solutions.

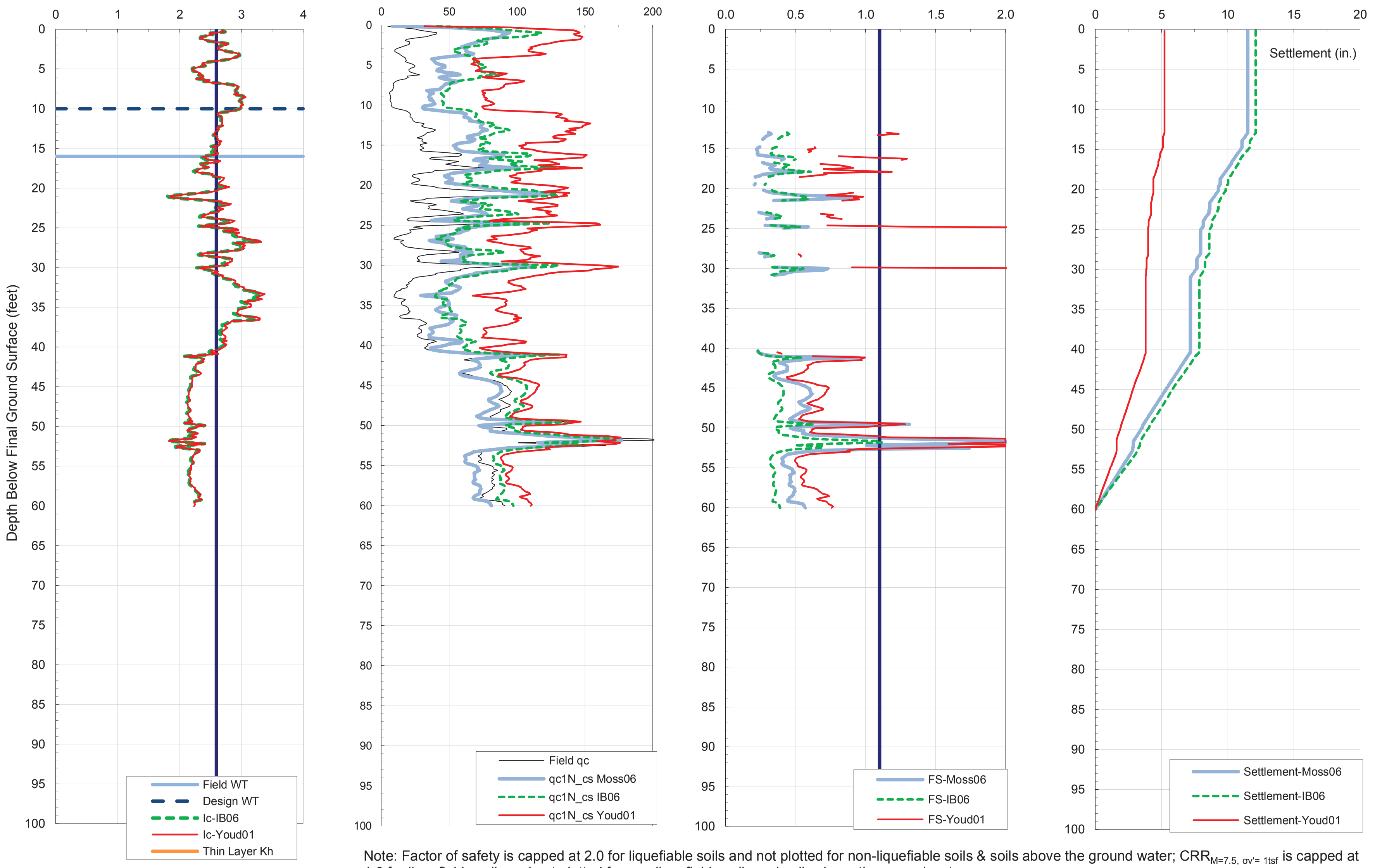
**Project Name:** **Laguna Hills Mall**
**Project No.:** **20155150**
**Project Location:** **Laguna Hills, CA**

## LIQUEFACTION ANALYSIS

Date 4/27/2015

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CPT ID: | **KCPT-10** | $M_w$= | **6.8** | Field Ground Water Depth (ft)= | **16.0 ft** | Existing Ground Elevation= | **352.0 ft** |
| | | PGA= | **0.51g** | Design Ground Water Depth (ft)= | **10.0 ft** | Final Ground Elevation= | **352.0 ft** |

Ana. by: Y. Zhou
Checked by:




Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5,\ \sigma v'=1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

KLEINFELDER
Bright People. Right Solutions.

**Project Name:** **Laguna Hills Mall**
**Project No.:** **20155150**
**Project Location:** **Laguna Hills, CA**

**LIQUEFACTION ANALYSIS**

Date 4/27/2015

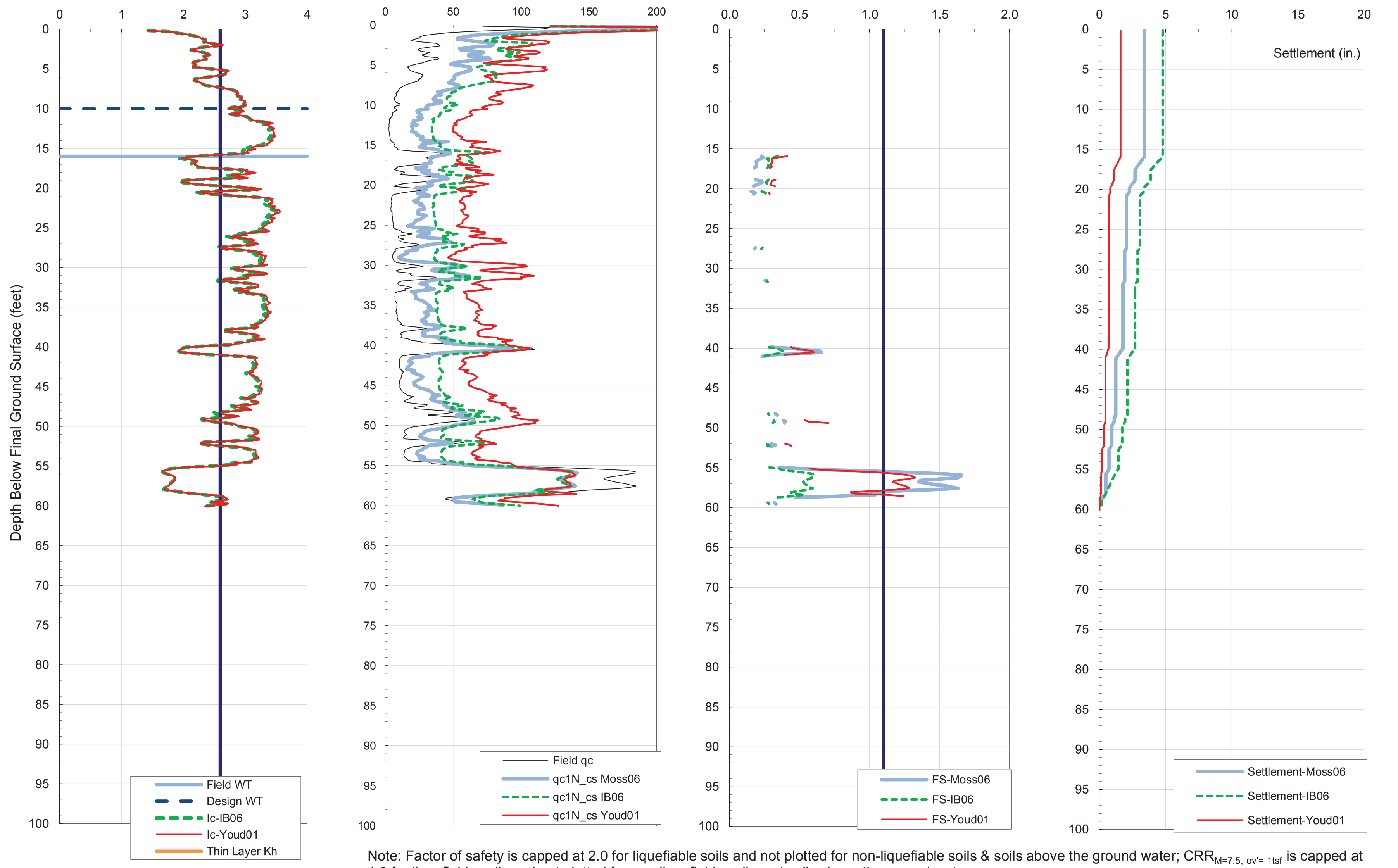
CPT ID: **KCPT-11**

$M_w$= **6.8**
PGA= **0.51g**

Field Ground Water Depth (ft)= **16.0 ft**
Design Ground Water Depth (ft)= **10.0 ft**

Existing Ground Elevation= **351.0 ft**
Final Ground Elevation= **351.0 ft**

Ana. by: Y. Zhou
Checked by:




Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5,\ \sigma v'=1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

KLEINFELDER
Bright People. Right Solutions.

**Project Name:** **Laguna Hills Mall**
**Project No.:** **20155150**
**Project Location:** **Laguna Hills, CA**

**LIQUEFACTION ANALYSIS**

Date 4/27/2015

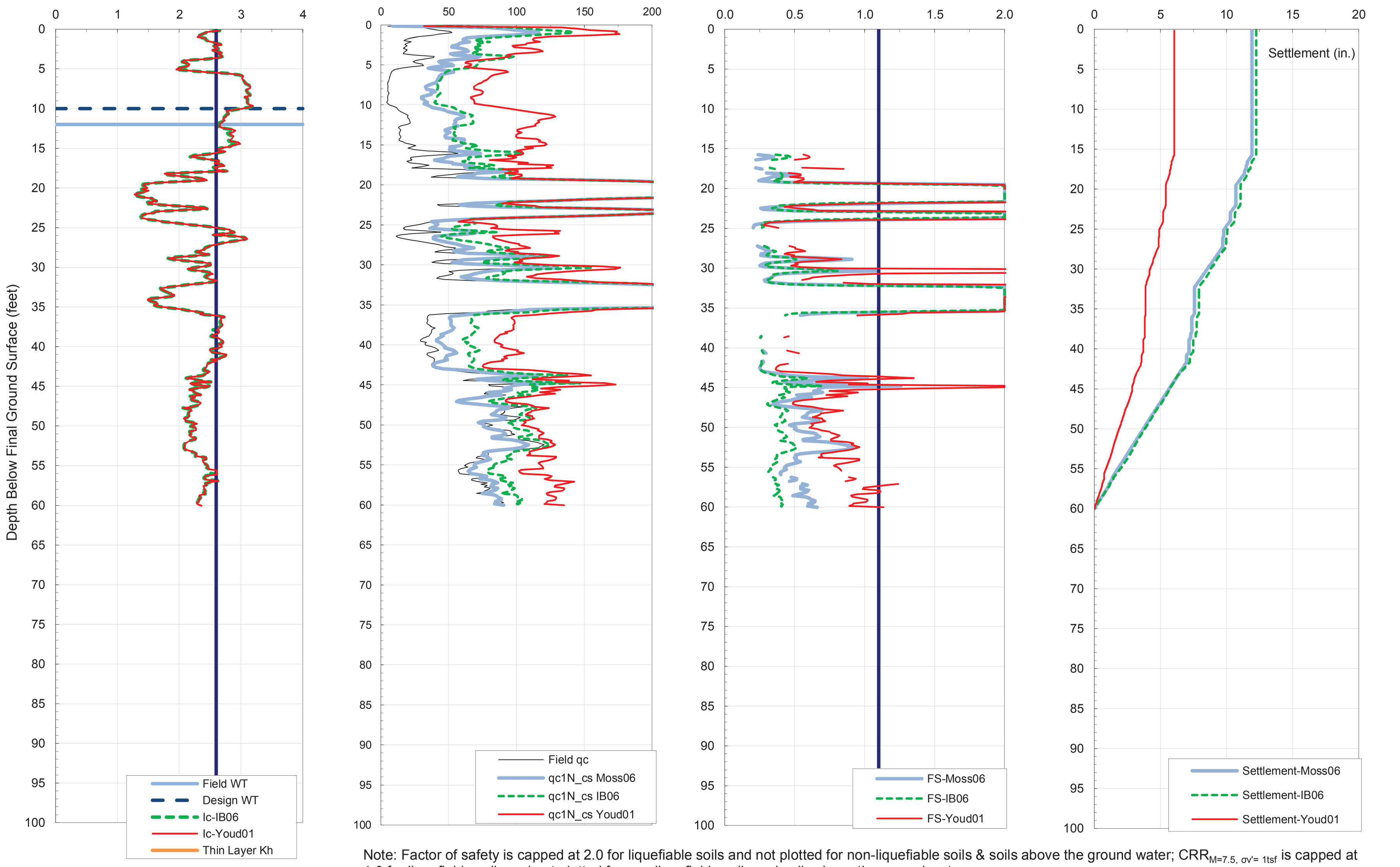
CPT ID: **KCPT-12**

$M_w$= **6.8**
PGA= **0.51g**

Field Ground Water Depth (ft)= **12.0 ft**
Design Ground Water Depth (ft)= **10.0 ft**

Existing Ground Elevation= **349.0 ft**
Final Ground Elevation= **349.0 ft**

Ana. by: Y. Zhou
Checked by:




Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5,\ \sigma v'=1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

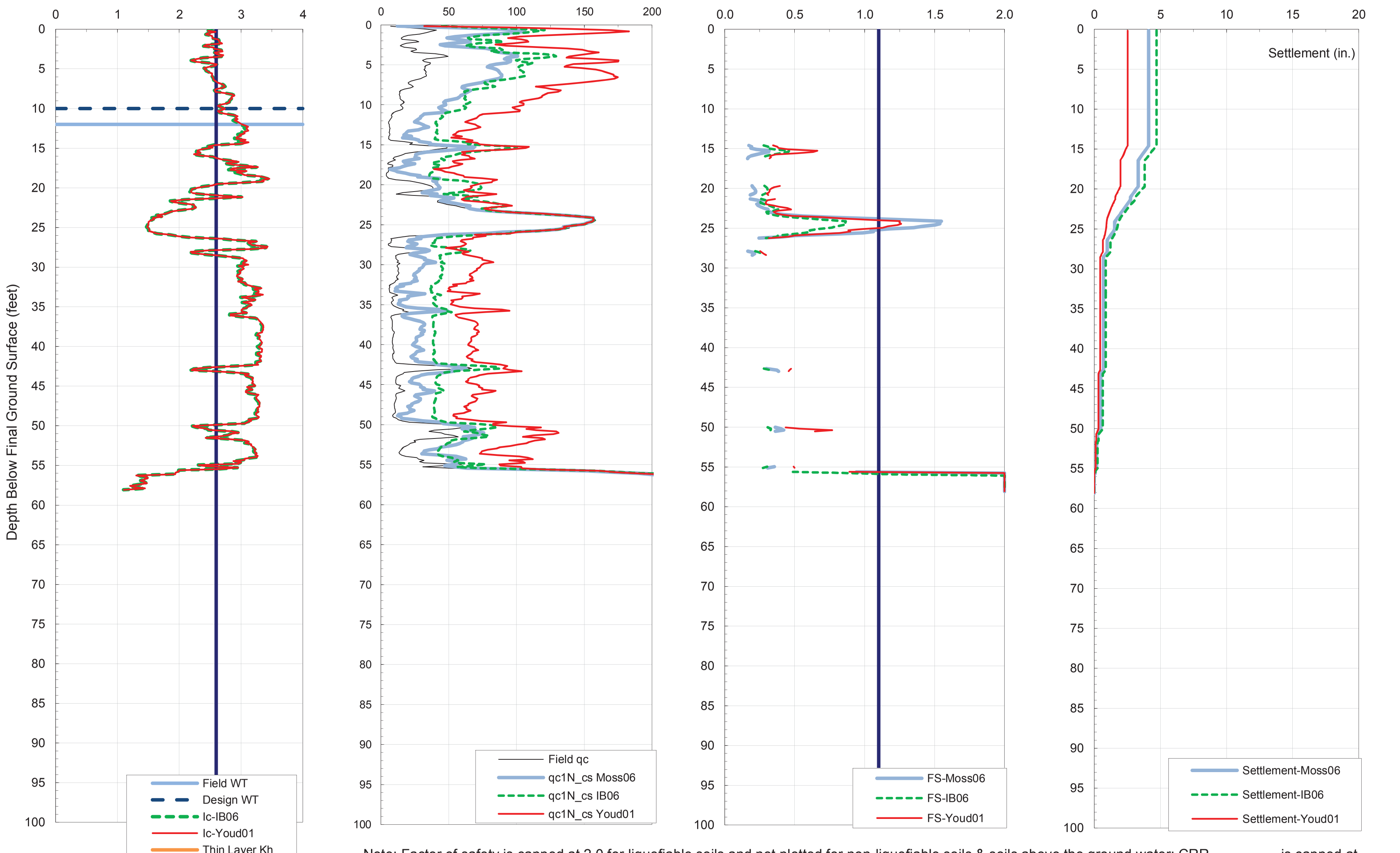
KLEINFELDER
Bright People. Right Solutions.

**Project Name:** **Laguna Hills Mall**
**Project No.:** **20155150**
**Project Location:** **Laguna Hills, CA**

## LIQUEFACTION ANALYSIS

Date 4/27/2015

| | | | | | |
|---|---|---|---|---|---|
| CPT ID: **KCPT-13** | $M_w$= **6.8** | Field Ground Water Depth (ft)= **12.0 ft** | Existing Ground Elevation= **350.0 ft** | Ana. by: | Y. Zhou |
| | PGA= **0.51g** | Design Ground Water Depth (ft)= **10.0 ft** | Final Ground Elevation= **350.0 ft** | Checked by: | |




Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5,\ \sigma v'=1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

KLEINFELDER
Bright People. Right Solutions.

**Project Name:** **Laguna Hills Mall**
**Project No.:** **20155150**
**Project Location:** **Laguna Hills, CA**

## LIQUEFACTION ANALYSIS

Date 4/27/2015

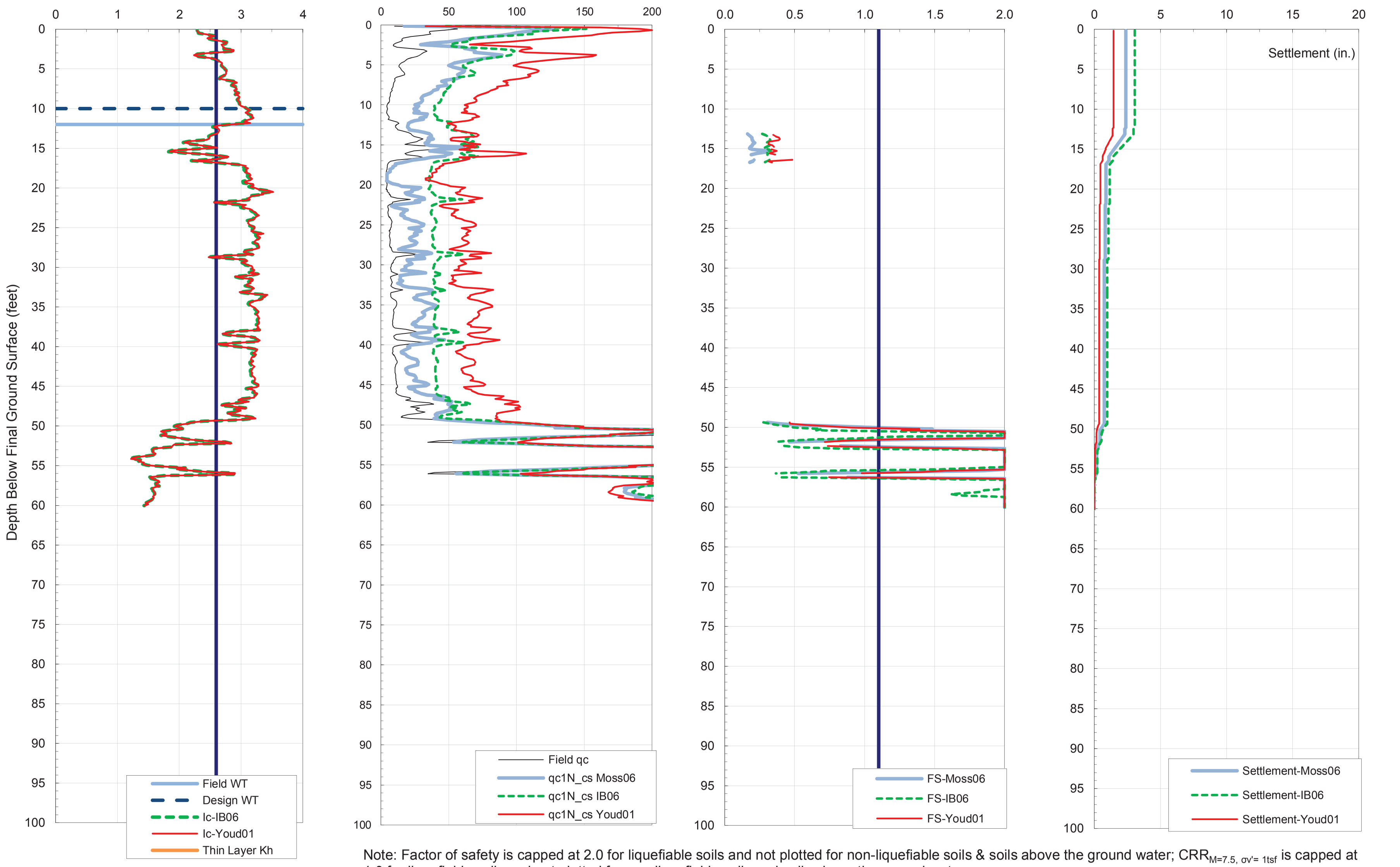
CPT ID: **KCPT-14**

$M_w$= **6.8**
PGA= **0.51g**

Field Ground Water Depth (ft)= **12.0 ft**
Design Ground Water Depth (ft)= **10.0 ft**

Existing Ground Elevation= **350.0 ft**
Final Ground Elevation= **350.0 ft**

Ana. by: Y. Zhou
Checked by:




Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5, \sigma v'=1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

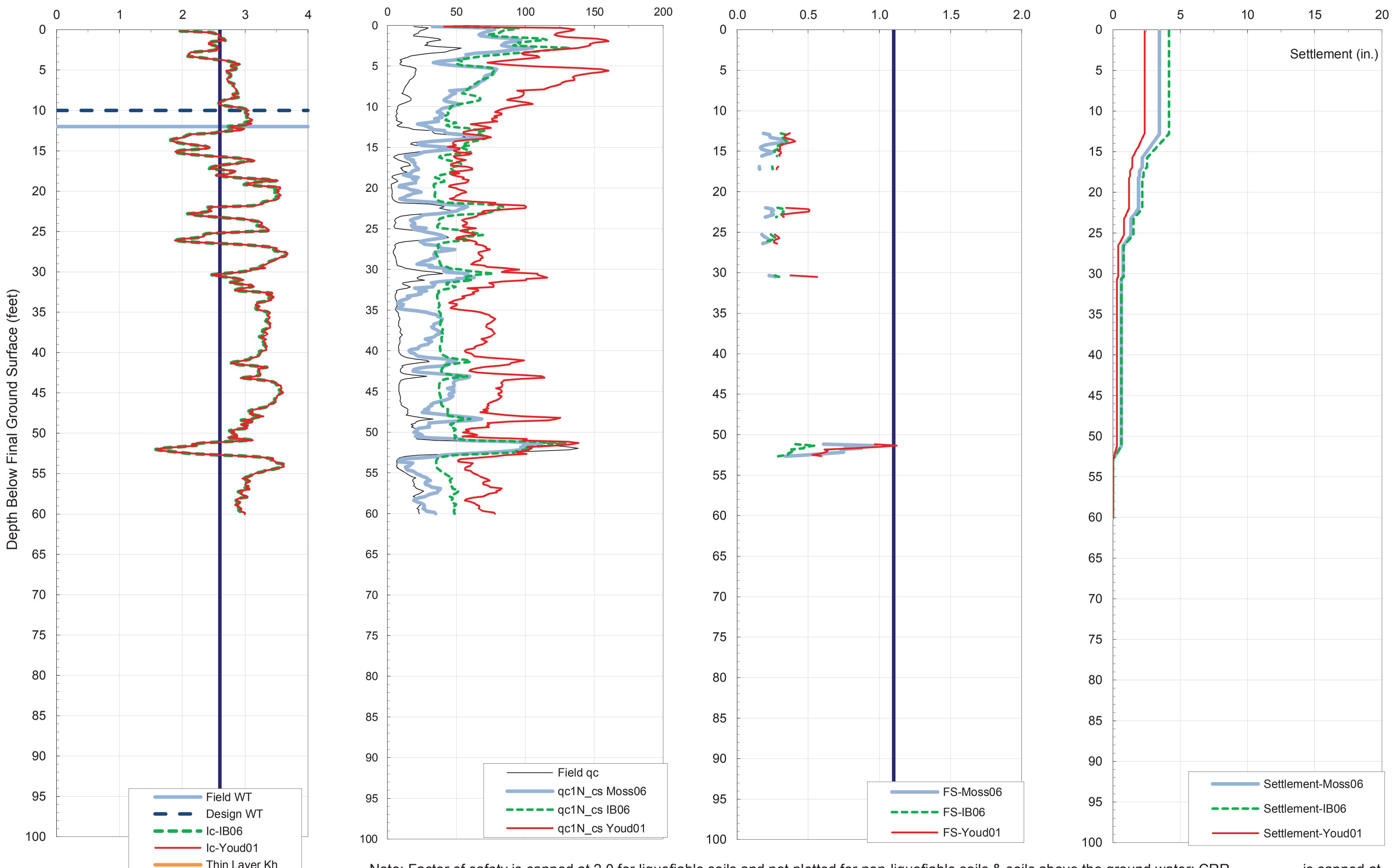
KLEINFELDER
Bright People. Right Solutions.

| | |
|---|---|
| **Project Name:** | **Laguna Hills Mall** |
| **Project No.:** | **20155150** |
| **Project Location:** | **Laguna Hills, CA** |

## LIQUEFACTION ANALYSIS

Date 4/27/2015

| | | | | | |
|---|---|---|---|---|---|
| CPT ID: **KCPT-15** | $M_w$= **6.8** | Field Ground Water Depth (ft)= **12.0 ft** | Existing Ground Elevation= **348.0 ft** | Ana. by: | Y. Zhou |
| | PGA= **0.51g** | Design Ground Water Depth (ft)= **10.0 ft** | Final Ground Elevation= **348.0 ft** | Checked by: | |




Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5,\ \sigma v'=1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

KLEINFELDER
Bright People. Right Solutions.

**Project Name:** **Laguna Hills Mall**
**Project No.:** **20155150**
**Project Location:** **Laguna Hills, CA**

## LIQUEFACTION ANALYSIS

Date 4/27/2015

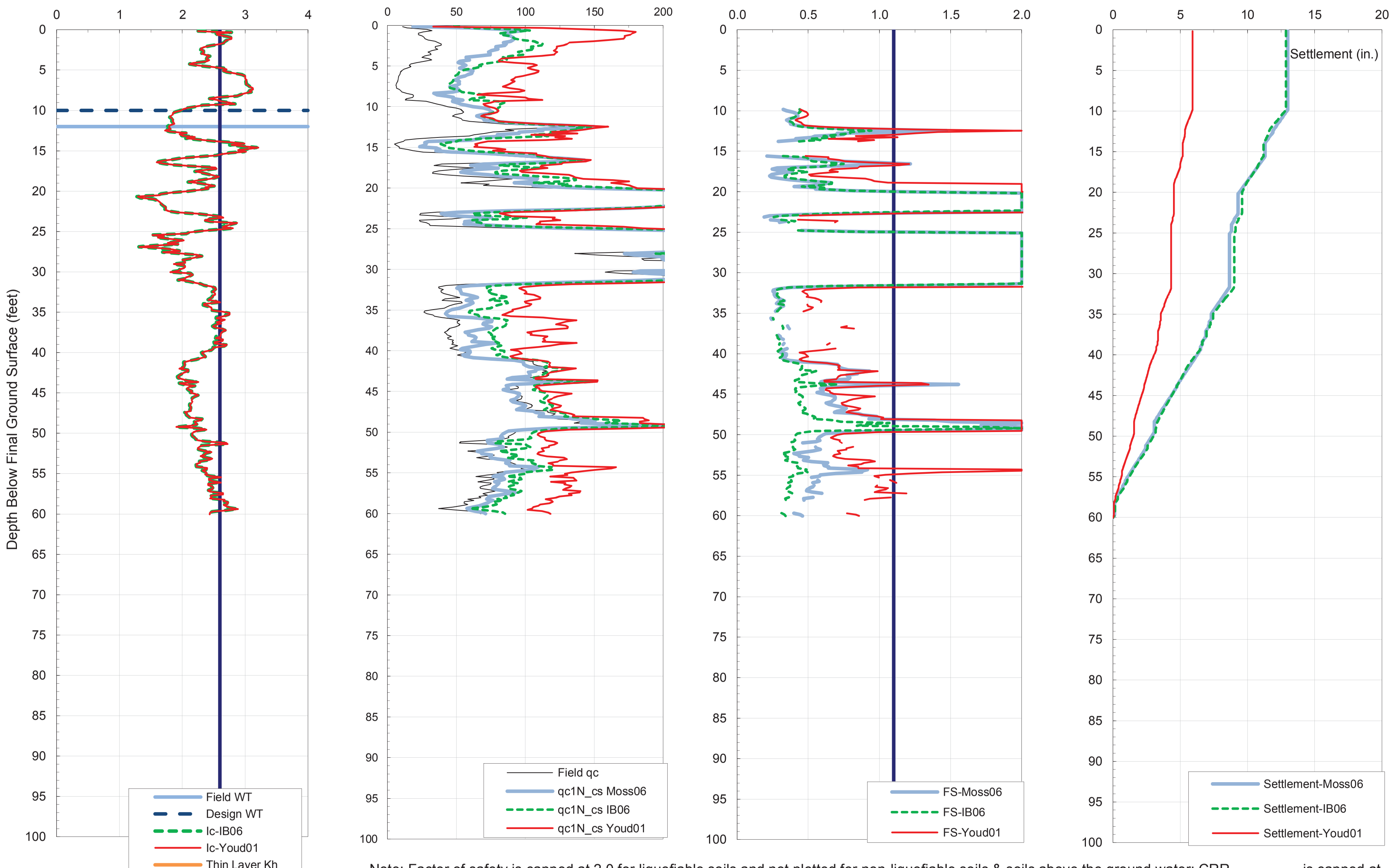
CPT ID: **KCPT-16**

$M_w$= **6.8**
PGA= **0.51g**

Field Ground Water Depth (ft)= **12.0 ft**
Design Ground Water Depth (ft)= **10.0 ft**

Existing Ground Elevation= **346.0 ft**
Final Ground Elevation= **346.0 ft**

Ana. by: Y. Zhou
Checked by:




Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5,\ \sigma v'=1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

KLEINFELDER
Bright People. Right Solutions.

**Project Name:** **Laguna Hills Mall**
**Project No.:** **20155150**
**Project Location:** **Laguna Hills, CA**

## LIQUEFACTION ANALYSIS

Date 4/27/2015

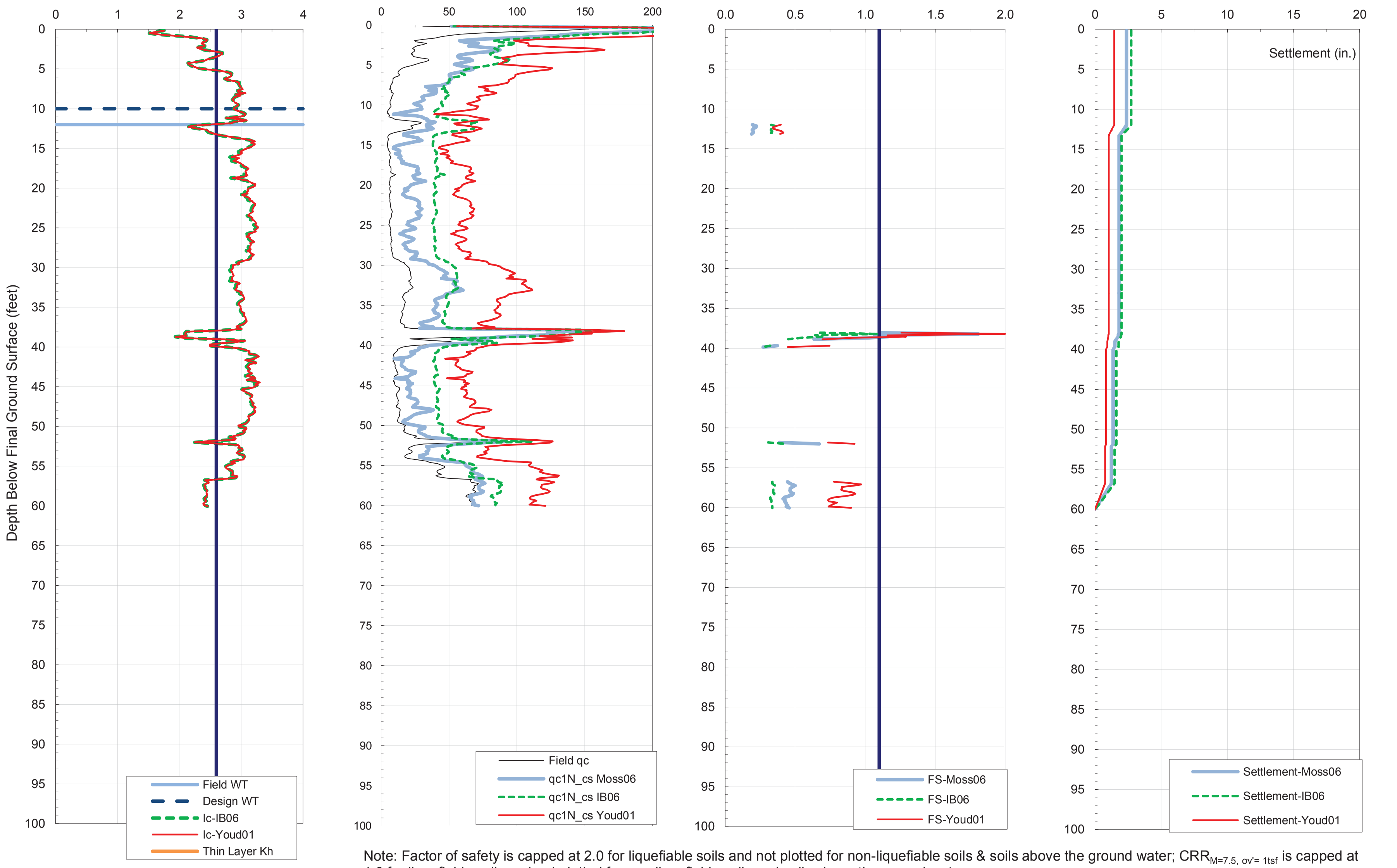
CPT ID: **KCPT-17**

$M_w$= **6.8**
PGA= **0.51g**

Field Ground Water Depth (ft)= **12.0 ft**
Design Ground Water Depth (ft)= **10.0 ft**

Existing Ground Elevation= **345.0 ft**
Final Ground Elevation= **345.0 ft**

Ana. by: Y. Zhou
Checked by:



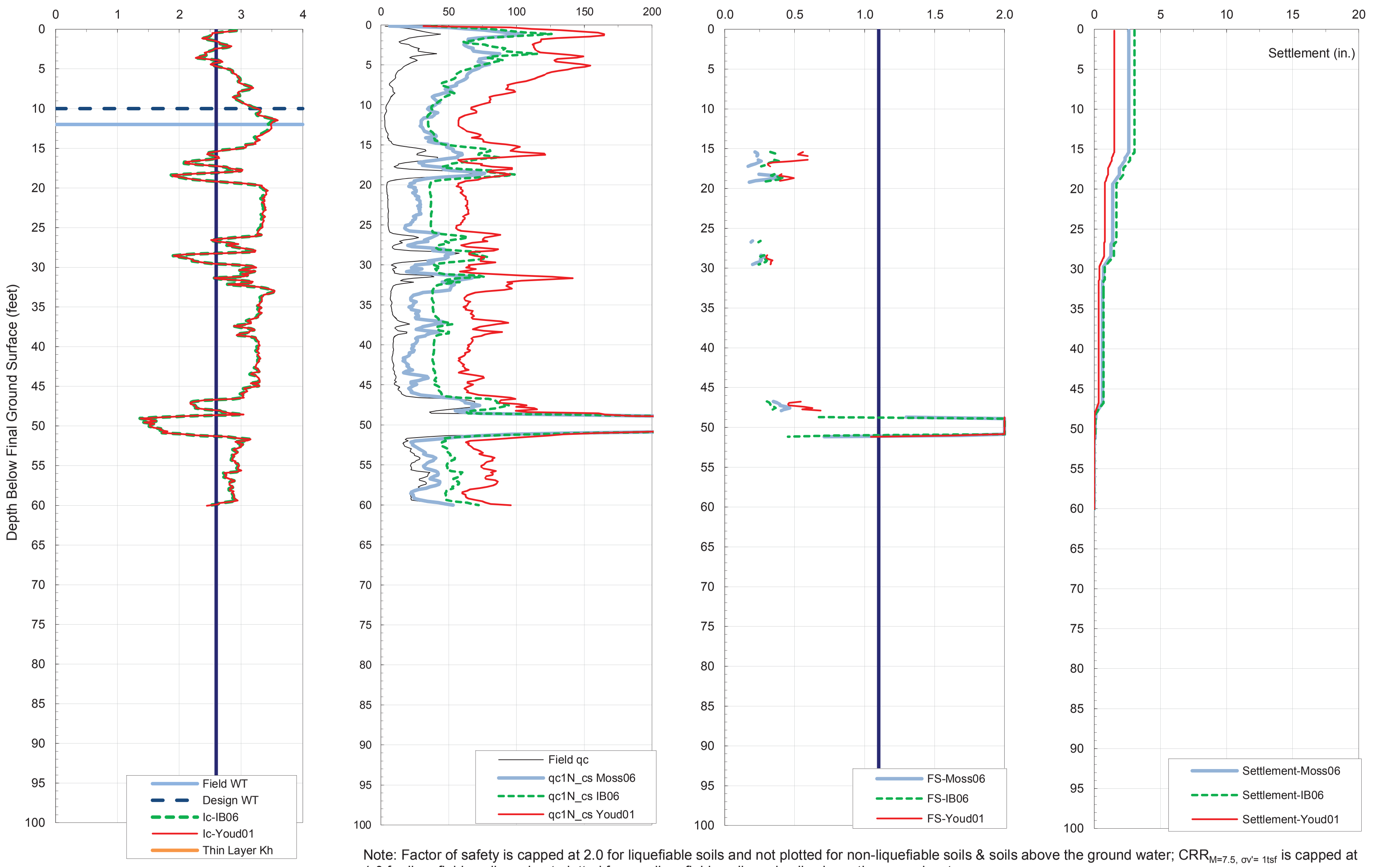

Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5, \sigma v'= 1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

**Project Name:** **Laguna Hills Mall**
**Project No.:** **20155150**
**Project Location:** **Laguna Hills, CA**

## LIQUEFACTION ANALYSIS

Date 4/27/2015

| | | | | | | |
|---|---|---|---|---|---|---|
| CPT ID: | **KCPT-18** | $M_w$= **6.8** | Field Ground Water Depth (ft)= **12.0 ft** | Existing Ground Elevation= **345.0 ft** | Ana. by: | Y. Zhou |
| | | PGA= **0.51g** | Design Ground Water Depth (ft)= **10.0 ft** | Final Ground Elevation= **345.0 ft** | Checked by: | |




Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5,\ \sigma v'=1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

KLEINFELDER
Bright People. Right Solutions.

**Project Name:** **Laguna Hills Mall**
**Project No.:** **20155150**
**Project Location:** **Laguna Hills, CA**

## LIQUEFACTION ANALYSIS

Date 4/27/2015

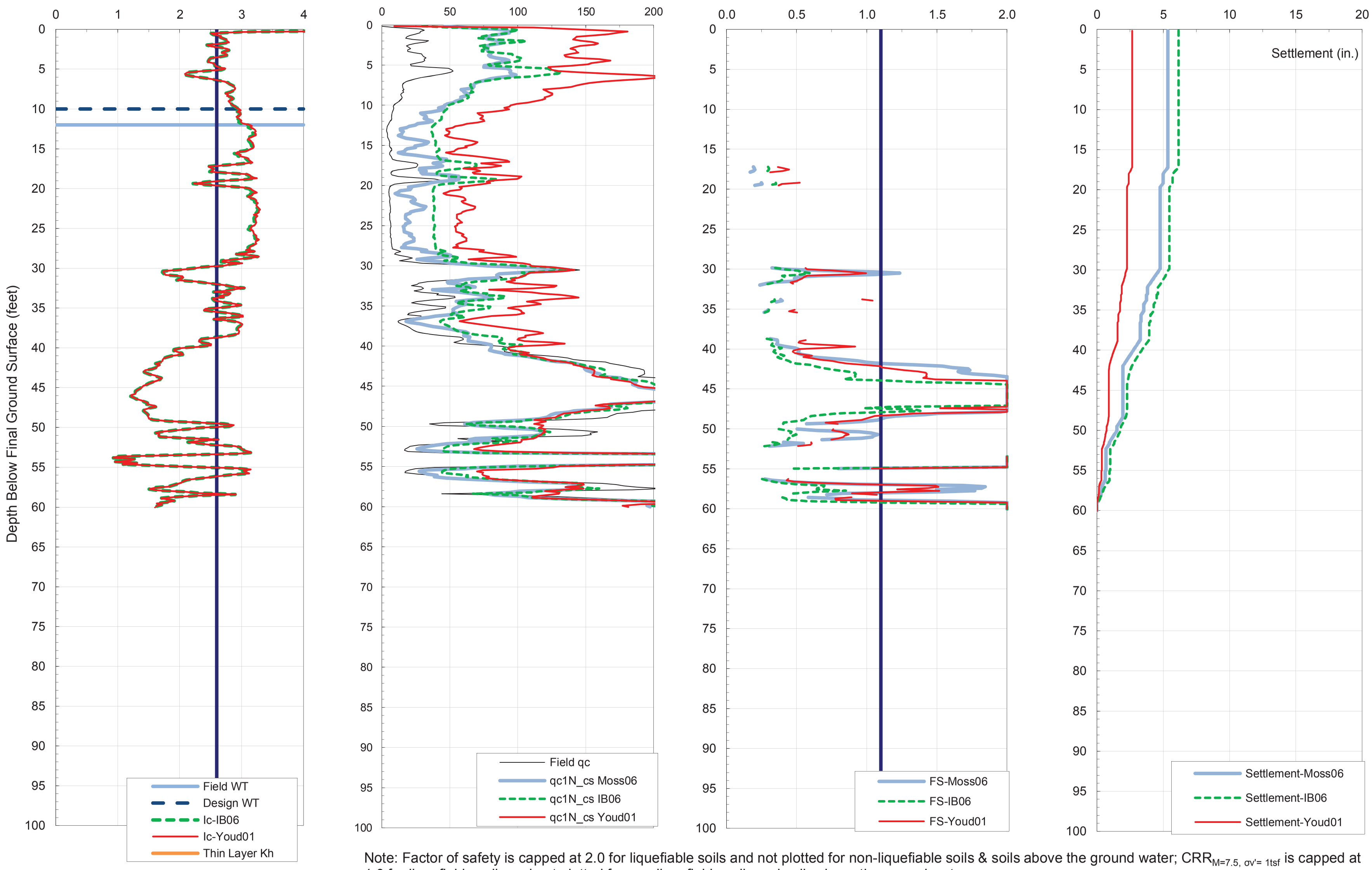
CPT ID: **KCPT-19**

$M_w$= **6.8**
PGA= **0.51g**

Field Ground Water Depth (ft)= **12.0 ft**
Design Ground Water Depth (ft)= **10.0 ft**

Existing Ground Elevation= **348.0 ft**
Final Ground Elevation= **348.0 ft**

Ana. by: Y. Zhou
Checked by:




Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5, \sigma v'= 1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

KLEINFELDER
Bright People. Right Solutions.

**Project Name:** **Laguna Hills Mall**
**Project No.:** **20155150**
**Project Location:** **Laguna Hills, CA**

## LIQUEFACTION ANALYSIS

Date 4/27/2015

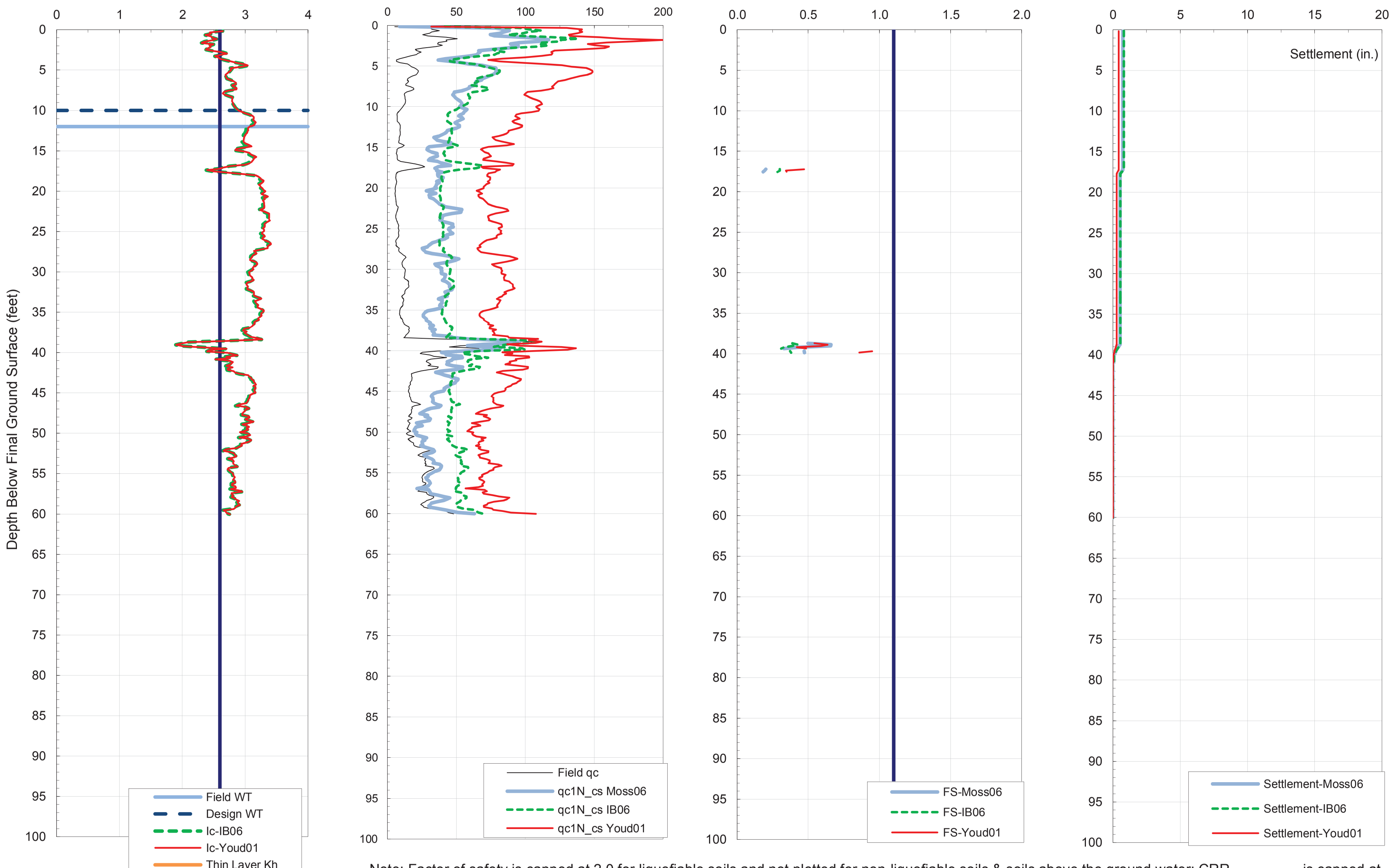
CPT ID: **KCPT-20**

$M_w$= **6.8** PGA= **0.51g**

Field Ground Water Depth (ft)= **12.0 ft**
Design Ground Water Depth (ft)= **10.0 ft**

Existing Ground Elevation= **346.0 ft**
Final Ground Elevation= **346.0 ft**

Ana. by: Y. Zhou
Checked by:




Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5, \sigma v'= 1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

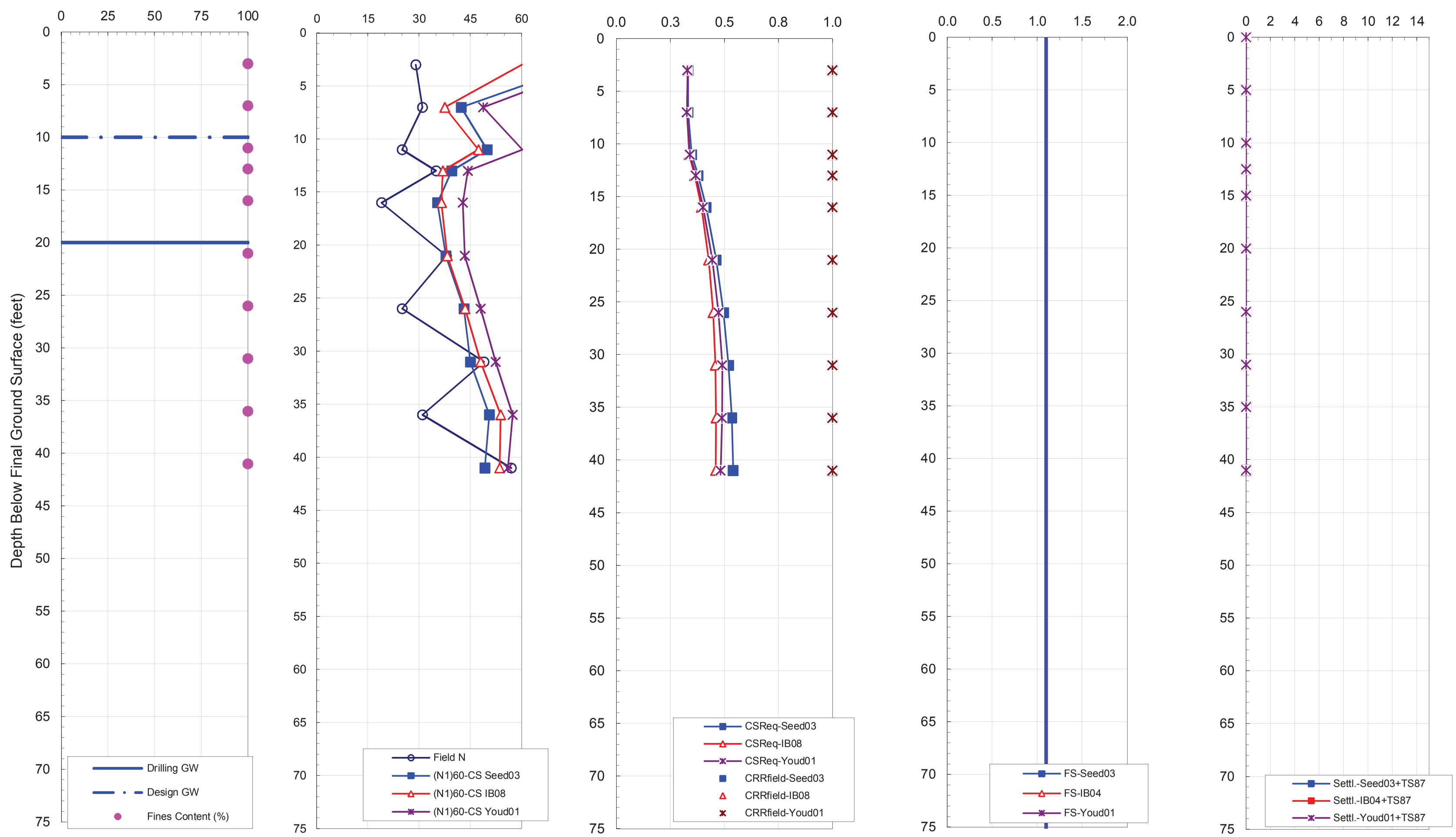
KLEINFELDER
Bright People. Right Solutions.

**Project Name:** **Laguna Hills Mall**
**Project No.:** **20155150**
**Project Location:** **Laguna Hills, CA**

## LIQUEFACTION ANALYSIS

Date 4/27/2015

| | | | |
|---|---|---|---|
| Boring ID: **KB-5** | $M_w$= **6.8** | Groundwater Depth During Drilling (ft) = **20.0 ft** | Existing Ground Elevation = **357.0 ft** | Ana. by: Youwei Zhou |
| | PGA= **0.51g** | Design Groundwater Depth (ft) = **10.0 ft** | Final Ground Elevation = **357.0 ft** | Checked by: |




1. $(N_1)_{60\text{-}CS}$ capped at 60; 2. CRRfield = 1 for non-liquefiable soils; 3. FS is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils including soils above G.W.T.

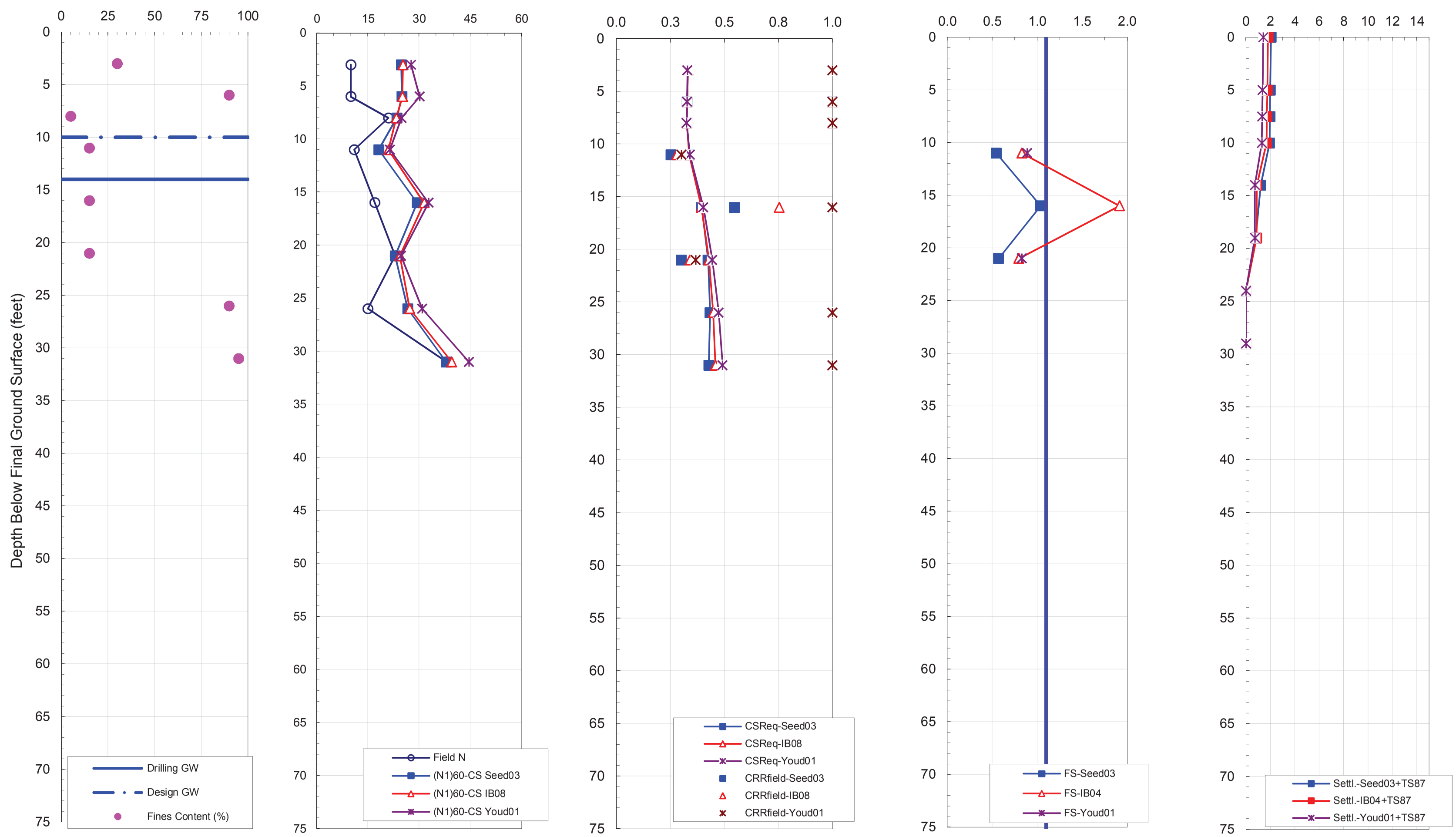
KLEINFELDER
Bright People. Right Solutions.

**Project Name:** Five Lagunas Redevelopment
**Project No.:** 20155150.001A
**Project Location:** Laguna Hills, Ca

**EARTHQUAKE-INDUCED SETTLEMENTS**

Date 4/28/2015 **FIGURE A-1**

| | | | | | |
|---|---|---|---|---|---|
| Boring ID: | KB-6 | $M_w$= 6.8 | Groundwater Depth During Drilling (ft) = 14.0 ft | Existing Ground Elevation = 358.0 ft | Ana. by: Youwei Zhou |
| | | PGA= 0.51g | Design Groundwater Depth (ft) = 10.0 ft | Final Ground Elevation = 358.0 ft | Checked by: |




1. $(N_1)_{60\text{-}CS}$ capped at 60; 2. CRRfield = 1 for non-liquefiable soils; 3. FS is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils including soils above G.W.T.

KLEINFELDER
Bright People. Right Solutions.

**Project Name:** Five Lagunas Redevelopment
**Project No.:** 20155150.001A
**Project Location:** Laguna Hills, Ca

**EARTHQUAKE-INDUCED SETTLEMENTS**

Date 4/28/2015 **FIGURE A-2**

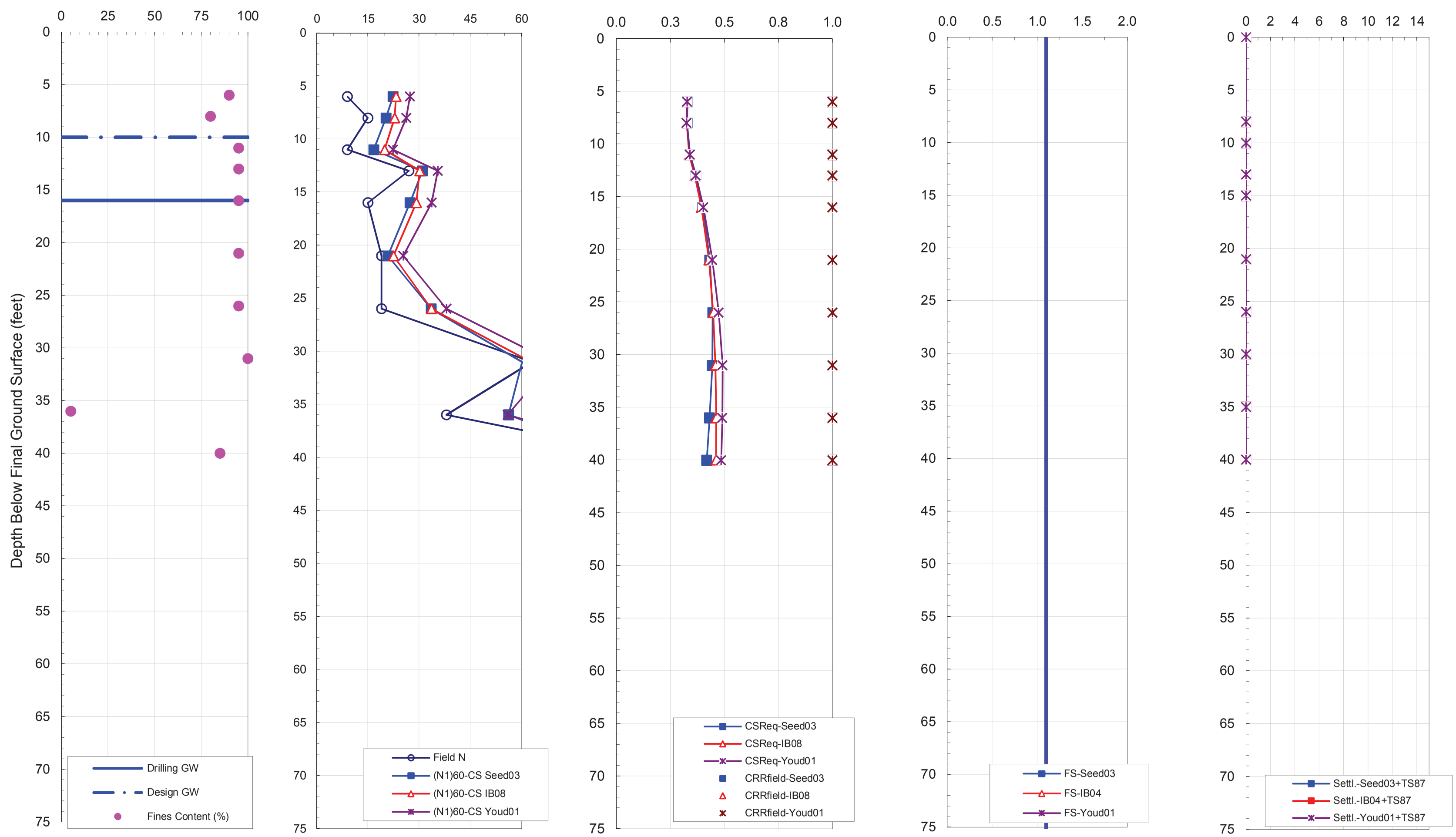
Boring ID: **KB-7**

$M_w$= **6.8**
PGA= **0.51g**

Groundwater Depth During Drilling (ft) = **16.0 ft**
Design Groundwater Depth (ft) = **10.0 ft**

Existing Ground Elevation = **353.0 ft**
Final Ground Elevation = **353.0 ft**

Ana. by: Youwei Zhou
Checked by:




1. $(N_1)_{60\text{-}CS}$ capped at 60; 2. CRRfield = 1 for non-liquefiable soils; 3. FS is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils including soils above G.W.T.

KLEINFELDER
Bright People. Right Solutions.

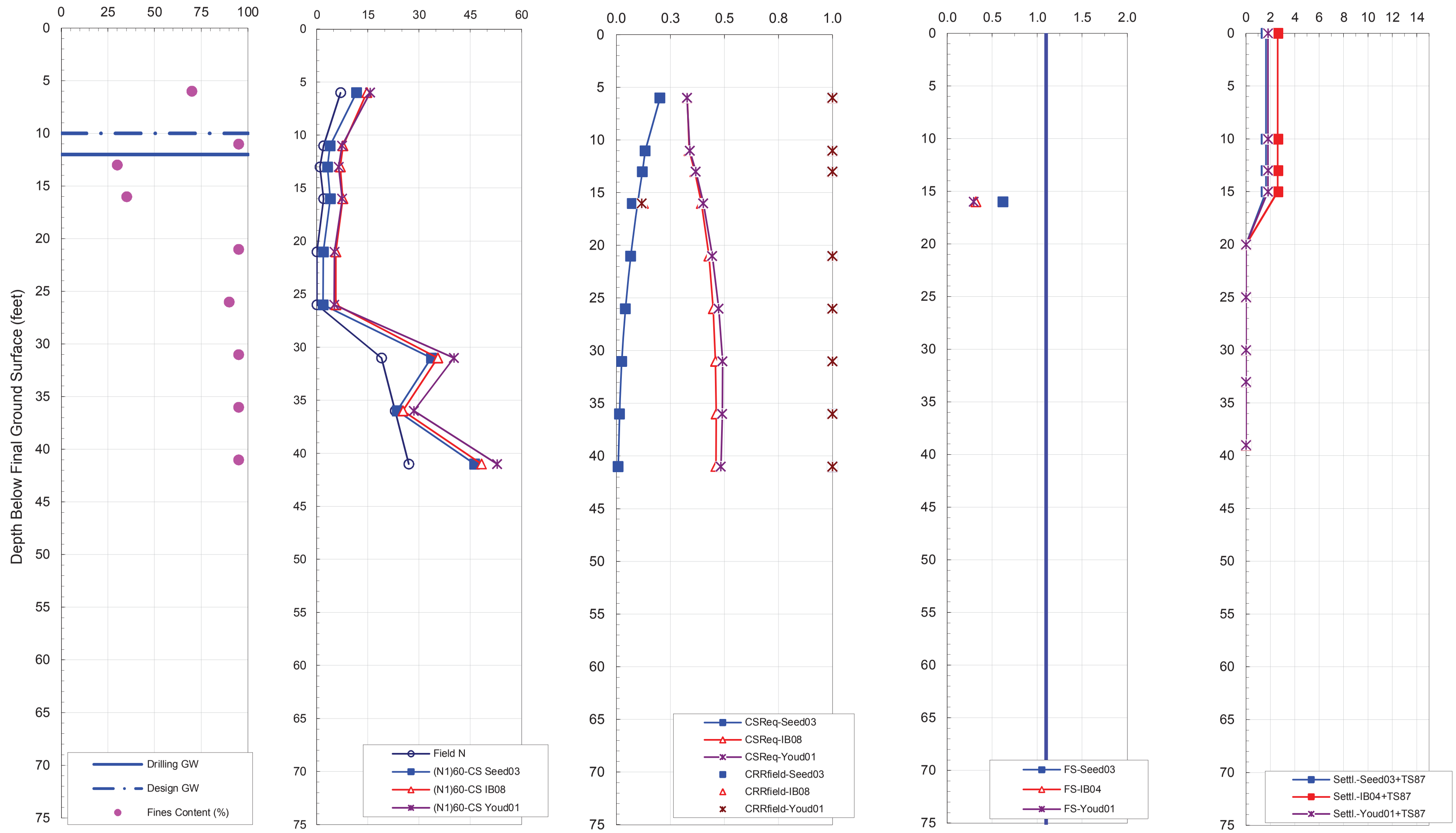
**Project Name:** **Five Lagunas Redevelopment**
**Project No.:** **20155150.001A**
**Project Location:** **Laguna Hills, Ca**

**EARTHQUAKE-INDUCED SETTLEMENTS**

Date 4/27/2015

**FIGURE A-3**

| | | | | | |
|---|---|---|---|---|---|
| Boring ID: | KB-8 | $M_w$= 6.8 | Groundwater Depth During Drilling (ft) = 12.0 ft | Existing Ground Elevation = 349.0 ft | Ana. by: Youwei Zhou |
| | | PGA= 0.51g | Design Groundwater Depth (ft) = 10.0 ft | Final Ground Elevation = 349.0 ft | Checked by: |




1. $(N_1)_{60\text{-}CS}$ capped at 60; 2. CRRfield = 1 for non-liquefiable soils; 3. FS is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils including soils above G.W.T.

KLEINFELDER
Bright People. Right Solutions.

**Project Name:** Five Lagunas Redevelopment
**Project No.:** 20155150.001A
**Project Location:** Laguna Hills, Ca

**EARTHQUAKE-INDUCED SETTLEMENTS**

Date 4/28/2015

**FIGURE A-4**

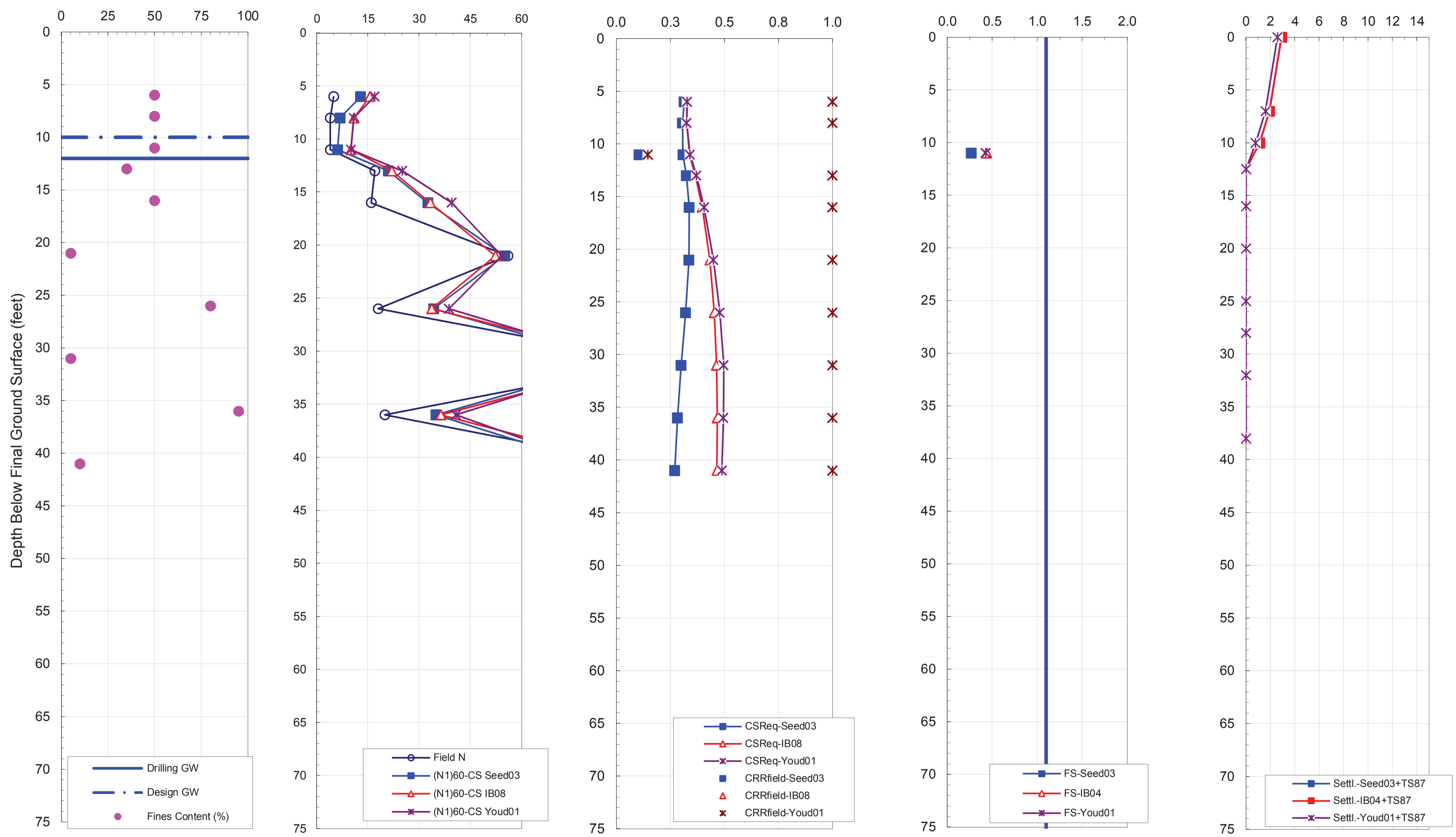
Boring ID: **KB-9**

$M_w$= **6.8**
PGA= **0.51g**

Groundwater Depth During Drilling (ft) = **12.0 ft**
Design Groundwater Depth (ft) = **10.0 ft**

Existing Ground Elevation = **347.0 ft**
Final Ground Elevation = **347.0 ft**

Ana. by: Youwei Zhou
Checked by:




1. $(N_1)_{60\text{-}CS}$ capped at 60; 2. CRRfield = 1 for non-liquefiable soils; 3. FS is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils including soils above G.W.T.

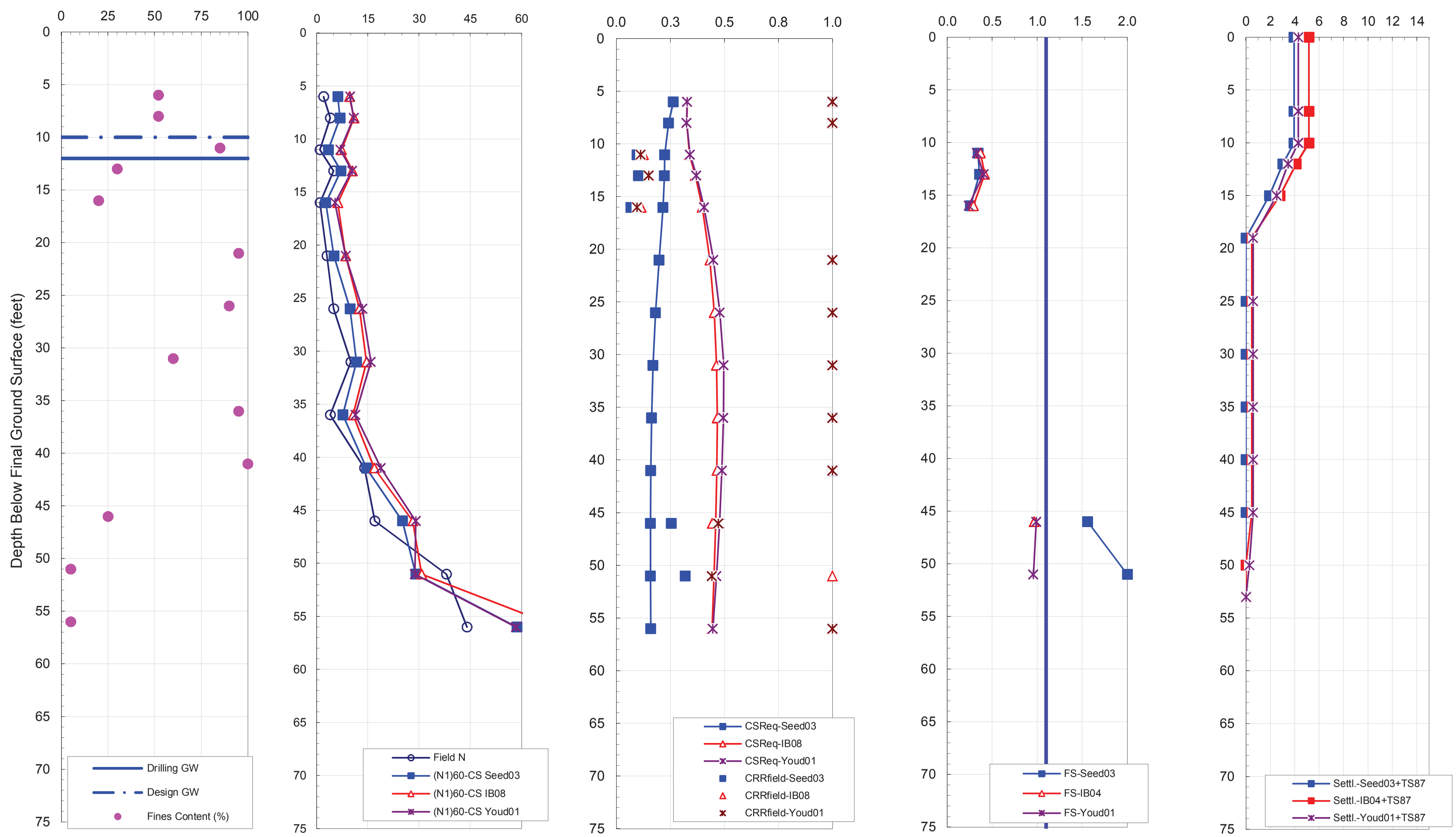
KLEINFELDER
Bright People. Right Solutions.

**Project Name:** **Five Lagunas Redevelopment**
**Project No.:** **20155150.001A**
**Project Location:** **Laguna Hills, Ca**

**EARTHQUAKE-INDUCED SETTLEMENTS**

Date 4/28/2015 **FIGURE A-5**

| | | | | | |
|---|---|---|---|---|---|
| Boring ID: | KB-10 | $M_w$= 6.8 | Groundwater Depth During Drilling (ft) = 12.0 ft | Existing Ground Elevation = 346.0 ft | Ana. by: Youwei Zhou |
| | | PGA= 0.51g | Design Groundwater Depth (ft) = 10.0 ft | Final Ground Elevation = 346.0 ft | Checked by: |




1. $(N_1)_{60\text{-}CS}$ capped at 60; 2. CRRfield = 1 for non-liquefiable soils; 3. FS is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils including soils above G.W.T.

KLEINFELDER
Bright People. Right Solutions.

**Project Name:** Five Lagunas Redevelopment
**Project No.:** 20155150.001A
**Project Location:** Laguna Hills, Ca

**EARTHQUAKE-INDUCED SETTLEMENTS**

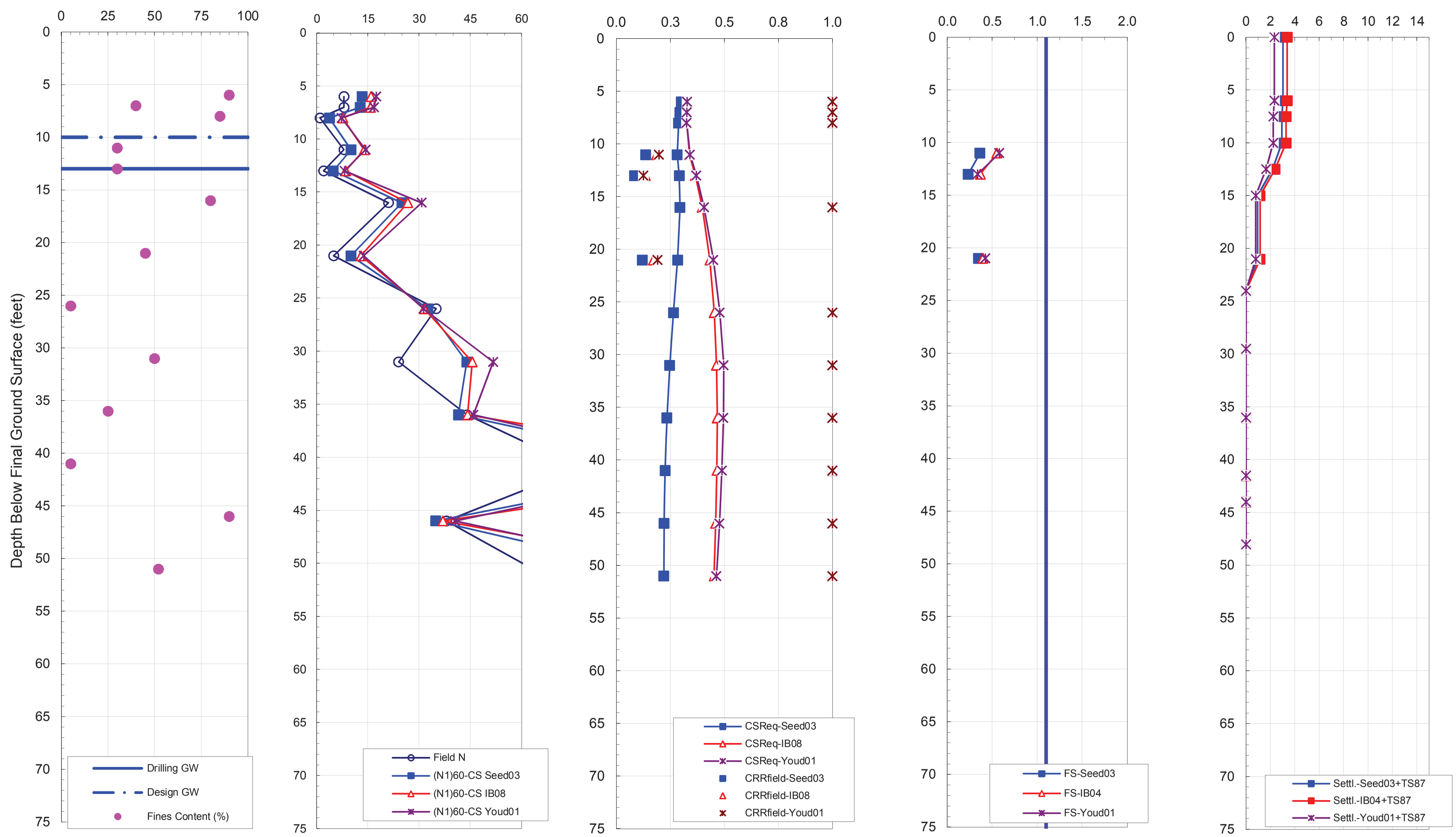
Date 4/28/2015

**FIGURE A-6**

| | | | |
|---|---|---|---|
| Boring ID: **KB-11** | $M_w$= **6.8** | Groundwater Depth During Drilling (ft) = **13.0 ft** | Existing Ground Elevation = **346.0 ft** |
| | PGA= **0.51g** | Design Groundwater Depth (ft) = **10.0 ft** | Final Ground Elevation = **346.0 ft** |

Ana. by: Youwei Zhou

Checked by:




1. $(N_1)_{60\text{-}CS}$ capped at 60; 2. CRRfield = 1 for non-liquefiable soils; 3. FS is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils including soils above G.W.T.

KLEINFELDER
Bright People. Right Solutions.

**Project Name:** Five Lagunas Redevelopment

**Project No.:** 20155150.001A

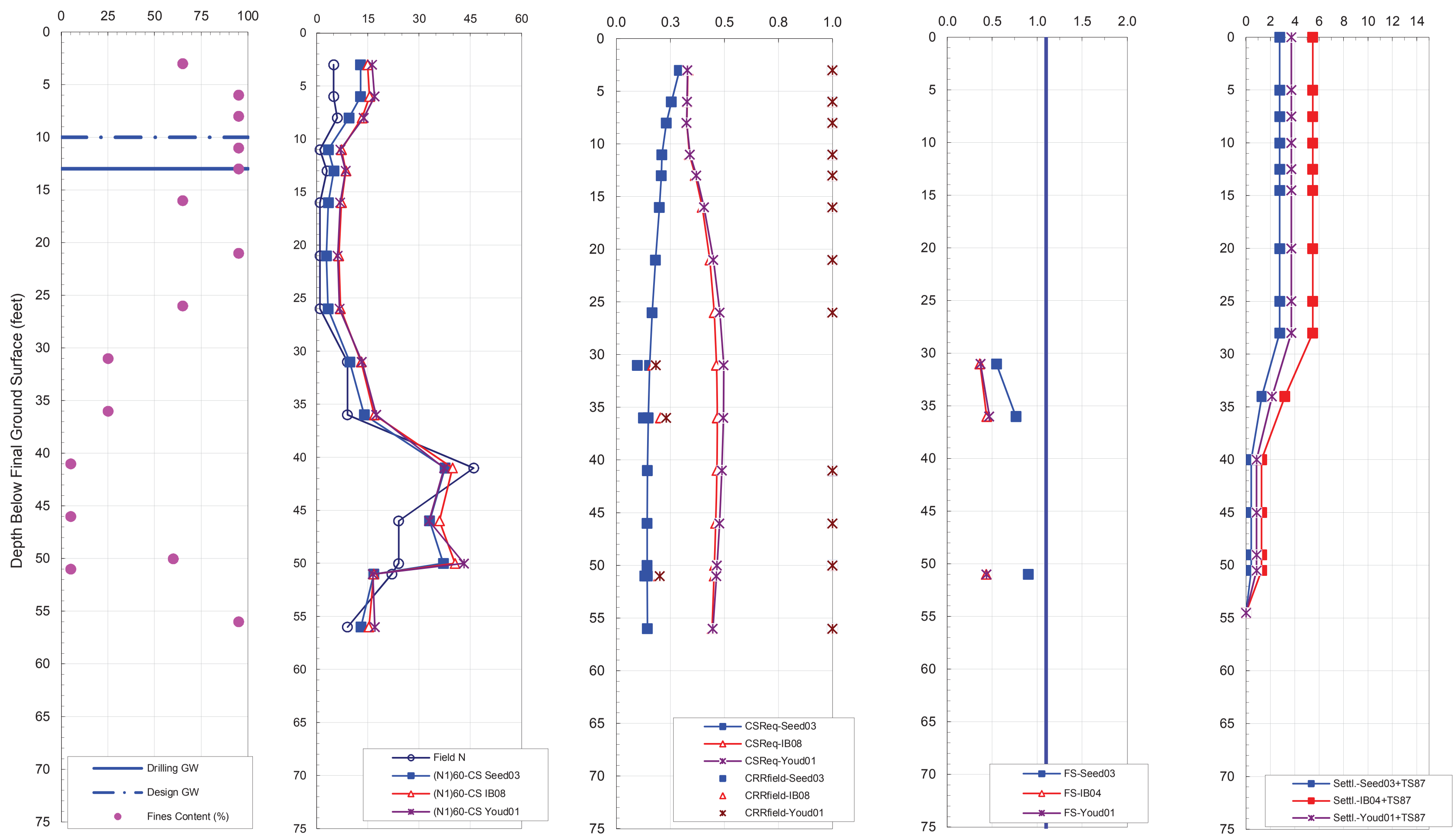
**Project Location:** Laguna Hills, Ca

**EARTHQUAKE-INDUCED SETTLEMENTS**

Date 4/28/2015

**FIGURE A-7**

| | | | | | |
|---|---|---|---|---|---|
| Boring ID: | KB-12 | $M_w$= 6.8 | Groundwater Depth During Drilling (ft) = 13.0 ft | Existing Ground Elevation = 344.0 ft | Ana. by: Youwei Zhou |
| | | PGA= 0.51g | Design Groundwater Depth (ft) = 10.0 ft | Final Ground Elevation = 344.0 ft | Checked by: |




1. $(N_1)_{60\text{-}CS}$ capped at 60; 2. CRRfield = 1 for non-liquefiable soils; 3. FS is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils including soils above G.W.T.

KLEINFELDER
Bright People. Right Solutions.

**Project Name:** Five Lagunas Redevelopment
**Project No.:** 20155150.001A
**Project Location:** Laguna Hills, Ca

**EARTHQUAKE-INDUCED SETTLEMENTS**

Date 4/27/2015 **FIGURE A-8**

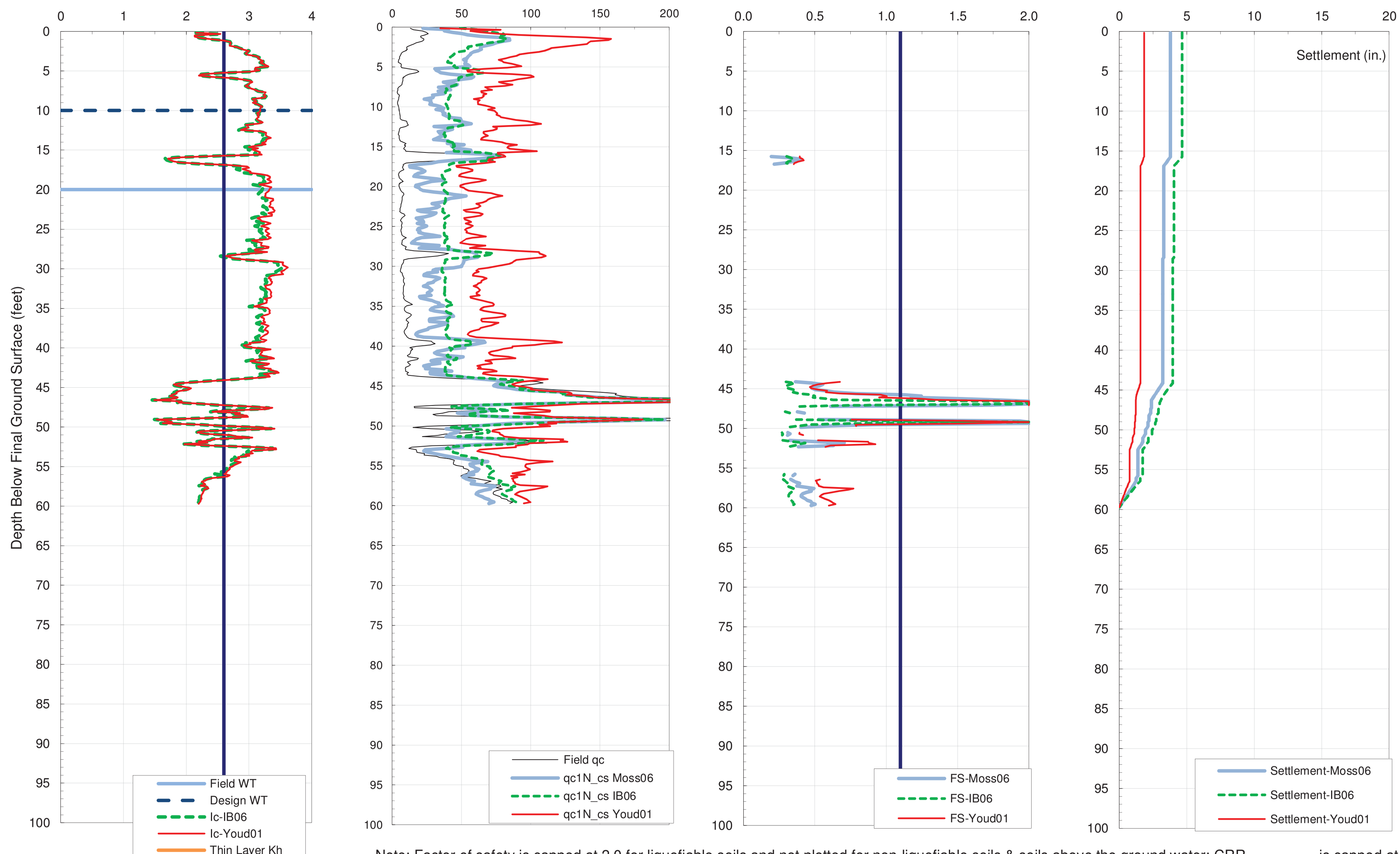
CPT ID: **CPT-1**

$M_w$= **6.8**
PGA= **0.51g**

Field Ground Water Depth (ft)= **20.0 ft**
Design Ground Water Depth (ft)= **10.0 ft**

Existing Ground Elevation= **357.0 ft**
Final Ground Elevation= **357.0 ft**

Ana. by: SK
Checked by:




Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5,\ \sigma v'=1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

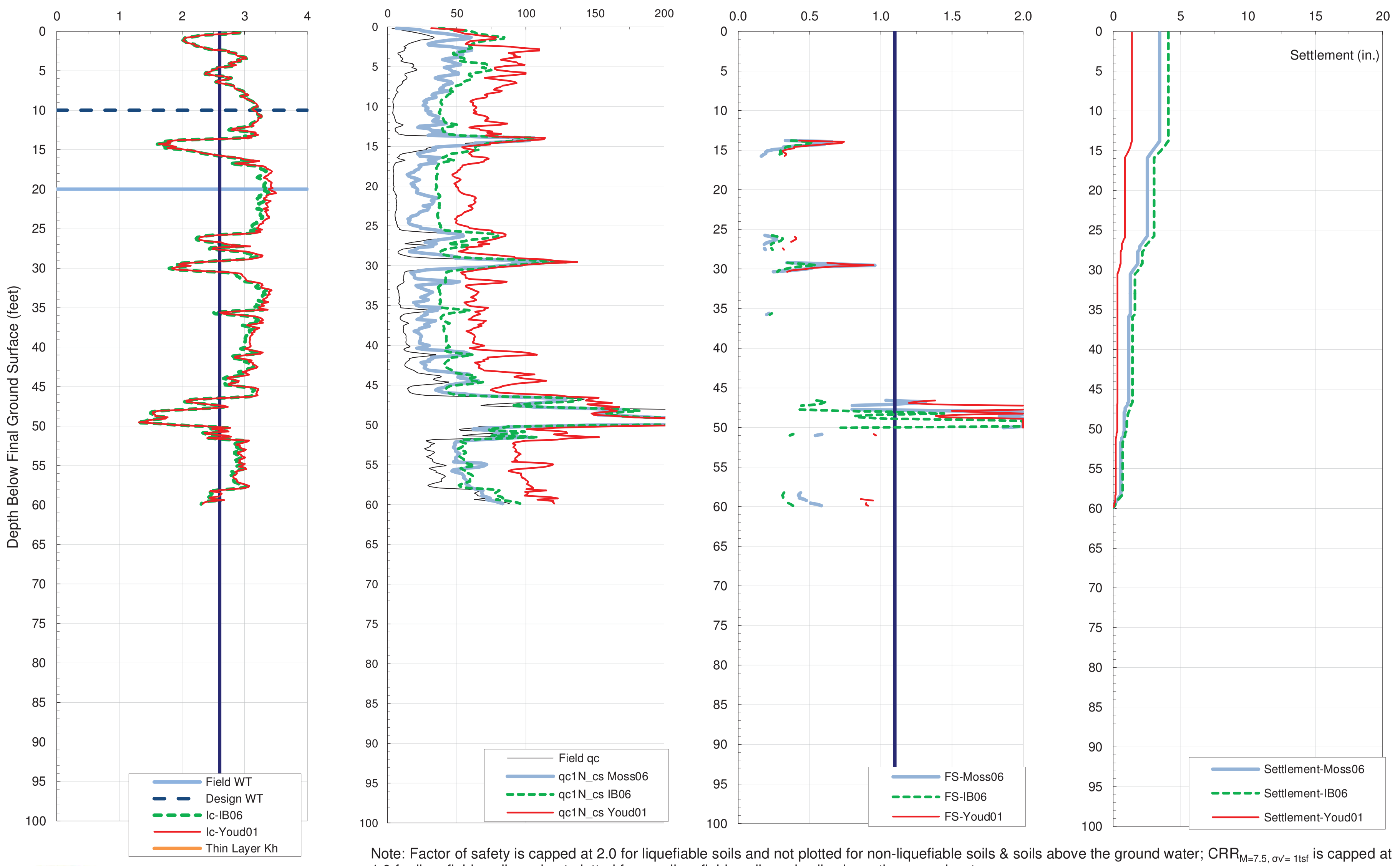
KLEINFELDER
Bright People. Right Solutions.

**Project Name:** **Laguna Hills Mall**
**Project No.:** **20155150**
**Project Location:** **Laguna Hills, CA**

**LIQUEFACTION ANALYSIS**

Date 4/30/2015

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CPT ID: | **CPT-2** | $M_w$= | **6.8** | Field Ground Water Depth (ft)= **20.0 ft** | Existing Ground Elevation= **357.0 ft** | Ana. by: | SK |
| | | PGA= | **0.51g** | Design Ground Water Depth (ft)= **10.0 ft** | Final Ground Elevation= **357.0 ft** | Checked by: | |




Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5, \sigma v'=1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

KLEINFELDER
Bright People. Right Solutions.

**Project Name:** **Laguna Hills Mall**
**Project No.:** **20155150**
**Project Location:** **Laguna Hills, CA**

## LIQUEFACTION ANALYSIS

Date 4/30/2015

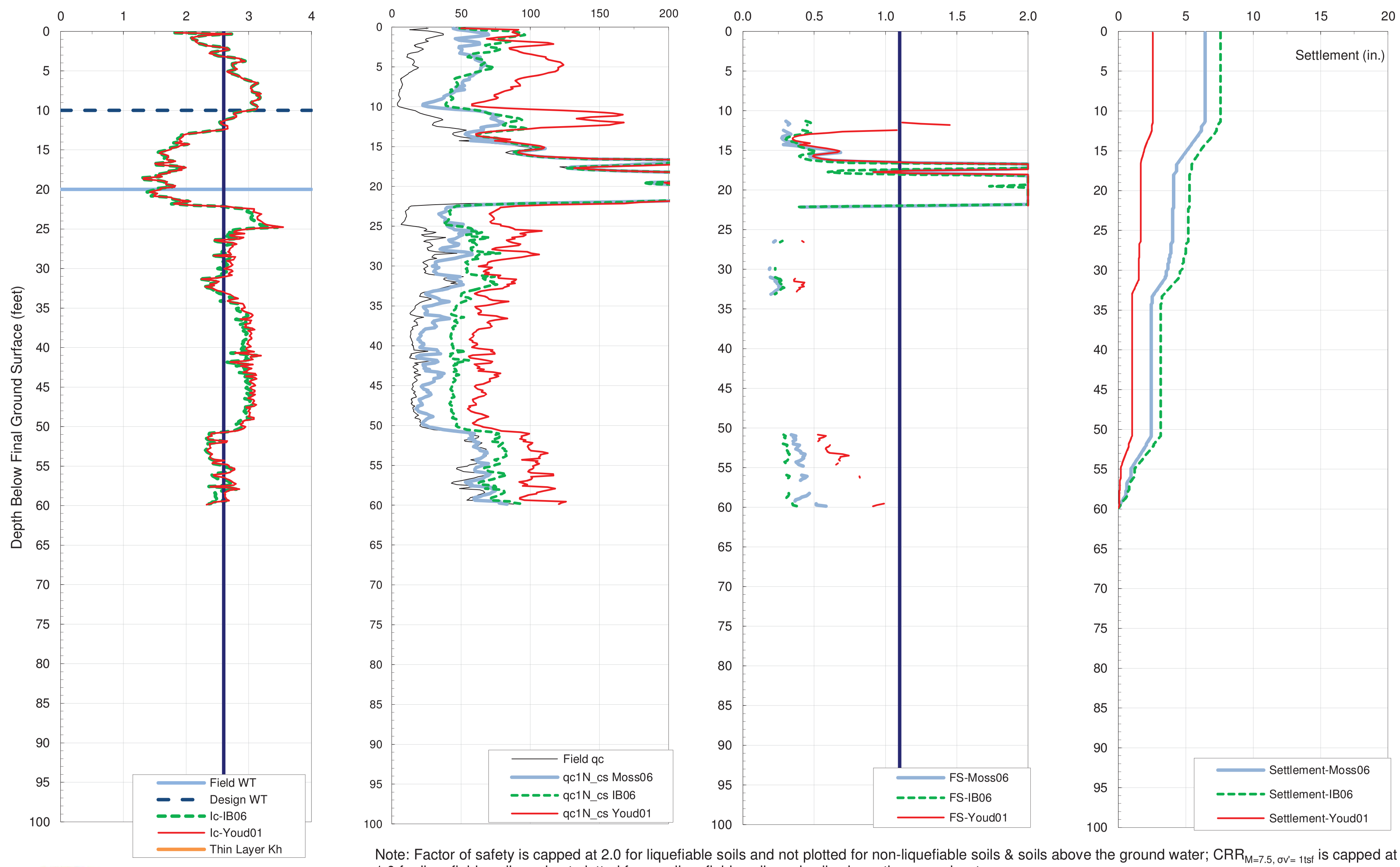
CPT ID: **CPT-3**

$M_w$= **6.8**
PGA= **0.51g**

Field Ground Water Depth (ft)= **20.0 ft**
Design Ground Water Depth (ft)= **10.0 ft**

Existing Ground Elevation= **357.0 ft**
Final Ground Elevation= **357.0 ft**

Ana. by: SK
Checked by:




Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5, \sigma v'= 1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

KLEINFELDER
Bright People. Right Solutions.

**Project Name:** **Laguna Hills Mall**
**Project No.:** **20155150**
**Project Location:** **Laguna Hills, CA**

**LIQUEFACTION ANALYSIS**

Date 4/30/2015

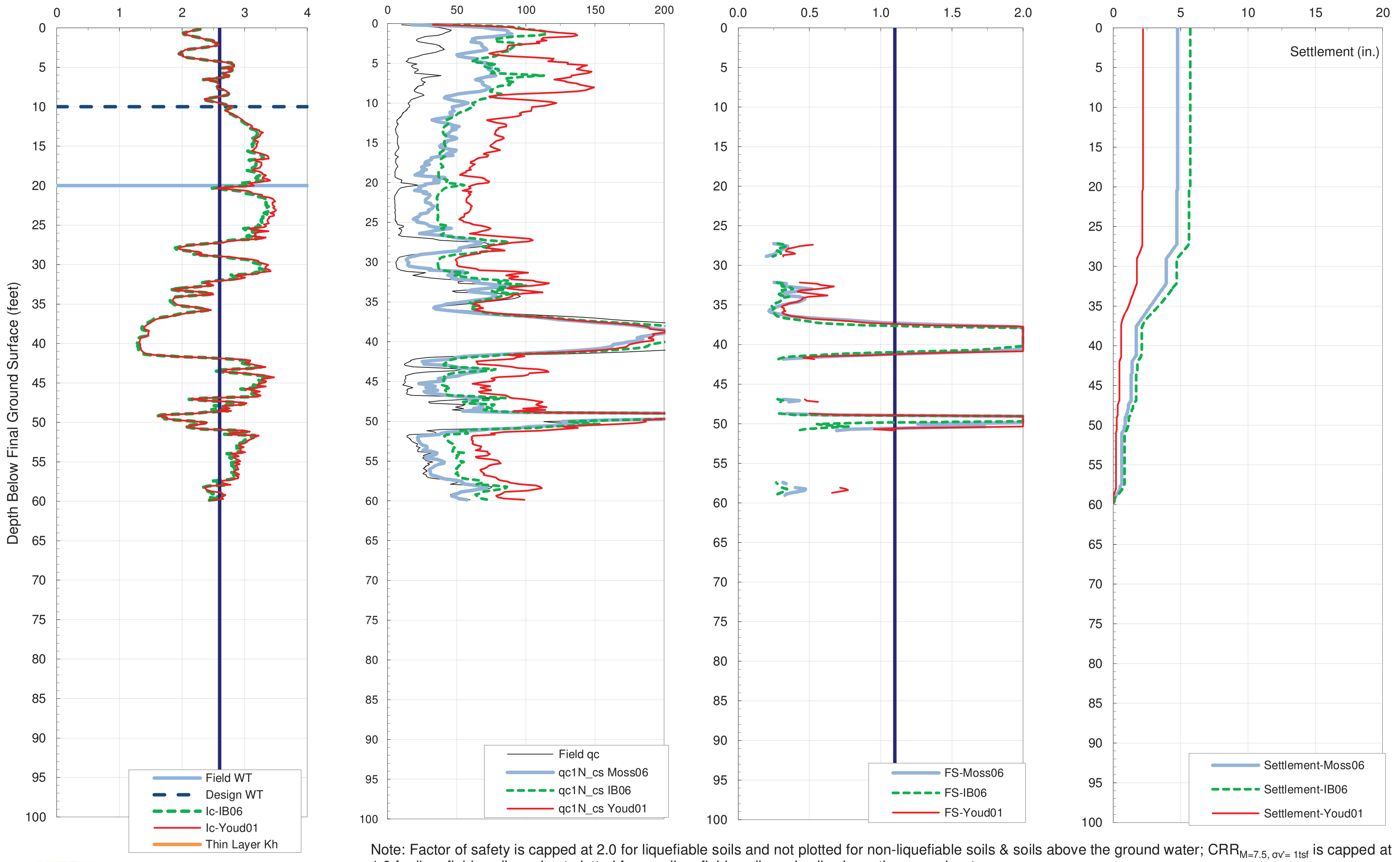
CPT ID: **CPT-4**

$M_w$= **6.8**
PGA= **0.51g**

Field Ground Water Depth (ft)= **20.0 ft**
Design Ground Water Depth (ft)= **10.0 ft**

Existing Ground Elevation= **357.0 ft**
Final Ground Elevation= **357.0 ft**

Ana. by: SK
Checked by:




Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5, \sigma v'=1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

**Project Name:** **Laguna Hills Mall**
**Project No.:** **20155150**
**Project Location:** **Laguna Hills, CA**

## LIQUEFACTION ANALYSIS

Date 4/30/2015

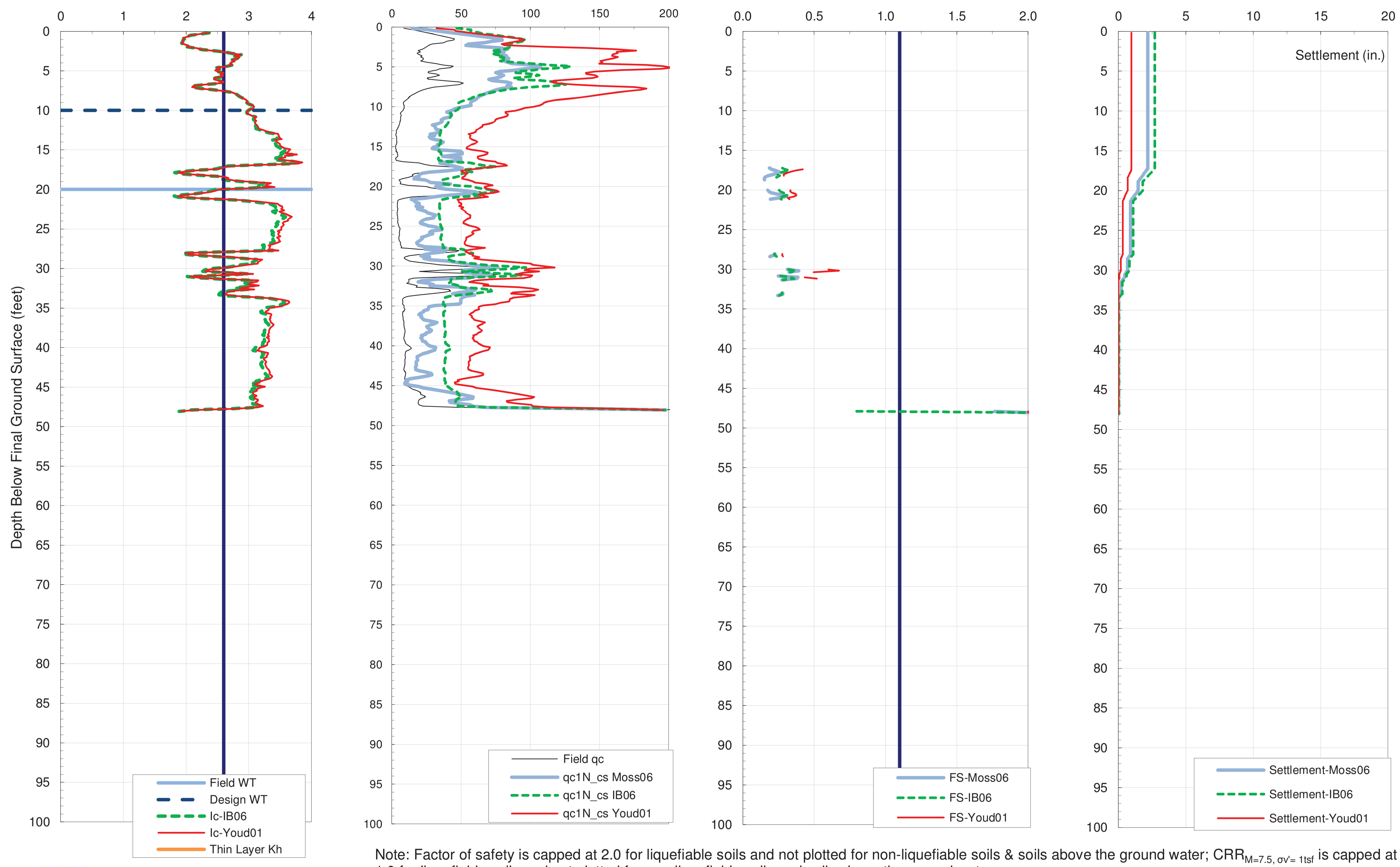
CPT ID: **CPT-5**

$M_w$= **6.8**
PGA= **0.51g**

Field Ground Water Depth (ft)= **20.0 ft**
Design Ground Water Depth (ft)= **10.0 ft**

Existing Ground Elevation= **357.0 ft**
Final Ground Elevation= **357.0 ft**

Ana. by: SK
Checked by:




Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5, \sigma v'=1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

KLEINFELDER
Bright People. Right Solutions.

**Project Name:** **Laguna Hills Mall**
**Project No.:** **20155150**
**Project Location:** **Laguna Hills, CA**

## LIQUEFACTION ANALYSIS

Date 4/30/2015

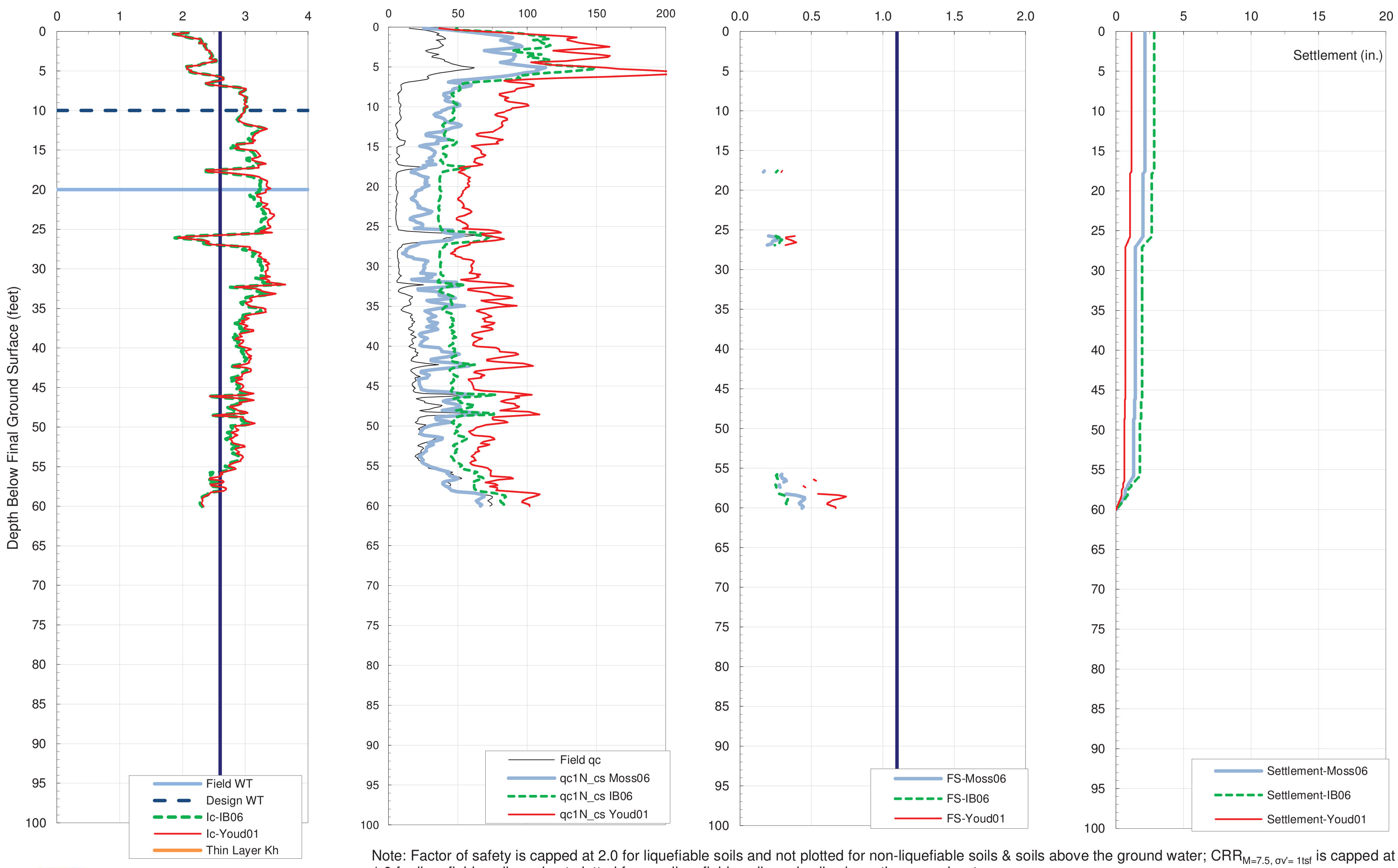
CPT ID: **CPT-6**

$M_w$= **6.8**
PGA= **0.51g**

Field Ground Water Depth (ft)= **20.0 ft**
Design Ground Water Depth (ft)= **10.0 ft**

Existing Ground Elevation= **357.0 ft**
Final Ground Elevation= **357.0 ft**

Ana. by: SK
Checked by:




Note: Factor of safety is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils & soils above the ground water; $CRR_{M=7.5, \sigma v'=1tsf}$ is capped at 1.0 for liqeufiable soils and not plotted for non-liquefiable soils and soils above the ground water.

KLEINFELDER
Bright People. Right Solutions.

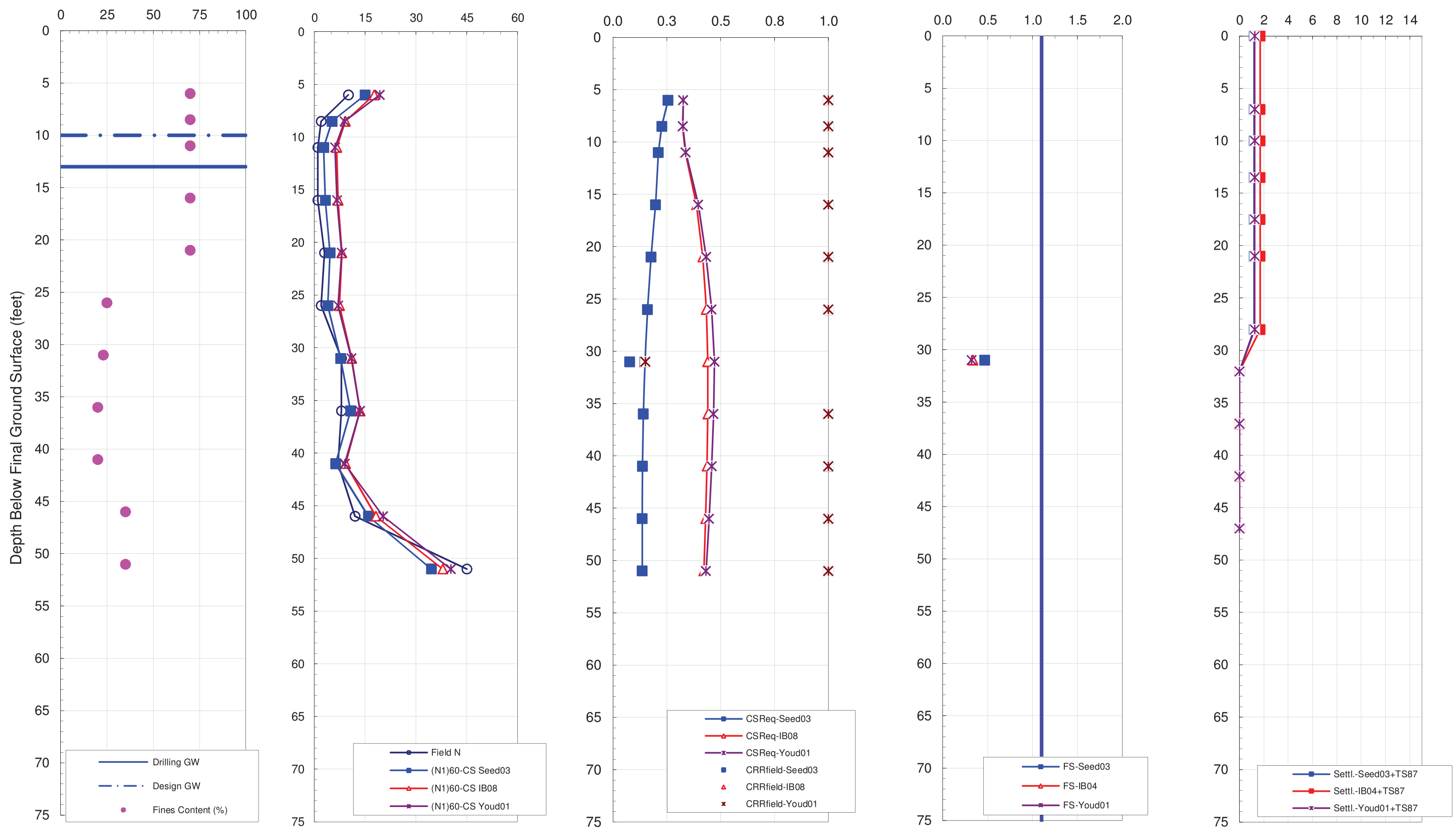
**Project Name:** **Laguna Hills Mall**
**Project No.:** **20155150**
**Project Location:** **Laguna Hills, CA**

## LIQUEFACTION ANALYSIS

Date 4/30/2015

| | | | |
|---|---|---|---|
| Boring ID: **B-3** | $M_w$= **6.8** | Groundwater Depth During Drilling (ft) = **13.0 ft** | Existing Ground Elevation = **344.0 ft** |
| | PGA= **0.51g** | Design Groundwater Depth (ft) = **10.0 ft** | Final Ground Elevation = **344.0 ft** |

Ana. by: Steven Kuo
Checked by:




1. $(N_1)_{60\text{-}CS}$ capped at 60; 2. CRRfield = 1 for non-liquefiable soils; 3. FS is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils including soils above G.W.T.

KLEINFELDER
Bright People. Right Solutions.

**Project Name:** **Five Lagunas Redevelopment**
**Project No.:** **20155150.001A**
**Project Location:** **Laguna Hills, Ca**

**EARTHQUAKE-INDUCED SETTLEMENTS**

Date 4/30/2015

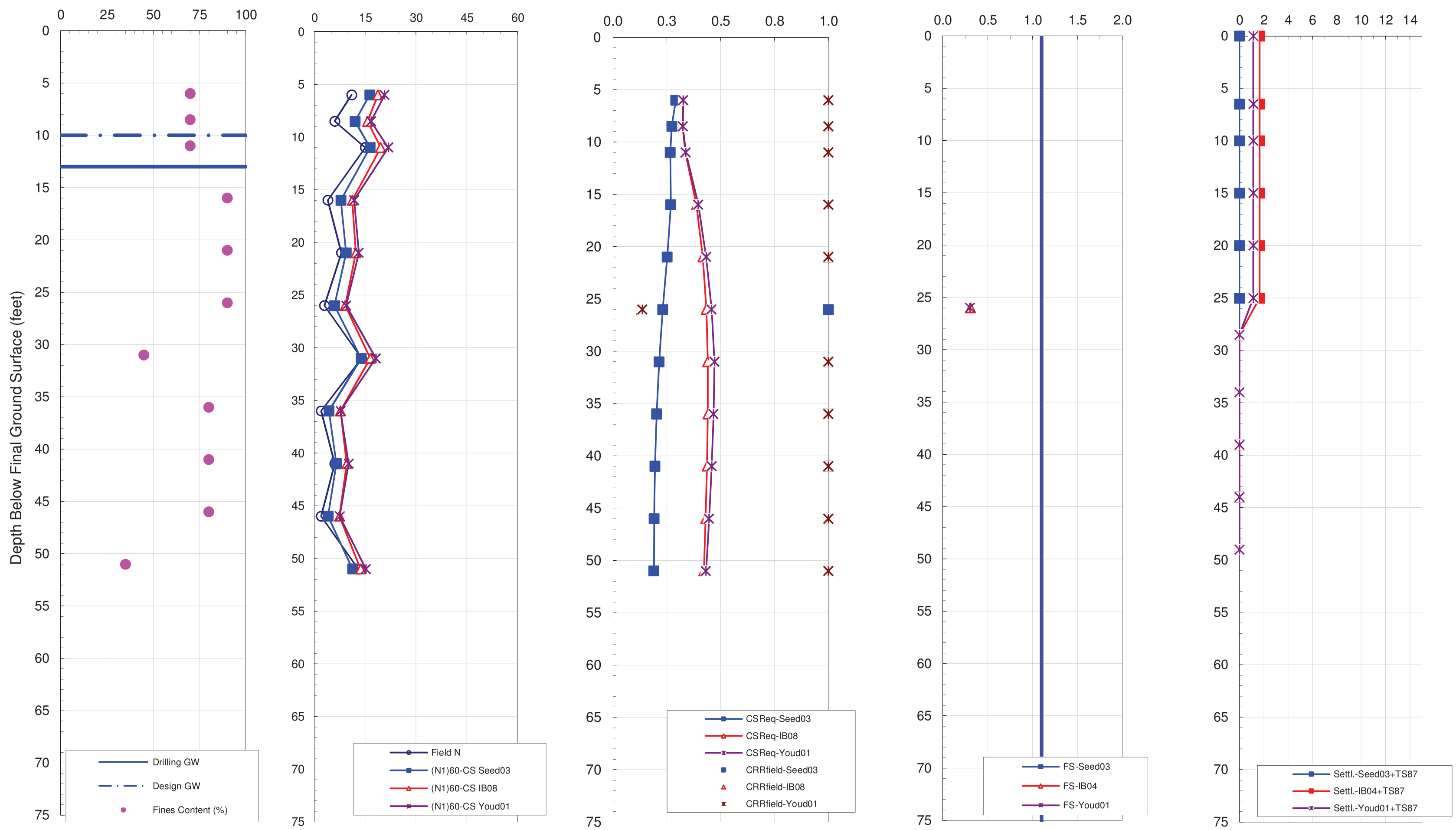
Boring ID: **B-5**

$M_w$= **6.8**
PGA= **0.51g**

Groundwater Depth During Drilling (ft) = **13.0 ft**
Design Groundwater Depth (ft) = **10.0 ft**

Existing Ground Elevation = **344.0 ft**
Final Ground Elevation = **344.0 ft**

Ana. by: Steven Kuo
Checked by:




1. $(N_1)_{60\text{-}CS}$ capped at 60; 2. CRRfield = 1 for non-liquefiable soils; 3. FS is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils including soils above G.W.T.

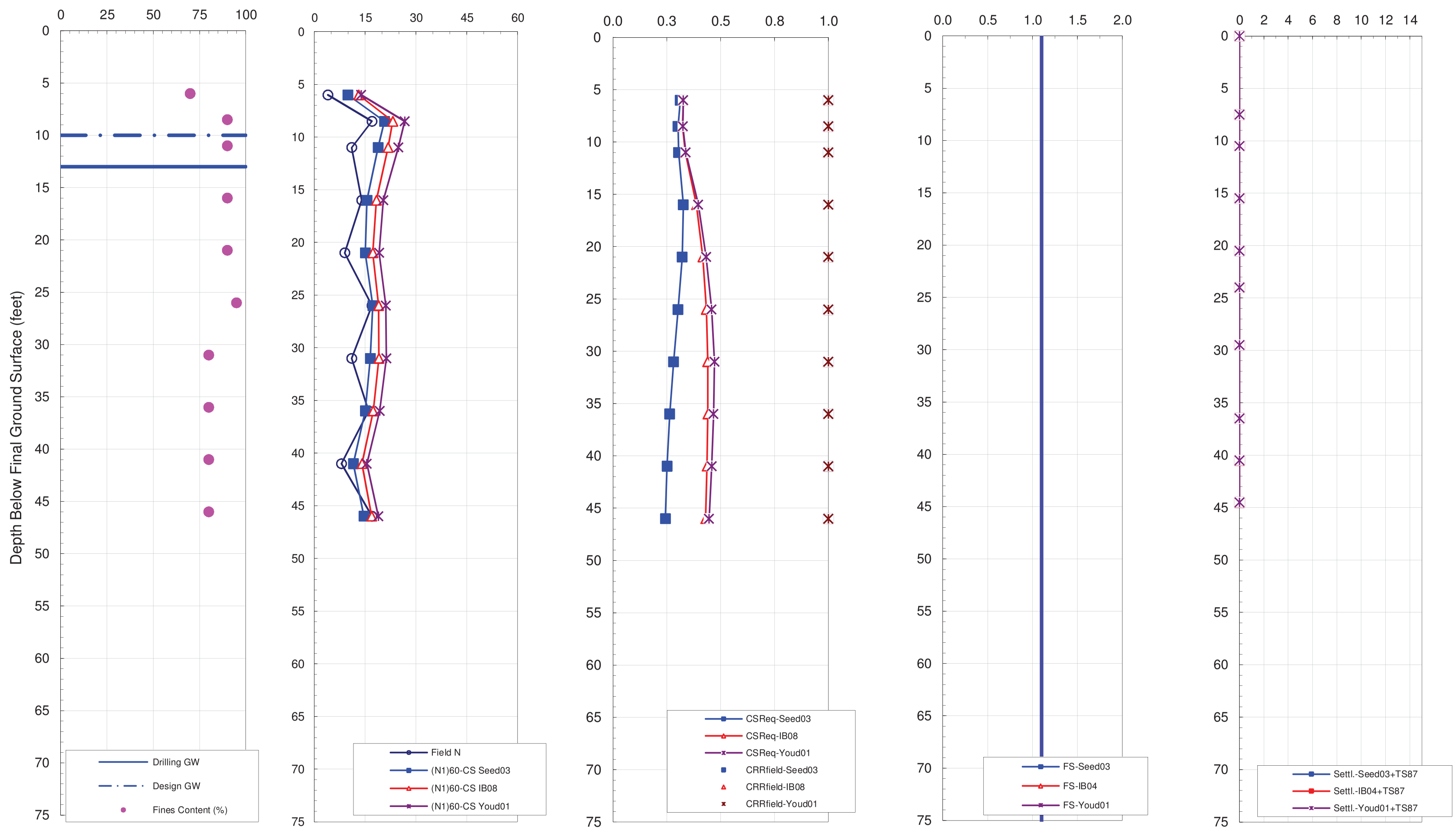
KLEINFELDER
Bright People. Right Solutions.

**Project Name:** **Five Lagunas Redevelopment**
**Project No.:** **20155150.001A**
**Project Location:** **Laguna Hills, Ca**

## EARTHQUAKE-INDUCED SETTLEMENTS

Date 4/30/2015

| Boring ID: | B-7 | $M_w$= 6.8 | Groundwater Depth During Drilling (ft) = **13.0 ft** | Existing Ground Elevation = **344.0 ft** | Ana. by: Steven Kuo |
|---|---|---|---|---|---|
| | | PGA= **0.51g** | Design Groundwater Depth (ft) = **10.0 ft** | Final Ground Elevation = **344.0 ft** | Checked by: |



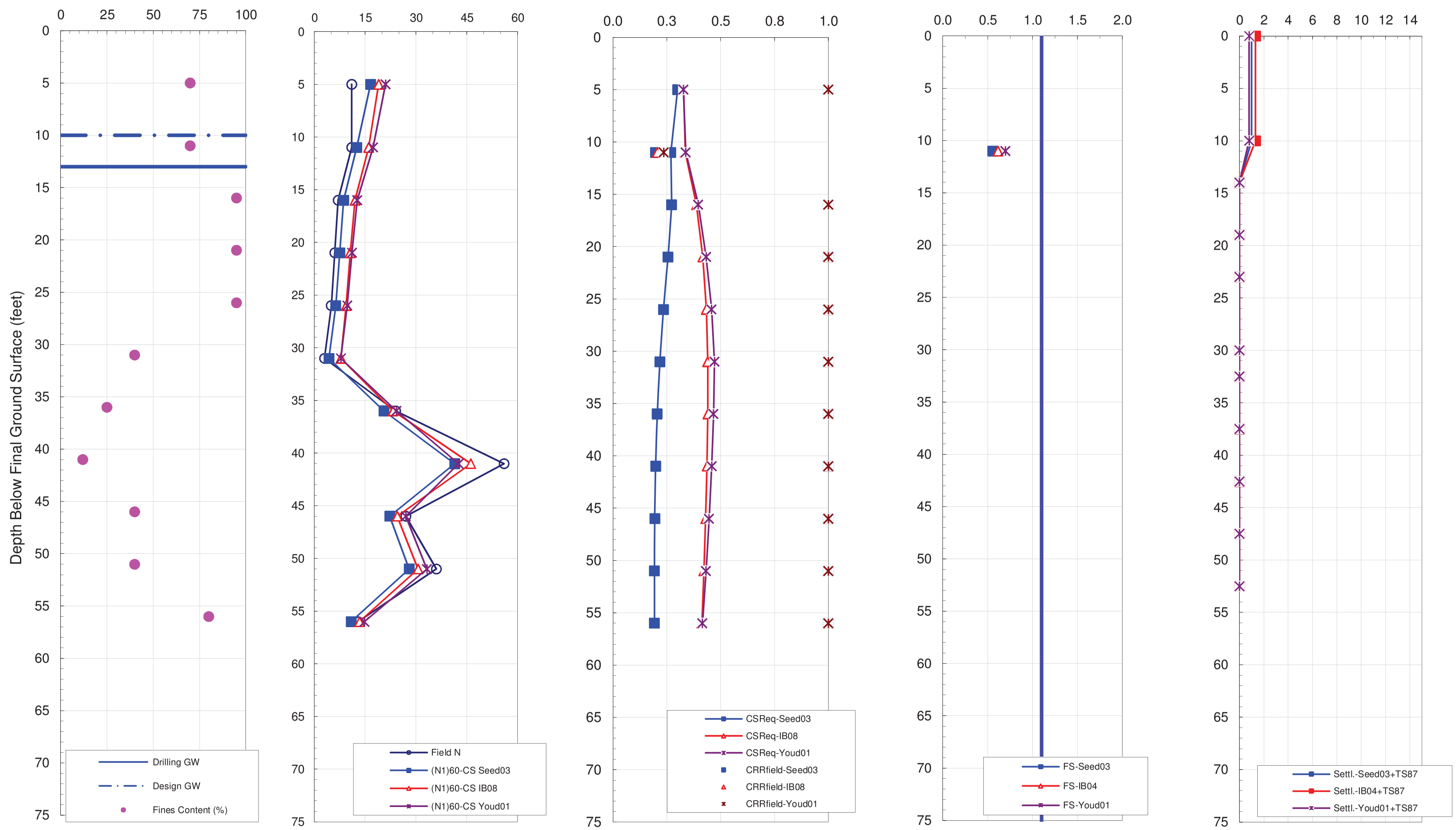

1. $(N_1)_{60\text{-}CS}$ capped at 60; 2. CRRfield = 1 for non-liquefiable soils; 3. FS is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils including soils above G.W.T.

**Project Name:** Five Lagunas Redevelopment
**Project No.:** 20155150.001A
**Project Location:** Laguna Hills, Ca

## EARTHQUAKE-INDUCED SETTLEMENTS

Date 4/30/2015

| | | | | | |
|---|---|---|---|---|---|
| Boring ID: | **B-12** | $M_w$= **6.8** | Groundwater Depth During Drilling (ft) = **13.0 ft** | Existing Ground Elevation = **344.0 ft** | Ana. by: Steven Kuo |
| | | PGA= **0.51g** | Design Groundwater Depth (ft) = **10.0 ft** | Final Ground Elevation = **344.0 ft** | Checked by: |




1. $(N_1)_{60\text{-}CS}$ capped at 60; 2. CRRfield = 1 for non-liquefiable soils; 3. FS is capped at 2.0 for liquefiable soils and not plotted for non-liquefiable soils including soils above G.W.T.

KLEINFELDER
Bright People. Right Solutions.

**Project Name:** Five Lagunas Redevelopment
**Project No.:** 20155150.001A
**Project Location:** Laguna Hills, Ca

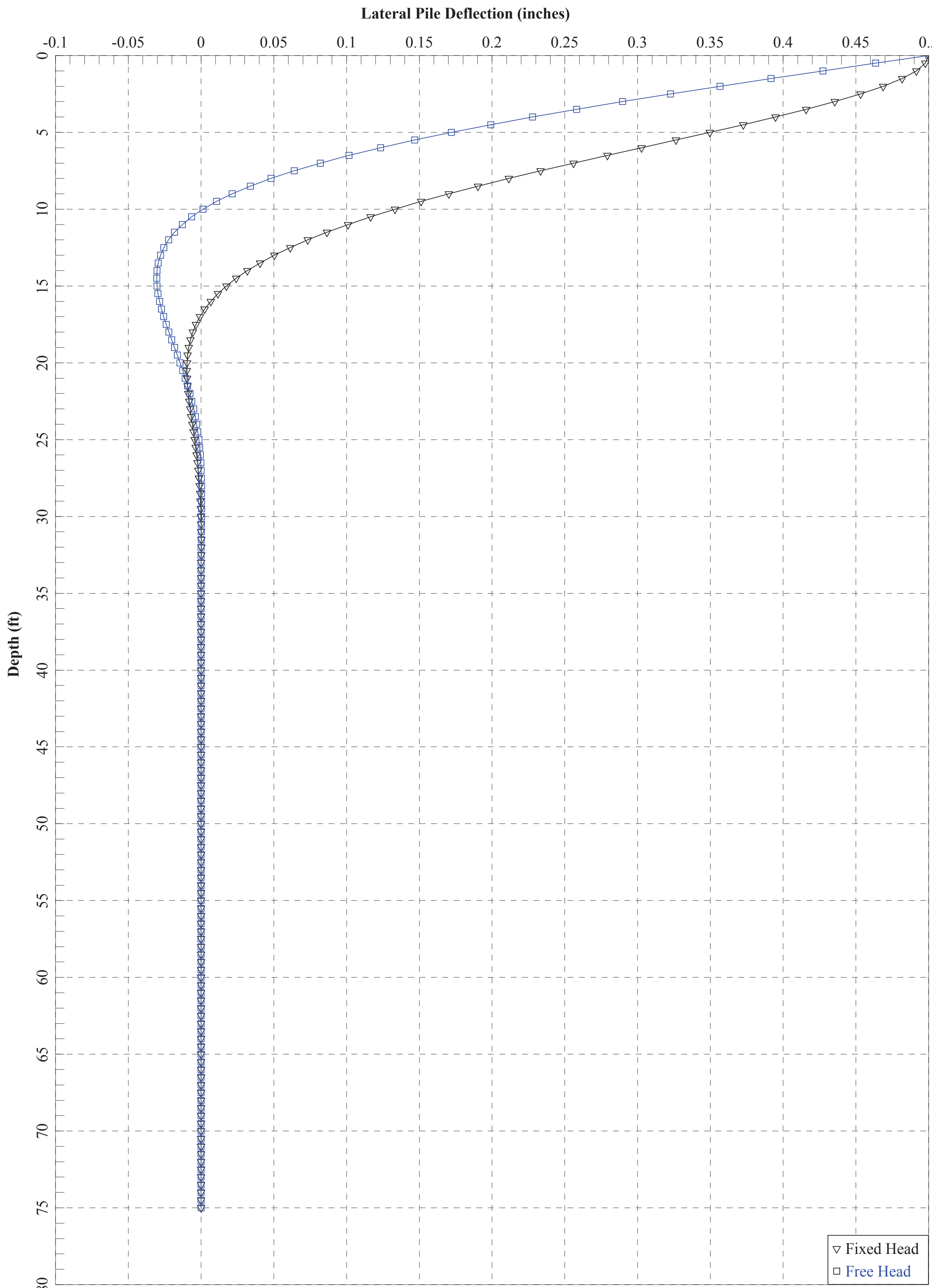
**EARTHQUAKE-INDUCED SETTLEMENTS**

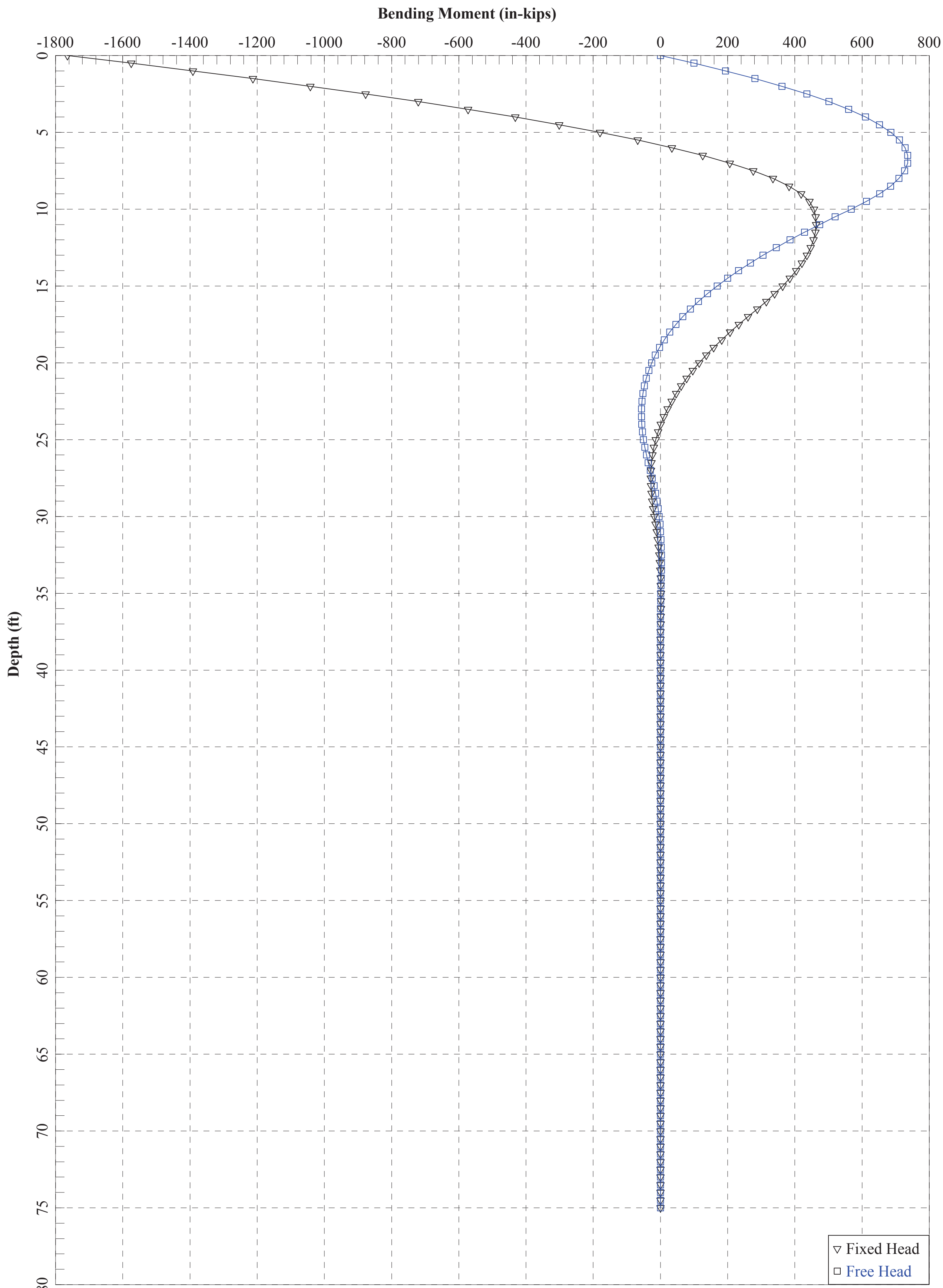
Date 4/30/2015

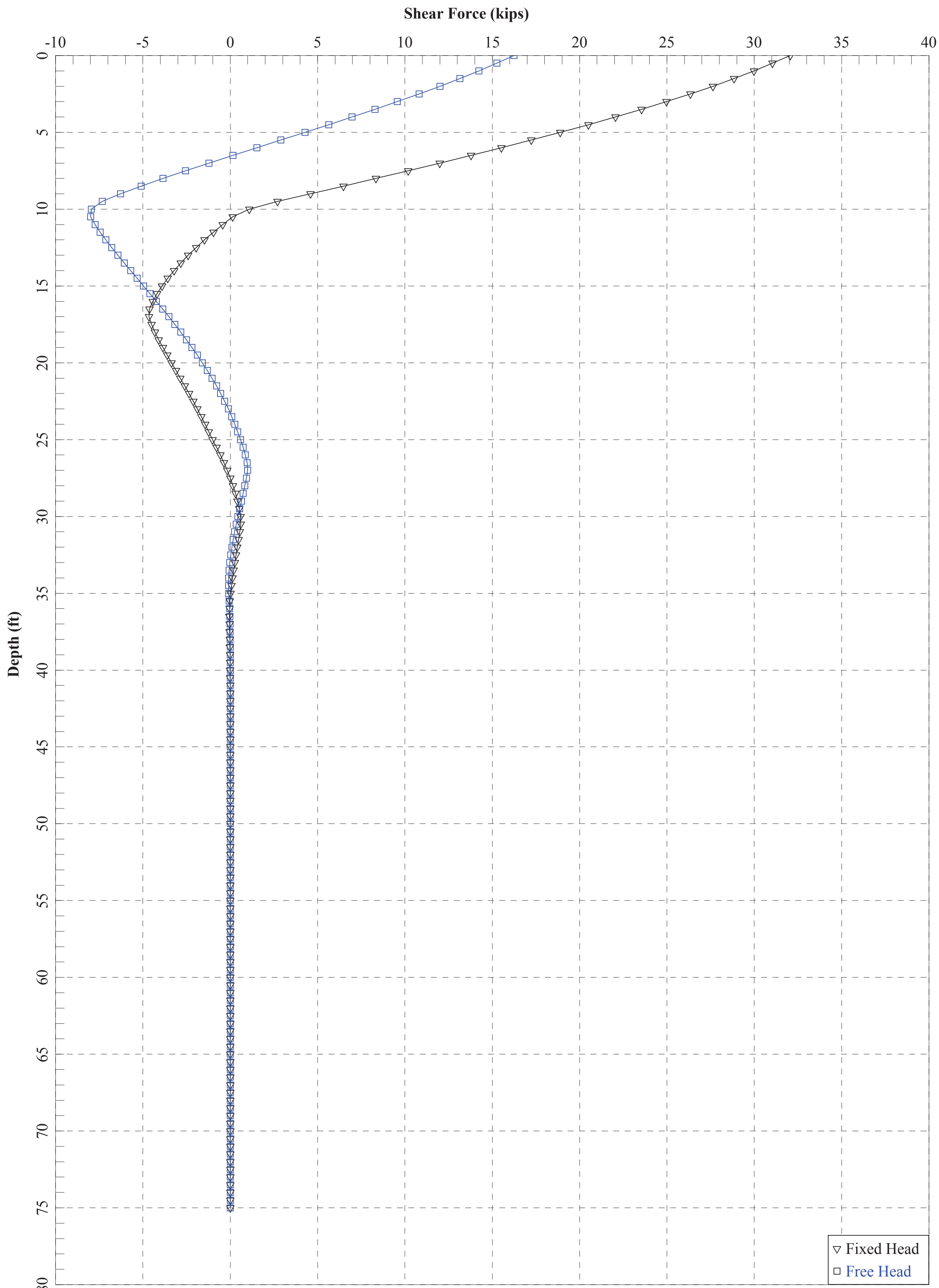
# Lateral Pile Capacity Analysis

# LPILE OUTPUT

## (75-foot 14-inch-square Driven Pile)


Lateral Pile Deflection (inches)
-0.1
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
Fixed Head
Free Head

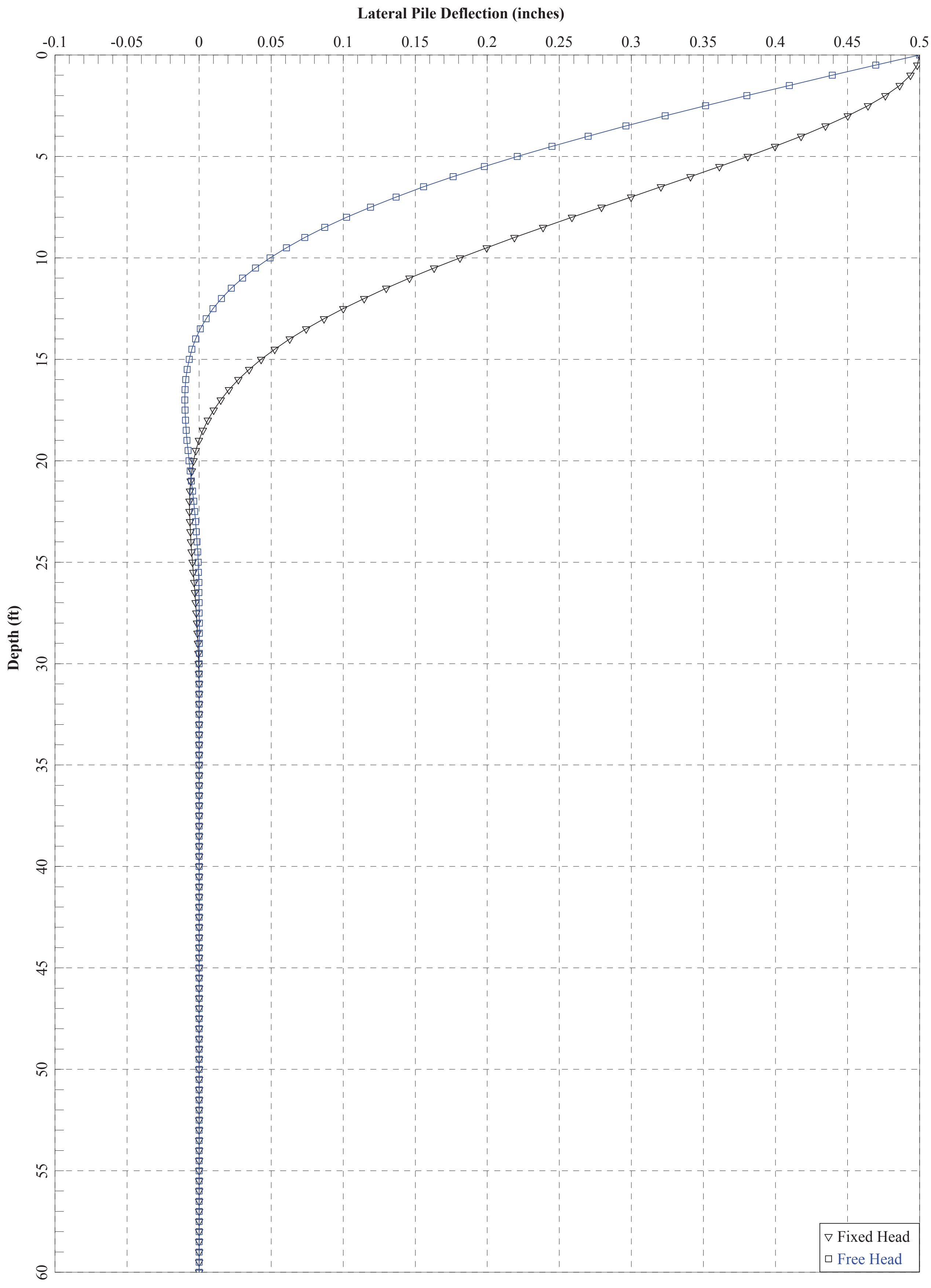

Bending Moment (in-kips)
-1800
-1600
-1400
-1200
-1000
-800
-600
-400
-200
0
200
400
600
800
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
Fixed Head
Free Head



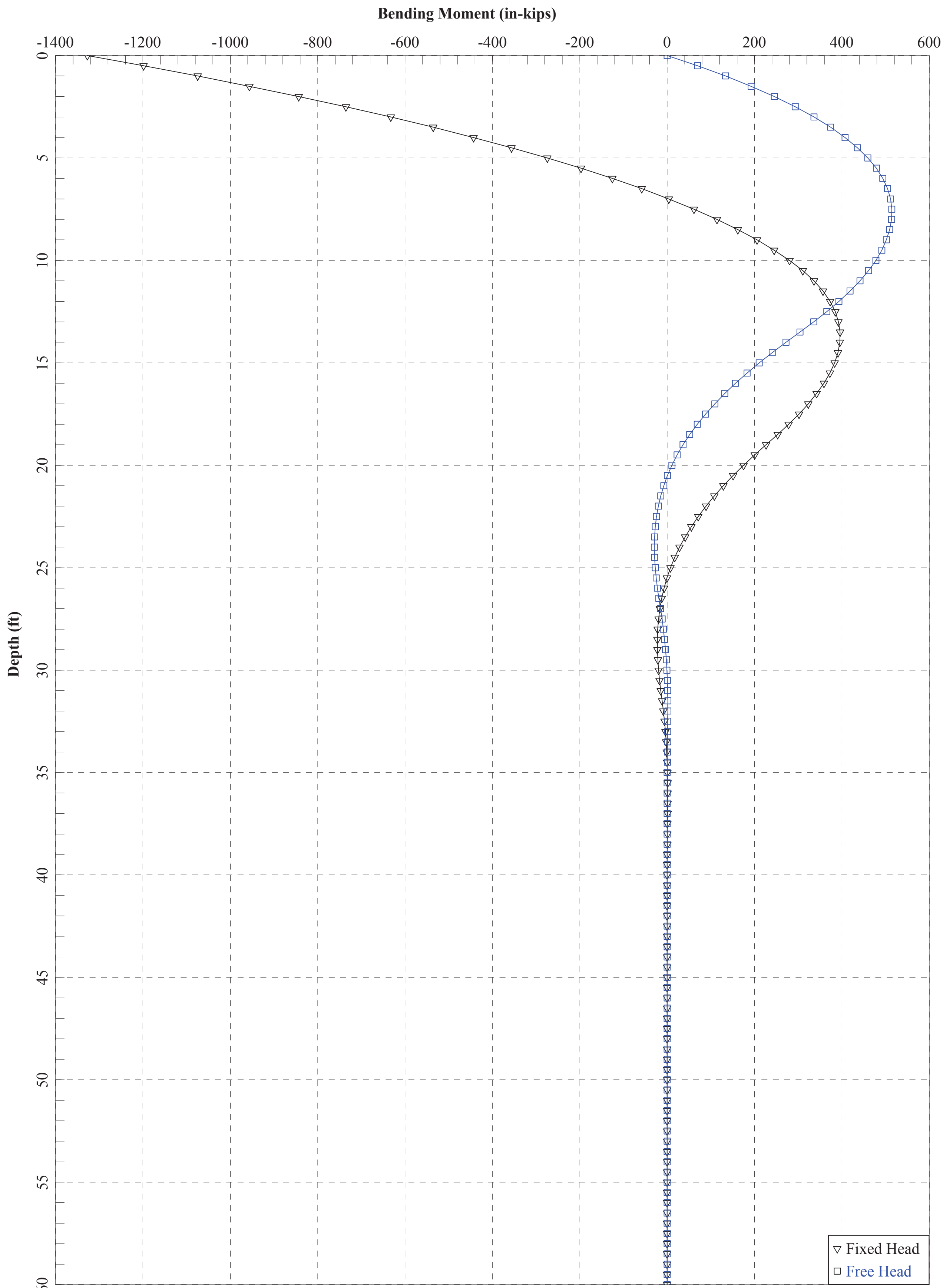
Shear Force (kips)
-10
-5
0
5
10
15
20
25
30
35
40
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
Fixed Head
Free Head

# LPILE OUTPUT

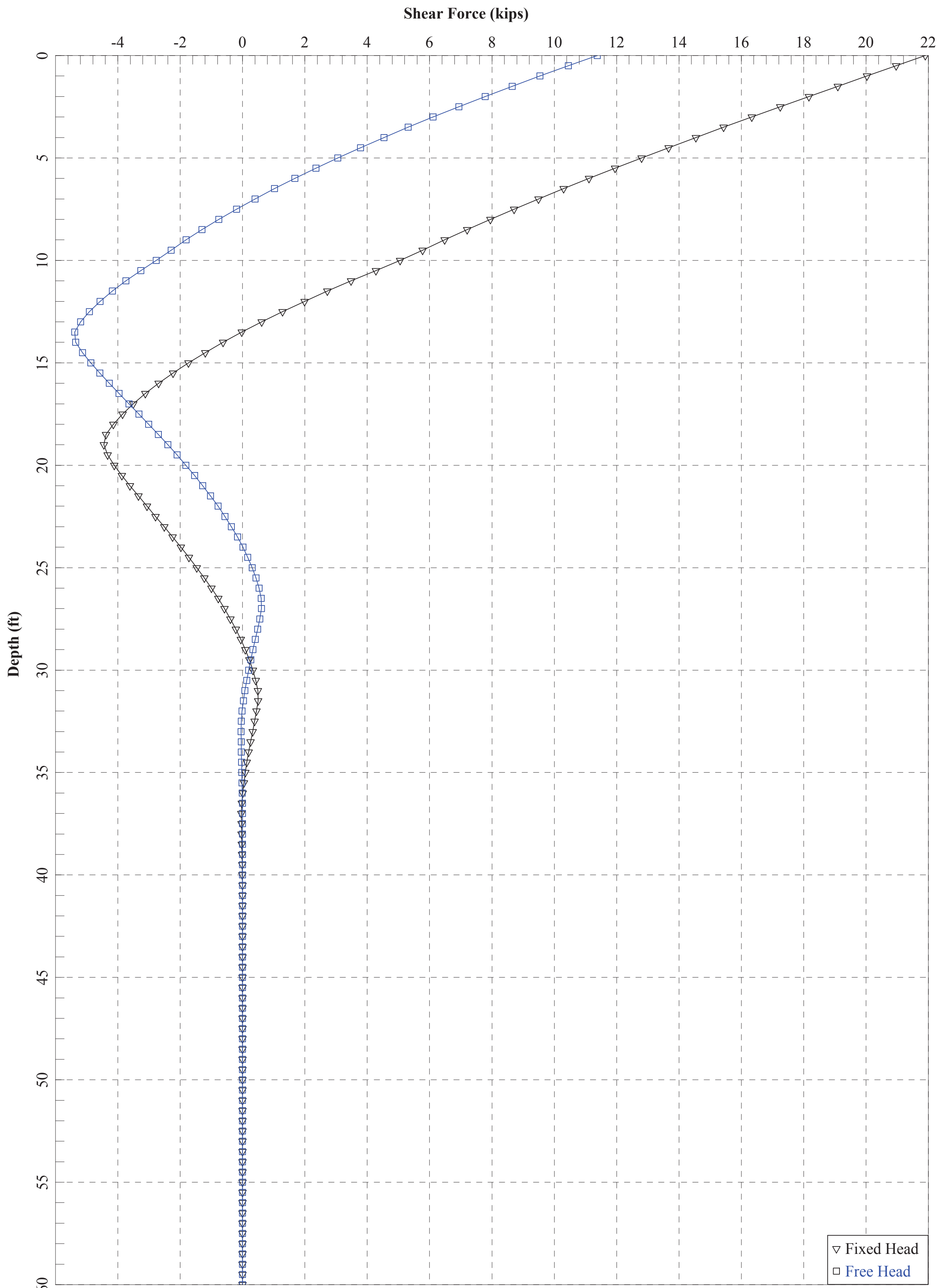
## (60-foot 14-inch-square Driven Pile)



Lateral Pile Deflection (inches)
-0.1
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Fixed Head
Free Head



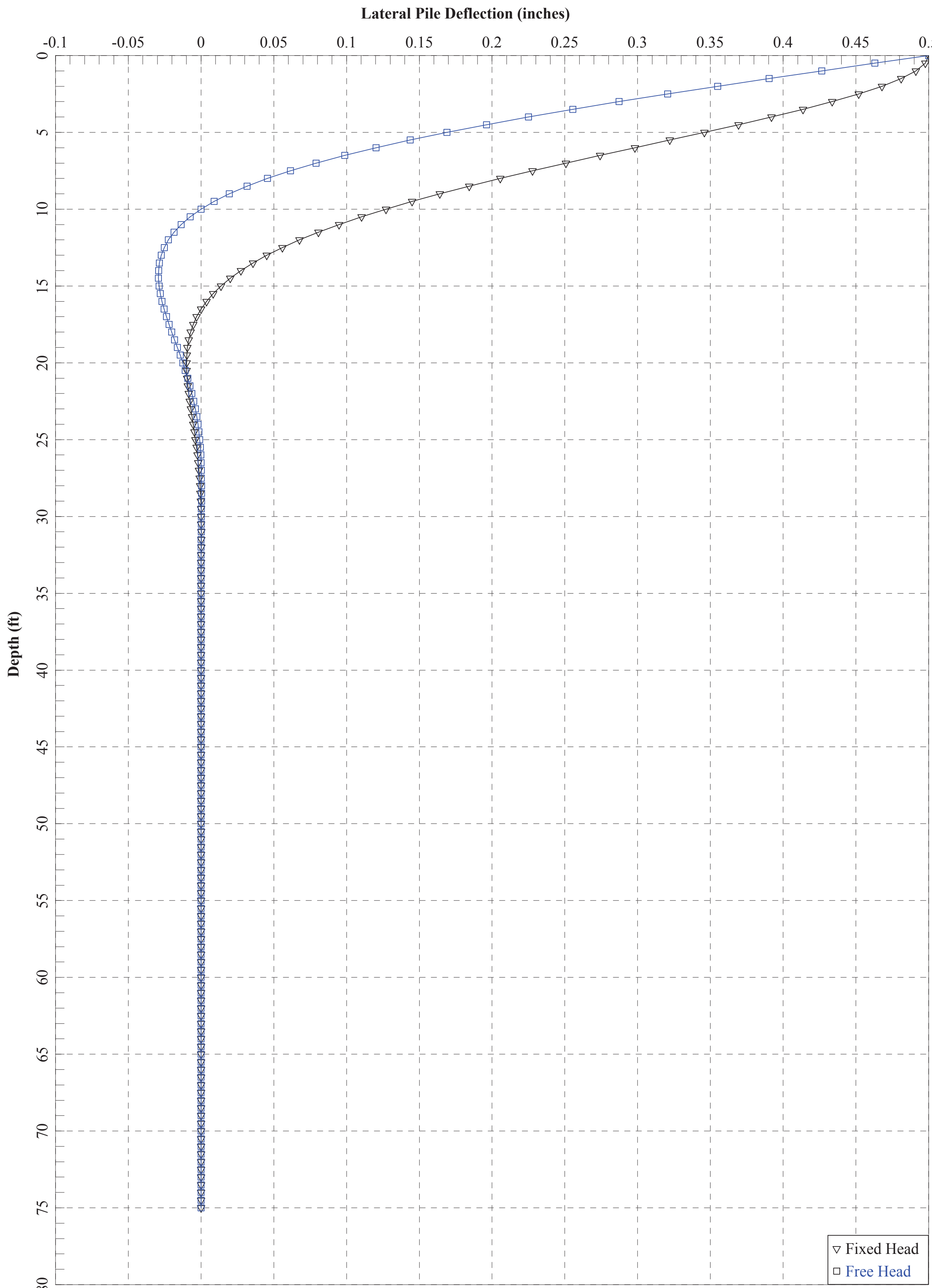
Bending Moment (in-kips)
-1400
-1200
-1000
-800
-600
-400
-200
0
200
400
600
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Fixed Head
Free Head

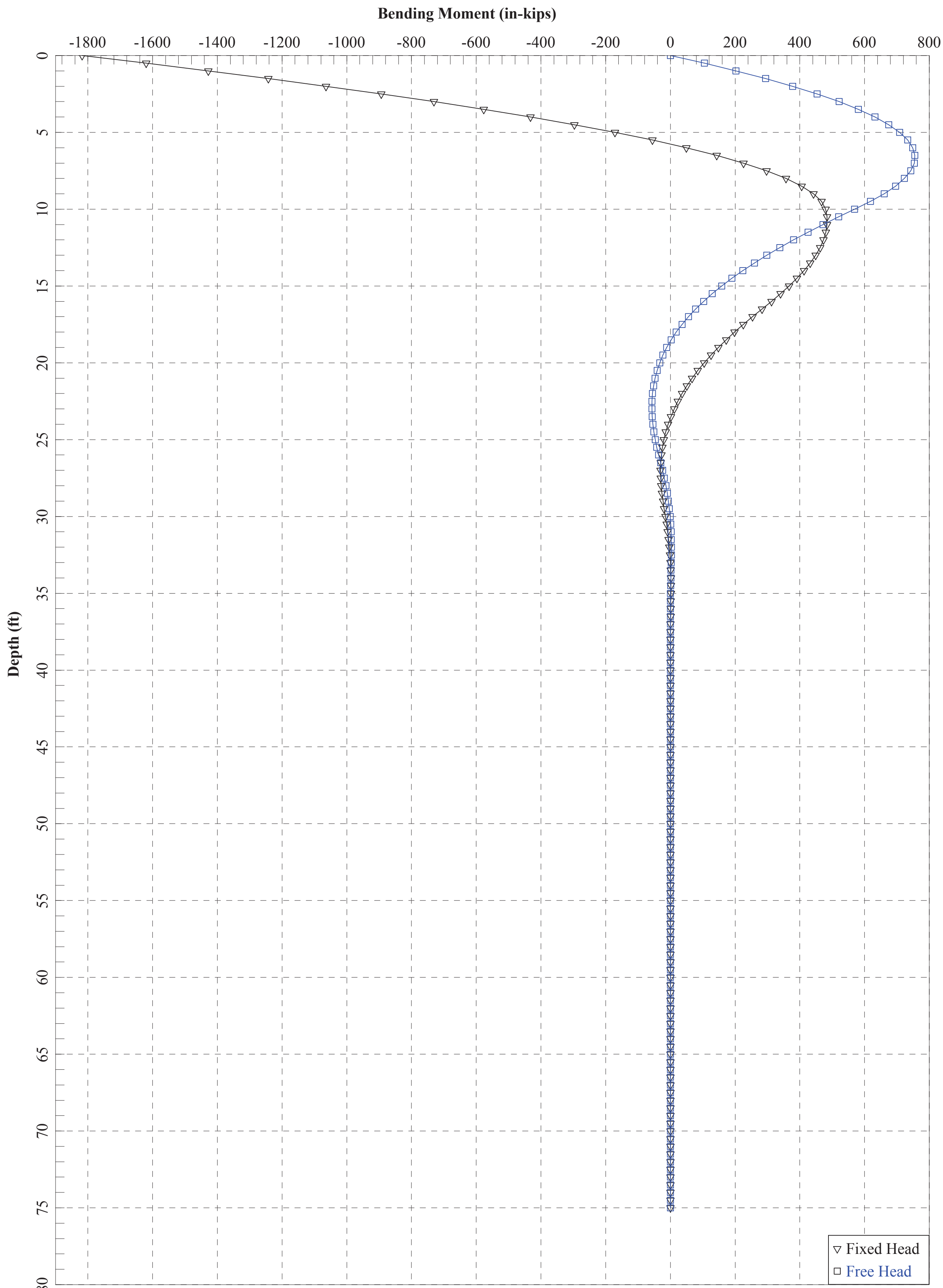


Shear Force (kips)
-4
-2
0
2
4
6
8
10
12
14
16
18
20
22
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Fixed Head
Free Head

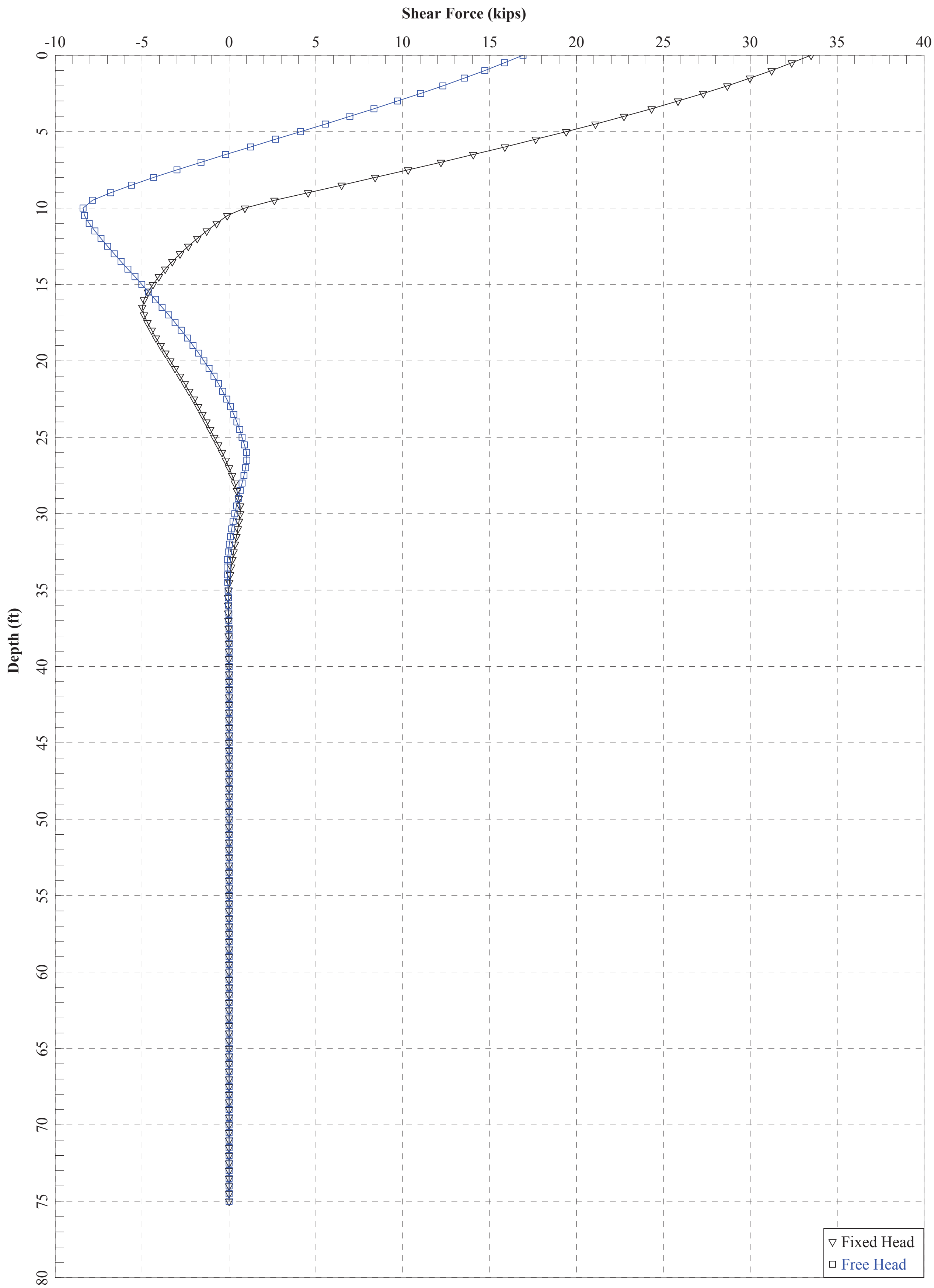
# LPILE OUTPUT

## (75-foot 16-inch-square Driven Pile)


Lateral Pile Deflection (inches)
-0.1
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
Fixed Head
Free Head



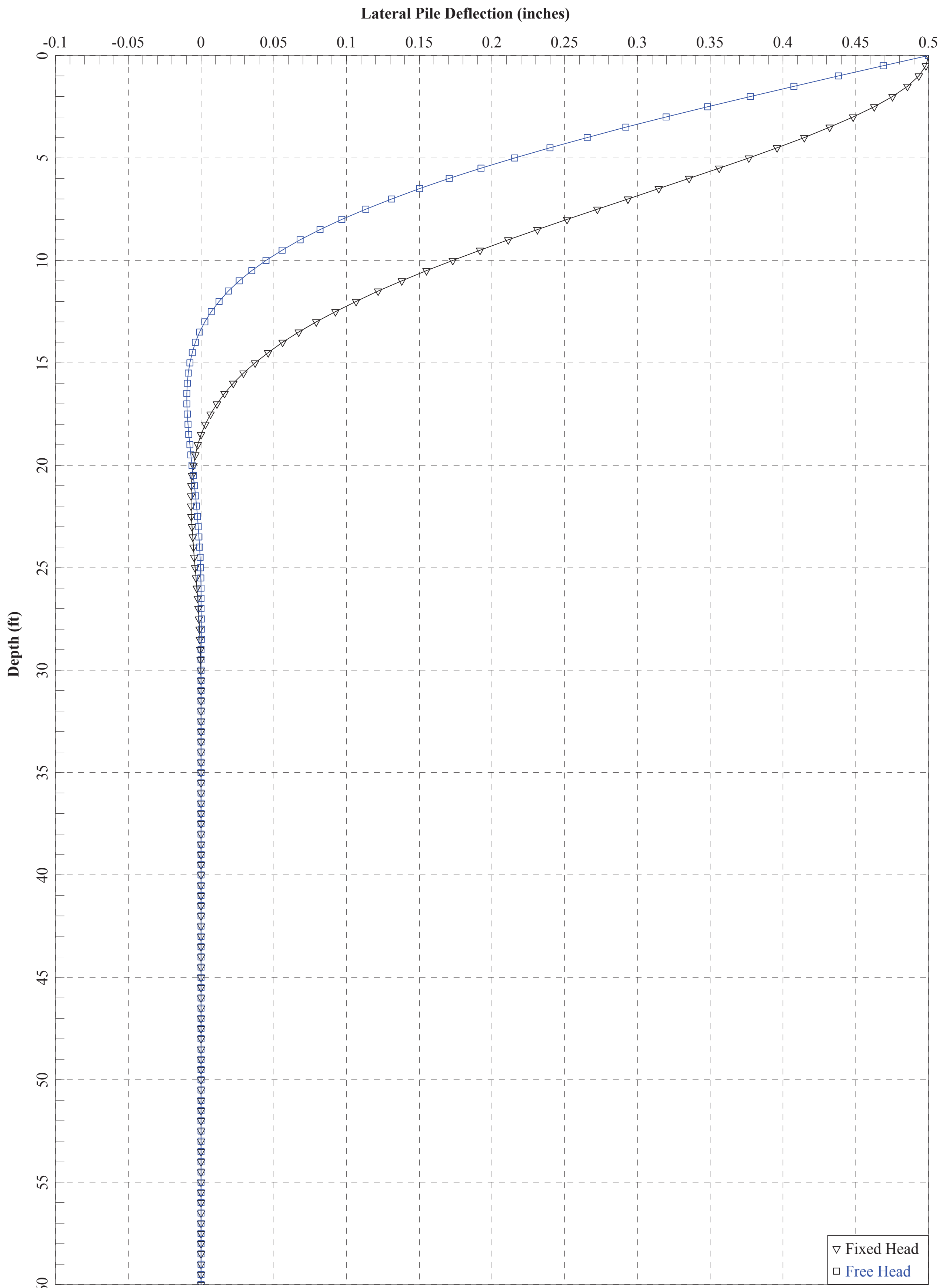
Bending Moment (in-kips)
-1800
-1600
-1400
-1200
-1000
-800
-600
-400
-200
0
200
400
600
800
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
Fixed Head
Free Head

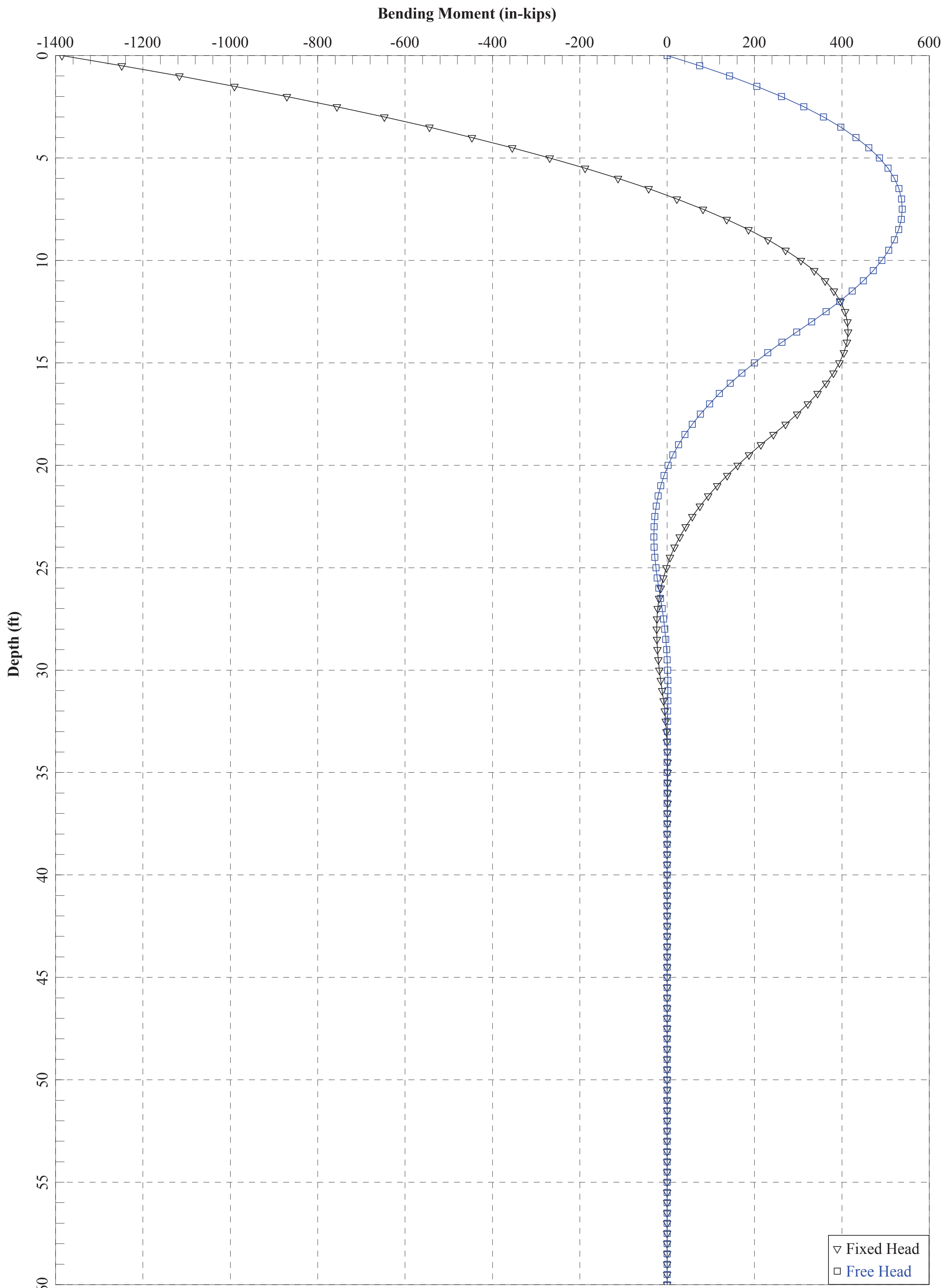


Shear Force (kips)
-10
-5
0
5
10
15
20
25
30
35
40
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
Fixed Head
Free Head

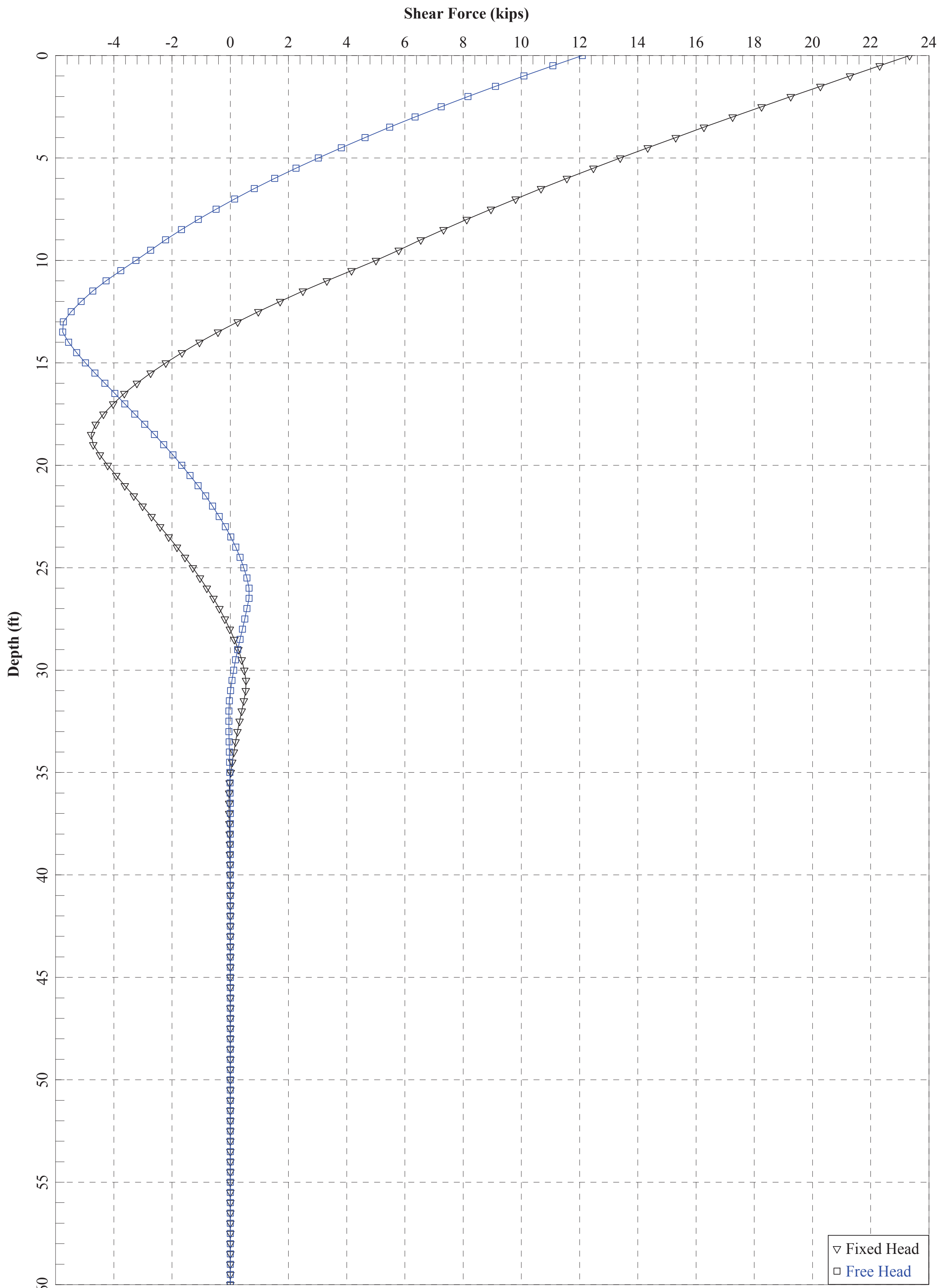
# LPILE OUTPUT

## (60-foot 16-inch-square Driven Pile)


Lateral Pile Deflection (inches)
-0.1
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Fixed Head
Free Head



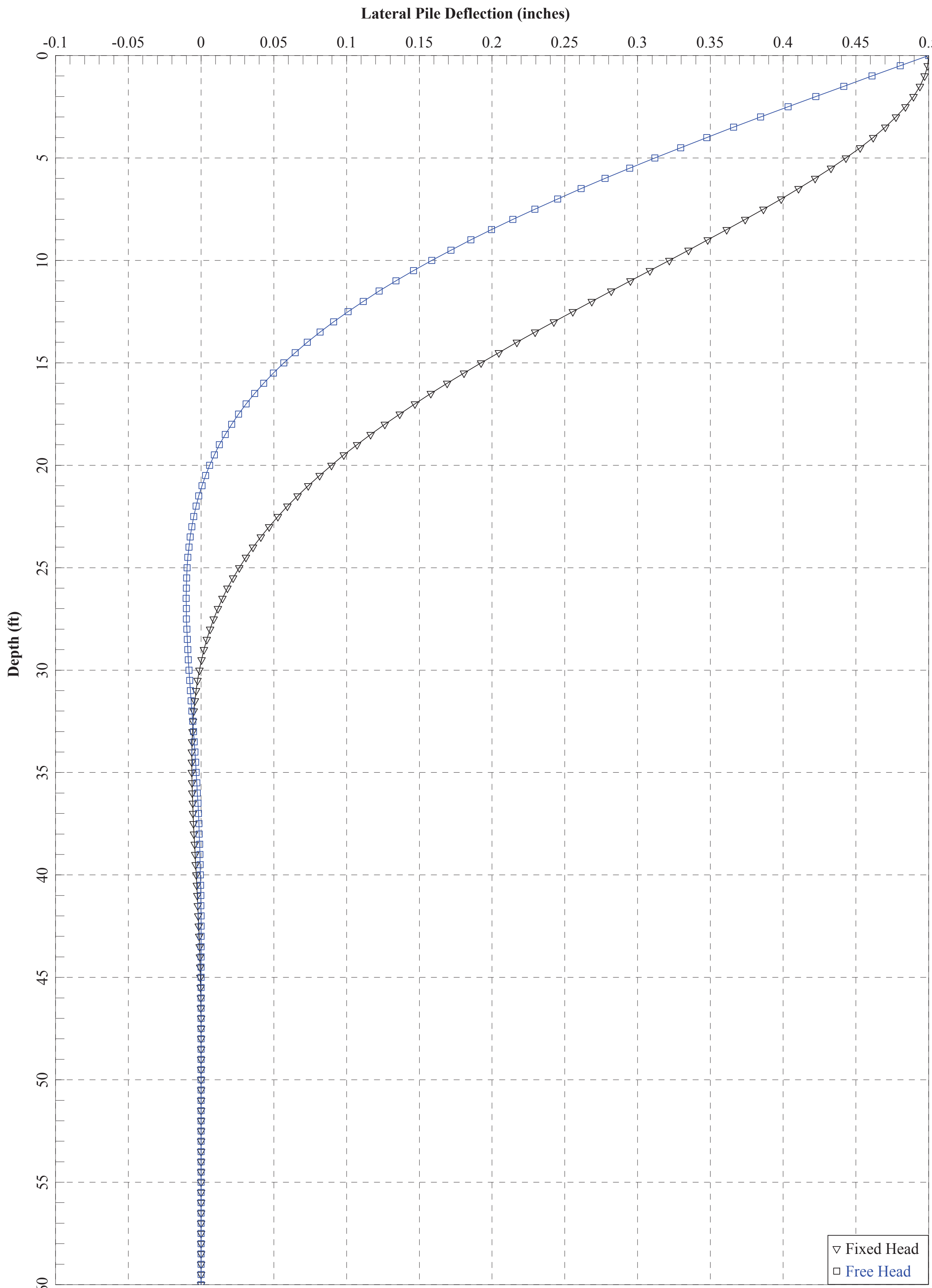
Bending Moment (in-kips)
-1400
-1200
-1000
-800
-600
-400
-200
0
200
400
600
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Fixed Head
Free Head



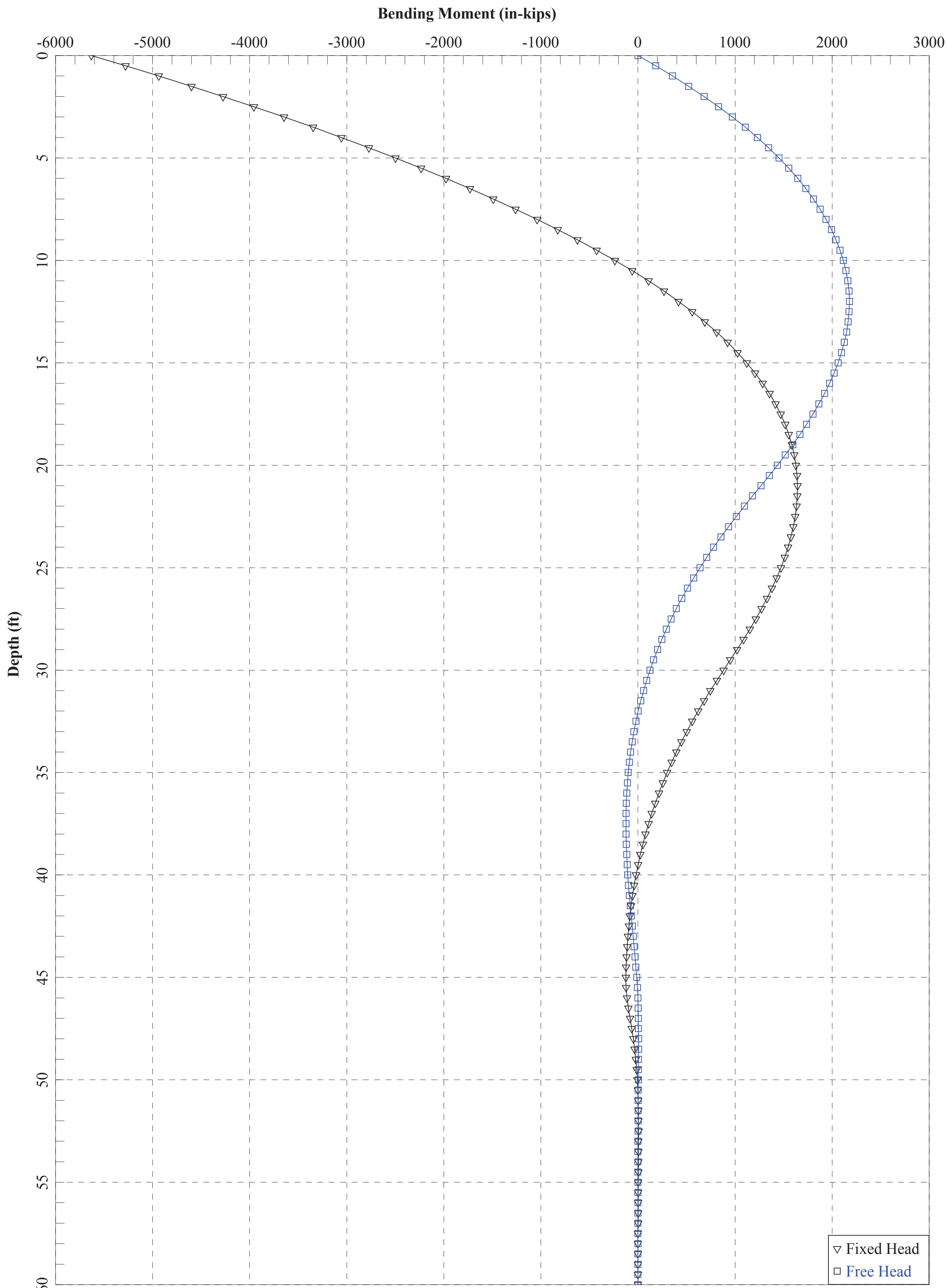
Shear Force (kips)
-4
-2
0
2
4
6
8
10
12
14
16
18
20
22
24
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Fixed Head
Free Head

# LPILE OUTPUT

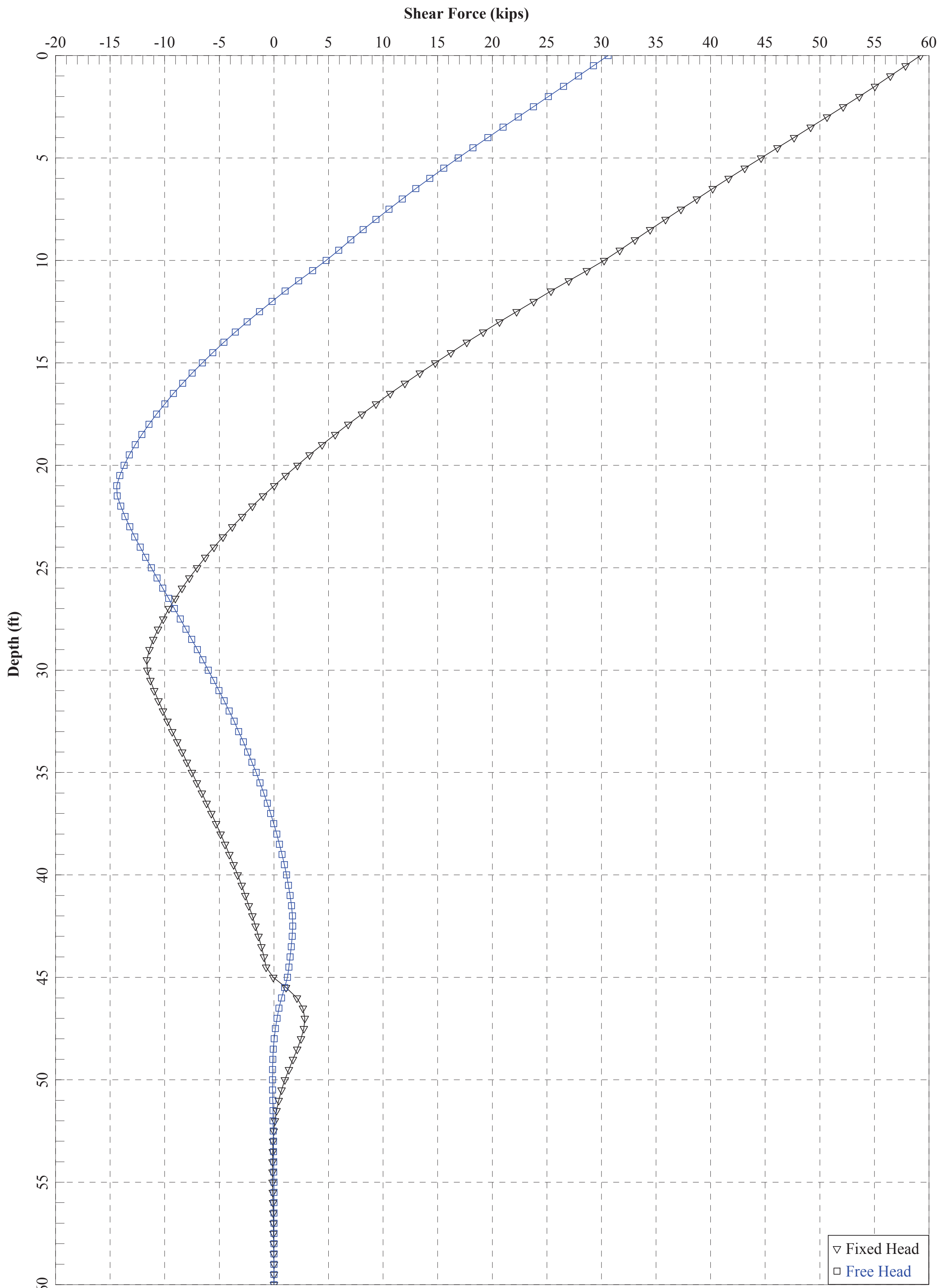
## (75-foot 30-inch Drilled SHAFT)



Lateral Pile Deflection (inches)
-0.1
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Fixed Head
Free Head



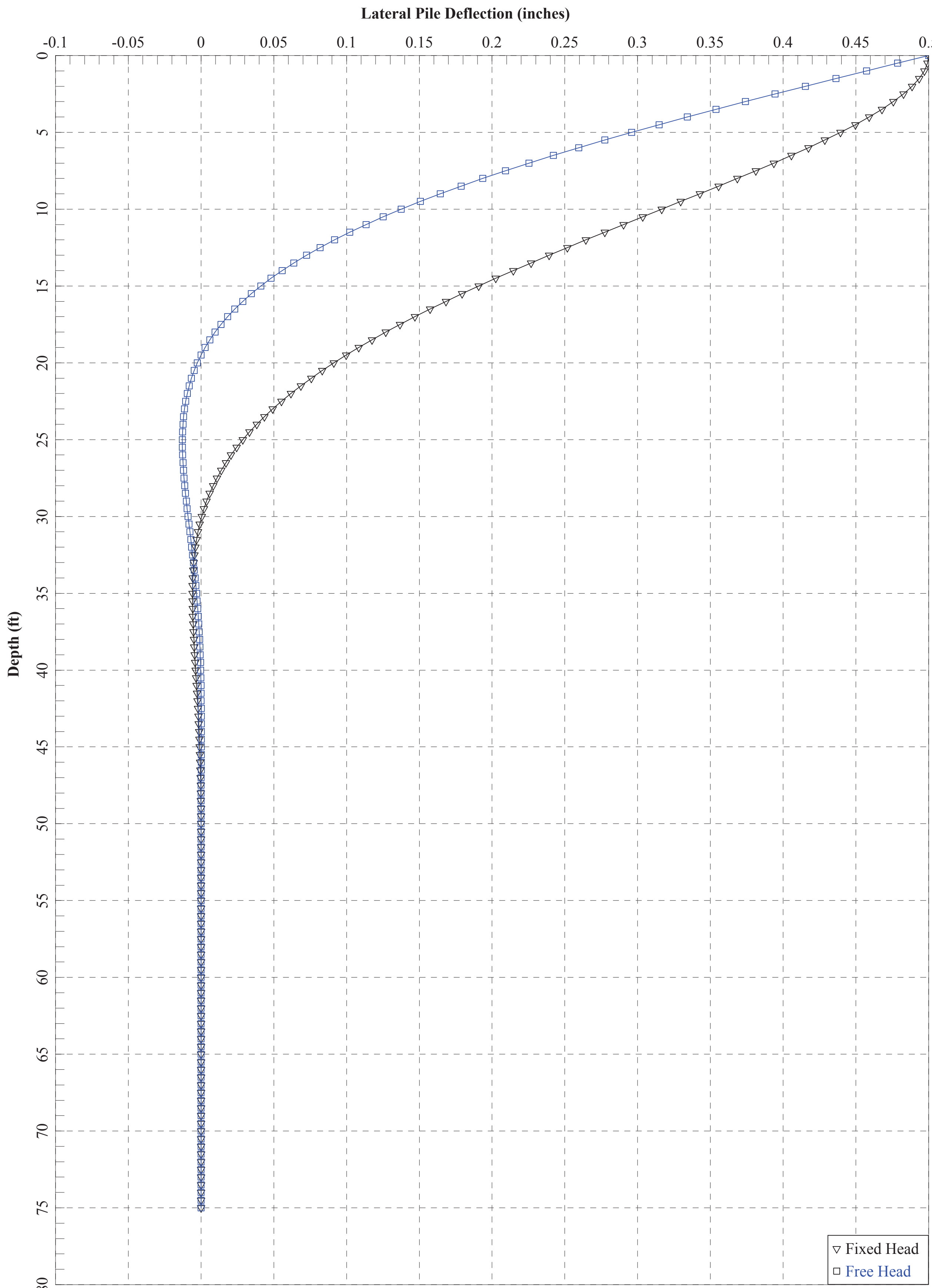
Bending Moment (in-kips)
-6000
-5000
-4000
-3000
-2000
-1000
0
1000
2000
3000
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Fixed Head
Free Head



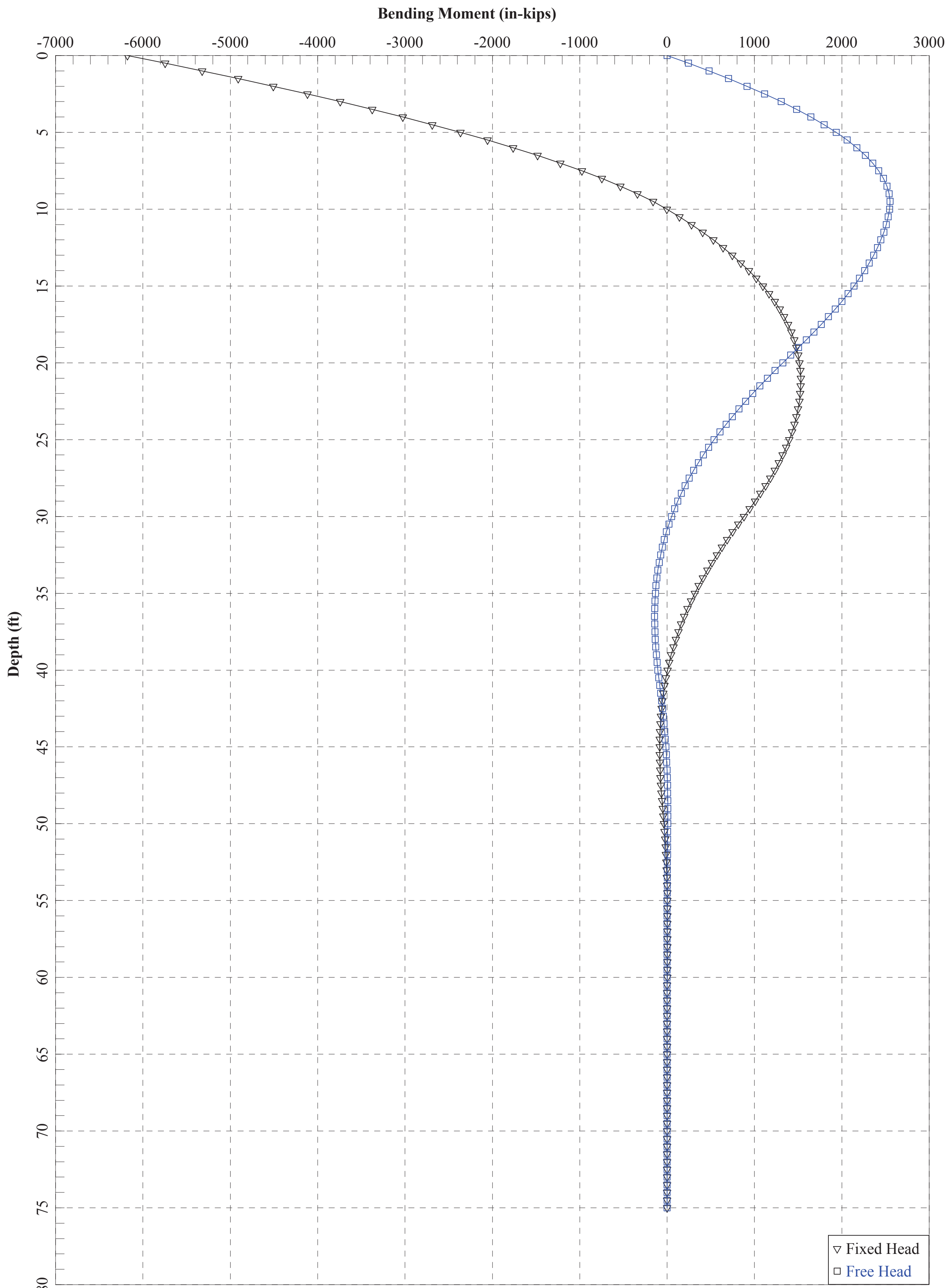
Shear Force (kips)
-20
-15
-10
-5
0
5
10
15
20
25
30
35
40
45
50
55
60
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Fixed Head
Free Head

# LPILE OUTPUT

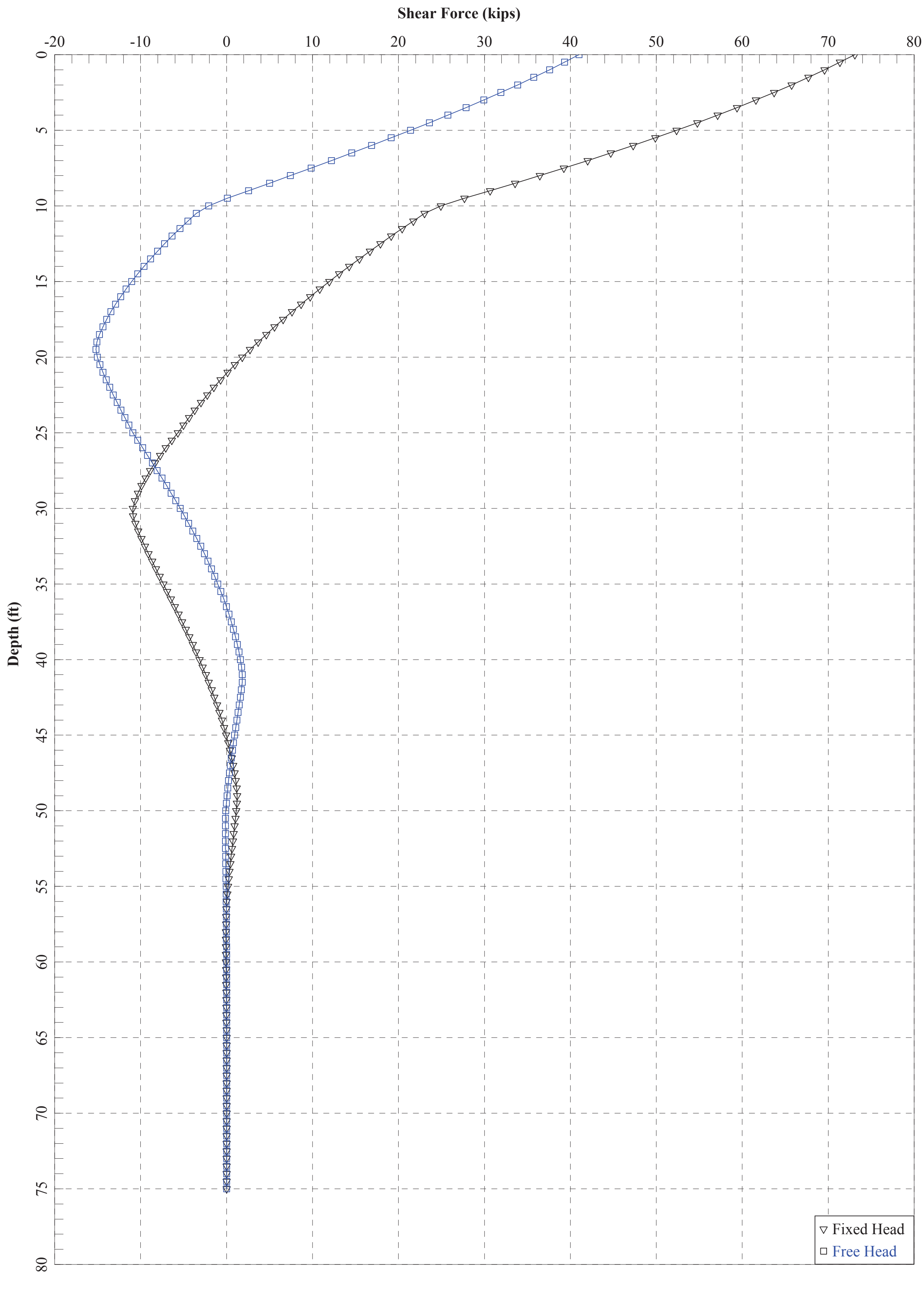
## (60-foot 30-inch Drilled SHAFT)



Lateral Pile Deflection (inches)
-0.1
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
Fixed Head
Free Head



Bending Moment (in-kips)
-7000
-6000
-5000
-4000
-3000
-2000
-1000
0
1000
2000
3000
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
Fixed Head
Free Head



Shear Force (kips)
-20
-10
0
10
20
30
40
50
60
70
80
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
Fixed Head
Free Head