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PRELIMINARY GEOTECHNICAL SITE ASSESSMENT AND REPORT REVIEW AND UPDATE SUBAREA 29 SPECIFIC PLAN AMENDMENT – PLANNING AREAS 30 - 34 SW AND SE CORNER OF EUCALYPTUS AND HAVEN AVES ONTARIO, CA

for

Lewis Management Corp
1156 N. Mountain Avenue P.O. Box 670
Upland, CA 91785-0670

January 28, 2022

21-1464-01

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Lewis Management Corp
1156 N. Mountain Avenue P.O. Box 670
Upland, CA 91785-0670

Attention: Sage McCleve, Vice President - Planned Communities

Subject: Preliminary Geotechnical Site Assessment and Report Review and Update
Subarea 29 Specific Plan Amendment - Planning Areas 30 - 34
SW and SE Corner of Eucalyptus and Haven Aves
Ontario, CA

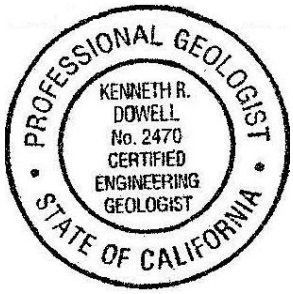
Dear Mr. McCleve:

In accordance with your request, a geotechnical site assessment and report review and update has been completed for the above referenced project. The report addresses both engineering geologic and geotechnical conditions. The results of the assessment are presented in the accompanying report, which includes a description of site conditions, results of our field exploration, laboratory testing, conclusions, and recommendations.

We appreciate this opportunity to be of continued service to you. If you have any questions regarding this report, please do not hesitate to contact us at your convenience.

Respectfully submitted,

RMA Group



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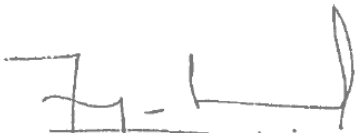

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1.00 INTRODUCTION

1.01 Purpose

A geotechnical site assessment and report review and update has been completed for Subarea 29 Specific Plan Amendment and General Plan Amendment, which includes Planning Areas (PA) 30-34. The proposed development for PA's 30-34 consists of residential housing and a middle school. The purpose of the investigation was to summarize geotechnical and geologic conditions at the site, to assess their potential impact on the proposed development, and to develop geotechnical and engineering geologic design parameters.

The purpose of this report was to review the existing geotechnical reports prepared by Lawson and Associates Geotechnical Consulting, Inc. (LGC), Inc. in 2007 and update the recommendations contained within those report to the current 2019 CBC. Additionally we have reviewed methane reports prepared by GeoKinetics in 2005 for both PA 30 and 31 and Phase I Environmental Site Assessment prepared by LOR Geotechnical Group in 2008 for PA 32 and 34. No additional subsurface investigations were undertaken as part of our scope of work and it is our understanding that geotechnical investigations for PA's 32 through 34 have not been completed. As such we have provided recommendations for additional investigations at the site in the Conclusions section below.

1.02 Scope of the Investigation

The general scope of this investigation included the following:

- Review of published and unpublished geologic, seismic, groundwater and geotechnical literature.
- Review of reports prepared by Lawson and Associates Geotechnical Consulting, Inc. (LGC), Inc. in 2007 for the Vander Kooi (west half of PA 30) and Van Dam III (east half of PA 30 and all of PA 31) properties.
- Methane assessments prepared by GeoKinetics in 2005 for the Vander Kooi (west half of PA 30) and in 2003 Van Dam III (east half of PA 30 and all of PA 31) properties.
- Phase I Environmental Site Assessments prepared by LOR Geotechnical Group, Inc. for the Koolhaas (south half of PA 32 and north half of PA 34) and Kroes (north half of PA 32) properties.
- Examination of aerial photographs.
- A site reconnaissance to observe current site conditions.
- Geotechnical evaluation of the compiled data.
- Preparation of this report presenting our findings, conclusions and recommendations.

1.03 Site Location and Description

The Project site is located at the southeast and southwest corners of Eucalyptus and Haven Avenues in Ontario, California. The geographic position of the site is at Latitude 33.98691° and Longitude -117.57522°. The approximate location of the site is shown on Figure 1.

The approximately 168.9-acre Project site consists of Planning Areas 30 through 34. It is bounded by Eucalyptus Avenue to the north, Mill Creek Avenue to the east, Bellegrave Avenue and residential properties to the south, and

Haven Avenue and residential developments to the west. Haven Avenue traverses the site in a north-south direction and Planning Areas 30 and 31 are located west of Haven Avenue and Planning Areas 32 to 34 are located east of Haven Avenue. A Southern California Edison easement runs between PA 30 and 31.

Overall the site slopes gently to the south and elevations range from about 676 to 703 feet above sea level. Vegetation at the site consists mainly of ruderal and non-native, invasive plant species, non-native grasses, agricultural crops. A row of large trees runs north-south through the middle of PA 30. These trees are located along the boundary between the former Vander Kooi and Van Dam III properties. An unlined and concrete lined storm drain channel runs along the south boundary of PA 33. A small holding pond is located in the center of PA 30. It appears in aerial photographs during the prior use of the site as a dairy. A shallow depression of about 3 to 5 feet deep is located in the southern part of PA30. This area appears to have been used for borrow during the constructions of the residential development in the surrounding areas.

1.04 Current and Past Land Usage

Planning Area 30

Planning area 30 is vacant with the former dairy improvements demolished in the west dairy and still present in the eastern portion.

Based on historic aerial photographs PA 30 has been as described above until 2017 when the southwest and western edge was disturbed during the grading of the residential developments located to the west of the site. Prior to 2017 the southwestern portion of PA30 was used to grow sod. The aerials then indicate that the dairy on the west side of PA 30 ceased operation by 2007 and most of the structures and surface paving was demolished, except for some concrete paving in the northern part of the dairy. This area was completely demolished in 2017. Dairy operations ceased on the eastern dairy ceased in the latter half of 2007. The dairies had been in operation since 1966 and prior to that it was used for agriculture.

Planning Area 31

Planning area 31 is mostly unused with the former dairy improvements still present.

Based on historic aerial photographs PA 31 has been as described above until 2020 when a few cows were present in the middle pens in the SCE easement. Cows are visible in the aerials and regular dairy operations are seen as far back as 1967. Prior to that PA 31 was used for agriculture. The east half of PA 31 was used as pasture during the dairy operations and the pens were located in the west half of the dairy. A dry, shallow holding pond is located in the southeast corner of the site.

Planning Area 32

Planning area 32 is currently used for sod farming. Prior to that PA 32 was a vacant dairy where the buildings and pens were demolished in 2007 and the remaining concrete paving was demolished in 2020. The dairies were in operation from early 1960's through 2006. Prior to the early 1960's PA 32 was used for agriculture.

Planning Area 33

Planning area 33 is currently vacant with portions of the existing concrete pavement still in place. Prior to that PA 33

consisted of two dairies that were in operation from the early 1960's to 2005 when the dairies were demolished and much of the concrete and soil from the demolition was stockpiled on site. Prior to the early 1960's PA 33 was used for agriculture.

Planning Area 34

Planning area 34 is currently vacant. Since 2005 until August of 2021, the south half of PA 34 was used by a trucking company to store tractor and trailers. From 2003 to 2005 the southern half of PA 34 was used by a construction company that stockpiled soil and stored equipment. Prior to 2003 the south half of PA 34 was used for agriculture.

The north half is used for sod farming since 2009. A dairy was located on the north half of PA 34 and was in operation since the early 1964 to 2007 when the pens and buildings were demolished. The remaining concrete paving was demolished in 2020. Prior to the early 1964 PA 34 was used for agriculture.

A Site Reconnaissance Map (Figure 2) indicates the location of the holding ponds and soil stockpiles.

1.05 Planned Usage

It is our understanding that the proposed development will consist of a middle school and 1,470 detached and attached residential units.

Our investigation was performed prior to the preparation of grading or foundation plans. To aid in preparation of this report, we utilized the following assumptions:

- Maximum foundation loads of 2 to 3 kips per linear foot for continuous footings and 60 kips for isolated spread footings.
- Cuts and fills will be less than 5 feet.

1.06 Investigation Methods

Our investigation consisted of office research, field exploration, laboratory testing, review of the compiled data, and preparation of this report. It has been performed in a manner consistent with generally accepted engineering and geologic principles and practices, and has incorporated applicable requirements of California Building Code. Definitions of technical terms and symbols used in this report include those of the ASTM International, the California Building Code, and commonly used geologic nomenclature.

Technical supporting data are presented in the attached appendices. Appendix A presents the boring, CPT and trench logs from the LGC, Inc. 2007 Geotechnical Feasibility Report for the Vander Kooi Parcel. Appendix B presents the boring, CPT and trench logs from the LGC, Inc. 2007 Geotechnical Feasibility Report for the Van Dam III Farm. Standard grading specifications, Liquefaction and Seismic Settlement Calculations and References are presented in Appendices C, D and E, respectively.

2.00 FINDINGS

2.01 Geologic Setting

The site is located on a broad, coalescing alluvial fan that emanates from the San Gabriel Mountains to the north. These sediments fill the western portion of a deep structural depression known as the upper Santa Ana River Valley. According to Fife and others (1976), the alluvial deposits beneath the site are approximately 650 feet thick and rest on a basement of crystalline bedrock.

The upper Santa Ana River Valley is bordered by the San Gabriel Mountains and the active Cucamonga fault to the north, and the Puente Hills and potentially active Chino fault to the west. To the south are the Jurupa Mountains and other resistant granitic and metamorphic hills. The eastern boundary of the valley is the San Bernardino Mountains and the active San Andreas Fault.

A regional geologic map of the area is presented as Figure 3.

2.02 Previous Reports

LGC, Inc. completed two geotechnical reports that included PA 30 and 31 in January 2007. Copies of the Figures, boring, CPT and trench logs and laboratory testing are included as Appendix A for the Vander Kooi Parcel (western half of PA 30). Copies of the Figures, boring, CPT and trench logs and laboratory testing are included as Appendix B for the Van Dam III Farm (eastern half of PA 30 and all of PA 31). The Vader Kooi Parcel investigation included 2 hollow stem auger borings to depths of 31.5 to 51.5 feet, 4 CPT soundings up to 50 feet, 5 backhoe trenches excavated up to 10 feet deep and 33 shallow test pit to determine surface manure thicknesses. The report indicates that the dairy buildings were partially demolished at the time of their field investigation and some of the concrete feed aisles and dried manure in the pen areas remained. They also noted a wastewater pond on the east side of the site (pond location is indicated on Figure 2). They recommended that the surface manure be removed prior to grading operations. Their report indicated that surface manure was present from 16 up to 84 inches thick. They completed 1 expansion index test on a sample at 7 to 9 feet below the ground surface that returned a result of 57 (medium expansion potential). In Section 4.2.1 *Provisional Post-Tensioned Foundation Design Parameters* of their report LGC indicate that even though they had the medium expansion potential in their test, they anticipate low expansion for the majority of the soils onsite. They also indicated that the site has negligible amounts of water soluble sulfates but is extremely corrosive to ferrous metals. The overexcavation recommendations from the report and repeated in Section 3.04 below.

The Van Dam III Farm investigation included 4 hollow stem auger borings to depths of 21.5 to 51.5 feet, 6 CPT soundings up to 50 feet, 7 backhoe trenches excavated up to 10 feet deep and 51 shallow test pit to determine surface manure thicknesses. The report indicates that the dairy buildings were located in the north-central and northwestern portion of the site, fencing for cattle pens south of the buildings in the west and central portions of the site and pasture area on the east side of the site. They also noted two wastewater ponds on the south side of the site (these ponds are located in the Edison easement). They recommended that the surface manure be removed prior to grading operations. Their report indicated that surface manure was present from 3 up to 42 inches thick. They completed 1 expansion index test on a sample at 5 to 7 feet below the ground surface that returned a result of 0 (very low expansion potential). They recommended post-tensioned foundations due to total seismically induced settlement of up to 1 inch. They also indicated that the site has negligible amounts of water soluble sulfates but is extremely corrosive to ferrous metals. The overexcavation recommendations from the report and repeated in Section 3.04 below.

The 2005 GeoKinetics Methane Investigation Report included installation of 15 multistage subsurface gas probes for the Van Dam property and the 2003 Report for the Vander Kooi property included 12 gas probes. Each set of gas probes were monitored over a period of three days and each location had a probe installed at 5, 10 and 15 feet

below the ground surface. The report for Van Dam did not indicate any reading greater than 0.5% (5,000 ppm) of methane during the monitoring period. The report for Vander Kooi property indicated only 1 location with reading greater than 0.5% (5,000 ppm) of methane during the monitoring period. This location was within the active cattle pens at a depth of 5 feet. All other reading were either 0% or 0.1%. Both reports recommended segregation and disposal offsite of near surface organic-rich soils, segregation of soil with organic contents greater than 0.4% for controlled placement and these soils not be used for "deep" fill and should be placed in open areas and no deeper than 2 feet. They also recommended soil with organic contents greater than 2% should not be placed as structural fill. No further recommendations for methane mitigation are given in the report such as additional testing or specific methane mitigation requirements for the proposed structures.

LOR Geotechnical Group completed a Phase I Environmental Site Assessments for the Kroes and Koolhaas Dairies in 2008. The Koolhaas Dairy is located in the south half of PA 32 and north half of PA 34 and the Kroes Dairy is located in the north half of PA 32. The reports indicate that the dairies were constructed in the early 1960's and prior to that they were used for agriculture. They indicated that the Kroes Dairy had 2 groundwater wells located in the east and north portions of the property with estimated depths of 80 to 100 feet deep. The Kroes Dairy was demolished in 2002 and at the time of their study no structures remained. After the end of dairy operations the property was vacant at the time of their investigation. Chemical tests were conducted and indicated low levels of DDE (a product of the breakdown of the insecticide DDT) (below both California DTSC and US EPA residential screening levels) and arsenic, which were within area background levels and no further sampling was recommended. No environmental concerns were noted in their report.

They also indicated that the Koolhaas Dairy had 1 well located in the west portion of the property with an approximate depth of 80 to 100 feet. They also indicated that the site had contained 2 400-gallon underground storage tanks, one for gas and one for diesel, that were removed in 1993 without any regulatory oversight. Dairy operations ceased in 2006. The dairy buildings were demolished prior to their study and only some surface pavement remained. Chemical tests were conducted and indicated low levels of DDE (below screening levels) and arsenic, which were within area background levels and no further sampling was recommended. No environmental concerns were noted in their report.

2.03 Earth Materials

The LGC investigations encountered artificial fill and alluvial soils. The fill soils ranged from 2 to 7 feet thick and consisted of sand with silt and silty sand. The alluvium consisted of layered sand, silty sand and sandy silt. Copies of the LCG boring and trench logs and CPT data sheets are included in Appendix A and B.

During our site reconnaissance it was observed that the surface of PA 30 that has been cleared of the former dairy structures and has a thin layer of loose artificial fill and alluvium across its surface and small amounts of concrete, wood and other debris most likely from the demolition at the site. Surficial conditions at PA 31 are similar to those indicated in the LGC report since the dairy at that site has not yet been demolished. Stockpiles of soil and concrete debris were also observed in PA's 33 and 34, again associated with the demolition of the former dairies.

A Site Reconnaissance Map showing the locations of larger stockpiles is presented as Figure 2.

2.04 Expansive Soils

Two expansion tests were performed by LGC, one on the Vander Kooi site on a sample from 5 to 7 feet below the ground surface and one from the Van Dam III site from a sample at 7 to 9 feet below the ground surface. The Vander Kooi test indicated that the soil has an expansion index of very low and the one from Van Dam III indicated medium expansion potential. Due to the changes that the surface conditions at the site have undergone since the LGC reports, we would recommend additional expansion testing, especially for surficial fill soils and stockpiles placed on the site after demolition of the former structures and placement of the soils and stockpiles in order to verify overall expansion potential and provide foundation design recommendations relative to near surface (within the upper 5 feet of the ground surface) soils that would make up the majority of the fill soils.

Additionally, since site grading will redistribute earth materials, potential expansive properties should be verified during rough grading and prior to any import soil being brought to the site.

2.05 Surface and Groundwater Conditions

No areas of ponding or standing water were present at the time of our site reconnaissance other than a small amount of water in the storm channel in PA 33. Further, no springs or areas of natural seepage were found. Groundwater was not encountered within LGC's exploratory trenches or borings. Further they indicated that groundwater levels recorded in the area by the California Department of Water Resources (2007) were at a depth of 120 feet below the ground surface.

2.06 Faults

The site is not located within the boundaries of an Earthquake Fault Zone for fault-rupture hazard as defined by the Alquist-Priolo Earthquake Fault Zoning Act. The nearest Alquist-Priolo Earthquake Fault Zoning is located about 6½ miles to the southwest of the site along the Chino fault. No faults are known to pass through the property.

The nearest active fault is the Central Avenue fault located approximately 6 miles to the southwest. The accompanying Regional Fault Map (Figure 4) illustrates the location of the site with respect to major faults in the region. The distance to notable faults within 100 kilometers of the site is presented on Table 1.

2.07 Historic Seismicity

There have been two large historic strong earthquakes epicentered within about 20 miles of the site. These events were the 1858 magnitude 6.0 San Bernardino Area earthquake, the1923 magnitude 6.0 San Bernardino Earthquake and the 1990 magnitude 5.5 Upland Earthquake.

Strong earthquakes that have occurred in this region in historic time and their approximate epicentral distances are summarized in Table 2.

Our research of regional geologic and seismic data did not reveal any known instances of ground failure within the site associated with regional seismic activity.

Seismic design parameters relative to the project are presented in Section 3.09.

2.08 Flooding Potential

According to the Federal Emergency Management Agency (FEMA, 2016) the site does not lie within the boundaries of a 100-year flood plain. Control of surface runoff originating from within and outside of the site should, of course, be included in design of the project.

2.09 Regional Land Subsidence and Fissure Potential

According to the Chino Basin Watermaster (Wildermuth, 2002), an interformetric synthetic aperature radar survey detected no relative change in land surface elevation within the site from 1993 to 1999, and no fissures are known to exist within the property. In addition, surface fissures suggestive of land subsidence within the site were not observed or found during our site reconnaissance, nor does LGC mention observing indication of land subsidence in their reports.

2.10 Organic Soils, Manure and Methane Gas

The LGC geotechnical reports for the Vander Kooi and Van Dam properties (PA's 30 and 31) indicate that at the time of their field investigation manure or highly organic soil was observed in their trenches from 3 to up to 84 inches thick. The thickest section of manure they noted was located in the holding pond on the Vander Kooi property (PA 30). During our site reconnaissance we observed surficial manure at both PA 30 and 31, but it seemed to be limited to just the surface and that the Planning Areas were cleaned of the majority of manure at the conclusion of dairy operations or during demolition and the properties. We would recommend that prior to start of construction that a further assessment of the site for manure be completed and final recommendations related to the current conditions at the site prior to the start of constructed be done.

GeoKinetic conducted methane surveys in the Vander Kooi and Van Dam properties (PA's 30 and 31) as discussed in Section 2.02. They installed a total of 27 probes in the two properties and only encountered methane in one probe with concentrations above 0.5% (5,000ppm) with the highest reading at 5 feet of 2.8% (28,000ppm) and this reading decreased to 1.7% (17,000ppm) over their 3 day monitoring period. The monitoring was done in 2003. They did not recommend additional testing or specific post-grade methane testing or mitigation.

Since the anticipated overexcavation in PA's 30 and 31 will extend at least 5 feet below the existing ground surface and the amount of time since the prior test (18 years) and the lack of dairy operations in the area of the test since 2007, the probability of methane gas in the near surface soil are very low and further testing is not suggested. Additionally, soil with organic contents of greater than 2% should not be placed as fill.

Geotechnical and methane specific investigations have not been completed for Planning Areas 32, 33 or 34 at the date of this report. The dairy operations on PA 32 and 33 ceased in 2006 and 2005, respectively. PA 32 was not used for dairy operations.

Since the anticipated overexcavation at PA's 32, 33 and 34 is anticipated to extend at least 5 feet below the existing ground surface and the amount of time since the end of dairy operations in PA's 32 and 33 (16+ years) and the lack of dairy operations in PA34, the probability of methane gas in the near surface soil are very low and further testing is not suggested. Additionally, soil with organic contents of greater than 2% should not be placed as fill.

2.11 Landslides

Landslides are not a hazard within the site due to the low gradient of the property, which is located the floor of the upper Santa Ana River valley.

3.00 CONCLUSIONS AND RECOMMENDATIONS

3.01 General Conclusions and Limitations

Based on specific data and information contained in this report, our understanding of the project and our general experience in engineering geology and geotechnical engineering, it is our professional judgment that the proposed development is geologically and geotechnically feasible. This is provided that the recommendations presented below are fully implemented during design, grading and construction.

Since the LGC reports are dated 2007 and PA's 30 and 31 have undergone surficial changes since the report was completed, particularly in the western portion of PA 30 where the former dairy was completely demolished and the dairy operations in the eastern portion of PA 30 and all of PA 31 continued to varying degrees up to 2020, we recommend additional supplemental exploration at PA 30 and 31 consisting of backhoe excavated surface potholes to verify any existing manure or organic soils and verify surficial artificial fill depths. The recommendations included below are based upon the LGC reports for PA's 30 and 31 and the similar soil types observed at the surface at all the planning areas and may be utilized as preliminary design data. In PA's 32, 33, and 34 we would recommend full geotechnical investigation including a similar scope of work as in the LGC reports to include a number of borings, CPTs and backhoe trenches in order to produce site specific geotechnical recommendations based upon the site conditions at the time of the supplemental and full geotechnical investigations.

3.02 General Earthwork and Grading

All grading should be performed in accordance with the General Earthwork and Grading Specifications outlined in Appendix C, unless specifically revised or amended below. Recommendations contained in Appendix C are general specifications for typical grading projects and may not be entirely applicable to this project.

It is also recommended that all earthwork and grading be performed in accordance with Appendix J of the 2019 California Building Code and all applicable governmental agency requirements. In the event of conflicts between this report and Appendix J, this report shall govern.

3.03 Earthwork Shrinkage and Subsidence

Shrinkage is the decrease in volume of soil upon removal and recompaction expressed as a percentage of the original in-place volume. Subsidence occurs as natural ground is densified to receive fill. These factors account for changes in earth volumes that will occur during grading. The LGC estimate for the sinkage is as follows:

- Shrinkage factor = 10%-15% for soil removed and replaced as compacted fill.

Based upon the data included in the LGC reports we would estimate a subsidence factor = 0.1 foot.

These shrinkage and subsidence estimate can be used as preliminary estimate for PA's 30 – 34. These estimates may be revised with additional investigations at the Planning Areas.

The degree to which fill soils are compacted and variations in the insitu density of existing soils will influence earth volume changes. Consequently, some adjustments in grades near the completion of grading could be required to balance the earthwork.

3.04 Removals and Overexcavation

The LGC reports recommended the following overexcavation and removals for Pas 30 and 31:

> *In order to provide a relatively uniform bearing condition for the planned improvements, we recommend that the building pad areas be over-excavated to a depth of at least 3 feet plus the depth of planned footing embedment from future finish grade elevation or a minimum of 5 feet below existing grade, whichever is deeper*. (Based on the LGC reports, the manure and organic soil extends more than 5 feet below the ground surface – see last paragraph of this section for additional recommendations.) *The envelope for over-excavation should extend laterally a minimum distance of 5 feet beyond the edges of the proposed improvements. Hardscape and pavement areas should be over-excavated to a depth of 3 feet below future grade, with a minimum 3-foot lateral extension beyond the areas of future improvements.*
>
> *Over-excavated bottom areas to receive compacted fill should be scarified to a minimum depth of 6 inches, brought to a near-optimum moisture condition, and recompacted to at least 90 percent relative compaction (based on American Standard of Testing and Materials [ASTM] Test Method D1557).*
>
> *Local conditions may be encountered during excavation that could require additional overexcavation beyond the above noted minimum in order to obtain an acceptable subgrade. The actual depths and lateral extents of grading will be determined by the geotechnical consultant, based on subsurface conditions encountered during grading.*
>
> *Areas of soft clay or silt may potentially be exposed during grading. Although we anticipate this material is suitable for use as compacted fill, it may result in an increased foundation cost due to the potential for clayey materials to be expansive and/or corrosive. If these conditions are encountered, the owner may elect (at their discretion) to selectively grade the site in order to limit the number of pads on which the clayey or silty material is placed; this determination should be made during grading.*

Based upon a review of the LGC reports we would concur with their recommendations for overexcavation and removals to be performed during grading and these recommendations can be used as a basis of preliminary design. However, we would recommend prior to grading that additional potholes in the PA's 30 and 31 be performed to verify removal depths especially in the areas of the former and current structures and areas designated with deeper manure thicknesses (greater than the 5 feet of overexcavation recommended). Since geotechnical investigations have not been completed for PA's 32, 33, and 34 we would recommend additional exploration within these areas to provide specific overexcavation, organic soil removal and foundation requirements in these areas.

3.05 Rippability and Rock Disposal

The LGC exploratory trenches and borings were advanced without difficulty and no oversize materials were encountered in our subsurface investigation. Accordingly we expect that all earth materials will be rippable with conventional heavy-duty grading equipment and oversized materials (greater than 12-inches in maximum dimension) are not expected.

We recommend that debris from demolition of existing structures and improvements be hauled from the site. Pieces of concrete without reinforcing steel may be incorporated into fills provided the concrete is free of rebar and

the concrete fragments do not exceed 12 inches in maximum dimension.

3.06 Subdrains

Groundwater and surface water were not encountered during the course of the LGC investigations and the proposed grading will not fill any large canyons. Groundwater levels recorded in the area by the California Department of Water Resources (2007) were at a depth of 120 feet below the ground surface. Consequently, installation of canyon subdrains is not expected to be necessary.

3.07 Fill and Cut Slopes

Due to the low gradient of the property, it appears that construction of cut and fill slopes will not be required. If such slopes are proposed, they should be inclined no steeper than 2 horizontal to 1 vertical.

3.08 Faulting

Since the site is not located within the boundaries of an Earthquake Fault Zone and no active faults are known to pass through the property.

3.09 Seismic Design Parameters

The potential damaging effects of regional earthquake activity must be considered in the design of structures.

Mapped Design Parameters

Mapped seismic design parameters have been developed in accordance with Section 1613 of the 2019 California Building Code (CBC) using the online U.S. Geological Survey Seismic Design Maps Calculator (ASCE 10 Standard), a site location based on latitude and longitude, and site characterization as Site Class D based on our preliminary geotechnical investigation.

The parameters generated for the subject site are presented below:

2019 California Building Code Seismic Parameters

Parameter	Value
Site Location	Latitude = 33.98691° degrees Longitude = -117.57522 degrees
Site Class	Site Class = D Soil Profile Name = Stiff Soil
Mapped Spectral Accelerations (Site Class D)	S_s (0.2- second period) = 1.626 S_1 (1-second period) = 0.585
Site Coefficients (Site Class D)	F_a = 1.0 F_v = 1.7
Risk-Targeted Maximum Considered Earthquake Spectral Accelerations (Site Class D)	S_{MS} (short, 0.2- second period) = 1.626g S_{M1} (1-second period) = 0.995g
Risk-Targeted Design Earthquake Spectral Accelerations (Site Class D)	S_{DS} (short, 0.2- second period) = 1.084g S_{D1} (1-second period) = 0.663g

The above seismic design parameters were obtained utilizing ASCE 7-16, Section 11.4.8, Exception 3, where structures on Site Class D sites with S_1 greater than or equal to 0.2, provided the value of the seismic response coefficient C_s is calculated per equations 12.8-2, 12.8-3 or 12.8-4 The above table shows that the mapped spectral response acceleration parameter at 1-second period (S_1) < 0.75g. Therefore, for the Seismic Design Category is D for all Risk Categories (CBC Section 1613.2.5). Consequently, as required for Seismic Design Categories D through F by CBC Section 1803A.5.12, lateral pressures for earthquake ground motions, liquefaction and soil strength loss have been evaluated (see Sections 3.10 and 3.16).

Peak earthquake ground acceleration adjusted for site class effects (PGA_M) has been calculated in accordance with ASCE 7-16 Section 11.8.3 as follows: $PGA_M = F_{PGA} \times PGA = 0.674 \times 1.1 = 0.741g$.

3.10 Liquefaction and Secondary Earthquake Hazards

Potential secondary seismic hazards that can affect land development projects include liquefaction, tsunamis, seiches, seismically induced settlement, seismically induced flooding and seismically induced landsliding.

Liquefaction

Liquefaction is a phenomenon where earthquake-induced ground motions increase the pore pressure in saturated, sand-like soils until it is equal to the confining, overburden pressure. When this occurs, the soil can completely lose its shear strength and enter a liquefied state. The possibility of liquefaction is dependent upon grain size, relative density, confining pressure, saturation of the soils, and intensity and duration of ground shaking. In order for liquefaction to occur, three criteria must be met: underlying loose, sand-like soils, a groundwater depth of less than about 50 feet, and a potential for seismic ground motions from nearby large-magnitude earthquake.

Groundwater levels recorded in the area by the California Department of Water Resources (2007) were at a depth of 120 feet below the ground surface. Therefore, due to the absence of groundwater in the upper 50 ft at the site, soil liquefaction at the site is unlikely to occur at the site and is not a design concern.

Tsunamis and Seiches

Tsunamis are sea waves that are generated in response to large-magnitude earthquakes. When these waves reach shorelines, they sometimes produce coastal flooding. Seiches are the oscillation of large bodies of standing water, such as lakes, that can occur in response to ground shaking. Tsunamis and seiches do not pose hazards due to the inland location of the site and lack of nearby bodies of standing water.

Seismically Induced Settlement

Seismically induced settlement occurs most frequently in areas underlain by loose, sand-like sediments. Damage as a result of seismically induced settlement is most dramatic when differential settlement occurs in areas with large variations in the thickness of underlying sediments. Settlement caused by ground shaking is often non-uniformly distributed, which can result in differential settlement.

Seismic settlement calculations have been run using LiquefyPro, a commercially available computer program developed by Civiltech Software. We used the empirical method developed by Tokimatsu and Seed (1987) based on site-specific SPT blow counts and soil information obtained from the LGC borings. The calculations yield results of 2.87 inches of seismically induced settlement for LGC Boring B-1 from the Van Dam report, 1.98 inches of seismically induced settlement for LGC Boring B-2 from the Vander Kooi report, and 1.25 inches of seismically induced

settlement for LGC Boring B-3 from the Van Dam III report. In our opinion the total seismic settlement may be assumed as 2½ inch and the differential settlement as 1¼ inch over a length of 30 feet. Seismically induced settlements calculations are presented in Appendix D. These estimates may be applied over the entire study area, however, a specific liquefaction and seismically induced settlement analysis for the proposed development should be part of any further site specific geotechnical studies.

Seismically Induced Flooding

According to City of Ontario Policy Plan (https://www.ontarioplan.org/policy-plan/) and the City of Ontario 2018 Hazard Mitigation Plan (Figure 4-24), the site is located within the San Antonio Creek Dam Failure Inundation Area.

Seismically Induced Landsliding

Due to the low gradient of the site, the potential for seismically induced landsliding is nil. This assumes that any slopes created during development of the site will be properly designed and constructed.

3.11 Foundations

The LGC reports recommended post-tensioned foundations due to their calculated up to 1 inch of seismically induced settlement and medium expansive soils on the Van Dam II property. Due to the limited expansion testing (2 tests) that was conducted at the nearly 170 acres of the site and the potential for expansive soils at the site, we would recommend additional testing of the near surface soils to characterize the expansion potential at the site prior to providing recommendations for foundation design.

3.12 Foundation Setbacks from Slopes

Setbacks for footings adjacent to slopes should conform to the requirements of the California Building Code. Specifically, footings should maintain a horizontal distance or setback between any adjacent slope face and the bottom outer edge of the footing.

For slopes descending away from the foundation, the horizontal distance may be calculated by using h/3, where h is the height of the slope. The horizontal setback should not be less than 5 feet, nor need not be greater than 40 feet per the California Building Code. Where structures encroach within the zone of h/3 from the top of the slope the setback may be maintained by deepening the foundations. Flatwork and utilities within the zone of h/3 from the top of slope may be subject to lateral distortion caused by gradual downslope creep. Walls, fences and landscaping improvements constructed at the top of descending slopes should be designed with consideration of the potential for gradual downslope creep.

For ascending slopes, the horizontal setback required may be calculated by using h/2 where h is the height of the slope. The horizontal setback need not be greater than 15 feet per the California Building Code.

3.13 Slabs on Grade

Specific slab on grade recommendations will be provided once further expansion testing is done on the near surface soils to characterize expansion potential. Depending upon the results of those tests conventional slab on grade or post-tensioned foundations may be recommended.

3.14 Miscellaneous Concrete Flatwork

Miscellaneous concrete flatwork and walkways may be designed with a minimum thickness of 4 inches. Large slabs should be reinforced with a minimum of 6x6-10/10 welded wire mesh placed at mid-height in the slab. Control joints should be constructed to create squares or rectangles with a maximum spacing of 15 feet.

Walkways may be constructed without reinforcement. Walkways should be separated from foundations with a thick expansion joint filler. Control joints should be constructed into non-reinforced walkways at a maximum of 5 feet spacing.

The subgrade soils beneath all miscellaneous concrete flatwork should be compacted to a minimum of 90 percent relative compaction for a minimum depth of 12 inches. The geotechnical engineer should monitor the compaction of the subgrade soils and perform testing to verify that proper compaction has been obtained.

Revisions to these recommendations may be necessary once further expansion potential testing of the onsite soils is completed.

3.15 Footing Excavation and Slab Preparations

All footing excavations should be observed by the geotechnical consultant to verify that they have been excavated into competent soils. The foundation excavations should be observed prior to the placement of forms, reinforcement steel, or concrete. These excavations should be evenly trimmed and level. Prior to concrete placement, any loose or soft soils should be removed. Excavated soils should not be placed on slab or footing areas unless properly compacted.

Prior to the placement of the moisture barrier and sand, the subgrade soils underlying the slab should be observed by the geotechnical consultant to verify that all under-slab utility trenches have been properly backfilled and compacted, that no loose or soft soils are present, and that the slab subgrade has been properly compacted to a minimum of 90 percent relative compaction within the upper 12 inches.

Footings may experience and overall loss in bearing capacity or an increased potential to settle where located in close proximity to existing or future utility trenches. Furthermore, stresses imposed by the footings on the utility lines may cause cracking, collapse and/or a loss of serviceability. To reduce this risk, footings should extend below a 1:1 plane projected upward from the closest bottom of the trench.

Slabs on grade and walkways should be moist prior to the placement of concrete.

3.16 Lateral Load Resistance

Lateral loads may be resisted by soil friction and the passive resistance of the soil. The following parameters are based upon the results of laboratory direct shear test results in the LGC reports.

- Passive Earth Pressure = 390 pcf (equivalent fluid weight).
- Coefficient of Friction (soil to footing) = 0.43
- Retaining structures should be designed to resist the following lateral active earth pressures:

Surface Slope of Retained Materials (Horizontal:Vertical)	Equivalent Fluid Weight (pcf)
Level	29
5:1	31
4:1	31
3:1	33
2:1	41

These active earth pressures are only applicable if the retained earth is allowed to strain sufficiently to achieve the active state. The required minimum horizontal strain to achieve the active state is approximately 0.0025H. Retaining structures should be designed to resist an at-rest lateral earth pressure if this horizontal strain cannot be achieved.

- At-rest Lateral Earth Pressure = 46 pcf (equivalent fluid weight)

The Mononobe-Okabe method is commonly utilized for determining seismically induced active and passive lateral earth pressures and is based on the limit equilibrium Coulomb theory for static stress conditions. This method entails three fundamental assumptions (e.g., Seed and Whitman, 1970): Wall movement is sufficient to ensure either active or passive conditions, the driving soil wedge inducing the lateral earth pressures is formed by a planar failure surface starting at the heel of the wall and extending to the free surface of the backfill, and the driving soil wedge and the retaining structure act as rigid bodies, and therefore, experiences uniform accelerations throughout the respective bodies (U.S. Army Corps of Engineers, 2003, Engineering and Design - Stability Analysis of Concrete Structures).

- Seismic Lateral Earth Pressure = 17 pcf (equivalent fluid weight).

The seismic lateral earth pressure given above is a triangle increasing with depth, and the resultant of this pressure is an increment of force which should be applied to the back of the wall at 1/3 of the wall height from the wall base. The seismic increment of earth pressure should be added to the static active earth pressure. Even for the at-rest (K_o) condition, the seismic increment of earth pressure should be added to the static active earth pressure, not to the at-rest static earth pressure (SEAOC Seismology Committee 2019). Per 2019 CBC Section 1803.5.12 dynamic seismic lateral earth pressures shall be applied to foundation walls and retaining walls supporting more than 6 feet of backfill. Dynamic seismic lateral earth pressures may also be applied to shorter walls at the discretion of the structural engineer.

3.17 Drainage and Moisture Proofing

Surface drainage should be directed away from the proposed structure into suitable drainage devices. Neither excess irrigation nor rainwater should be allowed to collect or pond against building foundations or within low-lying or level areas of the lot. Surface waters should be diverted away from the tops of slopes and prevented from draining over the top of slopes and down the slope face.

Walls and portions thereof that retain soil and enclose interior spaces and floors below grade should be

waterproofed and dampproofed in accordance with CBC Section 1805.

Retaining structures should be drained to prevent the accumulation of subsurface water behind the walls. Backdrains should be installed behind all retaining walls exceeding 3 feet in height. A typical detail for retaining wall back drains is presented in Appendix C. All backdrains should be outlet to suitable drainage devices. Retaining wall less than 3 feet in height should be provided with backdrains or weep holes. Dampproofing and/or waterproofing should also be provided on all retaining walls exceeding 3 feet in height.

3.18 Cement Type and Corrosion Potential

Soluble sulfate tests from the LGC reports indicate that concrete at the subject site will have a negligible exposure to water-soluble sulfate in the soil. Our recommendations for concrete exposed to sulfate-containing soils are presented in the table below.

Recommendations for Concrete exposed to Sulfate-containing Soils

Sulfate Exposure	Water Soluble Sulfate (SO_4) in Soil (% by Weight)	Sulfate (SO_4) in Water (ppm)	Cement Type (ASTM C150)	Maximum Water-Cement Ratio (by Weight)	Minimum Compressive Strength (psi)
Negligible	0.00 - 0.10	0-150	--	--	2,500
Moderate	0.10 - 0.20	150-1,500	II	0.50	4,000
Severe	0.20 - 2.00	1,500-10,000	V	0.45	4,500
Very Severe	Over 2.00	Over 10,000	V plus pozzolan or slag	0.45	4,500

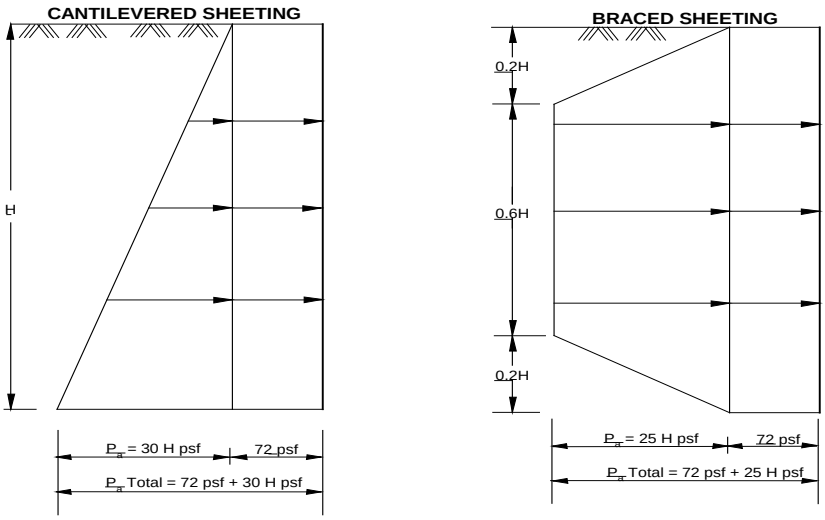
Use of alternate combinations of cementitious materials may be permitted if the combinations meet design recommendations contained in American Concrete Institute guideline ACI 318-11.

LGC also included tests for soil reactivity (pH), electrical resistivity (ohm-cm) and chloride content. The test results indicate that the on-site soils have a soil reactivity of 8.2 to 9.1, an electrical resistivity of 620 to1,480 ohm-cm, and a chloride content of 74 ppm. A neutral or non-corrosive soil has a soil reactivity value ranging from 5.5 to 8.4. Generally, soils that could be considered moderately corrosive to ferrous metals have resistivity values of about 3,000 ohm-cm to 10,000 ohm-cm. Soils with resistivity values less than 3,000 ohm-cm can be considered corrosive and soils with resistivity values less than 1,000 ohm-cm can be considered extremely corrosive. Soil with a chloride content of 500 ppm or greater are generally considered corrosive.

Based on a review of the data from the LGC reports and similar soil conditions across the entire site, it appears that the underlying onsite soils are extremely corrosive to ferrous metals. Protection of buried pipes utilizing coatings on all underground pipes; clean backfills and a cathodic protection system can be effective in controlling corrosion. As RMA Group, Inc. does not practice corrosion engineering, a qualified corrosion engineer may be consulted to further assess the corrosive properties of the soil. We would also recommend additional corrosion sampling at the site, particularly in Planning Areas 31 to 33.

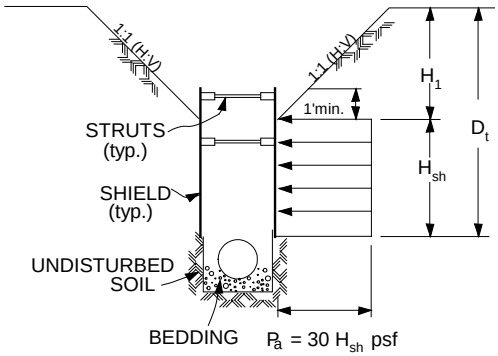
3.19 Temporary Slopes

Excavation of utility trenches will require either temporary sloped excavations or shoring. Temporary excavations in existing alluvial soils may be safely made at an inclination of 1:1 or flatter. If vertical sidewalls are required in excavations greater than 5 feet in depth, the use of cantilevered or braced shoring is recommended. Excavations less than 5 feet in depth may be constructed with vertical sidewalls without shoring or shielding. Our recommendations for lateral earth pressures to be used in the design of cantilevered and/or braced shoring are presented below. These values incorporate a uniform lateral pressure of 72 psf to provide for the normal construction loads imposed by vehicles, equipment, materials, and workmen on the surface adjacent to the trench excavation. However, if vehicles, equipment, materials, etc., are kept a minimum distance equal to the height of the excavation away from the edge of the excavation, this surcharge load need not be applied.



SHORING DESIGN: LATERAL SHORING PRESSURES

Design of the shield struts should be based on a value of 0.65 times the indicated pressure, Pa, for the approximate trench depth. The wales and sheeting can be designed for a value of 2/3 the design strut value.



HEIGHT OF SHIELD, H_{sh} = DEPTH OF TRENCH, D_t , MINUS DEPTH OF SLOPE, H_1

TYPICAL SHORING DETAIL

Placement of the shield may be made after the excavation is completed or driven down as the material is excavated from inside of the shield. If placed after the excavation, some overexcavation may be required to allow for the shield width and advancement of the shield. The shield may be placed at either the top or the bottom of the pipe zone. Due to the anticipated thinness of the shield walls, removal of the shield after construction should have negligible effects on the load factor of pipes. Shields may be successively placed with conventional trenching equipment.

Vehicles, equipment, materials, etc. should be set back away from the edge of temporary excavations a minimum distance of 15 feet from the top edge of the excavation. Surface waters should be diverted away from temporary excavations and prevented from draining over the top of the excavation and down the slope face. During periods of heavy rain, the slope face should be protected with sandbags to prevent drainage over the edge of the slope, and a visqueen liner placed on the slope face to prevent erosion of the slope face.

Periodic observations of the excavations should be made by the geotechnical consultant to verify that the soil conditions have not varied from those anticipated and to monitor the overall condition of the temporary excavations over time. If at any time during construction conditions are encountered which differ from those anticipated, the geotechnical consultant should be contacted and allowed to analyze the field conditions prior to commencing work within the excavation.

Cal/OSHA construction safety orders should be observed during all underground work.

3.20 Utility Trench Backfill

The onsite fill soils will not be suitable for use as pipe bedding for buried utilities. All pipes should be bedded in a sand, gravel or crushed aggregate imported material complying with the requirements of the Standard Specifications for Public Works Construction Section 217. Crushed rock products that do not contain appreciable fines should not be utilized as pipe bedding and/or backfill. Bedding materials should be densified to at least 90% relative compaction (ASTM D1557) by mechanical methods. The geotechnical consultant should review and approve of proposed bedding materials prior to use.

The on-site soils are expected to be suitable as trench backfill provided they are screened of organic matter and cobbles over 12 inches in diameter. Trench backfill should be densified to at least 90% relative compaction (ASTM D1557) by mechanical compaction methods.

All utility trench backfill within street right of way, utility easements, under or adjacent to sidewalks, driveways, or building pads should be observed and tested by the geotechnical consultant to verify proper compaction. Trenches excavated adjacent to foundations should not extend within the footing influence zone defined as the area within a line projected at a 1:1 drawn from the bottom edge of the footing. Trenches crossing perpendicular to foundations should be excavated and backfilled prior to the construction of the foundations. The excavations should be backfilled in the presence of the geotechnical engineer and tested to verify adequate compaction beneath the proposed footing.

Cal/OSHA construction safety orders should be observed during all underground work.

3.21 Pavement Sections

The LGC reports recommend a preliminary design R-value of 30 and a pavement section for interior local streets of 4

inches of asphalt over 5 inches of base. They also recommend that a final design section be done at the conclusion of grading and confirmation of traffic index from the City for the streets. The City of Ontario has minimum traffic indices for local streets of 5.5 and 8 for local industrial street and collector streets. The City also has minimum pavement sections of 4 inches asphalt over 6 inches of base or 7 inches of asphalt for a full depth section (no base) for local streets and 6 inches asphalt over 8 inches of base or 7 inches of asphalt for a full depth section (no base) for local industrial street and collector streets. We would recommend the use of the City's minimum pavement section and also performing R-value tests on the onsite soils to provide a true engineered pavement design.

Recommendations for Portland cement concrete (PCC) are not given in the LGC reports. We would recommend preliminary PCC pavements for areas which are not subject to traffic loads may be designed with a minimum thickness of 4.0 inches of Portland cement concrete on compacted native soils. If traffic loads are anticipated, PCC pavements should be designed for a minimum thickness of 6.0 inches of Portland cement concrete on 4.0 inches of crushed aggregate base.

Prior to paving, the subgrade soils should be scarified and the moisture adjusted to within 2% of the optimum moisture content. The subgrade soils should be compacted to a minimum of 90% relative compaction. All aggregate base courses should be compacted to a minimum of 95% relative compaction.

3.22 Plan Review

Once a formal grading and foundation plans are prepared for the subject property, this office should review the plans from a geotechnical viewpoint, comment on changes from the plan used during preparation of this report and revise the recommendations of this report where necessary.

3.23 Geotechnical Observation and Testing During Rough Grading

The geotechnical engineer should be contacted to provide observation and testing during the following stages of grading:

- During the clearing and grubbing of the site.
- During the demolition of any existing structures, buried utilities or other existing improvements.
- During excavation and overexcavation of compressible soils.
- During all phases of grading including ground preparation and filling operations.
- When any unusual conditions are encountered during grading.

A final geotechnical report summarizing conditions encountered during grading should be submitted upon completion of the rough grading operations.

3.24 Post-Grading Geotechnical Observation and Testing

After the completion of grading the geotechnical engineer should be contacted to provide additional observation and testing during the following construction activities:

- During trenching and backfilling operations of buried improvements and utilities to verify proper backfill and compaction of the utility trenches.

- After excavation and prior to placement of reinforcing steel or concrete within footing trenches to verify that footings are properly founded in competent materials.
- During fine or precise grading involving the placement of any fills underlying driveways, sidewalks, walkways, or other miscellaneous concrete flatwork to verify proper placement, mixing and compaction of fills.
- When any unusual conditions are encountered during construction.

4.00 CLOSURE

The findings, conclusions and recommendations in this report were prepared in accordance with generally accepted engineering and geologic principles and practices. No other warranty, either expressed or implied, is made. This report has been prepared for Lewis Management Corp to be used solely for design purposes. Anyone using this report for any other purpose must draw their own conclusions regarding required construction procedures and subsurface conditions.

The geotechnical and geologic consultant should be retained during the earthwork and foundation phases of construction to monitor compliance with the design concepts and recommendations and to provide additional recommendations as needed. Should subsurface conditions be encountered during construction that are different from those described in this report, this office should be notified immediately so that our recommendations may be re-evaluated.

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FIGURES AND TABLES

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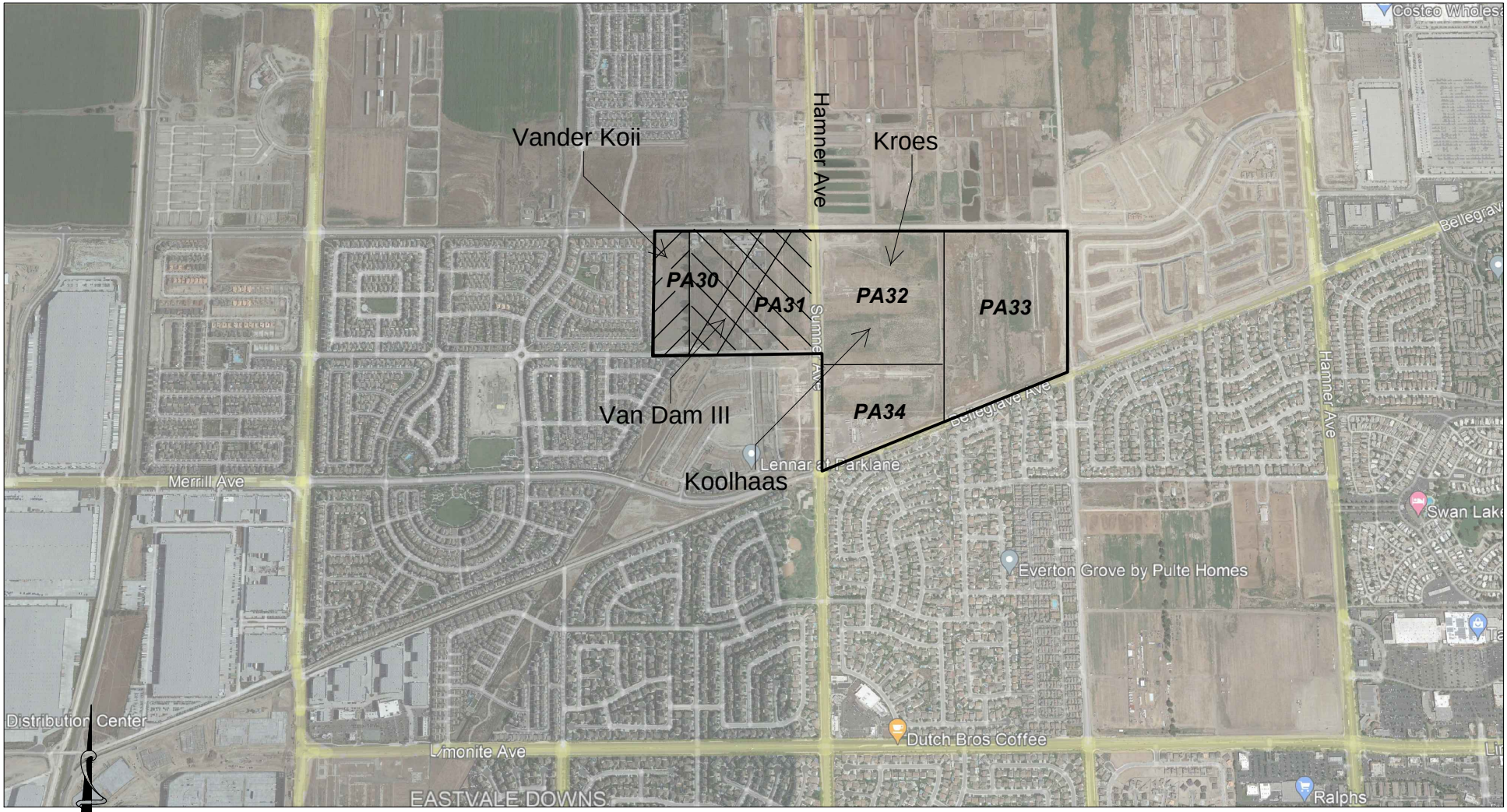

Site Location Map

Scale: 1"=2,500'
Source: Google Earth, 2021

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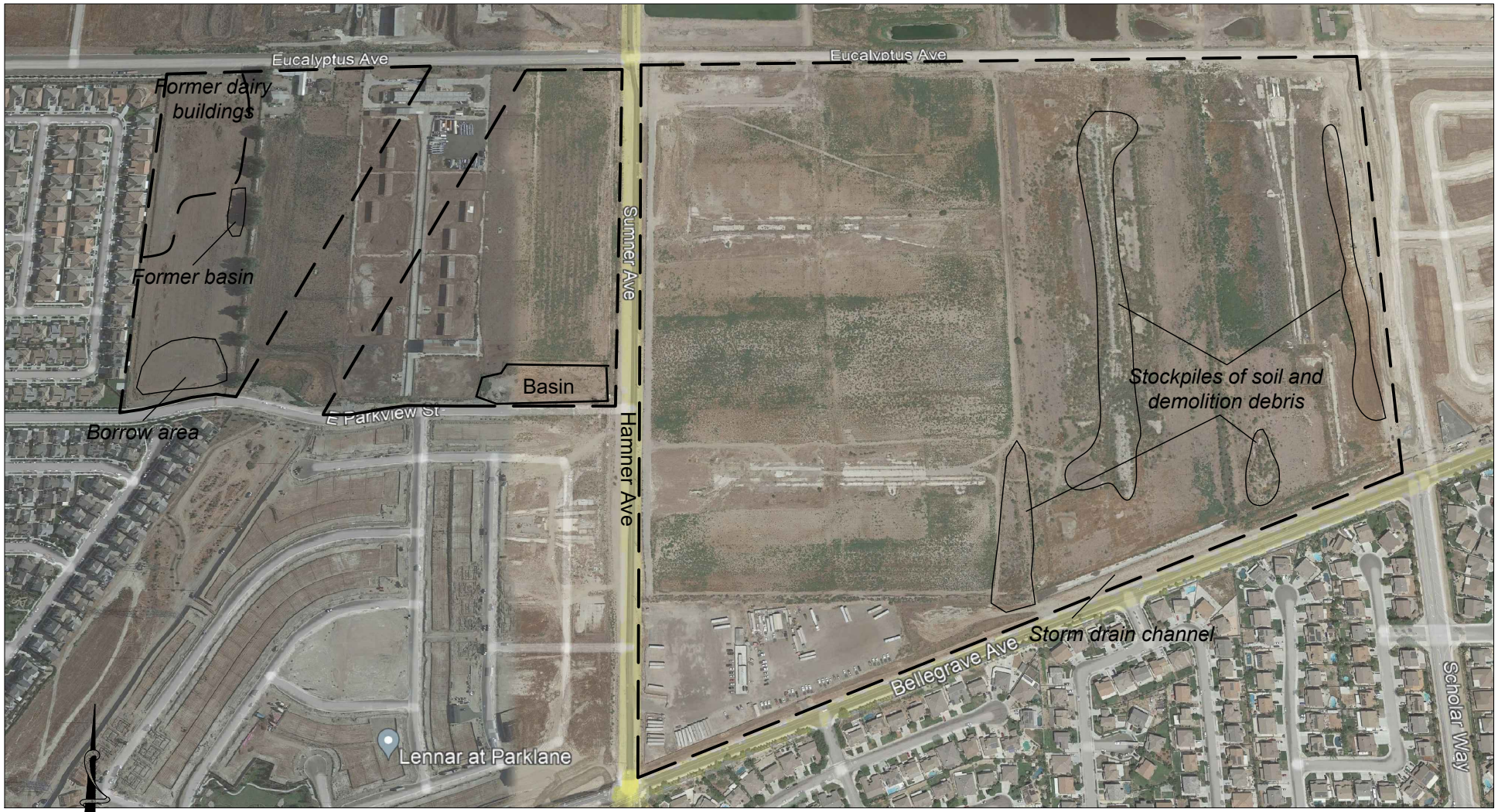
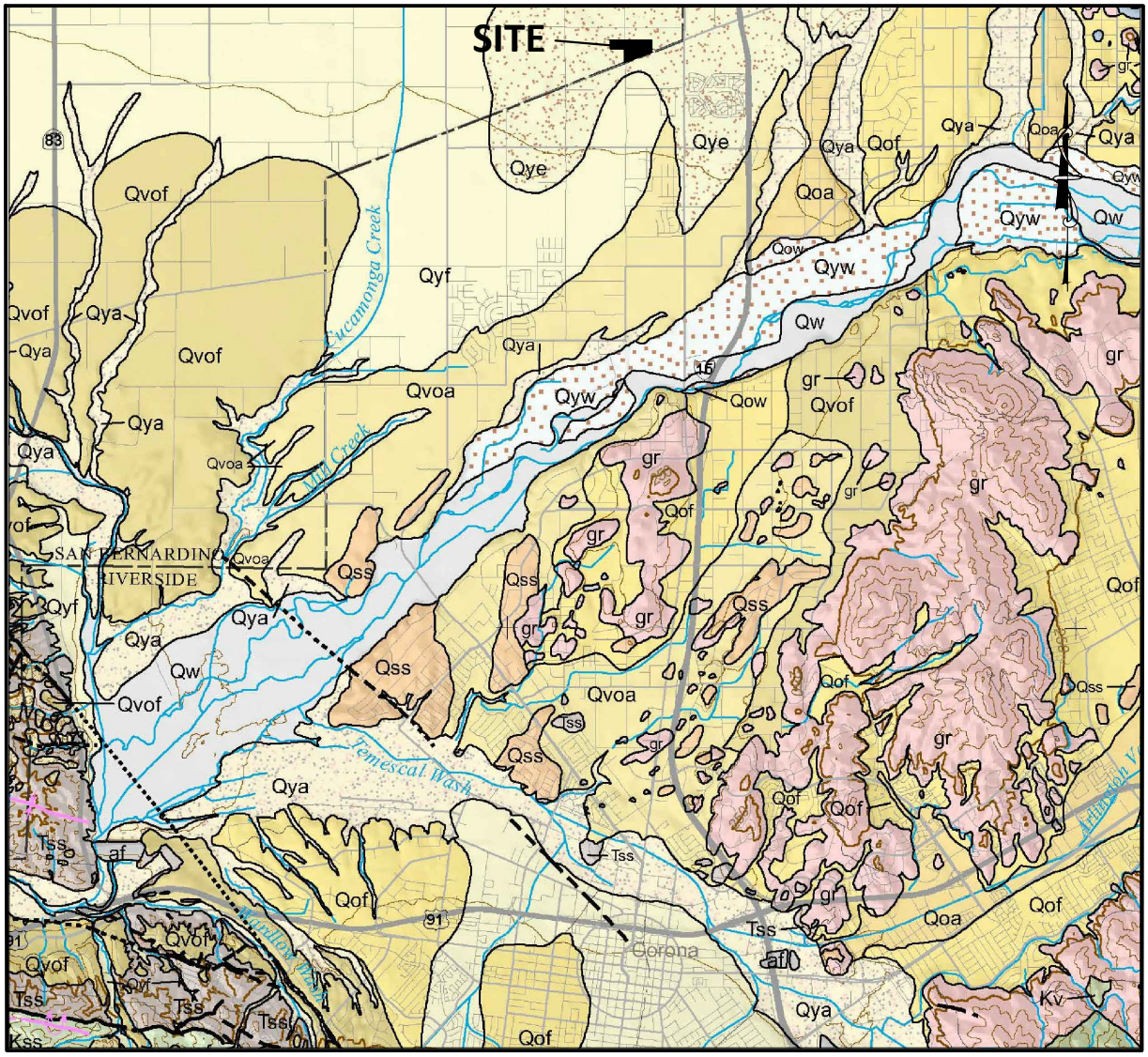


Site Reconnaissance Map

Scale: 1"= 500'
Source: Google Earth, 2021



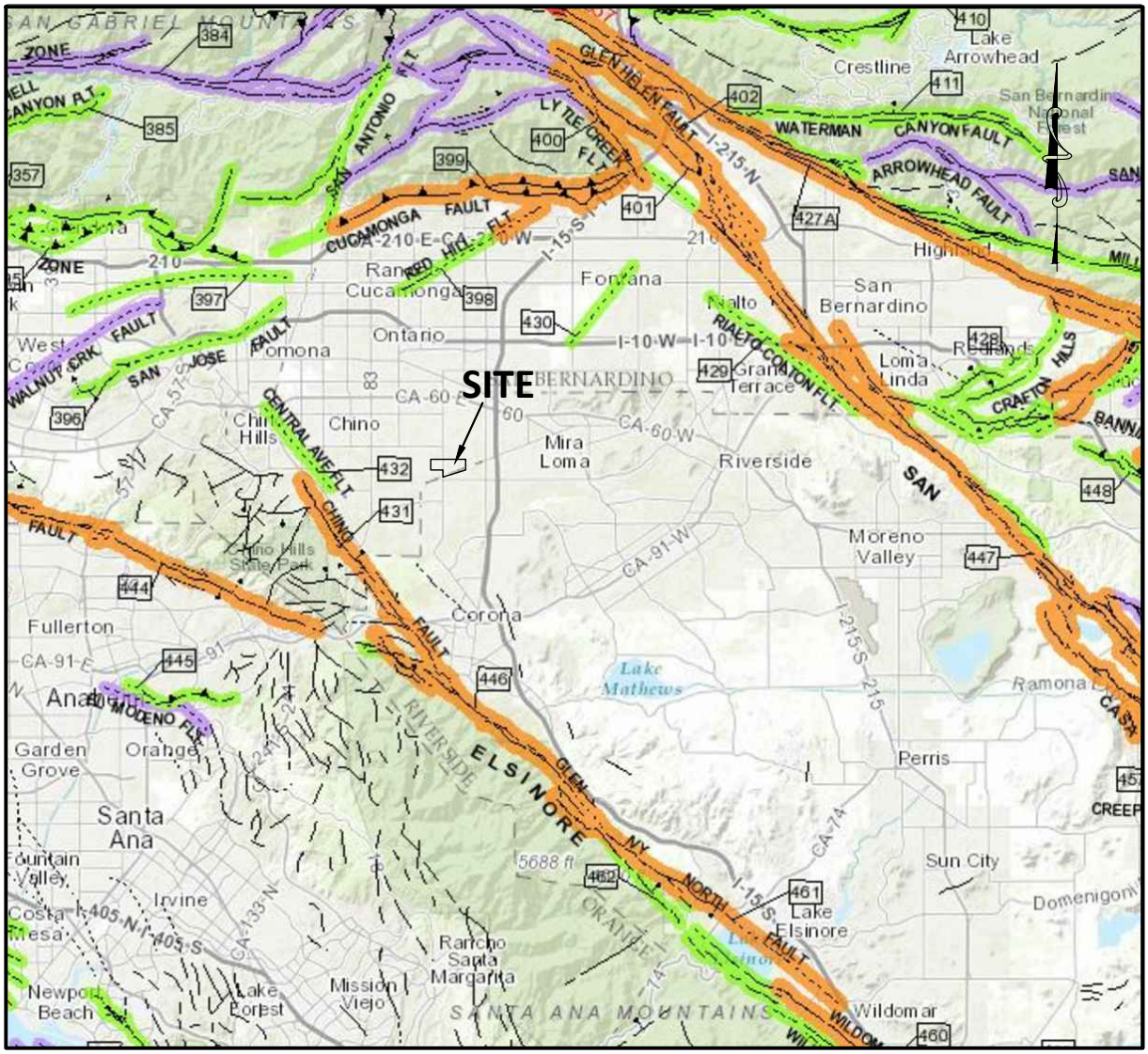
REGIONAL GEOLOGIC MAP

Scale: 1" ≈ 5,000'

Partial Legend

Qyf - Young Alluvial Fan Deposits (Middle to Early Pleistocene)
Qya - Young Alluvial Valley Deposits (Middle to Early Pleistocene)
Qye - Young Eolian and Dune Deposits (Middle to Early Pleistocene)
Qoa - Old Alluvial Valley Deposits (Late to Middle Pleistocene)
Qvoa - Very Old Alluvial Valley Deposits (Late to Middle Pleistocene)

Source: Bedrossian and Roffers, California Geological Survey, SR-217.



REGIONAL FAULT MAP

Scale: 1" ≈ 10 miles

Partial Legend

Orange - Holocene fault displacement

Green - Late Quaternary fault displacement

Purple - Quaternary fault

Black - Pre-Quaternary fault

Base Map: California Geological Survey Fault Activity Map of California, 2010

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NOTABLE FAULTS WITHIN 100 KILOMETERS AND SEISMIC DATA

Fault Zone & geometry	Distance (km)	Distance (mi.)	Maximum Moment Magnitude	Slip Rate (mm/yr)
Chino-Central Ave. (rl-r-o)	10	6	6.7	1.0
Clamshell-Sawpit (r)	36	22	6.5	0.5
Cleghorn (ll-ss)	38	24	6.5	3.0
Coronado Bank (rl-ss)	91	57	7.4	3.0
Cucamonga (r)	17	11	6.9	5.0
Elsinore - Temecula (rl-ss)	18	11	6.8	5.0
Elsinore - Glen Ivy (rl-ss)	17	11	6.8	5.0
Hollywood (ll-r-o)	52	32	6.4	1.0
Malibu Coast (ll-r-o)	87	54	6.7	0.3
Newport-Inglewood (rl-ss)	52	32	6.9	1.5
Newport-Inglewood - Offshore (rl-ss)	57	35	7.1	1.5
North Frontal - Western (r)	47	29	7.2	1.0
Palos Verde (rl-ss)	58	36	7.3	3.0
Puente Hills Blind Thrust (r)	23	14	7.1	0.7
Raymond (ll-r-o)	43	27	6.5	1.5
Rose Canyon (rl-ss)	97	60	6.9	1.5
San Andreas - Coachella (rl-ss)	37	23	7.2	25.0
San Andreas (rl-ss)	33	21	7.5	24.0
San Andreas - Mojave (rl-ss)	41	25	7.4	30.0
San Gabriel (rl-ss)	73	45	7.2	1.0
San Jacinto - San Jacinto Valley (rl-ss)	31	19	6.9	12.0
San Jacinto (rl-ss)	25	16	6.7	12.0
San Joaquin Hills (r)	28	17	6.6	0.5
San Jose (ll-r-o)	17	11	6.4	0.5
Santa Monica (ll-r-o)	76	47	6.6	1.0
Sierra Madre (r)	21	13	7.2	2.0
San Fernando (r)	54	34	6.7	2.0
Upper Elysian Park (r)	51	32	6.4	1.3
Whittier (rl-ss)	18	11	6.8	2.5

Notes:

(ss) strike slip, (r) reverse, (n) normal, (rl) right lateral, (ll) left lateral, (o) oblique

Fault and Seismic Data - California Geological Survey (Cao), 2003

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HISTORIC STRONG EARTHQUAKES IN SOUTHERN CALIFORNIA SINCE 1812

Date	Event	Causitive Fault	Magnitude	Epicentral Distance (miles)
Dec. 12, 1812	Wrightwood	San Andreas?	7.3	31
Jan. 9, 1857	Fort Tejon	San Andreas	7.9	245
Dec. 16, 1858	San Bernardino Area	uncertain	6.0	16
Feb. 9,1890	San Jacinto	uncertain	6.3	85
May 28, 1892	San Jacinto	uncertain	6.3	86
July 30, 1894	Lytle Creek	uncertain	6.0	22
July 22, 1899	Cajon Pass	uncertain	6.4	22
Dec.25, 1899	San Jacinto	San Jacinto	6.7	36
Sept. 20, 1907	San Bernardino Area	uncertain	5.3	32
May 15, 1910	Elsinore	Elsinore	6.0	22
April 21, 1918	Hemet	San Jacinto	6.8	38
July 23, 1923	San Bernardino	San Jacinto	6.0	16
March 11, 1933	Long Beach	Newport-Inglewood	6.4	32
April 10, 1947	Manix	Manix	6.4	92
Dec. 4, 1948	Desert Hot Springs	San Andreas or Banning	6.5	70
July 21, 1952	Wheeler Ridge	White Wolf	7.3	111
Feb. 9, 1971	San Fernando	San Fernando	6.6	57
July 8, 1986	North Palm Springs	Banning or Garnet Hills	5.6	57
Oct. 1, 1987	Whittier Narrows	Puente Hills Thrust	6.0	30
Feb. 28, 1990	Upland	San Jose	5.5	13
June 28, 1991	Sierra Madre	Clamshell Sawpit	5.8	31
April 22, 1992	Joshua Tree	Eureka Peak	6.1	74
June 28, 1992	Landers	Johnson Valley & others	7.3	69
June 28, 1992	Big Bear	uncertain	6.5	46
Jan. 17, 1994	Northridge	Northridge Thrust	6.7	59
Oct. 16, 1999	Hector Mine	Lavic Lake	7.1	88

Notes:

Earthquake data: U.S. Geological Survey P.P. 1515 & online data, Southern California Earthquake Center & California Geological Survey online data

Magnitudes prior to 1932 are estimated from intensity.

Magnitudes after 1932 are moment, local or surface wave magnitudes.

Site Location:

Site Longitude: - 117.57522

Site Latitude: 33.98691

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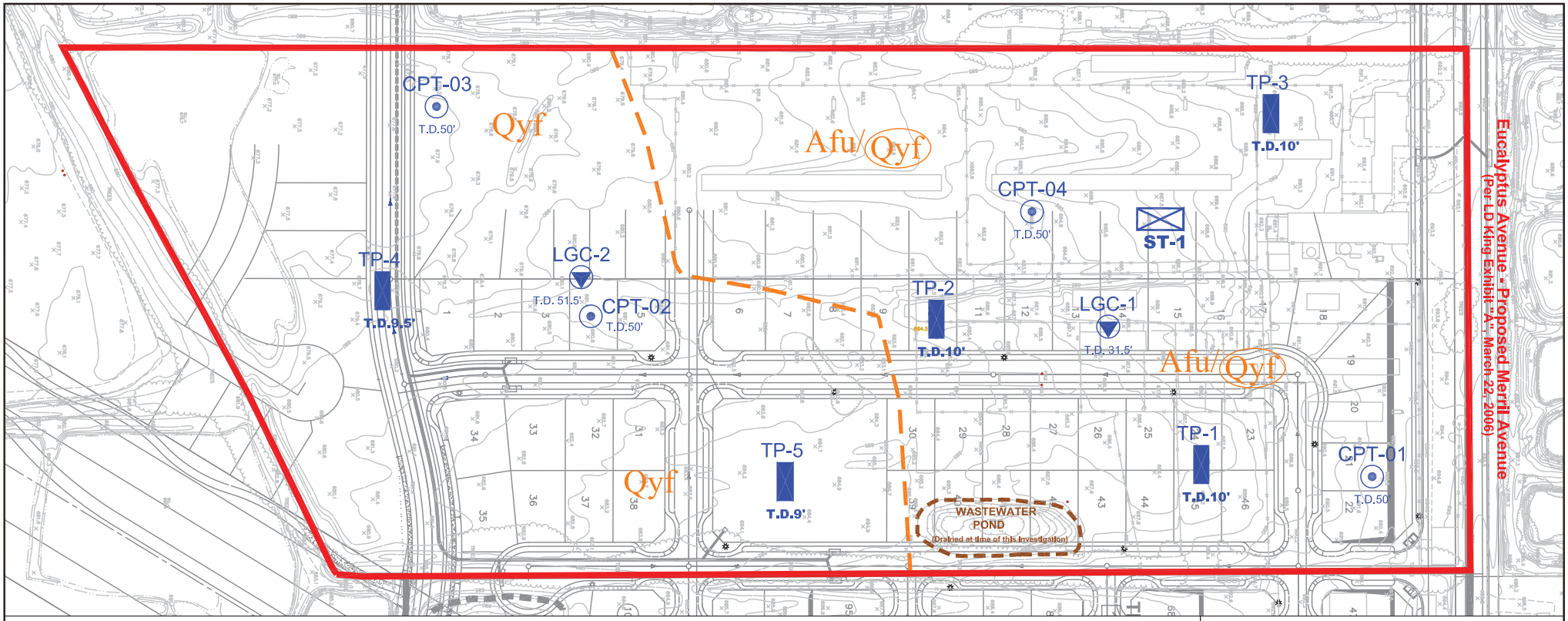
APPENDIX A

LGC, Inc Figures, Logs and Laboratory Tests
For Vander Kooi Parcel



LEGEND

LGC-2 / T.D. 51.5' — Approximate Location of Hollow Stem Boring (With Total Depth Indicated)

ST-1 — Approximate Location of Shrinkage Test

Geologic Contact

CPT-04 / T.D.50' — Approximate Location of Cone Penetration Test - CPT (With Total Depth Indicated)

Afu — Undocumented Artificial Fill

Approximate Limits of This Report

TP-5 / T.D. 10' — Approximate Location of Test Pits (With Total Depth Indicated)

Qyf — Holocene Age Alluvial Fan Deposits, Circled Where Buried

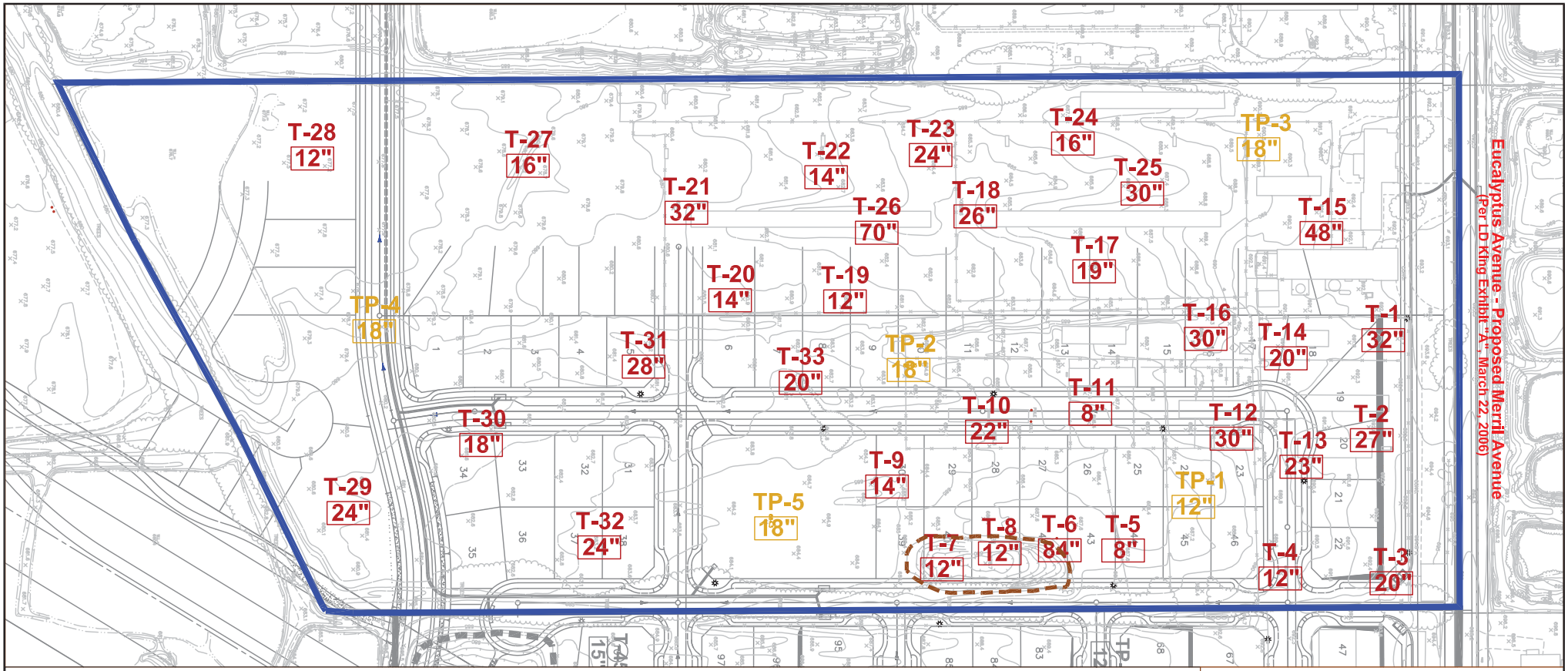
SCALE: 1"=120'

60' 0 120'

LGC

FIGURE 2
Geotechnical Map

PROJECT NAME	Richland - Vander Kooi - TT 18269
PROJECT NO.	061102-01
ENG. / GEOL.	DJB/GDS
SCALE	1" = 120'
DATE	January 2007



LEGEND

T-33 84" — Approximate Location of "Shallow" Test Pits With Total Depth of Existing Manure/Organic Rich Soil Indicated in Inches

TP-5 18" — Approximate Location of "Deep" Test Pits With Total Depth of Existing Manure/Organic Rich Soil Indicated in Inches

WASTEWATER POND — Approximate Limits of Wastewater Pond

Approximate Limits of This Report

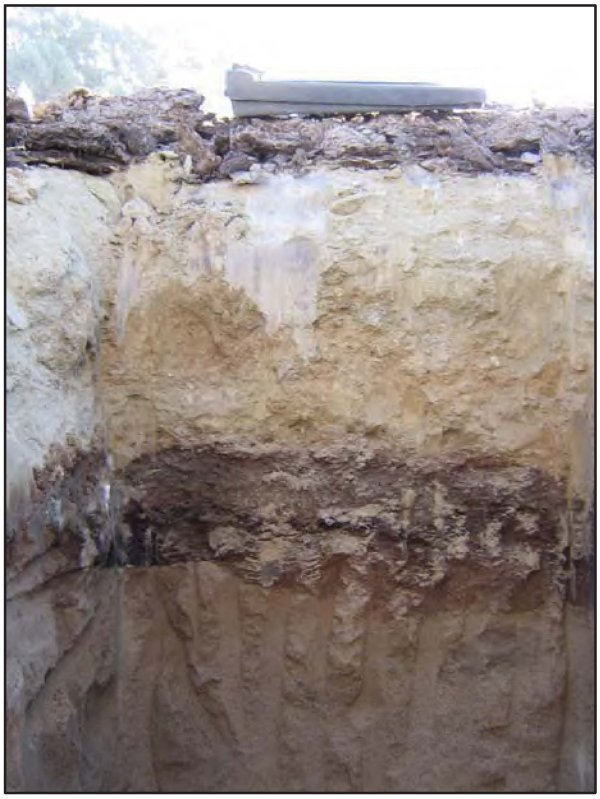
SCALE: 1"=120'

60' 0 120'

LGC

FIGURE 3
Test Pits Location Map
Manure Investigation

PROJECT NAME	Richland - Vander Kooi - TT 18269
PROJECT NO.	061102-01
ENG. / GEOL.	DJB/GDS
SCALE	1" = 120'
DATE	January 2007



"Shallow" Test Pit T-2

"Shallow" Test Pit T-5

"Shallow" Test Pit T-8

"Shallow" Test Pit T-10

LGC

Figure 4
Typical Photos of Test Pits

PROJECT NAME	Richland - Vander Kooi - TT 18269
PROJECT NO.	061102-01
ENG. / GEOL.	DJB/GDS
SCALE	Not to Scale
DATE	January 2007

"Shallow" Test Pit T-12

"Shallow" Test Pit T-15

"Shallow" Test Pit T-21

"Shallow" Test Pit T-24

LGC

Figure 5
Typical Photos of Test Pits

PROJECT NAME	Richland - Vander Kooi - TT 18269
PROJECT NO.	061102-01
ENG. / GEOL.	DJB/GDS
SCALE	Not to Scale
DATE	January 2007

"Shallow" Test Pit T-26

"Shallow" Test Pit T-29

Manure Piles - Western Corrals Areas

LGC

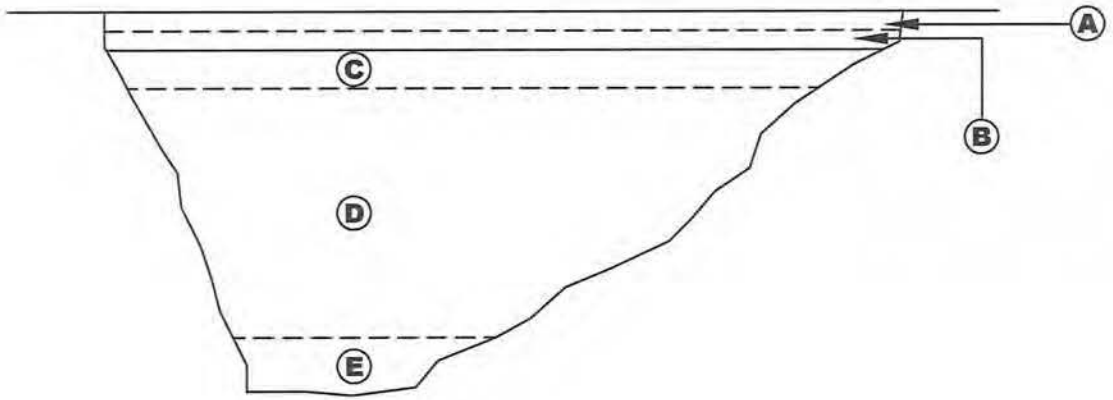
Figure 6
Typical Photos of Test Pits

PROJECT NAME	Richland - Vander Kooi - TT 18269
PROJECT NO.	061102-01
ENG. / GEOL.	DJB/GDS
SCALE	Not to Scale
DATE	January 2007

Project Name: Richland - Vander Kooi	Logged By: SR	Trench No: TP-1	LGC
Project Number : 061102-01	Date : 11/7/2006	Engineering Properties:	
Equipment: Case	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
		Undocumented Artificial Fill	Afu				
	A	0-0.5' - manure tainted soils, light to medium brown, slightly moist to dry, rich organic soil		OH			
	B	0.5'-1' - silty SAND, light brown, slightly moist, few root hairs, trace manure		SM			
		Quaternary Alluvial Fan Deposits	Qyf				
	C	1'-2' - silty SAND, light brown, moist, few root hairs		SM			
	D	2'-8.5' - silty SAND and sandy SILT, light brown, moist, scattered root hairs up to 5', abundant caliche between 3'-4', slightly porous		SM-ML	B-1 (4'-5')		
	E	8.5'-10' - sandy SILT and silty SAND, light to medium brown, moist, fine grained		ML-SM			

GRAPHICAL REPRESENTATION BELOW: **Elevation : 688 ' MSL** **Surface Slope: Flat** **Trend: EW**



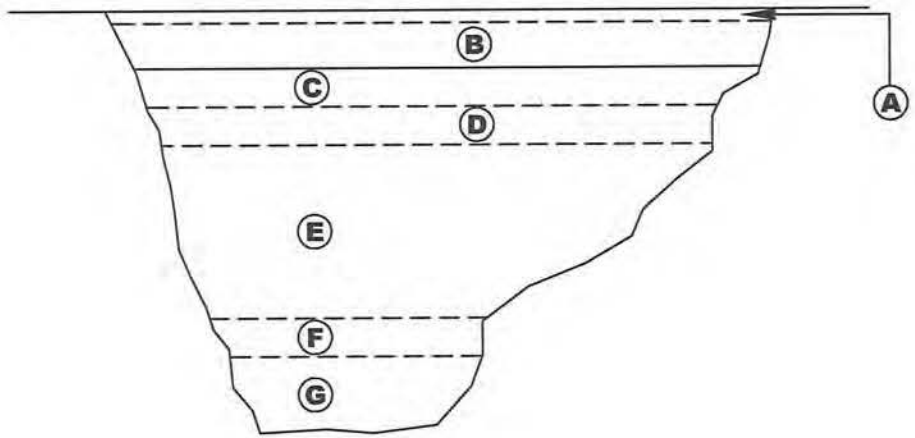
Total Depth: 10'
Groundwater: None
Backfilled: 11/7/2006

scale : 1 in = 5 ft

Project Name: Richland - Vander Kooi	Logged By: SR	Trench No: TP-2	LGC
Project Number : 061102-01	Date : 11/7/2006	Engineering Properties:	
Equipment: Case	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
		Undocumented Artificial Fill	Afu				
	A	0-4" - Manure tainted soil, light to medium brown, slightly moist, rich organic soil		OH			
	B	4"-1.5' - sandy SILT, light gray, slightly moist, few gravel		ML			
		Quaternary Alluvial Fan Deposits	Qyf				
	C	1.5' - 2.5' - silty SAND, medium brown, moist, few root hairs, few charcoal, fine grained, scattered iron oxidation		SM			
	D	2.5'-3.5' - sandy SILT, light gray/green, moist, abundant caliche		ML			
	E	3.5'-8' - sandy SILT and silty SAND, light to medium brown, moist, porous, fine grained		ML-SM	B-1 (4'-5')		
	F	8'-9' - sandy SILT, medium brown, moist, slightly porous, fine grained		ML			
	G	9'-11' - silty SAND, medium brown, moist, fine grained		SM			

GRAPHICAL REPRESENTATION BELOW: **Elevation : 684 ' MSL** **Surface Slope: Flat** **Trend: E-W**



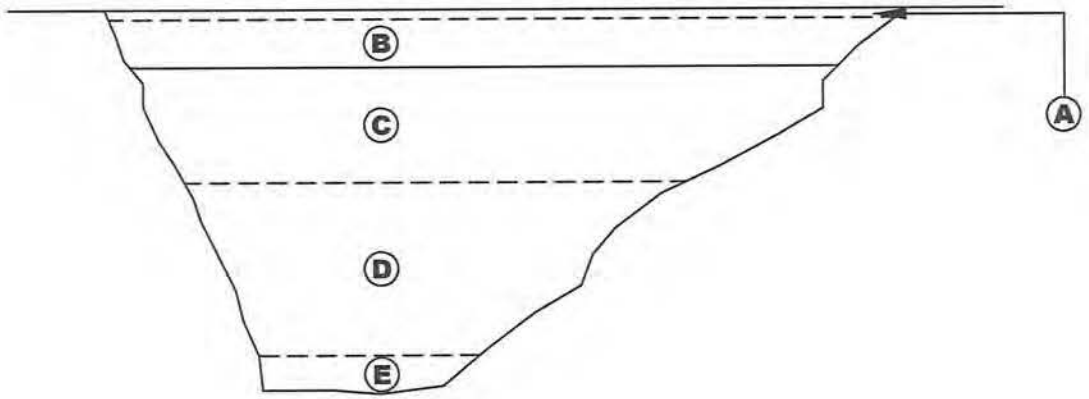
Total Depth: 11'
Groundwater: None
Backfilled: 11/7/2006

scale : 1 in = 5 ft

Project Name: Richland - Vander Kooi	Logged By: SR	Trench No: TP-3	LGC
Project Number : 061102-01	Date : 11/7/2006	Engineering Properties:	
Equipment: Case	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
		Undocumented Artificial Fill	Afu				
	A	0-3" - Manure tainted soil, dark to medium brown, moist, rich organic soil		OH			
	B	3"-1.5' - silty SAND and sandy SILT, gray/reddish/dark brown/ black, moist, few gravel, iron oxidation, trace gravel		SM-ML			
		Quaternary Alluvial Fan Deposits	Qyf				
	C	1.5' - 4.5' - sandy SILT, medium brown, moist, few root hairs		ML	B-1 (3'-4')		
	D	4.5'-9' - sandy SILT, light gray/green/brown, moist, abundant caliche, sligthly porous		ML			
	E	9'-10' - sandy SILT, medium/grayish brown, moist, fine grained		ML-SM			

GRAPHICAL REPRESENTATION BELOW: **Elevation : 680 ' MSL** **Surface Slope: Flat** **Trend: E-W**



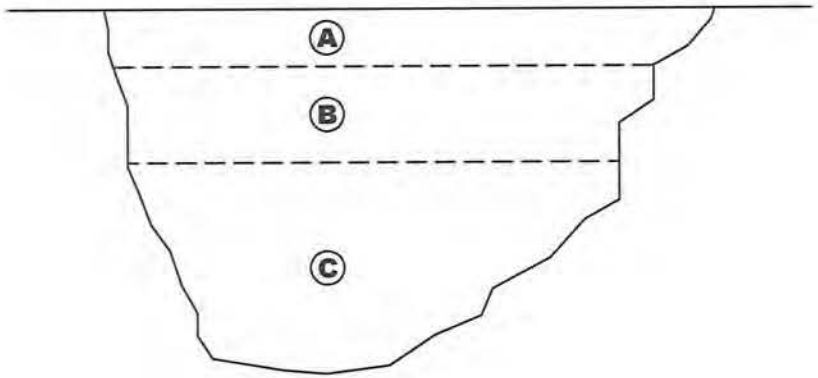
Total Depth: 10'
Groundwater: None
Backfilled: 11/7/2006

scale : 1 in = 5 ft

Project Name: Richland - Vander Kooi	Logged By: SR	Trench No: TP-4	LGC
Project Number : 061102-01	Date : 11/7/2006	Engineering Properties:	
Equipment: Case	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
		Quaternary Alluvial Fan Deposits	Qyf				
	A	0-1.5' - topsoil - silty SAND, dark to medium brown, slightly moist, abundant root hairs, some organic rich soils		SM-OH			
	B	1.5'-4' - sandy SILT, light gray, moist, abundant caliche, slightly porous, trace clay		ML			
	C	4' - 9.5' - silty SAND and sandy SILT, medium brown, moist, fine grained		SM-ML			

GRAPHICAL REPRESENTATION BELOW: **Elevation : 678 ' MSL** **Surface Slope: Flat** **Trend: E-W**



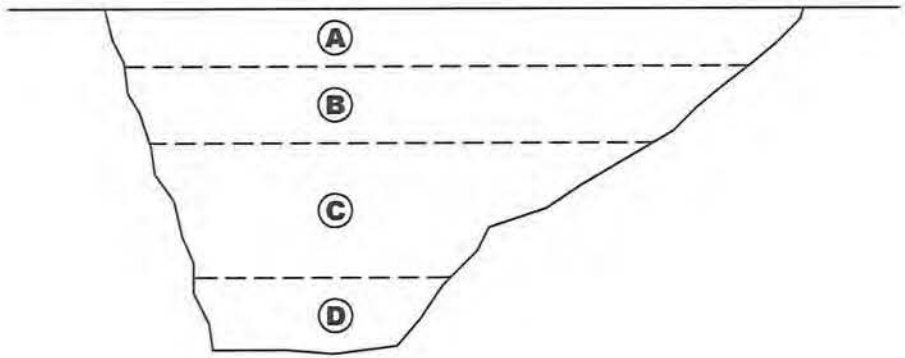
Total Depth: 9.5'
Groundwater: None
Backfilled: 11/7/2006

scale : 1 in = 5 ft

Project Name: Richland - Vander Kooi	Logged By: SR	Trench No: TP-5	LGC
Project Number : 061102-01	Date : 11/7/2006	Engineering Properties:	
Equipment: Case	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
		Quaternary Alluvial Fan Deposits	Qyf				
	A	0'-1.5' - topsoil - silty SAND, dark to medium brown, slightly moist, abundant root hairs, wood stalks, organic rich soils		SM-OH			
	B	1.5'-3.5' - silty SAND, medium brown, moist, few root hairs, slightly porous, fine grained		SM			
	C	3.5'-7' - sandy SILT, light gray and light brown, moist, abundant caliche, few root hairs, trace iron oxidation, trace clay		ML			
	D	7'-9' - lean CLAY, dark and medium brown, moist, slightly porous, few caliche		CL			

GRAPHICAL REPRESENTATION BELOW: **Elevation : 684 ' MSL** **Surface Slope: Flat** **Trend: E-W**



Total Depth: 9'
Groundwater: None
Backfilled: 11/7/2006

scale : 1 in = 5 ft

Geotechnical Boring Log Borehole LGC-1

Date: 11/2/2006 | **Drilling Company:** 2R Drilling Incorporated

Project Name: Richland - Vander Kooi | **Type of Rig:** CME-85

Project Number: 061102-01 | **Drop:** 30" | **Hole Diameter:** 8"

Elevation of Top of Hole: ~687' MSL | **Drive Weight:** 140 pounds

Hole Location: See Geotechnical Map

Logged By SR
Sampled By SR
Checked By GDS

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
	0						SM+ML	**Undocumented Artificial Fill (Afu)** silty SAND and sandy SILT, medium brown, slightly moist; few gravel, trace of demolition debris within upper foot	
685			R-1	8 13 18	111.4	4.0		**Quaternary Alluvial Fan Deposits (Qyf)**	
							SM	@2.5' - silty SAND, reddish brown, moist, medium dense; fine to medium grained	
	5	B-1	R-2	7 8 5	105.2	2.4		@5' - silty SAND, reddish brown, slightly moist, loose; fine to medium grained	MD EI CR
680			R-3	6 13 13	117.8	11.6	ML	@7.5' - sandy SILT, reddish brown and gray brown, stiff; few caliche stringers	SA-CO (-#200 62%)
	10		R-4	6 11 11	101.0	4.8	SM	@10' - silty SAND, reddish brown, moist, medium dense; few coarse grained	
675									
	15		SPT-1	3 4 6		11.1	SM	@15' - silty SAND, gray and light brown, moist, medium dense; pin hole porosity, few caliche stringers, trace clay	
670									
	20		R-5	13 16 24	118.4	13.0	ML	@20' - sandy SILT, reddish brown, moist, very stiff; porous, few caliche stringers, iron oxidation	
665									
	25		SPT-2	3 6 6		30.0	ML	@25' - sandy SILT, reddish and grayish light brown, moist, stiff; abundant caliche stringers, some iron oxidation, trace clay	
660									
	30								

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THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

SAMPLE TYPES:

B	BULK SAMPLE
R	RING SAMPLE
G	GRAB SAMPLE
SPT	STANDARD PENETRATION TEST SAMPLE

TEST TYPES:

DS	DIRECT SHEAR
MD	MAXIMUM DENSITY
SA	SIEVE ANALYSIS
S&H	SIEVE AND HYDROMETER
EI	EXPANSION INDEX
CN	CONSOLIDATION
CR	CORROSION
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
RV	R-VALUE
-#200	% PASSING # 200 SIEVE

Geotechnical Boring Log Borehole LGC-1

Date: 11/2/2006
Drilling Company: 2R Drilling Incorporated
Project Name: Richland - Vander Kooi
Type of Rig: CME-85
Project Number: 061102-01
Drop: 30" **Hole Diameter:** 8"
Elevation of Top of Hole: ~687' MSL
Drive Weight: 140 pounds
Hole Location: See Geotechnical Map

Logged By SR
Sampled By SR
Checked By GDS

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
655	30		R-6	7 12 13	96.8	19.3	ML	@30' - sandy SILT, reddish brown, moist, very stiff; few caliche stringers, porous, few iron oxidation, trace clay	
650	35							Total Depth = 31.5' Groundwater Not Encountered Backfilled with Cuttings on 11/2/2006	
645	40								
640	45								
635	50								
630	55								
	60								

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SAMPLE TYPES:

B	BULK SAMPLE
R	RING SAMPLE
G	GRAB SAMPLE
SPT	STANDARD PENETRATION TEST SAMPLE

TEST TYPES:

DS	DIRECT SHEAR
MD	MAXIMUM DENSITY
SA	SIEVE ANALYSIS
S&H	SIEVE AND HYDROMETER
EI	EXPANSION INDEX
CN	CONSOLIDATION
CR	CORROSION
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
RV	R-VALUE
-#200	% PASSING # 200 SIEVE

Geotechnical Boring Log Borehole LGC-2

Date: 11/3/2006 | **Drilling Company:** 2R Drilling Incorporated

Project Name: Richland - Vander Kooi | **Type of Rig:** CME-85

Project Number: 061102-01 | **Drop:** 30" | **Hole Diameter:** 8"

Elevation of Top of Hole: ~681' MSL | **Drive Weight:** 140 pounds

Hole Location: See Geotechnical Map

Logged By SR
Sampled By SR
Checked By GDS

Elevation (ft)	Depth (ft)	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
680	0					SM	**Undocumented Artificial Fill (Afu)** silty SAND, light to dark brown, slightly moist; some root hair, wood stalks, trace organic matter	
		R-1	13 28 36	113.2	18.2	ML	**Quaternary Alluvial Fan Deposits (Qyf)** @2.5' - sandy SILT, light green and gray, moist, hard; slightly porous, caliche stringers, trace coarse grained	
675	5	R-2	9 15 22	111.4	14.2	CL	@5' - lean CLAY, gray and greenish brown, moist, very stiff; few iron oxidation, caliche stringers, fine grained, trace silt	AL
		R-3	9 15 16	107.1	7.8	SM	@7.5' - silty SAND, medium to dark brown, moist, medium dense; fine to medium coarse grained	SA-DS (-#200 43%)
670	10	R-4	7 13 17	97.7	2.7	SM	@10' - silty SAND, orange to light brown, slightly moist, medium dense; abundant iron oxidation	CO
665	15	SPT-1	2 3 8		28.7	CL	@15' - lean CLAY, green and gray light brown, moist, stiff; few iron oxidation, few caliche stringers, few pin hole porosity	
660	20	R-5	13 24 30		1.7	SP	@20' - poorly graded SAND, light brown, slightly moist, dense; few gravel, medium coarse grained	SA (-#200 5%)
655	25	SPT-2	2 3 4		18.2	ML-SM	@25' - sandy SILT and silty SAND, light and grayish brown, moist, soft and loose; few iron oxidation	
	30							

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SAMPLE TYPES:

B	BULK SAMPLE
R	RING SAMPLE
G	GRAB SAMPLE
SPT	STANDARD PENETRATION TEST SAMPLE

TEST TYPES:

DS	DIRECT SHEAR
MD	MAXIMUM DENSITY
SA	SIEVE ANALYSIS
S&H	SIEVE AND HYDROMETER
EI	EXPANSION INDEX
CN	CONSOLIDATION
CR	CORROSION
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
RV	R-VALUE
-#200	% PASSING # 200 SIEVE

Geotechnical Boring Log Borehole LGC-2

Date: 11/3/2006 | **Drilling Company:** 2R Drilling Incorporated

Project Name: Richland - Vander Kooi | **Type of Rig:** CME-85

Project Number: 061102-01 | **Drop:** 30" | **Hole Diameter:** 8"

Elevation of Top of Hole: ~681' MSL | **Drive Weight:** 140 pounds

Hole Location: See Geotechnical Map

Logged By SR
Sampled By SR
Checked By GDS

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
650	30		R-6	5 9 12	91.4	30.4	CL	@30' lean CLAY, greenish brown, moist, stiff; iron stains, few caliche stringers and pin hole porosity, trace clay	
645	35		SPT-3	5 8 11		16.1	ML	@35' sandy SILT, greenish and reddish brown, moist, very stiff; few caliche stringers and pin hole porosity, trace coarse grains, trace clay	
640	40		R-7	12 23 35	119.8	13.0	ML	@40 - sandy SILT, reddish brown, moist, very stiff; abundant iron oxidation, few coarse grained, trace clay	
635	45		SPT-4	4 5 8		30.0	CL	@45' lean CLAY, gray and reddish brown, moist, stiff; few caliche stringers and pin hole porosity, few charcoal	
630	50		R-8	15 34 46	112.9	5.7	SM	@50' - silty SAND, light and orange brown, moist, dense; abundant iron oxidation, medium grained	
625	55							Total Depth = 51.5' Groundwater Not Encountered Backfilled with Cuttings on 11/3/2006	
	60								

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THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

SAMPLE TYPES:

B	BULK SAMPLE
R	RING SAMPLE
G	GRAB SAMPLE
SPT	STANDARD PENETRATION TEST SAMPLE

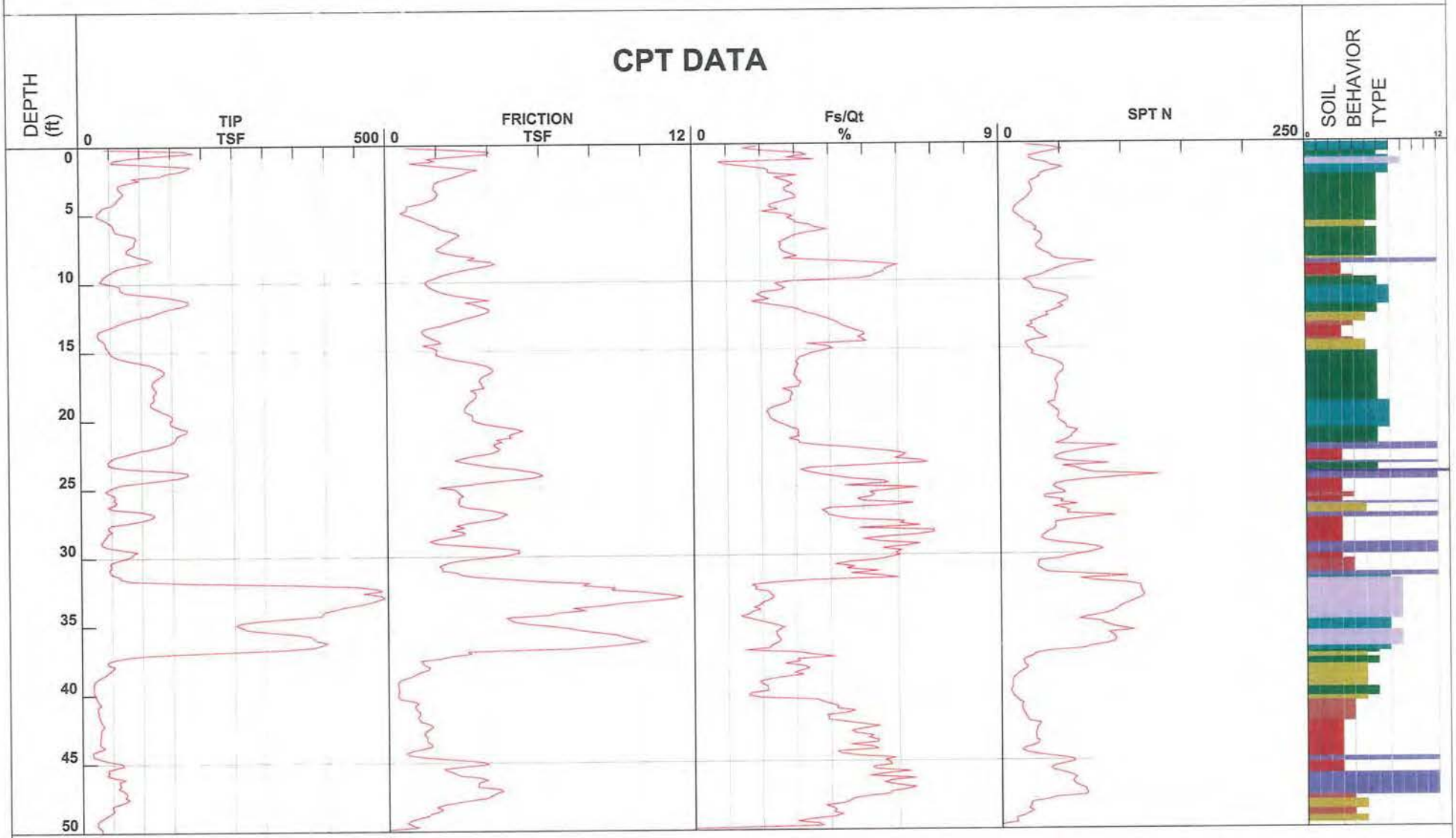
TEST TYPES:

DS	DIRECT SHEAR
MD	MAXIMUM DENSITY
SA	SIEVE ANALYSIS
S&H	SIEVE AND HYDROMETER
EI	EXPANSION INDEX
CN	CONSOLIDATION
CR	CORROSION
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
RV	R-VALUE
-#200	% PASSING # 200 SIEVE

LGC-Lawson & Associates-SC

Location	Vander Kooi	Operator	ML-CW	Filename	SDF(564).cpt
Job Number	061102-01	Cone Number	DSG0705	GPS	
Hole Number	CPT-01	Date and Time	11/9/2006 1:26:02 PM	Maximum Depth	50.03 ft
Water Table Depth		120.00 ft			

CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

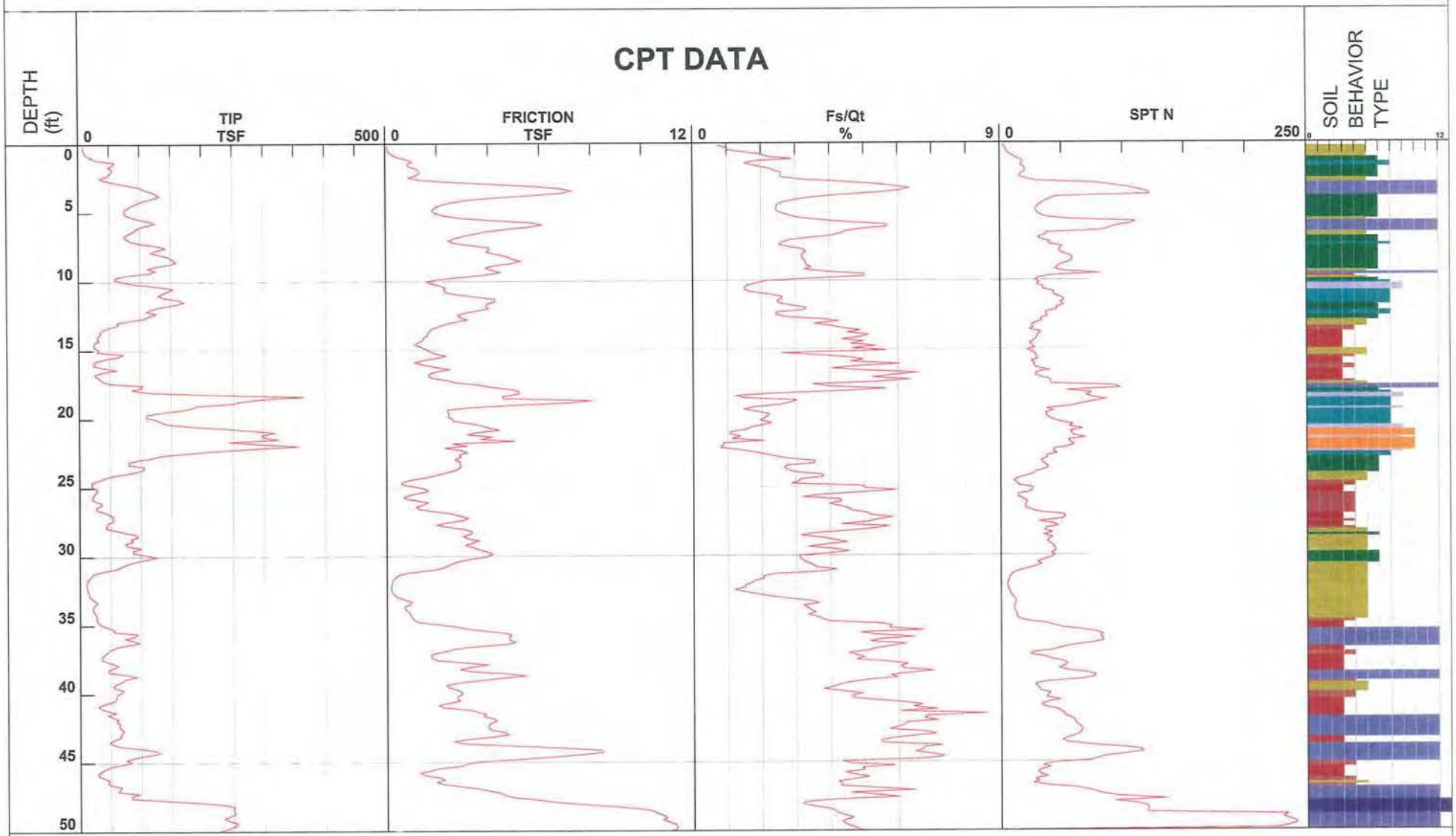
Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

LGC-Lawson & Associates-SC

Location	Vander Kooi	Operator	ML-CW	Filename	SDF(566).cpt
Job Number	061102-01	Cone Number	DSG0705	GPS	
Hole Number	CPT-02	Date and Time	11/10/2006 7:57:21 AM	Maximum Depth	50.36 ft
Water Table Depth		120.00 ft			

CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

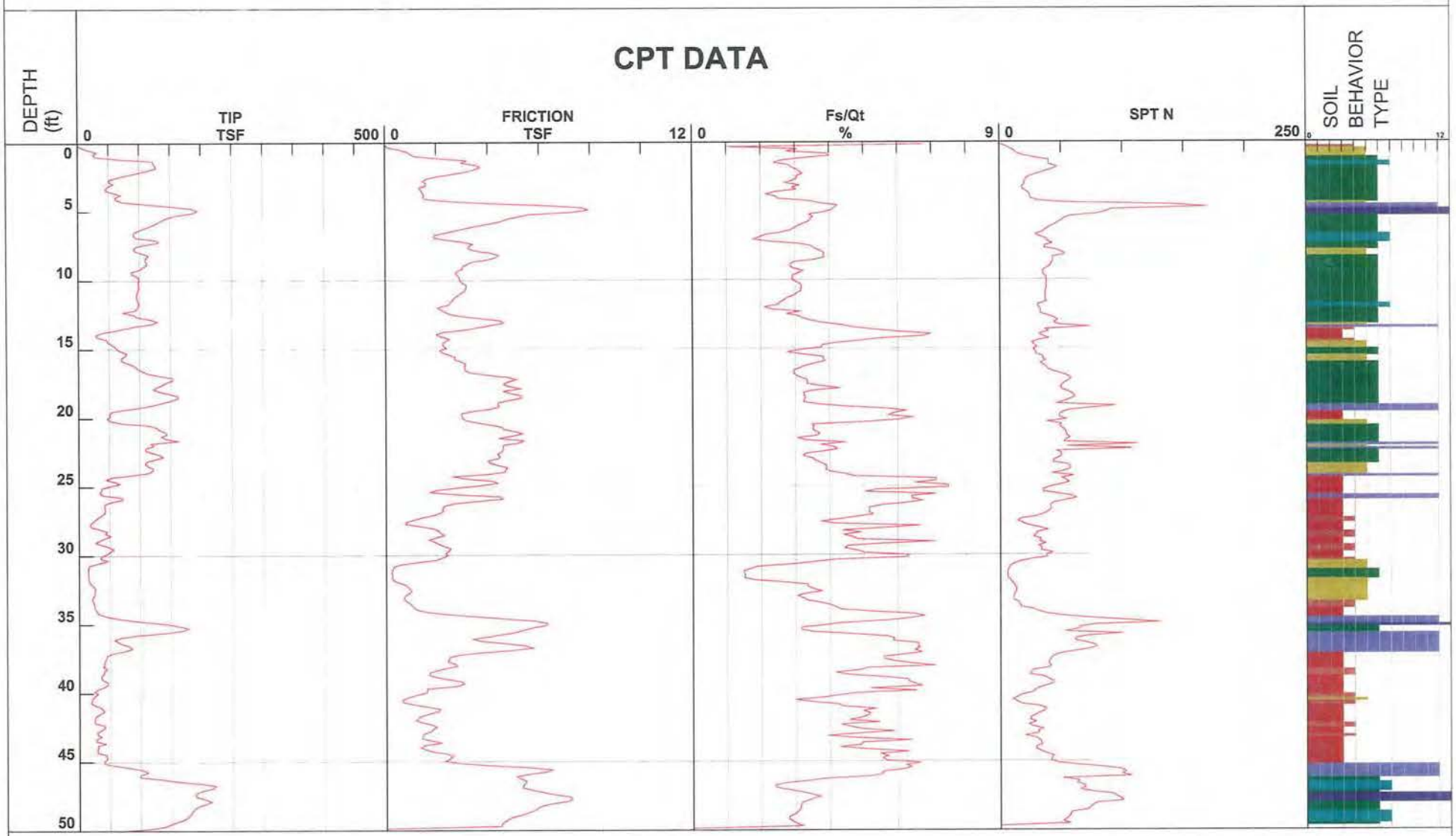
Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

LGC-Lawson & Associates-SC

Location	Vander Kooi	Operator	ML-CW	Filename	SDF(568).cpt
Job Number	061102-01	Cone Number	DSG0705	GPS	
Hole Number	CPT-03	Date and Time	11/10/2006 8:44:25 AM	Maximum Depth	50.03 ft
Water Table Depth		120.00 ft			

CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

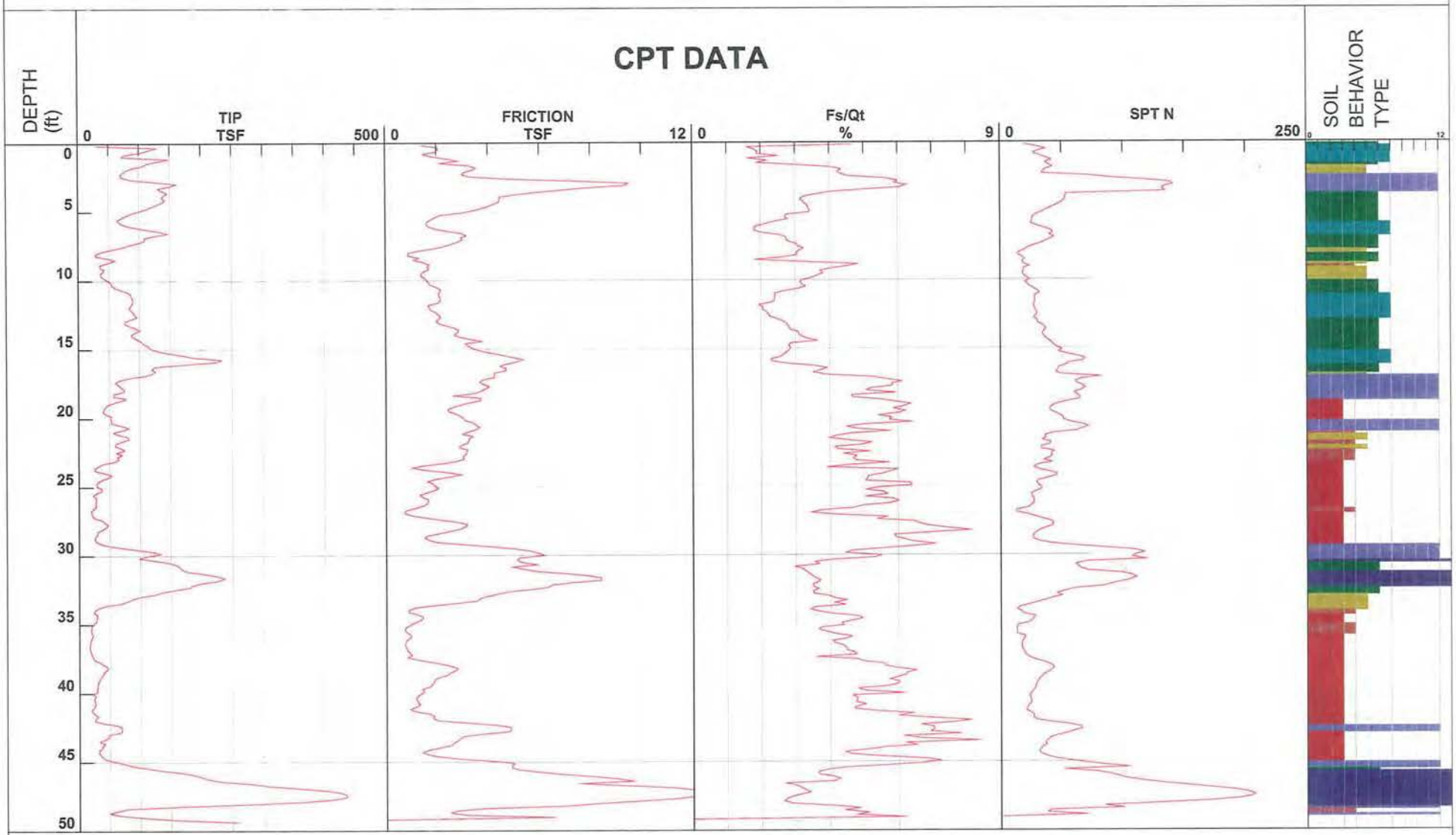
Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

LGC-Lawson & Associates-SC

Location	Vander Kooi	Operator	ML-CW	Filename	SDF(565).cpt
Job Number	061102-01	Cone Number	DSG0705	GPS	
Hole Number	CPT-04	Date and Time	11/9/2006 2:18:22 PM	Maximum Depth	49.38 ft
Water Table Depth	120.00 ft				

CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

Appendix C
Laboratory Test Results & Test Procedures

APPENDIX C

Laboratory Testing Procedures and Test Results

The laboratory testing program was directed towards providing quantitative data relating to the relevant engineering properties of the soils. Samples considered representative of site conditions were tested in general accordance with American Society for Testing and Materials (ASTM) procedure and/or California Test Methods (CTM), where applicable. The following summary is a brief outline of the test type and a table summarizing the test results.

Atterberg Limits: The liquid and plastic limits ("Atterberg Limits") were determined in accordance with ASTM Test Method D4318 for engineering classification of fine-grained material and presented in the table below.

Sample Location	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	USCS Soil Classification
LGC-2 @ 5'	27	18	9	CL

Grain Size Distribution: Representative samples were dried, weighed, and soaked in water until individual soil particles were separated (per ASTM D421) and then washed on a No. 200 sieve. The portion retained on the No. 200 sieve was dried and then sieved on a U.S. Standard brass sieve set in accordance with ASTM D422 (CTM 202). Where an appreciable amount of fines were encountered (greater than 20 percent passing the No. 200 sieve) a hydrometer analysis was done to determine the distribution of soil particles passing the No. 200 sieve.

Sample Location	Description	% Passing # 200 Sieve
LGC-1 @ 7.5'	Sandy Silt	62%
LGC-2 @ 7.5'	Silt Sand	43%
LGC-2 @ 25.0'	Poorly Graded Sand	5%

Chloride Content: Chloride content was tested in accordance with Caltrans Test Method (CTM) 422. The results are presented below.

Sample Location	Chloride Content, ppm
LGC-1 @ 5'-7'	64

Minimum Resistivity and pH Tests: Minimum resistivity and pH tests were performed in general accordance with CTM 643 and standard geochemical methods. The electrical resistivity of a soil is a measure of its resistance to the flow of electrical current. As a result of a decrease in resistivity, the potential for corrosion increases. The results are presented in the next table.

Laboratory Testing Procedures and Test Results

Sample Location	pH	Minimum Resistivity (ohms-cm)
LGC-1 @ 5'-7'	8.2	620

Soluble Sulfates: The soluble sulfate contents of selected samples were determined by standard geochemical methods (CTM 417). The soluble sulfate content is used to determine the appropriate cement type and maximum water-cement ratios. The test results are presented in the table below.

Sample Location	Sulfate Content (ppm)	Sulfate Exposure*
LGC-1 @ 5'-7'	160	Negligible

*Based on the 1997 edition of the Uniform Building Code (U.B. C.), Table No. 19-A-4, prepared by the International Conference of Building Officials (ICBO, 1997).

Hydro-consolidation: Hydro-consolidation tests (collapse) were performed on selected, relatively undisturbed ring samples (ASTM D4546). Samples were placed in a consolidometer and a load approximately equal to the in-situ overburden pressure was applied. Water was then added to the sample and the percent hydro-consolidation under the applied load was measured. The percent for the load was calculated as the ratio of the amount of vertical deformation to the original sample height. The percent hydroconsolidation is presented below.

Sample Location	In-Situ Overburden (psf)	Percent Hydroconsolidation
LGC-1 @ 7.5'	1000 psf	0.17
LGC-2 @ 10.0'	1000 psf	0.53

Note: Positive values of hydro-consolidation represent collapse of the soil structure, while negative values represent heave (or swelling) or the soil structure.

Expansion Index: The expansion potential of selected samples were evaluated by the Expansion Index Test, U.B.C. Standard No. 18-2 and/or ASTM D4829. Specimens are molded under a given compactive energy to approximately the optimum moisture content and approximately 50 percent saturation or approximately 90 percent relative compaction. The prepared 1-inch-thick by 4-inch-diameter specimens are loaded to an equivalent 144 psf surcharge and are inundated with tap water until volumetric equilibrium is reached. The results of these tests are presented in the next table.

Laboratory Testing Procedures and Test Results

Sample Location	Compacted Dry Density (pcf)	Expansion Index	Expansion Potential*
LGC-1@5'-7'	110.8	0	Very Low

* Per Table 18-1-B of 1997 U.B.C.

Moisture and Density Determination Tests: Moisture content (ASTM D2216) and dry density determinations (ASTM D2937) were performed on relatively undisturbed samples obtained from the test borings and/or trenches. The results of these tests are presented in the boring and/or trench logs. Where applicable, only moisture content was determined from undisturbed or disturbed samples.

Maximum Density Tests: The maximum dry density and optimum moisture content of typical materials were determined in accordance with ASTM D1557. The results of these tests are presented in the table below:

Sample Location	Sample Description	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
LGC-1 @ 5'-7'	Silty Sand	112.5	11.5
TP-1 @ 4'-5'	Silty Sand	121.0	12.5
TP-3 @ 3'-4'	Sandy Silt	110.5	9.5

Direct Shear: Direct shear tests were performed on selected remolded samples, which were soaked for a minimum of 24 hours under a surcharge equal to the applied normal force during testing. After transfer of the sample to the shear box, and reloading the sample, pore pressures set up in the sample due to the transfer were allowed to dissipate for a period of approximately 1 hour prior to application of shearing force. The samples were tested under various normal loads, a motor-driven, strain-controlled, direct-shear testing apparatus at a strain rate of less than 0.05 inch per minute (for sandy soil).

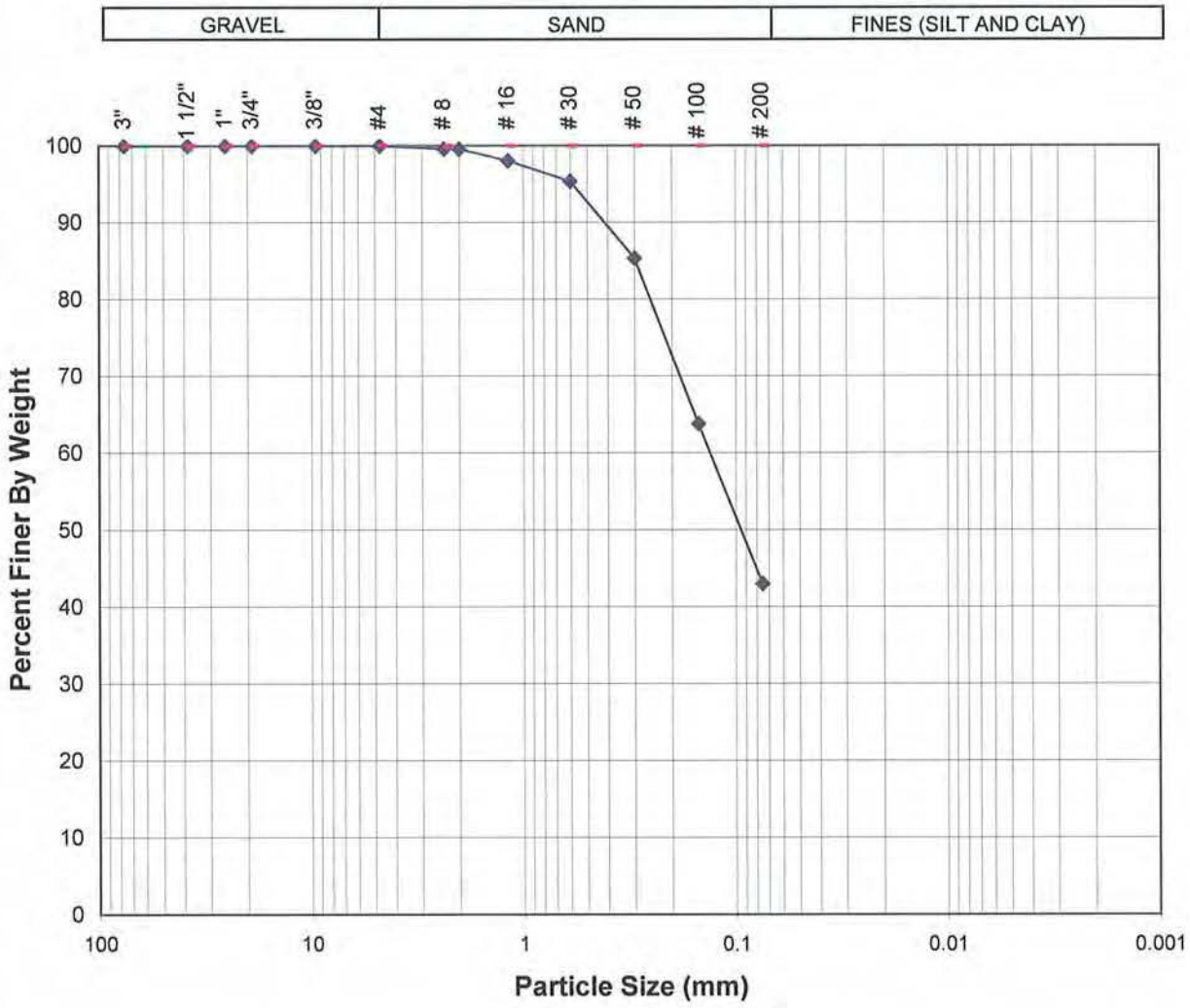
Project Name: Richland - Vander Kooi - TT 18269
Project No.: 061102-01
Client: Richland Communities

LGC

SUMMARY OF LABORATORY TEST RESULTS

Boring No.	Sample No.	Depth (ft.)	Moisture Content ASTM D 2216 (%)	Dry Density ASTM D 2937 (pcf)	Total Density (pcf)	Atterberg Limits ASTM D 4318 LL,PL,PI[1]	Particle - Size Distribution ASTM D 422 GR:SA:FI[2] (%)	Modified Proctor Compaction (ASTM D 1557) Procedure A Maximum Dry Density (pcf)	Modified Proctor Compaction (ASTM D 1557) Procedure A Optimum Moisture Content (%)	Expansion Index ASTM D 4829	Collapse Potential ASTM D 4546 (%)	Direct Shear Test Peak Cohesion (psf)	Direct Shear Test Peak Friction Angle (deg)	Direct Shear Test Ultimate Cohesion (psf)	Direct Shear Test Ultimate Friction Angle (deg)	Corrosion Suite (Soils) CTM 532/643 Soil pH CTM 532/643	Corrosion Suite (Soils) CTM 532/643 Chloride Content CTM 422 (ppm)	Corrosion Suite (Soils) CTM 532/643 Sulfate Content (gravimetric) DOT CA Test 417 (ppm)	Corrosion Suite (Soils) CTM 532/643 Min. Resistivity @ moist. Cont. CTM 532/643 (ohm-cm @ %)	Soil Identification / Classification ASTM D 2488 ASTM D 2487* (Group Symbol)
LGC-1	R-1	2.5	4.0	111.4	115.9															SM
	B-1	5-7						122.5	11.5	0						8.2	64	160	620	SM
	R-2	5.0	2.4	105.2	107.7															SM
	R-3	7.5	11.6	117.8	131.5		0:38:62				0.17									ML
	R-4	10.0	4.8	101.0	105.8															SM
	SPT-1	15.0	11.1																	SM
	R-5	20.0	13.0	118.4	133.8															ML
	SPT-2	25.0	30.0																	ML
	R-6	30.0	19.3	96.8	115.5															ML
LGC-2	R-1	2.5	18.2	113.2	133.8															ML
	R-2	5.0	14.2	111.4	127.2	27,18,9														CL
	R-3	7.5	7.8	107.1	115.5		0:57:43					105	37	150	30					SM
	R-4	10.0	2.7	97.7	100.3						0.53									SM
	SPT-1	15.0	28.7																	CL
	R-5	20.0	1.7				1:94:5													SP
	SPT-2	25.0	18.2																	ML-SM
	R-6	30.0	30.4	91.4	119.2															CL
	SPT-3	35.0	16.1																	ML
	R-7	40.0	13.0	119.8	135.4															ML
	SPT-4	45.0	30.0																	CL
	R-8	50.0	5.7	112.9	119.3															SM
TP-1	B-1	4.0-5.0						121.0	12.5											SM-ML
TP-2	B-1	4.0-5.0																		ML-SM
TP-3	B-1	3.0-4.0						110.5	9.5											ML

[1] LL,PL,PI = Liquid Limit, Plastic Limit, Plasticity Index
[2] GR:SA:FI = Gravel: Sand: Fines (Percent Passing #200 Sieve)



Location:	Sample No.:	Depth (ft.)	Soil Type	Gravel (%)	Sand (%)	Fines (%)
LGC-2	**R-3**	**7.5**	**SM**	**0**	**57**	**43**

Sample Description: Silty Sand

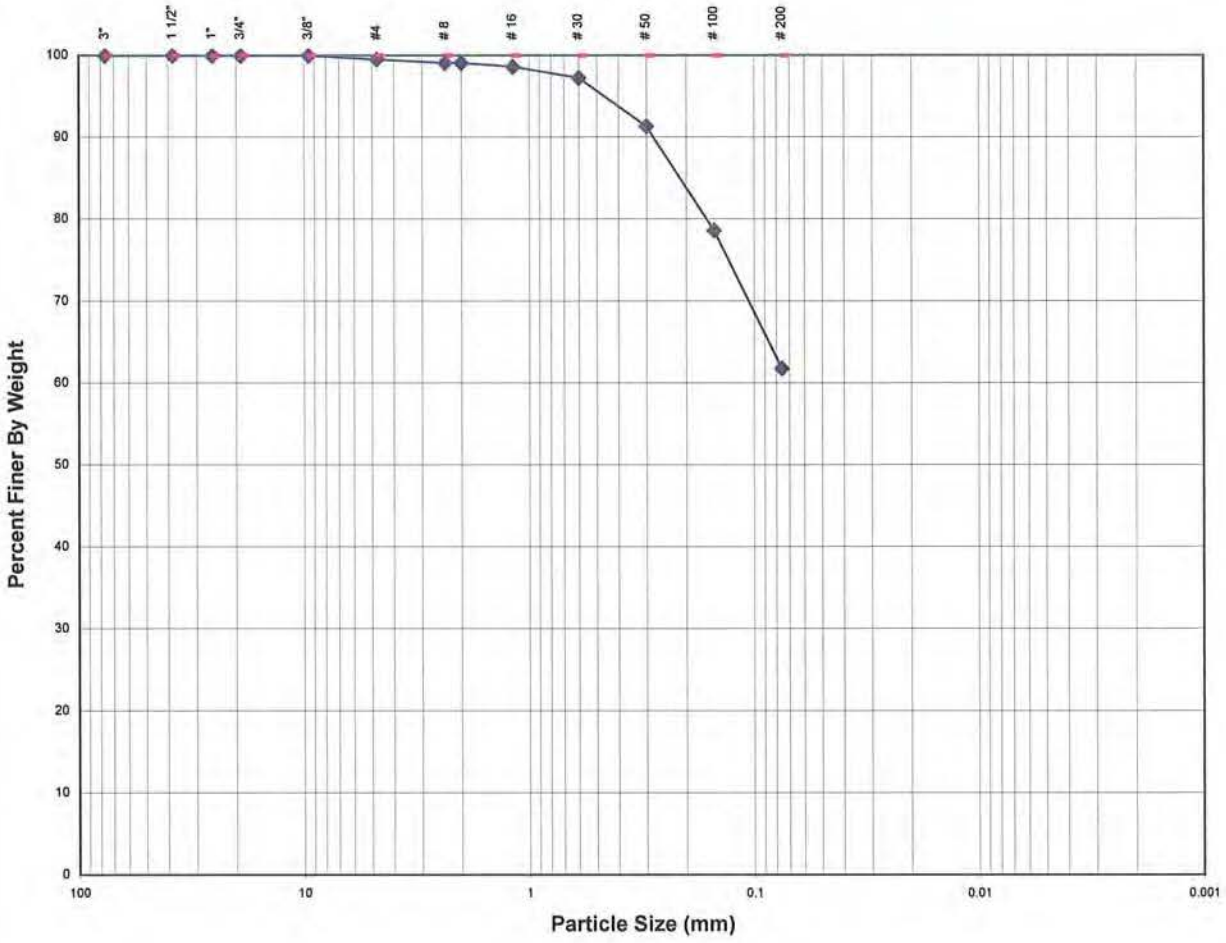
LGC

PARTICLE SIZE ANALYSIS
(ASTM D 422)

Project Number: 061102-01
Date: Jan-07

Richland - Vander Kooi

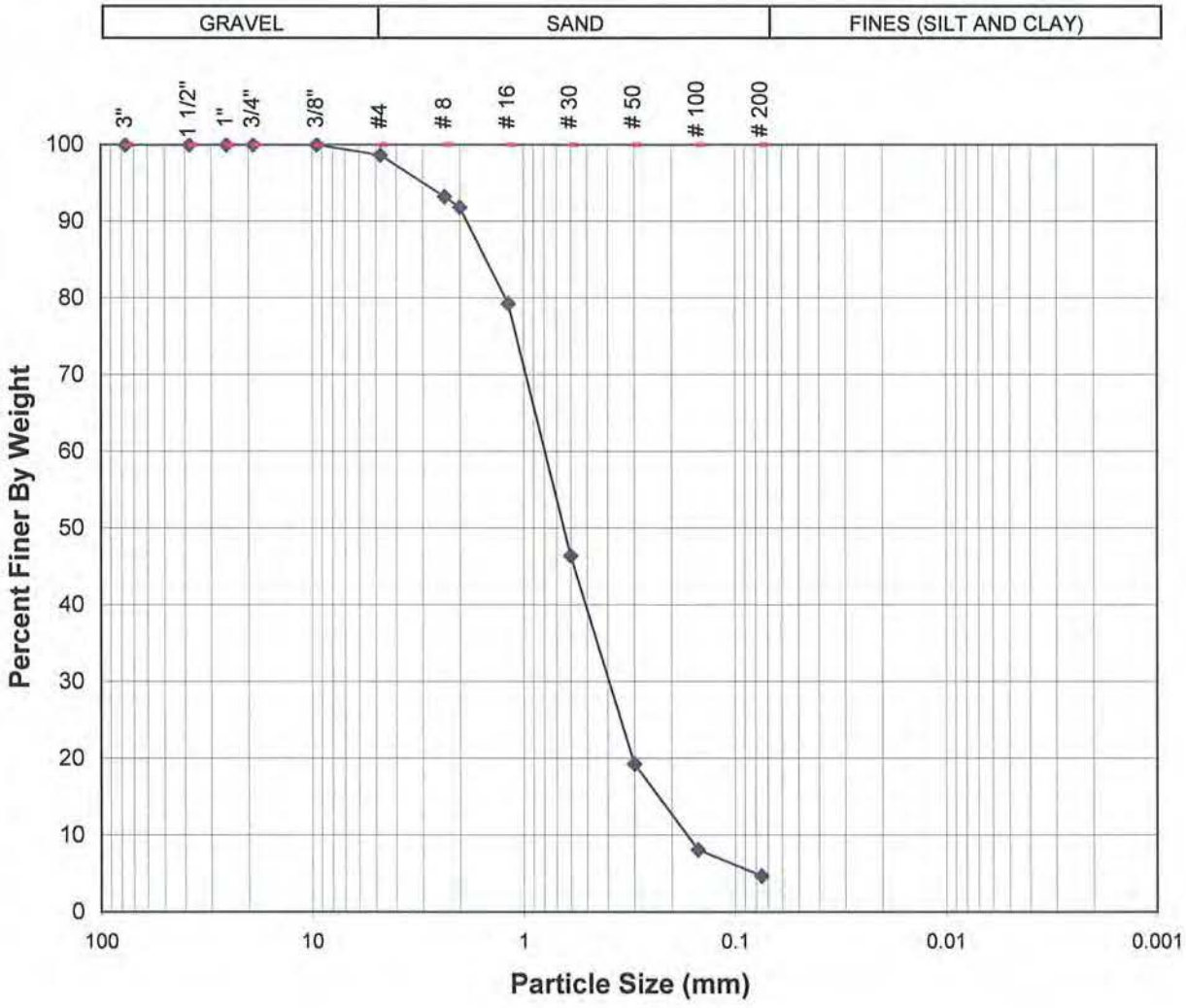
GRAVEL	SAND	FINES (SILT AND CLAY)



Location:	Sample No.:	Depth (ft.)	Soil Type	Gravel (%)	Sand (%)	Fines (%)
LGC-1	**R-3**	**7.5**	**ML**	**0**	**38**	**62**

Sample Description: Sandy Silt

LGC	PARTICLE SIZE ANALYSIS (ASTM D 422)	Project Number: 061102-01 Date: Jan-07
		Richland - Vander Kooi



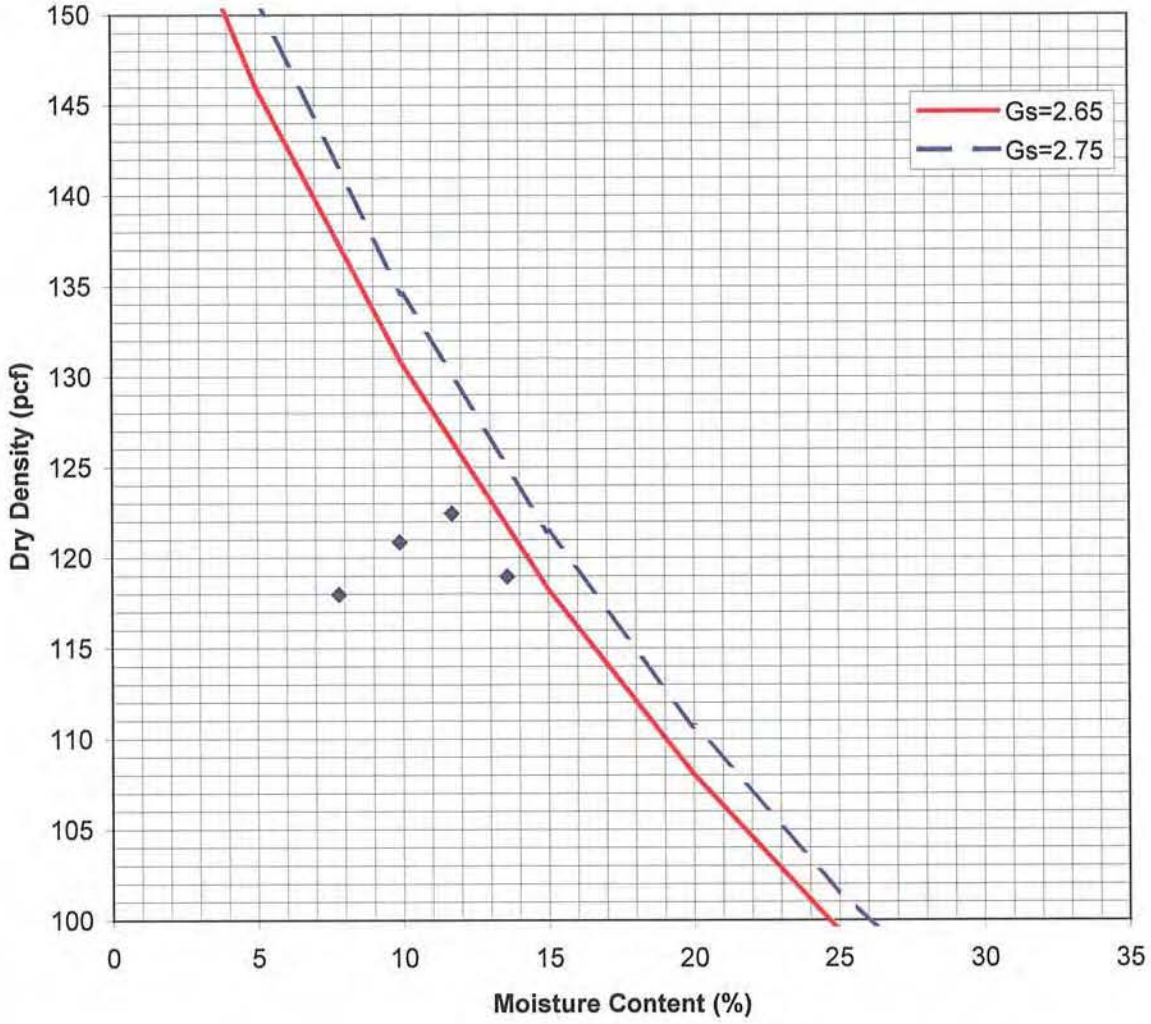
Location:	Sample No.:	Depth (ft.)	Soil Type	Gravel (%)	Sand (%)	Fines (%)
LGC-2	**R-5**	**20**	**SP**	**1**	**94**	**5**

Sample Description: Poorly Graded Sand

LGC

PARTICLE SIZE ANALYSIS
(ASTM D 422)

Project Number:	061102-01
Date:	Jan-07
Richland - Vander Kooi	

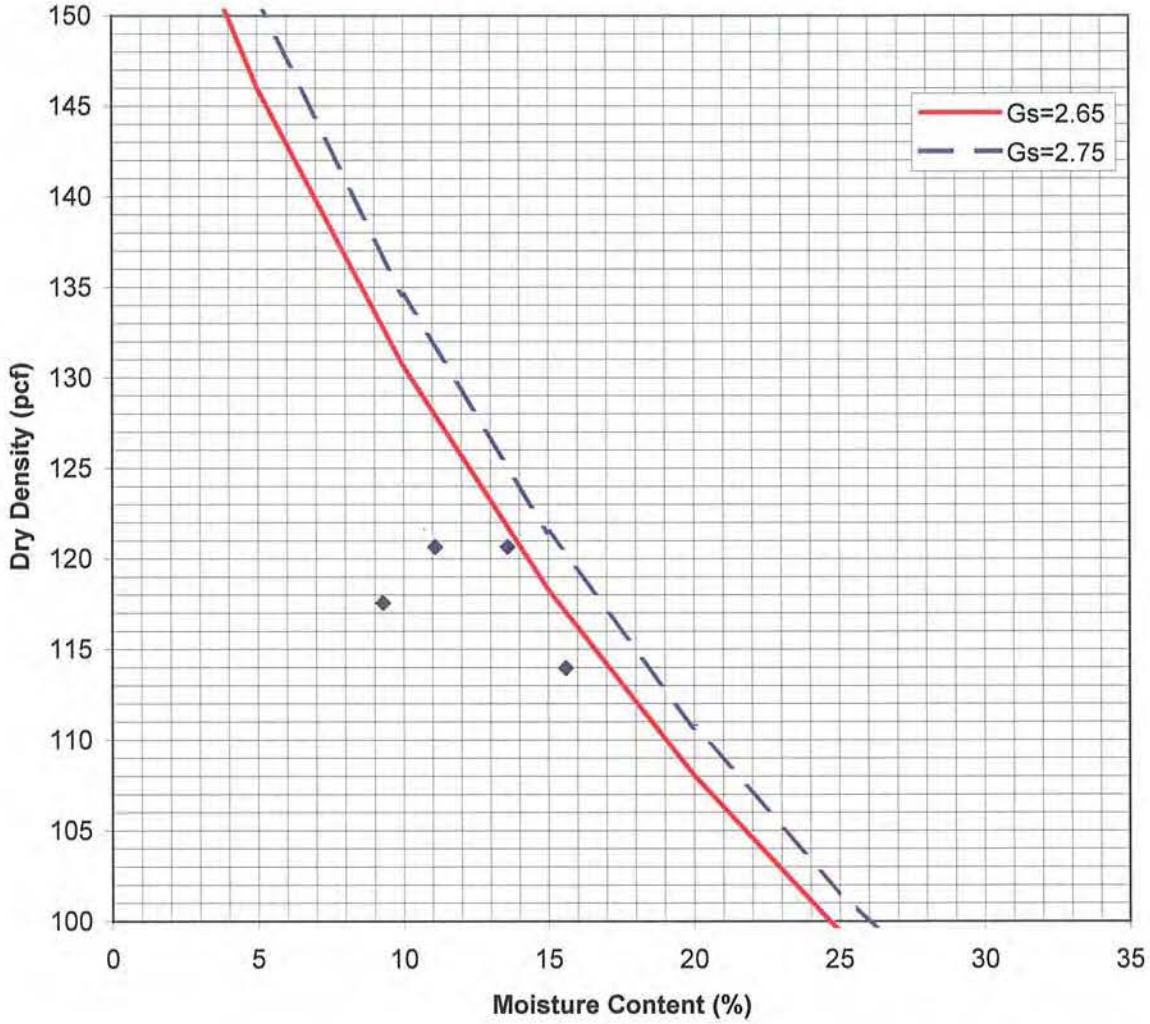


Location:	Sample No.:	Depth (ft)	Sample Description	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
LGC-1	**B-1**	**5-7**	**Silty Sand**	**122.5**	**11.5**

LGC

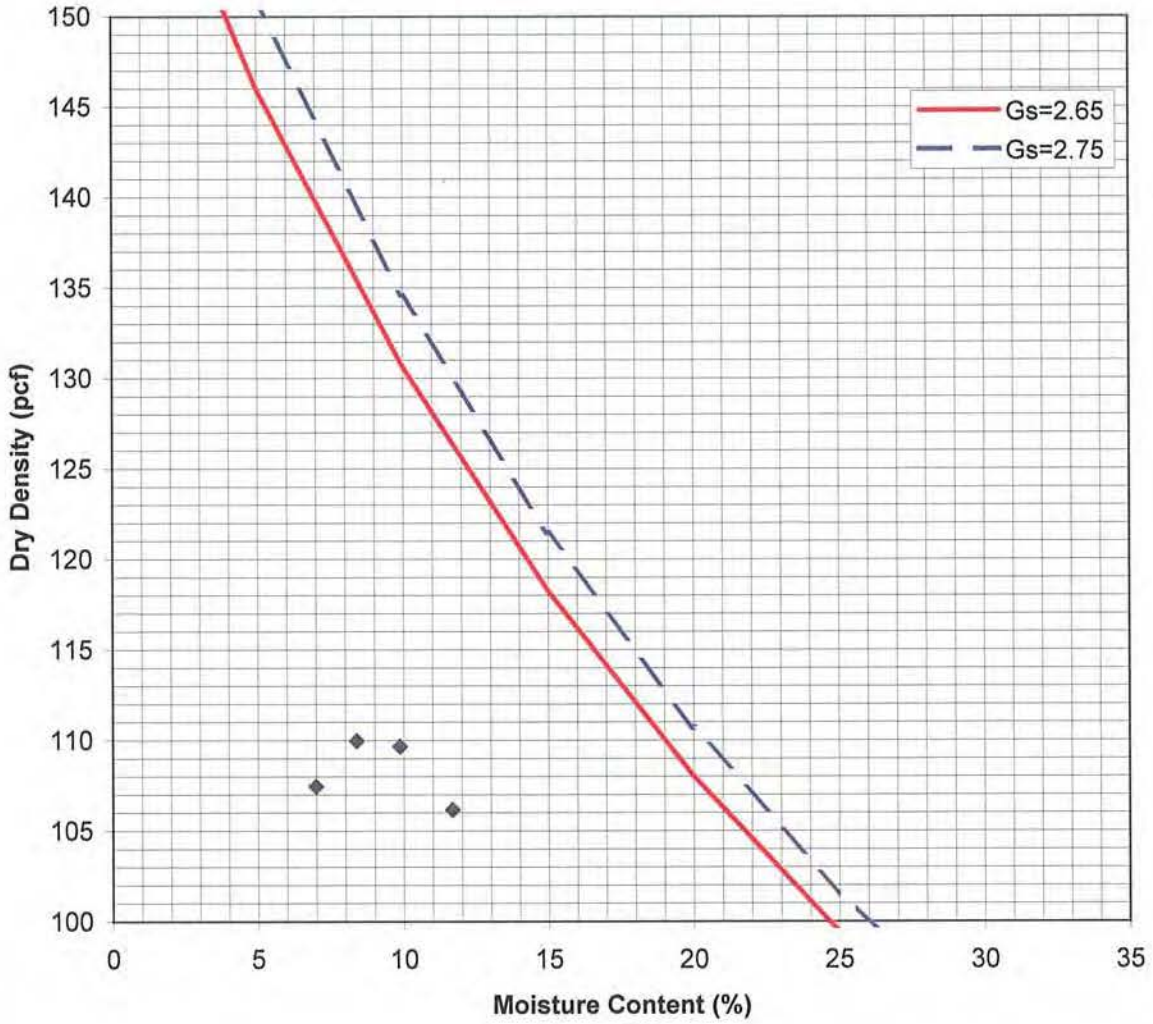
LABORATORY COMPACTION
(ASTM D 1557)

Project Number:	061102-01
Date:	Jan-07
Richland - Vander Kooi	



Location:	Sample No.:	Depth (ft)	Sample Description	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
TP-1	**B-1**	**4-5**	**Silty Sand**	**121.0**	**12.5**

LGC	**LABORATORY COMPACTION** (ASTM D 1557)	**Project Number:** 061102-01 **Date:** Jan-07 **Richland - Vander Kooi**

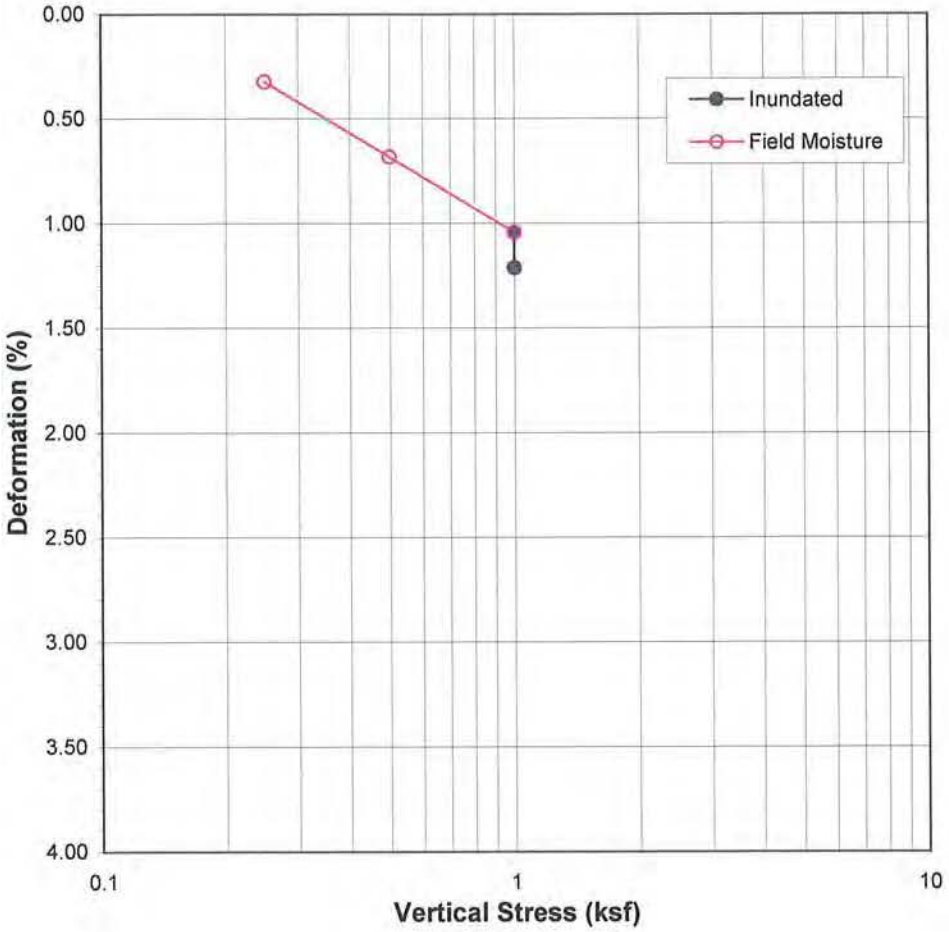


Location:	Sample No.:	Depth (ft)	Sample Description	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
TP-3	**B-1**	**3-4**	**Sandy Silt**	**110.5**	**9.5**

LGC

LABORATORY COMPACTION
(ASTM D 1557)

Project Number:	061102-01
Date:	Jan-07
Richland - Vander Kooi	

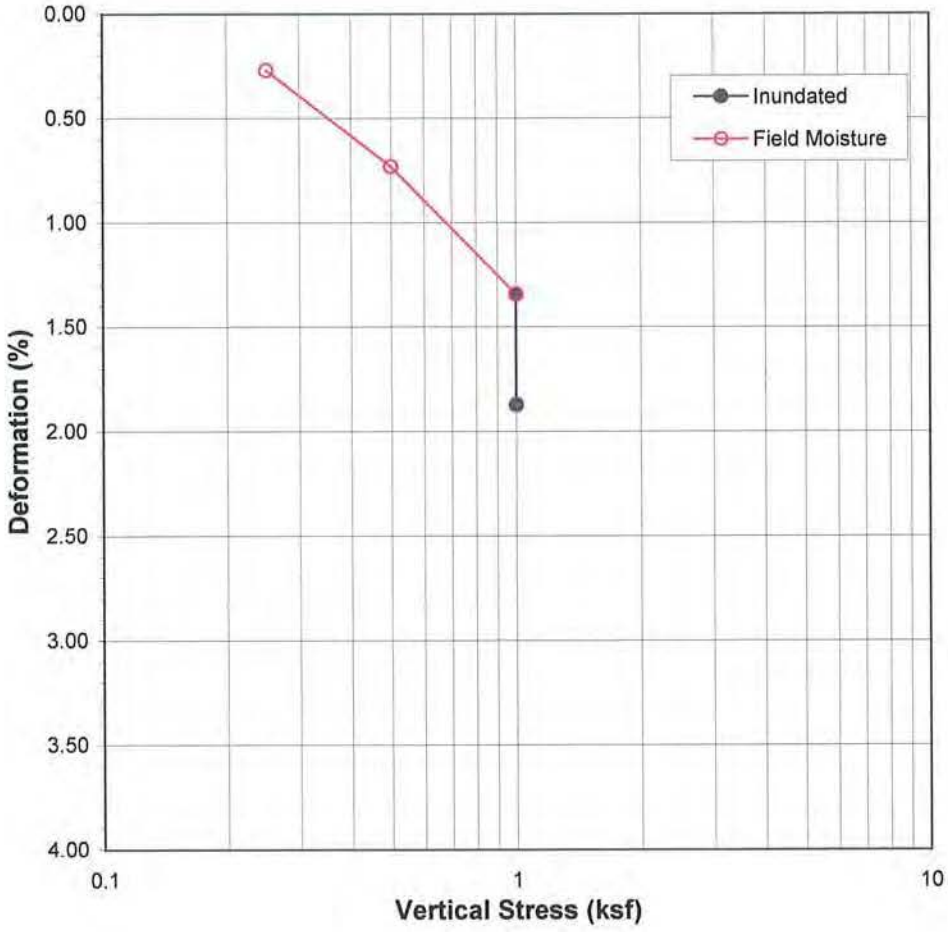


Percent Swell / Settlement After Inundation = 0.17

Location:	Sample No.:	Depth (ft)	Degree of Saturation (%)	Dry Density (pcf)	Initial Moisture Content (%)	Final Moisture Content (%)
LGC-1	**R-3**	**7.5**	**73**	**117.8**	**11.6**	**13.8**

Sample Description: Sandy Silt

LGC	ONE-DIMENSIONAL SETTLEMENT / SWELL	Project Number: 061102-01 Date: Jan-07
		Richland - Vander Kooi



Percent Swell / Settlement After Inundation = 0.53

Location:	Sample No.:	Depth (ft)	Degree of Saturation (%)	Dry Density (pcf)	Initial Moisture Content (%)	Final Moisture Content (%)
LGC-2	**R-4**	**10**	**10**	**97.7**	**2.7**	**23.5**

Sample Description: Silty Sand

LGC	**ONE-DIMENSIONAL SETTLEMENT / SWELL**	**Project Number:** 061102-01 **Date:** Jan-07 **Richland - Vander Kooi**

Location	Sample No.	Depth (ft)	Molding Moisture Content (%)	Initial Dry Density (pcf)	Final Moisture Content (%)	Expansion Index	Expansion Classification[1]
LGC-1	B-1	5-7	9.6	110.8	18.0	0	Very Low

[1] 1997 U.B.C. / 2001 C.B.C. Table 18-I-B

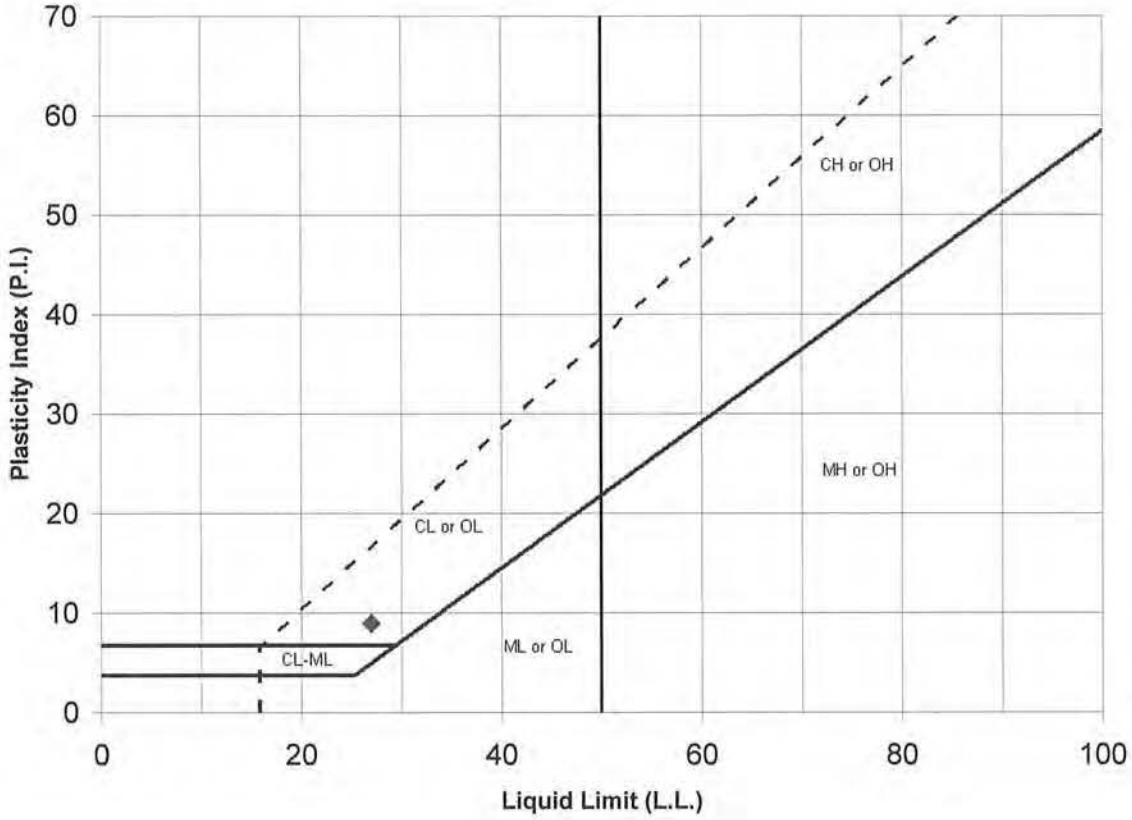
LGC

EXPANSION INDEX
(ASTM D 4829)

Project Number: 061102-01
Date: Jan-07

Richland - Vander Kooi

PLASTICITY CHART - CLASSIFICATION OF FINE-GRAINED SOILS



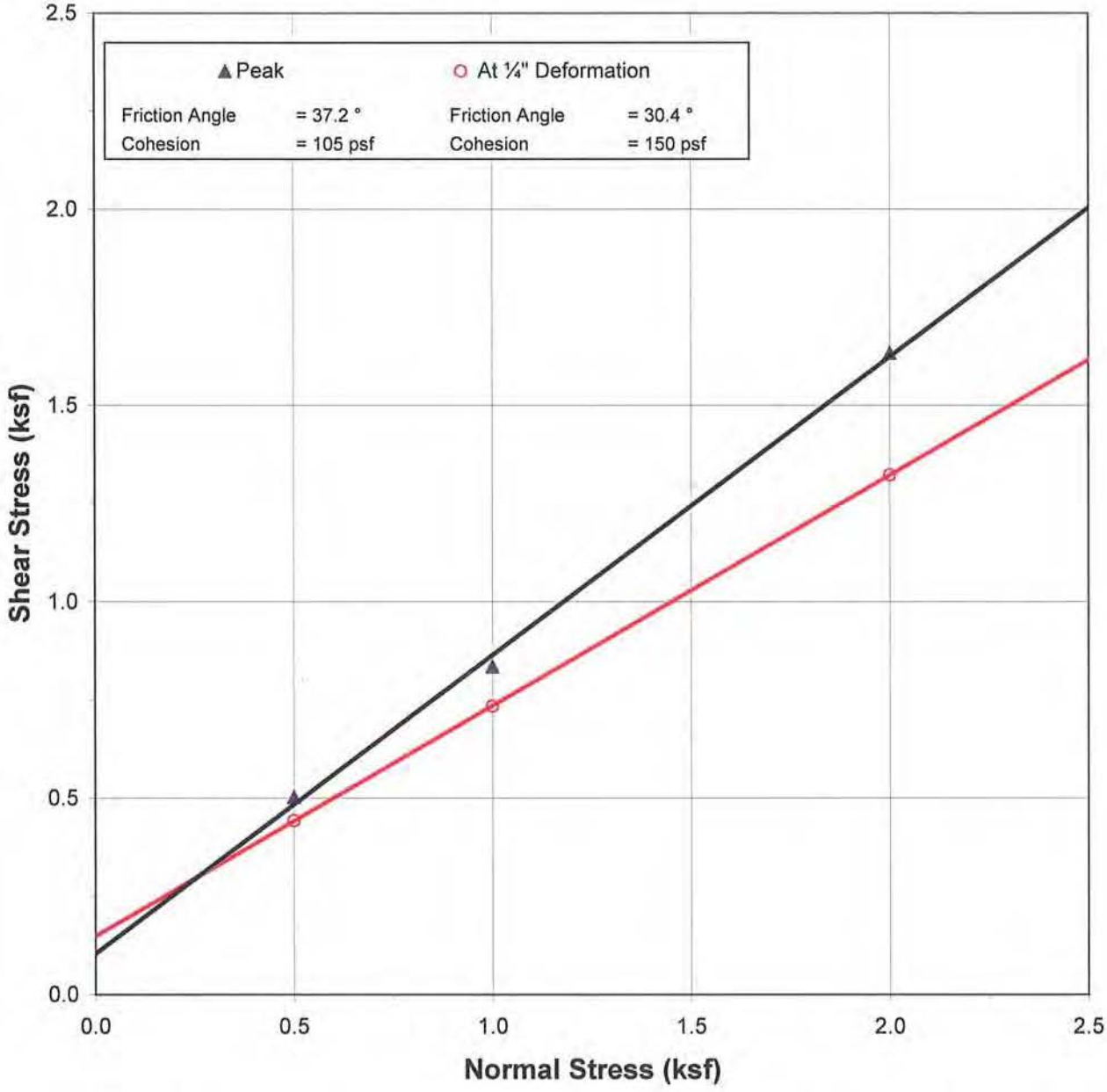
Symbol	Location.:	Sample No.:	Depth (ft)	Passing No. 200 Sieve (%)	Liquid Limit (%) LL	Plastic Limit (%) PL	Plasticity Index (%) PI	USCS
◆	LGC-2	R-2	5	-	27	18	9	CL

LGC

ATTERBERG LIMITS
(ASTM D 4318)

Project Number: 061102-01
Date: Jan-07

Richland - Vander Kooi



Location:	Sample No.:	Depth (ft)	Sample Type	Shear Rate (inch/min)	Dry Density (pcf)	Initial Moisture Content (%)	Final Moisture Content (%)
LGC-2	**R-3**	**7.5**	**In Situ**	**0.001**	**107.1**	**7.8**	**25.9**

Sample Description: Silty Sand

LGC	**DIRECT SHEAR PLOT**	**Project Number:** 061102-01 **Date:** Jan-07
		Richland - Vander Kooi

Electrochemical Suite (Results)

pH/Resistivity (CTM 643), Sulfate (CTM 417), Chloride (CTM 422)

Project # I061102-01 **Project Name:** Richland Vander Kooi **Track:**

							NAVFAC / UBC Corrosion Potentials
Sample #	B-1						
Lot #	lgc-1						
Loc. / Rep'd Lots:							
Depth (ft.):	5-7						
Description:							
Min. Resistivity (Ω-cm)	620 VERY HIGH	na	na	na	na	na	Ω > 10,000 Seldom 5,000 - 10,000 Mild 2,000 - 5,000 Moderate 1,000 - 2,000 High Ω < 1,000 Very High
pH (round down 0.1)	8.2 MILD	na	na	na	na	na	pH > 6.5 Mild 6.0 - 6.5 Moderate 4.5 - 6 High pH < 4.5 Very High
Chloride (ppm)	64 MODERATE	na	na	na	na	na	ppm < 500 Moderate ppm > 500 High
Sulfate (% by wt.)	0.016 NEGLIGIBLE	na	na	na	na	na	Net NTU < 0.1 Negligible 0.1 - 0.2 Moderate 0.2 - 2.0 Severe Net NTU > 2 Very Severe
Chloride: Endpoint(mL):	0.6	-	-	-	-	-	
Chloride: Normality:	0.02	0	0	0	0	0	
Chloride: Sample Vol.:	20	0	0	0	0	0	
Sulfate: Dilution 1:_	5	5	5	5	5	5	
Sulfate: Blank (NTU):	1	-	-	-	-	-	
Sulfate: Test (NTU):	49						
Expected Lifetime of Steel Culverts: 18 ga.=	20 Years						
16 ga.=	26						
14 ga.=	32						
12 ga.=	45						
10 ga.=	57						
8 ga.=	69						

Completion Date:
11/24/06
Technicians:
CJB

LGC INLAND

CJB for LGC, Inland 2006
na = not analyzed

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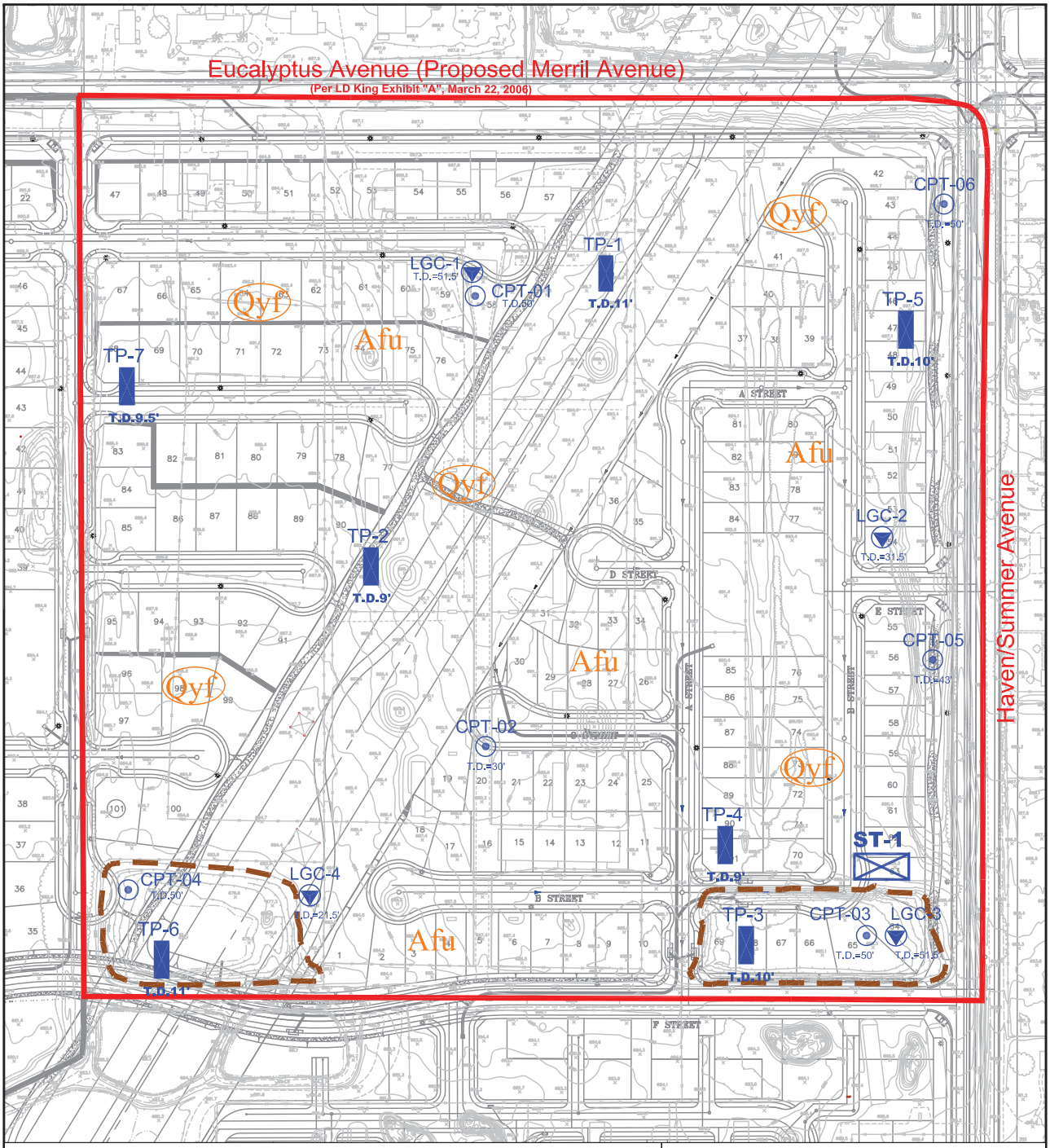
APPENDIX B

LGC, Inc Figures, Logs and Laboratory Tests
For Van Dam III Farm



LEGEND

LGC-4 — T.D. 51.5' — Approximate Location of Hollow Stem Boring (With Total Depth Indicated)

CPT-06 — T.D.50' — Approximate Location of Cone Penetration Test-CPT (With Total Depth Indicated)

TP-7 — T.D.11' — Approximate Location of Test Pits (With Total Depth Indicated)

ST-1 — Approximate Location of Shrinkage Test

Afu — Undocumented Artificial Fill

Qyf — Holocene Age Alluvial Fan Deposits, Circled Where Buried

Approximate Limits of Wastewater Pond (Drained at Time of This Investigation)

Approximate Limits of This Report

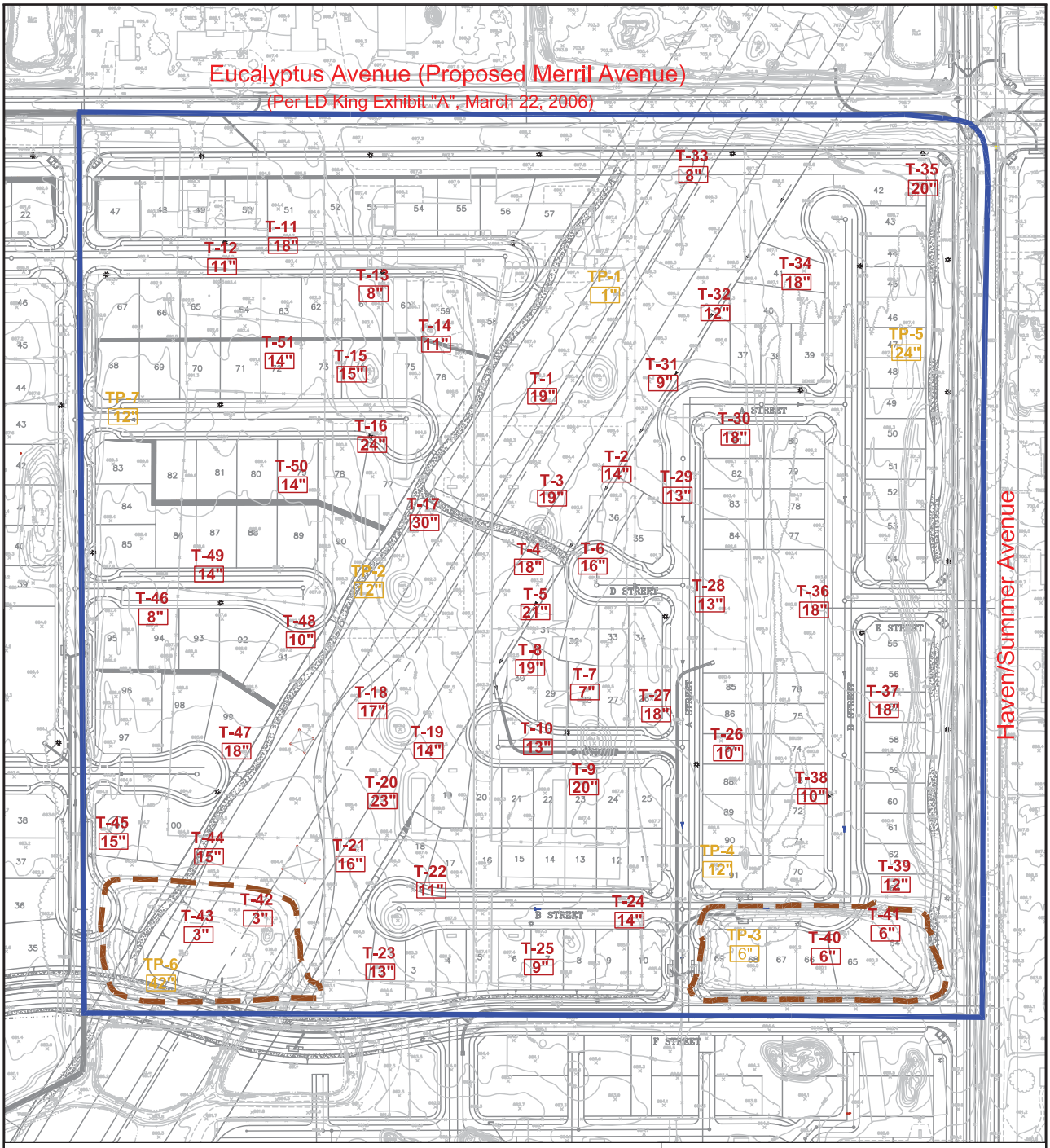
SCALE: 1"=150'

150' 75' 0 150'

LGC

FIGURE 2
Geotechnical Map

PROJECT NAME	Richland - Van Dam III - Tract 18270
PROJECT NO.	061103-01
ENG. / GEOL.	DJB/GDS
SCALE	1" = 150'
DATE	January 2007



LEGEND

T-51 30" — Approximate Location of "Shallow" Test Pits With Total Depth of Existing Manure/Organic Rich Soil Indicated In inches

TP-7 42" — Approximate Location of "Deep" Test Pits With Total Depth of Existing Manure/Organic Rich Soil Indicated In inches

WASTEWATER POND — Approximate Limits of Wastewater Ponds (Drained at Time of this Investigation)

Approximate Limits of This Report

SCALE: 1"=150'

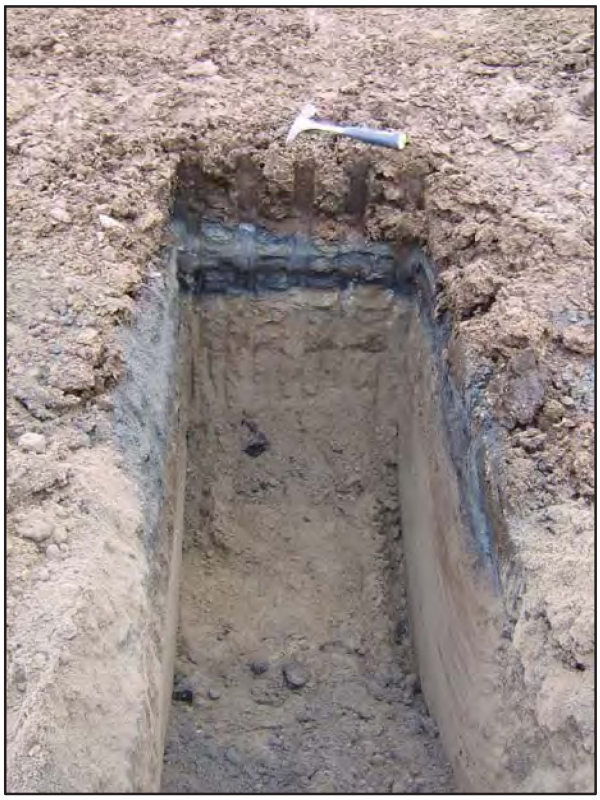
150' 75' 0 150'

LGC

FIGURE 3
Test Pit Location Map
Manure Investigation

PROJECT NAME	Richland - Van Dam III - Tract 18270
PROJECT NO.	061103-01
ENG. / GEOL.	DJB/GDS
SCALE	1" = 150 '
DATE	January 2007

"Shallow" Test Pit T-2



"Shallow" Test Pit T-4

"Shallow" Test Pit T-8

"Shallow" Test Pit T-12

LGC

Figure 4
Typical Photos of Test Pits

PROJECT NAME	Richland - Van Dam III - TT 18270
PROJECT NO.	061103-01
ENG. / GEOL.	DJB/GDS
SCALE	Not to Scale
DATE	January 2007

"Shallow" Test Pit T-16

"Shallow" Test Pit T-24

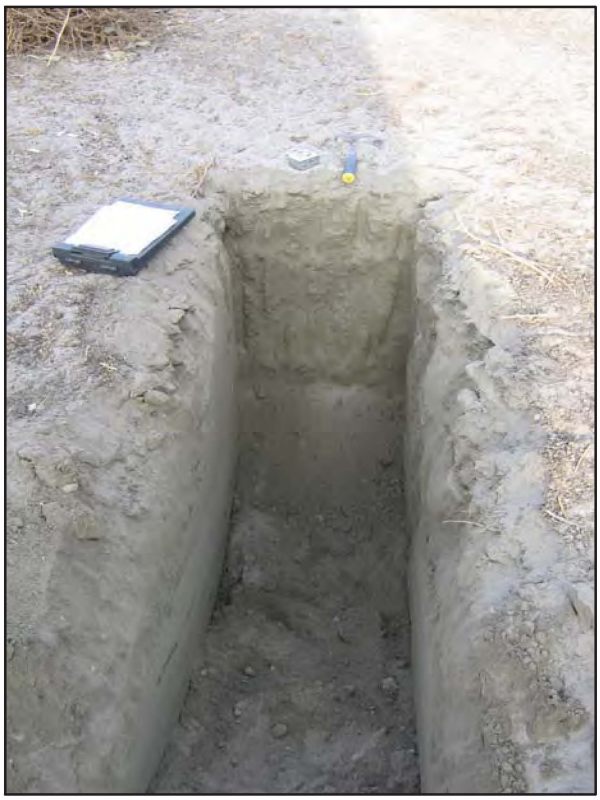
"Shallow" Test Pit T-38

"Shallow" Test Pit T-51

LGC

Figure 5
Typical Photos of Test Pits

PROJECT NAME	Richland - Van Dam III - TT 18270
PROJECT NO.	061103-01
ENG. / GEOL.	DJB/GDS
SCALE	Not to Scale
DATE	January 2007



"Shallow" Test Pit T-41

"Shallow" Test Pit T-43

Southwest Wastewater Pond

LGC

Figure 6
Typical Photos of Test Pits

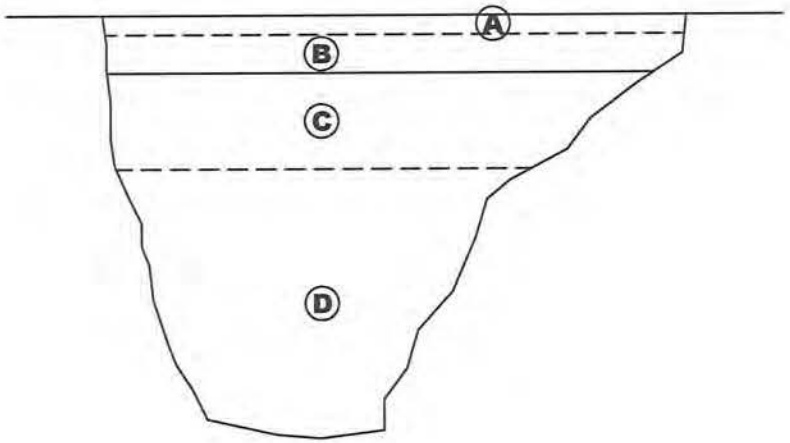
PROJECT NAME	Richland - Van Dam III - TT 18270
PROJECT NO.	061103-01
ENG. / GEOL.	DJB/GDS
SCALE	Not to Scale
DATE	January 2007

Appendix B
Test Pit, Boring, & CPT Logs

Project Name: Richland- Van Dam III	Logged By: SR	Trench No: TP-1	LGC
Project Number : 061103-01	Date : 10/31/2006	Engineering Properties:	
Equipment: CASE 580 Super L	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
		Undocumented Artificial fill	Afu				
	A	0-6" - Concrete wash		-			
	B	6"-1.5' - Silty SAND, GRAVEL, Poorly graded SAND, medium to reddish brown, coarse grained; some organic matter		SM+SP			
		Quaternary Alluvial Fan Deposits	Qyf				
	C	1.5'-9' - silty SAND, reddish brown, moist, medium to fine grained		SM			
	D	9'-11' - sandy SILT, grayish brown, moist, slightly porous, few caliche stringers		ML			

GRAPHICAL REPRESENTATION BELOW: **Elevation : 695 ' MSL** **Surface Slope: Flat** **Trend: N-S**



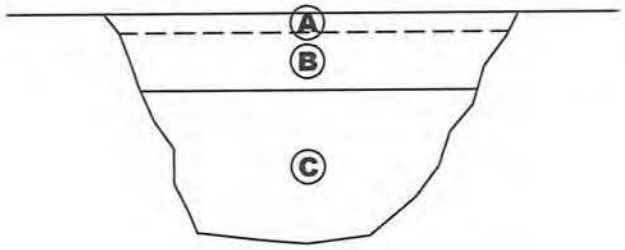
Total Depth: 11'
Groundwater: None
Backfilled: 10/31/2006

scale : 1 in = 5 ft

Project Name: Richland- Van Dam III	Logged By: SR	Trench No: TP-2	LGC
Project Number : 061103-01	Date : 10/31/2006	Engineering Properties:	
Equipment: CASE 580 Super L	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
		Undocumented Artificial Fill	Afu				
	A	0-0.5' - Organic rich soil - Manure, black to dark brown, odor		OH			
	B	0.5'-2' - concrete wash over silty SAND, orange/light gray/ reddish brown, moist, trace manure tainted soil, few gravel, coarse grained		SM			
		Quaternary Alluvial Fan Deposits	Qyf				
	C	2'-6' - silty SAND, light to medium brown, fine to medium grained, few coarse grains		SM	B-1 (3'-5')		

GRAPHICAL REPRESENTATION BELOW: **Elevation : 690 ' MSL** **Surface Slope: Flat** **Trend: N-S**



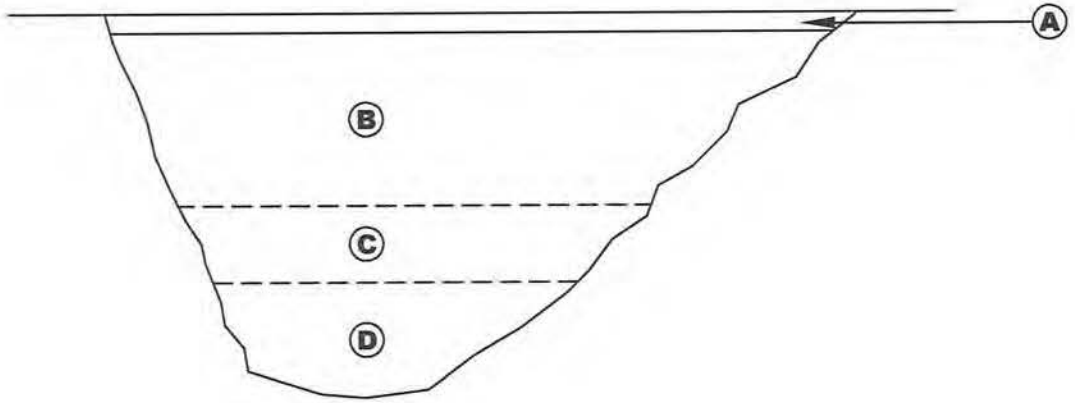
Total Depth: 6'
Groundwater: None
Backfilled: 10/31/2006

scale : 1 in = 5 ft

Project Name: Richland- Van Dam III	Logged By: SR	Trench No: TP-3	LGC
Project Number : 061103-01	Date : 10/31/2006	Engineering Properties:	
Equipment: CASE 580 Super L	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
		Undocumented Artificial Fill	Afu				
	A	0-6" - silty SAND, slightly moist, abundant root hairs; organic tainted soil		SM-OH			
		Quaternary Alluvial Fan Deposits	Qyf				
	B	6"-5' - sandy SILT, light gray, moist, fine grained, slightly porous, scattered root hairs, trace caliche stringers, few coarse grains		ML			
	C	5'-7' - silty SAND, reddish brown, moist, iron oxidation		SM			
	D	7'-10' - sandy SILT, reddish to grayish brown, moist, iron oxidation, slightly porous, caliche, few charcoal		ML	B-1 (7'-9')		

GRAPHICAL REPRESENTATION BELOW: **Elevation : 680 ' MSL** **Surface Slope: Flat** **Trend: N-S**



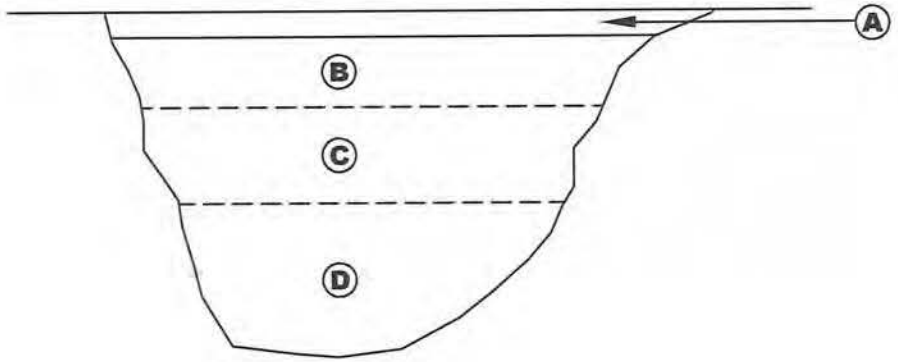
Total Depth: 10'
Groundwater: None
Backfilled: 10/31/2006

scale : 1 in = 5 ft

Project Name: Richland- Van Dam III	Logged By: SR	Trench No: TP-4	LGC
Project Number : 061103-01	Date : 10/31/2006	Engineering Properties:	
Equipment: CASE 580 Super L	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
	A	Undocumented Artificial Fill 0-8" - Organic rich soil, manure tainted soil, slightly moist to dry, brown	Afu	OH			
	B	Quaternary Alluvial Fan Deposits 8"-2.5' - silty SAND and sandy SILT, light brown and greenish gray, moist, root hairs up to 2 ft	Qyf	SM-ML			
	C	2.5'-5' - poorly graded SAND with silt, light to reddish brown, moist, gradation varies from medium to coarse grained, abundant charcoal		SP-SM			
	D	5'-9' - sandy SILT, greenish brown, moist, iron oxidation, few porous, caliche stringers, few charcoal		ML			

GRAPHICAL REPRESENTATION BELOW: **Elevation : 688 ' MSL** **Surface Slope: Flat** **Trend: N-S**



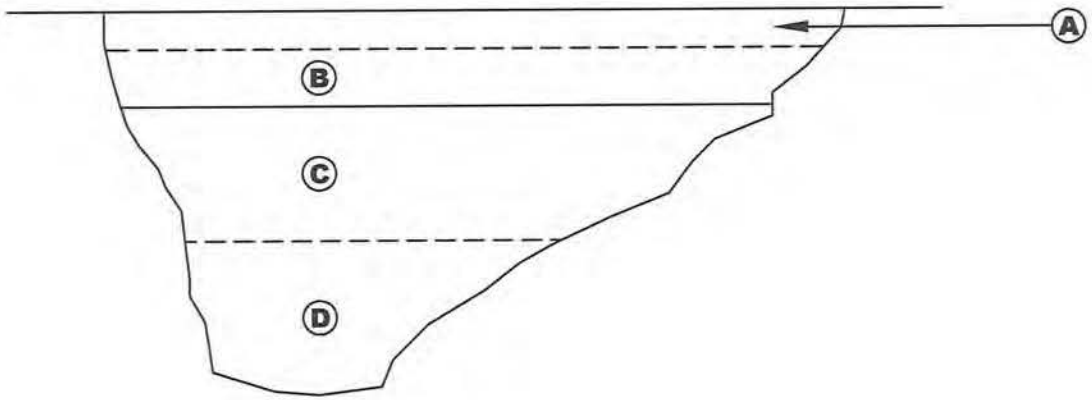
Total Depth: 9'
Groundwater: None
Backfilled: 10/31/2006

scale : 1 in = 5 ft

Project Name: Richland- Van Dam III	Logged By: SR	Trench No: TP-5	LGC
Project Number : 061103-01	Date : 10/31/2006	Engineering Properties:	
Equipment: CASE 580 Super L	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
		Undocumented Artificial Fill	Afu				
	A	0-1' - silty SAND, dark brown, wood stalks, abundant root hairs, trace organic matter		SM-OH			
	B	1'-2.5' - silty SAND, few manure and organic tainted soil, light to reddish brown, root hairs, coarse grained		SM			
		Quaternary Alluvial Fan Deposits	Qyf				
	C	2.5'-6' - silty SAND, light to medium brown, moist, fine to medium grained, root hairs up to 4.5 feet, trace clay		SM			
	D	6'-10' - sandy SILT, greenish brown, moist, fine grained, scattered root hairs		ML			

GRAPHICAL REPRESENTATION BELOW: **Elevation : 696 ' MSL** **Surface Slope: Flat** **Trend: N-S**



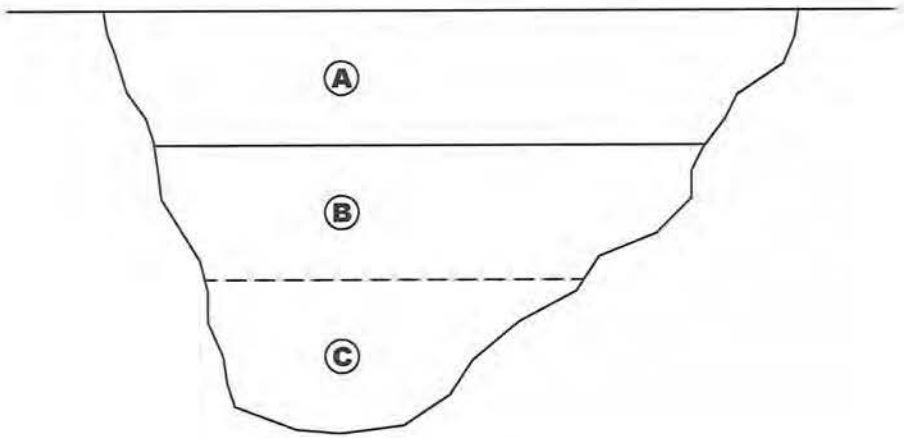
Total Depth: 10'
Groundwater: None
Backfilled: 10/31/2006

scale : 1 in = 5 ft

Project Name: Richland- Van Dam III	Logged By: SR	Trench No: TP-6	LGC
Project Number : 061103-01	Date : 10/31/2006	Engineering Properties:	
Equipment: CASE 580 Super L	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
	A	**Undocumented Artificial Fill** 0'-3.5' - sandy SILT and silty SAND, manure/organic rich soil, grayish green to dark brown, few root hairs, some gravel	Afu	ML+SM			
	B	**Quaternary Alluvial Fan Deposits** 3.5'-7' - silty SAND, light gray to green, moist, medium to fine grained, interbedding of sandy SILT layer at 5 feet.	Qyf	SM			
	C	7'-11' - sandy SILT, gray to light green, slightly porous, few caliche stringers, trace clay		ML-CL			

GRAPHICAL REPRESENTATION BELOW: **Elevation : 675 ' MSL** **Surface Slope: Flat** **Trend: N-S**



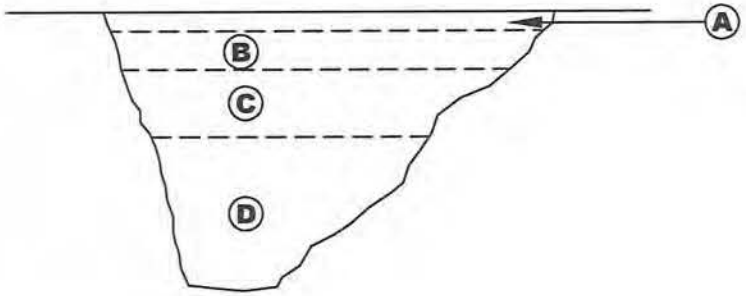
Total Depth: 11'
Groundwater: None
Backfilled: 10/31/2006

scale : 1 in = 5 ft

Project Name: Richland- Van Dam III	Logged By: SR	Trench No: TP-7	LGC
Project Number : 061103-01	Date : 10/31/2006	Engineering Properties:	
Equipment: CASE 580 Super L	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
		Quaternary Alluvial Fan Deposits	Qyf				
	A	0'-6" - silty SAND, light to medium brown, slightly moist, abundant root hairs, wood stalks, fine grained		SM-OH			
	B	6"-3' - silty SAND, light brown, slightly moist, fine grained, abundant root hairs, trace caliche		SM			
	C	3'-6.5' - silty SAND, light to medium brown, moist, root hairs up to 5 feet, fine to medium grained, few iron oxidation, trace gravel strains		SM			
	D	6.5'-9.5' - sandy SILT, light gray/green, moist, sligthly porous, few iron oxidation, caliche stringers, trace clay		ML			

GRAPHICAL REPRESENTATION BELOW: **Elevation : 690 ' MSL** **Surface Slope: Flat** **Trend: N-S**



Total Depth: 9.5'
Groundwater: None
Backfilled: 10/31/2006

scale : 1 in = 10 ft

Geotechnical Boring Log Borehole LGC-1

Date: 11/2/2006 | **Drilling Company:** 2R Drilling Incorporated

Project Name: Richland, Van Dam III | **Type of Rig:** CME-85

Project Number: 061103-01 | **Drop:** 30" | **Hole Diameter:** 8"

Elevation of Top of Hole: ~698' MSL | **Drive Weight:** 140 pounds

Hole Location: See Geotechnical Map

Logged By SR
Sampled By SR
Checked By GDS

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
695	0	B-1					SM	**Undocumented Artificial Fill (Af)** - 6" of asphalt concrete over silty SAND, reddish brown, slightly moist; medium coarse grained. Hand auger excavation up to 5 feet.	
								Quaternary Alluvial Fan Deposits (Qyf)	MD
	5		R-1	10 16 37	107.6	2.7	SM	@ 5' - silty SAND, reddish brown, slightly moist, dense; medium coarse grained	
690			R-2	7 9 9	105.3	4.2	SP-SM	@7.5' - poorly graded SAND with silt, reddish brown, moist, medium dense; medium coarse grained	SA (-#200 8%)
	10		R-3	3 4 4	101.8	2.6	SM	@10' - silty SAND, reddish brown, slightly moist, loose; medium coarse grained	CO
685									
	15		SPT-1	2 3 4		8.3	SM	@15' - silty SAND, medium brown, moist, loose; medium coarse grained	
680									
	20		R-4	8 15 25	107.5	23.8	ML	@20' - sandy SILT, reddish brown and greenish brown, moist, very stiff; abundant iron oxidation, slightly porous, few caliche stringers	
675									
	25		SPT-2	4 6 9		6.6	SM	@25' - silty SAND, medium to reddish brown, moist, medium dense; abundant iron oxidation, medium to coarse grained	
670									
	30								

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THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

SAMPLE TYPES:

B	BULK SAMPLE
R	RING SAMPLE
G	GRAB SAMPLE
SPT	STANDARD PENETRATION TEST SAMPLE

TEST TYPES:

DS	DIRECT SHEAR
MD	MAXIMUM DENSITY
SA	SIEVE ANALYSIS
S&H	SIEVE AND HYDROMETER
EI	EXPANSION INDEX
CN	CONSOLIDATION
CR	CORROSION
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
RV	R-VALUE
-#200	% PASSING # 200 SIEVE

Geotechnical Boring Log Borehole LGC-1

Date: 11/2/2006 | **Drilling Company:** 2R Drilling Incorporated

Project Name: Richland, Van Dam III | **Type of Rig:** CME-85

Project Number: 061103-01 | **Drop:** 30" | **Hole Diameter:** 8"

Elevation of Top of Hole: ~698' MSL | **Drive Weight:** 140 pounds

Hole Location: See Geotechnical Map

Logged By SR
Sampled By SR
Checked By GDS

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
	30		R-5	11 18 24	105.9	4.8	SM	@30' - silty SAND, reddish brown, moist, medium dense; medium to coarse grained	
665									
	35		SPT-3	6 8 10		13.0	ML	@35' - sandy SILT, medium to reddish brown, moist, medium dense; few coarse grains, iron oxidation	
660									
	40		R-6	5 8 16	108.4	20.4	ML	@40' - sandy SILT, reddish brown, moist, stiff, abundant iron oxidation, caliche stringers, slightly porous	
655									
	45		SPT-4	3 7 8		19.3	ML	@45' - sandy SILT, gray to light brown, moist, stiff; abundant iron oxidation, few caliche stringers	
650									
	50		R-7	21 37 43	128.7	8.3	SM	@50' silty SAND, reddish gray, moist, dense; medium to coarse grained, some iron oxidation	
645								Total Depth = 51.5' Groundwater Not Encountered Backfilled with Cuttings and Capped with 6 inches with Portland Concrete on 11/2/2006	
	55								
640									
	60								

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SAMPLE TYPES:

B	BULK SAMPLE
R	RING SAMPLE
G	GRAB SAMPLE
SPT	STANDARD PENETRATION TEST SAMPLE

TEST TYPES:

DS	DIRECT SHEAR
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SA	SIEVE ANALYSIS
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EI	EXPANSION INDEX
CN	CONSOLIDATION
CR	CORROSION
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
RV	R-VALUE
-#200	% PASSING # 200 SIEVE

Geotechnical Boring Log Borehole LGC-2

Date: 11/2/2006 | **Drilling Company:** 2R Drilling Incorporated

Project Name: Richland, Van Dam III | **Type of Rig:** CME-85

Project Number: 061103-01 | **Drop:** 30" | **Hole Diameter:** 8"

Elevation of Top of Hole: ~694' MSL | **Drive Weight:** 140 pounds

Hole Location: See Geotechnical Map

Logged By SR
Sampled By SR
Checked By GDS

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
	0						SM	**Quaternary Alluvial Fan Deposits (Qyf)** - silty SAND, light brown, slightly moist; abundant root hairs, wood stalks	
		B-1	R-1	9 10 11	98.1	2.8	SM	@2.5' - silty SAND, medium brown, slightly moist, medium dense; fine grained	MD
690	5		R-2	4 7 10	112.9	11.1	ML	@5' - sandy SILT, medium and reddish brown, slightly moist, very stiff; few coarse grained	SA-DS (-#200 60%)
			R-3	3 4 9	106.6	15.0	ML	@7.5' - sandy SILT, dark brown and light brown, medium stiff, moist; few coarse grained, slightly porous with abundant caliche stringers, trace clay	CO
685	10		R-4	7 7 10	97.6	23.8	CL	@10' - lean CLAY, greenish gray, moist, stiff; slightly porous, few iron oxidation	
680	15		SPT-1	3 5 9		6.6	SM	@15' - silty SAND, dark brown and light brown, medium dense; coarse grained, trace gravel	
675	20		R-5	6 10 12	116.7	14.0	ML	@20' - sandy SILT, green and gray, moist, medium dense; slightly porous, scattered iron oxidation, few caliche stringers, medium to coarse grained	
670	25		SPT-2	4 8 10		22.6	ML	@25' - sandy SILT, green, gray and light brown, moist, very stiff; few coarse grained, some iron oxidation, trace clay	
665	30								

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SAMPLE TYPES:

B	BULK SAMPLE
R	RING SAMPLE
G	GRAB SAMPLE
SPT	STANDARD PENETRATION TEST SAMPLE

TEST TYPES:

DS	DIRECT SHEAR
MD	MAXIMUM DENSITY
SA	SIEVE ANALYSIS
S&H	SIEVE AND HYDROMETER
EI	EXPANSION INDEX
CN	CONSOLIDATION
CR	CORROSION
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
RV	R-VALUE
-#200	% PASSING # 200 SIEVE

Geotechnical Boring Log Borehole LGC-2

Date: 11/2/2006 | **Drilling Company:** 2R Drilling Incorporated

Project Name: Richland, Van Dam III | **Type of Rig:** CME-85

Project Number: 061103-01 | **Drop:** 30" | **Hole Diameter:** 8"

Elevation of Top of Hole: ~694' MSL | **Drive Weight:** 140 pounds

Hole Location: See Geotechnical Map

Logged By SR
Sampled By SR
Checked By GDS

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
	30		R-6	18 28 50/5"	108.8	4.0	SM	silty SAND, light to reddish brown, moist, very dense; fine to coarse grained, abundant iron oxidation	
660	35							Total Depth = 31.5' Groundwater Not Encountered Backfilled with Cuttings on 11/2/2006	
655	40								
650	45								
645	50								
640	55								
635	60								

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SAMPLE TYPES:

B	BULK SAMPLE
R	RING SAMPLE
G	GRAB SAMPLE
SPT	STANDARD PENETRATION TEST SAMPLE

TEST TYPES:

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AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
RV	R-VALUE
-#200	% PASSING # 200 SIEVE

Geotechnical Boring Log Borehole LGC-3

Date: 11/2/2006 | **Drilling Company:** 2R Drilling Incorporated

Project Name: Richland, Van Dam III | **Type of Rig:** CME-85

Project Number: 061103-01 | **Drop:** 30" | **Hole Diameter:** 8"

Elevation of Top of Hole: ~681' MSL | **Drive Weight:** 140 pounds

Hole Location: See Geotechnical Map

Logged By SR
Sampled By SR
Checked By GDS

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
680	0						SM	**Undocumented Artificial Fill (Afu)** - silty SAND, light brown, slightly moist; few gravel, some root hairs	
		B-1	R-1	9 10 9	111.8	1.6	SM	**Quaternary Alluvial Fan Deposits (Qyf)** @2.5' - silty SAND, light brown, slightly moist, medium dense; few root hairs, fine to coarse grained, few gravel	
675	5		R-2	4 6 10	99.4	6.6	SM+ML	@5' - silty SAND and sandy SILT, reddish brown and light greenish gray, moist, loose and stiff; few root hairs, few coarse grained, iron oxidation, slightly porous, few caliche stringer	
			R-3	6 16 22	108.8	1.6	SP-SM	@7.5' - poorly graded SAND with silt, light brown, slightly moist, medium dense; coarse grained, few gravel	SA (-#200 7%)
670	10		R-4	8 14 8	111.5	13.0	SP+ML	@10' - poorly graded SAND and sandy SILT, moist, light brown and greenish brown, medium dense and stiff; iron oxidation, slightly porous	CO
665	15		SPT-1	4 5 8		10.2	SM	@15' - silty SAND, medium to reddish brown, moist, medium dense; iron oxidation stains, caliche stringers, slightly porous, fine grained	
660	20		R-5	8 16 24	105.8	21.0	ML	@20' - sandy SILT, greenish gray, moist, very stiff, few charcoal, some iron oxidation, few caliche stringers, trace clay	
655	25		SPT-2	4 6 12		18.2	ML	@25' - sandy SILT, greenish gray, moist, very stiff; trace clay, charcoal, iron oxidation, some caliche stringers	
	30								

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SAMPLE TYPES:

B	BULK SAMPLE
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G	GRAB SAMPLE
SPT	STANDARD PENETRATION TEST SAMPLE

TEST TYPES:

DS	DIRECT SHEAR
MD	MAXIMUM DENSITY
SA	SIEVE ANALYSIS
S&H	SIEVE AND HYDROMETER
EI	EXPANSION INDEX
CN	CONSOLIDATION
CR	CORROSION
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
RV	R-VALUE
-#200	% PASSING # 200 SIEVE

Geotechnical Boring Log Borehole LGC-3

Date: 11/2/2006 | **Drilling Company:** 2R Drilling Incorporated

Project Name: Richland, Van Dam III | **Type of Rig:** CME-85

Project Number: 061103-01 | **Drop:** 30" | **Hole Diameter:** 8"

Elevation of Top of Hole: ~681' MSL | **Drive Weight:** 140 pounds

Hole Location: See Geotechnical Map

Logged By SR
Sampled By SR
Checked By GDS

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
650	30		R-6	5 13 18	101.6	25.0	CL	@30' - lean CLAY, reddish to light brown, moist, very stiff; abundant caliche stringers, slightly porous, trace silt	
645	35		SPT-3	4 6 7		18.2	ML-CL	@35' - sandy SILT with clay, light brown and reddish brown, moist, stiff; trace coarse grained sand, abundant iron oxidation	
640	40		R-7	5 10 21	114.4	18.1	ML	@40' - sandy SILT, reddish brown, moist, medium dense and very stiff, abundant iron oxidation, medium to coarse grained	
635	45		SPT-4	4 6 12		27.5	CL	@45' - lean CLAY, reddish brown, moist, very stiff; abundant iron oxidation, few coarse grains, trace silt	
630	50		R-8	13 28 45	122.0	8.3	SM	@50' - silty SAND, reddish brown, moist, dense; abundant iron oxidation, few coarse grains, few gravel	
625	55							Total Depth = 51.5' Groundwater Not Encountered Backfilled with Cuttings on 11/2/2006	
	60								

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LGC

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SAMPLE TYPES:

B	BULK SAMPLE
R	RING SAMPLE
G	GRAB SAMPLE
SPT	STANDARD PENETRATION TEST SAMPLE

TEST TYPES:

DS	DIRECT SHEAR
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EI	EXPANSION INDEX
CN	CONSOLIDATION
CR	CORROSION
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
RV	R-VALUE
-#200	% PASSING # 200 SIEVE

Geotechnical Boring Log Borehole LGC-4

Date: 11/2/2006 | **Drilling Company:** 2R Drilling Incorporated

Project Name: Richland, Van Dam III | **Type of Rig:** CME-85

Project Number: 061103-01 | **Drop:** 30" | **Hole Diameter:** 8"

Elevation of Top of Hole: ~684' MSL | **Drive Weight:** 140 pounds

Hole Location: See Geotechnical Map

Logged By SR
Sampled By SR
Checked By GDS

Elevation (ft)	Depth (ft)	Graphic Log	Sample Number	Blow Count	Dry Density (pcf)	Moisture (%)	USCS Symbol	DESCRIPTION	Type of Test
	0							**Quaternary Alluvial Fan Deposits (Qyf)**	
680			R-1	9 15 20	110.8	1.6	SM	@2.5' - silty SAND, light brown, slightly moist, medium dense; fine grained, few coarse grains, few iron oxidation	
	5		R-2	10 19 24	109.5	17.4	CL-ML	@5' - lean CLAY with silt, light gray, moist, very stiff; few iron oxidation, slightly porous, some caliche stringers	AL
675			R-3	5 8 13	102.7	22.0	CL	@7.5' - lean CLAY, gray and grayish brown, moist, stiff; some iron oxidation, few caliche stringers, trace silt	AL
	10		R-4	6 9 9	104.0	10.3	SM	@10' - silty SAND, grayish brown , moist, medium dense; coarse grained, trace clay	CO
670									
	15		SPT-1	4 4 6		15.0	SM	@15' - silty SAND, gray, moist, loose; abundant iron oxidation, interbedding coarse and fine grained, trace clay	
665									
	20		R-5	7 10 12	86.5	31.6	CL	@20' - lean CLAY, gray to reddish brown, moist, stiff; few pores, abundant iron oxidation, few caliche stringers	AL
660								Total Depth = 21.5' Groundwater Not Encountered Backfilled with Cuttings on 11/2/2006	
	25								
655									
	30								

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SAMPLE TYPES:

B	BULK SAMPLE
R	RING SAMPLE
G	GRAB SAMPLE
SPT	STANDARD PENETRATION TEST SAMPLE

TEST TYPES:

DS	DIRECT SHEAR
MD	MAXIMUM DENSITY
SA	SIEVE ANALYSIS
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EI	EXPANSION INDEX
CN	CONSOLIDATION
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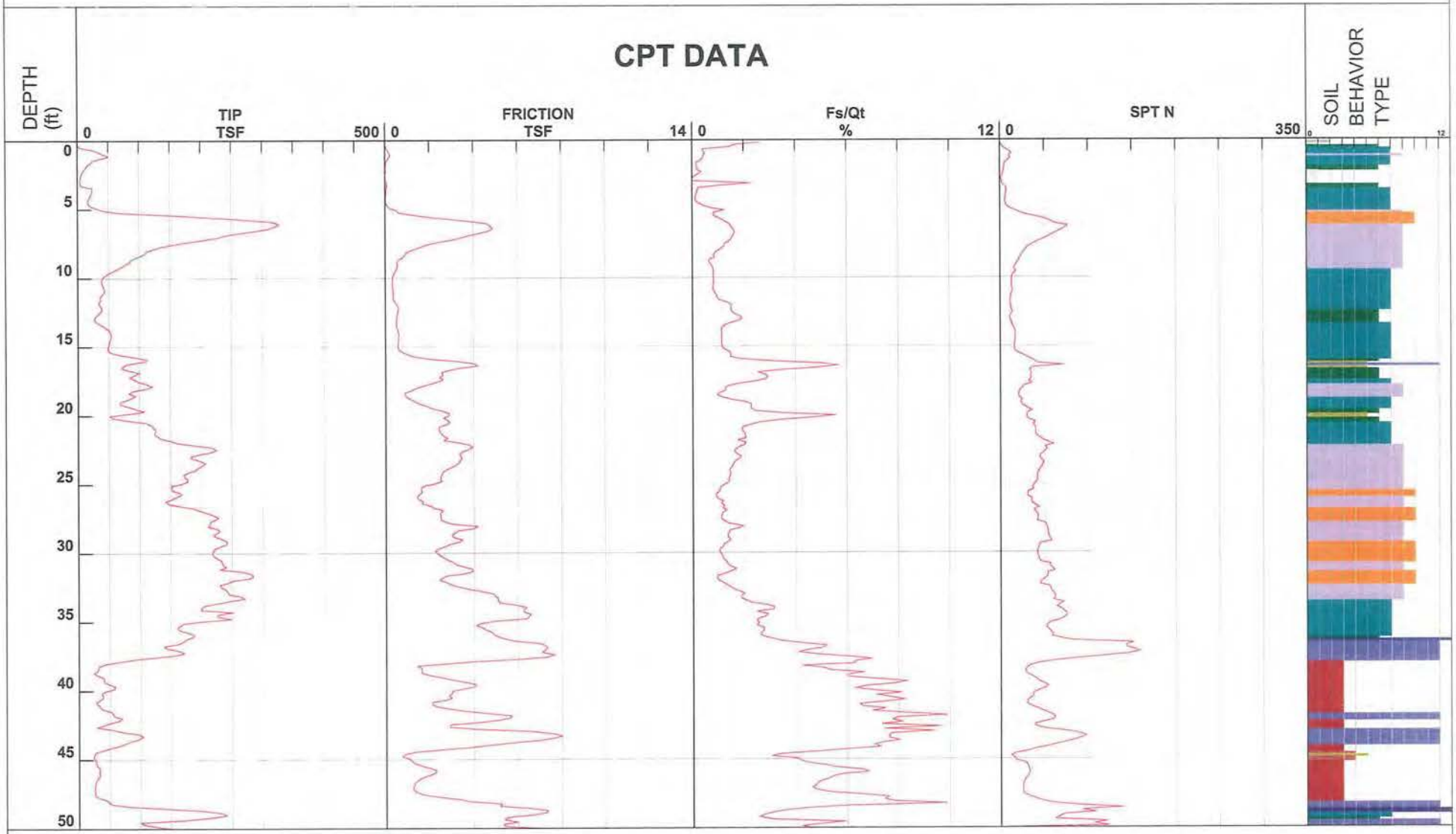
AL	ATTERBERG LIMITS
CO	COLLAPSE/SWELL
RV	R-VALUE
-#200	% PASSING # 200 SIEVE

LGC-Lawson & Associates-SC

Location	Van Dam III	Operator	ML-CW	Filename	SDF(558).cpt
Job Number	061103-01	Cone Number	DSG0705	GPS	
Hole Number	CPT-01	Date and Time	11/9/2006 8:05:23 AM	Maximum Depth	50.36 ft
Water Table Depth		120.00 ft			

CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

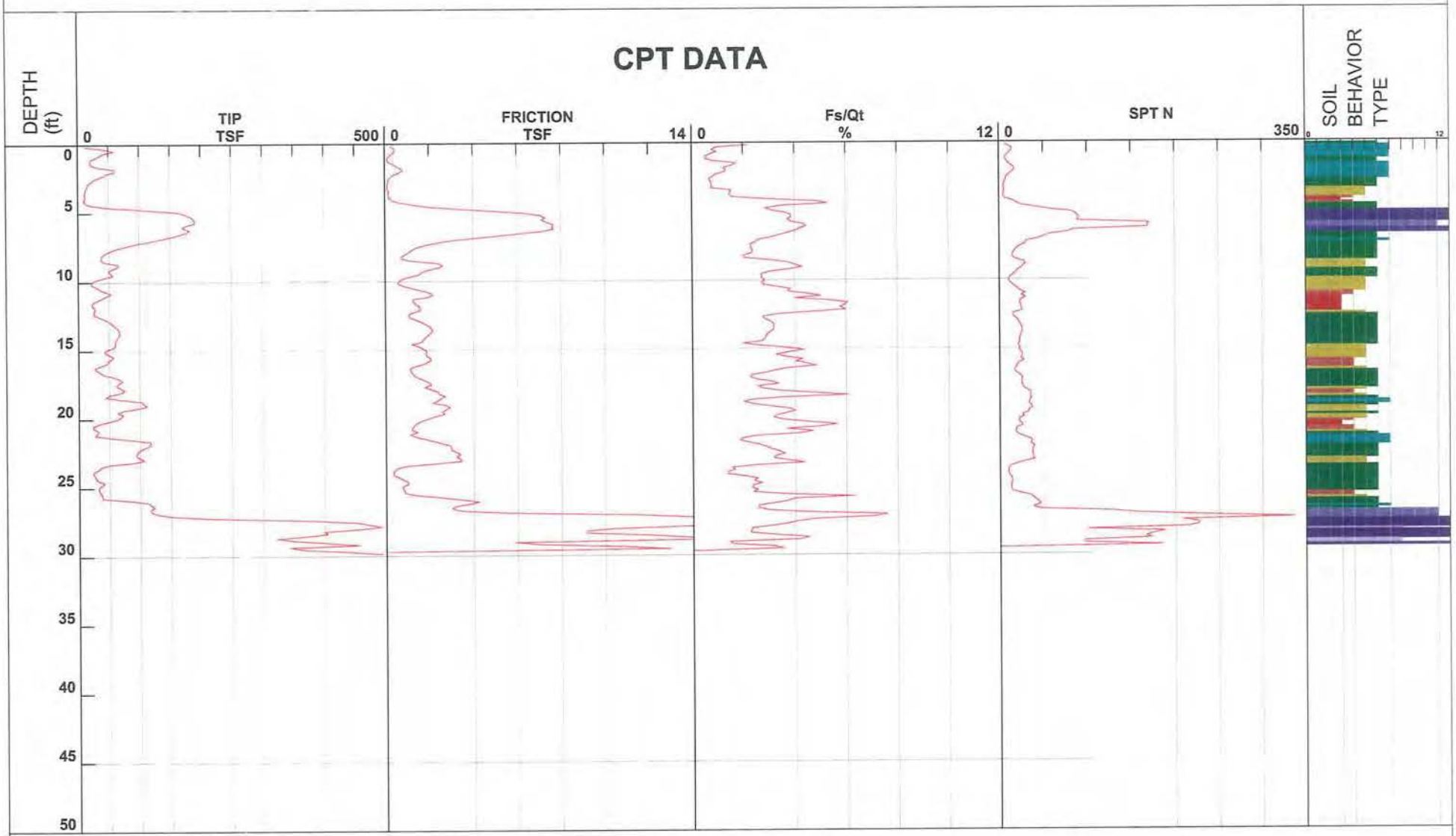
Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

LGC-Lawson & Associates-SC

Location	Van Dam III	Operator	ML-CW	Filename	SDF(560).cpt
Job Number	061103-01	Cone Number	DSG0705	GPS	
Hole Number	CPT-02	Date and Time	11/9/2006 9:52:35 AM	Maximum Depth	29.86 ft
Water Table Depth		120.00 ft			

CPT DATA



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8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

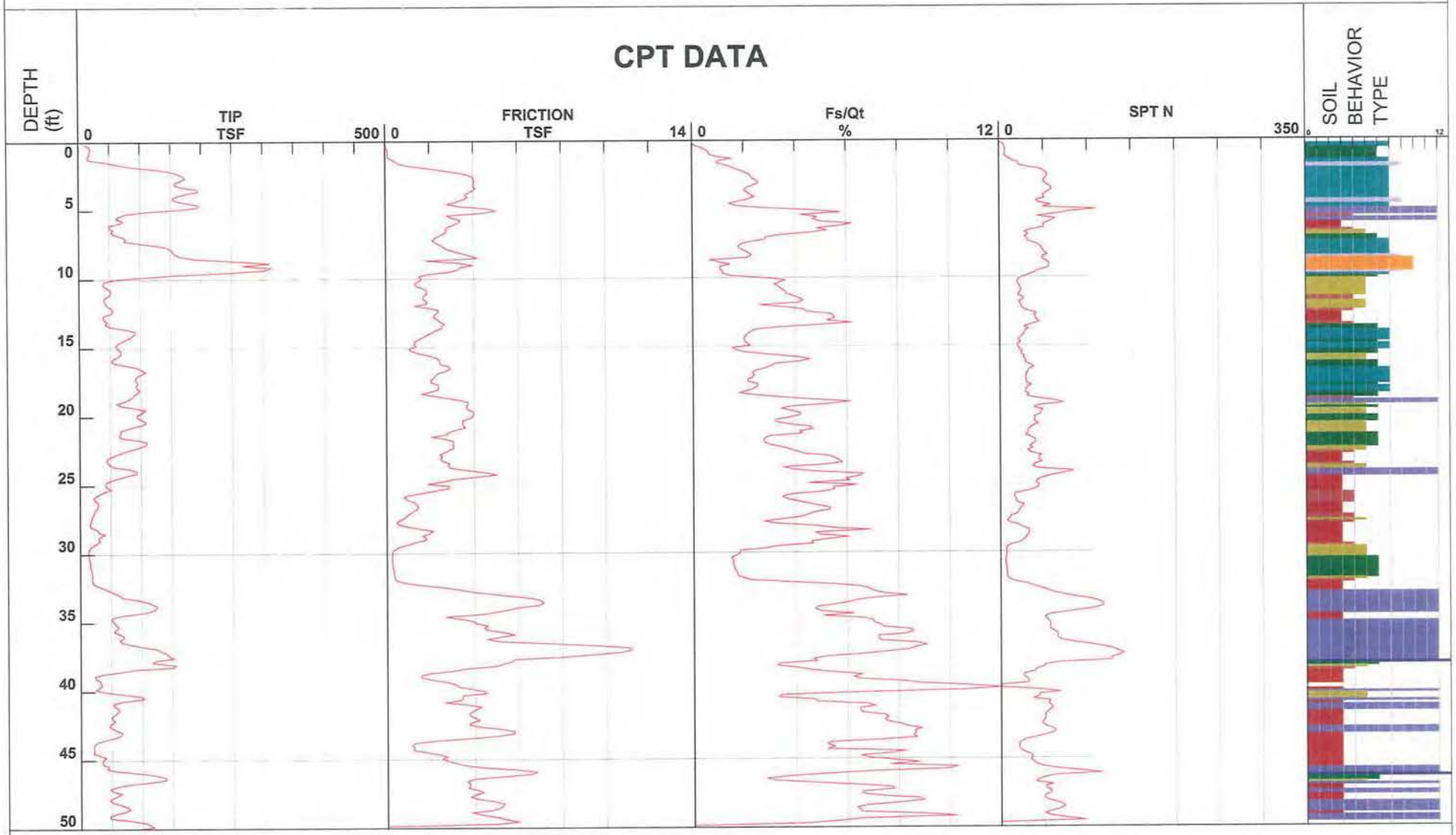
Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

LGC-Lawson & Associates-SC

Location	Van Dam III	Operator	ML-CW	Filename	SDF(559).cpt
Job Number	061103-01	Cone Number	DSG0705	GPS	
Hole Number	CPT-03	Date and Time	11/9/2006 8:53:01 AM	Maximum Depth	50.03 ft
Water Table Depth		120.00 ft			

CPT DATA



1 - sensitive fine grained
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3 - clay
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5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

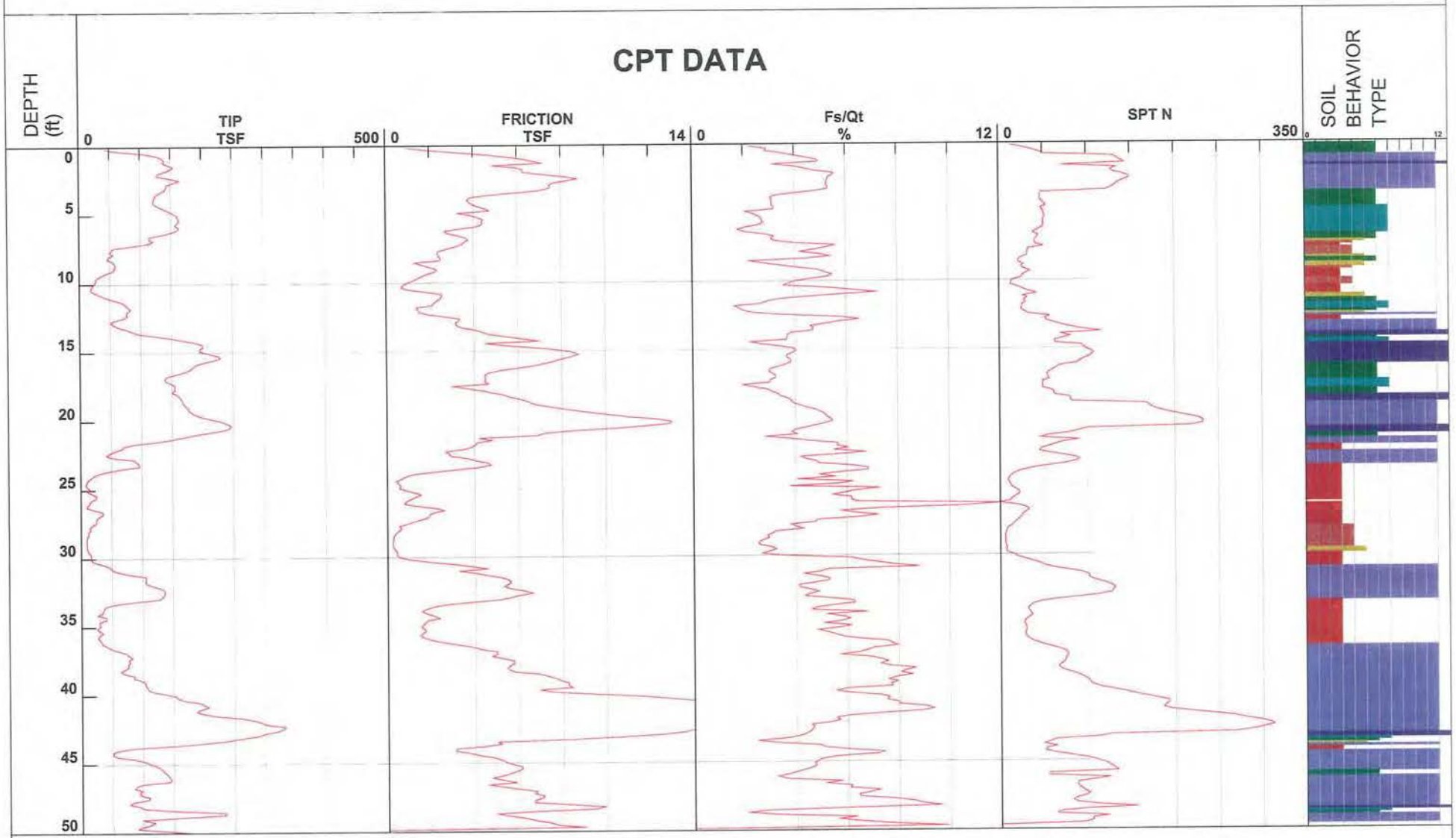
Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

LGC-Lawson & Associates-SC

Location	Van Dam III	Operator	ML-CW	Filename	SDF(563).cpt
Job Number	061103-01	Cone Number	DSG0705	GPS	
Hole Number	CPT-04	Date and Time	11/9/2006 12:18:53 PM	Maximum Depth	50.03 ft
Water Table Depth		120.00 ft			

CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

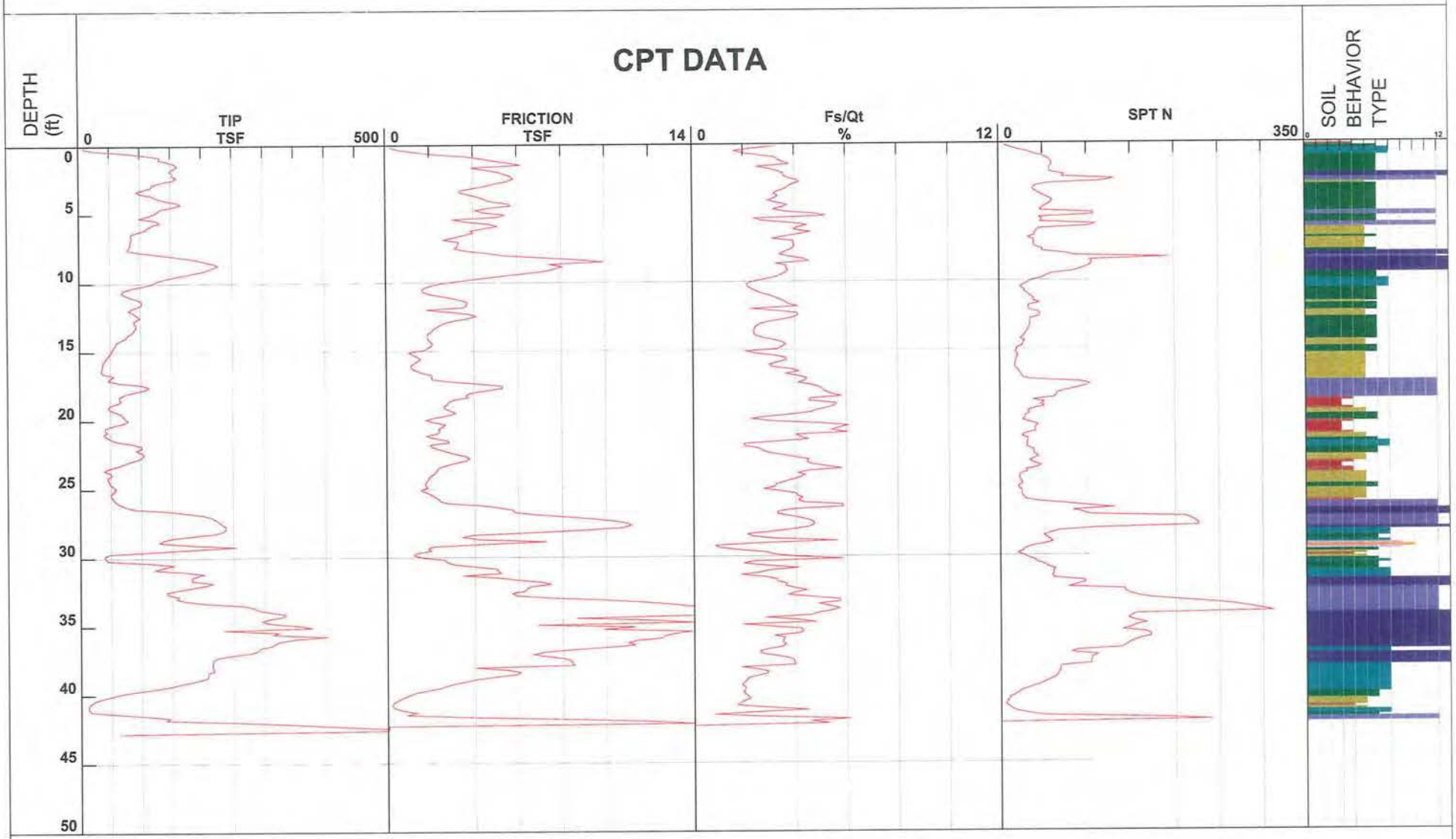
Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

LGC-Lawson & Associates-SC

Location	Van Dam III	Operator	ML-CW	Filename	SDF(561).cpt
Job Number	061103-01	Cone Number	DSG0705	GPS	
Hole Number	CPT-05	Date and Time	11/9/2006 10:34:25 AM	Maximum Depth	42.81 ft
Water Table Depth		120.00 ft			

CPT DATA



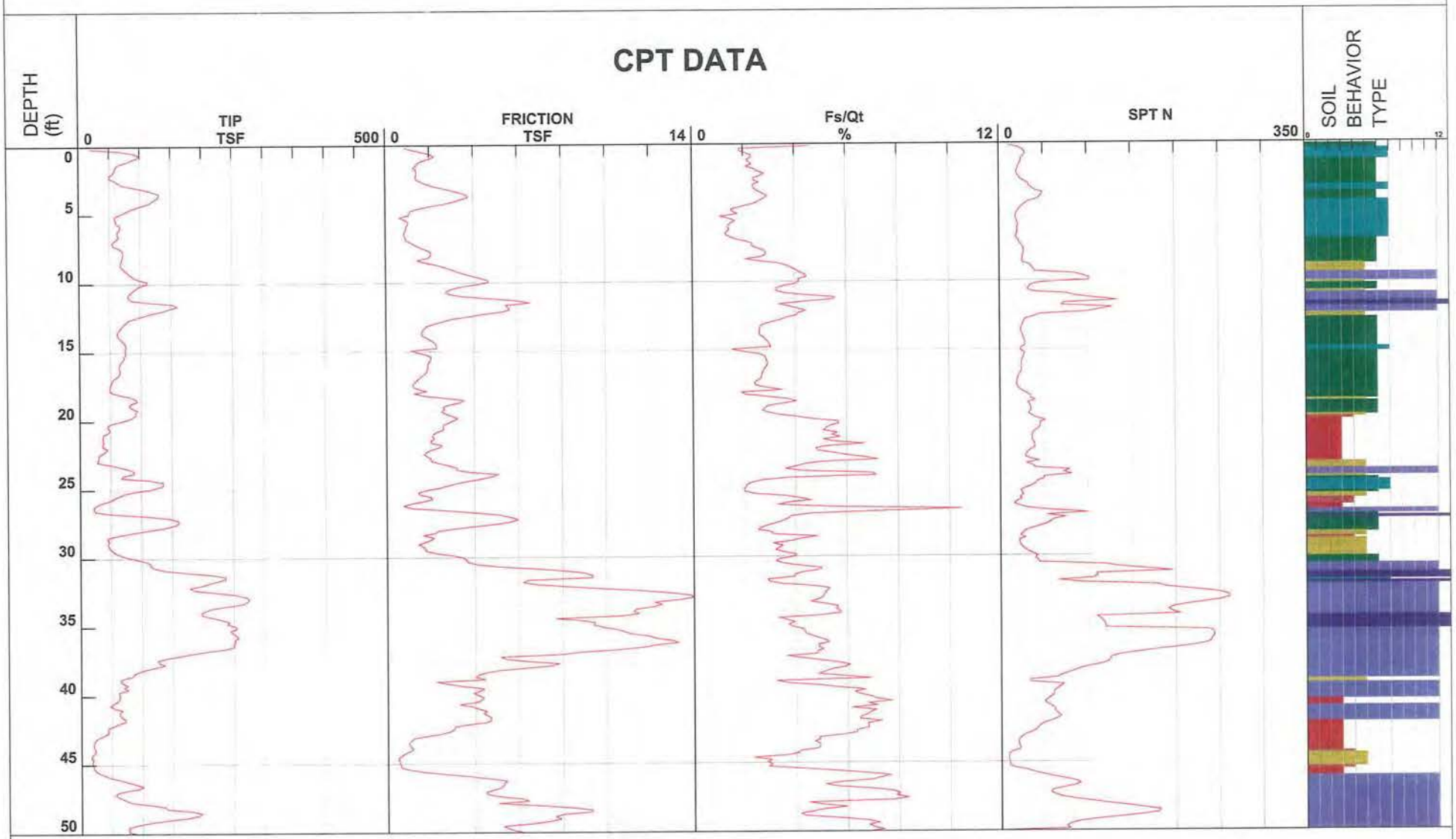
1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

LGC-Lawson & Associates-SC

Location	Van Dam III	Operator	ML-CW	Filename	SDF(562).cpt
Job Number	061103-01	Cone Number	DSG0705	GPS	
Hole Number	CPT-06	Date and Time	11/9/2006 11:28:58 AM	Maximum Depth	50.36 ft
Water Table Depth		120.00 ft			



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

Appendix C
Laboratory Test Results & Testing Procedures

APPENDIX C

Laboratory Testing Procedures and Test Results

The laboratory testing program was directed towards providing quantitative data relating to the relevant engineering properties of the soils. Samples considered representative of site conditions were tested in general accordance with American Society for Testing and Materials (ASTM) procedure and/or California Test Methods (CTM), where applicable. The following summary is a brief outline of the test type and a table summarizing the test results.

Atterberg Limits: The liquid and plastic limits ("Atterberg Limits") were determined in accordance with ASTM Test Method D4318 for engineering classification of fine-grained material and presented in the table below.

Sample Location	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	USCS Soil Classification
LGC-4 @ 5'	28	22	6	CL-ML
LGC-4 @ 7.5'	38	21	17	CL
LGC-4 @ 20'	44	24	20	CL

Grain Size Distribution: Representative samples were dried, weighed, and soaked in water until individual soil particles were separated (per ASTM D421) and then washed on a No. 200 sieve. The portion retained on the No. 200 sieve was dried and then sieved on a U.S. Standard brass sieve set in accordance with ASTM D422 (CTM 202). Where an appreciable amount of fines were encountered (greater than 20 percent passing the No. 200 sieve) a hydrometer analysis was done to determine the distribution of soil particles passing the No. 200 sieve.

Sample Location	Description	% Passing # 200 Sieve
LGC-1 @ 7.5'	Poorly Graded Sand with Silt	8%
LGC-2 @ 5.0'	Sand Silt	60%
LGC-3 @ 7.5'	Poorly Graded Sand	7%

Chloride Content: Chloride content was tested in accordance with Caltrans Test Method (CTM) 422. The results are presented below.

Sample Location	Chloride Content, ppm
TP-3 @ 7'-9'	74

Laboratory Testing Procedures and Test Results

Minimum Resistivity and pH Tests: Minimum resistivity and pH tests were performed in general accordance with CTM 643 and standard geochemical methods. The electrical resistivity of a soil is a measure of its resistance to the flow of electrical current. As a result of a decrease in resistivity, the potential for corrosion increases. The results are presented in the table below.

Sample Location	pH	Minimum Resistivity (ohms-cm)
TP-3 @ 7'-9'	9.1	1480

Soluble Sulfates: The soluble sulfate contents of selected samples were determined by standard geochemical methods (CTM 417). The soluble sulfate content is used to determine the appropriate cement type and maximum water-cement ratios. The test results are presented in the table below.

Sample Location	Sulfate Content (ppm)	Sulfate Exposure*
TP-3 @ 7'-9'	0	Negligible

* Based on the 1997 edition of the Uniform Building Code (U.B. C.), Table No. 19-A-4, prepared by the International Conference of Building Officials (ICBO, 1997).

Hydro-consolidation: Hydro-consolidation tests (collapse) were performed on selected, relatively undisturbed ring samples (ASTM D4546). Samples were placed in a consolidometer and a load approximately equal to the in-situ overburden pressure was applied. Water was then added to the sample and the percent hydro-consolidation under the applied load was measured. The percent for the load was calculated as the ratio of the amount of vertical deformation to the original sample height. The percent hydro-consolidation is presented below.

Sample Location	In-Situ Overburden (psf)	Percent Hydro-consolidation
LGC-1 @ 10.0'	1000 psf	0.65
LGC-2 @ 7.5'	1000 psf	0.06
LGC-3 @ 10.0'	1000 psf	0.23
LGC-4 @ 10.0'	1000 psf	0.73

Note: Positive values of hydro-consolidation represent collapse of the soil structure, while negative values represent heave (or swelling) or the soil structure.

Expansion Index: The expansion potential of selected samples were evaluated by the Expansion Index Test, U.B.C. Standard No. 18-2 and/or ASTM D4829. Specimens are molded under a given compactive energy to approximately the optimum moisture content and approximately 50 percent saturation or approximately 90 percent relative compaction. The prepared 1-inch-thick by 4-inch-diameter specimens are loaded to an

equivalent 144 psf surcharge and are inundated with tap water until volumetric equilibrium is reached. The results of these tests are presented in the table below.

Sample Location	Compacted Dry Density (pcf)	Expansion Index	Expansion Potential*
TP-3 @ 7'-9'	97.0	56	Medium

* Per Table 18-1-B of 1997 UBC.

Moisture and Density Determination Tests: Moisture content (ASTM D2216) and dry density determinations (ASTM D2937) were performed on relatively undisturbed samples obtained from the test borings and/or trenches. The results of these tests are presented in the boring and/or trench logs. Where applicable, only moisture content was determined from undisturbed or disturbed samples.

Maximum Density Tests: The maximum dry density and optimum moisture content of typical materials were determined in accordance with ASTM D1557. The results of these tests are presented in the table below.

Sample Location	Sample Description	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
LGC-1 @ 5'-7'	Silty Sand	110.0	7.5
LGC-2 @ 3'-5'	Silty Sand	108.0	11.0
TP-2 @ 3'-5'	Silty Sand	108.0	9.0
TP-3 @ 7'-9'	Sandy Silt	108.0	19.5
T-50 @ 4'	Silty Sand	110.0	8.5

Direct Shear: Direct shear tests were performed on selected remolded samples, which were soaked for a minimum of 24 hours under a surcharge equal to the applied normal force during testing. After transfer of the sample to the shear box, and reloading the sample, pore pressures set up in the sample due to the transfer were allowed to dissipate for a period of approximately 1 hour prior to application of shearing force. The samples were tested under various normal loads, a motor-driven, strain-controlled, direct-shear testing apparatus at a strain rate of less than 0.05 inch per minute (for sandy soil).

R-Value: The resistance R-value was determined by the ASTM D2844 for base, subbase, and basement soils. The samples were prepared and exudation pressure and R-value were determined. The graphically determined R-value at exudation pressure of 300 psi is reported in Appendix C. These results were used for pavement design purposes.

Sample Number	Sample Location	R-Value
TP-2 @ 3' – 5'	B-1	81

Project Name: Richland - Van Dam III - TT 18270
Project No.: 061103-01
Client: Richland Communities

LGC

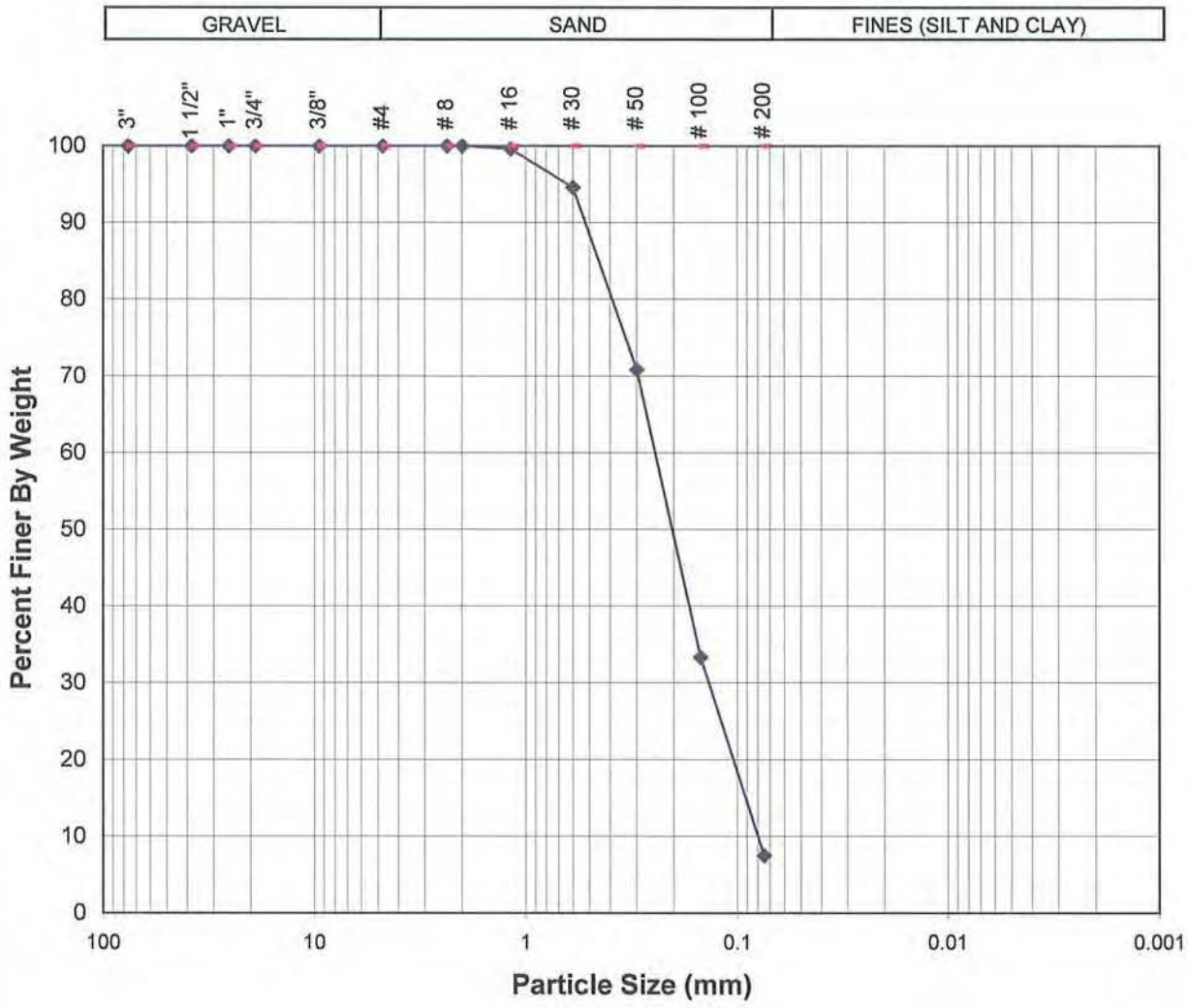
SUMMARY OF LABORATORY TEST RESULTS

Boring No.	Sample No.	Depth (ft.)	Moisture Content	Dry Density	Total Density	Atterberg Limits	Particle - Size Distribution	Modified Proctor Compaction (ASTM D 1557) Procedure A		Expansion Index	Collapse Potential	R-Value	Direct Shear Test				Corrosion Suite (Soils) CTM 532/643				Soil Identification / Classification
													Peak		Ultimate						
			ASTM D 2216	ASTM D 2937		ASTM D 4318 LL,PL,PI*	ASTM D 422 GR:SA:FI*	Maximum Dry Density	Optimum Moisture Content	ASTM D 4829	ASTM D 4546	CTM 301	Cohesion	Friction Angle	Cohesion	Friction Angle	Soil pH CTM 532/643	Chloride Content CTM 422	Sulfate Content (gravimetric) DOT CA Test 417	Min. Resistivity @ moist. Cont. CTM 532/643	ASTM D 2488 ASTM D 2487* (Group Symbol)
			(%)	(pcf)	(pcf)		(%)	(pcf)	(%)		(%)		(psf)	(deg)	(psf)	(deg)		(ppm)	(ppm)	(ohm-cm @ %)	
LGC-1	B-1	5.0-7.0						110.0	7.5												SM
	R-1	5.0	2.7	107.6	110.5																SM
	R-2	7.5	4.2	105.3	109.7		0:92:8														SP-SM
	R-3	10.0	2.6	101.8	104.4						0.65										SM
	SPT-1	15.0	8.3																		SM
	R-4	20.0	23.8	107.5	133.1																ML
	SPT-2	25.0	6.6																		SM
	R-5	30.0	4.8	105.9	111.0																SM
	SPT-3	35.0	13.0																		ML
	R-6	40.0	20.4	108.4	130.5																ML
	SPT-4	45.0	19.3																		ML
	R-7	50.0	8.3	128.7	139.4																SM
LGC-2	R-1	2.5	2.8	98.1	100.8																SM
	B-1	3.0-5.0						108.0	11.0												SM
	R-2	5.0	11.1	112.9	125.4		0:40:60						153	36	161	30					ML
	R-3	7.5	15.0	106.6	122.6						0.06										ML
	R-4	10.0	23.8	97.6	120.8																CL
	SPT-1	15.0	6.6																		SM
	R-5	20.0	14.0	116.7	133.0																ML
	SPT-2	25.0	22.6																		ML
	R-6	30.0	4.0	108.8	113.2																SM

SUMMARY OF LABORATORY TEST RESULTS

Boring No.	Sample No.	Depth (ft.)	Moisture Content	Dry Density	Total Density	Atterberg Limits	Particle - Size Distribution	Modified Proctor Compaction (ASTM D 1557) Procedure A		Expansion Index	Collapse Potential	R-Value	Direct Shear Test				Corrosion Suite (Soils) CTM 532/643				Soil Identification / Classification
													Peak		Ultimate						
			ASTM D 2216	ASTM D 2937		ASTM D 4318 LL,PL,PI[1]	ASTM D 422 GR:SA:FI[2]	Maximum Dry Density	Optimum Moisture Content	ASTM D 4829	ASTM D 4546	CTM 301	Cohesion	Friction Angle	Cohesion	Friction Angle	Soil pH CTM 532/643	Chloride Content CTM 422	Sulfate Content (gravimetric) DOT CA Test 417	Min. Resistivity @ moist. Cont. CTM 532/643	ASTM D 2488 ASTM D 2487*
			(%)	(pcf)	(pcf)		(%)	(pcf)	(%)		(%)		(psf)	(deg)	(psf)	(deg)		(ppm)	(ppm)	(ohm-cm @ %)	(Group Symbol)
LGC-3	R-1	2.5	1.6	111.8	113.6																SM
	B-1	3.0-5.0																			SM
	R-2	5.0	6.6	99.4	106.0																SM+ML
	R-3	7.5	1.6	108.8	110.5		5:88:7														SP-SM
	R-4	10.0	13.0	111.5	126.0						0.23										SP+ML
	SPT-1	15.0	10.2																		SM
	R-5	20.0	21.0	105.8	128.0																ML
	SPT-2	25.0	18.2																		ML
	R-6	30.0	25.0	101.6	127.0																CL
	SPT-3	35.0	18.2																		ML-CL
	R-7	40.0	18.1	114.4	135.1																ML
	SPT-4	45.0	27.5																		CL
	R-8	50.0	8.3	122.0	132.1																SM
LGC-4	R-1	2.5	1.6	110.8	112.6																SM
	R-2	5.0	17.4	109.5	128.6	28,22,6															CL-ML
	R-3	7.5	22.0	102.7	125.3	38,21,17															CL
	R-4	10.0	10.3	104.0	114.7						0.73										SM
	SPT-1	15.0	15.0																		SM
	R-5	20.0	31.0	86.5	113.3	44,24,20															CL
TP-2	B-1	3.0-5.0						108.0	9.0			81									SM
TP-3	B-1	7.0-9.0						108.0	19.5	56							9.1	74	0	1480	ML
TP-50	B-1	4.0						110.0	8.5												SM

[1] LL,PL,PI = Liquid Limit, Plastic Limit, Plasticity Index
[2] GR:SA:FI = Gravel: Sand: Fines (Percent Passing #200 Sieve)



Location:	Sample No.:	Depth (ft.)	Soil Type	Gravel (%)	Sand (%)	Fines (%)
LGC-1	**R-2**	**7.5**	**SP-SM**	**0**	**92**	**8**

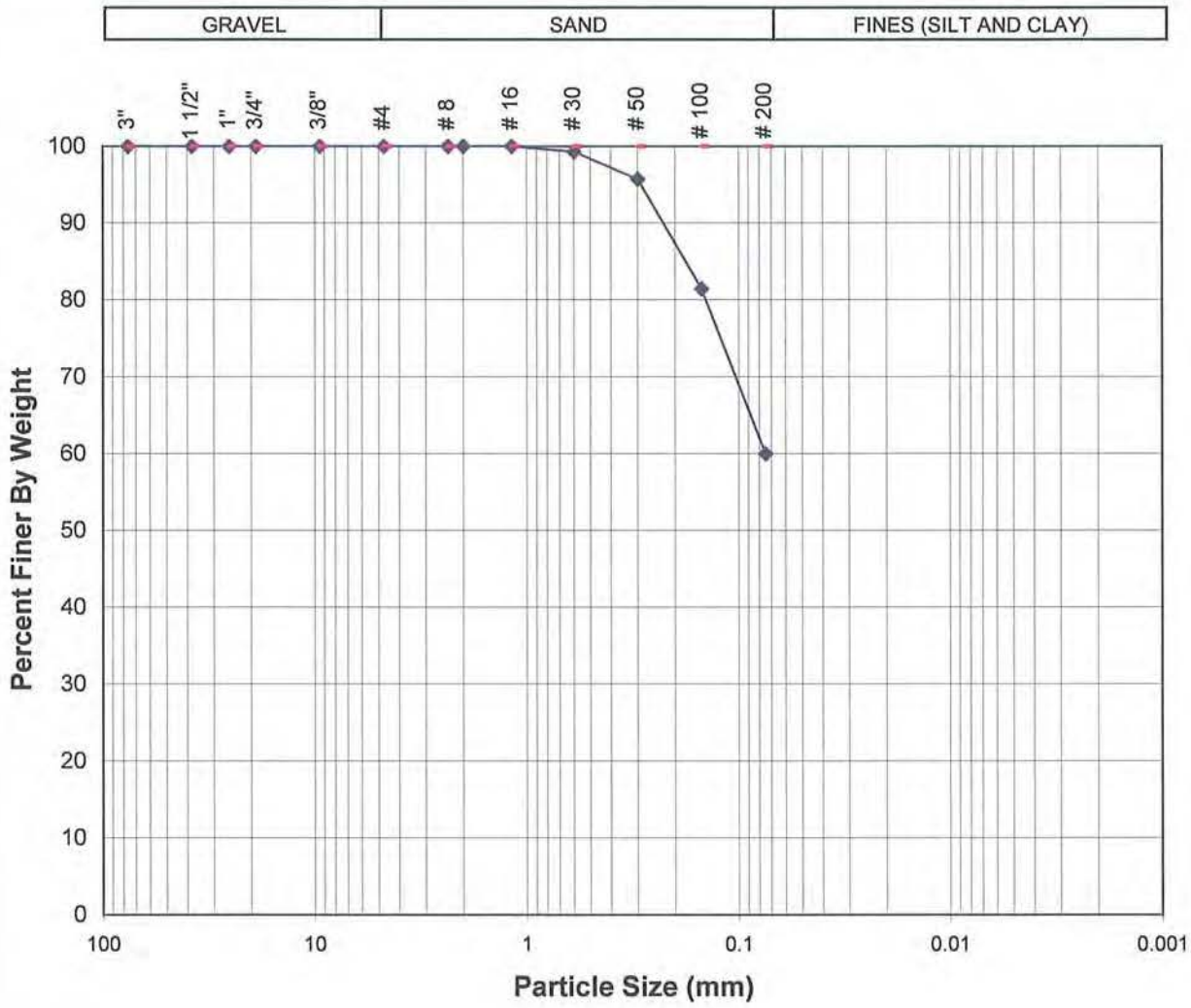
Sample Description: Poorly Graded Sand with Silt

LGC

PARTICLE SIZE ANALYSIS
(ASTM D 422)

Project Number: 061103-01
Date: Jan-07

Richland - Van Dam III



Location:	Sample No.:	Depth (ft.)	Soil Type	Gravel (%)	Sand (%)	Fines (%)
LGC-2	**R-2**	**5**	**ML**	**0**	**40**	**60**

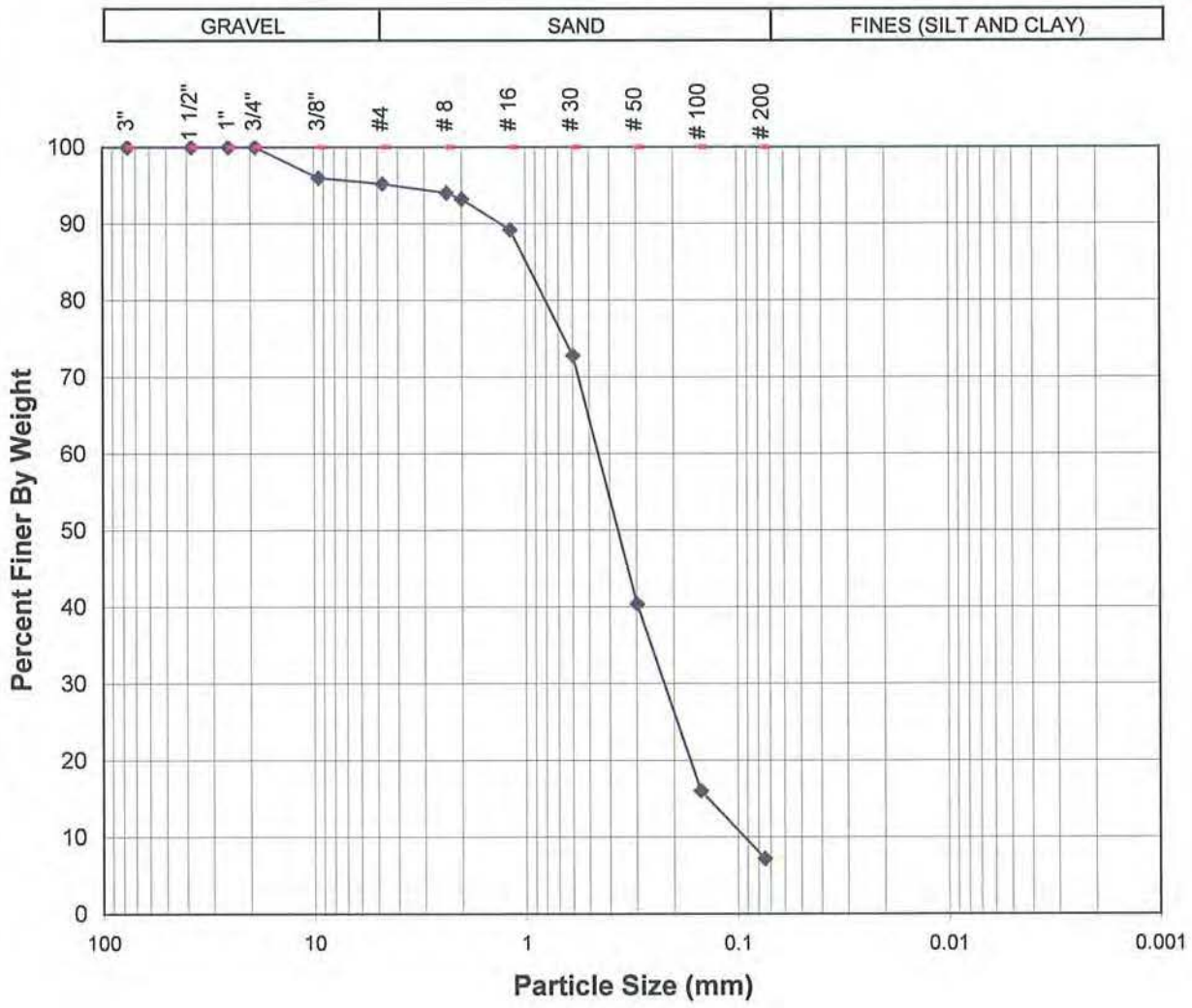
Sample Description: Sandy Silt

LGC

PARTICLE SIZE ANALYSIS
(ASTM D 422)

Project Number: 061103-01
Date: Jan-07

Richland - Van Dam III



Location:	Sample No.:	Depth (ft.)	Soil Type	Gravel (%)	Sand (%)	Fines (%)
LGC-3	**R-3**	**7.5**	**SP-SM**	**5**	**88**	**7**

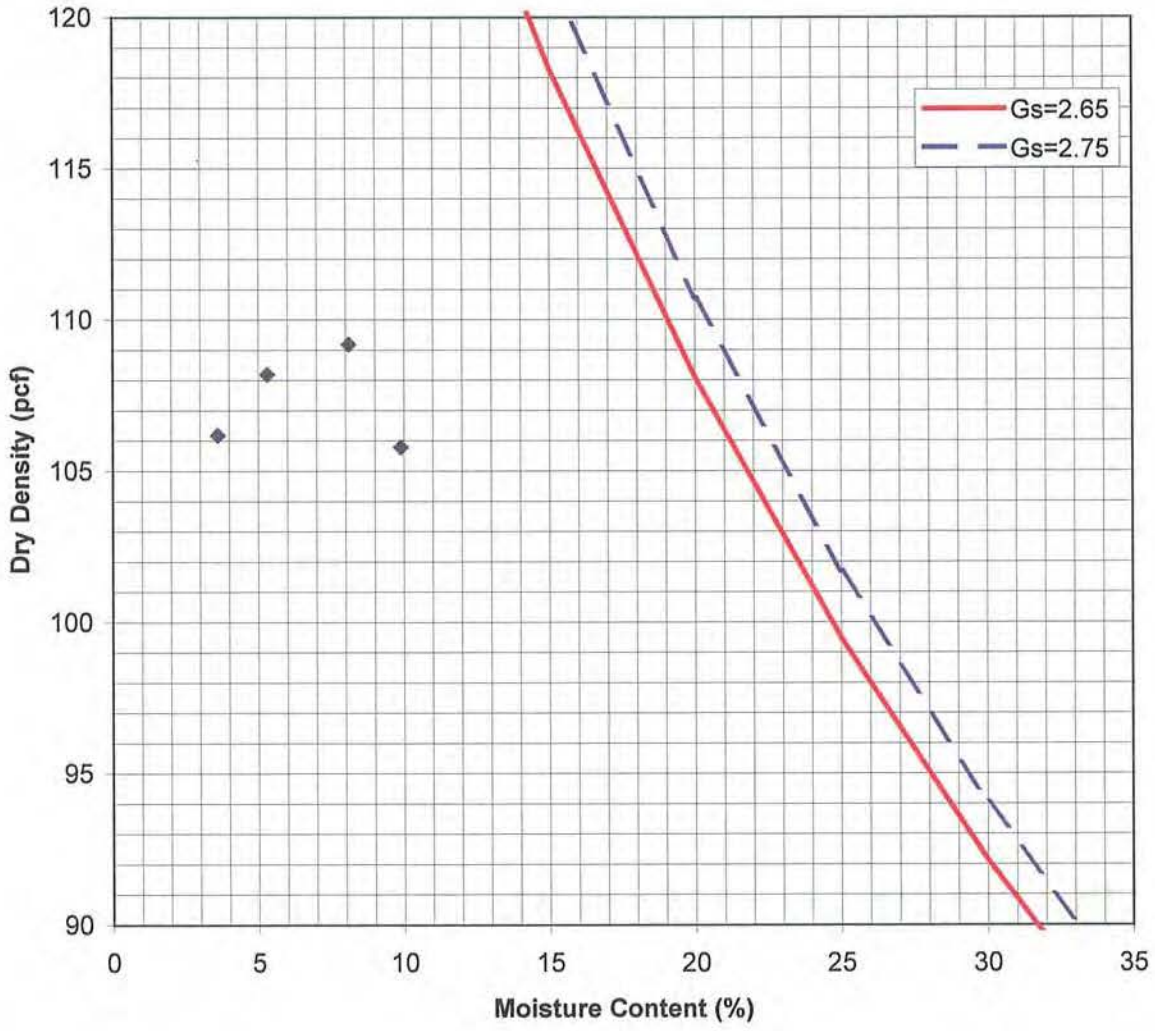
Sample Description: Poorly Graded Sand with Silt

LGC

PARTICLE SIZE ANALYSIS
(ASTM D 422)

Project Number: 061103-01
Date: Jan-07

Richland - Van Dam III



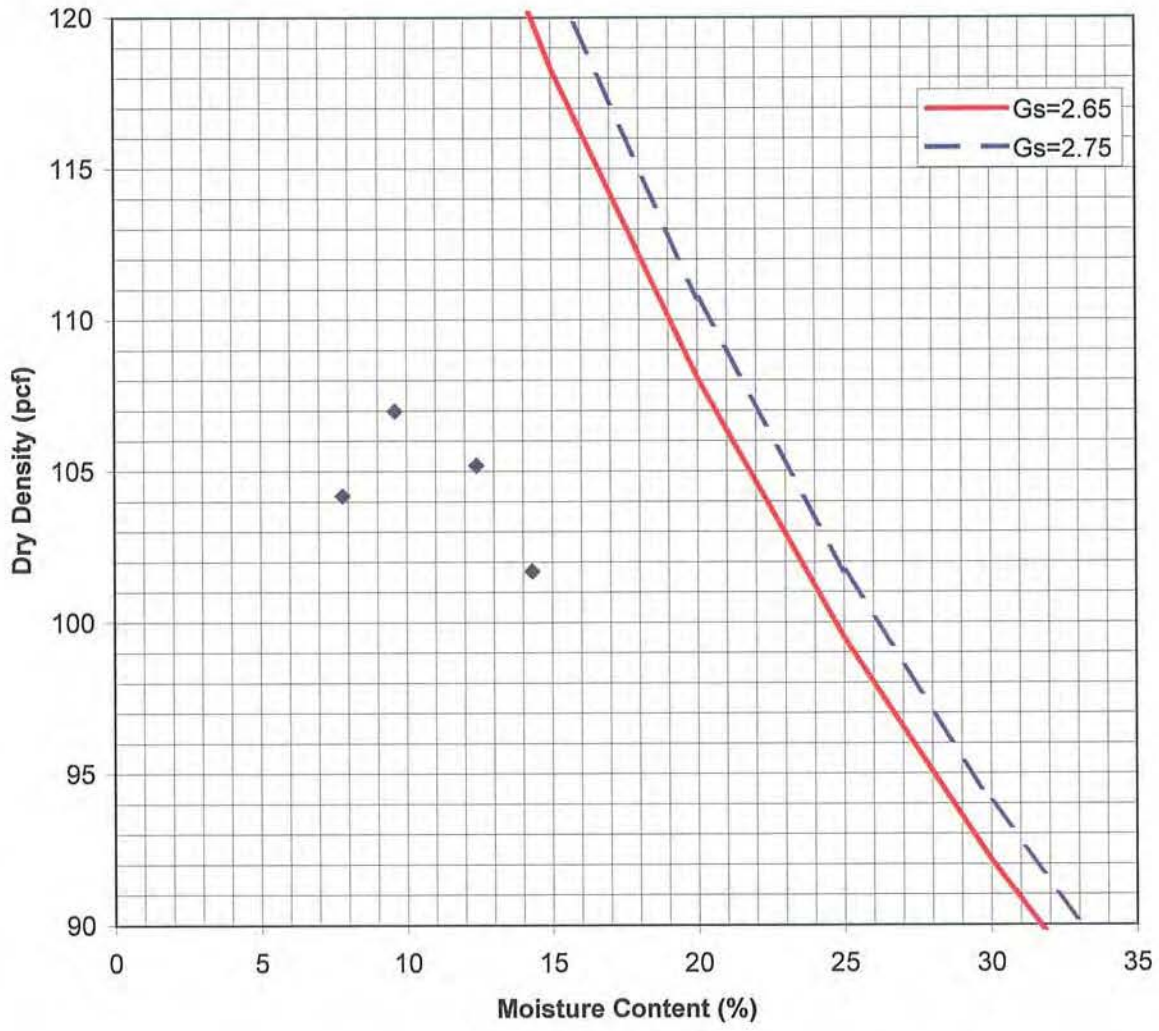
Location:	Sample No.:	Depth (ft)	Sample Description	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
LGC-1	**B-1**	**3-5**	**Silty Sand**	**110.0**	**7.5**

LGC

LABORATORY COMPACTION
(ASTM D 1557)

Project Number: 061103-01
Date: Jan-07

Richland - Van Dam III

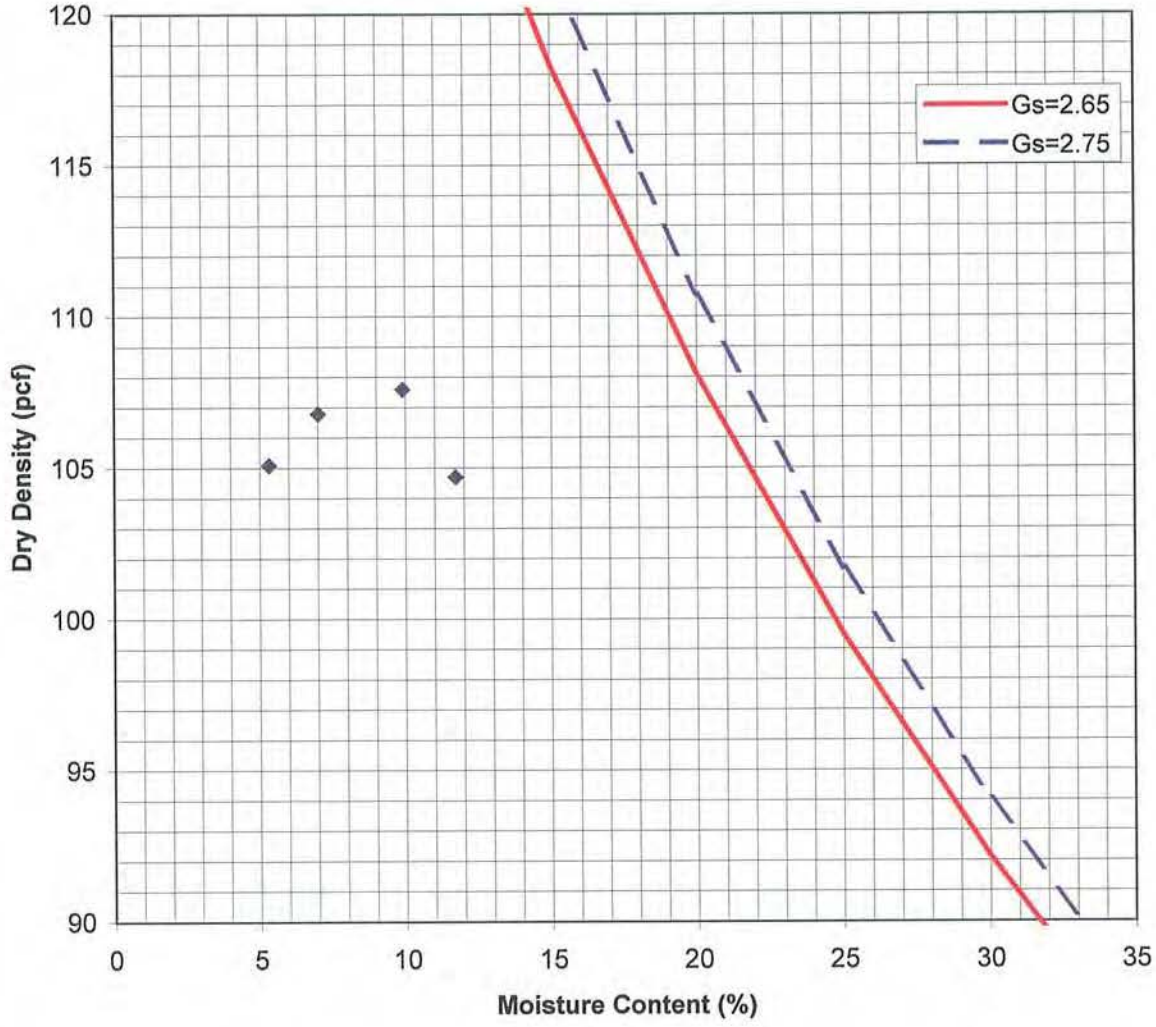


Location:	Sample No.:	Depth (ft)	Sample Description	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
LGC-2	**B-1**	**3-5**	**Silty Sand**	**108.0**	**11.0**

LGC

LABORATORY COMPACTION
(ASTM D 1557)

Project Number:	061103-01
Date:	Jan-07
Richland - Van Dam III	

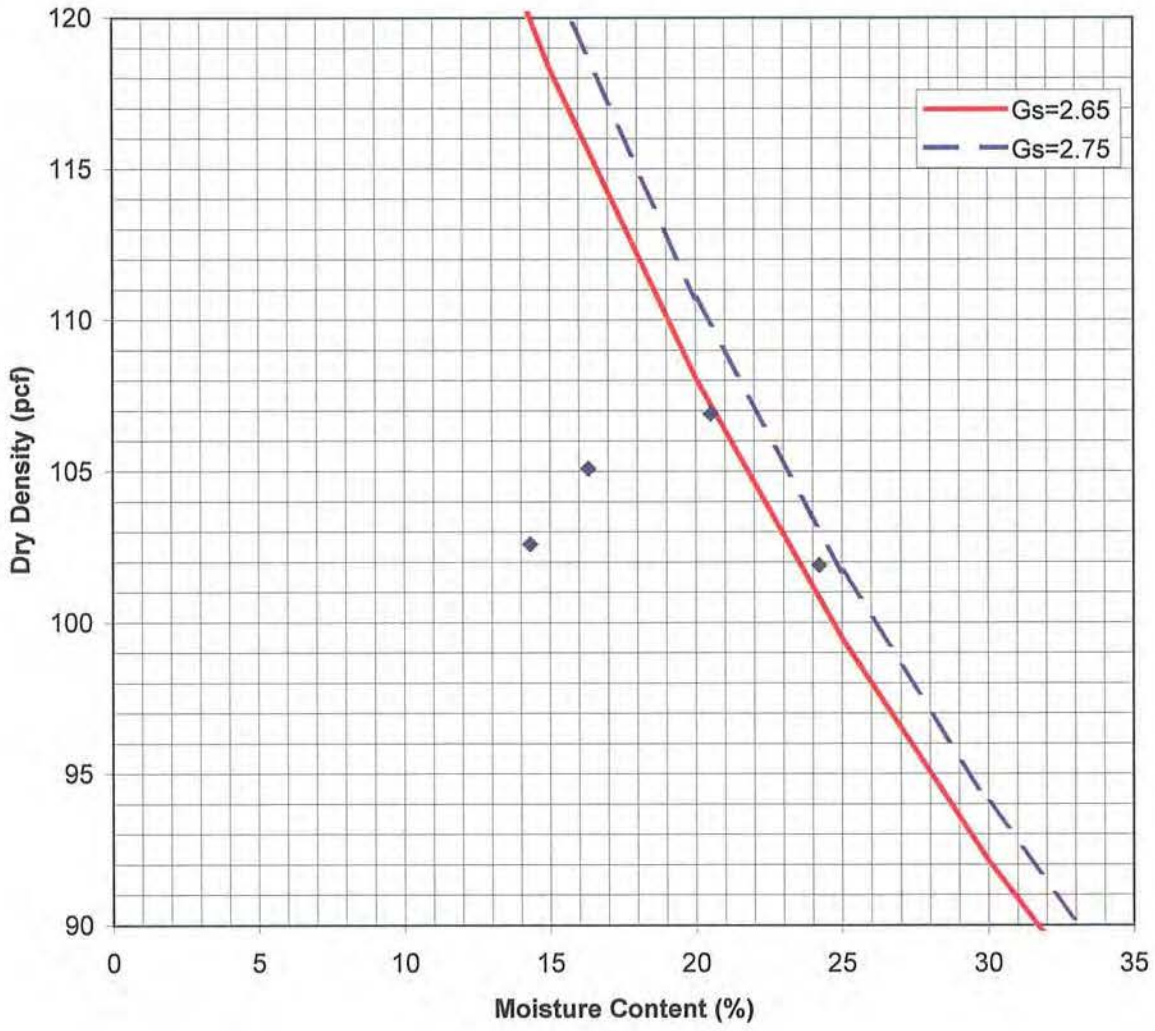


Location:	Sample No.:	Depth (ft)	Sample Description	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
TP-2	**B-1**	**3'-5'**	**Silty Sand**	**108.0**	**9.0**

LGC

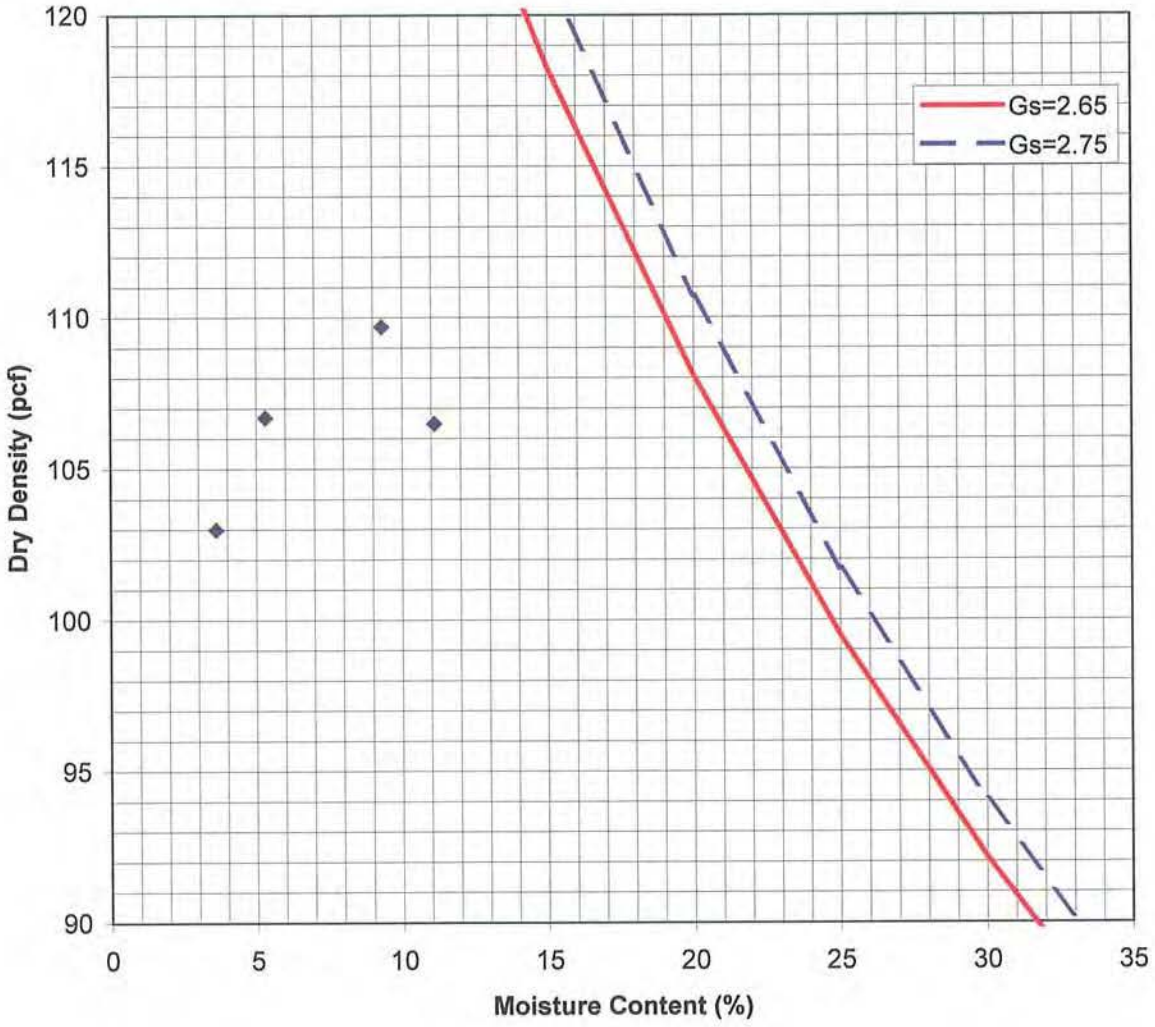
LABORATORY COMPACTION
(ASTM D 1557)

Project Number:	061103-01
Date:	Jan-07
Richland - Van Dam III	



Location:	Sample No.:	Depth (ft)	Sample Description	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
TP-3	**B-1**	**7-9**	**Sandy Silt**	**108.0**	**19.5**

LGC	**LABORATORY COMPACTION** (ASTM D 1557)	**Project Number:** 061103-01 **Date:** Jan-07 **Richland - Van Dam III**



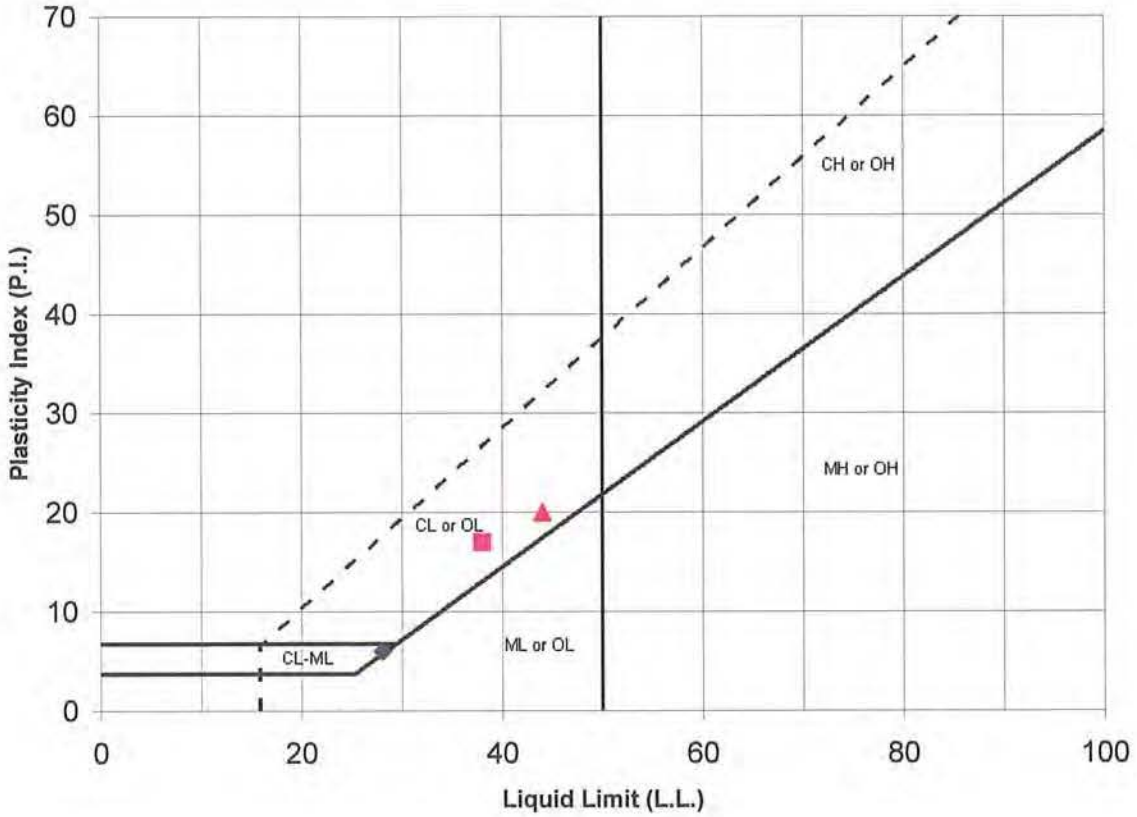
Location:	Sample No.:	Depth (ft)	Sample Description	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
T-50	**B-1**	**4**	**Silty Sand**	**110.0**	**8.5**

LGC

LABORATORY COMPACTION
(ASTM D 1557)

Project Number:	061103-01
Date:	Jan-07
Richland - Van Dam III	

PLASTICITY CHART - CLASSIFICATION OF FINE-GRAINED SOILS



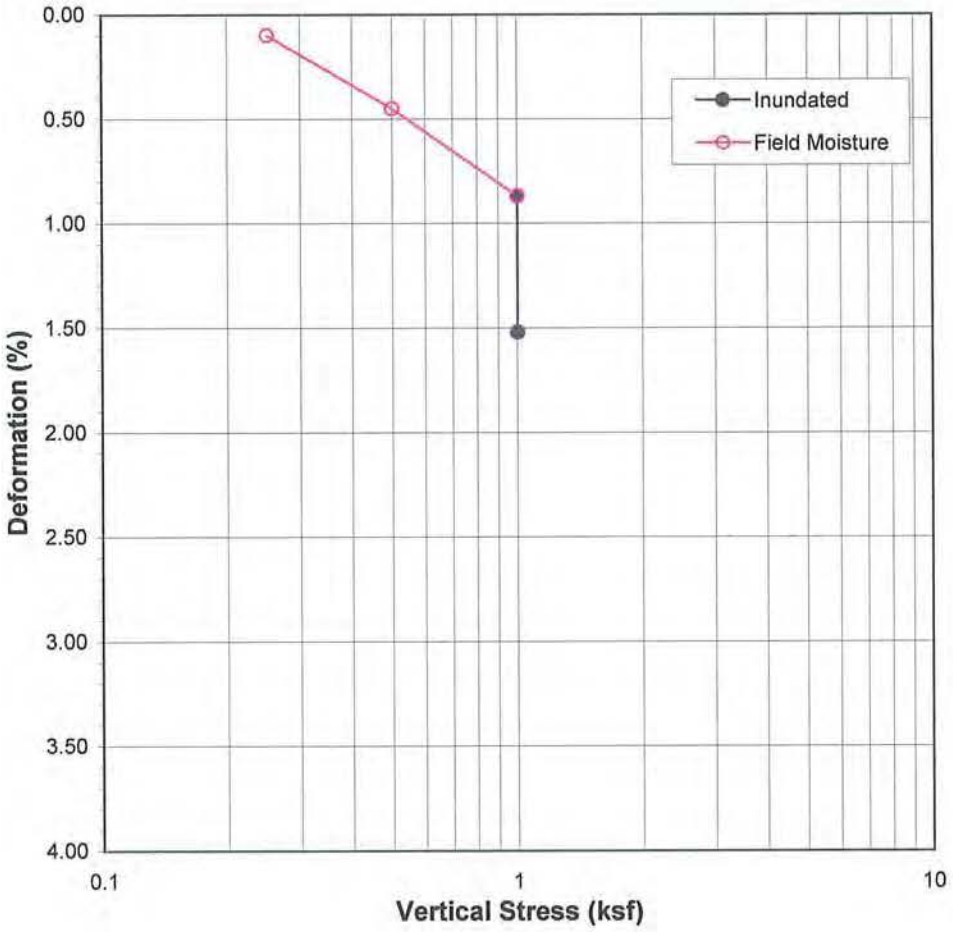
Symbol	Location.:	Sample No.:	Depth (ft)	Passing No. 200 Sieve (%)	Liquid Limit (%) LL	Plastic Limit (%) PL	Plasticity Index (%) PI	USCS
◆	LGC-4	R-2	5	-	28	22	6	CL-ML
■	LGC-4	R-3	7.5	-	38	21	17	CL
▲	LGC-4	R-5	20	-	44	24	20	CL

LGC

ATTERBERG LIMITS
(ASTM D 4318)

Project Number: 061103-01
Date: Jan-07

Richland - Van Dam III

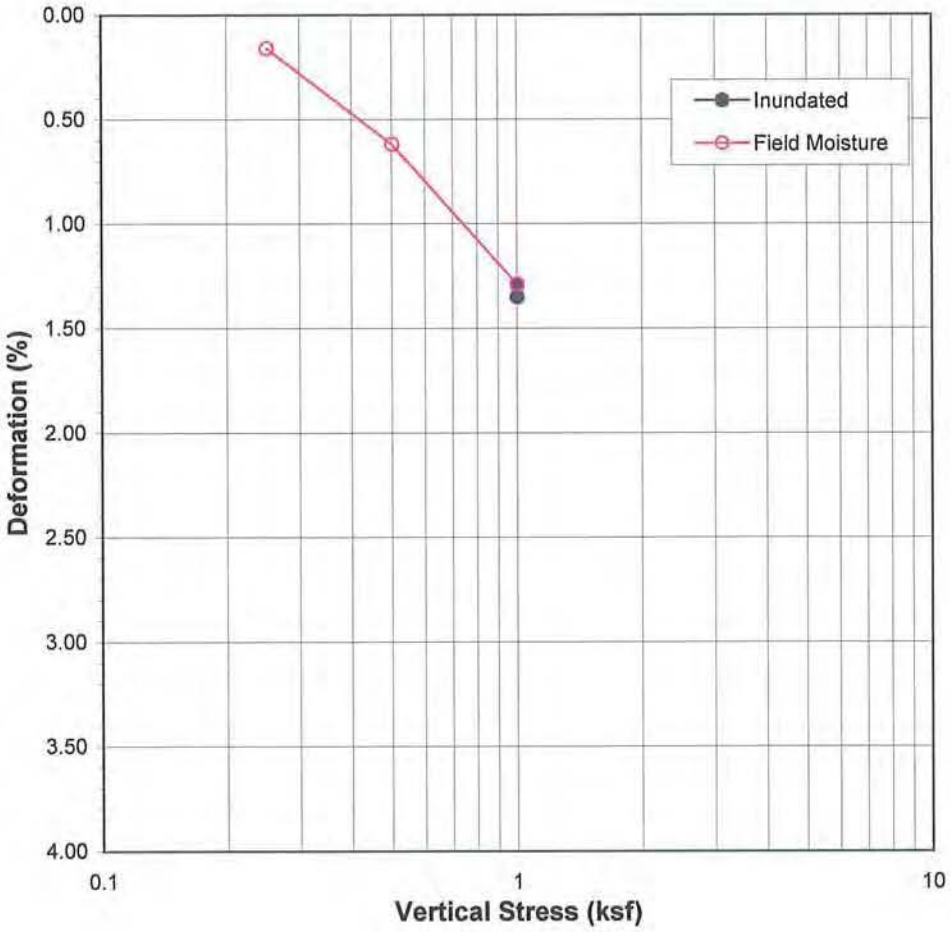


Percent Swell / Settlement After Inundation = 0.65

Location:	Sample No.:	Depth (ft)	Degree of Saturation (%)	Dry Density (pcf)	Initial Moisture Content (%)	Final Moisture Content (%)
LGC-1	**R-3**	**10**	**11**	**101.8**	**2.6**	**22.6**

Sample Description: Silty Sand

LGC	**ONE-DIMENSIONAL SETTLEMENT / SWELL**	**Project Number:** 061103-01 **Date:** Jan-07
		Richland - Van Dam III

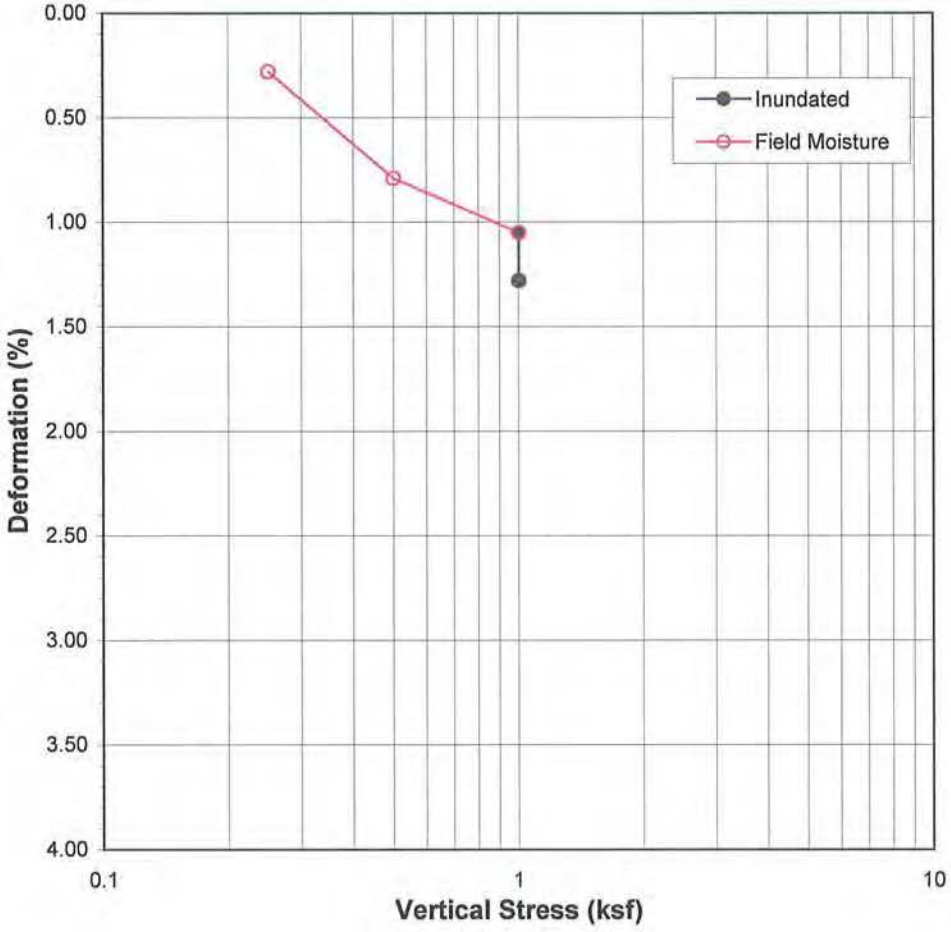


Percent Swell / Settlement After Inundation = 0.06

Location:	Sample No.:	Depth (ft)	Degree of Saturation (%)	Dry Density (pcf)	Initial Moisture Content (%)	Final Moisture Content (%)
LGC-2	**R-3**	**7.5**	**70**	**106.6**	**15.0**	**25.0**

Sample Description: Sandy Silt

LGC	**ONE-DIMENSIONAL SETTLEMENT / SWELL**	**Project Number:** 061103-01 **Date:** Jan-07 **Richland - Van Dam III**

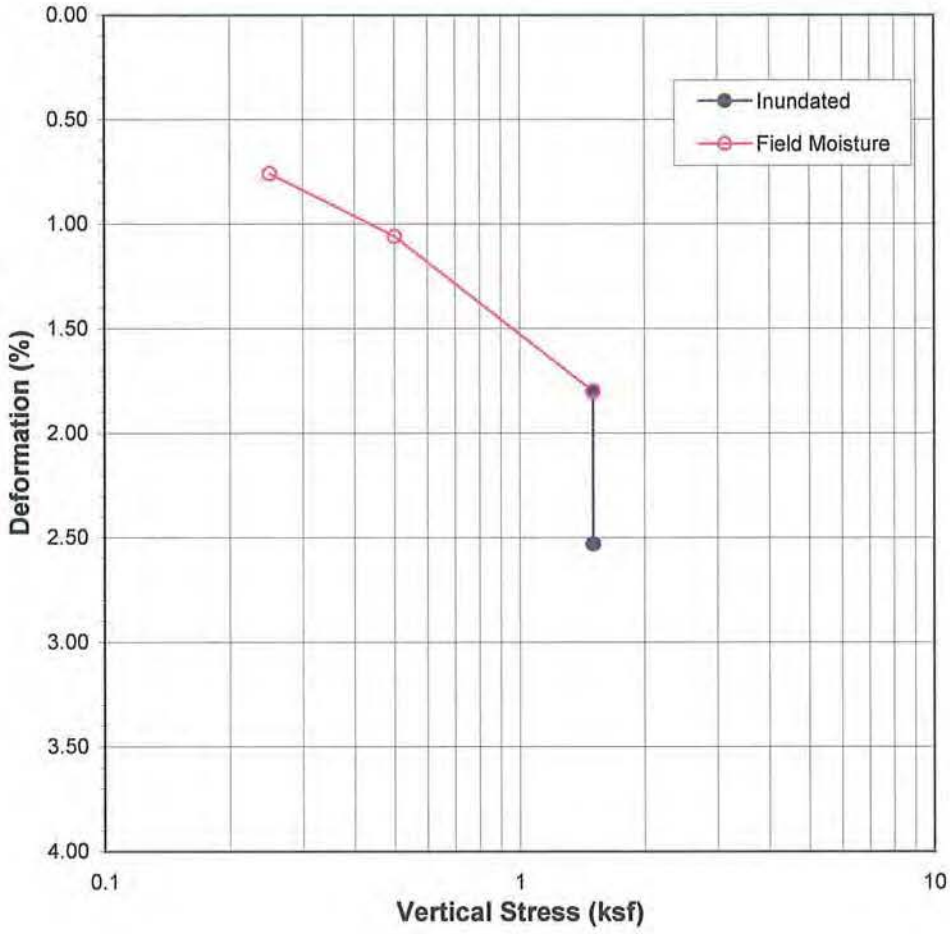


Percent Swell / Settlement After Inundation = 0.23

Location:	Sample No.:	Depth (ft)	Degree of Saturation (%)	Dry Density (pcf)	Initial Moisture Content (%)	Final Moisture Content (%)
LGC-3	**R-4**	**10**	**69**	**111.5**	**13.0**	**26.4**

Sample Description: Sandy Silt

LGC	**ONE-DIMENSIONAL SETTLEMENT / SWELL**	**Project Number:** 061103-01 **Date:** Jan-07 **Richland - Van Dam III**

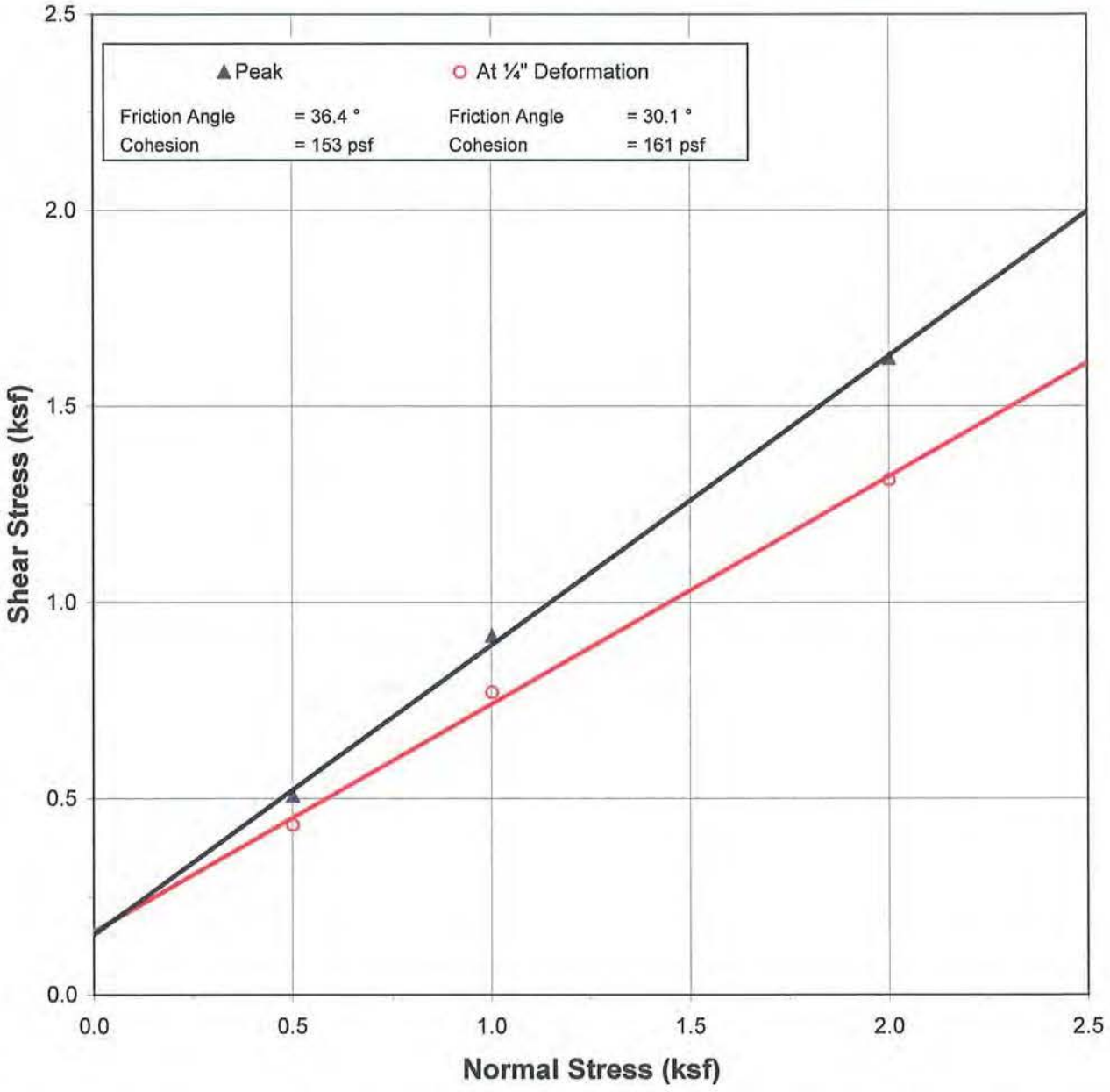


Percent Swell / Settlement After Inundation = 0.73

Location:	Sample No.:	Depth (ft)	Degree of Saturation (%)	Dry Density (pcf)	Initial Moisture Content (%)	Final Moisture Content (%)
LGC-4	**R-4**	**10**	**45**	**104.0**	**10.3**	**19.2**

Sample Description: Silty Sand

LGC	**ONE-DIMENSIONAL SETTLEMENT / SWELL**	**Project Number:** 061103-01 **Date:** Jan-07 **Richland - Van Dam III**



Location:	Sample No.:	Depth (ft)	Sample Type	Shear Rate (inch/min)	Dry Density (pcf)	Initial Moisture Content (%)	Final Moisture Content (%)
LGC-2	**R-2**	**5**	**Driven**	**0.001**	**106.6**	**15.0**	**23.5**

Sample Description: Sandy Silt

LGC	**DIRECT SHEAR PLOT**	**Project Number:** 061103-01 **Date:** Jan-07 **Richland - Van Dam III**

Location	Sample No.	Depth (ft)	Molding Moisture Content (%)	Initial Dry Density (pcf)	Final Moisture Content (%)	Expansion Index	Expansion Classification[1]
TP-3	B-1	9	13.6	97.0	30.1	56	Medium

[1] 1997 U.B.C. / 2001 C.B.C. Table 18-I-B

LGC

EXPANSION INDEX
(ASTM D 4829)

Project Number:	061103-01
Date:	Jan-07

Richland - Van Dam III

Leighton

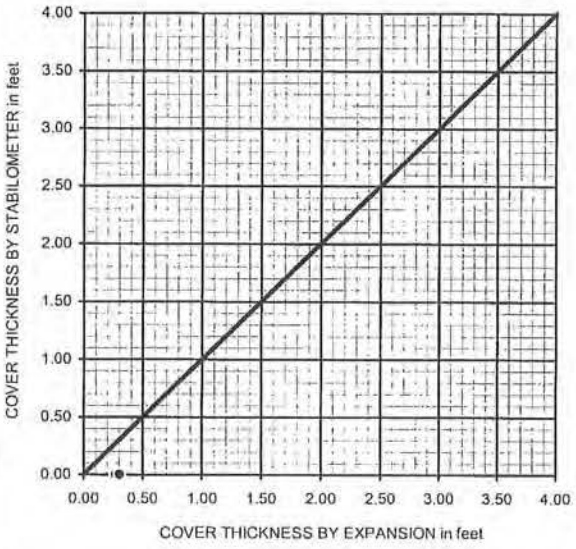
R-VALUE TEST RESULTS

PROJECT NAME:	Richland - Van Dam III	PROJECT NUMBER:	064403-01
SAMPLE NUMBER:	B-1	SAMPLE LOCATION:	TP-2 @ 3'-5'
SAMPLE DESCRIPTION:	Si.Sa.	TECHNICIAN:	SCF
		DATE COMPLETED	11/27/2006

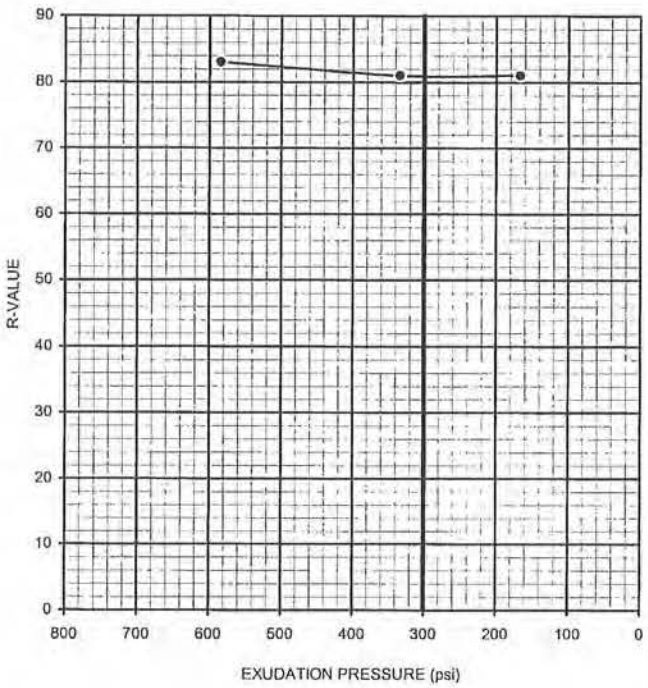
TEST SPECIMEN	a	b	c
MOISTURE AT COMPACTION %	11.8	12.6	13.0
HEIGHT OF SAMPLE, Inches	2.56	2.48	2.62
DRY DENSITY, pcf	106.0	105.8	106.1
COMPACTOR PRESSURE, psi	275	175	125
EXUDATION PRESSURE, psi	584	334	167
EXPANSION, Inches x 10exp-4	0	0	0
STABILITY Ph 2,000 lbs (160 psi)	17	19	20
TURNS DISPLACEMENT	4.27	4.39	4.51
R-VALUE UNCORRECTED	83	81	80
R-VALUE CORRECTED	83	81	81

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT FACTOR	1.0	1.0	1.0
TRAFFIC INDEX	5.0	5.0	5.0
STABILOMETER THICKNESS, ft.	0.27	0.30	0.30
EXPANSION PRESSURE THICKNESS, ft.	0.00	0.00	0.00

EXPANSION PRESSURE CHART



EXUDATION PRESSURE CHART



R-VALUE BY EXPANSION:	n/a
R-VALUE BY EXUDATION:	81
EQUILIBRIUM R-VALUE:	81

Electrochemical Suite (Results)

pH/Resistivity (CTM 643), Sulfate (CTM 417), Chloride (CTM 422)

Project # I02111-061103-01 **Project Name:** Richland - Van Dam III **Track:** _____

Sample #	B-1						NAVFAC / UBC Corrosion Potentials
Lot #	TP-3						
Loc. / Rep'd Lots:							
Depth (ft.):	7-9						
Description:							
Min. Resistivity (Ω-cm)	1480 HIGH	na	na	na	na	na	Ω > 10,000 Seldom 5,000 - 10,000 Mild 2,000 - 5,000 Moderate 1,000 - 2,000 High Ω < 1,000 Very High
pH (round down 0.1)	9.1 MILD	na	na	na	na	na	pH > 6.5 Mild 6.0 - 6.5 Moderate 4.5 - 6 High pH < 4.5 Very High
Chloride (ppm)	74 MODERATE	na	na	na	na	na	ppm < 500 Moderate ppm > 500 High
Sulfate (% by wt.)	0.000 NEGLIGIBLE	na	na	na	na	na	Net NTU < 0.1 Negligible 0.1 - 0.2 Moderate 0.2 - 2.0 Severe Net NTU > 2 Very Severe
Chloride: Endpoint(mL):	0.7	-	-	-	-	-	
Chloride: Normality:	0.02	0	0	0	0	0	
Chloride: Sample Vol.:	20	0	0	0	0	0	
Sulfate: Dilution 1:_	5	5	5	5	5	5	
Sulfate: Blank (NTU):	14	-	-	-	-	-	
Sulfate: Test (NTU):	14						
Expected Lifetime of Steel Culverts: 18 ga.=	29 Years						
16 ga.=	38						
14 ga.=	46						
12 ga.=	64						
10 ga.=	82						
8 ga.=	99						

Completion Date:
11/24/06
Technicians:
CJB

LGC INLAND

CJB for LGC, Inland 2006
na = not analyzed

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APPENDIX C

GENERAL EARTHWORK AND GRADING SPECIFICATIONS

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APPENDIX C

GENERAL EARTHWORK AND GRADING SPECIFICATIONS

C-1.00 GENERAL DESCRIPTION

C-1.01 Introduction

These specifications present our general recommendations for earthwork and grading as shown on the approved grading plans for the subject project. These specifications shall cover all clearing and grubbing, removal of existing structures, preparation of land to be filled, filling of the land, spreading, compaction and control of the fill, and all subsidiary work necessary to complete the grading of the filled areas to conform with the lines, grades and slopes as shown on the approved plans.

The recommendations contained in the geotechnical report of which these general specifications are a part of shall supersede the provisions contained hereinafter in case of conflict.

C-1.02 Laboratory Standard and Field Test Methods

The laboratory standard used to establish the maximum density and optimum moisture shall be ASTM D1557.

The insitu density of earth materials (field compaction tests) shall be determined by the sand cone method (ASTM D1556), direct transmission nuclear method (ASTM D6938) or other test methods as considered appropriate by the geotechnical consultant.

Relative compaction is defined, for purposes of these specifications, as the ratio of the in-place density to the maximum density as determined in the previously mentioned laboratory standard.

C-2.00 CLEARING

C-2.01 Surface Clearing

All structures marked for removal, timber, logs, trees, brush and other rubbish shall be removed and disposed of off the site. Any trees to be removed shall be pulled in such a manner so as to remove as much of the root system as possible.

C-2.02 Subsurface Removals

A thorough search should be made for possible underground storage tanks and/or septic tanks and cesspools. If found, tanks should be removed and cesspools pumped dry.

Any concrete irrigation lines shall be crushed in place and all metal underground lines shall be removed from the site.

C-2.03 Backfill of Cavities

All cavities created or exposed during clearing and grubbing operations or by previous use of the site shall be cleared of deleterious material and backfilled with native soils or other materials approved by the soil engineer. Said backfill

shall be compacted to a minimum of 90% relative compaction.

C-3.00 ORIGINAL GROUND PREPARATION

C-3.01 Stripping of Vegetation

After the site has been properly cleared, all vegetation and topsoil containing the root systems of former vegetation shall be stripped from areas to be graded. Materials removed in this stripping process may be used as fill in areas designated by the soil engineer, provided the vegetation is mixed with a sufficient amount of soil to assure that no appreciable settlement or other detriment will occur due to decaying of the organic matter. Soil materials containing more than 3% organics shall not be used as structural fill.

C-3.02 Removals of Non-Engineered Fills

Any non-engineered fills encountered during grading shall be completely removed and the underlying ground shall be prepared in accordance to the recommendations for original ground preparation contained in this section. After cleansing of any organic matter the fill material may be used for engineered fill.

C-3.03 Overexcavation of Fill Areas

The existing ground in all areas determined to be satisfactory for the support of fills shall be scarified to a minimum depth of 6 inches. Scarification shall continue until the soils are broken down and free from lumps or clods and until the scarified zone is uniform. The moisture content of the scarified zone shall be adjusted to within 2% of optimum moisture. The scarified zone shall then be uniformly compacted to 90% relative compaction.

Where fill material is to be placed on ground with slopes steeper than 5:1 (H:V) the sloping ground shall be benched. The lowermost bench shall be a minimum of 15 feet wide, shall be a minimum of 2 feet deep, and shall expose firm material as determined by the geotechnical consultant. Other benches shall be excavated to firm material as determined by the geotechnical consultant and shall have a minimum width of 4 feet.

Existing ground that is determined to be unsatisfactory for the support of fills shall be overexcavated in accordance to the recommendations contained in the geotechnical report of which these general specifications are a part.

C-4.00 FILL MATERIALS

C-4.01 General

Materials for the fill shall be free from vegetable matter and other deleterious substances, shall not contain rocks or lumps of a greater dimension than is recommended by the geotechnical consultant, and shall be approved by the geotechnical consultant. Soils of poor gradation, expansion, or strength properties shall be placed in areas designated by the geotechnical consultant or shall be mixed with other soils providing satisfactory fill material.

C-4.02 Oversize Material

Oversize material, rock or other irreducible material with a maximum dimension greater than 12 inches, shall not be placed in fills, unless the location, materials, and disposal methods are specifically approved by the geotechnical consultant. Oversize material shall be placed in such a manner that nesting of oversize material does not occur and in such a manner that the oversize material is completely surrounded by fill material compacted to a minimum of

90% relative compaction. Oversize material shall not be placed within 10 feet of finished grade without the approval of the geotechnical consultant.

C-4.03 Import

Material imported to the site shall conform to the requirements of Section 4.01 of these specifications. Potential import material shall be approved by the geotechnical consultant prior to importation to the subject site.

C-5.00 PLACING AND SPREADING OF FILL

C-5.01 Fill Lifts

The selected fill material shall be placed in nearly horizontal layers which when compacted will not exceed approximately 6 inches in thickness. Thicker lifts may be placed if testing indicates the compaction procedures are such that the required compaction is being achieved and the geotechnical consultant approves their use.
Each layer shall be spread evenly and shall be thoroughly blade mixed during the spreading to insure uniformity of material in each layer.

C-5.02 Fill Moisture

When the moisture content of the fill material is below that recommended by the soils engineer, water shall then be added until he moisture content is as specified to assure thorough bonding during the compacting process.

When the moisture content of the fill material is above that recommended by the soils engineer, the fill material shall be aerated by blading or other satisfactory methods until the moisture content is as specified.

C-5.03 Fill Compaction

After each layer has been placed, mixed, and spread evenly, it shall be thoroughly compacted to not less than 90% relative compaction. Compaction shall be by sheepsfoot rollers, multiple-wheel pneumatic tired rollers, or other types approved by the soil engineer.

Rolling shall be accomplished while the fill material is at the specified moisture content. Rolling of each layer shall be continuous over its entire area and the roller shall make sufficient trips to insure that the desired density has been obtained.

C-5.04 Fill Slopes

Fill slopes shall be compacted by means of sheepsfoot rollers or other suitable equipment. Compacting of the slopes may be done progressively in increments of 3 to 4 feet in fill height. At the completion of grading, the slope face shall be compacted to a minimum of 90% relative compaction. This may require track rolling or rolling with a grid roller attached to a tractor mounted side-boom.

Slopes may be over filled and cut back in such a manner that the exposed slope faces are compacted to a minimum of 90% relative compaction.

The fill operation shall be continued in six inch (6") compacted layers, or as specified above, until the fill has been brought to the finished slopes and grades as shown on the accepted plans.

C-5.05 Compaction Testing

Field density tests shall be made by the geotechnical consultant of the compaction of each layer of fill. Density tests shall be made at locations selected by the geotechnical consultant.

Frequency of field density tests shall be not less than one test for each 2.0 feet of fill height and at least every one thousand cubic yards of fill. Where fill slopes exceed four feet in height their finished faces shall be tested at a frequency of one test for each 1000 square feet of slope face.

Where sheepsfoot rollers are used, the soil may be disturbed to a depth of several inches. Density reading shall be taken in the compacted material below the disturbed surface. When these readings indicate that the density of any layer of fill or portion thereof is below the required density, the particular layer or portion shall be reworked until the required density has been obtained.

C-6.00 SUBDRAINS

C-6.01 Subdrain Material

Subdrains shall be constructed of a minimum 4-inch diameter pipe encased in a suitable filter material. The subdrain pipe shall be Schedule 40 Acrylonitrile Butadiene Styrene (ABS) or Schedule 40 Polyvinyl Chloride Plastic (PVC) pipe or approved equivalent. Subdrain pipe shall be installed with perforations down. Filter material shall consist of 3/4" to 1 1/2" clean gravel wrapped in an envelope of filter fabric consisting of Mirafi 140N or approved equivalent.

C-6.02 Subdrain Installation

Subdrain systems, if required, shall be installed in approved ground to conform the approximate alignment and details shown on the plans or herein. The subdrain locations shall not be changed or modified without the approval of the geotechnical consultant. The geotechnical consultant may recommend and direct changes in the subdrain line, grade or material upon approval by the design civil engineer and the appropriate governmental agencies.

C-7.00 EXCAVATIONS

C-7.01 General

Excavations and cut slopes shall be examined by the geotechnical consultant. If determined necessary by the geotechnical consultant, further excavation or overexcavation and refilling of overexcavated areas shall be performed, and/or remedial grading of cut slopes shall be performed.

C-7.02 Fill-Over-Cut Slopes

Where fill-over-cut slopes are to be graded the cut portion of the slope shall be made and approved by the geotechnical consultant prior to placement of materials for construction of the fill portion of the slope.

C-8.00 TRENCH BACKFILL

C-.01 General

Trench backfill within street right of ways shall be compacted to 90% relative compaction as determined by the ASTM D1557 test method. Backfill may be jetted as a means of initial compaction; however, mechanical compaction will be required to obtain the required percentage of relative compaction. If trenches are jetted, there must be a suitable delay for drainage of excess water before mechanical compaction is applied.

C-9.00 SEASONAL LIMITS

C-9.01 General

No fill material shall be placed, spread or rolled while it is frozen or thawing or during unfavorable weather conditions. When the work is interrupted by heavy rain, fill operations shall not be resumed until field tests by the soils engineer indicate that the moisture content and density of the fill are as previously specified.

C-10.00 SUPERVISION

C-10.01 Prior to Grading

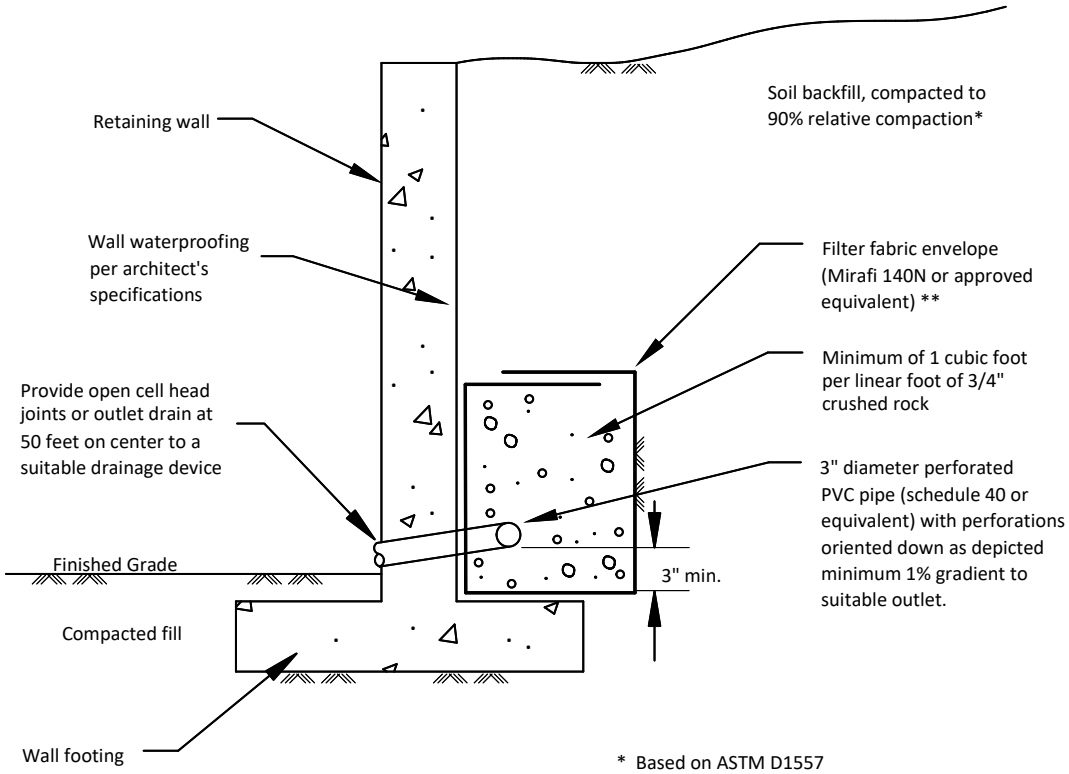
The site shall be observed by the geotechnical consultant upon completion of clearing and grubbing, prior to the preparation of any original ground for preparation of fill.

The supervisor of the grading contractor and the field representative of the geotechnical consultant shall have a meeting and discuss the geotechnical aspects of the earthwork prior to commencement of grading.

C-10.02 During Grading

Site preparation of all areas to receive fill shall be tested and approved by the geotechnical consultant prior to the placement of any fill.

The geotechnical consultant or his representative shall observe the fill and compaction operations so that he can provide an opinion regarding the conformance of the work to the recommendations contained in this report.



* Based on ASTM D1557

** If class 2 permeable material (See gradation to left) is used in place of 3/4" - 1 1/2" gravel. Filter fabric may be deleted. Class 2 permeable material compacted to 90% relative compaction. *

SPECIFICATIONS FOR CLASS 2 PERMEABLE MATERIAL (CAL TRANS SPECIFICATIONS)

Sieve Size	% Passing
1"	100
3/4"	90-100
3/8"	40-100
No.4	25-40
No.8	18-33
No.30	5-15
No.50	0-7
No.200	0-3

RETAINING WALL DRAINAGE DETAIL

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APPENDIX D

LIQUEFACTION AND SEISMIC SETTLEMENT CACULATIONS

APPENDIX E

REFERENCES

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APPENDIX E

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