APPENDIX D
Geotechnical Report/ Paleontological Memorandum

Memo

To:	Amy Harbin at the City of Long Beach		
From:	Sandra Pentney	**Email:**	Sandra.Pentney@atkinsglobal.com
Phone:	858-514-1083	**Date:**	Dec 12, 2018
Ref:	Long Beach Cruise Terminal Improvement Project	**cc:**	Mark Stroik, Brian Leslie, Alan Ashimine
Subject:	Geology and Soils Technical Report		

The objective of this memorandum is to provide information in support of environmental permitting with findings from the technical study of geology and soils as it relates to the Long Beach Cruise Terminal Improvement Project.

Geotechnical sampling was conducted by Gregg Drilling & Testing, Inc. on July 24-26, 2018. Three full length borings were collected in the immediate vicinity of the proposed project as laid out in Figure 1. One boring was collected near each of the anticipated pile-founded structure locations. The borings were collected using a standard penetration test (SPT) method and followed current ASTM standards.

These samples were processed in the laboratory and analyzed by Leighton Consulting, Inc. for the purpose of determining design elements related to the pile-founded structures. The results were used to answer all questions in Appendix G of the CEQA guidelines, presented in the Seismic and Geologic Hazards Assessment attached herein. A full geotechnical report prepared under the supervision of a California Geotechnical Engineer and a certified Engineering Geologist is presented in Attachment 2 of this document.

Memo

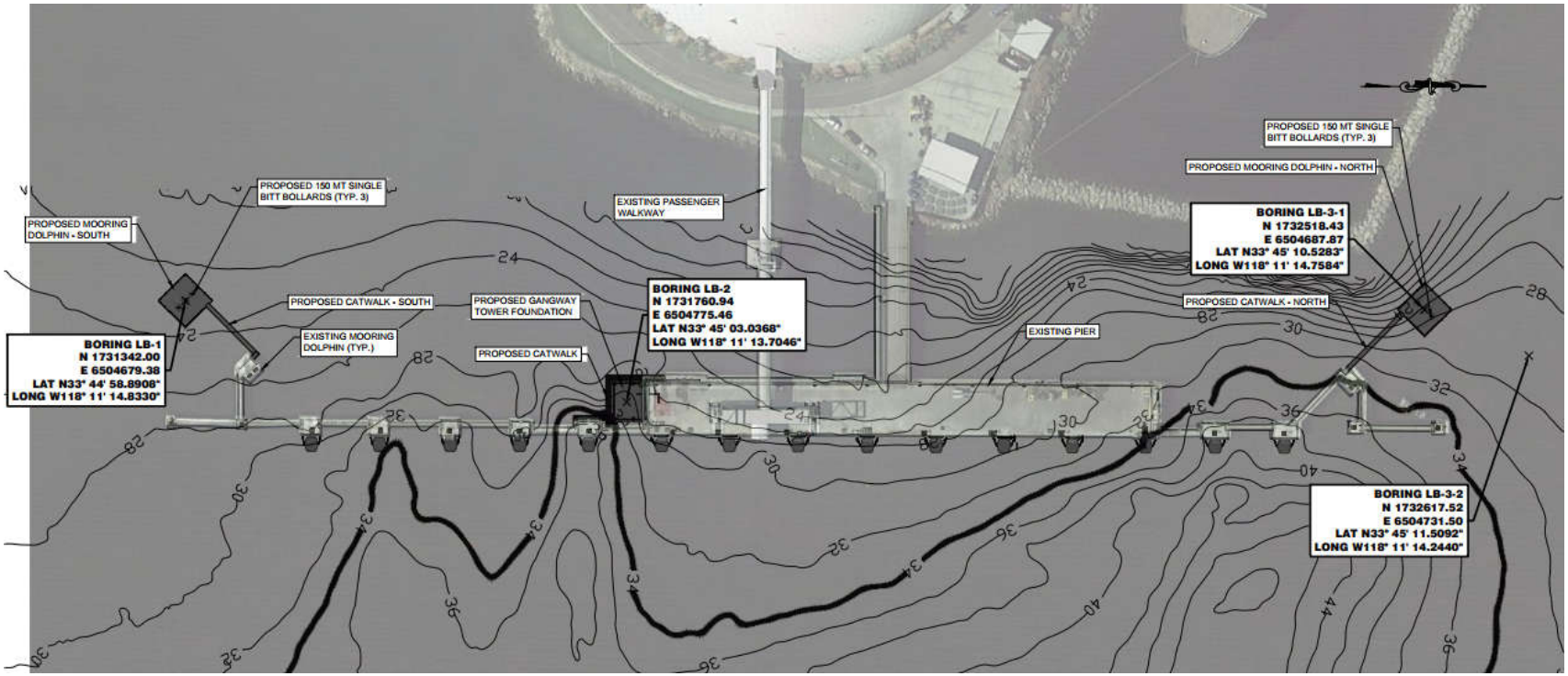

Figure 1. Boring locations for structural elements at the Long Beach Cruise Terminal

ATKINS
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Memo

Attachment 1. Seismic and Geologic Hazards Assessment

Leighton Consulting, Inc.
A LEIGHTON GROUP COMPANY

SEISMIC AND GEOLOGIC HAZARDS ASSESSMENT

Carnival Cruise Line Pier Expansion Project
Long Beach, California

SURFACE FAULT RUPTURE

The project site is located near the eastern end of the 45-acre Queen Mary Complex at Pier J in the Port of Long Beach (POLB), Long Beach, California (Figure 1, *Site Location Map*). Our review of available in-house literature indicates that no known active faults have been mapped across the site, and the site is not located within a designated Alquist-Priolo Earthquake Fault Zone (CGS, 1986; Bryant and Hart, 2007). Therefore, the potential for surface fault rupture at the site is expected to be low and a surface fault rupture hazard evaluation is not mandated for this site.

The location of the closest active faults to the site was evaluated using the United States Geological Survey (USGS) Earthquake Hazards Program National Seismic Hazard Maps (USGS, 2008). The closest active faults to the site are the Newport-Inglewood Fault Zone (NIFZ), Palos Verdes fault and the Puente Hills fault, located approximately 3.4 miles, 3.5 miles and 11.1 miles from the site, respectively. The Puente hills fault is a blind thrust fault that is concealed at depth, without the potential for surface fault rupture. The San Andreas fault, which is the largest active fault in California, is approximately 51 miles northeast of the site. Major regional faults with surface expression in proximity to the site are shown on Figure 2, *Regional Fault and Historical Seismicity Map*.

The THUMS-Huntington Beach fault is located to the southwest of the project site, splays southeastward from the onshore portion of the Palos Verdes fault. This fault forms the southwestern border of the Wilmington and Huntington Beach anticlines where it extends southeastward from the Huntington Beach anticline merging with the Newport-Inglewood fault zone (Ishutov, 2013). This fault does not pose a surface rupture hazard to the project site.

STRONG GROUND SHAKING

Future earthquakes are expected to generate moderate to strong ground shaking at the site. The current code-based Maximum Considered Earthquake (MCE) corresponds to an earthquake event with a probability of exceedance of 2 percent in 50 years (i.e., 2475-year return period).

Based on review of the Port-wide Ground Motion Study Report (EMI, 2015), the shear wave velocity in the vicinity of the site is on the order of 150 meters per second (m/sec). It corresponds to a Site Class E soil profile based on California Building Code (CBC, 2016). For the purpose of this report, a Site Class E was used in calculating the seismic design parameters for the site since the existing and new structures for the pier expansion will be supported on piles established in competent soil underlying the dredge fills and tidal deposits.

The design and risk-targeted MCE spectral acceleration parameters for the site at five percent structural damping are presented in the Table below. These parameters were calculated based on the general procedures of the 2016 CBC using the USGS U.S. Seismic Design Map Tool (USGS 2016a).

Table 1 - 2016 CBC Spectral Acceleration Parameters

Categorization/Coefficient	Design Value
Site Latitude	33.7515°
Site Longitude	-118.1871°
Site Class	E
Mapped Spectral Response Acceleration at Short Period (0.2 sec), S_S	1.592g
Mapped Spectral Response Acceleration at Long Period (1 sec), S_1	0.599g
Short Period (0.2 sec)Site Coefficient, F_a	0.9
Long Period (1 sec) Site Coefficient, F_v	2.4
Adjusted Spectral Response Acceleration at Short Period (0.2 sec), S_{MS}	1.432g
Adjusted Spectral Response Acceleration at Long Period (1 sec), S_{M1}	1.438g
Design Spectral Response Acceleration at Short Period (0.2 sec), S_{DS}	0.955g
Design Spectral Response Acceleration at Long Period (1 sec), S_{D1}	0.959g
Mapped Geometric Mean MCE_G Peak Ground Acceleration, PGA	0.624g

In accordance with Section 11.8.3 of ASCE Standard 7-10, the mapped Geometric Mean peak horizontal ground acceleration (PGA) is 0.624g for the site. For a Site Class E, the F_{PGA} is 0.9 and the mapped peak ground acceleration adjusted for Site Class effects (PGA_M) is 0.562g.

By deaggregating the peak ground acceleration with respect to magnitude and distance, the MCE at the site will most likely a magnitude 7.4 event occurring approximately 3.5 miles from the site (USGS, 2016b).

HISTORICAL SEISMICITY

Although Southern California has been seismically active during the past 200 years, written accounts of only the strongest shocks survive the early part of this period. Early descriptions of earthquakes are rarely specific enough to allow an association with any particular fault zone. It is also not possible to precisely locate epicenters of earthquakes that have occurred prior to the twentieth century.

A search of historical earthquakes was performed using the computer program EQ Search (Blake, 2000) for the time period between 1800 and 2016. Within that time frame 526 earthquakes between magnitude 4.00 and 9.0 were found within a 62-mile (100-kilometer) radius of the site. Of these earthquakes, the closest was an earthquake located 0.5 mile (0.8 kilometer) from the site, and occurred on August 4, 1933. Although not precisely located, the epicenter for this earthquake event is located to the east of the project site. The earthquake registered magnitude 4.0 Mw and induced an estimated peak ground acceleration (PGA) of 0.153g at the project site.

There are records of three earthquakes with a magnitude 7.0 or larger within the search performed, which were magnitude 7.0 Mw earthquakes that occurred on December 8, 1812, September 24, 1827 and December 16, 1858. The largest PGA at the site is estimated to have been roughly 0.232g from the magnitude 5.4 Mw earthquake that shook the region on November 14, 1941. For a general view of recorded historical seismic activity see Figure 2, *Regional Fault and Historical Seismicity Map*.

Review of additional data available from the Center for Engineering Strong Motion Data (CESMD) website (http://strongmotioncenter.org/) indicates that the highest recorded ground acceleration in the vicinity of the project site was 0.70g for a station located approximately 3,000 feet northwest from the site. The recorded ground acceleration was from the magnitude 6.4Mw Northridge earthquake that occurred on January 17, 1994.

LIQUEFACTION POTENTIAL

Soil liquefaction is the degradation of strength and stiffness in soils due to build-up of pore water pressure when subject to cyclic or monotonic loading. Liquefaction occurs when three general conditions exist:

- shallow groundwater
- low density, fine, clean sandy soils and sensitivity fine-grained soils
- high-intensity ground motion with significant duration

As shown on the State of California Seismic Hazard Zones Map for the Long Beach Quadrangle (CGS, 1999), the site is mapped within an area that has been identified as being susceptible to liquefaction (Figure 3, *Seismic Hazard Map*).

The site for the existing pier structure and the proposed new improvements consist of 20 to 25 feet of dredge fill and tidal deposits overlying Pleistocene Estuarine Deposits (i.e., native alluvium). Based on our subsurface exploration, the dredged fill and tidal deposits beneath the site generally consist of very soft to soft or loose to medium dense layers of silt, sand, and clay. Laboratory test and analysis suggested that the materials are prone to liquefaction during the ground motions from earthquakes anticipated at the site. The native alluvium soils below the dredge fill and tidal deposit consist of dense to very dense silty sand and stiff to very stiff silt, sandy silt, and silty clay. The native alluvium is not considered susceptible to liquefaction.

The potential impacts of soil liquefaction on the project site are discussed below.

Ground Settlement

The dredge fill and tidal deposits will subject to settlement during earthquake. Based on exploration for other Carnival Cruise Line's projects in the vicinity (Leighton 2017 and 2018), most of the materials will behave mainly as "clay-like" soils. Therefore, the seismically-induced settlement is not anticipated to be excessive. However, the settlement will impose additional loads on the existing and proposed new piles.

Loss of Bearing Strength

The shear strength of the dredge fill and the tidal flat deposits will be partially loss due to liquefaction. The strength loss in the materials should be considered in the design of the pile foundation supporting the existing pier and the proposed new structures. The

shear strength of the underlying native alluvium is not expected to be degraded during earthquake shaking.

Lateral Ground Displacements

The dredge fill and the tidal deposits are susceptible to lateral spread resulted from liquefaction due to loss of strength and stiffness in the soils during and shortly after earthquake. The lateral displacement of the materials should be considered in the design of the pile foundation supporting the pier and the proposed new structures.

SEISMICALLY-INDUCED LANDSLIDES

Based on the State of California Seismic Hazard Zones Map for the Long Beach Quadrangle (CGS, 1999), the site is not located within an area that has been identified by the State of California as being potentially susceptible to seismically induced landslides (Figure 3, *Seismic Hazard Map*). However, the post-dredging slope in the dredge fill and tidal deposits are susceptible to lateral displacements resulted from liquefaction.

SOIL EROSION AND LOSS OF TOP SOIL

The potential for soil erosion and loss of top soils is not a consideration for the proposed project.

EXPANSIVE SOIL

Expansion potential of the site soils is negligible because the soils will not subject to change in moisture content.

SEPTIC TANKS AND ALTERNATIVE WASTE WATER DISPOSAL SYSTEM

The use of septic tank and alternative waste water disposal system are not planned for the project.

Attachments: References
Figure 1 – *Site Location Map*
Figure 2 – *Regional Fault and Historical Seismicity Map*
Figure 3 – *Seismic Hazard Map*

REFERENCES

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

California Building Standards Commission, 2016, 2016 California Building Code (CBC), California Code of Regulations, Title 24, Part 2, Volume 2 of 2, Based on 2015 International Building Code, Effective January 1, 2017.

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Engineering Mechanics, Inc., 2015, "Port-wide Ground Motion Study, Port of Long Beach, California, Final Addendum No.3", EMI Project No. 14-137, dated May 13, 2015.

Leighton Consulting, Inc. 2017, Geotechnical Exploration Report, Proposed 66kV Line Service Substation, Carnival Cruise Line Terminal Site, Port of Long Beach, Long Beach, California, dated July 12, 2017, Project No. 11564.001.

Leighton Consulting, Inc. 2018, Geotechnical Exploration Report, Proposed Parking Structure Expansion, Carnival Cruise Line Terminal Site, Port of Long Beach, Long Beach, California, dated October, 2, 2018, Project No. 12018.001.

Ishutov, S., 2013, Technical Characterization of the THUMS-Huntington Beach Fault, Offshore Southern California, A Thesis Presented to the Department of Geological Sciences, California State University at Long Beach, dated December 2013.

United States Geological Survey (USGS), 2008, National Seismic Hazard Maps – Fault Parameters, http://geohazards.usgs.gov/cfusion/hazfaults_2008_search/query_main.cfm

_____, 2016a, U.S. Seismic Design map, https://earthquake.usgs.gov/designmaps/us/application.php

_____, 2016b, Unified Hazard Tool, https://earthquake.usgs.gov/hazards/interactive/

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Scale:1 " = 1,000 '	Date: October 2018

Base Map: ESRI ArcGIS Online 2018
Thematic Information: Leighton
Author: Leighton Geomatics (btran)

SITE LOCATION MAP

Propsoed Supplemental Pier Facilities
Existing Carnival Crusie Lines Terminal
Port of Long Beach, Long Beach, California

Figure 1

Leighton

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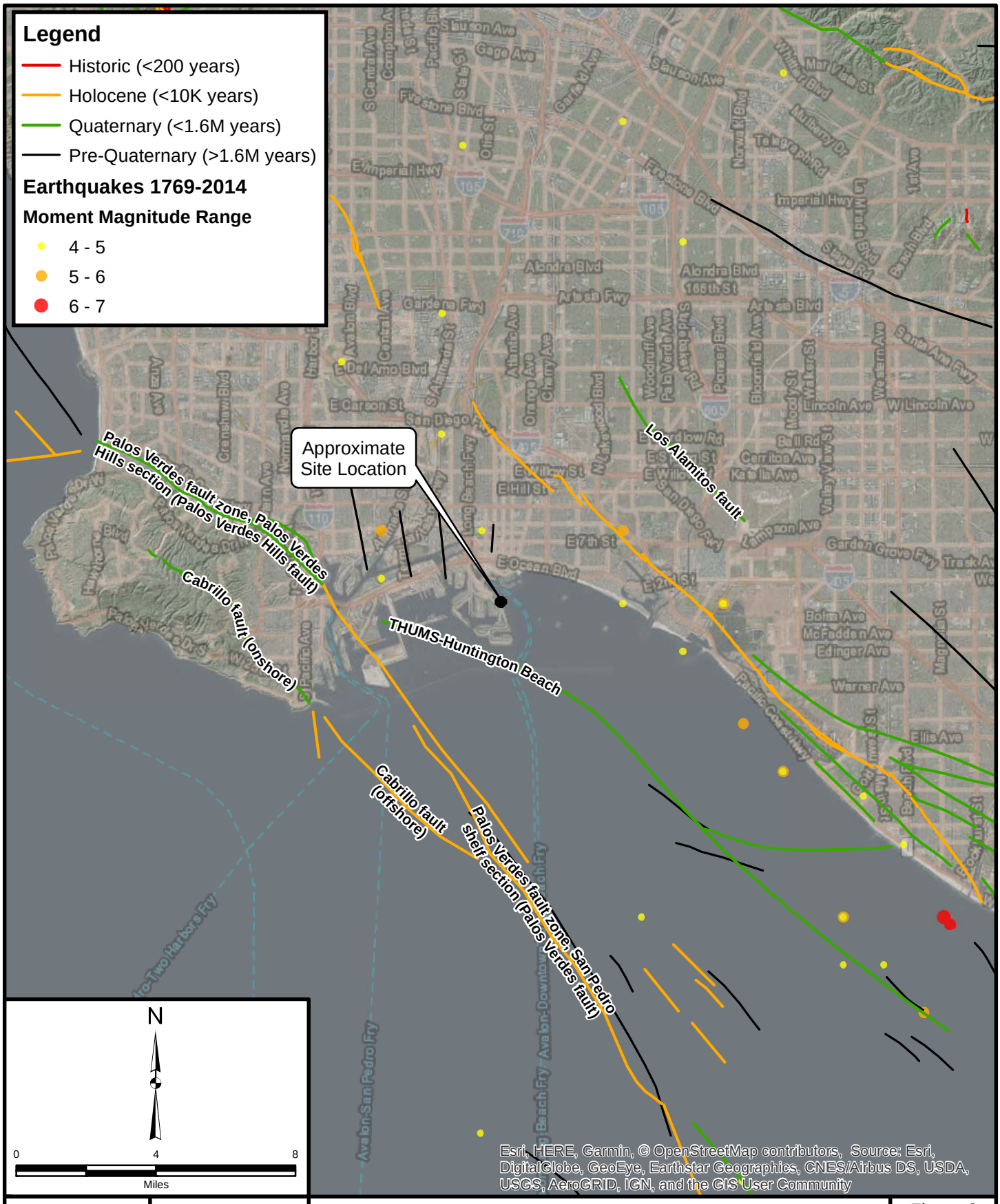

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Scale:1 " = 4 miles	Date: October 2018

Base Map: ESRI ArcGIS Online 2018
Thematic Information: Leighton, CGS, Bryant 2010
Author: Leighton Geomatics (btran)

REGIONAL FAULT AND HISTORIC SEISMICITY MAP

Propsoed Supplemental Pier Facilities
Existing Carnival Crusie Lines Terminal
Port of Long Beach, California

Figure 2

Leighton

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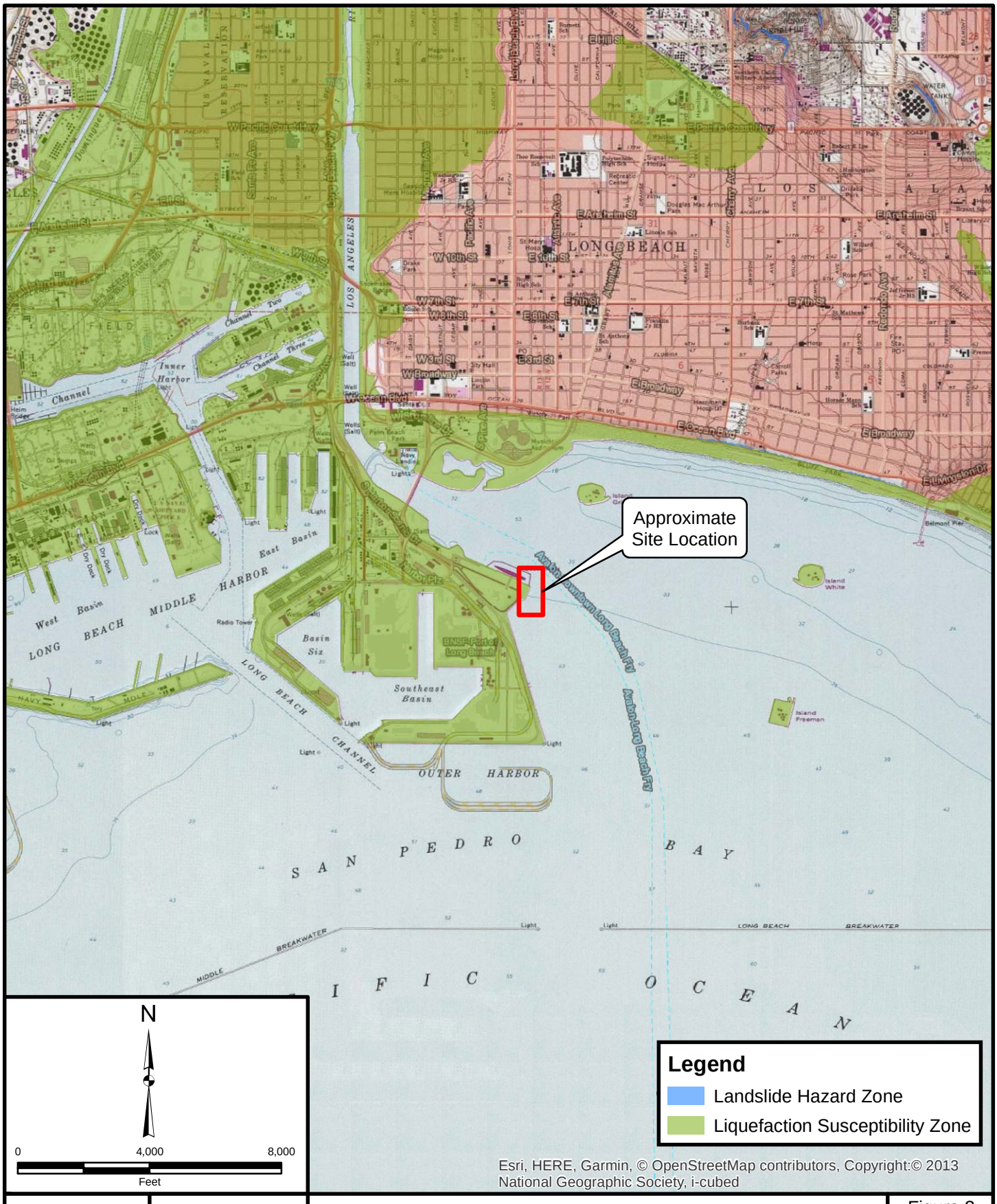

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Base Map: ESRI ArcGIS Online 2018
Thematic Information: Leighton, CGS
Author: Leighton Geomatics (btran)

SEISMIC HAZARD MAP

Propsoed Supplemental Pier Facilities
Existing Carnival Crusie Lines Terminal
Port of Long Beach, California

Figure 3

Leighton

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ATKINS
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Memo

Attachment 2. Geotechnical Design Report

GEOTECHNICAL EXPLORATION REPORT
PROPOSED EXPANSION OF
EXISTING CARNIVAL CRUISE LINE PIER
PORT OF LONG BEACH,
LONG BEACH, CALIFORNIA

Prepared for:

Atkins

17220 Katy Freeway, Suite 200
Houston, Texas 77094

Project No. 12096.001

December 10, 2018

Leighton Consulting, Inc.
A LEIGHTON GROUP COMPANY

Leighton Consulting, Inc.
A LEIGHTON GROUP COMPANY

December 10, 2018

Project No. 12096.001

Atkins
17220 Katy Freeway, Suite 200
Houston, Texas, 77094

Attention: Mr. Brandon Smith

Subject: Geotechnical Exploration Report
Expansion of Existing Carnival Cruise Line Pier
Port of Long Beach, Long Beach, California

Per your request and authorization, Leighton Consulting, Inc. (Leighton) has performed a geotechnical exploration in support of the expansion of the existing Carnival Cruise Line Pier located at the Port of Long Beach (POLB), Long Beach, California. The scope of work for this exploration was outlined in our proposal dated June 13, 2018 and authorized by you on July 12, 2018.

The proposed expansion of the existing pier will consisted of addition of two new mooring dolphins to the existing mooring dolphins and an extension of the existing pier gangway. Based on our exploration and analysis, the construction of the proposed supplemental facilities is considered feasible from a geotechnical standpoint. Geotechnical recommendations for the design of the supplemental pier facility foundations are presented in this report.

17781 Cowan ▪ Irvine, CA 92614-6009
949.250.1421 ▪ 949.250.1114 Fax

We appreciate this opportunity to be of service. If you have any questions regarding this report or if we can be of further service, please call us at your convenience at **(866) *LEIGHTON***, directly at the phone extensions or e-mail addresses listed below.

Respectfully submitted,

LEIGHTON CONSULTING, INC.

Robert Hennessey, PE 86902
Senior Project Engineer
Ext 3023, rhennessey@leightongroup.com

Review By

Vincent P. Ip, PE, GE 2522
Senior Principal Engineer
Ext 1682; vip@leightongroup.com

NA/RPH/VPI/lr

Distribution: (1) Addressee

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TABLES

LIST OF ATTACHMENTS

Leighton

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APPENDICES

1.0 INTRODUCTION

1.1 Site Description and Proposed Development

The existing Carnival Cruise Line pier facility is located east of the Carnival Cruise Line Terminal at Queensway Bay at Pier J in the Port of Long Beach (POLB), Long Beach, California (Figure 1, *Site Location Map*).

The proposed expansion of the pier facility will consist of adding two new mooring dolphins (north and south) and an extension of the existing pier gangway (Figure 2.2, *Exploration Location Map*). As currently planned, the new mooring dolphins will be approximately 38 feet wide and 30 feet long by 5 feet thick reinforced concrete structures. One mooring dolphin is proposed to be located approximately 110 feet north of the existing Mooring Dolphin No.1. The second mooring dolphin is proposed to be located120 feet south of the existing Mooring Dolphin No.4. Both new dolphins will be situated in line with the existing dolphins. The gangway extension is planned to be approximately 40 feet long and 35 feet wide by 5 feet thick reinforced concrete structure and located on the southern edge of the existing gangway. Based on the 30% design plan, the finish surface of the three new structures will be at elevation +15 feet mean sea level (msl) and supported on 36-inch diameter steel pipe piles.

1.2 Purpose and Scope of Exploration

The purpose of our geotechnical exploration was to evaluate the subsurface conditions at the site through review of available data and exploratory borings, in order to provide geotechnical recommendations to aid in design and construction for the project as currently proposed.

The scope of work includes the following tasks:

- *Background Review* – A background review was performed of readily available, relevant geotechnical and geological literature pertinent to the project site, References reviewed in preparation of this report are listed in Section 7.0.
- *Field Exploration* – Our field exploration was performed on July 24, 25, and 26, 2018, and consisted of three (3) rotary wash borings (designated B-1 through B-2). B-1 and B-2 were drilled to approximate depths of 123.5 and 118.0 feet below the seafloor (corresponding elevations of -151.5 and -150 msl). Boring B-3-1 (at North Mooring Dolphin) encountered drilling refusal at

approximate depth of 22 feet below the seafloor (Elevation -52 msl). Consequently, the drilling activities was relocated approximately 100 feet to the east and drilled to a depth of 98 feet below seafloor (Elevation -130 msl). The new boring was designated as B-3-2.

During drilling of the rotary wash borings, drive samples were obtained from the borings for geotechnical laboratory testing. Tube and ring samples were collected from the borings using a Thin-Walled Steel Sample Tubes (Shelby Tubes) and Modified California Ring sampler conducted in accordance with ASTM Test Method D 1587 and D 3550. Standard Penetration Tests (SPTs) were also performed within the rotary wash borings in accordance with ASTM Test Method D 1586. The tube samples were pushed/driven for a total penetration of 24 inches and the ring and SPT samplers were driven for a total penetration of 18 inches using a 140-pound automatic hammer falling freely for 30 inches. The number of blows per 6 inches of penetration was recorded on the boring logs.

The borings were logged in the field by members of our technical staff. Each soil sample collected was reviewed and described in general accordance with the Unified Soil Classification System (USCS). The samples were sealed and packaged for transportation to our laboratory. After completion of drilling, the borings were backfilled with cement grout per the approved well permit from the City of Long Beach. The boring logs are presented in Appendix A, *Field Exploration Logs*.

- *Geotechnical Laboratory Testing* – Laboratory tests were performed on representative soil samples to evaluate geotechnical engineering properties of subsurface materials. The following laboratory tests were performed:
  - In-situ Moisture Content and Dry Density (ASTM D2216 and ASTM D2937);
  - Sieve Analysis (ASTM D 422);
  - Atterberg Limits (ASTM D 4318);
  - Direct Shear (ASTM D 3080); and
  - Consolidated-Undrained Triaxial Compression Test (ASTM D 4767).

  The results of the laboratory tests are presented in Appendix B – *Geotechnical Laboratory Test Results.*

- *Engineering Analysis* – Geotechnical analysis was performed on the collected data to develop conclusions and recommendations for design and construction of the planned improvements.

- *Report Preparation* - This geotechnical report presents our findings, conclusions, and recommendations.

It should be noted that the recommendations in this report are subject to the limitations presented in Section 6.0 of the report.

2.0 GEOTECHNICAL FINDINGS

2.1 Geologic Setting

The site is located within the Peninsular Ranges geomorphic province of California in the southwestern margin of the Los Angeles Basin and east of the Palos Verdes Peninsula. The Peninsular Ranges province extends approximately 900 miles southward from the Santa Monica Mountains to the tip of Baja California (Yerkes, et al., 1965) and is characterized by elongated, northwest-trending mountain ridges and sediment-floored valleys. The province includes numerous northwest trending fault zones, most of which either die out, merge with, or are terminated by faults that form the southern margin of the Transverse Ranges province. These northwest trending fault zones include the San Jacinto, Whittier-Elsinore, Palos Verdes, and Newport-Inglewood fault zones.

Approximately 65 million years ago (at the end of the Cretaceous Period) a deep, structural trough existed off the coast of southern California (Yerkes, 1972). Over time the trough was filled with sediments eroded from the surrounding highlands and mountains. About 7 million years ago the boundary between the Pacific and North American plates shifted to its present position and the geologically modern Los Angeles basin began to form. The deepest part of the Los Angeles basin contains Tertiary to Quaternary-aged (65 million years and younger) marine and nonmarine sedimentary rocks that are about 24,000 feet thick (Yerkes, et al, 1965; Wright, 1991). During the Pleistocene epoch (the last two million years) the region was flooded as the sea level rose in response to the worldwide melting of the Pleistocene glaciers.

The project site is located in Long Beach Harbor approximately 7.5 miles to the east of the Palos Verdes Hills near the mouth of the Los Angeles River channel. Long Beach Harbor lies on the edge of a broadly elevated coastal terrace on the southern edge of the Los Angeles Basin. This terrace has been deeply dissected by the Los Angeles River in response to the sharply lowered sea levels during the last global glaciation, approximately 20,000 years ago. The channel incision, known locally as the Dominguez Gap, was several hundred feet deep. With the Waning of the continental glaciers, it has been filled with alluvial channel and flood plain sediments as the Los Angeles River adjusted its grade to accommodate the resultant rise in sea level. Modern sea level was reached roughly 6,000 years ago. Regional geologic mapping of the project site and vicinity indicates that near-surface soils beneath the site consist of recent artificial fill (Saucedo et al., 2003;

CGS, 2010). The surficial geologic units mapped in the vicinity of the project site are shown on Figure 3, *Regional Geology Map*.

2.2 Subsurface Soil Conditions

Our field exploration consisted of drilling and sampling a total of four (4) mud-rotary borings (B-1, B-2, B-3-1, and B-3-2) to a maximum depth of approximately 125 feet below seafloor (bsf). Drilling was conducted overwater on a drill ship operated by Gregg Drilling between July 24 and July 26, 2018.

Based on our subsurface exploration, tidal deposits were encountered in boring B-1 and B-2 to a depth of 23 feet and 18 feet bsf, respectively. Refusal was encountered immediately beneath approximately 22 feet of dredge fill at B-3-1. Consequently, drilling operations were relocated approximately 100 feet to the east to B-3-2 where dredge fill was encountered to a depth of approximately 50 feet bsf. Underlying the tidal deposits or dredge fill to the maximum depth of exploration is the native alluvium. Descriptions of the subsurface soils encountered in our borings are as follows:

Tidal Deposits/Dredge Fill: The materials consist of very soft to soft or loose to medium dense silt, clayey silt/silty clay, and silty sand. Based on review of the soil behavior type index (i.e., I_C) from the previous CPTs (By Leighton 2017 and 2018), it suggested that most of the dredge fill and the tidal flat deposits behave mainly as “clay-like” soils. It is consistent with the soil samples retrieved from the soil borings.

Native Alluvium: The native alluvium underlying the tidal deposits and dredge fill consists of interbedded dense to very dense sand to stiff to very stiff silt, clay, and silty clay.

The stratigraphy of the subsurface soils encountered in each soil boring is presented in the Appendix A, *Field Exploration logs*.

3.0 SEISMIC AND GEOLOGIC HAZARDS ASSESSMENTS

3.1 Surface Fault Rupture

The project site is located near the eastern end of the 45-acre Queen Mary Complex at Pier J in the Port of Long Beach (POLB), Long Beach, California (Figure 1, *Site Location Map*). Our review of available in-house literature indicates that no known active faults have been mapped across the site, and the site is not located within a designated Alquist-Priolo Earthquake Fault Zone (CGS, 1986; Bryant and Hart, 2007). Therefore, the potential for surface fault rupture at the site is expected to be low and a surface fault rupture hazard evaluation is not mandated for this site.

The location of the closest active faults to the site was evaluated using the United States Geological Survey (USGS) Earthquake Hazards Program National Seismic Hazard Maps (USGS, 2008). The closest active faults to the site are the Newport-Inglewood Fault Zone (NIFZ), Palos Verdes fault and the Puente Hills fault, located approximately 3.4 miles, 3.5 miles and 11.1 miles from the site, respectively. The Puente hills fault is a blind thrust fault that is concealed at depth, without the potential for surface fault rupture. The San Andreas fault, which is the largest active fault in California, is approximately 51 miles northeast of the site. Major regional faults with surface expression in proximity to the site are shown on Figure 4, *Regional Fault and Historical Seismicity Map*.

The THUMS-Huntington Beach fault is located to the southwest of the project site, splays southeastward from the onshore portion of the Palos Verdes fault. This fault forms the southwestern border of the Wilmington and Huntington Beach anticlines where it extends southeastward from the Huntington Beach anticline merging with the Newport-Inglewood fault zone (Ishutov, 2013). This fault does not pose a surface rupture hazard to the project site.

3.2 Strong Ground Shaking

The site is located within a 62-mile (100 kilometers) radius of several major faults in the region (Figure 4). Earthquakes occur along one of these major faults are expected to generate moderate to strong ground shaking at the site. The current (2016) code-based Maximum Considered Earthquake (MCE) corresponds to an earthquake event with a probability of exceedance of 2 percent in 50 years (i.e., 2475-year return period).

Based on review of the Port-wide Ground Motion Study Report (EMI, 2015), the shear wave velocity in the vicinity of the site is on the order of 150 meters per second (m/sec). It corresponds to a Site Class E soil profile based on California Building Code (CBC, 2016). Using a Site Class E profile, the spectral accelerations at five percent structural damping for the Design Earthquake and risk-targeted MCE are presented in the Table below. These parameters were calculated based on the general procedures of the 2016 CBC using the USGS U.S. Seismic Design Map Tool (USGS 2016a).

Table 1 - 2016 CBC Spectral Acceleration Parameters

Categorization/Coefficient	Design Value
Site Latitude	33.7515°
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Adjusted Spectral Response Acceleration at Short Period (0.2 sec), S_{MS}	1.430g
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Design Spectral Response Acceleration at Short Period (0.2 sec), S_{DS}	0.953g
Design Spectral Response Acceleration at Long Period (1 sec), S_{D1}	0.956g
Mapped Geometric Mean MCE_G Peak Ground Acceleration, PGA	0.622g
All were derived from the USGS web page: http://earthquake.usgs.gov/designmaps/us/application.php	

In accordance with Section 11.8.3 of ASCE Standard 7-10, the mapped geometric mean peak ground acceleration (PGA) is 0.622g for the site. For a Site Class E, the F_{PGA} is 0.9 and the mapped peak ground acceleration adjusted for Site Class effects (PGA_M) is 0.56g.

By deaggregating the peak ground acceleration with respect to magnitude and distance, the MCE at the site will most likely a magnitude 7.4 event occurring approximately 3.5 miles from the site (USGS, 2016b). The seismicity data are included in Appendix C.

3.3 Historical Seismicity

Although Southern California has been seismically active during the past 200 years, written accounts of only the strongest shocks survive the early part of this period. Early descriptions of earthquakes are rarely specific enough to allow an association with any particular fault zone. It is also not possible to precisely locate epicenters of earthquakes that have occurred prior to the twentieth century.

A search of historical earthquakes was performed using the computer program EQ Search (Blake, 2000) for the time period between 1800 and 2016. Within that time frame 526 earthquakes between magnitude 4.00 and 9.0 were found within a 62-mile (100-kilometer) radius of the site. Of these earthquakes, the closest was an earthquake located 0.5 mile (0.8 kilometer) from the site, and occurred on August 4, 1933. Although not precisely located, the epicenter for this earthquake event is located to the east of the project site. The earthquake registered magnitude 4.0 Mw and induced an estimated peak ground acceleration (PGA) of 0.153g at the project site.

There are records of three earthquakes with a magnitude 7.0 or larger within the search performed, which were magnitude 7.0 Mw earthquakes that occurred on December 8, 1812, September 24, 1827 and December 16, 1858. The largest PGA at the site is estimated to have been roughly 0.232g from the magnitude 5.4 Mw earthquake that shook the region on November 14, 1941. For a general view of recorded historical seismic activity see Figure 4, *Regional Fault and Historical Seismicity Map*.

Review of additional data available from the Center for Engineering Strong Motion Data (CESMD) website (http://strongmotioncenter.org/) indicates that the highest recorded ground acceleration in the vicinity of the project site was 0.70g for a station located approximately 3,000 feet northwest from the site. The recorded ground acceleration was from the magnitude 6.4Mw Northridge earthquake that occurred on January 17, 1994.

3.4 Liquefaction Potential

Liquefaction is loss of soil shear strength due to a build-up of pore water pressure during severe ground shaking. Soils most susceptible to liquefaction are clean and uniformly graded, loose, saturated fine-grained sands. Additionally loose and saturated fine grained soil deposits can behave like liquid due to loss of strength and stiffness during or shortly after prolonged strong earthquake ground motions.

Where sloping ground conditions are present, soil liquefaction or loss of strength can result in ground instability (i.e., lateral spread or flow failure).

As shown on the State of California Seismic Hazard Zones Map for the Long Beach Quadrangle (CGS, 1999), the site is mapped within an area that has been identified as being susceptible to liquefaction (Figure 5, *Seismic Hazard Map*).

The site for the existing pier structure and the proposed new improvements consist of 20 to 25 feet of dredge fill and tidal deposits overlying alluvium (i.e., native alluvium). Based on our subsurface exploration, the dredged fill and tidal deposits beneath the site generally consist of very soft to soft or loose to medium dense layers of silt, sand, and clay. Previous laboratory test and analysis by Leighton suggested that the materials are prone to liquefaction and/or loss of strength during the strong ground motions from earthquakes anticipated at the site. The native alluvium soils below the dredge fill and tidal deposit consist of dense to very dense silty sand and stiff to very stiff silt, sandy silt, and silty clay. Given the dense to very dense nature of the underlying native alluvium, these soils are not considered susceptible to liquefaction.

The potential impacts of soil liquefaction on the project site are discussed below.

Ground Settlement: Based on our analysis, the dredge fill and tidal deposits are considered to be susceptible to liquefaction-induced settlement during strong ground motions due to earthquakes. Based on our experience and exploration for other Carnival Cruise Line's projects in the vicinity of this site (Leighton 2017 and 2018), the materials are anticipated to behave primarily as "clay-like" soils. Due to the "clay-like" behavior of the soil materials, the seismically-induced settlement is not anticipated to be excessive. However, any settlement that will occur will impose additional loads (i.e., downdrag) on the existing and new piles, during an earthquake event.

Loss of Bearing Strength: The shear strength of the dredge fill and the tidal flat deposits will be partially loss due to liquefaction. The strength loss in the materials should be considered in the design of the pile foundation supporting the existing pier and the proposed new structures. The shear strength of the underlying native alluvium is not expected to be degraded during earthquake shaking.

Lateral Ground Displacement: The dredge fill and the tidal deposits are susceptible to lateral spread resulted from liquefaction due to loss of strength and stiffness in the soils during and shortly after an earthquake. The lateral

displacement of the materials should be considered in the design of the pile foundation supporting the pier and the proposed new structures.

The calculations of lateral ground displacement due to liquefaction was performed using the Newmark sliding block (Newmark 1965) model. For the purpose of this report, the slinging mass was considered rigid. Using the rigid block model developed by Bray and Travasarou (2007), the maximum lateral displacements of the dredge fill and tidal deposits was estimated to be on the order of 30 inches.

3.5 Seismically-Induced Landslides

Based on the State of California Seismic Hazard Zones Map for the Long Beach Quadrangle (CGS, 1999), the site is not located within an area that has been identified by the State of California as being potentially susceptible to seismically induced landslides (Figure 5, *Seismic Hazard Map*).

3.6 Flood Hazard

According to a Federal Emergency Management Agency (FEMA) flood insurance rate map (FEMA, 2008), the site is not located within a flood hazard zone (Figure 6, *Flood Hazard Zone Map*). Flooding in the vicinity of the project site is generally isolated to the Queensway Bay located to the north of the project site. Therefore, the effect of regional flooding affecting the site is considered negligible.

3.7 Seiches and Tsunamis

As shown on Figure 7, *Tsunami Inundation Map*, the project site is located within a tsunami inundation area identified by the California Emergency Management Agency and the California Geological Survey (CGS, 2009). Based on the Tsunami Hazard Assessment for the Port of Long Beach report (Moffatt & Nichol, 2007), the maximum water level in Pier J produced by the Santa Catalina 7-segment scenario is approximately 10 feet (3.13 m) msl which should be taken into consideration for design and construction of the proposed new dolphin and gangway expansion tower structure.

4.0 FINDINGS AND CONCLUSIONS

No apparent evidence of adverse geological or geotechnical hazards was noted at the site that will preclude the development of the project. Presented below is a summary of findings based upon the results of our geotechnical evaluation of the site:

- The site is likely to experience moderate to strong earthquake. The most probable code-based earthquake event is a 7.4 magnitude earthquake occurring at approximately 3.5 miles from the site.
- The site is mapped within an area shown as susceptible to liquefaction on the California Seismic Hazard Zones Map for the Long Beach Quadrangle. Based on previous exploration by Leighton in the immediate vicinity of the pier, the dredge fill and tidal deposits are susceptible to loss of strength and stiffness when subject to ground shaking.
- The seismically-induced settlement of the tidal deposits and dredge fill at the site is not expected to be excessive but it will impose downdrag to the existing and new piles.
- The maximum lateral displacement of the tidal deposits and dredge fill due to ground shaking was estimated to be approximately 30 inches.
- Concrete elements in contact with the seawater, shall be designed for extreme marine environment. The onsite environment is also considered corrosive to ferrous metal.

5.0 DESIGN RECOMMENDATIONS

Geotechnical recommendations for the proposed additions are presented in the following sections and are intended to provide sufficient geotechnical information to develop the project in general accordance with Port of Long Beach Wharf Design Criteria, 2015 and 2016 CBC requirements. The following recommendations should be considered minimal from a geotechnical viewpoint as there may be more restrictive requirements of the architect, structural engineer, governing agencies and the City of Long Beach.

The geotechnical consultant should review the foundation plan and specifications as they become available to verify that the recommendations presented in this report have been incorporated into the plans prepared for the project.

5.1 Foundation Recommendations

Soil Profile and Shear Strength: The idealized soil profile and shear strength parameters for analyzing the existing piles and design of new deep foundations are presented in Table 2 below:

It should be noted that the dredge fill thickness at the North Mooring Dolphin was assumed as the same dredge fill thickness at Boring B-3-1 when drilling refusal was encountered (i.e., 22 feet bsf). The listed shear strength parameters were derived primarily based on laboratory test results from current and previous exploration by Leighton (2017 and 2018).

Table 2 - Idealized Soil Profile and Strength Parameters

Locations	Elevations	Predominant Soil Types	Effective Unit Weight (pcf)	Friction Angle (degree)	Undrained Shear Strength (psf)	Strain ε_{50}	k (pci)
South Mooring Dolphin	-28 to -51	Soft Clay with Free Water (Tidal Deposits and dredge fill)	38.4	N/A	0 to 150 S 0 to 315 L 0 to 610 U	0.07	30
	-51 to -76.5	API Sand	61.1	38-41			125
	-76.5 to -111	Stiff Clay with Free Water	62.0		1,667 to 2,952 L 1,835 to 3,070 U	0.03	1,000 static 400 Cyclic
	-111 to -141.5	API Sand	61.1	38-41			175
	-141.5 to -151.5	Stiff Clay with Free Water	62.0	N/A	4,145 to 4,500 U	0.03	1750 static 800 Cyclic
Gangway Tower	-32 to -50	Soft Clay with Free Water (Tidal Deposits and dredge fill)	38.4	N/A	0 to 150 S 0 to 280 L 0 to 510 U	0.07	30
	-50 to -84	API Sand	61.1	38-41			125
	-84 to -105	Stiff Clay with Free Water	62.0		1,864 to 2,646 L 2,023 to 2,775 U	0.03	1,000 static 400 Cyclic
	-105 to -150	API Sand	61.1	38-41			175
North Mooring Dolphin	-32 to -54	Soft Clay with Free Water (Tidal Deposits and dredge fill)	38.4	N/A	0 to 150 S 0 to 519 L 0 to 655 U	0.10	30
	-54 to -89.5	API Sand	61.1	38-41			125
	-89.5 to -109.5	Stiff Clay with Free Water	62.0		2,011 to 2,756 L 2,236 to 2,650 U	0.03	1,000 static 400 Cyclic
	-109.5 to -130	API Sand	61.1	38-41			175

Notes:

S: Seismic Loading
L: Lower Bound
U: Upper bound

- All values are nominal.
- The recommended values above are for 36-inch diameter pipe piles.

Downward Pile Capacity: The downward capacity of the 36-inch diameter steel pipe piles was calculated using the computer software APILE (Ensoft 2018). In our analysis, we assume a soil plug will start to develop inside the pipe piles at a penetration to diameter ratio of 20 (FHWA 2016). Based on the information presented in Table 2, the lower bound pile ultimate capacity curves for a single 36-inch diameter pile for each new structure are presented on Figures 8 through 10. The following notes should be taken into consideration when using the figures:

- All curves were developed for nominal capacity (i.e., no load factor was used in calculating the capacity).
- The downward capacity curves were developed for seismic loading conditions when the frictional resistance in the tidal deposits and dredge fill are temporarily loss due to liquefaction (i.e., resistance to downward load was derived only from the section of the pile embedded in the native alluvium).
- The down drag load resulted from the settling soils as shown on the figures should be added to the design load.
- The tension capacity curves were developed for service load condition.
- No reduction in capacity is required if the piles are spaced at a minimum of 3 times its diameter on center.
- A safety of 2 is recommended for allowable stress design.
- The equivalent spring constant shown is applicable for both service loading and seismic loading.

Lateral Load Capacity: As requested by Atkins, p-y curves were developed along the piles for analyzing the response of the piles under lateral loads. The p-y curves coordinates at each new structure locations are included in Appendix D, p-y Curves Coordinates.

In addition to develop the p-y curves for analyzing the response of the 36-inch pipe piles, we also evaluate the kinematic loading from displacement of the submarine slope due to seismic shaking for analyzing the pipe piles as well as the existing 24-inch prestressed concrete piles. Following the procedures described in the Wharf Design Manual (Long Beach 2015), the lateral displacement of the post-dredging submarine slope under the MCE was estimated to be on the order of 30 inches.

5.2 Construction Consideration

We recommend additional exploration be performed to determine the probable cause of drilling refusal encountered at Boring B-3-1 and the extent of refusal near the North Mooring Dolphin. Based on the location of the boring relative to the existing Queen Mary rock dike, the proposed mooring dolphin may be located within the footprint of the dike. Due to the relatively thick layer of dredge fill encountered in boring B-3-2 (i.e. approximately 50 feet), relocating the North Mooring Dolphin to the vicinity of the boring is not recommended. Additionally, it is recommended that an indicator pile program be performed during the exploration. The program should include dynamic pile load test to verify the pile capacity, driving resistance, and drivability. Prior to implementing the indicator pile program, a wave equation analysis should also be performed to select the proper pile-hammer system for driving the piles to the specified depth.

Pile installation should be performed in accordance with the latest edition of Section 305 of the *Standard Specifications for Public Works Construction,* ("Greenbook"), 2015 Edition.

6.0 LIMITATIONS

This report was based solely on data obtained from a limited number of geotechnical exploration, and soil samples and tests. Such information is, by necessity, incomplete. The nature of many sites is such that differing soil or geologic conditions can be present within small distances and under varying climatic conditions. Changes in subsurface conditions can and do occur over time. Therefore, the findings, conclusions, and recommendations presented in this report are only valid if Leighton has the opportunity to observe subsurface conditions during grading and construction, to confirm that our preliminary data are representative for the site. Leighton should also review the construction plans and project specifications, when available, to comment on the geotechnical aspects.

This report was prepared using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical consultants practicing in this or similar localities. The findings, conclusion, and recommendations included in this report are considered preliminary and are subject to verification. We do not make any warranty, either express or implied.

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Important Information about This

Geotechnical-Engineering Report

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

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

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled*. No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

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

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed*. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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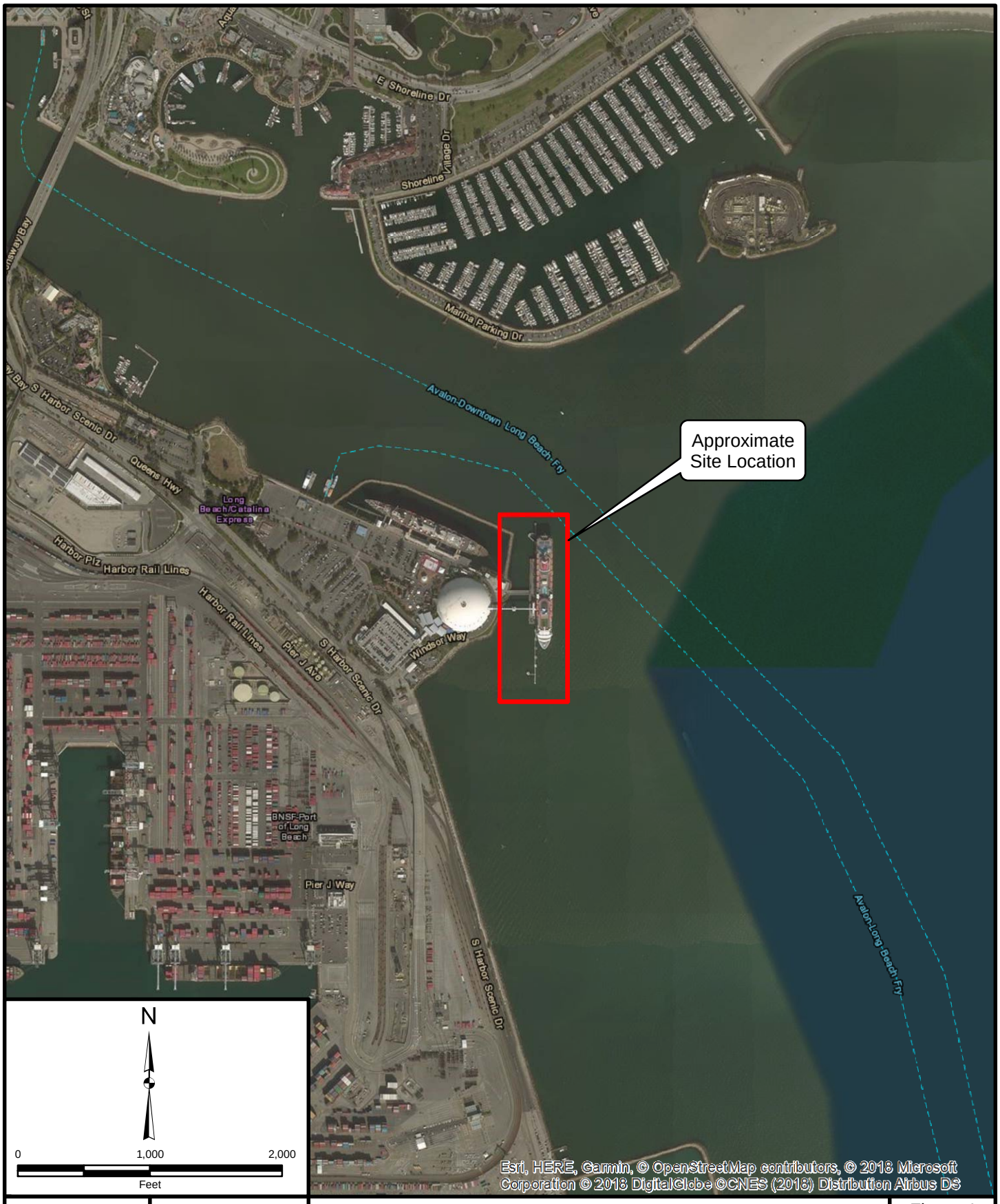
e-mail: info@geoprofessional.org www.geoprofessional.org



Project: 12096.001	Eng/Geol: VPI
Scale:1 " = 1,000 '	Date: December 2018

Base Map: ESRI ArcGIS Online 2018
Thematic Information: Leighton
Author: Leighton Geomatics (btran)

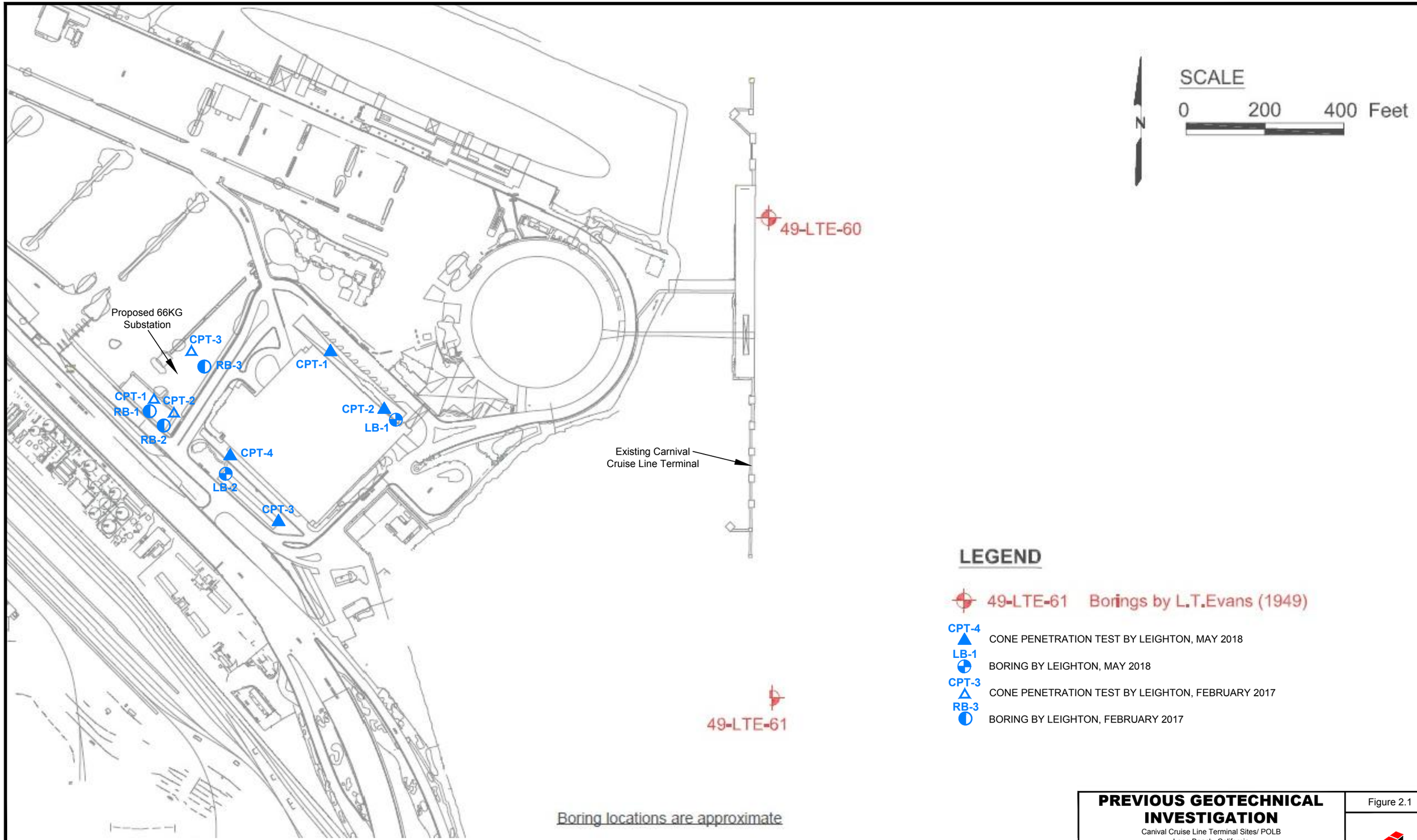
SITE LOCATION MAP

Canival Cruise Line Terminal Sites/ POLB
Long Beach, California

Figure 1

Leighton

Map Saved as V:\Drafting\12096\001\Maps\Queen Mary Complex Report\12096-001_F01_SLM_2018-12-10.mxd on 12/10/2018 1:06:09 PM



LEGEND

49-LTE-61 Borings by L.T.Evans (1949)

CPT-4 — CONE PENETRATION TEST BY LEIGHTON, MAY 2018

LB-1 — BORING BY LEIGHTON, MAY 2018

CPT-3 — CONE PENETRATION TEST BY LEIGHTON, FEBRUARY 2017

RB-3 — BORING BY LEIGHTON, FEBRUARY 2017

Boring locations are approximate

PREVIOUS GEOTECHNICAL INVESTIGATION

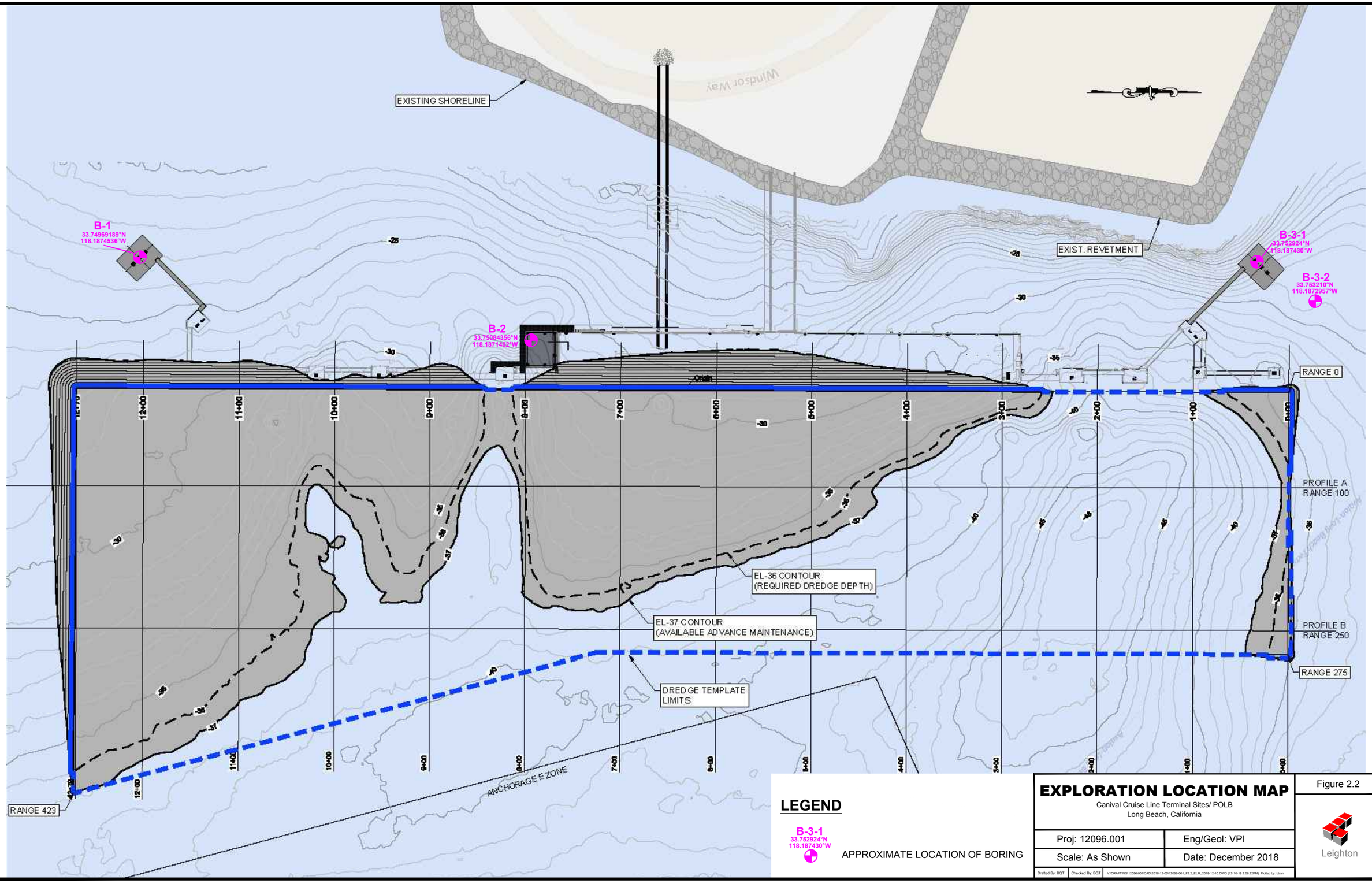
Canival Cruise Line Terminal Sites/ POLB
Long Beach, California

Figure 2.1

Proj: 12096.001	Eng/Geol: VPI
Scale: As Shown	Date: December 2018

Drafted By: BQT | Checked By: BQT | V:\DRAFTING\12096\001\CAD\2018-12-05\12096-001_F2.1_BLM_2018-12-10.DWG (12-10-18 2:26:35PM) Plotted by: btran

Leighton



LEGEND

B-3-1
33.752924°N
118.187430°W
APPROXIMATE LOCATION OF BORING

EXPLORATION LOCATION MAP

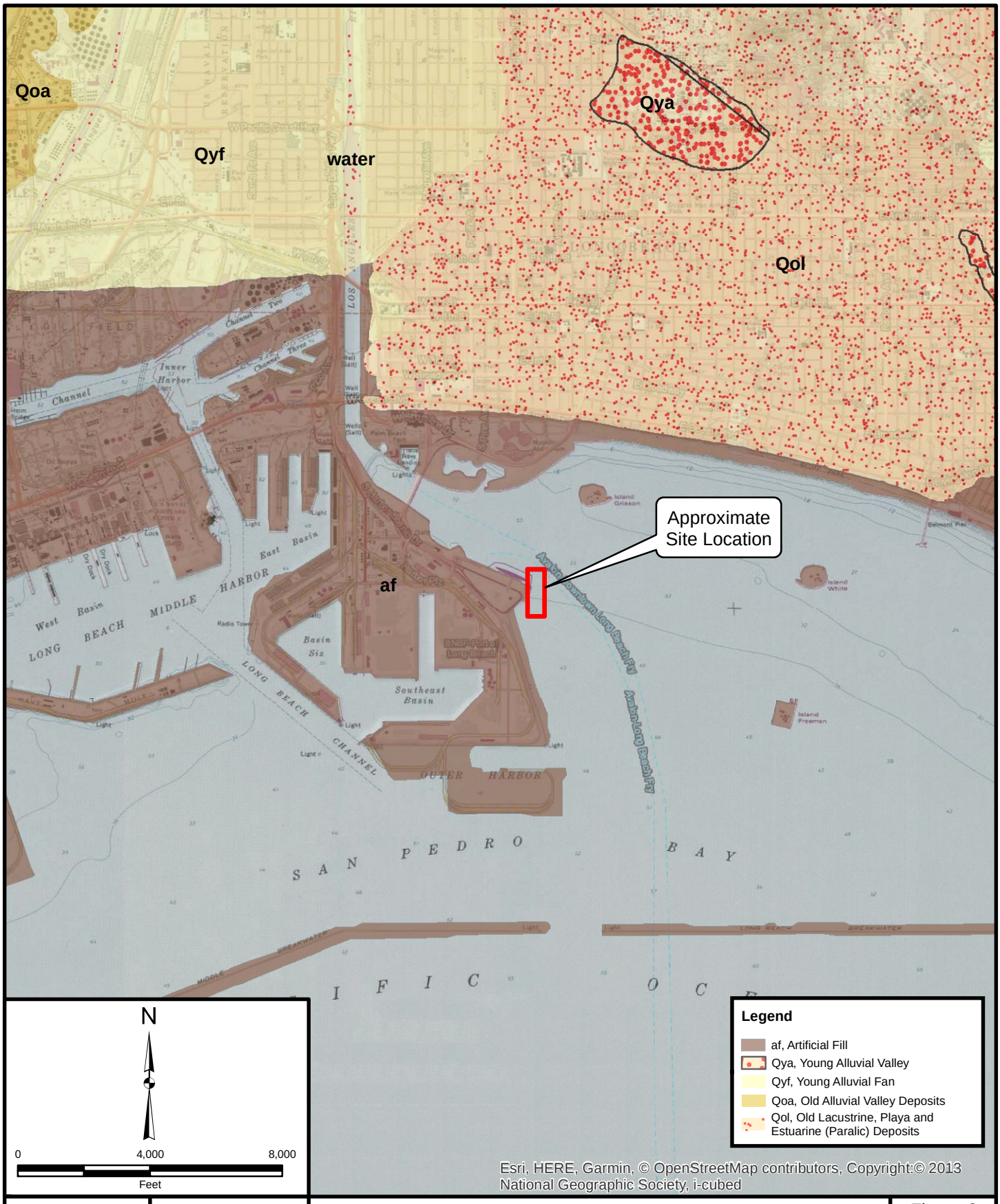
Canival Cruise Line Terminal Sites/ POLB
Long Beach, California

Figure 2.2

Proj: 12096.001	Eng/Geol: VPI
Scale: As Shown	Date: December 2018

Drafted By: BQT | Checked By: BQT | V:\DRAFTING\12096001\CAD\2018-12-06\12096-001_F2.2_ELM_2018-12-10.DWG (12-10-18 2:26:22PM) Plotted by: bban

Leighton



Project: 12018.001	Eng/Geol: VPI
Scale:1 " = 4,000 '	Date: December 2018

Base Map: ESRI ArcGIS Online 2018
Thematic Information: Leighton, USGS
Author: Leighton Geomatics (btran)

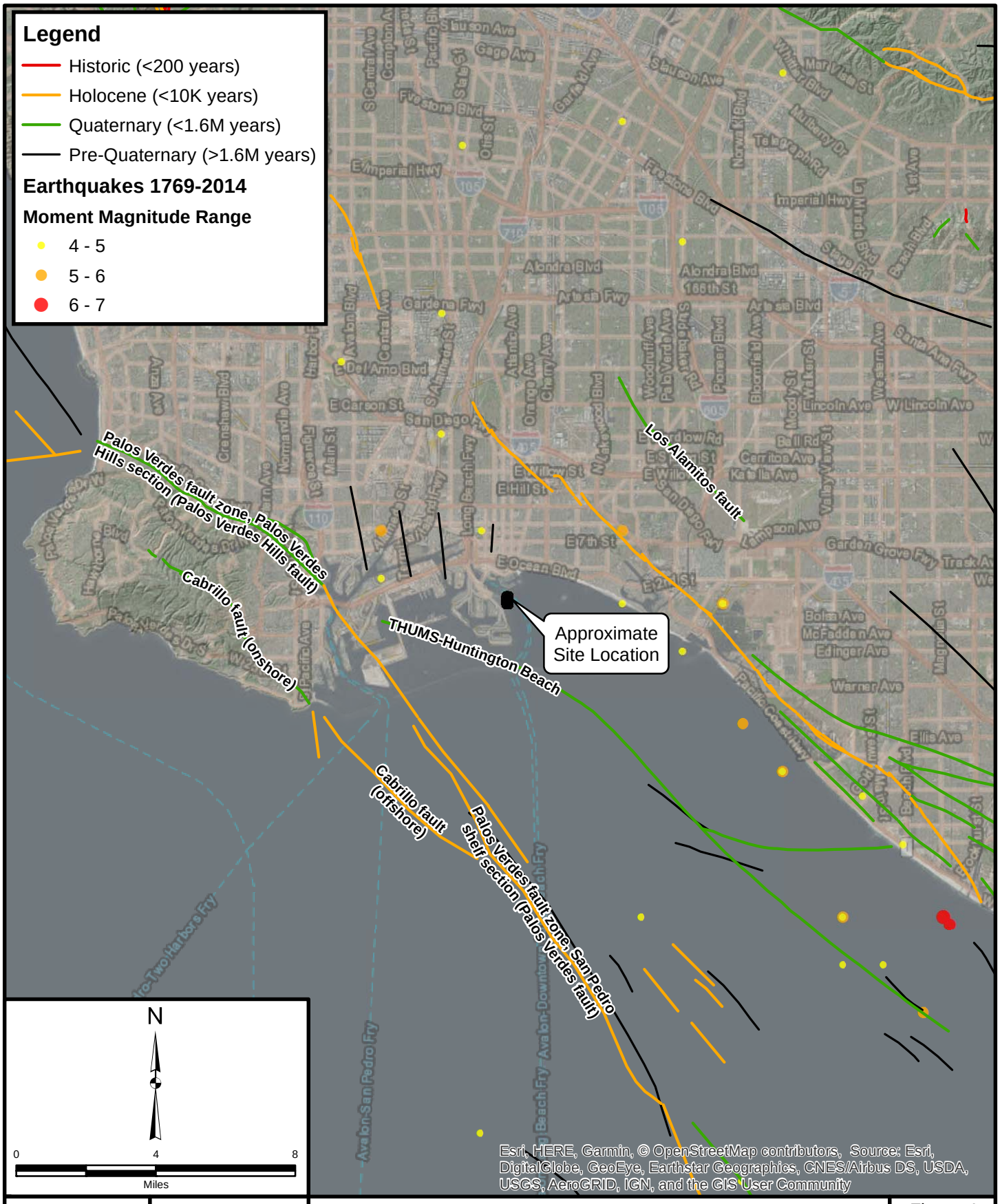
REGIONAL GEOLOGY MAP

Canival Cruise Line Terminal Sites/ POLB
Long Beach, California

Figure 3

Leighton

Map Saved as V:\Drafting\12096\001\Maps\Queen Mary Complex Report\12096-001_F03_RGM_2018-12-10.mxd on 12/10/2018 1:07:57 PM



Project: 12096.001	Eng/Geol: VPI
Scale:1 " = 4 miles	Date: December 2018

Base Map: ESRI ArcGIS Online 2018
Thematic Information: Leighton, CGS, Bryant 2010
Author: Leighton Geomatics (btran)

REGIONAL FAULT AND HISTORIC SEISMICITY MAP

Canival Cruise Line Terminal Sites/ POLB
Long Beach, California

Figure 4

Leighton

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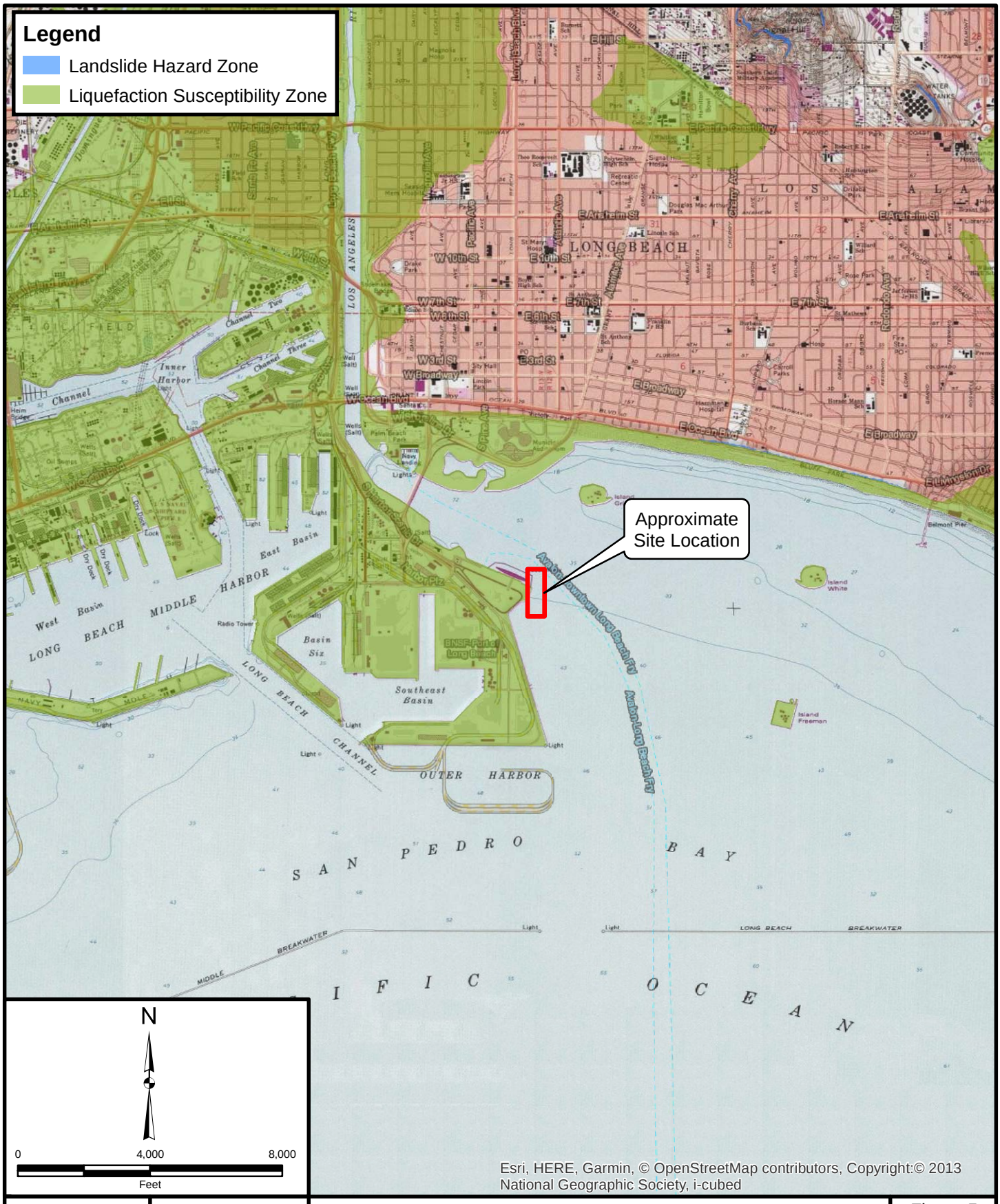


Project: 12096.001	Eng/Geol: VPI
Scale:1 " = 4,000 '	Date: December 2018

Base Map: ESRI ArcGIS Online 2018
Thematic Information: Leighton, CGS
Author: Leighton Geomatics (btran)

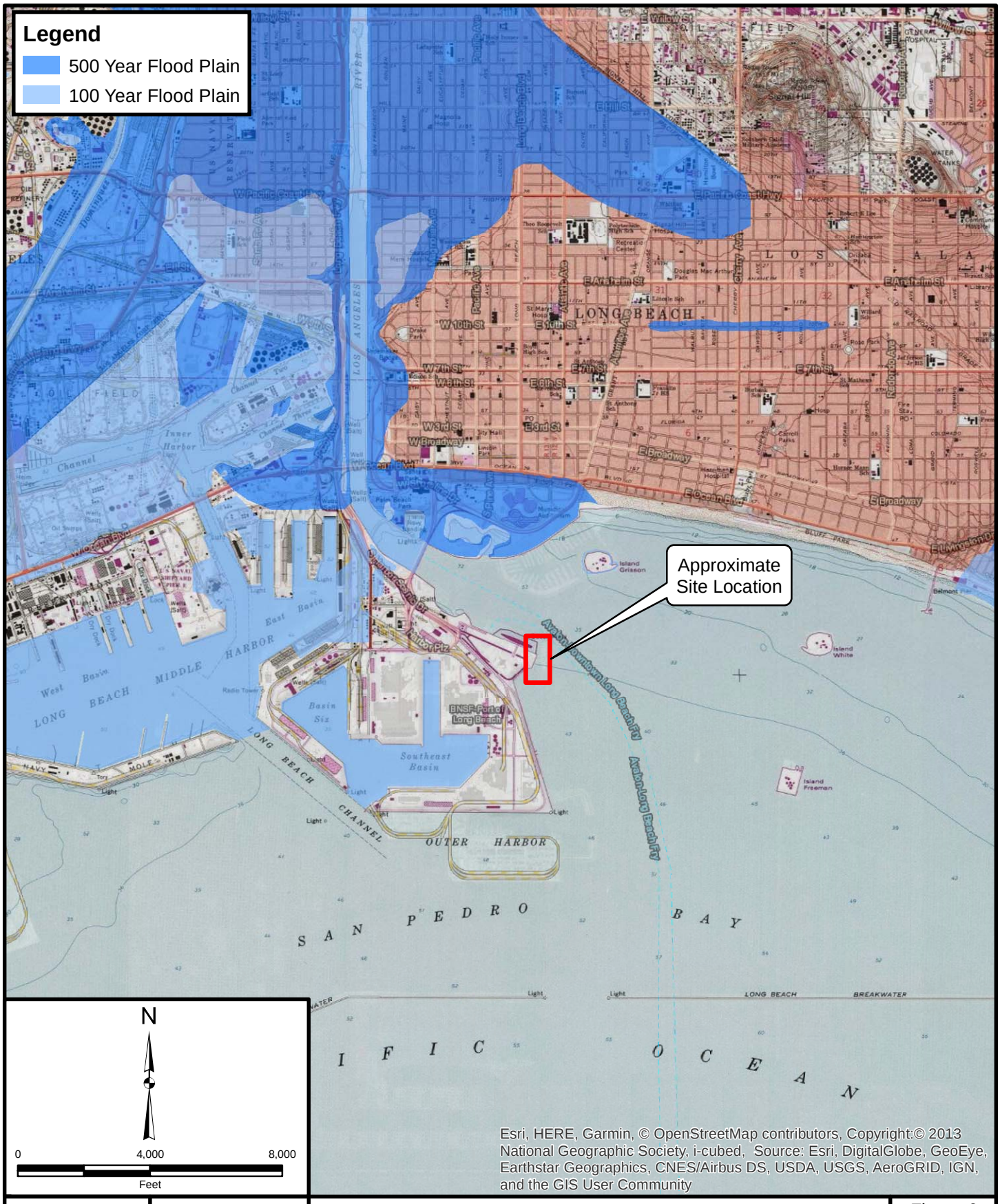
SEISMIC HAZARD MAP

Canival Cruise Line Terminal Sites/ POLB
Long Beach, California

Figure 5

Leighton

Map Saved as V:\Drafting\12096\001\Maps\Queen Mary Complex Report\12096-001_F05_SHM_2018-12-10.mxd on 12/10/2018 1:27:27 PM



N

0 4,000 8,000

Feet

Project: 12096.001	Eng/Geol: VPI
Scale:1 " = 4,000 '	Date: December 2018

Base Map: ESRI ArcGIS Online 2018
Thematic Information: Leighton, CA DWR, FEMA
Author: Leighton Geomatics (btran)

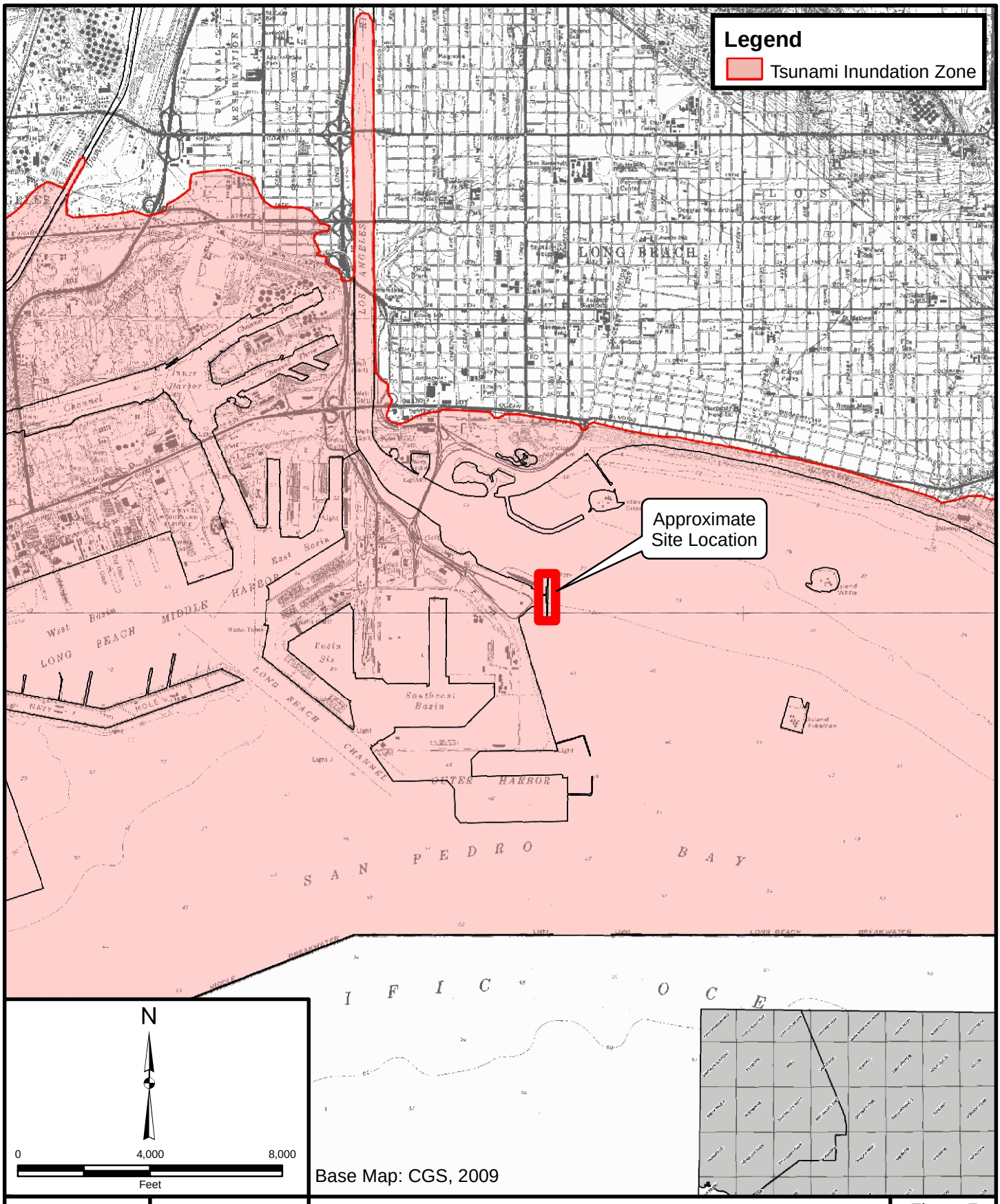
FLOOD HAZARD ZONE MAP

Canival Cruise Line Terminal Sites/POLB
Long Beach, California

Figure 6

Leighton

Map Saved as V:\Drafting\12096\001\Maps\Queen Mary Complex Report\12096-001_F06_FHZM_2018-12-10.mxd on 12/10/2018 3:23:55 PM



Project: 12096.001	Eng/Geol: VPI
Scale:1 " = 4,000 '	Date: December 2018

Base Map: ESRI ArcGIS Online 2018
Thematic Information: Leighton, CA DWR, FEMA
Author: Leighton Geomatics (btran)

TSUNAMI INUNDATION MAP

Canival Cruise Line Terminal Sites/ POLB
Long Beach, California

Figure 7

Leighton

Map Saved as V:\Drafting\12096\001\Maps\Queen Mary Complex Report\12096-001_F07_TIM_2018-12-10.mxd on 12/10/2018 3:14:48 PM

Ultimate Axial Capacity (kips)
Single 36-inch Open-Ended Pipe Pile

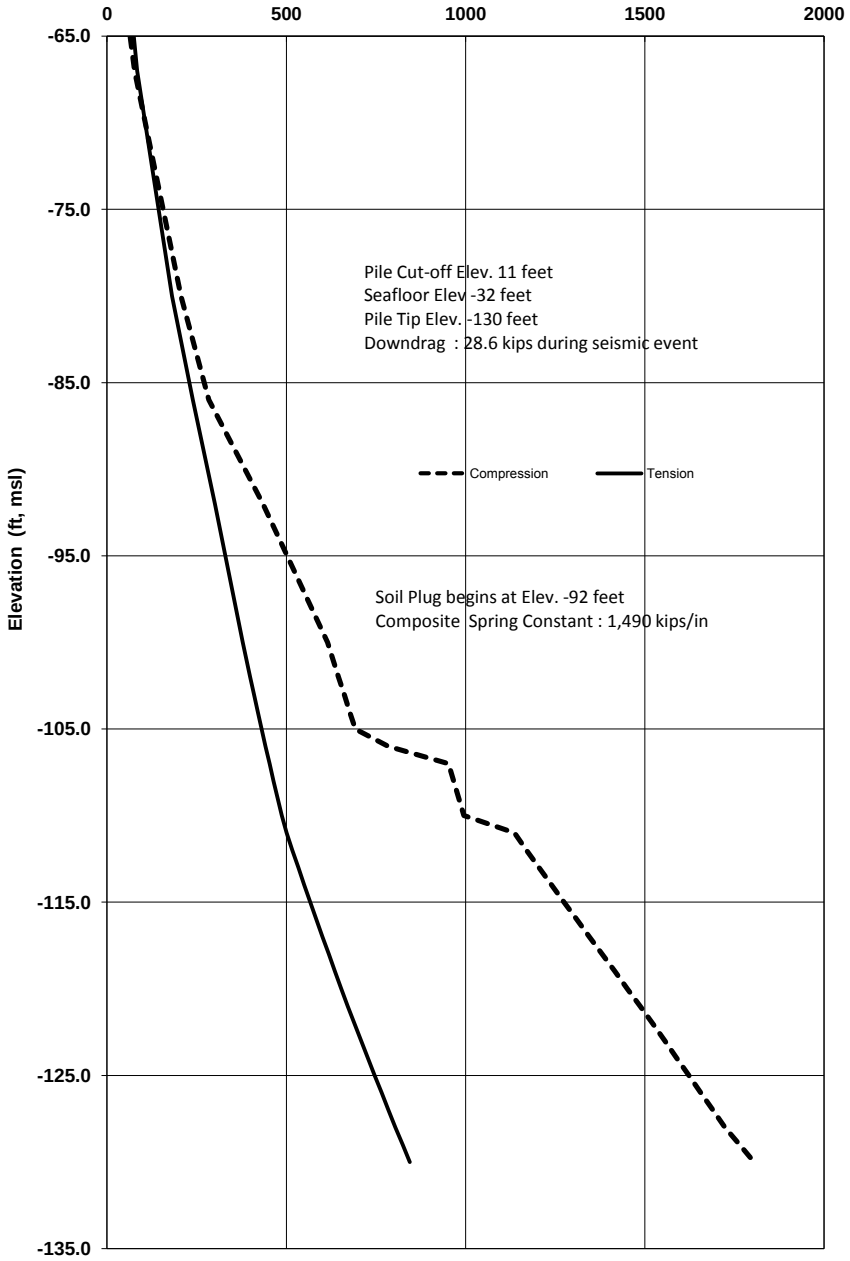


Figure 8

Leighton

Carnival Cruise Line Pier Expansion
North Mooring Dolphin
Port of Long Beach, Long Beach, California

Project Number: 12096.001	Date: December 2018

Ultimate Axial Capacity (kips)
Single 36-inch Open-Ended Pipe Pile

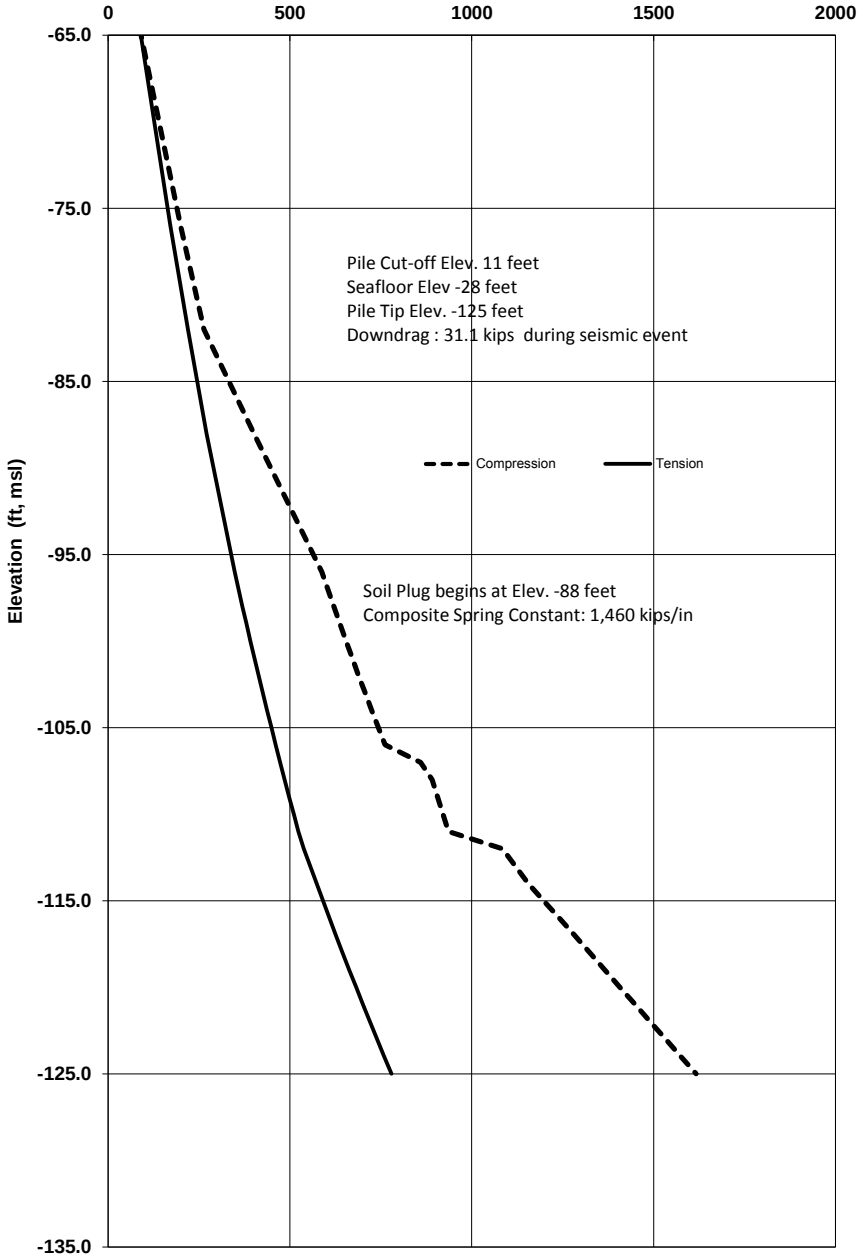


Figure 9

Leighton

Carnival Cruise Line Pier Expansion
South Mooring Dolphin
Port of Long Beach, Long Beach, California

Project Number: 12096.001	Date: December 2018

Ultimate Axial Capacity (kips)
Single 36-inch Open-Ended Pipe Pile

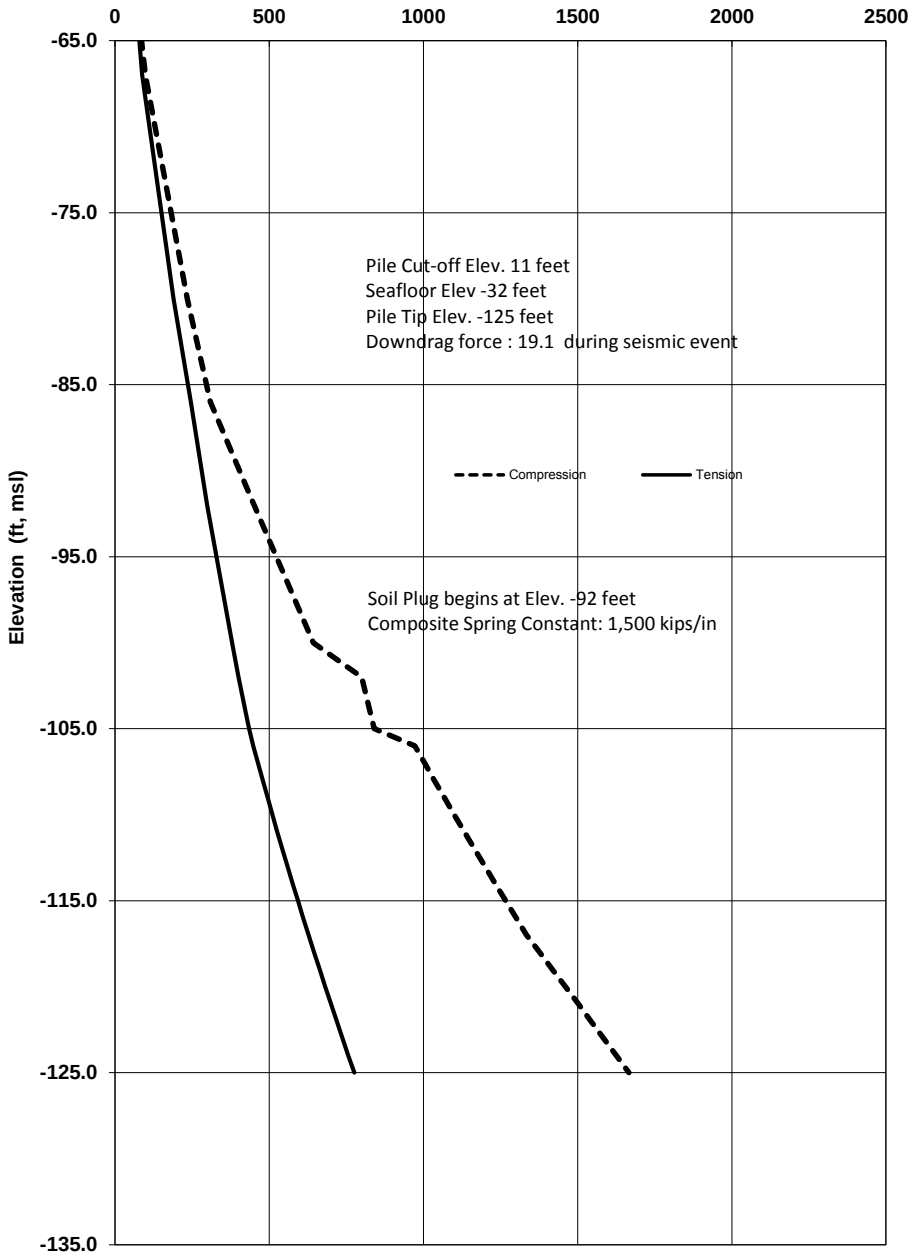


Figure 10

Leighton

Carnival Cruise Line Pier Expansion
Gangway Tower
Port of Long Beach, Long Beach, California

Project Number: 12096.001	Date: December 2018

APPENDIX A

Field Exploration Logs

Leighton

A-1
“Carnival Cruise Line Terminal”

By L.T. Evans (1949)

Leighton

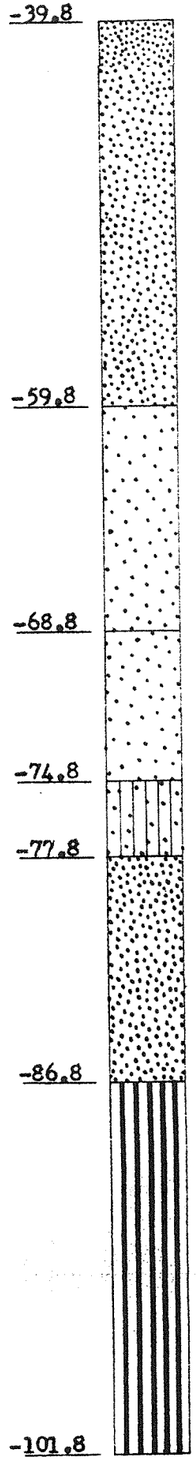
LOG AND PROPERTIES

HOLE NO. 60

			φ	C	G	D_N	DD	D_R	e_o	e_{max}	e_{min}	k	LL	PL
-38.0														
	Medium sand		39° 00'	0	2.66	119.6	97.4	87.8	0.705	1.100	0.650	70×10^{-4}	NA	NA
-66.0														
	Fine sand		38° 30'	0	2.67	119.2	93.5	100.0	0.782	1.260	0.782	14×10^{-4}	NA	NA
-70.0														
	Lost all samples due to cave in of holes													
-80.0														
	Clayey silt		24° 00'	400	2.71	123.1	94.8		0.784			0.06×10^{-4}	NA	NA
-86.0														
	Silt		28° 00'	0	2.68	123.3	95.1		0.755			0.004×10^{-4}	NA	NA
-91.0														
	Very fine to fine sand		41° 00'	0	2.70	124.0	96.0	90.7	0.752	1.260	0.700	20×10^{-4}	NA	NA
-96.0														
	Very fine sand		40° 00'	0	2.69	123.8	96.0	90.0	0.748	1.125	0.707	1.0×10^{-4}	NA	NA
-100.0														

LOG AND PROPERTIES

HOLE NO. 61



	ϕ	C	G	D_N	DD	D_R	P_o	e_{max}	e_{min}	k	LL	PL
Fine sand	38° 35'	0	2.66	122.2	91.6	81.1	0.812	1.250	0.710	12×10^{-4}	NA	NA
Medium sand	39° 40'	0	2.67	117.5	92.5	71.3	0.801	1.150	0.660	55×10^{-4}	NA	NA
Fine to medium sand	40° 00'	0	2.66	118.7	90.3	72.4	0.838	1.200	0.700	60×10^{-4}	NA	NA
Silty medium sand	39° 40'	0	2.67	120.4	91.1	76.7	0.829	1.220	0.710	40×10^{-4}	NA	NA
Very fine to fine sand	39° 30'	0	2.68	116.6	97.5	96.5	0.715	1.125	0.700	8×10^{-4}	NA	NA
Compacted siltstone	Classified only											

A-2
"Carnival Cruise Line Terminal
66kV Line Service Substation"

By Leighton Consulting, Inc.
(February, 2017)

Leighton

GEOTECHNICAL BORING LOG RB-1

Project No.	11564.001	**Date Drilled**	2-10-17
Project	Carnival Cruise Substation	**Logged By**	JMP
Drilling Co.	Socal Drilling CO.	**Hole Diameter**	4+3/4"
Drilling Method	Rotary Wash - 140lb - Autohammer - 30" Drop	**Ground Elevation**	~20.8'
Location	See Plate 1 - Geotechnical Exploration Map	**Sampled By**	JMP

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0	N S		BB1				SM	@Surface: 2-inches Asphalt Concrete over 5-inches Aggregate Base **Artificial Fill, undocumented (dredged fill)** @1': Silty SAND, yellow brown, slightly moist to moist, fine to medium grained sand, few gravels R-Value = 76 SO_4 = 513 ppm Cl = 215 ppm	CR, RV, SA
	5			R1	1 3 3	80	37	ML	@5': SILT, gray, wet, soft, sample disturbed	
	10			S1	Push Push Push			CL	@10': CLAY, dark gray, wet, very soft	
	15			R2	1 1 1				@15': No Recovery	
				R3	1 3 3				@16.5': No Recovery	
	20			S2	1/18				@20': CLAY, dark gray, wet, very soft	
	25			R4	Push 1 2				@25': CLAY, disturbed, sand catcher used	
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

GEOTECHNICAL BORING LOG RB-1

Project No.	11564.001	**Date Drilled**	2-10-17
Project	Carnival Cruise Substation	**Logged By**	JMP
Drilling Co.	Socal Drilling CO.	**Hole Diameter**	4+3/4"
Drilling Method	Rotary Wash - 140lb - Autohammer - 30" Drop	**Ground Elevation**	~20.8'
Location	See Plate 1 - Geotechnical Exploration Map	**Sampled By**	JMP

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Bulk / Driven	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	30			S3		2 2 2			SM	@30': Silty SAND, gray, wet, loose, fine grained sand	
				S4		6 7 8				@32.5': Medium dense, some fine shell fragments	
	35			S5		Push Push Push			CL	@35': CLAY, gray, wet, very soft	
				S6		Push Push 2					
	40			S7		4 1 1					
				S8		Push Push Push					
	45			S9		2 2 1			ML	@45': SILT, gray, wet, soft, micaceous	
				S10		4 3 2			CL/SM	@47.5': Interlayered CLAY and Silty fine SAND, gray, wet, soft/loose, micaceous	
	50			S11		5 6 7			SM	@50': Silty fine SAND, gray, wet, medium dense, fine grained sand, micaceous	
				S12		4 5 4					
	55			S13		Push Push 2			CL	**Mudline or Tidal Flat Deposits** @55': CLAY, gray to dark gray, wet, very soft, organic odor from dark gray material	
				S14		Push Push 1					
	60										

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG RB-1

Project No.	11564.001	**Date Drilled**	2-10-17
Project	Carnival Cruise Substation	**Logged By**	JMP
Drilling Co.	Socal Drilling CO.	**Hole Diameter**	4+3/4"
Drilling Method	Rotary Wash - 140lb - Autohammer - 30" Drop	**Ground Elevation**	~20.8'
Location	See Plate 1 - Geotechnical Exploration Map	**Sampled By**	JMP

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Bulk / Driven	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	60			S15		2 3 7				@60': CLAY, dark gray, soft to medium stiff, wet, slight organic odor	
				S16		12 16 17			SM	@62.5': Silty SAND, gray, wet, medium dense to dense, fine to medium grained sand, abundant shell fragments	
	65			S17		12 16 20			ML	**Quaternary Alluvium** @65': Sandy SILT, yellow brown, very moist, hard, micaceous, fine grained sand (62.8% passing #200)	-200
				S18		17 25 34			SM	@ 67.5': Silty SAND, yellow brown, very moist, very dense, fine grained sand	
	70			S19		19 32 39				@ 70': same as above (29.1% passing #200)	-200
										Total Depth of Boring: 71.5 feet bgs Groundwater encountered at 13.0 feet during drilling; rose to 12.0 feet after 10 minutes Boring backfilled with bentonite-cement grout upon completion of drilling; capped with six-inches cold patch asphalt mix.	
	75										
	80										
	85										
	90										

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

GEOTECHNICAL BORING LOG RB-2

Project No.	11564.001	**Date Drilled**	2-9-17
Project	Carnival Cruise Substation	**Logged By**	JMP
Drilling Co.	Socal Drilling CO.	**Hole Diameter**	4+3/4"
Drilling Method	Rotary Wash - 140lb - Autohammer - 30" Drop	**Ground Elevation**	~20.4'
Location	See Plate 1 - Geotechnical Exploration Map	**Sampled By**	JMP

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No. (Bulk / Driven)	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0							CL	@Surface: 2-inches Asphalt Concrete over 4-inches Aggregate Base **Artificial Fill, undocumented (dredged fill)**	
	5			S1	Push 1 1		54		@5': CLAY, olive gray, wet, very soft, trace brown organics	
	10			R1	Push Push 1	69	54		@10': CLAY, dark gray, wet/saturated, very soft LL = 49 PI = 27 C = 0 Phi = 21°	AL, CN, DS
	15			S2	Push 1 2			CL/ML	@15': Interlayered SILT and CLAY, gray, wet/saturated, very soft, micaceous, few gravels	
	20			R2	1 1 1	83	38	CL	@20': CLAY, gray, wet, very soft, micaceous LL = 28 PI = 11 C = 0 Phi = 34°	AL, DS
	25			S3	Push Push 1					
	30									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG RB-2

Project No.	11564.001	**Date Drilled**	2-9-17
Project	Carnival Cruise Substation	**Logged By**	JMP
Drilling Co.	Socal Drilling CO.	**Hole Diameter**	4+3/4"
Drilling Method	Rotary Wash - 140lb - Autohammer - 30" Drop	**Ground Elevation**	~20.4'
Location	See Plate 1 - Geotechnical Exploration Map	**Sampled By**	JMP

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Bulk / Driven	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	30			R3		5 10 14			SM	@30': Silty SAND, gray, wet, medium dense, fine grained sand, micaceous, some fine shell fragments LL = 28 PI = 11 UU = 2 psi at 50% strain	
	35			S4		3 3 3				@35': Fine to medium grained sand, abundant shell fragments (16.8% passing #200)	-200
	40			R4		3 3 4	95	30	CL	@40': CLAY, gray, wet, soft, micaceous LL = 28 PI = 11 UU = 2 psi at 50% strain	AL, SA, Tx
	45			S5		3 5 5			SM	@45': Silty SAND, gray, wet, medium dense, fine grained sand, micaceous, few fine shell fragments (39.1% passing #200)	-200
	50			R5		4 12 14					
	55			S6		1 1 1			CL	**Mudline or Tidal Flat Deposits** @55': CLAY to Silty CLAY, gray to dark gray, very moist to wet, very soft, slight organic odor, mudline LL = 43 PI = 23	AL
	60										

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG RB-2

Project No.	11564.001	**Date Drilled**	2-9-17
Project	Carnival Cruise Substation	**Logged By**	JMP
Drilling Co.	Socal Drilling CO.	**Hole Diameter**	4+3/4"
Drilling Method	Rotary Wash - 140lb - Autohammer - 30" Drop	**Ground Elevation**	~20.4'
Location	See Plate 1 - Geotechnical Exploration Map	**Sampled By**	JMP

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No. (Bulk / Driven)	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	60			R6	4 7 12			ML	@60': Sandy SILT, gray, wet, medium dense, fine grained sand, micaceous, some fine shell fragments	
	65			S7	16 23 29			ML	**Quaternary Alluvium** @65': Sandy SILT, yellow brown, very moist, hard, fine grained sand, micaceous (56.1% passing #200)	-200
	70			R7	32 67			SM	@70': Silty SAND, yellow brown, very moist, very dense, fine grained sand, micaceous	
									Total Depth of Boring: 71.5 feet bgs Groundwater encountered at 14.0 feet during drilling; rose to 10.5 feet after 10 minutes Boring backfilled with bentonite-cement grout upon completion of drilling; capped with six-inches cold patch asphalt mix.	
	75									
	80									
	85									
	90									

The Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:

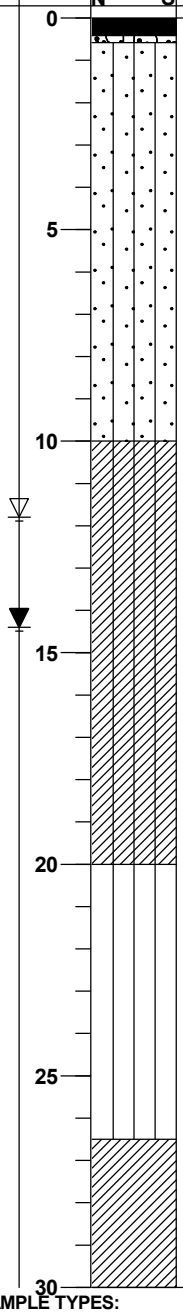
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG RB-3

Project No.	11564.001	**Date Drilled**	2-9-17
Project	Carnival Cruise Substation	**Logged By**	JMP
Drilling Co.	Socal Drilling CO.	**Hole Diameter**	4+3/4"
Drilling Method	Rotary Wash - 140lb - Autohammer - 30" Drop	**Ground Elevation**	~21.7'
Location	See Plate 1 - Geotechnical Exploration Map	**Sampled By**	JMP



Elevation Feet	Depth Feet	Attitudes	Sample No.	Bulk / Driven	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0							SM	@Surface: 5-inches Asphalt Concrete over 2-inches Aggregate Base **Artificial Fill, undocumented (dredged fill)**	
	5		R1		8 8 4				@5': Silty SAND with gravel, olive brown, moist, loose to medium dense, fine to medium grained sand	
	10		S1		Push			ML/CL	@10': Clayey SILT to Silty CLAY, gray, wet, very soft	
	15		R2		Push 1 1					
	20		S2		2 2 2			ML	@20': SILT, gray, wet, soft	
	25		R3		1 1 2					
			R4		1 3 2	83	39	CL	@26.5': CLAY, gray, wet, soft, sample disturbed by sand catcher used for recovery LL = 48 PI = 29 UU = 2 pst at 5% strain	AL, Tx
	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

GEOTECHNICAL BORING LOG RB-3

Project No.	11564.001	**Date Drilled**	2-9-17
Project	Carnival Cruise Substation	**Logged By**	JMP
Drilling Co.	Socal Drilling CO.	**Hole Diameter**	4+3/4"
Drilling Method	Rotary Wash - 140lb - Autohammer - 30" Drop	**Ground Elevation**	~21.7'
Location	See Plate 1 - Geotechnical Exploration Map	**Sampled By**	JMP

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Bulk / Driven	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	30			S3		1 2 2			ML	@30': SILT to Clayey SILT, gray, wet, micaceous, soft	
	35			R5		4 4 5				@35': SILT, gray, wet/saturated, soft, micaceous	
	40			S4		Push 1 2			CL	@40': CLAY, gray, wet/saturated, very soft, micaceous	
	45			R6		5 7 8			SM	@45': Silty SAND, gray, wet/saturated, medium dense, fine grained sand, micaceous	
	50			S5		4 4 5				@50': Loose (27.1% passing #200)	-200
	55			R7		1 3 4	73	49	CL	**Mudline or Tidal Flat Deposits** @55': CLAY to Sandy CLAY, gray to dark gray, very moist, soft, micaceous, organic odor in dark gray portion, fine grained sand LL = 45 PI = 26 UU = 3 psi at 5% strain	AL, Tx
	60										

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG RB-3

Project No.	11564.001	**Date Drilled**	2-9-17
Project	Carnival Cruise Substation	**Logged By**	JMP
Drilling Co.	Socal Drilling CO.	**Hole Diameter**	4+3/4"
Drilling Method	Rotary Wash - 140lb - Autohammer - 30" Drop	**Ground Elevation**	~21.7'
Location	See Plate 1 - Geotechnical Exploration Map	**Sampled By**	JMP

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Bulk / Driven	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	60			S6		2 3 5				@60': CLAY to Silty CLAY, gray to dark gray, wet, stiff to medium stiff, few shell fragments	
	65			R8		27 50/5"			SM	**Quaternary Alluvium** @65': Silty SAND, yellowish gray, moist, very dense, fine grained sand, thinnly bedded (42.8% passing #200)	-200
	70			S7		23 35 42				@ 70': same as above (21.1% passing #200)	-200
										Total Depth of Boring: 71.5 feet bgs Groundwater encountered at 14.4 feet during drilling; rose to 11.8 feet after 10 minutes Boring backfilled with bentonite-cement grout upon completion of drilling; capped with six-inches cold patch asphalt mix.	
	75										
	80										
	85										
	90										

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

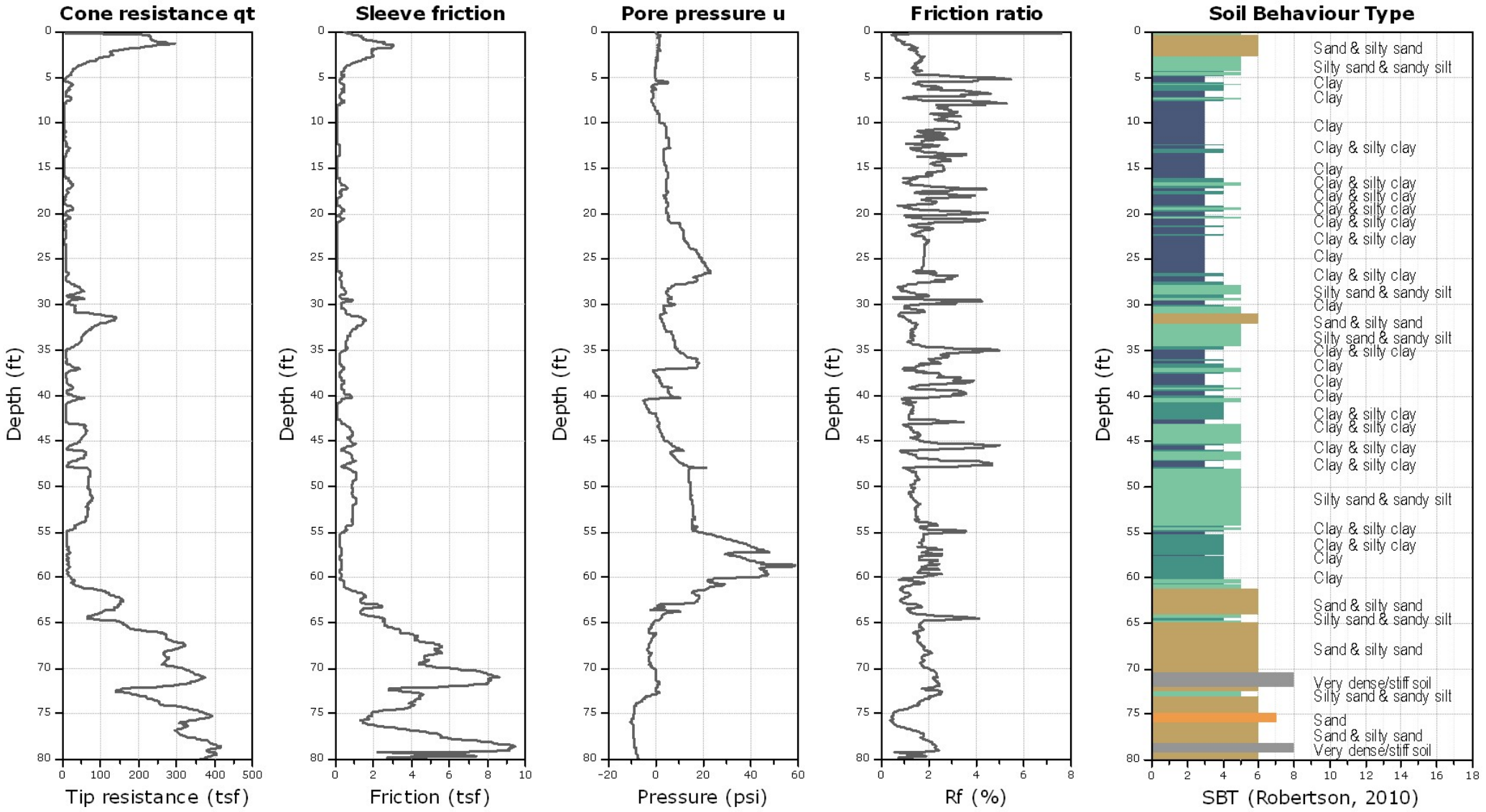
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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

CPT-1

Project: **Leighton & Associates/Consulting/Port of Long Beach**
Location: **Queens Highway Long Beach, CA**

Total depth: 80.49 ft, Date: 2/3/2017
Cone Type: Vertek

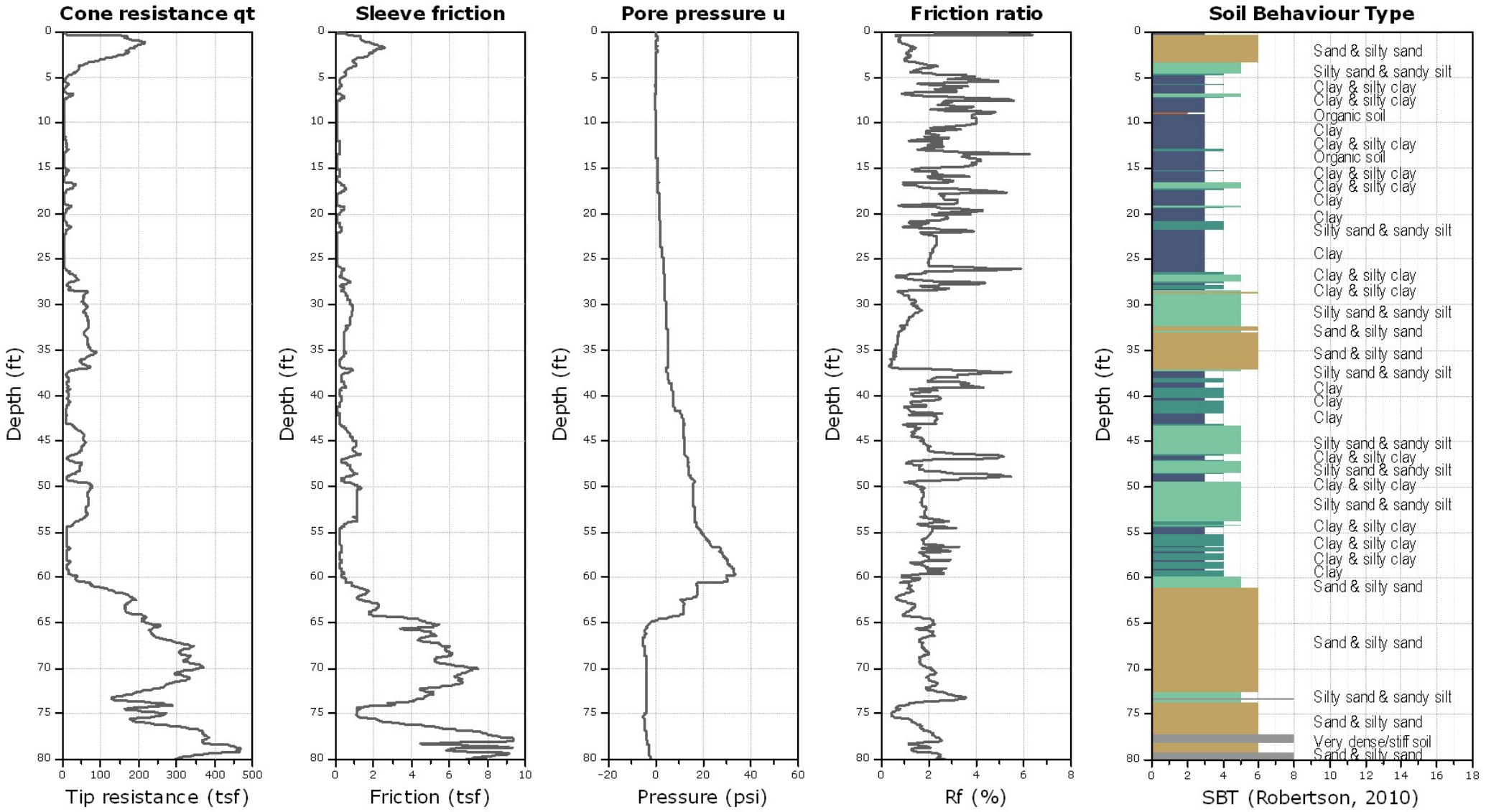


Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

CPT-2

Project: **Leighton & Associates/Consulting/Port of Long Beach**
Location: **Queens Highway Long Beach, CA**

Total depth: 80.39 ft, Date: 2/3/2017
Cone Type: Vertek

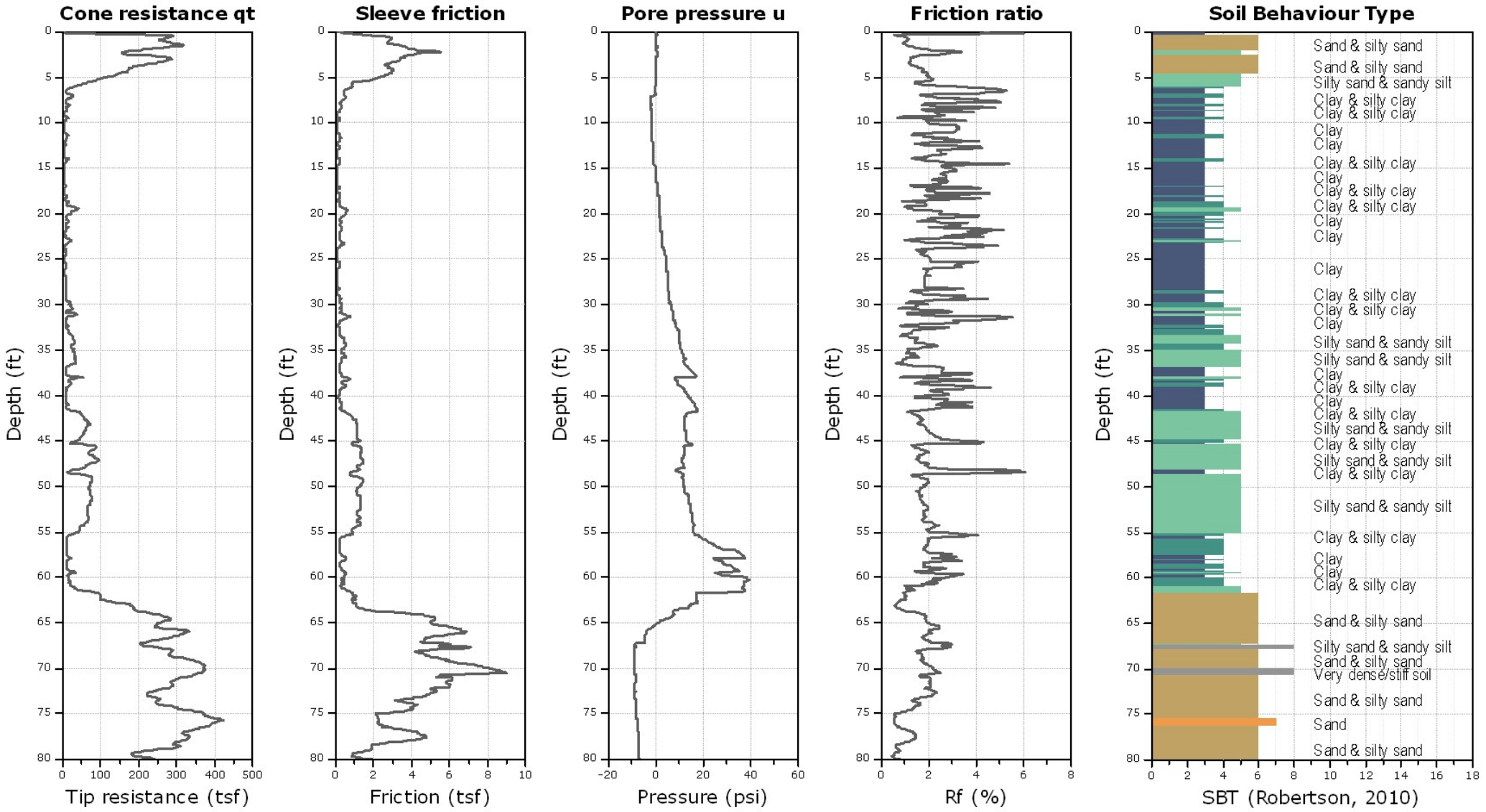


Kehoe Testing and Engineering
714-901-7270
rich@kehoetesting.com
www.kehoetesting.com

CPT-3

Project: **Leighton & Associates/Consulting/Port of Long Beach**
Location: **Queens Highway Long Beach, CA**

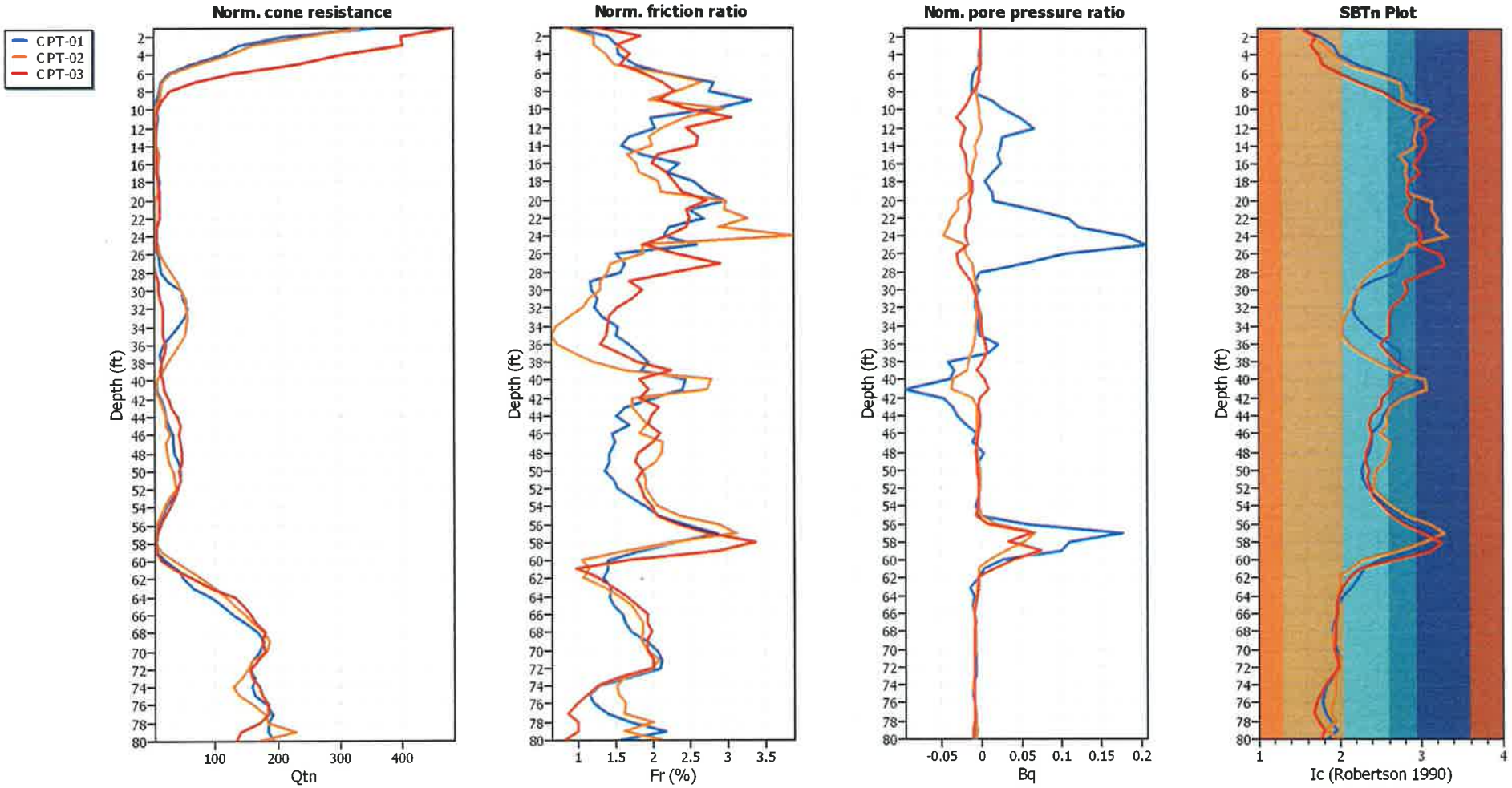
Total depth: 80.94 ft, Date: 2/3/2017
Cone Type: Vertek



Leighton Consulting, Inc.
611 Wilshire Boulevard, Suite 1404
Los Angeles, CA 90017

Project: Carnival Cruise Substation

Overlay Normalized Plots



A-3
"Existing Parking Structure Expansion Project,
Queen Mary Complex"

By Leighton Consulting, Inc.
(May, 2018)

Leighton

GEOTECHNICAL BORING LOG LB-1

Project No.	12018.001	**Date Drilled**	6-13-18
Project	Carnival Cruise Parking Structure Expansion	**Logged By**	EMH
Drilling Co.	SoCal Drilling	**Hole Diameter**	4"
Drilling Method	Rotary Wash - Autohammer	**Ground Elevation**	15'
Location	See Plate 1, Exploration Location Map	**Sampled By**	EMH

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
									This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
15	0								@0': 5-inches of asphalt concrete over 12-inches base.	
								SP	**Artificial Fill, undocumented (Afu)**:	
									@1.5': Dredge fill.	
10	5			R-1	5 8 9				@5': SAND, olive, medium dense, fine sand, low silt content, shells, poorly graded.	CR
									SO4 = 33 ppm Cl = 40 ppm	
5	10			S-1	1 2 3			SM	@10': Silty SAND, brown, loose, moist, fine sand.	
0	15			R-2	Push Push 1				@15': No Recovery	
-5	20			S-2	Push Push Push			ML	@20': SILT, dark grey, very soft, wet, some fine sand and clay.	
-10	25			R-3	Push Push Push	95.1	30.2	SM	@25': Silty SAND, olive grey, very soft, wet, fine sand, slightly micaceous, little clay, nonplastic.	AL
-15	30									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG LB-1

Project No.	12018.001	**Date Drilled**	6-13-18
Project	Carnival Cruise Parking Structure Expansion	**Logged By**	EMH
Drilling Co.	SoCal Drilling	**Hole Diameter**	4"
Drilling Method	Rotary Wash - Autohammer	**Ground Elevation**	15'
Location	See Plate 1, Exploration Location Map	**Sampled By**	EMH

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
									This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
-15	30			S-3	Push Push Push			CL	@30': Silty CLAY with sand, dark grey, very soft, wet, fine sand.	
-20	35			R-4	6 10 11			SM	@35': Silty SAND, greyish brown, medium dense, wet, fine sand, slightly micaceous.	
-25	40			S-4	2 2 1			SM-ML	@40': Silty SAND to sandy SILT, greyish brown, loose/ very soft, fine sand, little clay.	
-30	45			R-5	Push 2 3		54	CH	**Mudline or Tidal Flat Deposits**: @45': Fat CLAY, very dark grey, soft, some silt and fine sand, medium to high plasticity. LL = 56 PI = 27	AL
-35	50			S-5	Push Push Push				@50': CLAY, grey, very soft, wet, some silt, medium to high plasticity, with black organic staining.	
-40	55			R-6	Push 1 2	76.7	46.8		@55': CLAY, grey, very soft, wet, some silt, medium to high plasticity, with black organic staining. PP = 1.0	
-45	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
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GEOTECHNICAL BORING LOG LB-1

Project No.	12018.001	**Date Drilled**	6-13-18
Project	Carnival Cruise Parking Structure Expansion	**Logged By**	EMH
Drilling Co.	SoCal Drilling	**Hole Diameter**	4"
Drilling Method	Rotary Wash - Autohammer	**Ground Elevation**	15'
Location	See Plate 1, Exploration Location Map	**Sampled By**	EMH

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
									This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
-45	60			S-6	Push Push Push			CL	@60': Silty CLAY, dark grey, very soft, wet, little fine sand, medium plasticity.	
-50	65			R-7	Push 1 1	81.7	41.7	ML	@65': Sandy SILT, dark olive grey, very soft, wet, fine sand, trace clay, odorous. LL = 33 PI = 7 PP = 1.0	AL
								SM-ML	**Quaternary Alluvium (Qa):**	
-55	70			S-7	15 19 25				@70': Sandy SILT to silty SAND, yellowish brown, medium dense, mostly fine sand, with some medium sand laminations.	
-60	75			R-8	24 56/6"			SM	@75': Silty SAND, yellowish brown to orange brown, very dense, fine to medium sand, abundant shell fragments, low silt content.	
-65	80			S-8	25 53/6"				@80': Silty SAND, yellowish brown, very dense, fine sand, abundant micas.	
-70	85			R-9	33 50/4"				@85': Increase in silt content, grades finer.	
-75	90									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
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- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG LB-1

Project No.	12018.001	**Date Drilled**	6-13-18
Project	Carnival Cruise Parking Structure Expansion	**Logged By**	EMH
Drilling Co.	SoCal Drilling	**Hole Diameter**	4"
Drilling Method	Rotary Wash - Autohammer	**Ground Elevation**	15'
Location	See Plate 1, Exploration Location Map	**Sampled By**	EMH

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
-75	90			S-9	24 29 33			ML	@90': Sandy SILT, greyish brown, hard, fine sand, abundant micas, minor cementation.	
-80	95			R-10	14 25 30				@95': SILT, olive brown, hard, little fine sand, micaceous, heavily oxidized, nonplastic.	
-85	100			S-10	8 14 16				@100': SILT with clay, laminated orange brown to grey brown, slightly micaceous, some fine sand, oxidized laminations, low to medium plasticity.	
-90	105			R-11	15 25 35				@105': SILT, grey, hard, little fine sand, nonplastic, partially cemented.	DS
-95	110			S-11	8 14 17				@110': Same as above, with little clay, low plasticity.	
-100	115			R-12	31 50/5"				@115': Sandy SILT, olive grey, hard, fine sand, micaceous. (70.4% passing #200) UU = 88 psi at 5% strain	SA, Tx
-105	120									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

GEOTECHNICAL BORING LOG LB-1

Project No.	12018.001	**Date Drilled**	6-13-18
Project	Carnival Cruise Parking Structure Expansion	**Logged By**	EMH
Drilling Co.	SoCal Drilling	**Hole Diameter**	4"
Drilling Method	Rotary Wash - Autohammer	**Ground Elevation**	15'
Location	See Plate 1, Exploration Location Map	**Sampled By**	EMH

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
-105	120			S-12	23 30 42			ML	@120': Sandy SILT, grey, hard, fine sand, micaceous.	
									Total Depth: 121.5 feet bgs Groundwater measured at 12 feet bgs after drilling. Boring backfilled with cement bentonite grout, and asphalt cold-patched upon completion.	
-110	125									
-115	130									
-120	135									
-125	140									
-130	145									
-135	150									

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

GEOTECHNICAL BORING LOG LB-2

Project No.	12018.001	**Date Drilled**	6-21-18
Project	Carnival Cruise Parking Structure Expansion	**Logged By**	EMH/KMD
Drilling Co.	SoCal Drilling	**Hole Diameter**	4"
Drilling Method	Rotary Wash - Autohammer	**Ground Elevation**	15'
Location	See Plate 1, Exploration Location Map	**Sampled By**	EMH/KMD

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
		N S							*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
15	0							ML	@0': 5-inches asphalt concrete, then **Artificial Fill, undocumented (Afu), Dredge Fill:** SO4 = 782 ppm Cl = 52 ppm	CR
10	5			S-1	2 2 5				@5': Sandy SILT, greyish brown, medium stiff, moist, fine sand, nonplastic.	
5	10									
0	15			R-1	1 2 2				@15': No recovery.	
-5	20									
-10	25			S-2	2 3 3				@25': SILT with clay, dark greyish brown, medium stiff, wet, micaceous, low to medium plasticity.	
-15	30									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG LB-2

Project No.	12018.001	**Date Drilled**	6-21-18
Project	Carnival Cruise Parking Structure Expansion	**Logged By**	EMH/KMD
Drilling Co.	SoCal Drilling	**Hole Diameter**	4"
Drilling Method	Rotary Wash - Autohammer	**Ground Elevation**	15'
Location	See Plate 1, Exploration Location Map	**Sampled By**	EMH/KMD

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
									This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
-15	30									
-20	35			R-2	1 2 2	75.3	45.4		@35': SILT with clay, greyish brown, soft, wet, low plasticity, trace fine sand. PL = 27 PI = 19	AL
-25	40									
-30	45			S-3	1 2 2				@45': Sandy SILT with clay, greyish brown, soft, wet, fine sand, nonplastic.	
-35	50			R-3	10 10 11			SM	@50': Silty SAND, grey, medium dense, wet, mostly fine sand, micaceous, disturbed.	
-40	55			S-4	Push Push Push		48.3	ML	**Mudline/Tidal Flat Deposits:** @55': Sandy SILT with clay, very dark grey to black, soft, wet, fine sand, low plasticity, organic staining.	
-45	60									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
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- H HYDROMETER
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- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG LB-2

Project No.	12018.001	**Date Drilled**	6-21-18
Project	Carnival Cruise Parking Structure Expansion	**Logged By**	EMH/KMD
Drilling Co.	SoCal Drilling	**Hole Diameter**	4"
Drilling Method	Rotary Wash - Autohammer	**Ground Elevation**	15'
Location	See Plate 1, Exploration Location Map	**Sampled By**	EMH/KMD

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
									This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
-45	60			R-4	10 29 32			SM	**Quaternary Alluvium (Qa):** @60': Silty SAND, grey, dense, wet, fine to medium sand, abundant shell fragments, slightly micaceous.	
-50	65			S-5	16 24 27				@65': Silty SAND, yellowish brown, dense, wet, normally graded, grades to fine silty SAND with thin lamination of silty CLAY.	
-55	70			R-5	25 50/3"				@70': Silty SAND, yellowish brown, dense, moist, mostly fine sand, slightly micaceous.	
-60	75			S-6	14 21 25			SP	@75': SAND with silt, yellowish brown, dense, moist, mostly fine sand, some medium sand, trace coarse sand, slightly micaceous.	
-65	80			R-6	38 50/5"				@80': Grades finer.	
-70	85			S-7	19 24 28			SM	@85': Silty SAND, yellowish brown, very dense, moist, very fine sand, faintly laminated, slightly micaceous.	
-75	90									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG LB-2

Project No.	12018.001	**Date Drilled**	6-21-18
Project	Carnival Cruise Parking Structure Expansion	**Logged By**	EMH/KMD
Drilling Co.	SoCal Drilling	**Hole Diameter**	4"
Drilling Method	Rotary Wash - Autohammer	**Ground Elevation**	15'
Location	See Plate 1, Exploration Location Map	**Sampled By**	EMH/KMD

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
-75	90			R-7	26 55/6"			ML	@90': Sandy SILT, mottled olive brown to orangeish brown, hard, moist, very fine sand, trace clay, oxidation staining, slightly micaceous, grades sandier, nonplastic (62.6% passing #200).	DS
-80	95			S-8	14 26 35				@95': Sandy SILT, yellowish brown to greyish brown, moist, fine sand, gleyed laminations, nonplastic.	
-85	100			R-8	11 27 38				@100': SILT with clay, mottled olive grey to orangeish brown, hard, moist, slightly cemented, low plasticity, slightly micaceous, oxidation blebs and stains, ~2-inch CaCO3 stringer at the base of the sample.	UC
-90	105			S-9	8 12 14				@105': SILT, olive brown to greyish brown, with orange oxidation staining, moist, very stiff, trace clay and fine sand, low plasticity.	
-95	110			R-9	14 23 26				@110': SILT, grey, hard, moist, slightly cemented, little clay and fine sand, low plasticity.	SA, AL, UC
-100	115			S-10	8 10 12				@115': SILT with clay, grey, very stiff, moist, trace fine sand, low plasticity.	
-105	120									

Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

GEOTECHNICAL BORING LOG LB-2

Project No.	12018.001	**Date Drilled**	6-21-18
Project	Carnival Cruise Parking Structure Expansion	**Logged By**	EMH/KMD
Drilling Co.	SoCal Drilling	**Hole Diameter**	4"
Drilling Method	Rotary Wash - Autohammer	**Ground Elevation**	15'
Location	See Plate 1, Exploration Location Map	**Sampled By**	EMH/KMD

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
-105	120			R-10	21 55				@120': SILT, dark grey, hard, moist, some fine sand, nonplastic.	UC
									Total Depth: 121.5 feet bgs Groundwater measured at 12 feet bgs after drilling. Boring backfilled with cement bentonite grout, and asphalt cold-patched upon completion.	
-110	125									
-115	130									
-120	135									
-125	140									
-130	145									
-135	150									

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
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- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

5/31/18

Leighton Consulting
Attn: Vincent Ip

Subject: CPT Site Investigation
Carnival Cruise Parking Garage
Long Beach, California
GREGG Project Number: D1180558SH

Dear Mr. Ip:

The following report presents the results of GREGG Drilling & Testing's Cone Penetration Test investigation for the above referenced site. The following testing services were performed:

1	Cone Penetration Tests	(CPTU)	☒
2	Pore Pressure Dissipation Tests	(PPD)	☒
3	Seismic Cone Penetration Tests	(SCPTU)	☐
4	UVOST Laser Induced Fluorescence	(UVOST)	☐
5	Groundwater Sampling	(GWS)	☐
6	Soil Sampling	(SS)	☐
7	Vapor Sampling	(VS)	☐
8	Pressuremeter Testing	(PMT)	☐
9	Vane Shear Testing	(VST)	☐
10	Dilatometer Testing	(DMT)	☐

A list of reference papers providing additional background on the specific tests conducted is provided in the bibliography following the text of the report. If you would like a copy of any of these publications or should you have any questions or comments regarding the contents of this report, please do not hesitate to contact our office at (562) 427-6899.

Sincerely,
GREGG Drilling & Testing, Inc.

Frank Stolfi
HRSC Division Manager, Gregg Drilling & Testing, Inc.

Cone Penetration Test Sounding Summary

-Table 1-

CPT Sounding Identification	Date	Termination Depth (feet)	Depth of Groundwater Samples (feet)	Depth of Soil Samples (feet)	Depth of Pore Pressure Dissipation Tests (feet)
CPT-1	5/18/2018	47.24	-	-	-
CPT-2	5/18/2018	70.05	-	-	68.0
CPT-3	5/18/2018	70.37	-	-	46.0
CPT-4	5/18/2018	66.76	-	-	-

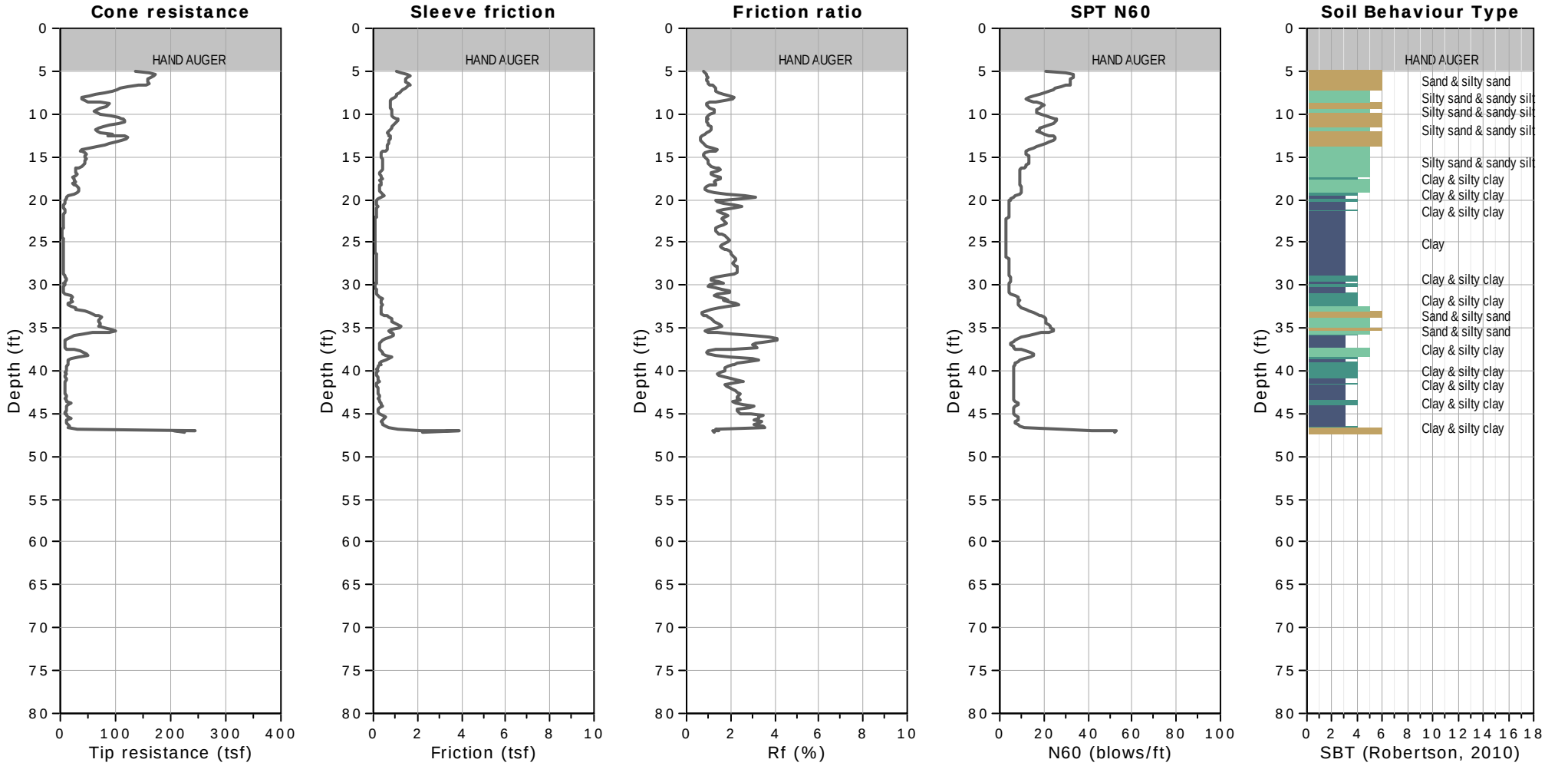
CPT: CPT-1

CLIENT: LEIGHTON CONSULTING

Field Rep: BRIAN

SITE: CARNIVAL CRUISE PARKING GARAGE - LONG BEACH, CA

Total depth: 47.24 ft, Date: 5/18/2018

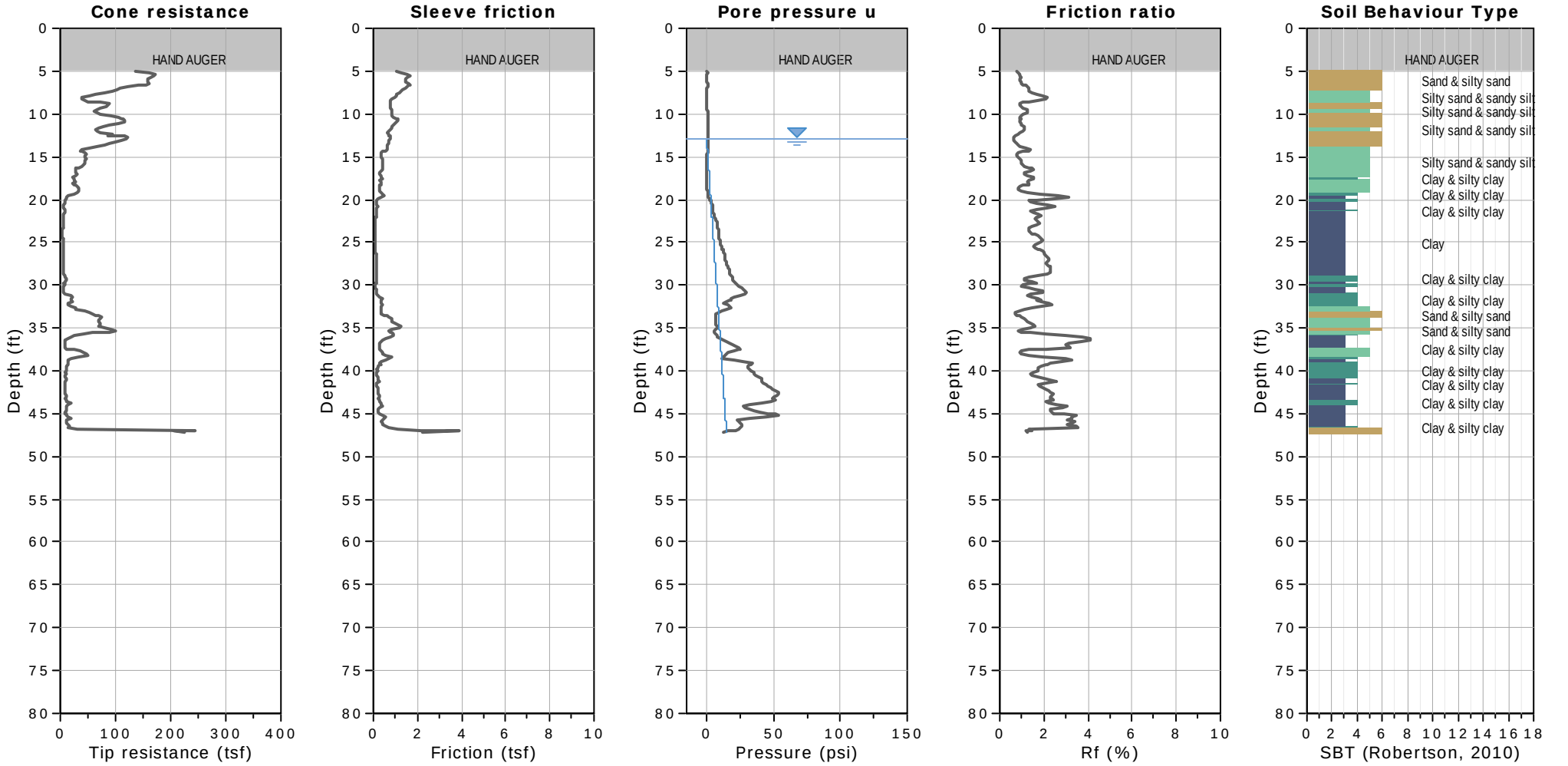


CLIENT: LEIGHTON CONSULTING

SITE: CARNIVAL CRUISE PARKING GARAGE - LONG BEACH, CA

Field Rep: BRIAN

Total depth: 47.24 ft, Date: 5/18/2018



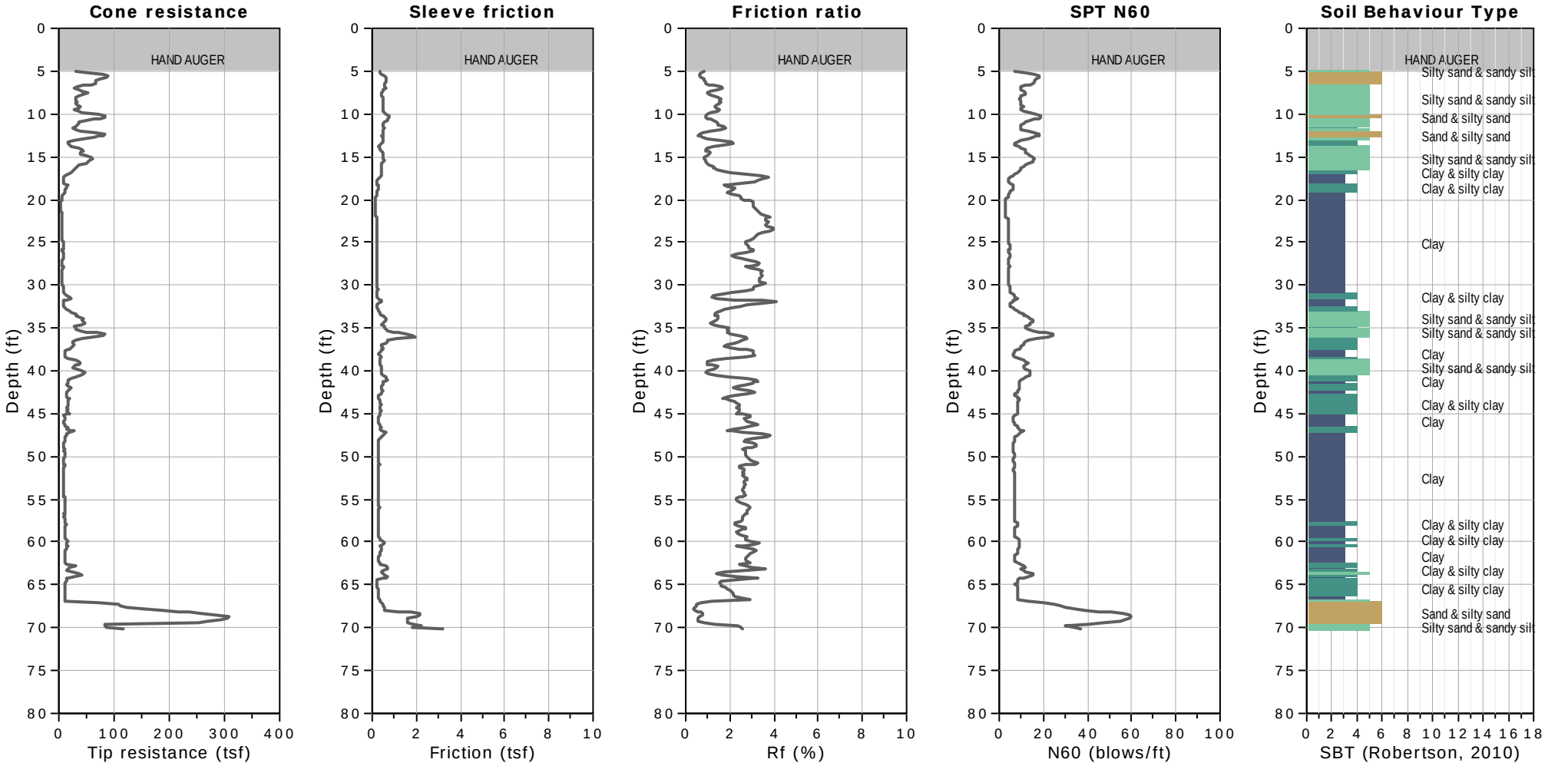
WATER TABLE FOR ESTIMATING PURPOSES ONLY

CLIENT: LEIGHTON CONSULTING

SITE: CARNIVAL CRUISE PARKING GARAGE - LONG BEACH, CA

Field Rep: BRIAN

Total depth: 70.05 ft, Date: 5/18/2018

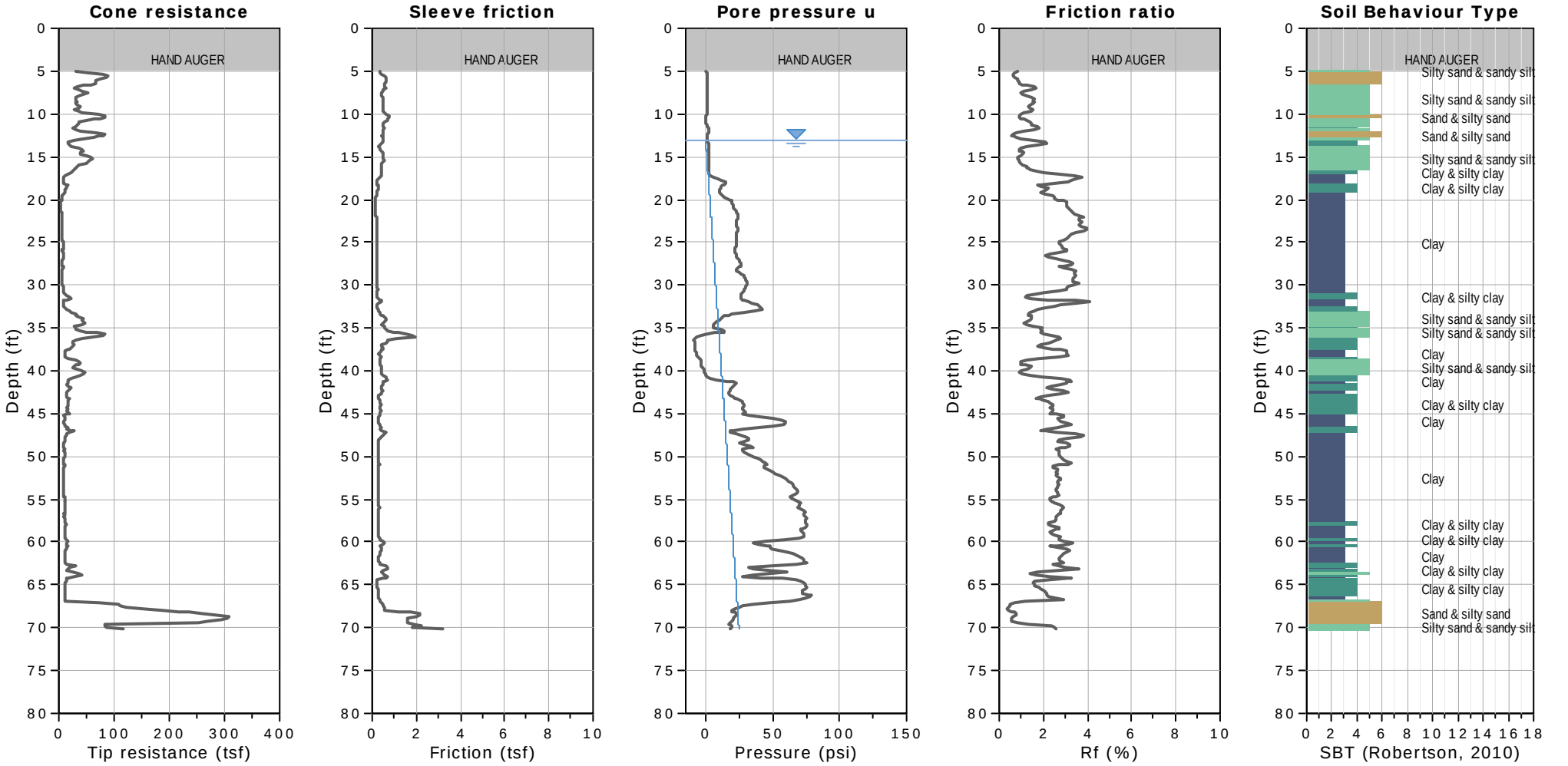


CLIENT: LEIGHTON CONSULTING

SITE: CARNIVAL CRUISE PARKING GARAGE - LONG BEACH, CA

Field Rep: BRIAN

Total depth: 70.05 ft, Date: 5/18/2018



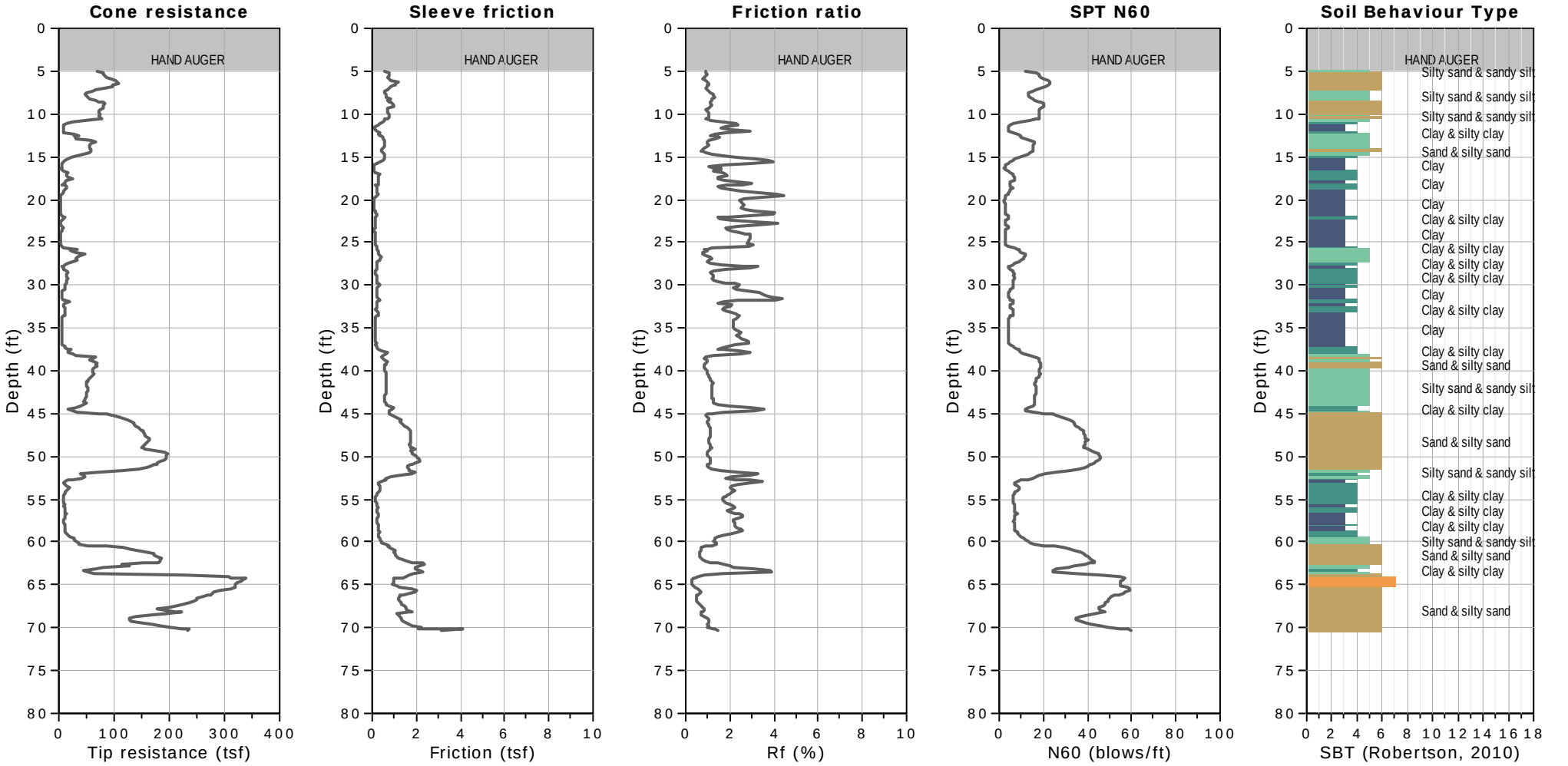
WATER TABLE FOR ESTIMATING PURPOSES ONLY

CLIENT: LEIGHTON CONSULTING

Field Rep: BRIAN

SITE: CARNIVAL CRUISE PARKING GARAGE - LONG BEACH, CA

Total depth: 70.37 ft, Date: 5/18/2018

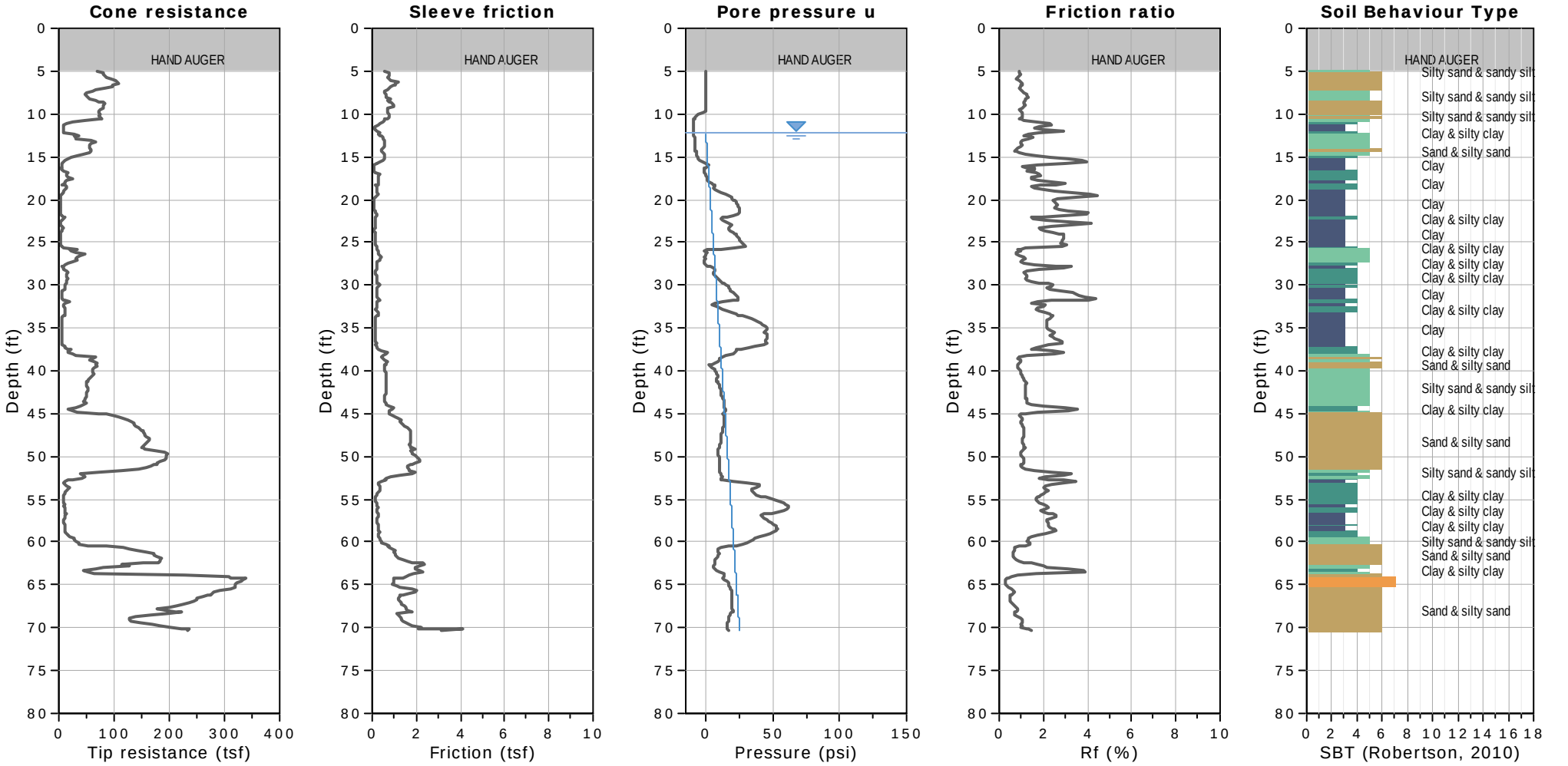


CLIENT: LEIGHTON CONSULTING

SITE: CARNIVAL CRUISE PARKING GARAGE - LONG BEACH, CA

Field Rep: BRIAN

Total depth: 70.37 ft, Date: 5/18/2018



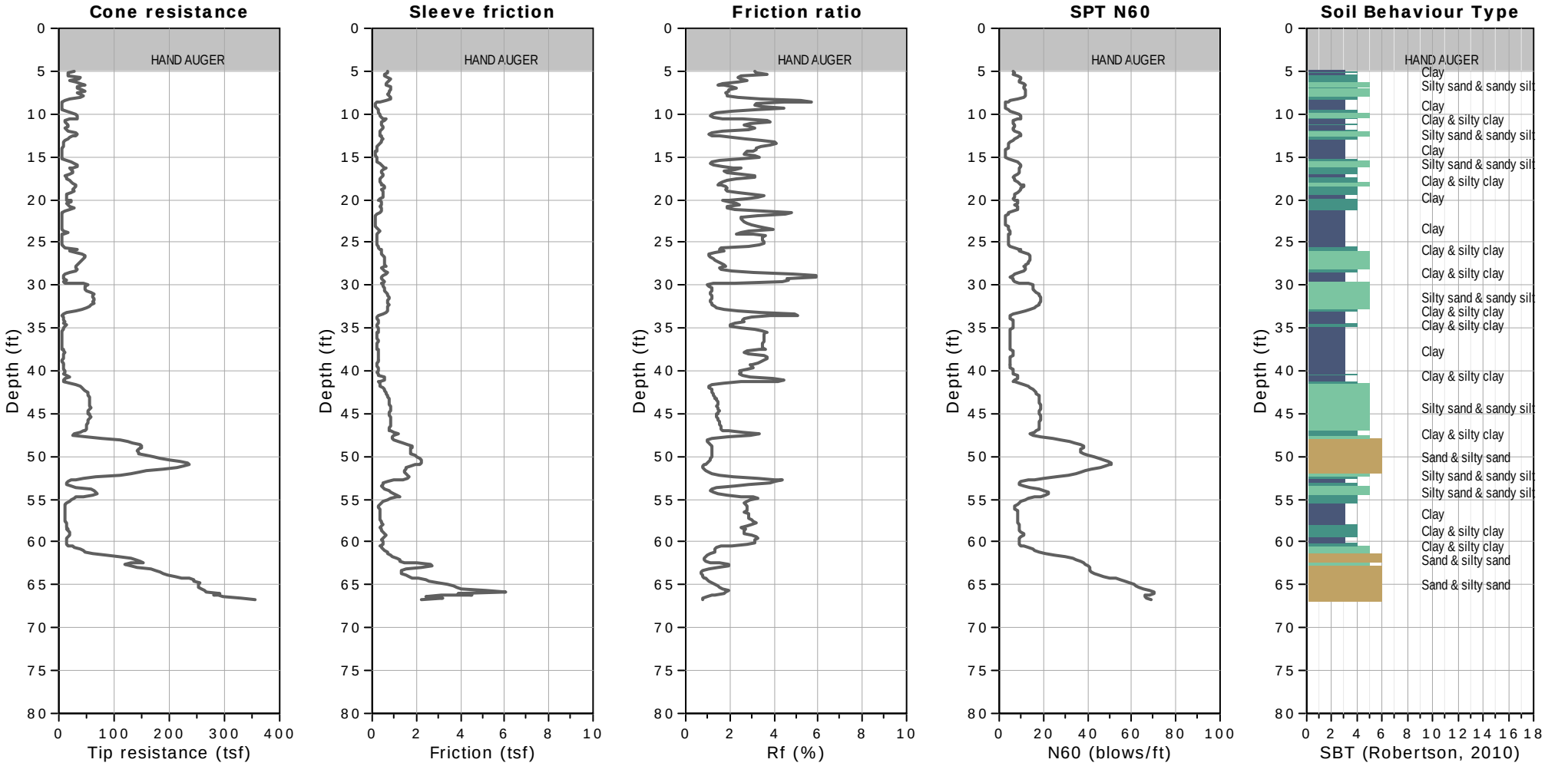
WATER TABLE FOR ESTIMATING PURPOSES ONLY

CLIENT: LEIGHTON CONSULTING

Field Rep: BRIAN

SITE: CARNIVAL CRUISE PARKING GARAGE - LONG BEACH, CA

Total depth: 66.76 ft, Date: 5/18/2018

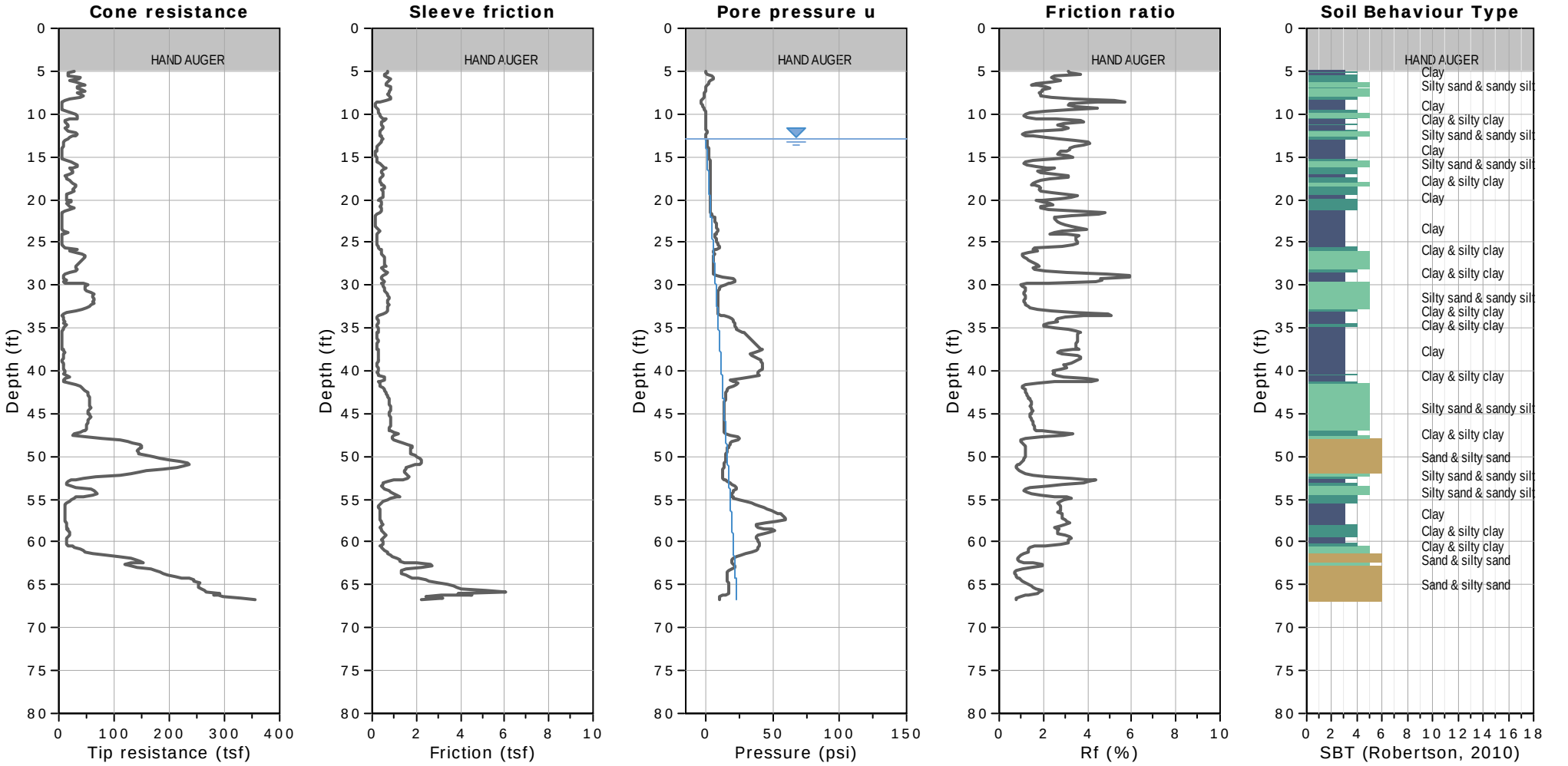


CLIENT: LEIGHTON CONSULTING

SITE: CARNIVAL CRUISE PARKING GARAGE - LONG BEACH, CA

Field Rep: BRIAN

Total depth: 66.76 ft, Date: 5/18/2018



WATER TABLE FOR ESTIMATING PURPOSES ONLY

A-4
“Expansion of Carnival Cruise Line Terminal”

By Leighton Consulting, Inc.
(July, 2018)

Leighton

GEOTECHNICAL BORING LOG B-1

Project No.	12096.001	**Date Drilled**	7-24-18
Project	Atkins Carnival Cruise	**Logged By**	JLH
Drilling Co.	Gregg Drilling	**Hole Diameter**	4.5"
Drilling Method	Mobile B80 Marine Platform - 140lb - Autohammer	**Ground Elevation**	-28'
Location	Northing: 1731342.00, Easting: 6504679.38	**Sampled By**	JP

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
		N S							*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
	0			T-1	PUSH PUSH PUSH			OL (SILT)	**Tidal Deposits:**	
-30				R-1	PUSH PUSH PUSH				@2': SILT, dark grey, soft, wet, micaceous, nonplastic.	
									@3.5': SILT, dark grey, soft, wet, micaceous, nonplastic.	
	5									
-35				S-1	PUSH PUSH PUSH		60	CH	@7': CLAY with silt, gray, wet.	M, AL, H
									@8': Clayey SILT, very dark brown, soft, very moist to wet, moderate plasticity, some organic matter, odorous.	
	10									
-40				R-2	PUSH PUSH PUSH	71.5	50.2	ML	@12': SILT, dark gray, soft, moist.	M, DS, H
									@13.5': Clayey SILT, dark grey to black, soft, very moist to wet, very plastic, organic odor, indistinct laminations, locally micaceous.	
	15									
-45				S-2	PUSH PUSH 3		33	SM	@17': Sandy SILT, gray, soft, moist, fine sand. @18': Silty SAND, dark grey, loose, wet, fine sand, scattered shell fragments, locally micaceous.	M
	20									
-50				R-3	PUSH PUSH 20			SP	**Alluvium:** @23': SAND with silt, trace clay, mottled brown and olive grey, loose, wet, fine sand, micaceous, local FeO staining, scattered shell fragments.	
	25									
-55				S-3	18 20 23				@28': SAND, light yellow brown, dense, moist, fine sand, local FeO stained partings, local FeO stained fossil fragments.	
	30									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

*** * * This log is a part of a report by Leighton and should not be used as a stand-alone document. * * ***

GEOTECHNICAL BORING LOG B-1

Project No.	12096.001	**Date Drilled**	7-24-18
Project	Atkins Carnival Cruise	**Logged By**	JLH
Drilling Co.	Gregg Drilling	**Hole Diameter**	4.5"
Drilling Method	Mobile B80 Marine Platform - 140lb - Autohammer	**Ground Elevation**	-28'
Location	Northing: 1731342.00, Easting: 6504679.38	**Sampled By**	JP

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
		N S							*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
	30									
-60				R-4	25 50/4"				@32.5-32.83': SAND, yellow-brown, very dense, moist, fine to medium grained sand, local layers of shell fragments.	
	35									
-65				S-4	21 28 30				@38': SAND, yellow-brown, very dense, moist, micaceous, local FeO stained laminae, minor shell fragments.	
	40									
-70				R-5	28 49 50/5"			CL	@42': Clay, dark grey.	H
								SP	@43.5': SAND with silt, light brown, very dense, moist, fine to medium grained sand, micaceous, interbeds and laminae of dark grey shell mash, with local FeO stains, quartzitic.	
	45									
-75				S-5	9 16 31					
								ML	@48.5': SILT with sand, light yellow brown, dense, slightly moist to moist, poorly sorted, thinly horizontally laminated, FeO staining along laminae, with partings where broken, sugary texture.	
	50									
-80				R-6	12 25 30	97.3	24		@52': SILT , medium yellow brown, hard, moist, medium plastic, micaceous.	DS, M
	55									
-85				S-6	8 10 13					
	60								@58.5': SILT with clay, light yellow-brown, very stiff, moist, low plasticity, micaceous, locally FeO stained.	

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
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- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG B-1

Project No.	12096.001	**Date Drilled**	7-24-18
Project	Atkins Carnival Cruise	**Logged By**	JLH
Drilling Co.	Gregg Drilling	**Hole Diameter**	4.5"
Drilling Method	Mobile B80 Marine Platform - 140lb - Autohammer	**Ground Elevation**	-28'
Location	Northing: 1731342.00, Easting: 6504679.38	**Sampled By**	JP

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
		N S							*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
	60									
-90				R-7	15 21 25			CL	@62': CLAY with silt, yellow-brown with grey mottling, moderate to high plasticity, minor shell fragments.	
								ML	@63.5': SILT with clay, yellow-brown to dark green-grey, hard, moist, slightly plastic, micaceous, minor woody fragments.	
	65									
-95				S-7	8 12 15				@67': SILT, minor sand, dark grey, very stiff, moist, fine sand, thinly laminated, scattered shells and shell fragments in layers.	
	70									
-100				R-8	26 50/3"	96	27.5		@72': SILT, medium to dark grey, stiff, moist, micaceous, local shell fragments.	DS, M
	75									
-105										
	80									
-110				S-8	30 50/4"					
								SP	@83': SAND, grey, very dense, moist, fine to medium grained, quartzitic, minor shell fragments, local 1-inch shell hash bed.	
	85									
-115										
	90									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

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- AL ATTERBERG LIMITS
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GEOTECHNICAL BORING LOG B-1

Project No.	12096.001	**Date Drilled**	7-24-18
Project	Atkins Carnival Cruise	**Logged By**	JLH
Drilling Co.	Gregg Drilling	**Hole Diameter**	4.5"
Drilling Method	Mobile B80 Marine Platform - 140lb - Autohammer	**Ground Elevation**	-28'
Location	Northing: 1731342.00, Easting: 6504679.38	**Sampled By**	JP

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	90								*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
-120				R-9	41 50/4"				@92': SAND with clay, dark grey, very dense, wet, fine sand, local shell mash deposits (+/- 2 inches thick), local woody fragments, local interbeds of soft plastic clayey SILT to silty CLAY.	
	95									
-125										
	100									
-130				S-9	22 50/3"				@102.5': SAND, medium grey, very dense, moist to wet, fine to medium grained, shell hash bed.	
	105									
-135										
	110									
-140				R-10	25 36 50/3"	97	25.3	ML	@112' : SILT, gray, moist. @112.5': ~3-inch thick shell mash. @113.5': SILT with clay, grey, hard, moist, locally micaceous SAND interbeds.	DS, M
	115									
-145										
	120									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
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GEOTECHNICAL BORING LOG B-1

Project No.	12096.001	**Date Drilled**	7-24-18
Project	Atkins Carnival Cruise	**Logged By**	JLH
Drilling Co.	Gregg Drilling	**Hole Diameter**	4.5"
Drilling Method	Mobile B80 Marine Platform - 140lb - Autohammer	**Ground Elevation**	-28'
Location	Northing: 1731342.00, Easting: 6504679.38	**Sampled By**	JP

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
		N S							*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
	120									
-150				S-10	22 43 50/4"			CL SP	@123': 1-inch CLAY underlies 2-inch thick shell mash lens. @123.5': SAND with silt, dark grey, dense, wet, fine to medium grained sand, scattered shells.	
	125									
-155									Total Depth: 123.5 feet bgs Boring backfilled with cement grout upon completion of drilling.	
	130									
-160										
	135									
-165										
	140									
-170										
	145									
-175										
	150									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

GEOTECHNICAL BORING LOG B-2

Project No.	12096.001	**Date Drilled**	7-25-18
Project	Atkins Carnival Cruise	**Logged By**	JLH
Drilling Co.	Gregg Drilling	**Hole Diameter**	4.5"
Drilling Method	Mobile B80 Marine Platform - 140lb - Autohammer	**Ground Elevation**	-32'
Location	Northing: 1731760.94, Easting: 6504775.46	**Sampled By**	NA

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
									This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
-32	0			T-1	PUSH PUSH PUSH			OL (SILT)	**Tidal Deposits:** @0': SILT, black, very soft, wet, organic odor.	
-35					PUSH PUSH PUSH				@2': No recovery.	
	5				PUSH PUSH PUSH				@5': No recovery.	
-40				T-2	PUSH PUSH PUSH			CL ML	@8': CLAY, olive gray, soft, moist. @9': SILT, with clay, grey-brown, very soft, wet, medium plasticity.	AL, Tx, H
	10									
-45				R-1	PUSH PUSH PUSH	73.3	45		@12': SILT, dark green-grey, soft, moist. @13.5': Clayey SILT, dark grey to black, very soft, wet to very moist, medium plasticity, organic-rich, slightly odorous, local shell fragments.	DS, AL, M
	15									
-50				S-1	PUSH PUSH 3			SM	**Alluvium:** @18': Silty SAND, blue-grey, loose, wet, fine sand, scattered shell fragments, noncohesive.	
	20									
-55				R-2	15 29 48				@23.5': Silty SAND, grey-brown, very dense, moist, fine to medium grained sand.	
	25									
-60				S-2	18 27 30				@27': 3-inch shell mash bed.	
								SP	@28.5': SAND, light gray to pale brown, very dense, moist, fine to medium grained sand, local shell fragments.	
-62	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

GEOTECHNICAL BORING LOG B-2

Project No.	12096.001	**Date Drilled**	7-25-18
Project	Atkins Carnival Cruise	**Logged By**	JLH
Drilling Co.	Gregg Drilling	**Hole Diameter**	4.5"
Drilling Method	Mobile B80 Marine Platform - 140lb - Autohammer	**Ground Elevation**	-32'
Location	Northing: 1731760.94, Easting: 6504775.46	**Sampled By**	NA

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
		N S							*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
	30									
-65				R-3	7 19 45				@32': SAND, dark grey to grey, medium dense, moist, medium grained, blebs of black clay rip-up clasts. @33.25': SAND, medium yellow, dense, moist, fine to medium grained, quartzitic.	
	35									
-70				S-3	18 35 35				@36.75': Shell hash (storm deposit). @37.5': SAND, light blue-grey, dense, moist, fine grained.	
	40									
-75				R-4	10 20 50	125.3	12.75	CL SM	@42': CLAY with silt, medium to light brown and mottled grey, moist, plastic. @43': Silty SAND, light brown to grey, dense, fine sand, scattered shells.	DS, M
	45									
-80				S-4	21 28 40			SP	@47': 6-inch layer of shell hash, black sand matrix. @47.5': SAND, with clay, brown, very dense, moist, medium grained sand, angular grains.	
	50									
-85				R-5B R-5A	11 18 25			CL	@52': CLAY, with silt, light olive brown, very stiff, moist, medium plasticity.	
	55									
-90				S-5	9 10 10			SP CL	@57': SAND, trace gravel, pale brown, loose, wet, coarse sand, fine gravel, with shell fragments. @58.25': CLAY, with silt, yellow-brown with grey mottling, very stiff, plastic.	
	60									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG B-2

Project No.	12096.001	**Date Drilled**	7-25-18
Project	Atkins Carnival Cruise	**Logged By**	JLH
Drilling Co.	Gregg Drilling	**Hole Diameter**	4.5"
Drilling Method	Mobile B80 Marine Platform - 140lb - Autohammer	**Ground Elevation**	-32'
Location	Northing: 1731760.94, Easting: 6504775.46	**Sampled By**	NA

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	60	N S							*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
				R-6B R-6A	8 13 38	102.7	24	ML SM	@62': SILT, with clay, light blue-grey, moist, slightly micaceous. @63': Silty SAND, grey-brown, dense, moist, find sand.	DS, M
-95	65									
				S-6	12 22 31			SP ML	@67': SAND, trace gravel, light brown, dense, wet, medium to coarse grained sand, fine gravel. @67.5': SILT, yellow-brown, hard, moist.	
-100	70									
				R-7	24 34 50/4"					
-105	75							SP	@73.5': SAND, green-grey, very dense, wet, fine sand, slightly micaceous and quartzitic, with small shell fragments.	
-110	80									
				S-7	21 40 50/4"			CL SP	@82.5': Silty CLAY, dark green-grey to black, moist, low to high plasticity, with blue bentonite bed. @83.25': SAND, blue-brown and white-grey, very dense, moist, fine to medium grained sand, local grey CLAY rip-up clasts.	
-115	85									
-120	90									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

GEOTECHNICAL BORING LOG B-2

Project No.	12096.001	**Date Drilled**	7-25-18
Project	Atkins Carnival Cruise	**Logged By**	JLH
Drilling Co.	Gregg Drilling	**Hole Diameter**	4.5"
Drilling Method	Mobile B80 Marine Platform - 140lb - Autohammer	**Ground Elevation**	-32'
Location	Northing: 1731760.94, Easting: 6504775.46	**Sampled By**	NA

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	90								*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
-125				R-8	45 50/1"			SM	@92': Silty SAND, green-grey, very dense, moist, fine sand, quartz grains, moderately cohesive.	
	95									
-130										
	100									
-135				S-8	7 33 50/4"			CL	@102': CLAY, blue-grey, moist, plastic.	
								SP	@103': SAND, blue-grey, very dense, moist, fine sand, quartzitic, micaceous, with local shell fragments.	
	105									
-140										
	110									
-145				R-9	17 29 50/4"				@112': SAND, with silt, blue-grey, very dense, wet, fine sand, noncohesive, slightly micaceous.	
	115									
-150										
	120									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG B-2

Project No.	12096.001	**Date Drilled**	7-25-18
Project	Atkins Carnival Cruise	**Logged By**	JLH
Drilling Co.	Gregg Drilling	**Hole Diameter**	4.5"
Drilling Method	Mobile B80 Marine Platform - 140lb - Autohammer	**Ground Elevation**	-32'
Location	Northing: 1731760.94, Easting: 6504775.46	**Sampled By**	NA

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
		N S							*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
	120									
-155				S-9	20 36 50/5"			SM	@122.5': Silty SAND, green-grey to black, very dense, wet, fine sand, micaceous, 1-inch of blue grey silty CLAY.	
	125								Total Depth: 124.5 feet bgs Boring backfilled with cement grout upon completion of drilling.	
-160										
	130									
-165										
	135									
-170										
	140									
-175										
	145									
-180										
	150									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG B-3-1

Project No.	12096.001	**Date Drilled**	7-26-18
Project	Atkins Carnival Cruise	**Logged By**	JLH
Drilling Co.	Gregg Drilling	**Hole Diameter**	4.5"
Drilling Method	Mobile B80 Marine Platform - 140lb - Autohammer	**Ground Elevation**	-32'
Location	Northing: 1732518.43, Easting: 6504687.87	**Sampled By**	KD

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
		N S							*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
-32	0				PUSH PUSH PUSH			OL (SILT)	**Artificial Fill, (Dredge Fill), undocumented (Afu):** @0': SILT, black, very soft, wet, organic. (minor recovery)	
-35										
-37	5			T-1	PUSH PUSH PUSH				@5': SILT, black, very soft, wet, organic.	
-40				S-1	PUSH PUSH PUSH		74	ML CL	@7': SILT , black, wet, very soft, strong H2S odor. @7.5': CLAY, with silt, black, very soft, wet, scant shells, structureless, strong H2S odor.	M, AL
-42	10									
-45					PUSH PUSH PUSH				@12': No recovery.	
-47	15				PUSH PUSH PUSH				@15': No recovery.	
-50				S-2	PUSH PUSH PUSH					
								ML	@18.5': Clayey SILT , black to dark olive grey, very soft, wet to very moist, moderate plasticity, indistinct laminae, local shell fragments, local grey SAND blebs.	
-52	20							Rip-Rap	@20': Refusal.	
-55									Total Depth: 20.15 feet bgs Driller refusal at 20 feet bgs, presumably on existing revetment. Relocating rig 110 feet North East of B-3-1.	
-60	25									
-62	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

GEOTECHNICAL BORING LOG B-3-2

Project No.	12096.001	**Date Drilled**	7-26-18
Project	Atkins Carnival Cruise	**Logged By**	JLH
Drilling Co.	Gregg Drilling	**Hole Diameter**	4.5"
Drilling Method	Mobile B80 Marine Platform - 140lb - Autohammer	**Ground Elevation**	-32'
Location	-118.18729, 33.753197	**Sampled By**	KD

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
									This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
-32	0				PUSH PUSH PUSH			OL (SILT)	**Artificial Fill, (Dredge Fill), undocumented (Afu):** @0': No recovery.	
-35										
-37	5				PUSH PUSH PUSH				@5': No recovery.	
				S-1	PUSH PUSH PUSH			SP	@7': SAND, medium to dark grey, very loose, wet, medium grained sand.	
-40										
-42	10				PUSH PUSH 1				@9': No recovery.	
-45										
-47	15				PUSH PUSH PUSH				@14': No recovery.	
-50										
				S-2	PUSH PUSH PUSH			CL	@19': CLAY, black, very soft, wet, plastic, no odor to slight odor, light grey mottling and grey alternating laminations.	
-55	20									
-57	25			R-1	PUSH 1 1	66.7	58	ML	@25': Sandy SILT, black to medium blue-grey, soft, very moist, medium to coarse sand, plastic, slightly odorous, indistinctly laminated, quartzitic.	DS, M
-60										
-62	30			R-2	PUSH PUSH	73.3	48		@29': SILT, with sand , dark olive brown, soft, wet, fine sand, significantly petroliferous odor, thinly laminated, alternating	DS, M

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG B-3-2

Project No.	12096.001	**Date Drilled**	7-26-18
Project	Atkins Carnival Cruise	**Logged By**	JLH
Drilling Co.	Gregg Drilling	**Hole Diameter**	4.5"
Drilling Method	Mobile B80 Marine Platform - 140lb - Autohammer	**Ground Elevation**	-32'
Location	-118.18729, 33.753197	**Sampled By**	KD

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	30				PUSH	73.3	48		grey and black laminae, slightly plastic to plastic.	
-65										
				S-3	PUSH PUSH PUSH					
	35							SP	@35': SAND, medium to dark grey, loose, wet, fine sand, minor shell fragments.	
-70										
				R-3	PUSH PUSH PUSH	68.2	55	ML	@39': SILT, dark gray, soft, very moist, cohesive, slight petroliferous odor, plastic.	DS, M
	40									
-75										
					PUSH PUSH PUSH				@44': same. (1 inch recovered)	
	45									
-80										
	50							SP ML	@49.42': SAND, medium grey, loose to medium dense, moist, fine to medium grained sand, steel wool fragment.	
				S-4	PUSH 2 8				**Alluvium:** @49.83': Sandy SILT, medium yellow-brown, stiff, moist, fine sand, micaceous.	
-85										
	55			R-4	47 50/5"			SP	@55': SAND, yellow-brown, medium dense, wet, fine sand, micaceous, quartzitic. @55.5': 1-inch thick shell hash layer.	
-90										
	60									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

GEOTECHNICAL BORING LOG B-3-2

Project No.	12096.001	**Date Drilled**	7-26-18
Project	Atkins Carnival Cruise	**Logged By**	JLH
Drilling Co.	Gregg Drilling	**Hole Diameter**	4.5"
Drilling Method	Mobile B80 Marine Platform - 140lb - Autohammer	**Ground Elevation**	-32'
Location	-118.18729, 33.753197	**Sampled By**	KD

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	60			S-5	1 3 9			ML	@61.67': SILT, brown, stiff, moist, plastic.	
-95										
	65			R-5	16 38 50/2"				@65': Clayey SILT, medium grey-yellow, moist, plastic.	
								SP	@66': SAND, medium yellow- brown, very dense, moist to wet, fine to medium grained sand.	
-100										
	70			S-6	5 7 22				@70': SAND, black to grey, moist, local 3-inch thick shell bed, scattered shell fragments, clast of yellow clay. @70.5': SAND, medium yellow grey, medium dense, wet, medium grained sand.	
-105										
	75			R-6	35 50/4"				@75': SAND, green-grey, very dense, wet, fine sand, micaceous.	
-110										
	80									
-115										
	85			S-7	10 20 24			ML	@85.5': Clayey SILT, medium blue grey, hard, slightly plastic.	
-120										
	90									

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG B-3-2

Project No.	12096.001	**Date Drilled**	7-26-18
Project	Atkins Carnival Cruise	**Logged By**	JLH
Drilling Co.	Gregg Drilling	**Hole Diameter**	4.5"
Drilling Method	Mobile B80 Marine Platform - 140lb - Autohammer	**Ground Elevation**	-32'
Location	-118.18729, 33.753197	**Sampled By**	KD

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	90								*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
-125										
	95			R-7	16 31 50	99.5	26	SM	@95': Silty SAND, medium dark blue-grey, very dense, moist, fine sand, local shell fragments along indistinct laminae, micaceous, very low plasticity.	DS, M
-130										
	100									
-135										
	105			S-8 S-9	17 35 39 41 50/4"			SP	@105.5': SAND, medium blue-grey, medium dense, wet, medium grained sand, angular grains, quartzitic.	
-140										
	110									
-145										
	115								@115': No recovery.	
-150									Total Depth 115.83 feet bgs Boring backfilled with cement grout upon completion of drilling.	
	120									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

APPENDIX B

Geotechnical Laboratory Test Results

Leighton

B-1

Leighton Consulting, Inc.
(February, 2017)

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ATTERBERG LIMITS

ASTM D 4318

Project Name:	Carnival Cruise Substation	Tested By:	S. Felter	Date:	02/22/17
Project No. :	11564.001	Input By:	J. Ward	Date:	03/02/17
Boring No.:	RB-2	Checked By:	J. Ward		
Sample No.:	R-1	Depth (ft.)	10.0		
Soil Identification:	Olive gray lean clay (CL)				

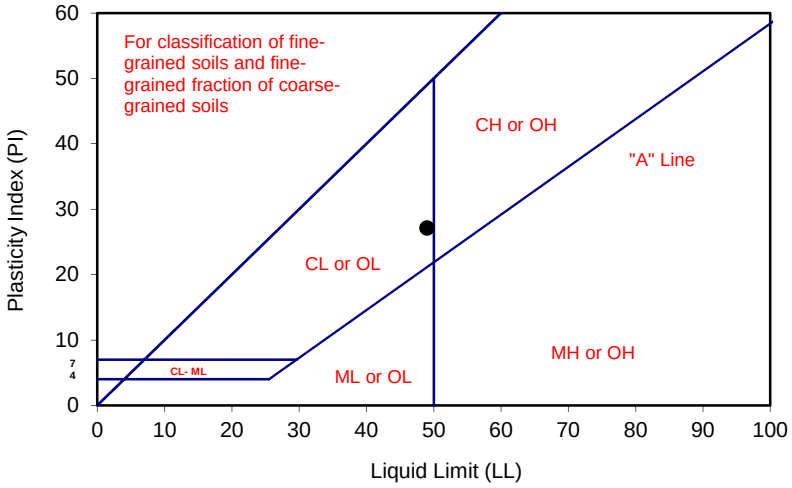
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			34	27	19	
Wet Wt. of Soil + Cont. (g)	23.59	23.65	35.04	38.41	36.66	
Dry Wt. of Soil + Cont. (g)	21.82	21.80	28.02	30.27	28.92	
Wt. of Container (g)	13.58	13.49	13.48	13.55	13.48	
Moisture Content (%) [Wn]	21.48	22.26	48.28	48.68	50.13	

Liquid Limit	**49**
Plastic Limit	**22**
Plasticity Index	**27**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 21.17

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



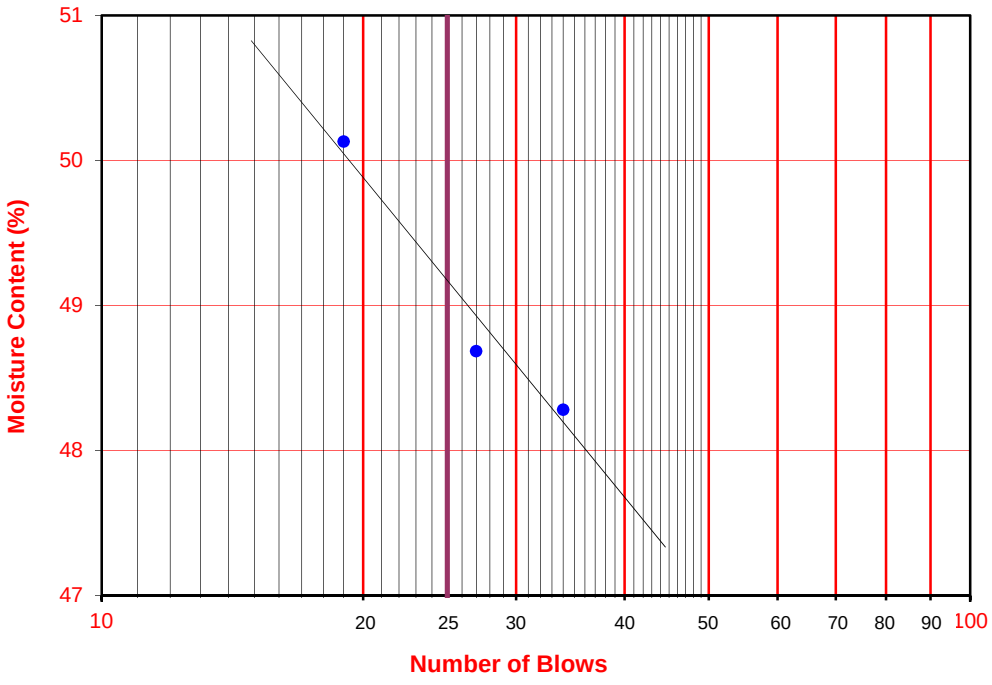
PROCEDURES USED

[ ] Wet Preparation
Multipoint - Wet

[X] Dry Preparation
Multipoint - Dry

[X] Procedure A
Multipoint Test

[ ] Procedure B
One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	Carnival Cruise Substation	Tested By:	S. Felter	Date:	02/24/17
Project No. :	11564.001	Input By:	J. Ward	Date:	03/02/17
Boring No.:	RB-3	Checked By:	J. Ward		
Sample No.:	R-7	Depth (ft.)	55.0		
Soil Identification:	Dark grayish olive sandy lean clay s(CL)				

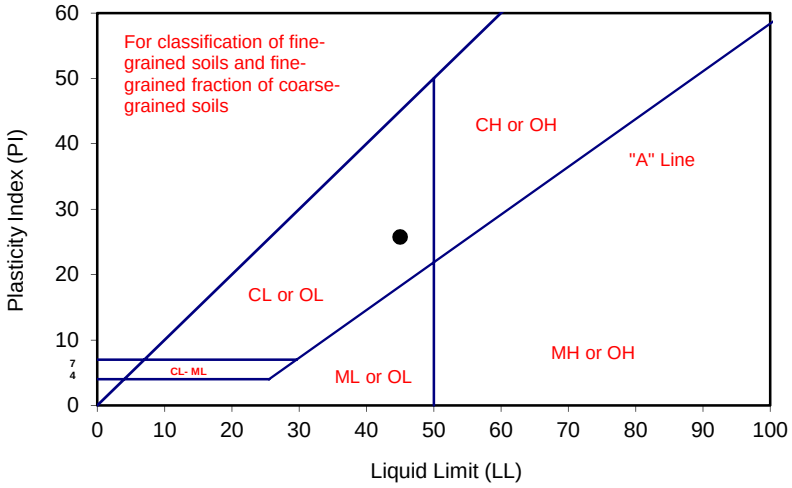
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			34	25	18	
Wet Wt. of Soil + Cont. (g)	21.73	21.56	36.46	37.21	34.60	
Dry Wt. of Soil + Cont. (g)	20.11	19.93	29.51	29.95	27.94	
Wt. of Container (g)	11.64	11.51	13.47	13.57	13.48	
Moisture Content (%) [Wn]	19.13	19.36	43.33	44.32	46.06	

Liquid Limit	**45**
Plastic Limit	**19**
Plasticity Index	**26**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 18.25

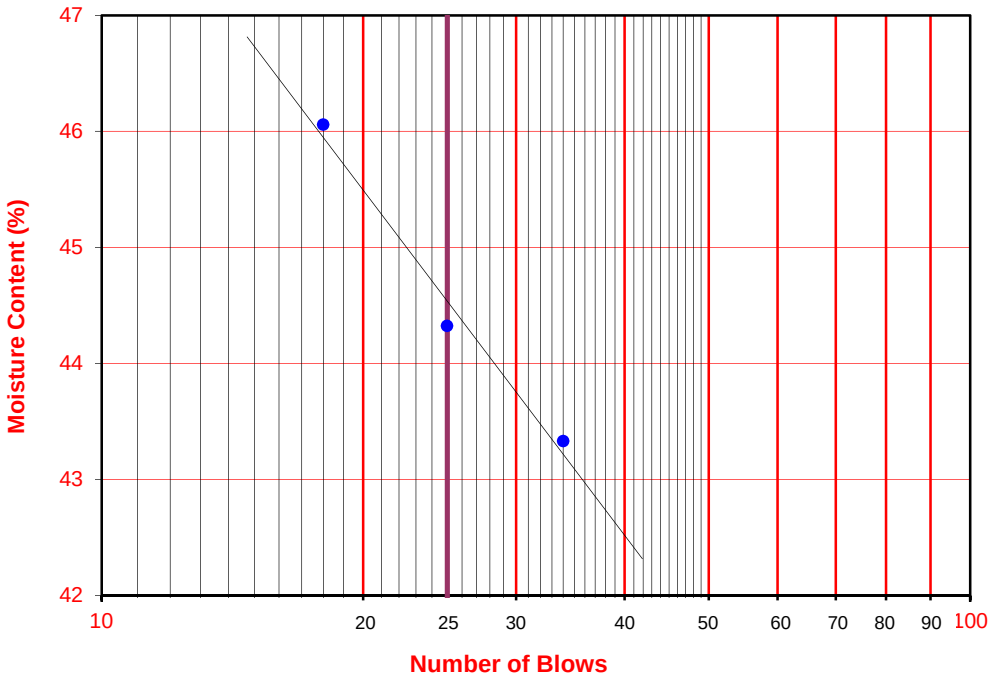
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



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ATTERBERG LIMITS

ASTM D 4318

Project Name:	Carnival Cruise Substation	Tested By:	S. Felter	Date:	02/23/17
Project No. :	11564.001	Input By:	J. Ward	Date:	03/02/17
Boring No.:	RB-3	Checked By:	J. Ward		
Sample No.:	R-4	Depth (ft.)	26.5		
Soil Identification:	Olive lean clay (CL)				

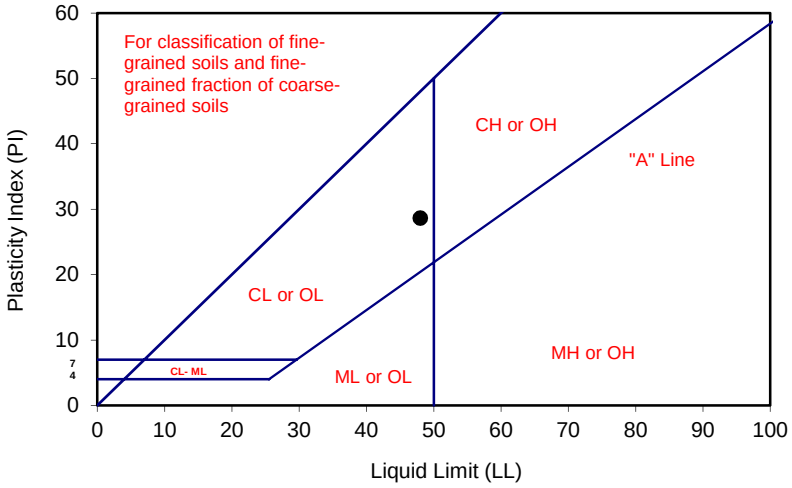
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			33	24	18	
Wet Wt. of Soil + Cont. (g)	23.66	23.84	35.86	35.19	35.27	
Dry Wt. of Soil + Cont. (g)	22.03	22.15	28.73	28.16	28.10	
Wt. of Container (g)	13.57	13.47	13.52	13.61	13.47	
Moisture Content (%) [Wn]	19.27	19.47	46.88	48.32	49.01	

Liquid Limit	**48**
Plastic Limit	**19**
Plasticity Index	**29**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 20.44

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



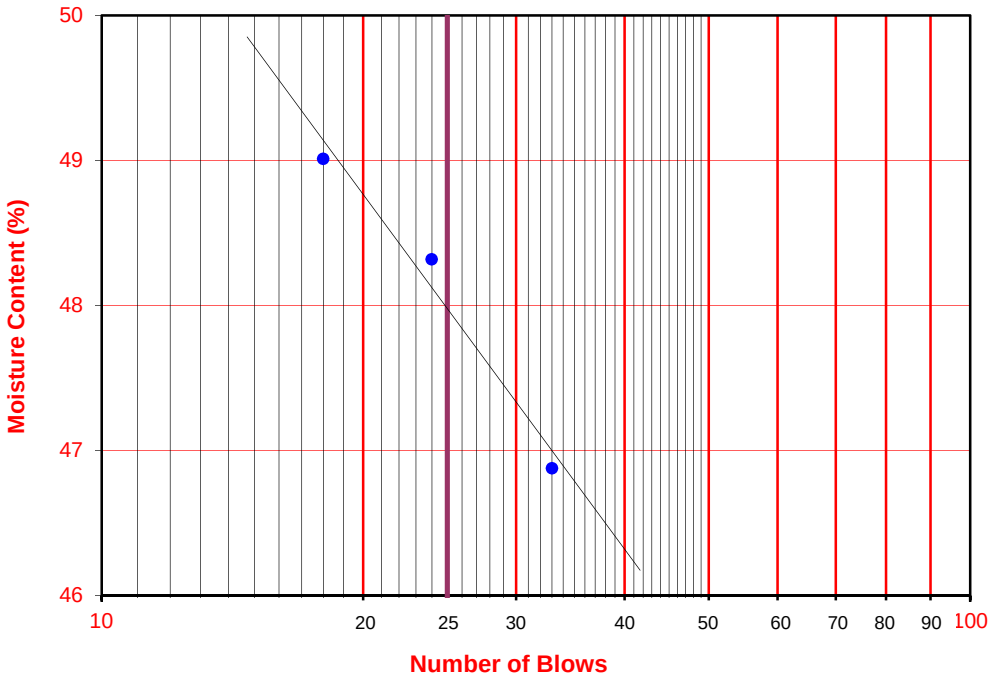
PROCEDURES USED

[ ] Wet Preparation
Multipoint - Wet

[X] Dry Preparation
Multipoint - Dry

[X] Procedure A
Multipoint Test

[ ] Procedure B
One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	Carnival Cruise Substation	Tested By:	S. Felter	Date:	02/23/17
Project No. :	11564.001	Input By:	J. Ward	Date:	03/02/17
Boring No.:	RB-2	Checked By:	J. Ward		
Sample No.:	S-6	Depth (ft.)	55.0		
Soil Identification:	Gray lean clay (CL)				

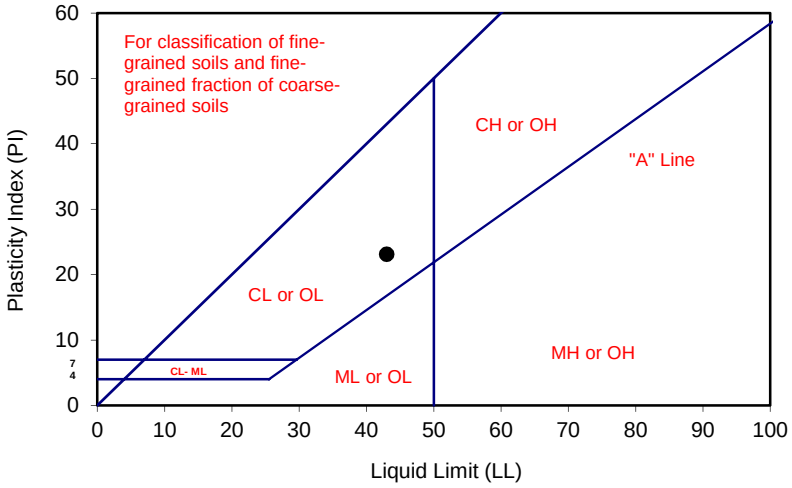
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			34	26	19	
Wet Wt. of Soil + Cont. (g)	23.60	23.68	36.21	35.57	38.25	
Dry Wt. of Soil + Cont. (g)	21.94	21.99	29.49	28.97	30.62	
Wt. of Container (g)	13.51	13.58	13.52	13.65	13.53	
Moisture Content (%) [Wn]	19.69	20.10	42.08	43.08	44.65	

Liquid Limit	**43**
Plastic Limit	**20**
Plasticity Index	**23**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 16.79

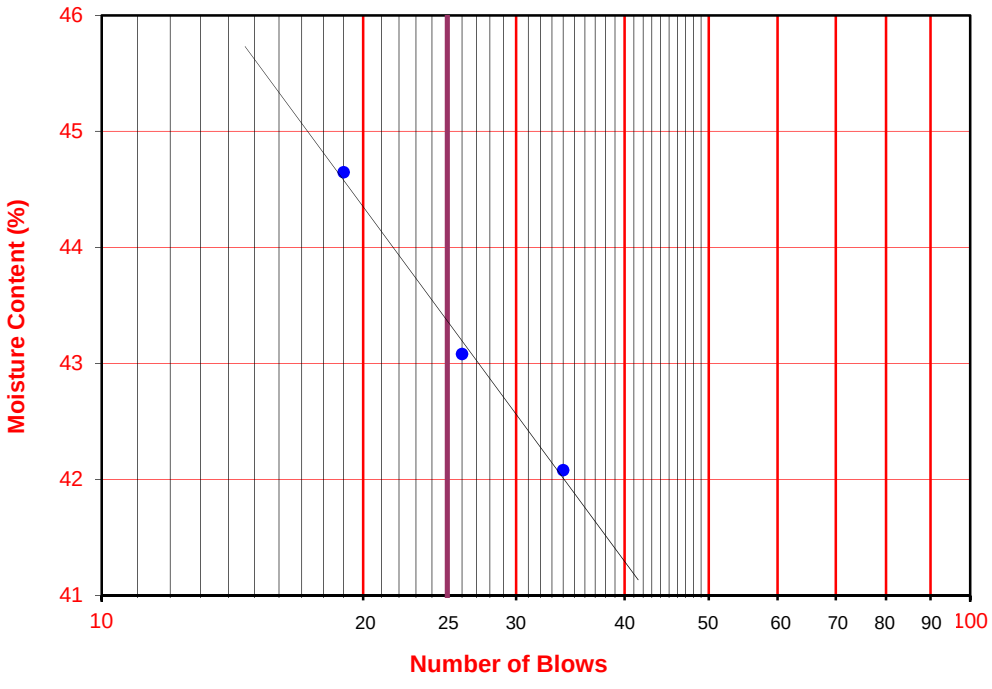
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



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ATTERBERG LIMITS

ASTM D 4318

Project Name:	Carnival Cruise Substation	Tested By:	S. Felter	Date:	02/24/17
Project No. :	11564.001	Input By:	J. Ward	Date:	03/02/17
Boring No.:	RB-2	Checked By:	J. Ward		
Sample No.:	R-4	Depth (ft.)	40.0		
Soil Identification:	Olive lean clay (CL)				

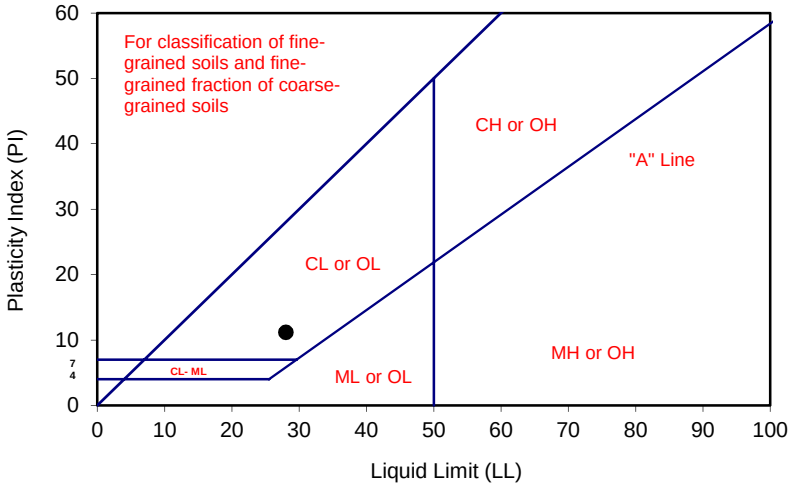
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			34	25	17	
Wet Wt. of Soil + Cont. (g)	24.04	24.07	35.50	36.43	34.16	
Dry Wt. of Soil + Cont. (g)	22.56	22.52	30.70	31.36	29.51	
Wt. of Container (g)	13.55	13.51	13.47	13.55	13.50	
Moisture Content (%) [Wn]	16.43	17.20	27.86	28.47	29.04	

Liquid Limit	**28**
Plastic Limit	**17**
Plasticity Index	**11**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 5.84

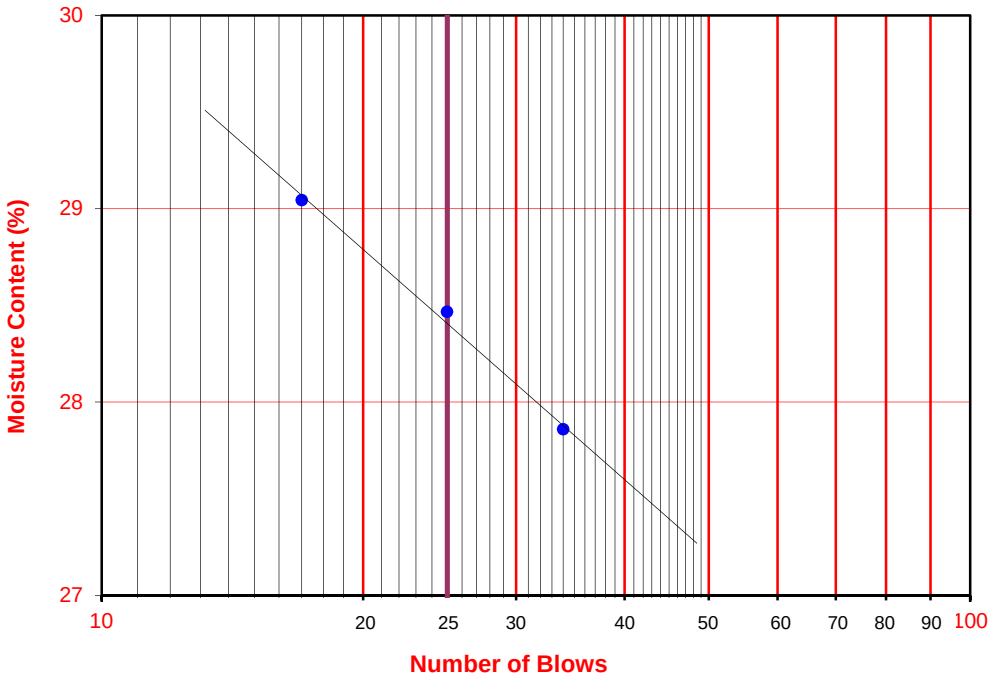
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	Carnival Cruise Substation	Tested By:	S. Felter	Date:	02/22/17
Project No. :	11564.001	Input By:	J. Ward	Date:	03/02/17
Boring No.:	RB-2	Checked By:	J. Ward		
Sample No.:	R-2	Depth (ft.)	20.0		
Soil Identification:	Olive gray lean clay (CL)				

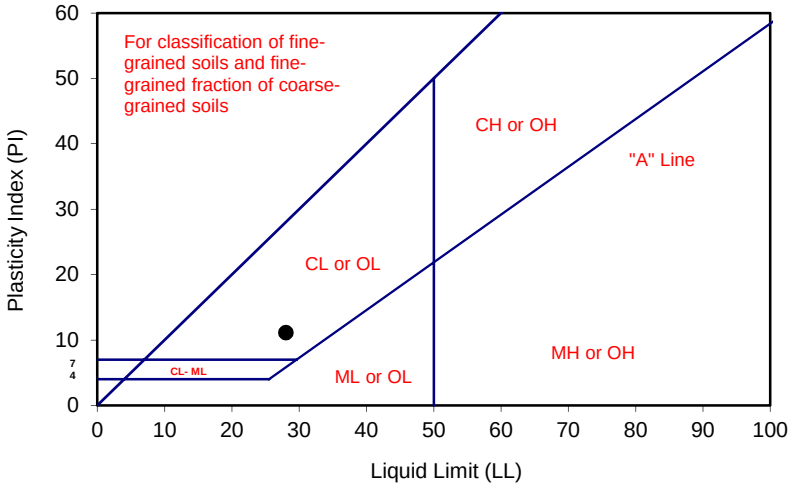
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			33	24	17	
Wet Wt. of Soil + Cont. (g)	23.97	23.73	42.00	36.74	35.51	
Dry Wt. of Soil + Cont. (g)	22.47	22.26	35.84	31.61	30.53	
Wt. of Container (g)	13.52	13.60	13.48	13.44	13.52	
Moisture Content (%) [Wn]	16.76	16.97	27.55	28.23	29.28	

Liquid Limit	**28**
Plastic Limit	**17**
Plasticity Index	**11**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 5.84

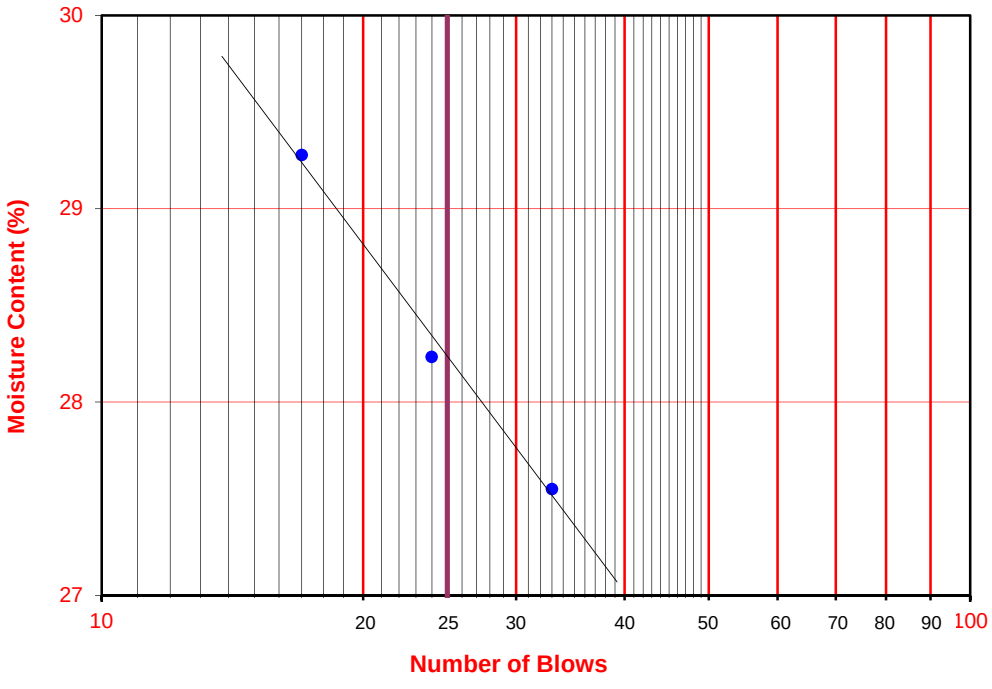
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	Carnival Cruise Substation	Tested by:	A. Santos	Date:	02/14/17
Project No:	11564.001	Checked by:	J. Ward	Date:	02/16/17
Boring No.:	RB-3	Sample Type:	Ring		
Sample No.:	R-7	Depth(ft):	55.0		
Sample Description:	Dark grayish olive sandy lean clay s(CL)				

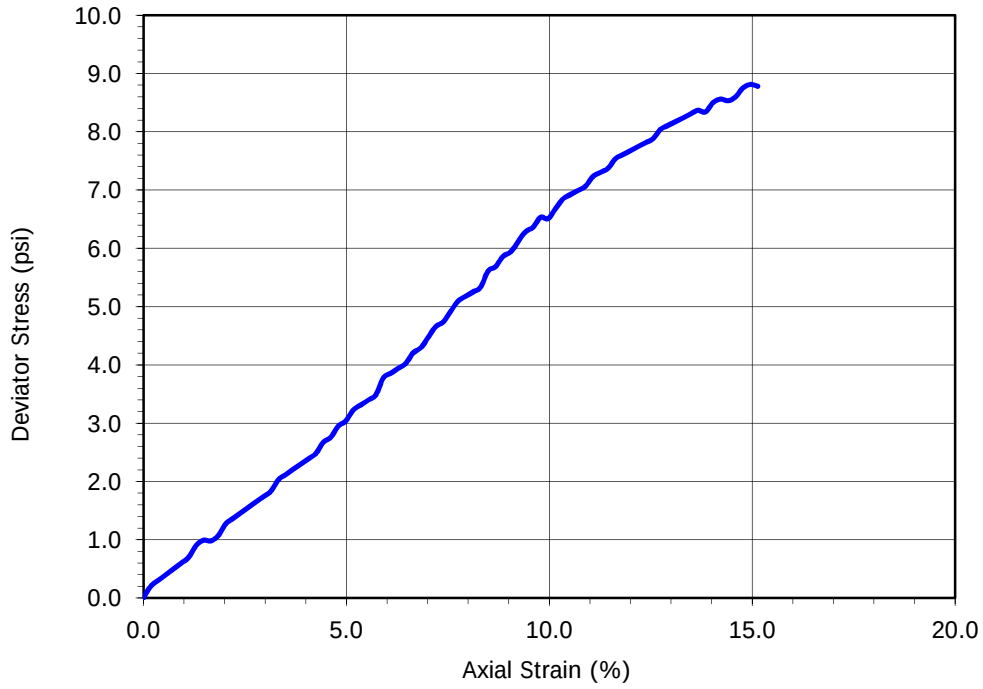
Diameter (in)	1	2.424
	2	2.424
	3	2.422
	Average	2.423
Height (in)	1	5.418
	2	5.417
	3	5.415
	Average	5.417
Weight of Sample + Tube / Rings (g)		751.40
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		857.80
Weight of Dry Sample + Container (g)		649.40
Weight of Container (g)		108.10
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		10.0
Rate of Deformation (in/min)		0.045

Sample Properties	
Moisture Content (%)	38.50
Dry Density (pcf)	82.7
Void Ratio	1.037
% Saturation	100.3

At Failure*	
Deviator stress (psi)	**8.81**
Minor principal total stress (psi)	**10.00**
Major principal total stress (psi)	**18.81**
Axial strain (%)	**14.95**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	Carnival Cruise Substation	Tested by:	A. Santos	Date:	02/14/17
Project No:	11564.001	Checked by:	J. Ward	Date:	02/16/17
Boring No.:	RB-3	Sample Type:	Ring		
Sample No.:	R-4	Depth(ft):	26.5		
Sample Description:	Olive lean clay (CL)				

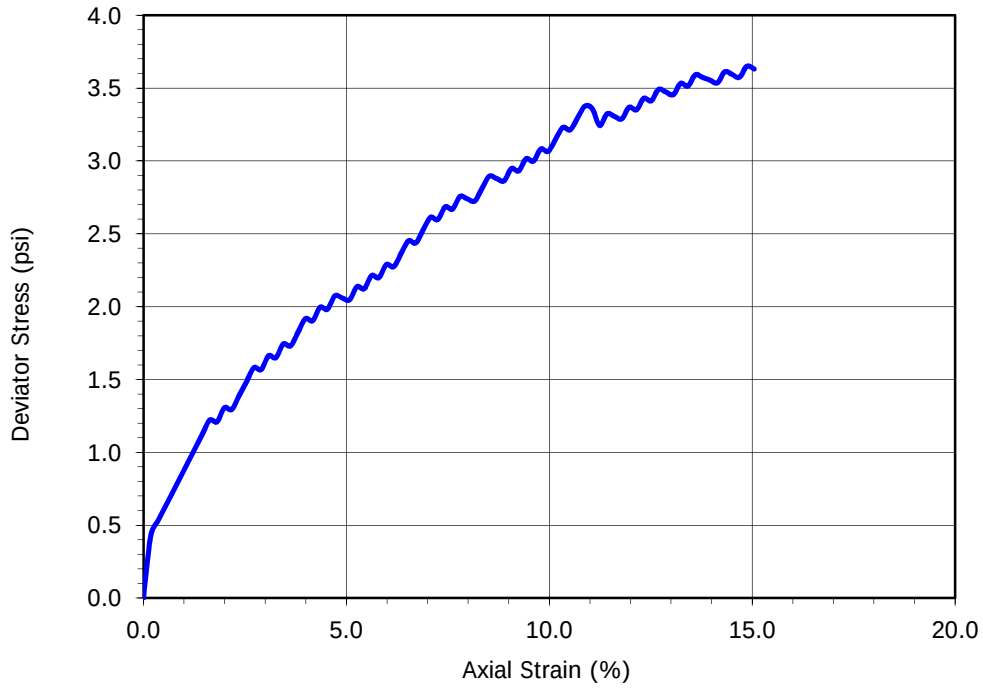
Diameter (in)	1	2.395
	2	2.398
	3	2.400
	Average	2.398
Height (in)	1	5.517
	2	5.515
	3	5.514
	Average	5.515
Weight of Sample + Tube / Rings (g)		711.80
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		815.70
Weight of Dry Sample + Container (g)		583.60
Weight of Container (g)		108.08
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		5.0
Rate of Deformation (in/min)		0.045

Sample Properties	
Moisture Content (%)	48.81
Dry Density (pcf)	73.2
Void Ratio	1.302
% Saturation	101.2

At Failure*	
Deviator stress (psi)	**3.65**
Minor principal total stress (psi)	**5.00**
Major principal total stress (psi)	**8.65**
Axial strain (%)	**14.87**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	Carnival Cruise Substation	Tested by:	A. Santos	Date:	02/22/17
Project No:	11564.001	Checked by:	J. Ward	Date:	03/02/17
Boring No.:	RB-2	Sample Type:	Ring		
Sample No.:	R-4	Depth(ft):	40.0		
Sample Description:	Olive lean clay (CL)				

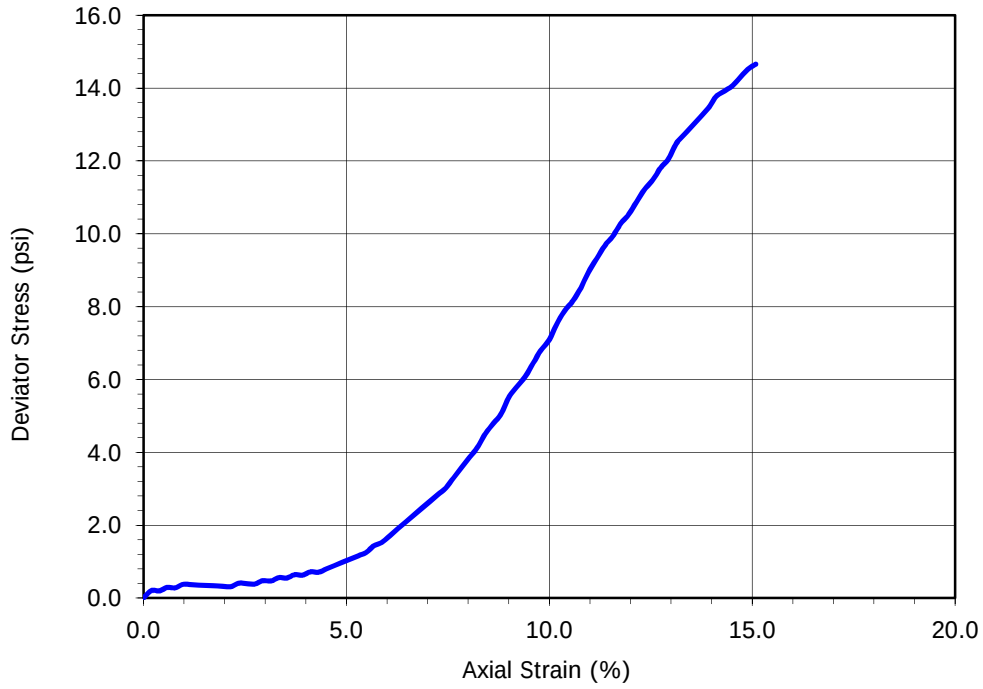
Diameter (in)	1	2.425
	2	2.425
	3	2.426
	Average	2.425
Height (in)	1	5.105
	2	5.103
	3	5.100
	Average	5.103
Weight of Sample + Tube / Rings (g)		766.60
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		873.00
Weight of Dry Sample + Container (g)		695.50
Weight of Container (g)		111.90
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		6.5
Rate of Deformation (in/min)		0.045

Sample Properties	
Moisture Content (%)	30.41
Dry Density (pcf)	95.0
Void Ratio	0.774
% Saturation	106.1

At Failure*	
Deviator stress (psi)	**14.65**
Minor principal total stress (psi)	**6.50**
Major principal total stress (psi)	**21.15**
Axial strain (%)	**15.09**

* Stress values have been corrected for membrane effects

Stress - Strain Curve

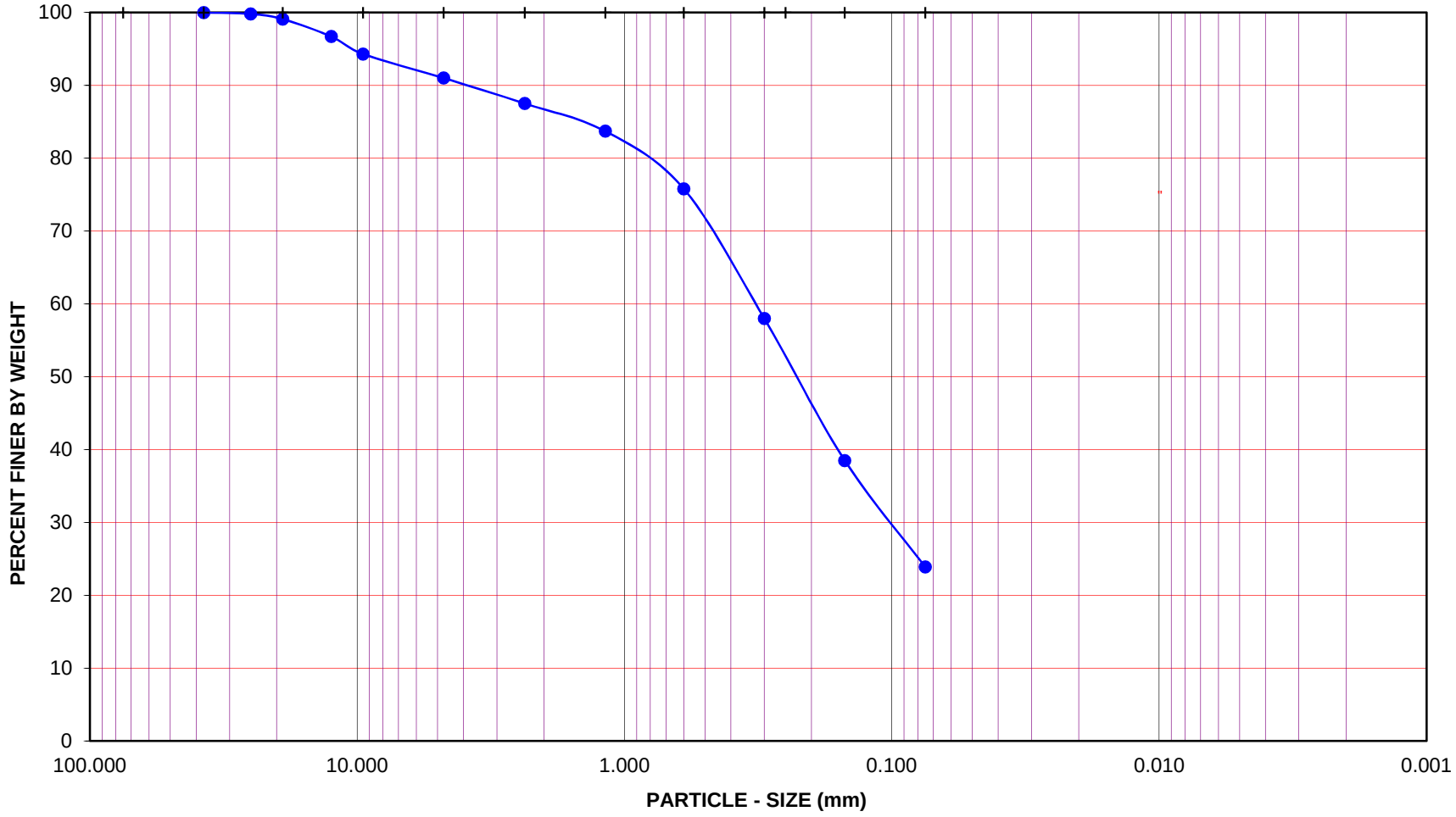


GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: Carnival Cruise Substation

Project No.: 11564.001

Boring No.: RB-1 Sample No.: BB-1

Depth (feet): 0-5 Soil Type : SM

Soil Identification: Olive silty sand (SM), some clay chunks noted

GR:SA:FI : (%) 9 : 67 : 24

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PARTICLE - SIZE DISTRIBUTION ASTM D 6913

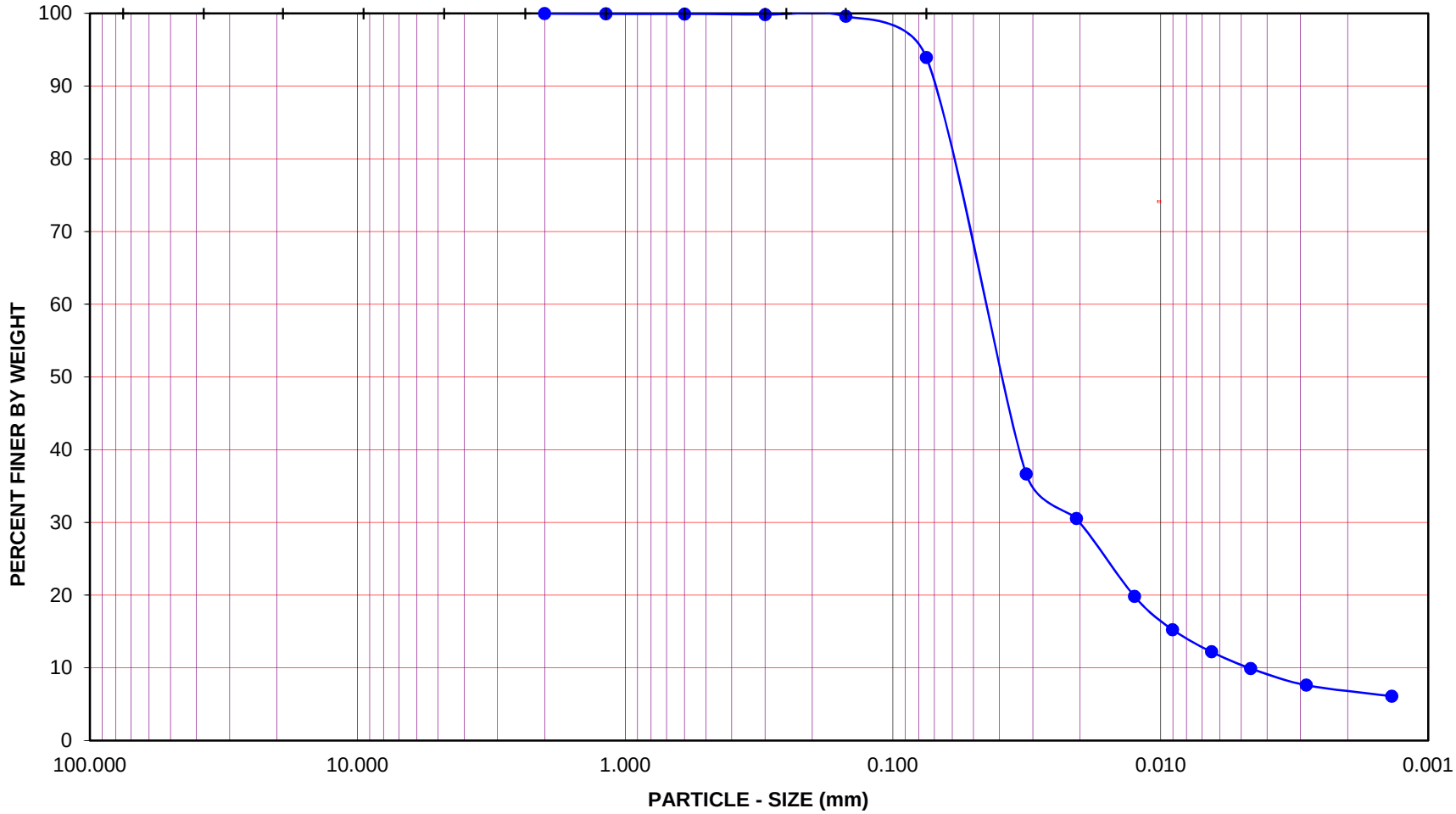
Mar-1/

GRAVEL		SAND			FINES	
COARSE	FINE	CRSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" | 1 1/2" | 3/4" | 3/8"

U.S. STANDARD SIEVE NUMBER: #4 | #8 | #16 | #30 | #50 | #100 | #200

HYDROMETER



Project Name: Carnival Cruise Substation

Project No.: 11564.001

Boring No.: RB-2 Sample No.: R-4

Depth (feet): 40.0 Soil Type : CL

Soil Identification: Olive lean clay (CL)

GR:SA:FI : (%) 0 : 6 : 94

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

Mar-17

B-2

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(May, 2018)

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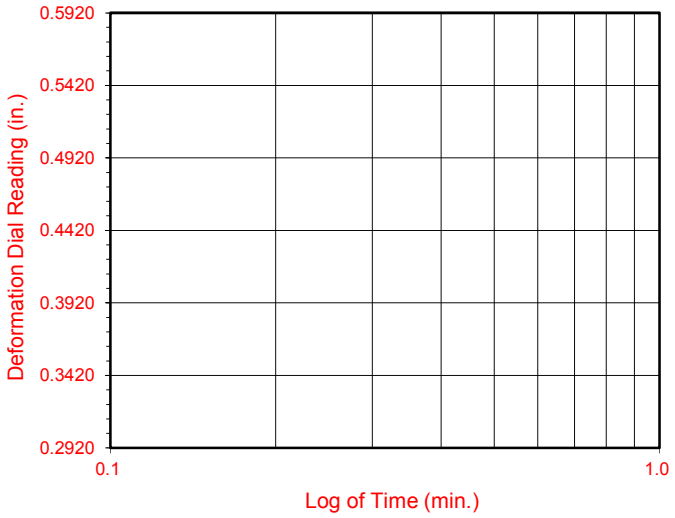
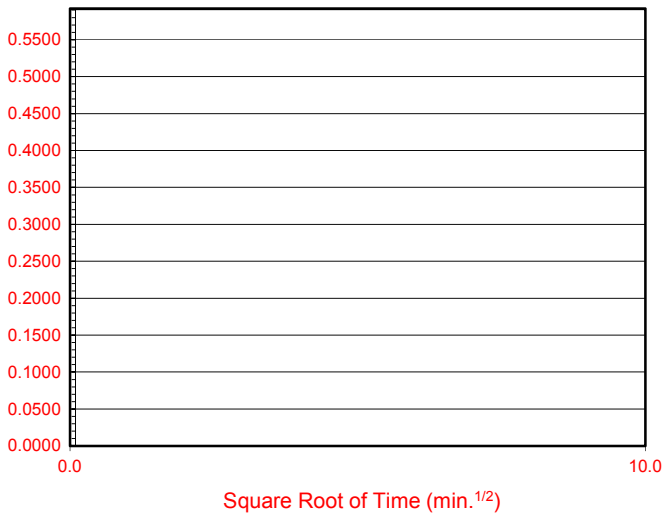
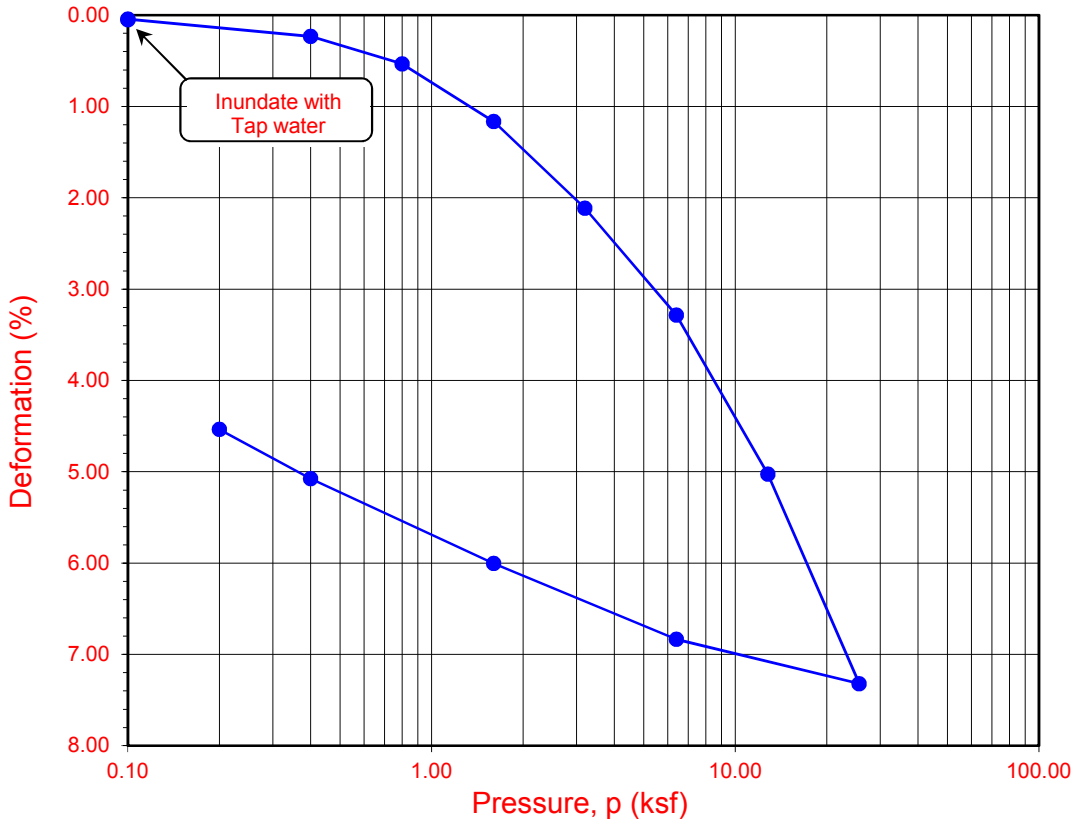
Time Readings







Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
LB-1	**R-10**	**95.0**	**26.5**	**25.1**	**97.5**	**100.7**	**0.735**	**0.656**	**98**	**100**

Soil Identification: Olive brown silt (ML)

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

Project No.: 12018.001

Carnival Cruise Terminal

06-18

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SOIL RESISTIVITY TEST

DOT CA TEST 643

Project Name: Carnival Cruise Terminal

Project No. : 12018.001

Boring No.: LB-1

Sample No. : R-1

Tested By : O. Figueroa Date: 06/25/18

Data Input By: J. Ward Date: 06/25/18

Depth (ft.) : 5.0

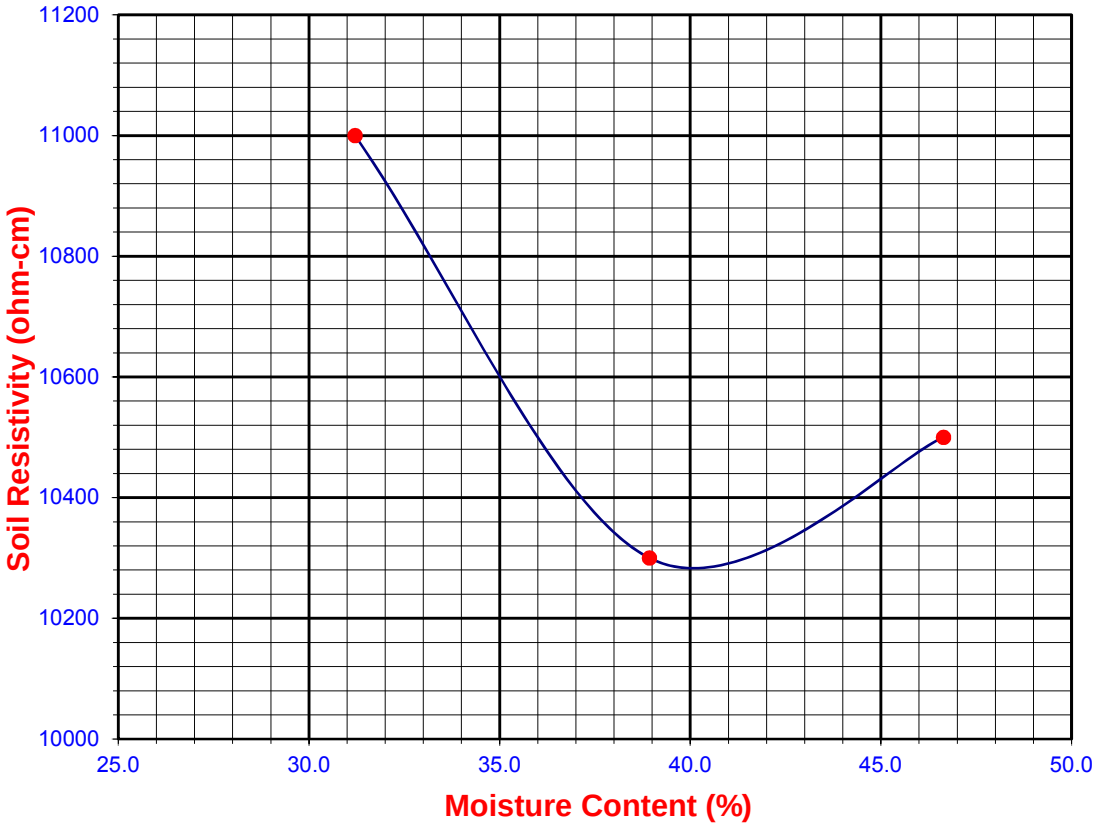
Soil Identification:* Olive SP, shells noted

*California Test 643 requires soil specimens to consist only of portions of samples passing through the No. 8 US Standard Sieve before resistivity testing. Therefore, this test method may not be representative for coarser materials.

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	40	31.21	11000	11000
2	50	38.93	10300	10300
3	60	46.65	10500	10500
4				
5				

Moisture Content (%) (MCi)	0.34
Wet Wt. of Soil + Cont. (g)	225.58
Dry Wt. of Soil + Cont. (g)	225.02
Wt. of Container (g)	58.52
Container No.	
Initial Soil Wt. (g) (Wt)	130.00
Box Constant	1.000
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 643	
10280	**40.1**	**33**	**40**	**8.18**	**22.4**



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SOIL RESISTIVITY TEST

DOT CA TEST 643

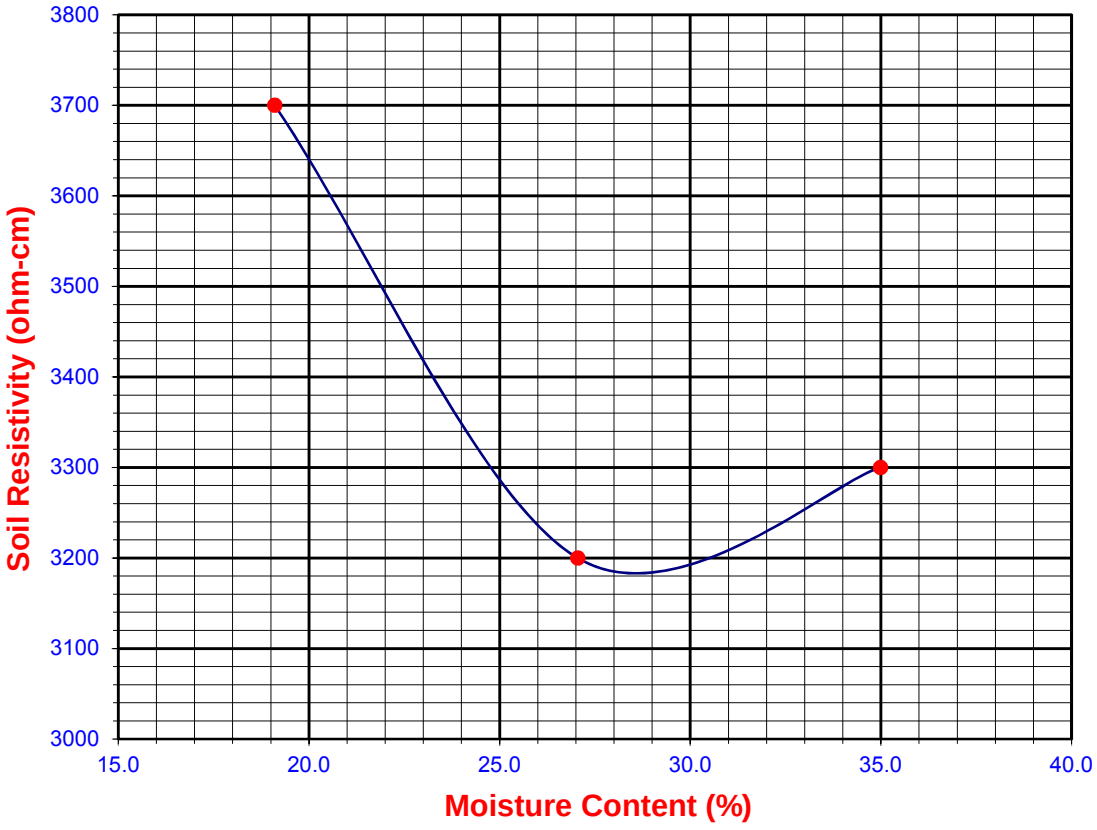
Project Name:	Carnival Parking Structure		Tested By :	A. Santos	Date: 07/06/18
Project No. :	12018.001		Data Input By:	J. Ward	Date: 07/06/18
Boring No.:	LB-2		Depth (ft.) :	0-5	
Sample No. :	BB-1				
Soil Identification:*	Olive SP				

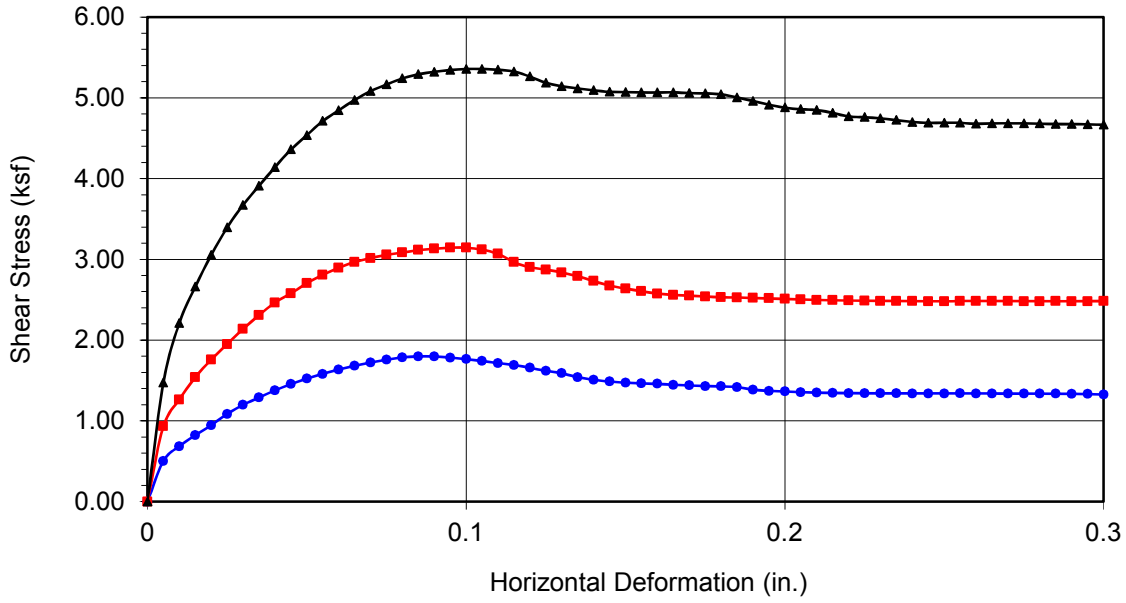
*California Test 643 requires soil specimens to consist only of portions of samples passing through the No. 8 US Standard Sieve before resistivity testing. Therefore, this test method may not be representative for coarser materials.

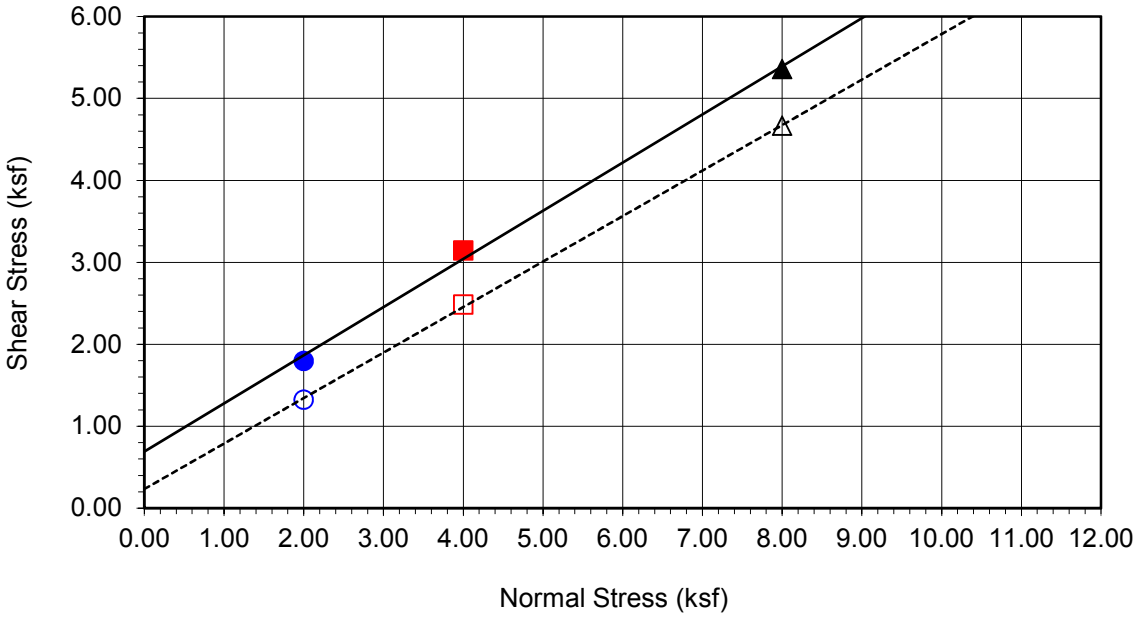
Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	20	19.11	3700	3700
2	30	27.05	3200	3200
3	40	34.99	3300	3300
4				
5				

Moisture Content (%) (MCi)	3.23
Wet Wt. of Soil + Cont. (g)	215.31
Dry Wt. of Soil + Cont. (g)	210.20
Wt. of Container (g)	51.86
Container No.	
Initial Soil Wt. (g) (Wt)	130.00
Box Constant	1.000
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 643	
3180	**28.6**	**782**	**52**	**8.07**	**22.3**







Boring No.	**LB-1**
Sample No.	**R-10**
Depth (ft)	**95**
Sample Type:	Ring
Soil Identification:	Olive brown silt (ML)

Strength Parameters

	C (psf)	ϕ (^{o})
Peak	692	30
Ultimate	234	29

Normal Stress (kip/ft²)	2.000	4.000	8.000
Peak Shear Stress (kip/ft²)	● 1.798	■ 3.144	▲ 5.357
Shear Stress @ End of Test (ksf)	○ 1.324	□ 2.484	△ 4.665
Deformation Rate (in./min.)	0.0500	0.0500	0.0500
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	26.48	26.48	26.48
Dry Density (pcf)	97.7	98.7	98.8
Saturation (%)	98.7	100.9	101.2
Soil Height Before Shearing (in.)	0.9793	0.9646	0.9405
Final Moisture Content (%)	27.1	25.9	25.3

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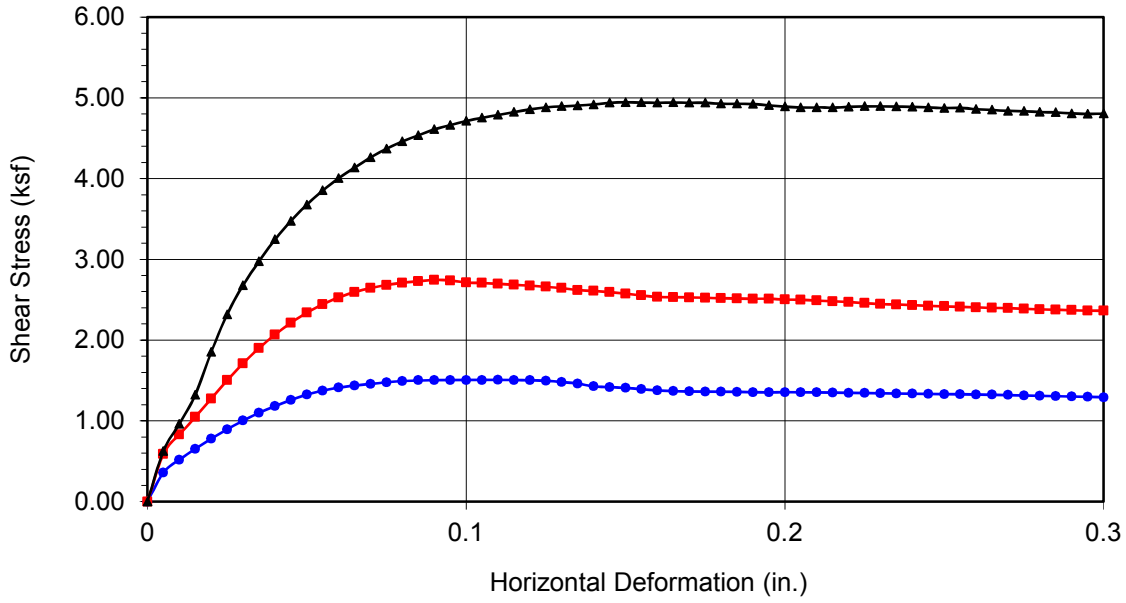
DIRECT SHEAR TEST RESULTS

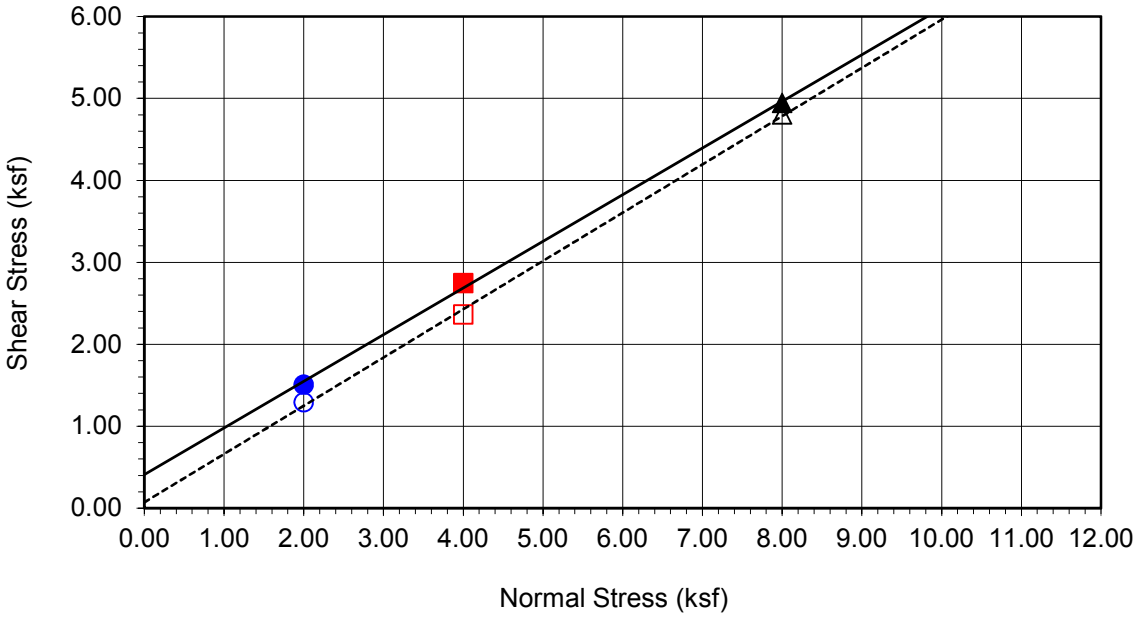
Consolidated Undrained

Project No.: 12018.001

Carnival Cruise Terminal

06-18





Boring No.	**LB-1**
Sample No.	**R-11**
Depth (ft)	**105**
Sample Type:	Ring
Soil Identification:	Gray silt (ML)

Strength Parameters

	C (psf)	ϕ (^{o})
Peak	409	30
Ultimate	72	30

Normal Stress (kip/ft²)	2.000	4.000	8.000
Peak Shear Stress (kip/ft²)	● 1.509	■ 2.745	▲ 4.945
Shear Stress @ End of Test (ksf)	○ 1.292	□ 2.364	△ 4.804
Deformation Rate (in./min.)	0.0025	0.0025	0.0025
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	27.29	27.29	27.29
Dry Density (pcf)	97.8	98.4	98.9
Saturation (%)	101.8	103.3	104.6
Soil Height Before Shearing (in.)	0.9669	0.9526	0.9342
Final Moisture Content (%)	26.3	26.4	25.2

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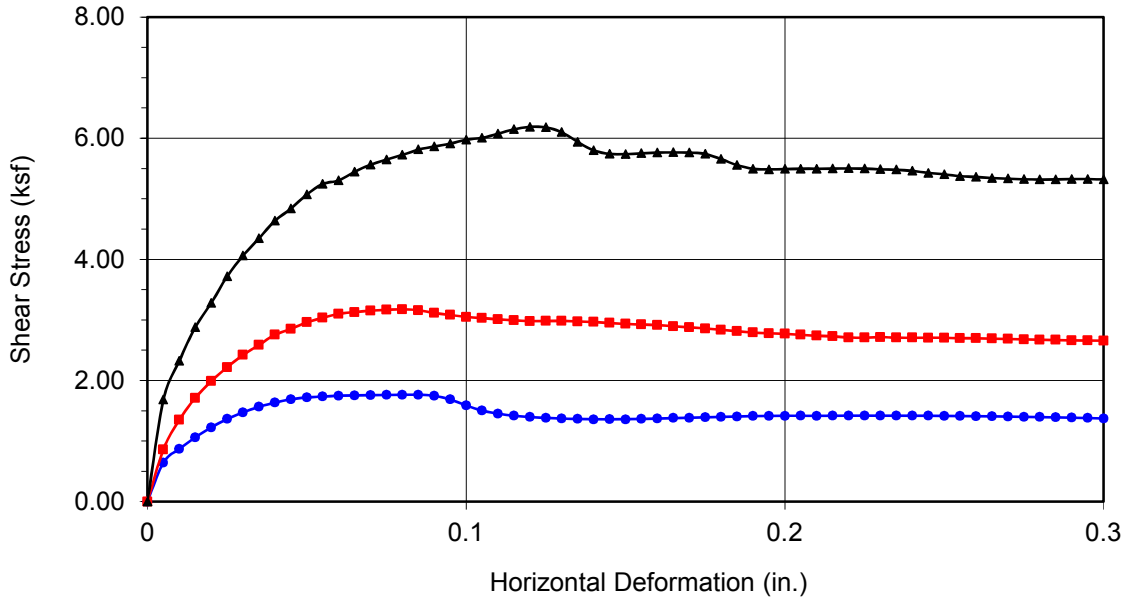
DIRECT SHEAR TEST RESULTS

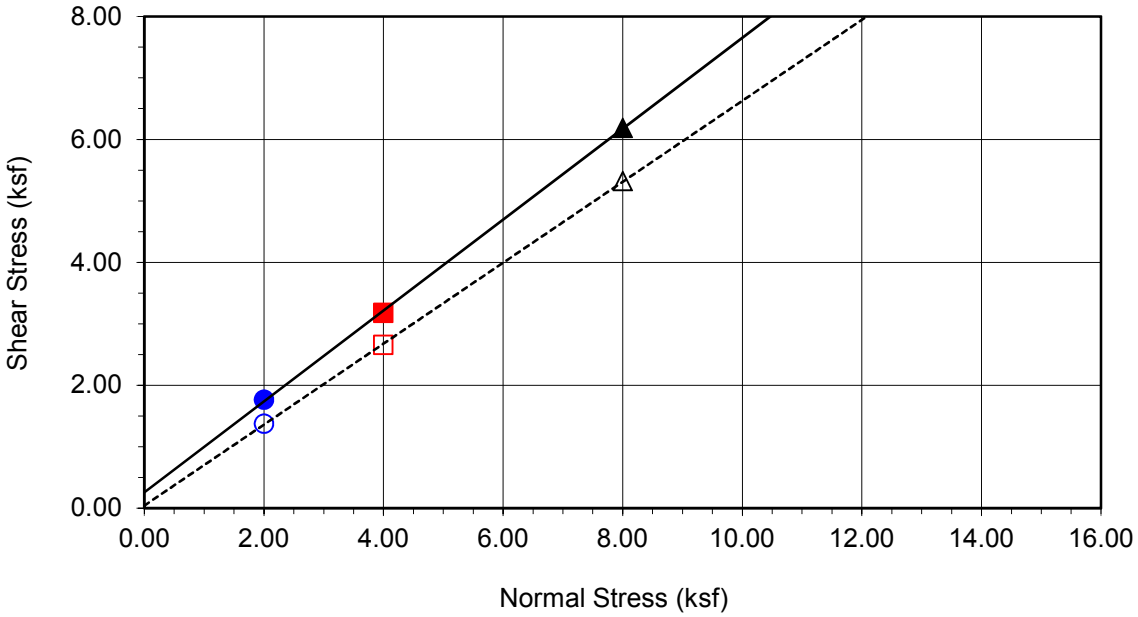
Consolidated Drained - ASTM D 3080

Project No.: 12018.001

Carnival Cruise Terminal

06-18





Boring No.	**LB-2**
Sample No.	**R-7**
Depth (ft)	**90**
Sample Type:	Ring
Soil Identification:	Olive silt (ML)

Strength Parameters

	C (psf)	ϕ (^{o})
Peak	258	36
Ultimate	43	33

Normal Stress (kip/ft²)	2.000	4.000	8.000
Peak Shear Stress (kip/ft²)	● 1.764	■ 3.175	▲ 6.187
Shear Stress @ End of Test (ksf)	○ 1.374	□ 2.656	△ 5.319
Deformation Rate (in./min.)	0.0500	0.0500	0.0500
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	25.35	25.35	25.35
Dry Density (pcf)	97.2	99.4	101.6
Saturation (%)	93.2	98.3	103.8
Soil Height Before Shearing (in.)	0.9887	0.9818	0.9741
Final Moisture Content (%)	27.6	25.4	23.9

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DIRECT SHEAR TEST RESULTS

Consolidated Undrained

Project No.: 12018.001

Carnival Parking Structure

06-18

ATTERBERG LIMITS

ASTM D 4318

Project Name:	Carnival Cruise Terminal	Tested By:	R. Manning	Date:	06/18/18
Project No. :	12018.001	Input By:	J. Ward	Date:	06/21/18
Boring No.:	LB-1	Checked By:	J. Ward		
Sample No.:	R-3	Depth (ft.)	25.0		
Soil Identification:	Olive silty sand (SM)				

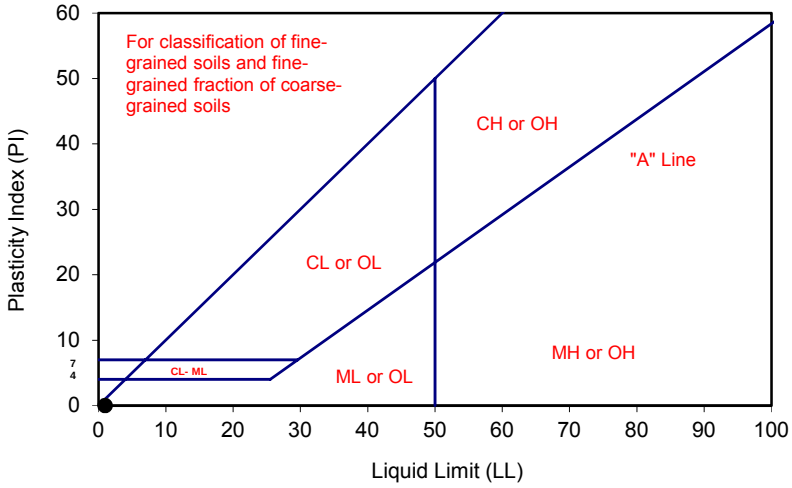
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			4			
Wet Wt. of Soil + Cont. (g)	**Cannot be rolled:**		26.59	**Cannot get more than 4 blows:**		
Dry Wt. of Soil + Cont. (g)	**NonPlastic**		23.48	**NonPlastic**		
Wt. of Container (g)			13.58			
Moisture Content (%) [Wn]			31.41			

Liquid Limit	**NP**
Plastic Limit	**NP**
Plasticity Index	**NP**
Classification	**NP**

PI at "A" - Line = 0.73(LL-20) =

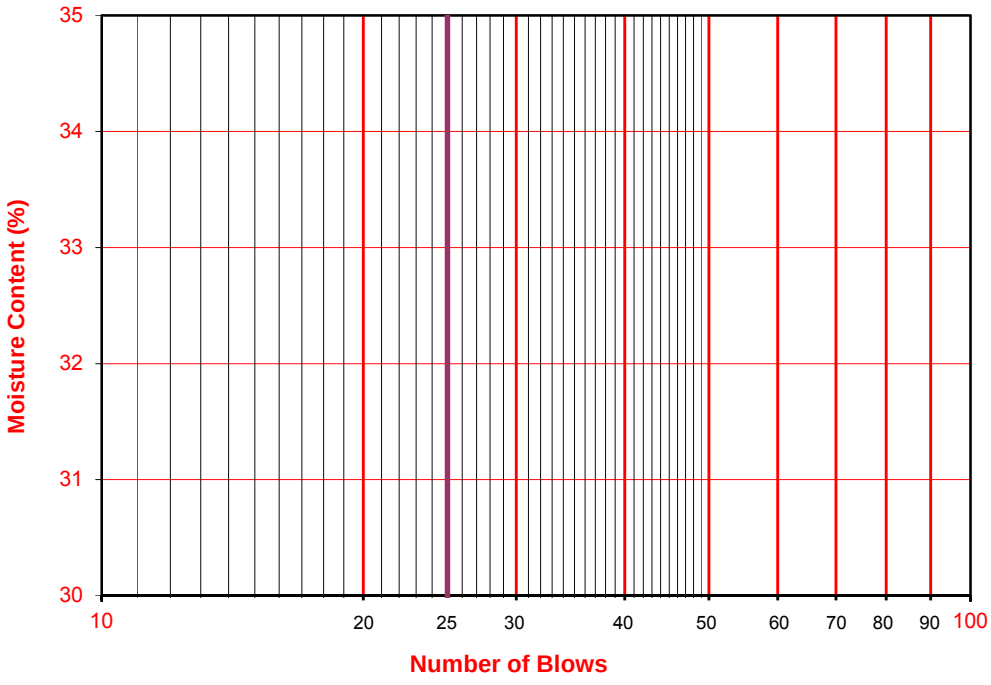
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test



Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	Carnival Cruise Terminal	Tested By:	R. Manning	Date:	06/18/18
Project No. :	12018.001	Input By:	J. Ward	Date:	06/21/18
Boring No.:	LB-1	Checked By:	J. Ward		
Sample No.:	R-5	Depth (ft.)	45.0		
Soil Identification:	Dark gray fat clay (CH)				

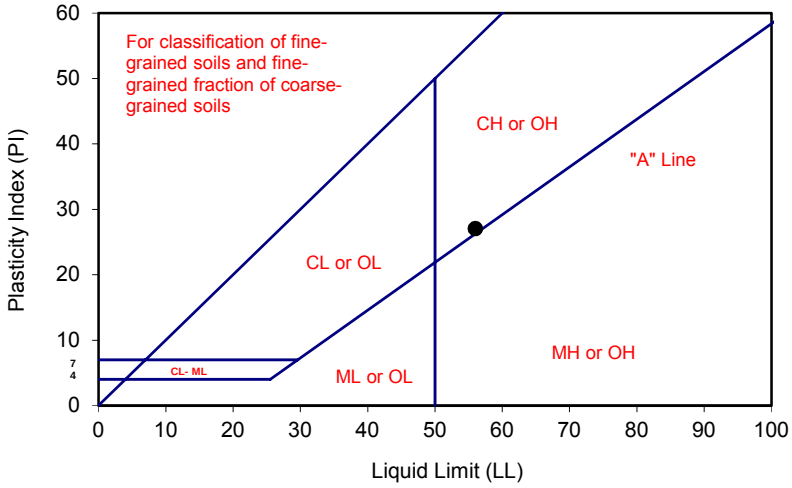
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	24	19	
Wet Wt. of Soil + Cont. (g)	17.99	18.19	26.64	25.02	22.85	
Dry Wt. of Soil + Cont. (g)	16.46	16.74	22.11	20.93	19.42	
Wt. of Container (g)	11.15	11.75	13.61	13.59	13.53	
Moisture Content (%) [Wn]	28.81	29.06	53.29	55.72	58.23	

Liquid Limit	**56**
Plastic Limit	**29**
Plasticity Index	**27**
Classification	**CH**

PI at "A" - Line = 0.73(LL-20) 26.28

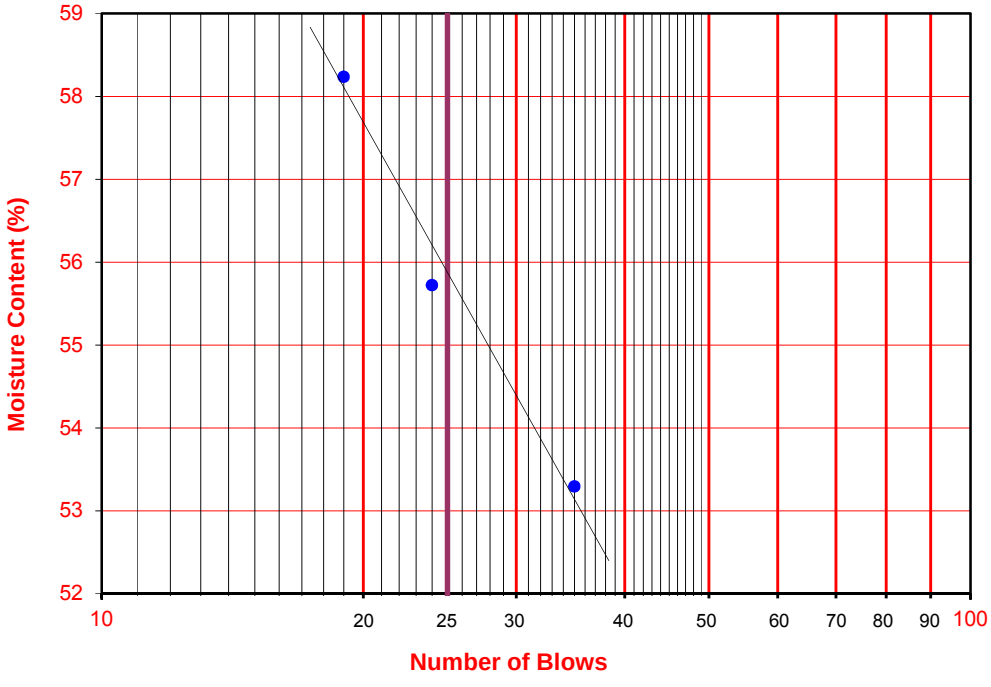
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	Carnival Cruise Terminal	Tested By:	R. Manning	Date:	06/18/18
Project No. :	12018.001	Input By:	J. Ward	Date:	06/21/18
Boring No.:	LB-1	Checked By:	J. Ward		
Sample No.:	R-7	Depth (ft.)	65.0		
Soil Identification:	Dark olive gray sandy silt s(ML)				

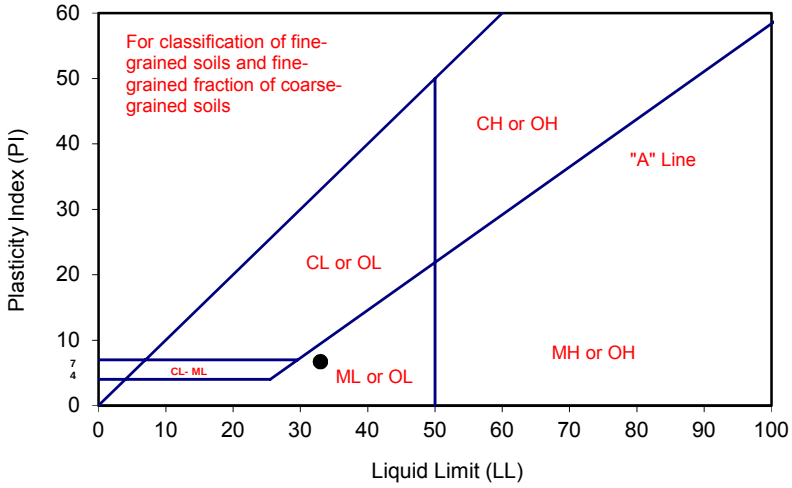
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	27	17	
Wet Wt. of Soil + Cont. (g)	17.93	17.94	23.78	22.32	24.72	
Dry Wt. of Soil + Cont. (g)	16.65	16.59	21.31	20.13	21.82	
Wt. of Container (g)	11.78	11.46	13.61	13.54	13.49	
Moisture Content (%) [Wn]	26.28	26.32	32.08	33.23	34.81	

Liquid Limit	**33**
Plastic Limit	**26**
Plasticity Index	**7**
Classification	**ML**

PI at "A" - Line = 0.73(LL-20) 9.49

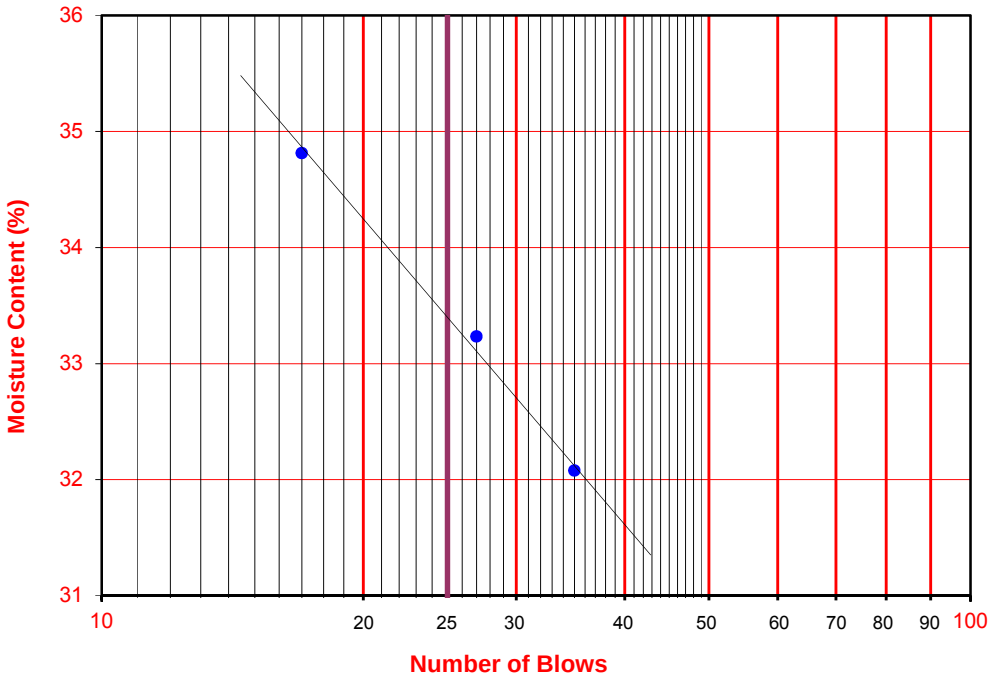
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	Carnival Parking Structure	Tested By:	R. Manning	Date:	07/05/18
Project No. :	12018.001	Input By:	J. Ward	Date:	07/06/18
Boring No.:	LB-2	Checked By:	J. Ward		
Sample No.:	R-2	Depth (ft.)	35.0		
Soil Identification:	Gray lean clay (CL)				

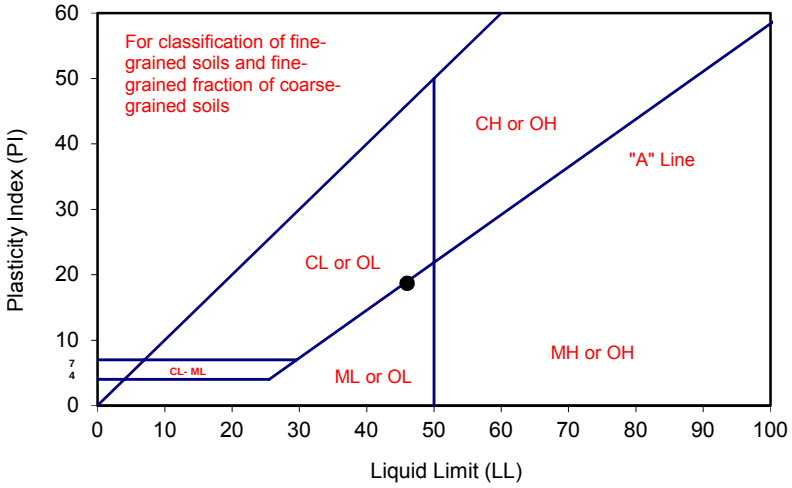
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			33	24	16	
Wet Wt. of Soil + Cont. (g)	18.19	18.53	25.44	23.28	24.04	
Dry Wt. of Soil + Cont. (g)	16.66	16.93	21.74	20.18	20.67	
Wt. of Container (g)	11.05	11.09	13.57	13.55	13.60	
Moisture Content (%) [Wn]	27.27	27.40	45.29	46.76	47.67	

Liquid Limit	**46**
Plastic Limit	**27**
Plasticity Index	**19**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 18.98

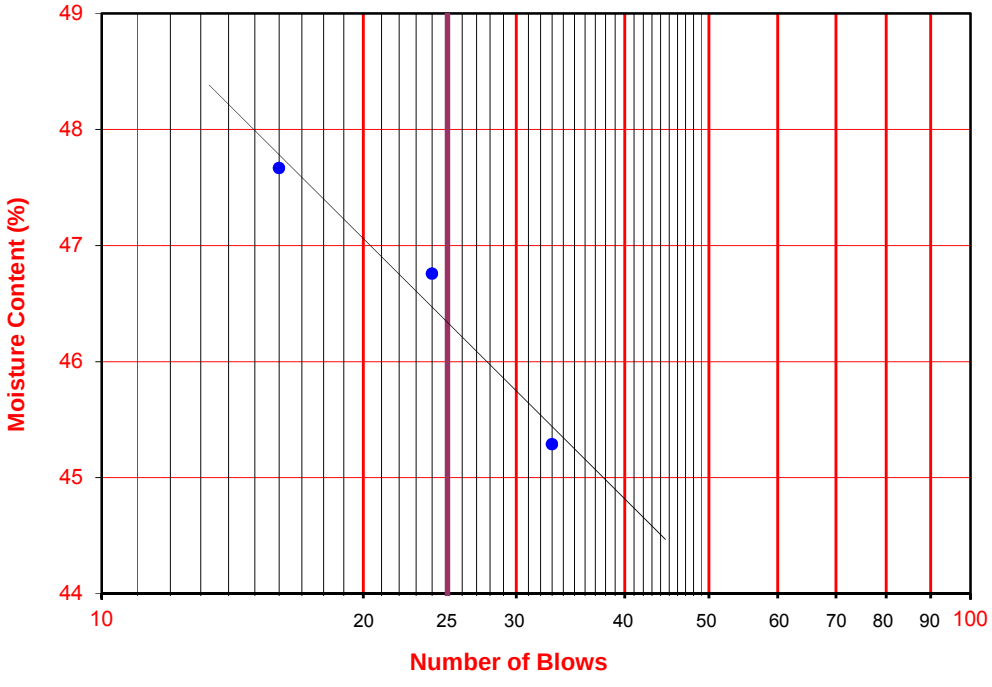
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	Carnival Parking Structure	Tested By:	R. Manning	Date:	07/03/18
Project No. :	12018.001	Input By:	J. Ward	Date:	07/06/18
Boring No.:	LB-2	Checked By:	J. Ward		
Sample No.:	R-7	Depth (ft.)	90.0		
Soil Identification:	Olive sandy silt s(ML)				

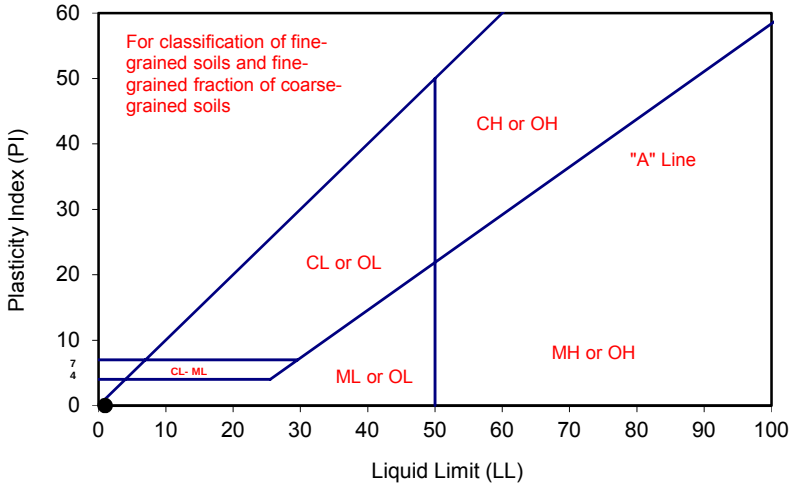
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			2			
Wet Wt. of Soil + Cont. (g)	**Cannot be rolled:**		24.04	**Cannot get more than 2 blows:**		
Dry Wt. of Soil + Cont. (g)	**NonPlastic**		20.67	**NonPlastic**		
Wt. of Container (g)			11.64			
Moisture Content (%) [Wn]			37.32			

Liquid Limit	**NP**
Plastic Limit	**NP**
Plasticity Index	**NP**
Classification	**NP**

PI at "A" - Line = 0.73(LL-20) =

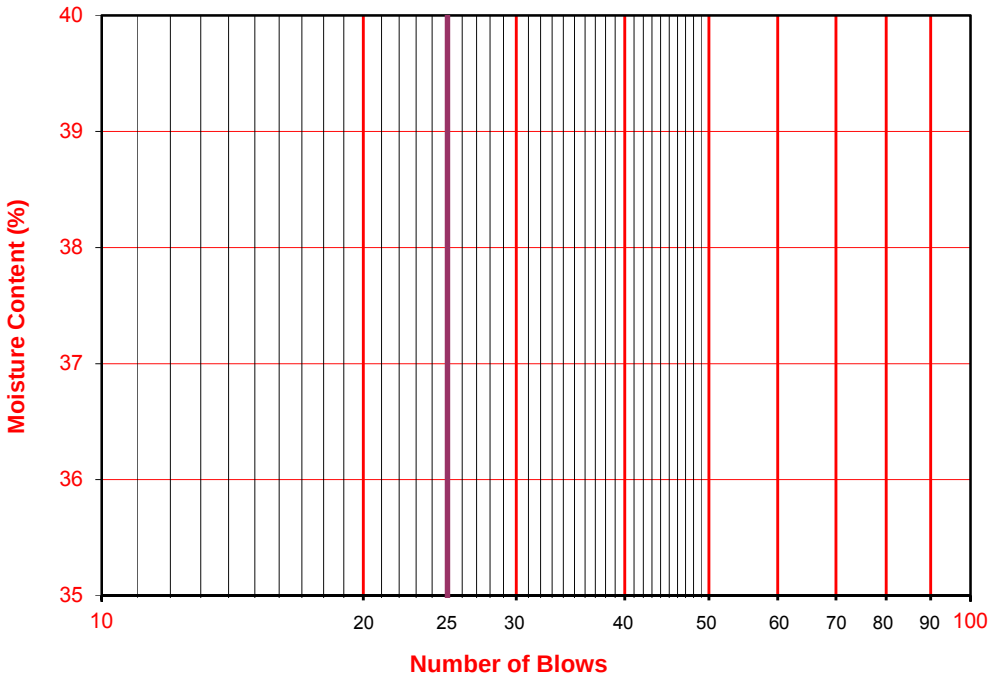
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

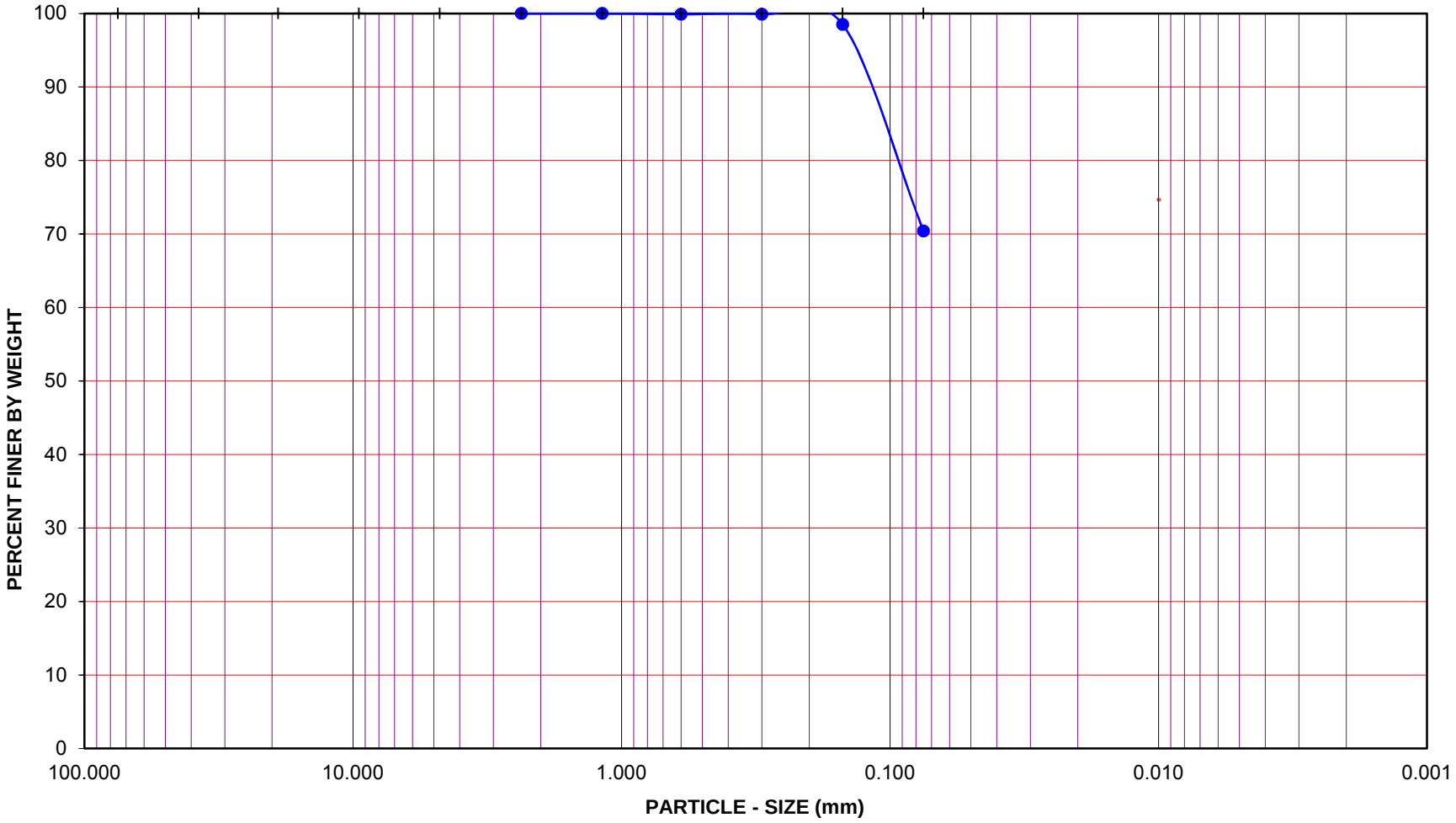
- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING — U.S. STANDARD SIEVE NUMBER — HYDROMETER

3.0" 1 1/2" 3/4" 3/8" #4 #8 #16 #30 #50 #100 #200



Project Name: Carnival Cruise Terminal

Project No.: 12018.001

Boring No.: LB-1 Sample No.: R-12

Depth (feet): 115.0 Soil Type : s(ML)

Soil Identification: Olive gray sandy silt s(ML)

GR:SA:FI : (%) 0 : 30 : 70

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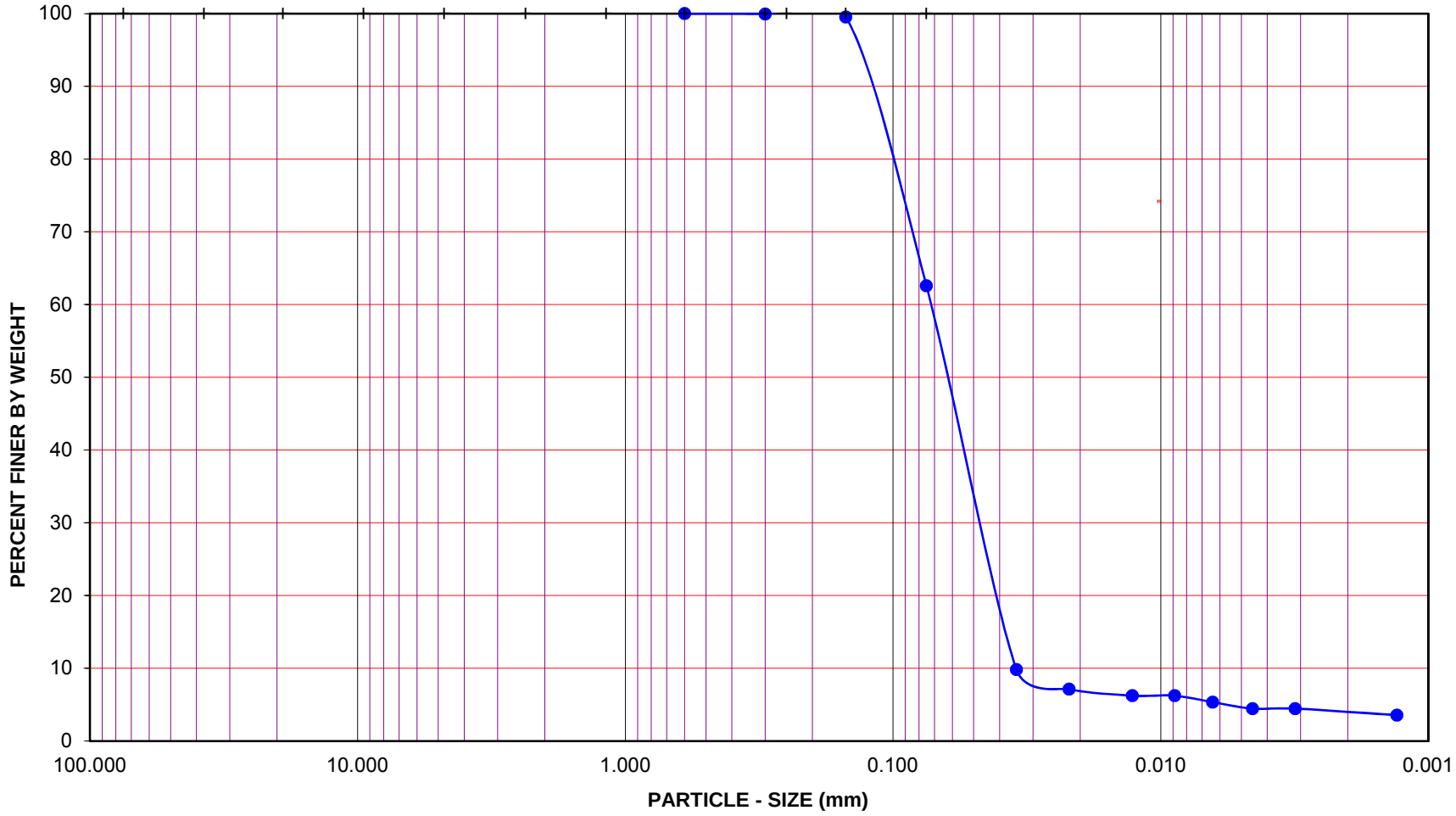
PARTICLE - SIZE DISTRIBUTION ASTM D 6913

Jun-18

GRAVEL		SAND			FINES	
COARSE	FINE	CRSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING — U.S. STANDARD SIEVE NUMBER — HYDROMETER

3.0" 1 1/2" 3/4" 3/8" #4 #8 #16 #30 #50 #100 #200



Project Name: Carnival Parking Structure

Project No.: 12018.001

Boring No.: LB-2 Sample No.: R-7

Depth (feet): 90.0 Soil Type : s(ML)

Soil Identification: Olive sandy silt s(ML)

GR:SA:FI : (%) 0 : 37 : 63

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

Jul-18

Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	Carnival Cruise Terminal	Tested by:	A. Santos	Date:	06/17/18
Project No:	12018.001	Checked by:	J. Ward	Date:	06/17/18
Boring No.:	LB-1	Sample Type:	Ring		
Sample No.:	R-12	Depth(ft):	115.0		
Sample Description:	Olive gray sandy silt s(ML)				

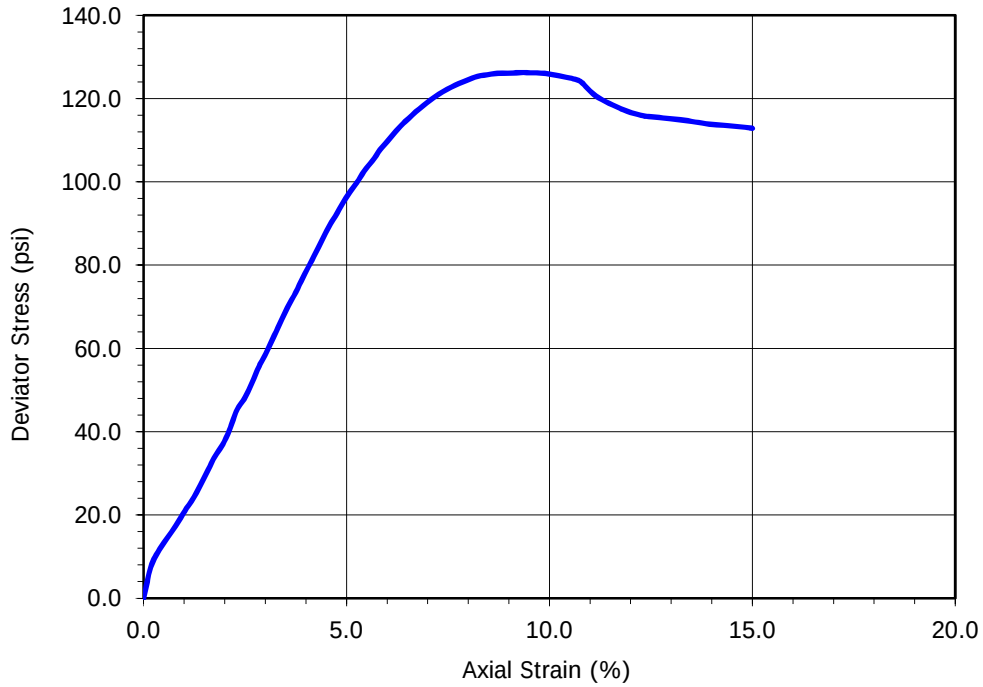
Diameter (in)	1	2.415
	2	2.415
	3	2.414
	Average	2.415
Height (in)	1	5.668
	2	5.666
	3	5.665
	Average	5.666
Weight of Sample + Tube / Rings (g)		838.5
Weight of Tube / Rings (g)		0.0
Weight of Wet Sample + Container (g)		914.8
Weight of Dry Sample + Container (g)		746.4
Weight of Container (g)		77.6
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		27.8
Rate of Deformation (in/min)		0.045

Sample Properties	
Moisture Content (%)	25.18
Dry Density (pcf)	98.3
Void Ratio	0.713
% Saturation	95.3

At Failure*	
Deviator stress (psi)	**126.26**
Minor principal total stress (psi)	**27.80**
Major principal total stress (psi)	**154.06**
Axial strain (%)	**9.35**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



B-3

Leighton Consulting, Inc.
(July, 2018)

Leighton

MOISTURE CONTENT

ASTM D 2216

Project Name: **Atkins Carnival**
Project No.: **12096.001**

Tested By: R. Manning
Date: 08/31/18
Checked By: J. Ward
Date: 09/11/18

Boring No.	B-1	B-1	B-2	B-3-1	
Sample No.	S-1	S-2	R-1	S-1	
Depth (ft)	7.0	17.0	12.0	7.0	
Sample Type	SPT	SPT	Ring	SPT	
Sample Description	Gray fat clay (CH)	Gray sandy silt s(ML)	Dark olive gray silt (ML)	Gray silt (ML)	
Wt. wet soil + container (g)	708.46	251.71	188.53	447.43	
Wt. dry soil + container (g)	468.40	200.60	147.93	279.00	
Weight of container (g)	70.93	43.70	58.68	51.99	
Moisture Content (%)	**60**	**33**	**45**	**74**	

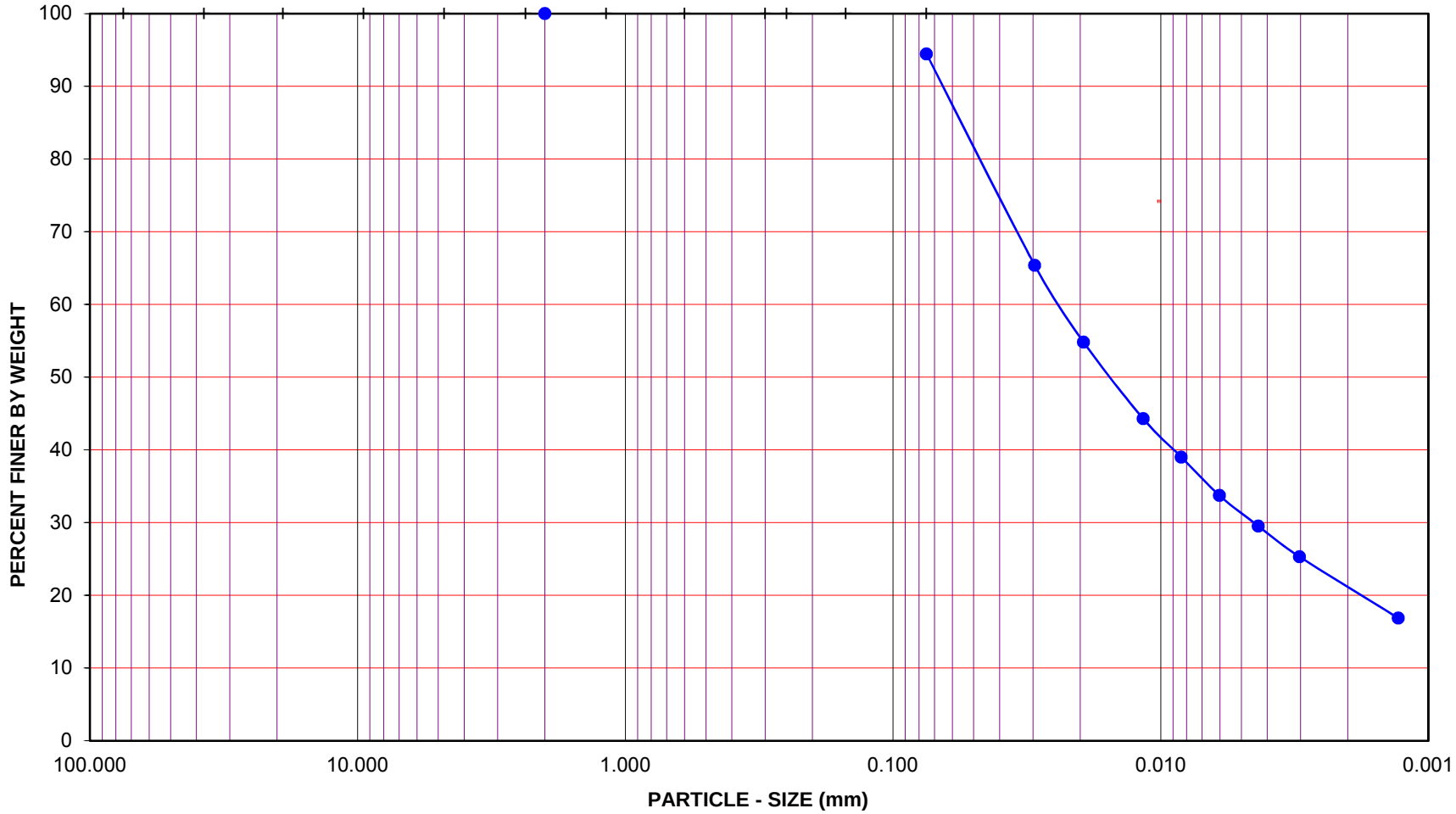
Boring No.					
Sample No.					
Depth (ft)					
Sample Type					
Sample Description					
Wt. wet soil + container (g)					
Wt. dry soil + container (g)					
Weight of container (g)					
Moisture Content (%)					

GRAVEL		SAND			FINES	
COARSE	FINE	CRSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: Atkins Carnival

Project No.: 12096.001

Boring No.: B-1 Sample No.: R-2

Depth (feet): 12.0 Soil Type : ML

Soil Identification: Dark olive gray silt (ML)

GR:SA:FI : (%) 0 : 6 : 94

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

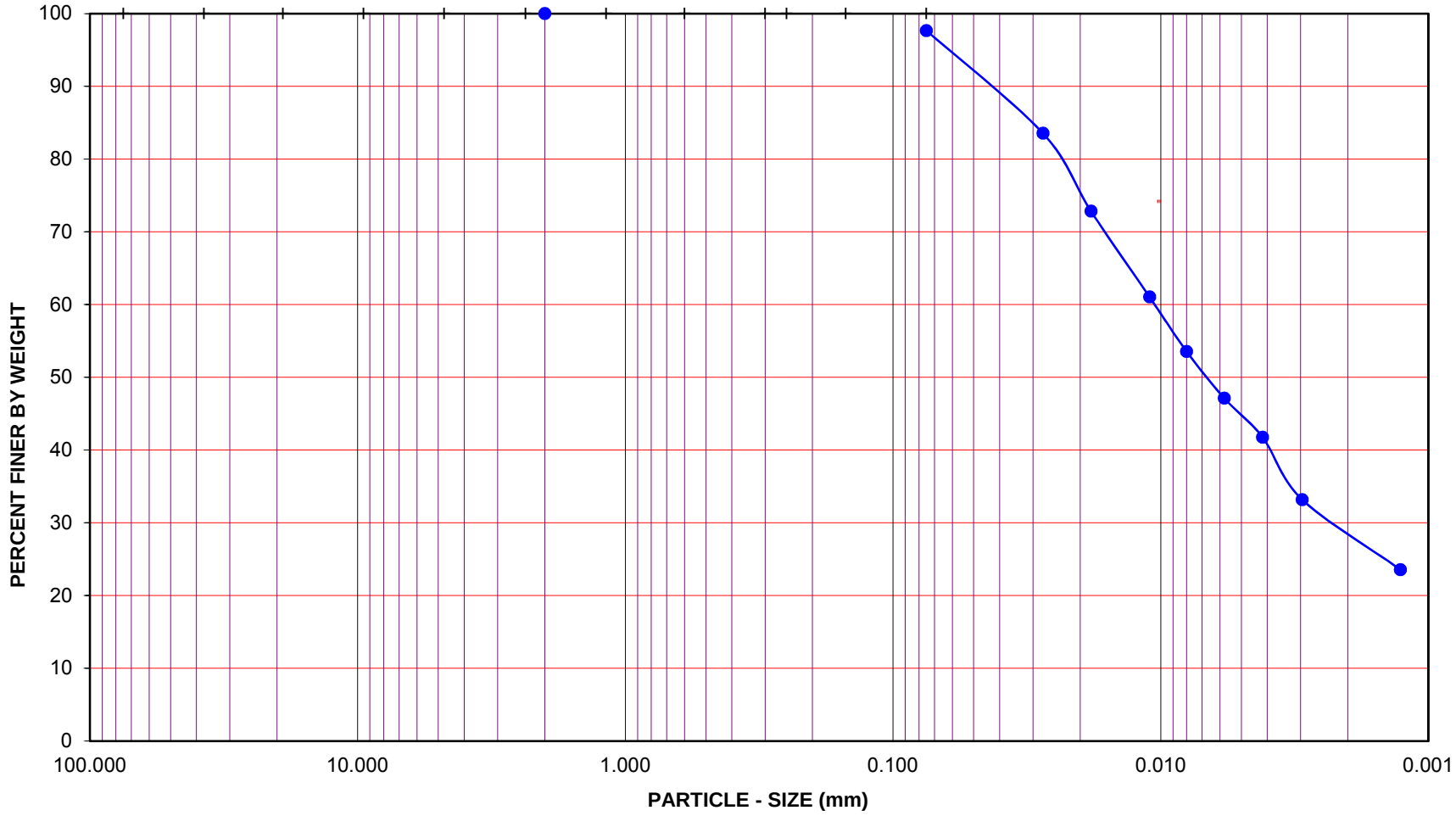
Nov-18

Hydro B-1, R-2 @ 12.0

GRAVEL		SAND			FINES	
COARSE	FINE	CRSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING | U.S. STANDARD SIEVE NUMBER | HYDROMETER

3.0" 1 1/2" 3/4" 3/8" #4 #8 #16 #30 #50 #100 #200



Project Name: Atkins Carnival

Project No.: 12096.001

Boring No.: B-1 Sample No.: S-1

Depth (feet): 7.0 Soil Type : CH

Soil Identification: Gray fat clay (CH)

GR:SA:FI : (%) 0 : 2 : 98

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

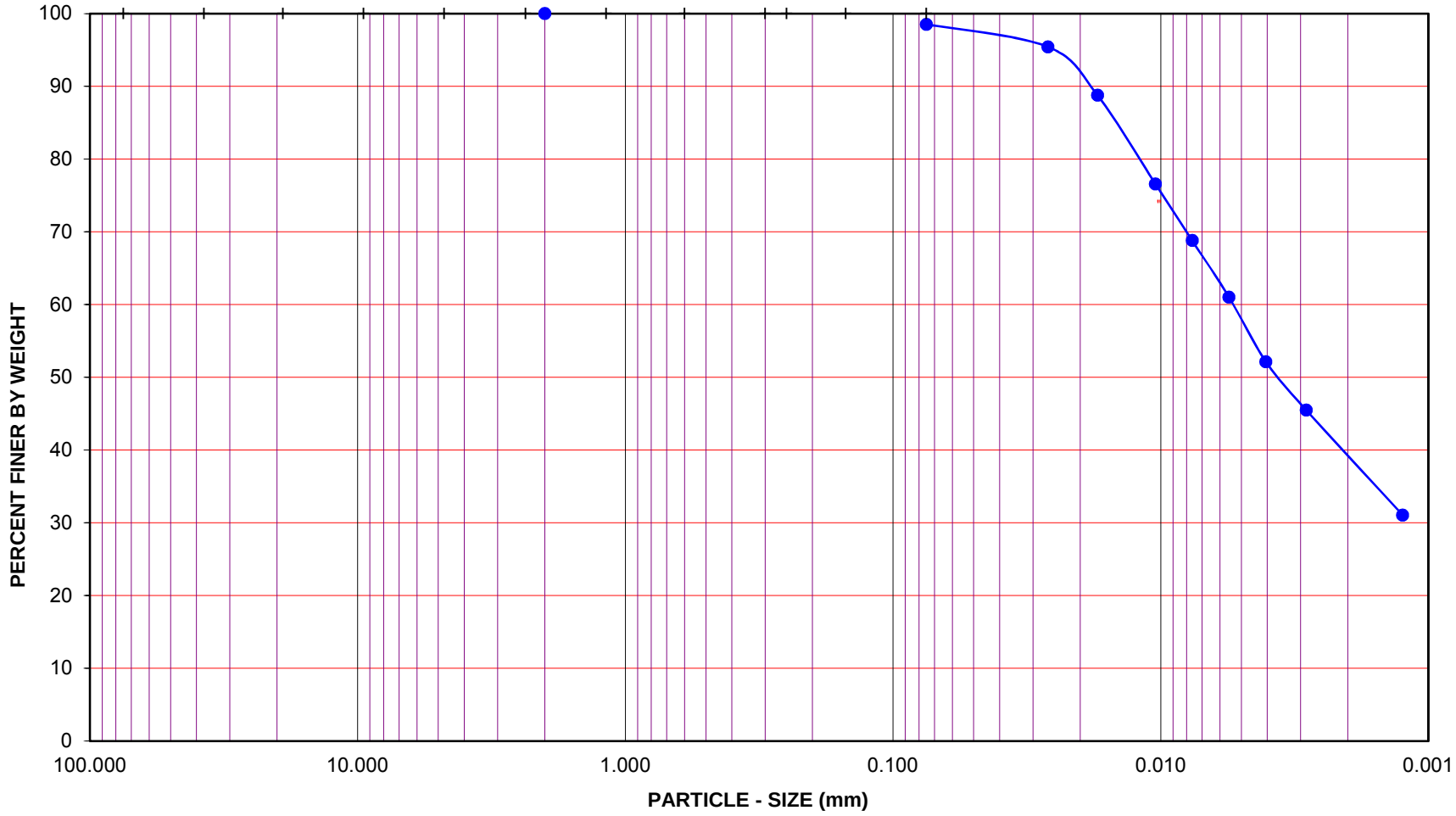
Nov-18

Hydro B-1, S-1 @ 7.0

GRAVEL		SAND			FINES	
COARSE	FINE	CRSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING — U.S. STANDARD SIEVE NUMBER — HYDROMETER

3.0" 1 1/2" 3/4" 3/8" #4 #8 #16 #30 #50 #100 #200



Project Name: Atkins Carnival

Project No.: 12096.001

Boring No.: LB-1 Sample No.: R-5

Depth (feet): 42.0 Soil Type : CH

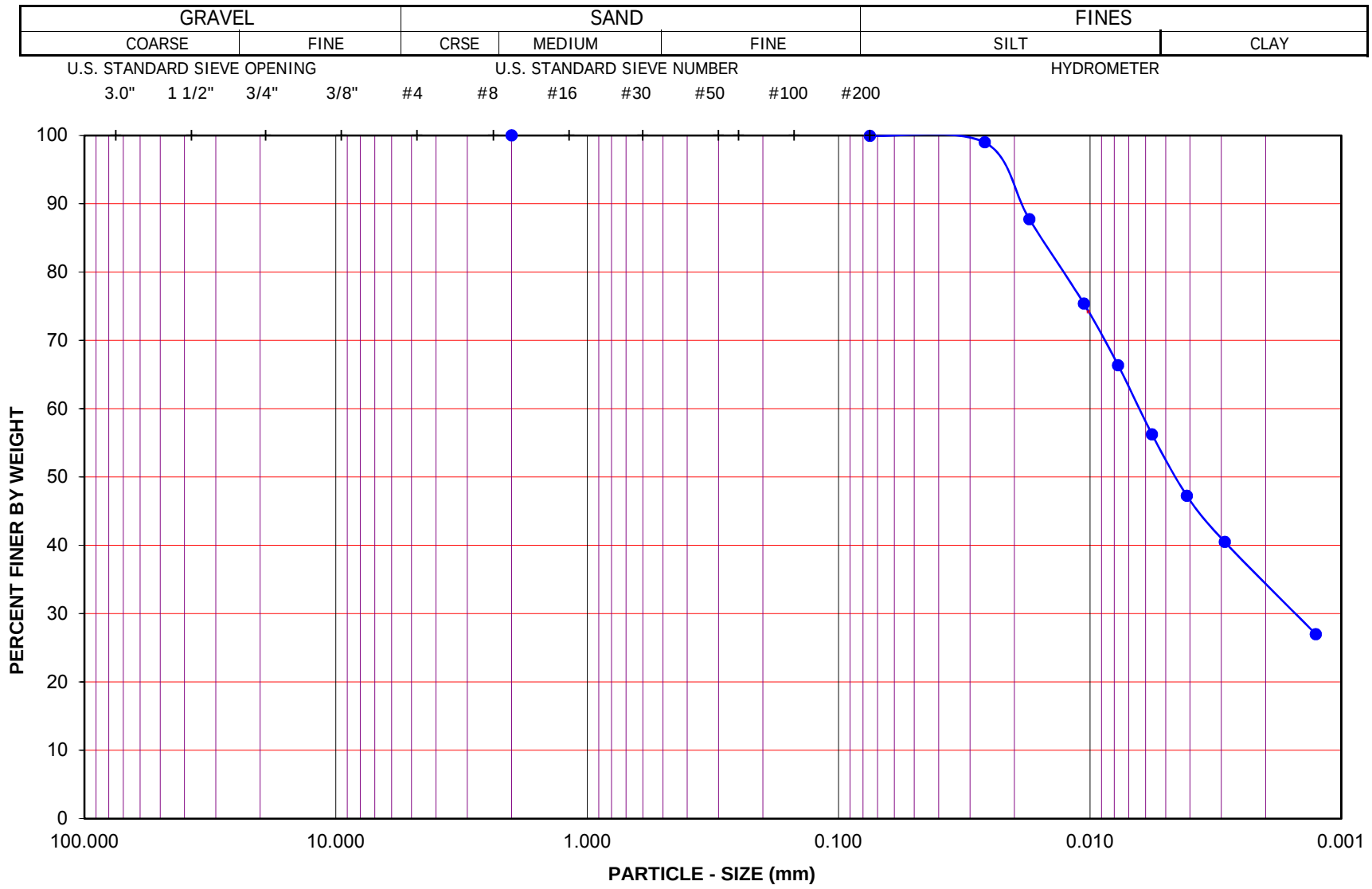
Soil Identification: Dark gray fat clay (CH)

GR:SA:FI : (%) 0 : 1 : 99

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

Nov-18



Project Name: Atkins Carnival

Project No.: 12096.001

Boring No.: B-2 Sample No.: T-2

Depth (feet): 8.0 Soil Type : CL

Soil Identification: Olive gray lean clay (CL)

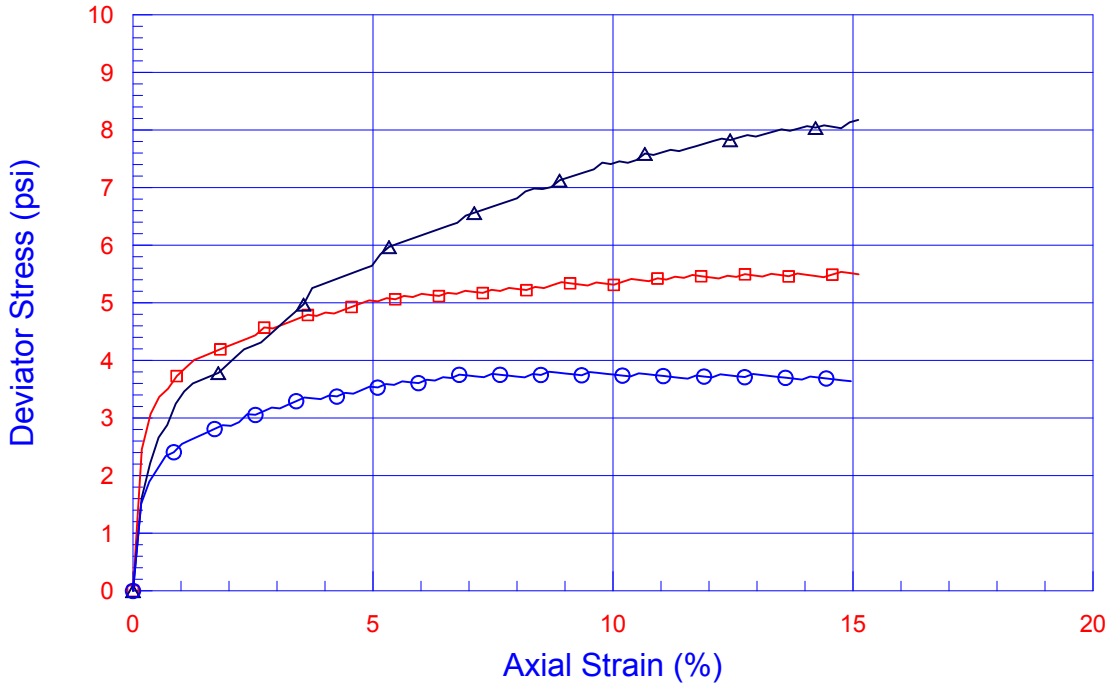
GR:SA:FI : (%) 0 : 0 : 100

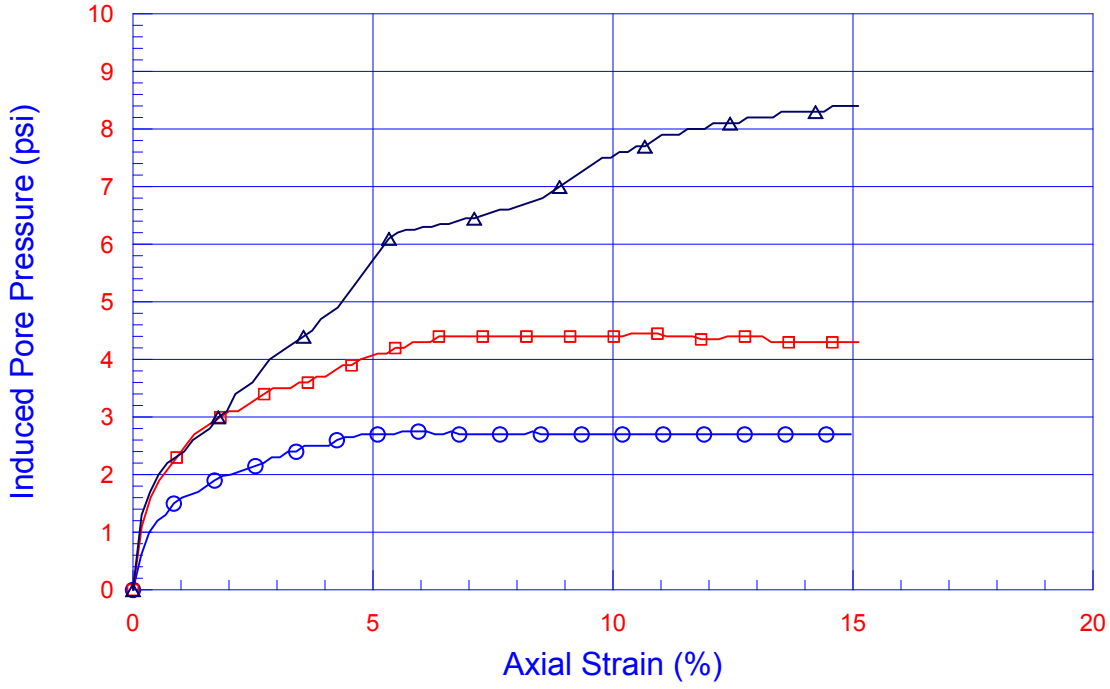
Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

Nov-18

Hydro B-2, T-2 @ 8.0





	Boring No.	Sample No.	Depth (ft.)	Eff. Conf. Pressure (psi)	Max. Dev. Stress (psi)
○	B-2	T-2	8.0	2.8	3.8
□	B-2	T-2	8.0	5.6	5.5
△	B-2	T-2	8.0	11.1	8.2

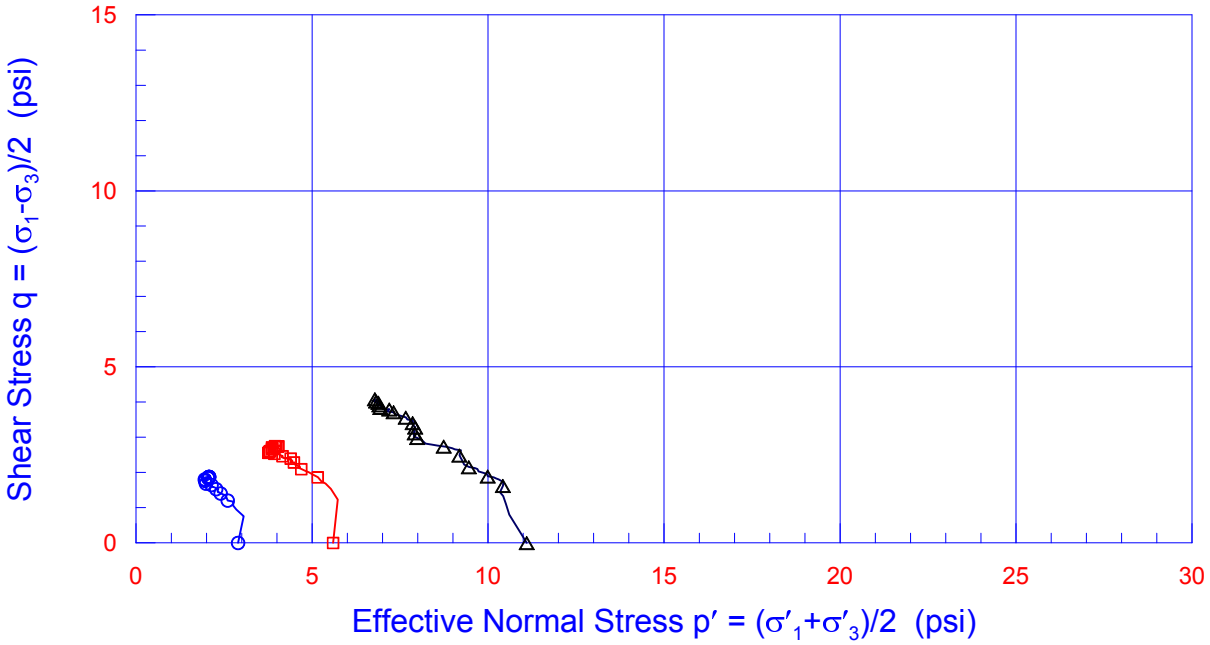
Leighton

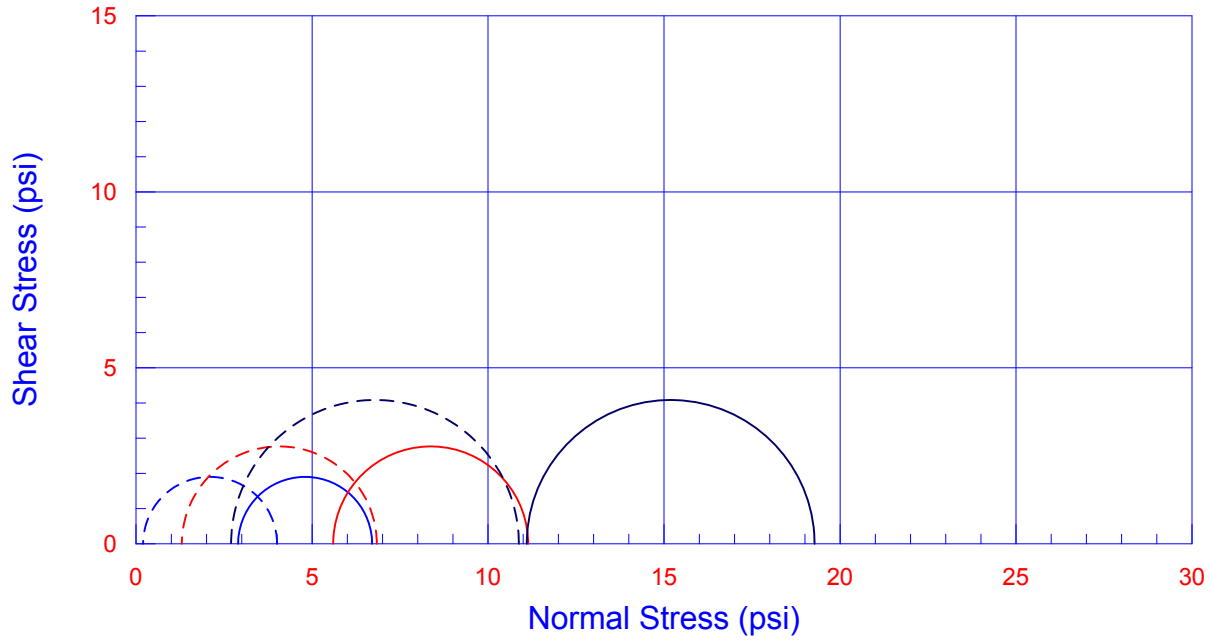
Project No.: 12096.001

Atkins Carnival

Consolidated Undrained
Triaxial Compression Test
ASTM D 4767

08-18





	Boring No.	Sample No.	Depth (ft.)	Eff. Conf. Pressure (psi)	Max. Dev. Stress (psi)
○	B-2	T-2	8.0	2.8	3.8
□	B-2	T-2	8.0	5.6	5.5
△	B-2	T-2	8.0	11.1	8.2

——— Mohr Circle based on Total Stress

– – – – – – Mohr Circle based on Effective Stress

Leighton

Project No.: 12096.001

Atkins Carnival

Consolidated Undrained
Triaxial Compression Test
ASTM D 4767

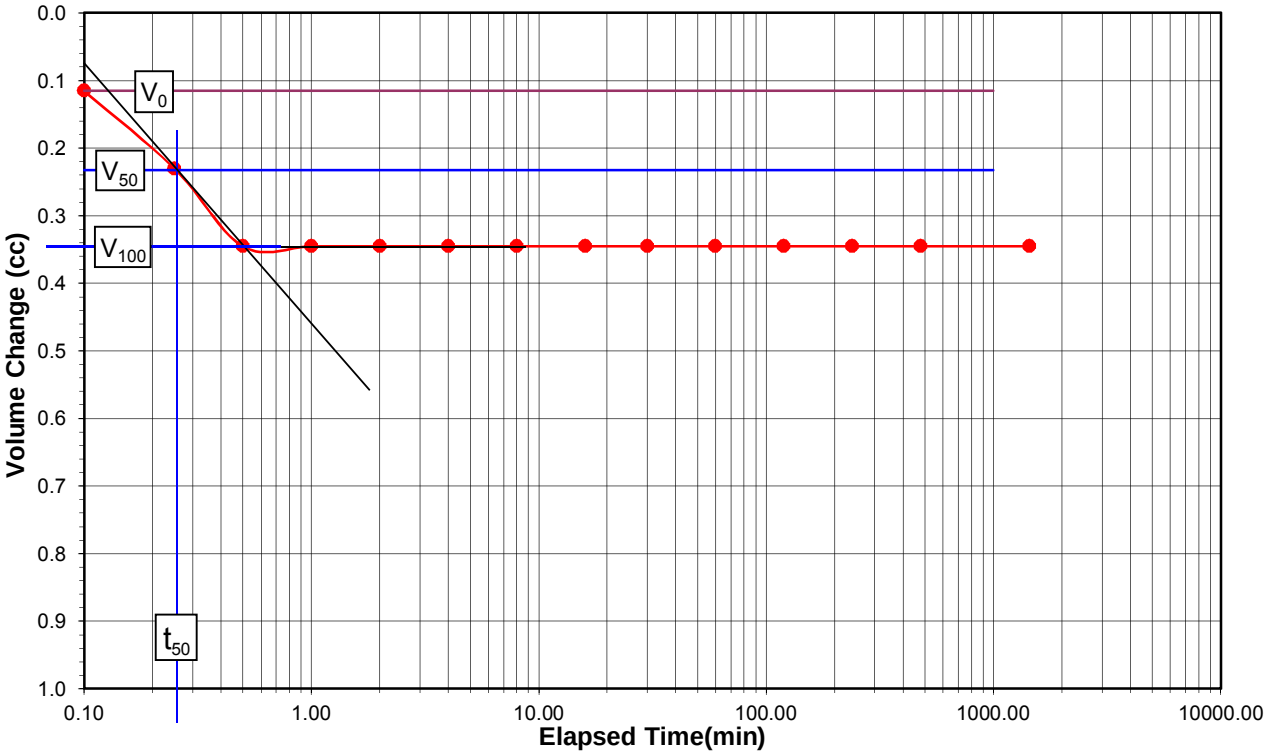
08-18

CU TRIAXIAL TEST CONSOLIDATION CURVE

Leighton

Project Name:	Atkins Carnival	Tested By:	A. Santos	
Project No.:	12096.001	Depth (ft.) :	8.0	
Boring No.:	B-2	Eff. Stress (psi):	2.80	
Sample No.:	T-2	Burette Area:	0.357	in²

Date	Time	Elapsed Time (min)	Square Root Time (min½)	Dial Rdgs (in.)	Burette Rdgs (cm.)	Volume Change (cc)
08/14/18	8:26:00			Initial Burette	6.40	
08/14/18	8:26:06	0.10	0.32		6.45	0.1
08/14/18	8:26:15	0.25	0.50		6.50	0.2
08/14/18	8:26:30	0.50	0.71		6.55	0.3
08/14/18	8:27:00	1.00	1.00		6.55	0.3
08/14/18	8:28:00	2.00	1.41		6.55	0.3
08/14/18	8:30:00	4.00	2.00		6.55	0.3
08/14/18	8:34:00	8.00	2.83		6.55	0.3
08/14/18	8:42:00	16.00	4.00		6.55	0.3
08/14/18	8:56:00	30.00	5.48		6.55	0.3
08/14/18	9:26:00	60.00	7.75		6.55	0.3
08/14/18	10:26:00	120.00	10.95		6.55	0.3
08/14/18	12:26:00	240.00	15.49		6.55	0.3
08/14/18	16:26:00	480.00	21.91		6.55	0.3
08/15/18	8:26:00	1440.00	37.95		6.55	0.3



V_0	(cc)	0.12
V_{100}	(cc)	0.35
V_{50}	(cc)	0.23
t_{50}	(min)	0.25
Height After Consolidation (in)		5.885
Strain Rate	(in/min)	**0.0942**
Duration of Test*	(hr)	0.2

*Based on a total strain of 15%

Height (ft)	5.967
	5.968
	5.968
Average	5.968

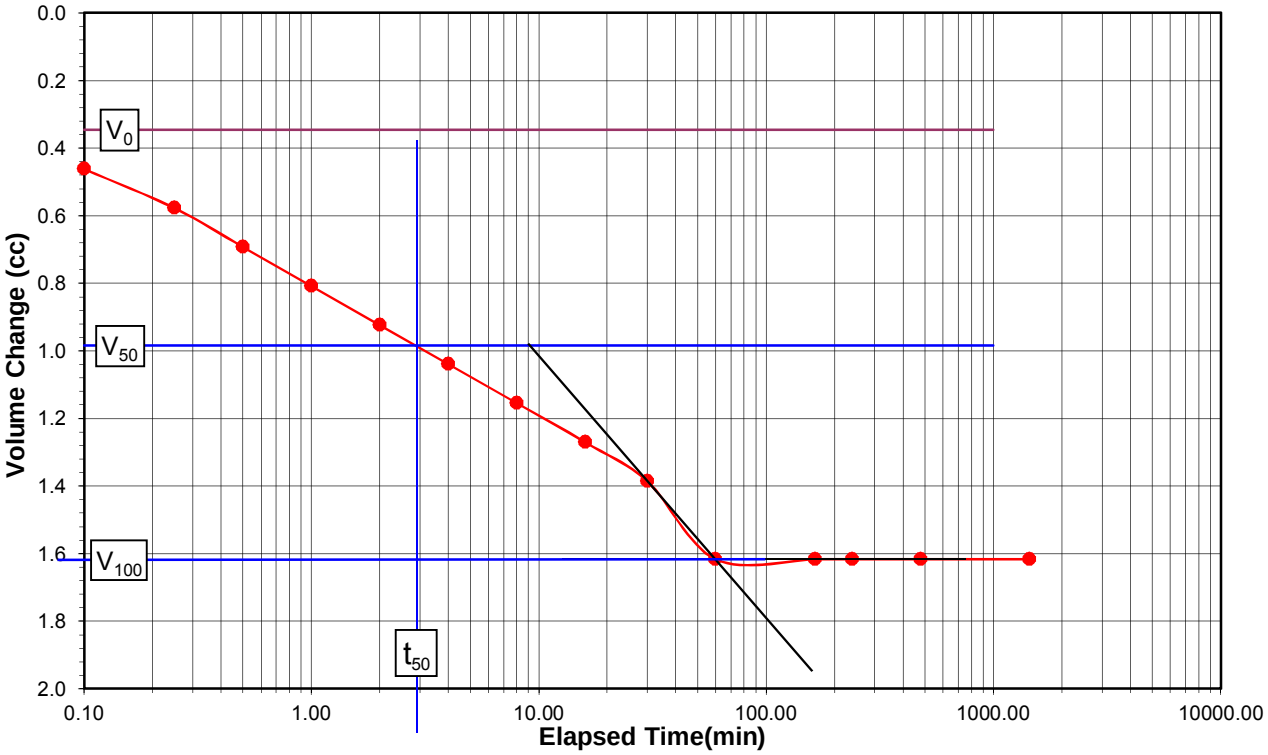
Dial Readings	Saturation	Consolidation
Initial Rdg. (in)	0.2400	0.3100
Final Rdg. (in)	0.3110	0.3220

CU TRIAXIAL TEST CONSOLIDATION CURVE

Leighton

Project Name:	Atkins Carnival	Tested By:	A. Santos	
Project No.:	12096.001	Depth (ft.) :	8.0	
Boring No.:	B-2	Eff. Stress (psi):	5.60	
Sample No.:	T-2	Burette Area:	0.358	in²

Date	Time	Elapsed Time (min)	Square Root Time (min½)	Dial Rdgs (in.)	Burette Rdgs (cm.)	Volume Change (cc)
08/14/18	8:15:00			Initial Burette	4.00	
08/14/18	8:15:06	0.10	0.32		4.20	0.5
08/14/18	8:15:15	0.25	0.50		4.25	0.6
08/14/18	8:15:30	0.50	0.71		4.30	0.7
08/14/18	8:16:00	1.00	1.00		4.35	0.8
08/14/18	8:17:00	2.00	1.41		4.40	0.9
08/14/18	8:19:00	4.00	2.00		4.45	1.0
08/14/18	8:23:00	8.00	2.83		4.50	1.2
08/14/18	8:31:00	16.00	4.00		4.55	1.3
08/14/18	8:45:00	30.00	5.48		4.60	1.4
08/14/18	9:15:00	60.00	7.75		4.70	1.6
08/14/18	10:59:00	164.00	12.81		4.70	1.6
08/14/18	12:15:00	240.00	15.49		4.70	1.6
08/14/18	16:15:00	480.00	21.91		4.70	1.6
08/15/18	8:15:00	1440.00	37.95		4.70	1.6



V_0	(cc)	0.35
V_{100}	(cc)	1.62
V_{50}	(cc)	0.98
t_{50}	(min)	2.90
Height After Consolidation (in)		5.491
Strain Rate	(in/min)	**0.0076**
Duration of Test*	(hr)	1.8

*Based on a total strain of 15%

Height (ft)	5.732
	5.730
	5.733
Average	5.732

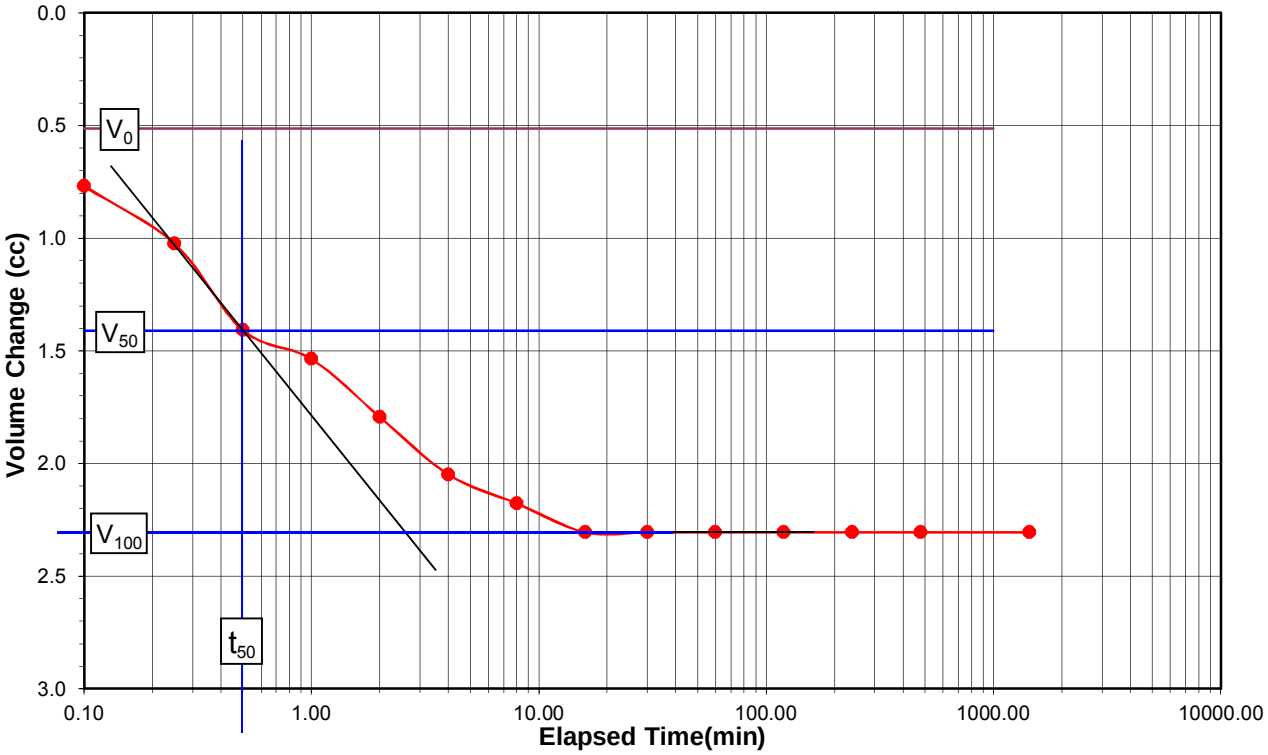
Dial Readings	Saturation	Consolidation
Initial Rdg. (in)	0.2050	0.3240
Final Rdg. (in)	0.3250	0.4450

CU TRIAXIAL TEST CONSOLIDATION CURVE

Leighton

Project Name:	Atkins Carnival	Tested By:	A. Santos
Project No.:	12096.001	Depth (ft.) :	8.0
Boring No.:	B-2	Eff. Stress (psi):	11.10
Sample No.:	T-2	Burette Area:	0.397 in²

Date	Time	Elapsed Time (min)	Square Root Time (min½)	Dial Rdgs (in.)	Burette Rdgs (cm.)	Volume Change (cc)
08/13/18	8:48:00			Initial Burette	4.90	
08/13/18	8:48:06	0.10	0.32		5.20	0.8
08/13/18	8:48:15	0.25	0.50		5.30	1.0
08/13/18	8:48:30	0.50	0.71		5.45	1.4
08/13/18	8:49:00	1.00	1.00		5.50	1.5
08/13/18	8:50:00	2.00	1.41		5.60	1.8
08/13/18	8:52:00	4.00	2.00		5.70	2.0
08/13/18	8:56:00	8.00	2.83		5.75	2.2
08/13/18	9:04:00	16.00	4.00		5.80	2.3
08/13/18	9:18:00	30.00	5.48		5.80	2.3
08/13/18	9:48:00	60.00	7.75		5.80	2.3
08/13/18	10:48:00	120.00	10.95		5.80	2.3
08/13/18	12:48:00	240.00	15.49		5.80	2.3
08/13/18	16:48:00	480.00	21.91		5.80	2.3
08/14/18	8:48:00	1440.00	37.95		5.80	2.3



V_0	(cc)	0.51
V_{100}	(cc)	2.31
V_{50}	(cc)	1.41
t_{50}	(min)	0.50
Height After Consolidation (in)		5.626
Strain Rate	(in/min)	**0.0450**
Duration of Test*	(hr)	0.3

*Based on a total strain of 15%

Height (ft)	5.677
	5.677
	5.678
Average	5.677

Dial Readings	Saturation	Consolidation
Initial Rdg. (in)	0.2230	0.2500
Final Rdg. (in)	0.2550	0.2690

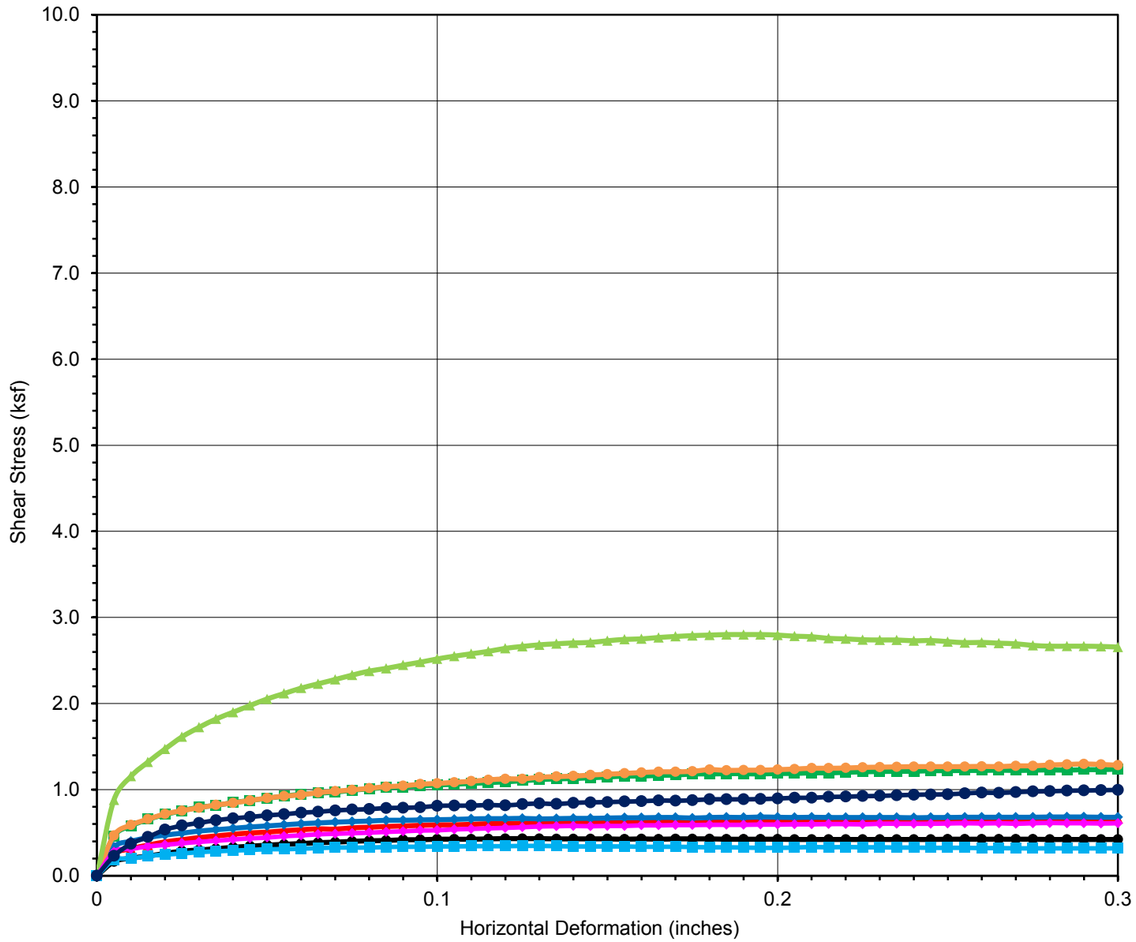
CONSOLIDATED UNDRAINED TRIAXIAL TEST
ASTM D 4767

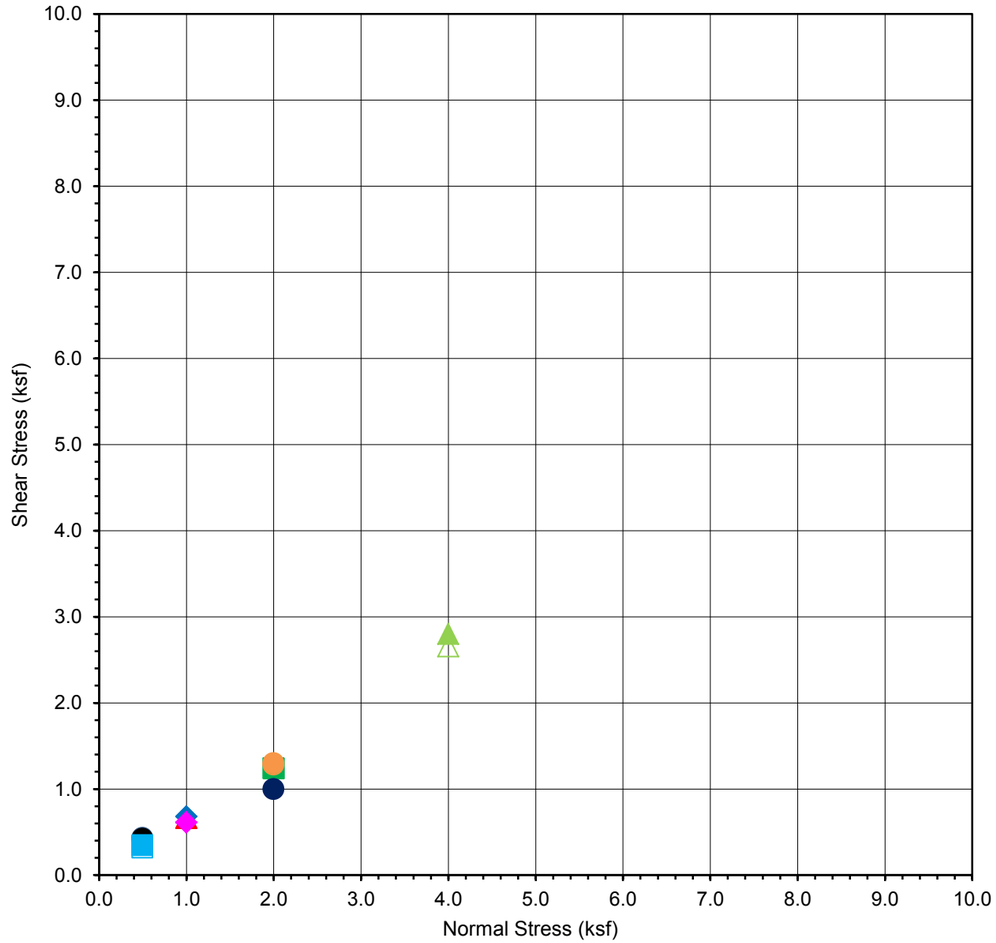
Project Name:	Atkins Carnival	Tested By:	A. Santos	Date:	08/12/18
Project No:	12096.001	Checked By:	J. Ward	Date:	08/23/18
Boring No.:	B-2				
Sample No.:	T-2				
Depth (ft.):	8.0				
Sample Type:	Shelby				

2.8 psi

5.6 psi

11.1 psi





Boring Number:	B-1	B-1	B-1	B-2	B-2	B-2	B-3-2	B-3-2	B-3-2							
Sample Number:	R-2	R-2	R-2	R-1	R-1	R-1	R-1	R-2	R-3							
Symbol	●	▲	■	◆	●	▲	■	◆	●							
Normal Stress (kip/square-foot) or (ksf):	0.5	1	2	1	2	4	0.5	1	2							
Peak Shear Stress (ksf):	0.43	0.66	1.24	0.68	1.30	2.80	0.35	0.61	1.00							
Shear Stress at end of test (ksf):	0.42	0.66	1.24	0.68	1.28	2.66	0.32	0.61	1.00							
Deformation Rate (inches/minute):	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05							
Initial Sample Height (inches):	1															
Diameter (inches):	2.415															
Initial Moisture Content (%):	50	50	50	45	45	45	58	48	55							
Dry Density (pcf):	70	72	72	73	74	77	67	73	68							
Saturation (%):	97	101	102	95	95	104	102	99	101							
Soil Height Before Shearing (inches):	0.9720	0.9462	0.9112	0.9390	0.8900	0.9439	0.9385	0.9096	0.9079							
Final Moisture Content (%):	45	40	38	42	37	31	41	38	46							

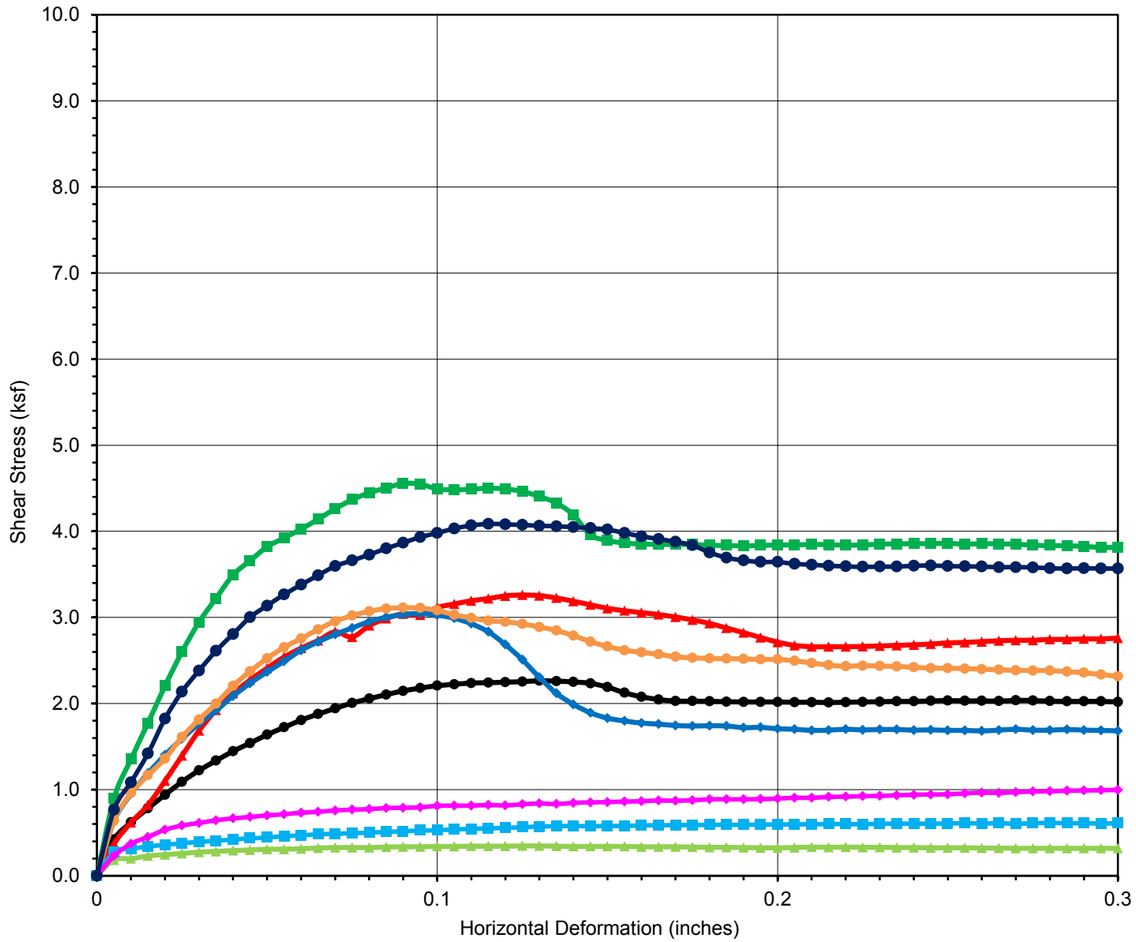
Leighton

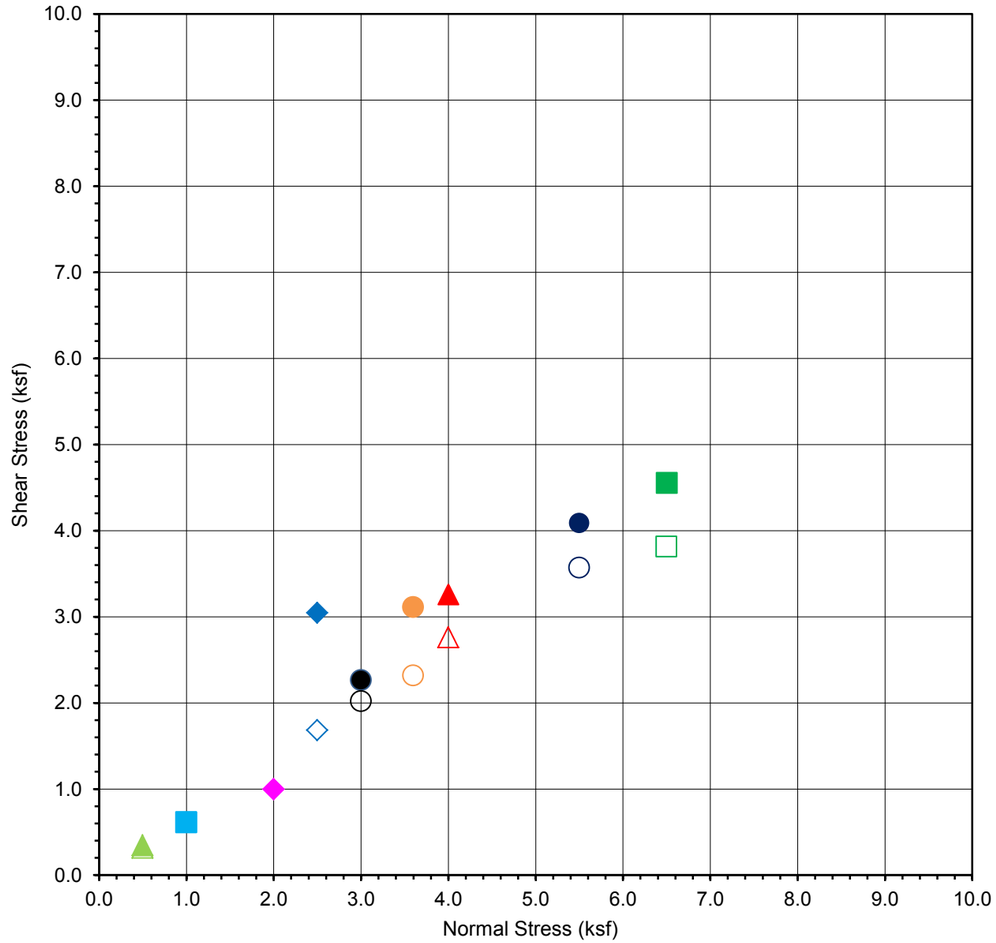
DIRECT SHEAR TEST RESULTS

Consolidated Undrained

Project No.: 12096.001

Atkins Carnival





Boring Number:	B-1	B-1	B-1	B-2	B-2	B-3-2	B-3-2	B-3-2	B-3-2							
Sample Number:	R-6	R-8	R-10	R-4	R-6A	R-1	R-2	R-3	R-7							
Symbol	●	▲	■	◆	●	▲	■	◆	●							
Normal Stress (kip/square-foot) or (ksf):	3	4	6.5	2.5	3.6	0.5	1	2	5.5							
Peak Shear Stress (ksf):	2.26	3.26	4.56	3.05	3.11	0.35	0.61	1.00	4.09							
Shear Stress at end of test (ksf):	2.02	2.76	3.81	1.68	2.32	0.32	0.61	1.00	3.57							
Deformation Rate (inches/minute):	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05							
Initial Sample Height (inches):	1															
Diameter (inches):	2.415															
Initial Moisture Content (%):	24	28	25	13	24	58	48	55	26							
Dry Density (pcf):	97	96	97	125	103	67	73	68	99							
Saturation (%):	88	98	93	100	101	102	99	101	101							
Soil Height Before Shearing (inches):	0.9714	0.9672	0.9630	0.9838	0.9688	0.9385	0.9096	0.9079	0.9648							
Final Moisture Content (%):	28	30	33	13	25	41	38	46	27							

Leighton

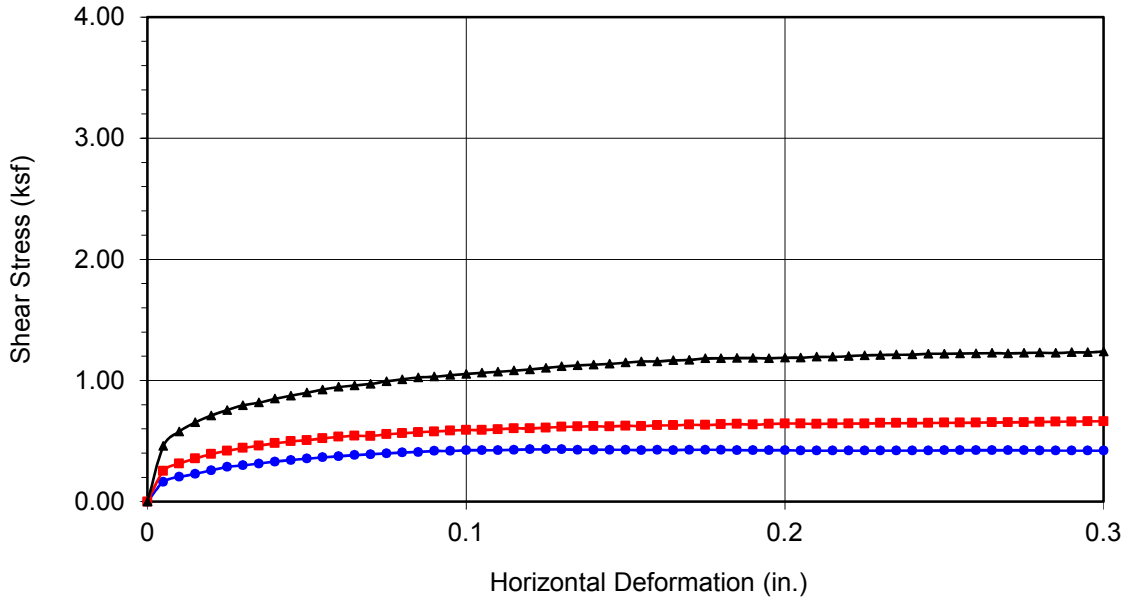
DIRECT SHEAR TEST RESULTS

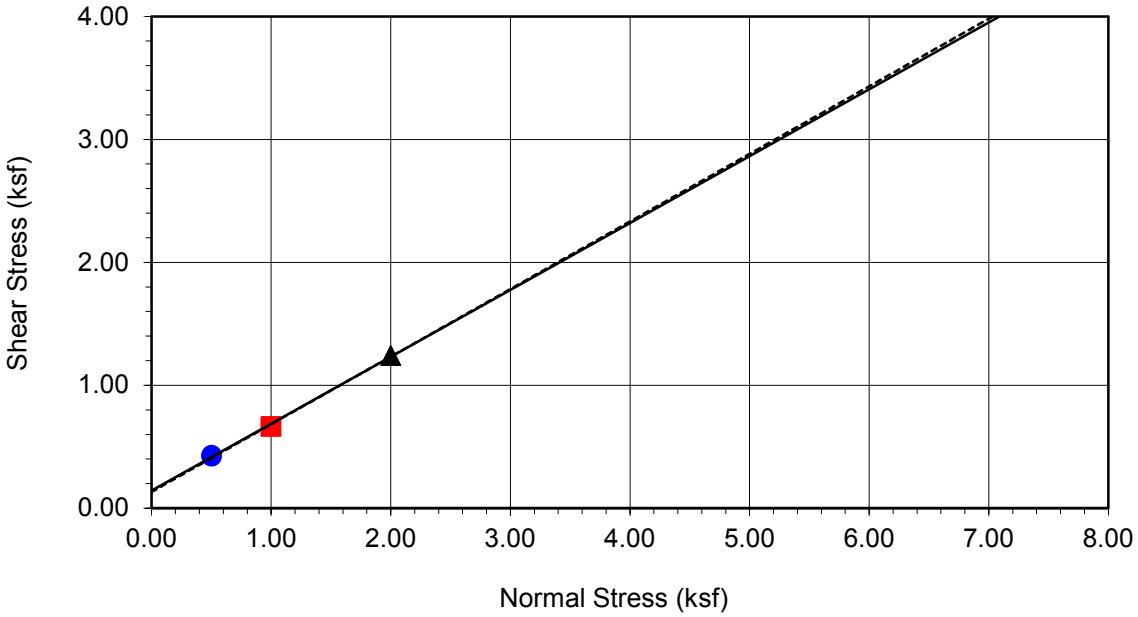
Consolidated Undrained

Project No.: 12096.001

Atkins Carnival

DS 1-point tests (11 x 17), B-1, B-2, B-3-2





Boring No.	**B-1**
Sample No.	**R-2**
Depth (ft)	**12**
Sample Type:	Ring
Soil Identification:	Dark olive gray silt (ML)

Strength Parameters

	C (psf)	ϕ (^{o})
Peak	143	29
Ultimate	133	29

Normal Stress (kip/ft²)	0.500	1.000	2.000
Peak Shear Stress (kip/ft²)	● 0.431	■ 0.663	▲ 1.239
Shear Stress @ End of Test (ksf)	○ 0.421	□ 0.663	△ 1.239
Deformation Rate (in./min.)	0.0500	0.0500	0.0500
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	50.16	50.16	50.16
Dry Density (pcf)	70.1	72.1	72.5
Saturation (%)	96.5	101.2	102.1
Soil Height Before Shearing (in.)	0.9720	0.9462	0.9112
Final Moisture Content (%)	44.6	40.5	37.5

Leighton

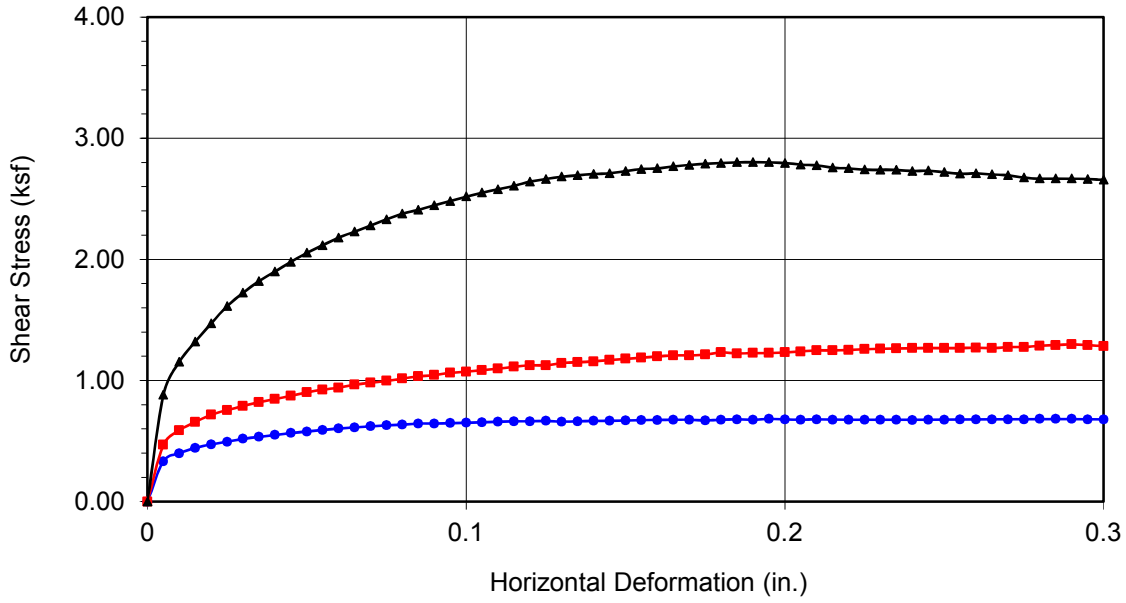
DIRECT SHEAR TEST RESULTS

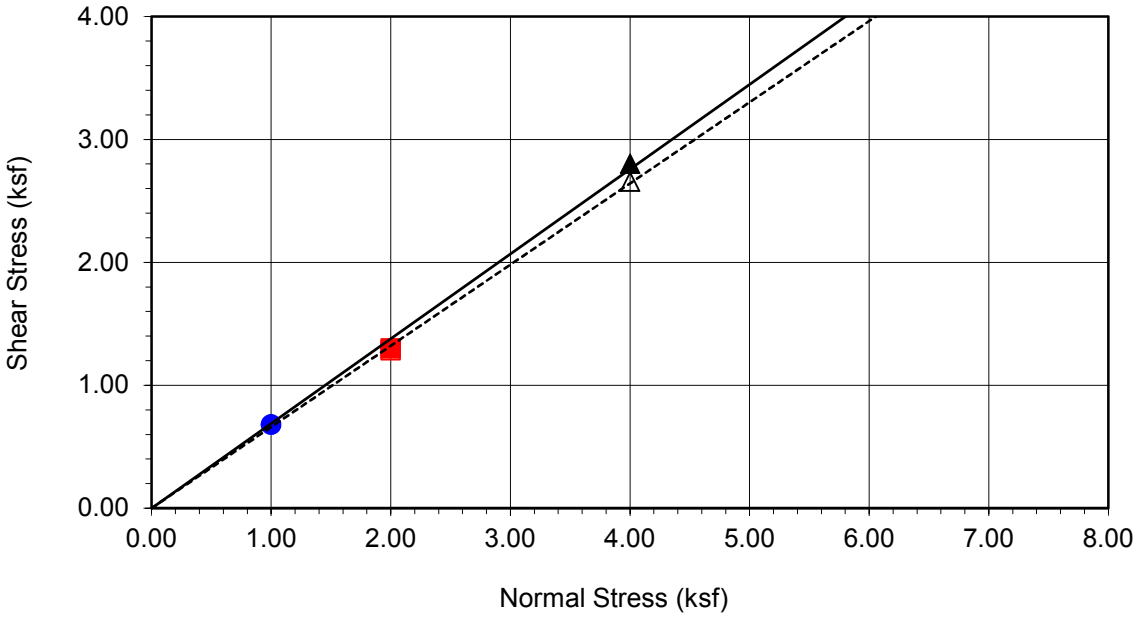
Consolidated Undrained

Project No.: 12096.001

Atkins Carnival

08-18





Boring No.	**B-2**
Sample No.	**R-1**
Depth (ft)	**12**
Sample Type:	Ring
Soil Identification:	Dark olive gray silt (ML)

Strength Parameters

	C (psf)	ϕ (^{o})
Peak	0	35
Ultimate	0	33

Normal Stress (kip/ft²)	1.000	2.000	4.000
Peak Shear Stress (kip/ft²)	● 0.682	■ 1.298	▲ 2.801
Shear Stress @ End of Test (ksf)	○ 0.679	□ 1.283	△ 2.656
Deformation Rate (in./min.)	0.0500	0.0500	0.0500
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	45.49	45.49	45.49
Dry Density (pcf)	73.3	73.7	77.5
Saturation (%)	94.5	95.4	104.5
Soil Height Before Shearing (in.)	0.9390	0.8900	0.9439
Final Moisture Content (%)	42.2	37.4	31.3

Leighton

DIRECT SHEAR TEST RESULTS

Consolidated Undrained

Project No.: 12096.001

Atkins Carnival

08-18

Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	Atkins Carnival	Tested By:	R. Manning	Date:	08/31/18
Project No. :	12096.001	Input By:	J. Ward	Date:	09/11/18
Boring No.:	B-1	Checked By:	J. Ward		
Sample No.:	S-1	Depth (ft.)	7.0		
Soil Identification:	Gray fat clay (CH)				

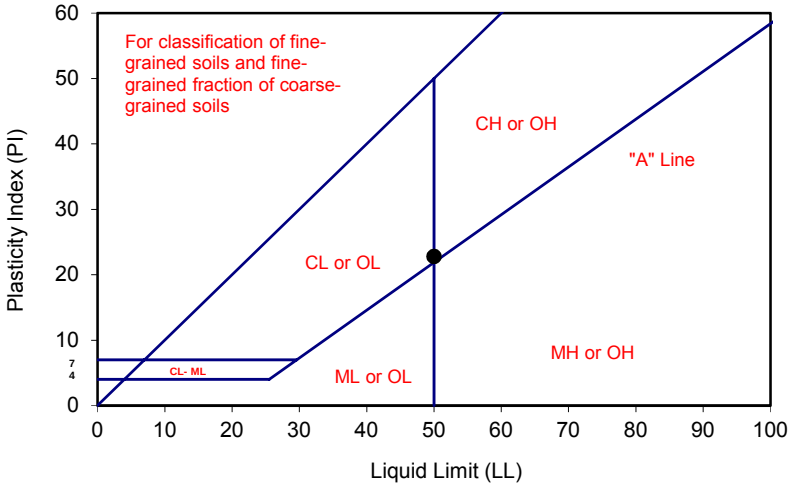
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			30	23	15	
Wet Wt. of Soil + Cont. (g)	18.23	18.21	24.27	23.62	24.67	
Dry Wt. of Soil + Cont. (g)	16.84	16.70	20.73	20.23	20.90	
Wt. of Container (g)	11.75	11.12	13.58	13.58	13.75	
Moisture Content (%) [Wn]	27.31	27.06	49.51	50.98	52.73	

Liquid Limit	**50**
Plastic Limit	**27**
Plasticity Index	**23**
Classification	**CH**

PI at "A" - Line = 0.73(LL-20) 21.9

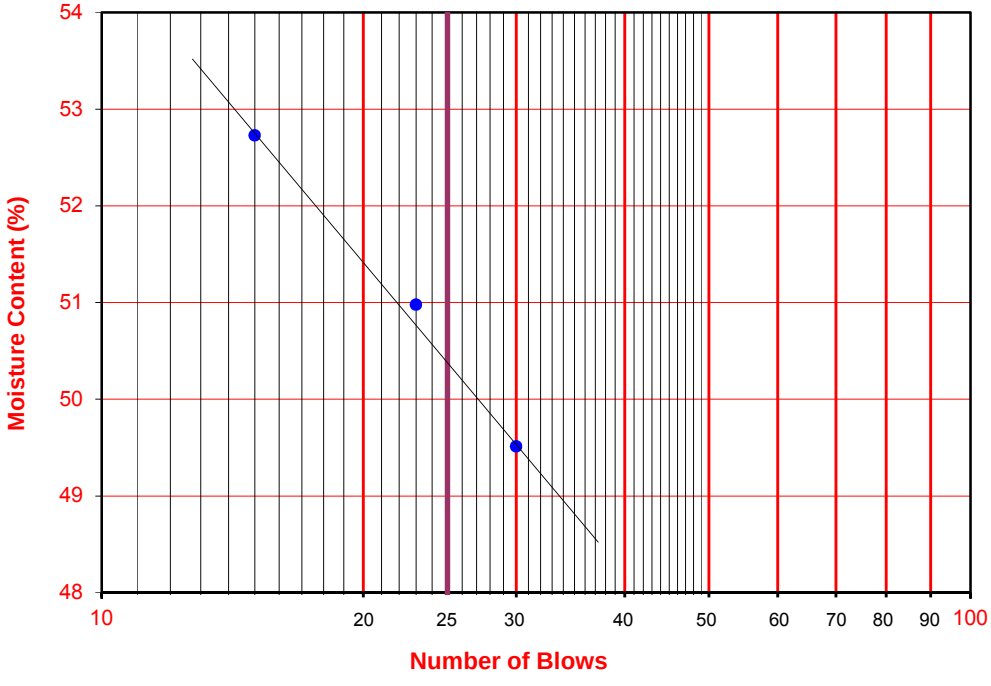
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	Atkins Carnival	Tested By:	R. Manning	Date:	08/31/18
Project No. :	12096.001	Input By:	J. Ward	Date:	09/11/18
Boring No.:	B-1	Checked By:	J. Ward		
Sample No.:	S-2	Depth (ft.)	17.0		
Soil Identification:	Gray sandy silt s(ML)				

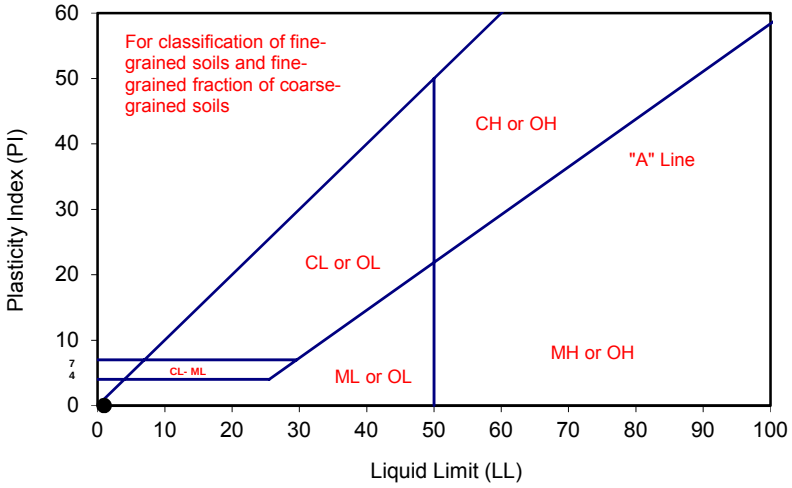
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			11			
Wet Wt. of Soil + Cont. (g)	**Cannot be rolled:**		28.28	**Cannot get more than 11 blows:**		
Dry Wt. of Soil + Cont. (g)	**NonPlastic**		24.96	**NonPlastic**		
Wt. of Container (g)			13.59			
Moisture Content (%) [Wn]			29.20			

Liquid Limit	**NP**
Plastic Limit	**NP**
Plasticity Index	**NP**
Classification	**NP**

PI at "A" - Line = 0.73(LL-20) =

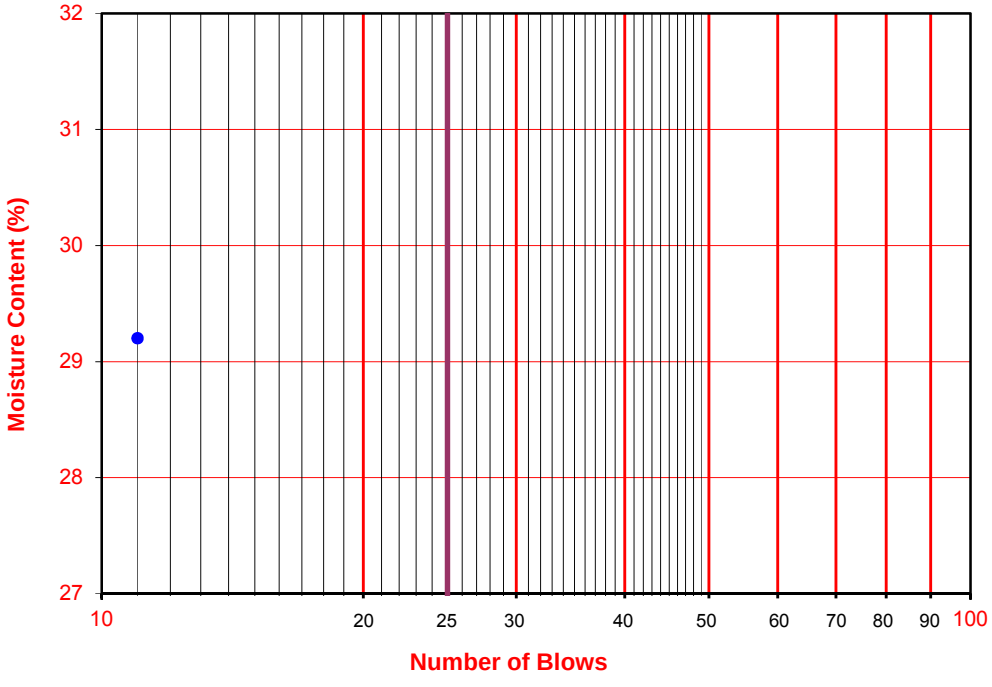
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test



Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	Atkins Carnival	Tested By:	R. Manning	Date:	09/05/18
Project No. :	12096.001	Input By:	J. Ward	Date:	09/11/18
Boring No.:	B-2	Checked By:	J. Ward		
Sample No.:	R-1	Depth (ft.)	12.0		
Soil Identification:	Dark olive gray silt (ML)				

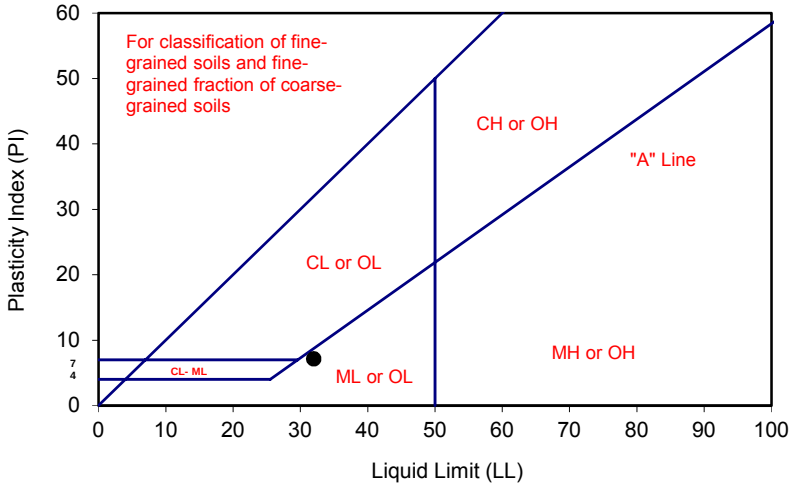
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			32	23	17	
Wet Wt. of Soil + Cont. (g)	18.57	18.19	23.89	26.45	24.93	
Dry Wt. of Soil + Cont. (g)	17.08	16.82	21.45	23.33	22.07	
Wt. of Container (g)	11.12	11.27	13.57	13.64	13.60	
Moisture Content (%) [Wn]	25.00	24.68	30.96	32.20	33.77	

Liquid Limit	**32**
Plastic Limit	**25**
Plasticity Index	**7**
Classification	**ML**

PI at "A" - Line = 0.73(LL-20) 8.76

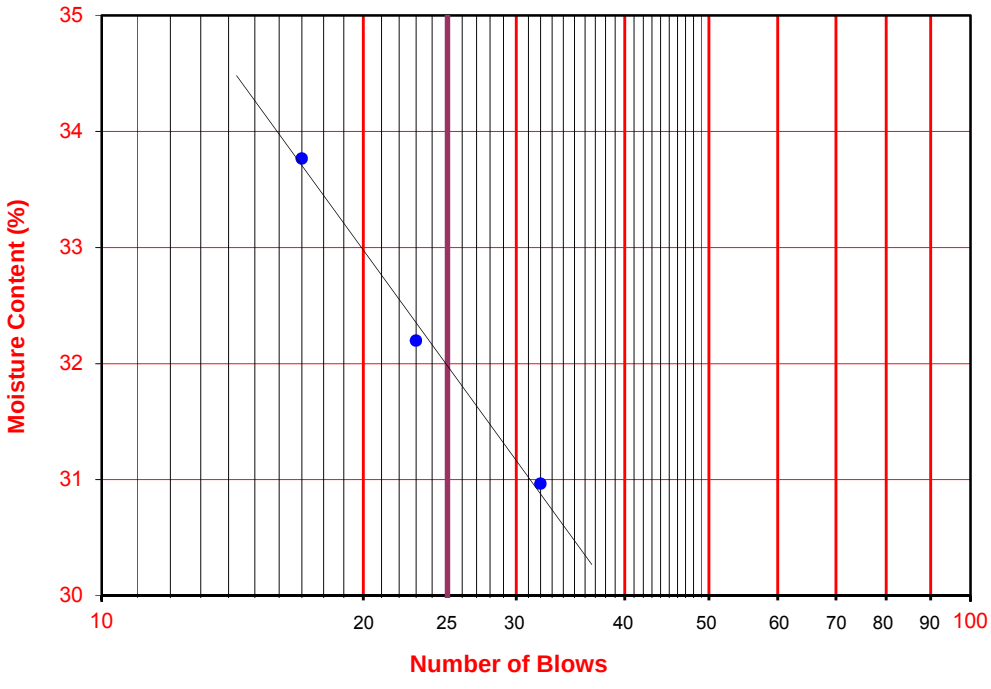
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	Atkins Carnival	Tested By:	R. Manning	Date:	08/30/18
Project No. :	12096.001	Input By:	J. Ward	Date:	09/11/18
Boring No.:	B-2	Checked By:	J. Ward		
Sample No.:	T-2	Depth (ft.)	8.0		
Soil Identification:	Olive gray lean clay (CL)				

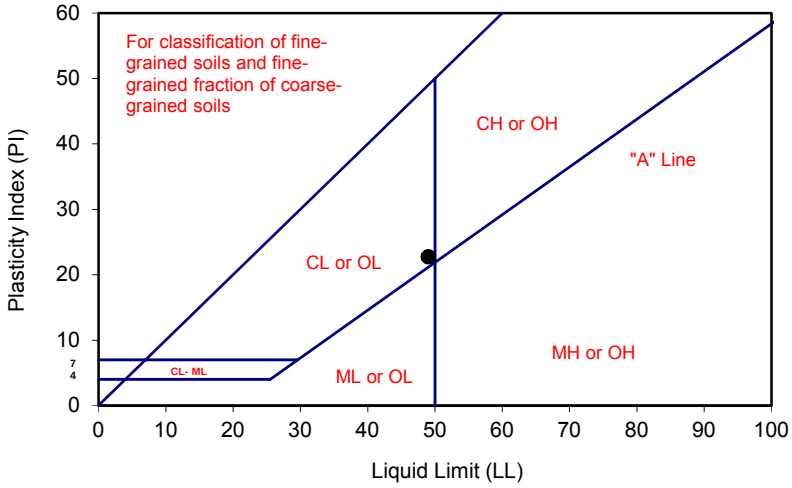
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			30	25	20	
Wet Wt. of Soil + Cont. (g)	18.68	17.71	24.77	23.85	24.08	
Dry Wt. of Soil + Cont. (g)	17.24	16.36	21.20	20.46	20.55	
Wt. of Container (g)	11.75	11.23	13.73	13.55	13.50	
Moisture Content (%) [Wn]	26.23	26.32	47.79	49.06	50.07	

Liquid Limit	**49**
Plastic Limit	**26**
Plasticity Index	**23**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 21.17

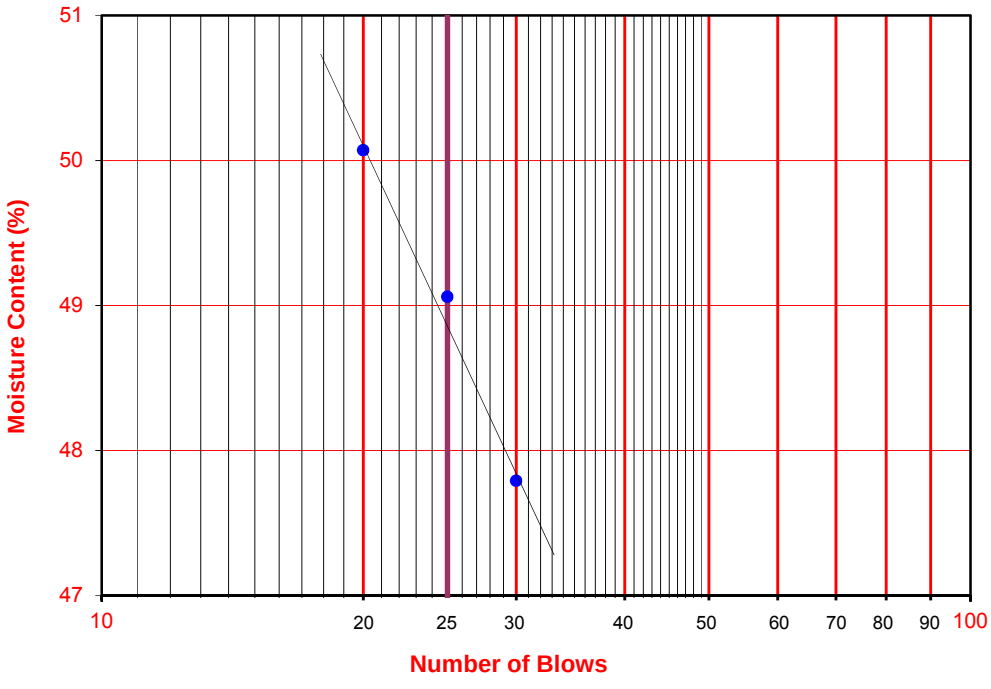
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	Atkins Carnival	Tested By:	R. Manning	Date:	08/30/18
Project No. :	12096.001	Input By:	J. Ward	Date:	09/11/18
Boring No.:	B-2	Checked By:	J. Ward		
Sample No.:	T-2	Depth (ft.)	8.0		
Soil Identification:	Olive gray lean clay (CL)				

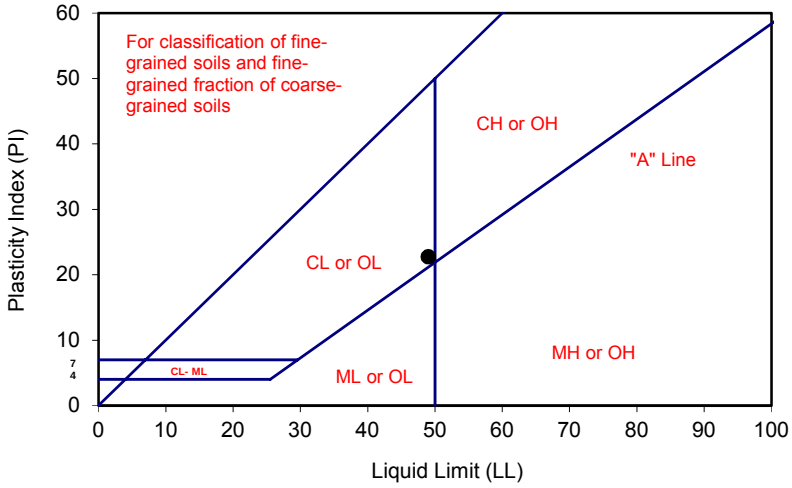
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			30	25	20	
Wet Wt. of Soil + Cont. (g)	18.68	17.71	24.77	23.85	24.08	
Dry Wt. of Soil + Cont. (g)	17.24	16.36	21.20	20.46	20.55	
Wt. of Container (g)	11.75	11.23	13.73	13.55	13.50	
Moisture Content (%) [Wn]	26.23	26.32	47.79	49.06	50.07	

Liquid Limit	**49**
Plastic Limit	**26**
Plasticity Index	**23**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 21.17

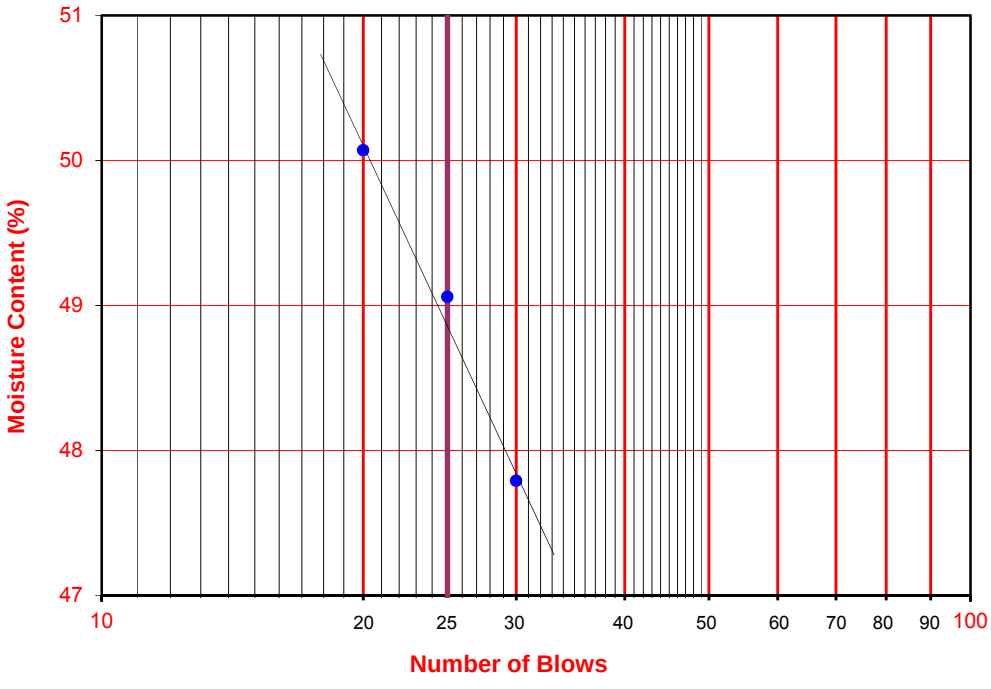
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	Atkins Carnival	Tested By:	R. Manning	Date:	08/31/18
Project No. :	12096.001	Input By:	J. Ward	Date:	09/11/18
Boring No.:	B-3-1	Checked By:	J. Ward		
Sample No.:	S-1	Depth (ft.)	7.0		
Soil Identification:	Gray silt (ML)				

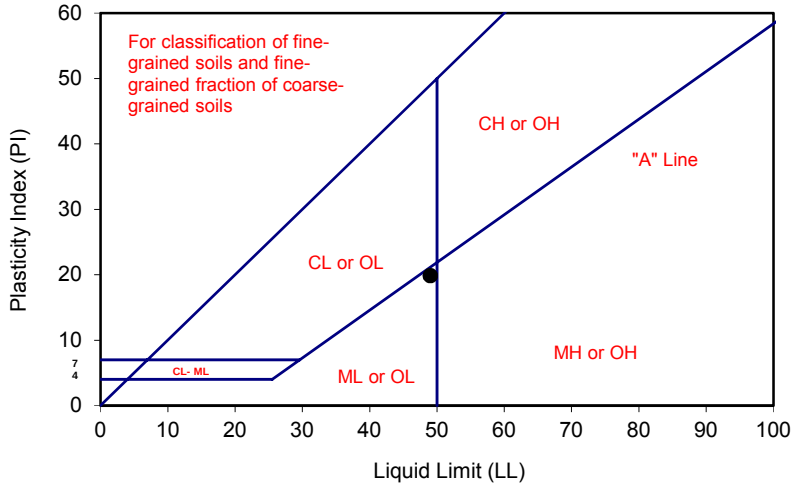
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			31	24	16	
Wet Wt. of Soil + Cont. (g)	18.79	18.34	22.03	25.60	23.41	
Dry Wt. of Soil + Cont. (g)	17.14	16.73	19.25	21.65	20.10	
Wt. of Container (g)	11.47	11.22	13.52	13.61	13.50	
Moisture Content (%) [Wn]	29.10	29.22	48.52	49.13	50.15	

Liquid Limit	**49**
Plastic Limit	**29**
Plasticity Index	**20**
Classification	**ML**

PI at "A" - Line = 0.73(LL-20) 21.17

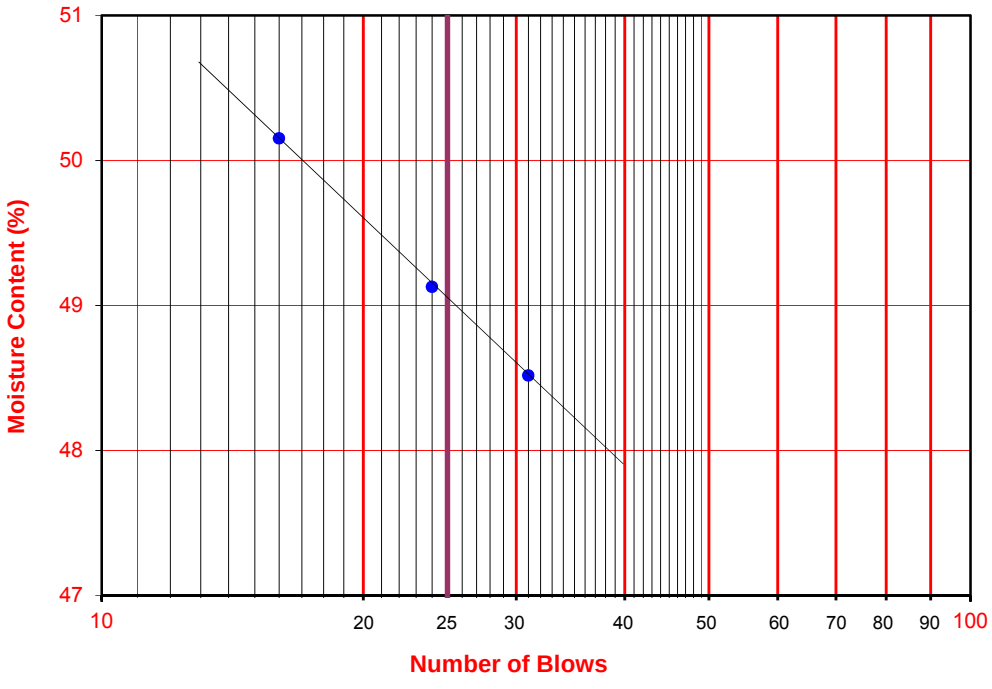
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



APPENDIX C

Seismicity Data

Leighton

USGS Design Maps Summary Report

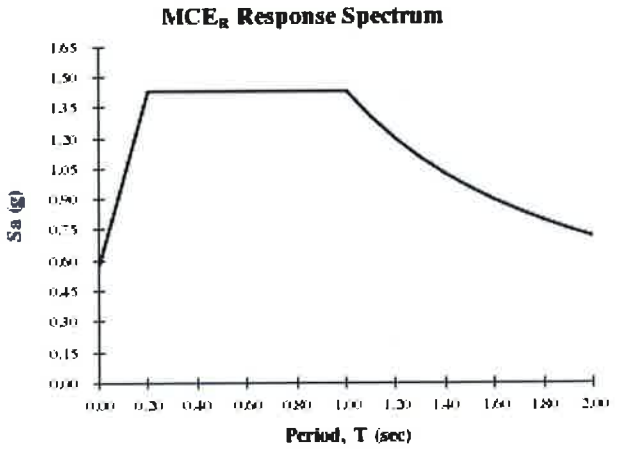
User-Specified Input

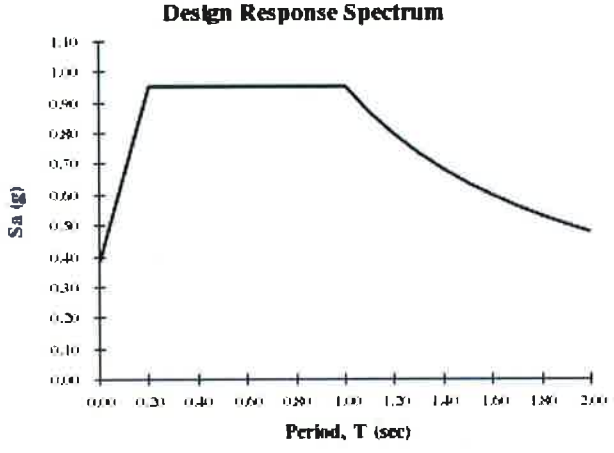
Report Title	Atkins Carnival Cruise Sat December 1, 2018 00:18:10 UTC
Building Code Reference Document	ASCE 7-10 Standard (which utilizes USGS hazard data available in 2008)
Site Coordinates	33.7515°N, 118.1871°W
Site Soil Classification	Site Class E – "Soft Clay Soil"
Risk Category	I/II/III

USGS-Provided Output

S_S =	1.589 g	S_{MS} =	1.430 g	S_{DS} =	0.953 g
S_1 =	0.598 g	S_{M1} =	1.434 g	S_{D1} =	0.956 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.





For PGA_M, T_L, C_{RS}, and C_{R1} values, please view the detailed report.

USGS Design Maps Detailed Report

ASCE 7-10 Standard (33.7515°N, 118.1871°W)

Site Class E – "Soft Clay Soil", Risk Category I/II/III

Section 11.4.1 — Mapped Acceleration Parameters

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

From Figure 22-1 [1] $S_s = 1.589$ g

From Figure 22-2 [2] $S_1 = 0.598$ g

Section 11.4.2 — Site Class

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

Table 20.3–1 Site Classification

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

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

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

Table 11.4-1: Site Coefficient F_a

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

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

For Site Class = E and S_S = 1.589 g, F_a = 0.900

Table 11.4-2: Site Coefficient F_v

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

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

For Site Class = E and S_1 = 0.598 g, F_v = 2.400

Equation (11.4–1): $S_{MS} = F_a S_S = 0.900 \times 1.589 = 1.430$ g

Equation (11.4–2): $S_{M1} = F_v S_1 = 2.400 \times 0.598 = 1.434$ g

Section 11.4.4 — Design Spectral Acceleration Parameters

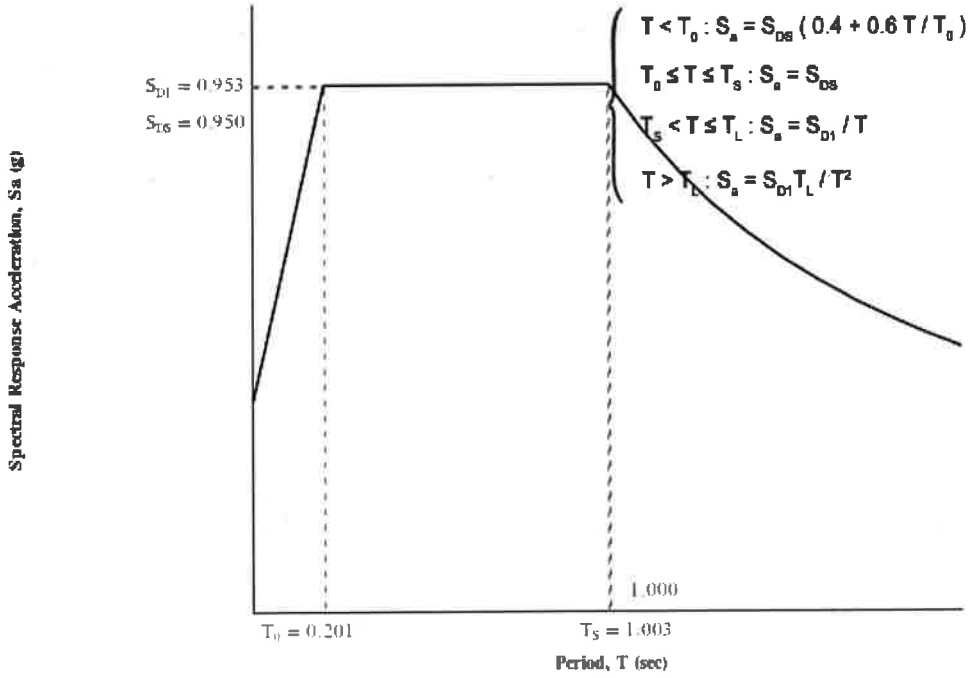
Equation (11.4–3): $S_{DS} = \frac{2}{3} S_{MS} = \frac{2}{3} \times 1.430 = 0.953$ g

Equation (11.4–4): $S_{D1} = \frac{2}{3} S_{M1} = \frac{2}{3} \times 1.434 = 0.956$ g

Section 11.4.5 — Design Response Spectrum

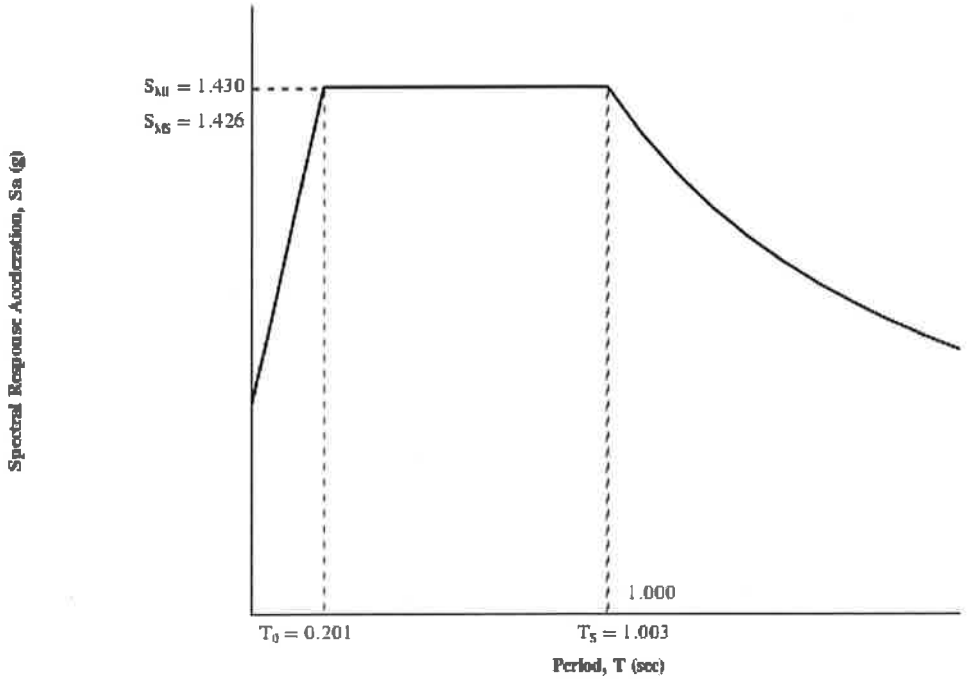
From Figure 22-12[3] $T_L = 0$ seconds

Figure 11.4–1: Design Response Spectrum



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

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



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

From Figure 22-7 [4] PGA = 0.622

Equation (11.8-1): $PGA_M = F_{PGA}PGA = 0.900 \times 0.622 = 0.56$ g

Table 11.8-1: Site Coefficient F_{PGA}

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

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

For Site Class = E and PGA = 0.622 g, F_{PGA} = 0.900

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

From Figure 22-17 [5] C_{RS} = 0.938

From Figure 22-18 [6] C_{R1} = 0.948

Section 11.6 — Seismic Design Category

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

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

For Risk Category = I and S_{DS} = 0.953 g, Seismic Design Category = D

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

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

For Risk Category = I and S_{D1} = 0.956 g, Seismic Design Category = D

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

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

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

References

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

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

^ Input

Edition
Dynamic: Conterminous U.S. 2014

Spectral Period
Peak ground acceleration

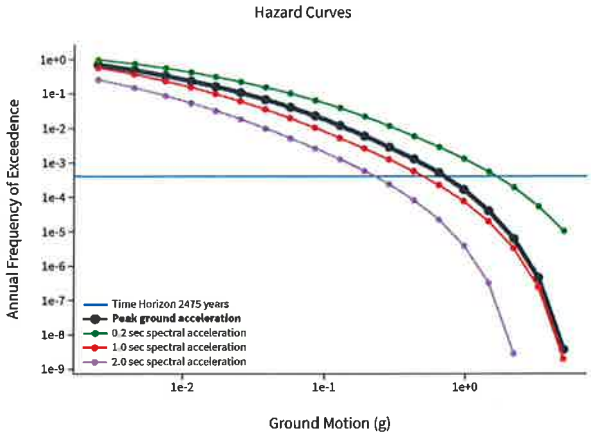
Latitude
Decimal degrees
33.7515

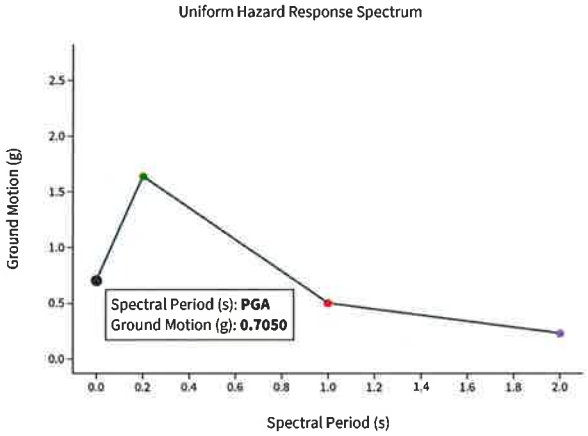
Time Horizon
Return period in years
2475

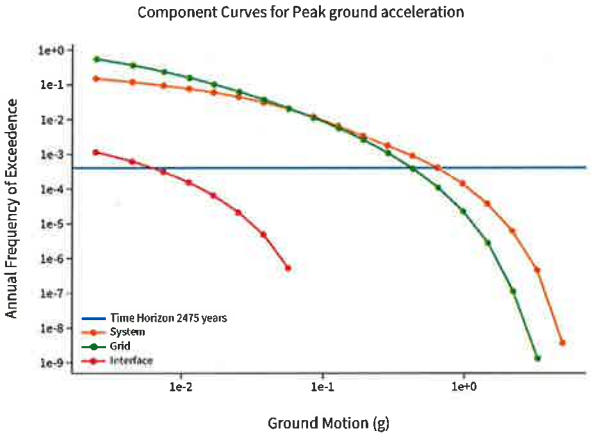
Longitude
Decimal degrees, negative values for western long...
-118.1871

Site Class
760 m/s (B/C boundary)

Hazard Curve





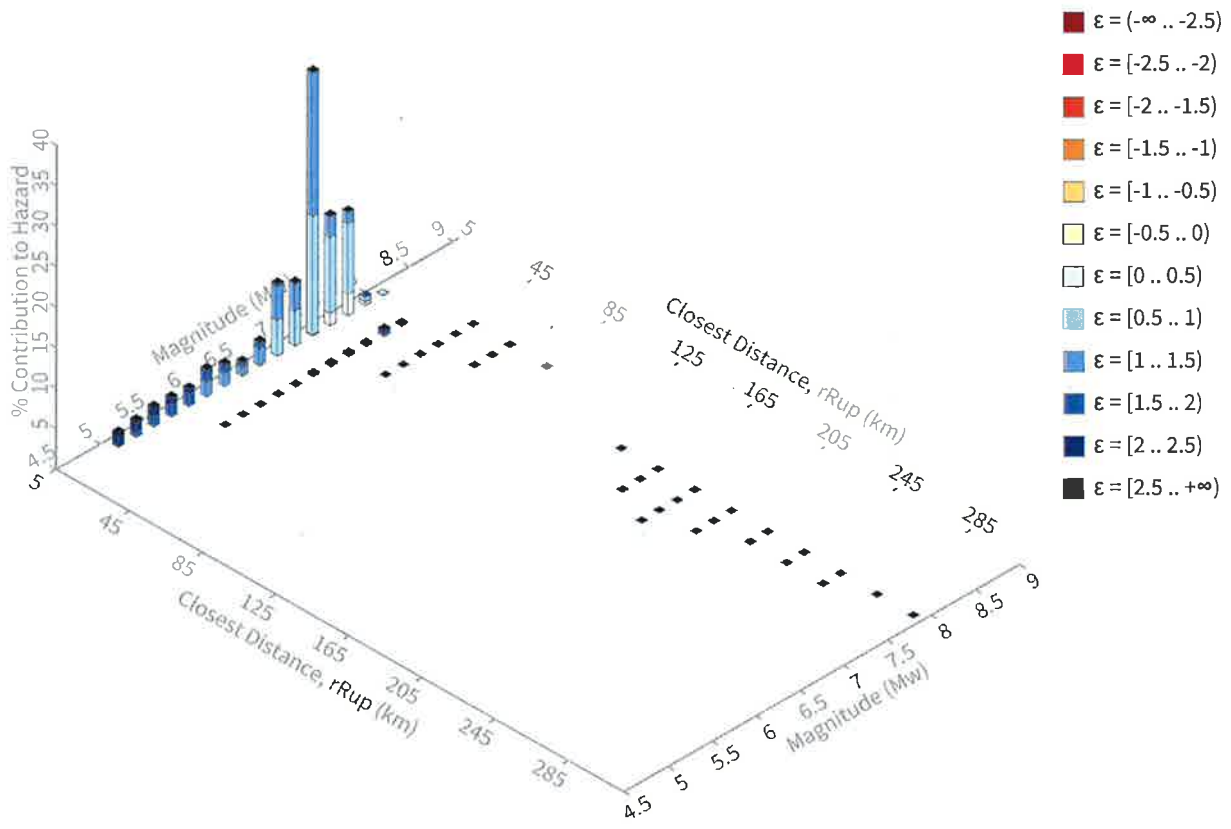


View Raw Data

Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.70498602 g

Recovered targets

Return period: 2748.2102 yrs
Exceedance rate: 0.00036387318 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.06 %

Mean (for all sources)

r: 7.11 km
m: 7.05
ε_0: 1.11 σ

Mode (largest r-m bin)

r: 6.33 km
m: 7.3
ε_0: 0.92 σ
Contribution: 32.57 %

Mode (largest ε_0 bin)

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
UC33brAvg_FM31	System							42.95
Palos Verdes [10]		6.20	7.24	1.01	118.250°W	33.738°N	255.13	19.35
Newport-Inglewood alt 1 [3]		5.61	7.46	0.78	118.149°W	33.789°N	40.38	11.13
Compton [1]		6.63	7.25	0.74	118.181°W	33.771°N	14.48	9.09
UC33brAvg_FM32	System							39.08
Palos Verdes [10]		6.20	7.36	0.98	118.250°W	33.738°N	255.13	17.54
Compton [1]		6.63	7.30	0.72	118.181°W	33.771°N	14.48	9.51
Newport-Inglewood alt 2 [3]		5.69	7.45	0.81	118.148°W	33.789°N	41.26	8.34
UC33brAvg_FM31 (opt)	Grid							9.12
PointSourceFinite: -118.187, 33.801		7.25	5.74	1.76	118.187°W	33.801°N	0.00	3.10
PointSourceFinite: -118.187, 33.801		7.25	5.74	1.76	118.187°W	33.801°N	0.00	3.10
UC33brAvg_FM32 (opt)	Grid							8.84
PointSourceFinite: -118.187, 33.801		7.27	5.73	1.76	118.187°W	33.801°N	0.00	3.02
PointSourceFinite: -118.187, 33.801		7.27	5.73	1.76	118.187°W	33.801°N	0.00	3.02

APPENDIX D

P-Y Curves Coordinates

Leighton

Carnival Cruise Line Pier Expansion
Long Beach, California
North Mooring Dolphin
P-Y Curves
36-inch Open-Ended Pipe Pile

Soil Layer	Elevations (ft)	Depth (Below Seafloor)	Point 1		Point 2		Point 3		Point 4	
			Y (in)	P (lb/in)	Y (in)	P (lb/in)	Y (in)	P (lb/in)	Y (in)	P (lb/in)
Soft Clay	-32 to -54	0	0	0	0.5	1.1	3	1.1	14 ≤	1.1
		2	0	0	0.5	7	3	11	14 ≤	19
		4	0	0	0.5	12	3	24	14 ≤	40
		6	0	0	0.5	19	3	39	14 ≤	63
		8	0	0	0.5	28	3	55	14 ≤	90
		10	0	0	0.5	37	3	72	14 ≤	119
		12	0	0	0.5	50	3	90	14 ≤	149
		14	0	0	0.5	60	3	110	14 ≤	182
		16	0	0	0.5	68	3	130	14 ≤	218
		18	0	0	0.5	90	3	153	14 ≤	256
		20	0	0	0.5	100	3	178	14 ≤	297
		22	0	0	0.5	112	3	204	14 ≤	340
Sand	-54 to -89.5	22	0	0	0.05	710	0.1	985	0.25 ≤	1050
		24	0	0	0.05	840	0.1	1275	0.25 ≤	1460
		26	0	0	0.05	950	0.1	1610	0.25 ≤	1940
		28	0	0	0.05	1050	0.1	1810	0.25 ≤	2475
		30	0	0	0.05	1170	0.1	2070	0.25 ≤	3150
		32	0	0	0.25	3600	0.4	3800	0.5 ≤	3900
		34	0	0	0.25	4200	0.4	4600	0.5 ≤	4600
		36	0	0	0.25	4700	0.4	5400	0.5 ≤	5500
		38	0	0	0.25	5400	0.4	6200	0.5 ≤	6400
		40	0	0	0.25	6000	0.4	7100	0.5 ≤	7400
		42	0	0	0.25	6500	0.4	8000	0.5 ≤	8700
		44	0	0	0.25	7000	0.4	8600	0.5 ≤	9830
		57.5	0	0	0.25	10500	0.4	14800	0.5 ≤	19600
Stiff Clay w/Free Water	-89.5 to -109.5	57.5	0	0	1.1	1490	3	1760	11.7 ≤	280
		67.5	0	0	1.1	1520	3	1940	11.7 ≤	300
		77.5	0	0	1.1	1770	3	2130	11.7 ≤	320
Sand	-109.5 to -130	77.5	0	0	0.35	17989	0.75	19900	1.2 ≤	19613
		85	0	0	0.35	22500	0.75	26375	1.2 ≤	26582
		90	0	0	0.35	26000	0.75	31279	1.2 ≤	31821
		95	0	0	0.35	28500	0.75	36914	1.2 ≤	37519
		98	0	0	0.35	30500	0.75	40000	1.2 ≤	41187

Carnival Cruise Line Pier Expansion
Long Beach, California
South Mooring Dolphin
P-Y Curves
36-inch Open-Ended Pipe Pile

Soil Layer	Elevations (ft)	Depth (Below Seafloor)	Point 1		Point 2		Point 3		Point 4	
			Y (in)	P (lb/in)	Y (in)	P (lb/in)	Y (in)	P (lb/in)	Y (in)	P (lb/in)
Soft Clay	-28 to -51	0	0	0	0.5	0.02	3	0.04	14 ≤	0.04
		2	0	0	0.5	5	3	9	14 ≤	15
		4	0	0	0.5	11	3	19	14 ≤	32
		6	0	0	0.5	16	3	30	14 ≤	51
		8	0	0	0.5	24	3	42	14 ≤	70
		10	0	0	0.5	31	3	55	14 ≤	93
		12	0	0	0.5	41	3	68	14 ≤	115
		14	0	0	0.5	47	3	85	14 ≤	139
		16	0	0	0.5	55	3	98	14 ≤	167
		18	0	0	0.5	60	3	117	14 ≤	195
		20	0	0	0.5	71	3	131	14 ≤	221
		22	0	0	0.5	75	3	145	14 ≤	243
		23	0	0	0.5	80	3	152	14 ≤	251
Sand	-51 to -76.5	23	0	0	0.05	670	0.1	803	0.25 ≤	817
		25	0	0	0.05	830	0.1	1135	0.25 ≤	1180
		27	0	0	0.05	935	0.1	1483	0.25 ≤	1614
		29	0	0	0.05	1040	0.1	1759	0.25 ≤	2119
		31	0	0	0.05	1153	0.1	2242	0.25 ≤	2663
		33	0	0	0.25	3241	0.4	3358	0.5 ≤	3368
		35	0	0	0.25	3947	0.4	4073	0.5 ≤	4099
		37	0	0	0.25	4510	0.4	4877	0.5 ≤	4899
		39	0	0	0.25	5324	0.4	5702	0.5 ≤	5758
		41	0	0	0.25	5597	0.4	6508	0.5 ≤	6714
		43	0	0	0.25	6458	0.4	7509	0.5 ≤	7672
		48	0	0	0.25	8889	0.4	9860	0.5 ≤	10335
		48.5	0	0	0.25	9101	0.4	10095	0.5 ≤	10581
Stiff Clay w/Free Water	-76.5 to -111	48.5	0	0	1.1	1361	3	1407	11.7 ≤	221
		65.75	0	0	1.1	1700	3	1950	11.7 ≤	306
		83	0	0	1.1	2100	3	2489	11.7 ≤	400
Sand	-111 to 134	83	0	0	0.18	10569	0.25	11078	0.5 ≤	11519
		86	0	0	0.18	12443	0.25	13043	0.5 ≤	13556
		90	0	0	0.18	13690	0.25	15185	0.5 ≤	16495
		95	0	0	0.18	15500	0.25	18000	0.5 ≤	20554
		100	0	0	0.18	16636	0.25	20975	0.5 ≤	24916

Carnival Cruise Line Pier Expansion
Long Beach, California
Gangway Tower
P-Y Curves
36-inch Open-Ended Pipe Pile

Soil Layer	Elevations (ft)	Depth (Below Seafloor)	Point 1		Point 2		Point 3		Point 4	
			Y (in)	P (lb/in)	Y (in)	P (lb/in)	Y (in)	P (lb/in)	Y (in)	P (lb/in)
Soft Clay	-32 to -50	0	0	0	0.5	0.02	3	0.048	14 ≤	0.08
		2	0	0	0.5	5	3	9	14 ≤	16
		4	0	0	0.5	11	3	20	14 ≤	33
		6	0	0	0.5	17	3	32	14 ≤	53
		8	0	0	0.5	25	3	45	14 ≤	76
		10	0	0	0.5	30	3	59	14 ≤	100
		12	0	0	0.5	40	3	73	14 ≤	125
		14	0	0	0.5	50	3	91	14 ≤	152
		16	0	0	0.5	59	3	108	14 ≤	181
		18	0	0	0.5	68	3	125	14 ≤	211
Sand	-50 to -84	18	0	0	0.05	460	0.1	517	0.25 ≤	517
		20	0	0	0.05	510	0.1	800	0.25 ≤	810
		22	0	0	0.05	755	0.1	1090	0.25 ≤	1200
		24	0	0	0.05	860	0.1	1380	0.25 ≤	1630
		26	0	0	0.05	970	0.1	1520	0.25 ≤	2130
		28	0	0	0.05	1090	0.1	1870	0.25 ≤	2680
		30	0	0	0.05	1180	0.1	2100	0.25 ≤	3300
		32	0	0	0.05	1250	0.1	2290	0.25 ≤	3900
		34	0	0	0.25	4400	0.4	4900	0.5 ≤	5100
		36	0	0	0.25	5000	0.4	5700	0.5 ≤	5830
		38	0	0	0.25	5550	0.4	6550	0.5 ≤	6750
		40	0	0	0.25	6080	0.4	7380	0.5 ≤	7700
		42	0	0	0.25	6600	0.4	8250	0.5 ≤	8700
		44	0	0	0.25	7200	0.4	9050	0.5 ≤	9700
		52	0	0	0.25	9100	0.4	12400	0.5 ≤	14600
Stiff Clay w/Free Water	-84 to -105	52	0	0	1.1	1320	3	1570	11.7 ≤	250
		62.5	0	0	1.1	1500	3	1900	11.7 ≤	300
		73	0	0	1.1	1870	3	2230	11.7 ≤	360
Sand	-105 to -132	73	0	0	0.35	15000	0.75	16000	1.2 ≤	16000
		80	0	0	0.35	19700	0.75	21850	1.2 ≤	21850
		85	0	0	0.35	22600	0.75	26500	1.2 ≤	26800
		90	0	0	0.35	25080	0.75	31400	1.2 ≤	32000
		95	0	0	0.35	28400	0.75	36600	1.2 ≤	37600
		100	0	0	0.35	31500	0.75	42000	1.2 ≤	43700

December20, 2018

Ms. Sandra P Pentney
Atkins
3570 Carmel Mountain Road, Suite 300
San Diego, California 92130

RE: Paleontological mitigation – Long Beach Cruise Terminal Improvement at the Port of Long Beach, Long Beach, California

Dear Ms. Pentney:

It is my understanding that Carnival Corporation & PLC proposes improvements to the Long Beach Cruise Terminal located at Pier H at the Port of Long Beach (POLB), Long Beach, California. Further, it is my understanding that these proposed improvements include earthwork, both offshore and onshore. The proposed offshore earthwork includes dredging of approximately 35,400 cubic yards of material from the existing berth and surrounding area and approximately 50 direct driven piles (Atkins, Inc.). The proposed onshore earthwork improvements include the expansion of a parking garage which will include the instillation of 236 foundation piles.

Per your request, the San Diego Natural History Museum, Department of Paleontology reviewed the Project Description for the Long Beach Cruise Terminal Improvement at the Port of Long Beach (Atkins, Inc., August 16, 2018) and project specific geotechnical report (Leighton, December 10, 2018). A review of these documents indicate clearly that the proposed excavation activities for this project will not impact previously undisturbed and paleontologically sensitive sedimentary deposits. Paleontological resources (i.e., fossils) are preserved in layered sedimentary rocks that accumulated in ancient depositional settings. Although potentially fossil-bearing sedimentary rocks of Pleistocene age do underlie the off shore project at depth, these older sediments are buried beneath 18 or more feet of Holocene bay deposits in the off shore areas. This thickness of modern bay deposits is much greater than the maximum depth of the proposed dredging depth (~7 feet). Additionally, the foundation piles will be directly driven into the earth; therefore, sediments from this work will not be observable. The entirety onshore portion of the project is constructed upon approximately 55 to 65 feet of artificial fill.

In summary, because of the thickness of Holocene bay deposits, the onshore facilities reside on a thick package of artificial fill, and the piles will be directly driven into the earth, it is unlikely that construction activities at the project site will produce any direct impacts to paleontological resources. Consequently,

it is my opinion that a paleontological resource mitigation program is unnecessary for the proposed improvements for the Long Beach Cruise Terminal Improvement at the Port of Long Beach project.

If you have any questions, please feel free to contact me at 619.255.0346 or rhubscher@sdnhm.org.

Sincerely,

Paleontological Field Manager
Department of PaleoServices