APPENDIX E

Geotechnical Investigation Report

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GEOTECHNICAL INVESTIGATION REPORT
BALLONA WETLANDS RESTORATION PROJECT
MARINA DEL REY AREA
LOS ANGELES COUNTY, CALIFORNIA

Prepared for:

Santa Monica Bay Restoration Commission
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Pereira Annex MS:8160
Los Angeles, California, 90045

Prepared by

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GDC Project No. LA-962A
July 1, 2013

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DELTA
CONSULTANTS

Geotechnical Engineering

Geology

HydroGeology

Earthquake Engineering

Materials Testing & Inspection

Forensic Services

July 1, 2013 LA-962A

Santa Monica Bay Restoration Commission
1 LMU Drive, North Hall
Pereira Annex MS:8160
Los Angeles, California, 90045

Attention: Ms. Diana Hurlbert
Restoration Project Coordinator

Subject: Geotechnical Investigation Report
Ballona Wetlands Restoration Project
Marina Del Rey Area
Los Angeles County, California

Dear Ms. Diana Hurlbert:

Group Delta Consultants, Inc. is pleased to submit this Geotechnical Report for the Ballona Wetlands Restoration Project. This report summarizes the results of our geotechnical investigation, laboratory testing and engineering analyses for the project and provides geotechnical recommendations for the proposed earthwork and construction.

We appreciate the opportunity to provide geotechnical services for this significant project. If you have any questions pertaining to this report, or if we can be of further service, please do not hesitate to contact us.

Very truly yours,
Group Delta Consultants, Inc

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GEOTECHNICAL INVESTIGATION REPORT
BALLONA WETLANDS RESTORATION PROJECT
MARINA DEL REY AREA
LOS ANGELES COUNTY, CALIFORNIA

EXECUTIVE SUMMARY

This report presents the results of our geotechnical investigation performed in support of the restoration of the Ballona Wetland under the conditions of a United States Army Corps of Engineers (USACE) 408 permit. The proposed restoration would restore estuarine wetland and upland habitats that are connected to a realigned Ballona Creek. The project area is shown in Figures 1 and 2 (Areas A, B and C).

The project site encompasses about 600 acres between Marina Del Rey to the north and Playa Del Rey to the south. Key elements of the restoration are described in the Preliminary Design Report (PDR; ESA PWA, 2013a) for the project, and include:

Ballona Creek Channel Restoration

- Removal of the existing north and south levees in four locations, and the realignment of the channel for the creation of a natural meandering channel. This requires backfilling a portion of the existing channel
- Armoring against current induced erosion at locations of potential high creek flow velocities.

Area A

- Mass excavation to reclaim wetlands lost when the area was hydraulically filled during the development of Marina Del Rey. The excavation will slope down to the south from Fiji Way at a gradient of about 10 horizontal to 1 vertical or flatter, to a maximum depth of about 20 to 25 feet in the area of the existing channel. The excavation will remove primarily hydraulic fill soils.
- Construction of flood protection levees along the west, north and east perimeter of Area A. The levees will generally extend about 5 to 10 feet above the existing grade.

Area B

- Construction of flood protection levees along the north side of Culver Boulevard and east of the dunes in West Area B. The levees will generally extend up to a maximum of about 15 feet above existing grade.
- Full restoration of wetlands between the new levees and the realigned Ballona Channel and managed restoration of the wetlands area located south of the new levees.

- The area between Culver and Jefferson Boulevards will be used as a balance site, where excess cut material will be placed and compacted, resulting in uplands habitat.

Area C

- North Area C, located north of Culver Boulevard, will also be used as a balance site where excess cut material will be placed and compacted with primarily uplands habitat created.
- South Area C will be graded with uplands and will be the site for the construction of a planned complimentary service facility to the Wetlands Restoration Project.

Other Elements

- Construction of a pedestrian/bicycle bridge spanning the Ballona Channel near the existing Culver Boulevard Bridge, and an at-grade bicycle path along the new levee in Area B.
- Construction of buried culverts in Area B, extending under Culver Boulevard.

Group Delta Consultants (GDC) conducted a geotechnical subsurface investigation for the project during September/October 2012. The investigation included a total of 25 rotary wash borings, 31 cone penetration tests (CPT), 8 hollow stem auger borings and 1 hand auger boring. In addition, 10 borings were performed for obtaining samples for chemical, environmental and erosion testing. Explorations were advanced to a maximum depth of 71.5 feet. Shear Wave Velocity measurements were performed in 7 of the CPTs. Four field permeability tests were performed to evaluate the permeability of the soils in the area where the Ballona Channel will be breached. The findings from the GDC investigation were supplemented by data from previous geotechnical and environmental investigations conducted within the project areas to characterize the soil properties (Law Crandall, 1988, 1991; Diaz Yourman & Associates, 2010; and Weston Solutions, 2009).

Based on our findings and analyses, it is our opinion that the project is feasible from a geotechnical standpoint and can be successfully accomplished as planned, following the recommendations addressed in this report. The major geotechnical factors affecting the project are briefly discussed below.

The stability analyses performed indicate that the new levees planned will be stable and meet or exceed the minimum factor of safety required under static, seismic and rapid drawdown conditions. Where a new levee ties into an existing levee, the existing levee will experience additional loading and settlement that can cause cracking of the existing levee. Therefore, it is recommended that mitigation measures, such as deep soil mixing, be performed at and adjacent to tie-in locations to improve the stability of the existing levees that will remain in Areas A and B. In

Area C, the restoration project will not alter or impose any new loads on the existing levees. It is recommended that any surcharge loads planned in Area C should be setback a minimum of 70 feet away from the top of the channel slope.

The soils that will be excavated in Area A were found to be loose/soft and have high moisture contents, generally ranging about 5% to 35% above the optimum. Therefore, the use of heavy scrapers and dozers is expected to be limited. The excavation must be carefully planned and conducted to avoid overstressing the soils and/or bogging down equipment. The need for excavators, support mats, moving haul roads, low ground pressure equipment and dredging should be considered in planning how to accomplish the excavation. The need to control the ground water should also be anticipated during excavation. Because of the high moisture content in the excavated soils, it will be necessary to dry the excavated soils prior to placement, which will require spreading and turning/disking.

The soils excavated from Area A will also undergo significant volume reduction when compacted for the levee construction. This loss of volume is estimated to range up to 20 to 30 percent. Additional soil “loss” will also occur as the soft soils below the new levees settle under the embankment load.

Prior to placement of compacted fill for the new levees, the subgrade soils along the levee alignments should be excavated and recompacted to a minimum depth 4 feet under the levee “core.” The levee “core” is defined as the zone of the levee within 3 to 1 slopes extending down from the edges of the levee crest. Beyond the core, the removal should extend to a depth of 2 feet for a minimum equipment width, as shown in Appendix I (Plates I-2 through I-4). Outside the removal zones, vegetation should be stripped.

The actual limits for removals should be determined by the project geotechnical engineer during construction, based on the conditions exposed. Deeper removals under the levee core will be needed if unsuitable soils are present. In particular, deeper removals should be planned where the levee crosses the existing drainage channels in West Area B. Deeper excavation should also be planned to remove buried organics in the area of a celery dump known to have been present in northeast Area A. The location and limits of the celery dump will be determined during grading operations.

If permeable sand layers are exposed that could provide a path for seepage under the new levee core. It will be necessary to overexcavate and replace such layers to the limits determined by the project geotechnical engineer during grading. In particular, shallow sand layers may extend below the alignment of the levee planned in West Area B, because of the proximity of the natural dunes.

If wet and/or soft soils are exposed in the excavation made for removals, the excavation will need to be performed using an excavator or low ground pressure equipment. In addition, geogrid (Tensar BX 1200 or equivalent) may be needed to stabilize the exposed bottom and provide a firm working surface before the new fill can be placed.

In general, the hydraulic fill in Area A is a fine-grained silty to clayey loose/soft soil with a high moisture content, and the near surface native soils and fill in area B are moderately soft to soft with a high moisture content and a shallow ground water table. Temporary excavations should be planned at a maximum inclination of 1-1/2 (horizontal) to 1 (vertical).

The subgrade conditions along the new levees generally consist of moderately soft to soft fine-grained silts and clays that are weak and compressible. Therefore, the selection and operation of equipment and the placement of compacted fill for levees should be planned and controlled to avoid overstressing these soils. The fill should be advanced uniformly without creating unbalanced loads. The rate of fill placement should also be controlled to allow the soft soils to consolidate and gain strength. Increasing the height of the fill slowly, at about 5 feet per month, will also provide time for settlement to occur and mitigate the potential for differential settlement to create cracks in the embankment. Recommendations for monitoring the fill settlement are discussed in Section 15.8.

The new levee in West Area B will cross two existing drainage channels (Refer to Figure 4A). Both of these channels range from 5 to 8 feet in depth and are expected to contain soft sediment. The easternmost of these channels crosses perpendicular to the levee alignment. The westernmost channel extends under the length of the planned levee at the west end of Area B. It should be anticipated that there is the possibility that other old channels may also be present in the area, and may have been filled in. All soft and sandy material should be removed and replaced with compacted fill. The excavation for these removals will extend below ground water and, dewatering will be required to accomplish the removals and backfilling. Shoring or cofferdams are anticipated to be needed. The exposed bottom should be stabilized with geogrid before placing backfill.

The new levees will range from about 5 to 10 feet high in Area A to a maximum of 15 feet high in Area B. The levee fill will cause compression of the underlying native silts and clays and any remaining hydraulic fill, resulting in settlement on the order of 1 to 2 inches for every foot of fill placed. Therefore, the maximum settlement is expected to range from about 10 inches to on the order of 2.5 feet. It is anticipated that 90 percent of the consolidation settlement will essentially be complete within three to six months of fill placement. Settlement plates should be installed to monitor the rate of settlement to confirm when primary compression is complete, as well as to control the rate of fill loading. Capping of the levee core should be planned as the last step of grading, after settlements are complete.

New culverts should not be installed until 90% of the primary consolidation is completed. Culvert locations could be surcharged in advance of placement of the levee embankment to avoid a delay in their installation. A temporary culvert pipe can be installed before placing the fill. Once the settlement is completed, the temporary pipe can be excavated, removed and the permanent culvert installed and backfilled.

The proposed pedestrian and bicycle bridge can be supported on piles installed into the dense sand and gravel bearing layer that underlies the site at a depth of about 50 to 60 feet.

1.0 INTRODUCTION

This report presents the results of our geotechnical investigation conducted in support for the restoration of the Ballona Wetland under the conditions of a United States Army Corps of Engineers (USACE) 408 permit. The proposed restoration would restore estuarine wetland and upland habitats that are connected to a realigned Ballona Creek.

The project site is shown on the Vicinity Map in Figure 1 and is comprised of approximately 600 acres, between Marina Del Rey (to the north) and Playa Del Rey (to the south), and from about 2,000 feet east of the Pacific Ocean to about 10,500 feet farther upstream along Ballona Creek. The project is divided into three primary Areas: Areas A, B and C. Area A is located north of Ballona Creek and west of Lincoln Boulevard. Area B is located south of Ballona Creek, and Area C is located north of Ballona Creek and east of Lincoln Boulevard.

The Ballona Wetlands Restoration Project (Project) involves the expansion and enhancement of wetlands adjacent to lower Ballona Creek, and associated site modifications necessary to avoid adverse effects to the surrounding property and interests. The Project includes removing the existing flood control levees, constructing new flood protection levees around the perimeter of Area A and along the north side of Culver Boulevard in Area B, upland of the restored wetlands; constructing a new creek meander channel; mass excavating of soil from Area A to remove previously placed dredged fill; full restoration of wetlands between the new levees and the realigned Ballona Channel; and placement of excess cut material as compacted fill in North Area C and in Area B between Culver and Jefferson Boulevards. The project also includes the construction of a pedestrian and bicycle bridge spanning Ballona Creek near the Culver Boulevard Bridge; an at-grade bicycle path along the new Area B levee; and, the construction of culverts to provide drainage of south Area B (ESA PWA, 2013a).

2.0 PURPOSES AND SCOPE OF WORK

The purposes of this investigation were to investigate the subsurface conditions within the project site by performing field explorations; characterize the soil conditions; identify the geotechnical factors impacting the project; geotechnical analyses to evaluate the feasibility of the project from a geotechnical standpoint, and development of recommendations for design and construction, including earthwork, construction of levees, the pedestrian bridge and culverts.

Our scope of work for the Project includes the following:

- Performing a site reconnaissance and developing a Geotechnical Work Plan for the planning and executing the field investigation, depicting the proposed exploratory boring locations and access routes for review and approval by the appropriate agencies. The Geotechnical Work Plan was also used to obtain permits from the California Department of Fish and Wildlife, USACE and the California Coastal Commission.

- Review of available published geotechnical and geologic maps and reports pertaining to the project area, including previous geotechnical and environmental reports for the property.
- Conducting a field investigation including drilling 25 rotary wash borings, 8 hollow stem borings, and 31 Cone Penetrations tests (CPT), performing shear wave velocity measurements at seven locations using specially equipped CPTs, and conducting four field permeability tests. In addition, 10 borings were performed to obtain representative samples for chemical, biological and erosion testing, performed and analyzed by others.
- Performing geotechnical laboratory testing on selected representative samples to evaluate their physical properties and engineering characteristics. Collected samples for chemical testing, and sediment analysis were sent to outside laboratories for testing, as directed by the project environmental consultant.
- Performing engineering analyses of the field and laboratory data to develop geotechnical recommendations for the design and development of the wetland restoration project. This included performing stability analyses of the proposed levees under static, seismic and rapid drawdown conditions and development of recommendations concerning excavation; levee design and construction; stripping/clearing, excavation; dewatering; removals; placement of fill; anticipated settlements; foundation support of the pedestrian bridge and culverts and recommendations to address constructing options, phasing, monitoring and logistics.
- Attending and participating in project meetings, telephone calls, and reviews, as requested.
- Preparation of this Geotechnical Investigation Report.

3.0 HISTORICAL BACKGROUND

3.1 Historical Land Use

The following information was taken from a report by the U.S. Environmental Protection Agency (USEPA), titled "*Ballona Creek Wetlands, Total Maximum Loads for Sedimentation and Invasive Exotic Vegetation*" (USEPA, 2012). Table 1 summarizes some of the anthropogenic activities perform at Ballona Wetlands since the early 1900s until 1960s.

During the late 1800's the Ballona Wetlands were used by several hunting lodges and resorts for recreation. Rail lines were constructed through the marsh in the 1880's and roadways were built between 1900 and 1910. Oil and gas exploration and production began in the 1930's and in 1934 Ballona Creek was channelized to the ocean. The channelization of Ballona Creek (See aerial photos in Appendix C) caused flow to the wetlands and lagoons to be limited, and caused them to dry (USEPA, 2012).

Between the 1930's and 1950's, oil derricks were built throughout the wetland areas including the construction of dikes, which caused the wetlands to be drained or artificial ponds to develop. The Marina Del Rey development in the late 1950's removed a large portion of the remaining wetlands, when hydraulic fill was placed in Area A. As a result, the wetlands shrank to less than 200 acres, about 10 percent of the original area (USEPA, 2012).

The precise limits of Ballona Creek Wetlands are complex. Until about 2004, only the undeveloped Area B (south of Ballona Creek and north of Culver Boulevard) was identified as the Ballona Creek Wetlands. The construction of tide gates between the late 1990s to early 2000s restored some tidal flushing to the central portion of Area B. In 2001, the State of California retained Area C (north of Ballona Creek and east of Lincoln Boulevard) as part of a tax settlement. The Freshwater Marsh was completed in 2008 (south of Jefferson Boulevard and west of Lincoln Boulevard), where storm water runoff from the Playa Vista development and Jefferson Drain is discharged (USEPA, 2012).

Table 1: Anthropogenic Activities at Ballona Wetlands since the 1880's

Time period	Anthropogenic Activity	Impact
1880's to Early 1900s	Pacific Electric railroad tracks built on artificial fill earthen berms altered tidal flows in areas A, B and C	Sediment deposition; habitat alteration; reduced tidal flushing
1918	Lincoln and Jefferson Blvds. were constructed. Surface flows from eastern portions of wetlands were routed into culverts under Culver Blvd. in area B	Sediment movement; habitat alteration; reduced and/or restricted freshwater flows
1920s	Artificial fill was dumped in several places to construct oil and gas drilling platforms and protect them from extreme tides, and to build on artificial fill berms for access roads for the platforms; The Gas Company Rd. in Area B especially restricts flows from the east, and platforms and access roads in Area A created depressions where water continues to pond sporadically	Sediment deposition; habitat alteration; reduced tidal flushing and/or restricted freshwater flows
1930-1958	Farming of lima beans and barley in Areas B (east of The Gas Company Rd.) and C resulted in filling of many natural tidal channels	Sediment deposition and transport; habitat burial
1930s	Ballona Creek was straightened and channelized in concrete levees by the USACE; culverts with flap gates allowed drainage from Area B but prevented tidal inflows (except when gates malfunctioned)	Sediment deposition; habitat alteration; reduced and/or restricted freshwater flows and tidal flushing
1950s-60s	Centinela Ditch was excavated through Area B before 1950. The ditch directed freshwater flows from east of Lincoln Blvd. along the south border of the wetlands area. In 1962, Centinela Creek was fully channelized in concrete and diverted to Ballona Creek channel at Centinela Ave, at the then-eastward extent of the remaining wetlands.	Sediment deposition and removal; reduced and/or restricted freshwater flows
1960s	The southwest portion of the extant wetlands in 1960 was dredged to create Marina Del Rey marina. The dredged mud was deposited on what is now Area A, and raised the land surface 12 – 15 feet above previous mean sea level.	Sediment deposition; reduced tidal flushing

Excerpt from, *U. S. Environmental Protection Agency, 2012, Ballona Creek Wetlands, Total Maximum Loads for Sedimentation and Invasive Exotic Vegetation*

3.2 Historical Aerial Photos

Historical aerial photos from the UCLA Spence oblique aerial photo collection and other photos available on line at HistoricAerials.com (http://www.historicaerials.com) were reviewed to identify changes that occurred a within the project site from 1924 to 2005.

The Spence oblique aerial collection includes photographs taken from 1924 to 1938, which span the period before and after the construction of the Ballona Creek levees. Copies of some of these photographs are included in Appendix C. In the 1924 and 1928 photos, parcels to the east of the wetlands were being farmed. Ballona Creek had meandering channels throughout its central portion and Centinela Creek was flowing along the north edge of the El Segundo Sand Hills. At that time, water from both creeks was blocked by the coastal sand dunes and flowed to the north through the sand dune complex, then west to the coastal waters near the El Segundo Sand Hills.

The1933 Spence aerial photos show widespread farming parcels located through the Ballona Gap, with a moderate density of oil wells along the coast. Ballona Creek flowed west to the sand dune hills along the coast while the Centinela Creek flowed north along the toe area of the Westchester Cliffs to the west. In 1937, the photos show the Ballona Creek channel has concrete levee slopes east of Lincoln Boulevard with rip rap levees to the west. They show that when the channel was excavated, most of the excavated soils was placed on the north side and lesser amounts placed on the south side of the channel, as hydraulic fill for the levee. Construction of the levee system core was built up using the excavated soils. The 1938 photos indicate an increase of oil well density along the coast and inland to the east, with farm parcels increasing to the north.

The HistoricalAerials.com collection included aerial photos from the years 1952, 1972, 1980 and 2003 – 2005. The 1952 photo shows that the Marina Del Rey Harbor channel was not yet dredged and farm parcels were scattered within the Ballona Wetland area, and were more abundant to the north. The 1972 and 1980 photos show the Marina Del Rey Harbor channel as dredged with the dredged hydraulic fill placed across Area A and part of Area C. The old Howard Hughes Airport is visible east of Lincoln Boulevard and south of Jefferson Boulevard. The 1972 and 1980 photos show that to the north, the majority of the farming was gone and was replaced with residential and commercial buildings. By this time most of the farmland had been developed to the north. The 2003 – 2005 aerial photos show the airport as abandoned and the Playa Vista development under construction.

4.0 SITE DESCRIPTION

The Ballona Wetlands Restoration Project area consists of over 600 acres and is located in the northwest corner of the Los Angeles Basin, just south of Marina Del Rey. The project is divided into three primary Areas: Areas A, B and C, as shown in Figure 2. Area A is located north of Ballona Creek and west of Lincoln Boulevard. Area B is located south of Ballona Creek, and Area C is located north of Ballona Creek and east of Lincoln Boulevard. A brief description of each of the areas is provided in the USEPA (2012) report, as is summarized below.

4.1 Area A

Area A is approximately 139 acres in size and lies north of Ballona Creek, west of Lincoln Boulevard and south of Fiji Way (Figure 2). Elevations range between approximately 12 and 20 feet NAVD, with the higher ground located near Fiji Way. The original grade generally ranged from Elevation +2 to +10 feet NAVD. Fill was placed in Area A during the excavation of Ballona Creek in the early 1930's and in the 1960's when dredged soils from the development of Marina Del Rey were placed on the site. Area A is generally undeveloped, with the exception of a parking area along the western boundary and an unlined drainage channel located along Fiji Way located along the northern boundary in the eastern portion of the area (Fiji ditch). The Gas Company also currently maintains five monitoring well pad sites in the western end of this area (USEPA, 2012).

4.2 Area B

Area B is approximately 338 acres in size and lies south of Ballona Creek and west of Lincoln Boulevard. Area B extends south to Cabora Drive, a utility access road located near the base of the Playa Del Rey Bluffs (Figure 2). To the west, Area B extends into the natural sand dunes that border homes along Vista Del Mar. Elevations across Area B typically range between approximately +5 and +8 feet NAVD in the lower flat portions, and slopes up to about 50 feet NAVD below the Del Rey Bluffs, south of Culver Boulevard. Area B contains the largest area of remnant unfilled wetlands with abandoned agricultural lands to the southwest and the existing Freshwater Marsh to the northeast. The Gas Company has easements in Area B for 12 well sites (1 injection/withdrawal well and 11 monitoring wells) and a system of access roads (USEPA, 2012).

4.3 Area C

Area C is located north of Ballona Creek and east of Lincoln Boulevard (Figure 2). The Marina Freeway forms the northeastern border of Area C. The area is approximately 64 acres in size and is traversed in an east-west direction by Culver Boulevard. North Area C lies north of Culver and south Area C lies to the south. Area C contains fill from the construction of the Ballona Creek channel, and fill generated from developments such as Marina Del Rey, the Pacific Electric Railroad, the raising of Culver Boulevard and the Marina Freeway. Elevations within Area C range from approximately +7 to +28 feet NAVD. Area C is mostly undeveloped with the exception of 4 baseball fields and supporting minor structures, located in the west portion of south Area C. The Gas Company has no facilities in Area C (USEPA, 2012).

5.0 DESCRIPTION OF PROJECT

The proposed restoration would restore estuarine wetland and upland habitats that are connected to a realigned Ballona Creek. The construction will be performed in phases.

1) Phase 1 involves excavation in Area A and construction of new levees around the enhanced wetland areas in Areas A and B.
2) Phase 2 involves excavation of a new meander channel for Ballona Creek; breaching and removing the existing Ballona Creek levees and filling in Ballona Creek between breach points; and, increasing muted tidal action in South Area B by constructing new culverts.
3) Phase 3 involves restoring tidal action to West Area B by lowering and breaching the intermediate Ballona Creek levee placed during phase1 in the eastern portion of West Area B.

Key Elements of the Restoration:

Key elements of the restoration project are described in the PDR (ESA PWA, 2013a), and include:

Ballona Creek Channel Restoration

- Removal of the existing levees downstream of the Culver Boulevard Bridge for a length of about 4,000 feet along the existing north levee and about 6,000 feet along the existing south levee, and the lowering and realignment of the channel for the creation of a natural meandering channel.

Area A

- Mass excavation to reclaim wetlands lost when the area was hydraulically filled during the development of Marian Del Rey. The excavation will slope down to the south from Fiji Way at a gradient of about 10 horizontal to 1 vertical to approximate elevation of 11 feet, and then at flatter gradients of about 100H:1V (horizontal to vertical) to a maximum depth of about 20 to 25 feet below the existing grade near the existing channel. The excavation will remove primarily hydraulic fill soils.

- Construction of flood protection levees along the west, north and east perimeter of Area A. The levees will generally extend about 5 to 10 feet above the existing grade in Area A.

Area B

- Construction of flood protection levees along the north side of Culver Boulevard in north and west Area B and east of the dunes in West Area B. The levees will generally extent up to a maximum of about 15 feet above existing grade.
- Full restoration of wetlands between the new levees and the realigned Ballona Channel and managed restoration of the wetlands area located south of the new levees.
- The area between Culver and Jefferson Boulevards will be used as a balance site, where excess cut material will be placed and compacted.

Area C

- North Area C, located north of Culver Boulevard, will also be used as a balance site where excess cut material will be placed and compacted.
- South Area C may be graded and developed by others as a complimentary service facility to the Wetlands Restoration Project.

Other Elements

- Construction of a pedestrian and bicycle bridge spanning the Ballona Channel near the Culver Boulevard Bridge, and an at-grade bicycle path along the new levee in Area B.
- Construction of buried culverts.

5.1 New Perimeter Levees

New engineered flood control levees will be built along the north, west and east perimeter of Area A and in Area B, north of Culver Boulevard and east of the dunes in West Area B. The proposed levees will be designed to meet or exceed the current flood control standards. The hydraulic analysis has been performed for hydraulic modeling for a number of flood events, including the project 100-year design flow, and future sea level rise (SLR), as included in the Preliminary Hydrology and Hydraulics Report of the project (ESA PWA, 2013b). The SLR is considered to be approximately 4.9 feet by 2100. The locations of the new levees are shown on Figure 4A.

At the preliminary design level, the perimeter levees have been designed with a constant levee crest of El. 20.5 feet NAVD. With this design elevation, the minimum freeboard considering SLR along the new levees will be about 4 feet (i.e. 3.81 feet). In general, all levees will include a compacted low permeability core with 3H:1V side slopes. However, the actual levee slopes are significantly flatter with creek side slopes as flat as 10H:1V.

5.1.1 Area A Levee

The proposed levee is planned to follow the perimeter of Area A with a minimum of about 30 feet offset from Fiji Way and Lincoln Boulevard. and placed just south of Fiji Channel (Figure 4A). The proposed levee will be offset to maintain the existing parking lots along Fiji Way and to avoid existing natural gas monitoring well, Del Rey 17. The levee will tie into the existing Ballona Creek levee at Culver Boulevard, at the upstream limit of the marsh restoration area.

The levee incorporates an idealized 6H:1V protected side slope and a 10H:1V channel side slope from El. 20.5 feet at the crest down to El. 11.0 feet. This levee is generally located 800 to 1,200 feet from the realigned Ballona Creek Channel.

5.1.2 Culver Levee in Area B

The Culver levee in Area B includes three distinct design sections.

1) The first section includes a wide plateau at the upstream limit between Culver Boulevard and the old railroad alignment. This wide section is intended to vary the widening of the restored Ballona Creek floodplain to help even out the hydraulic drop of flood levels as flood flows enter the Wetland Restoration Project Site.
2) A narrow section (20 feet top width) along Culver Boulevard, extending to the intersection with Jefferson Boulevard.
3) A wide section (100 feet top width) along Culver Boulevard, from Jefferson Boulevard, to West Area B.

The culver levee sections are planned with a minimum 30 foot offset from Culver Boulevard, and will be built with 3H:1V protected outside side slopes, and 10H:1V interior slopes down to El. +6.5 feet NAVD, with a flatter transitional slope to the adjacent tidal marsh plain.

5.1.3 West Area B Levee

The proposed West Area B Levee (Figure 4A) will be located about 300 feet east of the toe of the natural dunes that border the west end of West Area B. The levee will have a top width of 20 feet, a 3H:1V slope toward the existing dunes to the west and a 10H:1V slope down to the existing managed marsh to the east.

5.1.4 Temporary Area B Levee

The project will be phased will full restoration of West Area B delayed for a number of years until the restoration in Area A and North Area B demonstrates success. During this interim period, a temporary levee will connect the Culver Levee to the existing Ballona Creek South Levee just north of the existing natural gas monitoring well cluster in West Area B. The location of this levee is shown in Figure 4A.The temporary levee will be constructed with 5H:1V side slopes on the channel side, and a 3H:1V slope on the protected side.

5.2 Excavation and Channel Realignment

The reintroduction and revival of critical wetland habitat, involves mass grading, soil excavation and hauling of previously placed dredged materials to lower the grades in Area A to create tidal wetlands, salt pans, transitional habitat, upland habitat and seasonal wetlands.

Realignment of Ballona Creek will entail construction of new meander channel segments and filling of the existing channel segment that will be abandoned. A fully-connected Ballona Creek channel and wetland system will be restored across the site, beginning west of the Culver Bridge and extending through the site to the southwest (downstream) project boundary. The channel banks would be graded to slopes of approximately 5H:1V.

5.3 Stockpiles in Area B and Area C

The intent of the project is to balance earthwork on site. Excess excavated soils will be placed as stockpile fill in portions of Areas B and North Area C. The fill mounds in East Area B will be located in the area south of Culver Boulevard and North of Jefferson Boulevard Fill mounds will be offset from the streets to avoid significant settlements in roadways or utility lines, and will be sloped at a gradient of 10H:1V. The height of the fill mounds will be depend on the amount of excess soils.

5.4 Hydraulic Structures (Culverts)

Two new water control structures will be installed in Area B at the locations shown on Plate I-1. Both culverts will extend under the new Culver Levee and under Culver Boulevard.

5.5 Public Access Plan

A public access plan is being developed to maintain existing uses and provide additional access opportunities. Anticipated elements include a pedestrian bridge west of the Culver Boulevard Bridge, and parking and access at the southwest corner of Area B, where existing parking and trails are heavily used.

It should be noted that the Annenberg Foundation currently has plans for development in portions of Area C. Additional public access to other areas within the Wetlands may be created as part of these planned developments.

6.0 SUMMARY OF PREVIOUS INVESTIGATIONS

Several geotechnical investigations have previously been performed at the Project Site by Law Crandall Inc., Diaz Yourman & Associates, and Weston Solutions (Law Crandall, 1988, 1991; Diaz Yourman & Associates, 2010; and Weston Solutions, 2009). The previous investigations by Law Crandall, Inc. and Diaz Yourman & Associates were performed primarily for geotechnical purposes. Law Crandall, Inc. performed preliminary geotechnical investigations in each of the Areas within the project (Areas A, B and C) and presented the results of investigations in separate reports. Diaz Yourman & Associates performed a preliminary geotechnical investigation for Areas B and C. The investigations by Weston Solutions, Inc. were performed primarily for the chemistry and environmental testing of the soils present.

Data from these previous investigations was reviewed and used to supplement the information developed during the current investigation. However, in general, the previous investigations were performed to primarily characterize the physical properties, and limited data is provided regarding the engineering properties of the soils encountered. A summary of each of the previous investigations is provided below. The locations of the field explorations performed during these previous investigations are shown in Figure 3. Boring logs and CPT interpretations of previous investigations are included in Appendix A2. Selected results of the previous laboratory testing are presented in Appendix B2

GDC also has long-term experience with similar soils present within the Playa Vista Development, located east of Lincoln Boulevard. The experience at the Playa Vista Development was used in characterizing the engineering properties of the soils at this site.

6.1 Area A

Law Crandall, Inc. - 1991 Area A –Playa Vista Marina

This report presents the results of a preliminary geotechnical investigation of Area A for a then-proposed Playa Vista Marina, which included excavation to about Elevation -15 feet. Law Crandall, Inc. had done an earlier study to determine the location of an existing natural gas storage reservoir and the effect of the reservoir on the marina construction. In this study they investigated the physical characteristics of the soils to provide recommendations for perimeter wall lateral earth pressures, and foundation support.

The field investigation included 20 borings (14 Rotary Wash and 6 Bucket-type borings) and 5 cone penetration tests (CPT) that were performed in December 1988 and January 1989.

According to this report, fill soils were encountered to 9 to 17 feet below ground surface, and consisted primarily of silts, clays and silty sands. The majority of the fill was placed hydraulically during dredging of the Marina Del Rey Harbor although some dump fill was also apparent to be present. Beneath the fill, the site is underlain by Holocene Alluvium extending to an estimated depth of 100 feet below ground surface. The alluvial deposits are predominantly cohesive soils to depths of about 50 to 70 feet and are underlain by dense sand and gravel. The upper cohesive soils consist of soft to medium stiff silts and clays with some layers of loose to dense silty sand and sand and occasional minor layers of peat. The alluvial deposits are of estuarine origin and contain decomposing organic materials, which generate the organic odor (hydrogen sulfide). The dense sands and gravel deposits were encountered at depths between 48 and 67 feet. These coarser sediments were described by Poland (1959) as the “50-foot-Gravel” a ground water aquifer.

Early Pleistocene San Pedro Formation sediments underlie the Holocene deposits. The sediments consist primarily of sand with some gravel, with some interbeds of silt. This layer extends to a depth of about 200 feet below ground surface. Below the Pleistocene soils underlies 5,800 feet of Tertiary age sedimentary rocks, which rest on metamorphic basement rocks of the Mesozoic Catalina Schist.

Groundwater was encountered in the borings at depths about 7 to 15 feet below ground surface corresponding to elevations of about +0 to +10 NAVD. The site was identified as potentially liquefiable. Liquefaction settlements on the order of 1 to 4 inches were indicated to be anticipated in looser interbedded sandy layers.

According to the report some peat deposits were encountered, but the peat deposits were below the ground water level and thus not subject to oxidation and drying. Collapsible soils were not encountered.

Law Crandall, Inc. - 1991 Area A – Playa Vista Marina – Supplemental Report

This report provides supplementary information for the 1991 Marina Report. According to this report a review of Los Angeles County Waste Management records revealed the presence of a former dump site, known as the *Celery Dump*, in the northeast portion of Area A that could affect ground water quality. The celery dump was apparently operated between 1945 and 1953. Two borings were drilled to depths of 17 and 22 feet to collect ground water samples for laboratory analyses and to explore for organic materials that might be present from the former celery dump. Two additional shallow borings were also drilled to further explore the organic materials. Ground water was encountered at a depth of 14 to 17 feet.

The results of the environmental testing showed higher lead concentrations that were deemed acceptable for disposing of the ground water into the ocean. According to the report settlement due to placement of the fill in the area was estimated to be about 2 inches per foot of fill placed.

Weston Solutions, 2009 – Area A – Preliminary Geotechnical Investigation and Beneficial Use Assessment – for Port of Los Angeles

A total of five alternatives were assessed for the Restoration Project in Area A. The objectives of this preliminary Area A study were to identify the geotechnical, chemical, and physical characteristics of the soil and existing dredged material, determine the potential used of the dredged material and assess the cost associated with excavation and transporting the material. Chemical and geotechnical testing were performed on the samples collected from 20 direct push borings drilled to a maximum depth of about 24 feet. The geotechnical testing on the samples was limited to physical properties of the soils.

6.2 Area B

Law Crandall, Inc. - 1991 Area B – Proposed Wetland Restoration and Development north of Jefferson Boulevard

The investigation for the Wetland Restoration Project included 32 initial borings including 7 borings in the existing levee, and 5 additional borings to study a proposed embankment near Culver Boulevard in January and February of 1991. Additionally 21 borings were drilled in December of 1986 and April of 1987. Monitoring wells were installed in 12 of the borings to measure the fluctuations in the ground water levels beneath the site. Most of the borings were drilled using 5-inch-diameter rotary wash drilling equipment to a depth of approximately 20 to 60 feet. Six (6) borings were performed using 8-inch-diameter hollow-stem auger equipment to a depth of approximately 30 feet. Additionally, six 8-inch-diameter hand auger borings were drilled to a depth of 5 to 9 feet below the existing grade.

The report identified the artificial fill at the roads as dark reddish-brown sand, silty sand, and sandy silt. According to this report the surface soils near the western boundary are composed of Holocene dune sands. The sand dunes were characterized as poorly cemented, highly susceptible to erosion and at least 30 feet deep.

According to this report settlement due to placement of the fill in the area was estimated to be about 1.5 inches per foot of fill placed. Liquefaction and seismic settlement were anticipated to be limited. The ground water level ranged from about 0.1 to 4.5 feet below the ground surface, corresponding to elevations of +4 to +7.5 feet NAVD.

6.3 Areas B and C

Diaz Yourman & Associates, 2010 Areas B & C – Proposed improvement and restoration of Ballona Creek wetlands

The purpose of this study was to provide subsurface sediment sampling and laboratory testing on the sediment samples to determine the physical and chemical characteristics of sediments located in Areas B & C. Field investigation was performed using hollow-stem auger drilling equipment in February of 2009 and included drilling 13 borings in Area B and 7 boings in Area C to depths ranging from 16 to 32 feet below the existing grade, as well as collecting grab samples at three locations in Area B. Samples were collected for chemistry testing down to elevation -5 feet MLLW and for geotechnical testing down to elevation -10 feet MLLW.

Ground water was encountered in the borings at depths ranging from 2 to 11 feet bgs corresponding to elevations +8 and 2 feet NAVD in Area B, and at depths ranging from 17 to 23 feet bgs corresponding to Elevation +6 and +2 feet NAVD in Area C.

6.4 Area C

Law Crandall, Inc. - 1988 Area C – Report of Contamination Assessment

A study was performed to determine if soil or ground water contamination is present on the subject property. Up to 15 feet of fill were identified in the borings. The "50-foot-Gravel" layer was identified to be present at a depth of 60 feet. This investigation included 16 borings and 5 monitoring wells. The findings of this investigation indicated that no significant soil or ground water contamination is present beneath the site.

Law Crandall, Inc. - 1991 Area C – Proposed Development in Area C

The site conditions were explored by drilling 5 borings to depths of 60 to 75 feet using 5-inch-diameter rotary wash drilling equipment. Fill soils from 4 to 15 feet were encountered in the borings. At depths of about 41 to 57 feet below the existing grade the dense sandy and gravelly layer "50-foot Gravel" was identified.

The report used information from an earlier contamination assessment study at the site, which included 16 borings and 5 monitoring wells. According to the report settlement due to placement of the fill in the area was estimated to be about 1 inch per foot of fill placed. Water was measured in the borings at depths of 12 to 22 feet below the existing grade, corresponding to elevations between +0 to +6 feet NAVD.

7.0 SUBSURFACE EXPLORATION BY GDC

GDC conducted a geotechnical subsurface investigation for the project site from September 11, 2012 to October 22, 2012. Prior to the subsurface investigation, a geotechnical investigation work plan (GDC, 2012) was prepared, which outlined and defined the procedures for obtaining the necessary access and work permits, developing access routes and a plan to avoid special status plants, minimize impact to natural habitat, and/or archaeological sites within the project area. This work plan also describes the drilling equipment, soil sampling (including geotechnical, chemistry, and agronomy sampling), post-investigation site cleanup, and the laboratory testing program (geotechnical, chemical, and agronomy). The geotechnical investigation work plan and procedures were followed prior to, during, and subsequent to the field exploration, to obtain necessary site information for the project while minimizing environmental impact to the project.

The investigation consisted of rotary-wash and hollow-stem auger soil borings, one hand auger boring, and cone penetration tests. Exploration locations were planned approximately every 700 feet along the length of the levees. Typically, two explorations were performed at the crest and the toe of the levee. The exploration locations are shown in Figure 3. Geotechnical drive samples and bulk samples of the encountered materials were obtained from the borings, and tested in the laboratory to evaluate the physical and engineering characteristics of the subsurface materials encountered. In addition to geotechnical sampling, samples for chemical testing, and sediment analysis, were also collected in 10 borings, as directed by the project environmental consultants. Boring logs and CPT interpretations are included in Appendix A1. Geotechnical laboratory test results are included in Appendix B1.

7.1 Soil Borings

Twenty five (25) rotary wash borings were advanced to a maximum depth of 71.5 feet in Areas A and B. The rotary wash borings were located along the proposed levees as well as along the existing Ballona Creek levees. Eight (8) hollow stem auger borings were drilled to a maximum depth of 31.5 feet in planned excavation areas within Area A, and surcharge areas within Areas B and C. One hand auger boring was drilled to a depth of 5 feet in West Area B, where access was limited, due the presence of protected habitat plant. All borings were drilled from approximate elevations ranging from +5 to +21.1 feet NAVD. Subsurface materials were visually logged and classified by a GDC field engineer in accordance with the Unified Soil Classification System (USCS).

Drive samples and bulk samples of the encountered materials were obtained from the borings and recorded on the boring logs. Drive samples were obtained with a California Sampler lined with 1-inch high metal sample rings and a Standard Penetration Test (SPT) sampler. Standard penetration tests (SPT) were conducted in accordance with ASTM D 1586 and samples were collected. Six-inch-long Shelby tubes were also used for sampling relatively undisturbed soil samples in the rotary wash borings.

In addition, representative bulk samples were taken within the upper 5 feet, as well as at depths as deep as 20 feet for compaction testing, expansion potential and corrosion testing, as well as chemistry and agronomy testing.

The boring logs are presented in Appendix A1.

7.2 Cone Penetration Tests (CPT)

Thirty one (31) Cone Penetration Test (CPT) probes were conducted at the site on from September 13, 2012 to October 15, 2012. The CPTs were generally advanced to depths ranging from 48 to 71.5 feet below existing grade. The CPT soundings were performed in general accordance with ASTM D3441, using a truck-mounted electric piezocone penetrometer. The locations of the soundings are shown in Figure 3.

As the CPT probe was advanced, electronic instruments recorded a continuous profile of both the tip and frictional resistances, which were then analyzed using established correlations, to classify the soils and evaluate insitu properties, including density, strength and compressibility. Additional details concerning the field exploration program, including copies of all the boring and CPT logs, are included in Appendix A.

The CPT logs and interpretations are presented in Appendix A1.

7.3 Shear Wave Velocity Measurement using CPTs

Shear Wave Velocity measurements were performed in seven (7) of the CPTs (A-CPT001, A-CPT004, A-CPT022, B-CPT031, B-CPT041, B-CPT048, and C-CPT060) to a depth of 70 feet, using a Seismic CPT. For the test large amplitude shear waves were generated by striking a seismic beam at the ground surface, and recording shear waves at various depths using a seismometer in the cone penetrometer. The seismic CPT test is typically performed at 5-foot intervals. The results of the seismic shear wave velocity measurements are presented in Appendix A1.

The average shear wave velocity in the upper 30 meters (Vs30) was estimated to be 202 m/s (662 feet/s). The shear wave velocity is used in seismic hazard analyses for the project.

Shear Wave Velocity Profiles are included in Appendix D.

7.4 Field Permeability Testing

As part of our field exploration program, four field permeability tests were performed at depths of 5 and 10 feet, at two exploration locations (i.e., A-HSA064 and A-HSA066) near the existing north levee to evaluate the permeability of the near surface soils. The tests were performed by filling hollow stemmed borings with water and estimating permeability of near surface soils using the falling head method, by measuring the drop in water elevation in the hole, over time. The results of the field permeability testing are presented in Appendix E.

7.5 Laboratory Testing Program

The following geotechnical laboratory testing was performed to evaluate the physical properties and engineering characteristics of representative subsurface materials at the site. The tests include:

- Natural moisture content & dry unit weight
- Atterberg Limit Tests
- Percent passing No. 200 sieve
- Grain Size Distribution
- Consolidation
- Direct shear
- Lab Vane shear
- Pocket penetrometer
- Expansion index
- Compaction
- Corrosivity (pH, sulfate, chloride, electrical resistivity)

A detailed description of the GDC geotechnical laboratory testing program and test results are presented in Appendix B1.

8.0 GEOLOGY AND SOIL CONDITIONS

8.1 Regional Geology and Faulting

Regionally, the Ballona Wetlands are located near the western edge of the southwest block of the Los Angeles Basin, within the Peninsular Range Geomorphic Province. To the north, the Peninsular Range Geomorphic Province merges with the Santa Monica Mountains, which is within the Transverse Range Geomorphic Province of California.

The project site is located within the seismically active area of southern California, and has the potential to experience strong ground shaking from local and regional faults. Table 2 provides a summary of the active faults in the site area, which have the potential to general strong ground shaking, within 30 kilometers of the Project Site. A Fault Map showing the major faults in the vicinity of the site is included in Appendix D (Plate D-1).

The closest mapped fault near the site is the Charnock Fault, mapped as being present about 1 mile east of the site. The Charnock Fault has been speculated to be a ground water barrier, a fault or both (Poland, 1959; Geo-Consultants, Inc, 1999). Various investigators concluded that the Charnock Fault was a deep fault and did not break the Pleistocene “50”-foot gravel layer, giving evidence that it is not active. During one of the latest investigations by Davis and Namson Consulting Geologists (2000), and Thomas Wright (1991), using seismic reflection and oil well data, it was concluded that the Charnock Fault was not detected within the depth of the geophysical acquisition and oil well data. Namson and Davis (2000) further suggested that if the Charnock Fault exists below the extent of the seismic reflection acquisition, the fault would likely be 1 to 2 million years old. The mapped location of the Charnock fault is also included in Appendix D (Plate D-2).

Table 2: Major Faults in the Vicinity of the Site

Fault Name	Type of Faulting	Maximum Magnitude (Mw)	Distance from Site (km)	Slip Rate (mm/yr)
Newport-Inglewood	Strike Slip	7.5	7.3	1.0
Santa Monica	Strike Slip	7.3	7.8	2.6
Palos Verdes	Strike Slip	7.7	8.9	3.0
Malibu Coast	Strike Slip	6.7	10.2	0.3
Puente Hills	Thrust	7.0	11.7	0.7
Hollywood	Strike Slip	6.7	12.8	1.0
Elysian Park (Upper)	Reverse	6.7	20.4	1.3
Anacapa-Dume	Reverse	7.2	23.7	3.0
Raymond	Strike Slip	6.8	25.9	1.5
Verdugo	Reverse	6.9	28.0	0.5

Note: USGS Fault Database (2008)

8.2 Historical Earthquakes

Historically, several major earthquakes with a Magnitude of 5.9 to 6.7 have occurred not too far from the Project Site. A brief description of the most recent of these historical earthquakes follows.

8.2.1 Long Beach Earthquake of 1933

The 6.4 magnitude Long Beach earthquake took place on March 10, 1933, causing widespread damage to buildings throughout Southern California. The epicenter was offshore, southeast of Long Beach on the Newport-Inglewood Fault, and approximately 35 miles south east of the site. The estimated ground motion caused at the site was less than 0.1g.

Although only moderate in terms of magnitude, this earthquake caused serious damage to weak masonry structures on land fill from Los Angeles south to Laguna Beach. Property damage was estimated at $40 million, and 115 people were killed. The earthquake was felt almost everywhere in the 10 southern counties of California. Damage to school buildings, which were among the structures most commonly and severely damaged by this earthquake, led to the State Legislature passing the Field Act, which now regulates building-construction practices in California (earthquake.usgs.gov).

8.2.2 San Fernando Earthquake of 1971

The 6.6 magnitude San Fernando earthquake occurred on February 9, 1971, in a sparsely populated area of the San Gabriel Mountains, near the city of San Fernando. It lasted about 60 seconds, and, in that brief span of time, took 65 lives, injured more than 2,000, and caused property damage estimated at $505 million. The epicenter was located about 30 miles north of the site. The Modified Mercalli Intensity (MMI) felt at the site ranged from V to VI (i.e. Moderate to Strong), corresponding to PGA values in the range of 0.04g to 0.18g and Peak Ground Velocity (PGV) of about 3 to 16 cm/sec (www.cisn.org).

8.2.3 Whittier Narrows Earthquake of 1987

The 5.9 magnitude Whittier Narrows earthquake occurred in the southern San Gabriel Valley and surrounding communities of Southern California on October 1, 1987. The epicenter was in the town of Rosemead, about 22 miles east of the site. The earthquake was caused by slip on a blind throughst fault near the northern end of the Whittier Fault, which is part of the Elsinore Fault Zone, on a previously unknown fault structure. There was no surface rupture. The Modified Mercalli Intensity (MMI) felt at the site was V (i.e. Moderate) corresponding to PGA values in the range of 0.04g to 0.09g and Peak Ground Velocity (PGV) of about 3 to 8 cm/sec (www.cisn.org).

8.2.4 Northridge Earthquake of 1994

The Northridge Earthquake occurred on January 17, 1994 in Northridge, California, approximately 20 miles northeast of the site. It was a magnitude 6.7 earthquake and ended up being the most costly earthquake in United States history.

The shaking heavily damaged communities throughout the San Fernando Valley and Simi Valley, and within the surrounding mountains north and west of Los Angeles, causing 20 billion dollars of loss.

Sixty people were killed, more than 7,000 were injured, and more than 40,000 buildings suffered damaged. This earthquake was occurred about 18 miles north of the site. The Modified Mercalli Intensity (MMI) felt at the site ranged from VI to VII (i.e. Strong to Very Strong) corresponding to PGA values in the range of 0.20g to 0.30g and Peak Ground Velocity (PGV) of about 30 cm/sec (www.cisn.org; and earthquake.usgs.gov).

8.3 Local Geology

The Ballona Wetlands are located in the Ballona Gap, which is bounded by the El Segundo Sand Hills to the south and the Ocean Park Plain to the north. The Ballona Gap was formed by erosion, repeated sea level fluctuations, and river channel migration. During the Holocene period, the Los Angeles River channel flowed though the Ballona Gap, while today the Los Angeles River flows through the Dominguez Gap and the Ballona Creek flows though the Ballona Gap.

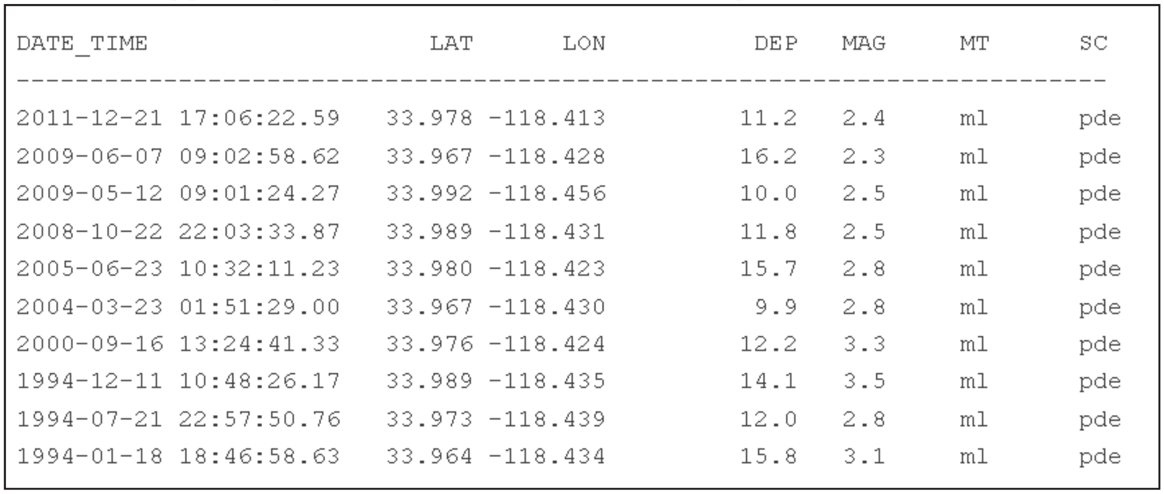
The geologic map of the site is included in Appendix C (Plate C-1). In the Ballona Creek region, marine and non-marine sediments are around 6,000 feet thick and unconformably overlay the crystalline basement rock of the Mesozoic aged Catalina Schist.

During recent historic times, fill has been placed over the natural deposits, locally. The upper 50 feet of sediments consists of Holocene aged fluvial silts, clay and sand deposits from the flooding of creeks and streams, tidal marshes and sand dunes and other windblown deposits that filled the Ballona Valley. These Holocene sediments overlay on top of the “50 foot” gravel in isolated areas and the San Pedro and Pico Formations. Below the San Pedro and Pico Formations, the lower Tertiary formations were found to be rich in petroleum.

8.3.1 Local Site Micro-Seismicity

From 1994 to 2012, 10 micro-earthquakes were recorded near the site area with magnitudes in the range of 2.3 M_L to 3.5 M_L (Local Magnitude) and with epicenters at a depth of 9 to 16 kilometers. These micro-events occurred within a 3-kilometer radius from the approximate center point of the restoration area located at 33.974N and 118.438W. Table 3 summarizes the epicenter data for these 10 events (http://earthquake.usgs.gov/earthquakes/eqarchives/epic/). A map showing the location of the epicenters is included in Appendix D (Plate D-2).

Table 3: Mapped Epicenter for Recent Micro-Earthquakes within 3 km of Site



```
DATE_TIME                    LAT      LON          DEP   MAG     MT      SC
---------------------------------------------------------------------------
2011-12-21 17:06:22.59   33.978 -118.413         11.2   2.4     ml      pde
2009-06-07 09:02:58.62   33.967 -118.428         16.2   2.3     ml      pde
2009-05-12 09:01:24.27   33.992 -118.456         10.0   2.5     ml      pde
2008-10-22 22:03:33.87   33.989 -118.431         11.8   2.5     ml      pde
2005-06-23 10:32:11.23   33.980 -118.423         15.7   2.8     ml      pde
2004-03-23 01:51:29.00   33.967 -118.430          9.9   2.8     ml      pde
2000-09-16 13:24:41.33   33.976 -118.424         12.2   3.3     ml      pde
1994-12-11 10:48:26.17   33.989 -118.435         14.1   3.5     ml      pde
1994-07-21 22:57:50.76   33.973 -118.439         12.0   2.8     ml      pde
1994-01-18 18:46:58.63   33.964 -118.434         15.8   3.1     ml      pde
```

Notes: 1) LAT = latitude; LON = Longitude; DEP = Depth; MAG = Magnitude; MT = Magnirude Type; SC = Source
2) ml = Richter Local Magnitude
3) pde = Preliminary Determination of Epicenters.

It should be noted that none of the reported micro-earthquakes are shallow (minimum depth is 9.9 km) and that the depth and magnitude estimates were generated using seismometers located at relatively large distances from the source. Thus the accuracy of this data, including their location, is approximate. In our opinion, this micro-seismicity does not reveal the presence of shallow (near surface) active faults in the subject area.

8.4 Surface Conditions

8.4.1 Area A

Surface conditions in Area A consist of a somewhat level brushy soil surface. The surface elevation typically ranges from about +12 feet to +20 feet NAVD. The brush found to be low to medium in height with isolated patches of exposed to thinly vegetated soil. Area A is currently fenced off and is undeveloped with the exception of a parking area along the western boundary and a drainage channel along the northern boundary. The existing Ballona Creek levees are located along the southern edge of Area A. An excavated, unlined drainage channel known as the “Fiji Ditch” runs parallel to Fiji Way along the northern boundary in the eastern portion of the area, and drains to the ocean through an existing culvert perpendicular to Fiji Way. The elevations within Fiji Ditch are as low as about El. +4 feet NAVD. In addition, the Gas Company operates five gas monitoring well sites in the western end of the area. In general, the surface soils are dry and loose. Some areas have abundant rodent activity and are difficult to walk over.

8.4.2 Area B

Area B which lies south of Ballona Creek, is undeveloped, and contains the largest area of the existing wetlands with elevations at about +5 feet NAVD. Though some fill is present in this area, most of the fills are limited to Culver Boulevard and Jefferson Boulevard Roads. Area B is divided into four sections: north, south, west and east. The existing Ballona Creek levees are located along the northern edge of Area B (north and west). The Gas Company maintains a gas storage facility beneath the site in the oil field between north Area B and west Area B. South Area B is located south of Jefferson Blvd and East Area B is located south of Culvert Blvd. and west of Lincoln Blvd.

8.4.3 Area C

Area C is located north of Ballona Creek and east of Lincoln Boulevard. The Marina Freeway forms the northeastern border of Area C. The area is approximately 64 acres in size and is divided into a north and south portion by Culver Boulevard.

North Area C is undeveloped and contains low mounds, low to medium-high brush and isolated patches of exposed to thinly vegetated soil. The surface elevation typically ranges from about +14 feet to +17 feet NAVD. The Fiji Ditch runs southeast to northwest through the center of the site. In south Area C, the western portion contains baseball diamonds and associated minor structures, with some trees and grass. The eastern portion is undeveloped. The elevation is typically about +20 to +24 feet NAVD, There is a low area adjacent to the on/off ramps which has an elevation of +9 feet NAVD. The elevation of the levee along the channel ranges from about +19 feet to +22 feet NAVD.

8.5 Subsurface Conditions

Generalized subsurface profiles developed from the borings and CPTs performed in each area of the site are presented in Figures 5A, 5C, and 5D for Area A, Figures 5B and 5C for Area B and in Figures 5E and 5F for Area C. The soil conditions in each area are described below.

8.5.1 Area A

Surface elevations at exploration locations generally range approximately between +12 to +21 feet NAVD. Three distinct layers were identified in our exploration locations.

Plots of moisture content, dry density, and consistency of Area A soils from our investigation and previous investigations are shown in Appendix B3 and B4, respectively (Plates B3-1 through B3-4 and B4-1 through B4-4).

8.5.1.1 Layer No. 1: Artificial (Hydraulic) Fill

Artificial fill primarily from dredging of Marina Del Rey and Ballona Creek Channel cover the surface of Area A. The thickness of the Fill layer varies from 8 to 20 feet, with bottom of the layer at elevations ranging from El -3 feet NAVD near the channel to El +9 feet NAVD near Fiji Way.

The fill materials encountered in our explorations were consistent with the findings of previous investigation and are comprised predominantly of soft to medium stiff sandy silts and clays (ML, and CL), and loose to medium dense silty sands (SM). To a lesser extent, other soil types encountered in the borings include poorly graded sands and gravels (SP, GP) as well as small layers of elastic silts (MH).

Moisture contents in the fill soils ranges from 6 to 57 percent, and dry densities range from 64 to 117 pcf. Liquid Limit ranges from 28 to 69, and Plasticity Index ranges from 13 to 37.

8.5.1.2 Layer No. 2: Fine Grained Soils with Interbedded Sands Layers

Below the Fill layer, lies a predominantly fine grained layer with interbedded sand and silt layers. This layer is approximately 35 to 50 feet thick, and predominantly includes very soft to medium stiff clays and silts (CL, CH, ML, and MH), and loose to medium dense sands (SM, SC, and SP). Some denser/stiffer soils are also present within this layer, but individual layers are not found to be laterally continuous.

Moisture contents in this layer ranges from 15 to 91 percent, and dry densities range from 44 to 115pcf. Liquid Limit ranges from 29 to 92, and Plasticity Index ranges from 8 to 40. Undrained Shear Strengths in the layer generally varies in the range of 250 psf and 2,000 psf, with typical values between 500 and 1,500 psf. Plots of undrained shear strength results from laboratory vane shear within Area A soils are included on Plate B3-1.

8.5.1.3 Layer No. 3: Dense to Very Dense Sands and Gravels

Dense to very dense sands are present at depth of about 55 to 70 feet NAVD (El -32 to El -52) with SPT blow counts greater than 30 blows per foot. The CPT tip resistance is generally greater than 100tsf, which depicts that the materials are generally very dense.

8.5.2 Area B

Surface elevations at exploration locations in Area B generally range approximately between +5 to +8 feet NAVD, and as high as El +21 feet at existing levees and eastern portions of Culver Blvd. Three distinct layers were identified in our exploration locations.

Plots of moisture content, dry density and consistency of Area B soils from our investigation and previous investigations are shown in Appendix B3 and B4, respectively (Plates B3-15 through B3-18, and B4-7 through B4-10).

8.5.2.1 Layer No. 1: Artificial Fill

A Fill layer is also present in non-wetland areas within Area B. The thickness of the Fill layer varies from 0 to about 15 feet, with bottom of the layer at elevations ranging from El 0 to El +6 NAVD.

The Fill materials predominantly include loose to medium dense silty sands (SM) and soft to stiff sandy silts and clays (ML). Other soil types encountered in the borings include poorly graded silty sands and gravels (SP-SM, GP).

Moisture contents in the Fill soils ranges from 21 to 31 percent, and dry densities range from 76 to 94pcf. Materials in this layer were either non-plastic or had low plasticity.

8.5.2.2 Layer No. 2: InterbeddedFine Grained and Coarse Grained Soils

Below the Fill layer, lies interbedded fine grained and coarse grained soils. Immediately below the fill very soft to medium stiff fine grained soils are present to about El -5 to -10 feet NAVD. These soils predominately consist of fat clays (CH) with lesser amounts of elastic silts (MH), low to medium plasticity clays and silts (CL, ML). Interbedded loose to very dense sands and fine grained soils extend below El -10 feet to about El -45. The interbedded sand layers are generally thicker on the west side of the Area B, with a thickness of about 35 feet near the sand dunes. Moisture contents in this layer ranges from 14 to 81 percent, and dry densities range from 51 to 118pcf. Liquid Limit ranges from 27 to 84, and Plasticity Index ranges from 3 to 50. Undrained Shear Strengths in the layer generally varies in the range of 250 psf and 2,000 psf, with typical values between 300 and 1,500 psf. Plots of undrained shear strength results from laboratory vane shear within Area B soils are included on Plate B3-14.

8.5.2.3 Layer No. 3: Dense to Very Dense Sands

Dense to very dense sands are present at depth of about 60 to 70 feet NAVD (El -45 to El -58) with SPT blow counts generally greater than 40 blows per foot. The CPT tip resistance is generally greater than 100 tsf, which depicts that the materials are generally very dense.

8.5.3 Area C

Surface elevations at exploration locations in Area C generally range approximately between +13 to +24 feet NAVD. Three distinct layers were identified in our exploration locations.

Plots of moisture content, dry density and consistency of Area B soils from our investigation and previous investigations are shown in Appendix B3 and B4, respectively (Plates B3-21 through B3-24, and B4-13 through B4-16).

8.5.3.1 Layer No. 1: Artificial Fill

Artificial Fill is present in the upper 8 to 15 feet of Area C. The thickness of the Fill layer varies from 8 to 15 feet, with bottom of the layer at elevations ranging from El +7 to El +15 NAVD.

The Fill materials are a mixture of fine grained and coarse grained soils, and predominantly include loose to medium dense silty sands (SM) and soft to stiff sandy silts and clays (ML, and CL). Other soil types encountered in the borings include poorly graded sands and clayey sand (SP, SC) as well as high plasticity silts and clays (MH, CH).

Moisture contents in the Fill soils ranges from 2 to 53 percent, and dry densities range from 69 to 119pcf. Liquid Limit ranges from 40 to 71, and Plasticity Index ranges from 13 to 36.

8.5.3.2 Layer No. 2: InterbeddedFine Grained and Coarse Grained Soils

Below the Fill layer, interbedded layers of fine grained and coarse grainedsoils are present. This layer is approximately 40 to 50 feet thick, and predominantly includes soft to stiff clays and silts (CL, CH, ML, and MH), and loose to dense sands (SM, SC, and SP).

Moisture contents in this layer ranges from 8 to 53 percent, and dry densities range from 68 to 134pcf. Liquid Limit ranges from 24 to 75, and Plasticity Index ranges from 12 to 47. Undrained Shear Strengths in the layer generally varies in the range of 500 psf and 2,500 psf.

8.5.3.3 Layer No. 3: Dense to Very Dense Sands

Dense to very dense sands are present at depth of about 50 to 60 feet (El -30 to El -33 NAVD). The CPT tip resistance is generally greater than 200 tsf, which depicts that the materials are generally very dense.

8.6 Generalized Subsurface Cross sections

Based on the subsurface explorations performed, generalized subsurface cross sections along the length of the new levees planned in Area A and Area B are shown on Figures 5A and 5B, and a generalized subsurface profile along the existing Ballona Creek levees is shown on Figure 5C. These profiles include borings and CPTs located within about 100 feet of the levee alignment.

A generalized subsurface cross section within the interior of Area A showing the soils that will be excavated is presented on Figure 5D. Two generalized subsurface profiles were developed for Area C. An East-West cross section in Area C south, as shown on Figure 5E, and a North-South cross section extending through both north and south Area C is shown on Figure 5F.

In addition, for the analysis of levee stability, generalized subsurface cross-sections, were developed at critical locations that were selected for analyses based on the subsurface and topographical conditions encountered. The locations of these critical sections are shown on Figure 4 (4A and 4B). The cross-sections are labeled A-A' through L-L' and are shown in Figure 6 (6A through 6L). These cross-sections were chosen conservatively at locations where either softer and/or thicker fine-grained soils were present or where the topography was steepest, for static analyses, and where the thickness of the liquefied soils was thickest, for seismic analyses. The cross-sections are discussed in greater detail in the Slope Stability Section of this report.

9.0 SEISMICITY

9.1 Seismic Hazard Analysis

A probabilistic seismic hazard analysis (PSHA) is the preferred approach for seismic evaluation of levees. The PSHA incorporates an earthquake's frequency of occurrence for different magnitude events occurring on various seismic sources, the uncertainty of an earthquake's location, and a ground motion prediction, including its uncertainty of occurrence. A ground motion return period for seismic evaluation was selected based on the levee's category and the agency that coordinates the evaluation policy, and is often about the same level as the flood return period.

For levees in urban areas, such as the levees in this project, the Department of Water Resource (DWR, 2012) requires a 200-year return period for seismic evaluations, which is consistent with the targeted 200-year flood protection level. A return period of 224 years, defined as having a 20% probability of exceedence in 50 years, was adopted for seismic evaluation of the levees for the Project.

A PSHA was performed using the 2008 Interactive Deaggregation Tool Developed by USGS (USGS, 2008), for a return period of 224 years, and using a $V_{s,30}$ of 202 m/s (based on our seismic CPT measurements which are presented in Appendix D (Plates D-14 through D-17). The 2008 Interactive Deaggregation Tool is available on the web, and utilizes the 2008 Next Generation Attenuation (NGA) ground motion prediction equations (GMPEs).

The acceleration response spectrum based on USGS Deaggregations (2008) and a return period of 224 years is presented in Table4. The Deaggregation Results are shown in Appendix D.

Table 4: Acceleration Response Spectrum

Period (Sec)	Sa (g)
0.0	0.32
0.1	0.53
0.2	0.69
0.3	0.71
0.5	0.63
1.0	0.43
2.0	0.23
3.0	0.15
4.0	0.11
5.0	0.08

9.2 Design Earthquake

The design earthquake was selected based on the deaggregation of the seismic hazards for a return period of 224 years, at peak ground acceleration (PGA). Therefore, the design earthquake for this project was selected as an earthquake with a PGA of 0.32g, with a Magnitude of 6.7 that occurs at a distance of 13 kilometers from the site.

9.3 Seismic Hazards

The site is not within the Alquist-Priolo Earthquake Fault Zone, or a Fault Rupture Study Area. The closest Alquist-Priolo Earthquake Fault Zone is associated with the Newport-Inglewood fault, and is located approximately 3.5 miles east of the site. Based on the available geologic data, active or potentially active faults with the potential for surface fault rupture are not known to be located directly beneath or projecting toward the site. Therefore, the potential for surface rupture due to fault plane displacement propagating to the surface at the site is considered remote.

All low-lying areas along California's coast are subject to potentially dangerous tsunamis. Tsunamis are long-period waves generated primarily from distant and local offshore earthquakes, landslides, or volcanic eruptions. The magnitude of the potential hazard is a function of the coastline configuration, sea floor topography, individual wave characteristics, and distance and direction from the source. Two tsunamis, due to the 1960 Chile Earthquake, caused damage in the Los Angeles and Long Beach Harbors. In 1960, waves up to 5 feet in height occurred in Cerritos Channel, and currents up to 12 knots were reported. A 5-foot run-up for a 100-year tsunami, and an 8-foot run-up for a 500-year tsunami are predicted near the Marina Del Rey area (Ziony, Editor, 1985). If a 100-year and 500-year tsunamis coincide with high tide, the maximum water elevation near the site may reach El. +11 and +14 feet NAVD, respectively. Although the damage potential from a tsunami is expected to be low, it cannot be ruled out.

The possibility of seiches (wave oscillations in a body of water due to earthquake shaking) within the Ballona Creek is considered remote.

The hills to the south of the site in Playa Del Rey are mapped in the City of Los Angeles Landslide Map, according to the website, NavigateLA.lacity.org. However, these hillsides are relatively far from any Project Improvements and there does not appear to pose a threat to project improvement.

Seismic slope stability is discussed under Slope Stability Analysis. Seismic Hazard Maps for the Project Site are also included in Appendix D (Plates D-18 through D-21).

10.0 GROUNDWATER CONDITIONS

10.1 Groundwater in Current and Previous Investigations

Groundwater was measured in GDC's investigation at some of the hollow stem boring locations in Area A, and Area C and in one hand auger boring in Area B. A summary of groundwater measurements in our investigation is shown in Table 5.

Depth to groundwater was also measured in selected borings in the previous geotechnical investigations, as shown in Table 5. The elevations were presented in mean sea level (MSL) datum. Since the datum adopted for the Project is the North American Vertical Datum (NAVD), we have converted the MSL elevations to NAVD datum. The highest measured groundwater elevation was 10 feet NAVD in Area A.

Table 5: Groundwater Measured in Current and Previous Investigations

Area	Report	Depths (feet)	Approximate Elevations (NAVD)
A	Current Investigation by GDC	7 to 17	-6 to 5
	Law Crandall, 1991	7 to 15	0 to 10
	Law Crandall, 1991 (Supplementary Report)	14 to 17	N/A
B	Current Investigation by GDC	2	3
	Law Crandall, 1991	0.1 to 4.5	4 to 7
	Diaz Yourman & Associates	2 to 11	2 to 8
C	Current Investigation by GDC	18	-2
	Law Crandall, 1991	12 to 22	0 to 6
	Diaz Yourman & Associates	17 to 23	2 to 6
Note: N/A = Not Available			

10.2 Historically Highest Groundwater

The CGS Open File Report 98-36 Venice Quadrangle (CGS, 1998) includes Historically Highest Groundwater Contours and Borehole Log Data Locations for the Venice Quadrangle, which includes the project site. Historical highest groundwater map is shown in Appendix D (Plate D-19). Historically highest groundwater is at a depth of less than 5 feet in Area B (El. +0 to +5 feet), and at depths of 5 to 10 feet in Areas A, and C, (corresponding to approximate elevations of about El. +5 to +15 feet NAVD).

10.3 Design Groundwater

According to the in-progress USACE Technical Letter, dated September 1, 2012 (USACE, 2012) titled, “Guidelines for Seismic Evaluation of Levees”, a typical “coincident water level” should be considered for the liquefaction triggering analysis and seismic slope stability analysis for design of levees.” According to this Technical Letter, the water level should be assumed to be the highest of the following three conditions:

1) <u>Median Annual Water Level (in Ballona Creek or groundwater):</u> This water level corresponds to mean sea level (MSL), which corresponds to Elevation +2.6 feet NAVD.

2) <u>Typical Seasonal Water Level:</u> This water level could be conservatively assumed to be the flood water level in the creek during a relatively typical water level fluctuation, e.g., during a typical winter rainstorm. For this condition we used a water level for a two-year flood conservatively assumed to be around +9 feet NAVD.

3) <u>Mean High Tide Elevation (including Sea Level Rise):</u> The Mean Higher High Water (MHHW) elevation corresponds to an elevation of+5.2 feet NAVD. Assuming a Sea Level Rise of 4.6 feet, by 2100, this water level can be estimated to be at about +9.8 feet NAVD.

Based on the above, a coincident water level of +10 feet NAVD was adopted for the liquefaction triggering and seismic slope stability analyses. It is noted that a design groundwater level of +10 feet is also consistent with measurements taken during previous and current geotechnical investigations, and with the historically highest groundwater level for the site area.

It should be noted that other groundwater levels are used for non-seismic load cases, depending on the loading conditions, as applicable.

11.0 LIQUEFACTION

Liquefaction involves the sudden loss in strength of a saturated, cohesionless soil (predominantly sand or non-plastic silt/clay) caused by the build-up of pore water pressure during cyclic loading, such as that produced by an earthquake. This increase in pore water pressure can temporarily transform the soil into a fluid mass, resulting in vertical settlement and can also cause lateral ground deformations. Typically, liquefaction occurs in areas where there are loose sands and the depth to groundwater is less than 50 feet from the surface. Seismic shaking can also cause soil compaction and ground settlement without liquefaction occurring, including settlement of dry sands above the water table.

The site is located within a State of California Liquefaction Hazard Zone mapped by California Geologic Survey (CGS reference), as indicated in Appendix D (Plate D-19).

The site is underlain by relatively young and loose/soft interbedded deposits of fine-grained silt/clay with relatively thin discontinuous layers of sandy or non-plastic silt. Based on our analyses localized liquefaction is predicted to occur in the sand and non-plastic silt lenses and layers during the design earthquake. The results of the liquefaction analysis are presented in Appendix E. The post-liquefaction settlement was estimated at CPT locations using the NCEER Method (Youd et al., 2001) based on the design earthquake and the design groundwater for the project. Post-Liquefaction Settlement on the order of 0 to 3 inches is anticipated for the design earthquake.

The site is relatively flat, and the proposed levees are located approximately 300 to 1,200 feet away from the meandering channel. Therefore, it is anticipated that the layers in which liquefaction occurs are essentially laterally confined and that the main effect from liquefaction will be post-liquefaction settlement. This was partly confirmed by an estimation of free field lateral spreading was performed using the Youd et al. (2002) method (Plates E-30 and E-31). Free field lateral spreading displacement was estimated to be on the order of 3 to 6 inches at the location of the new levees, at a distance of about 300 to 1000 feet from the meander channel. The results of the analyses are also presented in Appendix E (Plates E-30 through E-32).

Liquefaction causes a temporary loss of strength during and immediately after an earthquake. The strength of soils that liquefy is typically very small and is typically known as the post-liquefaction undrained shear strength. To take into account the temporary loss of strength due to liquefaction we performed stability and deformation analyses using post-liquefaction undrained shear strength. These analyses are presented in the slope stability section provide estimates of lateral deformations of levees and embankments.

12.0 SEEPAGE ANALYSES

As discussed earlier, four field permeability tests were performed at depths of 5 and 10 feet, at two exploration locations (A-HSA064 and A-HSA066) near the existing north Ballona Creek levee, to evaluate the permeability of the soils near the base of the levee section. Based on the field tests, the average permeability of the soils was estimated to be in the range of 3.2×10^{-4} cm/s to 1.5×10^{-3} cm/s. The upper bound permeability value of 1.5×10^{-3} cm/s was used in numerical Finite Element seepage models using the RocScience computer program, Slide (version 5), for evaluation of the hydraulic gradients and discharge values expected along critical levee sections. The discharge values were also evaluated for the lower bound estimated permeability value, in order to obtain a rough range of the anticipated seepage discharge values expected through the levees. Figures depicting our seepage analyses are presented in Appendix F.

12.1 Factor of Safety Against Piping

12.1.1 Introduction

To evaluate the Factor of Safety (FOS) against piping during construction, the hydraulic gradient was estimated for the following conditions:

1) Existing north levee during excavation of Area A and the new channel
2) Existing south Area B levee at downstream end of the project

12.1.2 Existing Levees During Excavation of Area A

The hydraulic gradient was evaluated assuming a steady state seepage condition with channel water level of El +18 at the location of existing north levee, after completion of the excavation of the new north meander channel (under dry condition), and prior to the breach of the levee. This analysis assumes the unlikely condition of a having a long-term high water level of El +18 (i.e. steady state), while the excavations of the meander channel is being completed. It should be noted that El +18 assumed for this analyses is higher than the design flood elevation (El +17). The exit hydraulic gradient for this conservative and highly improbable scenario was estimated to be approximately 0.2 (Plate F-3). Thus, the FOS for piping was calculated to be at least FOS = 5.0 (FOS_{min} = 1.0). This implies that piping potential is remote for lower, for more likely high water conditions.

12.1.3 Existing Levees During 100 Year Flood in West Area B

Second, the hydraulic gradient was evaluated assuming a steady state seepage condition with channel water level of El +13 (i.e. corresponding to the high water elevation during a 100-year flood event, including bed aggradation and also sea level rise) at the downstream of West Area B, where the existing levees are expected to remain. The existing levee crest elevation at its lowest point in Area B (i.e. El. +14) was used in this analysis. The exit hydraulic gradient for this very conservative scenario (steady state) was estimated to be approximately 0.27 (Plate F-4). Therefore, the FOS for piping was calculated to be at least FOS = 3.7 (FOS_{min} = 1.0).

12.1.4 New Levees During 100 Year Floods

The above results indicate that an internal erosion failure is not likely to occur for the existing levees, which are very steep compared to the new levees. The flatness of the new levees implies a longer flow path and thus much lower hydraulic gradients. Therefore, our seepage analyses in Appendix F indicate that the likelihood of piping for the new levees is remote.

12.2 Seepage Discharge Values

12.2.1 General

The discharge flow that is anticipated to seep into the excavation in Area A was evaluated using the range of permeabilities obtained from our field permeability tests, at the location of existing north levee, after completion of the excavation of the new north meander channel (under dry condition), and prior to the breach of the levee. The following two conditions were considered.

1) A typical transient condition of tidal changes over a period of a week.
2) After a storm event that would raise the water level in the channel to El +18 for a period of 10 days.

12.2.2 Discharge Due to Typical Tidal Changes

For this transient seepage analysis, it was first assumed that a steady state condition was reached with a water level at El +3 corresponding to an average tide level in the channel. Then, water levels corresponding to typical tidal changes at Santa Monica Bay over a period of one week were applied along the channel location as transient water levels. The discharge in the excavation zone was evaluated at different steps during the analysis. Very minor fluctuations of the discharge values were computed as a result of tidal fluctuations in the channel (Plates F-7 to F-16).

The typical discharge values due to tidal changes in the channel were estimated to be in the range of about 0.04 to 0.19 ft^3/hour/ft, or approximately 0.3 to 1.43 gallons/hour/ft. Assuming a total excavation length of 1,500 feet in Zone A, complete dewatering would require a pumping capacity in the range of 60 to 285 ft^3/hour (Plates F-7 to F-16). Our seepage analyses are presented in Appendix F.

12.2.3 Discharge Due to a Major Storm

The seepage discharge rates after a 10-day storm event were estimated using a transient seepage analysis. For this analysis, a steady state condition was reached with water level in the channel at El +3 corresponding to an average tide level. Subsequently the water level in the channel was raised to El +18 for a period of 10 days to simulate a 10-day storm. The water level was then lowered to El +3 after the 10-day period.

The discharge rates were calculated to be in the range 0.045 to 0.21ft^3/hour/ft, or approximately 0.33 to 1.57 gallons/hour/ft (Plates F-18 to F-29). The discharge values in the excavation zone showed an increase of approximately ten percent following the storm relative to the typical discharge rates. This implies that discharge from a major storm that lasts for a fairly long period of time is only marginally more that the discharge into the excavation during normal tidal fluctuations.

Our estimates do not include drainage run-off. Our seepage analyses are included in Appendix F.

12.3 Rapid Drawdown

Past performance of the existing levees along the Ballona Channel indicate that rapid drawdown is not an issue. This is likely due to the relatively low permeability and strength of the existing materials. Furthermore, as can be seen from the results of seepage analyses, the tidal fluctuations affect only a small volume of soil, located near the surface of the levees. This is also evident from observing the results of the seepage analyses during and after a 10-day storm.

Rapid drawdown is a condition that can affect levees when the water in the channel drops quickly following a long period of high water. Under such conditions, the soils within the embankment are usually fully saturated during the high water period. Shortly after drawdown the stabilizing external water pressure on the slope is removed, while the internal pore pressures within the saturated soils have not dissipated. The levees at Ballona Creek are geographically not prone to long period high water in the channel, where a large volume of levee soils become saturated. Therefore, a steady state high water condition will likely not develop at Ballona Creek levees. As a result, the likelihood of deep-seated failure during rapid drawdown failure is remote.

While shallow saturation of surface soils is possible on the slopes, due to the flatness of the protected slope of the new levees, the possibility of a surficial rapid drawdown failure also appears to be very low due to the strength of the materials. For example, assuming rapid drawdown creating a 5-foot-thick zone of saturation on a 5H:1V slope, the normal stress and shear stress at the base of the zone of saturation are on the order of 600 and 120 psf, respectively. Therefore, in order for the infinite slope to be stable, the base of the saturated zone should have either minimum undrained shear strength, S_u = 120 psf. At a depth of 5-feet out investigation typically showed undrained shear strengths of 300 psf, or higher. Therefore, further rapid drawdown analyses were not considered necessary for the levees.

13.0 SLOPE STABILITY OF LEVEES

13.1 Introduction

The static and seismic slope stability of the new (proposed) levees and the portions of the existing levees that will remain were evaluated for a 100-year flood event, and an earthquake with a hazard return period of 224 years. It was also found that the results of the analyses are not sensitive to higher water elevations in the channel (i.e., a less frequent, higher return period, flood event.)

Additionally, static slope stability of the existing north levee was evaluated for the temporary condition which involves the construction of the new meander channels. It should be noted that the existing north levee will be breached after the Area A excavation and the construction of the meander channel; however the construction will likely take several years, and thus the levee static stability was considered for a long term and not a short term condition.

The cross sections used for the slope stability analyses are shown in Figures 6 (6A through 6L). Slope stability analyses were performed at 12 locations along the new and the existing levees in areas (Sections A-A' through L-L').

Cross sections were made at locations were the levee cross section changes, as well as in areas where there was a significant change in subsurface soil conditions. Six conservatively selected idealized soil profiles were used for stability analyses.

13.2 Soil Strength Parameters

Soil strength parameters were assigned to each layer using field and laboratory data from our investigations as well as selected information from previous investigations (Tables G-1 through G-12 in Appendix G). The basis for adopted static soil strength parameters follow.

- Undrained shear strength in fine-grained clayey and silty soils were primarily selected on the basis of the results of a Geonor H-60 laboratory vane shear testing of Shelby Tube samples collected, as well as using correlations of undrained shear strength with CPT tip resistance (Plates G-7 through G-9). A number of direct shear tests were also performed on the clayey/silty soils to select the drained strength parameters of the fine-grained soils for use in the steady state long-term analyses (B1-3h and B1-3q).

- Shear strength soils parameters for fill soils, were conservatively selected based on the results of a number of direct shear tests performed on fill soils (Plates G-10 and G-11). Existing levee materials were slightly stronger than the fill soils based on direct shear test results. Therefore, a slightly higher cohesion value was adopted for levee embankment soils. New levee material strengths were taken to be the same as those of existing levees. This is conservative as the new levees will be compacted to modern standards that yield higher strengths.

- Shear strength parameters in coarser-grained sandy soils were conservatively selected based on the results of the direct shear parameters.

Liquefaction analyses indicated there are layers and lenses that will likely liquefy during a major seismic event. Therefore, stability analyses using the residual (post-liquefaction) shear strength were performed for seismic stability analyses.

- For seismic analyses, post-liquefaction residual strength of the liquefied layers were estimated using Seed and Harder (1990) correlations with blow counts, using representative SPT blow counts, corrected for the effects of overburden, energy, and fines content of the liquefied materials.

Plates showing shear strength ranges and adopted values for fill soils and undrained shear strength of fine-grained soils are included in Appendix G (Plates G-7 through G-11). Plates showing the depths and residual strength parameters are the liquefied soils are also included in Appendix G (Plates G-12 through G-15).

13.3 Idealized Soil Profiles

Six conservative idealized soil profiles were adopted along the alignment of the new and the existing levees based on distinct variations in the subsurface profile. Each of the levee cross sections analyzed was assumed to be underlain by one of the following idealized soil profiles.

- East Area A Profile (Levee Sections A-A' and B-B' and Existing North Levee; Table G-1 and G-2)
- West Area A Profile (Levee Sections C-C' and D-D'; Table G-3 and G-4)
- Eastern Ballona Creek Profile (Levee Sections E-E' and F-F'; Table G-5 and G-6)
- East Area B Profile (Levee Section G-G'; Table G-7 and G-8)
- West Area B Profile (Levee Sections H-H', I-I', J-J' and K-K'; Table G-9 and G-10)
- Area C Profile (Levee Section L-L'; Table G-11 and G-12)

13.4 Levee Cross Section Locations

Selected levee cross sections used for slope stability analyses are briefly discussed below.

- Section A-A' and Section B-B' were included to evaluate the stability of the new Area A perimeter levees in eastern portion of Area A.

- Section C-C' was included to evaluate the stability of the new Area A perimeters levees in western portion of Area A.

- Section D-D' was included to evaluate the stability of the existing portion of the north levee located at the downstream end of the new Area A levees. This is the downstream location were the existing north levees will tie in to the new levees and will remain as part of the improvements of the project.

- Section E-E' was included to evaluate the stability of the existing south levees just downstream of Lincoln Boulevard after placement of the Area B fill mounds to the south between Culver Boulevard and Jefferson Boulevard These existing levees will remain as part of the improved project and will tie into the new Culver Boulevard Levees.

- Section F-F' was included to evaluate the stability of the upstream end of the Culver Boulevard Area B levees. This is the widest section of the Culver Blvd Area B levees, and includes the old railroad fill area.

- Section G-G' was included to evaluate the stability of the Culver Boulevard Area B levees in East Area B.

- Section H-H' was included to evaluate the stability of the wide portion of Area B levees and using a West Area B subsurface soil profile.

- Section I-I' was included to evaluate the stability of the West Area B levees. The section in this area is planned with a varying wet side slope of ranging from 5H:1V to 10H:1V. The section analyzed was conservatively selected to have a 5H:1V wet side slope.

- Section J-J' was included to evaluate the stability of the temporary levees that will be built as part of the interim project. These levees will likely remain for many years after the first phase of construction, and thus, are analyzed as permanent levees.

- Section K-K' was included to evaluate the stability of the existing levees that remain a part of the improvement project, and tie-in to the new West Area B levees at the downstream end of Area B. Please note that this portion of the existing levees may be raised for flood management.

- Section L-L' was included to evaluate the stability of the existing north Area C levees located upstream of Lincoln Blvd. along the south side of South Area C. These levees will remain as part of the project, but are not affected by the improvements in the project.

13.5 Levee Cross Section Locations

The following loading conditions were considered in our levee slope stability analyses:

i) End of construction condition: This loading condition assumes that grading is being performed during the dry season and that the channel water elevation is affected primarily by tides. For stability, the critical stage of this loading condition is when excavations have reached the lowest level and surcharges are the highest, i.e., at the end of construction.

ii) High water short term condition: This conservative loading condition assumes that a near full channel water elevation is present due to large rainstorms, As previously discussed the duration of such event is not long enough for steady state conditions to develop and the corresponding soils to become fully saturated. Nevertheless, our analysis conservatively assumes the pore pressures of a fully developed steady state phreatic surface in coarse-grained materials, while undrained shear strength is used for fine-grained soils. This loading condition is more stringent than typically adopted conditions, and thus generally not considered by USACE for slope stability analysis of levees. This loading condition is most analogous to a long term steady state stability analysis in terms of water level, except for its conservatism in the strength assumptions. As can be seen in Table 6, the high water short term condition consistently yields lower FOS values, than the high water long term (steady state) stability condition.

iii) Long term steady state stability: This loading condition also assumes that a near full channel water elevation has been present for a long time due to large rainstorms. This loading condition is similar to the previous one, except that steady state pore pressures are assumed for all soils. Therefore, drained soil strength parameters are applicable for both the coarse-grained and fine-grained soils. This loading condition was analyzed for only a few levee cross sections, to verify that the Factor of Safety (FOS) values for this condition are higher than the high water short term condition. It should be noted that the minimum FOS slope stability requirement for the long-term steady state condition was conservatively adopted for both the short-term and long-term high water conditions.

iv) Seismic slope stability during the design earthquake: The site contains low density materials that are prone to liquefaction during a major earthquake. This seismic loading condition considers where appropriate post-earthquake strength parameters, to evaluate the potential of slide failures during the design earthquake (i.e., if FOS < 1.0).

v) Deformation analysis for seismic condition: To estimate permanent seismic displacements, a seismic slope stability is first performed to calculate the yield acceleration, i.e., the acceleration that results in FOS=1.0. Then displacements of the levee are estimated for the design event earthquake using simplified methods such as Bray and Rathje (1998) method. The performance of levees is considered acceptable, if the permanent seismic displacements are estimated to be below 6 inches (15 cm).

13.6 Factor of Safety Criteria and Design Considerations

i) Short-term condition: A minimum FOS> 1.3 is adopted for sudden and short term loading conditions, e.g., immediately after the end of construction of the new and remaining levees. Undrained soil strengths parameters are used to evaluate the resisting forces. A water level at Elevation +5 feet NAVD was assumed in the channel.

ii) High water short-term and long-term conditions: A minimum FOS > 1.5 is adopted for both short term and long term steady state conditions with water level conservatively selected at El +17 feet NAVD in the channel for the new levees and the existing levees, with the exception of the existing levee downstream of Area B (Section K-K'), where the water level was selected to be at El +13 NAVD, corresponding to the estimated high water for the 100-year flood at this location. It should be noted that short-term stability is essentially not very sensitive to a change in the water level in the channel.

iii) FOS > 1.0 is required for post-liquefaction condition, using undrained strength parameters and post-liquefaction residual shear strength for liquefiable soils. The water level in the analyses was assumed to be at El +10 NAVD for levee sections in Areas A and C, and assuming a groundwater at existing ground surface (i.e. ground surface elevation outside of the levee embankment cross section) for Area B, since generally ground surface elevations are lower than El +10 NAVD.

iv) A FOS greater than 1.0 under the previous loading condition (iii) does not guarantee acceptable performance. Hence, a deformation analysis was performed to evaluate the seismic displacements under design earthquake conditions. Seismic displacements on the order of 15 cm are generally considered acceptable for levees. The yield acceleration used in the deformation analysis is the horizontal acceleration that produces a FOS equal to 1.0. The yield acceleration was calculated for each levee section using conventional slope stability methods and the Bray and Rathje (1998) method was used to estimate seismic displacements.

A summary of the analyses results is presented in Table 6. The results of the slope stability analyses are included in Appendix G.

Table 6: Summary of Slope Stability Analyses

	Static Factor of Safety			Seismic Stability		
Section Analyzed	End of Construction Short term Stability	High Water Short Term Stability	High Water Long Term Stability (Steady State)	Post-liquefaction (Seismic)	Yield Acceleration	Deformations (cm)
	$FOS_{min} > 1.3$	$FOS_{min} > 1.5$	$FOS_{min} > 1.5$	$FOS_{min} > 1.0$		
Section A-A'	3.39	3.35	5.21	2.38	0.09	4
Section B-B'	3.51	4.32	N/C	2.38	0.08	4
Section C-C'	3.45	5.28	N/C	2.42	0.10	4
Section D-D'	1.49[1]	2.28	N/C	1.29	0.05	47
Section E-E'	1.57	2.07	N/C	1.33	0.08	40
Section F-F'	2.19	2.19	N/C	1.59	0.10	3
Section G-G'	2.55	2.73	3.42	1.79	0.05	9
Section H-H'	1.94	1.87	N/C	1.24	0.04	8
Section I-I'	1.68	1.61	2.29	1.17	0.04	11
Section J-J'	2.09	2.48	N/C	1.47	0.05	6
Section K-K'	1.58	2.13	N/C	1.26	0.04	15
Section L-L'	1.60	2.26	N/C	1.40	0.08	30

Note: N/C = not calculated

13.7 Discussion on the Slope Stability Results of New and Remaining Levees

The stability of the new and existing levees was analyzed at the end of construction, during high water (short term and long term), and seismic conditions. A discussion follows.

- **End of Construction Condition:** The FOS for the end of construction short-term condition with channel water levels at elevation +5 feet NAVD was found to be satisfactory for the new and existing levee sections that were analyzed ($FOS_{min} > 1.3$).

- **High Water Short Term Condition**: The FOS for the high water condition assuming short term loading is satisfactory for the new and existing levee sections that were analyzed ($FOS_{min} > 1.5$).

- **Post-liquefaction Condition:** During the design earthquake it is anticipated that some soil layers will liquefy, and thus lose significant resistance. The FOS calculated using post-liquefaction residual shear strength was found to be greater than 1.0 for a water level at El +10 NAVD, or at ground surface (for Area B). As a result the likelihood of a catastrophic flow slide failure is remote.

- **Yield Acceleration and Deformation Analysis:** A deformation analysis using the Bray and Rathje (1998) method calculated displacements on the order of 4 to 11 centimeters (approximately 1.5 to 4.5 inches) for the new levees, and displacements on the order of 15 to 47 centimeters (approximately 6 to 19 inches) for the existing levees under the design earthquake. Generally displacements less than 15 cm (about 6 inches) are considered acceptable for non-inhabited structures. Therefore, in our opinion, the calculated displacements for the new levees are deemed acceptable. However, the displacements in the existing levees are large, and do not meet current seismic criteria. Where the new levees will tie into an existing levee, excessive deformation and cracking of the existing levee is a concern not only during seismic conditions, but also due to the additional loading and settlement that will be caused by construction of the new levee. Therefore, mitigation measures are recommended for all the existing levees where new levees will tie-in.

13.8 Post Excavation Stability of the Existing North Levee in Area A

During the excavations within Area A and the new meander channel north of the existing levee, the Existing North Levee along the existing channel provides flood protection, and therefore should remain functional. Post Excavation stability of the existing north levee was evaluated assuming the excavation in Area A will take at least several months to be completed. Additionally it was assumed that the excavation will be performed in dry condition using dewatering, because this is the critical assumption for slope stability. However, the excavation may also be performed in the wet.

For this condition, the water level in the existing Ballona Creek channel was assumed to be about El +7 NAVD corresponding to approximately a 2-year flood condition. The water level in the protected side of the levee was assumed to be 1 to 2 feet below the elevation of the invert, at about El -6. Since the loading would be sudden, undrained soil strength parameters were used. Because the excavations in Area A will likely take at least several months, a minimum FOS of 1.5 was adopted,

Pursuant to our discussions with the civil designer, we assumed that the excavation in the protected side of the existing north levee will be sloped at 2.5H:1V to the top of the meander channel (approximately El +5 NAVD), and the meander channel will be sloped at 5H:1V to an invert elevation of El -5 NAVD. The distance between the bottom of the excavation on the protected side of the levee and the top of the meander channel forms a “stability berm”. The analysis was performed with varying distance from the toe of the excavation. The results of the analyses show that a minimum distance of 70 feet from the protected edge of crest is needed to satisfy a FOS of 1.5.

Thus, to maintain the existing levee functional, the excavation in Area A should be performed in two distinct stages:

- **First Stage:** If the excavation is performed under “dry” conditions (i.e., with dewatering), excavation of Area A, should be initially performed at least 70 feet away from the existing levee protected side edge of crest. This stage will result in the creation of a “stability berm”. If the excavation is not dewatered and the excavation is performed under wet conditions, a berm is not required for stability.

- **Second Stage:** Local excavation of the “stability berm” and existing levee should be performed immediately prior to breaching of the levee. Please note that locally lowering the top of the levee, prior to breaching, in areas where the levee will be breached, will also temporarily increase the static FOS.

13.9 Effect of Water Level in the Channel on Seismic Stability

13.9.1 Introduction

As discussed in the slope stability section, post liquefaction seismic stability analyses and seismic deformations analyses were performed assuming a design groundwater at Elevation +10 feet NAVD for levee sections in Areas A and C. For Area B the groundwater was assumed to be at the existing ground surface outside of the levee embankment, since the ground surface elevations are generally lower than Elevation +10 feet NAVD.

In all areas, for the seismic analysis the assumed water level in the channel is lower than the water level that occurs during an extreme high flow condition. Due to the low probability of the design earthquake coinciding with the period of high water, it is common practice to perform seismic slope stability and deformation analyses using water levels that are usually present in the channel, instead of extreme event water levels.

However, an evaluation was also made of the effect of changes in water level in the channel on the predicted seismic displacements for new and existing levees that will remain. A discussion of the findings of this evaluation is provided below.

13.9.2 New Levees

Our analyses show that the new levees are stable under post liquefaction conditions, and the predicted seismic displacements are within the acceptable range, based on a design water level Elevation of +10 feet NAVD in Areas A and C, and assuming a water level at the ground surface in Area B.

The new levees will be constructed a minimum distance of about 400 feet from the meander channel. As a result, the seismic stability of new levees will generally not be impacted by water level fluctuations in the meander channel (either tidal or seasonal). At the locations of the new levees, the water level is generally equal to the groundwater level, which is affected primarily by precipitation. Therefore, the effect of the water level in the channel on seismic displacements is negligible, for the new levees.

13.9.3 Existing Levees

The effect of changes in water level in the channel on the seismic displacements predicted for the existing levees was investigated for the levee located immediately downstream of Lincoln Boulevard (Section E-E’). The following four water levels were considered:

Case 1 – The water in the channel and in the area outside the channel coincide with the ground surface elevation of +7 feet NAVD. This is the design groundwater condition adopted for the previously presented seismic stability analyses of existing levees.

Case 2 – The water in the channel and in the area outside the channel is at Elevation +3 feet NAVD. This condition approximately corresponds to the average tidal condition.

Case 3 – A water level in the channel at Elevation +0 feet NAVD (corresponding to low tide) and a groundwater level outside the channel at Elevation +7 feet NAVD.

Case 4 – A water level in the channel of +0 feet NAVD and a groundwater level outside the channel at Elevation +3 feet NAVD.

The results of the seismic deformation slope stability analyses are included in Appendix G (Plates G-69 and G-70, and G-148 through G-153). A summary of the cases analyzed, including the estimated yield acceleration (ky) and calculated seismic displacements is presented in Table 7.

Table 7: Effect of Water Level on Seismic Displacement of Existing Levees

	Water Conditions			
Case	**Groundwater Elevation (feet; NAVD)**	**Channel Water Elevation (feet; NAVD)**	**Yield Acceleration (ky) in units of g**	**Seismic Displacement (cm)**
1	7	7	0.08	40
2	3	3	0.08	40
3	7	0	0.06	64
4	3	0	0.07	50

As indicated in Table 7, the maximum predicted deformation occurs when the water level in the channel corresponds with the low tide. However, the estimated seismic displacement for all cases is at least 40 cm (16 inches), which is unacceptable. On this basis, the variation in the water level in the channel has no effect on the acceptability of the performance of the existing levees, which for each Case are deficient under seismic conditions.

13.10 Mitigation Measures for the Remaining Existing Levees

As noted earlier, the Ballona Creek channel and levees were constructed in the 1930s, at a time when there was little geotechnical field quality control (including compaction testing) and virtually no geotechnical earthquake engineering. Portions of the existing levees in Areas A and B will act as abutments to the new levees, and consequently, will receive significant loading. If unimproved, we anticipate that in these “abutment areas” the existing levees will experience significant static settlement, and additional lateral displacements under seismic conditions. As discussed above, our analyses indicate that the original levees do not meet current USACE seismic requirements, and calculated displacements under the design earthquake are excessive even without additional loading.

Where a new levee ties into an existing levee, the existing levee will experience additional load and settlement that can cause cracking of the existing levee. Therefore, it is recommended that mitigation measures, such as deep soil mixing, be performed at and adjacent to tie-in locations to improve the stability of the existing levees that will remain in Areas A and B.

Ground Improvement is recommended at all locations where the new levees tie-in to an existing levee. These locations are delineated in Figure 7 and include:

- The existing south levee along the Ballona Creek channel between Lincoln Blvd. and Culver Blvd. Ground improvement should extend from the tie-in location for a minimum length of 80 feet from the centerline of the new levee crest (Figure 7).

- the existing north levees located along the Ballona Creek channel downstream of the new Area A levees. Ground improvement should extend from the tie-in location of the new and the existing levees for a minimum length of 80 feet from the centerline of the new levee crest (Figure 7).

- The existing south levee located along the Ballona Creek channel downstream of the new West Area B levee. Ground Improvement should extend from the tie-in point to the downstream property line (Figure 7). We understand that the crest elevation along this existing levee may be raised for additional flood protection. If ground improvement recommendations are followed, the levee can be raised without negatively impacting the integrity of the existing levee. The ground improvement should be done along the crest of the levee, and completed before the final grade is raised.

The Deep Soil Mixing (DSM) ground improvement zone for existing levees is anticipated to be on the order of 20 feet wide. The ground improvement zone should have a minimum average strength of 1,500 psf. The columns should extend to El -13 feet along south Ballona Creek channel between Lincoln Blvd. and Culver Blvd. down to El -25 feet downstream of the new Area A levees, and down to El -35 downstream of the West Area B new levees.

Please note that the alternative of replacing the deficient portions of the existing levees with new levee with flatter slope is significantly more costly. Rebuilding portions of the existing levees properly would require excavating to El. 0 NAVD to remove potentially liquefiable soils. This means that excavations should be extended below tide level and below groundwater using cofferdams and dewatering. Furthermore, surcharging a portion of any levee will also apply lateral loads on piles of Lincoln Boulevard and Culver Boulevard Bridges.

In Area C, where the existing levee will also remain, the restoration project will not alter or impose new loads to the existing levees, since stockpile soils will be placed a minimum of about 400 feet away from the edge of the channel. It is recommended that any surcharge or structure proposed near the unimproved existing levees be setback a minimum of 70 feet away from the top of the channel slope.

Please note that grading and development is currently planned in Area C, but will be kept at a minimum distance of 70 feet away from the top of the channel slope.

14.0 SETTLEMENT ANALYSES

14.1 Anticipated Settlements and Time Rate

A total of 20 consolidation tests were performed on representative soil samples collected during our field investigation. Settlement of the proposed levee embankments and surcharge areas was estimated using the consolidation test data, which was supplemented using correlations with liquid limit, and moisture content. In addition, we supplemented our settlement analyses with the extensive experience gained from surcharging similar nearby soils over the past 10 years, as the geotechnical engineer for the Playa Vista development, located immediately east of Lincoln Boulevard.

The consolidation test results showed that the soils are essentially normally consolidated below a depth of about 10 to 20 feet and slightly to moderately over-consolidated at shallower depths. The interpretation plots of consolidation parameters are provided in Appendix H.

The settlements under and extending out from the toe of new levees and embankments were evaluated for different surcharge heights and geometries. The results are provided in Table H-1 included in Appendix H.

The results indicate the anticipated settlement under new fill load is estimated to range from about 1 to 2 inches for every foot of embankment fill placed (i.e., a 10-foot high levee or embankment is anticipated to settle between 10 and 20 inches). More specifically, we anticipate that in Area A and B, settlements per foot of fill surcharge are likely to be about 1.5 to 2 inches, whereas 1.0 to 1.5 inches are anticipated in Area C.

Our analyses show that surcharges will cause a settlement bowl that may extend on the order of 30 to 50+ feet beyond the toe of the embankments, depending on the height of embankment. A summary of the estimated settlements, anticipated under levees of various heights is included in Table 8 for eight selected embankment locations and embankment heights ranging from about 5 to 15 feet.

Group Delta has significant experience with monitoring settlements in similar compressible soils during the development of the Playa Vista Development, located immediately east of Lincoln Boulevard, north and south of Jefferson Boulevard. Over the past 10 years, data has been collected from surcharge monitoring programs on numerous building sites. Representative data from these programs are graphically summarized on Plate H-47 (Appendix H), indicates 90 percent of primary consolidation occurred within about 100 to 150 days, generally considered to fall in a range of 3 to 6 months.

Based on the laboratory data and the empirical data from Playa Vista, within the Ballona wetlands primary consolidation during placement of the levees is expected to be 90 percent complete within three to six months of application of the last load increment.

Therefore, capping of the levee core should be planned as the last step of grading at least three to six months after completion of the levees, to raise the crest grade to the desired design elevation for flood control, after at least 90 percent of the primary consolidation has completed. Capping of the slopes is not required beyond the levee core.

Due to the soft nature of the subgrade soils and the large anticipated settlements, construction techniques typically used in soft ground, e.g., swamps have been considered. We recommended constructing levees slowly and using thin lifts to reduce post-construction long-term differential settlements and reduce the potential transverse cracking. For this purpose, the rate of fill placement should proceed at about 5 feet of fill per month or slower. The rate of settlement of the fill will be monitored during construction, and should be used to control the actual rate of fill placement.

14.2 Recommended Setback of New Embankments

Because of the soft nature of the existing ground, a settlement “bowl” will develop beyond the toe of new levees and surcharge areas and the resulting differential settlement could impact existing utility lines, pavement and other nearby improvements. A profile showing the shape and magnitude of the settlement bowl is presented on Plate H-7 (Appendix H).

The risk of damaging structures and utilities is generally considered minimal when the slope of the differential settlement, Δ / L, (where Δ is the differential settlement over a distance L) is less than about 1/480 (i.e., 1-inch in 40-feet). Based on the height of the fill planned, analyses indicate this controlling differential settlement slope generally occurs at a distance on the order of 25 to 30 feet beyond the toe of the embankment, and roughly coincides with the location where the total settlement is about 1-inch. However, it should be noted that the settlement bowl shown on Plate H-7 occurs perpendicular to the toe of the fill, and the existing improvements are oriented parallel to the fill toe. Therefore, the differential settlement along the improvements will actually be much less.

Using the 1/480 criteria, the following minimum setbacks between the toe of embankments and streets or utility lines are recommended. However, other, more stringent, criteria could be necessary for specific utilities, and the final criteria should be reviewed with utility agency.

Area A

- The toe of the new perimeter Area A levees should be setback along Fiji Way and from the existing parking lot pavement according to the following:
    - If the height of the levee is greater than 4 feet, the minimum setback should be 30 feet.
    - For levees that are 4 feet or less in height, the minimum setback should be 20 feet.
- In Area A, where the new levee will be placed near the Fiji Ditch, the toe of the levee should be setback behind a 3 to 1 slope extending up from the bottom of the Fiji Ditch.
- In the future, widening of Lincoln Boulevard is planned. The new levee planned along the west side of Lincoln Boulevard should be setback behind a 3 to 1 slope extending up from the west edge of the planned widening.

Area B

- The toe of the Area B levee should be setback a minimum of 30 feet from Culver Boulevard.
- The toe of the fill mounds placed in Area B should be setback a minimum of 30 feet from Culver Boulevard., Jefferson Boulevard, and Lincoln Boulevard.

Area C

- The toe of the fill mounds planned in North Area C should be setback a minimum of 25 feet from Culver Boulevard.

14.3 Protecting Utilities from Settlements

Where new culverts will extend under new the Area B levees, it should be planned to pre-load the area to remove most of the settlement prior to constructing of the culverts. This is discussed further in Section 15.8. If there are any existing, active or abandoned gas lines or other utility buried along the planned alignment of a levee, provisions should be made to relocate or reinstall them in a shallow trench that extends over the embankment fill. This would also provide easy access for any future maintenance.

Table 8: Summary of Estimates of Settlement at Different Sections along the Embankments

Area	Section	Approximate Embankment Height (feet)	Max Settlement (inches)	Max Settlement per foot of Fill (inches)	Settlement at Dry Side Toe (inches)	Settlement 10 feet from Dry Side Toe (inches)	Settlement 30 feet from Dry Side Toe (inches)	Settlement 50 feet from Dry Side Toe (inches)
Area A	Section A-A'	10	15.3	1.5	3.1	1.8	0.7	0.3
	Section B-B'	10	17.1	1.7	3.2	1.9	0.8	0.3
	Section C-C'	5	7.9	1.6	2.4	1.4	0.5	0.2
Area B	Section F-F'	14	26.7	1.9	5.8	3.4	1.3	0.6
	Section H-H'	14	26.3	1.9	5.8	3.4	1.3	0.6
	Section I-I'	15	26.0	1.7	5.8	3.4	1.3	0.6
	Surcharge Area B	25	41.4	1.7	2.2	1.4	0.6	0.3
Area C	Surcharge Area C	30	25.3	0.9	1.5	0.9	0.4	0.2

15.0 GRADING

15.1 General

The primary areas of grading for the project include:

- Excavation of approximately 2 million cubic yards of soil from Area A, to reclaim wetlands lost when the area was hydraulically filled during the development of Marina Del Rey. The excavation will slope down to the south from Fiji Way at a gradient of about 10 horizontal to 1 vertical to approximate elevation of 11 feet, and at flatter gradients of about 100H:1V (horizontal to vertical) to a maximum depth of about 20 to 25 feet in the area of the existing channel. The excavation will remove primarily hydraulic fill soils.

- The soils excavated from Area A will be used to construct the new levees around the west, north and east perimeter of Area A, and in Area B north of Culver Boulevard and east of the dunes in West Area B. The levees will generally extend about 5 to 10 feet above the existing grade in Area A, and up to a maximum of 15 feet above existing grade in Area B.

- Excavation of the meander channel for Ballona Creek and the lowering and breaching of the existing levees, at four locations.

- Any excavated soil not needed for new levee construction will be placed as compacted fill in north Area C and in Area B, between Culver Boulevard and Jefferson Boulevard.

The soils that will be excavated in Area A were found to be loose/soft and have high moisture contents, i.e., approximately 5% to 35% above the optimum moisture content. The alignments for the levees are in areas where the foundation soils are moderately soft to soft, and the ground water table is high. Therefore, earthwork must be carefully planned and conducted to avoid disturbing the soils, and the need for low ground pressure equipment and excavators should be planned. The use of heavy scrapers and dozers to excavate the soils in Area A is expected to be limited, and is discussed in Section 15.5.

Because of the high moisture content in the soils that will be excavated in Area A, it will be necessary to dry the soils before they can be used as compacted fill. Spreading and turning/disking will be needed to dry the excavated soils. In addition the loose soils excavated from Area A will undergo a significant compression, i.e., volume loss, when compacted for the levee construction. Volume loss is discussed below, in Section 15.7.

15.2 Clearing and Stripping

Prior to the start of earthwork, the areas planned for grading should be cleared of any trees and brush and stripped of any vegetation. When removing trees and bushes, all roots larger than 1-inch in diameter should be removed. All stripped vegetation should be removed from the site.

15.3 Removals

Prior to placement of compacted fill for the new levees, the subgrade soils along the levee alignments should be excavated and recompacted. The minimum limits for the recompaction under levees are shown in Appendix I (Plates I-2 through I-4) and are described below.

- Under the "core" of the levee, the removal and recompaction should extend to a minimum depth of 4 feet below the existing grade. The core is defined as the area within 3 (horizontal) to 1 (vertical) slopes extending down from the edge of the levee crest.

- Beyond the core, the removal should extend to a minimum depth of at least 2 feet below the existing grade for a minimum equipment width (10+ feet). Beyond this equipment width (10+ feet), specific overexcavation is not required under the flat (10 to 1) slopes planned, but vegetation should be stripped before placing fill,

- The actual limits for removals should be determined by the project geotechnical engineer during construction, based on the local conditions exposed during excavation. Deeper removals will be needed where unsuitable soils are present. In particular, deeper removals should be planned where the levees cross the existing drainage channels in West Area B. Please note that old buried channels may be present that require similar treatment. Deeper excavation should also be planned to remove buried organics in the area of the celery dump known to have been present in east Area A.

- In addition, if highly permeable layers are exposed in the excavation for levees, these layers would provide a path for seepage to occur, it will be necessary to overexcavate and replace these permeable layers to the limits determined by the project geotechnical engineer in the field.

- When wet and/or soft soils are exposed in the excavation made for removals, the excavation will need to be carefully performed using an excavator or low ground pressure equipment to avoid disturbing the soils and prevent equipment from bogging down. In addition, geogrid (Tensar BX 1200 or equivalent) may be needed to stabilize the exposed bottom and provide a firm working surface before new compacted fill can be placed.

15.4 Earthwork

All grading should conform to the requirements of the 2010 California Building Code, and the general grading recommendations outlined below.

1. The grading contractor is responsible for notifying the project geotechnical engineer of a pre-grading meeting prior to the start of earthwork operations and anytime that the operations are resumed after an interruption.

2. Prior to the start of earthwork the project civil engineer should locate any existing utilities in the area. Existing utilities should be removed, relocated or protected, as appropriate.

3. As discussed in Section 15.3, the subgrade soils along the new levee alignments should be overexcavated and recompacted to a minimum depth of 4 feet under the levee core, and 2 feet of overexcavation for a minimum of an equipment width beyond the levee core (Refer to Appendix I). Deeper removals will be needed where unsuitable soils are present. All removals should be performed under the direction of the project geotechnical engineer.

4. Temporary excavations in the soft, loose and wet soils should be planned at a maximum inclination of 1-1/2 (horizontal) to 1 (vertical).

5. The bottoms of excavations should be checked and approved by the project geotechnical engineer before placing any fill. If the bottoms of excavations encounter soft or wet soils, a 1 to 2 foot layer of dry soil with low permeability may be required to be placed over Biaxial Geogrid (Tensar BX 1200, or equivalent) to provide a firm base to support construction equipment and compaction activities. All fill material used under new levees should have low permeability to avoid providing a path for seepage, and must be approved by the geotechnical engineer before being placed. Dewatering of the excavation should also be anticipated.

6. All fill placed should be compacted to at least 90 percent of the maximum dry density determined by the most current ASTM D 1557 standard.

7. The soils encountered in Area A that will be excavated generally consist of fine-grained silty and clayey soils. It is anticipated that most of these soils will be suitable for use in the construction of new levees. However, as discussed in Section 15.5.2, much of the soils that will be excavated are very wet and will require spreading/disking to dry them back before they can be compacted in fills. Sandy soils will not be allowed to be used for the “core” of

the levees (per "core" definition in section 15.3, above). All fill soils shall be approved by the project geotechnical engineer.

8. All import soils should be free of highly expansive clay, organics, debris, rocks greater than 3 inches in any dimension, and other deleterious material. Import soils should have a maximum of about 60 percent passing the number 200 sieve and should have an Expansion Index of less than 60. Import soils should be approved by the geotechnical engineer before being brought to the site.

9. All earthwork and grading should be performed under the observation of the project geotechnical engineer. Compaction testing of the fill soils shall be performed at the discretion of geotechnical engineer. A test should be performed for approximately every 500 cubic yards of fill placed. If specified compaction is not achieved, additional compactive effort, moisture conditioning of the fill soils, and/or removal and recompaction of the below-minimum-compaction soils will be required.

10. Asphalt concrete used for levee roads shall conform to the 2012 "Green Book" or the equivalent, and shall be compacted to at least 95 percent relative compaction.

11. If, in the opinion of the geotechnical engineer, contractor, or owner, an unsafe condition is created or encountered during grading, all work in the area shall be stopped until measures can be taken to mitigate the unsafe condition. An unsafe condition shall be considered any condition that creates a danger to workers, on-site structures, on-site construction, or any off-site properties or persons.

15.5 Excavation

15.5.1 Excavation Slopes

In general, the hydraulic fill in Area A is a fine-grained silty to clayey lose/soft soil with a high moisture content, and the near surface native soils and fill in area B are and moderately soft to soft with a high moisture content and a shallow ground water table. Temporary excavations should be planned at a maximum inclination of 1-1/2 (horizontal) to 1 (vertical).

Surcharge loads, such as vehicular traffic, heavy construction equipment, and stockpiled materials, should be kept away from the top of temporary excavations a horizontal distance at least equal to the depth of excavation. Surface drainage should be controlled and prevented from running down the slope face. Seeping of water should not be allowed within the excavation. Construction equipment and foot traffic should be kept off excavation slopes to minimize sloughing.

All excavation slopes and shoring systems should meet the minimum requirements of the Occupational Safety and Health (OSHA) Standards. Maintaining safe and stable slopes on excavations is the responsibility of the contractor and will depend on the nature of the soils and groundwater conditions encountered and his method of excavation. Excavations during construction should be carried out in such a manner that failure or ground movement will not occur. The contractor should perform any additional studies deemed necessary to supplement the information contained in this report for the purpose of planning and executing his excavation plan.

15.5.2 Excavation Methods – Area A

The soils that will be excavated in Area A were found to be loose/soft and have a high moisture content, ranging approximately 5% to 35% above the optimum moisture content. Therefore, the use of heavy scrapers and dozers is expected to be limited. The excavation must be carefully planned and conducted to avoid overstressing the soils and/or bogging down equipment. The need for excavators, support mats, moving haul roads, low ground pressure equipment and dredging should be considered in planning how to accomplish the excavation. The need to control the ground water perched within the hydraulic fill should also be anticipated during excavation.

As noted previously, it will be necessary to dry the excavated soils back before they can be used in compacted fill. This will require having an area where the soils can be spread and turned and/or disked. In addition the loose soils excavated from Area A are expected to undergo a significant volume loss when compacted for the levee construction, which is discussed in Section 15.7.

15.6 Fill Placement

15.6.1 General

The subgrade conditions along the new levee alignments generally consist of moderately soft to soft, wet, fine-grained silt and clay soils. The excavated soils are also generally silty and clayey, and hence, can be used for construction of the embankments. In addition, these soils are compressible and will settle on the order of 1 to 2 inches for every foot of fill placed. Therefore, the placement of compacted fill for levees should be planned and controlled to avoid overstressing the soils. Based on experience with similar soft soils, the fill should be advanced uniformly along the entire length of each levee without creating unbalanced loads. Furthermore the rate of fill placement should be controlled to allow the soft soils to slowly consolidate and gain strength. Increasing the height of the fill slowly will also provide time for settlement to occur and thus mitigate the potential for differential settlement to create cracks in the embankment. Recommendations for monitoring the fill settlement are discussed in Section 15.8.

Following removals and before placing fill, the bottoms of excavations should be checked and approved by the project geotechnical engineer. If the bottom is soft or wet, a 1 to 2 foot layer of dry soil with low permeability may be required to be placed over Biaxial Geogrid (Tensar BX 1200, or equivalent) to provide a firm base to support construction equipment and compaction activities. Dewatering of the excavation should also be anticipated. The soil used for the backfill should have a low permeability to avoid creating a seepage path under the levee. All fill must be approved by the geotechnical engineer before being placed.

15.6.2 Special Considerations

In West Area B the alignment of the new levee will cross two existing channels. These channels range from about 5 to 8 feet deep and are expected to contain soft sediment, and may also contain sands eroded from the dunes present in West Area B. The easternmost of these channels crosses perpendicular to the levee alignment, about 300 feet east of the west end of Area B. The westernmost channel crosses extends under the length of the planned levee at the west end of Area B (Refer to Figure 4A). In addition, it should be anticipated that there is the possibility that other old channels may also be present, and may have been filled in.

At channel crossings, all soft and sandy material should be removed and replaced with compacted fill. The excavation for this removal will extend below the ground water. Therefore, dewatering will be required to accomplish the removal and backfilling. The exposed bottom should be stabilized with geogrid and a 1 to 2 foot layer of dry soil with low permeability, to provide a firm base to support construction equipment and compaction activities.

During construction of levees, after removals and before placing any fill, the geotechnical engineer should check for the presence of any sand layers that may extend below the alignment of the levee. This could be a particular problem in West Area B, because of the proximity of the natural dunes, there is the potential for eroded sand layers to be present throughout this area. If found to be present, the sand layers should be overexcavated and replaced with low permeability fill soils, to protect against seepage. The presence of any sand layers should also be looked for in all areas where the new levees are constructed.

15.7 Volume Change

The soils excavated from Area A will undergo significant volume reduction as they are compacted for the new levees. Based on our field explorations and the results of lab testing of representative soils, including in-situ density tests, compaction tests and consolidation tests, the gross estimated range of the anticipated volume change that will occur is summarized below.

However, these values are based on limited data for such a large site and should be considered as gross ball-park estimates for gross planning purposes only. The actual amount of volume change is difficult to predict and will depend on the materials in situ density, final in place compacted density achieved, amount of soil blending that occurs in the handling process, and other factors.

- Volume loss of excavated soils taken from Area A that then compacted to a minimum density of 90% modified proctor (average of 92%) is in the range of 15% to 25%.

- Volume loss due to stripping of vegetation, where present, is estimated to range from about 2 to 4 inches.

- Volume loss from compacting the existing subgrade soils along the alignment of new levees and/or in areas to receive excess fill, is estimated to range from 15 to 25% in Area A, and from 10 to 20% in Area B and Area C.

- The anticipated settlement in Areas A and B as a result of placement of fill is on the order of 1.5 to 2 inches per foot of fill placed.

- Settlement in Areas C as a result of placement of fill is on the order of 1.0 to 1.5 inches per foot of fill placed.

- Volume loss due to “spillage” during hauling, wind, etc. may be on the order of 1%.

Recommended Volume Change Monitoring Program

To develop a better estimate of the volume reduction that occurs during construction, it is recommended that a monitoring program be conducted to during the initial phases of the earthwork. This will require surveying to determine, the volume excavated in Area A and the volume of fill placed to create a new embankment with that volume of excavated soil. In addition, a settlement monitoring program should be established the actual amount of settlement that occurs during filling. The settlement monitoring program is discussed in Section 15.8.

15.8 Settlement Monitoring

To evaluate both the magnitude and the rate of actual settlements during construction, it is recommended that a settlement monitoring program be developed and maintained. A detail of a settlement plate is provided in Figure 8. In general, settlement plates should be installed on about 400-to 500-foot spacing along the alignment for new levees. The plates should be installed after removal and recompaction of the subgrade, and before placing the embankment fill.

The settlement plates should be surveyed every week as the fill placement is being placed, bi-weekly for the first two months after completion of the fill placement, and monthly thereafter, until 90 percent of the primary consolidation is deemed complete. Each time the plate is read, the elevation of the top of the fill should also be recorded. Care should be taken not to damage the monuments during grading. If a monument is irreparably damaged or destroyed, a replacement monument should be immediately installed within 10 feet of the lost monument and a new survey baseline established for the new monument.

16.0 CULVERTS

16.1 General

Two new culvert structures will be constructed to connect south Area B to the restored wetlands. The locations of the culverts are shown in Figure I-1 in Appendix I. Each of the culverts will extend under Culver Boulevard and the new Area B (Culver) levee.

Settlement on the order of about 20 to 27 inches is expected to occur as a result of construction of the new Culver levee. To minimize the potential for settlement of the culvert after construction, two options are presented.

- Culverts can be constructed after 90% of the primary consolidation is completed, after placing the Culver levee. This will require excavation of the new levee, installation of the culverts and then replacement of the levee fill.

- As an alternative, the culvert areas can be pre-surcharged 3 to 4 feet higher than the design levee height at each location along the alignment of the culvert. After 90% of the primary consolidation is complete, the surcharge can be removed to install the culvert.

A temporary culvert pipe can be installed before placing the fill. Once the settlement is completed, the temporary pipe can be removed and the permanent culvert can be installed.

Generally, it is expected that 90% of the primary settlement will occur within about three to six months. Settlement monitoring should be performed at culvert locations to determine when primary consolidation is complete and installation of the culverts can begin.

16.2 Construction Considerations

Excavations and shoring for culverts should comply with current OSHA regulations, and observed by the designated competent person on site. Excavations for the culverts should be planned at a maximum inclination of 1-1/2 (horizontal) to 1 (vertical). However, since the culverts will be installed below groundwater level, water should be controlled by installing sheet piles and performing dewatering, in lieu of sloping. The shoring should be designed for a lateral soil pressure equal to an equivalent fluid pressure of 40 pcf, if unbraced, and if braced, for a uniform pressure (psf) of 30H, where H is the height of the excavation. Both pressures assume the excavation is dewatered, and there are no hydrostatic pressures on the sheet piles.

The civil engineer should identify the presence of existing utilites in the area. Provisions should be developed to protect existing utilities, by supporting the utilities to span between the sheet piles. Because of the high volume of daily traffic on culver Boulevard, a traffic plan and phasing schedule are need to maintain traffic flow during construction of the culverts.

Very soft or wet soils are anticipated at the base of the Culverts. The bottoms of the excavation should be checked and approved by the project geotechnical engineer. If the bottom is soft or wet, a 1 to 2 foot layer of soil with low permeability may be required to be placed over Biaxial Geogrid (Tensar BX 1200, or equivalent) to provide a firm base to support construction equipment and compaction activities. Dewatering of the excavation should also be anticipated, and compaction of all fill should be performed in the dry. The soil used for the backfill should have a low permeability to avoid creating a seepage path under the levee. All fill must be approved by the geotechnical engineer before being placed. To minimize the potential of seepage around the culvert, a properly designed concrete headwall should be used at the entry and exit points of the culvert.

The bedding zone is defined as area containing the material specified that is supporting, surrounding, and extending to 1 foot above the top of Culvert. The bedding shall satisfy the requirements of Standard Specifications for Public Works Construction (SSPWC) Section 306-1.2.1.

Backfill shall be considered as starting 1-foot above, and 1-foot to the sides the Culvert. On-site excavated materials can be used as backfill. However, wet soils will need to be dried back. Any material larger than 3 inches in any dimensions shall be removed before backfilling. All backfill shall be placed in lifts not exceeding six to eight inches in thickness and be compacted to at least 90 percent of relative compaction as determined by the ASTM D-1557.

16.3 Earth Pressures on Culverts

Culverts should be designed for vertical and horizontal earth pressures according to pressures shown on Figure 9. Due to presence of shallow ground water, horizontal earth pressures shown on Figure 9, include hydrostatic earth pressures in addition to at-rest earth pressures.

For portions of the culverts, passing below Culver Blvd., traffic loads can be modeled as 2 feet of soil surcharge or 240 psf vertical pressures. For rigid wall of the culverts, a uniform lateral pressure of 100 psf should be added to the horizontal pressures, as shown on Figure 9.

17.0 PEDESTRIAN BRIDGE

As part of the public access plan, a pedestrian bridge is planned to be constructed west of the Culver Boulevard Bridge. Due to anticipated large loads of the bridge, presence of moderately to highly compressible clays below the site, and variable potential for liquefaction settlements anticipated across the site, it is recommended to use deep foundations for support of the pedestrian bridge. Pile foundation recommendations are provided below. The bridge may also be designed to accommodate trucks hauling excavated soil from Area A to Area B.

17.1 Pile Foundations

Due to the presence of moderately to highly compressible clays below the site, and variable potential for liquefaction settlements anticipated across the site, it is recommended to use deep foundations for support of the pedestrian bridge. The piles should be installed to practical refusal, about 3 to 5 feet into the dense sands below about El. -45 feet. We estimate the final tip elevations for piles to be roughly El. -50 feet.

We recommend the proposed building be supported using one of the following pile installation systems:

14-inch square
- Driven piles (square pre-stressed concrete)

14-inch diameter

- Auger cast displacement piles (ACD)

Based on our previous experience at the nearby Playa Vista, these pile types and diameter sizes can be successfully constructed. If driven piles are used we recommend that a Pile Driving Analyzer (PDA) be used during driving.

17.2 Pile Axial Capacity

Based on the results of our analyses and our experience at Playa Vista, allowable pile loads of 220 kips for 14-inch square driven piles, and 200 kips for 14-inch diameter ACD piles are recommended. .

Downdrag loads must be considered from ground settlement due to the potential liquefaction during a major seismic event. The downdrag calculations indicate that downdrag loads ranging from about 81 to 102 kips could develop during design seismic events.

If the site grade is raised (e.g., for elevating the roadway), additional downdrag loads may be expected that depend on final elevations. We recommend that downdrag loads from consolidation settlement due to any new fill be evaluated.

It should be noted that the maximum downdrag loads are based on the assumption that no settlement of the pile occurs due to the application of the downdrag load. It is estimated that piles could settle about 0.25 inches as the downdrag load is applied. This settlement will significantly reduce the downdrag load. However, for conservatism, we assumed the full downdrag.

Table 9 summarizes the axial pile capacity for the considered pile types.

Table 9: Axial Pile Capacity

Type	Pile Diameter	Allowable Compression	Allowable Uplift
Driven	14-inch square	220 k	125 k
ACD	14-inch round	200 k	100 k

It is generally recommended that the piles be installed to at least 3 pile diameters of penetration or practical refusal into the dense sands. Therefore, the final tip elevations for most piles are expected to be about El. -50 feet.

We recommend that piles be installed with a minimum 3 diameters center-to-center spacing. For piles with a minimum 3 diameters center-to-center spacing and two to three pile groups, no reduction in axial capacity is required.

17.3 Pile Settlement

It is anticipated these piles would settle about 0.25 inch under the recommended allowable load. No significant differential settlement is expected under static loads.

The additional settlement as a result of the design seismic event is estimated to be 0.25 inches or less. Hence, the estimated settlement including the static loads as well as drag loads due to potential liquefaction is anticipated to be about 0.5-inch. Differential settlement of similarly loaded columns may be taken as 50% of the total settlement.

17.4 Pile Lateral Capacity

We evaluated the lateral capacity of the recommended piles using the computer program LPILE 6.0 (Ensoft, 2010). The lateral capacities at 0.25 inches, 0.5 inches and 1.0 inch of pile head deflection, for both fixed head and free head conditions, and for single piles, are provided in Table 10. To utilize a fixed head condition, the pile and pile cap connections must be able to translate laterally without rotation, and be designed for the fixed head moment.

Table 10: Lateral Pile Capacity

Condition	Pile Type	Pile Head Deflection (inch)	Max Shear (kips)	Max Moment (kip-ft)	Depth to Max. Moment (feet)
Fixed	14-inch (square)	0.25	17	76	0
		0.5	31	146	0
		1	52	267	0
	14-inch (round)	0.25	14	56	0
		0.5	25	105	0
		1	41	192	0
Free	14-inch (square)	0.25	6	25	6.5
		0.5	12	50	6.5
		1	19	92	7
	14-inch (round)	0.25	5	19	6
		0.5	9	37	6
		1	15	68	6.5

Deflection, shear and moment diagrams for the piles under lateral load are provided in Appendix J. We recommend the project structural engineer verify the maximum moment capacity of the pile.

17.5 Lateral Resistance

For lateral resistance of pile caps, we recommend an allowable passive fluid pressure of 300 pcf above the water table (El. +10 feet NAVD). Friction resistance should not be used for pile caps due to potential seismic settlement, which may cause a slight separation between the pile caps and the subgrade soils.

18.0 CONSTRUCTION OF THE MEANDER CHANNEL

To create the new meander channel for Ballona Creek will require lowering and breaching of the existing levees. The construction of the meander will require careful planning, phasing and coordination. In general, the existing levee is lowered as much as possible prior to final breaching, to minimize the risk of uncontrolled breaching. Just prior to the breaching, the new meander channel is excavated.

The contractor could also use strategically located sheet piles and/or coffer dams to safely control the breaching. The use of coffer dams will also provide protection, so that with dewatering, the abandoned levee channel can be backfilled in the dry. The contractor’s plans for the breaching and backfilling of the abandoned channel should be submitted for review and approval, before proceeding. The contractor’s method should provide for controlled breaching and for the abandoned channel to be backfilled in the dry. Armor rock riprap is needed at the ends of the meander channel fill to provide protection against erosion. Since the fill will be compacted and the ends will have riprap, the ends of the meander channel fill are not critical for slope stability.

If the backfill in the abandoned creek channel is not adequately compacted, it could liquefy during a strong earthquake and flow laterally into the new meander channel. Potentially liquefiable backfill would require soil improvement along the edges to prevent lateral spreading into the new meander channel. This would be undesirable and expensive.

19.0 VEGETATION PLANTING

Generally, trees and deep rooted vegetation are not recommended on levees, since they have long term detrimental effects by creating voids due to root growth and root decay, hence having a potentially negative impact on the integrity of the levee (piping risk). The potential negative impact of the vegetation planting beyond the levee core is considered remote, because the flatness of the levee slopes results in a especially wide core.

Hydroseeding a native mix of plants (preferable perennial shallow rooted) is recommended to protect the surface of the levees again erosion.

Beyond the “vegetation-free zone” of the flood protection levees, larger vegetation and plants may be permitted.

Specific guidelines for the types and locations of the vegetation allowed on the levees should be addressed by the USACE.

20.0 ENVIRONMENTAL ISSUES

Evaluation of environmental issues for this project and their impact on site development are outside our scope of work and are the responsibility of the project environmental consultant.

21.0 CONCLUDING REMARKS

This investigation was performed in accordance with generally accepted Geotechnical Engineering principles and practice. The professional engineering work and judgments presented in this report meet the standard of care of our profession at this time. No other warranty, expressed or implied, is made. This report has been prepared for the Santa Monica Bay Restoration Commission, and their design consultants. It may not contain sufficient information for other parties or other purposes, and should not be used for other projects or other purposes without review and approval by GDC.

The recommendations for this project, to a high degree, are dependent upon proper quality control of site grading, fill and backfill placement. The recommendations are made contingent on the opportunity for GDC to observe the earthwork operations. This firm should be notified of any pertinent changes in the project, or if conditions are encountered in the field, which differ from those described herein. If parties other than GDC are engaged to provide such services, they must be notified that they will be required to assume complete responsibility for the geotechnical phase of the project, and must either concur with the recommendations in this report or provide alternate recommendations.

22.0 STATEMENT OF RESPONSIBILITY

We have reviewed the reports referenced in Appendix A2. Except as presented in this report, we concur with their findings and accept responsibility for using their results. However, the recommendations contained in our report supersede the recommendations contained in the reports in Appendix A2.

23.0 REFERENCES

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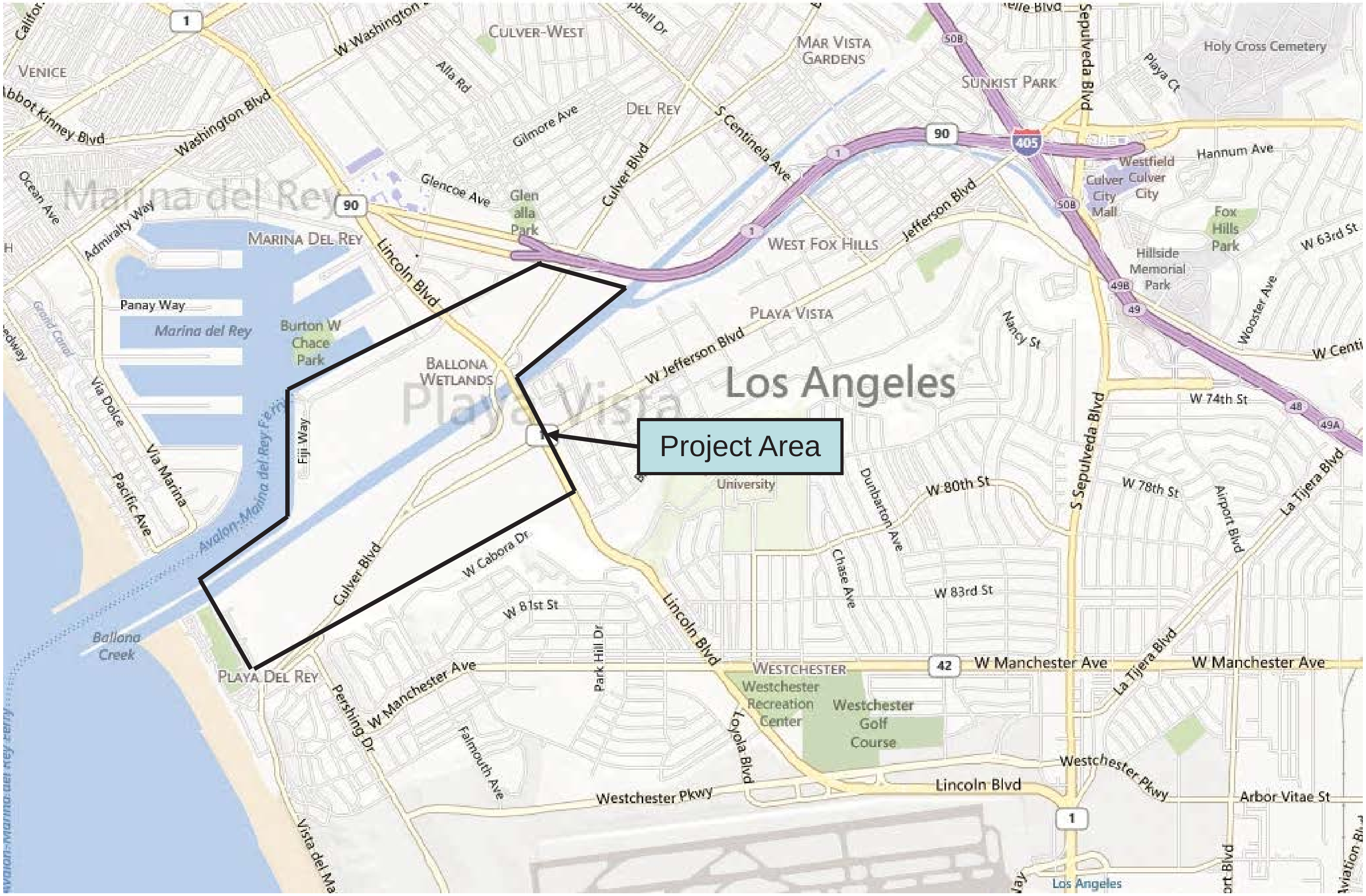
FIGURES



Vicinity Map

Project Number: LA-962A

Date: 5/28/2013

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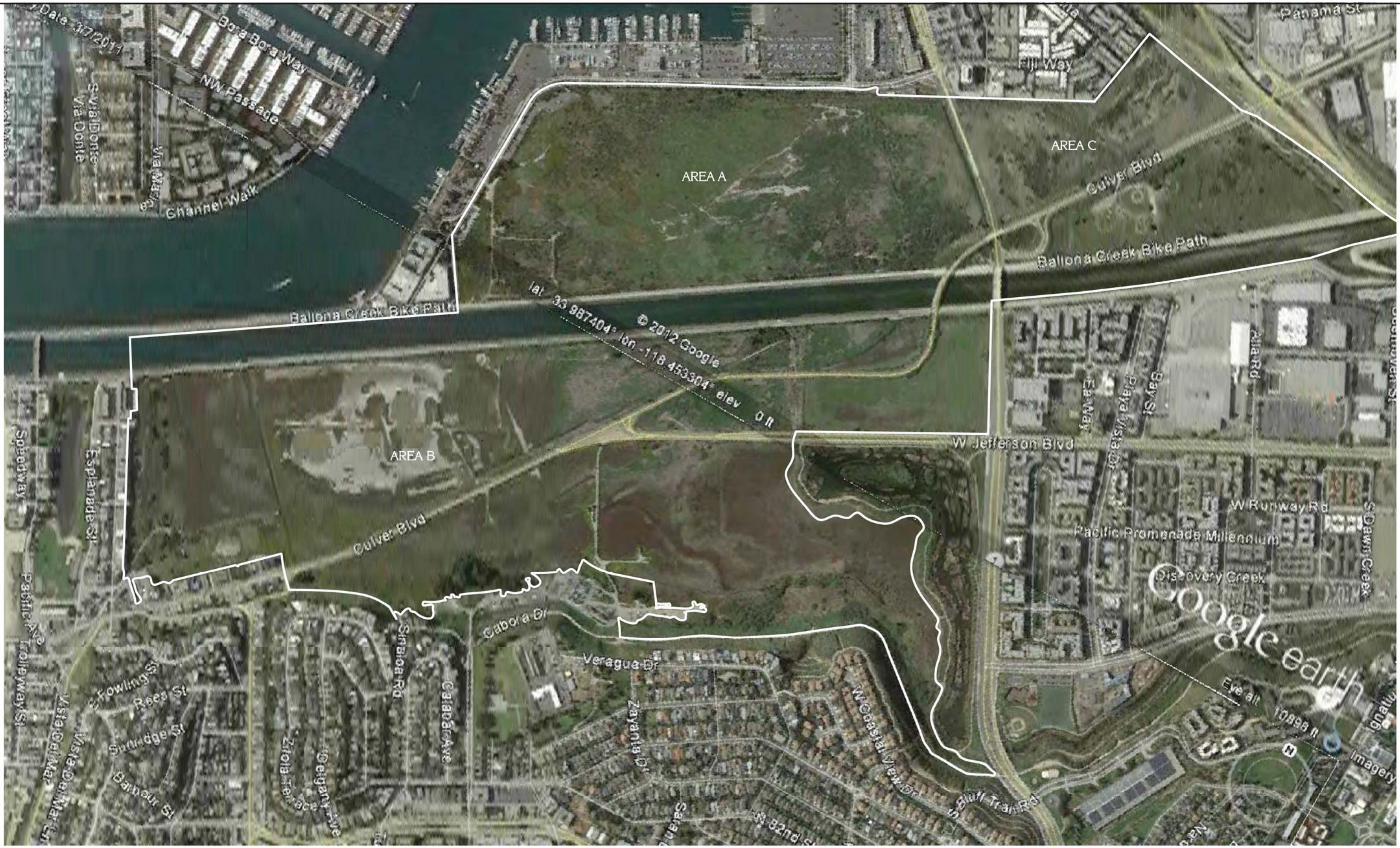
370 Amapola Ave.
Torrance, Ca 90501

Ballona Creek Wetlands Restoration

Figure 1



DATE: 8/28/12

DRAWN BY: A. Helma

REVISION:

APPROVED BY: P. Kashighandi

REVISION:

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SITE PLAN

Ballona Wetlands Restoration
Los Angeles, CA

PROJECT NUMBER: LA962A

SCALE: 1" = 750'

FIGURE NUMBER: 2

N:\Projects\900-999\L-962 Jones and Stokes - Ballona Wetland Conceptal geotech\Drawings\L-962 Figures 1-3 - Site Plan-prev and prop borings.dwg

LEGEND

● A-RW002 GDC Boring (RW/HSA) Location
▲ A-CPT001 GDC CPT Location
○ 33/91 Law Crandall Boring Locations (1991)
○ 18/87 Law Crandall Boring Locations (1987)
○ 24 Law Crandall Boring Locations in Area A (1991)
B-13 Diaz Yourman Boring Locations in Area B (2010)
C-07 Diaz Yourman Boring Locations in Area C (2010)
● 30 Weston Boring Locations (2009)

DATE: 1/22/2013
DRAWN BY: K. Madamba
REVISION:
APPROVED BY: P. Kashighandi
REVISION:

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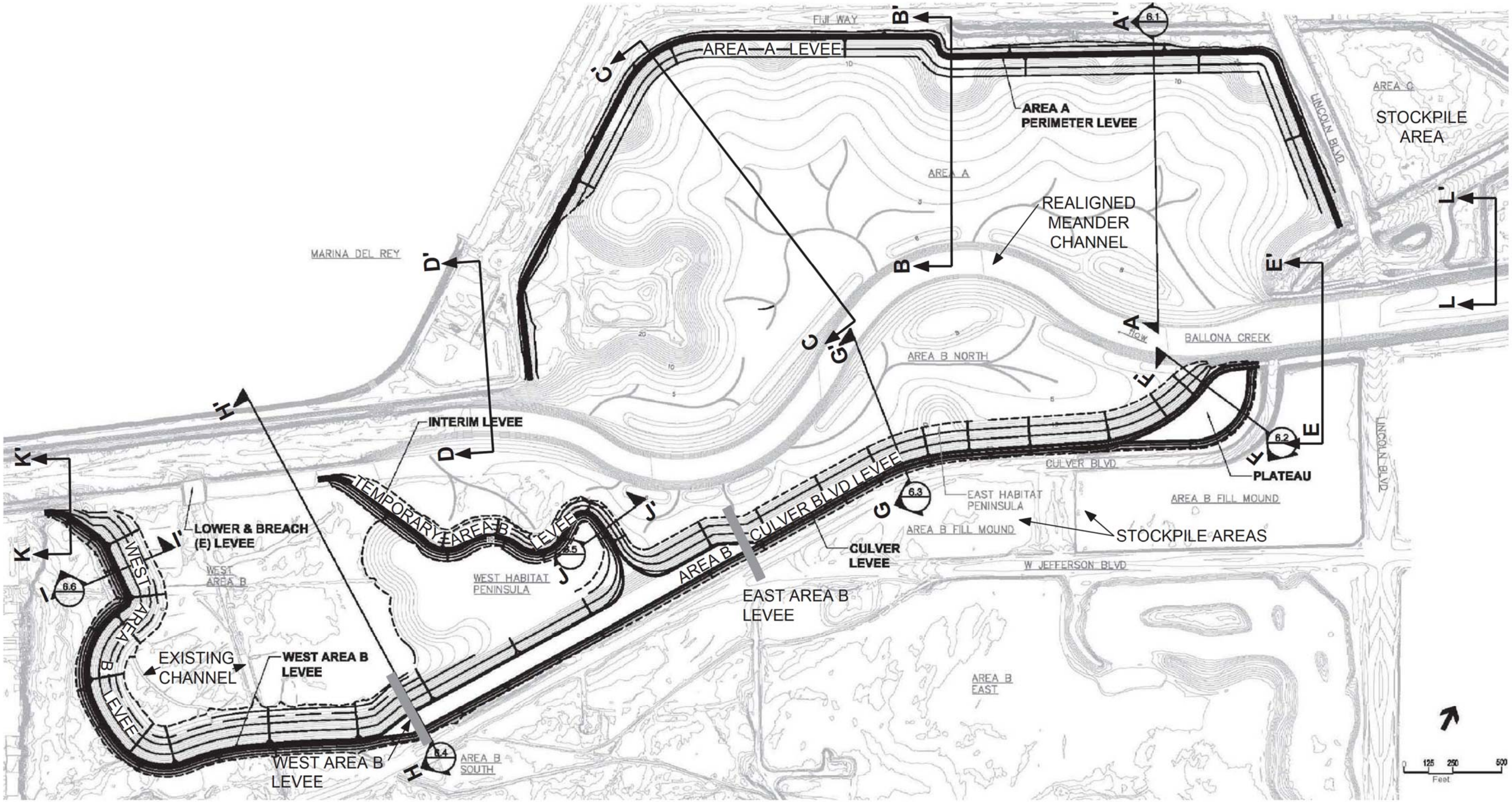
PREVIOUS AND CURRENT INVESTIGATION BORINGS

Ballona Wetlands Restoration
Los Angeles, CA

PROJECT NUMBER: LA962A
SCALE: 1" = 750'
FIGURE NUMBER: 3



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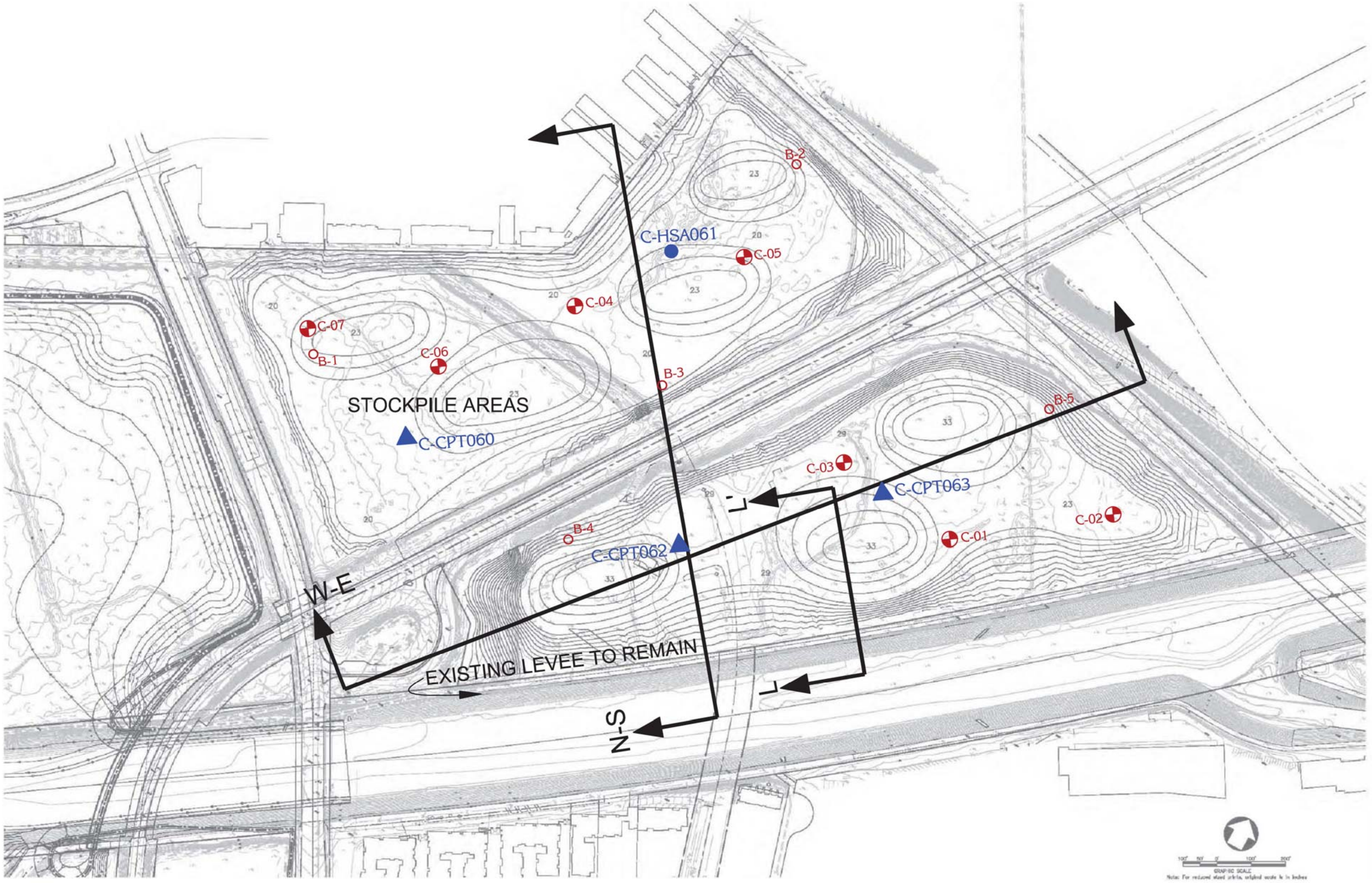
PROPOSED GRADING PLAN AND CROSS SECTIONS

BALLONA WETLANDS RESTORATION PROJECT
LOS ANGELES, CA

PROJECT NUMBER: L962A
SCALE: AS SHOWN
FIGURE NUMBER: 4A

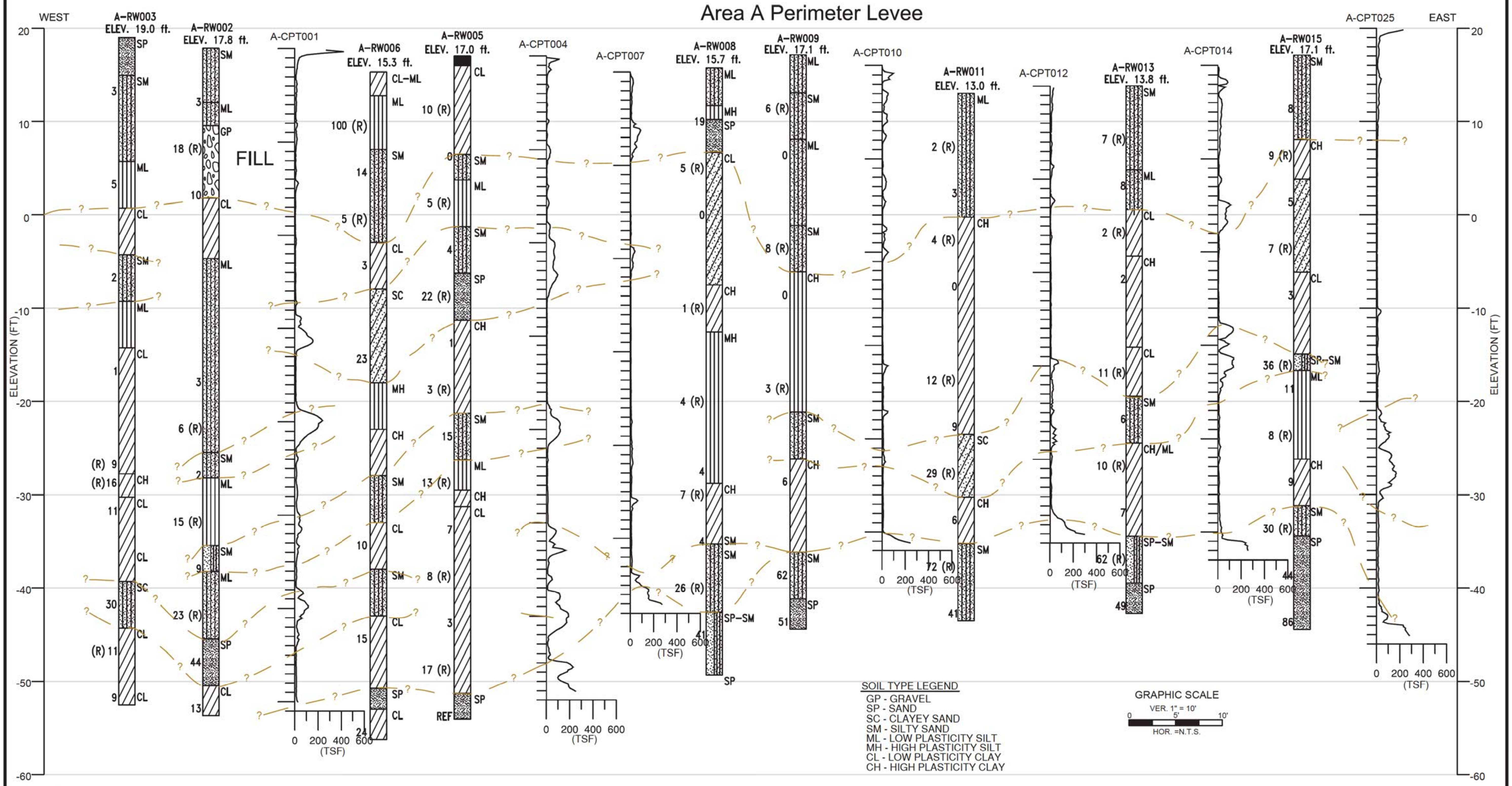


LEGEND

●	C-RW002	GDC Boring (RW/HSA) Location
▲	C-CPT001	GDC CPT Location
○	B-5	Law Crandall Boring Locations in Area C (1991)
⊕	C-07	Diaz Yourman Boring Locations in Area C (2010)

DATE: 1/22/2013	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	AREA C GRADING PLAN AND CROSS SECTIONS (LEVEE AND PERIMETER)	PROJECT NUMBER: LA962A
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi			BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	SCALE: AS SHOWN
REVISION:					FIGURE NUMBER: 4B

Area A Perimeter Levee



SOIL TYPE LEGEND

GP - GRAVEL
SP - SAND
SC - CLAYEY SAND
SM - SILTY SAND
ML - LOW PLASTICITY SILT
MH - HIGH PLASTICITY SILT
CL - LOW PLASTICITY CLAY
CH - HIGH PLASTICITY CLAY

LEGEND

9	SPT N-Value
20 (R)	Blowcounts of Modified California Ring Sample
— ? —	Interpreted Layer Boundry

NOTE

(1) PLOT INCLUDES BORINGS WITHIN ABOUT 100 FEET OF THE PROPOSED AREA A PERIMETER LEVEES.
(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.
(3) BORINGS ARE SHOWN FROM WEST TO EAST. HORIZONTAL DISTANCES BETWEEN BORINGS ARE NOT TO SCALE.

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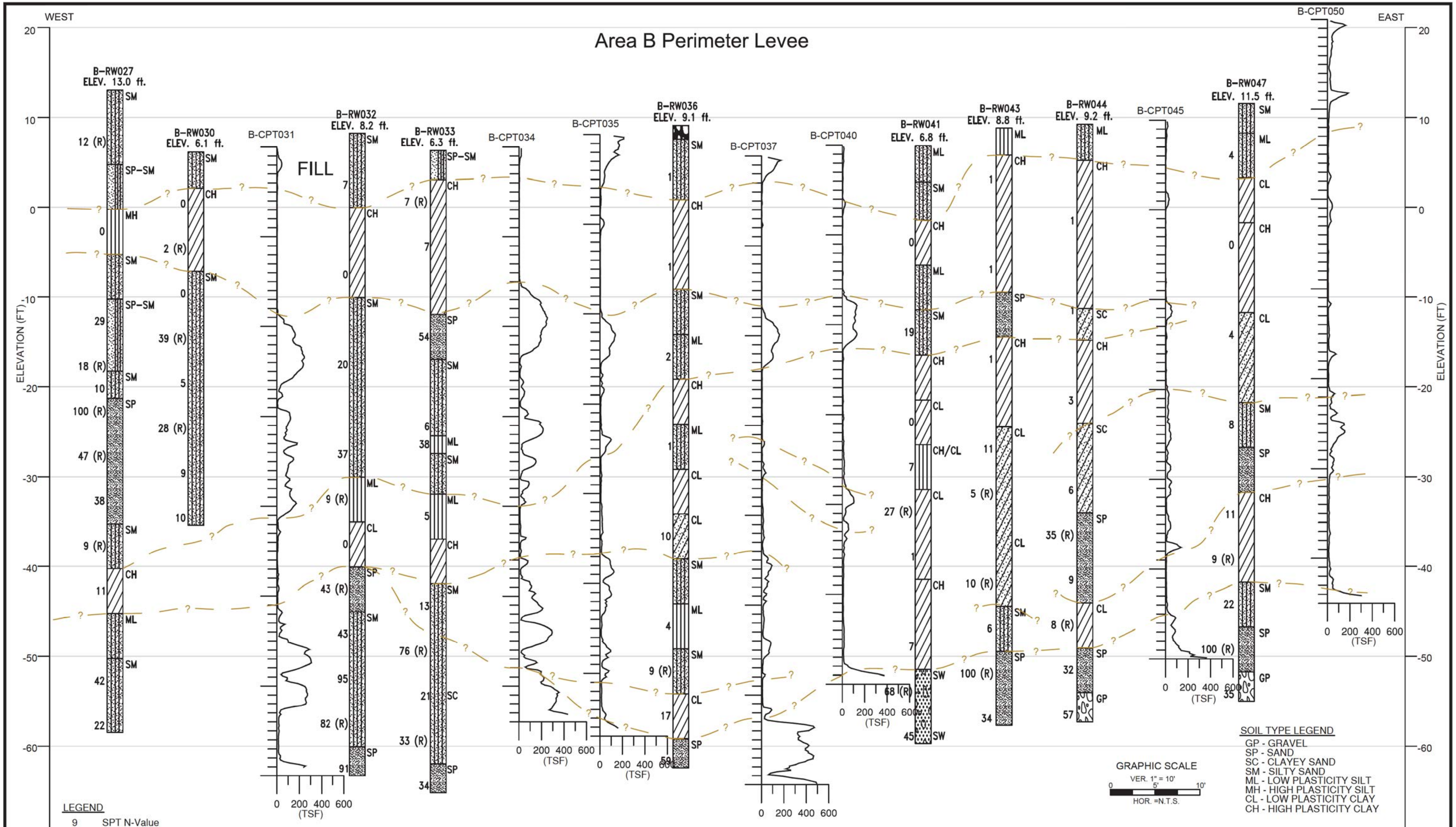
SUBSURFACE PROFILE ALONG AREA A PERIMETER LEVEE

BALLONA WETLANDS RESTORATION PROJECT
LOS ANGELES, CA

PROJECT NUMBER: L962A
SCALE: AS SHOWN
FIGURE NUMBER: 5A



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

— ? — Interpreted Layer Boundry

SOIL TYPE LEGEND

GP - GRAVEL
SP - SAND
SC - CLAYEY SAND
SM - SILTY SAND
ML - LOW PLASTICITY SILT
MH - HIGH PLASTICITY SILT
CL - LOW PLASTICITY CLAY
CH - HIGH PLASTICITY CLAY

NOTE

1. (1) PROFILE INCLUDES BORINGS WITHIN ABOUT 100 FEET OF THE PROPOSED AREA B LEVEES (WEST AREA B AND CULVER BLVD).
2. (2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.
3. (3) BORINGS ARE SHOWN FROM WEST TO EAST. HORIZONTAL DISTANCES BETWEEN BORINGS ARE NOT TO SCALE.

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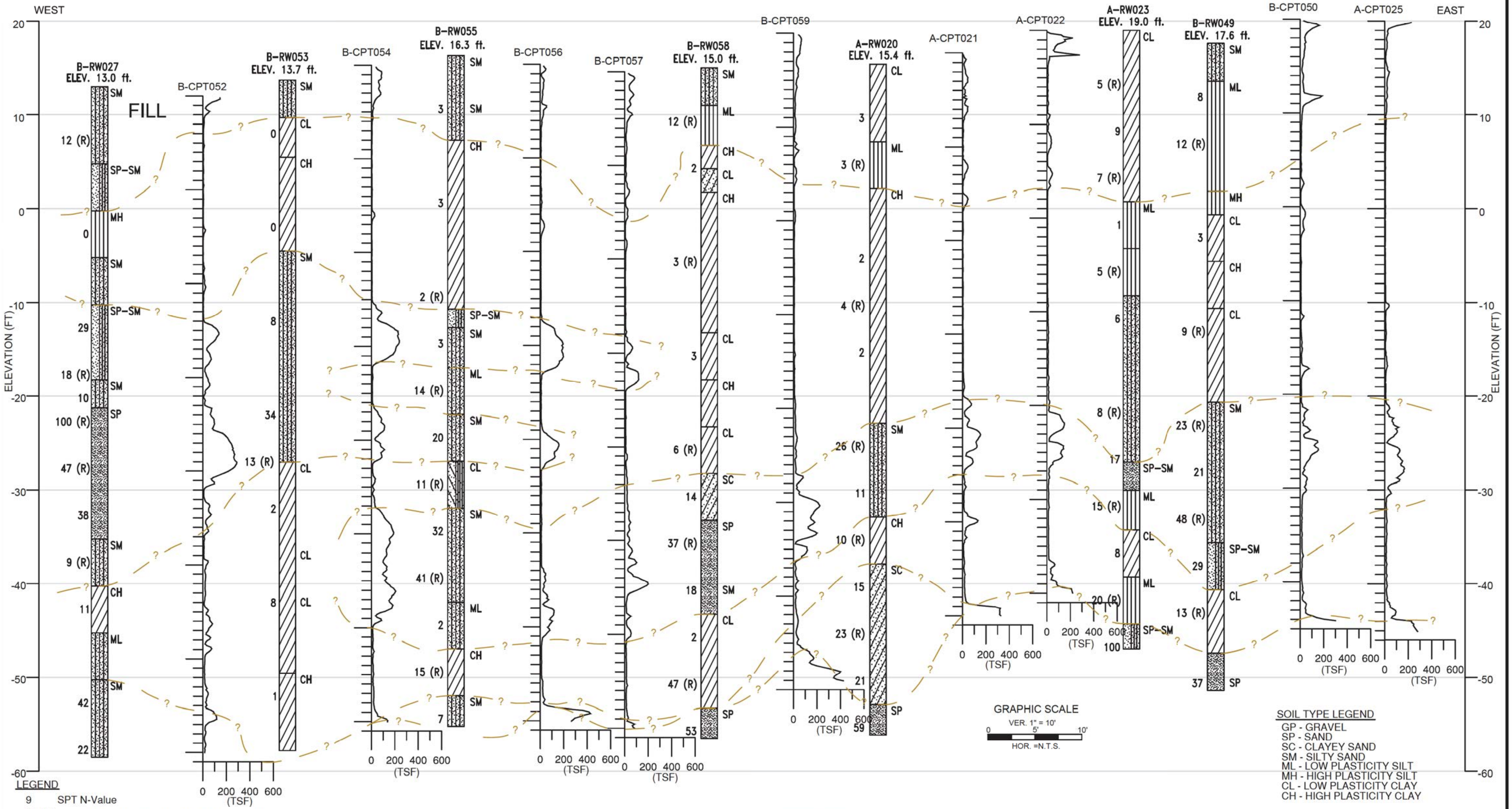
SUBSURFACE PROFILE ALONG AREA B PERIMETER LEVEE

BALLONA WETLANDS RESTORATION PROJECT
LOS ANGELES, CA

PROJECT NUMBER: L962A
SCALE: AS SHOWN
FIGURE NUMBER: 5B

Borings Along Ballona Creek Levee



SOIL TYPE LEGEND
GP - GRAVEL
SP - SAND
SC - CLAYEY SAND
SM - SILTY SAND
ML - LOW PLASTICITY SILT
MH - HIGH PLASTICITY SILT
CL - LOW PLASTICITY CLAY
CH - HIGH PLASTICITY CLAY

LEGEND

9 SPT N-Value
20 (R) Blowcounts of Modified California Ring Sample
— ? — Interpreted Layer Boundry

NOTE

(1) PROFILE INCLUDES BORINGS WITHIN ABOUT 100 FEET OF THE EXISTING BALLONA CREEK LEVEES.
(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.
(3) BORINGS ARE SHOWN FROM WEST TO EAST. HORIZONTAL DISTANCES BETWEEN BORINGS ARE NOT TO SCALE.

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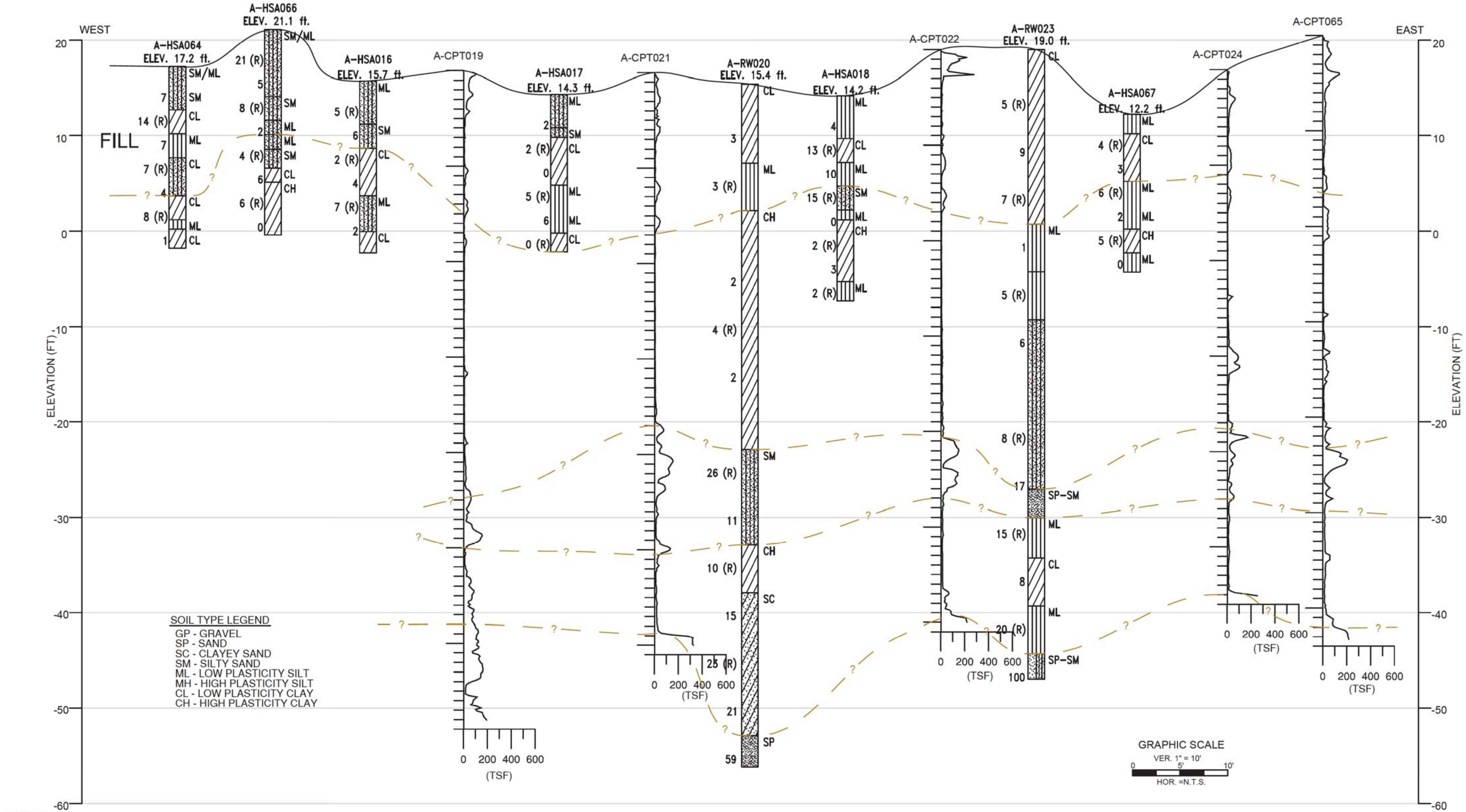
SUBSURFACE PROFILE ALONG BALLONA CREEK CHANNEL

BALLONA WETLANDS RESTORATION PROJECT
LOS ANGELES, CA

PROJECT NUMBER: L962A
SCALE: AS SHOWN
FIGURE NUMBER: 5C



LEGEND

9	SPT N-Value
20 (R)	Blowcounts of Modified California Ring Sample
— ? —	Interpreted Layer Boundry

NOTE

(1) PROFILE INCLUDES BORINGS WITHIN ABOUT 100 FEET WITHIN AREA A EXCAVATION ZONE.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

(3) BORINGS ARE SHOWN FROM WEST TO EAST. HORIZONTAL DISTANCES BETWEEN BORINGS ARE NOT TO SCALE.

DATE: 12/18/2012

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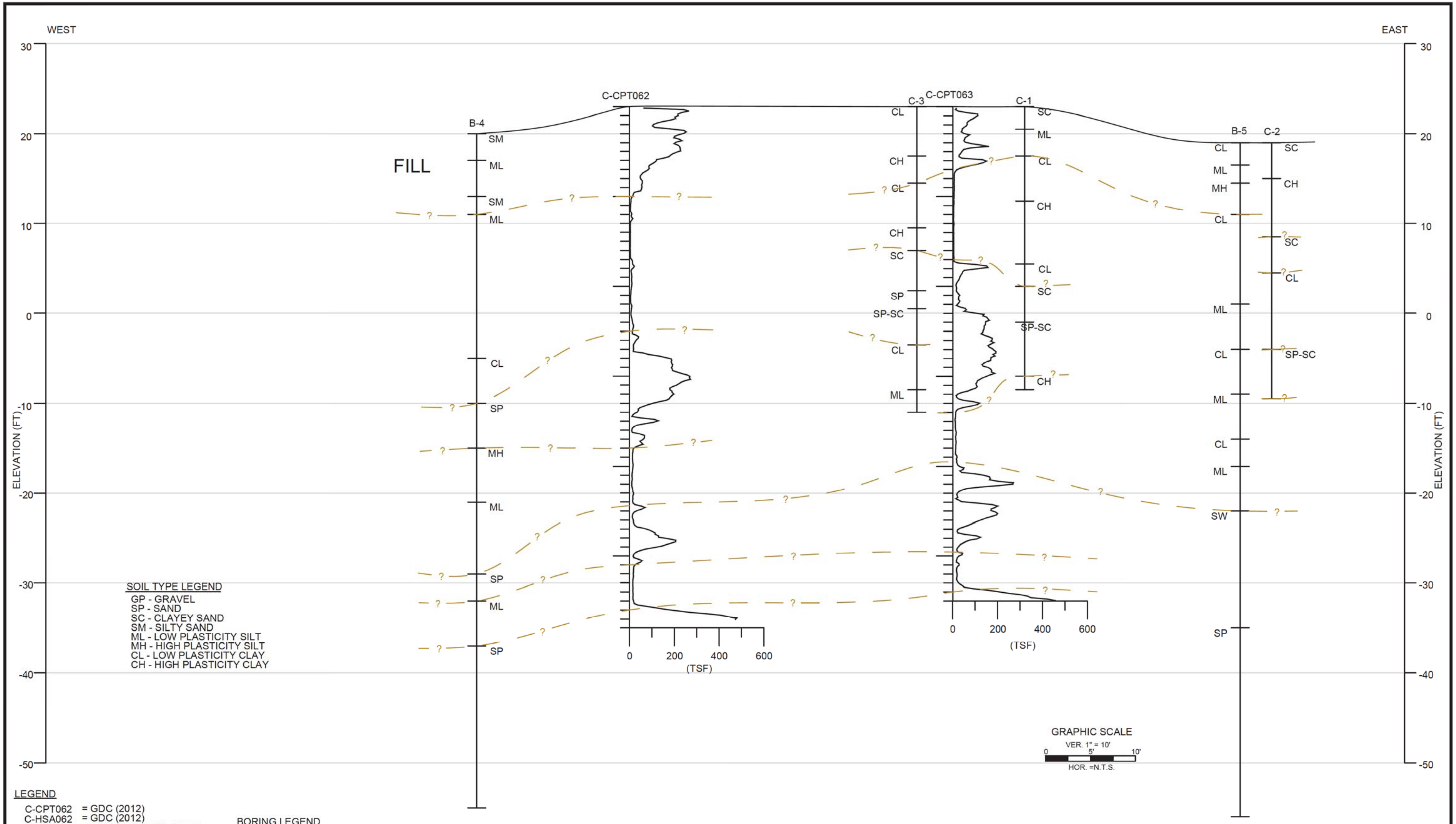
SUBSURFACE PROFILE WITHIN AREA A EXCAVATION ZONE

BALLONA WETLANDS RESTORATION PROJECT
LOS ANGELES, CA

PROJECT NUMBER: L962A

SCALE: AS SHOWN

FIGURE NUMBER: 5D



SOIL TYPE LEGEND

GP - GRAVEL
SP - SAND
SC - CLAYEY SAND
SM - SILTY SAND
ML - LOW PLASTICITY SILT
MH - HIGH PLASTICITY SILT
CL - LOW PLASTICITY CLAY
CH - HIGH PLASTICITY CLAY

LEGEND

C-CPT062 = GDC (2012)
C-HSA062 = GDC (2012)
B-4 = LAW CRANDALL (1991)
C-1 = DIAZ YOURMAN (2010)
— ? — Interpreted Layer Boundry

BORING LEGEND

9 SPT N-Value
20 (R) Blowcounts of Modified California Ring Sample

NOTE

(1) PROFILE INCLUDES GDC's BORINGS/CPT's AND SELECTED BORINGS FROM PREVIOUS INVESTIGATIONS WITHIN AREA C.
(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.
(3) BORINGS ARE SHOWN FROM WEST TO EAST. HORIZONTAL DISTANCES BETWEEN BORINGS ARE NOT TO SCALE.

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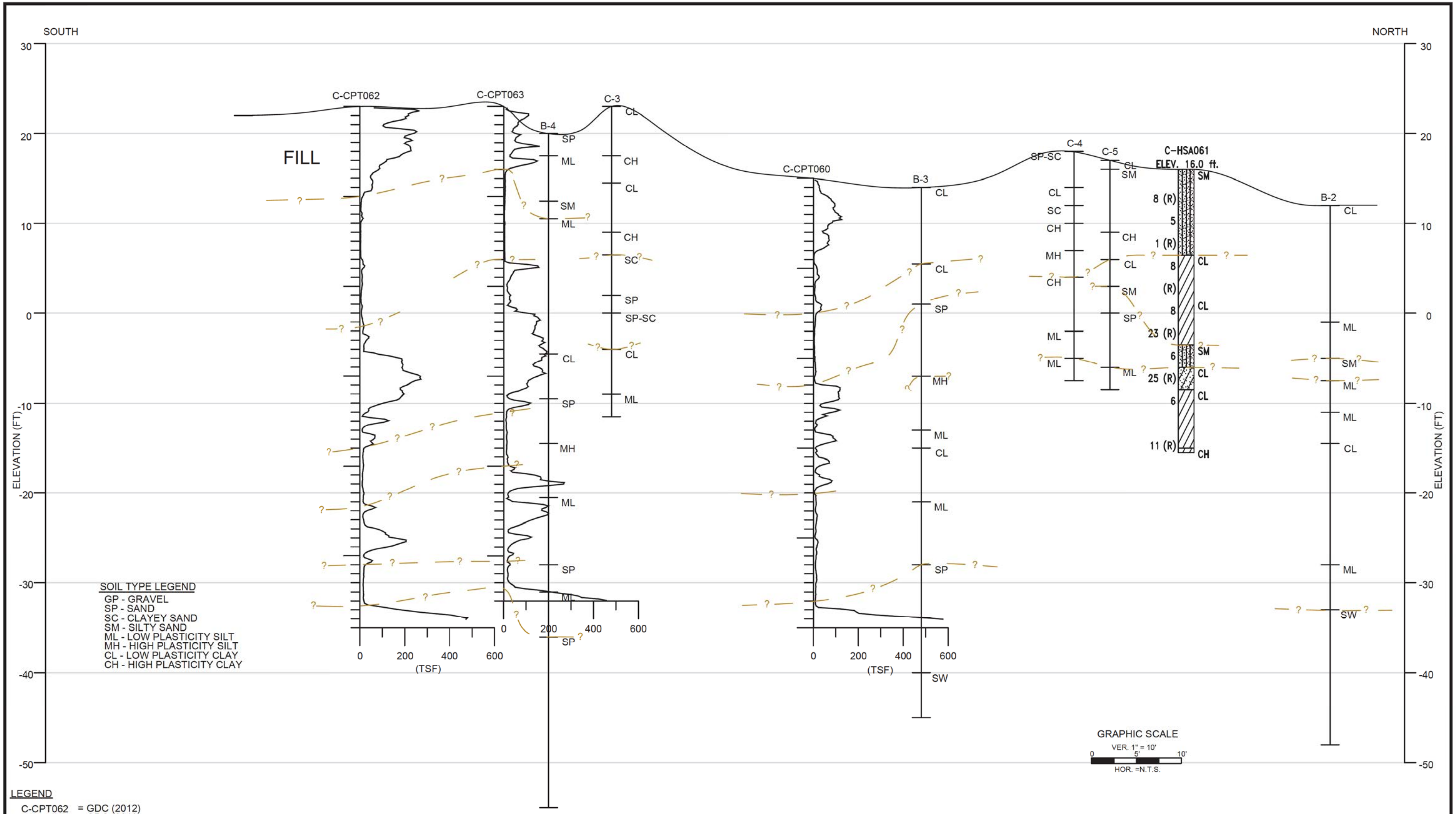
SUBSURFACE PROFILE ALONG SOUTH AREA C (W-E)

BALLONA WETLANDS RESTORATION PROJECT
LOS ANGELES, CA

PROJECT NUMBER: L962A
SCALE: AS SHOWN
FIGURE NUMBER: 5E



LEGEND

C-CPT062 = GDC (2012)
C-HSA061 = GDC (2012)
B-3 = LAW CRANDALL (1991)
C-3 = DIAZ YOURMAN (2010)
— ? — Interpreted Layer Boundry

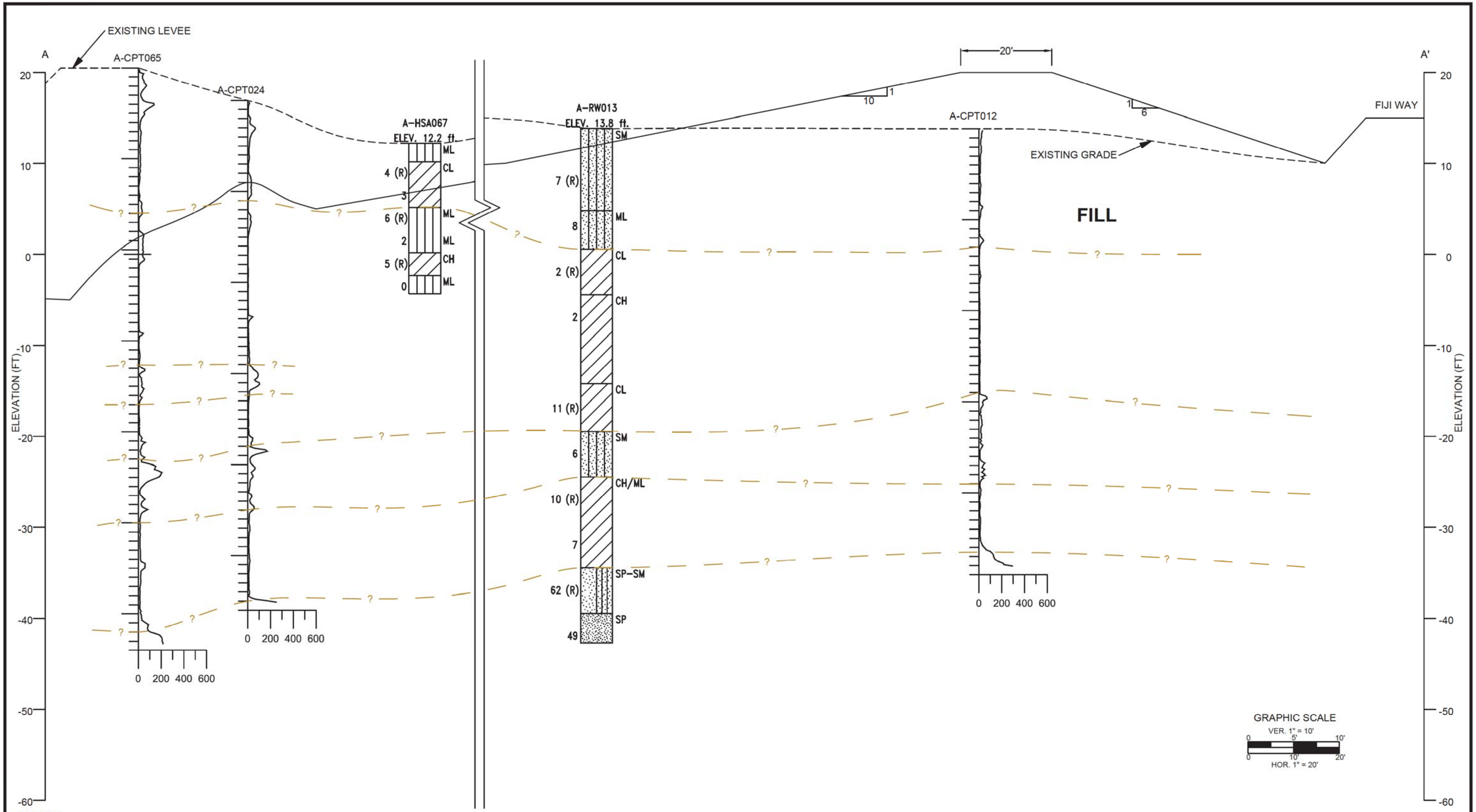
BORING LEGEND

9 SPT N-Value
20 (R) Blowcounts of Modified California Ring Sample

NOTE

(1) PROFILE INCLUDES GDC's BORINGS/CPT's AND SELECTED BORINGS FROM PREVIOUS INVESTIGATIONS WITHIN AREA C.
(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.
(3) BORINGS ARE SHOWN FROM SOUTH TO NORTH. HORIZONTAL DISTANCES BETWEEN BORINGS ARE NOT TO SCALE.

DATE: 12/4/2012	DRAWN BY: K. Madamba	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	SUBSURFACE PROFILE WITHIN AREA C (N-S)	PROJECT NUMBER: L962A
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi		BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	SCALE: AS SHOWN
REVISION:				FIGURE NUMBER: 5F



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

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REVISION:	

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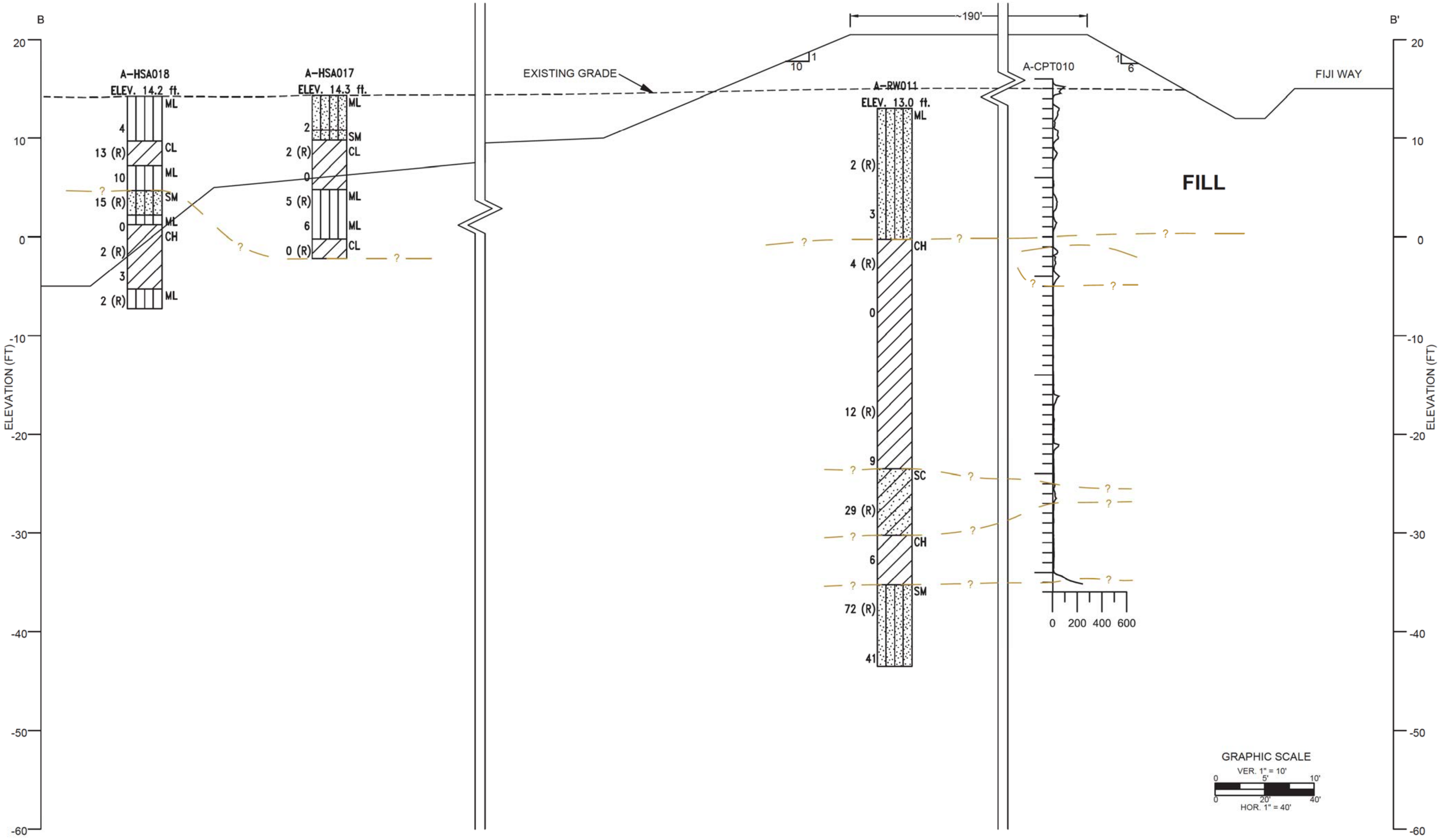
CROSS SECTION A-A'

BALLONA WETLANDS RESTORATION PROJECT
LOS ANGELES, CA

PROJECT NUMBER: L962A
SCALE: AS SHOWN
FIGURE NUMBER: 6A



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013
DRAWN BY: K. Madamba
REVISION: 2/28/2013
APPROVED BY: P. Kashighandi
REVISION:

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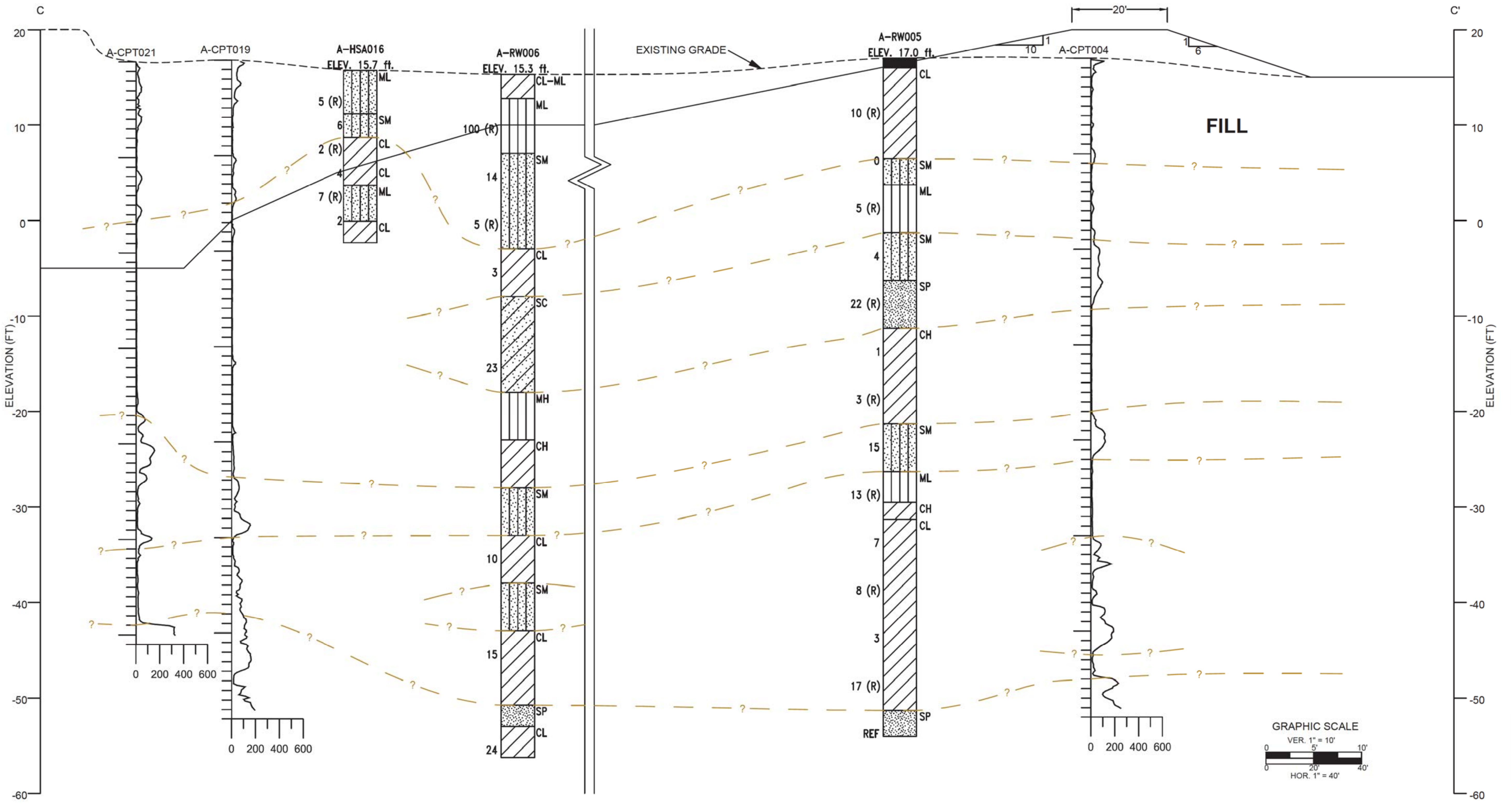
Torrance, CA. 90501

CROSS SECTION B-B'

BALLONA WETLANDS RESTORATION PROJECT
LOS ANGELES, CA

PROJECT NUMBER: L962A
SCALE: AS SHOWN
FIGURE NUMBER: 6B



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013
DRAWN BY: K. Madamba
REVISION: 2/28/2013
APPROVED BY: P. Kashighandi
REVISION:

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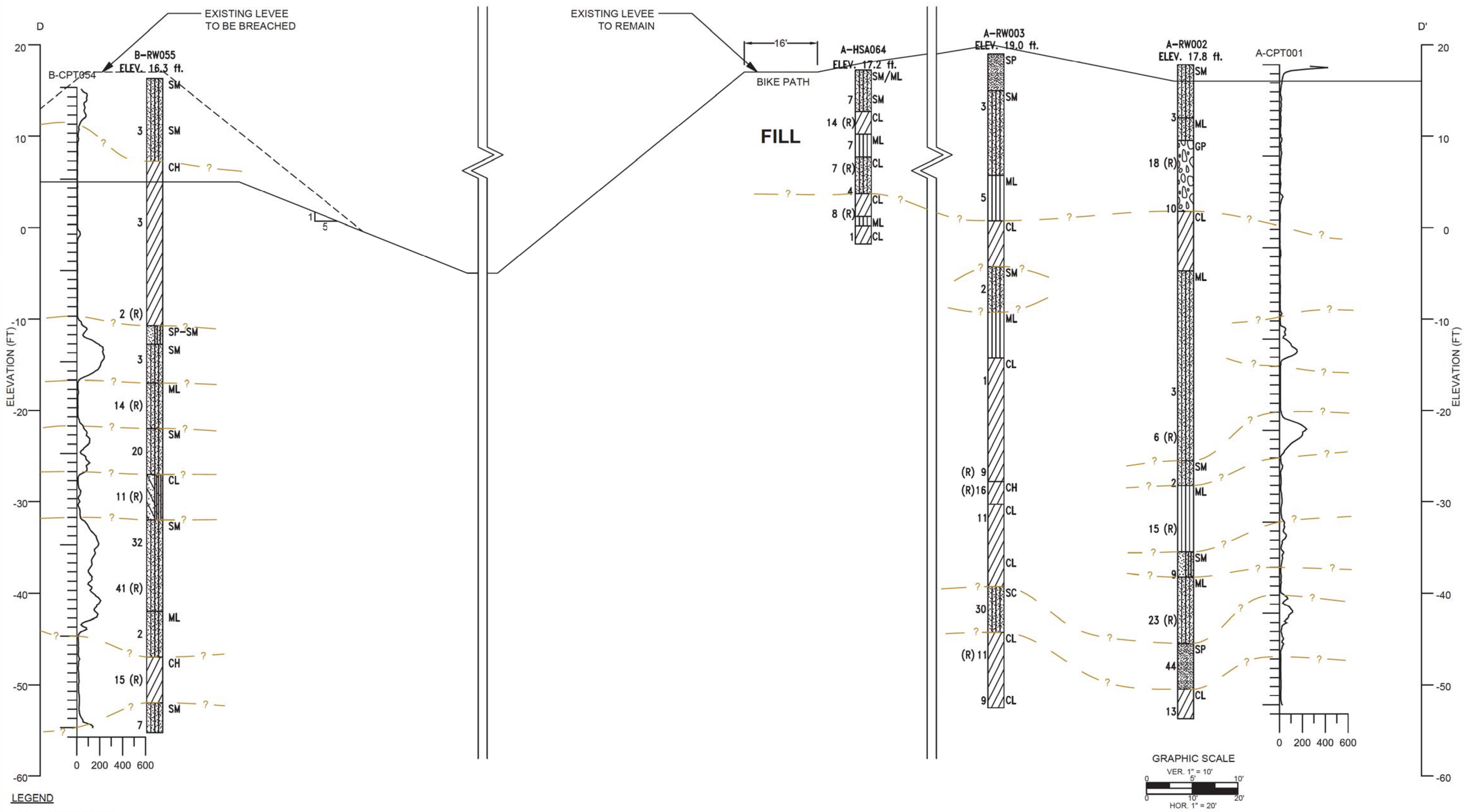
Torrance, CA. 90501

CROSS SECTION C-C'

BALLONA WETLANDS RESTORATION PROJECT
LOS ANGELES, CA

PROJECT NUMBER: L962A
SCALE: AS SHOWN
FIGURE NUMBER: 6C



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

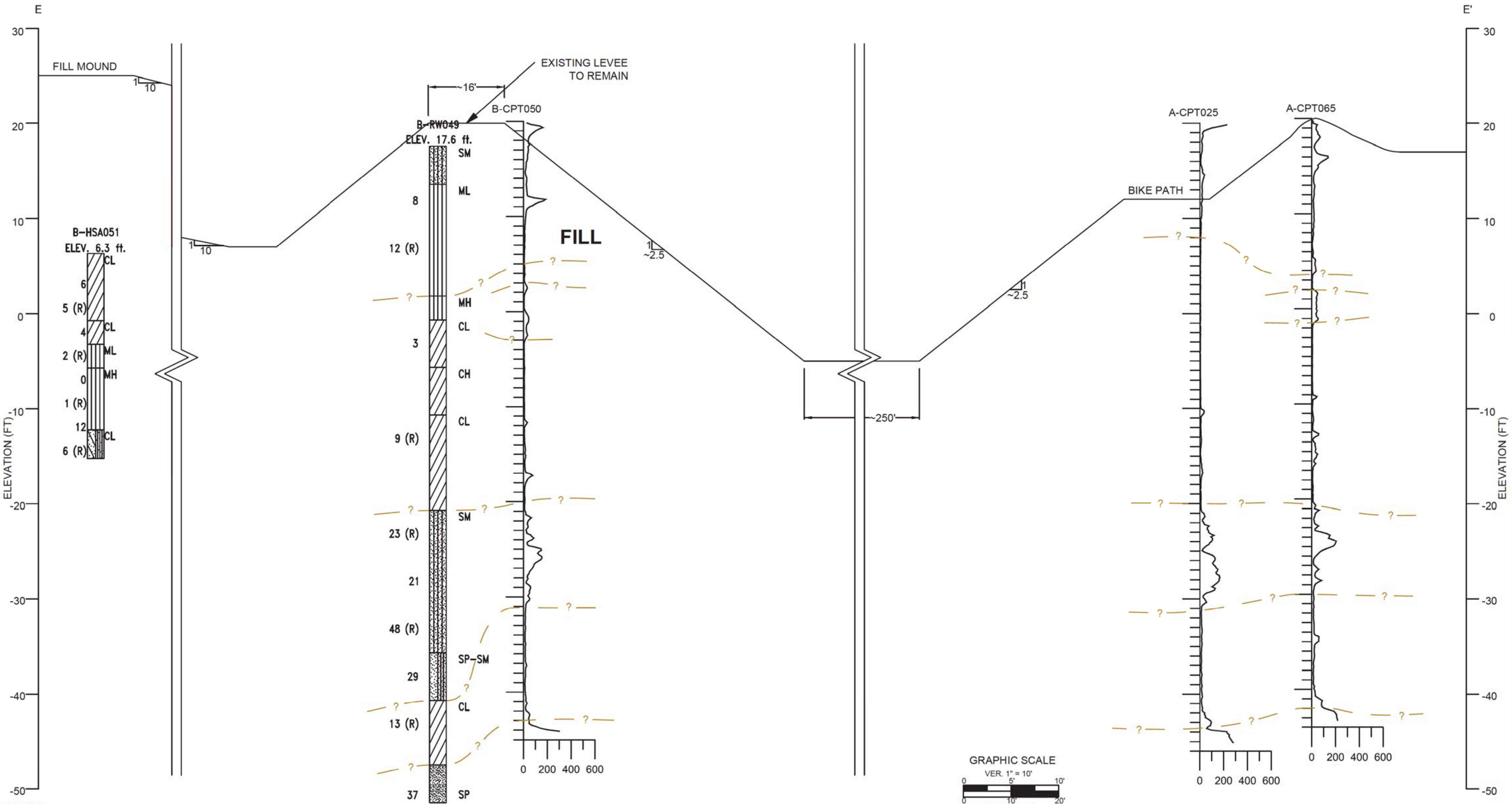
— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013	DRAWN BY: K. Madamba	GROUP DELTA	GROUP DELTA CONSULTANTS, INC 370 Amapola Ave. Suite 212 Torrance, CA. 90501	CROSS SECTION D-D'	PROJECT NUMBER: L962A
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi			BALLONA WETLANDS RESTORATION PROJECT LOS ANGELES, CA	SCALE: AS SHOWN
REVISION:					FIGURE NUMBER: 6D



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE:	DRAWN BY:
2/7/2013	K. Madamba
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi
REVISION:	

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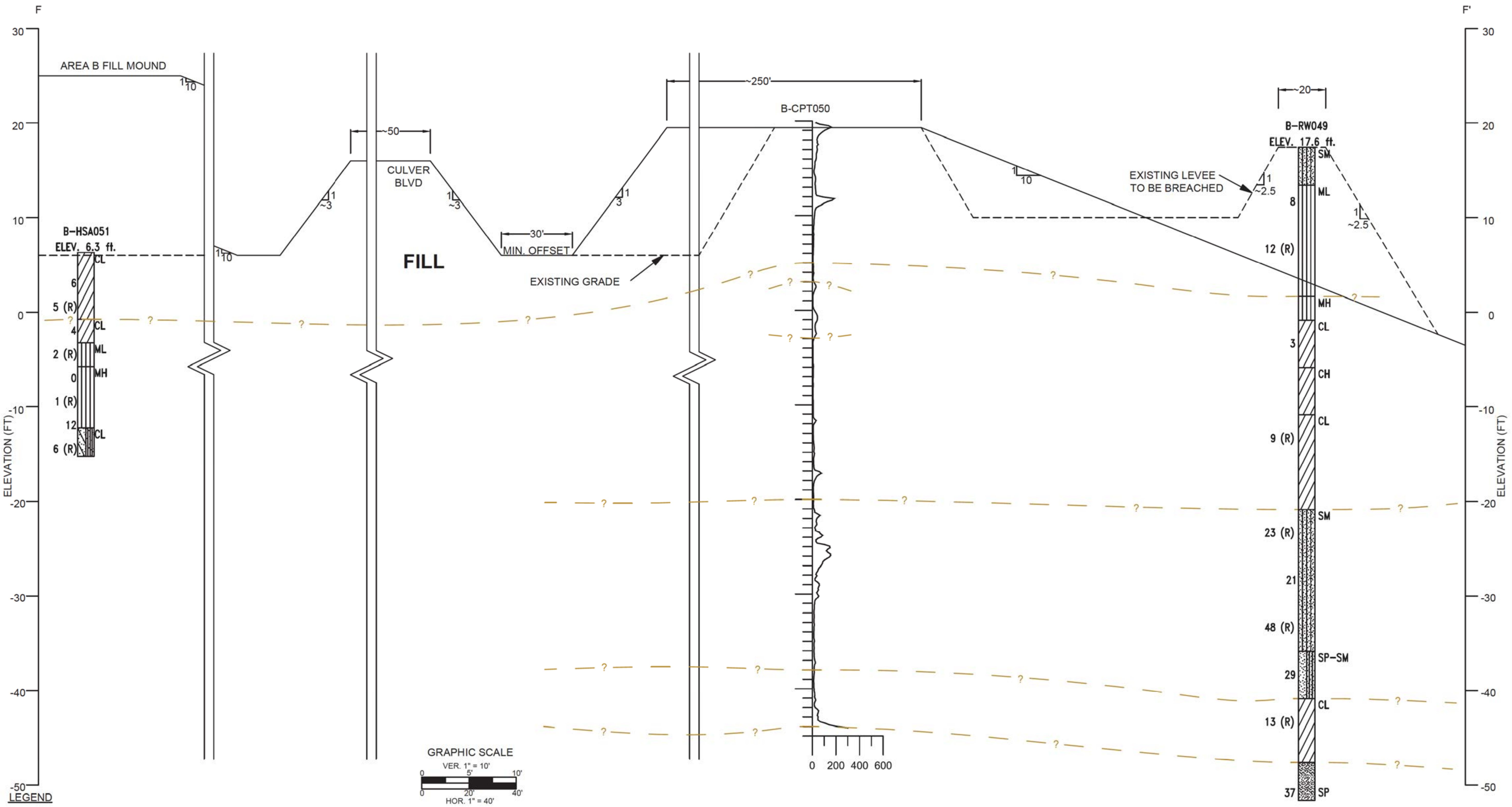
Torrance, CA. 90501

CROSS SECTION E-E'

BALLONA WETLANDS RESTORATION PROJECT
LOS ANGELES, CA

PROJECT NUMBER: L962A
SCALE: AS SHOWN
FIGURE NUMBER: 6E



LEGEND

9	SPT N-Value
20 (R)	Blowcounts of Modified California Ring Sample
— ? —	Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

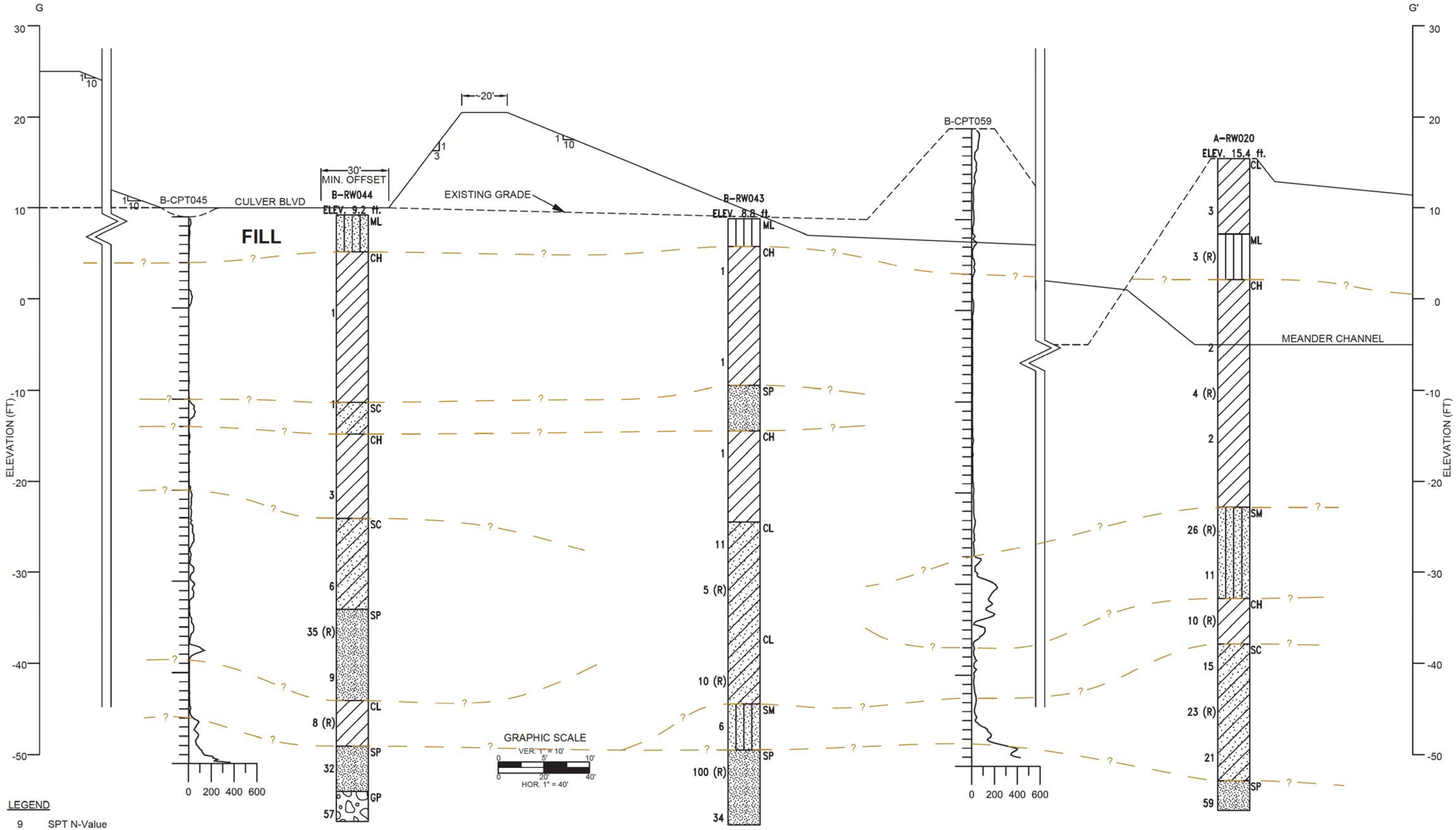
DATE: 2/7/2013
DRAWN BY: K. Madamba
REVISION: 2/28/2013
APPROVED BY: P. Kashighandi
REVISION:

GROUP DELTA CONSULTANTS, INC
370 Amapola Ave.
Suite 212
Torrance, CA. 90501

CROSS SECTION F-F'

BALLONA WETLANDS RESTORATION PROJECT
LOS ANGELES, CA

PROJECT NUMBER: L962A
SCALE: AS SHOWN
FIGURE NUMBER: 6F



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013
DRAWN BY: K. MADANBA
REVISION: 2/28/2013
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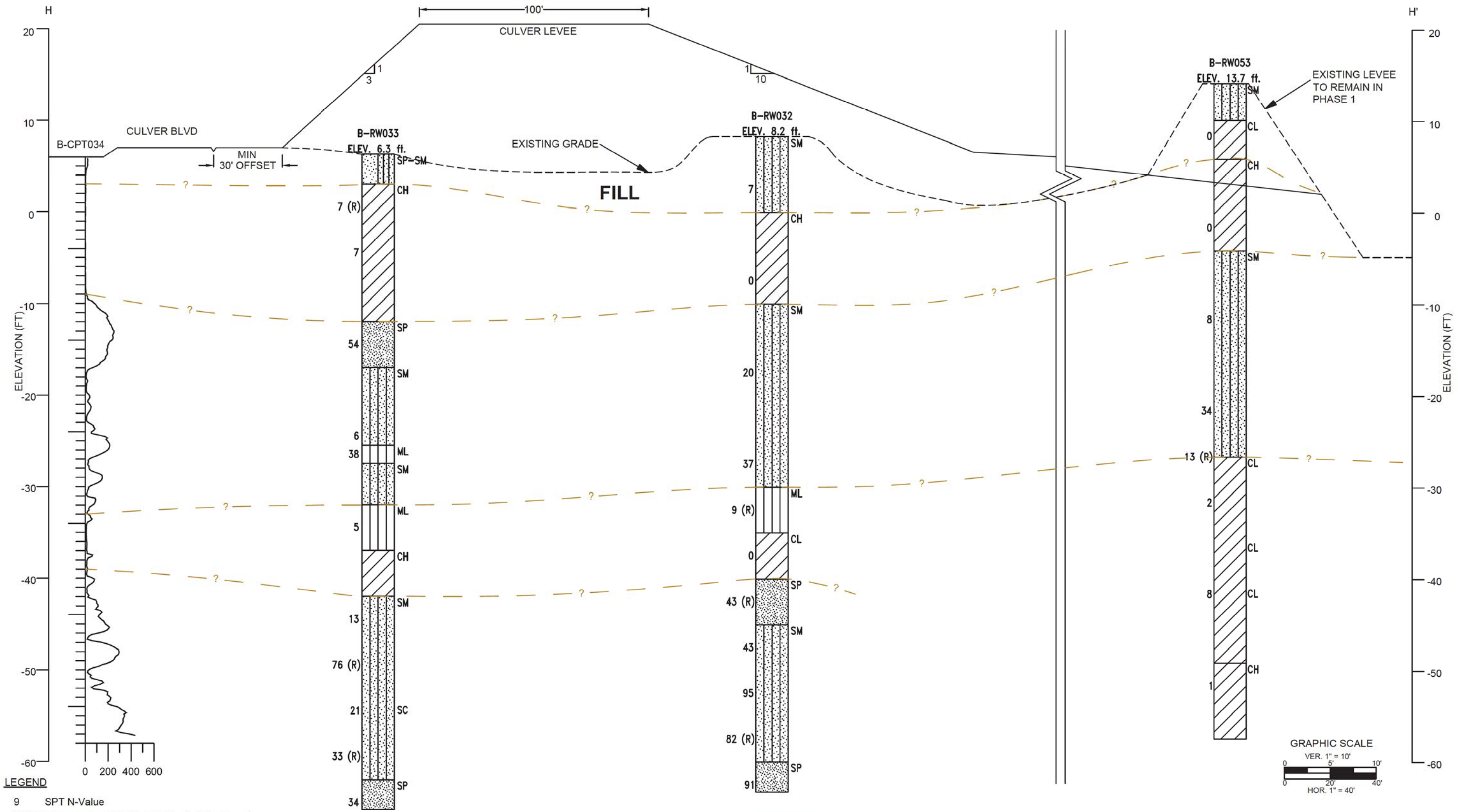
CROSS SECTION G-G'

BALLONA WETLANDS RESTORATION PROJECT
LOS ANGELES, CA

PROJECT NUMBER: L962A
SCALE: AS SHOWN
FIGURE NUMBER: 6G



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013

DRAWN BY: K. Madamba

REVISION: 2/28/2013

APPROVED BY: P. Kashighandi

REVISION:

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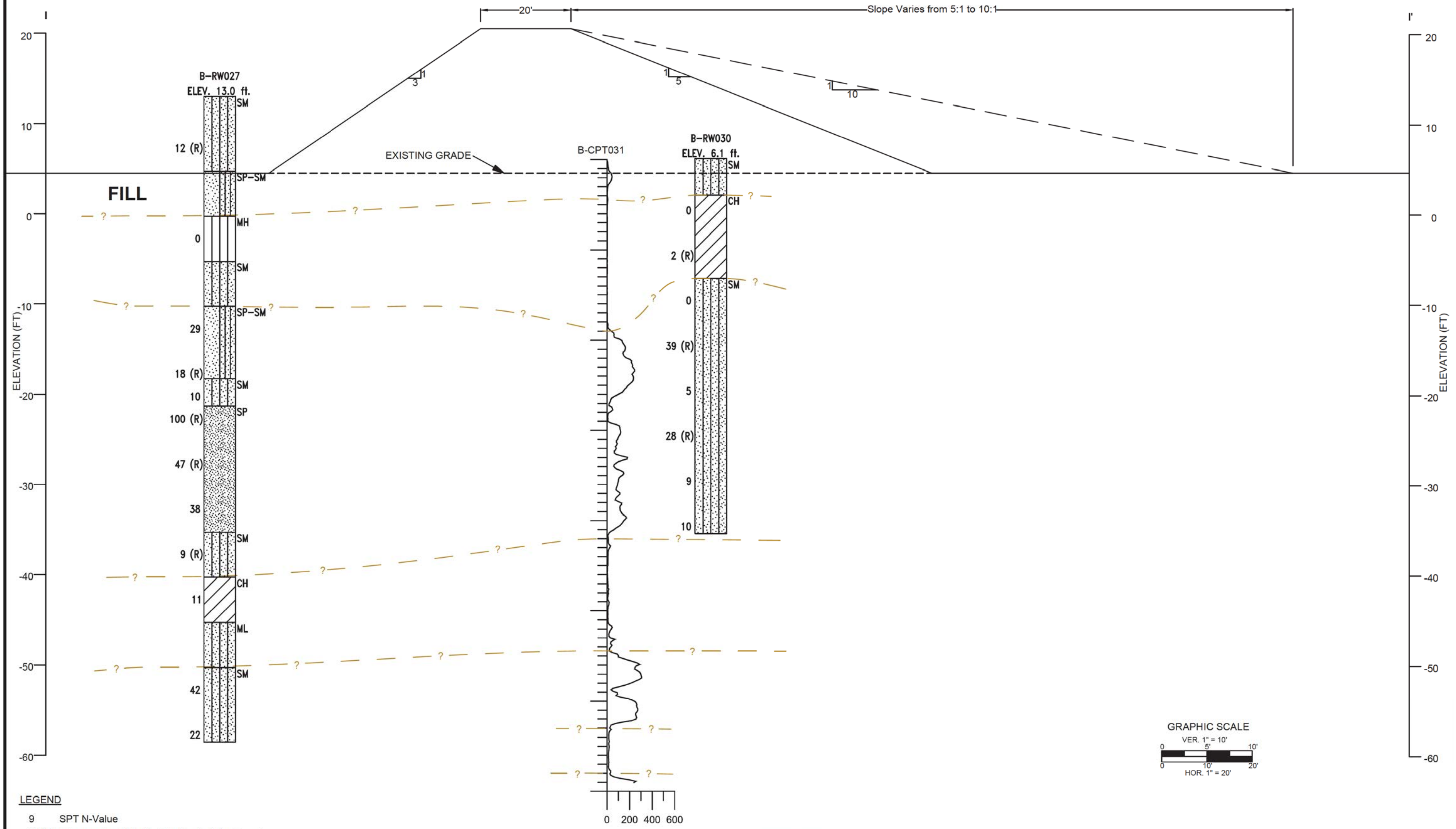
CROSS SECTION H-H'

BALLONA WETLANDS RESTORATION PROJECT
LOS ANGELES, CA

PROJECT NUMBER: L962A

SCALE: AS SHOWN

FIGURE NUMBER: 6H



LEGEND

9	SPT N-Value
20 (R)	Blowcounts of Modified California Ring Sample
— ? —	Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013
DRAWN BY: K. Madamba
REVISION: 2/28/2013
APPROVED BY: P. Kashighandi
REVISION:

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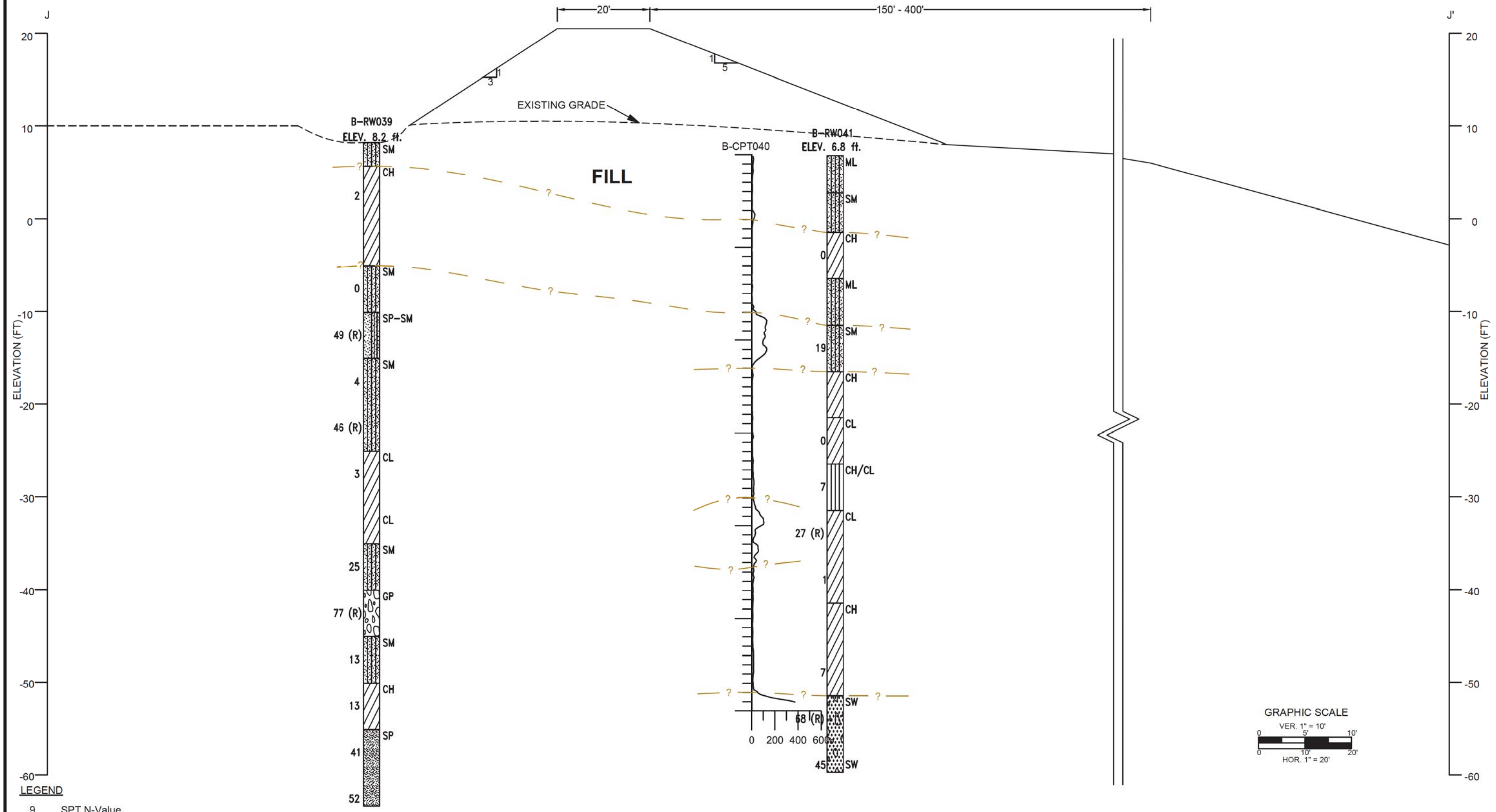
CROSS SECTION I-I'

BALLONA WETLANDS RESTORATION PROJECT
LOS ANGELES, CA

PROJECT NUMBER: L962A
SCALE: AS SHOWN
FIGURE NUMBER: 6I



LEGEND

9	SPT N-Value
20 (R)	Blowcounts of Modified California Ring Sample
— ? —	Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013	DRAWN BY: K. Madamba
REVISION: 2/28/2013	APPROVED BY: P. Kashighandi
REVISION:	

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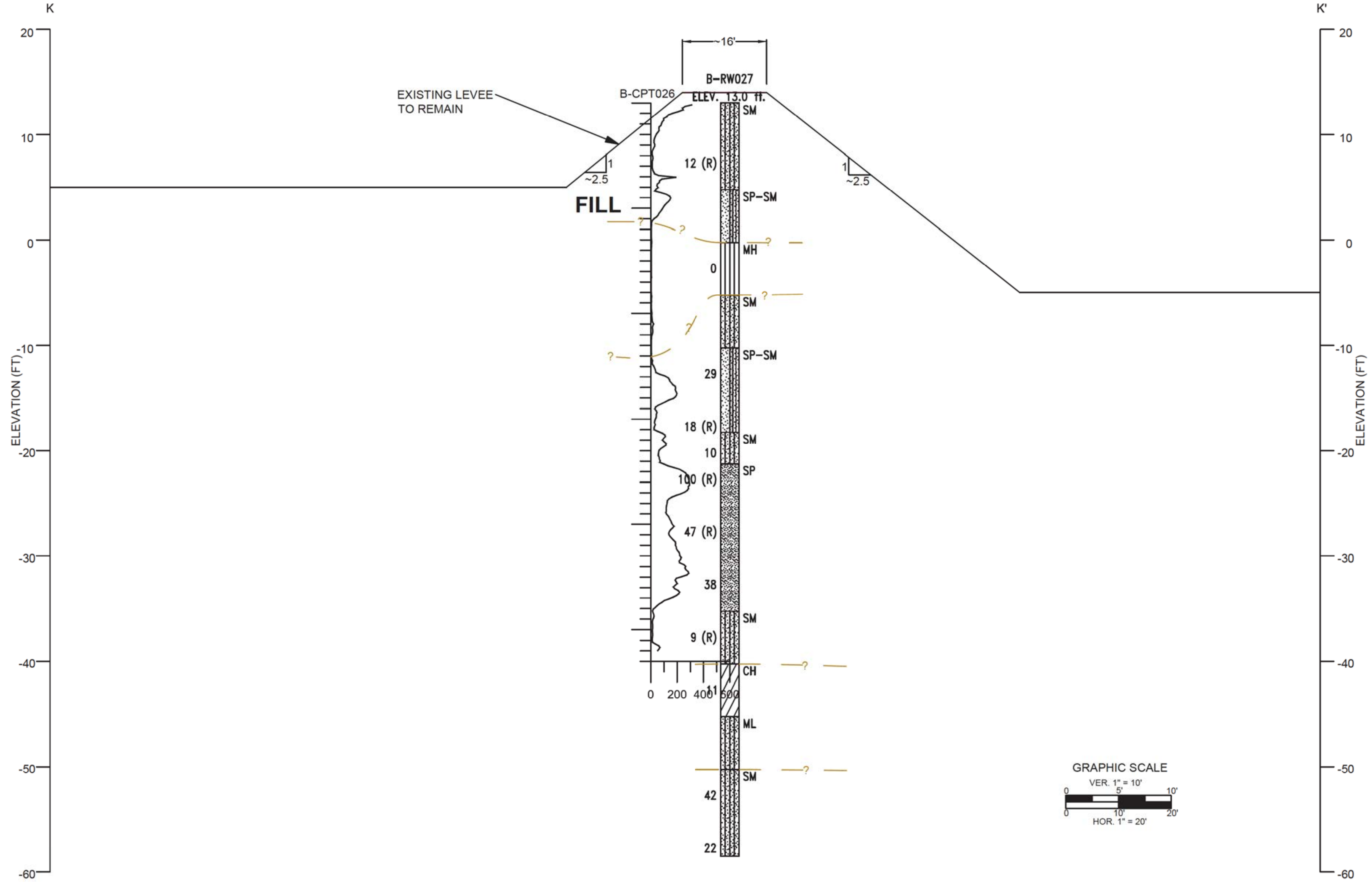
CROSS SECTION J-J'

BALLONA WETLANDS RESTORATION PROJECT
LOS ANGELES, CA

PROJECT NUMBER: L962A
SCALE: AS SHOWN
FIGURE NUMBER: 6J



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 2/7/2013
DRAWN BY: K. Madamba
REVISION: 2/28/2013
APPROVED BY: P. Kashighandi
REVISION:

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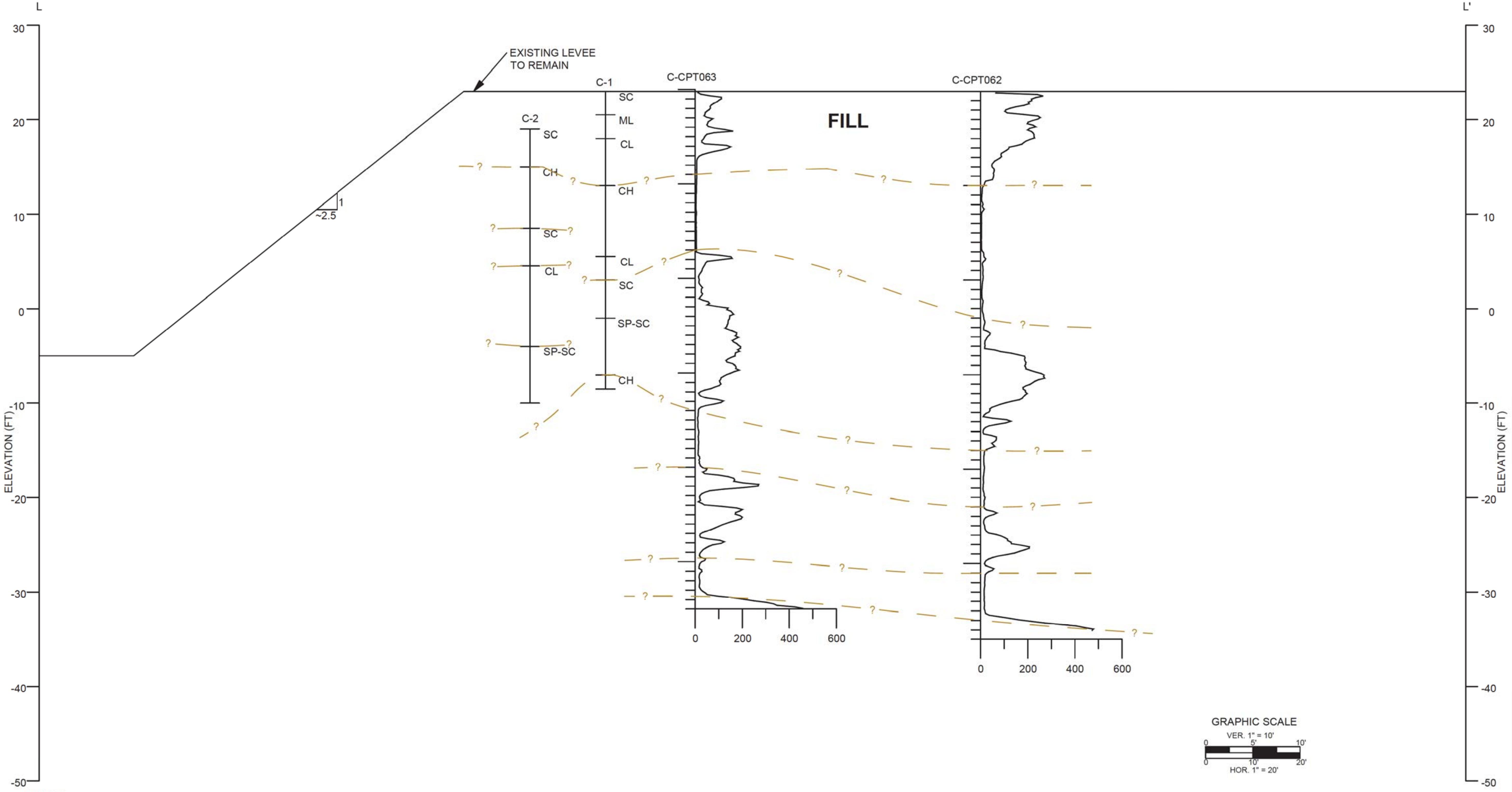
Torrance, CA. 90501

CROSS SECTION K-K'

BALLONA WETLANDS RESTORATION PROJECT
LOS ANGELES, CA

PROJECT NUMBER: L962A
SCALE: AS SHOWN
FIGURE NUMBER: 6K



LEGEND

9 SPT N-Value

20 (R) Blowcounts of Modified California Ring Sample

— ? — Interpreted Layer Boundry

NOTE

(1) SOME BORINGS/CPT'S ARE SHOWN PROJECTED.

(2) THE CROSS SECTION IS BASED ON GEOLOGIC INTERPRETATION OF CONDITIONS ENCOUNTERED AT EXPLORATION LOCATIONS. ACTUAL CONDITIONS MAY VARY BETWEEN EXPLORATIONS.

DATE: 12/4/2012

DRAWN BY: K. Madamba

REVISION: 2/28/2013

APPROVED BY: P. Kashighandi

REVISION:

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Torrance, CA. 90501

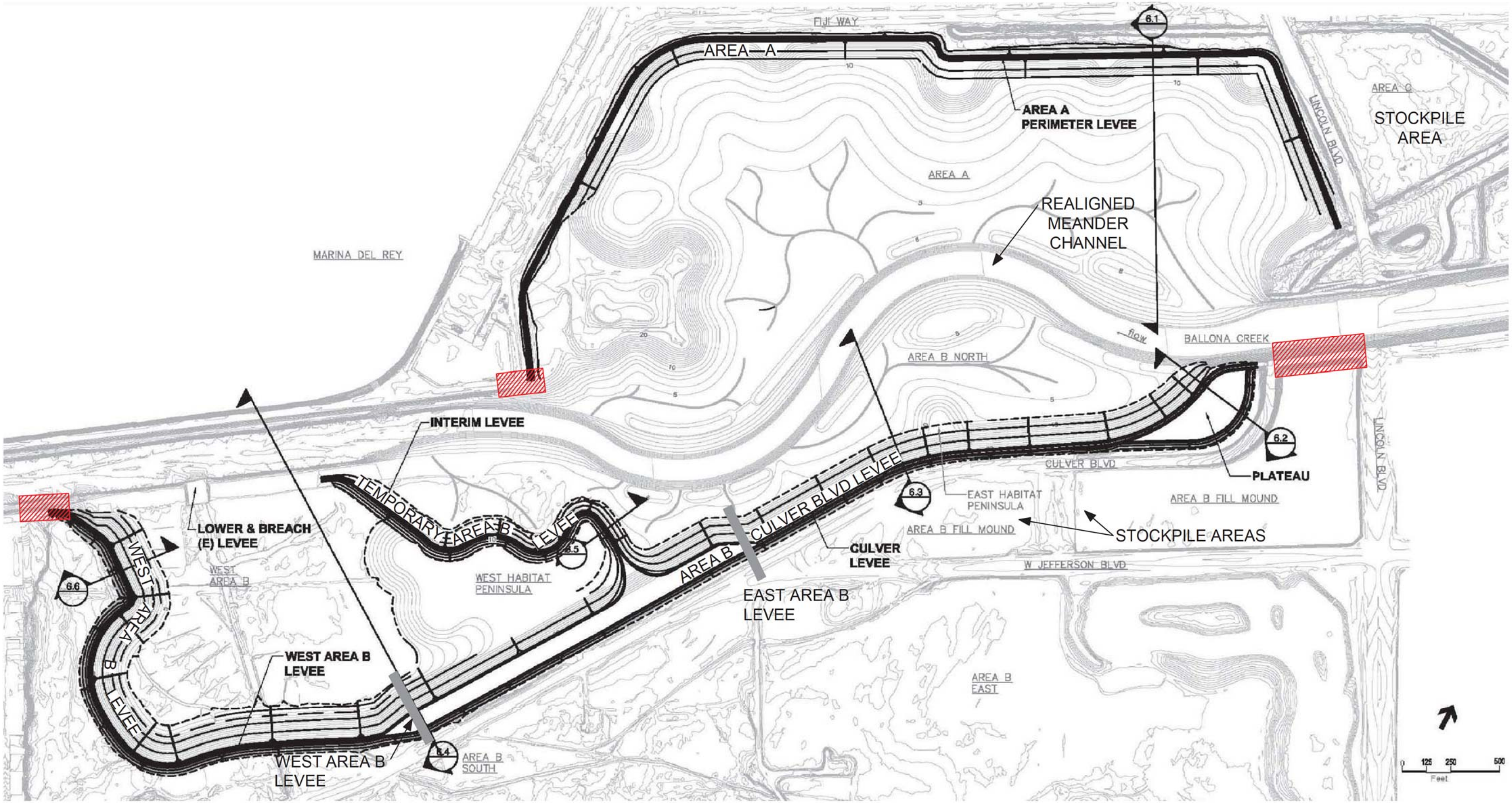
CROSS SECTION L-L'

BALLONA WETLANDS RESTORATION PROJECT
LOS ANGELES, CA

PROJECT NUMBER: L962A

SCALE: AS SHOWN

FIGURE NUMBER: 6L



LEGEND

▨ ZONES OF GROUND IMPROVEMENTS

DATE: 6/28/2013

DRAWN BY: K. Madamba

REVISION:

APPROVED BY: P. Kashighandi

REVISION:

GROUP DELTA CONSULTANTS, INC
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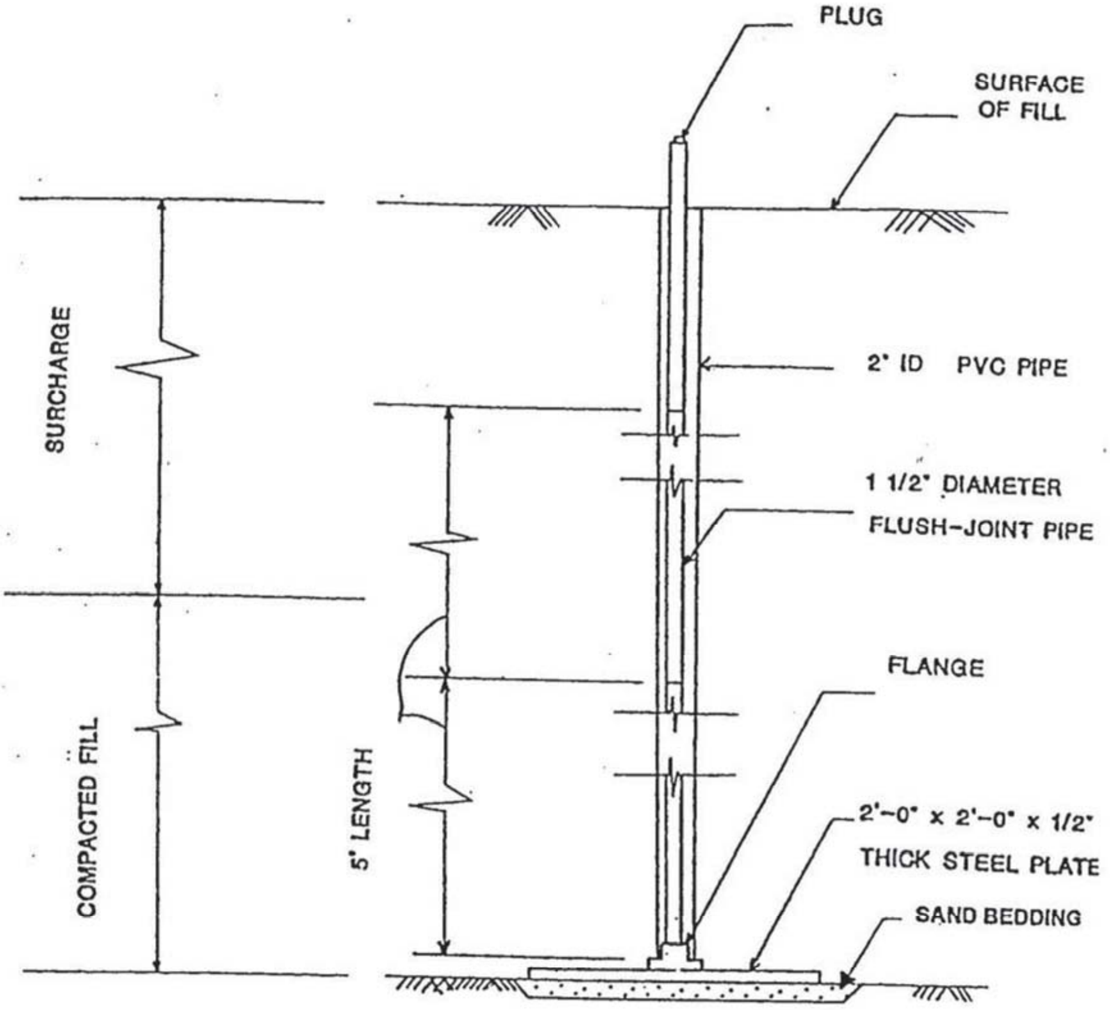
DELINEATED ZONES OF GROUND IMPROVEMENT

BALLONA WETLANDS RESTORATION PROJECT
LOS ANGELES, CA

PROJECT NUMBER: L962A

SCALE: AS SHOWN

FIGURE NUMBER: 7



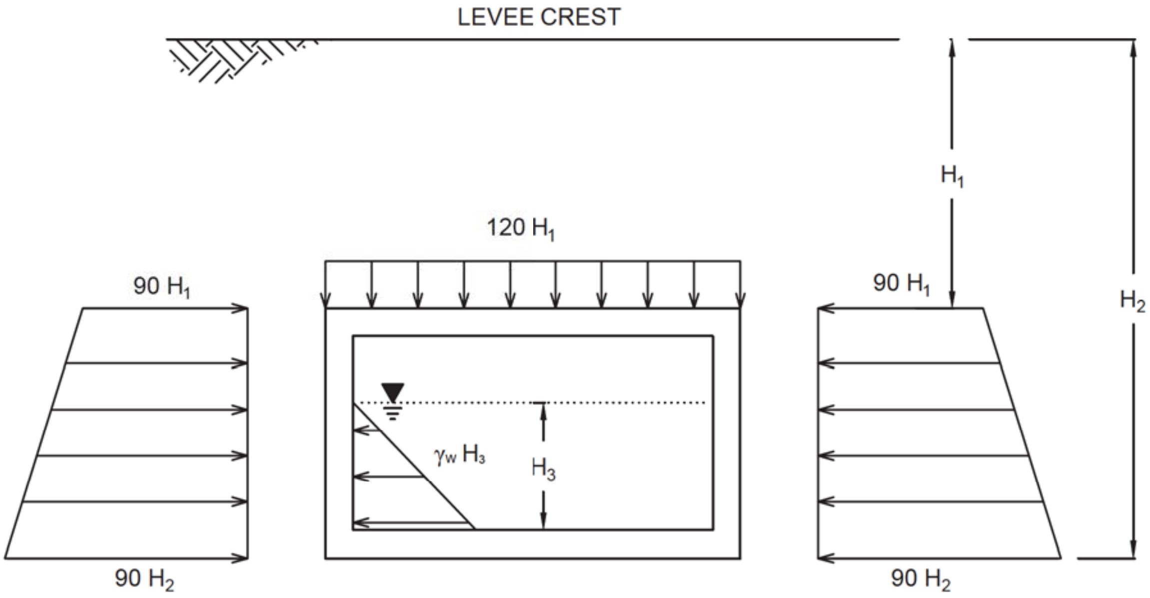
Ballona Wetlands Restoration Project

Settlement Monitoring Plate Detail

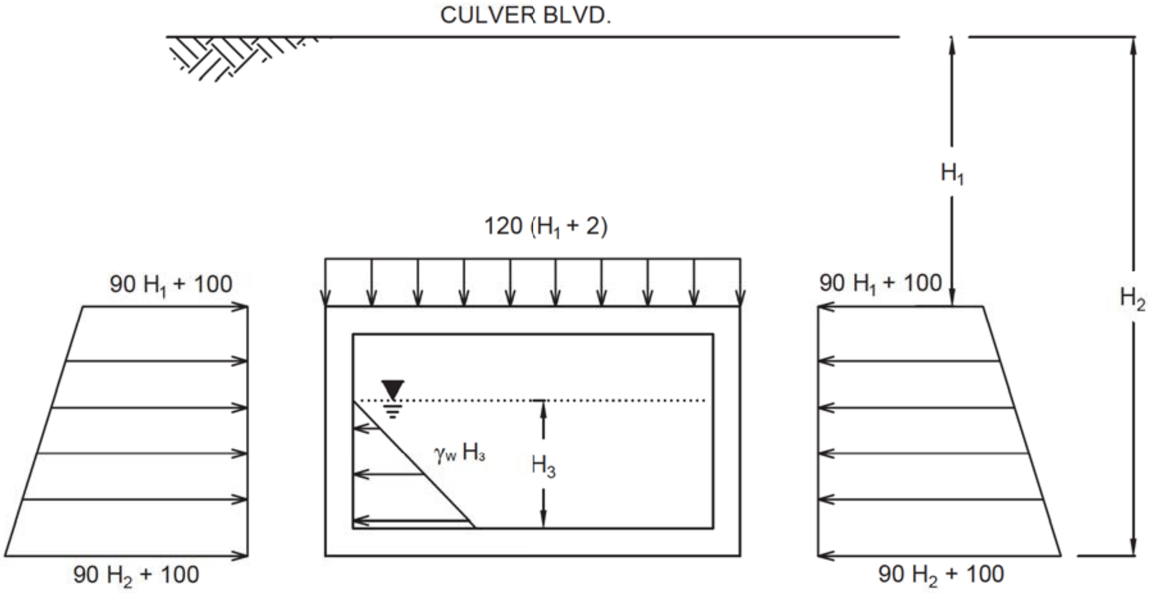
PROJECT NUMBER: LA-962A8
DATE:
SCALE: NOT TO SCALE
DRAWN BY: T Ybarra
APPROVED BY: T Armstrong
REVISED:
FIGURE:

GROUP DELTA CONSULTANTS, INC.

UNDER LEVEE



UNDER CULVER BLVD.



NOTE: ALL PRESSURES ARE IN UNITS OF POUNDS PER SQUARE FOOT (psf). ALL DEPTHS ARE IN UNITS OF FEET (ft).

GROUP DELTA CONSULTANTS, INC.
ENGINEERS AND GEOLOGISTS
370 Amapola Ave, Suite 212
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PROJECT NUMBER: L962A

PROJECT NAME:
BALLONA WETLANDS RESTORATION PROJECT
LOS ANGELES, CALIFORNIA

FIGURE NUMBER: 9

LATERAL EARTH PRESSURE FOR CULVERTS

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APPENDIX A1
GDC FIELD EXPLORATION

APPENDIX A1
GDC FIELD EXPLORATION

A1.1 INTRODUCTION

GDC conducted a geotechnical subsurface investigation for the project site from September 11, 2012 to October 22, 2012. Prior to the geotechnical subsurface investigation, a geotechnical investigation work plan (GDC, 2012) was prepared. The work plan outlined the procedures for obtaining site access and work permits; defined access routes to avoid special status plants as well as plans to minimize impact to natural habitats and/or archaeological sites within the project area. The work plan also describes the drilling equipment, soil sampling schedule (geotechnical, chemical, and agronomical sampling), post-investigation site cleanup, and laboratory testing program (geotechnical, chemical, and agronomical). The geotechnical investigation work plan was referenced throughout the project to obtain necessary site information while minimizing environmental impact to the project site.

The investigation consisted of rotary wash borings, hollow-stem auger borings, hand auger borings, and cone penetration tests. The exploration locations are shown in Figure 3 of the report. A summary of the field investigations is provided in Table A1-1.

A1.2 SOIL BORINGS

Twenty five (25) rotary wash borings were advanced to depths ranging from 56.5 to 71.5 feet in Areas A, B and C of the project site. The rotary wash borings were selected along the proposed levees as well as along the existing Ballona Creek levees. Eight (8) hollow stem auger borings were drilled to a depths ranging from 16 31.5 feet in areas planned for excavation in Area A, and surcharge areas within Areas B and C. In addtition, direct push exploration were also conducted to obtain environmental samples at the location of our hollow stem borings. Boring B-RW028 originally planned as a rotary wash boring in Area B, was drilled using hand auger equipment to a depth of 5 feet, due of proximity of special species plants. All borings were drilled at approximate elevations ranging from +5 to +21.1 feet NAVD. Subsurface materials were visually classified and recorded by a GDC field engineer in accordance with the Unified Soil Classification System (USCS).

Drive samples, bulk samples and push samples of the encountered materials were obtained from the borings and recorded on the boring logs. Drive samples were obtained with a California Sampler ring sampler and a Standard Penetration Test (SPT) sampler. The California Sampler, lined with 1-inch tall rings, has an outside diameter of 3-inches, and the inside diameter of 2.42-inches. The samples were retained in brass rings and placed in sealed plastic canisters to prevent moisture loss. Standard penetration tests (SPT) were conducted using a standard 2-inch outside diameter, 1.375-inch inside diameter, split-spoon sampler in accordance with ASTM D 1586. SPT samples were placed in sealable plastic bags to prevent loss of moisture. The SPT and California samplers were driven into the soil at the using a 140-pound hammer free-falling 30 inches. The penetration resistance (or “blowcounts”) were recorded in blows per six inches of driving. When soft fine grained soils were encountered, 6-inch-long Shelby tubes were used for sampling relatively undisturbed soil samples in the rotary wash borings.

Representative bulk samples were taken within the upper 5 feet, and selectively at depths as deep as 20 feet for compaction testing, expansion potential, corrosion testing, as well as chemical and agronomical testing. Bulk samples were placed into polyethylene bags. Additional chemistry testing samples were also obtained using direct push sampling equipment under the supervision of a project environmental engineer. Chemistry and agronomy samples were provided to the project environmental engineers for their use.

Additionally, four field permeability tests were performed at depths of 5 and 10 feet, at boring locations A-HSA064 and A-HSA066 near the existing north levee and existing gas injection wells to evaluate the permeability of the near surface soils. The tests were performed by filling the hollow stem auger borings with water and estimating permeability of near surface soils by measuring the drop in water elevation in the hole over time. The results of the field permeability testing are presented in Appendix F.

A key for soil classification and a legend for the logs of test borings are presented in Figures A1-1a and A1-1b. The boring logs are attached at the end of this Appendix.

A1.3 CONE PENETRATION TESTS (CPT)

Thirty one (31) cone penetration test (CPT) soundings were conducted at the site on from September 13, 2012 to October 15, 2012. The CPT soundings were generally advanced to depths ranging from 48 to 71.5 feet below existing grade. Two CPT locations in Area B (B-CPT029 and B-CPT042) encountered refusal at shallow depths, and had to be abandoned. In addition, B-CPT046 encountered shallow refusal at at a depth of 6 feet after making several attempts for advancement in adjacent locations. The CPT soundings were performed in general accordance with ASTM D3441, using a truck-mounted electric piezocone penetrometer. The locations of the soundings are shown in Figure 3 in the main body of the report.

CPTs are advanced from the ground surface with a truck-mounted hydraulic ram that pushes a steel rod with a conical tip and a cylindrical friction-sleeve into the ground. The conical tip has a 60-degree apex angle and a projected cross-sectional area of 1.55 square inches. The cylindrical friction sleeve has a surface area of 23.25 square inches. Both the tip and the sleeve have outside diameters of 1.4 inches.

As the rod is advanced, electronic instruments measure and record both the tip resistance and the frictional resistance on the sleeve. The tip and frictional resistance are then analyzed, using available correlations, to estimate soil classification, density, strength, and compressibility of the subsurface materials. Unlike soil borings, in which drive samples are typically taken at discrete intervals, the CPT provides a continuous record of soil properties with depth. Hence, the CPT can define the subsurface soil profile with much higher resolution than a soil boring, often detecting thin layers that are easily missed with conventional drilling and sampling.

Using a Seismic CPT test setup, Shear Wave Velocity measurements were performed in seven (7) of the CPTs to a maximum depth of 70 feet. The measurements were generally obtained in 5-foot intervals. The test involves generating large amplitude shear waves by striking a seismic beam at ground surface, and recording shear waves using a built-in seismometer in the cone penetrometer at various depths. The results of the seismic shear wave velocity measurements are presented in Appendix F.

The CPT logs and interpretations are presented at the end of this Appendix.

A1.4 LIST OF THE ATTACHED TABLE AND FIGURES

The following table and figures are attached and complete this appendix:

Table A1-1	Field Exploration Summary
Figure A1-1a	Key for Soil Classification
Figure A1-1b	Legend of CPT Interpretation Input
Figure A1-1c	Boring Log Legend
Figures A1-2 to A1-35	Boring Logs
Figures A1-36 to A1-66	CPT Logs

TABLE A1-1
FIELD EXPLORATION SUMMARY

Exploration No.	Date Performed	Ground Surface Elevation (feet, NAVD)	Total Depth (feet)	Exploration Type
A-CPT001	10/15/12	17.8	70	Cone Penetration Test
A-RW002	10/5/12	17.8	71.5	Rotary Wash Boring
A-RW003	9/21/12	19	71.5	Rotary Wash Boring
A-CPT004	10/15/12	17	68	Cone Penetration Test
A-RW005	10/9/12	17	71	Rotary Wash Boring
A-RW006	9/13/12	15.3	71.5	Rotary Wash Boring
A-CPT007	9/24/12	15.3	57	Cone Penetration Test
A-RW008	9/27/12	15.7	65	Rotary Wash Boring
A-RW009	9/27/12	17.1	61.5	Rotary Wash Boring
A-CPT010	9/24/12	16	51	Cone Penetration Test
A-RW011	9/28/12	13	56.5	Rotary Wash Boring
A-CPT012	9/24/12	13.8	48	Cone Penetration Test
A-RW013	9/26/12	13.8	56.5	Rotary Wash Boring
A-CPT014	9/24/12	16	51	Cone Penetration Test
A-RW015	10/2/12	17.1	61.5	Rotary Wash Boring
A-HSA016	10/10/12	15.7	18	Hollow Stem Auger Boring
A-HSA017	10/10/12	14.3	16.5	Hollow Stem Auger Boring
A-HSA018	10/10/12	14.2	21.5	Hollow Stem Auger Boring
A-CPT019	9/24/12	16.8	68	Cone Penetration Test
A-RW020	10/3/12	15.4	71.5	Rotary Wash Boring
A-CPT021	9/24/12	16.6	59	Cone Penetration Test
A-CPT022	9/26/12	19	59	Cone Penetration Test
A-RW023	10/3/12	19	65.9	Rotary Wash Boring
A-CPT024	9/24/12	16.9	55	Cone Penetration Test
A-CPT025	9/26/12	20	65	Cone Penetration Test
A-HSA064	10/15/12	17.2	19	Hollow Stem Auger Boring
A-CPT065	9/26/12	20.5	63	Cone Penetration Test
A-HSA066	10/15/12	21.1	21.5	Hollow Stem Auger Boring
A-HSA067	10/10/12	12.2	16.5	Hollow Stem Auger Boring
B-CPT026	9/14/12	13	52	Cone Penetration Test
B-RW027	9/24/12	13	71.5	Rotary Wash Boring
B-RW028	10/22/12	5	5	Hand Auger Boring
B-RW030	10/4/12	6.1	41.5	Rotary Wash Boring
B-CPT031	10/10/12	6	69	Cone Penetration Test
B-RW032	9/14/12	8.2	71.5	Rotary Wash Boring
B-RW033	9/12/12	6.3	71.5	Rotary Wash Boring
B-CPT034	9/13/12	6	63	Cone Penetration Test
B-CPT035	9/13/12	7.4	67	Cone Penetration Test
B-RW036	9/17/12	9.1	71.5	Rotary Wash Boring
B-CPT037	9/13/12	5	70	Cone Penetration Test
B-CPT038	9/13/12	8.4	68	Cone Penetration Test
B-CPT039	9/17/12	8.2	71	Cone Penetration Test
B-CPT040	10/15/12	6.9	59	Cone Penetration Test
Continued				

TABLE A1-1
FIELD EXPLORATION SUMMARY (CONTINUED)

Exploration No.	Date Performed	Ground Surface Elevation (feet, NAVD)	Total Depth (feet)	Exploration Type
B-RW041	9/20/12	6.8	66.5	Rotary Wash Boring
B-RW043	9/19/12	8.8	66.5	Rotary Wash Boring
B-RW044	9/19/12	9.2	66.5	Rotary Wash Boring
B-CPT045	9/13/12	9	60	Cone Penetration Test
B-CPT046	10/15/12	10.6	6	Cone Penetration Test
B-RW047	9/18/12	11.5	66.5	Rotary Wash Boring
B-CPT048	10/15/12	11	63	Cone Penetration Test
B-RW049	10/1/12	17.6	69	Rotary Wash Boring
B-CPT050	9/14/12	20.2	64	Cone Penetration Test
B-HSA051	10/16/12	6.3	21.5	Hollow Stem Auger Boring
B-CPT052	9/14/12	12	70	Cone Penetration Test
B-RW053	9/24/12	13.7	71.5	Rotary Wash Boring
B-CPT054	9/14/12	15.3	70	Cone Penetration Test
B-RW055	9/25/12	16.3	71.5	Rotary Wash Boring
B-CPT056	9/14/12	15.4	70	Cone Penetration Test
B-CPT057	9/14/12	14.6	70	Cone Penetration Test
B-RW058	9/25/12	15	71.5	Rotary Wash Boring
B-CPT059	9/14/12	18.7	70	Cone Penetration Test
C-CPT060	10/10/12	14.6	49	Cone Penetration Test
C-HSA061	10/16/12	16	31.5	Hollow Stem Auger Boring
C-CPT062	10/10/12	23	57	Cone Penetration Test
C-CPT063	10/10/12	23.2	55	Cone Penetration Test

KEY FOR SOIL CLASSIFICATION

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D-2487)

PRIMARY DIVISIONS			***GROUP SYMBOL***	***SECONDARY DIVISIONS***
COARSE GRAINED SOILS (less than 50% fines passing the No. 200 Sieve)	GRAVEL (% GRAVEL > % SAND)	CLEAN GRAVEL (Less than 5% fines)	GW	Well-graded gravel, gravel with sand, little or no fines
			GP	Poorly-graded gravel, gravel with sand, little or no fines
		"DIRTY" GRAVEL (More than 12% fines)	GM	Silty gravel, silty gravel with sand, silty or non-plastic fines
			GC	Clayey gravel, clayey gravel with sand, clayey or plastic fines
	SAND (% SAND $\geq$ % GRAVEL)	CLEAN SAND (Less than 5% fines)	SW	Well-graded sand, sand with gravel, little or no fines
			SP	Poorly-graded sand, sand with gravel, little or no fines
		"DIRTY" SAND (More than 12% fines)	SM	Silty sand, silty sand with gravel, silty or non-plastic fines
			SC	Clayey sand, clayey sand with gravel, clayey or plastic fines
FINE GRAINED SOILS (50% or more fines passing the No. 200 Sieve)	SILTS AND CLAYS (Liquid Limit less than 50)		ML	Inorganic silt, sandy silt, gravelly silt, or clayey silt with low plasticity
			CL	Inorganic clay of low to medium plasticity, sandy clay, gravelly clay, silty clay, Lean Clay
			OL	Low to medium plasticity Silt or Clay with significant organic content (vegetative matter)
	SILTS AND CLAYS (Liquid Limit 50 or more)		MH	Inorganic elastic silt, sandy silt, gravelly silt, or clayey silt of medium to high plasticity
			CH	Inorganic clay of high plasticity, Fat Clay
			OH	Medium to high plasticity Silt or Clay with significant organic content (vegetative matter)
HIGHLY ORGANIC SOILS			PT	Peat or other highly organic soils

Note: Dual symbols are used for coarse grained soils with 5 to 12% fines (ex: SP-SM), and for soils with Atterberg Limits falling in the CL-ML band in the Plasticity Chart. Borderline classifications between groups may be indicated by two symbols separated by a slash (ex: CL/CH, SW/GW).

CONSISTENCY CLASSIFICATION

COARSE GRAINED SOILS		***FINE GRAINED SOILS***		
Blowcount SPT^1 (CAL)^2	Consistency	Blowcount^3 SPT^1 (CAL)^2	Consistency	Undrained Shear Strenth^3, S_u (ksf)
0-4 (0-6)	Very Loose	<2 (<3)	Very Soft	< 0.25
		2-4 (3-6)	Soft	0.25 -0.50
5-10 (7-15)	Loose	5-8 (7-12)	Medium Stiff	0.50 - 1.0
11-30 (16-45)	Med. Dense	9-15 (13-22)	Stiff	1.0 - 2.0
31-50 (46-75)	Dense	16-30 (23-45)	Very Stiff	2.0 - 4.0
>50 (>75)	Very Dense	>31 (>45)	Hard	> 4.0

MOISTURE CLASSIFICATION

DRY - Absence of moisture, dusty, dry to the touch
MOIST- Damp but no visible water
WET- Visible free water, usually soil is below water table

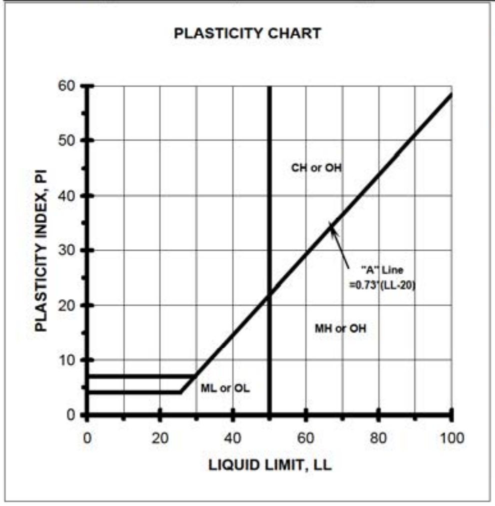
CONSISTENCY NOTES:

1. Number of blows of a 140-lb. hammer falling 30-inches to drive a 2-inch OD (1.375-inch ID) **SPT Sampler** [ASTM D-1585] the final 12-inches of driving
2. Number of blows of a 140-lb. hammer falling 30-inches to drive a 3-inch OD (2.42-inch ID) **California Ring Sampler** the final 12-inches of driving.
3. Undrained shear strength of cohesive soils predicted from field blowcounts is generally unreliable. Where possible, consistency should be based on S_u data from pocket penetrometer, torvane, or laboratory testing.

CLASSIFICATION CRITERIA BASED ON LABORATORY TESTS

Grain Size Classification

CLAY AND SILT		SAND			GRAVEL		COBBLES		BOULDERS	
		Fine	Medium	Coarse	Fine	Coarse				
US Std Sieve	**No. 200**	**No. 40**	**No. 10**	**No. 4**	**3/4"**	**3"**		**12"**		
Grain Size (mm)	0.075	0.425	2	4.75	19.1	76.2		304.8		



Classification of earth materials shown on the logs is based on field inspection and should not be construed to imply laboratory analysis unless so stated.

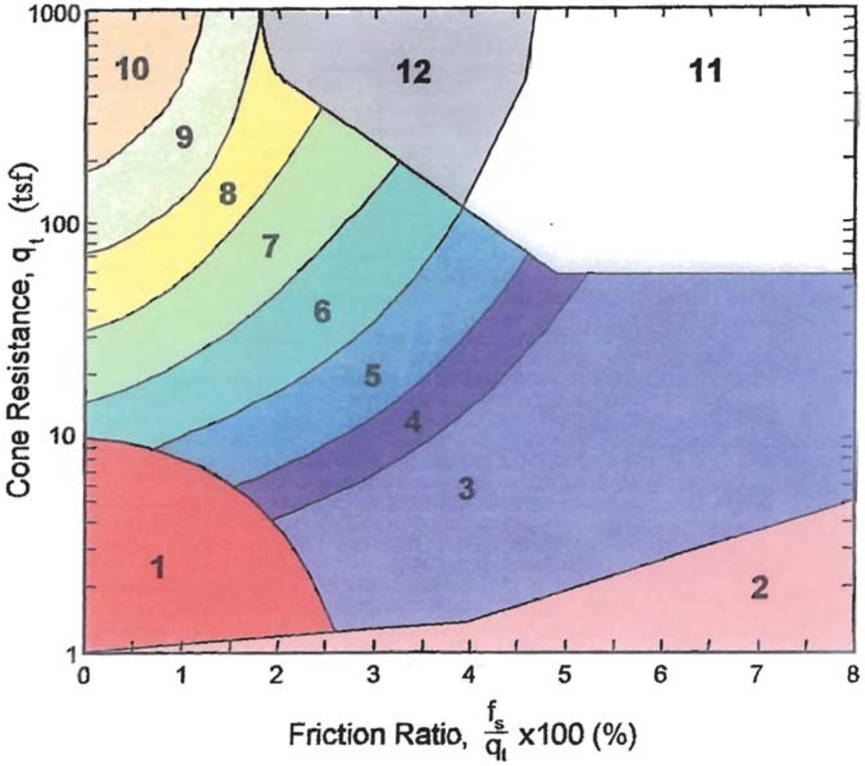
Granular Soil Gradation Parameters

Coefficient of Uniformity: $C_u = D_{60} / D_{10}$
Coefficient of Curvature: $C_C = (D_{30})^2 / (D_{10} \times D_{60})$
D_{10}= 10% of the soil is finer than this diameter
D_{30}= 30% of the soil is finer than this diameter
D_{30}= 60% of the soil is finer than this diameter

Group Symbol	**Gradation or Plasticity Requirement**
SW	C_u>6 and C_c between 1 and 3
GW	C_u>4 and C_c between 1 and 3
GP or SP	Clean gravel or sand not meeting requirement for GW or SW
GM or SM	Plots below "A" Line on Plasticity Chart or PI < 4
GC or SC	Plots above "A" Line on Plasticity Chart and PI > 7

FIGURE A1-1a

CPT Soil Behavior Type Legend
(Robertson et al. 1986)



Zone		Soil Behavior Type
1	🟥	Sensitive, Fine Grained
2	🟥	Organic Material
3	🟪	Clay
4	🟪	Silty Clay to Clay
5	🟦	Clayey Silt to Silty Clay (Silt Mix)
6	🟦	Sandy Silt to Clayey Silt
7	🟩	Silty Sand to Sandy Silt (Sand Mix)
8	🟨	Sand to Silty Sand
9	⬜	Sand
10	🟧	Gravelly Sand to Sand
11	⬜	Very Stiff Fine Grained*
12	⬜	Sand to Clayey Sand*
		*Overconsolidated or cemented

Figure A1-1b

LOG OF TEST BORING

PROJECT NAME Ballona Wetlands

PROJECT NUMBER LA-962A

BORING **LEGEND**

SITE LOCATION Marina Del Rey, CA

START

FINISH

SHEET NO. 1 of 1

DRILLING COMPANY Cascade

DRILLING METHOD Rotary Wash

LOGGED BY NB

CHECKED BY PK

DRILLING EQUIPMENT CME 85

BORING DIA. (in) 3.875"

TOTAL DEPTH (ft)

GROUND ELEV (ft)

DEPTH/*ELEV.* GROUND WATER (ft) ▼ / *na*

SAMPLING METHOD SPT & Cal. Mod.

NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	DRY DENSITY (pcf)	MOISTURE (%)	OTHER TESTS	% PASSING #200	ATTERBERG LIMITS LL:PL:PI	POCKET PEN (tsf)	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
												BULK, CAL, SPT - Refers to the sampling method as described below
5		▮	B-1									BULK - Refers to collecting sample by method of placing disturbed soil cuttings into a large plastic bag
10		⧗	R-2									CAL (CALIFORNIA MODIFIED) - A 3.0" o.d. split tube sampler lined with 2.42" i.d. metal sample rings generally driven into the soil by a 140 lbs. hammer free falling 30 inch
15		☒	S-3									SPT (STANDARD PENETRATION TEST) - A 2.0" o.d. split spoon sampler with a 1.375" i.d. driven into the soil with a 140# hammer free falling a height of 30"
20												ABBREVIATIONS FOR OTHER TESTS:

AL = Atterberg Limits
CN = Consolidation
CO = Corrosivity
CP = Laboratory Compaction
DS = Direct Shear
LL = Liquid Limit

GS = Grain Size Analyses
PP = Pocket Pen
RV = R-Value
WA = Wash on #200 Sieve
EI = Expansion Index
TV = Torvane

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Figure A1-1c

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-RW002
SITE LOCATION Ballona Wetlands
START 10/5/2012
FINISH 10/5/2012
SHEET NO. 1 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY J. Wright
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 71.5
GROUND ELEV (ft) 17.8
DEPTH/ELEV. GW (ft) ∇ / na DURING DRILLING; ▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														Artificial Fill (af) **Silty Sand (SM)**, brown, dry to moist, fine to coarse grained sand, little oxidation, trace organics.
	15													
5														
		☒	S-1	1 1 2	3									**Alluvium (Qa)** **Sandy Silt (ML)**, gray, moist, soft, fine to medium grained sand, low plasticity.
	10													
														Sandy Gravel (GP), gray, moist to wet, medium dense, medium to coarse grained sand, fine to coarse gravel, trace shells.
10														
		■	R-2	4 8 10	18	15								
	5													
15														-Loose, trace coarse gravel.
		☒	S-3	2 5 5	10									
														Sandy/Gravelly Clay (CL), gray, moist, coarse grained sand, trace fine to coarse gravel, low to medium plasticity.
	0													
20														
	-5													**Sandy Silt (ML)**, gray, fine grained sand, H2S odor.

GDC_LOG_BORING_2011 L-962_PART 1.GPJ GDCLOG.GDT 1/24/13

FIGURE
A1-2 a

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project	**PROJECT NUMBER** LA-962A	**HOLE ID** A-RW002	
SITE LOCATION Ballona Wetlands	**START** 10/5/2012	**FINISH** 10/5/2012	**SHEET NO.** 2 of 3
DRILLING COMPANY Cascade Drilling	**DRILL RIG** CME 85	**DRILLING METHOD** Rotary Wash	**LOGGED BY** J. Wright
CHECKED BY P. Kashighandi	**HAMMER TYPE (WEIGHT/DROP)** Hammer: 140 lbs., Drop: 30 in.	**HAMMER EFFICIENCY (ERi)**	**BORING DIA. (in)** 3.875
TOTAL DEPTH (ft) 71.5	**GROUND ELEV (ft)** 17.8	**DEPTH/ELEV. GW (ft)** ☆ / na DURING DRILLING ▼ / na AFTER DRILLING	
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")	**NOTES**		

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		☒	B-4					65			PA			Driller having problems keeping hole open due to caving from gravel material. Drilled to reach more clayey material to thicken mud.
	-10													
30														
	-15													
35														
		☒	S-5	1 1 2	3			74			PA			**Sandy Silt (ML)**, gray, moist, soft, fine grained sand, low plasticity, trace shell fragments, trace organics, H2S odor.
	-20													
40														
		⧗	R-6	3 3 3	6	42	78			1.25	DS			**Clayey Silt (ML)**, gray, moist, soft, low to medium plasticity, trace oxidation.
	-25													
														Silty Sand (SM), gray, moist, very loose, fine grained sand.
45														
		☒	S-7	5 1 1	2			49			PA			**Clayey Silt (ML)**, gray, moist, low plasticity, trace shell fragments, trace oxidation.
	-30													

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FIGURE
A1-2 b

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-RW002
SITE LOCATION Ballona Wetlands
START 10/5/2012
FINISH 10/5/2012
SHEET NO. 3 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY J. Wright
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 71.5
GROUND ELEV (ft) 17.8
DEPTH/ELEV. GW (ft) ∇ / na DURING DRILLING; ▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		⧗	R-8	5 7 8	15	22	106			1.0				-Loose, fine to medium grained sand, low plasticity, trace oxidation.
	-35													
														Silty Sand (SM), gray, wet, loose, fine to medium coarse grained sand, trace fine gravel.
55														
		☒	S-9	8 5 4	9					1.5				**Sandy Silt (ML)**, gray, moist, stiff, fine grained sand, low to medium plasticity.
	-40													
60														-Trace organics.
		⧗	R-10	5 7 16	23	27	90			1.5				
	-45													
														Sand (SP), gray, wet, dense, fine to coarse grained sand, trace fine gravel.
65														
		☒	S-11	27 22 22	44									
	-50													
														Lean Clay (CL), gray, moist, stiff, low to medium plasticity, trace organics. Note: Few fine grained sand in tip of sampler.
70														
		☒	S-12	3 6 7	13	34								
	-55													Boring terminated at 71.5 ft. Groundwater not measured. Hole backfilled with bentonite grout.

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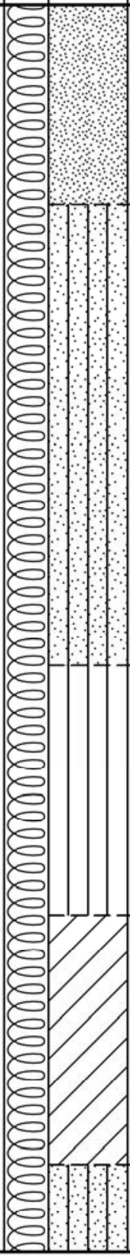
FIGURE A1-2 c

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-RW003
SITE LOCATION Ballona Wetlands
START 9/21/2012
FINISH 9/21/2012
SHEET NO. 1 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 71.5
GROUND ELEV (ft) 19
DEPTH/*ELEV.* GW (ft) ⊻ / *na* **DURING DRILLING**
▼ / *na* **AFTER DRILLING**
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES



DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		▨	B-1											**Artificial Fill (af)** **Sand (SP)**, brown, dry, loose, little roots, trace fine to coarse gravel. -Increase in density, no roots.
	15													**Silty Sand (SM)**, brown, wet, very loose, fine grained sand, trace medium grained sand, no plasticity.
5														
		☒	S-2	4 2 1	3			16			PA			
	10													
10														-Gray, fine to medium grained sand, few shell fragments.
		■	SH-3			23	99				DS			
														Sandy Silt (ML), gray, wet, medium stiff, fine grained sand, low plasticity, trace shell fragments.
	5													
15														
		☒	S-4	1 3 2	5									
														Alluvium (Qa)
	0													**Silty Clay (CL)**, gray, moist, fine grained sand, trace oxidation. Vane Shear = 0.5 ksf
20														
		■	SH-5			54	71		40:21	0.35				
														Silty Sand (SM), gray, wet, very loose, fine grained sand, trace shell fragments, slight H2S odor.
	-5													

FIGURE

A1-3 a

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-RW003
SITE LOCATION Ballona Wetlands
START 9/21/2012
FINISH 9/21/2012
SHEET NO. 2 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 71.5
GROUND ELEV (ft) 19
DEPTH/ELEV. GW (ft) ∇ / na DURING DRILLING; ▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-6	2 1 1	2									
														Sandy Silt (ML), gray, moist, soft, low to medium plasticity, little shell fragments.
	-10													
30														Vane Shear = 1.4 ksf
			SH-7			37	85			0.25	C DS			
														Sandy Clay (CL), gray, moist, very soft, fine grained sand, medium plasticity, few organics, trace fine rootlets, trace shell fragments, H2S odor.
	-15													
35			S-8	0 0 1	1				47:28					
	-20													
40			S-9							0.25				-No rootlets, no H2S odor.
	-25													
45			R-10	2 4 5	9									-No recovery, firm.
														Fat Clay (CH), gray, moist, medium stiff, high plasticity, trace shell fragments.
			R-11	5 7 9	16					0.75				
	-30													**Clay with Sand (CL)**, gray, moist, stiff, fine grained sand,

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FIGURE
A1-3 b

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-RW003
SITE LOCATION Ballona Wetlands
START 9/21/2012
FINISH 9/21/2012
SHEET NO. 3 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 71.5
GROUND ELEV (ft) 19
DEPTH/ELEV. GW (ft) ∇ / na DURING DRILLING; ▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		☒	S-12	2 5 6	11					1.75				medium plasticity.
	-35													
55		■	SH-13			32	89		34:11	0.5				**Lean Clay (CL)**, gray, wet, medium stiff, few fine grained sand, medium plasticity. Vane shear = 0.9 ksf
														Clayey Sand (SC), gray, wet, medium dense, fine grained sand, trace medium grained sand, trace organics.
	-40													
60		☒	S-14	8 14 16	30									
														Sandy Clay (CL), gray, wet, medium stiff, fine grained sand, medium, some tree roots up to ~1/2" in diameter and over 2.5" long. Vane shear = 0.37 ksf
	-45													
65		⧗	R-15	3 5 6	11	30	89		29:8					
	-50													
70		☒	S-16	2 3 6	9	34				0.25				**Lean Clay (CL)**, gray, moist, stiff, medium plasticity, trace fine grained sand, trace roots, trace calcite.
														Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
	-55													

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FIGURE
A1-3 c

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-RW005
SITE LOCATION Ballona Wetlands
START 10/9/2012
FINISH 10/9/2012
SHEET NO. 1 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 71
GROUND ELEV (ft) 17
DEPTH/ELEV. GW (ft) ⊻ / na DURING DRILLING; ▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
0														Asphalt
														Artificial Fill (af)
	15													**Lean Clay (CL)**, olive brown, moist, medium stiff, trace fine grained sand, medium plasticity, few sea shells.
5														
			R-1	3 5 5	10	30	89				C DS			
	10													
10														**Alluvium (Qa)**
			S-2	0 0 0	0									**Silty Sand (SM)**, gray, wet, very loose, fine grained sand, few shell fragments.
	5													
														Silt (ML), gray, wet, soft, trace fine grained sand, none to low plasticity, trace sea shells, trace rootlets.
15														
			R-3	2 2 3	5	45	77				C			
	0													
														Silty Sand (SM), mottled gray and orangish brown, wet, very loose, fine grained sand, none to low plasticity, some oxidation, trace sea shells.
20														
			S-4	2 1 3	4			28			PA			
	-5													
														Sand (SP), gray, wet, medium dense, fine grained sand, trace fines.

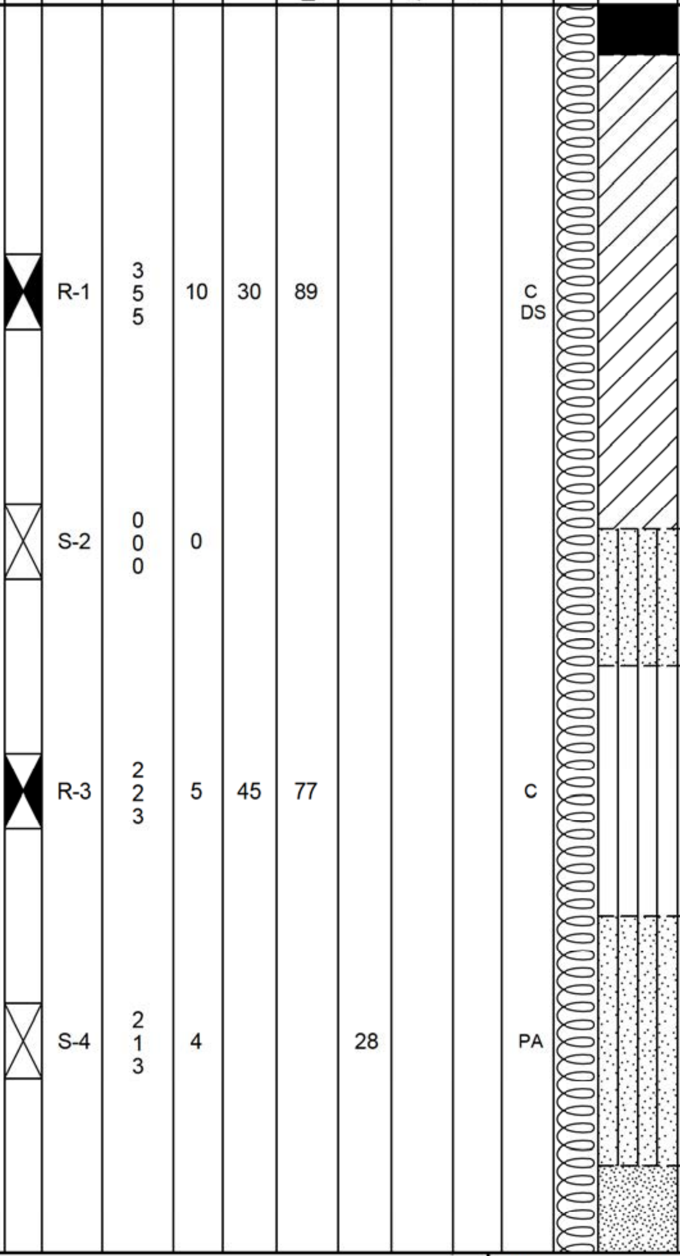

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FIGURE A1-4 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	A-RW005

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	10/9/2012	10/9/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/ELEV. GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71	17	∇ / na DURING DRILLING ▼ / na AFTER DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES
SPT (1.4"), CAL (2.4")	

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		⧗	R-5	12 14 8	22	28	94							
	-10													
														Fat Clay (CH) or Organic Matter (OH) gray, moist, very soft, high plasticity, laminations of fine shell fragments, H2S odor.
30														
		⧖	S-6	0 0 1	1	81			92:51	0.25				
	-15													
35														-Soft, trace shell fragments.
		⧗	R-7	0 0 3	3	64	63				DS			Vane shear = 0.32 ksf
	-20													
														Silty Sand (SM), gray, wet, medium dense, fine grained sand.
40														
		⧖	S-8	4 5 10	15			41			PA			
	-25													
														Clayey Silt (ML), gray, moist, medium stiff, few fine grained sand, low plasticity.
45														
		⧗	R-9	4 6 7	13	34	88			0.75				
														Fat Clay (CH), gray, moist, high plasticity.
	-30													
														Silty Clay (CL), gray, moist, firm, few fine grained sand, medium plasticity.

FIGURE
A1-4 b

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-RW005
SITE LOCATION Ballona Wetlands
START 10/9/2012
FINISH 10/9/2012
SHEET NO. 3 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 71
GROUND ELEV (ft) 17
DEPTH/*ELEV.* GW (ft) ∇ / *na* **DURING DRILLING**; ▼ / *na* **AFTER DRILLING**
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		☒	S-10	1 3 4	7	28				0.75				
	-35													
55														-Little recovery with sand catcher.
		■	R-11	2 3 5	8									
	-40													
60														-Wet, soft, trace fine grained sand, trace wood fibers, trace fine rootlets.
		☒	S-12	0 1 2	3	38				0.25				
	-45													
65														-Stiff.
		■	R-13	6 7 10	17									
	-50													
														Sand (SP), gray, wet, very dense, fine grained sand, trace fines, one gravel in tip of sampler.
70														
		☒	S-14	40 50/5"	REF									
														Boring terminated at 71 ft. Groundwater not measured. Boring backfilled with bentonite grout.
	-55													

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

FIGURE
A1-4 c

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-RW006
SITE LOCATION Ballona Wetlands
START 9/13/2012
FINISH 9/13/2012
SHEET NO. 1 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 71.5
GROUND ELEV (ft) 15.3
DEPTH/*ELEV.* GW (ft) ⊻ / *na* DURING DRILLING; ▼ / *na* AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DESCRIPTION AND CLASSIFICATION
	15	▨	B-1									**Artificial Fill (af)** **Silty Clay w/ Sand (CL)**, brown, dry, fine grained sand, low plasticity, trace shell fragments, trace fine gravel.
												Sandy Silt (ML), brown, dry, hard, fine grained sand, with hard dark gray clay seams. trace of gravel and cobbles
5	10	⧓	R-2	14 50/3"	100	6	88	54			DS PA	
												Silty Sand with Clay (SM), brown, moist, medium dense, fine grained sand, trace roots.
10	5	☒	S-3	4 7 7	14			30			PA	
15	0	⧓	R-4	1 2 3	5	16	106					-Wet, very loose.
												Alluvium (Qa) **Silty Clay (CL)**, gray, wet, soft, trace oxidation, micaceous.
20	-5	☒	S-5	1 1 2	3				50:23			
												Clayey Sand (SC), gray, wet, loose, fine grained sand, few oxidation, trace shell fragments, low plasticity.

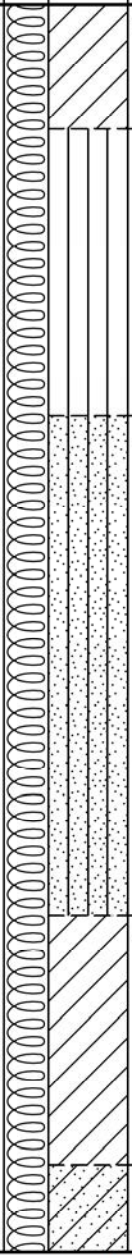

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FIGURE
A1-5 a

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-RW006
SITE LOCATION Ballona Wetlands
START 9/13/2012
FINISH 9/13/2012
SHEET NO. 2 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 71.5
GROUND ELEV (ft) 15.3
DEPTH/*ELEV.* GW (ft) ∇ / *na* **DURING DRILLING**
▼ / *na* **AFTER DRILLING**
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-10	■	SH-6			33	87	32			PA			-Shelby tube disturbed ~2" remain.
30	-15	☒	S-7	11 15 8	23									-Medium dense, trace organics.
														Clayey Silt (MH) with laminations of light gray silt and light brown silt, gray, wet, trace fine grained sand, few shell fragments, strong H2S odor (~7ppm on gas meter), high plasticity.
35	-20	■	SH-8			68	65		64:31		C			Vane Shear = 0.65 ksf
														Silty Clay (CH), gray, wet, soft, little shell fragments and sea shells, strong H2S odor, micaceous, high plasticity.
40	-25	☒	S-9			57			53:24					
														Silty Sand (SM), gray, wet, medium dense, fine grained sand, trace sea shells.
45	-30	■	SH-10			27	99							
														Silty Clay (CL), gray, moist, medium stiff, low to medium plasticity.

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FIGURE
A1-5 b

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-RW006
SITE LOCATION Ballona Wetlands
START 9/13/2012
FINISH 9/13/2012
SHEET NO. 3 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 71.5
GROUND ELEV (ft) 15.3
DEPTH/ELEV. GW (ft) ∇ / na DURING DRILLING
▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-35	☒	S-11	0 5 5	10				44:21	0.5				
														Silty Sand (SM), gray, wet, fine grained sand.
55	-40	■	SH-12			25	100							
														Silty Clay (CL), gray, wet, stiff, low to medium plasticity, trace shell fragments, micaceous.
60	-45	☒	S-13	1 6 9	15				48:24	1.25				
65	-50	■	SH-14											
														Poorly Graded Sand (SP), gray, wet, fine to medium grained sand.
														Sandy Clay (CL), gray, moist, stiff, fine grained sand, medium plasticity, trace organics.
70	-55	☒	S-15	6 7 17	24				32:13	1.25				
														Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

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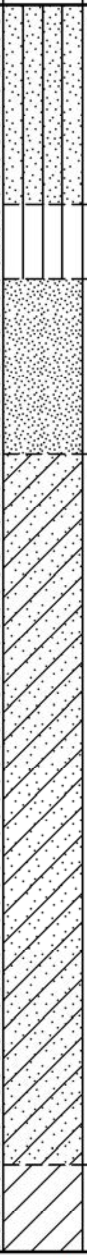
FIGURE
A1-5 c

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-RW008
SITE LOCATION Ballona Wetlands
START 9/27/2012
FINISH 9/28/2012
SHEET NO. 1 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 65
GROUND ELEV (ft) 15.7
DEPTH/ELEV. GW (ft) ⊻ / na DURING DRILLING; ▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES



DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	15													**Artificial Fill (af)** **Silt with Sand (ML)**, gray, dry, fine grained sand, no plasticity, trace organics.
														Elastic Silt (MH), gray, moist, trace fine grained sand, high plasticity.
5														
														Sand (SP), brown, medium dense, fine grained sand, trace coarse grained sand, trace fine gravel.
	10	☒	S-1	4 7 12	19			88			PA			
														Alluvium (Qa) **Sandy Clay (CL)**, gray, wet, stiff, fine grained sand, medium plasticity, micaceous.
10														
	5	⧗	R-2	2 3 2	5	32	83		48:25	1.25	DS			
15														-Very soft, trace organics, slight H2S odor.
	0	☒	S-3	0 0 0	0					0.25				
20														-No recovery.
	-5	■	SH-4											
														Fat Clay (CH), gray, wet, very soft, trace fine grained sand, high plasticity, shell fragments, H2S odor.

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FIGURE

A1-6 a

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project	**PROJECT NUMBER** LA-962A	**HOLE ID** A-RW008	
SITE LOCATION Ballona Wetlands	**START** 9/27/2012	**FINISH** 9/28/2012	**SHEET NO.** 2 of 3
DRILLING COMPANY Cascade Drilling	**DRILL RIG** CME 85	**DRILLING METHOD** Rotary Wash	**LOGGED BY** N. Briffa
CHECKED BY P. Kashighandi			
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.	**HAMMER EFFICIENCY (ERi)**	**BORING DIA. (in)** 3.875	**TOTAL DEPTH (ft)** 65
GROUND ELEV (ft) 15.7	**DEPTH/ELEV. GW (ft)** ▽ / na DURING DRILLING; ▼ / na AFTER DRILLING		
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")	**NOTES**		

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-10		R-5	0 0 1	1	63	64		50:23	0.25				
														Elastic Silt (MH), gray, wet, high plasticity, trace shell fragments, H2S odor.
30														Vane Shear = 0.6 ksf
	-15		SH-6			61	63		68:34	0.25	C			
35														-Soft.
	-20		R-7	1 1 3	4	50	71			0.25				
40														-No recovery.
	-25		SH-8											
			S-9	2 2 2	4					0.25				-Moist, very soft.
45														**Fat Clay (CH)**, gray, soft, wet, trace fine grained sand, high plasticity.
	-30		R-10	2 3 4	7	44	74		54:26	0.25				

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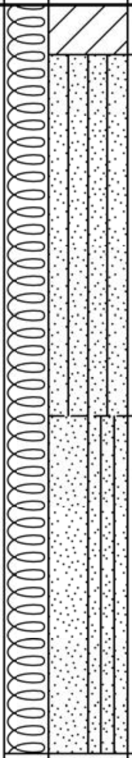
FIGURE A1-6 b

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-RW008
SITE LOCATION Ballona Wetlands
START 9/27/2012
FINISH 9/28/2012
SHEET NO. 3 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 65
GROUND ELEV (ft) 15.7
DEPTH/ELEV. GW (ft) ▽ / na DURING DRILLING
▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES



DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														-Moist, trace organics.
	-35	☒	S-11	3 2 2	4					0.25				
														Silty Sand (SM), gray, wet, very loose, fine to medium grained sand, trace organics.
55														
														Peat (PT), brown, moist.
	-40	■	R-12	7 12 14	26	211	24							
														Sand with Silt (SP-SM), gray, wet, fine to medium grained sand, trace coarse grained sand, trace fine gravel, trace organics, trace seams of silt.
60														
	-45	☒	S-13	13 19 22	41									
65														**Sand with Gravels (SP)**, gray, wet, fine to coarse grained sand, fine to coarse gravel. NOTE: Hole kept collapsing, most of sample (S-14) was collapsed soil, blow counts not accurate. Boring terminated at 65 ft. Groundwater not measured. Boring backfilled with bentonite grout.
	-50	☒	S-14											
70														
	-55													

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FIGURE A1-6 c

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project	PROJECT NUMBER LA-962A	HOLE ID **A-RW009**	
SITE LOCATION Ballona Wetlands	START 9/27/2012	FINISH 9/27/2012	SHEET NO. 1 of 3
DRILLING COMPANY Cascade Drilling	DRILL RIG CME 85	DRILLING METHOD Rotary Wash	LOGGED BY N. Briffa
CHECKED BY P. Kashighandi			
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.	HAMMER EFFICIENCY (ERi)	BORING DIA. (in) 3.875	TOTAL DEPTH (ft) 61.5
GROUND ELEV (ft) 17.1	DEPTH/*ELEV.* GW (ft) ▽ / *na* DURING DRILLING ▼ / *na* AFTER DRILLING		
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")	NOTES		

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														Artificial Fill (af) **Silt with Sand (ML)**, gray, dry, fine grained sand, no plasticity, few shell fragments, trace organics.
	15													
														Silty Sand (SM), gray and olive brown, moist, very loose, fine grained sand, no plasticity, few oxidation, trace shell fragments, micaceous.
5														
		⧗	R-2	2 2 4	6	23	89	29			PA			
	10													
														Alluvium (Qa)
10														**Sandy Silt (ML)**, gray, wet, very soft, fine grained sand, none to low plasticity.
		⧖	S-3	0 0 0	0			76			PA			
	5													
15														-Trace oxidation, highly micaceous.
		■	SH-4			40	83							
	0													
														Silty Sand (SM), gray, wet, loose, fine grained sand, little oxidation.
20														
		⧗	R-5	4 4 4	8	35	79							
	-5													
														Fat Clay (CH), gray, moist, very soft, high plasticity, H2S odor, trace organics.

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FIGURE
A1-7 a

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project		**PROJECT NUMBER** LA-962A	**HOLE ID** A-RW009
SITE LOCATION Ballona Wetlands	**START** 9/27/2012	**FINISH** 9/27/2012	**SHEET NO.** 2 of 3
DRILLING COMPANY Cascade Drilling	**DRILL RIG** CME 85	**DRILLING METHOD** Rotary Wash	**LOGGED BY** N. Briffa
			CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.	**HAMMER EFFICIENCY (ERi)**	**BORING DIA. (in)** 3.875	**TOTAL DEPTH (ft)** 61.5
GROUND ELEV (ft) 17.1	**DEPTH/ELEV. GW (ft)**	⊻ / na DURING DRILLING	▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")	**NOTES**		

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		☒	S-6	0 0 0	0				56:36					
	-10													
30														-Soft, trace fine grained sand, no organics, trace shell fragments.
		■	SH-7			48	73							Vane Shear = 0.6 ksf
	-15													
35														-Very soft, no fine grained sand.
		⧗	R-8	0 1 2	3	56	65			0.25				
	-20													
														Silty Sand (SM), gray, moist, fine grained sand, micaceous, few blebs of lightly cemented Sandy Silt.
40														
		■	SH-9			28	94	47			PA			
	-25													
														Fat Clay (CH), gray and dark grayish brown, moist, stiff, few fine grained sand, medium plasticity.
45														
		☒	S-10	3 3 3	6					1.25				
	-30													

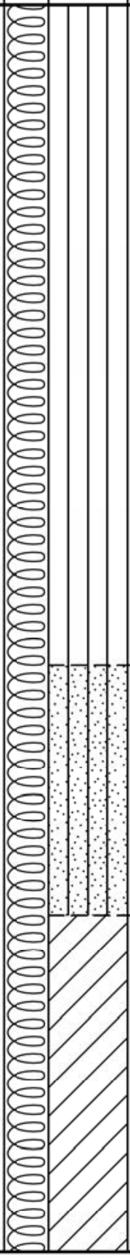

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FIGURE A1-7 b

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-RW009
SITE LOCATION Ballona Wetlands
START 9/27/2012
FINISH 9/27/2012
SHEET NO. 3 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 61.5
GROUND ELEV (ft) 17.1
DEPTH/ELEV. GW (ft) ▽ / na DURING DRILLING; ▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		■	SH-11			106	44		72:34	1.0				-Gray, wet, stiff, high plasticity, some organics.
	-35													
														Silty Sand (SM), gray, wet, very dense, fine grained sand, few organics.
55														
		☒	S-12	5 27 35	62									-Fine to coarse grained sand, fine to coarse gravel.
	-40													
														Sand (SP), gray, wet, very dense, fine to medium grained sand, trace fine to coarse gravel.
60														
		☒	S-13	23 27 24	51									
	-45													Boring terminated at 61.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
65														
	-50													
70														
	-55													

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FIGURE
A1-7 c

BORING RECORD

PROJECT NAME: Ballona Wetlands Restoration Project
PROJECT NUMBER: LA-962A
HOLE ID: A-RW011
SITE LOCATION: Ballona Wetlands
START: 9/28/2012
FINISH: 9/28/2012
SHEET NO.: 1 of 3
DRILLING COMPANY: Cascade Drilling
DRILL RIG: CME 85
DRILLING METHOD: Rotary Wash
LOGGED BY: N. Briffa
CHECKED BY: P. Kashighandi
HAMMER TYPE (WEIGHT/DROP): Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi):
BORING DIA. (in): 3.875
TOTAL DEPTH (ft): 56.5
GROUND ELEV (ft): 13
DEPTH/ELEV. GW (ft): ⊻ / na DURING DRILLING; ▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID): SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES:

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			B-1											**Artificial Fill (af)** **Silt with Sand (ML)**, gray, dry, fine grained sand, no plasticity, trace organics.
	10													
5			R-2	1 1 1	2	29	88		28:1		C			**Sandy Silt (ML)**, gray, wet, very soft, fine grained sand, low to medium plasticity.
	5													
10			S-3	1 1 2	3									-Soft, trace fine grained sand, trace oxidation, trace roots, micaceous.
	0													**Fat Clay (CH)**, gray, wet, soft, high plasticity, some oxidation, trace roots, micaceous.
15			R-4	2 2 2	4	41	74		62:33					Vane Shear = 0.25 ksf
	-5													
20			S-5	0 0 0	0				66:36					-Trace fine grained sand, trace sea shells, trace organics, slight H2S odor.
	-10													

FIGURE
A1-8 a

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-RW011
SITE LOCATION Ballona Wetlands
START 9/28/2012
FINISH 9/28/2012
SHEET NO. 2 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 56.5
GROUND ELEV (ft) 13
DEPTH/*ELEV.* GW (ft) ⊻ / *na* DURING DRILLING
AFTER DRILLING ▼ / *na*
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			SH-6						63:35					-Few fine grained sand.
	-15													
30			R-7	2 4 8	12	24	96			0.75				-Moist, medium stiff, trace fine grained sand.
	-20													
35			S-8	1 6 3	9					0.25				-Soft, trace blebs of lightly cemented soil.
														Clayey Sand (SC)with Silt seams, gray, wet, medium dense, fine grained sand, trace medium to coarse grained sand.
	-25													
40			R-9	9 12 17	29	23	102							
	-30													
														Silty Clay (CH), gray, moist, medium stiff, trace fine grained sand, high plasticity, some organics.
45			S-10	0 2 4	6				58:30	0.5				
	-35													
														Silty Sand (SM), gray, moist, dense, fine to coarse grained sand, few fine to coarse gravel, ~40% fines, little organics.

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FIGURE
A1-8 b

BORING RECORD

PROJECT NAME
Ballona Wetlands Restoration Project

PROJECT NUMBER
LA-962A

HOLE ID
A-RW011

SITE LOCATION
Ballona Wetlands

START
9/28/2012

FINISH
9/28/2012

SHEET NO.
3 of 3

DRILLING COMPANY
Cascade Drilling

DRILL RIG
CME 85

DRILLING METHOD
Rotary Wash

LOGGED BY
N. Briffa

CHECKED BY
P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)
Hammer: 140 lbs., Drop: 30 in.

HAMMER EFFICIENCY (ERi)

BORING DIA. (in)
3.875

TOTAL DEPTH (ft)
56.5

GROUND ELEV (ft)
13

DEPTH/*ELEV.* GW (ft)
∇ / *na* **DURING DRILLING**
▼ / *na* **AFTER DRILLING**

DRIVE SAMPLER TYPE(S) & SIZE (ID)
SPT (1.4"), CAL (2.4"), SHELBY (3")

NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		⧗	R-11	3 12 50	72	18								
	-40													
55														
		⧖	S-12	17 22 29	41									-No organics, decrease in fines.
														Boring terminated at 56.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
	-45													
60														
	-50													
65														
	-55													
70														
	-60													

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FIGURE
A1-8 c

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-RW013
SITE LOCATION Ballona Wetlands
START 9/26/2012
FINISH 9/26/2012
SHEET NO. 1 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 56.5
GROUND ELEV (ft) 13.8
DEPTH/ELEV. GW (ft) ☐ / na DURING DRILLING
▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		☒	B-1											**Artificial Fill (af)** **Silty Sand (SM)**, brown, dry, fine to coarse grained sand, fine to coarse gravel, few organics, trace shell fragments, denser than other locations in Area A.
	10													
5														-Loose, no organics, few shell fragments.
		⧗	R-2	0 4 3	7	20	117							
	5													
														Alluvium (Qa)
10														**Sandy Silt (ML)**, olive brown, wet, medium stiff, highly micaceous, some oxidation.
		⧖	S-3	3 4 4	8			84			PA			
														Lean Clay (CL), olive brown, wet, soft, medium plasticity, highly micaceous, some oxidation.
	0													
15														Vane Shear = 0.3 ksf
		⧗	R-4	0 0 2	2	48	71	88	47:20		C PA			
														Fat Clay (CH), gray, wet, soft, few fine grained sand, high plasticity, trace shell fragments, H2S odor.
	-5													
20														
		⧖	S-5	0 1 1	2				56:28					
	-10													

FIGURE A1-9 a

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-RW013

SITE LOCATION Ballona Wetlands
START 9/26/2012
FINISH 9/26/2012
SHEET NO. 2 of 3

DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi

HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 56.5
GROUND ELEV (ft) 13.8
DEPTH/ELEV. GW (ft) ∇ / na DURING DRILLING
▼ / na AFTER DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			SH-6								C			-No recovery.
														Lean Clay (CL), gray, wet, medium stiff, trace coarse grained sand, medium plasticity. NOTE: Increase in stiffness at bottom. Vane Shear = 1.2 ksf
	-15													
30														
			R-7	5 5 6	11	15	115		34:16					
														Silty Sand (SM), gray, wet, loose, fine grained sand, trace fine gravel.
	-20													
35														
			S-8	3 3 3	6									
														Interbedded layers of Fat Clay (CH) and Silt (ML): **Fat Clay (CH)**, gray, moist, stiff, medium to high plasticity, and; **Silt (ML)**, gray, wet, stiff, trace fine grained sand, medium plasticity.
	-25													
40														
			R-9	4 4 6	10	57	69			1.25				
	-30													
45														
														Peat (PT), brown, moist, firm, 4" layer of **Fat Clay (CH)**, tree stump or branch >3".
			S-10	3 3 4	7									
														Sand with Silt (SP-SM), gray, wet, dense, fine to medium grained sand, trace organics (wood fibers).
	-35													

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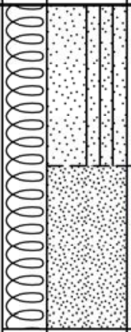
FIGURE
A1-9 b

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-RW013
SITE LOCATION Ballona Wetlands
START 9/26/2012
FINISH 9/26/2012
SHEET NO. 3 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 56.5
GROUND ELEV (ft) 13.8
DEPTH/*ELEV.* GW (ft) ▽ / *na* DURING DRILLING
▼ / *na* AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS
		⧗	R-11	22 27 35	62	21	104				
	-40										
55		☒	S-12	15 24 25	49						
	-45										
60											
	-50										
65											
	-55										
70											
	-60										



DESCRIPTION AND CLASSIFICATION

Sand with Gravel (SP), gray, wet, dense, fine to medium grained sand, few coarse grained sand, fine to coarse gravel, trace clay.

Boring terminated at 56.5 ft.
Groundwater not measured.
Boring backfilled with bentonite grout.

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FIGURE
A1-9 c

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-RW015
SITE LOCATION Ballona Wetlands
START 10/2/2012
FINISH 10/2/2012
SHEET NO. 1 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa/J. Wright
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 61.5
GROUND ELEV (ft) 17.1
DEPTH/*ELEV.* GW (ft) ⊻ / *na* DURING DRILLING; ▼ / *na* AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		☒	B-1											**Artificial Fill (af)** **Silty Sand (SM)**, brown, dry, fine to coarse grained sand, few fine to coarse gravels, trace cobble, little sea shells, little rootlets/branches.
	15													
5		⊠	S-2	1 4 4	8									-Dark gray to brown, moist, loose, fine to medium grained sand, low to medium plasticity, trace shell fragments, little oxidation.
	10													
10		■	R-3	2 4 5	9	27			57:35	0.75				**Alluvium (Qa)** **Fat Clay (CH)**, dark gray to brown, moist, stiff, fine grained sand, high plasticity, little medium grained sand. Vane Shear = 1.1 ksf
	5													**Clayey Sand (SC)**, gray with mottled brown, moist, loose, fine grained sand, some oxidation, micaceous.
15		⊠	S-4	1 2 3	5			43			PA			
	0													
20		■	R-5	5 4 3	7	43	78				DS			-Wet, low plasticity, large shell fragments.
	-5													**Silty Clay (CL)**, gray, moist, medium stiff, trace fine grained sand, medium plasticity, H2S odor.

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FIGURE
A1-10 a

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project			**PROJECT NUMBER** LA-962A		**HOLE ID** A-RW015	
SITE LOCATION Ballona Wetlands			**START** 10/2/2012	**FINISH** 10/2/2012	**SHEET NO.** 2 of 3	
DRILLING COMPANY Cascade Drilling	**DRILL RIG** CME 85	**DRILLING METHOD** Rotary Wash		**LOGGED BY** N. Briffa/J. Wright	**CHECKED BY** P. Kashighandi	
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.	**HAMMER EFFICIENCY (ERi)**	**BORING DIA. (in)** 3.875	**TOTAL DEPTH (ft)** 61.5	**GROUND ELEV (ft)** 17.1	**DEPTH/*ELEV.* GW (ft)** ⊻ / *na* **DURING DRILLING**	
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")	**NOTES**				▼ / *na* **AFTER DRILLING**	

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-6	0 1 2	3					0.75				
	-10													
30														-Moist, fine to medium grained sand.
			SH-7											
	-15													**Sand with Silt (SP-SM)**, gray, wet, medium dense, fine to coarse grained sand.
			R-8	13 18 18	36	25	107				DS			
														Silt (ML), gray, wet, soft, trace fine grained sand, none to low plasticity, ~3" layer of **Sand with Silt (SM)**
35														
			S-9	4 5 6	11			63		0.25	PA			
	-20													
40														**Sandy Silt (ML)**, gray, wet, firm, fine grained sand, trace coarse grained sand, low plasticity.
			R-10	3 4 4	8	25								
	-25													
														Fat Clay (CH), gray, moist, medium stiff, high plasticity, some organics.
45														
			S-11	1 4 5	9				57:29	0.5				
	-30													
														Silty Sand (SM), gray, moist to wet, medium dense, fine grained sand, trace organics.

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FIGURE
A1-10 b

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-RW015
SITE LOCATION Ballona Wetlands
START 10/2/2012
FINISH 10/2/2012
SHEET NO. 3 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa/J. Wright
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 61.5
GROUND ELEV (ft) 17.1
DEPTH/ELEV. GW (ft) ∇ / na DURING DRILLING
▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			R-12	9 15 15	30	25	100	44		0.5	PA			
	-35													**Sand (SP)**, gray, wet, very dense, fine to coarse grained sand, few fine subangular gravel.
55														
			S-13	12 27 27	44									
	-40													
60														-Few fine to coarse gravel.
			S-14	48 40 46	86									
	-45													Boring terminated at 61.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
65														
	-50													
70														
	-55													

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FIGURE
A1-10 c

BORING RECORD

PROJECT NAME: Ballona Wetlands Restoration Project
PROJECT NUMBER: LA-962A
HOLE ID: A-HSA016
SITE LOCATION: Ballona Wetlands
START: 10/10/2012
FINISH: 10/10/2012
SHEET NO.: 1 of 1
DRILLING COMPANY: Cascade Drilling
DRILL RIG: CME 85 All Terrain
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: N. Briffa
CHECKED BY: P. Kashighandi
HAMMER TYPE (WEIGHT/DROP): Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi):
BORING DIA. (in): 8
TOTAL DEPTH (ft): 18
GROUND ELEV (ft): 15.7
DEPTH/ELEV. GW (ft): ⊻ / na DURING DRILLING; ▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID): SPT (1.4"), CAL (2.4")
NOTES:

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														Artificial Fill (af)
	15		B-1								CP			**Sandy Silt (ML)**, brown, dry, fine grained sand, little organics.
			R-2	1 2 3	5	25	81	65		2.5	PA			-Very stiff, moist, trace organics, trace oxidation, trace fine rootlets, trace clay seams, trace calcite or salt.
5														**Silty Sand (SM)**, light brown, dry, loose, fine grained sand.
	10		S-3	2 4 2	6									
														Alluvium (Qa)
			R-4 B-5	1 1 1	2	51	70							**Silty Clay (CL)**, gray, wet, very soft, few fine grained sand, medium plasticity.
10														**Clay (CL)**, gray, wet, soft, medium plasticity, laminations of silty sand, some organics (wood fibers and rootlets).
	5		S-6	0 1 3	4	41								
														Sandy Silt (ML), gray, wet, soft, fine grained sand, no plasticity, few oxidation, trace organics, trace fine rootlets, micaceous.
			R-7	1 3 4	7	36	85			0.25				
15														-Light gray.
	0		S-8	0 0 2	2	41				0.25				**Clay (CL)**, light gray, moist, soft, medium plasticity.
														-Gray, wet.
			B-9						37:12					
														Boring terminated at 18 ft. Groundwater not encountered. Boring backfilled with tamped cuttings.
20														
	-5													

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FIGURE
A1-11

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-HSA017
SITE LOCATION Ballona Wetlands
START 10/10/2012
FINISH 10/10/2012
SHEET NO. 1 of 1
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85 All Terrain
DRILLING METHOD Hollow Stem Auger
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 8
TOTAL DEPTH (ft) 16.5
GROUND ELEV (ft) 14.3
DEPTH/ELEV. GW (ft) ▽ / na **DURING DRILLING**
▼ / na **AFTER DRILLING**
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														Artificial Fill (af)
			B-1								CP			**Sandy Silt (ML)**, light brown, dry, fine grained sand, no plasticity, little organics, trace snail shells.
														-Brown, moist, soft, low plasticity, little oxidation.
			S-2	0 1 1	2			56			PA			
														Silty Sand (SM), gray, moist, very loose, fine grained sand.
	10													
														Silty Clay (CL), gray, wet, soft, medium plasticity.
5														
			R-3	0 1 1	2	57	64							
			B-4											
														-Very soft.
			S-5	0 0 0	0	49								
	5													
														Silt (ML), gray, wet, soft, trace fine grained sand, low plasticity, trace wood fiber.
10														
			R-6	0 2 3	5	37	82	77		0.25	PA			
														-Soft, little oxidation.
														Silt with Sand (ML), mottled gray and orangish brown, wet, medium stiff, some oxidation, trace organics, micaceous.
			S-7	0 3 3	6	39								
	0													
														Silty Clay (CL), mottled gray and orangish brown, wet, soft, some oxidation, trace organics, micaceous.
15														
			R-8 B-9	0 0 0	0	48	74			0.25				
														Boring terminated at 16.5 ft. Groundwater not encountered. Boring backfilled with tamped cuttings.
	-5													
20														
	-10													

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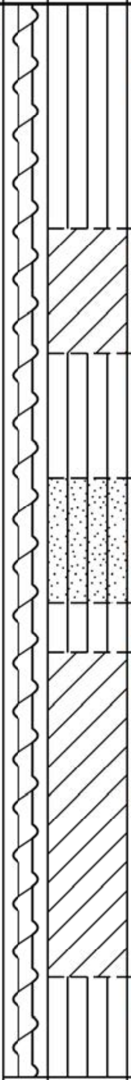
FIGURE
A1-12

BORING RECORD

PROJECT NAME: Ballona Wetlands Restoration Project
PROJECT NUMBER: LA-962A
HOLE ID: A-HSA018
SITE LOCATION: Ballona Wetlands
START: 10/10/2012
FINISH: 10/10/2012
SHEET NO.: 1 of 1
DRILLING COMPANY: Cascade Drilling
DRILL RIG: CME 85 All Terrain
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: N. Briffa
CHECKED BY: P. Kashighandi
HAMMER TYPE (WEIGHT/DROP): Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi):
BORING DIA. (in): 8
TOTAL DEPTH (ft): 21.5
GROUND ELEV (ft): 14.2
DEPTH/ELEV. GW (ft): ⊻ / na DURING DRILLING; ▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID): SPT (1.4"), CAL (2.4")
NOTES:



DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DESCRIPTION AND CLASSIFICATION
		☒	B-1								CP	**Artificial Fill (af)** **Silt (ML)** , brown, dry, trace fine grained sand, low plasticity, little organics (dry brush).
		☒	S-2	1 1 3	4	6						-Little recovery.
	10											
5												**Silty Clay (CL)**, brown, moist, very stiff, medium plasticity, trace shell fragments, trace calcite, micaceous.
		⧗	R-3	3 7 6	13	29	92			2.0		
												Clayey Silt (ML), brown, moist, stiff, medium plasticity, trace shell fragments, trace calcite, few oxidation, micaceous.
		☒	S-4	3 4 6	10	28				1.5		
	5											
10												**Alluvium (Qa)** Interbedded layers of **Silty Sand (SM) and Silty Clay (CL)**, gray, moist, loose/stiff, fine grained sand, trace fine rootlets in SM, trace organics in CL.
		⧗	R-5	4 7 8	15	23	95	38			PA	
												Silt (ML), gray, wet, very soft, no plasticity, few oxidation, micaceous.
		☒	S-6	1 0 0	0	33			63:32			**Fat Clay (CH)**, light gray, moist, very soft, high plasticity, trace sea shells.
	0											
15												
		⧗	R-7	1 0 2	2	48	75			0.25		**Fat Clay (CH)**, gray, wet, soft, few oxidation, trace organics.
		☒	S-8 B-9	0 1 2	3	46						-Trace fine rootlets, micaceous.
	-5											
20												**Clayey Silt (ML)**, gray, wet, very soft, few fine grained sand, few shell fragments, H2S odor.
		⧗	R-9	0 0 2	2	46	73					
												Boring terminated at 21.5 ft. Groundwater not encountered. Boring backfilled with tampered cuttings.
	-10											

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FIGURE
A1-13

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-RW020
SITE LOCATION Ballona Wetlands
START 10/3/2012
FINISH 10/3/2012
SHEET NO. 1 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY J. Wright
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 71.5
GROUND ELEV (ft) 15.4
DEPTH/ELEV. GW (ft) ⊻ / na DURING DRILLING; ⯆ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	15													**Artificial Fill (af)** **Silty Clay (CL)**, brown, moist, oxidation, trace shells.
5	10	☒	S-2	1 1 2	3	52				0.5				-Gray, moist, soft, low to medium plasticity.
														Silt (ML), gray, wet, very soft, fine to medium grained sand, none to low plasticity, trace shells.
10	5	⧗	R-3	1 2 1	3	53	71			0.15				
														Alluvium (Qa) **Silty Clay (CH)**, gray, moist to wet, fine to medium grained sand, high plasticity, some oxidation, trace shell fragments.
15	0	■	SH-4			83			63:35					
20	-5	☒	S-5	0 1 1	2	46			50:24					-Soft, high plasticity, fine grained sand, trace organics.

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FIGURE A1-14 a

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-RW020
SITE LOCATION Ballona Wetlands
START 10/3/2012
FINISH 10/3/2012
SHEET NO. 2 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY J. Wright
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 71.5
GROUND ELEV (ft) 15.4
DEPTH/ELEV. GW (ft) ⊻ / na DURING DRILLING
▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-10		R-6	1 2 2	4	91	48		75:40	0.1				-Moist to wet, H2S odor.
30	-15		S-7	0 1 1	2	46								-Soft, few shell fragments, H2S odor, no organics.
35	-20		SH-8			50	70		73:40					-Moist, stiff, few oxidation. Vane shear = 0.75 ksf
														Silty Sand (SM), gray, moist, medium dense, fine to coarse grained sand.
40	-25		R-9	9 13 13	26	20	109	28			PA			
45	-30		S-10	5 5 6	11									-Fine to medium grained sand, few organics.
														Fat Clay (CH), gray, moist, medium stiff, fine grained sand, high plasticity.

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

FIGURE
A1-14 b

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project	**PROJECT NUMBER** LA-962A	**HOLE ID** **A-RW020**	
SITE LOCATION Ballona Wetlands	**START** 10/3/2012	**FINISH** 10/3/2012	**SHEET NO.** 3 of 3
DRILLING COMPANY Cascade Drilling	**DRILL RIG** CME 85	**DRILLING METHOD** Rotary Wash	**LOGGED BY** J. Wright
CHECKED BY P. Kashighandi	**HAMMER TYPE (WEIGHT/DROP)** Hammer: 140 lbs., Drop: 30 in.	**HAMMER EFFICIENCY (ERi)**	**BORING DIA. (in)** 3.875
TOTAL DEPTH (ft) 71.5	**GROUND ELEV (ft)** 15.4	**DEPTH/*ELEV.* GW (ft)** ∇ / *na* **DURING DRILLING** ▼ / *na* **AFTER DRILLING**	
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")	**NOTES**		

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-35	⧗	R-11	3 5 5	10	42	77		52:28	0.75				
														Clayey Sand (SC), gray, wet, medium dense, fine grained sand, none to low plasticity, trace wood chunks.
55	-40	⧖	S-12	7 8 7	15									
60	-45	⧗	R-13	11 12 11	23	22	102							-Medium dense, no wood chunks, no plasticity.
65	-50	⧖	S-14	5 7 14	21									-Fine grained sand.
														Sand (SP), gray, wet, very dense, fine to coarse grained sand, few fine gravel.
70	-55	⧖	S-15	25 27 32	59									
														Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

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FIGURE
A1-14 c

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project	**PROJECT NUMBER** LA-962A	**HOLE ID** A-RW023	
SITE LOCATION Ballona Wetlands	**START** 10/3/2012	**FINISH** 10/3/2012	**SHEET NO.** 1 of 3
DRILLING COMPANY Cascade Drilling	**DRILL RIG** CME 85	**DRILLING METHOD** Rotary Wash	**LOGGED BY** J. Wright
CHECKED BY P. Kashighandi			
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.	**HAMMER EFFICIENCY (ERi)**	**BORING DIA. (in)** 3.875	**TOTAL DEPTH (ft)** 65.9
GROUND ELEV (ft) 19	**DEPTH/ELEV. GW (ft)** ⊻ / na DURING DRILLING	▼ / na AFTER DRILLING	
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")	**NOTES**		

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
0	19	▩	1										▨	**Artificial Fill (af)** **Sandy Clay (CL)**, brown, dry, fine to medium grained sand, low plasticity, some roots/branches, few snail shells.
	15													
5		⧗	2	1 2 3	5	42	80	82			PA			-Gray, moist, soft, fine grained sand, trace roots, trace shell fragments.
	10													
10		☒	3	2 4 5	9	37			38:13					-Stiff, trace roots.
	5													
15		⧗	4	1 2 5	7	48	72			0.25				-Medium stiff, low to medium plasticity.
	0													**Alluvium (Qa)** **Silt (ML)** , gray, moist, very soft, fine grained sand, medium plasticity, oxidation.
20		☒	5	0 0 1	1	48			46:16					
	-5													**Clayey Silt (ML)**, gray, moist to wet, soft, medium plasticity, few shells, strong H2S odor.

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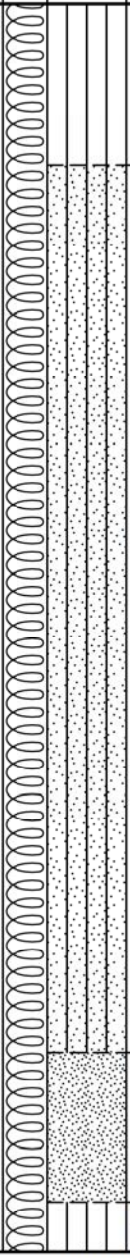
FIGURE A1-15 a

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID **A-RW023**
SITE LOCATION Ballona Wetlands
START 10/3/2012
FINISH 10/3/2012
SHEET NO. 2 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY J. Wright
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 65.9
GROUND ELEV (ft) 19
DEPTH/*ELEV.* GW (ft) ⊻ / *na* **DURING DRILLING**
▼ / *na* **AFTER DRILLING**
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		⧗	6	1 2 3	5	62	64			0.5				
														Sandy Silt (ML), gray, moist, stiff, low plasticity, trace shells.
	-10													
30		⊠	7	1 2 4	6			70		1.25	PA			
	-15													
35		■	8			30	91			1.0				-Stiff, fine to medium grained sand, trace coarse grained sand, low to medium plasticity.
	-20													
40		⧗	9	2 4 4	8	48	71			0.1				-Medium stiff, trace roots.
	-25													
45		⊠	10	7 10 7	17									-Low plasticity, no roots.
														Silty Sand (SP-SM), gray, wet, fine to coarse grained sand.
	-30													**Clayey Silt (ML)**, gray, moist, stiff, low to medium plasticity, trace organics.



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

FIGURE
A1-15 b

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-RW023
SITE LOCATION Ballona Wetlands
START 10/3/2012
FINISH 10/3/2012
SHEET NO. 3 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY J. Wright
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 65.9
GROUND ELEV (ft) 19
DEPTH/ELEV. GW (ft) ∇ / na DURING DRILLING; ▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		⧓	11	6 7 8	15	32	90			1.5				
														Silty Lean Clay (CL), gray, moist, medium stiff, medium plasticity, trace organics.
	-35													
55														
		☒	12	3 4 4	8	35				0.75				
														Clayey Silt (ML), gray, moist, very stiff, low to medium plasticity, trace organics.
	-40													
60														
		⧓	13	7 10 10	20	32	89			2.75				
														Silty Sand (SP-SM), gray, wet, very dense, fine to medium grained sand, coarse gravel.
	-45													
65														
		☒	14	60	100									
														Boring terminated at 65.9 ft. Groundwater not measured. Boring backfilled with bentonite grout.
	-50													
70														
	-55													

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FIGURE
A1-15 c

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-HSA064
SITE LOCATION Ballona Wetlands
START 10/15/2012
FINISH 10/15/2012
SHEET NO. 1 of 1
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85 All Terrain
DRILLING METHOD Hollow Stem Auger
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 8
TOTAL DEPTH (ft) 19
GROUND ELEV (ft) 17.2
DEPTH/ELEV. GW (ft) ⊻ / na DURING DRILLING; ▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														Artificial Fill (af)
	15													
		☒	S-1	1 4 3	7	9		45			PA			**Silty Sand (SM)**, light brown, dry, loose, fine grained sand, few fine roots, few shell fragments, trace dark brown clay seams.
														Clay (CL), olive brown and gray, moist, hard, medium plasticity, some oxidation, few sea shells.
5														
		⧓	R-2	6 6 8	14	24	95			>4.5				
	10													**Clayey Silt (ML)**, olive brown and gray, moist, very stiff, low plasticity.
		☒	S-3	3 4 3	7	27				2.5				
														Sandy Clay (CL), olive brown, wet, medium stiff, fine grained sand, few shell fragments, trace organics.
10														
		⧓	R-4	2 3 4	7	35	82							
	5													
		☒	S-5	0 0 4	4				42:20					
														Alluvium (Qa) **Silty Clay (CL)**, light gray and gray, moist, medium stiff, medium plasticity, trace shell fragments.
15														
		⧓	R-6	0 4 4	8	37	84							
														Silt (ML), gray, moist, medium stiff, micaceous.
	0													**Silty Clay (CL)**, gray, wet, very soft, little shell fragments.
		☒	S-7	0 0 1	1	42			43:20					
														Boring terminated at 19 ft. Groundwater not measured. Boring backfilled with tamped cuttings.
20														
	-5													

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FIGURE
A1-16

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-HSA066
SITE LOCATION Ballona Wetlands
START 10/15/2012
FINISH 10/15/2012
SHEET NO. 1 of 1
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85 All Terrain
DRILLING METHOD Hollow Stem Auger
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 8
TOTAL DEPTH (ft) 21.5
GROUND ELEV (ft) 21.1
DEPTH/ELEV. GW (ft) ⊻ / na DURING DRILLING; ▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS
			B-1								CP
	20										
			R-2	9 11 10	21	10	90			>4.5	
5											
			S-3	1 2 3	5	10					
	15										
			R-4	2 3 5	8	33	83	48			PA
10											
			S-5	0 1 1	2	38					
	10										
			R-6	0 0 4	4	42	75				
15											
			S-7	0 3 3	6	51					
	5										
			R-8	1 3 3	6	46	73		71:39		
20											
			S-9	0 0 0	0	56			51:24		
	0										

DRILLING METHOD · GRAPHIC LOG

DESCRIPTION AND CLASSIFICATION

Artificial Fill (af)

Sandy Silt (ML), light brown, dry, fine grained sand, none to low plasticity, trace dead ice plant.

- Hard, increase in fine grained sand, no plasticity, no ice plant, trace fine roots.

-Medium stiff.

Silty Sand (SM), grayish brown, wet, loose, fine grained sand, trace organics, trace shell fragments.

Sandy Silt (ML), grayish brown, moist, soft, fine grained sand, little oxidation, micaceous.

Alluvium (Qa)

Sandy Silt (ML), gray, moist, soft, fine grained sand, micaceous.

Silty Sand (SM), gray, moist, very loose, fine grained sand, micaceous.

Silty Clay (CL), light gray, moist, medium stiff, medium plasticity.

Silty Fat Clay (CH), gray, moist, soft, high plasticity.

-Brownish gray, medium plasticity, some oxidation, micaceous.

-Gray, very soft, trace shell fragments, H2S odor.

Boring terminated at 21.5 ft.
Groundwater not measured.
Boring backfilled with tamped cuttings.

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FIGURE
A1-17

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID A-HSA067
SITE LOCATION Ballona Wetlands
START 10/10/2012
FINISH 10/10/2012
SHEET NO. 1 of 1
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85 All Terrain
DRILLING METHOD Hollow Stem Auger
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 8
TOTAL DEPTH (ft) 16.5
GROUND ELEV (ft) 12.2
DEPTH/*ELEV.* GW (ft) ∇ / *na* **DURING DRILLING**
AFTER DRILLING ▼ / *na*
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														Artificial Fill (af)
														Silt (ML), light brown, dry, low plasticity.
	10													**Silty Clay (CL)**, brown, moist, soft, low to medium plasticity, few oxidation, trace calcite, slightly micaceous.
		⧗	R-1	1 2 2	4	36	74			0.25				
5														
		⧖	S-2	0 1 2	3	46				0.5				
	5													**Alluvium (Qa)**
														Silt (ML), olive brown, moist, medium stiff, trace fine grained sand, no plasticity, highly micaceous.
		⧗	R-3	1 3 3	6	36	78			0.75				
10														**Clayey Silt (ML)**, light brown, wet, soft, trace fine grained sand, low plasticity, few organics, trace sea shells.
		⧖	S-4	0 0 2	2	48								
	0													**Fat Clay (CH)**, olive brown, wet, medium stiff, trace fine grained sand, high plasticity, some oxidation, trace shell fragments, trace calcite or salt, micaceous.
		⧗	R-5	1 2 3	5	40	79		69:37					
														Silt (ML), mottled gray and orangish brown, wet, very soft, low plasticity, some to mostly oxidation, trace shell fragments, trace organics.
15														
		⧖	S-6	0 0 0	0	45								
	-5													Boring terminated at 16.5 ft. Groundwater not measured. Boring backfilled with tampered cuttings.
20														
	-10													

GDC_LOG_BORING_2011 L-962_PART 1.GPJ GDCLOG.GDT 1/24/13

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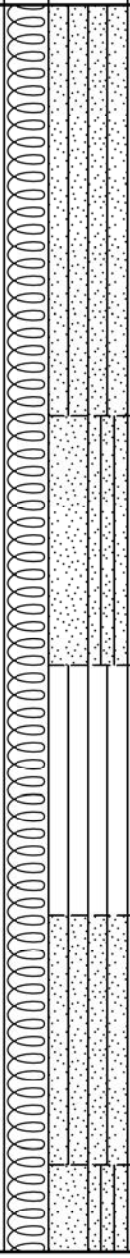
THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE A1-18

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID B-RW027
SITE LOCATION Ballona Wetlands
START 9/24/2012
FINISH 9/24/2012
SHEET NO. 1 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 71.5
GROUND ELEV (ft) 13
DEPTH/ELEV. GW (ft) ⊻ / na DURING DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES
▼ / na AFTER DRILLING



DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DESCRIPTION AND CLASSIFICATION
												Artificial Fill (af) **Silty Sand with Gravel (SM)**, light brown, dry, fine to coarse grained sand, fine to coarse gravel.
	10											
5			R-1	3 5 7	12	21	94				DS	**Silty Sand (SM)**, brown, moist, loose, fine grained sand, trace clay seams, trace rusted metal.
	5											
												Sand with Silt (SP-SM), brown, wet, fine grained sand, trace wood ~2" long and ~1/2" wide.
10			SH-2			23	103					
	0											
												Elastic Silt (MH), gray, wet, very soft, high plasticity.
15			S-3	0 0 0	0				71:33	0.25		- Brown, few shells, few rootlets, micaceous.
	-5											
												Alluvium (Qa) **Silty Sand (SM)**, gray, wet, fine grained sand, few shell fragments, trace fine rootlets, micaceous.
20			SH-4			35	83				DS	
	-10											
												Sand with Silt (SP-SM), gray, wet, medium dense, fine grained sand, H2S odor.

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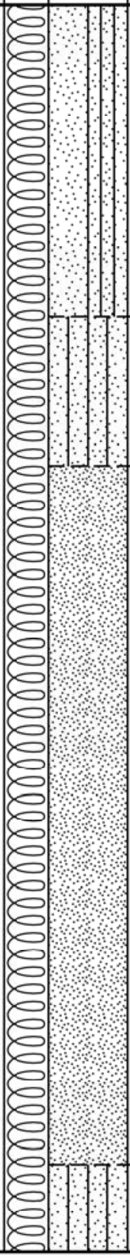
FIGURE A1-19 a

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID B-RW027
SITE LOCATION Ballona Wetlands
START 9/24/2012
FINISH 9/24/2012
SHEET NO. 2 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 71.5
GROUND ELEV (ft) 13
DEPTH/*ELEV.* GW (ft) ⊻ / *na* **DURING DRILLING**; ▼ / *na* **AFTER DRILLING**
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES



DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		⊠	S-5	9 14 15	29									
	-15													
30														-No recovery.
		⧓	R-6	7 8 10	18									
														Silty Sand (SM), gray, wet, loose, fine grained sand, trace shell fragments.
	-20	⊠	S-7	4 4 6	10									
														Sand (SP), gray, wet, very dense, fine grained sand, trace organics, trace fines.
35		⧓	R-8	38 50/5"	100	24	100							
	-25													
40														-Dense.
		⧓	R-9	18 21 26	47	28								
	-30													
45		⊠	S-10	14 18 20	38									
	-35													**Silty Sand (SM)**, gray, wet, firm, fine grained sand, low plasticity, trace shell fragments, micaceous.

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FIGURE
A1-19 b

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project			**PROJECT NUMBER** LA-962A	**HOLE ID** B-RW027
SITE LOCATION Ballona Wetlands		**START** 9/24/2012	**FINISH** 9/24/2012	**SHEET NO.** 3 of 3
DRILLING COMPANY Cascade Drilling	**DRILL RIG** CME 85	**DRILLING METHOD** Rotary Wash	**LOGGED BY** N. Briffa	**CHECKED BY** P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.	**HAMMER EFFICIENCY (ERi)**	**BORING DIA. (in)** 3.875	**TOTAL DEPTH (ft)** 71.5	**GROUND ELEV (ft)** 13
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")	**NOTES**			**DEPTH/*ELEV.* GW (ft)** ▽ / *na* **DURING DRILLING** ▼ / *na* **AFTER DRILLING**

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DESCRIPTION AND CLASSIFICATION
		⧗	R-11	2 4 5	9	34	86	88			PA	
	-40											
												Fat Clay(CH), dark brown, moist, stiff, fine grained sand, high plasticity.
55												
		☒	S-12	4 5 6	11				58:31	1.5		
	-45											
												Sandy Silt (ML), gray, wet, medium stiff, fine grained sand, low plasticity.
60												
		■	SH-13			21	107	50		0.75	PA	
	-50											
												Silty Sand (SM), greenish gray, wet, dense, fine to coarse grained sand, trace fine gravel, multi colored sand and gravel.
65												
		☒	S-14	11 22 20	42							
	-55											
70												
												-Gray, medium dense, fine grained sand.
		☒	S-15	5 8 14	22			29			PA	
												Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
	-60											

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FIGURE

A1-19 c

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project

PROJECT NUMBER LA-962A

HOLE ID B-RW028

SITE LOCATION Ballona Wetlands

START 10/22/2012

FINISH 10/22/2012

SHEET NO. 1 of 1

DRILLING COMPANY Cascade Drilling

DRILL RIG

DRILLING METHOD Hand Auger

LOGGED BY N. Briffa/E. Ycoy

CHECKED BY P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)

HAMMER EFFICIENCY (ERi)

BORING DIA. (in)

TOTAL DEPTH (ft) 5

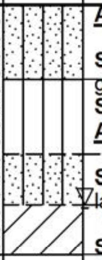
GROUND ELEV (ft) 5

DEPTH/*ELEV.* GW (ft) ⊻ 4.0 / *1.0* DURING DRILLING

▼ / *na* AFTER DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)

NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		▨	B-1											**Artificial Fill (af)** **Sandy Silt (ML)**, brown, dry, fine grained sand, trace fine gravel. **Silt (ML)**, brown, moist, low plasticity, few shells. **Alluvium (Qa)** **Silt (ML)**, brown, moist, low plasticity, few shells, laminations of Silty Clay (CL) and Peat (Pt): **Silty Clay (CL)**, gray and brown, moist, medium plasticity, little oxidation. **Peat (Pt)**, dark brownish gray, moist. **Silty Sand (SM)**, gray, wet, fine grained sand. **Fat Clay (CH)**, gray, wet, medium to high plasticity. Boring terminated at 5 ft. Groundwater encountered at 4 ft. Boring backfilled with tamped cuttings.
5	0													
10	-5													
15	-10													
20	-15													

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID B-RW030
SITE LOCATION Ballona Wetlands
START 10/4/2012
FINISH 10/4/2012
SHEET NO. 1 of 2
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY J. Wright
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 41.5
GROUND ELEV (ft) 6.1
DEPTH/*ELEV.* GW (ft) ☆ / *na* **DURING DRILLING**; ▼ / *na* **AFTER DRILLING**
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DESCRIPTION AND CLASSIFICATION
	5	▨	1									**Artificial Fill (af)** **Silty Sand (SM)**, brown, dry, fine to coarse grained sand, few roots/grass.
												Alluvium (Qa) **Fat Clay (CH)**, light gray, moist, very soft, fine to coarse grained sand, high plasticity, trace shells.
5	0	☒	2	0 0 0	0	65			72:40			
10	-5	⧗	3	0 1 1	2	81	51		70:37	0.05		-Gray, trace organics, trace shell fragments, H2S odor.
												Silty Sand (SM), gray, wet, very loose, fine to medium grained sand, low plasticity, trace shell fragments.
15	-10	☒	4	0 0 0	0			31			PA	
20	-15	⧗	5	7 14 25	39	31	92					-Medium dense, none to low plasticity, slight H2S odor.

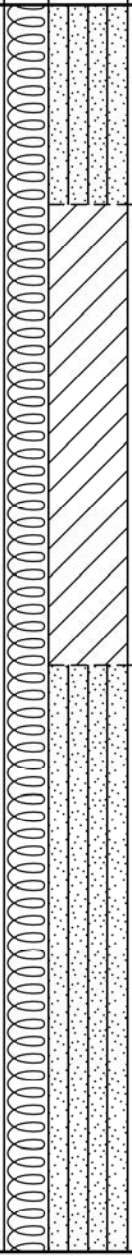


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FIGURE
A1-21 a

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID B-RW030
SITE LOCATION Ballona Wetlands
START 10/4/2012
FINISH 10/4/2012
SHEET NO. 2 of 2
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY J. Wright
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 41.5
GROUND ELEV (ft) 6.1
DEPTH/ELEV. GW (ft) ⊻ / na DURING DRILLING
▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-20	☒	6	3 3 2	5									-Loose, fine to coarse grained sand, no plasticity, no H2S odor, little to some shells/shell fragments.
30														
	-25	⧓	7	8 12 16	28	25	99				DS			-Medium dense, fine to medium grained sand, none to low plasticity, trace shells.
35														
	-30	☒	8	3 3 6	9									-Loose, fine grained sand.
40														
	-35	☒	9	6 5 5	10									-Fine to medium grained sand, low plasticity, some shells.
														Boring terminated at 41.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
45														
	-40													

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FIGURE

A1-21 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	**B-RW032**

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/14/2012	9/14/2012	1 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	8.2	∇ / *na* DURING DRILLING ▼ / *na* AFTER DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES
SPT (1.4"), CAL (2.4"), SHELBY (3")	

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		▩	B-1											**Artificial Fill (af)**
														Silty Sand (SM), brown, dry, fine to coarse grained sand, few fine to coarse gravel, little organics.
	5													
5														-Loose, decrease in organics, no coarse gravel.
		☒	S-2	15 6 1	7									
	0													
														Alluvium (Qa)
														Fat Clay (CH), gray, wet, high plasticity, trace sea shells, slight H2S odor, micaceous.
10														
		■	SH-3			58	66		71:43		CS			
														Vane Shear = 0.42 ksf
	-5													
15														-No shells, no H2S.
		☒	S-4	0 0 0	0	60								
	-10													
														Silty Sand (SM), gray, wet, some shell fragments. No recovery in shelby tube.
20														
		■	SH-5			40	83	28			PA			
	-15													

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FIGURE
A1-22 a

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	B-RW032

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/14/2012	9/14/2012	2 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	8.2	▽ / *na* DURING DRILLING ▼ / *na* AFTER DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES
SPT (1.4"), CAL (2.4"), SHELBY (3")	

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		☒	S-6	8 9 11	20									- gray, wet, medium dense, fine grained sand, micaceous.
	-20													
30														
		■	SH-7			34	89				DS			-Increase in silt, no recovery in shelby tube.
	-25													
35														
		☒	S-8	11 17 20	37									-Dense, decrease in silt, ~15%.
	-30													**Sand Silt (ML)**, gray, wet, medium stiff, fine grained sand, micaceous.
40														
		⧓	R-9	3 4 5	9	35	85				DS			
	-35													**Sandy Silty Clay (CL)**, gray, wet, soft, fine grained sand, medium plasticity, micaceous, trace shell fragments.
45														
		☒	S-10	0 0 0	0				36:13	0.5				
	-40													**Sand (SP)**, gray, wet, medium dense, fine to medium grained sand, few coarse grained sand, trace shell fragments.

GDC_LOG_BORING_2011 L-962_PART 1.GPJ GDCLOG.GDT 1/24/13

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FIGURE

A1-22 b

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Ballona Wetlands Restoration Project	LA-962A	B-RW032

SITE LOCATION	START	FINISH	SHEET NO.
Ballona Wetlands	9/14/2012	9/14/2012	3 of 3

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
Cascade Drilling	CME 85	Rotary Wash	N. Briffa	P. Kashighandi

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.		3.875	71.5	8.2	∇ / *na* DURING DRILLING ▼ / *na* AFTER DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES
SPT (1.4"), CAL (2.4"), SHELBY (3")	

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		■	R-11	20 26 17	43	21	104							
	-45													
														Silty Sand (SM), gray, wet, dense, fine grained sand, trace organics.
55														
		☒	S-12	7 21 22	43			21			PA			
	-50													
60														
		☒	S-13	17 45 50/4"	95			28			PA			-Very dense, micaceous, dark brown wood fibers in organics and silt.
	-55													
65														
		■	R-14	3 32 50/3"	82									No Recovery. Hole collapsed when inserting rod for next sample.
	-60													
														Sand (SP), gray, wet, very dense, fine to medium grained sand, trace organics (wood fibers).
70														
		☒	S-15	27 44 47	91									
														Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
	-65													

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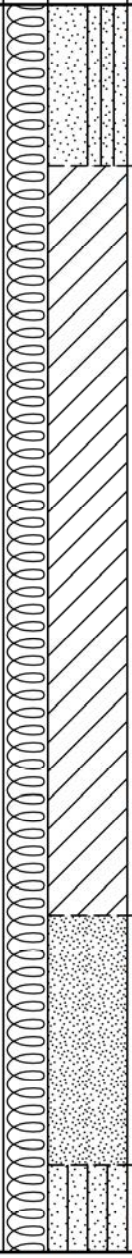
FIGURE

A1-22 c

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID B-RW033
SITE LOCATION Ballona Wetlands
START 9/11/2012
FINISH 9/12/2012
SHEET NO. 1 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) **HAMMER EFFICIENCY (ERi)** Hammer: 140 lbs., Drop: 30 in. (Auto/Manual)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 71.5
GROUND ELEV (ft) 6.3
DEPTH/*ELEV.* GW (ft) ∇ / na **DURING DRILLING**
▼ / na **AFTER DRILLING**
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES



DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DESCRIPTION AND CLASSIFICATION
	5											**Artificial Fill (af)** **Sand with Silt (SP-SM)**, yellowish brown, dry, fine grained sand. -Moist.
												Alluvium (Qa) **Fat Clay (CH)**, gray, wet, medium stiff, high plasticity, trace organics, trace sea shells and shell fragments, slight H2S odor, trace burned wood or charcoal.
5												
		⧗	R-1	3 3 4	7	63	59					
	0											
10												
		☒	S-2	2 3 4	7							
	-5											
15												-Soft, no H2S odor, trace fine grained sand.
		■	SH-3			76			75:42			Vane Shear = 0.25 ksf
	-10											
												Sand (SP), gray, wet, dense fine grained sand, trace shell fragments.
20												
		☒	S-4	14 26 28	54							
	-15											
												Silty Sand (SM) with clay laminations, gray, wet, fine grained sand, few shell fragments, slight H2S odor, pocket of light brown fine grained sand.

FIGURE

A1-23 a

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID B-RW033
SITE LOCATION Ballona Wetlands
START 9/11/2012
FINISH 9/12/2012
SHEET NO. 2 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) **HAMMER EFFICIENCY (ERi)** Hammer: 140 lbs., Drop: 30 in. (Auto/Manual)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 71.5
GROUND ELEV (ft) 6.3
DEPTH/ELEV. GW (ft) ⊻ / na **DURING DRILLING**
▼ / na **AFTER DRILLING**
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														-No recovery.
			SH-5			47	73	30			PA			
	-20													
30														
			S-6	3 4 2	6									
	-25													
														Sandy Silt (ML), gray, wet, stiff, fine grained sand, trace shell fragments.
			S-7	8 18 20	38					1.25				
														Silty Sand (SM), gray, wet, fine grained sand, trace shell fragments.
35														
			SH-8			30	91							
	-30													
														Sandy Silt (ML), gray, wet, medium stiff, fine grained sand, low plasticity, trace shell fragments.
40														
			S-9	1 2 3	5				28:3	0.75				
	-35													
														Fat Clay (CH), gray, wet, medium stiff, high plasticity.
45														
														Vane Shear = 0.7 ksf
			SH-10			42	82		53:31	0.5				
	-40													
														Silty Sand (SM), gray, wet, medium dense, fine grained sand.

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FIGURE
A1-23 b

BORING RECORD

PROJECT NAME	Ballona Wetlands Restoration Project
PROJECT NUMBER	LA-962A
HOLE ID	B-RW033
SITE LOCATION	Ballona Wetlands
START	9/11/2012
FINISH	9/12/2012
SHEET NO.	3 of 3
DRILLING COMPANY	Cascade Drilling
DRILL RIG	CME 85
DRILLING METHOD	Rotary Wash
LOGGED BY	N. Briffa
CHECKED BY	P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) / HAMMER EFFICIENCY (ERi)	Hammer: 140 lbs., Drop: 30 in. (Auto/Manual)
BORING DIA. (in)	3.875
TOTAL DEPTH (ft)	71.5
GROUND ELEV (ft)	6.3
DEPTH/*ELEV.* GW (ft)	⊻ / *na* DURING DRILLING ▼ / *na* AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID)	SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES	

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-45	☒	S-11	7 9 4	13									
55	-50	⧗	R-12	18 34 42	76			27			PA			-Very dense, trace organics, micaceous.
60	-55	☒	S-13	2 5 16	21									-Interbedded with layers of **Clayey Sand (SC)**, gray, wet, medium dense, fine to medium grained sand, trace organics in (SC).
65	-60	⧗	R-14	18 20 13	33									-Trace organics.
														-Gravels (drill rig chatter)
														Poorly Graded Sand with Gravel (SP) gray, wet, dense, fine to coarse grained sand, fine to coarse gravel, drilling mud mixed in sample.
70	-65	☒	S-15	14 15 19	34									
														Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

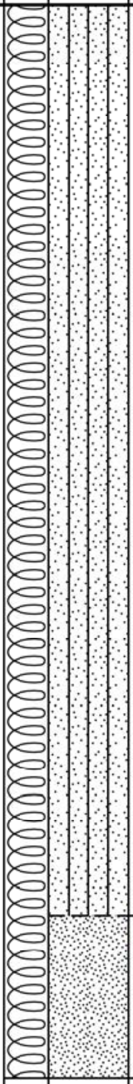

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FIGURE

A1-23 c

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project	**PROJECT NUMBER** LA-962A	**HOLE ID** B-RW036	
SITE LOCATION Ballona Wetlands	**START** 9/17/2012	**FINISH** 9/17/2012	**SHEET NO.** 1 of 3
DRILLING COMPANY Cascade Drilling	**DRILL RIG** CME 85	**DRILLING METHOD** Rotary Wash	**LOGGED BY** N. Briffa / **CHECKED BY** P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.	**HAMMER EFFICIENCY (ERi)**	**BORING DIA. (in)** 3.875	**TOTAL DEPTH (ft)** 71.5 / **GROUND ELEV (ft)** 9.1
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")	**NOTES**	**DEPTH/ELEV. GW (ft)** ⊻ / na DURING DRILLING	▼ / na AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	DESCRIPTION AND CLASSIFICATION
0													Base (~18").
1.5													**Artificial Fill (af)** Silty Sand (SM) , light brown, wet, very loose, fine grained sand, few gray clay seams.
	5												
5		☒	S-1	3 1/12"	1								
	0												
8.25													**Alluvium (Qf)** **Fat Clay (CH)**, gray, wet, soft, micaceous, high plasticity in clay, trace oxidation. Vane Shear = 0.3 ksf
10		■	SH-2			42	78		60:32		CS		
	-5												
15		☒	S-3	0 0 1	1				69:38				-H2S odor.
18.25													**Silty Sand (SM)**, gray, wet, fine grained sand, micaceous, H2S odor, trace shell fragments.
	-10												
20		■	SH-4			26	97						
23.25													**Sandy Silt (ML)**, gray, wet, soft, fine grained sand, micaceous, H2S odor, few shell fragments.
	-15												

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FIGURE A1-24 a

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID B-RW036
SITE LOCATION Ballona Wetlands
START 9/17/2012
FINISH 9/17/2012
SHEET NO. 2 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 71.5
GROUND ELEV (ft) 9.1
DEPTH/ELEV. GW (ft) ⊻ / na DURING DRILLING; ▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		☒	S-5	6 1 1	2					0.25				
														Fat Clay (CH), gray, wet, medium stiff, micaceous, trace shell fragments, high plasticity.
	-20													
30														
		■	SH-6			60	65	95	63:32	0.5	C DS PA			
														Silt with Sand (ML), gray, wet, very soft, fine grained sand, micaceous, trace shell fragments, low plasticity.
	-25													
35														
		☒	S-7	0 0 1	1					0.25				
														Silty Clay (CL), dark gray, moist, stiff, low to medium plasticity, few fine grained sand.
	-30													
40														
		■	SH-8			22	106			1.75				
														Sandy Clay (CL), gray, wet, soft, fine grained sand, low to medium plasticity.
	-35													
45														
		☒	S-9	4 4 6	10			50		0.25	PA			
														Silty Sand (SM), gray, wet, fine grained sand, trace organics.
	-40													

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FIGURE A1-24 b

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project

PROJECT NUMBER LA-962A

HOLE ID B-RW036

SITE LOCATION Ballona Wetlands

START 9/17/2012

FINISH 9/17/2012

SHEET NO. 3 of 3

DRILLING COMPANY Cascade Drilling

DRILL RIG CME 85

DRILLING METHOD Rotary Wash

LOGGED BY N. Briffa

CHECKED BY P. Kashighandi

HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.

HAMMER EFFICIENCY (ERi)

BORING DIA. (in) 3.875

TOTAL DEPTH (ft) 71.5

GROUND ELEV (ft) 9.1

DEPTH/ELEV. GW (ft) ▽ / na DURING DRILLING

▼ / na AFTER DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")

NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		■	SH-10			25	101							
														Silt (ML), gray, wet, soft, low to medium plasticity, few fine grained sand.
	-45													
55														
		☒	S-11	1 1 3	4					0.75				
														Silty Sand (SM), gray, wet, loose, fine grained sand, trace organics.
	-50													
60														
		⧓	R-12	6 5 4	9									
														Silty Clay (CL), gray, wet, soft, medium plasticity, few organics (wood chunks ~1/8" in diameter).
	-55													
65														
		☒	S-13	8 8 9	17					0.25				
														Sand (SP), gray, wet, very dense, fine to medium grained sand, trace fines.
	-60													
70														
		☒	S-14	28 29 30	59									
														Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
	-65													

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FIGURE A1-24 c

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project	**PROJECT NUMBER** LA-962A	**HOLE ID** B-RW039		
SITE LOCATION Ballona Wetlands	**START** 9/17/2012	**FINISH** 9/17/2012	**SHEET NO.** 1 of 3	
DRILLING COMPANY Cascade Drilling	**DRILL RIG** CME 85	**DRILLING METHOD** Rotary Wash	**LOGGED BY** N. Briffa	**CHECKED BY** P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.	**HAMMER EFFICIENCY (ERi)**	**BORING DIA. (in)** 3.875	**TOTAL DEPTH (ft)** 71.5	**GROUND ELEV (ft)** 8.2
DEPTH/*ELEV.* GW (ft) ▽ / na DURING DRILLING; ▼ / na AFTER DRILLING				
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")	**NOTES**			

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														Artifical Fill (af)
														Silty Sand with Gravel (SM), brown, dry, fine to coarse grained sand, fine gravel, few organics.
														Alluvium (Qa)
	5													**Fat Clay (CH)**, olive brown, moist, soft, micaceous, high plasticity, few oxidation.
5														
		☒	S-1	1 1 1	2				65:37	0.5				
	0													
10														-Gray, wet, trace shell fragments and sea shells, no oxidation, slight H2S odor.
		■	SH-2			57	69		68:37					Vane shear = 0.4 ksf
	-5													**Silty Sand (SM)**, gray, wet, fine grained sand, some shell fragments, H2S odor, low plasticity, possible organic.
15														
		☒	S-3	0 0 0	0			33			PA			
	-10													**Sand with Silt (SP-SM)**, gray, wet, dense, fine grained sand, few shell fragments.
20														
		⧗	R-4	8 26 23	49	22	104							
	-15													**Silty Sand (SM)**, gray, wet, very loose, fine grained sand, some silt, micaceous.

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FIGURE

A1-25 a

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project	**PROJECT NUMBER** LA-962A	**HOLE ID** B-RW039	
SITE LOCATION Ballona Wetlands	**START** 9/17/2012	**FINISH** 9/17/2012	**SHEET NO.** 2 of 3
DRILLING COMPANY Cascade Drilling	**DRILL RIG** CME 85	**DRILLING METHOD** Rotary Wash	**LOGGED BY** N. Briffa
CHECKED BY P. Kashighandi	**HAMMER TYPE (WEIGHT/DROP)** Hammer: 140 lbs., Drop: 30 in.	**HAMMER EFFICIENCY (ERi)**	**BORING DIA. (in)** 3.875
TOTAL DEPTH (ft) 71.5	**GROUND ELEV (ft)** 8.2	**DEPTH/*ELEV.* GW (ft)** ∇ / *na* DURING DRILLING	▼ / *na* AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")	**NOTES**		

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DESCRIPTION AND CLASSIFICATION
		☒	S-5	2 1 3	4							
	-20											
30		⧗	R-6	8 19 27	46	27	97					-Dense
	-25											**Silty Clay (CL)**, gray, wet, soft, trace fine grained sand, trace shell fragments, low to medium plasticity.
35		☒	S-7	0 1 2	3				40:15	0.5		
	-30											
40		■	SH-8			20	108		30:14	1.75		**Sandy Clay (CL)**, gray, moist, stiff, some fine grained sand, medium plasticity, trace medium grained sand, trace organics. Vane shear = 1.9 ksf
	-35											**Silty Sand (SM)**, gray, wet, medium dense, fine to coarse grained sand.
45		☒	S-9	8 12 13	25							
	-40											**Poorly Graded Gravel with Sand (GP)** greenish gray, wet, very dense, medium to coarse grained sand, fine to coarse subrounded gravel.

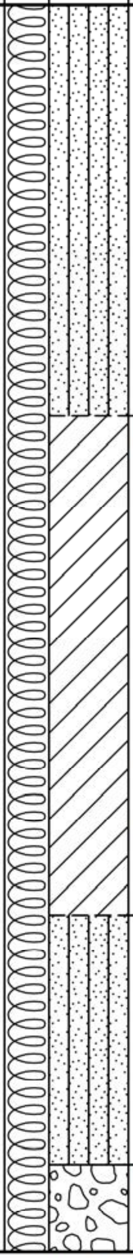

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FIGURE A1-25 b

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project	**PROJECT NUMBER** LA-962A	**HOLE ID** B-RW039	
SITE LOCATION Ballona Wetlands	**START** 9/17/2012	**FINISH** 9/17/2012	**SHEET NO.** 3 of 3
DRILLING COMPANY Cascade Drilling	**DRILL RIG** CME 85	**DRILLING METHOD** Rotary Wash	**LOGGED BY** N. Briffa
CHECKED BY P. Kashighandi			
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.	**HAMMER EFFICIENCY (ERi)**	**BORING DIA. (in)** 3.875	**TOTAL DEPTH (ft)** 71.5
GROUND ELEV (ft) 8.2	**DEPTH/*ELEV.* GW (ft)** ⊻ / *na* DURING DRILLING ▼ / *na* AFTER DRILLING		
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")	**NOTES**		

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		⧗	R-10	8 30 47	77	14	118							
	-45													
														Silty Sand (SM), gray, wet, medium dense, fine grained sand, some fines.
55														
		☒	S-11	3 5 8	13									
	-50													
														Silty Clay (CH), gray, moist, stiff, high plasiticity, trace rootlets ~1/16" in diameter.
60														
		☒	S-12	3 5 8	13					1.75				
	-55													
														Sand (SP) , gray, wet, dense, fine to medium grained sand, trace fines.
65														
		☒	S-13	12 19 22	41									
	-60													
70														
														- Light gray, wet, very dense, fine grained sand, trace medium grained sand, trace fines.
		☒	S-14	13 19 33	52									
														Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
	-65													

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FIGURE

A1-25 c

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID B-RW041
SITE LOCATION Ballona Wetlands
START 9/20/2012
FINISH 9/20/2012
SHEET NO. 1 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 66.5
GROUND ELEV (ft) 6.8
DEPTH/ELEV. GW (ft) ∇ / na **DURING DRILLING** ▼ / na **AFTER DRILLING**
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		▨	B-1											**Artificial Fill (af)** **Silt with Sand (ML)**, brown, dry, little organics, no plasticity.
	5													
														Alluvium (Qa) **Silty Sand (SM)**, gray, wet, fine grained sand, micaceous, few oxidation, trace fine rootlets.
5														
		■	SH-2			31	88	45			C DS PA			
	0													
														Fat Clay (CH), gray, wet, very soft, high plasticity, trace organics, H2S odor.
10														
		☒	S-3	0 0 0	0									
	-5													
														Sandy Silt (ML), gray, wet, fine grained sand, low plasticity, little shell fragments, 1 sea shell ~1.5", H2S odor.
15														
		■	SH-4			33	81				DS			
	-10													
														Silty Sand (SM), medium dense, few shell fragments.
20														
		☒	S-5	8 9 10	19			17			PA			
	-15													
														Fat Clay (CH), gray, wet, medium stiff, high plasticity, trace shell fragments.

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FIGURE
A1-26 a

BORING RECORD

PROJECT NAME	Ballona Wetlands Restoration Project	**PROJECT NUMBER**	LA-962A	**HOLE ID**	B-RW041
SITE LOCATION	Ballona Wetlands	**START**	9/20/2012	**FINISH**	9/20/2012
SHEET NO.	2 of 3				
DRILLING COMPANY	Cascade Drilling	**DRILL RIG**	CME 85	**DRILLING METHOD**	Rotary Wash
LOGGED BY	N. Briffa	**CHECKED BY**	P. Kashighandi		
HAMMER TYPE (WEIGHT/DROP)	Hammer: 140 lbs., Drop: 30 in.	**HAMMER EFFICIENCY (ERi)**		**BORING DIA. (in)**	3.875
TOTAL DEPTH (ft)	66.5	**GROUND ELEV (ft)**	6.8	**DEPTH/*ELEV.* GW (ft)**	∇ / *na* DURING DRILLING ▼ / *na* AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID)	SPT (1.4"), CAL (2.4"), SHELBY (3")	**NOTES**			

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														Vane shear = 0.5 ksf
		■	SH-6			52	67		75:42		C			
	-20													
														Lean Clay (CL), gray, wet, medium plasticity, trace shell fragments, 1 sea shell ~1.5".
30														
		☒	S-7	0 0 0	0				40:20	0.5				
	-25													
														Interbedded layers of Silty Clay (CH) and Sandy Clay (CL): -**Silty Clay (CH)**, gray, moist, medium stiff, medium plasticity.
35														
														-**Sandy Clay (CL)**, gray, wet, medium stiff, fine grained sand, trace shell fragments, trace fine rootlets.
		☒	S-8	1 2 5	7					2.0				
	-30													
														Lean Clay (CL), gray, moist, medium stiff, trace fine grained sand, medium plasticity.
40														
														Vane shear = 0.8 ksf
		⧗	R-9	8 11 16	27	21	103		33:13	1.25				
	-35													
45														-Wet, very soft, trace organics.
		☒	S-10	0 0 1	1					0.25				
	-40													
														Fat Clay (CH), gray, wet, medium stiff, fine grained sand, high plasticity, micaceous.

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FIGURE

A1-26 b

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID B-RW041
SITE LOCATION Ballona Wetlands
START 9/20/2012
FINISH 9/20/2012
SHEET NO. 3 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 66.5
GROUND ELEV (ft) 6.8
DEPTH/ELEV. GW (ft) ▽ / na DURING DRILLING
▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		■	SH-11			28	94			0.75				Vane shear = 0.8 ksf
	-45													
55		☒	S-12	1 3 4	7				59:34	1.25				-Moist, stiff, trace fine grained sand.
	-50													
														Well Graded Sand with Gravel (SW) gray, wet, dense, fine to coarse grained sand, fine to coarse gravel, trace fines, gravels up to 2".
60		⧗	R-13	32 31 37	68	9	131	6			PA			
	-55													
65		☒	S-14	20 22 23	45									**Sand (SW)**, gray, wet, fine to coarse grained sand, few fine to coarse gravel, gravels up to ~1".
	-60													Boring terminated at 66.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
70														
	-65													

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FIGURE
A1-26 c

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID B-RW043
SITE LOCATION Ballona Wetlands
START 9/19/2012
FINISH 9/19/2012
SHEET NO. 1 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 66.5
GROUND ELEV (ft) 8.8
DEPTH/*ELEV.* GW (ft) ⊻ / *na* DURING DRILLING; ▼ / *na* AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		▩	B-1											**Artificial Fill (af)** **Sandy Silt (ML)**, brown, dry, none to low plasticity, fine grained sand, few roots.
	5													**Alluvium (Qa)** **Fat Clay (CH)**, olive brown, moist, medium stiff, few oxidation streaks, trace fine grained sand, high plasticity, H2S odor.
5		☒	S-2	0 0 1	1	49				0.5				
	0													
10		■	SH-3			53	104		59:34	0.25				-Gray, wet, soft, few fine grained sand, micaceous, trace shell fragments, H2S odor. Vane shear = 0.5 ksf
	-5													
15		☒	S-4	0 0 1	1	80								
														Sand (SP), gray, wet, fine grained sand, some shells above shelby tube, no fines.
	-10													
20		■	SH-5			29								
														Fat Clay (CH), gray, wet, soft, trace fine grained sand, high plasticity, 1" layer with mostly shell fragments and wood chunk above (width of sampler)
	-15													

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FIGURE
A1-27 a

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID B-RW043
SITE LOCATION Ballona Wetlands
START 9/19/2012
FINISH 9/19/2012
SHEET NO. 2 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 66.5
GROUND ELEV (ft) 8.8
DEPTH/ELEV. GW (ft) ⊻ / na DURING DRILLING; ▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-6	0 0 1	1	60			63:35					
	-20													
30														
			SH-7			33				1.25				-Stiff, dark gray, no shells, no wood, trace fine grained sand, no ring samples. Vane shear = 1.25 ksf
														Sandy Clay (CL), gray , wet, stiff, fine grained sand, medium plasticity, trace wood pieces.
	-25													
35														
			S-8	5 5 6	11				47:27					
	-30													
40														
			R-9	5 3 2	5	32	89							-Soft, increase in fines, few wood fibers >1" long, trace black inclusions.
	-35													
														-Medium Stiff, fine to medium grained sand, trace wood fibers.
45														
			S-10							0.75				**Lean Clay (CL)**, gray, wet, medium stiff, medium plasticity, trace fine grained sand, trace wood fibers.
	-40													

FIGURE

A1-27 b

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID B-RW043
SITE LOCATION Ballona Wetlands
START 9/19/2012
FINISH 9/19/2012
SHEET NO. 3 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 66.5
GROUND ELEV (ft) 8.8
DEPTH/ELEV. GW (ft) ▽ / na DURING DRILLING
▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		■	R-11	2 4 6	10	37	85		44:24	0.75				Vane shear = 0.65 ksf
	-45													**Silty Sand (SM)**, gray, wet, loose, fine grained sand, trace organics.
55														
		☒	S-12	0 2 4	6									
	-50													**Sand with Gravel (SP)**, gray, wet, very dense, fine to medium grained sand, few coarse grained sand, few fine to coarse gravel, coarse gravel up to 2.5".
60														
		■	R-13	47 50 50/4"	100	16	112							
	-55													
65														
		☒	S-14	16 17 17	34									
														Boring terminated at 66.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
	-60													
70														
	-65													

GDC_LOG_BORING_2011 L-962 PART 1.GPJ GDCLOG.GDT 1/24/13

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FIGURE
A1-27 c

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID B-RW044
SITE LOCATION Ballona Wetlands
START 9/19/2012
FINISH 9/19/2012
SHEET NO. 1 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 66.5
GROUND ELEV (ft) 9.2
DEPTH/*ELEV.* GW (ft) ∇ / *na* **DURING DRILLING**
▼ / *na* **AFTER DRILLING**
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														Artificial Fill (Qa) **Sandy Silt (ML)**, brown, dry, fine grained sand, none to low plasticity.
	5													**Alluvium (Qa)**
5														**Fat Clay (CH)**, olive brown, moist, medium stiff, trace fine grained sand, high plasticity, trace calcite, trace oxidation.
		■	SH-1			58	63		84:52	0.39				Vane shear = 0.75 ksf
	0													
10														
		☒	S-2	0 0 1	1	53								-Wet, very soft.
	-5													
15														-Moist.
		■	SH-3			42	76		64:37	0.32				Vane shear = 0.55 ksf
	-10													
20														-Gray, wet. **Clayey Sand (SC)**, gray, wet, very loose, fine grained sand.
		☒	S-4	0 0 1	1									
	-15													**Fat Clay (CH)**, gray, wet, medium stiff, fine grained sand, high plasticity, little shells in middle of sampler.

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FIGURE
A1-28 a

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID **B-RW044**
SITE LOCATION Ballona Wetlands
START 9/19/2012
FINISH 9/19/2012
SHEET NO. 2 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 66.5
GROUND ELEV (ft) 9.2
DEPTH/*ELEV.* GW (ft) ∇ / *na* **DURING DRILLING**
▼ / *na* **AFTER DRILLING**
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		■	SH-5			38	77		58:34	0.5			▨	Vane shear = 0.55 ksf
	-20													
30														-Moist, few shell fragments.
		☒	S-6	0 0 3	3									
														Clayey Sand (SC), gray, moist, fine grained sand, medium plasticity, trace organics, trace shell fragments.
	-25													
35														
		■	SH-7			24	103				DS			
	-30													
40														-Wet, loose.
		☒	S-8	5 4 2	6									
														Sand with Gravels (SP), gray, wet, medium dense, fine to medium grained sand, fine gravel.
	-35													
45														
		⧗	R-9	16 17 18	35	21	109							
	-40													

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

FIGURE
A1-28 b

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID B-RW044
SITE LOCATION Ballona Wetlands
START 9/19/2012
FINISH 9/19/2012
SHEET NO. 3 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 66.5
GROUND ELEV (ft) 9.2
DEPTH/*ELEV.* GW (ft) ▽ / na DURING DRILLING; ▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		☒	S-10	10 7 2	9									-Loose. Note: Most of sample fell out with sand catcher on.
	-45													**Lean Clay (CL)**, gray, moist, medium stiff, trace fine grained sand, medium plasticity.
55		■	R-11	3 3 5	8	33	89		39:21	0.75	C			
	-50													**Sand (SP)**, gray, wet, dense, fine to medium grained sand, trace coarse grained sand, piece of wood ~3/8" in diameter.
60		☒	S-12	11 11 21	32									
	-55													**Poorly - Graded Gravel with Sand (GP)** gray, wet, very dense, medium to coarse grained sand, fine to coarse gravel.
65		☒	S-13	17 22 35	57									
														Boring terminated at 66.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
	-60													
70														
	-65													

GDC_LOG_BORING_2011 L-962_PART 1.GPJ GDCLOG.GDT 1/24/13

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Torrance, CA 90501

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

FIGURE

A1-28 c

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID B-RW047
SITE LOCATION Ballona Wetlands
START 9/18/2012
FINISH 9/18/2012
SHEET NO. 1 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 66.5
GROUND ELEV (ft) 11.5
DEPTH/*ELEV.* GW (ft) ⊻ / *na* **DURING DRILLING**; ▼ / *na* **AFTER DRILLING**
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	10	⊠	B-1											**Artifical FIll (af)** **Silty Sand with Gravels (SM)** light brown, dry, few organics.
														Alluvium (Qa) **Sandy Silt (ML)**, olive brown, moist, soft, fine grained sand, none to low elasticity.
5	5	☒	S-2	2 2 2	4			60			PA			
														Lean Clay (CL), olive brown, wet, medium stiff, medium plasticity, trace fine grained sand. Vane Shear = 0.6 ksf
10	0	■	SH-3			50	74		40:18	0.25				
														Fat Clay (CH), gray, wet, very soft, high plasticity, micaceous.
15	-5	☒	S-4	0 0 0	0					0.15				
20	-10	■	SH-5			65	59		82:50	0.75				-Medium stiff, not micaceous, laminations of light pinkish brown Clay with Sand, some sea shells in upper portion of sample, strong H2S odor. Vane shear = 0.9 ksf
														Sandy Clay (CL), gray, wet, soft, fine grained sand, medium plasticity, few organics, trace shell fragments, micaceous.

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

FIGURE A1-29 a

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID B-RW047
SITE LOCATION Ballona Wetlands
START 9/18/2012
FINISH 9/18/2012
SHEET NO. 2 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 66.5
GROUND ELEV (ft) 11.5
DEPTH/ELEV. GW (ft) ▽ / na DURING DRILLING
▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-15	☒	S-6	0 0 4	4			84	48:27		PA			
30		■	SH-7			23	105			0-2.25				-Moist, very soft to very stiff, few fine grained sand, low to medium plasticity.
	-20													
														Silty Sand (SM), gray, moist, loose, fine grained sand, some fines, trace shell fragments.
35	-25	☒	S-8	2 3 5	8									
														Sand (SP), gray, wet, medium grained sand, trace coarse grained sand, trace fine gravel.
40		■	SH-9											
	-30													
														Fat Clay (CH), gray, wet, stiff, high plasticity, micaceous.
45	-35	☒	S-10	3 5 6	11				57:36	1.5				

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

FIGURE A1-29 b

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project	**PROJECT NUMBER** LA-962A	**HOLE ID** B-RW047	
SITE LOCATION Ballona Wetlands	**START** 9/18/2012	**FINISH** 9/18/2012	**SHEET NO.** 3 of 3
DRILLING COMPANY Cascade Drilling	**DRILL RIG** CME 85	**DRILLING METHOD** Rotary Wash	**LOGGED BY** N. Briffa
CHECKED BY P. Kashighandi			
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.	**HAMMER EFFICIENCY (ERi)**	**BORING DIA. (in)** 3.875	**TOTAL DEPTH (ft)** 66.5
GROUND ELEV (ft) 11.5	**DEPTH/*ELEV.* GW (ft)** ⊻ / *na* DURING DRILLING; ▼ / *na* AFTER DRILLING		
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")	**NOTES**		

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														-Moist, soft.
		⧗	R-11	4 4 5	9	35	78		52:30	0.75				Vane shear = 0.4 ksf
	-40													
														Silty Sand (SM), gray, wet, medium dense, fine grained sand, trace organics.
55														
		⊠	S-12	11 12 10	22									
	-45													
														Sand (SP), gray, wet, very dense, fine to medium grained sand, few coarse grained sand, few fg.
60														
		⧗	R-13	26 50/4"	100	19	108							
	-50													
														Poorly graded Gravel with Sand (GP) gray, wet, dense, medium to coarse grained sand, fine to coarse gravel, subangular gravels.
65														
		⊠	S-14	17 18 17	35									
	-55													
														Boring terminated at 66.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
70														
	-60													

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

FIGURE A1-29 c

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID B-RW049
SITE LOCATION Ballona Wetlands
START 10/1/2012
FINISH 10/1/2012
SHEET NO. 1 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 69
GROUND ELEV (ft) 17.6
DEPTH/ELEV. GW (ft) ∇ / na DURING DRILLING; ▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DESCRIPTION AND CLASSIFICATION
		B-1									**Artificial Fill (af)** **Silty Sand with Gravel (SM)**, brown, dry, fine to coarse grained sand, fine to coarse gravel.
	15										
											Silt (ML), brown, moist, medium stiff, low plasticity, trace roots.
5		S-2	3 4 4	8							
	10										
10		R-3	2 4 8	12	31	81			1.25		-Olive brown, low to medium plasticity, trace dark brown clay seams. Vane Shear = 0.7 ksf
	5										
15		SH-4			37	74	55	84:43	0.25	PA	-None to low plasticity, increase in roots, highly micaceous, no clay seams. Vane Shear = 0.5 ksf
											Elastic Silt (MH), dark brown with orange spots of Silt, high plasticity, trace hair or fiber, trace shell fragments.
	0										**Alluvium (Qa)** **Lean Clay (CL)**, gray, wet, soft, low to medium plasticity, some laminations and pinholes of oxidation, micaceous.
20		S-5	2 1 2	3				27:7			
	-5										**Fat Clay (CH)**, gray, wet, medium stiff, trace fine grained sand, high plasticity, micaceous, H2S odor.

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

FIGURE A1-30 a

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID B-RW049
SITE LOCATION Ballona Wetlands
START 10/1/2012
FINISH 10/1/2012
SHEET NO. 2 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 69
GROUND ELEV (ft) 17.6
DEPTH/*ELEV.* GW (ft) ▽ / *na* **DURING DRILLING**; ▼ / *na* **AFTER DRILLING**
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														Vane Shear = 1.0 ksf
			SH-6			63	62		67:34	0.5				
	-10													
														Silty Clay (CL), gray, wet, medium stiff, few fine grained sand, low to medium plasticity, trace shell fragments, slight H2S odor.
30														
			R-7	3 4 5	9	32	89			1.0				
	-15													
35														-Moist, stiff, trace fine grained sand, medium plasticity, trace rootlets.
			SH-8			28	96		40:17	1.25				Vane Shear = 1.1 ksf
	-20													
														Silty Sand (SM), gray, wet, medium dense, fine to coarse grained sand.
40														
			R-9	10 10 13	23	22	105				DS			
	-25													
45														-Fine grained sand, trace seams of Elastic Silt.
			S-10	9 9 12	21									
	-30													

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FIGURE

A1-30 b

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID B-RW049
SITE LOCATION Ballona Wetlands
START 10/1/2012
FINISH 10/1/2012
SHEET NO. 3 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 69
GROUND ELEV (ft) 17.6
DEPTH/ELEV. GW (ft) ☒ / na DURING DRILLING; ☒ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			R-11	14 20 28	48	18	106							-Dense, fine to medium grained sand, trace fine gravel.
	-35													
														Sand with Silt (SP-SM), gray, wet, medium dense, fine to medium grained sand, few coarse grained sand.
55														
			S-12	16 14 15	29									
	-40													
														Silty Clay (CL), gray, moist, stiff, few fine grained sand, medium plasticity, trace organics. Vane Shear = 1.0 ksf
60														
			R-13	4 5 8	13	31	85		39:16	1.0				
	-45													
65			SH-14											No recovery.
	-50													
			S-15	3 14 23	37	21								**Sand (SP)**, gray, wet, dense, fine to medium grained sand, trace fines.
														Boring terminated at 69 ft. Groundwater not measured. Boring backfilled with bentonite grout.
70														
	-55													

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FIGURE A1-30 c

BORING RECORD

PROJECT NAME: Ballona Wetlands Restoration Project

PROJECT NUMBER: LA-962A

HOLE ID: B-HSA051

SITE LOCATION: Ballona Wetlands

START: 10/16/2012

FINISH: 10/16/2012

SHEET NO.: 1 of 1

DRILLING COMPANY: Cascade Drilling

DRILL RIG: CME 85 All Terrain

DRILLING METHOD: Hollow Stem Auger

LOGGED BY: N. Briffa

CHECKED BY: P. Kashighandi

HAMMER TYPE (WEIGHT/DROP): Hammer: 140 lbs., Drop: 30 in.

HAMMER EFFICIENCY (ERi):

BORING DIA. (in): 8

TOTAL DEPTH (ft): 21.5

GROUND ELEV (ft): 6.3

DEPTH/ELEV. GW (ft): ∇ / na DURING DRILLING; ▼ / na AFTER DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID): SPT (1.4"), CAL (2.4"), SHELBY (3")

NOTES:

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		▩	B-1											**Artificial Fill (af)** **Clay (CL)**, brown, dry, low to medium plasticity, trace organics, trace sea shells, few fine roots, trace white residue. -Moist
	5													
		⊠	S-2	0 2 4	6	17								-Firm, no snail shells.
5		⧓	R-3	1 2 3	5	42	76							-Soft, light brown and gray, moist, medium plasticity.
	0													
		⊠	S-4	1 2 2	4									**Alluvium (Qa)** Interbedded layers of **Silty Clay (CL) and Clayey Silt (ML)**, gray, wet, soft, fine grained sand, few oxidation, trace fine rootlets, micaceous.
														Clayey Silt (ML), gray, wet, very soft, low plasticity, trace oxidation, some small to large shell fragments, H2S odor.
10		⧓	R-5	0 0 2	2	49	68							
	-5													
		⊠	S-6	0 0 0	0				87:44					**Elastic Silt (MH)**, gray, wet, very soft, few fine grained sand, medium plasticity, few shell fragments, few tan color blebs of organics or CH, strong H2S odor.
15		⧓	R-7	0 0 1	1	103	43							-Trace fine rootlets.
	-10													
		⊠	S-8	0 5 7	12									-Increase in shell fragments.
														Sandy Clay (CL), gray, wet, stiff, some fine grained sand, trace sea shells, H2S odor.
20		⧓	R-9	0 2 4	6	17	111							
	-15													
														Boring terminated at 21.5 ft. Groundwater not encountered. Boring backfilled with tamped cuttings. Strong H2S odor occurred at ~20'. H2S reading of >150 ppm.

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FIGURE A1-31

BORING RECORD

PROJECT NAME: Ballona Wetlands Restoration Project
PROJECT NUMBER: LA-962A
HOLE ID: B-RW053
SITE LOCATION: Ballona Wetlands
START: 9/24/2012
FINISH: 9/24/2012
SHEET NO.: 1 of 3
DRILLING COMPANY: Cascade Drilling
DRILL RIG: CME 85
DRILLING METHOD: Rotary Wash
LOGGED BY: N. Briffa
CHECKED BY: P. Kashighandi
HAMMER TYPE (WEIGHT/DROP): Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi):
BORING DIA. (in): 3.875
TOTAL DEPTH (ft): 71.5
GROUND ELEV (ft): 13.7
DEPTH/ELEV. GW (ft): ∇ / na DURING DRILLING; ▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID): SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES:

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														Artificial Fill (af) **Silty Sand with Gravel (SM)**, brown, dry, fine to coarse sand, fine to coarse gravel.
	10													
														Alluvium (Qa) **Lean Clay (CL)**, olive brown, wet, very soft, trace fine grained sand, highly micaceous, interbedded layers of Fat Clay (CH).
5														
		☒	S-1	0 0 0	0				48:27					
														Fat Clay (CH), dark brown and gray, moist, medium stiff, high plasticity.
	5													
10														Vane Shear = 0.8 ksf
		■	SH-2			66	61		66:39		C			
	0													
15														- Gray, wet, very soft, few sea shells.
		☒	S-3	0 0 0	0									
														Silty Sand (SM), gray, wet, fine grained sand, low plasticity, little shells, H2S odor.
	-5													
20														
		■	SH-4			34	87	35	28:4		PA			
	-10													

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FIGURE
A1-32 a

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID B-RW053
SITE LOCATION Ballona Wetlands
START 9/24/2012
FINISH 9/24/2012
SHEET NO. 2 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 71.5
GROUND ELEV (ft) 13.7
DEPTH/ELEV. GW (ft) ⊻ / na DURING DRILLING
▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
			S-5	4 4 4	8									- Loose, trace shell fragments.
	-15													
30			SH-6			29	92	30			DS PA			- No H2S odor.
	-20													
35			S-7	16 17 17	34			15			PA			- Dense
	-25													
40			R-8	12 7 6	13									-No recovery **Lean Clay (CL)**, gray, moist, soft, medium plasticity, trace shell fragments.
	-30													
45			S-9	1 1 1	2				47:27	0.5				
	-35													

FIGURE
A1-32 b

BORING RECORD

PROJECT NAME: Ballona Wetlands Restoration Project
PROJECT NUMBER: LA-962A
HOLE ID: B-RW053
SITE LOCATION: Ballona Wetlands
START: 9/24/2012
FINISH: 9/24/2012
SHEET NO.: 3 of 3
DRILLING COMPANY: Cascade Drilling
DRILL RIG: CME 85
DRILLING METHOD: Rotary Wash
LOGGED BY: N. Briffa
CHECKED BY: P. Kashighandi
HAMMER TYPE (WEIGHT/DROP): Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi):
BORING DIA. (in): 3.875
TOTAL DEPTH (ft): 71.5
GROUND ELEV (ft): 13.7
DEPTH/ELEV. GW (ft): ∇ / na DURING DRILLING; ▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID): SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES:

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		■	SH-10			20	108		32:17	2.0				**Silty Clay with Sand (CL)**, gray, moist, stiff, fine grained sand, medium plasticity, micaceous. Vane Shear = 1.5 ksf
	-40													
55														
		☒	S-11	2 3 5	8			65		0.25	PA			**Sandy Clay (CL)**, gray, wet, soft, fine grained sand, medium plasticity, micaceous.
	-45													
60														
		■	SH-12			34	87		38:13	2.5				- Moist, very stiff. Vane Shear = 2.2 ksf
														Fat Clay (CH), gray, moist, stiff, high plasticity.
	-50													
65														
		☒	S-13	0 0 1	1					1.5				
	-55													
70														
		■	SH-14			39	81		81:53	2.0				- Very stiff, trace fine grained sand.
														Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.
	-60													

FIGURE

A1-32 c

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID B-RW055
SITE LOCATION Ballona Wetlands
START 9/25/2012
FINISH 9/25/2012
SHEET NO. 1 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 71.5
GROUND ELEV (ft) 16.3
DEPTH/*ELEV.* GW (ft) ⊻ / *na* DURING DRILLING
▼ / *na* AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	15													**Artificial Fill (af)** **Silty Sand with Gravels (SM)**, brown, dry, fine to coarse grained sand, fine to coarse gravel.
5	10	☒	S-1	1 2 1	3									**Silty Sand (SM)**, brown, moist, very loose, fine grained sand, trace coarse grained sand, trace oxidation, trace shell fragments.
														Alluvium (Qa)
10	5	■	SH-2			42	78		52:24					**Fat Clay (CH)**, olive brown, wet, medium stiff, high plasticity, few thin layers of oxidation (vertical), trace shell fragments, micaceous. Vane Shear = 0.7 ksf
15	0	☒	S-3	0 0 3	3					0.75				-Light olive brown, moist, trace fine grained sand, micaceous.
20	-5	■	SH-4			65	60			0.5				-Gray, H2S odor, seams of light gray, dry, very stiff **Silt**. Vane Shear = 0.5 ksf

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FIGURE
A1-33 a

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project	**PROJECT NUMBER** LA-962A	**HOLE ID** B-RW055	
SITE LOCATION Ballona Wetlands	**START** 9/25/2012	**FINISH** 9/25/2012	**SHEET NO.** 2 of 3
DRILLING COMPANY Cascade Drilling	**DRILL RIG** CME 85	**DRILLING METHOD** Rotary Wash	**LOGGED BY** N. Briffa
CHECKED BY P. Kashighandi			
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.	**HAMMER EFFICIENCY (ERi)**	**BORING DIA. (in)** 3.875	**TOTAL DEPTH (ft)** 71.5
GROUND ELEV (ft) 16.3	**DEPTH/*ELEV.* GW (ft)** ▽ / *na* **DURING DRILLING** ▼ / *na* **AFTER DRILLING**		
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")	**NOTES**		

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-10		R-5	1 1 1	2									-No recovery.
														Sand with Silt (SP-SM), gray, wet, fine grained sand.
			SH-6			26	61							
														Silty Sand (SM), gray, wet, very loose, fine grained sand, H2S odor.
30														
	-15		S-7	0 1 2	3									
														Sandy Silt (ML), gray, wet, soft, fine grained sand, none to low plasticity, micaceous.
35														
	-20		R-8	5 8 6	14	39	78	59		0.25	PA			
														Silty Sand (SM), gray, moist, medium dense, trace fine grained sand, micaceous.
40														
	-25		S-9	10 10 10	20									
														Silty Clay with Sand (CL), gray, moist, stiff, fine grained sand, medium plasticity, trace shell fragments.
45														
	-30		R-10	0 5 6	11	22	83		32:14	1.0				
														Silty Sand (SM), gray, wet, dense, fine to coarse grained sand.

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FIGURE

A1-33 b

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project			**PROJECT NUMBER** LA-962A		**HOLE ID** B-RW055
SITE LOCATION Ballona Wetlands		**START** 9/25/2012	**FINISH** 9/25/2012		**SHEET NO.** 3 of 3
DRILLING COMPANY Cascade Drilling	**DRILL RIG** CME 85	**DRILLING METHOD** Rotary Wash		**LOGGED BY** N. Briffa	**CHECKED BY** P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.	**HAMMER EFFICIENCY (ERi)**	**BORING DIA. (in)** 3.875	**TOTAL DEPTH (ft)** 71.5	**GROUND ELEV (ft)** 16.3	**DEPTH/ELEV. GW (ft)** ⊻ / na DURING DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")	**NOTES**				AFTER DRILLING ▼ / na

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-35	⊠	S-11	10 16 16	32									
55	-40	⧗	R-12	20 19 22	41	14	115							-Medium dense, few fine gravel, decrease in fines.
														Sandy Silt (ML), gray, wet, soft, fine grained sand, trace medium grained sand, low plasticity.
60	-45	⊠	S-13	0 1 1	2					0.5				
														Fat Clay (CH), gray, moist, stiff, high plasticity, micaceous, trace calcite.
65	-50	⧗	R-14	4 8 7	15	38	85			1.0				
														Silty Sand (SM), gray, wet, loose, fine to medium grained sand, few organics (roots).
70	-55	⊠	S-15	1 3 4	7									
														Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

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FIGURE A1-33 c

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID B-RW058
SITE LOCATION Ballona Wetlands
START 9/25/2012
FINISH 9/25/2012
SHEET NO. 1 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 71.5
GROUND ELEV (ft) 15
DEPTH/ELEV. GW (ft) ▽ / na DURING DRILLING
▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
														Artificial Fill (af) **Silty Sand with Gravels (SM)**, brown, dry, fine to coarse grained sand, fine to coarse gravel.
														Silt (ML), olive brown, moist, medium stiff, laminations of oxidation, highly micaceous.
5	10													
			R-1	5 5 7	12	18	96	55			PA			
														Fat Clay (CH), gray, moist, soft, high plasticity.
10	5													
			S-2	1 1 1	2				58:30	2.25				
														Alluvium (Qa) **Sandy Clay (CL)**, orangish brown, moist, soft, fine grained sand, medium plasticity, mostly oxidized.
														Fat Clay (CH), gray, moist, medium stiff, high plasticity, H2S odor, interbedded layers of peat and silt. Vane Shear = 0.65 ksf
15	0													
			SH-3			74	58		75:42	1.5				
20	-5													- Soft, few oxidation, micaceous, no H2S odor.
			R-4	2 1 2	3	66	61							

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FIGURE
A1-34 a

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID B-RW058
SITE LOCATION Ballona Wetlands
START 9/25/2012
FINISH 9/25/2012
SHEET NO. 2 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 71.5
GROUND ELEV (ft) 15
DEPTH/ELEV. GW (ft) ▽ / na DURING DRILLING; ▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		■	SH-5			85	51		71:38				▨	- Trace shell fragments, micaceous, H2S odor.
													▨	**Lean Clay (CL)**, gray, wet, medium stiff, low to medium plasticity, trace shell fragments.
30	-15	☒	S-6	1 1 2	3								▨	Vane Shear = 0.85 ksf
													▨	**Fat Clay (CH)**, gray, wet, high plasticity, micaceous.
35	-20	■	SH-7			44	74						▨	
													▨	**Lean Clay (CL)**, gray, wet, soft, few fine grained sand, medium plasticity, trace shell fragments.
40	-25	⧗	R-8	4 2 4	6	25	98						▨	
													▨	**Clayey Sand (SC)**, gray, wet, medium dense, fine grained sand.
45	-30	☒	S-9	2 6 8	14								▨	
													░	**Silty Sand with Gravel (SP)**, gray, wet, medium dense, fine to coarse grained sand, fine to coarse gravel, angular gravels.

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370 Amaploa Ave., Suite 212
Torrance, CA 90501

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

FIGURE
A1-34 b

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project
PROJECT NUMBER LA-962A
HOLE ID B-RW058
SITE LOCATION Ballona Wetlands
START 9/25/2012
FINISH 9/25/2012
SHEET NO. 3 of 3
DRILLING COMPANY Cascade Drilling
DRILL RIG CME 85
DRILLING METHOD Rotary Wash
LOGGED BY N. Briffa
CHECKED BY P. Kashighandi
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)
BORING DIA. (in) 3.875
TOTAL DEPTH (ft) 71.5
GROUND ELEV (ft) 15
DEPTH/ELEV. GW (ft) ▽ / na DURING DRILLING
▼ / na AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4"), SHELBY (3")
NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		■	R-10	32 28 9	37	13	123							
55	-40													**Silty Sand (SM)**, gray, wet, medium dense, fine grained sand, trace coarse grained sand, trace organics.
		☒	S-11	8 8 10	18									
														Lean Clay (CL), gray, moist, soft, trace fine grained sand, medium plasticity.
60	-45													
		☒	S-12	1 1 1	2				48:28	0.5				
65	-50													-Hard, no fine grained sand, decrease in moisture.
		■	R-13	9 21 26	47	28	96			>4.5				
														Sand (SP), gray, wet, very dense, fine grained sand, trace coarse grained sand, trace fine gravel, few organics (wood fibers).
70	-55													
		☒	S-14	17 24 29	53									
														Boring terminated at 71.5 ft. Groundwater not measured. Boring backfilled with bentonite grout.

GDC_LOG_BORING_2011 L-962 PART 1.GPJ GDCLOG.GDT 1/31/13

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370 Amaploa Ave., Suite 212
Torrance, CA 90501

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FIGURE
A1-34 c

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project	**PROJECT NUMBER** LA-962A	**HOLE ID** C-HSA061	
SITE LOCATION Ballona Wetlands	**START** 10/16/2012	**FINISH** 10/16/2012	**SHEET NO.** 1 of 2
DRILLING COMPANY Cascade Drilling	**DRILL RIG** CME 85 All Terrain	**DRILLING METHOD** Hollow Stem Auger	**LOGGED BY** N. Briffa
CHECKED BY P. Kashighandi			
HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.	**HAMMER EFFICIENCY (ERi)**	**BORING DIA. (in)** 8	**TOTAL DEPTH (ft)** 31.5
GROUND ELEV (ft) 16	**DEPTH/*ELEV.* GW (ft)** ⊻ / *na* DURING DRILLING	▼ / *na* AFTER DRILLING	
DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")	**NOTES**		

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	15													**Artificial Fill (af)** **Silty Sand (SM)**, light brown, dry, fine grained sand, few medium grained sand, trace dry brush.
		⧗	R-1	4 4 4	8	5	90	11			PA			-Grayish brown, loose, few olive brown clay seams, no dry brush.
5														
	10	☒	S-2	1 2 3	5									
		⧗	R-3	1 0 1	1	7	88							-Very loose, increase in fines.
10														**Alluvium (Qa)** **Clay (CL)**, mottled gray and light gray, moist, very stiff, few fine to medium grained sand, medium plasticity, few oxidation, trace organics, trace pieces of shale.
	5	☒	S-4	2 5 3	8	18				2.25				
		⧗	R-5			19	111			1.0				**Clay with Sand (CL)**, gray, moist, stiff, fine to medium grained sand, medium plasticity, few oxidation, trace pieces of shale.
15														**Sandy Silt (ML)**, mottled brown and gray, moist, medium stiff, fine grained sand, low plasticity, trace fine rootlets.
	0	☒	S-6	1 1 7	8			67		0.5	PA			Note: Auto hammer broke. Switched to down hole hammer.
		⧗	R-7	1 7 16	23	17	111		24:4					-Wet, very stiff, some fine grained sand, low plasticity, increase in sand at bottom.
20														-Brown, fine to medium grained sand.
	-5	☒	S-8	1 2 4	6									
		⧗	R-9	4 8 17	25	23	102	52			PA			-Mottled brown and gray, very stiff, fine grained sand, low plasticity.

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FIGURE
A1-35 a

BORING RECORD

PROJECT NAME Ballona Wetlands Restoration Project

PROJECT NUMBER LA-962A

HOLE ID C-HSA061

SITE LOCATION Ballona Wetlands

START 10/16/2012

FINISH 10/16/2012

SHEET NO. 2 of 2

DRILLING COMPANY Cascade Drilling

DRILL RIG CME 85 All Terrain

DRILLING METHOD Hollow Stem Auger

LOGGED BY N. Briffa

CHECKED BY P. Kashighandi

HAMMER TYPE (WEIGHT/DROP) Hammer: 140 lbs., Drop: 30 in.

HAMMER EFFICIENCY (ERi)

BORING DIA. (in) 8

TOTAL DEPTH (ft) 31.5

GROUND ELEV (ft) 16

DEPTH/ELEV. GW (ft) ▽ / na DURING DRILLING

▼ / na AFTER DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID) SPT (1.4"), CAL (2.4")

NOTES

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	MOISTURE (%)	DRY DENSITY (PCF)	PASSING #200 (%)	ATTERBERG LIMITS (LL:PL:PI)	POCKET PEN (TSF)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
	-10	⊠	S-10	4 4 2	6	36							▨	**Silty Clay (CL)**, mottled gray and brown, wet, medium stiff, trace fine grained sand, low to medium plasticity.
													▨	**Fat Clay (CH)**, mottled gray and brown, wet, medium stiff, trace fine grained sand, high plasticity.
30	-15	⧗	R-11	2 7 4	11	38	83		55:27	0.5			▨	
														Boring terminated 31.5 ft. Groundwater not encountered. Boring backfilled with tamped cuttings.
35	-20													
40	-25													
45	-30													

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370 Amaploa Ave., Suite 212
Torrance, CA 90501

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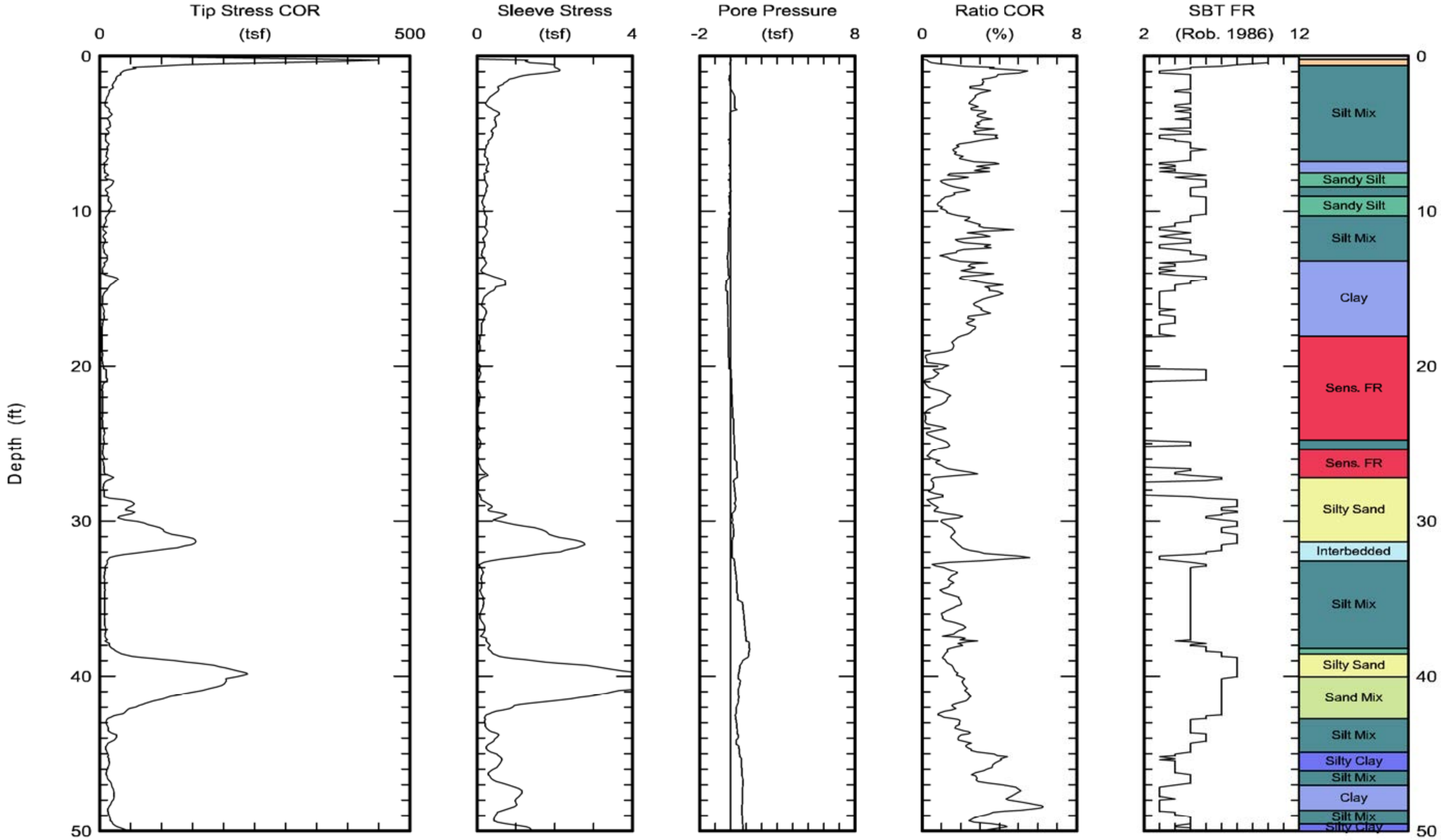
FIGURE A1-35 b

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 15/Oct/2012
Test ID: CPT-001
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands

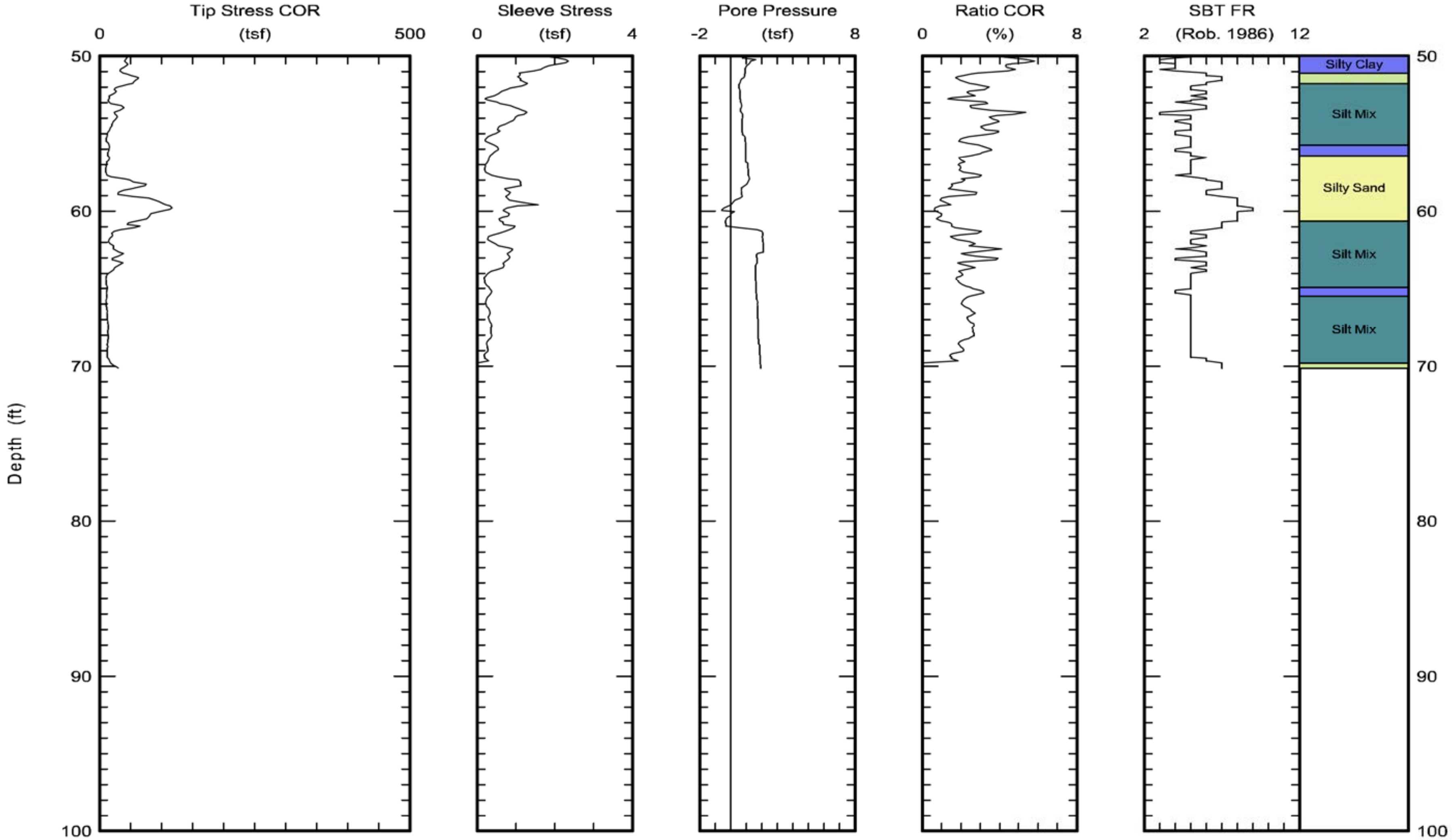


Maximum depth: 70.16 (ft)
Page 1 of 2

FIGURE

A1-36 a

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 15/Oct/2012 Test ID: CPT-001 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 70.16 (ft)
Page 2 of 2

FIGURE

A1-36 b

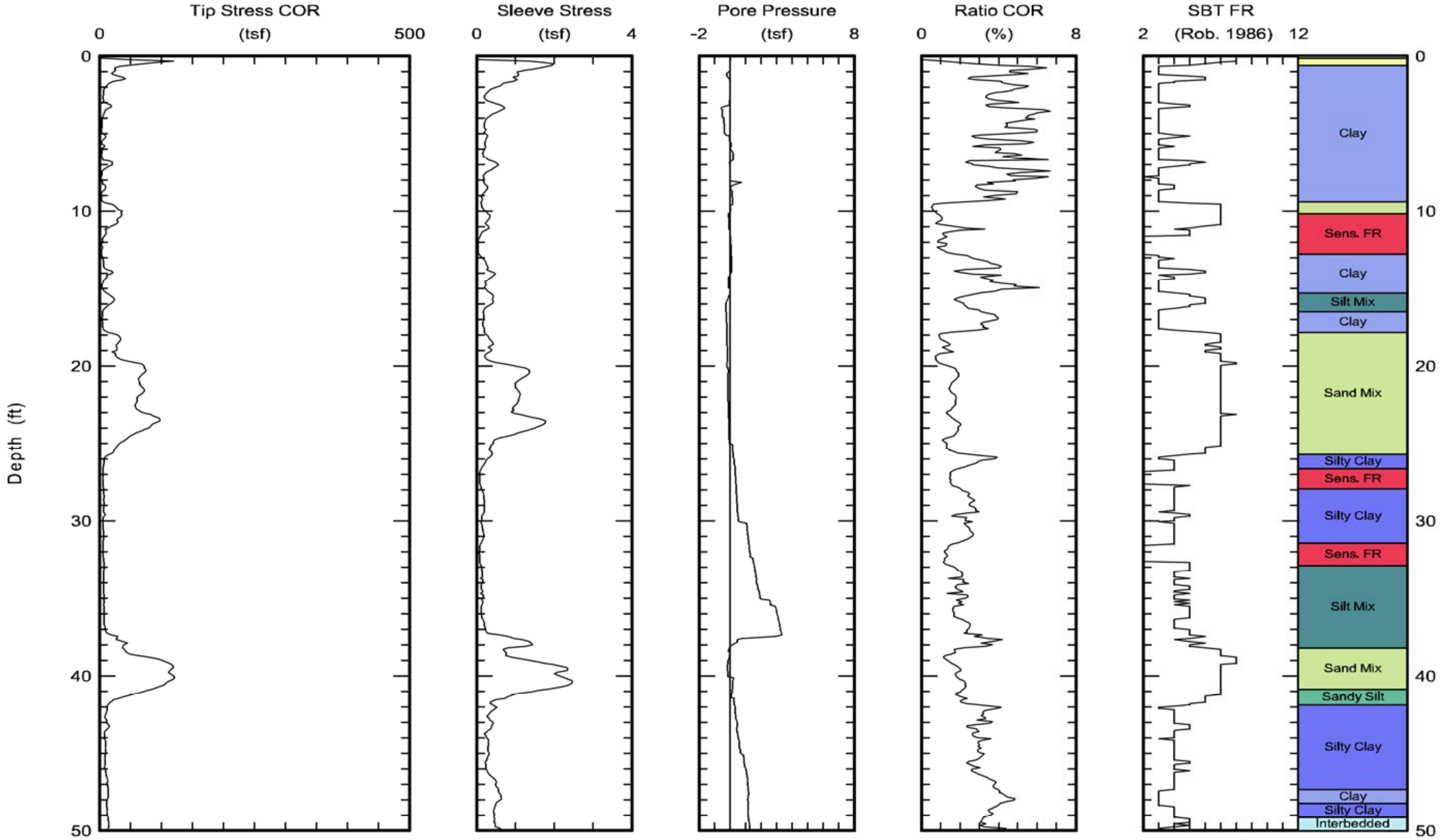
Test ID: CPT-001
File: Z15O1202C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 15/Oct/2012
Test ID: CPT-004
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 68.56 (ft)
Page 1 of 2

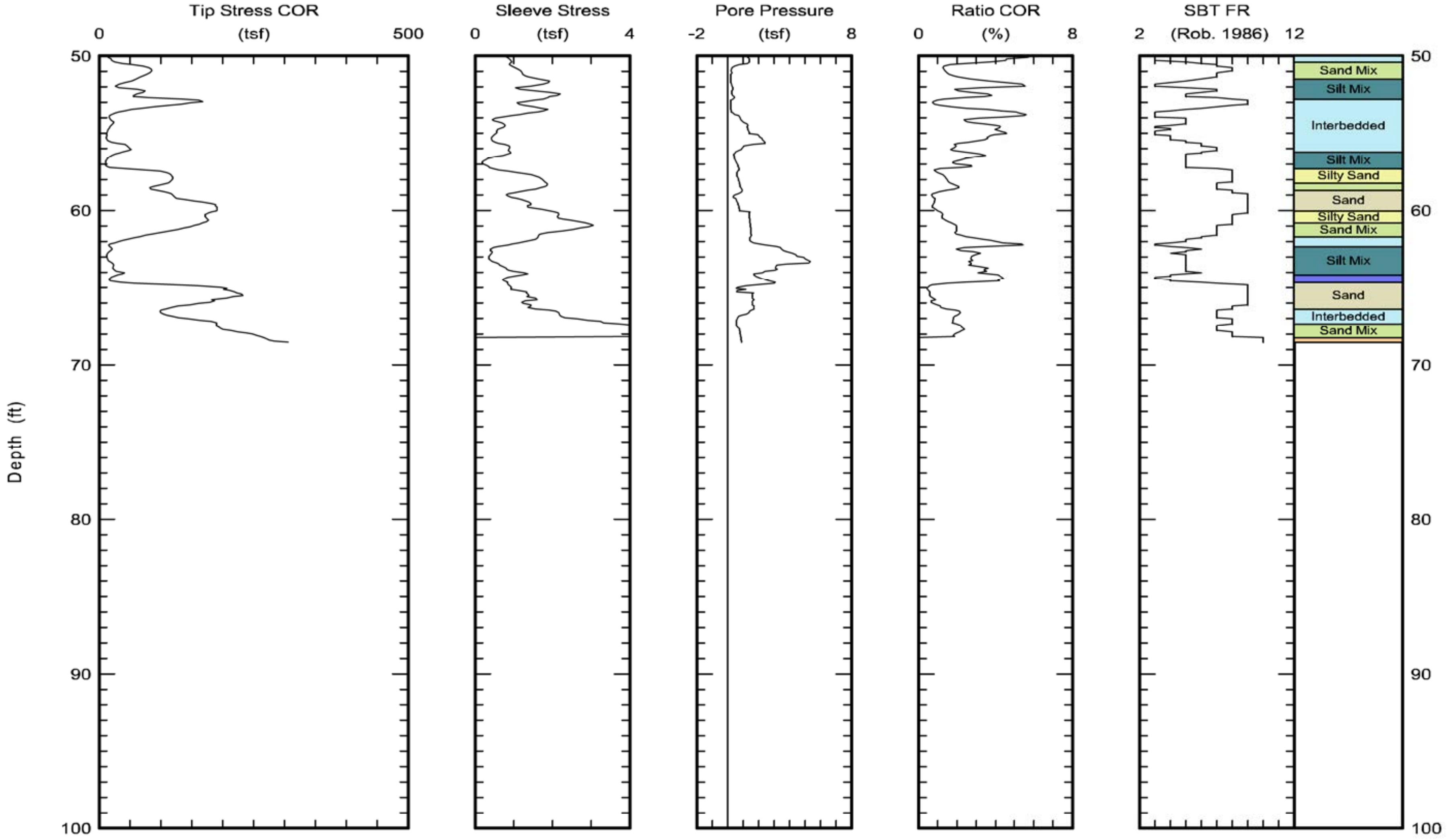
FIGURE
A1-37 a

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 15/Oct/2012
Test ID: CPT-004
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 68.56 (ft)
Page 2 of 2

FIGURE

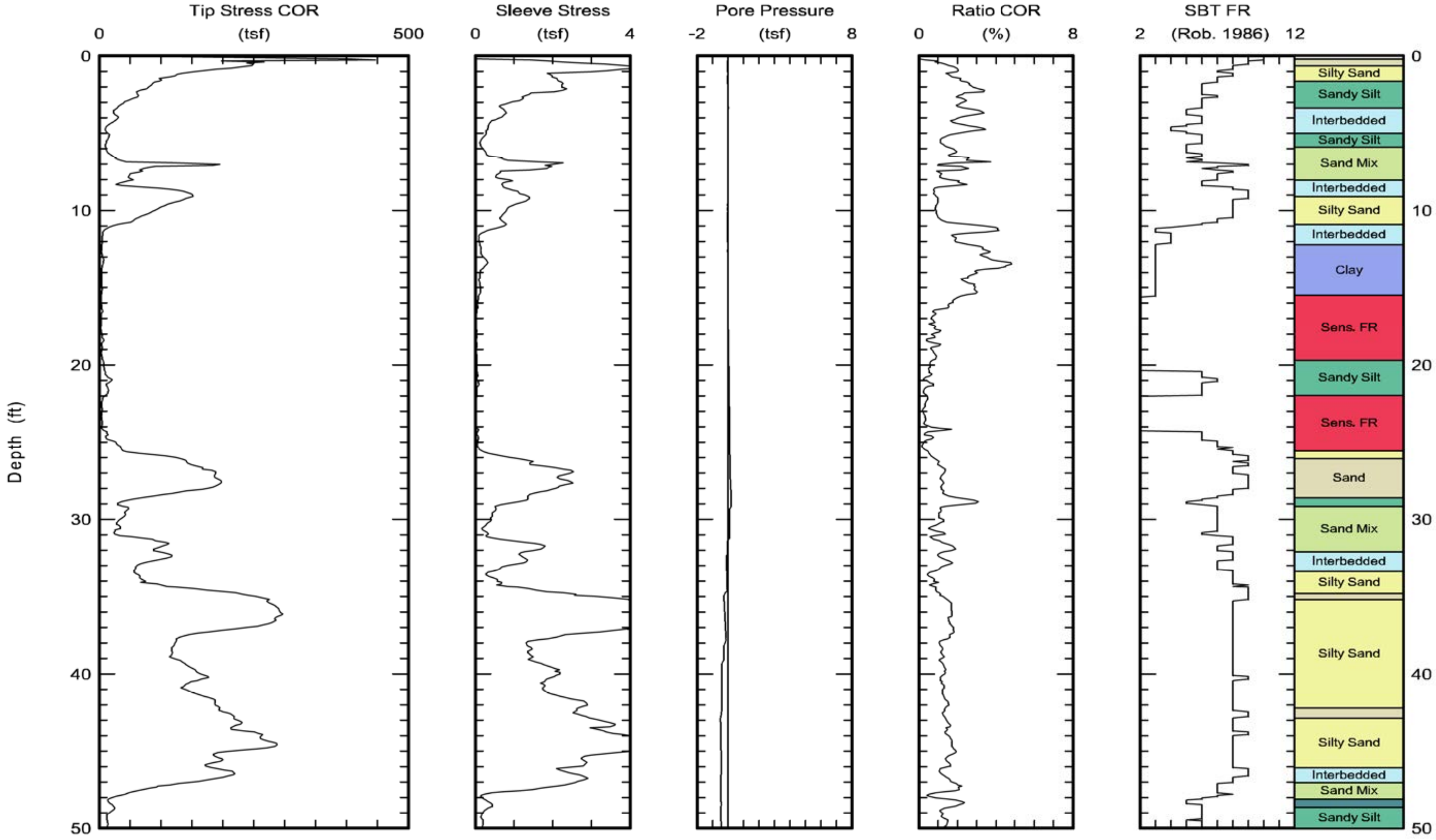
A1-37 b

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 14/Sep/2012
Test ID: B-CPT-026B
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 52.39 (ft)
Page 1 of 2

FIGURE

A1-38 a

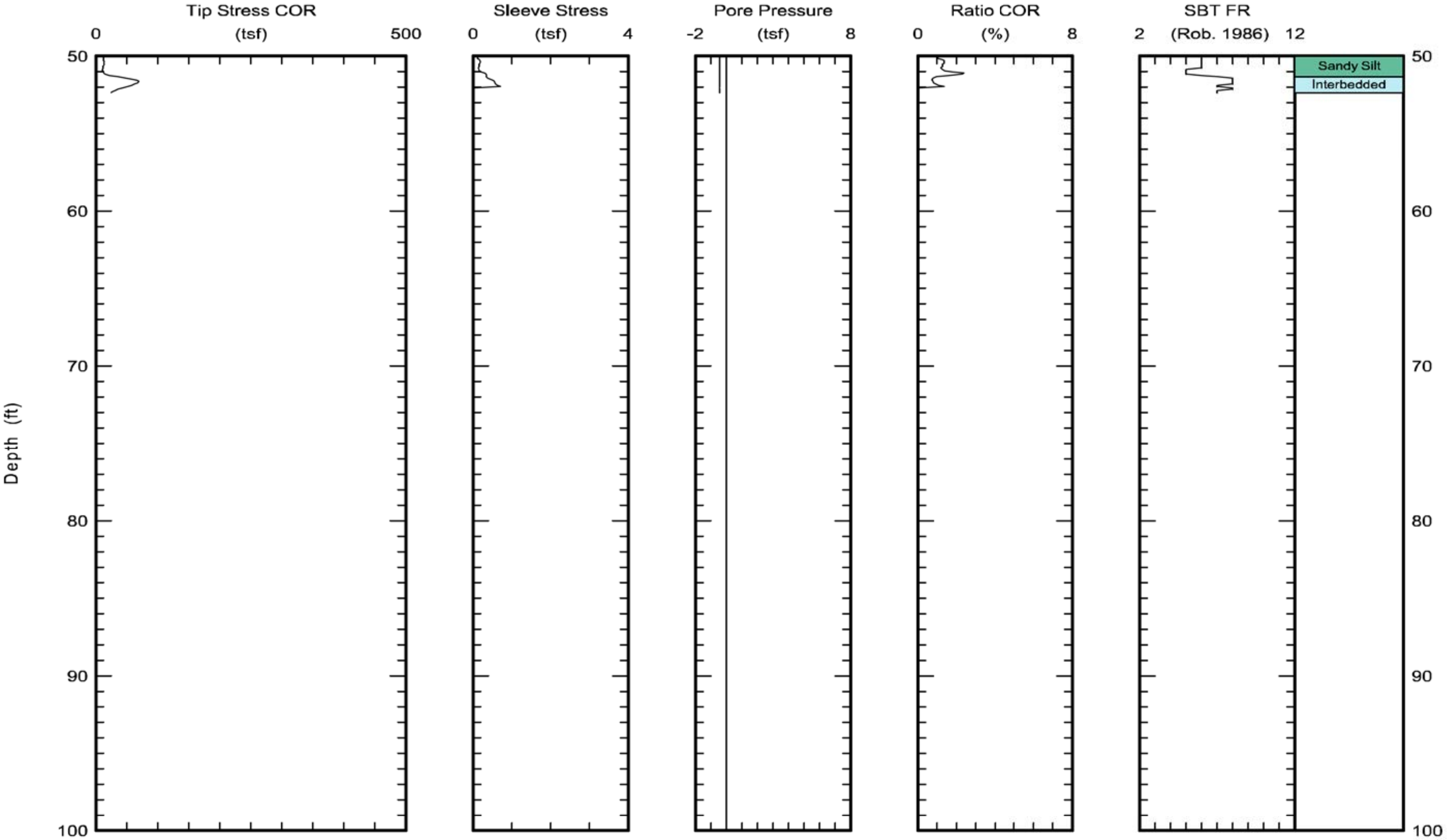
Test ID: B-CPT-026B
File: Z14S1212C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 14/Sep/2012
Test ID: B-CPT-026B
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 52.39 (ft)
Page 2 of 2

FIGURE

A1-38 b

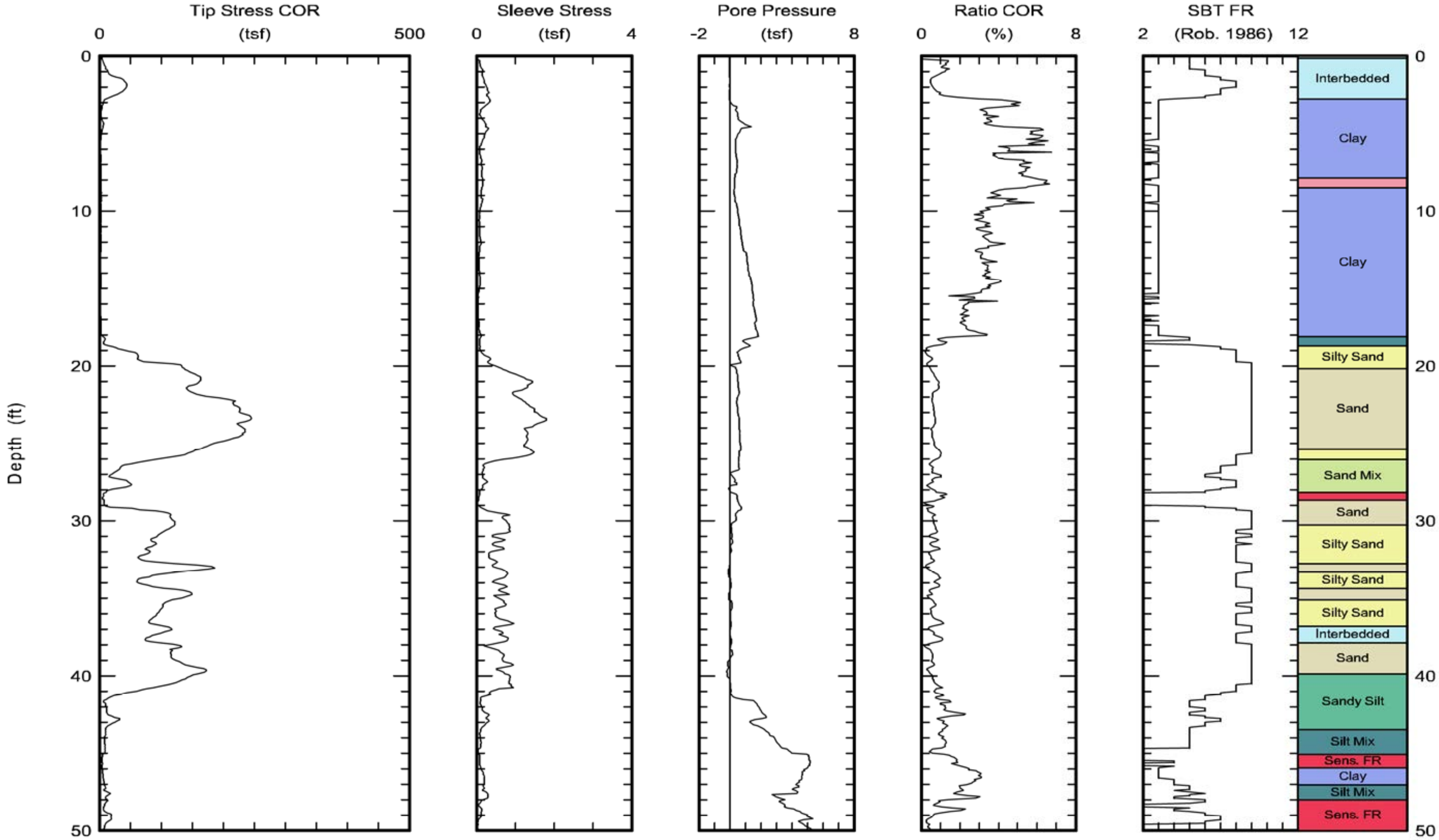
Test ID: B-CPT-026B
File: Z14S1212C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 10/Oct/2012
Test ID: CPT-031
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 69.62 (ft)
Page 1 of 2

FIGURE

A1-39 a

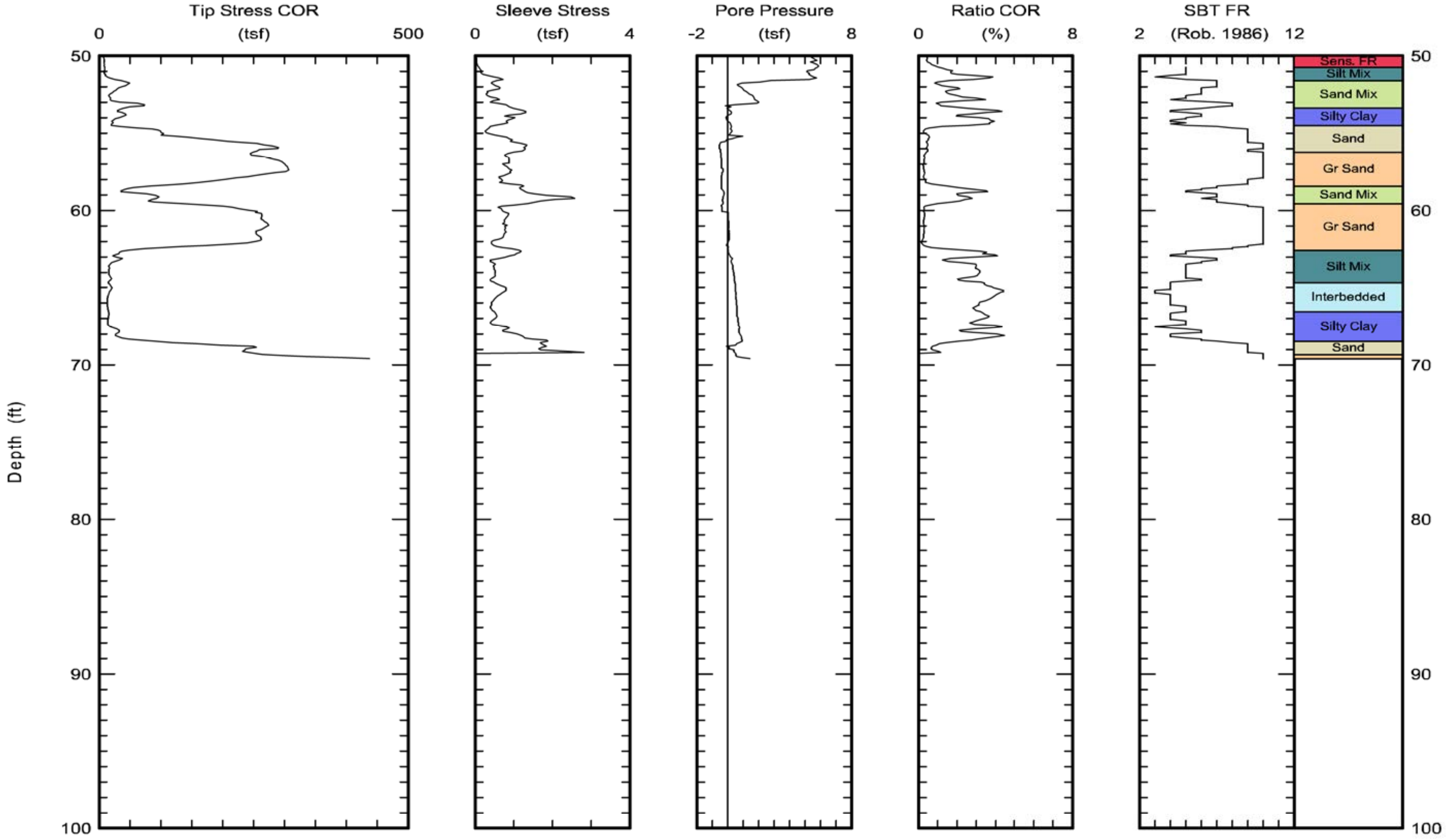
Test ID: CPT-031
File: Z10O1201C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 10/Oct/2012
Test ID: CPT-031
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 69.62 (ft)
Page 2 of 2

FIGURE

A1-39 b

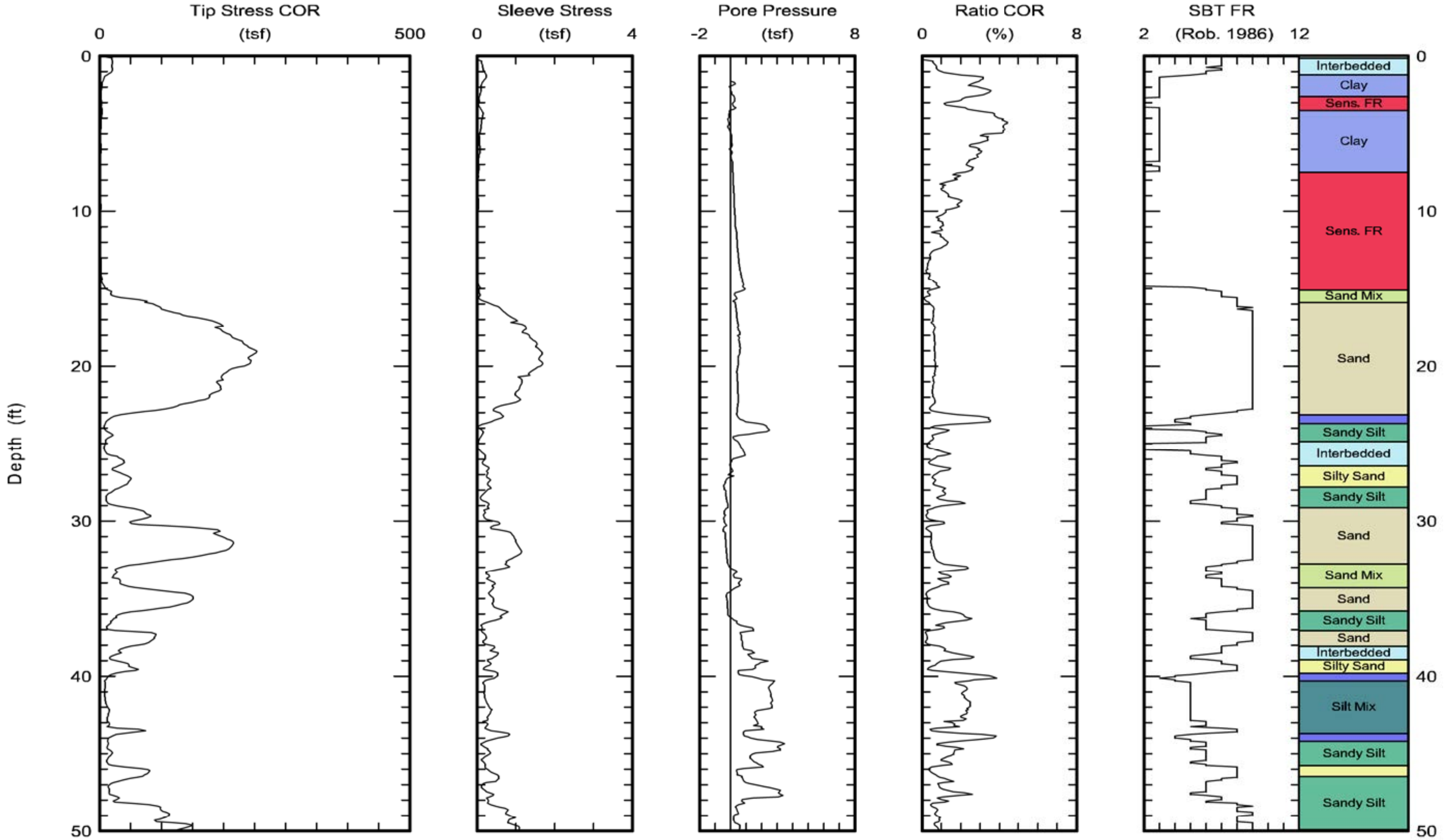
Test ID: CPT-031
File: Z10O1201C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 13/Sep/2012
Test ID: B-CPT-034
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 63.48 (ft)
Page 1 of 2

FIGURE

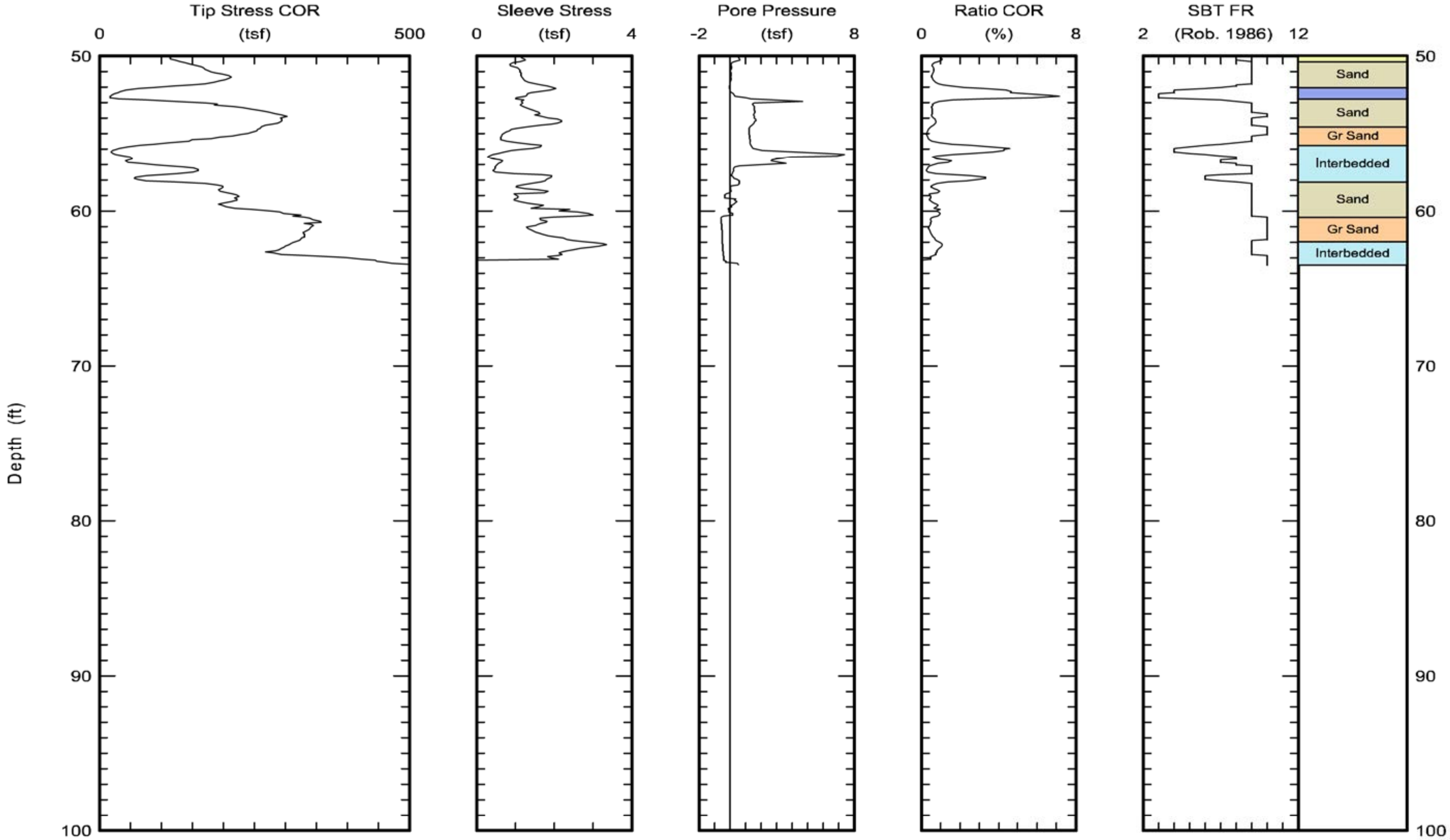
A1-40 a

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 13/Sep/2012
Test ID: B-CPT-034
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 63.48 (ft)
Page 2 of 2

FIGURE

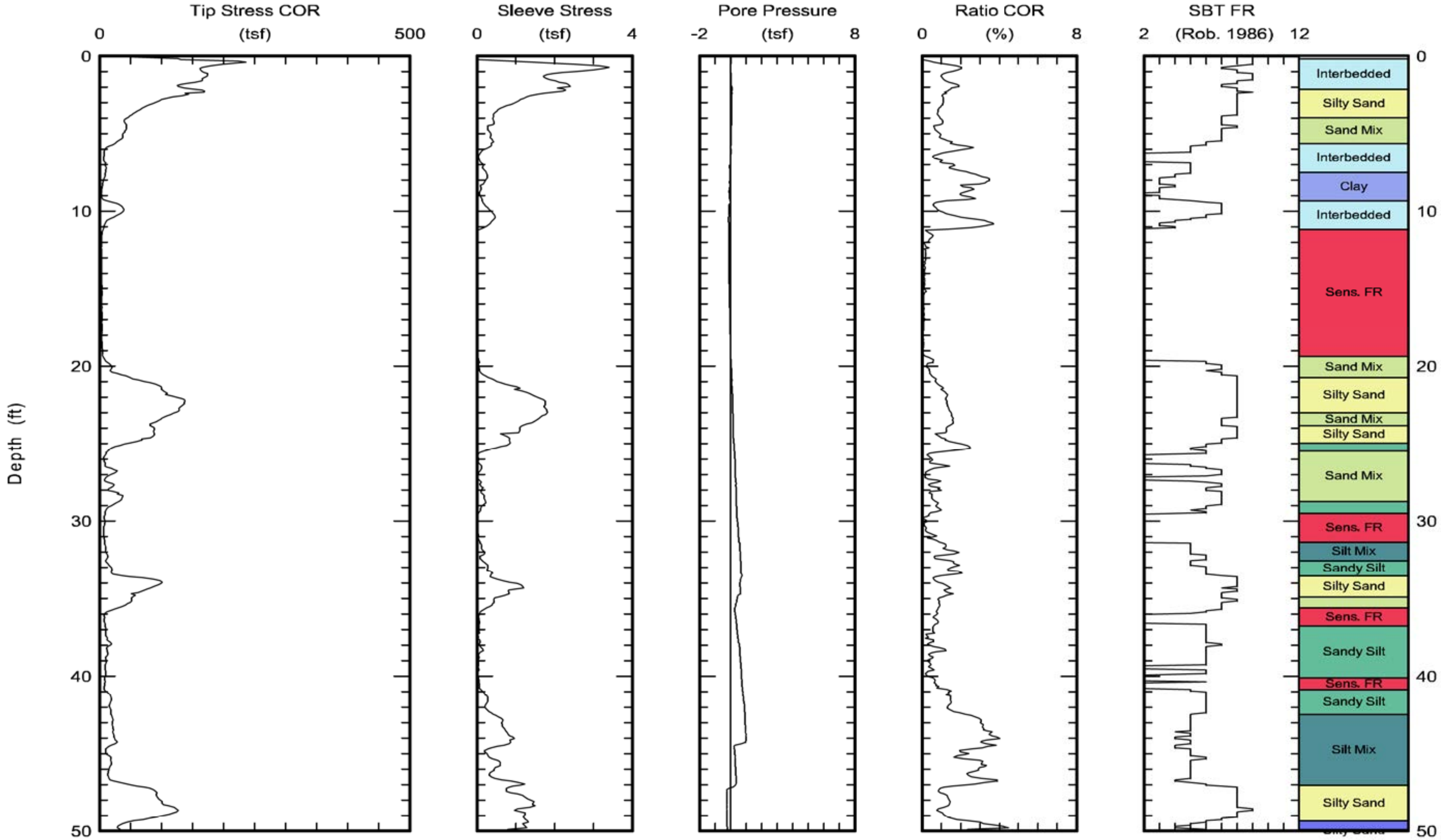
A1-40 b

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 13/Sep/2012
Test ID: B-CPT-035
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 66.86 (ft)
Page 1 of 2

FIGURE

A1-41 a

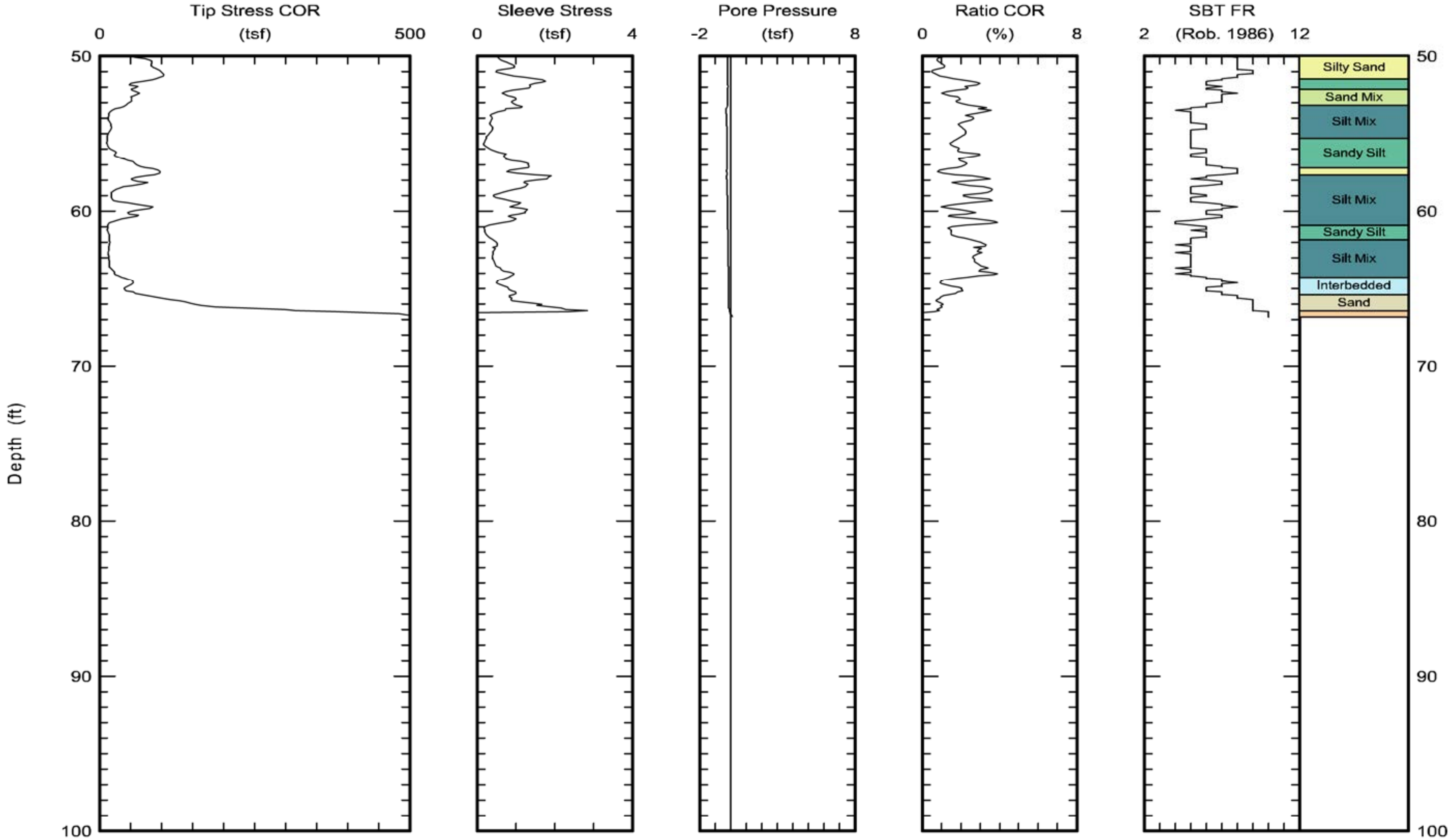
Test ID: B-CPT-035
File: Z13S1205C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 13/Sep/2012
Test ID: B-CPT-035
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 66.86 (ft)
Page 2 of 2

FIGURE

A1-41 b

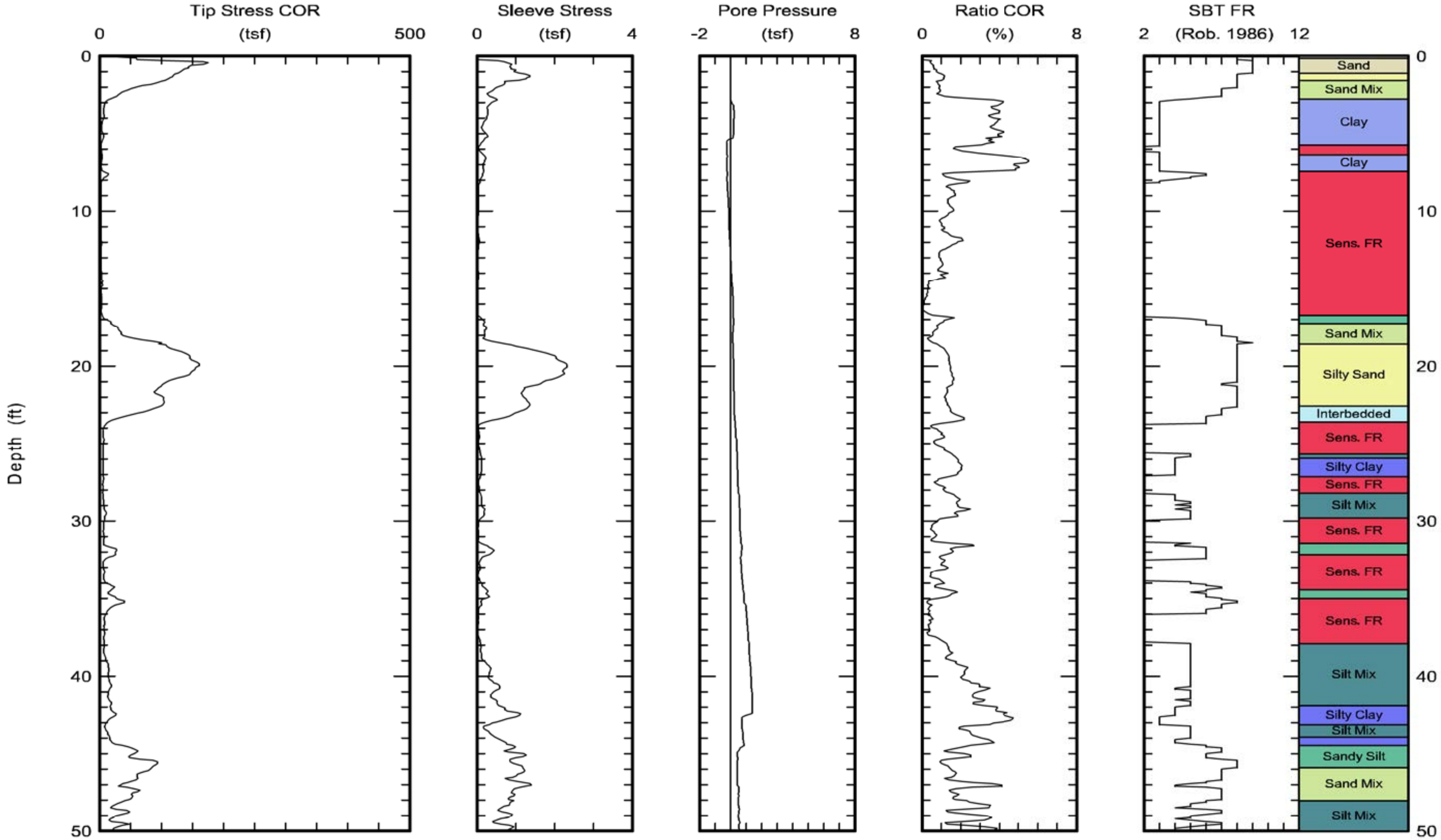
Test ID: B-CPT-035
File: Z13S1205C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 13/Sep/2012
Test ID: B-CPT-037
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 70.01 (ft)
Page 1 of 2

FIGURE

A1-42 a

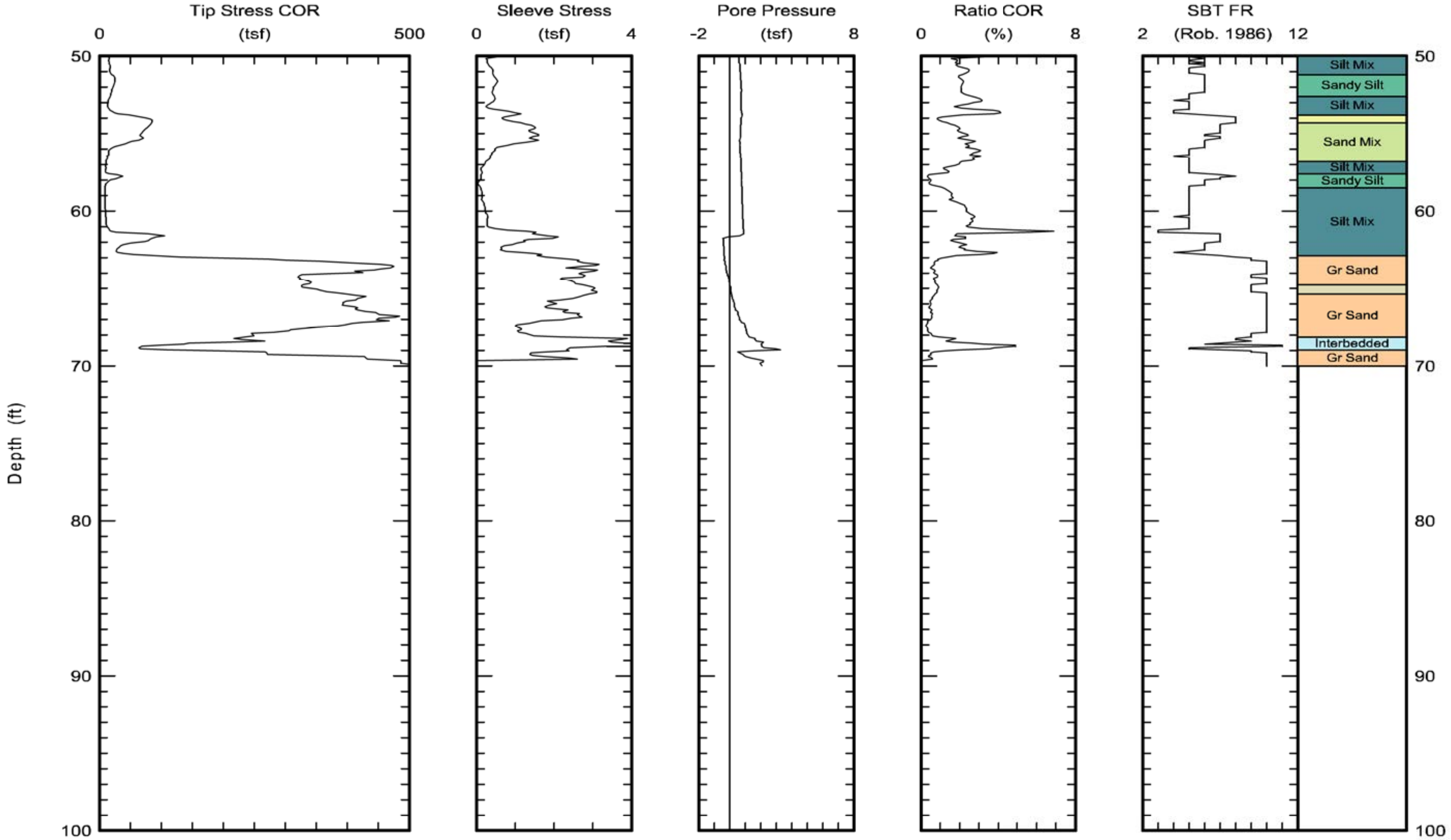
Test ID: B-CPT-037
File: Z13S1203C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 13/Sep/2012
Test ID: B-CPT-037
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 70.01 (ft)
Page 2 of 2

FIGURE

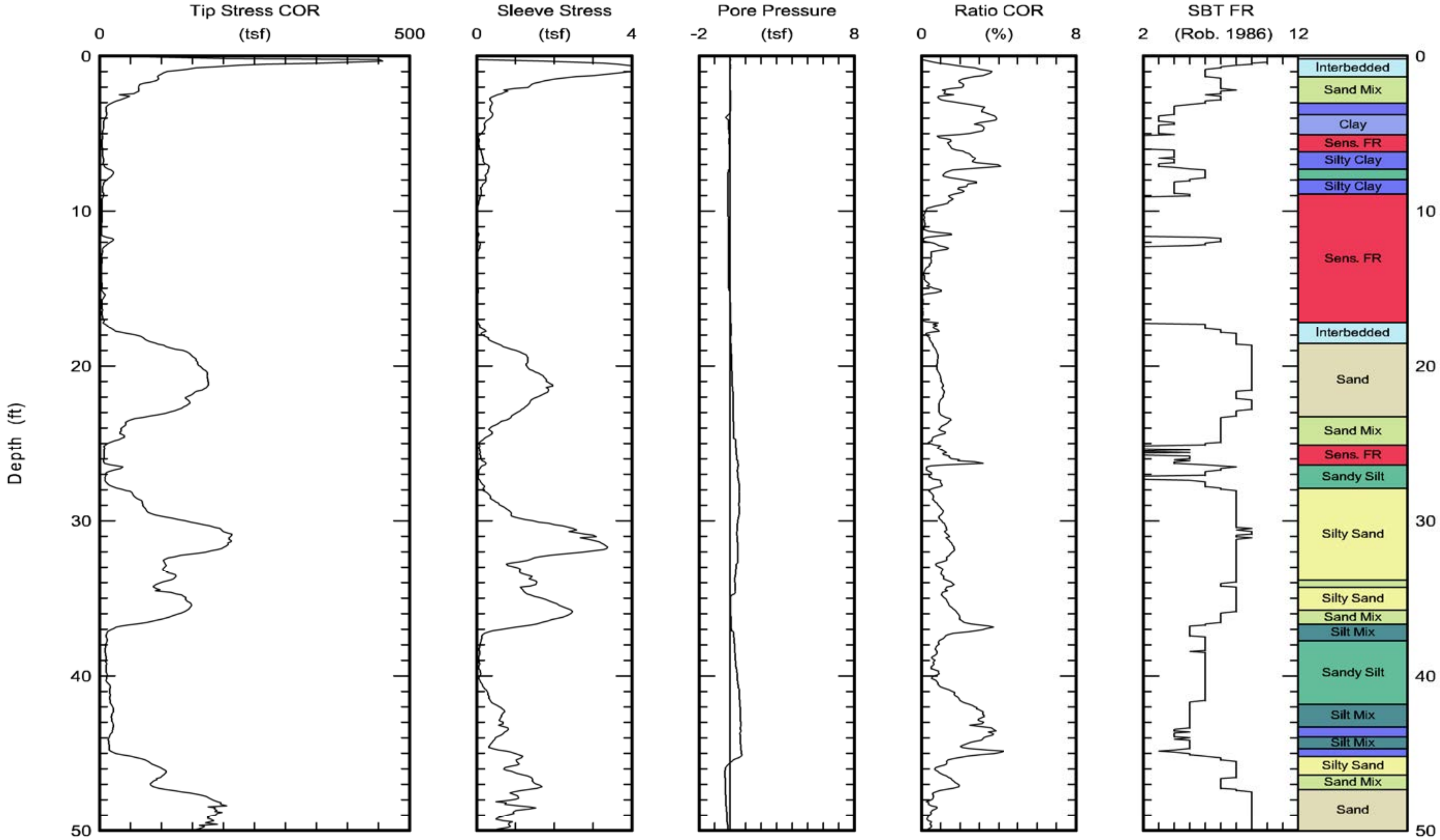
A1-42 b

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 13/Sep/2012
Test ID: B-CPT-038
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 67.93 (ft)
Page 1 of 2

FIGURE

A1-43 a

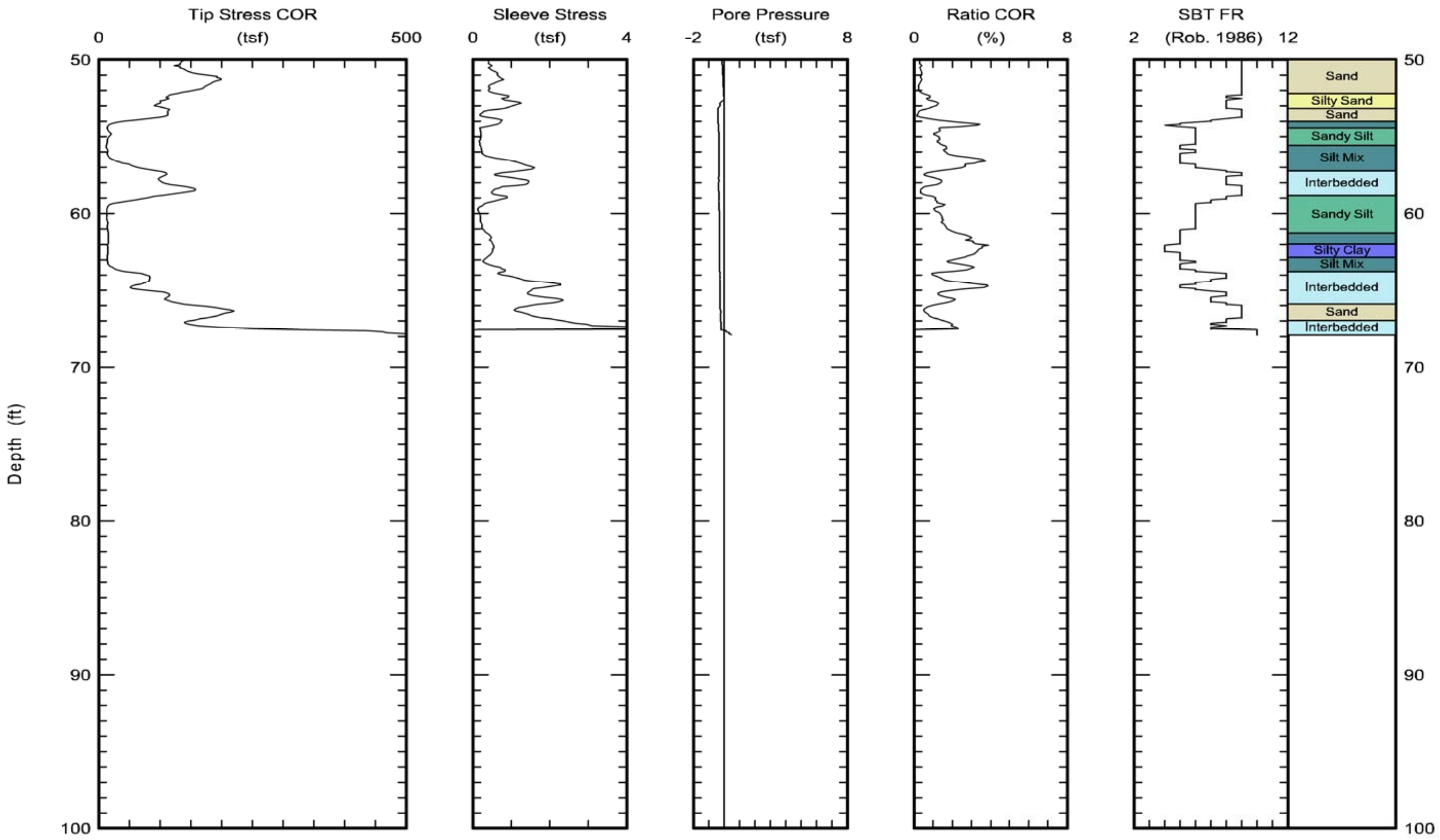
Test ID: B-CPT-038
File: Z13S1204C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 13/Sep/2012
Test ID: B-CPT-038
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 67.93 (ft)
Page 2 of 2

FIGURE

A1-43 b

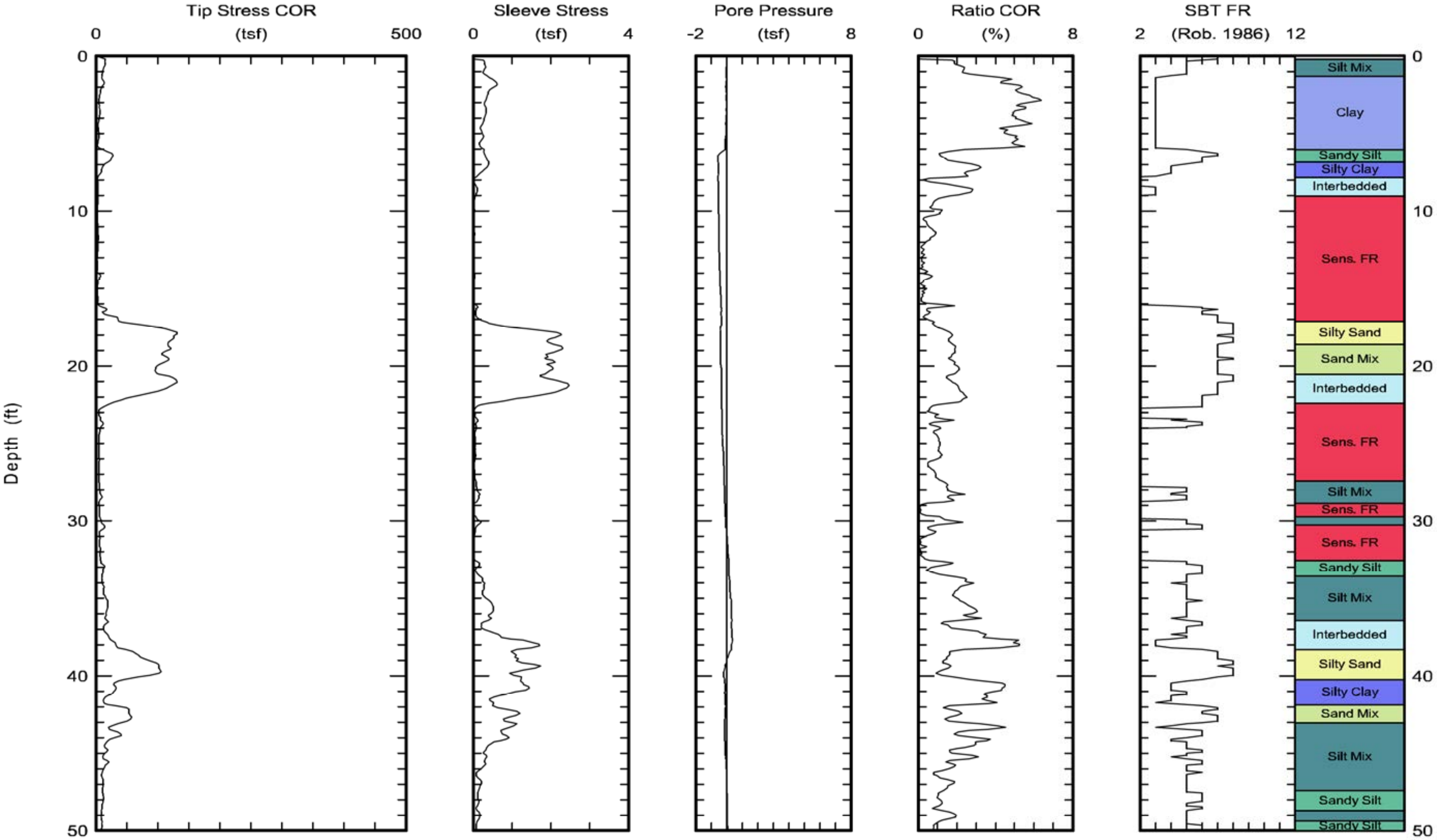
Test ID: B-CPT-038
File: Z13S1204C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 15/Oct/2012
Test ID: CPT-040
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 59.88 (ft)
Page 1 of 2

FIGURE

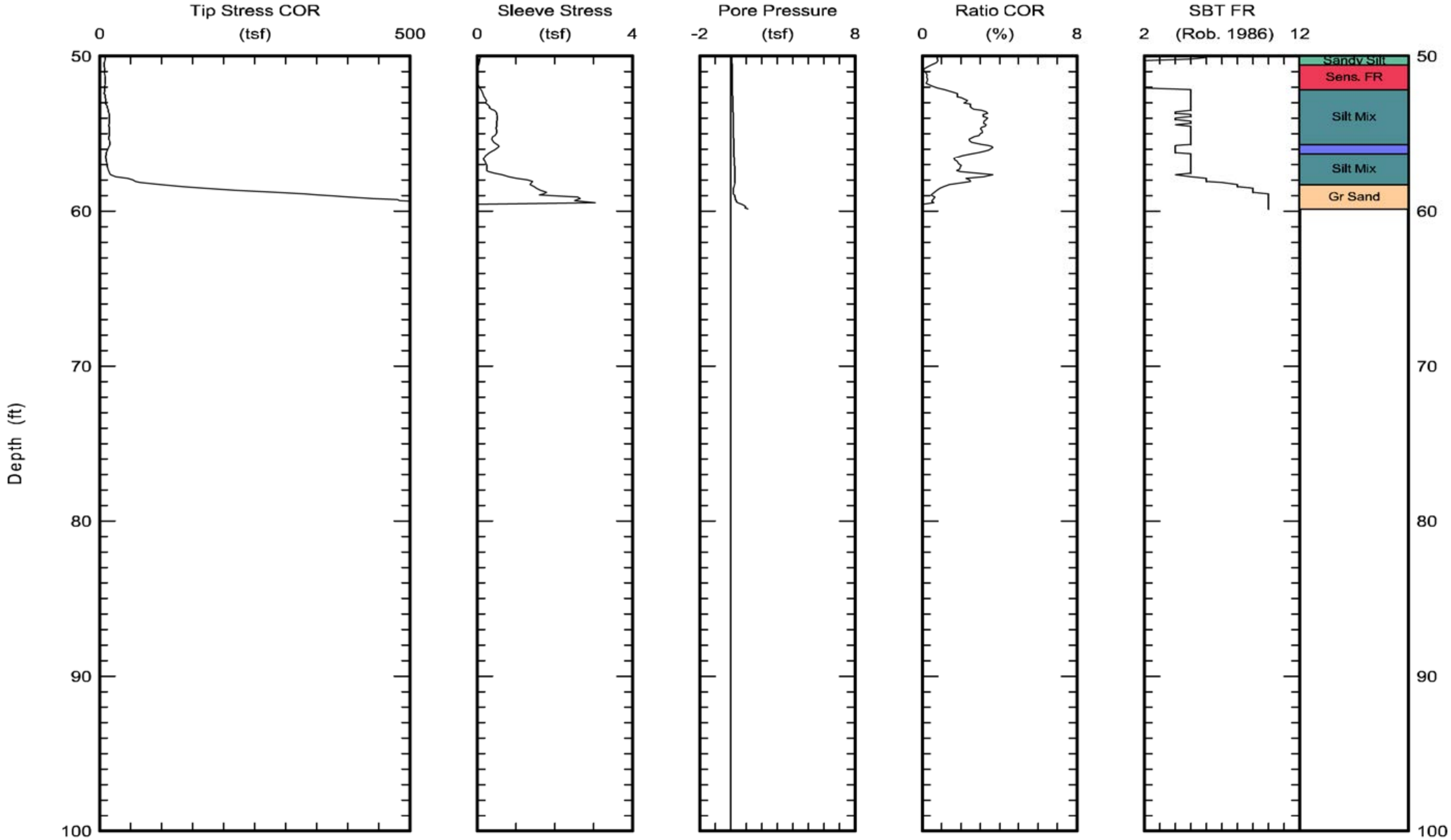
A1-44 a

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 15/Oct/2012
Test ID: CPT-040
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 59.88 (ft)
Page 2 of 2

FIGURE

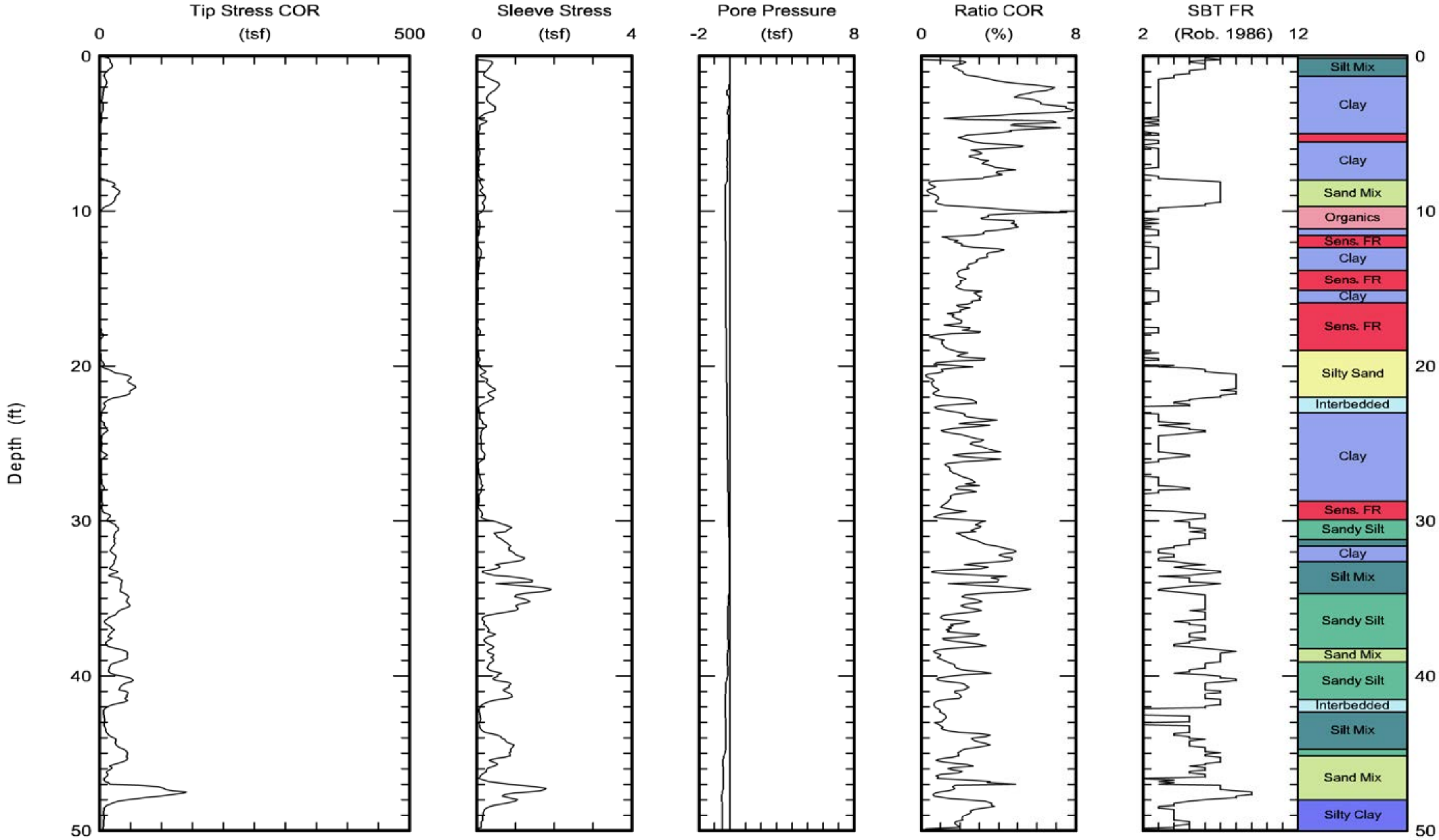
A1-44 b

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 13/Sep/2012
Test ID: B-CPT-045
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 60.03 (ft)
Page 1 of 2

FIGURE

A1-45 a

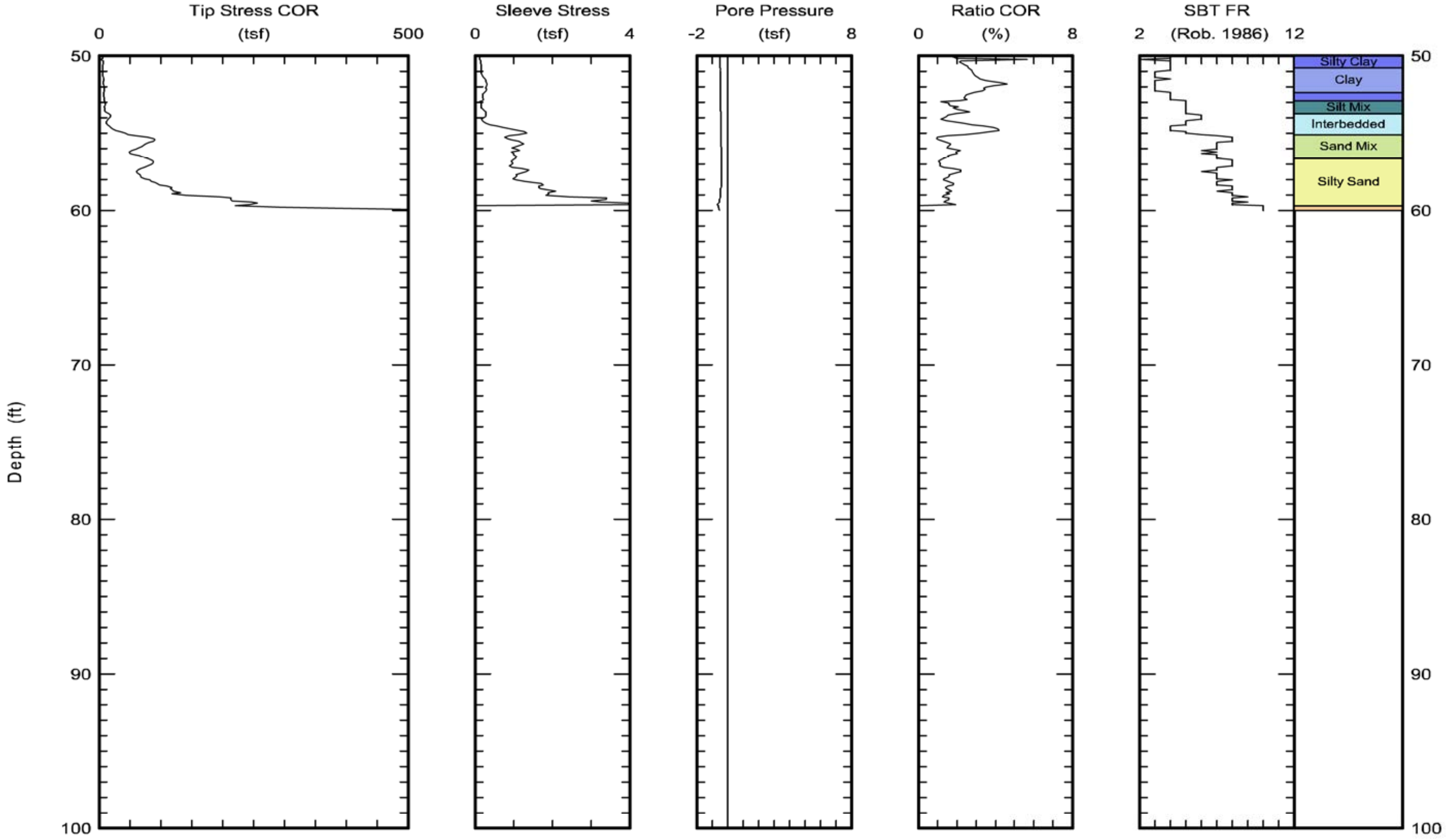
Test ID: B-CPT-045
File: Z13S1207C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 13/Sep/2012
Test ID: B-CPT-045
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 60.03 (ft)
Page 2 of 2

FIGURE

A1-45 b

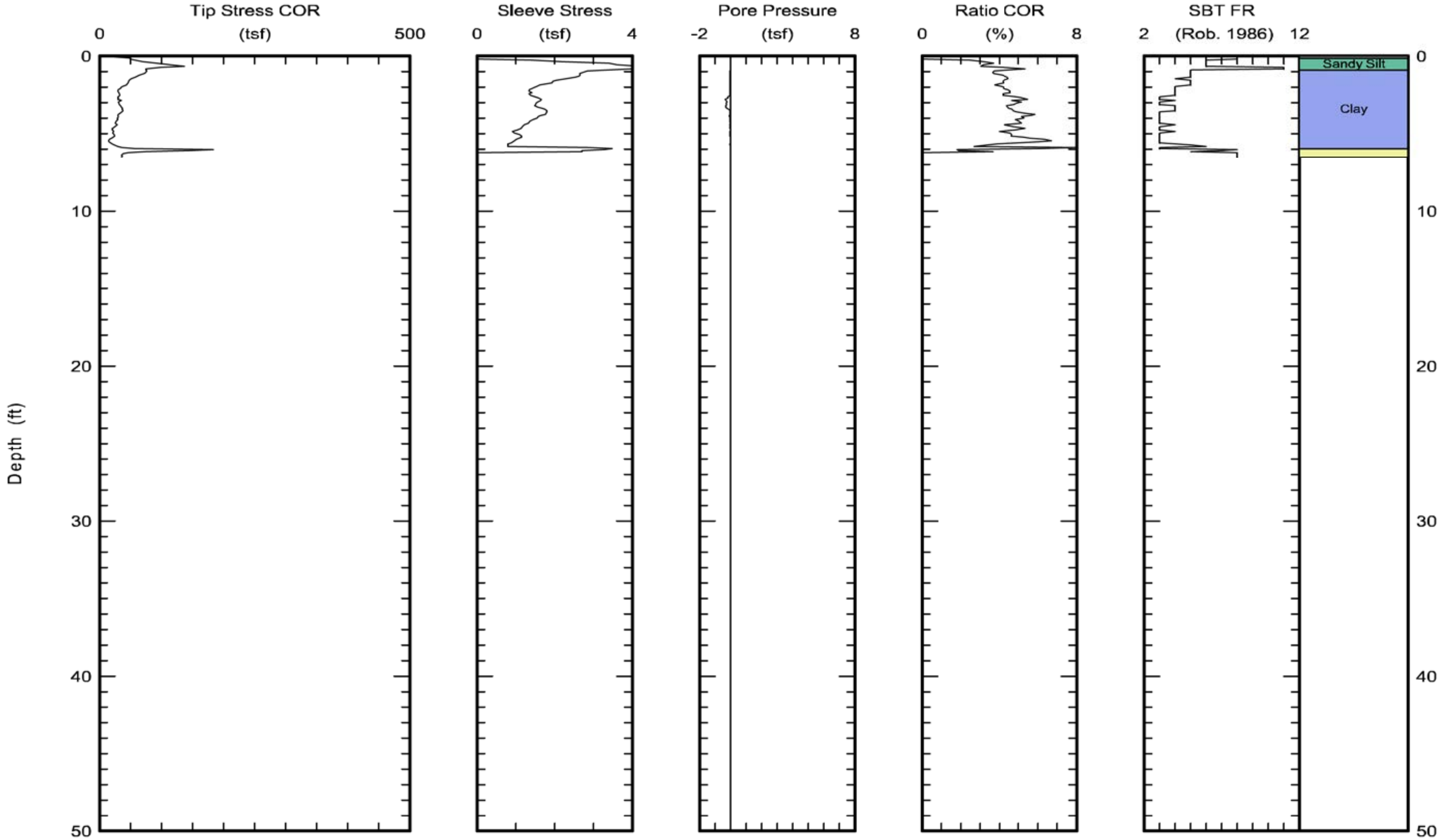
Test ID: B-CPT-045
File: Z13S1207C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 15/Oct/2012
Test ID: CPT-046C
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 6.54 (ft)

FIGURE

A1-46

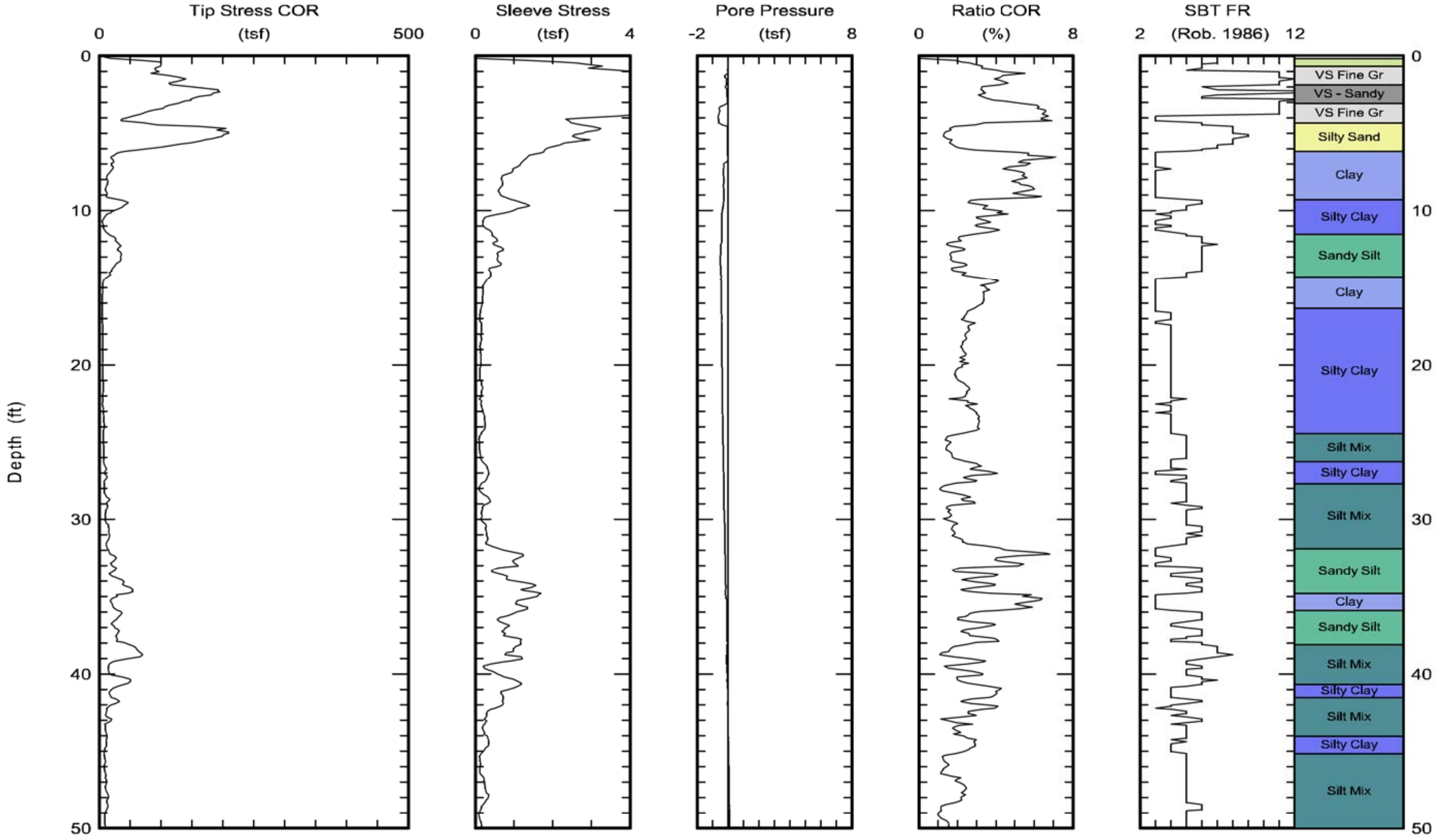
Test ID: CPT-046C
File: Z15O1208C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 15/Oct/2012
Test ID: CPT-048
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



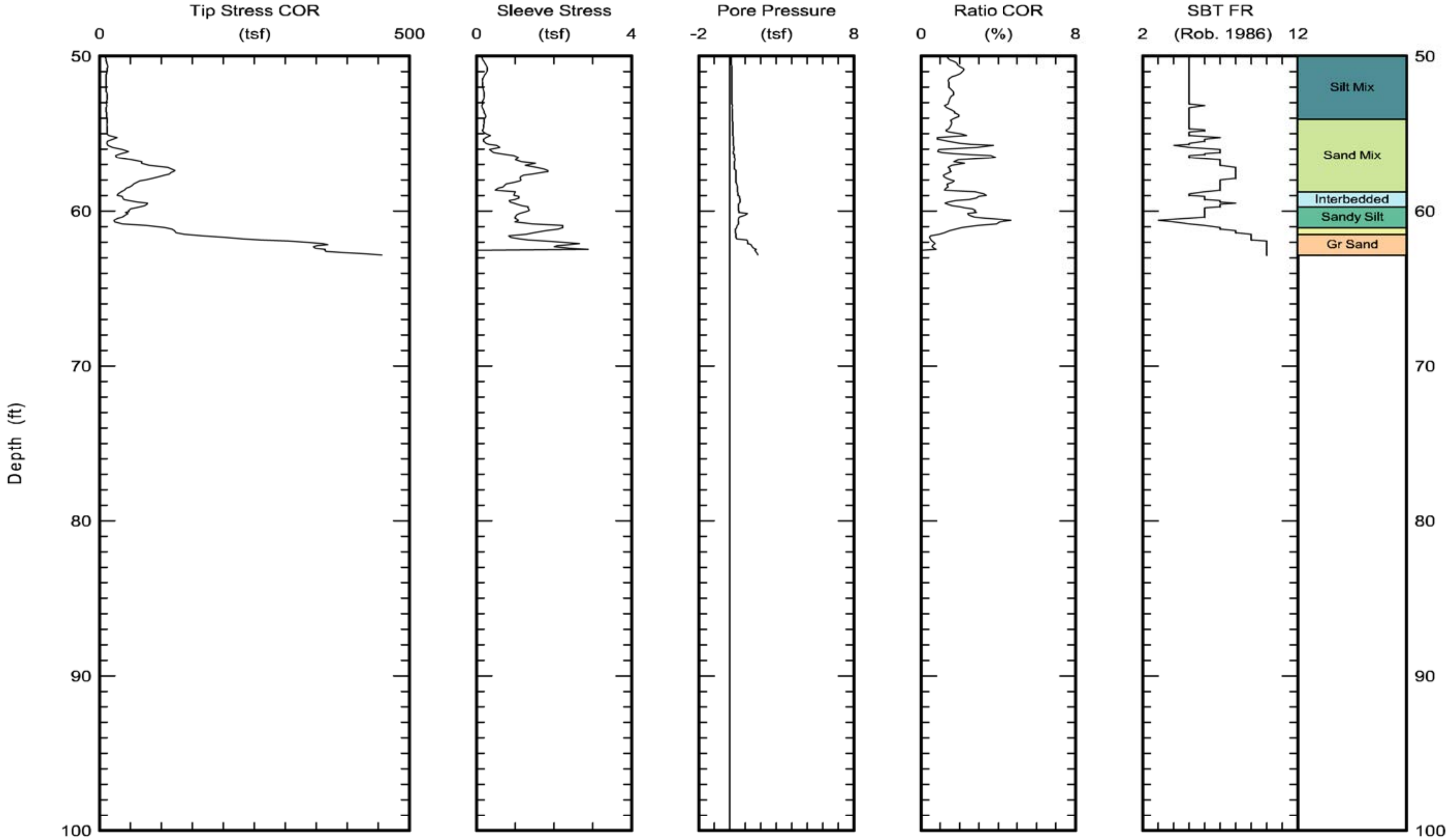
Maximum depth: 62.85 (ft)
Page 1 of 2

FIGURE

A1-47 a

Test ID: CPT-048
File: Z15O1204C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 15/Oct/2012 Test ID: CPT-048 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 62.85 (ft)
Page 2 of 2

FIGURE

A1-47 b

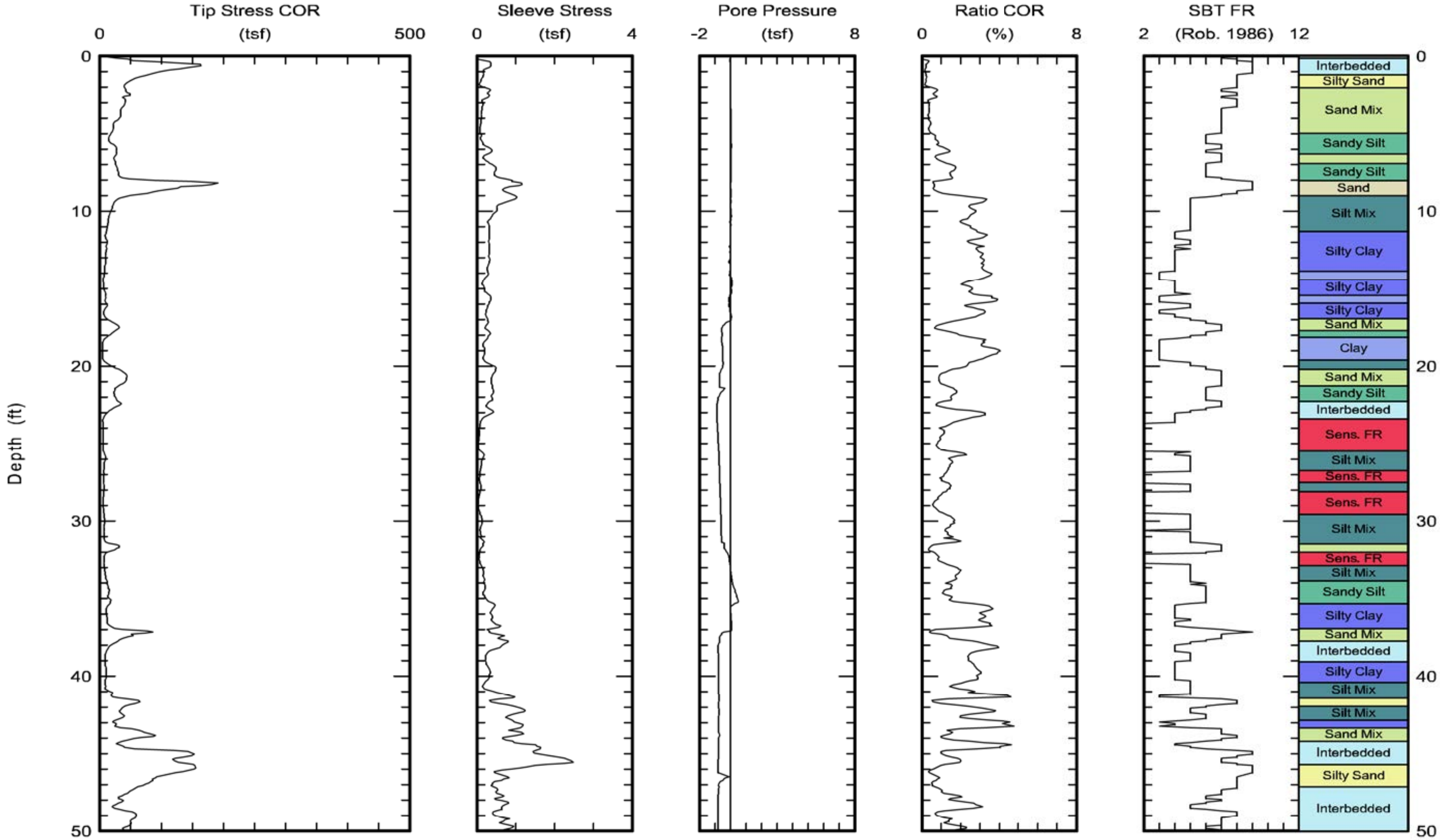
Test ID: CPT-048
File: Z15O1204C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 14/Sep/2012
Test ID: B-CPT-050
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 64.39 (ft)
Page 1 of 2

FIGURE

A1-48 a

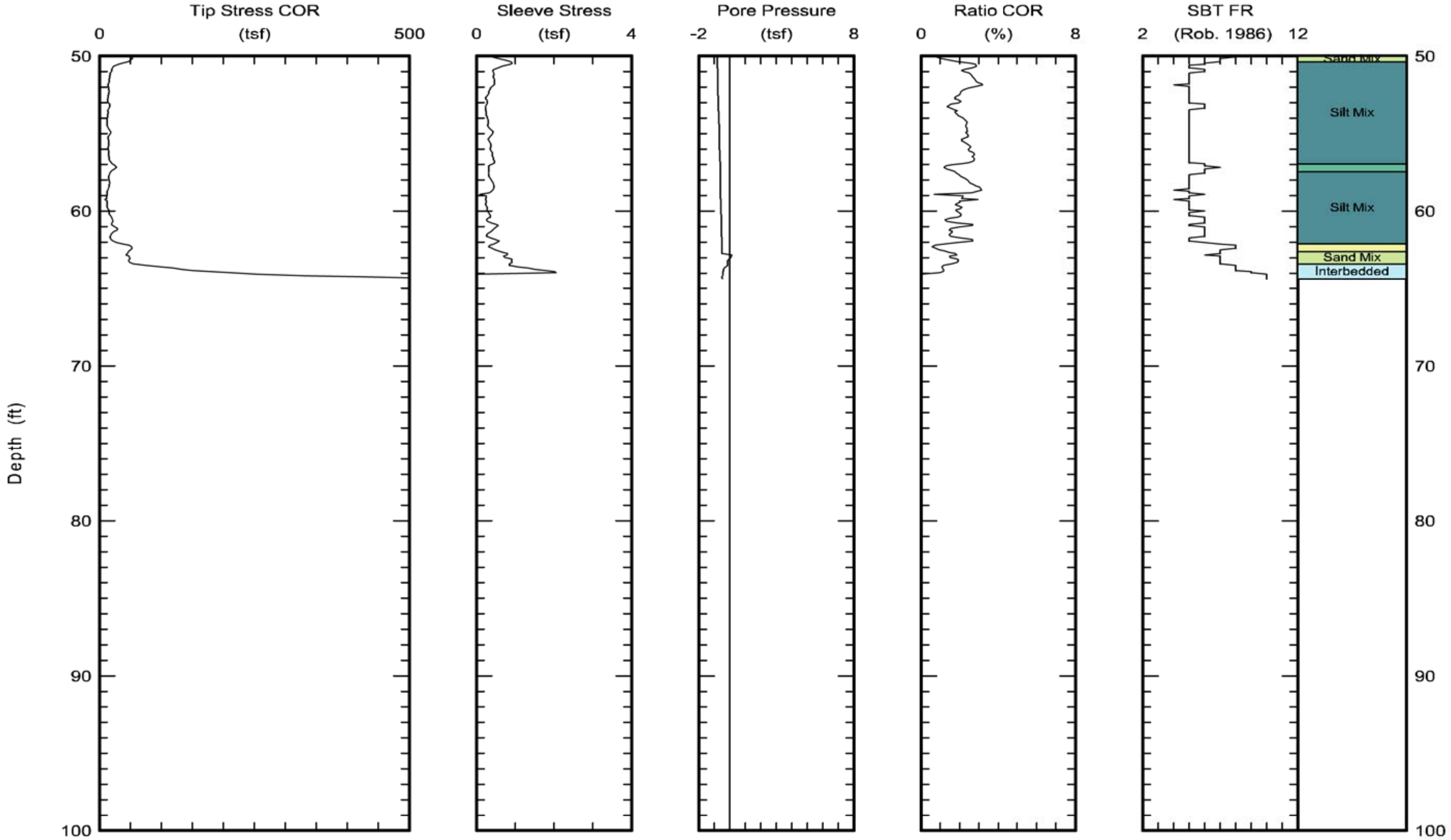
Test ID: B-CPT-050
File: Z14S1201C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 14/Sep/2012
Test ID: B-CPT-050
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 64.39 (ft)
Page 2 of 2

FIGURE

A1-48 b

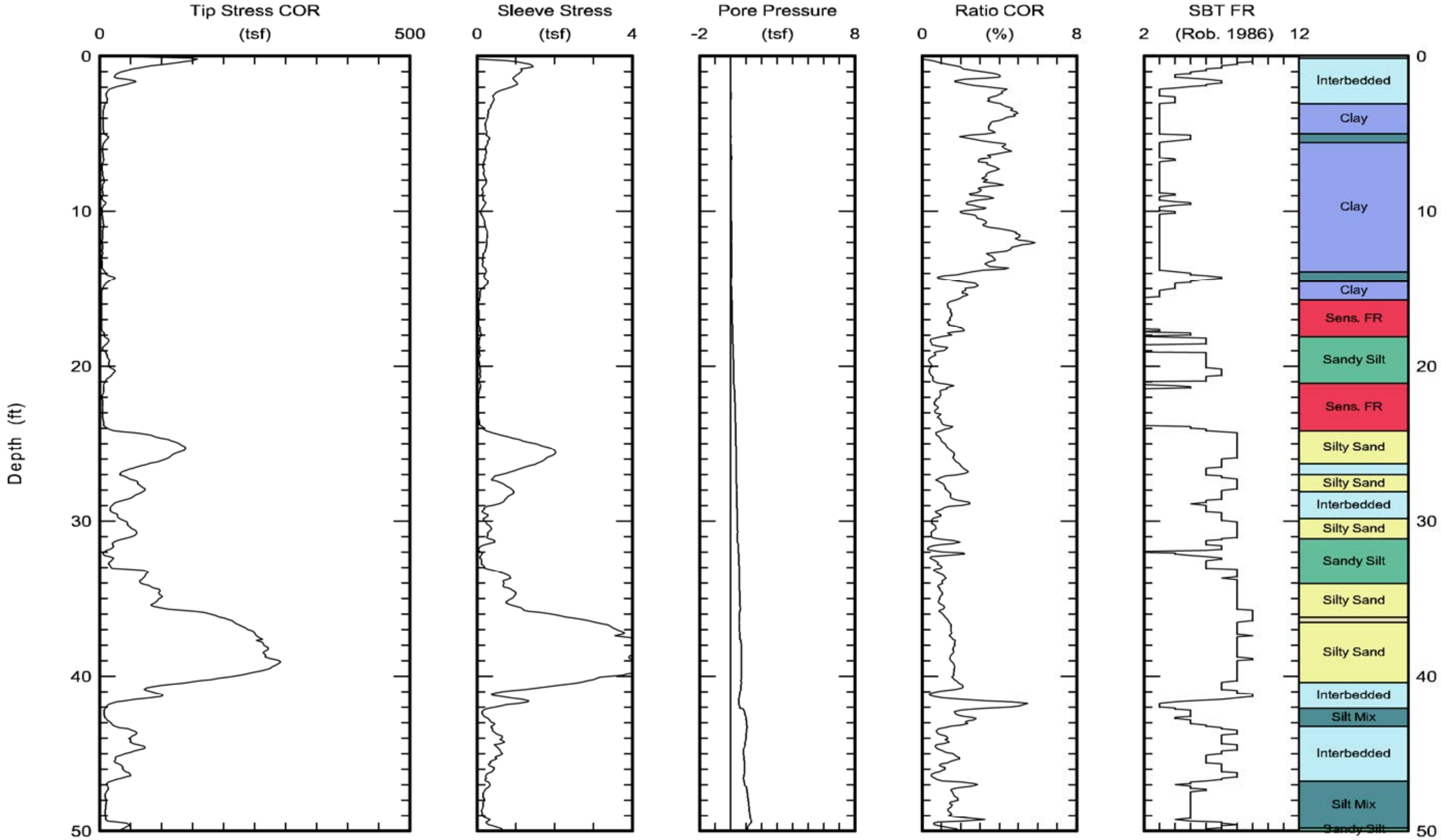
Test ID: B-CPT-05
File: Z14S1201C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 14/Sep/2012
Test ID: B-CPT-052
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



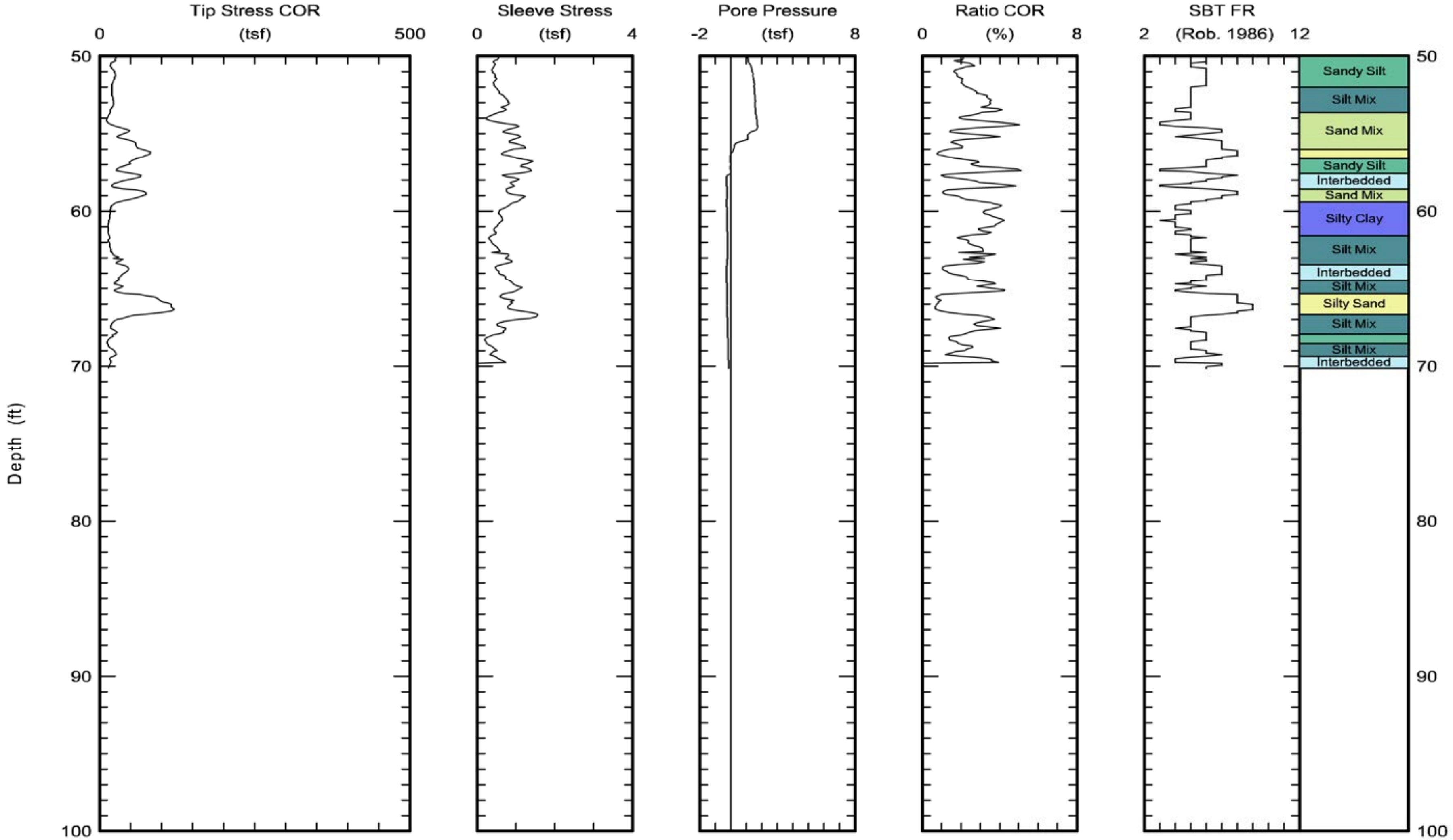
Maximum depth: 70.14 (ft)
Page 1 of 2

FIGURE

A1-49 a

Test ID: B-CPT-052
File: Z14S1209C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 14/Sep/2012 Test ID: B-CPT-052 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 70.14 (ft)
Page 2 of 2

FIGURE

A1-49 b

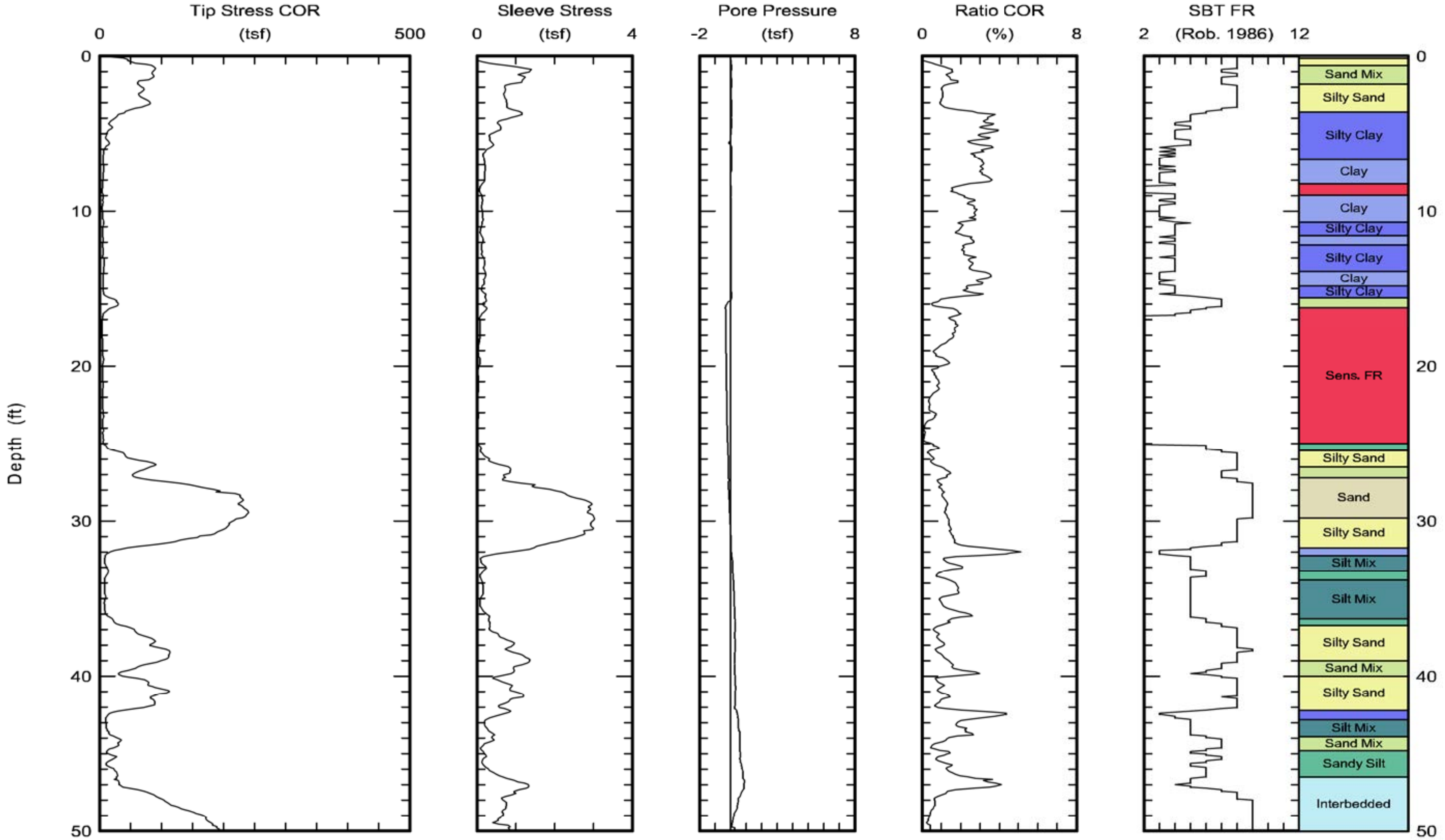
Test ID: B-CPT-052
File: Z14S1209C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 14/Sep/2012
Test ID: B-CPT-054
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



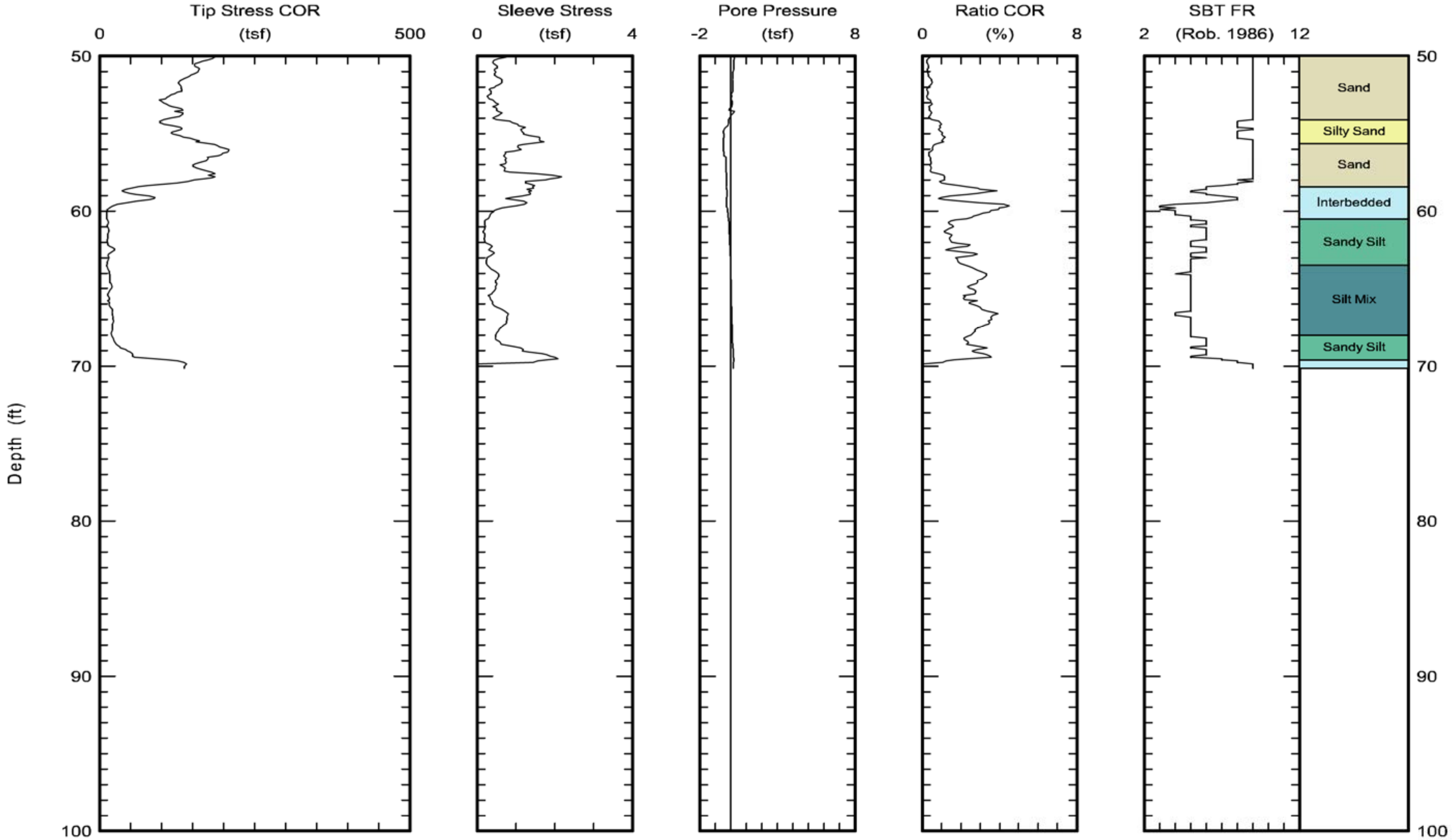
Maximum depth: 70.15 (ft)
Page 1 of 2

FIGURE

A1-50 a

Test ID: B-CPT-054
File: Z14S1207C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 14/Sep/2012 Test ID: B-CPT-054 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	

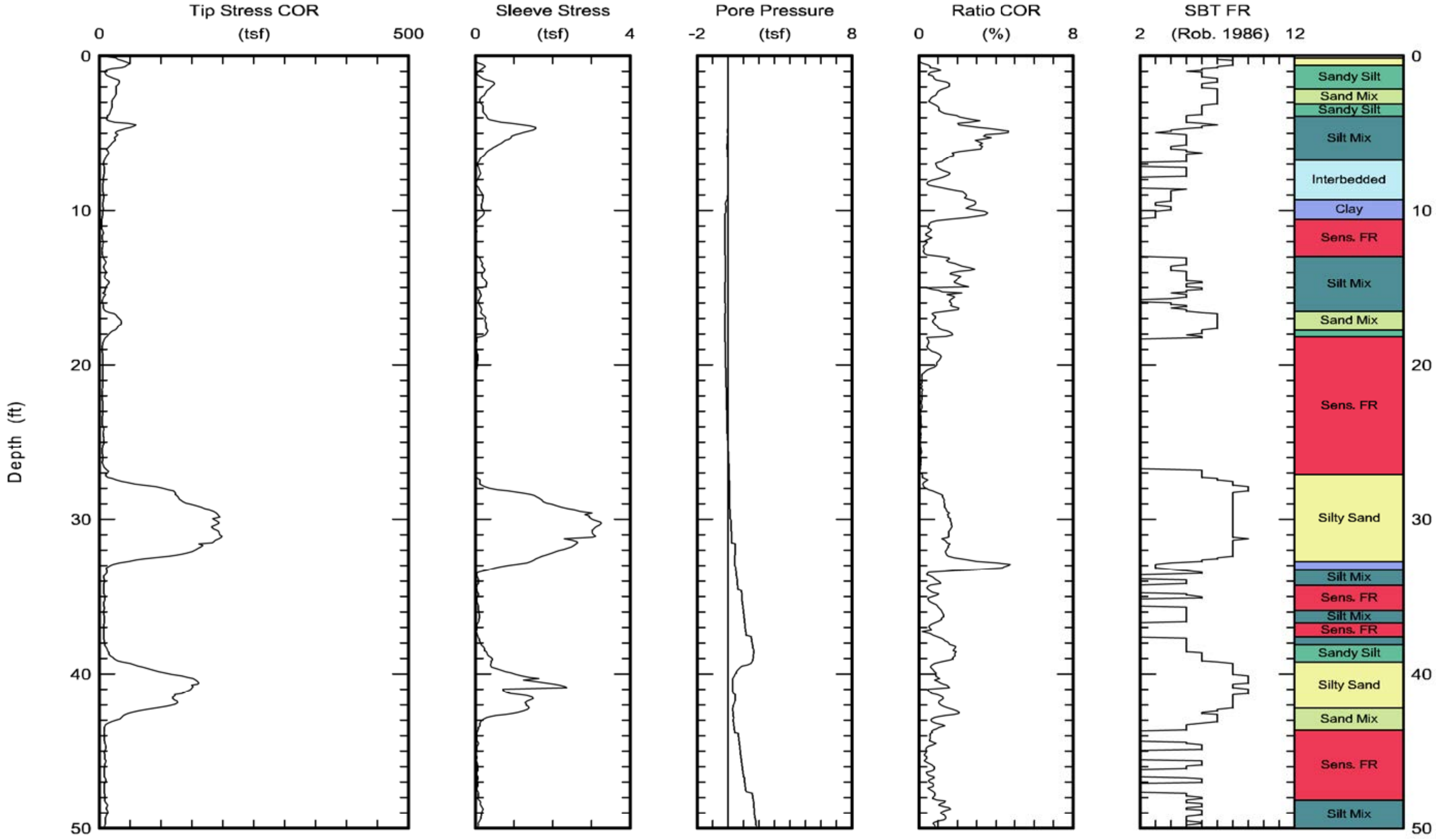


Maximum depth: 70.15 (ft)
Page 2 of 2

FIGURE

A1-50 b

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 14/Sep/2012 Test ID: B-CPT-056 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 70.07 (ft)

Page 1 of 2

FIGURE

A1-51 a

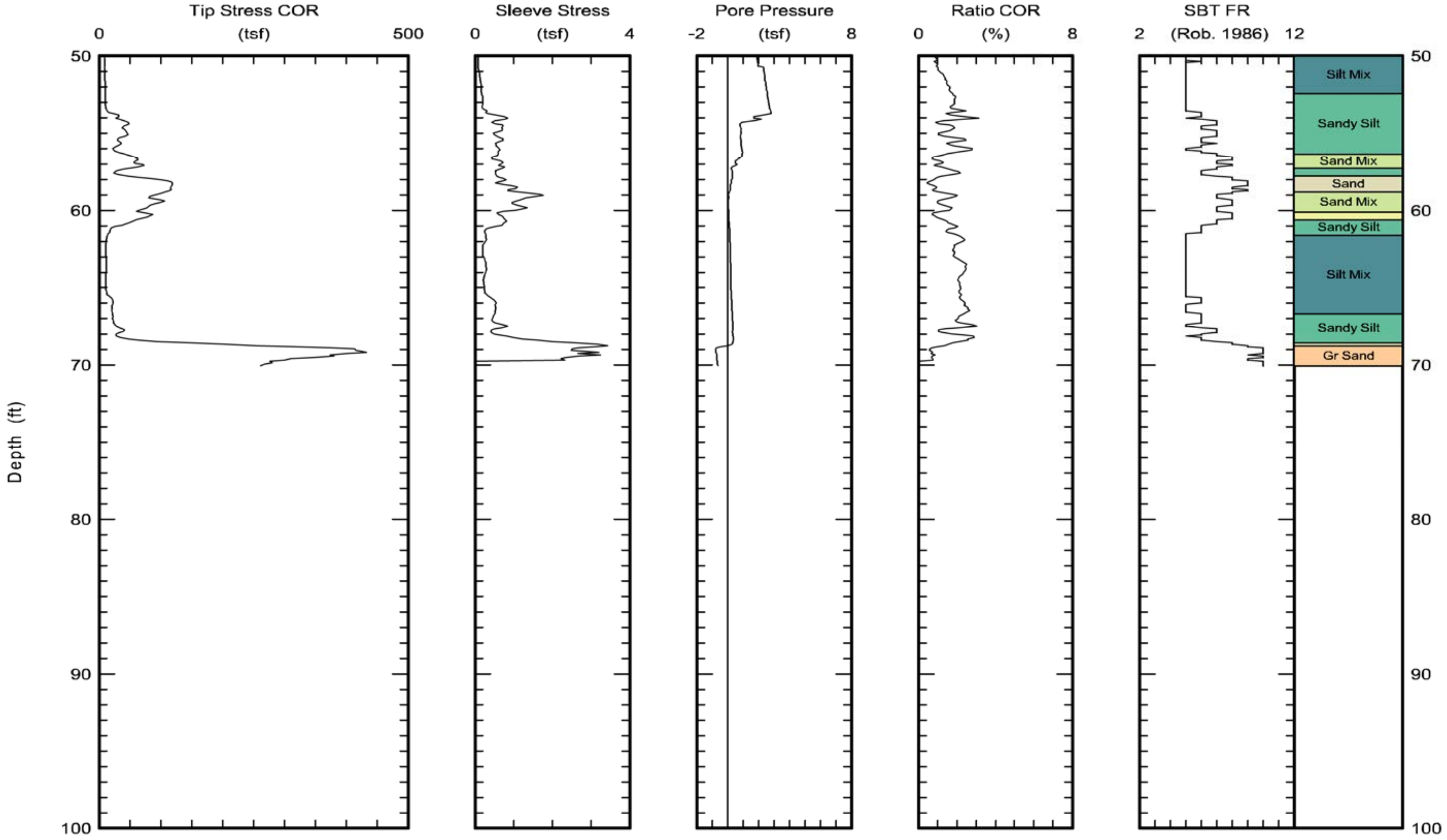
Test ID: B-CPT-056
File: Z14S1206C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 14/Sep/2012
Test ID: B-CPT-056
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 70.07 (ft)
Page 2 of 2

FIGURE

A1-51 b

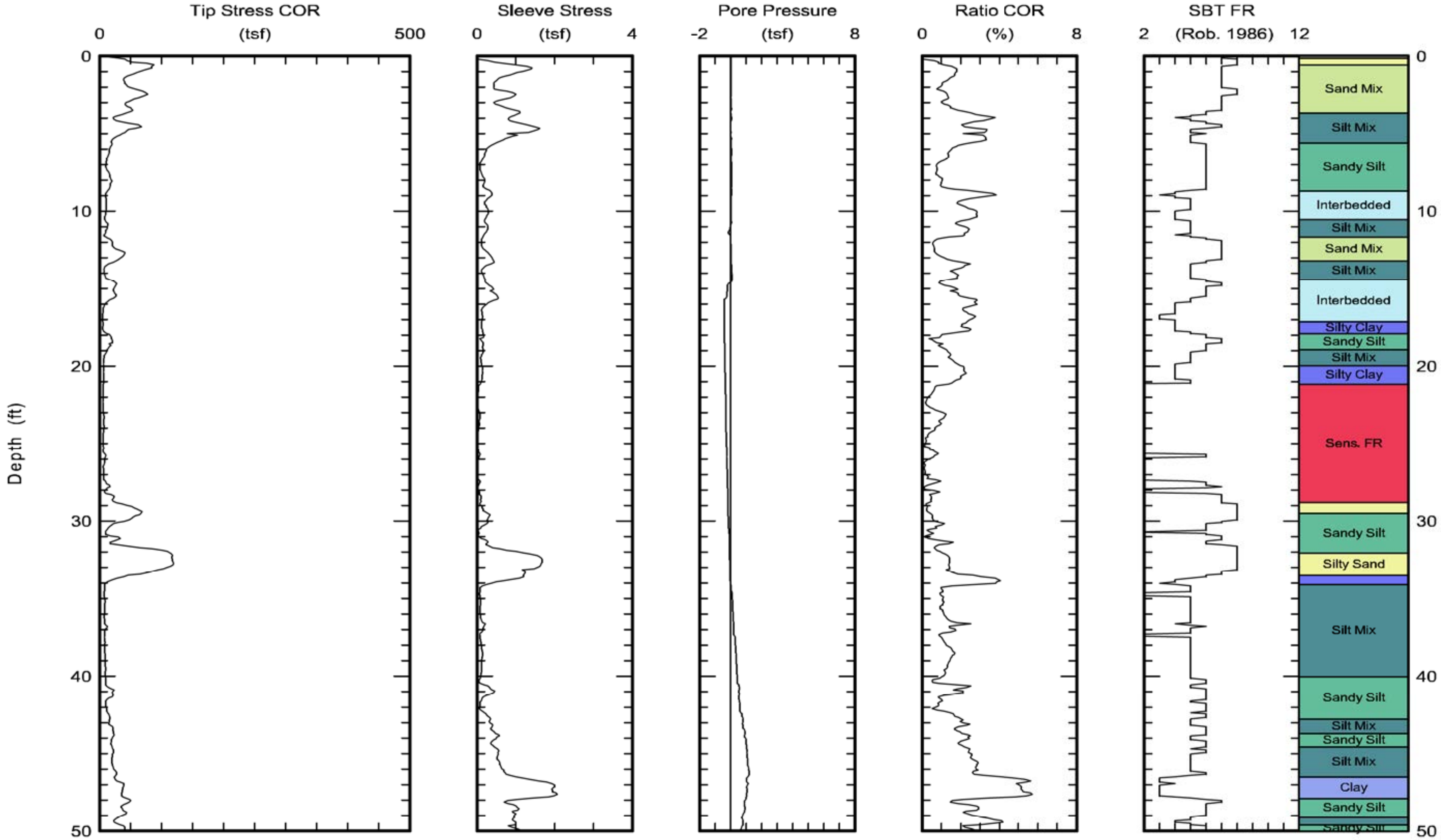
Test ID: B-CPT-056
File: Z14S1206C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 14/Sep/2012
Test ID: B-CPT-057
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 70.61 (ft)
Page 1 of 2

FIGURE

A1-52 a

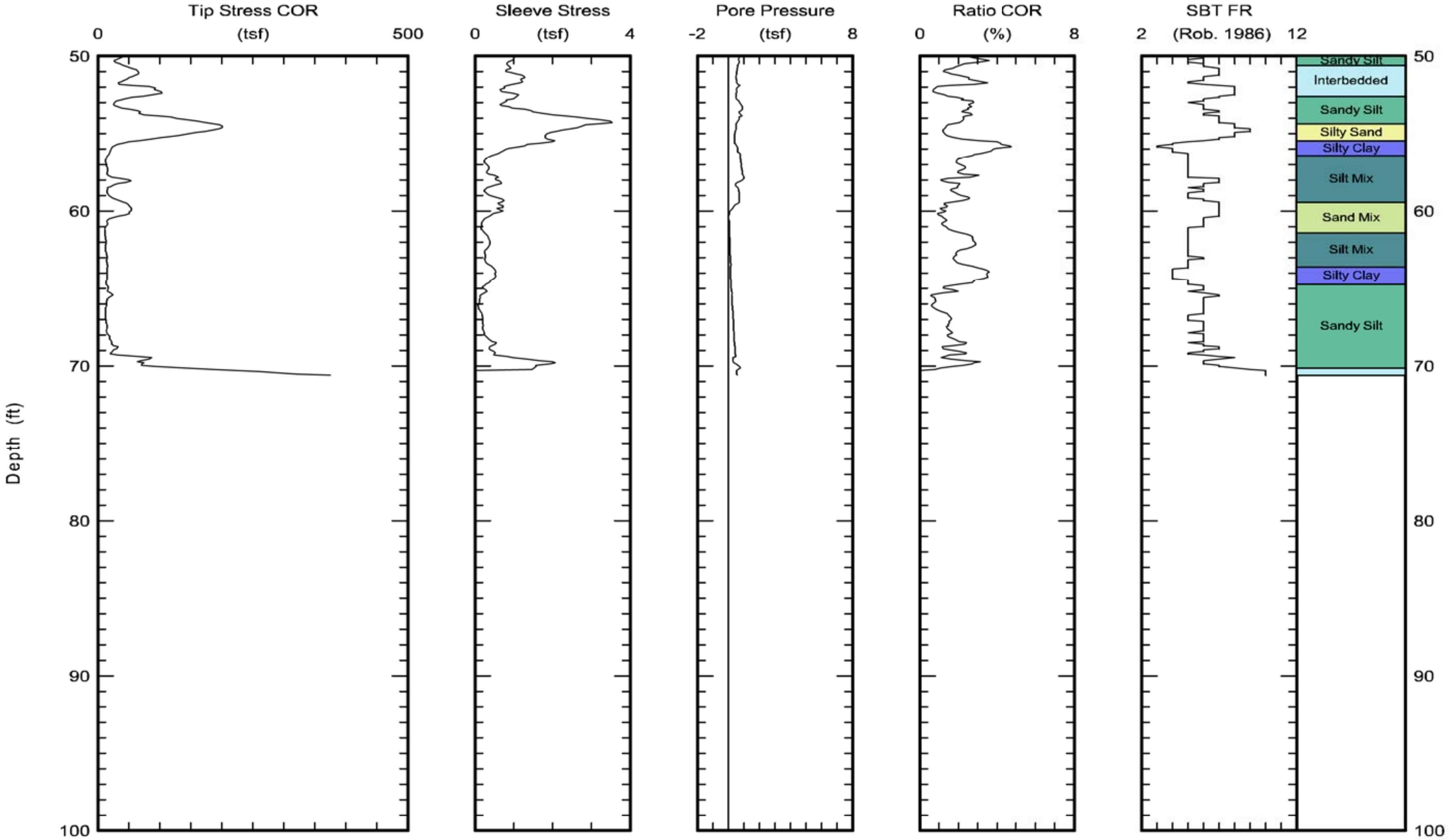
Test ID: B-CPT-057
File: Z14S1205C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 14/Sep/2012
Test ID: B-CPT-057
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 70.61 (ft)
Page 2 of 2

FIGURE

A1-52 b

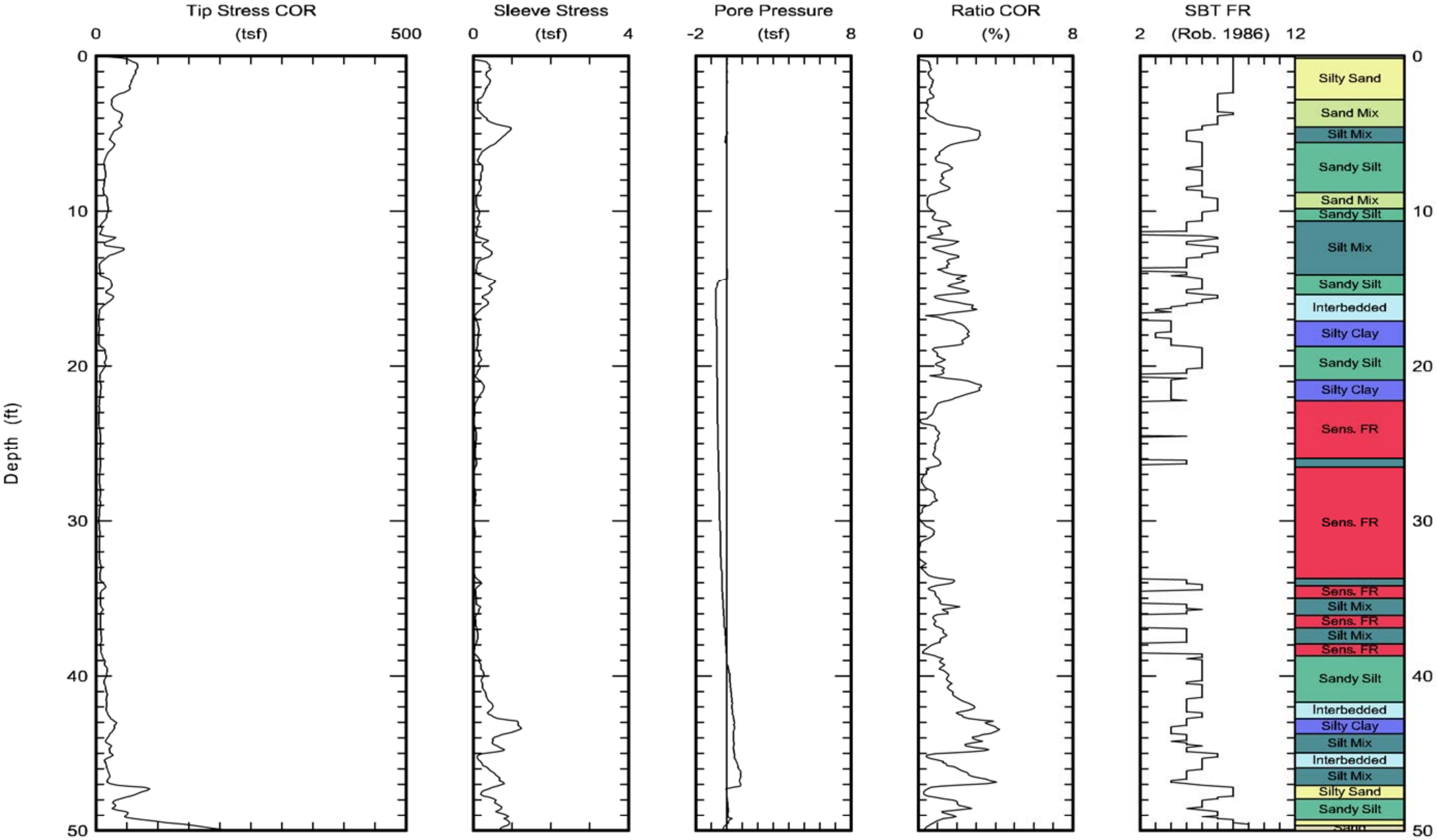
Test ID: B-CPT-057
File: Z14S1205C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 14/Sep/2012
Test ID: B-CPT-059
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



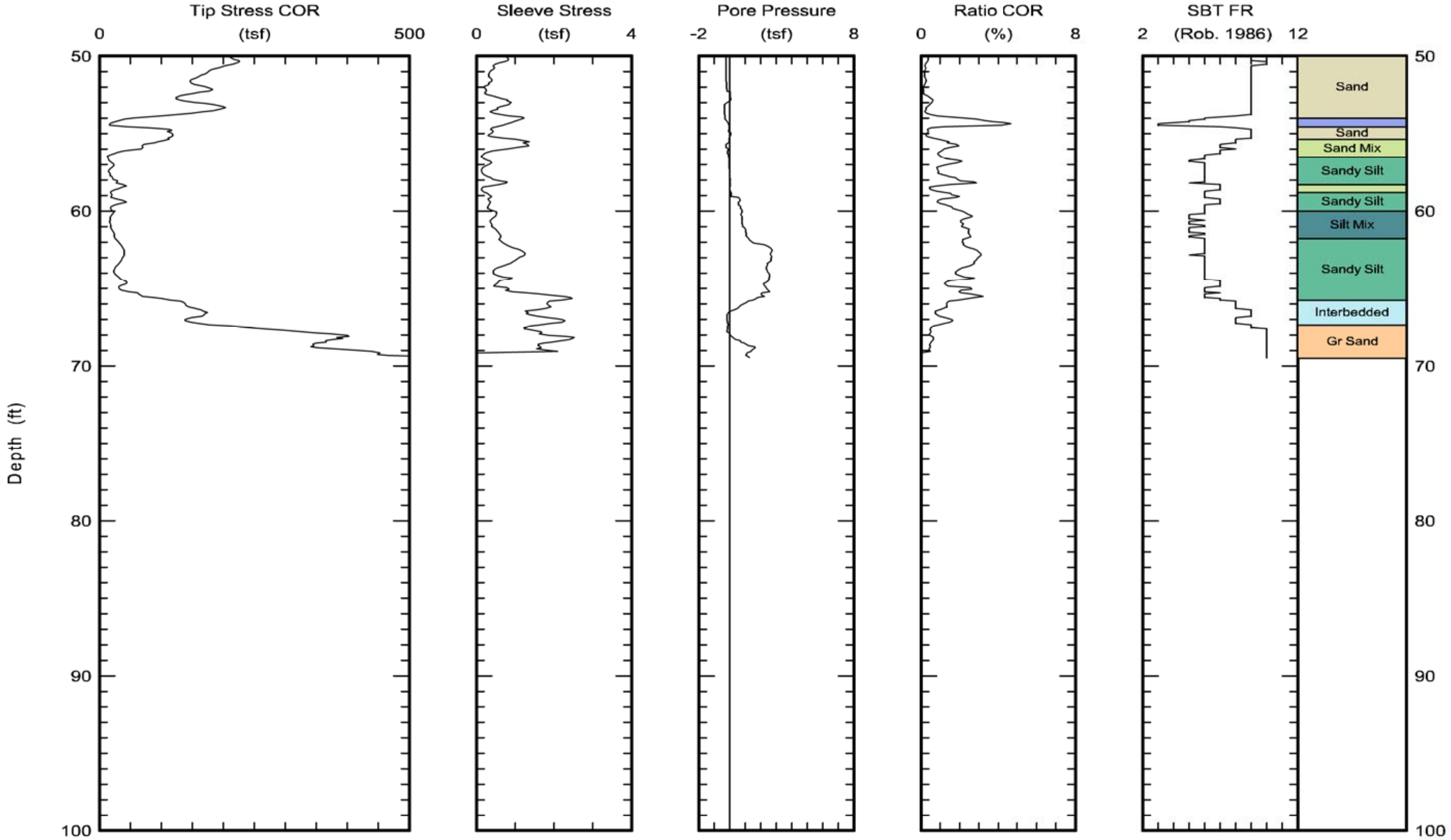
Maximum depth: 69.50 (ft)
Page 1 of 2

FIGURE

A1-53 a

Test ID: B-CPT-059
File: Z14S1204C.ECP

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 14/Sep/2012 Test ID: B-CPT-059 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	

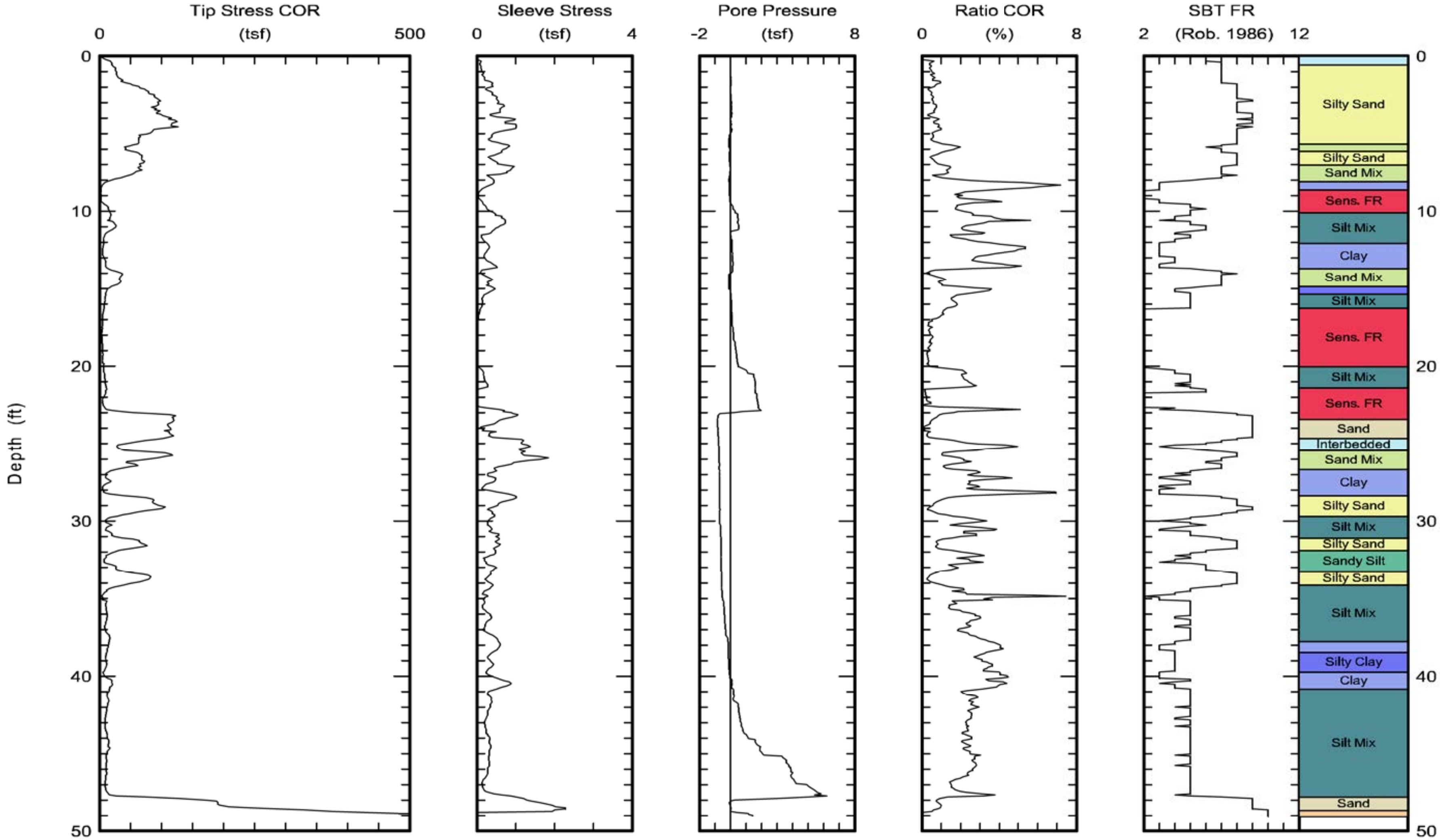


Maximum depth: 69.50 (ft)
Page 2 of 2

FIGURE

A1-53 b

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 rich@kehoetesting.com www.kehoetesting.com	CPT Data 30 ton rig	Date: 10/Oct/2012 Test ID: CPT-060 Project: MarinaDelRey
	Customer: Group Delta Consultants, Inc. Job Site: Ballona Wetlands	



Maximum depth: 49.09 (ft)

FIGURE

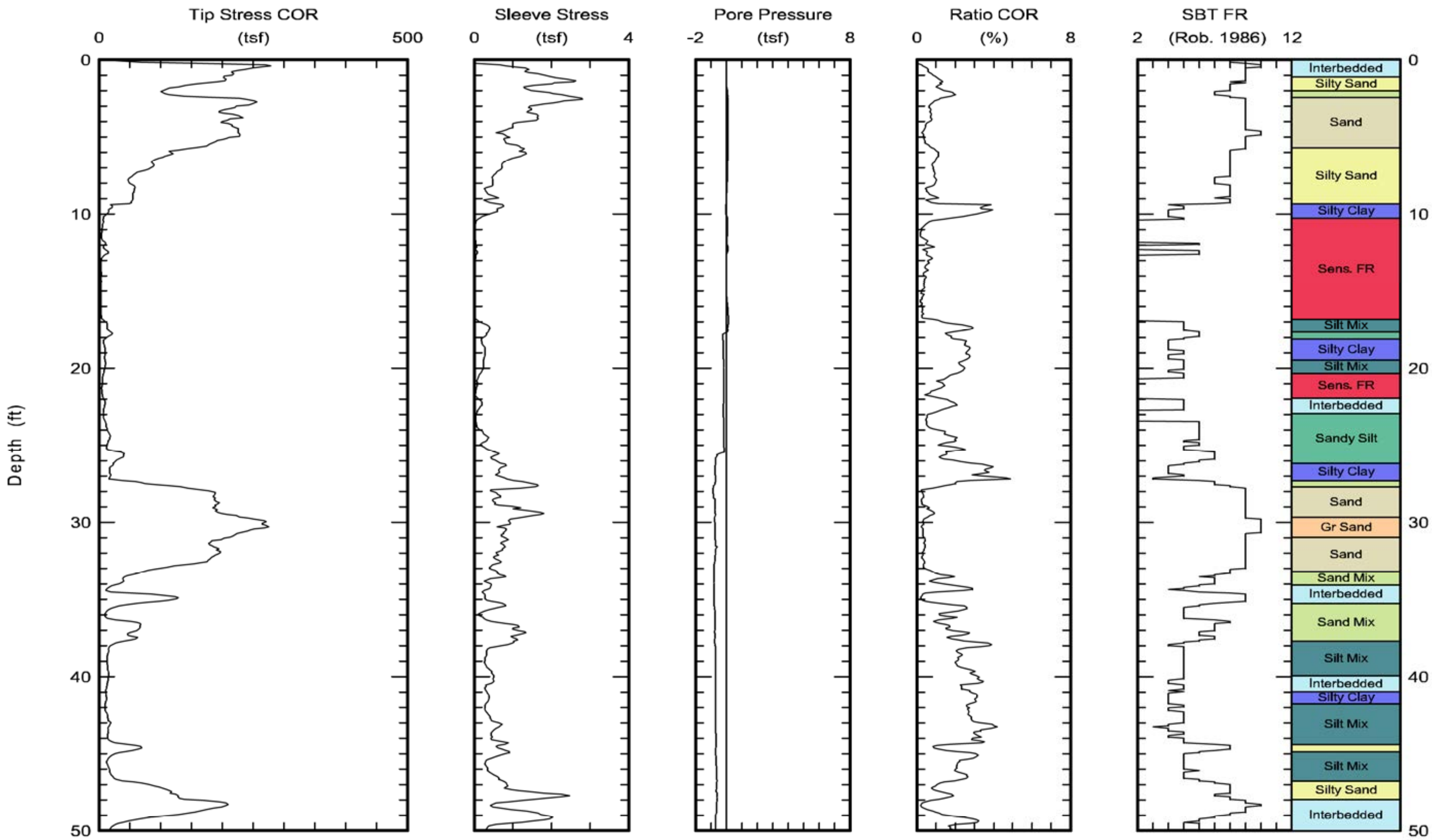
A1-54

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 10/Oct/2012
Test ID: CPT-062
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 57.62 (ft)
Page 1 of 2

FIGURE

A1-55 a

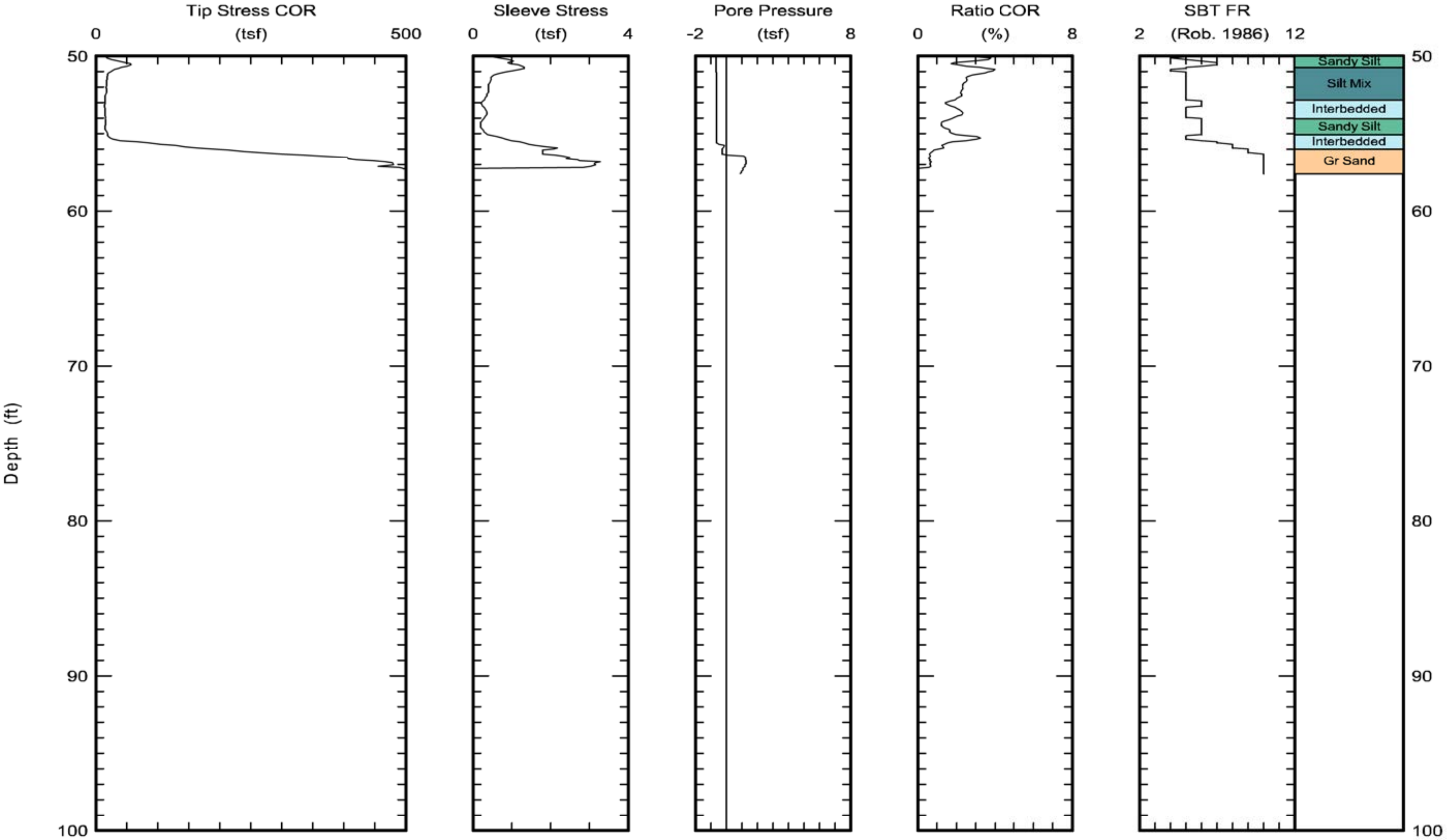
Test ID: CPT-062
File: Z10O1203C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 10/Oct/2012
Test ID: CPT-062
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 57.62 (ft)
Page 2 of 2

FIGURE

A1-55 b

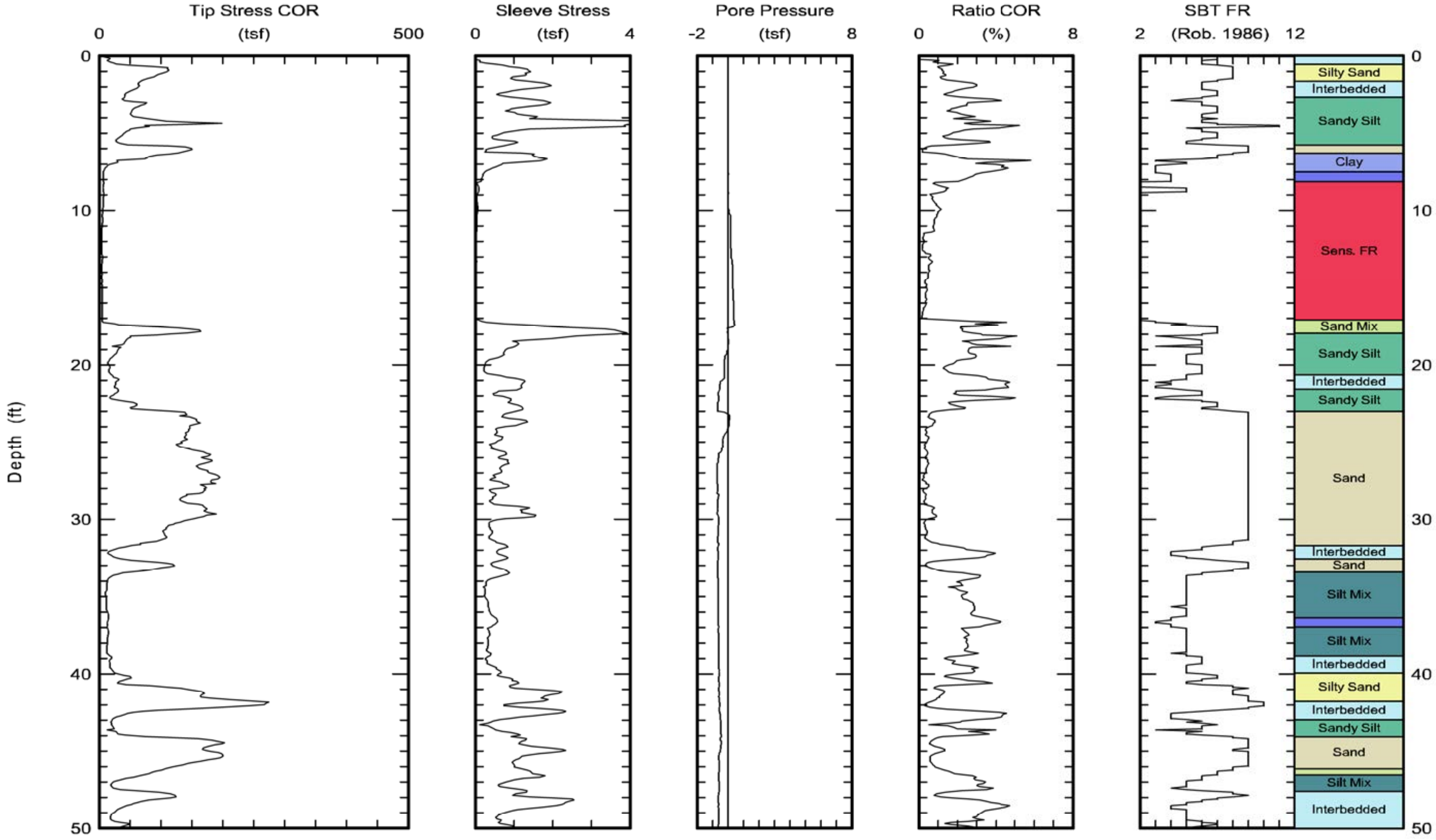
Test ID: CPT-062
File: Z10O1203C.ECP

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 10/Oct/2012
Test ID: CPT-063
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 55.03 (ft)
Page 1 of 2

FIGURE

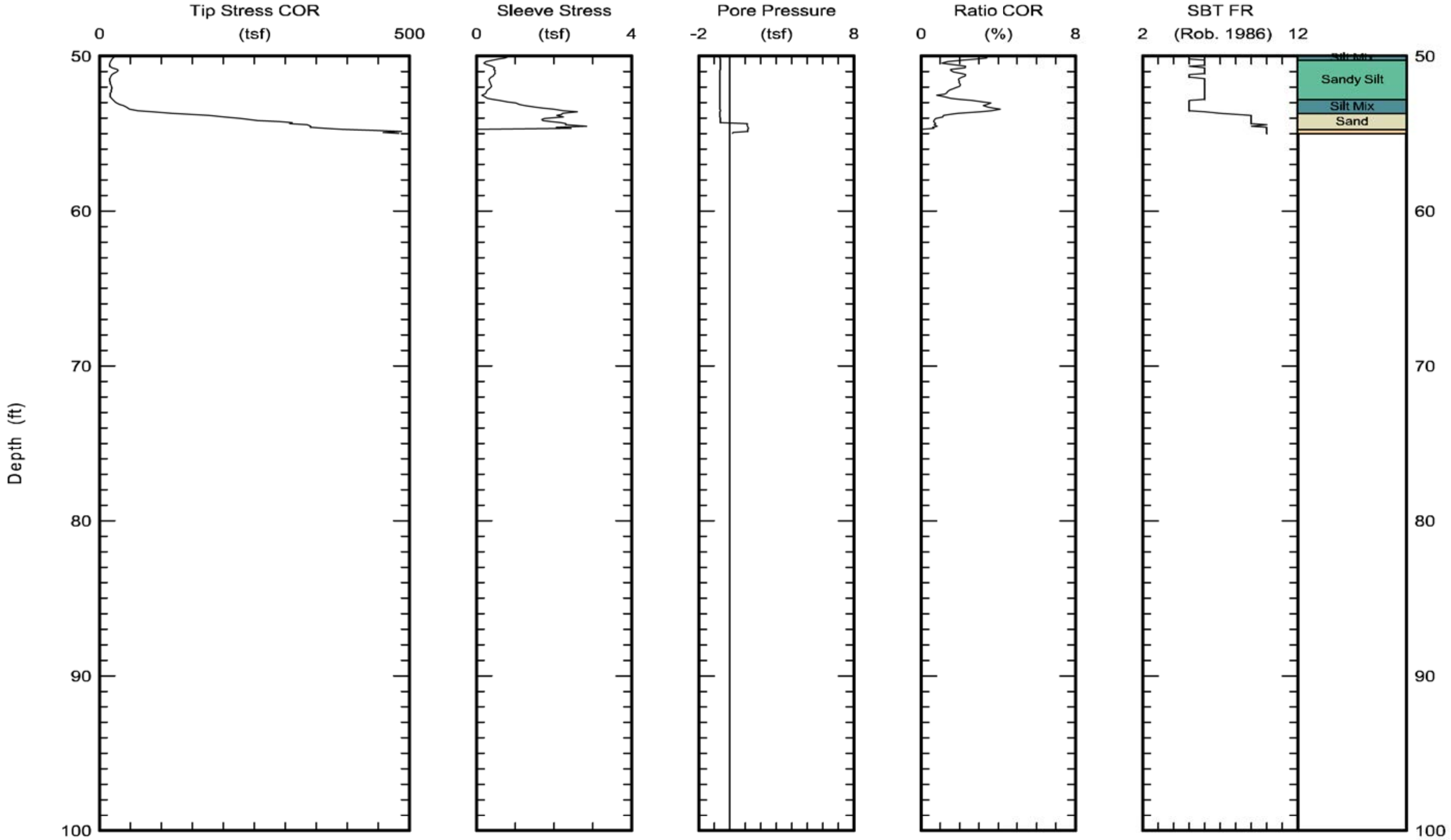
A1-56 a

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 10/Oct/2012
Test ID: CPT-063
Project: MarinaDelRey

Customer: Group Delta Consultants, Inc.
Job Site: Ballona Wetlands



Maximum depth: 55.03 (ft)
Page 2 of 2

FIGURE

A1-56 b

Site: BALLONA WETLANDS **Engineer: E.HOLLIDAY**
Sounding: ACPT-007 **Date: 9/24/2012 08:23**

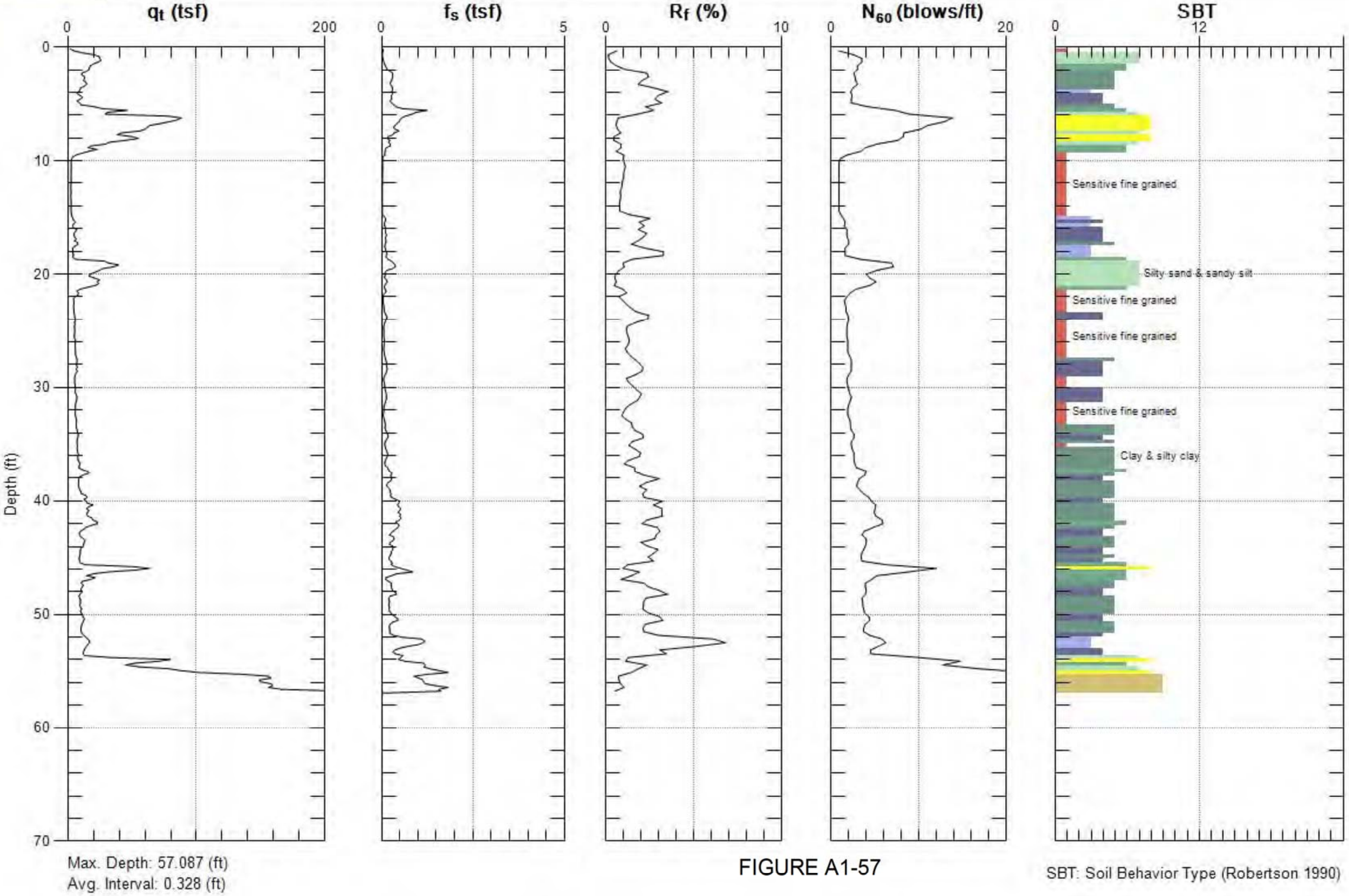
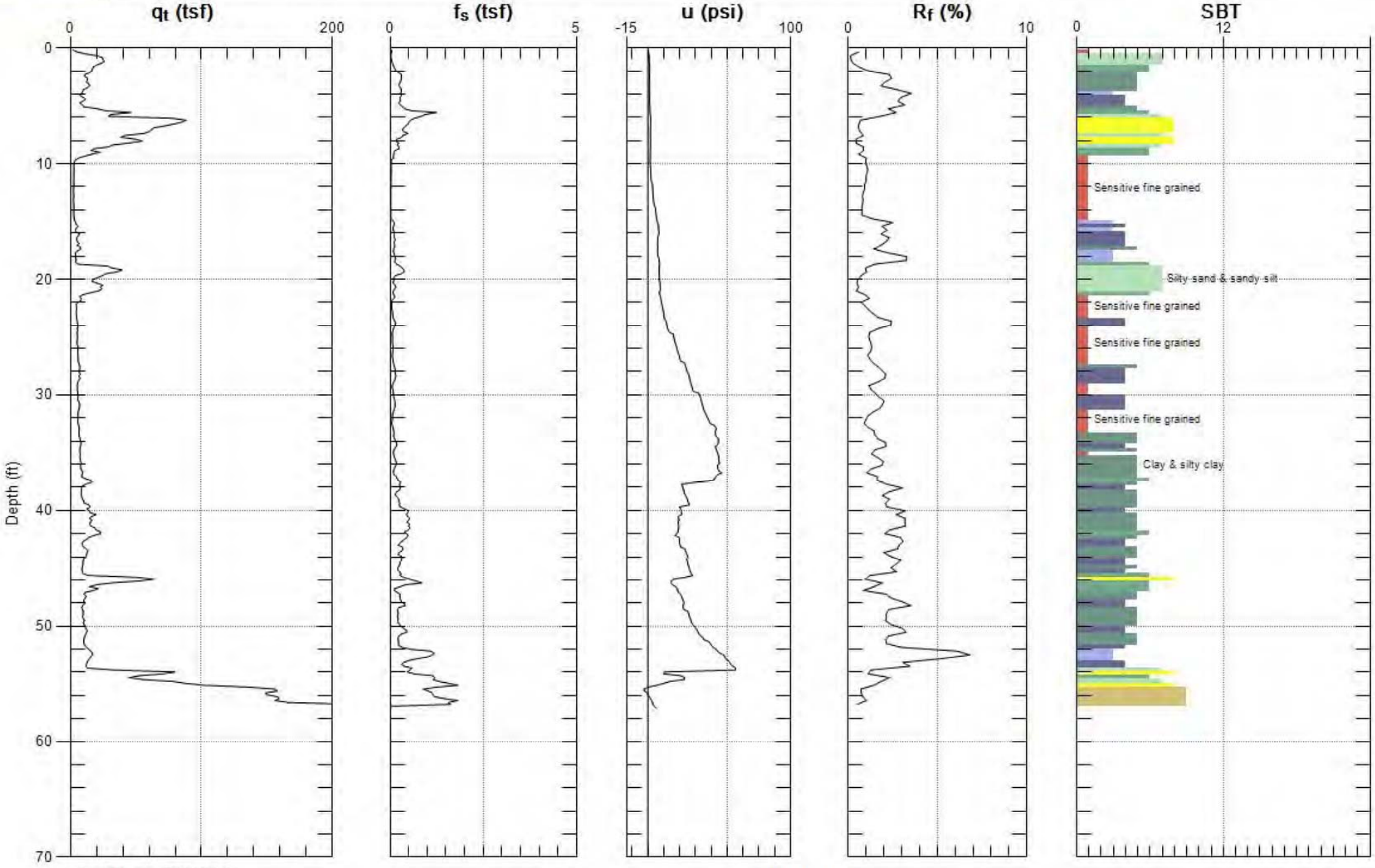


FIGURE A1-57

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: ACPT-007

Engineer: E.HOLLIDAY
Date: 9/24/2012 08:23



Max. Depth: 57.087 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-57

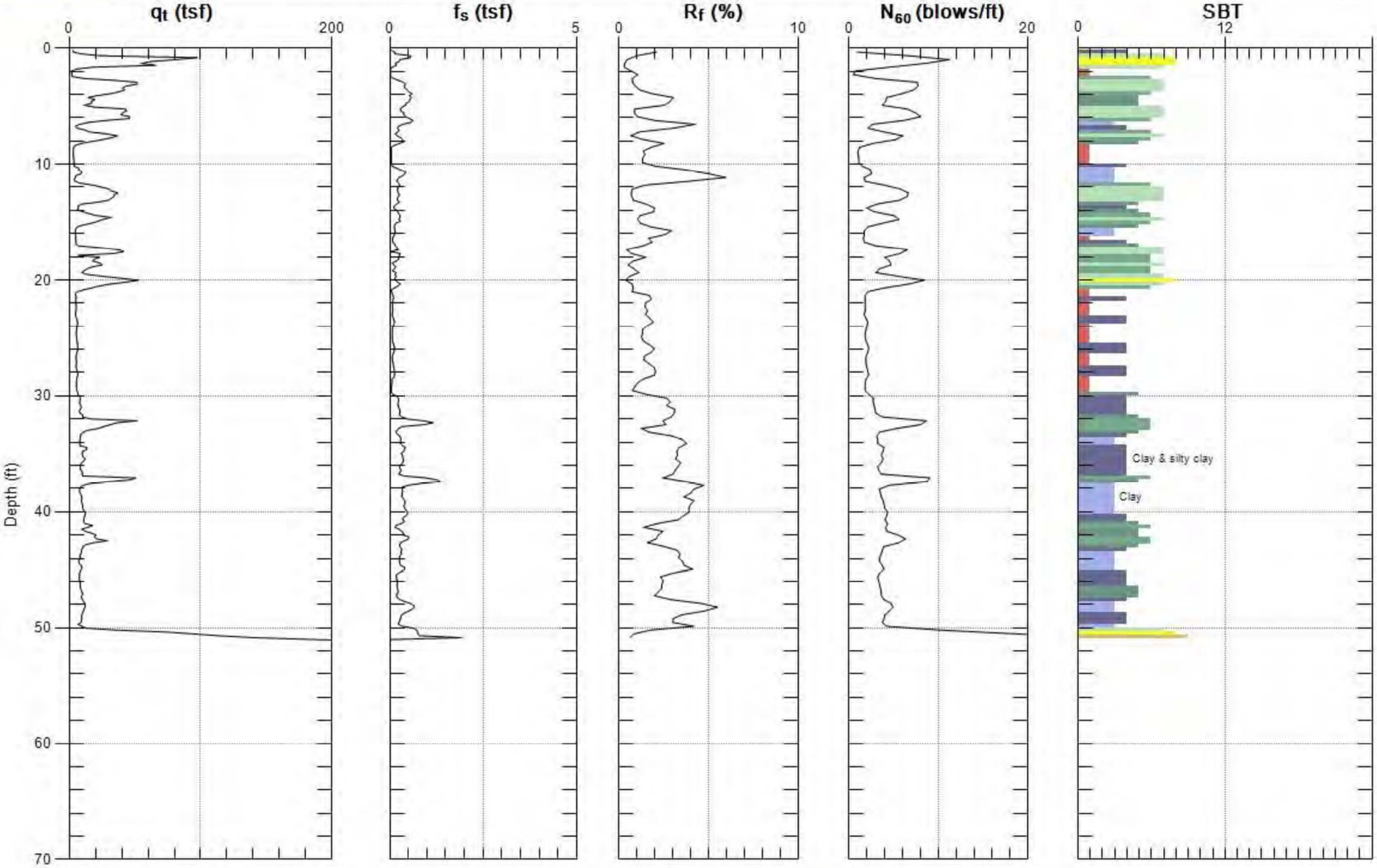
SBT: Soil Behavior Type (Robertson 1990)

Site: BALLONA WETLANDS

Sounding: A-CPT-010

Engineer: E.HOLLIDAY

Date: 9/24/2012 09:19



Max. Depth: 51.181 (ft)
Avg. Interval: 0.328 (ft)

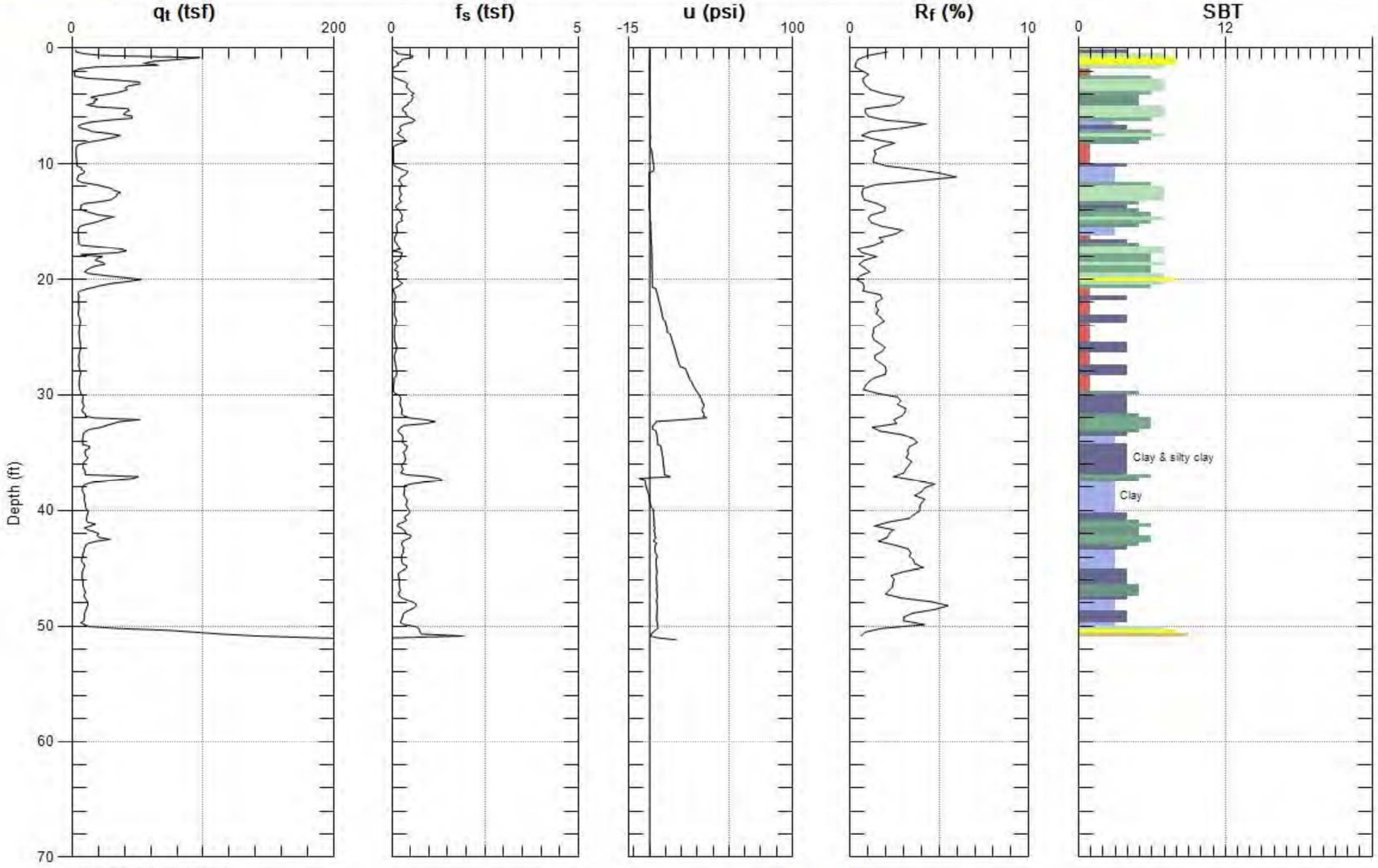
FIGURE A1-58

SBT: Soil Behavior Type (Robertson 1990)

GREGG **GROUP DELTA**

Site: BALLONA WETLANDS
Sounding: A-CPT-010

Engineer: E.HOLLIDAY
Date: 9/24/2012 09:19



Max. Depth: 51.181 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-58

SBT: Soil Behavior Type (Robertson 1990)

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-012
Engineer: E.HOLLIDAY
Date: 9/24/2012 09:59

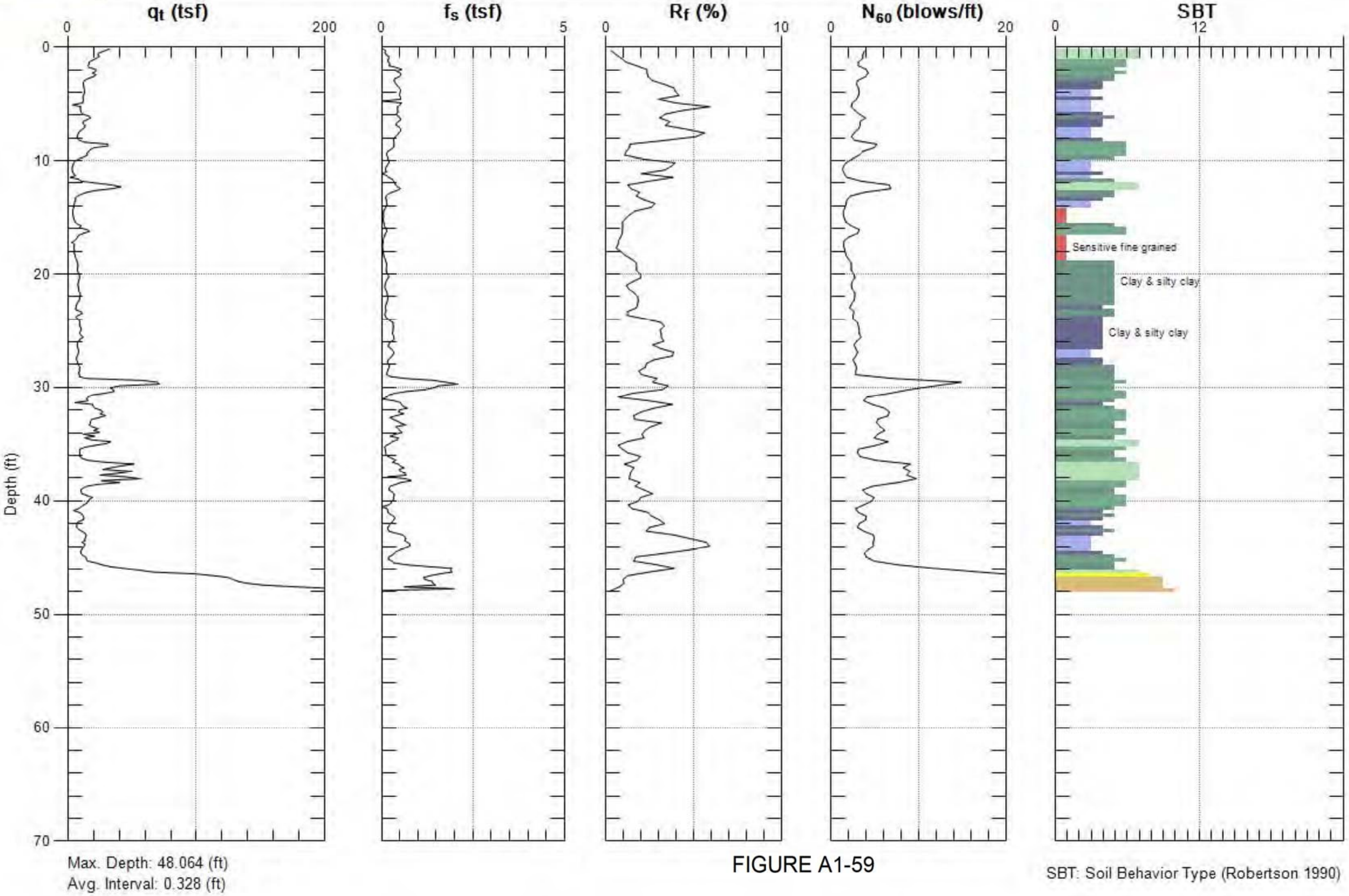


FIGURE A1-59

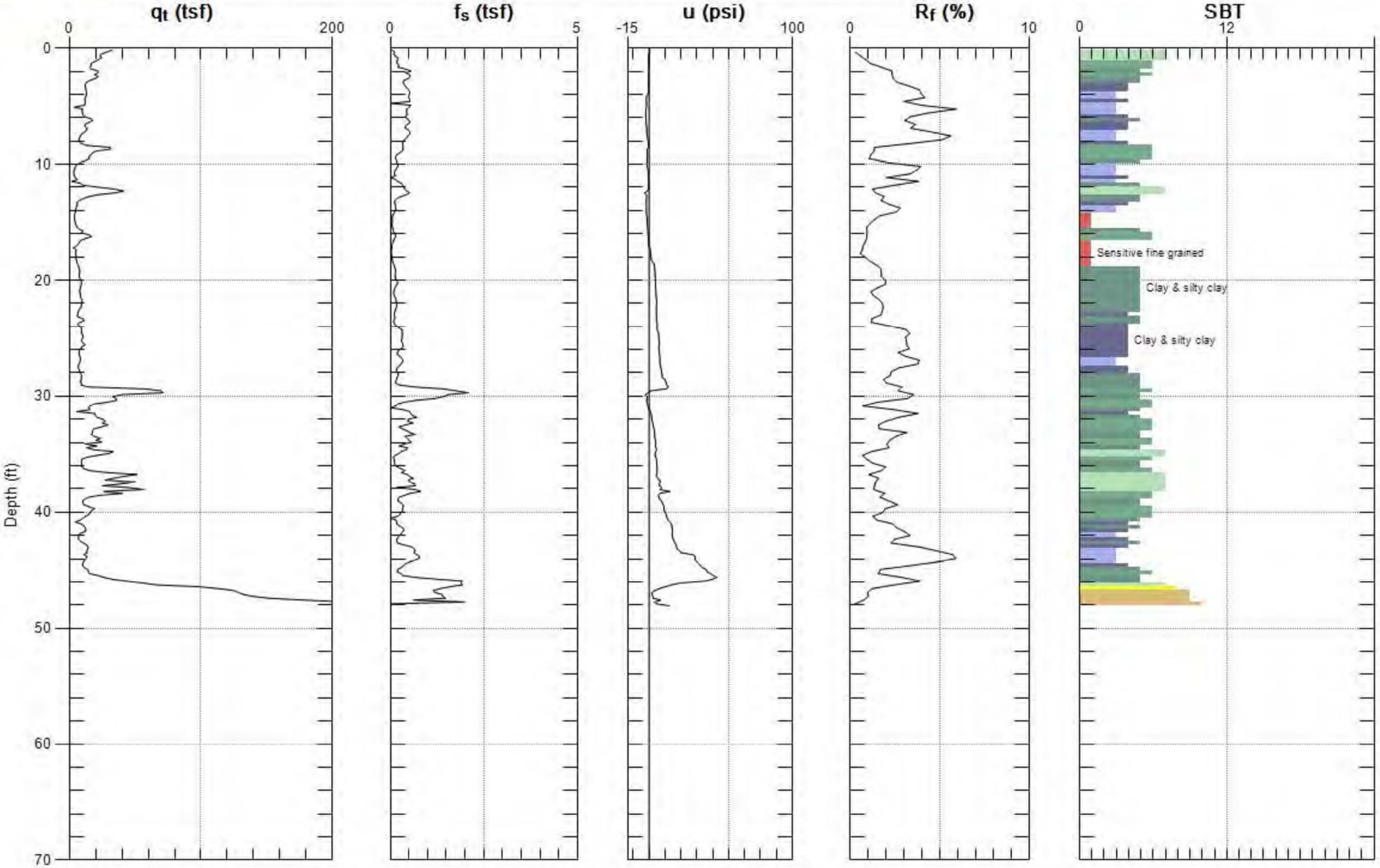
GROUP DELTA

Site: BALLONA WETLANDS

Sounding: A-CPT-012

Engineer: E.HOLLIDAY

Date: 9/24/2012 09:59



Max. Depth: 48.064 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-59

SBT: Soil Behavior Type (Robertson 1990)

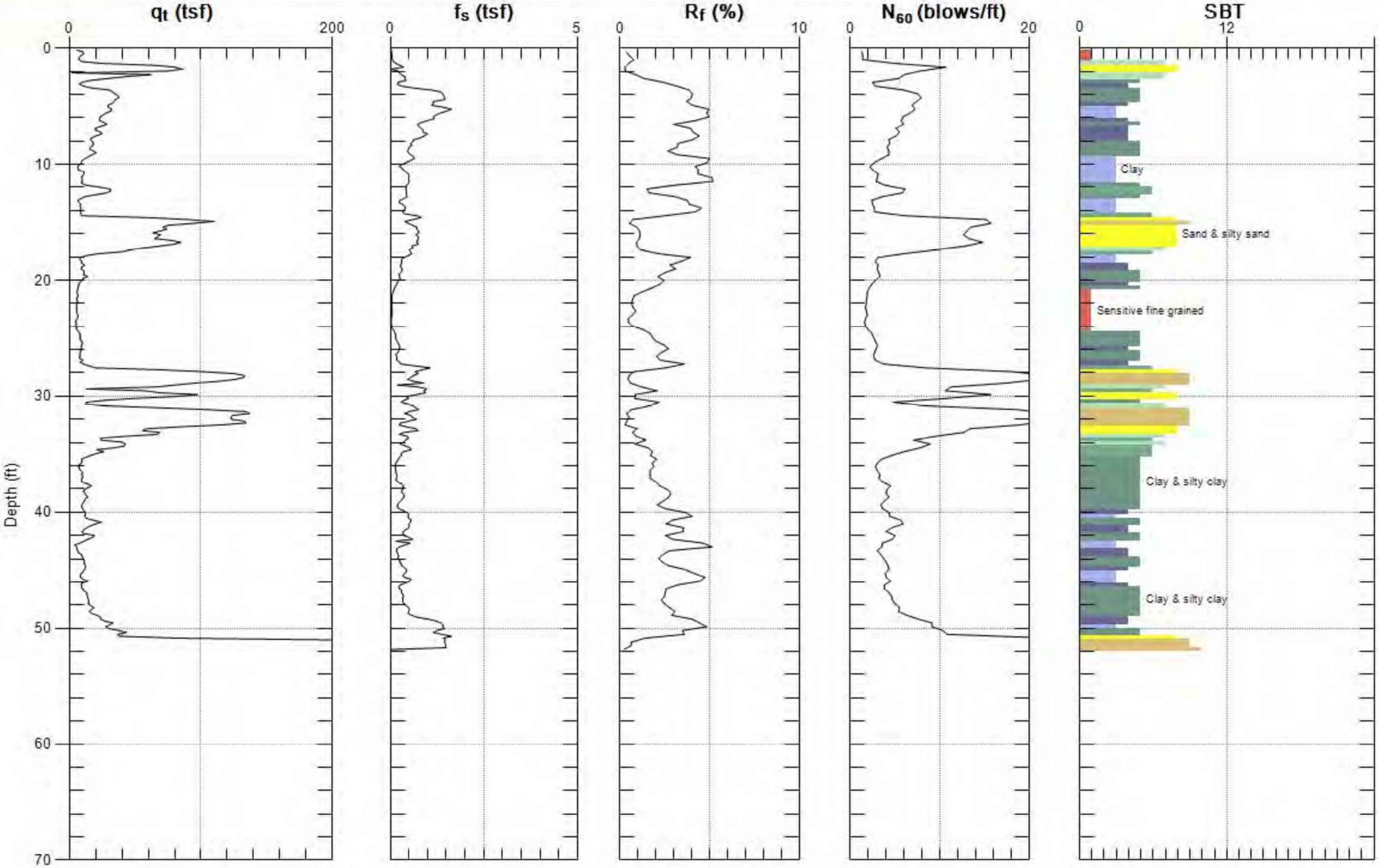
GROUP DELTA

Site: BALLONA WETLANDS

Sounding: A-CPT-014

Engineer: E.HOLLIDAY

Date: 9/24/2012 10:28



Max. Depth: 52.001 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-60

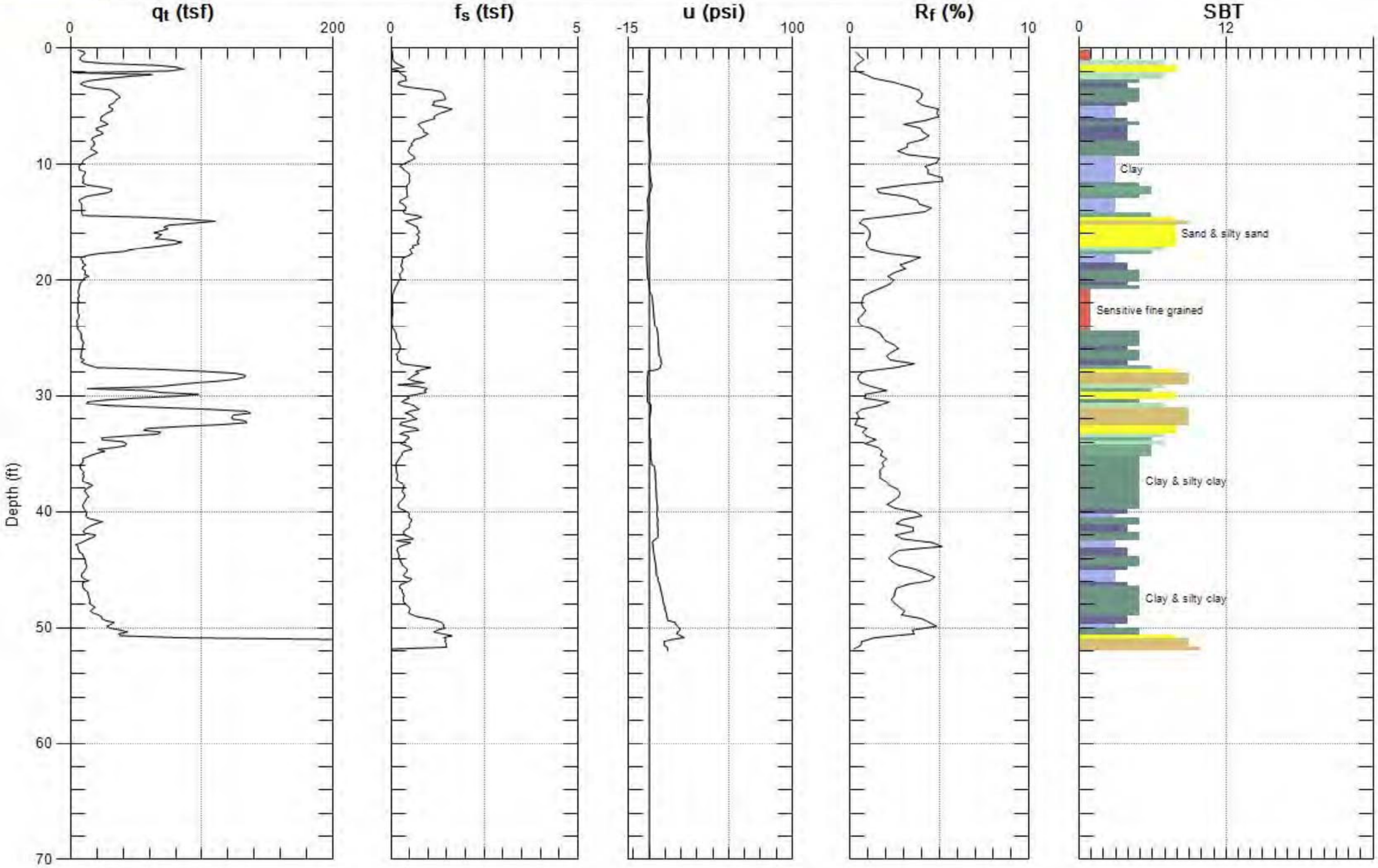
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-014

Engineer: E.HOLLIDAY
Date: 9/24/2012 10:28



Max. Depth: 52.001 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-60

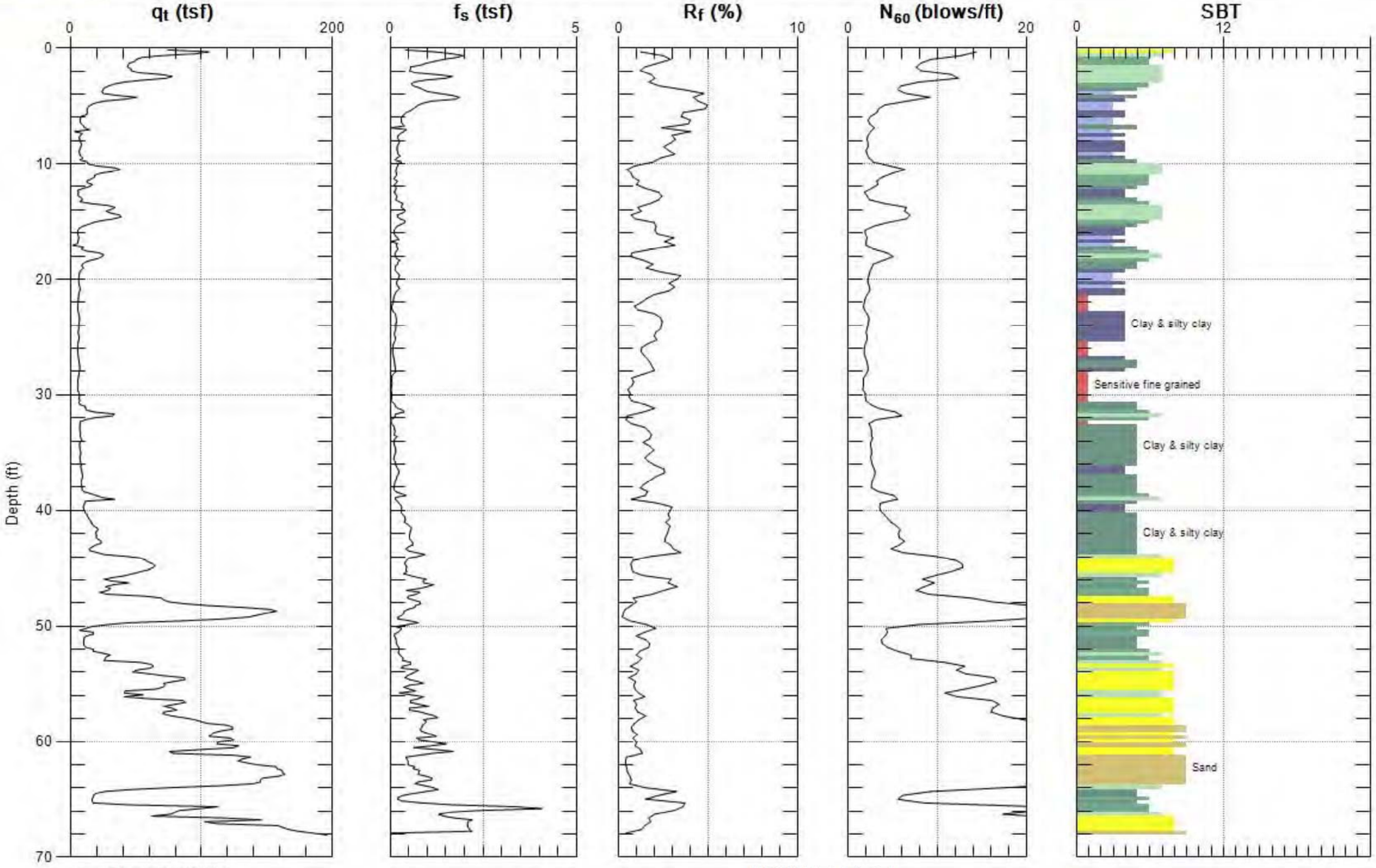
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-019

Engineer: E.HOLLIDAY
Date: 9/24/2012 12:47



Max. Depth: 68.077 (ft)
Avg. Interval: 0.328 (ft)

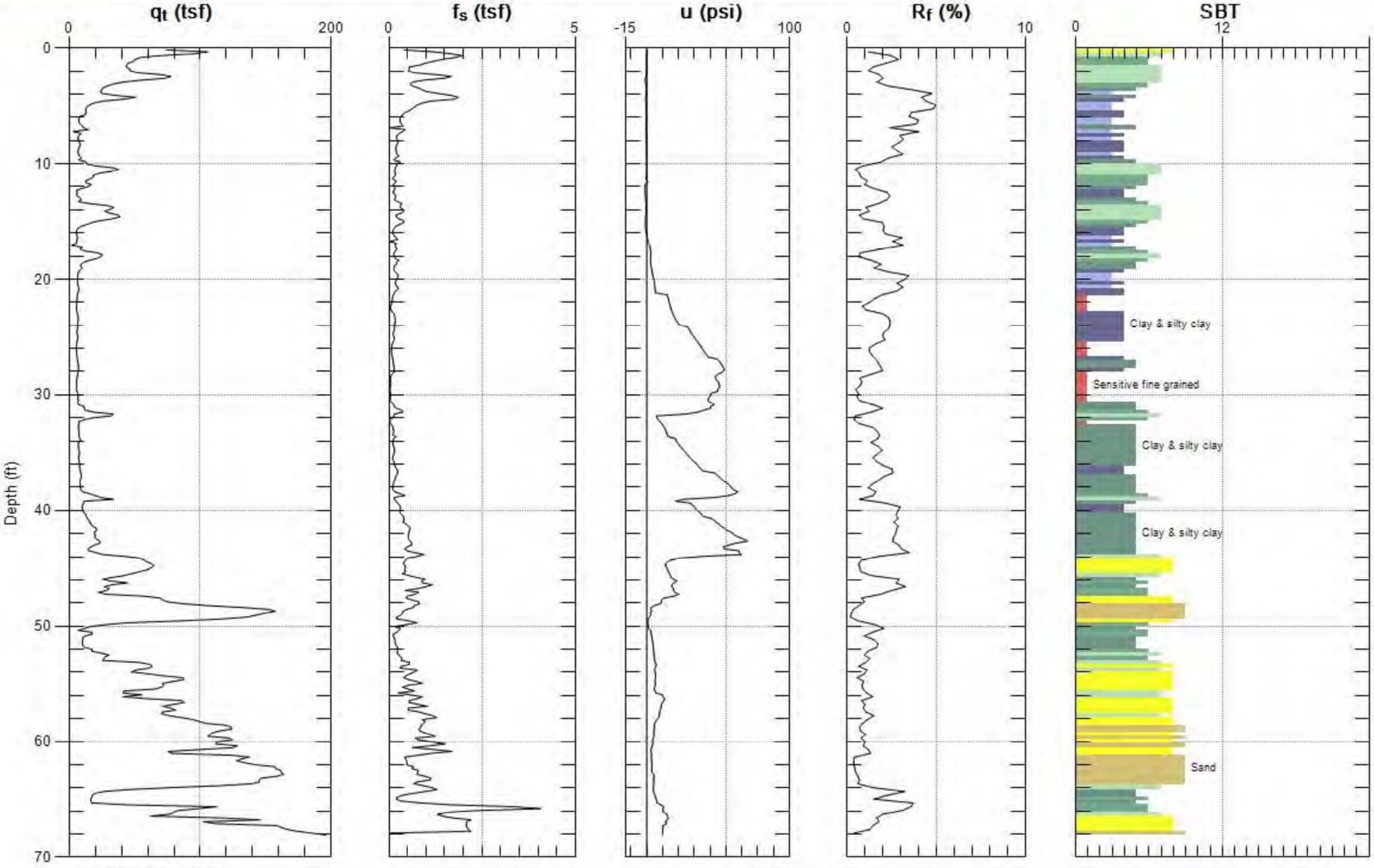
FIGURE A1-61

SBT: Soil Behavior Type (Robertson 1990)

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-019

Engineer: E.HOLLIDAY
Date: 9/24/2012 12:47



Max. Depth: 68.077 (ft)
Avg. Interval: 0.328 (ft)

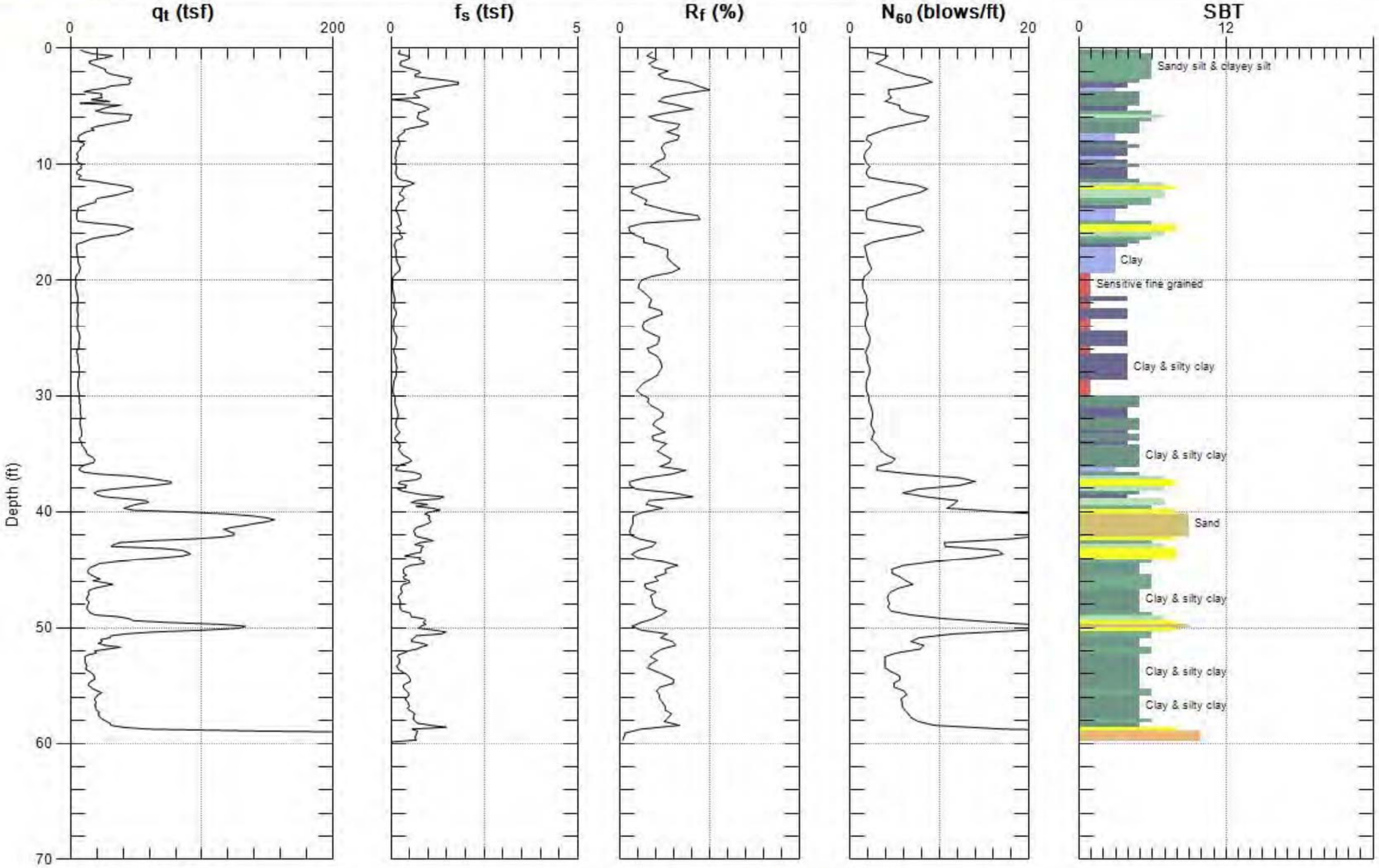
FIGURE A1-61

SBT: Soil Behavior Type (Robertson 1990)

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-021

Engineer: E.HOLLIDAY
Date: 9/24/2012 01:28



Max. Depth: 60.039 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-62

SBT: Soil Behavior Type (Robertson 1990)

GREGG **GROUP DELTA**

Site: BALLONA WETLANDS **Engineer: E.HOLLIDAY**
Sounding: A-CPT-021 **Date: 9/24/2012 01:28**

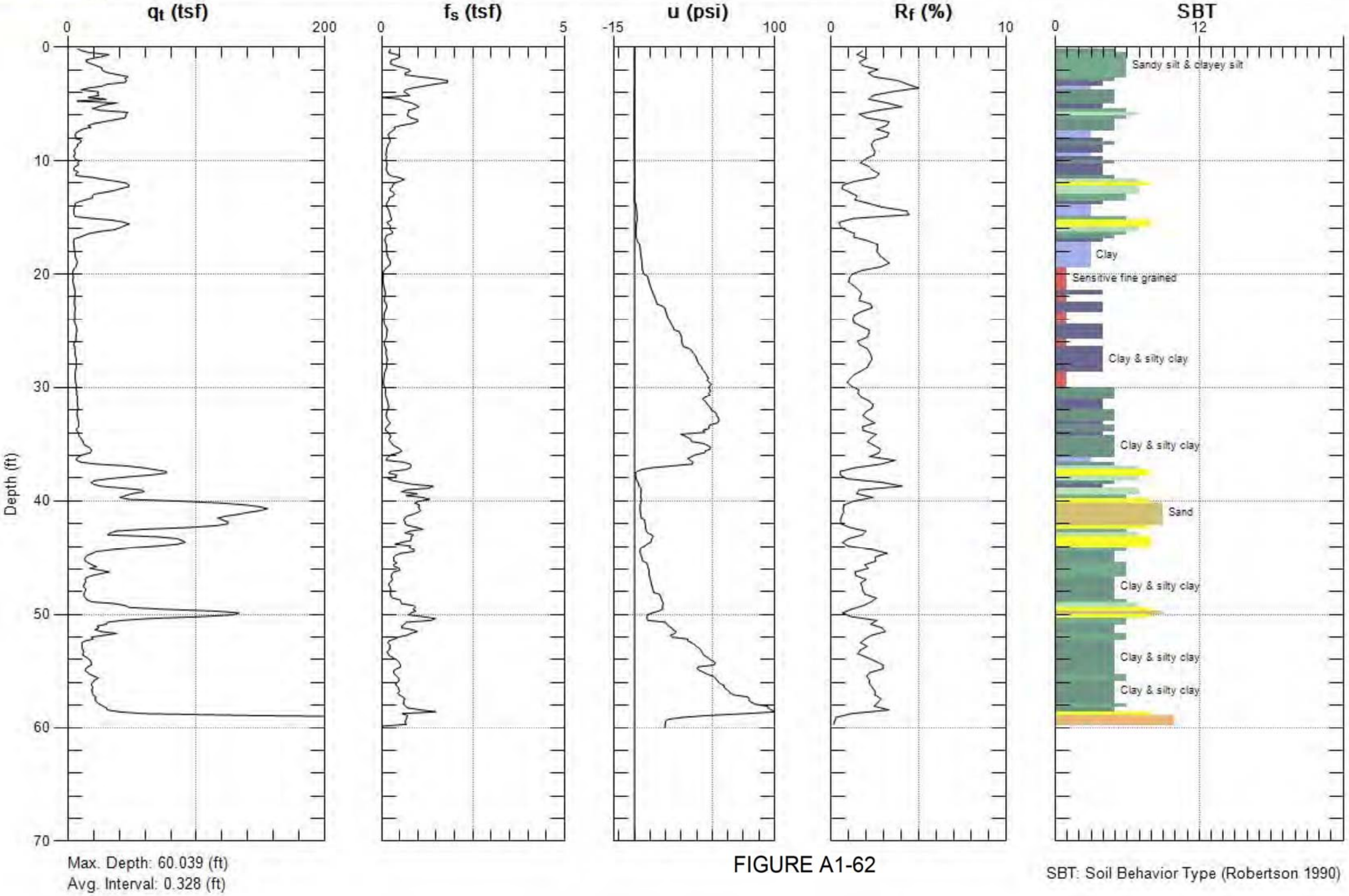
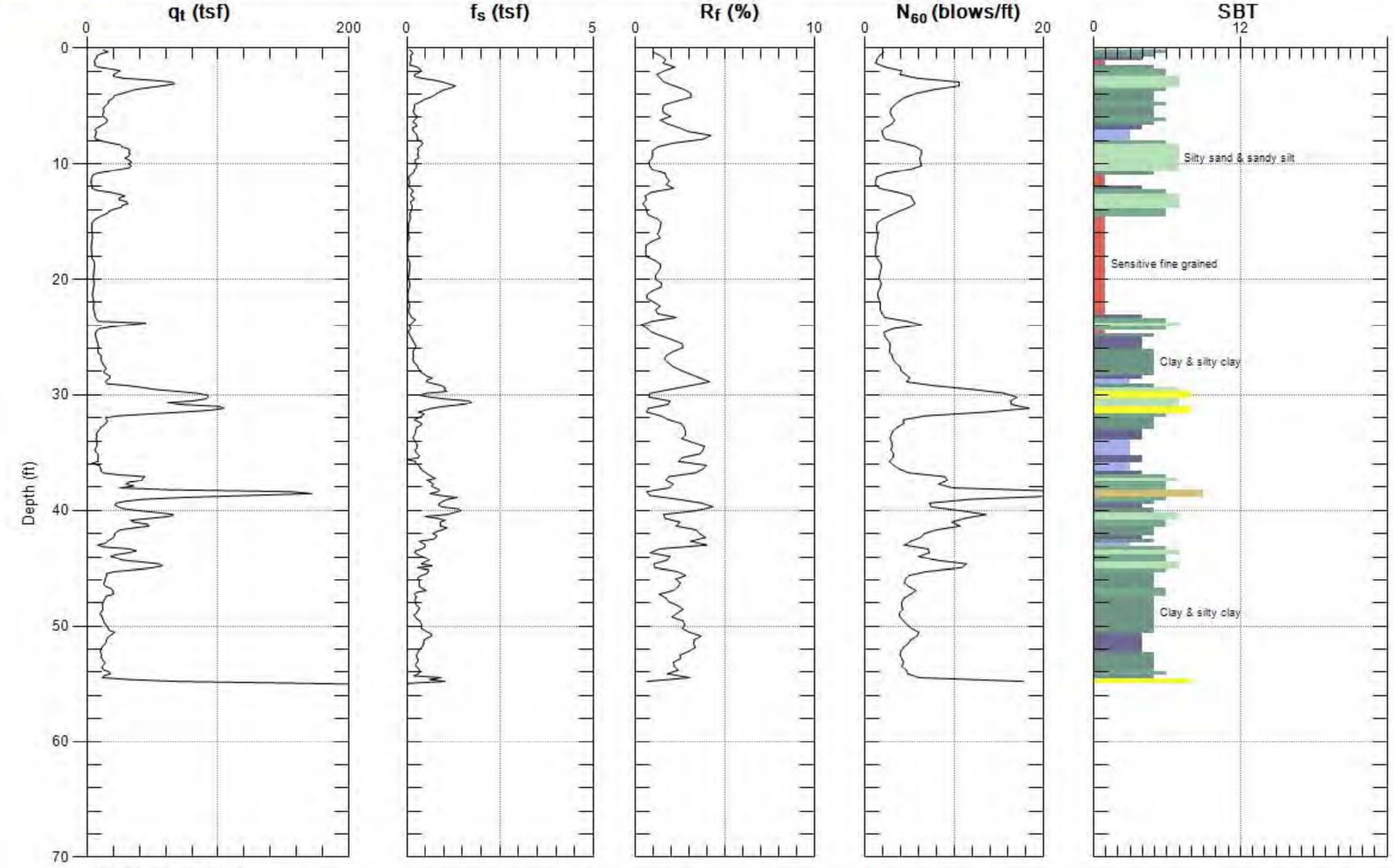


FIGURE A1-62

Site: BALLONA WETLANDS **Engineer: E.HOLLIDAY**

Sounding: A-CPT-024 **Date: 9/24/2012 11:40**



Max. Depth: 55.118 (ft)
Avg. Interval: 0.328 (ft)

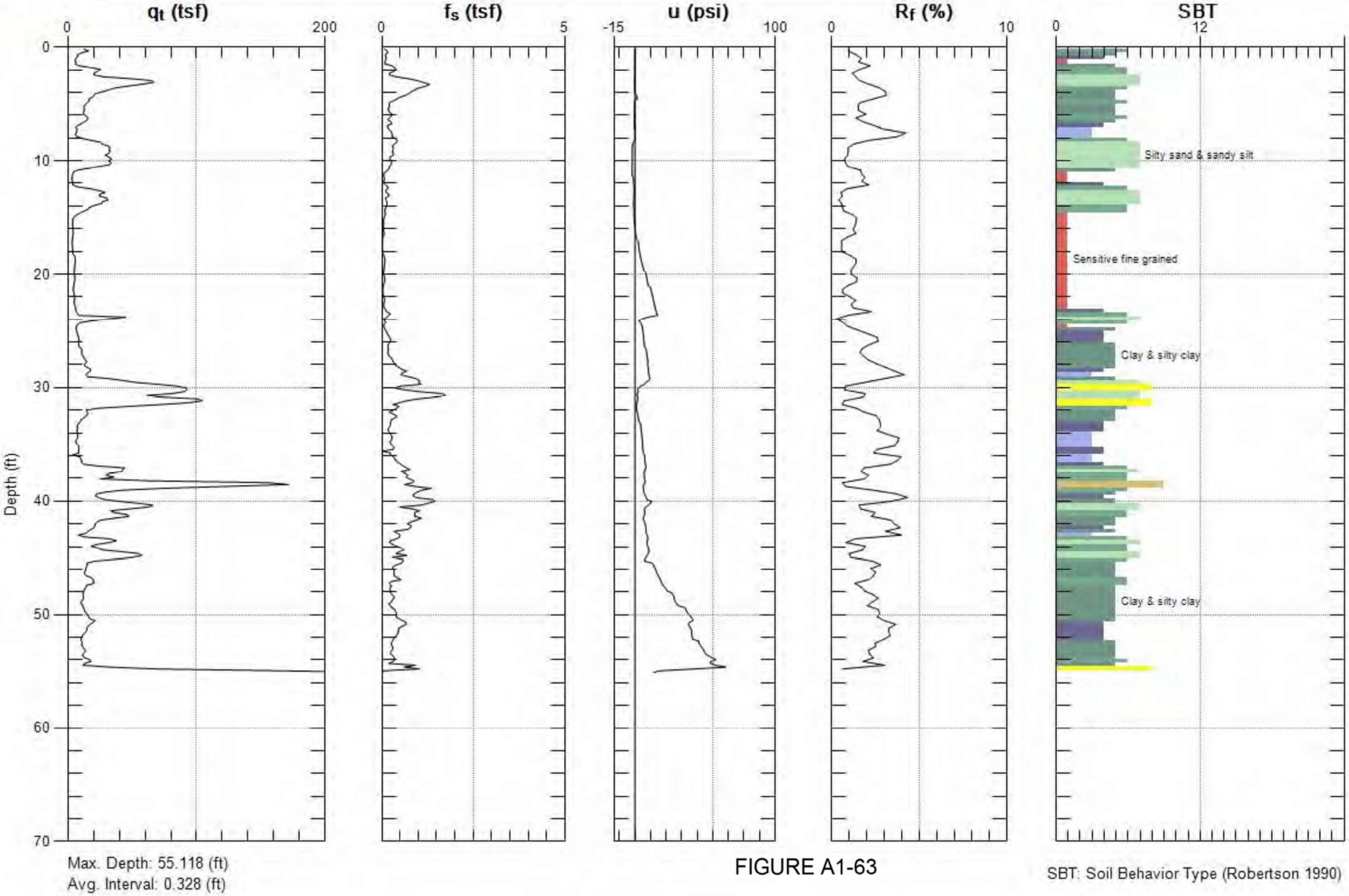
FIGURE A1-63

SBT: Soil Behavior Type (Robertson 1990)

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-024

Engineer: E.HOLLIDAY
Date: 9/24/2012 11:40



Max. Depth: 55.118 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-63

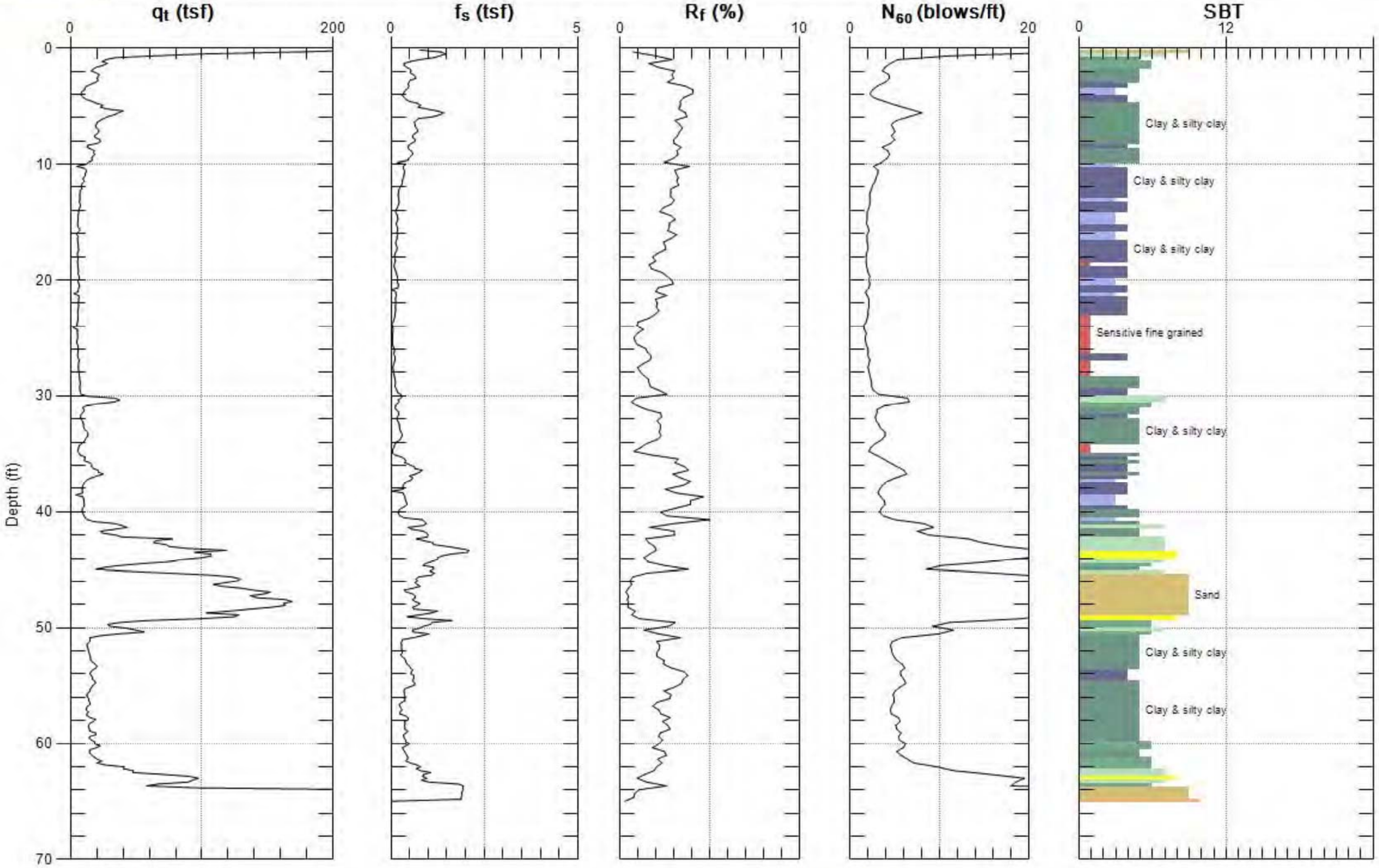
SBT: Soil Behavior Type (Robertson 1990)

GREGG

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-025

Engineer: E.HOLLIDAY
Date: 9/26/2012 10:30



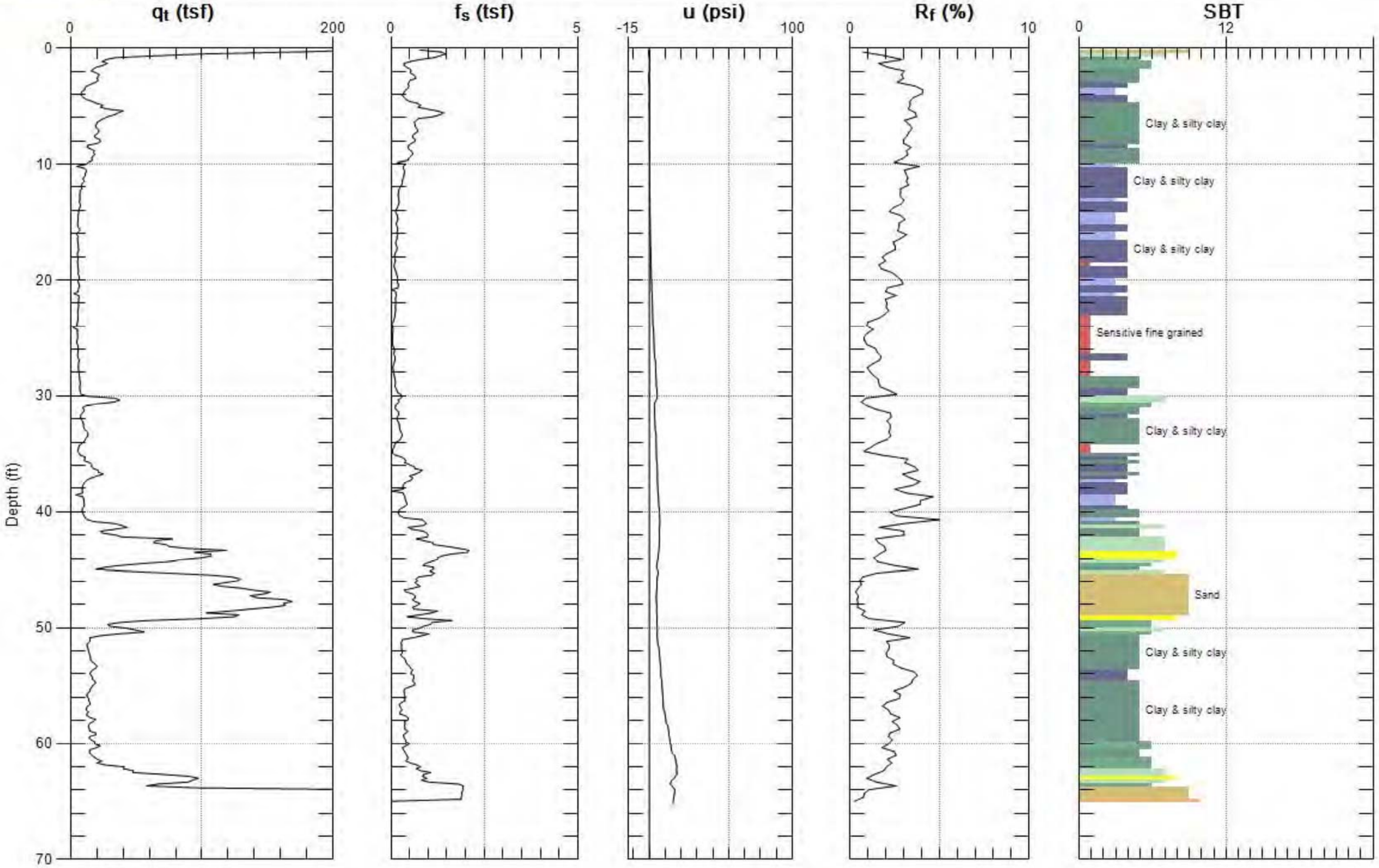
Max. Depth: 65.125 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-64

SBT: Soil Behavior Type (Robertson 1990)

GREGG **GROUP DELTA**

Site: BALLONA WETLANDS
Engineer: E.HOLLIDAY
Sounding: A-CPT-025
Date: 9/26/2012 10:30



Max. Depth: 65.125 (ft)
Avg. Interval: 0.328 (ft)

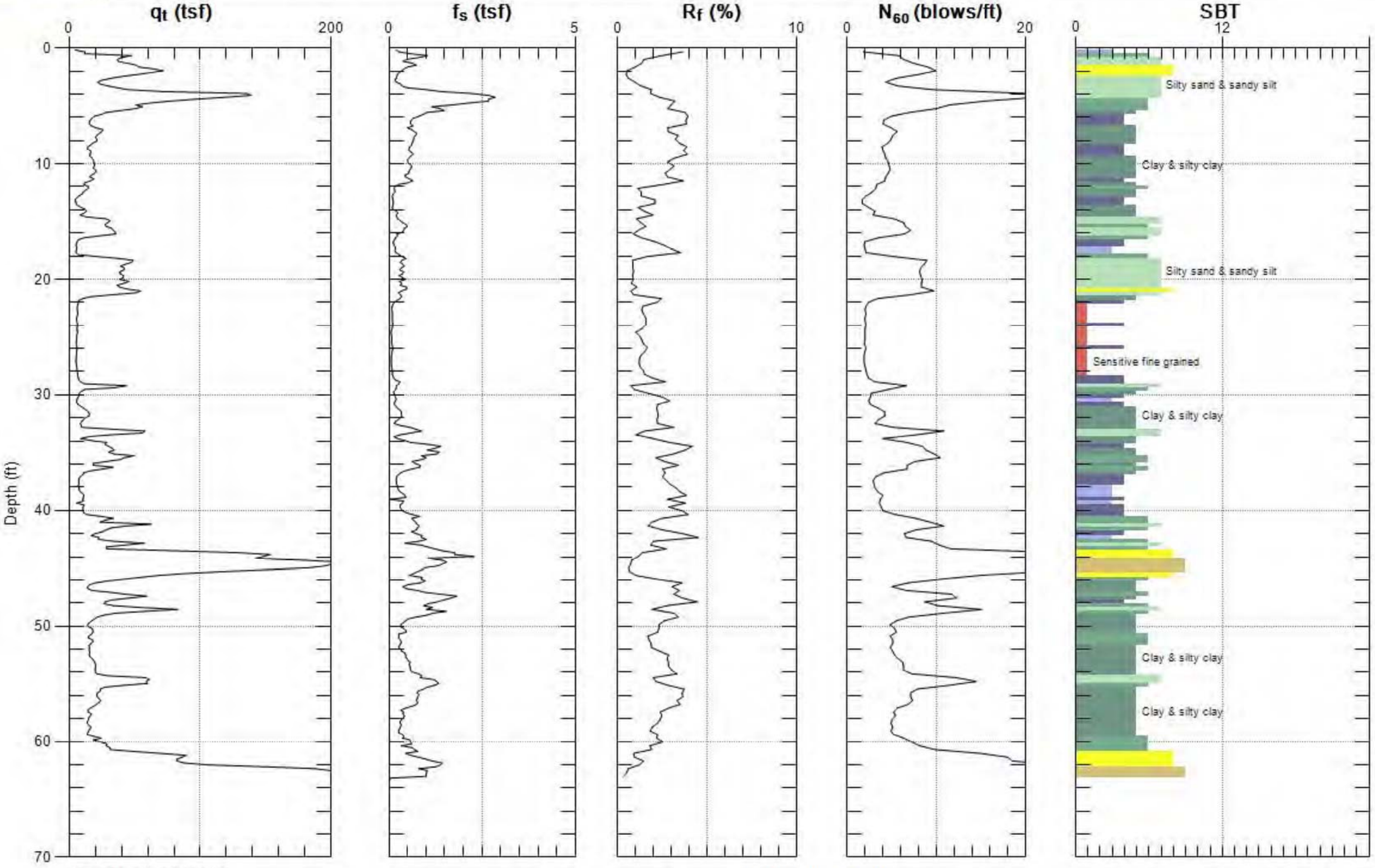
FIGURE A1-64

SBT: Soil Behavior Type (Robertson 1990)

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-065

Engineer: E.HOLLIDAY
Date: 9/26/2012 09:52



Max. Depth: 63.320 (ft)
Avg. Interval: 0.328 (ft)

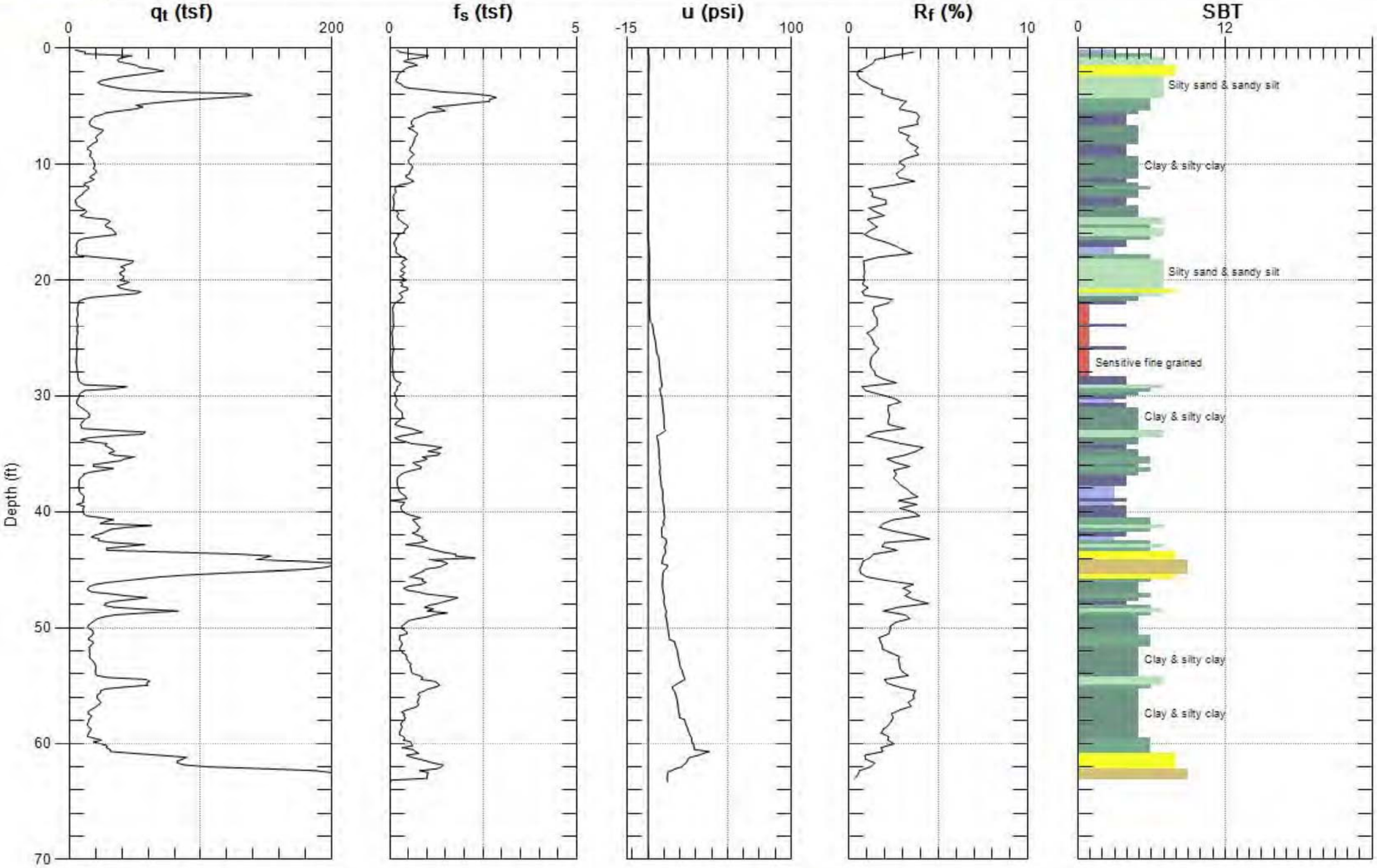
FIGURE A1-65

SBT: Soil Behavior Type (Robertson 1990)

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-CPT-065

Engineer: E.HOLLIDAY
Date: 9/26/2012 09:52



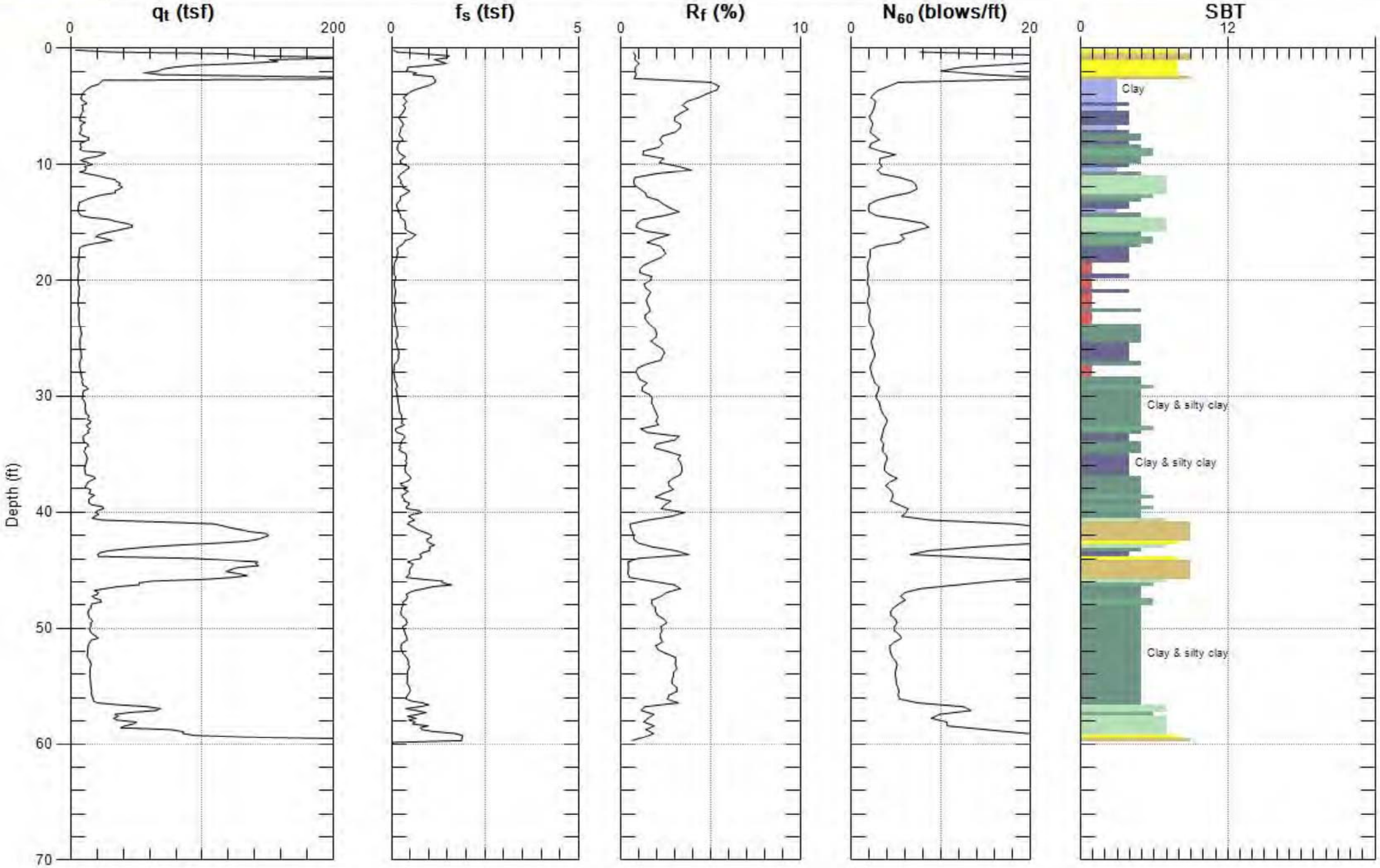
Max. Depth: 63.320 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-65

SBT: Soil Behavior Type (Robertson 1990)

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-SCPT-022
Engineer: E.HOLLIDAY
Date: 9/26/2012 08:18



Max. Depth: 60.039 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-66

SBT: Soil Behavior Type (Robertson 1990)

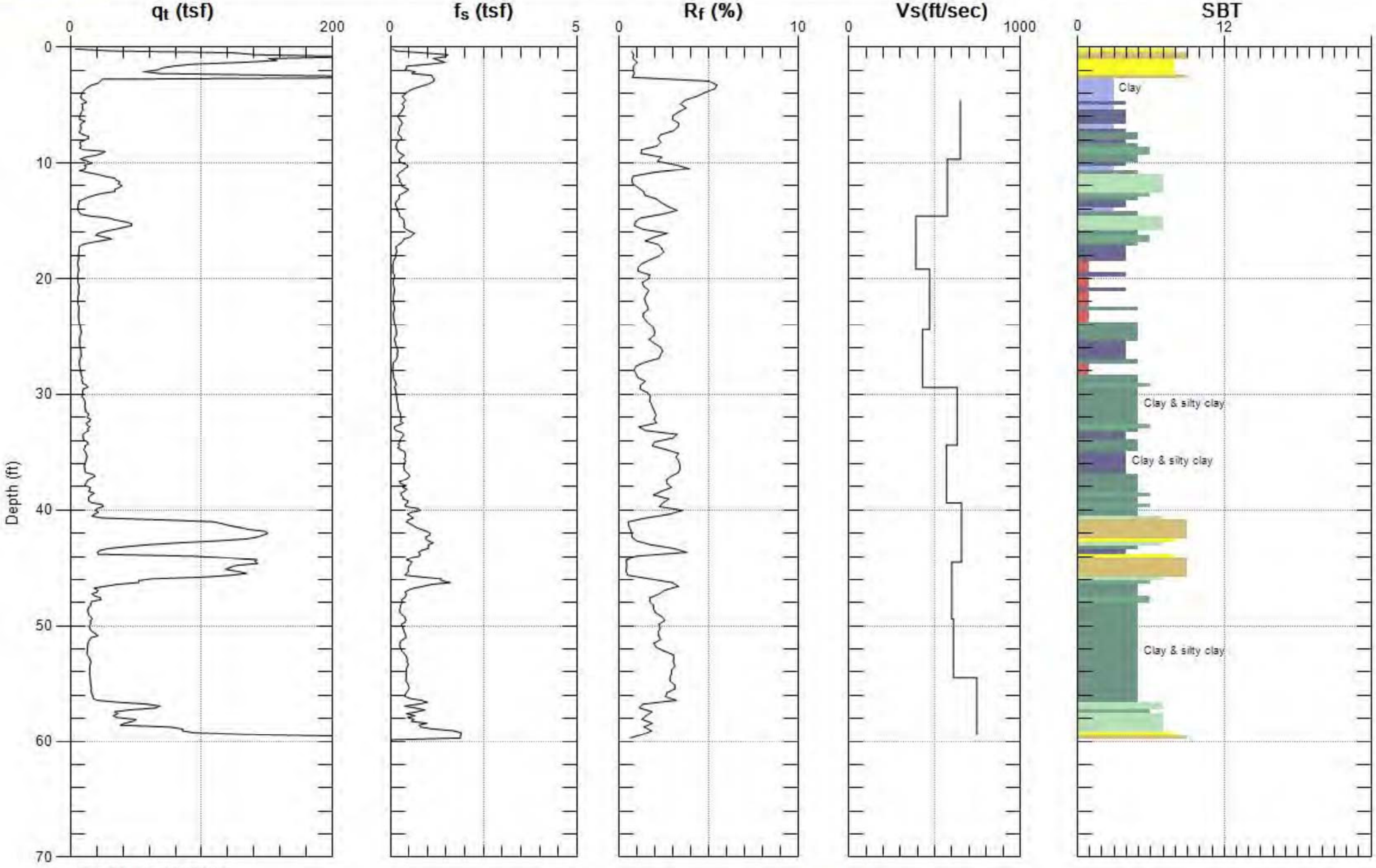
GROUP DELTA

Site: BALLONA WETLANDS

Sounding: A-SCPT-022

Engineer: E.HOLLIDAY

Date: 9/26/2012 08:18



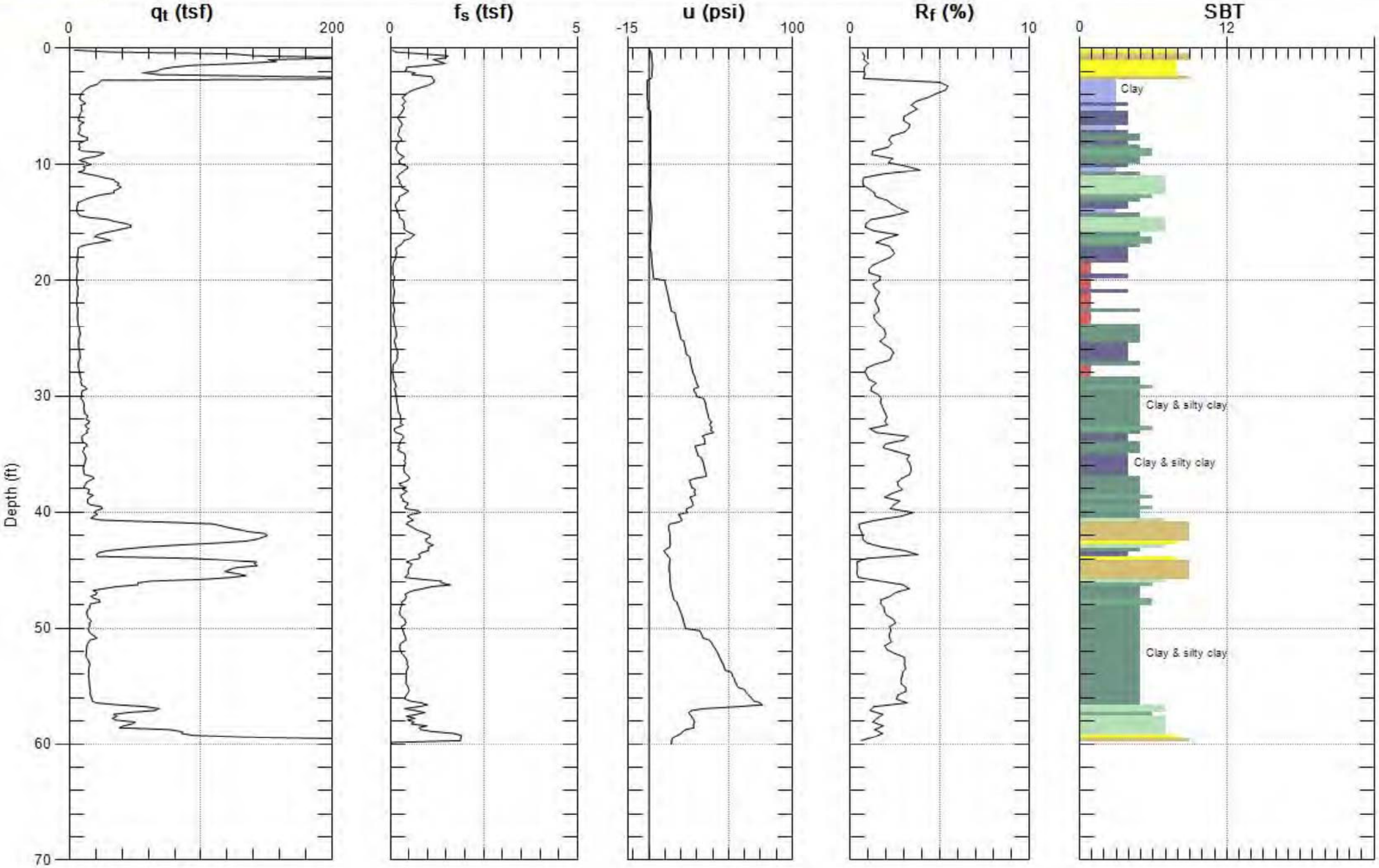
Max. Depth: 60.039 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-66

SBT: Soil Behavior Type (Robertson 1990)

GROUP DELTA

Site: BALLONA WETLANDS
Sounding: A-SCPT-022
Engineer: E.HOLLIDAY
Date: 9/26/2012 08:18



Max. Depth: 60.039 (ft)
Avg. Interval: 0.328 (ft)

FIGURE A1-66

SBT: Soil Behavior Type (Robertson 1990)

APPENDIX A2
FIELD EXPLORATIONS BY OTHERS

APPENDIX A2
PREVIOUS FIELD EXPLORATIONS

A2.1 INTRODUCTION

Several previous geotechnical and environmental investigations have been performed at the site location. Data from previous investigations by Law Crandall, Inc., Weston Solutions, Inc. and Diaz Yourman & Associates were used for preliminary analyses of this interim report. The exploration locations are shown in Figure 3 of the report.

Borings by Law Crandall, Inc. and Diaz Yourman & Associates were performed primarily for geotechnical purposes. Law Crandall, Inc. performed preliminary geotechnical investigations in each of the Areas within the project (Areas A, B and C) and presented the results of investigations within different areas in separate reports. Diaz Yourman & Associates performed a preliminary geotechnical investigation for Areas B and C. Borings by Weston Solutions, Inc. were performed primarily for the purpose of chemistry and environmental testing, and are not included in this Appendix. A summary of the geotechnical field investigations by Law Crandall, Inc. and Diaz Yourman & Associates, including previous geotechnical borings, is provided in this Appendix.

A2.2 LAW CRANDALL, INC. INVESTIGATIONS

In Area A, field investigation by Law Crandall, Inc. included 20 borings and 5 cone penetration tests (CPT). Drilling was performed in December 1988 and January 1989. Fourteen (14) of the borings were drilled using 5-inch-diameter rotary wash drilling equipment, while the other six (6) borings were performed using a bucket-type drilling equipement. Drilling mud was used for rotary wash borings to prevent caving. The rotary wash borings were drilled to a depth of approximately 60 feet. The bucket-type borings were drilled to a depth of approximately 16 to 20 feet below the existing grade using 16- and 18-inch bucket-type drilling equipment. Subsurface materials were visually classified and recorded by a field technician in accordance with the Unified Soil Classification System (USCS), and undisturbed and disturbed samples were collected for laboratory testing. Standard penetration tests (SPT) were performed in selected borings. CPTs were also advanced to a maximum depth of approximately 60 feet. The logs of borings and CPTs performed during this investigation are presented in this Appendix.

In Area B, field investigation by Law Crandall, Inc. included 32 borings in January and February 1991, and 21 borings at earlier investigation dates of December of 1986 and April of 1987. Most of the borings were drilled using 5-inch-diameter rotary wash drilling equipment to a depth of approximately 20 to 60 feet. Drilling mud was used for rotary wash borings to prevent caving. The drilling mud was removed following completion of the drilling to permit measurement of the groundwater level. Six (6) borings were performed using 8-inch-diameter hollow stem auger equipment to a depth of approximately 30 feet. Additionally, six 8-inch-diameter hand auger borings were drilled to a depth of 5 to 9 feet below the existing grade. At twelve locations, the rotary wash borings were converted to groundwater monitoring wells to measure the fluctuations in the groundwater levels. Subsurface materials were visually classified and recorded by a field technician in accordance with the Unified Soil Classification System (USCS), and undisturbed and disturbed samples were collected for laboratory testing. Standard penetration tests (SPT) were performed in 21 of more recent borings as well as several of the earlier borings. The logs of borings performed during this investigation are presented in this Appendix.

In Area C, geotechnical field investigation by Law Crandall, Inc. included 5 borings. Drilling was performed in June 1991. The borings were drilled using 5-inch-diameter rotary wash drilling equipment. Drilling mud was used for rotary wash borings to prevent caving. The drilling mud was removed following completion of the drilling to permit measurement of the groundwater level. The rotary wash borings were drilled to a depth of approximately 60 to 75 feet. Subsurface materials were visually classified and recorded by a field technician in accordance with the Unified Soil Classification System (USCS), and undisturbed and bulk samples were collected for laboratory testing. Standard penetration tests (SPT) were performed in all borings in accordance with the ASTM Designation D1986-84 test procedure. Prior to the geotechnical field investigation Law Crandall, Inc. performed an investigation in 1988 for contamination assessment, which included drilling 17 8-inch hollow-stem auger borings. The logs of borings performed during both investigations are presented in this Appendix.

A2.3 DIAZ YOURMAN & ASSOCIATES INVESTIGATION

Field investigation by Diaz Yourman & Associates in Areas B and C included a total of 20 deep borings (13 borings in Area B and 7 borings in Area C), as well as three grab samples in Area B. The borings were drilled by Layne Christenson Company in February 2009, with a rubber tire-mounted CME-750 rig using hollow-stem auger drilling equipment to depths ranging from 16 to 32 feet below the existing grade. Subsurface samples were collected for both geotechnical and bulk chemistry testing. Grab samples for sediments were collected near the tidal gates of the Ballona Creek using a hand auger. Drive samples were collected with a 2.4-inch-inside-diameter (3.0-inch-outside diameter) modified California split-barrel sample lined with brass tubes and a standard split-spoon penetrometer with dimensions in accordance with ASTM 3550 and 1586, respectively. Both samplers were driven with a 140-pound hammer falling 30 inches. After samples were collected, boreholes were backfilled with soils cuttings and bentonite chips. The logs of borings performed during this investigation are presented in this Appendix.

A2.4 REFERENCES

Diaz Yourman & Associates, 2010, Geotechnical Investigation, Ballona wetlands, task Order No. 003, Contract No. W912PL-06-D-004, Los Angeles County, California, PN 2006, 023.05 for the USACE, 2010.

Law Crandall, 1988, “Report of Contamination Assessment, Playa Vista Project – Parcel C, Culvert Boulevard Between Lincoln Boulevard and Marina Freeway, Los Angeles, California”, for Howard Hughes Properties, 1988.

Law Crandall, 1991, “Report of Preliminary Geotechnical Investigation, Proposed Marina, Playa Vista Project - Parcel A, Lincoln Boulevard and Ballona CreekLos Angeles County, California”.

Law Crandall, 1991, “Supplementary Information, Proposed Marina, Playa Vista Project-Parcel A, Lincoln Boulevard and Ballona Creek, Los Angeles County, California”.

Law Crandall, 1991, “Report of Geotechnical Investigation, Proposed Wetlands Restoration and Proposed Development, North of Jefferson Boulevard, Playa Vista Project – Parcel B, Los Angeles, California”.

Law Crandall, 1991 “Report of Preliminary Geotechnical Investigation, Playa Vista Project – Parcel C, Culver and Lincoln Boulevards, Los Angeles, California,” a report prepared for Maguire Thomas Partners, August 7, 1991.

JOB AE-88473 DATE 1/19/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD BK

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 1

DATE DRILLED: January 5, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 14.9*

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							SM	FILL - SILTY SAND - fine, brown
							ML	FILL - CLAYEY SILT - dark grey
			17.8	91	9			
							SM	FILL - SILTY SAND - fine, lenses of Clayey Silt, brownish grey
10	5							
								Some seashells
			22.2	101	17			
							ML	FILL - SANDY SILT - lenses of Clayey Silt, some seashells, grey
5	10	6						
			41.2	77	1			
							ML	▽ SURFACE OF NATURAL SOIL CLAYEY SILT - some seashells, grey
0	15							
		6						
			47.3	74	3			
-5	20							
							ML	SANDY SILT - grey
		11						
							MH	CLAYEY SILT - dark grey (LL = 68; PI = 21)
			62.4	60	2			
-10	25							
		2						
-15	30							
			79.9	53	2			Organic odor
		3						
-20	35							
			59.4	65	2			
							ML	CLAYEY SILT - brownish grey
-25	40	18						

* Elevations provided by Psomas & Associates.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.1a

Area A - Law Crandall Borings

PLATE A2-1

B AE-88473 DATE 1/19/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 1 (Continued)

DATE DRILLED: January 5, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
			31.5	89	3	■		Bluish grey
- 30	45							
		9						
- 35	50		29.0	88	3	■		
							SM	SILTY SAND - fine, bluish grey
- 40	55		21.6	106	18	■		
							ML	CLAYEY SILT - dark grey
- 45	60		34.2	87	6	■		

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Drilled 18" - Diameter Bucket Boring 5' south of Rotary Wash Boring to a depth of 11-1/2' on 1/12/89 for water level determination. Water seepage encountered at a depth of 9-1/2'. Caving below 9-1/2' (to 2' in diameter).

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

BORING 2

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 14.1

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							ML	FILL - SANDY SILT - some seashells, brown
			37.8	80	2	■		Large amount of seashells, greyish brown
10			12.9	93	4	■	SM	FILL - SILTY SAND - fine, light brown
	5							
			59.3	66	1	■		Layers of Sandy Silt, some seashells, dark grey
			26.6	99	4	■		Grey
5								
	10							
			43.6	76	< 1	■	ML	FILL - CLAYEY SILT - grey (LL = 43; PI = 10; oven dry LL = 39)
								▽ SURFACE OF NATURAL SOIL
0	15		34.0	88	3	■	ML	SANDY SILT - slightly Clayey, brown and grey
								Some seashells
- 5	20							Large amount of seashells
							MH	CLAYEY SILT - organic odor, grey
- 10	25		77.9	55	1	■		
- 15	30		48.4	71	2	■		Dark grey
- 20	35		54.3	69	2	■		
							ML	CLAYEY SILT - dark grey
- 25	40		35.4	85	4	■		(LL = 39; PI = 5)

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.2a

Area A - Law Crandall Borings

PLATE A2-3

B AE-88473 DATE 1/19/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD BK

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 2 (Continued)

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-30	45		33.8	86	4	
-35	50		52.3	65	3	
-40	55		19.1	111	18	
-45	60		19.5	104	54	

Layer of Peat

Traces of Peat

SANDY SILT - bluish grey

SILTY SAND - fine, some Gravel, traces of Peat, bluish grey

SAND - fine to medium, few Gravel and Cobbles, greyish brown

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 35' at completion of drilling. Water level measured at 7' after removal of mud. Boring grouted with cement-bentonite mixture.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.2b

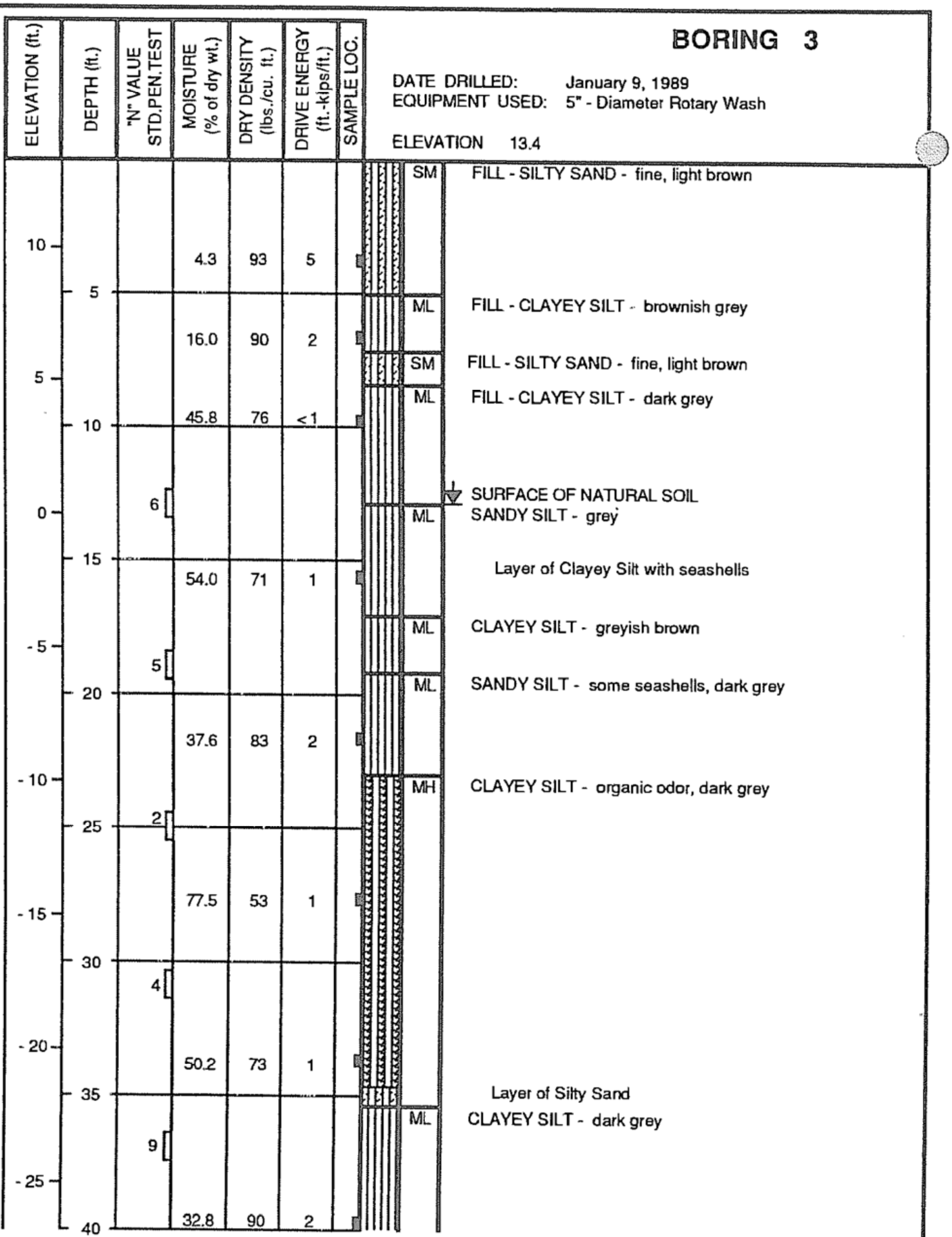
JOB AE-88473 DATE 1/19/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 3

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 13.4



"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)
	4.3	93	5
	16.0	90	2
	45.8	76	<1
6			
	54.0	71	1
5			
	37.6	83	2
2			
	77.5	53	1
4			
	50.2	73	1
9			
	32.8	90	2

SM FILL - SILTY SAND - fine, light brown

ML FILL - CLAYEY SILT - brownish grey

SM FILL - SILTY SAND - fine, light brown

ML FILL - CLAYEY SILT - dark grey

SURFACE OF NATURAL SOIL

ML SANDY SILT - grey

Layer of Clayey Silt with seashells

ML CLAYEY SILT - greyish brown

ML SANDY SILT - some seashells, dark grey

MH CLAYEY SILT - organic odor, dark grey

Layer of Silty Sand

ML CLAYEY SILT - dark grey

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

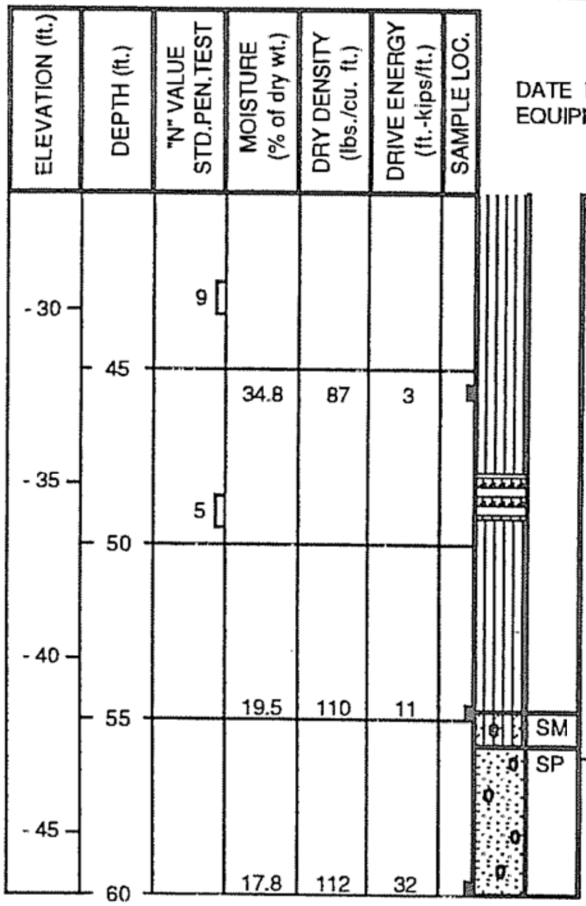
PLATE A - 1.3a

Area A - Law Crandall Borings

PLATE A2-5

BORING 3 (Continued)

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash



ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
- 30		9				
	45		34.8	87	3	
- 35		5				
	50					
- 40						
	55		19.5	110	11	
- 45						
	60		17.8	112	32	

Layer of Peat

SM SILTY SAND - fine to medium, some Gravel, traces of Peat, grey

SP SAND - medium to coarse, about 15% Gravel, light grey

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

AE-88473 DATE 1/19/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.3b

Area A - Law Crandall Borings

PLATE A2-6

JOB AE-88473 DATE 1/19/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 4

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 12.1

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)
10			14.4	91	3
	5		35.3	84	1
5			63.0	63	< 1
	10		39.5	82	< 1
0			33.6	88	4
	15		37.6	84	< 1
- 5					
	20		37.9	84	1
- 10					
	25		85.8	49	1
- 15					
	30		46.5	71	1
- 20					
	35		23.5	104	3
- 25					
	40		35.5	88	3

SM	FILL - SILTY SAND - fine, lenses of Clayey Silt, brown and grey
MH	FILL - CLAYEY SILT - dark grey
	Some rootlets
ML	FILL - CLAYEY SILT - brown
	SURFACE OF NATURAL SOIL
ML	CLAYEY SILT - lenses of Sandy Silt, light grey
SM	SILTY SAND - fine, light brown
	Grey
OH	CLAYEY SILT - some seashells, organic odor, dark grey
	(LL = 109; PI = 30; oven dry LL = 68)
	About 20% seashells, brownish grey
ML	CLAYEY SILT - some seashells, bluish grey
	Dark grey

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.4a

Area A - Law Crandall Borings

PLATE A2-7

AE-88473 DATE 1/19/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD BK

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 4 (Continued)

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-30						
	45		81.3	49	3	
-35						
	50		22.7	104	5	
-40						
	55		12.5	129	40	
-45						
	60		8.2	137	50	

Traces of Peat

PT PEAT - brown

ML CLAYEY SILT - traces of Peat, dark grey

SP SAND - fine to coarse, about 30% Gravel and Cobbles, grey

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.4b

Area A - Law Crandall Borings

PLATE A2-8

JOB AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD BK

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 5

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 10.9

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10							ML	FILL - SANDY SILT - lenses of Clayey Silt, greyish brown and dark grey
			48.7	73	1	▪		
							SM	FILL - SILTY SAND - fine, light brown
	5							
5								
			57.5	66	<1	▪	MH	FILL - CLAYEY SILT - dark grey (LL = 50; PI = 13)
								▽ SURFACE OF NATURAL SOIL
			36.8	84	4	▪	ML	CLAYEY SILT - traces of organic matter, dark grey
	10							
0								
		5						Some Sand
	15							
-5								
			37.8	84	1	▪	SM	SILTY SAND - fine, brownish grey
	20						MH	CLAYEY SILT - organic odor, bluish grey
-10		1						
								Few shells
			56.6	66	1	▪		(LL = 68; PI = 24)
	25							
-15								
		14					ML	CLAYEY SILT - dark grey
	30							
-20								
			25.1	101	5	▪		
								Lenses of Sandy Silt
	35							
-25								
		24						
							SP	SAND - fine to coarse, few Gravel, bluish grey
							ML	CLAYEY SILT - bluish grey
	40							

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.5a

Area A - Law Crandall Borings

PLATE A2-9

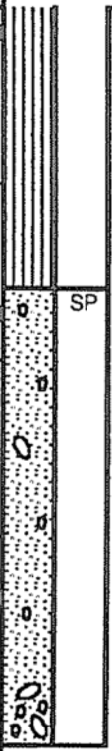
AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 5 (Continued)

DATE DRILLED: January 9, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.	
- 30			29.2	89	6	▪	
							Traces of Peat
- 35	45	8					
			17.7	114	54	▪	SP SAND - fine to coarse, some Silt, some Gravel and Cobbles, grey
- 40	50						
		53					
- 45	55						
			9.4	128	39	▪	
- 50	60						Large amount of Gravel and Cobbles
	65						



NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.5b

Area A - Law Crandall Borings

PLATE A2-10

JOB AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 6

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 8.1

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			39.6	83	2	
5						
	5		53.7	70	< 1	
0			50.7	70	< 1	
	10					
			42.2	80	< 1	
-5			52.2	69	1	
	15					
			70.5	57	< 1	
-10						
	20		70.4	57	< 1	
-15						
	25		23.5	103	2	
-20						
	30		20.9	107	2	
-25						
	35		16.5	114	11	
-30						
	40		59.7	64	2	

ML	FILL - CLAYEY SILT - lenses of Sandy Silt, dark grey
	SURFACE OF NATURAL SOIL
ML	CLAYEY SILT - grey
ML	SANDY SILT - brownish grey
MH	CLAYEY SILT - some seashells, bluish grey
	Dark grey
ML	SANDY SILT - layers of Clayey Silt, bluish grey
SM	SILTY SAND - fine, bluish grey
ML	SANDY SILT - bluish grey
PT	PEAT - brown to dark brown
ML	CLAYEY SILT - large amount of Peat, dark brown

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.6a

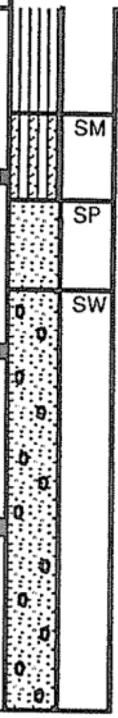
Area A - Law Crandall Borings

PLATE A2-11

BORING 6 (Continued)

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-35						
	45		20.2	108	14	▪
-40						
	50		11.3	126	32	▪
-45						
	55		10.0	130	36	▪
-50						
	60					



SM	SILTY SAND - fine to medium, bluish grey
SP	SAND - fine, grey
SW	SAND - well graded, about 20% Gravel, grey

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Drilled 18" - Diameter Bucket Boring 5' south of Rotary Wash Boring to a depth of 12-1/2' on 1/12/89 for water level determination. Water seepage encountered at a depth of 11'. Hole squeezing in below 11'.

AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD BK

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

JOB AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD BK

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 7

DATE DRILLED: January 5, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 12.3

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
10			20.3	96	6	▪
			29.0	88	2	▪
	5		37.6	86	1	▪
5			46.5	76	1	▪
	10		31.9	83	1	▪
0			35.0	87	4	▪
	15		32.6	87	1	▪
-5	20		80.1	53	1	▪
-10	25		78.0	54	2	▪
-15	30		36.6	84	2	▪
-20	35		46.6	72	2	▪
-25	40		33.6	88	7	▪

ML FILL - SANDY SILT - brown

Lenses of Clayey Silt
Some seashells, brown and grey

ML FILL - CLAYEY SILT - some Sand, light grey
Large amount of seashells

Brownish grey

SURFACE OF NATURAL SOIL

ML CLAYEY SILT - lenses of Sandy Silt, light grey

MH CLAYEY SILT - some organic matter, light grey

Bluish grey

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.7a

Area A - Law Crandall Borings

PLATE A2-13

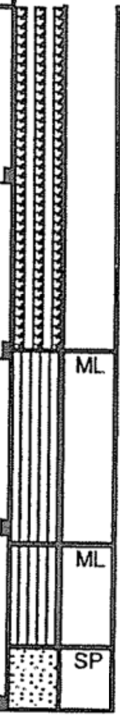
B ___ AE-88473 ___ DATE 1/20/89 ___ F.T. BG ___ DR. dmh ___ O.E. JC ___ W.P. dmh ___ CHKD BK

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 7 (Continued)

DATE DRILLED: January 5, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
- 30								
	45		36.8	81	5			(LL = 56; PI = 23)
- 35								
	50		23.8	103	10		ML	SANDY SILT - few seashells, bluish grey
- 40								
	55		26.6	96	6			Black
							ML	CLAYEY SILT - grey
- 45								
							SP	SAND - fine to medium, grey
	60		22.5	102	40			



NOTE: Drilling mud used in drilling process. Mud removed to a depth of 60' at completion of drilling. Water level measured at 7' after removal of mud. Boring grouted with cement-bentonite mixture.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

Area A - Law Crandall Borings

PLATE A - 1.7b
PLATE A2-14

JOB AE-88473 DATE 1/20/89 F.T. TC DR. dmh O.E. JC W.P. dmh CHKD BK

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 8

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 16" - Diameter Bucket

ELEVATION 12.9

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
10			24.8	92	< 1	■
	5					
			33.8	89	< 1	■
5						
			57.4	70	< 1	■
	10					
			48.1	73	< 1	■
0						
	15					
			35.8	86	< 1	■
-5						
	20					

ML FILL - SANDY SILT - brownish grey

Some lumps of Clayey Silt

ML FILL - CLAYEY SILT - grey

(LL = 37; PI = 8)

MH FILL - CLAYEY SILT - bluish grey

Brownish grey

▽ SURFACE OF NATURAL SOIL

ML CLAYEY SILT - light brown

NOTE: Water seepage encountered at 13'. Water level measured at 15' at completion of drilling and at 13' 20 minutes later. Caving below 13'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.8

Area A - Law Crandall Borings

PLATE A2-15

B ___ AE-88473 ___ DATE 1/20/89 ___ F.T. ___ TC ___ DR. dmh ___ O.E. JC ___ W.P. dmh ___ CHKD ___ BK

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 9

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 16" - Diameter Bucket

ELEVATION 12.0

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							SM	FILL - SILTY SAND - fine, light brown
10			19.2	96	< 1	■	ML	FILL - SANDY SILT - greyish brown
			41.6	82	< 1	■	ML	FILL - CLAYEY SILT - dark grey
	5							
			64.0	62	< 1	■	MH	FILL - CLAYEY SILT - dark grey
5								
			47.9	72	< 1	■		
	10							▽ SURFACE OF NATURAL SOIL
			55.6	68	< 1	■	ML	CLAYEY SILT - some Sand, some cemented nodules, dark brown
0								
	15							
- 5								
	20							

NOTE: Water seepage encountered at 13-1/2'. Water level measured at 13' 20 minutes after completion of drilling. Caving below 12'. Hole squeezed in below 14' after drilling to 17'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.9

Area A - Law Crandall Borings

PLATE A2-16

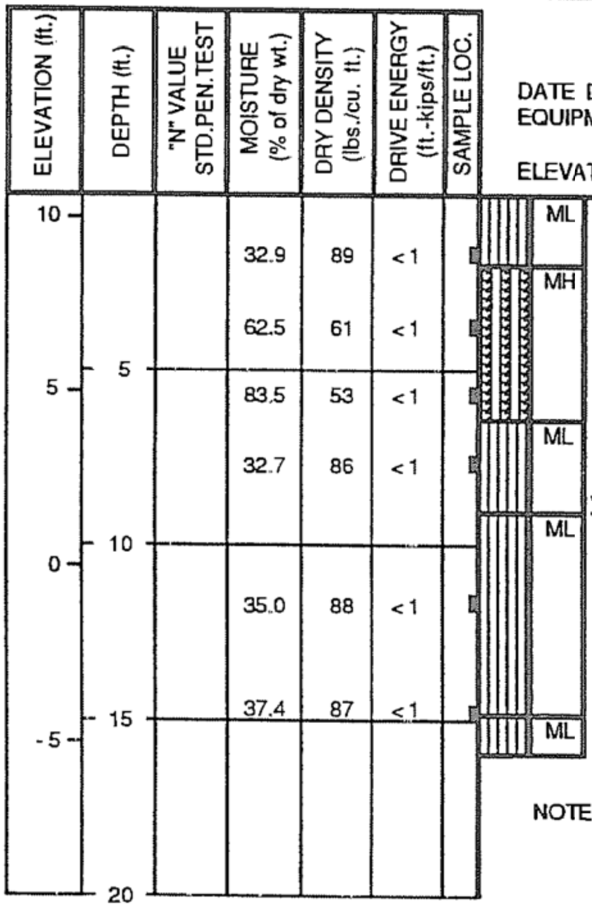
JOB AE-88473 DATE 1/20/89 F.T. TC DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 10

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 16" - Diameter Bucket

ELEVATION 10.6



ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			32.9	89	< 1	
			62.5	61	< 1	
			83.5	53	< 1	
			32.7	86	< 1	
			35.0	88	< 1	
			37.4	87	< 1	

ML FILL - SANDY SILT - brown

MH FILL - CLAYEY SILT - bluish grey and brown

Some organic matter

Lenses of Sandy Silt

ML FILL - CLAYEY SILT - brownish grey

SURFACE OF NATURAL SOIL

ML SANDY SILT - brownish grey

ML CLAYEY SILT - bluish grey

NOTE: Water seepage encountered at a depth of 11'. Caving below 11'. Hole squeezed in below 12-1/2' after drilling to 16'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.10

Area A - Law Crandall Borings

PLATE A2-17

BORING 11

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 10.3

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10							ML	FILL - CLAYEY SILT - greyish brown
			14.2	94	4			
							SM	FILL - SILTY SAND - fine, greyish brown
5	5							
							ML	FILL - CLAYEY SILT - some organic matter, brown
			39.6	83	4			
							ML	FILL - SANDY SILT - light grey
			41.7	83	2			
0	10							▽ SURFACE OF NATURAL SOIL
							MH	CLAYEY SILT - traces of organic matter, light greyish brown
		3						
								Greyish brown
-5	15							
			48.1	74	<1			Some seashells, organic odor, grey
		0						
								Bluish grey
-10	20							
			77.6	52	<1			
		5						
-15	25							
			19.1	109	1			Some Sand, dark grey
							SP SM	SAND - fine to coarse, some Silt, about 10% Gravel, dark grey
-20	30							
		33						
			25.7	99	7		ML	SANDY SILT - bluish grey
-25	35							
		14						
							MH	CLAYEY SILT - bluish grey
	40		46.5	75	2			(LL = 67; PI = 32; oven dry LL = 62)

(CONTINUED ON FOLLOWING PLATE)

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

OB AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD BK

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.11a

Area A - Law Crandall Borings

PLATE A2-18

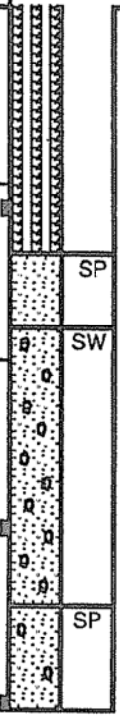
JOB AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD BK

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 11 (Continued)

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-30								
		11						Traces of Peat
-35	45							
			26.6	97	7	■		Some Sand
							SP	SAND - fine to medium, grey
		58						
-40	50						SW	SAND - well graded, about 30% Gravel, grey
			7.6	119	36	■		
-45	55							
							SP	SAND - fine to medium, some Gravel, light grey
	60		21.9	105	28	■		



NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.11b

Area A - Law Crandall Borings

PLATE A2-19

BORING 12

DATE DRILLED: January 12, 1989
EQUIPMENT USED: 18" - Diameter Bucket

ELEVATION 13.2

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			20.1	85	2	
10						
			30.3	83	< 1	
	5					
			22.7	91	< 1	
5			27.7	87	< 1	
	10					
			45.6	75	< 1	
0						
	15		53.4	69	< 1	
- 5						
	20		40.2	81	< 1	

ML FILL - CLAYEY SILT - layers of Sandy Silt, light brown and brown

Some organic matter

ML FILL - SANDY SILT - layers of Clayey Silt, brown and dark grey

MH FILL - CLAYEY SILT - dark grey

▽ SURFACE OF NATURAL SOIL

MH CLAYEY SILT - some Sand, few seashells, brownish grey

Bluish grey

NOTE: Water seepage encountered at a depth of 13'. Water level measured at 16' 10 minutes after completion of drilling. Caving below 13' (to 2' in diameter).

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD BK

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.12

Area A - Law Crandall Borings

PLATE A2-20

BORING 13

DATE DRILLED: January 12, 1989
EQUIPMENT USED: 18" - Diameter Bucket

ELEVATION 11.6

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							ML	FILL - SANDY SILT - light brown
10			39.4	83	< 1	■	ML	FILL - CLAYEY SILT - bluish grey
			21.3	83	< 1	■	ML	FILL - SANDY SILT - light brown
	5						MH	FILL - CLAYEY SILT - bluish grey
5			62.5	65	< 1	■		Layers of Silty Sand and Sandy Silt, grey and dark grey
			35.8	87	< 1	■		
	10							
			34.0	87	< 1	■		▽ SURFACE OF NATURAL SOIL
0							ML	CLAYEY SILT - some organic matter, bluish grey
			30.5	92	1	■		Brownish grey
	15							
- 5							MH	CLAYEY SILT - bluish grey
	20							

NOTE: Water seepage encountered at a depth of 12'. Water level measured at 14-1/2' 10 minutes after completion of drilling. Caving below 12' (to 2' in diameter).

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.13

Area A - Law Crandall Borings

PLATE A2-21

BORING 14

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 11.8

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							ML	FILL - CLAYEY SILT - some rootlets, brownish grey
10			19.9	92	5	■		
			24.3	86	5	■		Light brown
	5							
5			25.6	91	3	■	ML	FILL - SANDY SILT - greyish brown
								Some organic matter
	10		51.6	70	2	■		Dark brown to black, organic odor, some seashells
								▽ SURFACE OF NATURAL SOIL
0							ML	CLAYEY SILT - light grey
			47.8	78	3	■		
	15							
							ML	SILT - brownish grey
-5			37.9	83	3	■		
							MH	CLAYEY SILT - few seashells, organic odor, bluish grey
	20		64.6	67	1	■		
-10								
	25		43.5	74	1	■		Lenses of Sandy Silt, light grey Dark grey
-15								
			32.8	91	1	■	ML	CLAYEY SILT - some Peat, dark grey (LL = 38; PI = 11)
	30							
-20								
			27.1	96	1	■		
	35							
-25			23.8	99	5	■		
	40							

AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD BK

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

JOB AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD BK

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 14 (Continued)

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.	
			45.4	76	3	■	Bluish grey
-30							
	45		29.1	93	5	■	Dark grey
-35							
			35.9	84	4	■	
	50						
-40							
			80.2	52	4	■	Layers of Peat, dark brownish grey and brown
	55						
-45			89.6	45	4	■	
	60						
			31.1	93	7	■	Dark grey
-50							
	65						

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.14b

Area A - Law Crandall Borings

PLATE A2-23

B___ AE-88473___ DATE___1/20/89___ F.T.___ TC___ DR.___ dmh___ O.E.___ JC___ W.P.___ dmh___ CHKD___ BK

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 15

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 16" - Diameter Bucket

ELEVATION 10.7

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
10						
			24.2	92	2	■
5	5		30.9	81	<1	■
			40.0	80	<1	■
			44.2	79	<1	■
0	10					
			51.9	69	<1	■
-5	15		43.9	79	<1	■
	20					

ML FILL - SANDY SILT - greyish brown

Lenses of Clayey Silt

ML FILL - CLAYEY SILT - greyish brown
Some organic matter
Layer of Silty Sand

▽ SURFACE OF NATURAL SOIL

ML SANDY SILT - grey

MH CLAYEY SILT - light grey
(LL = 59; PI = 20)

Brownish grey

NOTE: Water seepage encountered at a depth of 12'. Water level measured at 12-1/2' 10 minutes after completion of drilling. Caving below 12'. Hole squeezed in below 13-1/2' after drilling to 16'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.15

Area A - Law Crandall Borings

PLATE A2-24

JOB AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 16

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 11.3

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							ML	FILL - CLAYEY SILT - brownish grey
10			43.6	73	1	▪		
							ML	FILL - SANDY SILT - light brown
			18.4	95	5	▪		
	5							
5			21.4	84	1	▪	ML	FILL - CLAYEY SILT - brown
			18.5	110	7	▪	ML	FILL - SANDY SILT - few Gravel, brownish grey
	10							
0								
			48.5	71	2	▪	MH	▽ SURFACE OF NATURAL SOIL CLAYEY SILT - some Sand, traces of organic matter, dark grey
	15							
-5								
		3						Brownish grey
	20							
-10			71.7	56	2	▪		Few seashells, organic odor, bluish grey
	25	4						Dark grey
-15								
								Layer of Sandy Silt, traces of Peat, dark greyish brown
			26.9	97	3	▪		
	30							
-20								
		23						
	35							
-25			42.8	77	2	▪		Traces of Peat
		15					ML	CLAYEY SILT - bluish grey
	40							

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.16a

Area A - Law Crandall Borings

PLATE A2-25

BORING 16 (Continued)

DATE DRILLED: January 10, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.	
- 30			23.8	100	8	▪	Some Sand
	45	8					
- 35			37.3	85	8	▪	Dark grey
	50						
- 40		15					Traces of Peat
	55						
- 45			32.5	86	6	▪	
	60						SP SAND - fine to coarse, some Gravel and Cobbles, light grey
- 50			10.5	129	72	▪	
	65						

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Drilled 18" - Diameter Bucket Boring 5' east of Rotary Wash Boring to a depth of 13' on 1/12/89 for water level determination. Water seepage encountered at a depth of 11-1/2'. No caving.

B ___ AE-88473 ___ DATE 1/20/89 ___ F.T. ___ BG ___ DR. dmh ___ O.E. JC ___ W.P. dmh ___ CHKD ___

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

Area A - Law Crandall Borings

PLATE A - 1.16b
PLATE A2-26

BORING 17

DATE DRILLED: December 30, 1988
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 18.2

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							CL	FILL - SANDY CLAY - reddish brown
			19.3	110	14	■		
15								
			14.5	114	13	■		Lenses of Silty Sand, some organic matter, brown and light grey
	5							
			15.3	115	5	■		Lenses of Clayey Silt, pieces of brick, reddish brown and brown
			20.6	107	4	■		
10								
							ML	FILL - SANDY SILT - grey
	10							
			27.0	96	7	■		
5								
			35.0	86	2	■		
	15							
							SM	FILL - SILTY SAND - fine, some vegetation, hydrocarbon odor, traces of hydrocarbon, dark brown to black
			11.8	117	13	■		
								▽ SURFACE OF NATURAL SOIL
0							MH	CLAYEY SILT - brownish grey
	20							
		6						
- 5								Large amount of seashells, organic odor, grey
			63.8	60	3	■		
	25							
- 10								
		3						
	30							
							SM	SILTY SAND - fine, grey
			28.1	94	18	■		
- 15								
	35							
		18						
- 20								
							MH	CLAYEY SILT - some seashells, grey
			46.8	77	3	■		
	40							

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

JOB AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD BK

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.17a

Area A - Law Crandall Borings

PLATE A2-27

BORING 17 (Continued)

DATE DRILLED: December 30, 1988
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
		8						Bluish grey
- 25							SM	SILTY SAND - fine, grey
	45		23.7	94	45	▪		
- 30		10					ML	CLAYEY SILT - some seashells, bluish grey
	50		19.9	109	16	▪		Some Sand
- 35			20.6	109	5	▪	ML	SANDY SILT - slightly Clayey, grey
	55							
			27.6	94	5	▪	ML	CLAYEY SILT - some cemented lumps, bluish grey
- 40								
	60		33.4	90	5	▪		

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 40' at completion of drilling. Water level measured at 15-1/2' 4 days after removal of mud. Boring grouted with sand and cement slurry.

B ___ AE-88473 ___ DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD BK

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.17b

JOB AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

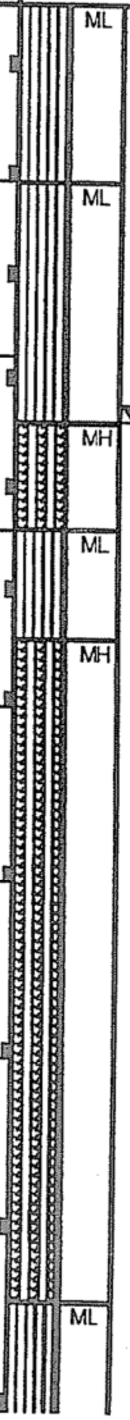
Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 18

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 12.7

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
10			35.4	87	2	▪
	5		9.0	88	1	▪
5			59.1	62	<1	▪
	10		38.0	84	<1	▪
0			56.1	66	<1	▪
	15		38.6	84	1	▪
-5	20		46.8	74	1	▪
-10	25		74.6	53	<1	▪
-15	30		32.1	90	1	▪
-20	35		51.0	68	<1	▪
-25	40		22.8	104	6	▪



ML FILL - SANDY SILT - greyish brown

Lenses of Clayey Silt

ML FILL - CLAYEY SILT - bluish grey

Dark grey
(LL = 45; PI = 14)

Brownish grey

SURFACE OF NATURAL SOIL
MH CLAYEY SILT - greyish brown

ML SANDY SILT - lenses of Clayey Silt, brown and grey

MH CLAYEY SILT - some seashells, organic odor, grey

Brownish grey

Some Sand, dark grey

No Sand, bluish grey

ML CLAYEY SILT - bluish grey

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.18a

Area A - Law Crandall Borings

PLATE A2-29

BORING 18 (Continued)

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
- 30						
	45		22.9	88	5	■
- 35						
	50		39.4	78	3	■
- 40						
	55		32.0	92	2	■
- 45						
	60		42.6	78	2	■

SM SILTY SAND - fine, grey

ML CLAYEY SILT - dark grey

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Drilled 18" - Diameter Bucket Boring 5' east of Rotary Wash Boring to a depth of 16' on 1/12/89 for water level determination. Water seepage encountered at a depth of 11'. Caving below 11' (to 2' in diameter).

JOB AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.18b

Area A - Law Crandall Borings

PLATE A2-30

JOB AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD BK

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 19

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 14.9

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
			22.1	92	6	▪	SM	FILL - SILTY SAND - fine, lenses of Clayey Silt, brown and grey Large amount of seashells
			5.0	102	11	▪		Light brown
10	5						ML	FILL - SANDY SILT - lenses of Clayey Silt, some seashells, grey and brown
			29.5	92	8	▪		
5	10		43.4	81	2	▪	ML	FILL - CLAYEY SILT - greyish brown
			43.4	76	1	▪		Some Sand, some vegetation, grey and black
0	15		40.4	80	1	▪		▽ SURFACE OF NATURAL SOIL
							MH	CLAYEY SILT - brownish grey
-5	20	3						
			42.1	77	1	▪		Few seashells, organic odor, dark grey
-10	25							
		1						
-15	30						SM	SILTY SAND - fine, few seashells, organic odor, dark grey
			26.5	98	12	▪		
							MH	CLAYEY SILT - brownish grey
-20	35	1						
			58.6	62	2	▪		Few seashells
-25	40							

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.19a

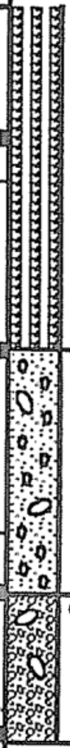
Area A - Law Crandall Borings

PLATE A2-31

BORING 19 (Continued)

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
		4						
			46.6	73	2	▪		Lenses of Silty Sand, traces of Peat, dark grey
- 30	45							
		4						
			47.6	76	6	▪		
- 35	50						SP	GRAVELLY SAND - fine to coarse, about 40% Gravel and Cobbles, lenses of Sandy Silt, traces of Peat, black
		25						
- 40	55							
			11.0	122	27	▪	GW	GRAVEL - well graded, some Sand, few Cobbles, black
- 45	60							
			9.0	120	24	▪		
- 50	65							



NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

B AE-88473 DATE 1/20/89 F.T. BG DR. dmh O.E. JC W.P. dmh CHKD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.19b

JOB AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD BK

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 20

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 12.3

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							ML	FILL - SANDY SILT - light brown
10								
			29.2	94	7	■		
							ML	FILL - CLAYEY SILT - brownish grey
	5							
							ML	FILL - SANDY SILT - lenses of Clayey Silt, grey and brown
			24.0	96	3	■		
5								
								SURFACE OF NATURAL SOIL
			41.1	80	1	■		
	10						ML	SANDY SILT - some organic matter, dark grey
0								
		5						
	15							
			32.8	90	4	■		Brownish grey
-5								
							MH	CLAYEY SILT - some seashells, organic odor, brown and dark grey
		0						
	20							
			48.7	72	<1	■		Dark grey
-10								
		0						
	25							
-15								
			57.4	64	<1	■		
	30							
		0						
-20								
			54.4	68	1	■		Grey
	35							
		8						
-25								
							SM	SILTY SAND - fine, dark grey
			20.7	109	8	■		
	40							

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.20a

Area A - Law Crandall Borings

PLATE A2-33

BORING 20 (Continued)

DATE DRILLED: January 11, 1989
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-30								Layers of Clayey Silt
		18						
	45							
			31.8	90	4	▪	ML	CLAYEY SILT - lenses of Silty Sand, dark grey
-35								
		8						
	50							
-40								
			35.1	85	3	▪		
	55							
-45								
	60		33.1	83	2	▪		

NOTE: Drilling mud used in drilling process. Boring grouted with cement-bentonite mixture. Water level not established.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB AE-88473 DATE 1/20/89 F.T. FH DR. dmh O.E. JC W.P. dmh CHKD

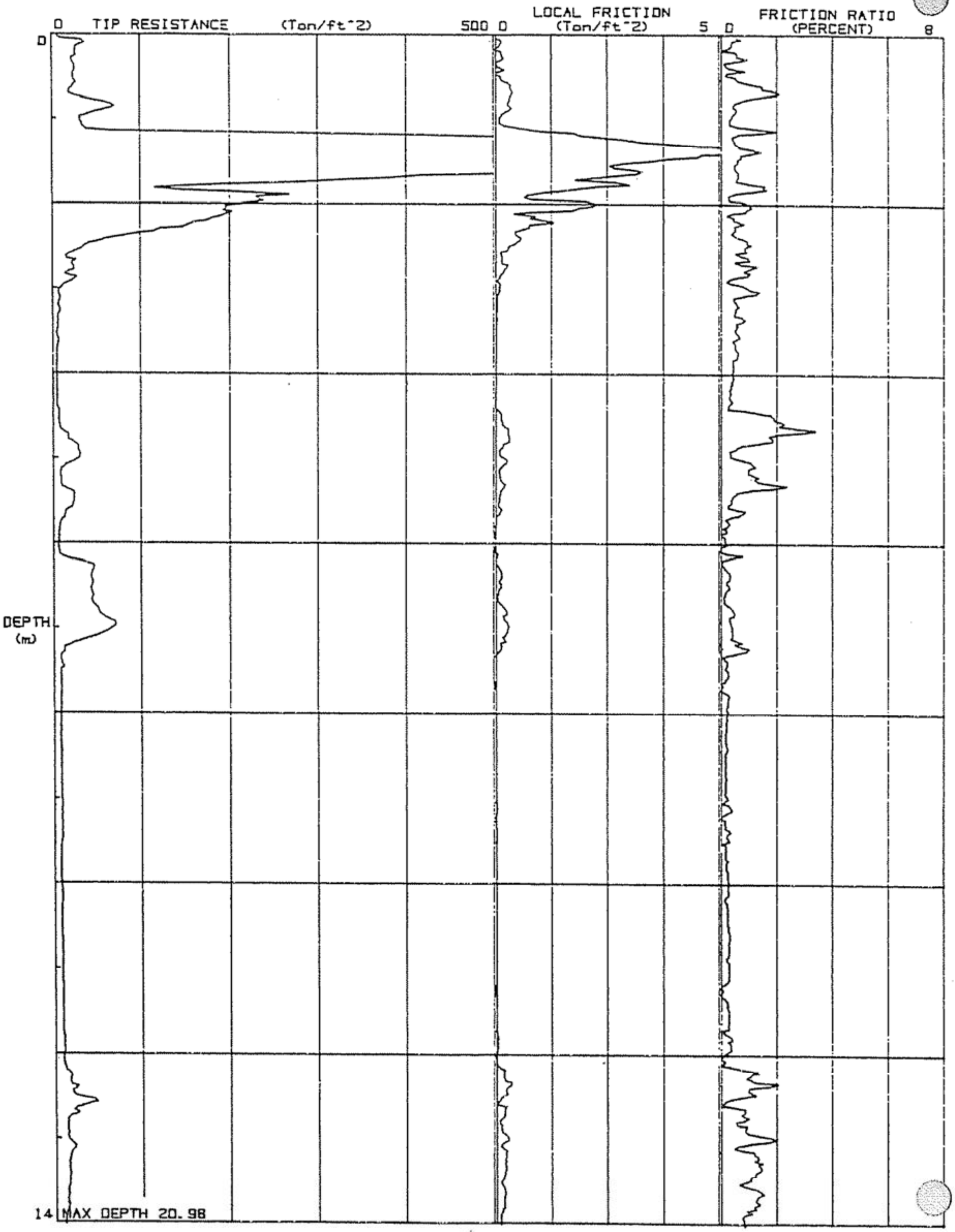
LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.20b

C.P.T. - 1

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 14.9 FT *



* Elevations provided by Psomas and Associates

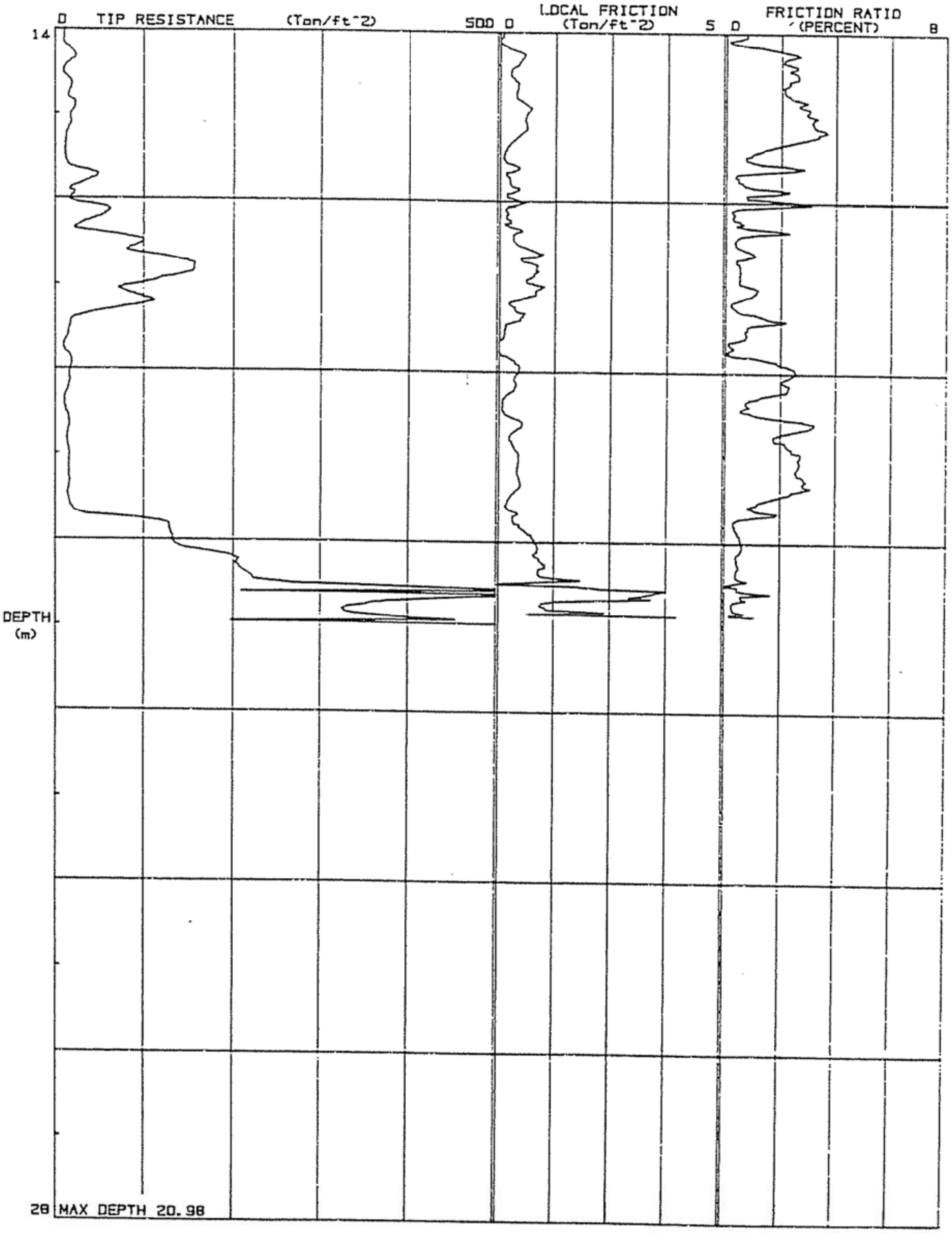
(CONTINUED)

Area A - Law Crandall CPTs

PLATE A2-35

C.P.T. - 1

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 14.9 FT

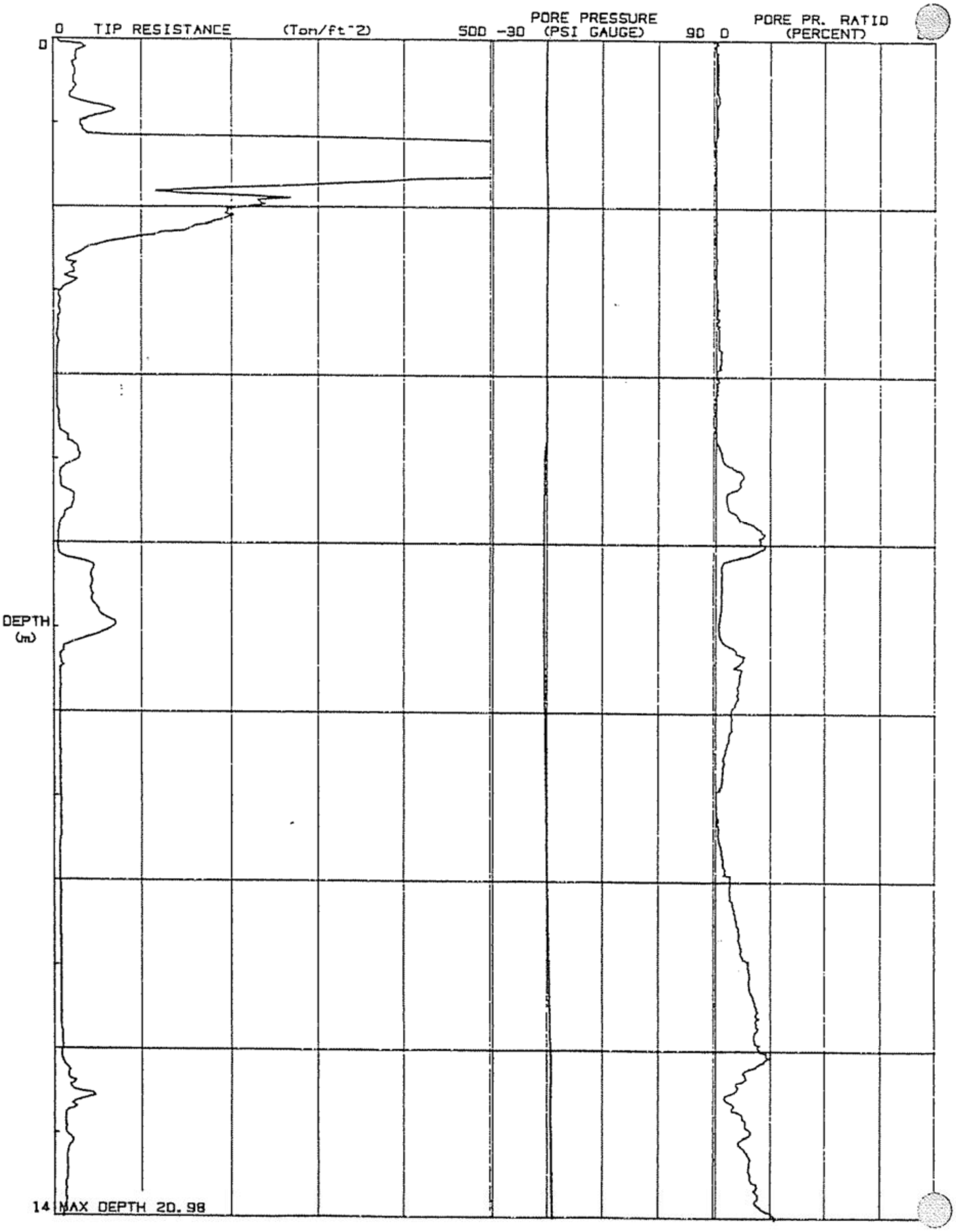


(CONTINUED)
Area A - Law Crandall CPTs

PLATE A2-36

C.P.T. - 1

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 14.9 FT



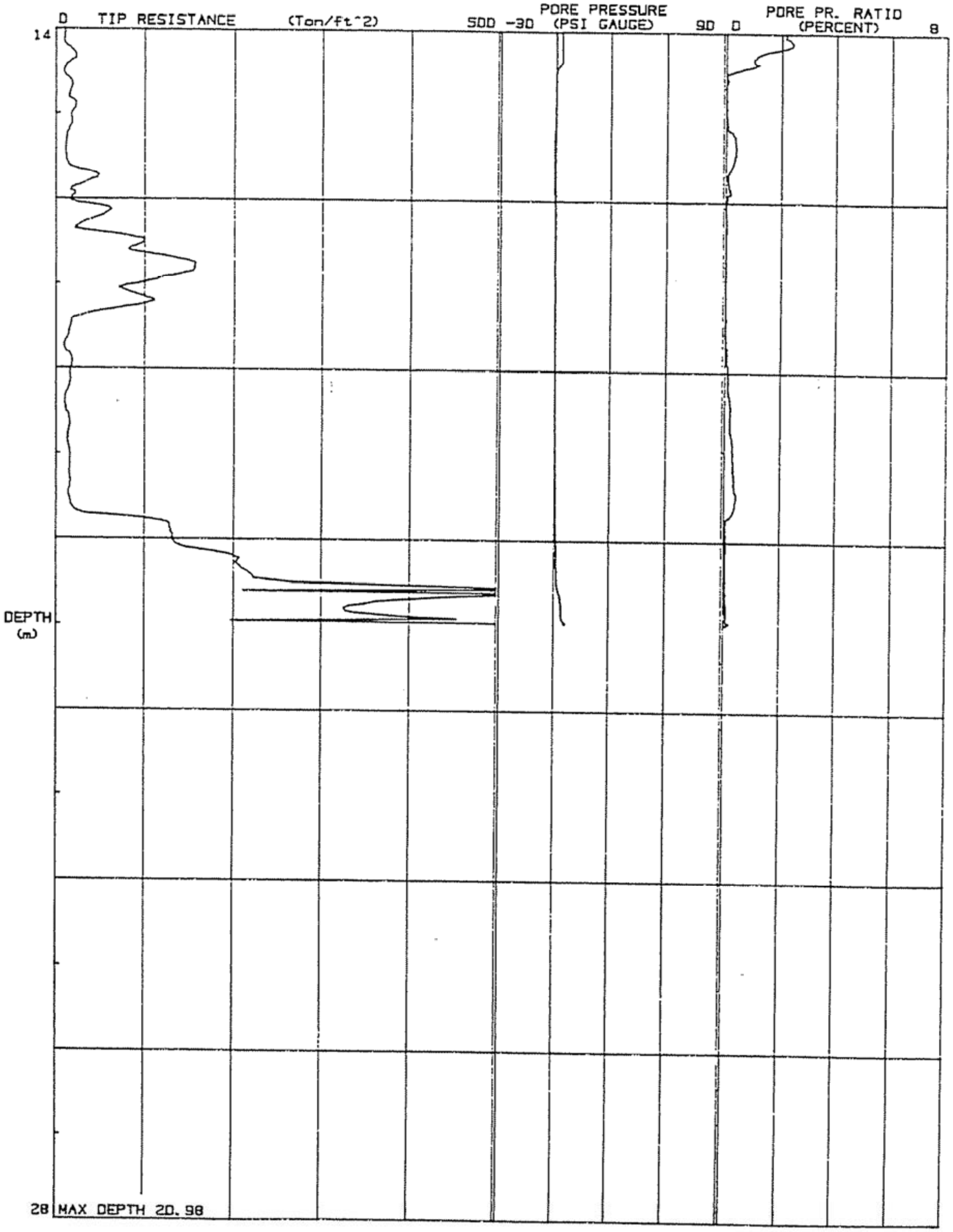
(CONTINUED)

Area A - Law Crandall CPTs

PLATE A2-37

C.P.T. - 1

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 14.9 FT

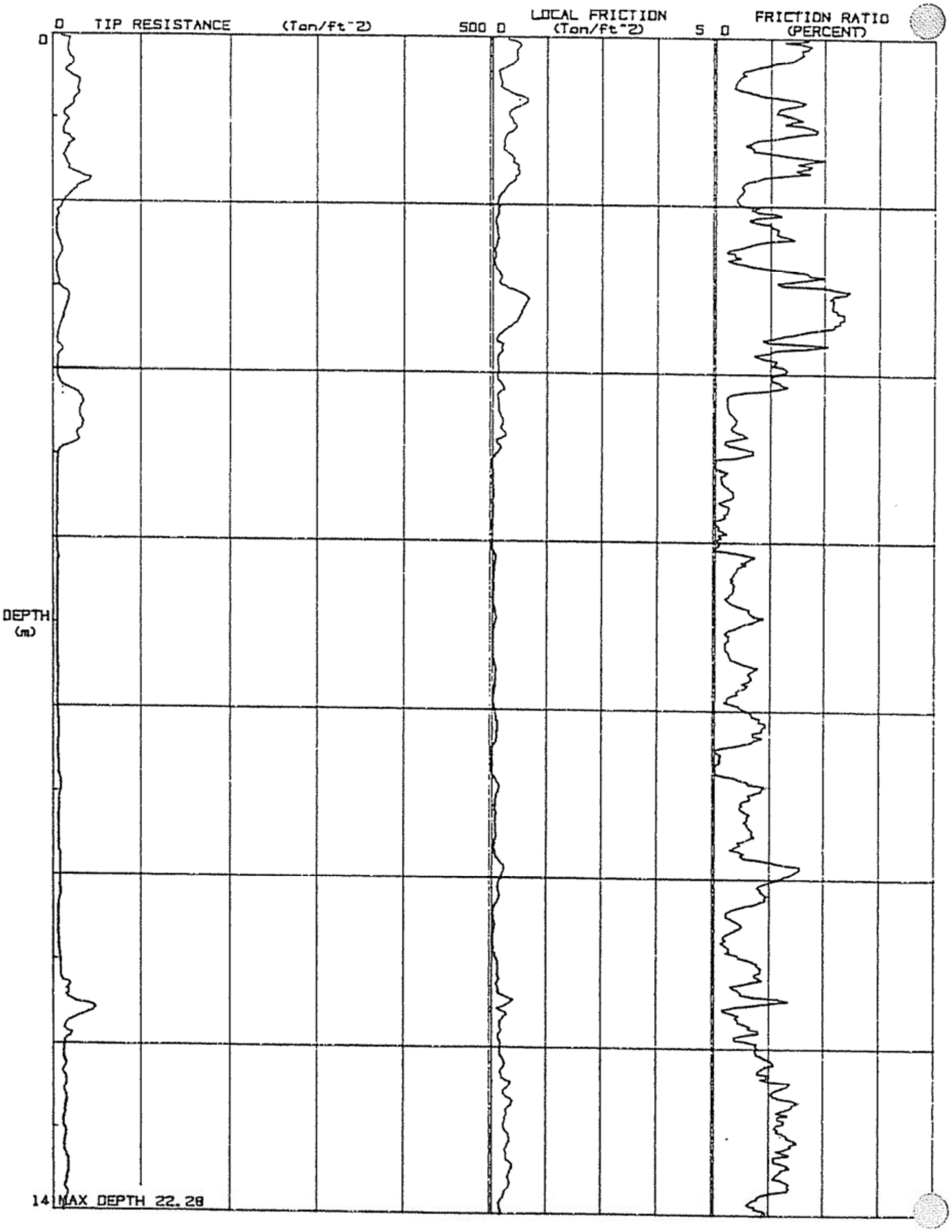


Area A - Law Crandall CPTs

PLATE A2-38

C.P.T. - 14

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 11.8 FT



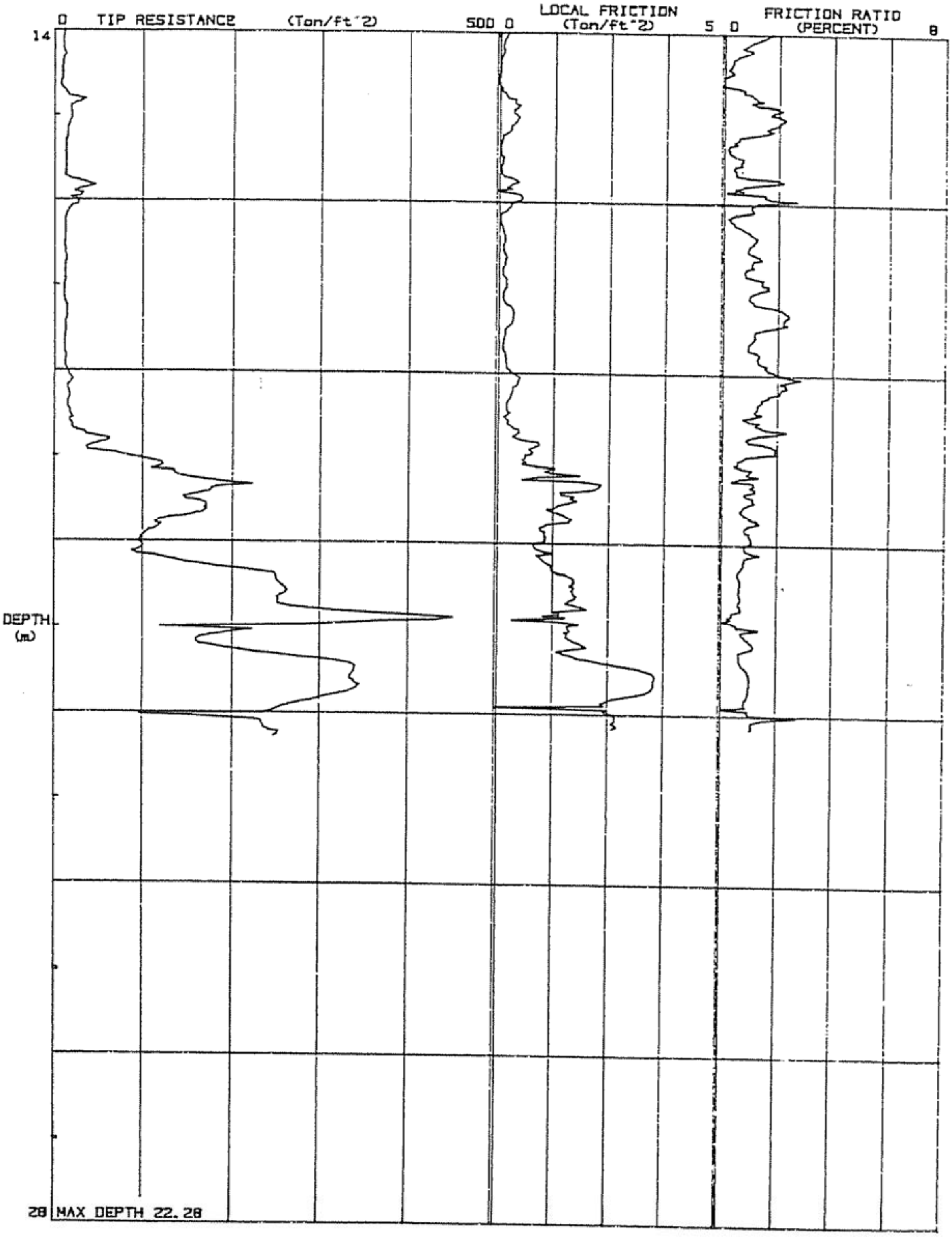
(CONTINUED)

Area A - Law Crandall CPTs

PLATE A2-39

C.P.T. - 14

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 11.8 FT



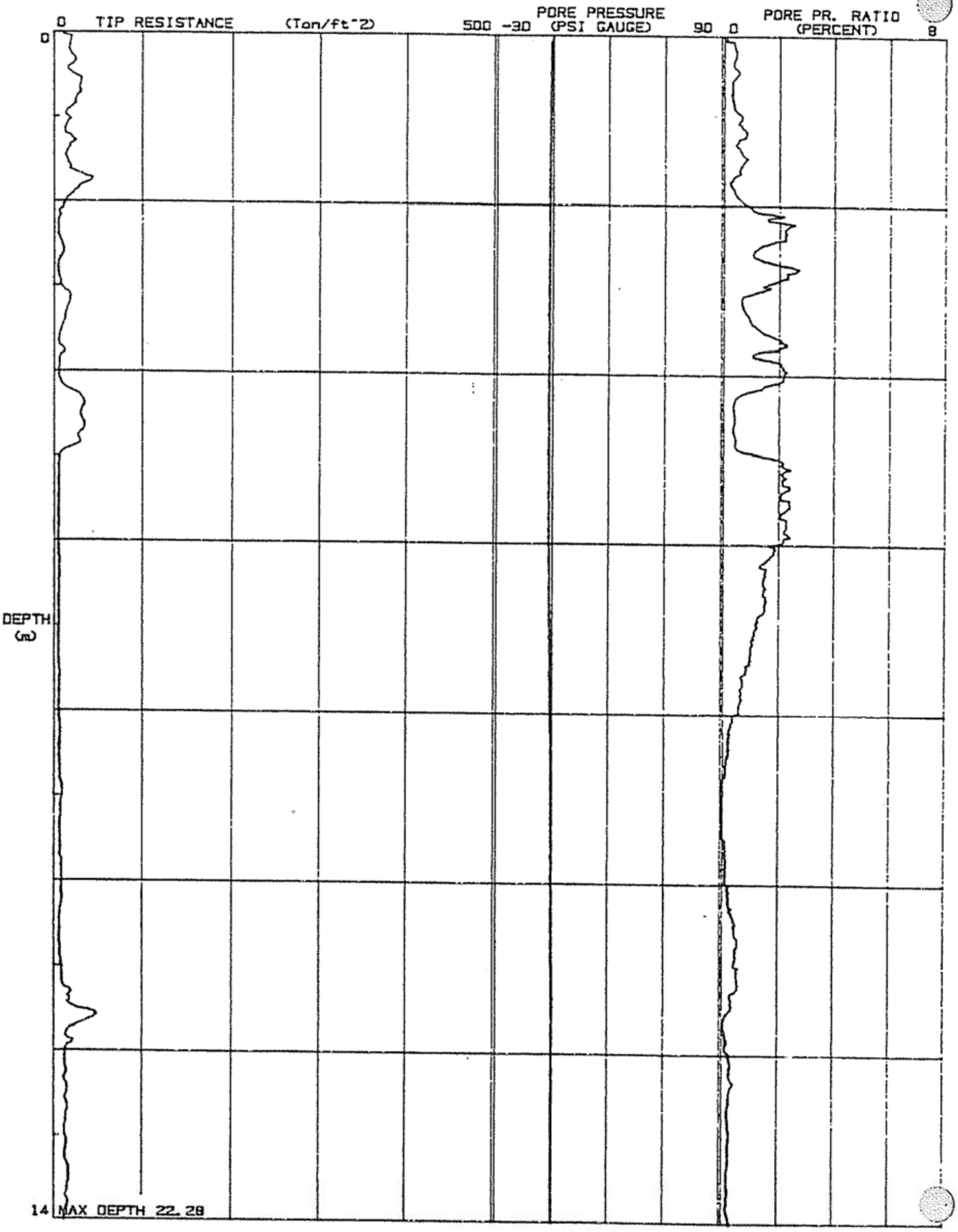
(CONTINUED)

Area A - Law Crandall CPTs

PLATE A2-40

C.P.T. - 14

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 11.8 FT

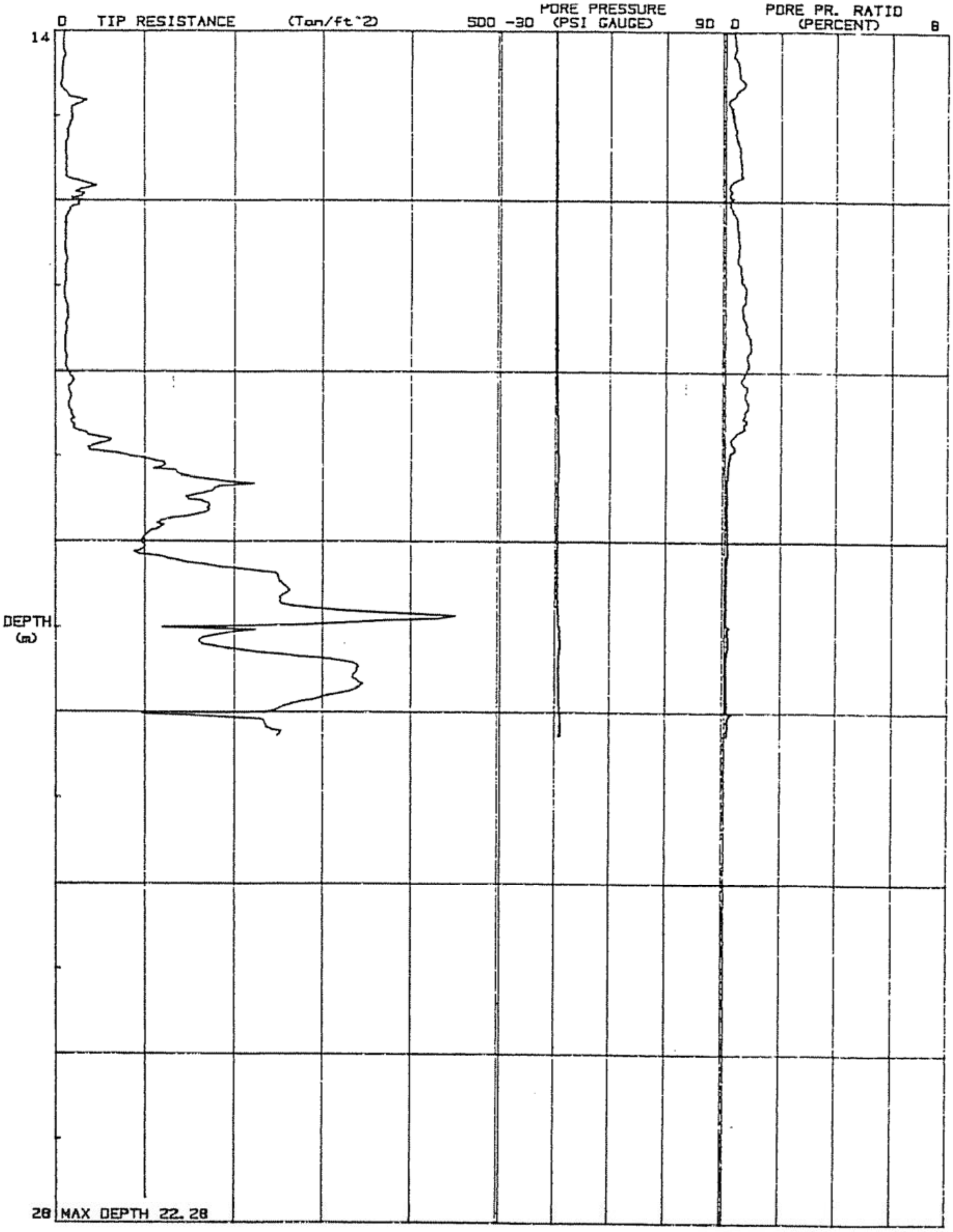


(CONTINUED)
Area A - Law Crandall CPTs

PLATE A2-41

C.P.T. - 14

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 11.8 FT

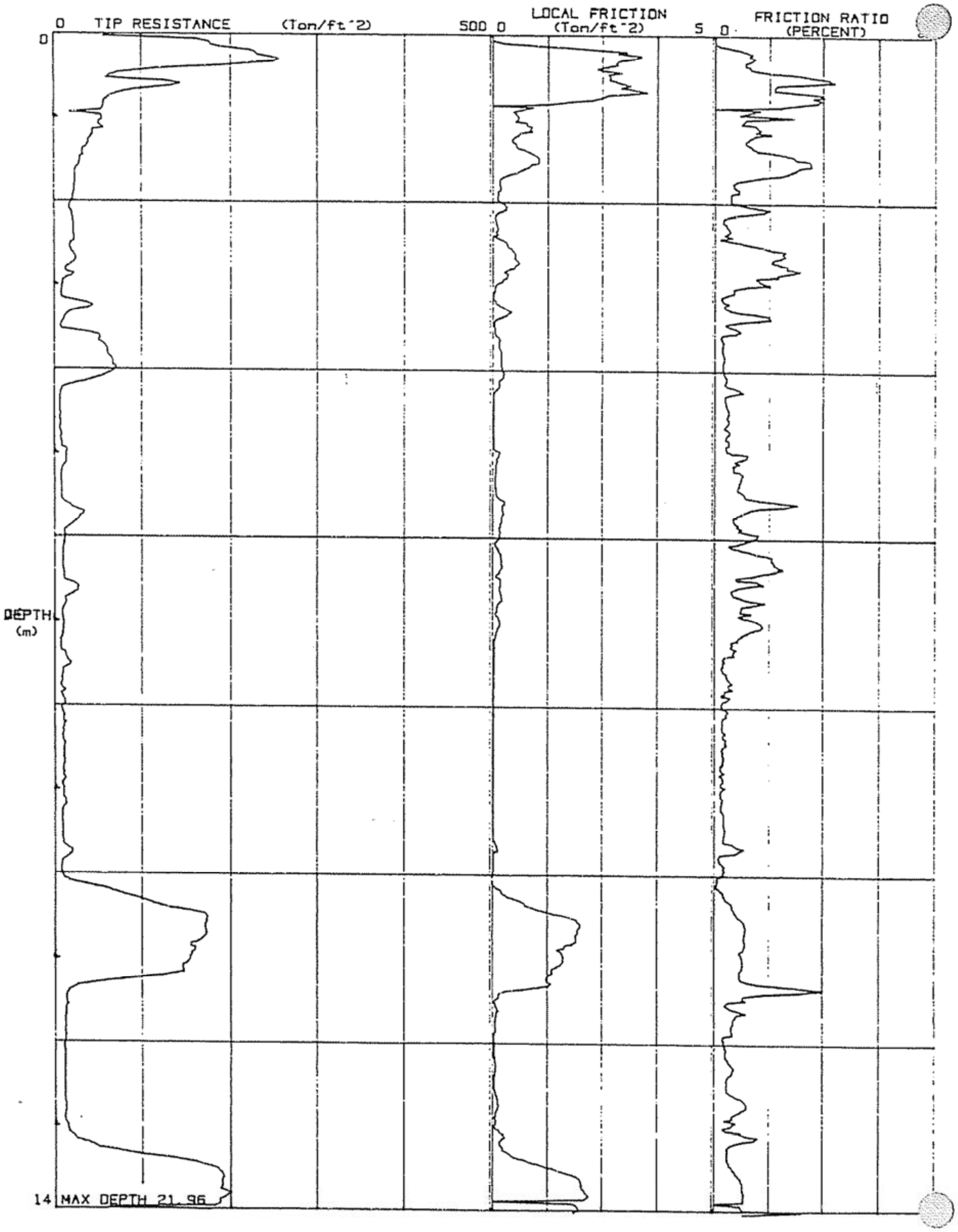


Area A - Law Crandall CPTs

PLATE A2-42

C.P.T. - 17

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 18.2 FT



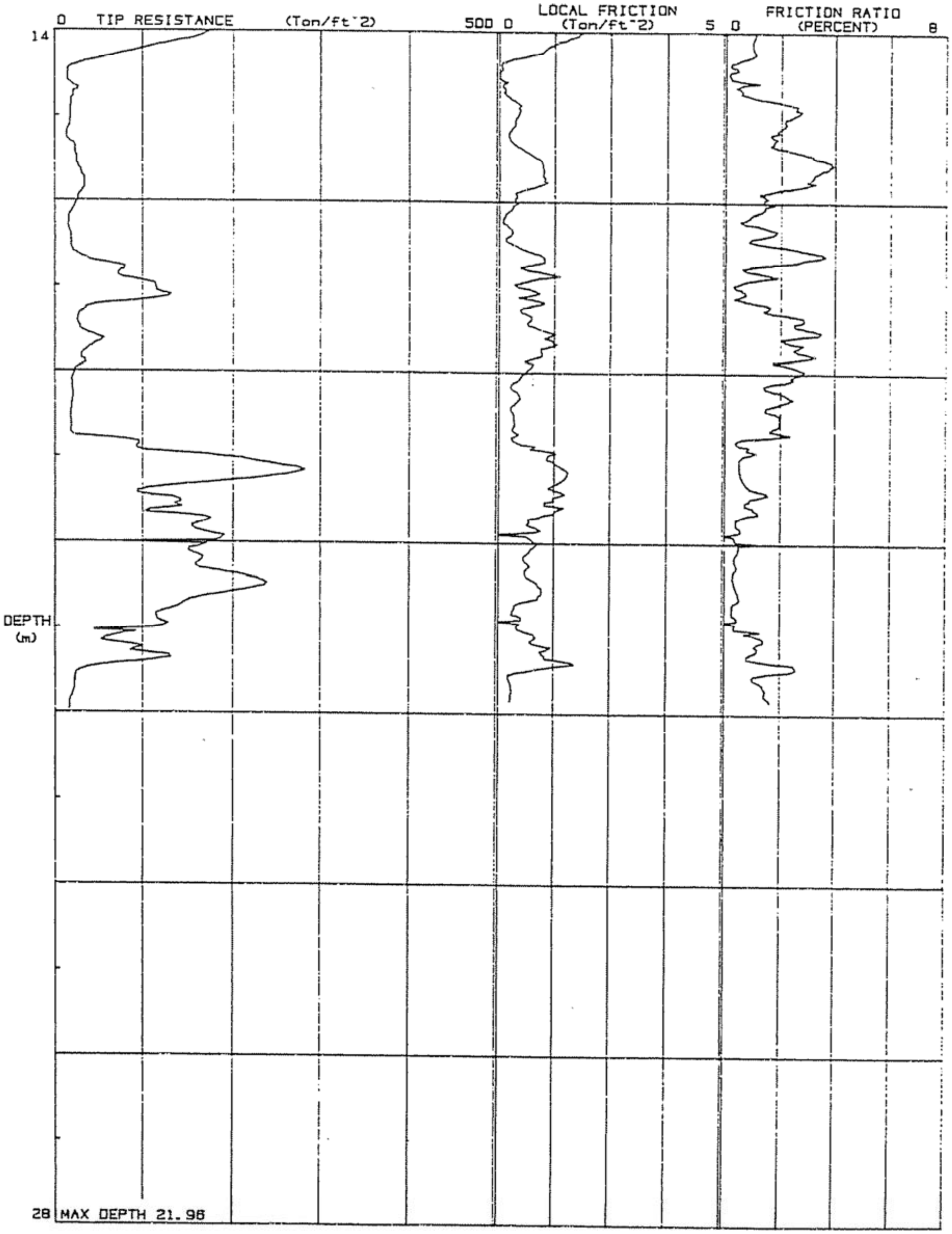
(CONTINUED)

Area A - Law Crandall CPTs

PLATE A2-43

C.P.T. - 17

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 18.2 FT



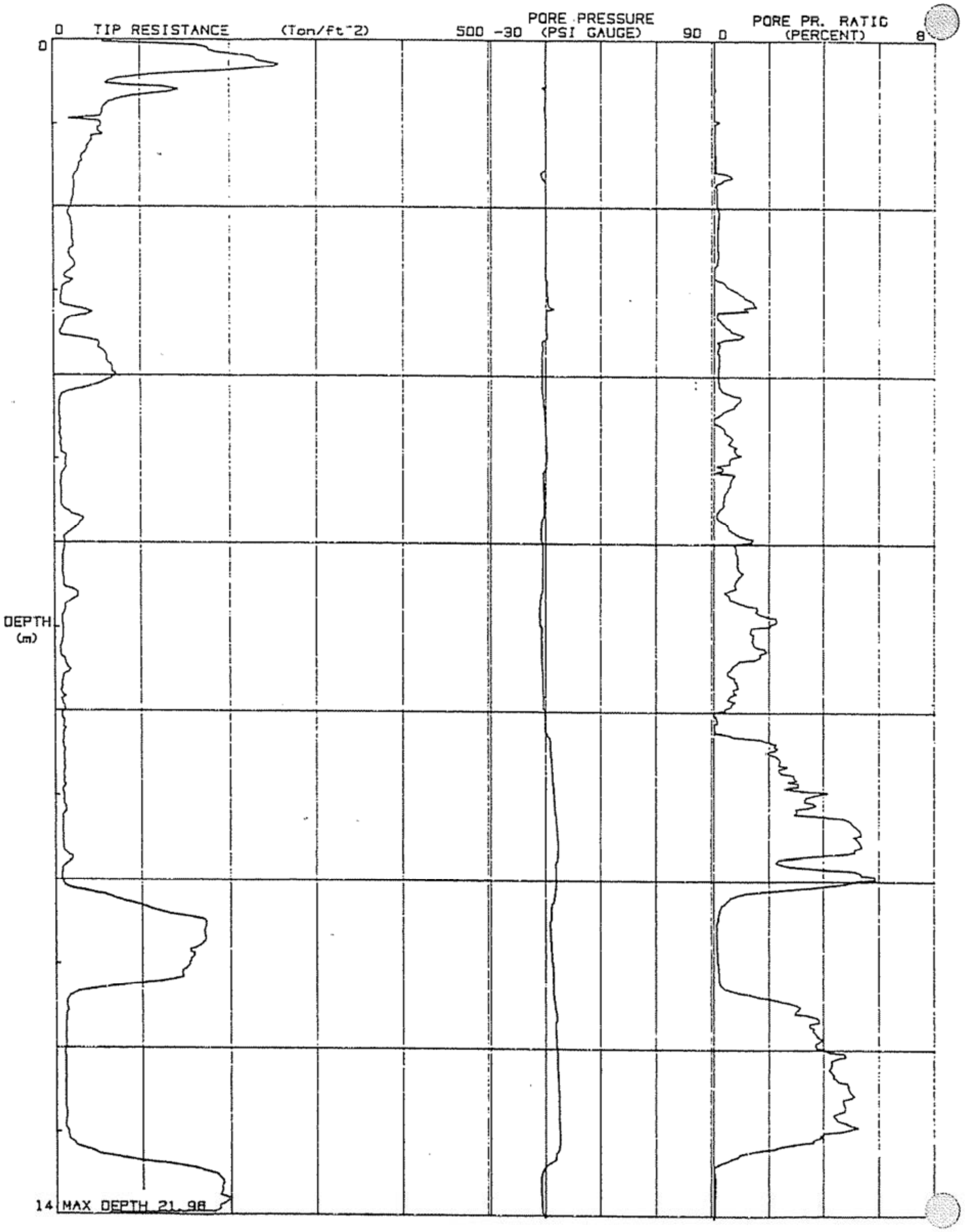
(CONTINUED)

Area A - Law Crandall CPTs

PLATE A2-44

C.P.T. - 17

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 18.2 FT



(CONTINUED)

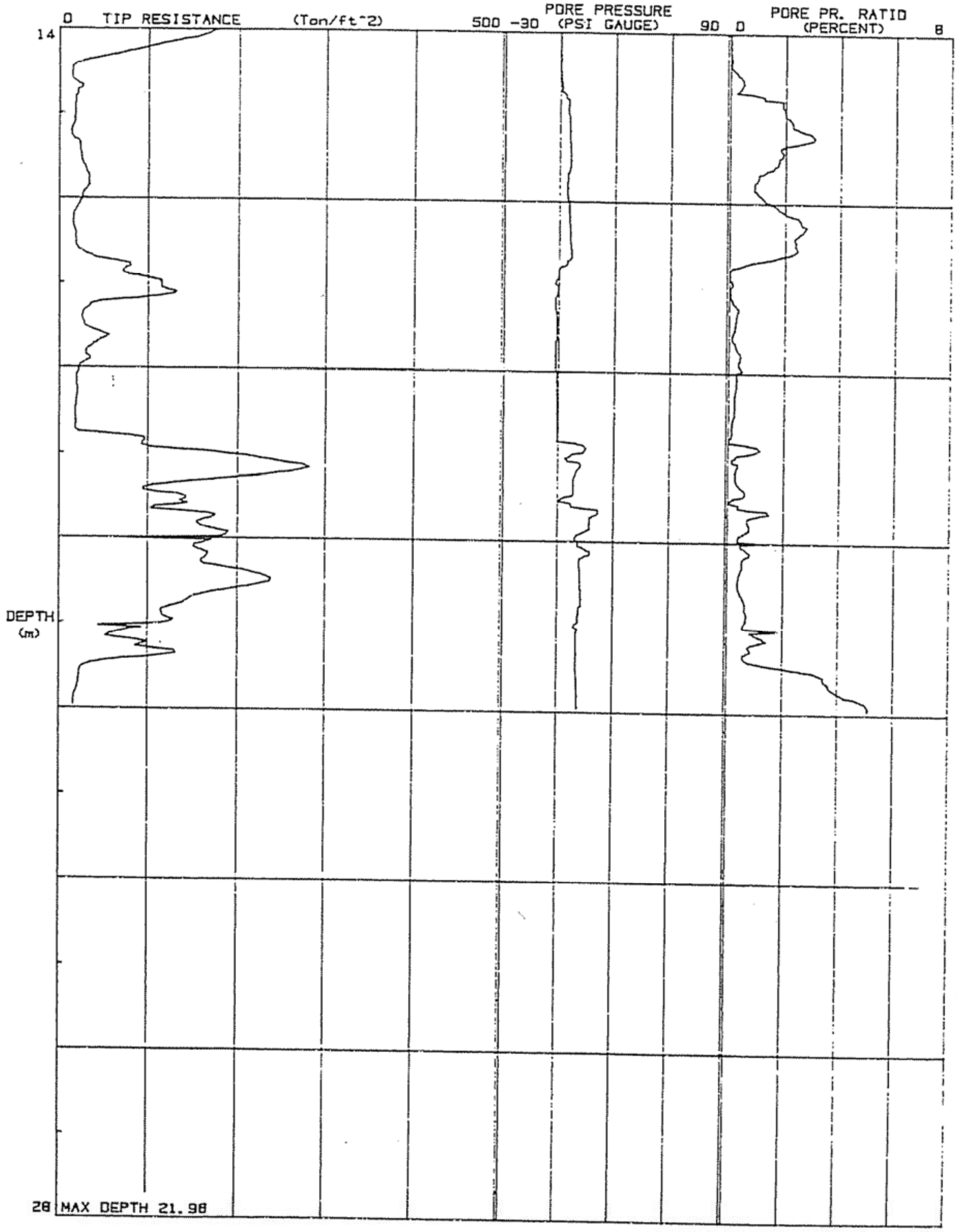
Area A - Law Crandall CPTs

PLATE A2-45

PLATE B-1.3c

C.P.T. - 17

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 18.2 FT



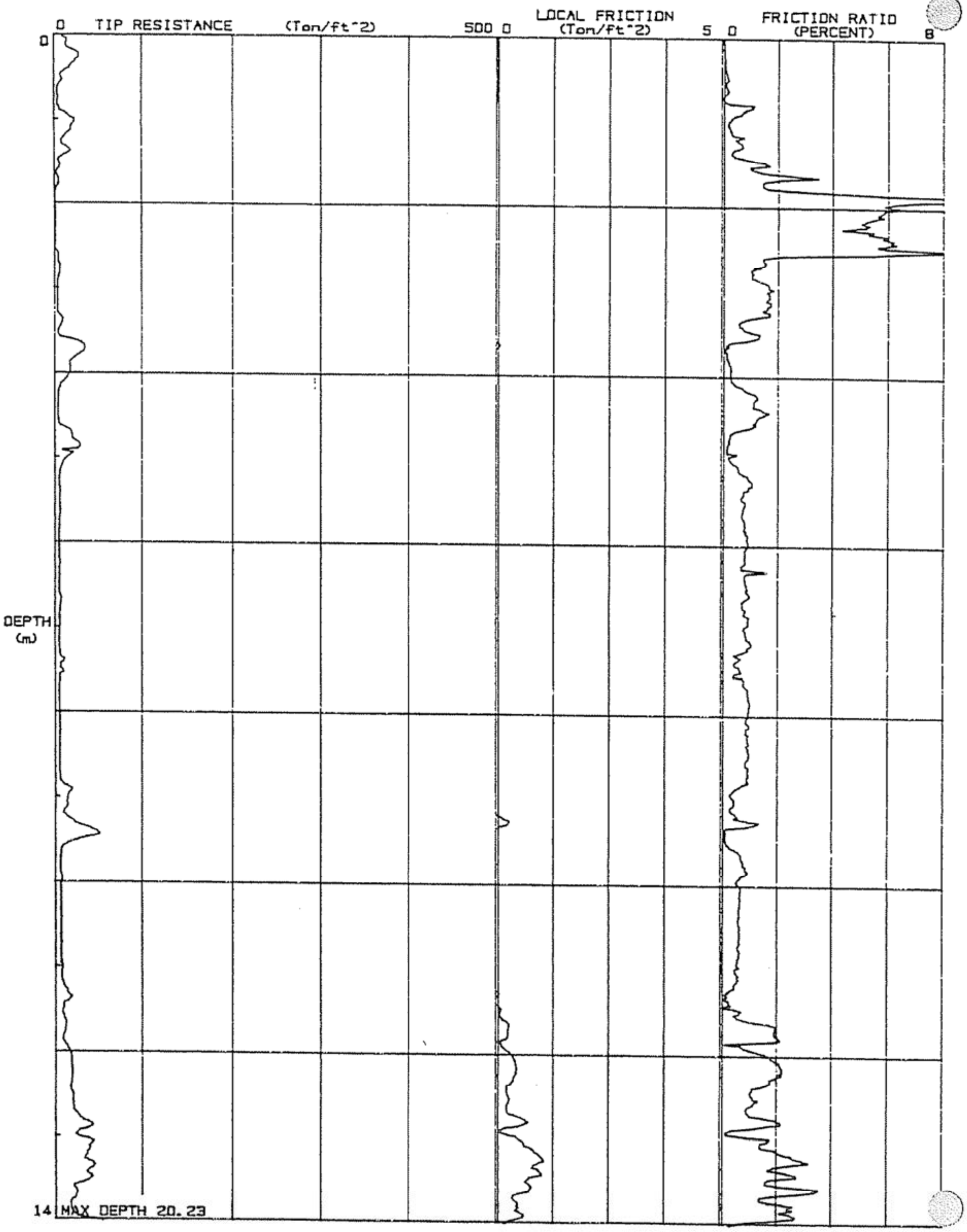
Area A - Law Crandall CPTs

PLATE A2-46

PLATE B-1

C.P.T. - 18

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 12.7 FT



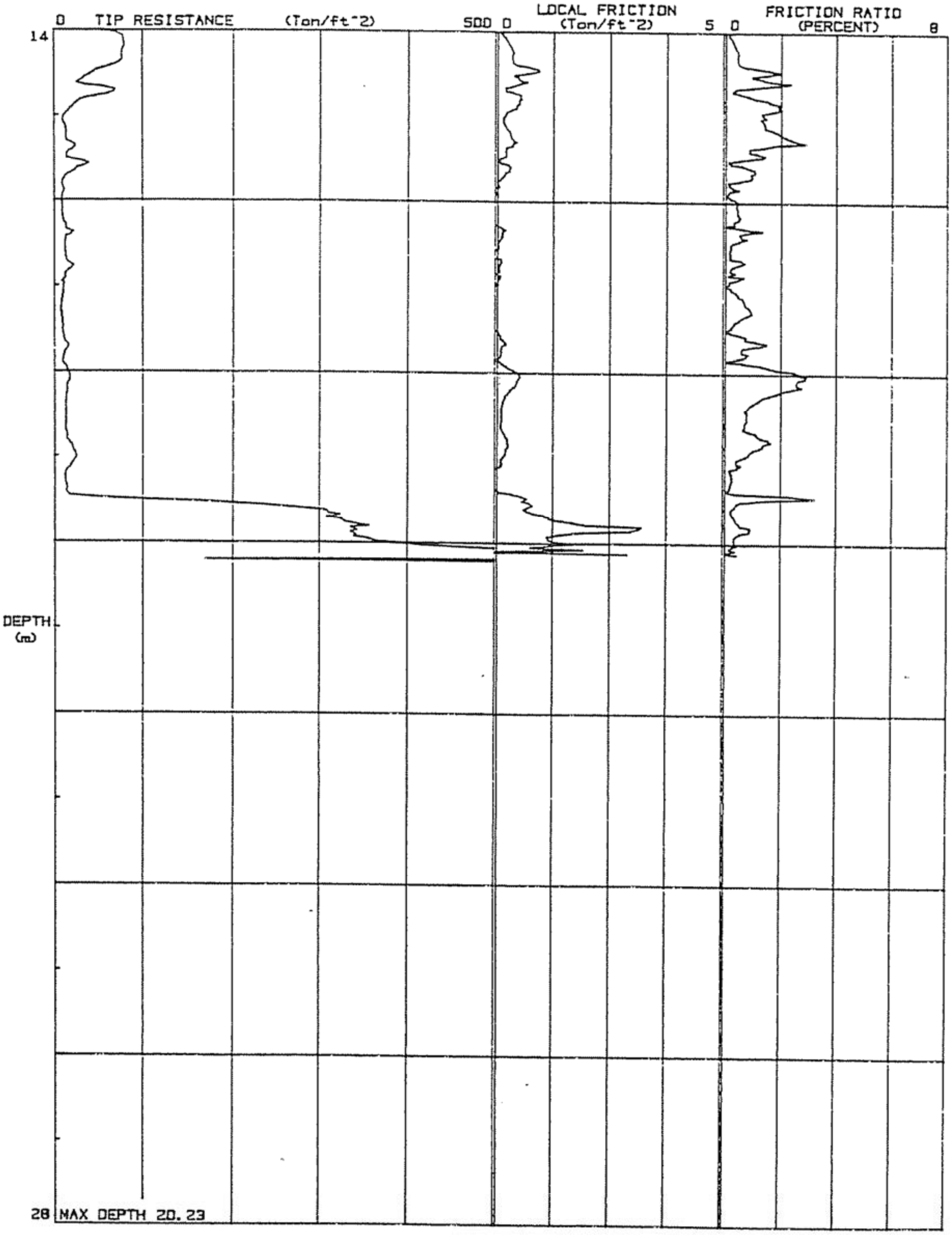
(CONTINUED)

Area A - Law Crandall CPTs

PLATE A2-47

C.P.T. - 18

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 12.7 FT



(CONTINUED)

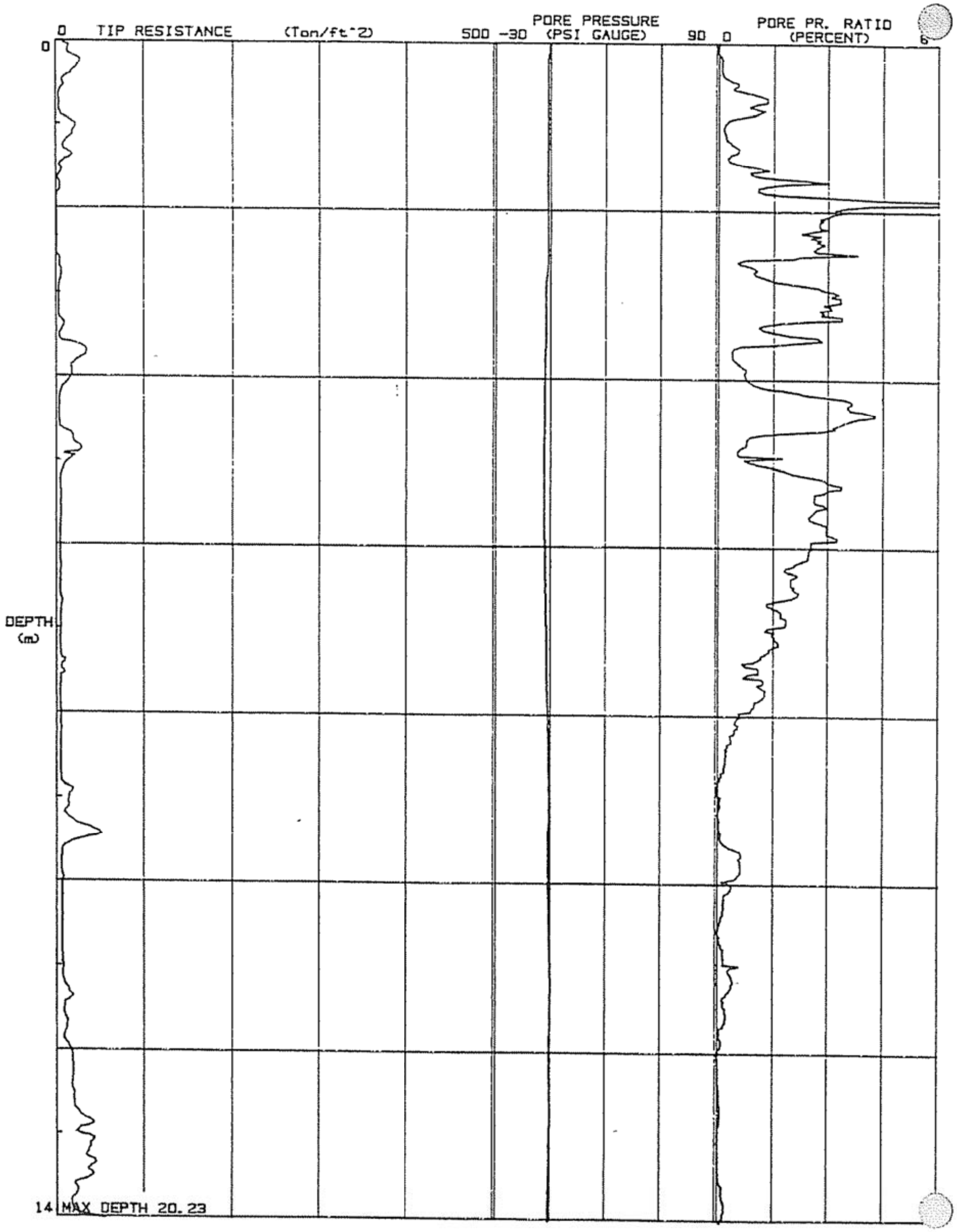
Area A - Law Crandall CPTs

PLATE A2-48

PLATE B-1 AL

C.P.T. - 18

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 12.7 FT

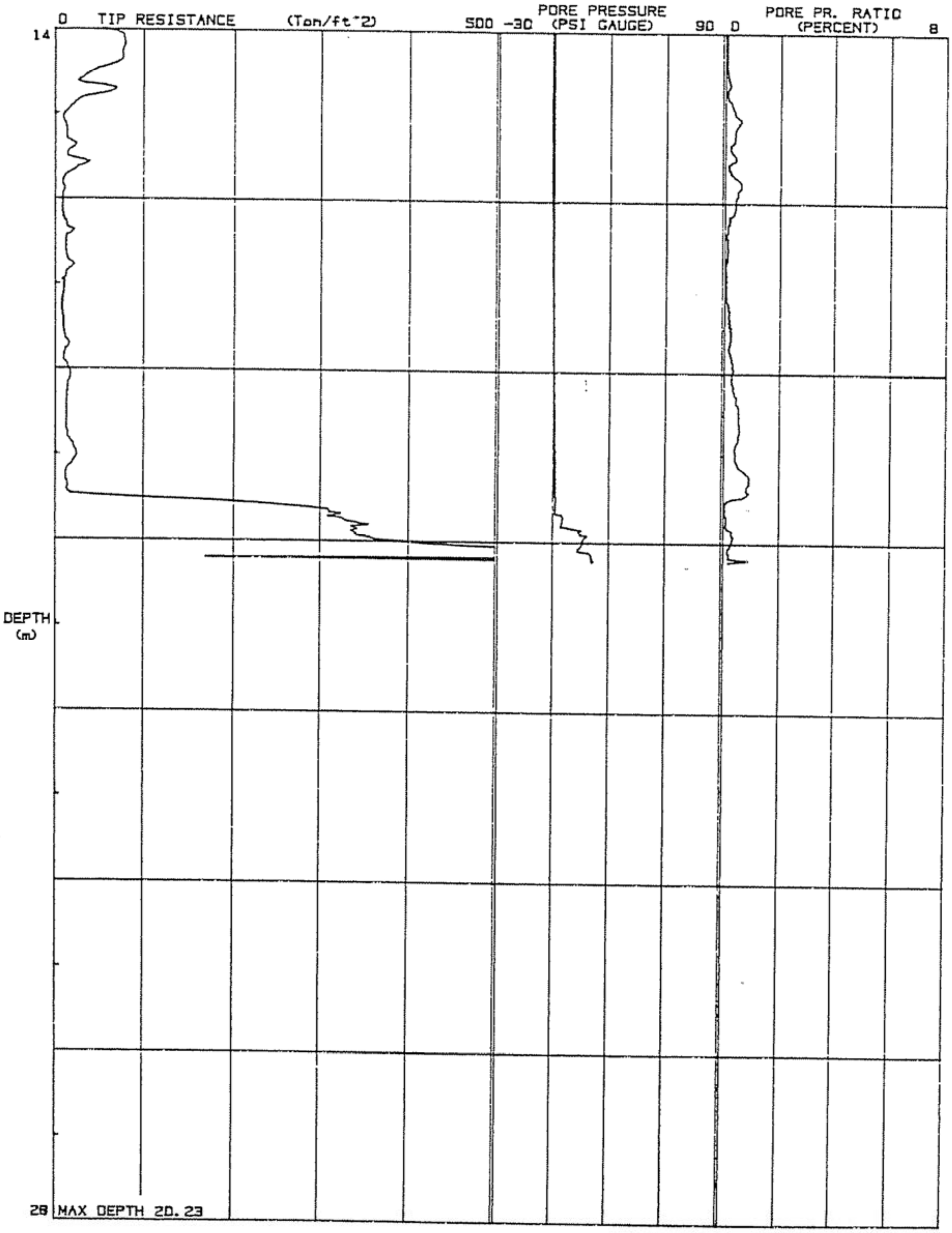


(CONTINUED)
Area A - Law Crandall CPTs

PLATE A2-49

C.P.T. - 18

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 12.7 FT

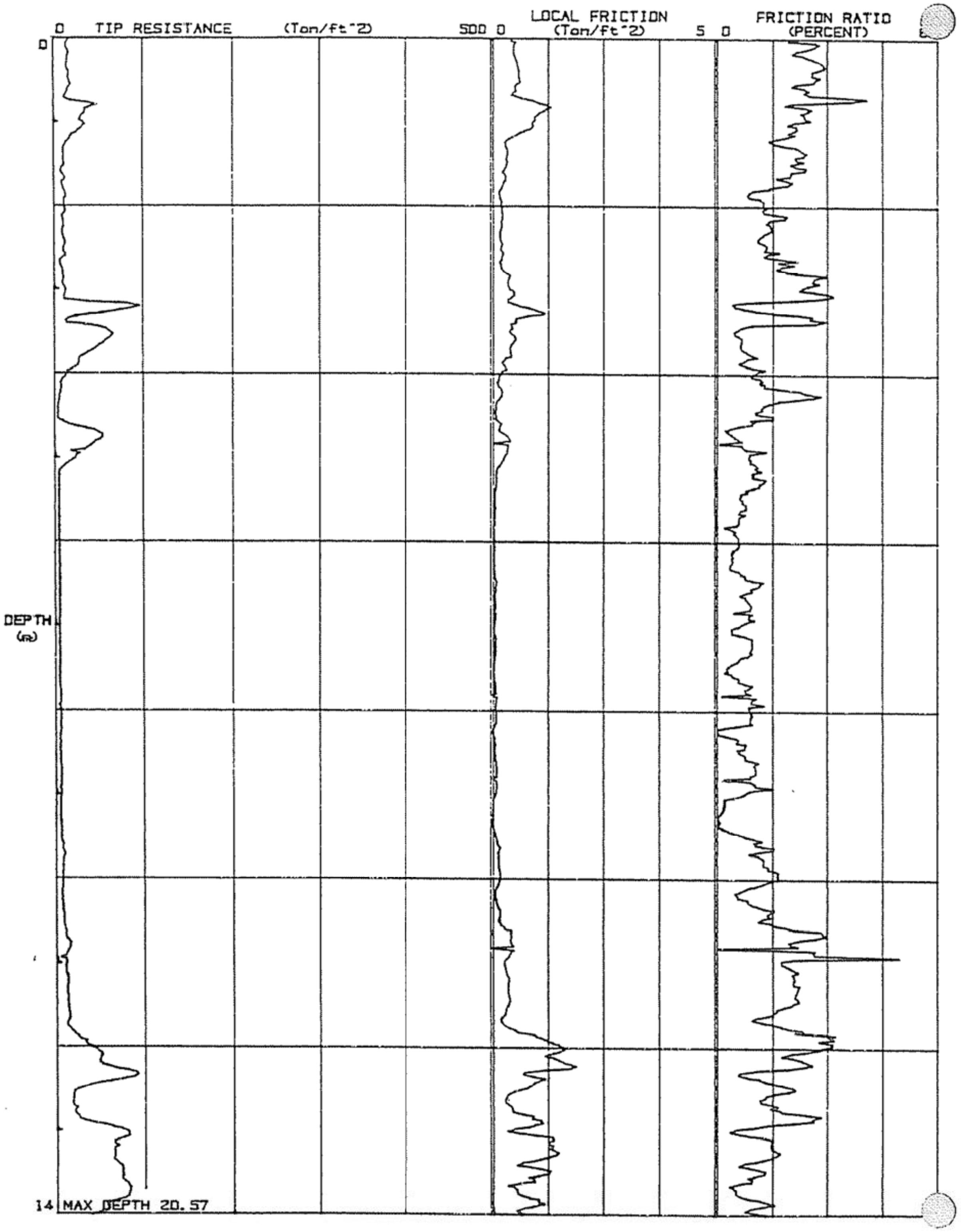


Area A - Law Crandall CPTs

PLATE A2-50

C.P.T. - 20

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 12.3 FT



(CONTINUED)

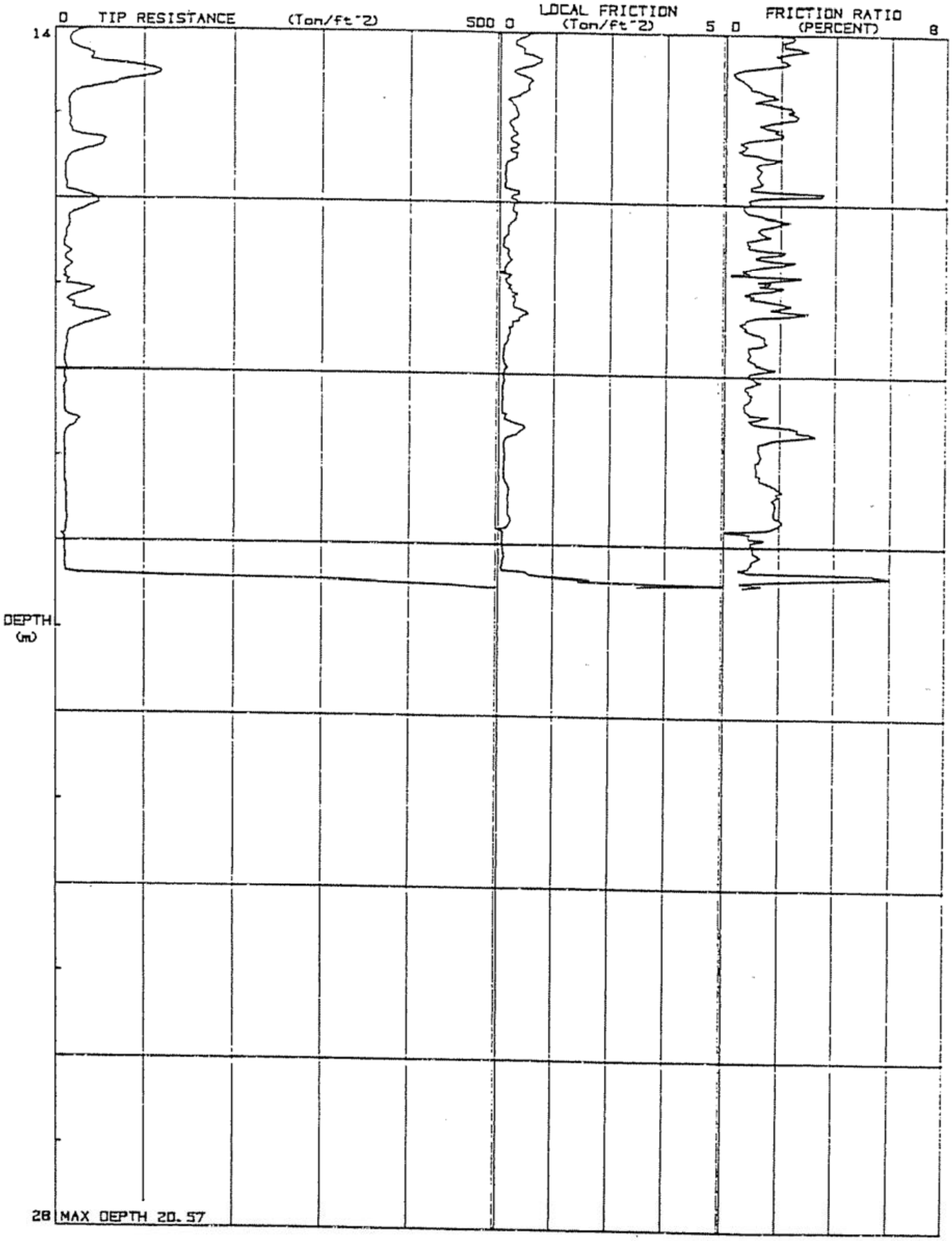
Area A - Law Crandall CPTs

PLATE A2-51

PLATE B-1 5

C.P.T. - 20

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 12.3 FT



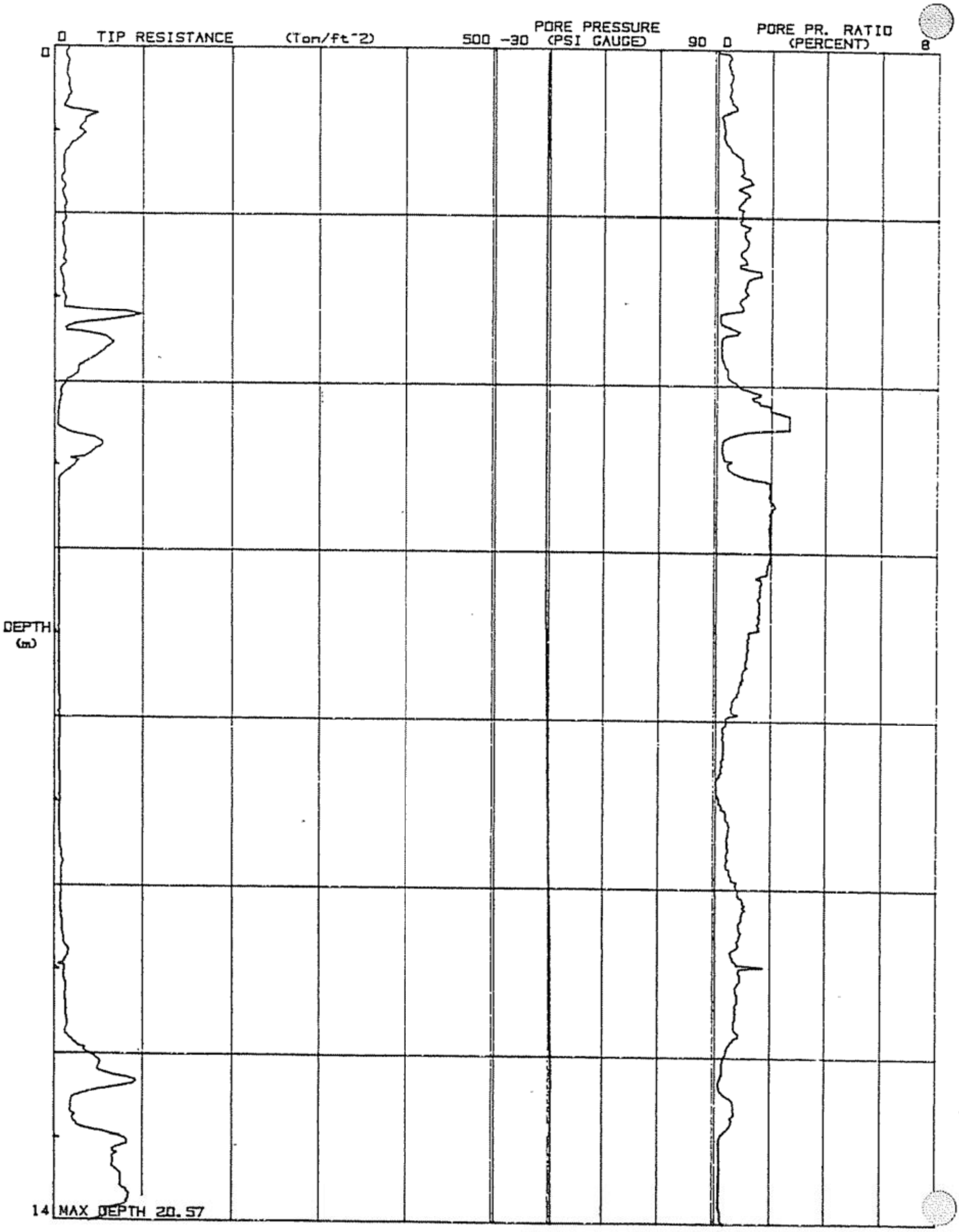
(CONTINUED)

Area A - Law Crandall CPTs

PLATE A2-52

C.P.T. - 20

CLIENT:	HOWARD HUGHES PROPERTIES
JOB NO.	AE-88473
DATE:	JANUARY 30, 1989
ELEVATION:	12.3 FT

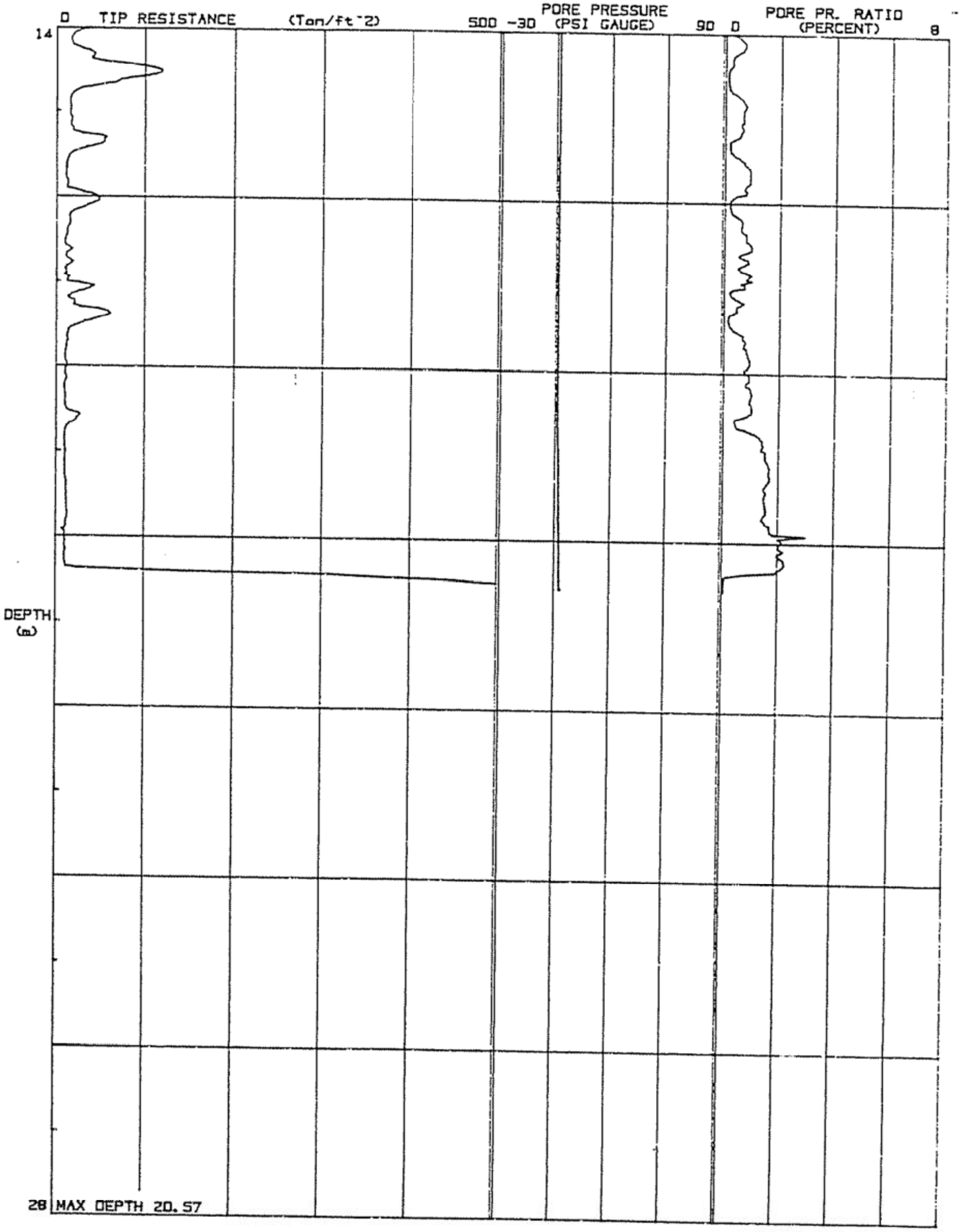


(CONTINUED)
Area A - Law Crandall CPTs

PLATE A2-53

C.P.T. - 20

CLIENT: HOWARD HUGHES PROPERTIES
JOB NO. AE-88473
DATE: JANUARY 30, 1989
ELEVATION: 12.3 FT



Area A - Law Crandall CPTs

PLATE A2-54

PLATE B-1 54

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 1

DATE DRILLED: February 8 &11, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 10.8 *

"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)
	32.8	82	1
	32.5	86	1
	26.8	98	< 1
	56.5	65	< 1
1			
	31.6	90	< 1
4			
	29.7	91	4
14			
	31.5	88	3
14			
	24.2	100	18
23			

ELEVATION (ft.): 10, 5, 0, -5, -10, -15, -20, -25

DEPTH (ft.): 5, 10, 15, 20, 25, 30, 35, 40

CH ML	FILL - FAT CLAY and SILT - some Sand, dark greyish brown Dark grey
	SURFACE OF NATURAL SOIL
MH	ELASTIC SILT - dark grey WATER LEVEL (2/11/91)
ML	SANDY SILT - dark grey
SP	SAND - fine, dark grey Few lenses of Silty Sand

* Elevations and locations provided by Psomas and Associates.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.1a

Area B - Law Crandall Borings

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 1 (Continued)

DATE DRILLED: February 8 &11, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-30			28.5	96	8	■		
		37						
	45							
-35			32.7	89	10	■	ML	SANDY SILT - dark grey
	50	2						
-40							ML	CLAYEY SILT - dark grey
			19.9	109	5	■		
	55						SM	SILTY SAND - fine, dark grey
-45		15						
							SP	SAND - fine, grey
	60		16.7	111	6	■		

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Water level measured at 13-1/2' 15 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A-1.1b

Area B - Law Crandall Borings

PLATE A2-56

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD F H

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 2

DATE DRILLED: February 8, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 11.5

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
10			28.9	92	4	■
	5		26.2	96	2	■
5						
			55.9	68	1	■
	10					
			56.5	66	< 1	■
0						
		1				
	15					
- 5			45.7	72	< 1	■
	20	5				
- 10						
			38.8	81	< 1	■
	25					
		26				
- 15						
			30.2	91	4	■
	30					
- 20		12				
			23.5	107	11	■
	35					
- 25						
		17				
	40					

CL ML	FILL - SILTY CLAY and SILT - some Sand, some seashells, dark brownish grey
	SURFACE OF NATURAL SOIL
CH	FAT CLAY - dark grey
	WATER LEVEL (2/11/91)
MH	ELASTIC SILT - dark grey
ML	SANDY SILT - fine, dark grey
SM	SILTY SAND - fine, dark grey
ML	CLAYEY SILT - dark grey
SP	SAND - fine, dark grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Water level measured at 11-1/2' on 2/11/91. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.2

Area B - Law Crandall Borings

PLATE A2-57

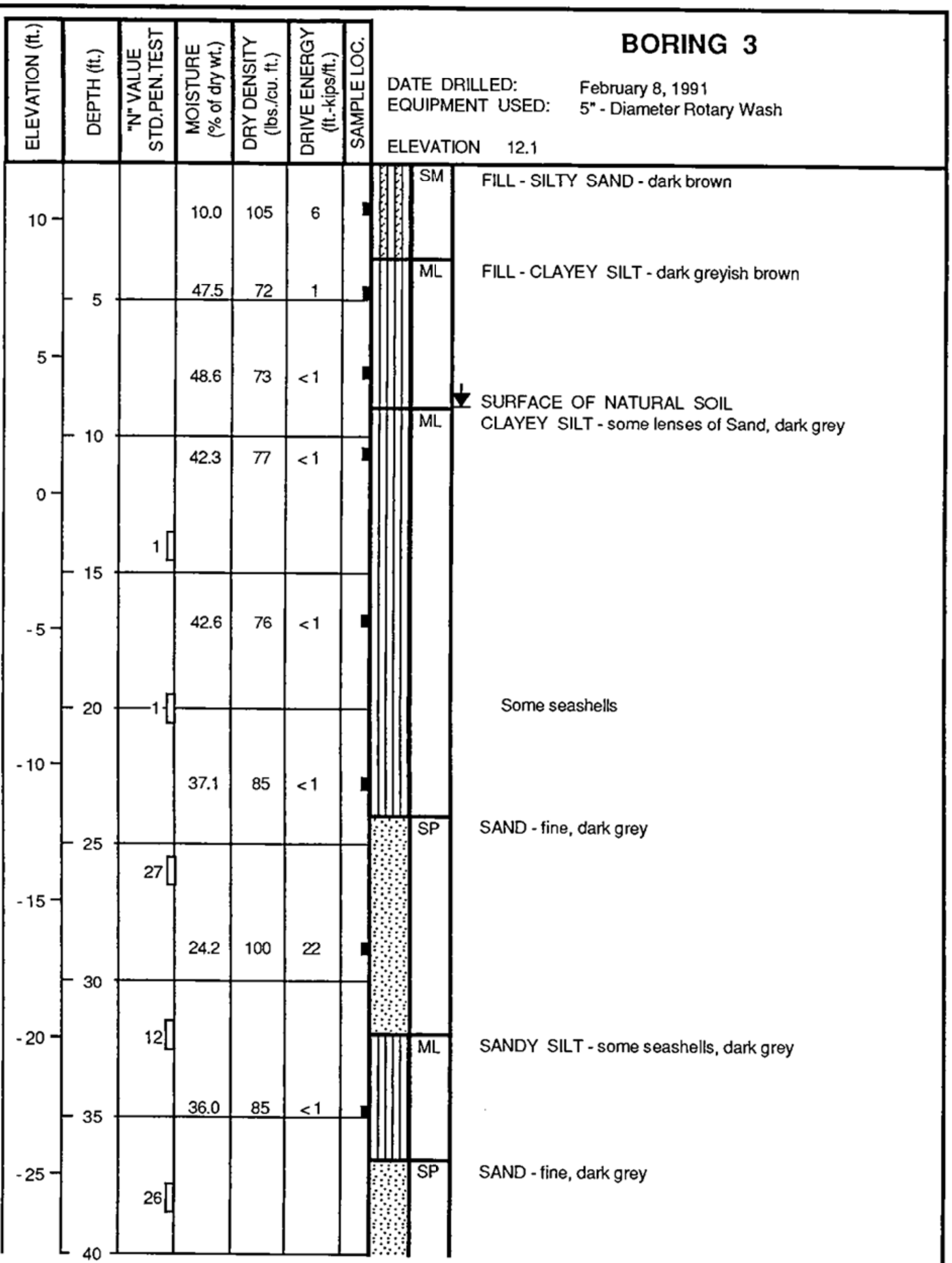
JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 3

DATE DRILLED: February 8, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 12.1



"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)
	10.0	105	6
	47.5	72	1
	48.6	73	< 1
	42.3	77	< 1
1			
	42.6	76	< 1
1			
	37.1	85	< 1
27			
	24.2	100	22
12			
	36.0	85	< 1
26			

SM FILL - SILTY SAND - dark brown

ML FILL - CLAYEY SILT - dark greyish brown

▼ SURFACE OF NATURAL SOIL

ML CLAYEY SILT - some lenses of Sand, dark grey

Some seashells

SP SAND - fine, dark grey

ML SANDY SILT - some seashells, dark grey

SP SAND - fine, dark grey

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.3a

Area B - Law Crandall Borings

PLATE A2-58

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD F-41

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 3 (Continued)

DATE DRILLED: February 8, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
			26.4	97	7	■	ML	CLAYEY SILT - some fine Sand, dark grey
-30								
		2						
	45							
-35			45.5	78	1	■		
	50	10						Layers of Sand
-40								
			27.5	96	3	■		
	55		31.6	92	1	■		
-45								
	60		27.3	95	3	■		

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Water level measured at 13' on 2/11/91. Grouted boring with cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.3b

Area B - Law Crandall Borings

PLATE A2-59

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD FH

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 4

DATE DRILLED: February 4, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash
ELEVATION 13.3

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			23.8	91	2	■
10						
	5		34.6	83	1	■
			50.0	73	< 1	■
5						
	10					
			49.9	70	< 1	■
0						
			43.5	78	1	■
	15					
		4				
-5						
			48.1	73	< 1	■
	20					
		1				
-10						
	25					
			27.4	96	5	■
-15						
		38				
	30					
			27.2	98	18	■
-20						
	35	1				
-25						
	40		22.6	96	10	■

ML FILL - SANDY SILT - some Sand and Clay, dark greyish brown

Greyish brown

ML FILL - CLAYEY SILT - grey

Dark grey

▼ SURFACE OF NATURAL SOIL

ML SILT - some lenses of Sandy Silt, dark grey

Many seashells

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Water level measured at 13-1/2' on 2/11/91. Grouted boring with a cement-bentonite slurry after water level determination.

SM SILTY SAND - fine, dark grey

SP SAND - fine, dark grey

ML CLAYEY SILT - dark grey

SP SAND - fine, dark grey

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.4

Area B - Law Crandall Borings

PLATE A2-60

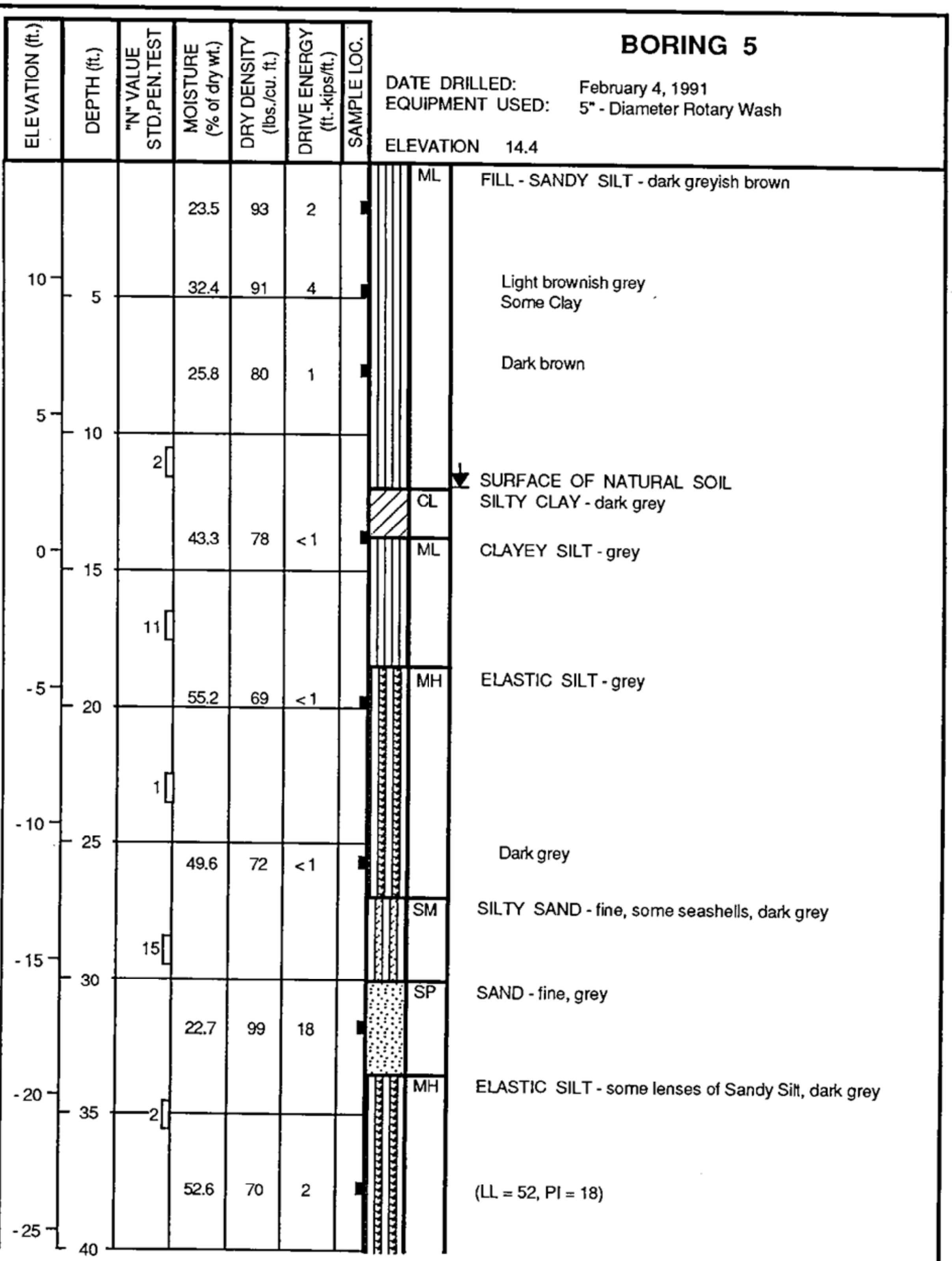
JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD FH

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 5

DATE DRILLED: February 4, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 14.4



"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)
	23.5	93	2
	32.4	91	4
	25.8	80	1
2			
	43.3	78	< 1
11			
	55.2	69	< 1
1			
	49.6	72	< 1
15			
	22.7	99	18
2			
	52.6	70	2

ML	FILL - SANDY SILT - dark greyish brown Light brownish grey Some Clay Dark brown SURFACE OF NATURAL SOIL
CL	SILTY CLAY - dark grey
ML	CLAYEY SILT - grey
MH	ELASTIC SILT - grey Dark grey
SM	SILTY SAND - fine, some seashells, dark grey
SP	SAND - fine, grey
MH	ELASTIC SILT - some lenses of Sandy Silt, dark grey (LL = 52, PI = 18)

(CONTINUED ON FOLLOWING PLATE)

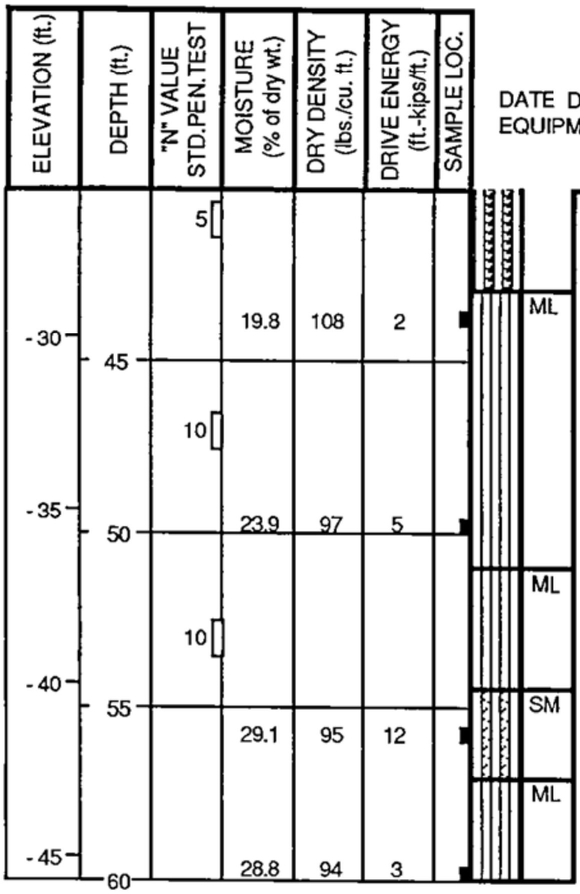
LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.5a

BORING 5 (Continued)

DATE DRILLED: February 4, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash



ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
		5				
			19.8	108	2	■
-30	45					
		10				
-35	50		23.9	97	5	■
		10				
-40	55					
			29.1	95	12	■
-45	60		28.8	94	3	■

ML SANDY SILT - dark grey

ML CLAYEY SILT - dark grey

SM SILTY SAND - fine, some seams of Sandy Silt, dark grey

ML CLAYEY SILT - some Sand, some seashells, dark grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 25' after completion of drilling. Water level measured at 14-1/2' on 2/5/91. Grouted boring with cement-bentonite slurry after water level determination.

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.5b

Area B - Law Crandall Borings

PLATE A2-62

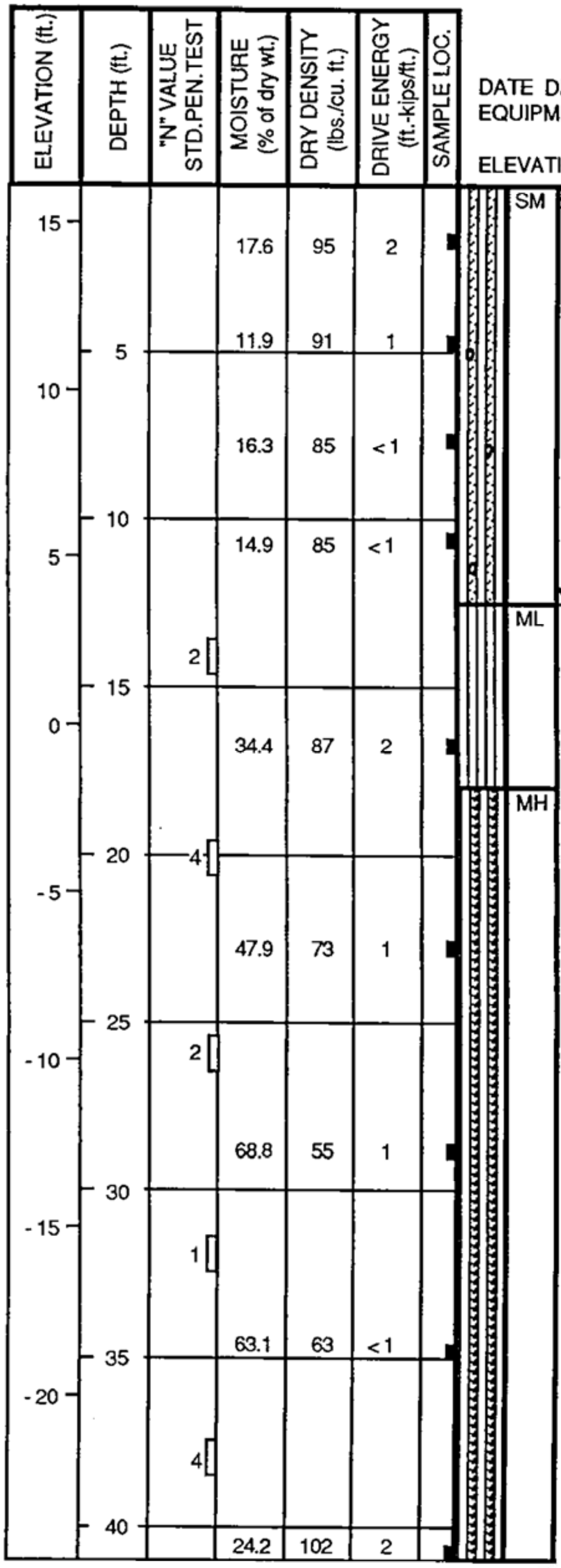
JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 6

DATE DRILLED: February 2, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 16.1



"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)
	17.6	95	2
	11.9	91	1
	16.3	85	< 1
	14.9	85	< 1
2			
	34.4	87	2
4			
	47.9	73	1
2			
	68.8	55	1
1			
	63.1	63	< 1
4			
	24.2	102	2

FILL - SILTY SAND - fine to medium, some Sandy Silt, dark greyish brown

Dark brownish grey
About 10% Gravel

Grey

Brownish grey

SURFACE OF NATURAL SOIL
SANDY SILT - some lenses of Sand, brownish grey

ELASTIC SILT - some lenses of Sand, dark grey

(LL = 52, PI = 18)
Some seashells

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 25' after completion of drilling. Water level measured at 16' on 2/4/91. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.6

Area B - Law Crandall Borings

PLATE A2-63

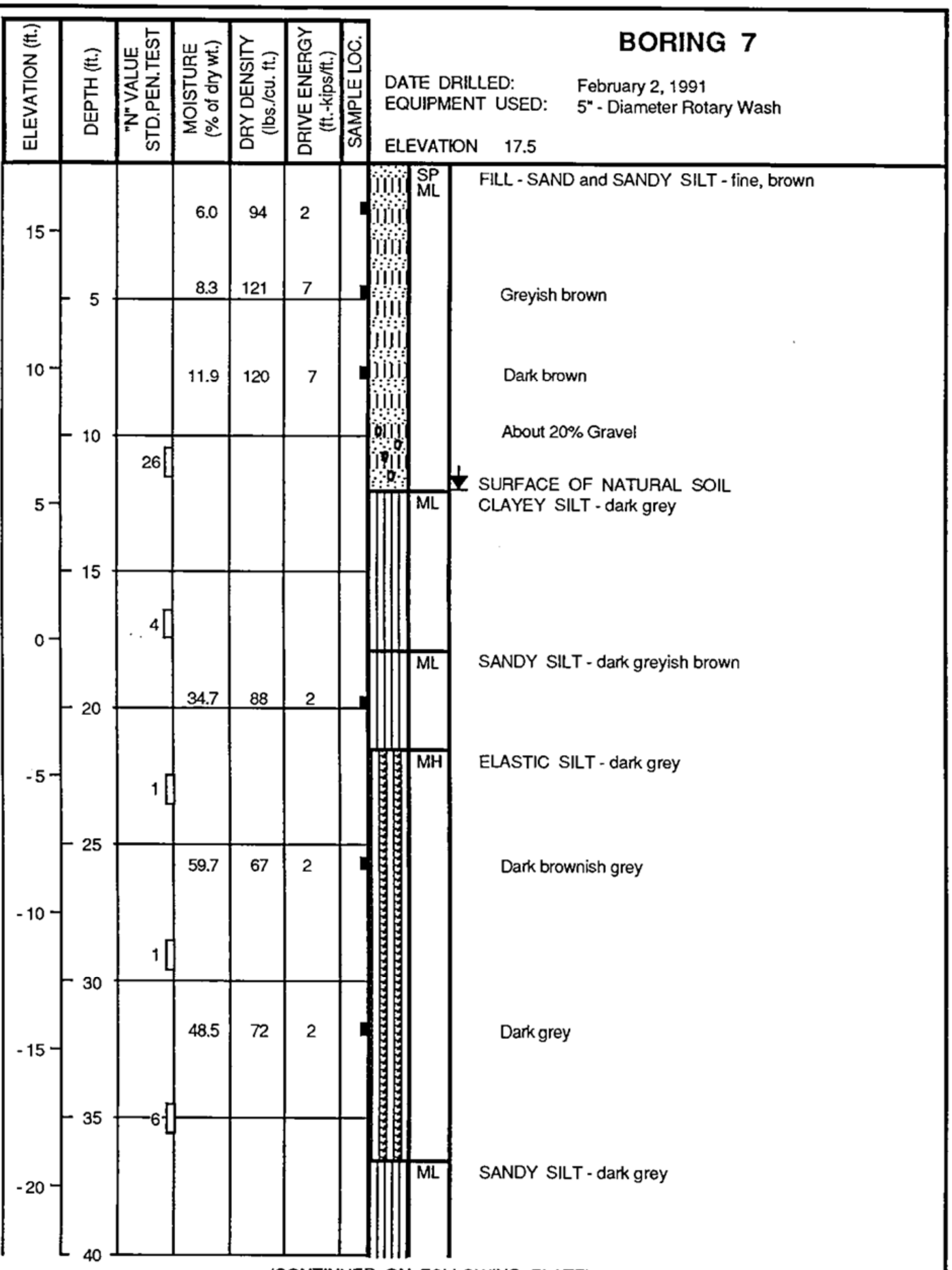
JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 7

DATE DRILLED: February 2, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 17.5



"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)
	6.0	94	2
	8.3	121	7
	11.9	120	7
26			
4			
	34.7	88	2
1			
	59.7	67	2
1			
	48.5	72	2
6			

SP ML — FILL - SAND and SANDY SILT - fine, brown

Greyish brown

Dark brown

About 20% Gravel

SURFACE OF NATURAL SOIL

ML — CLAYEY SILT - dark grey

ML — SANDY SILT - dark greyish brown

MH — ELASTIC SILT - dark grey

Dark brownish grey

Dark grey

ML — SANDY SILT - dark grey

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.7a

Area B - Law Crandall Borings

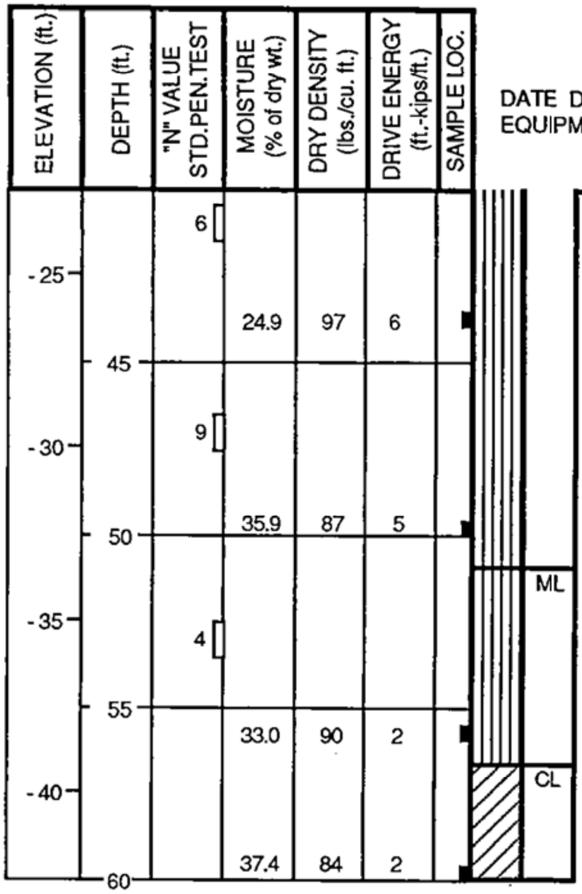
PLATE A2-64

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 7 (Continued)

DATE DRILLED: February 2, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash



Layers of Sand

ML CLAYEY SILT - dark grey

CL SILTY CLAY - dark grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Water level measured at 17' on 2/4/91. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.7b

Area B - Law Crandall Borings

PLATE A2-65

JOB L91028.AEO DATE 3/1/91 F.T. IS DR. ph O.E. JLB W.P. ph CHKD FH

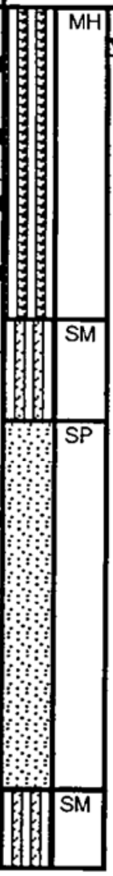
Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 8

DATE DRILLED: January 31, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 2.0

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
0			60.7	66	< 1	■
			68.0	60	< 1	■
	5					
			95.9	47	< 1	■
-5						
			73.0	57	< 1	■
	10					
		0				
-10						
			18.4	105	12	■
	15					
-15						
			22.9	102	11	■
	20					
-20						
			38.9	84	3	■
	25					



ELASTIC SILT - some lenses of fine Sand, mottled grey and dark grey

WATER LEVEL (1/31/91)

Light grey

Some seashells, dark grey

SILTY SAND - fine, dark grey

SAND - fine, grey

Dark grey

SILTY SAND - fine, layers of Sandy Silt, dark grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Water level measured at 1-1/2' 15 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.8

Area B - Law Crandall Borings

PLATE A2-66

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

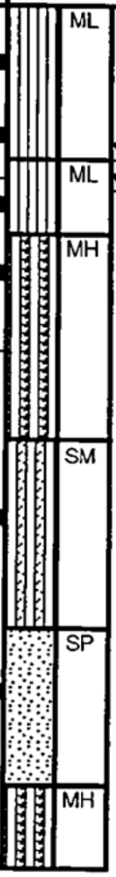
Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 9

DATE DRILLED: January 30, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 3.6

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			44.9	67	1	■
0						
			31.5	92	1	■
	5					
			42.0	81	1	■
			59.7	65	< 1	■
-5						
	10					
		1				
-10						
			28.8	92	< 1	■
	15					
-15						
			25.3	98	11	■
	20					
-20						
			52.3	72	1	■
	25					



ML FILL - CLAYEY SILT - some lenses of fine Sand, dark brownish grey

▼ SURFACE OF NATURAL SOIL

ML SANDY SILT - some seashells, dark brownish grey

▽ WATER LEVEL (1/31/91)

MH ELASTIC SILT - dark brownish grey

SM SILTY SAND - fine, dark grey

SP SAND - fine, grey

MH ELASTIC SILT - dark grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Water level measured at 5-1/2' 15 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A-1.9

Area B - Law Crandall Borings

PLATE A2-67

JOB L91028.AEO DATE 3/1/91 F.T. LS/AR DR. ph O.E. JLB W.P. ph CHKD FH

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 10-A

DATE DRILLED: February 12, 1991
EQUIPMENT USED: 8" - Diameter Hand Auger

ELEVATION 3.8

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			6.0	106		▪
			50.6	71		▪
0						
	5		69.9	57		▪
-5						
	10					

ML SP FILL - SANDY SILT and SAND - brown

SURFACE OF NATURAL SOIL

CH FAT CLAY - dark grey

MH ELASTIC SILT - grey

NOTE: Water level measured at 4-1/2' after completion of drilling. No caving.

BORING 10

DATE DRILLED: February 1, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 4.7

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			7.2	111	5	▪
			66.1	62	< 1	▪
0	5					
			60.8	64	< 1	▪
			54.8	68	< 1	▪
-5	10					
		1				
- 10	15		41.8	81	< 1	▪
- 15	20		24.2	100	12	▪

SM SP FILL - SILTY SAND and SAND - fine, light brown

SURFACE OF NATURAL SOIL

MH ELASTIC SILT - some layers of Sandy Silt, dark grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Water level measured at 6' 10 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

Some seashells

SP SAND - fine, grey

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.10

Area B - Law Crandall Borings

PLATE A2-68

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 11-A

DATE DRILLED: February 12, 1991
EQUIPMENT USED: 8" - Diameter Hand Auger

ELEVATION 3.8

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			5.9	97		■
			57.1	65		■
0						
	5		56.5	67		■
-5						
	10					

SM SP — FILL - SILTY SAND and SAND - fine to medium, mottled light brown and brown

SURFACE OF NATURAL SOIL

CH — FAT CLAY - dark grey

MH — ELASTIC SILT - some seashells, grey

NOTE: Water level measured at 4' after completion of drilling. No caving.

BORING 11

DATE DRILLED: January 31, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 7.2

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
5			36.8	80	2	■
	5		40.7	80	< 1	■
0						
		1				
	10					
			53.3	68	< 1	■
-5						
		0				
	15					
			89.1	51	< 1	■
-10						
	20	4				

CL ML — FILL - SILTY CLAY and SILT - mottled grey and brown

SURFACE OF NATURAL SOIL

MH — ELASTIC SILT - mottled light grey and grey

Some seashells

ML — SANDY SILT - dark grey

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.11a

Area B - Law Crandall Borings

PLATE A2-69

JOB 1.91028.AEO DATE 3/15/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD FH

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 11 (Continued)

DATE DRILLED: January 31, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-15						
			27.3	94	10	■
	25					
		10				
-20						
			49.8	72	1	■
	30					
		4				
-25						
			30.7	90	2	■
	35					
-30						
		2				
	40					
			21.1	106	2	■
-35						
		0				
	45					
			26.1	98	4	■
-40						
	50		21.2	105	6	■

SP	SAND - fine, some seashells, grey
MH	ELASTIC SILT - some Sand, grey
ML	CLAYEY SILT - some layers of Sandy Silt, some seashells, dark grey
ML	SANDY SILT - dark grey
SM	SILTY SAND - fine, dark grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Water level measured at 6' 15 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.11b

Area B - Law Crandall Borings

PLATE A2-70

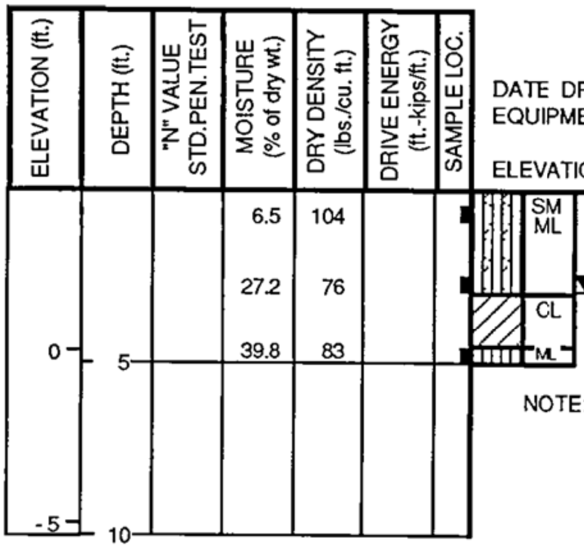
JOB L91028 AEO DATE 3/1/91 F.T. LS/AR DR. ph O.E. JLB W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 12A

DATE DRILLED: February 12, 1991
EQUIPMENT USED: 8" - Diameter Hand Auger

ELEVATION 4.6



FILL - SILTY SAND and SILT - fine, brown

Some Clay, dark brown

SURFACE OF NATURAL SOIL

SILTY CLAY - dark grey

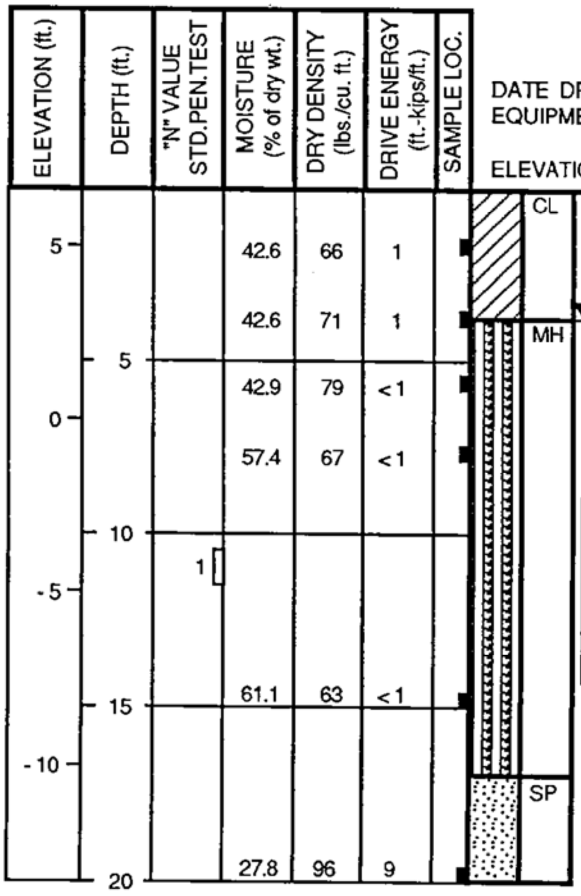
CLAYEY SILT - brownish grey

NOTE: Water not encountered. No caving.

BORING 12

DATE DRILLED: January 31, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 6.6



FILL - SILTY CLAY - light brownish grey

SURFACE OF NATURAL SOIL

ELASTIC SILT - mottled grey and light grey

Some seashells, dark grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Water level measured at 9-1/2' 15 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

SAND - fine, some seashells, grey

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.12

Area B - Law Crandall Borings

PLATE A2-71

JOB L91028.AEO DATE 3/1/91 F.T. LS/AR DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 13A

DATE DRILLED: February 12, 1991
EQUIPMENT USED: 8" - Diameter Hand Auger

ELEVATION 5.8

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
5			23.4	99		▪
			32.0	89		▪
			53.5	69		▪
	5					
0			40.6	76		▪
	10					

ML CH SP FILL - SANDY SILT, CLAY and SAND - fine, mottled light grey, brown, dark grey and dark brown

SURFACE OF NATURAL SOIL

ML SANDY SILT - some Clay, brownish grey

NOTE: Water not encountered. No caving.

BORING 13

DATE DRILLED: January 28, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 5.3

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
5						
			22.8	83	4	▪
0	5	2				
			50.0	73	1	▪
-5	10					
		1				
-10	15		63.2	62	<1	▪
		1				
			30.3	94	3	▪
	20					

CL ML FILL - SILTY CLAY and SILT - mottled brown, black and grey

SURFACE OF NATURAL SOIL

ML SANDY SILT - brown

MH ELASTIC SILT - some layers of Sandy Silt, brownish grey

Traces of organic matter, dark grey

Some seashells

SM SILTY SAND - fine, some seashells, dark grey

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.13a

Area B - Law Crandall Borings

PLATE A2-72

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLB W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 13 (Continued)

DATE DRILLED: January 28, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-15								
		2						
-20	25						MH	ELASTIC SILT - some lenses of fine Sand, dark grey Some organic matter
			69.6	59	< 1	■		
		1						
-25	30						ML	SANDY SILT - some seashells, dark grey
			26.0	100	3	■		
-30	35	7					SM	SILTY SAND - fine, some layers of Sandy Silt, grey
			23.9	102	5	■		
-35	40							
		14						
							ML	SANDY SILT - some layers of Clayey Silt, dark grey
			30.6	92	6	■		
-40	45							
		8						
							ML	CLAYEY SILT - dark grey
			31.9	91	6	■		

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 30' after completion of drilling. Water level measured at 6' on 1/29/91. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.13b

Area B - Law Crandall Borings

PLATE A2-73

JOB L91028.AEO DATE 3/1/91 F.T. LS/AR DR. ph O.E. JLB W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 14A

DATE DRILLED: February 13, 1991
EQUIPMENT USED: 8" - Diameter Hand Auger

ELEVATION 6.3

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
5			14.4	108		▪
			23.3	93		▪
			49.4	69		▪
	5					
0			44.1	72		▪
	10					

ML FILL - SANDY SILT - some Clay, mottled brown and grey

SURFACE OF NATURAL SOIL

ML SANDY SILT - grey
Some Clay

NOTE: Water not encountered. No caving.

BORING 14

DATE DRILLED: February 1, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 7.1

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
5			19.0	82	4	▪
			49.4	68	1	▪
	5					
			42.4	77	< 1	▪
0			53.4	68	< 1	▪
	10					
			58.6	63	< 1	▪
- 5						
	15	2				
- 10						
	20		60.9	65	< 1	▪

ML SP FILL - SANDY SILT and SAND - fine, some caliche, brown

SURFACE OF NATURAL SOIL

CH FAT CLAY - mottled grey and light grey

MH ELASTIC SILT - some lenses of Sand, brownish grey

(LL = 66, PI = 23)

Dark grey

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 15' after completion of drilling. Water level measured at 10' 15 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.14

Area B - Law Crandall Borings

PLATE A2-74

JOB L91028.AEO DATE 3/1/91 F.T. LS/AR DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 15A

DATE DRILLED: February 13, 1991
EQUIPMENT USED: 8" - Diameter Hand Auger

ELEVATION 10.7

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
10			21.6	82		■	ML CL	FILL - SANDY SILT and CLAY - some Sand, mottled light grey, light brown and brown
			12.1	95		■		
	5		10.0	114		■		
5								Some layers of Sand
			3.5	101		■		SURFACE OF NATURAL SOIL
							CL	SILTY CLAY - dark grey
			36.2	80		■	ML	SANDY SILT - grey
	10							

NOTE: Water not encountered. No caving.

BORING 15

DATE DRILLED: February 1, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 4.1

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							ML	FILL - SANDY SILT - grey
			18.1	81	3	■		
							MH	SURFACE OF NATURAL SOIL ELASTIC SILT - mottled light grey, grey and dark grey
0			45.7	70	1	■		
	5							
			34.4	88	2	■		Layer of Sandy Silt, grey
			48.2	74	< 1	■		
- 5								
	10							
		1						Dark grey
- 10								
	15		90.8	48	< 1	■		
							ML	SANDY SILT - about 10% Gravel, dark grey
- 15								
	20		12.1	125	5	■		

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 15' after completion of drilling. Water level measured at 13-1/2' 30 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.15

Area B - Law Crandall Borings

PLATE A2-75

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 16

DATE DRILLED: January 30, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 7.6

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			7.7	119	7	■
5						
			9.2	115	2	■
	5					
			56.6	66	< 1	■
0						
		2				
	10					
			58.1	61	< 1	■
-5						
	15	1				
-10						
			29.6	95	2	■
	20					
-15						
	25		28.3	95	9	■

3" Asphaltic Paving
FILL - SILTY SAND and SILT - fine, reddish brown

SURFACE OF NATURAL SOIL
SILTY CLAY - some seashells, dark grey

ELASTIC SILT - dark grey

SANDY SILT - some seashells, dark grey

SAND - fine, some seashells, grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Water level measured at 10-1/2' 10 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.16

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 18 *

DATE DRILLED: January 29, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 3.2

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			45.0	66	2	■
0						
			49.0	71	1	■
	5					
			49.0	74	< 1	■
-5			43.5	79	< 1	■
	10					
		1				
-10						
	15		37.7	84	< 1	■
-15						
	20		52.6	71	< 1	■
-20						
	25		17.7	112	2	■

CH FAT CLAY - some caliche, mottled black and dark grey

MH ELASTIC SILT - some layers of Sand, dark grey

Layer of Sandy Silt

(LL = 48, PI = 12)

About 30% seashells

Few seashells

Sand seam

ML SANDY SILT - some layers of Elastic Silt, about 20% seashells, dark grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Water level measured at 6-1/2' 15 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

* Boring 17 was deferred.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.17

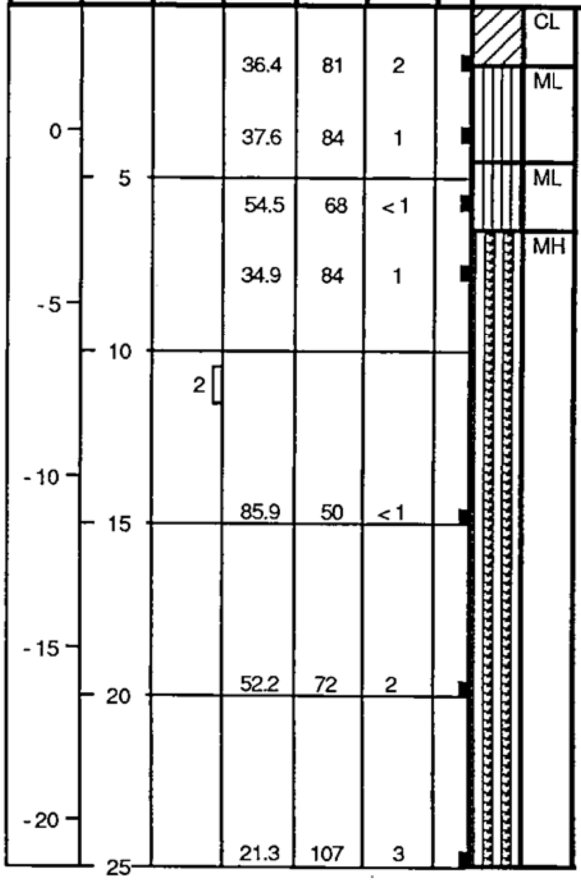
JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD FH

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 19

DATE DRILLED: January 29, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 3.6



ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)
			36.4	81	2
0			37.6	84	1
	5		54.5	68	< 1
-5			34.9	84	1
	10	2			
-10	15		85.9	50	< 1
-15	20		52.2	72	2
-20	25		21.3	107	3

CL SILTY CLAY - some caliche, mottled black, grey and dark grey

ML SANDY SILT - grey

ML CLAYEY SILT - dark grey

MH ELASTIC SILT - some layers of Sand, dark grey

About 50% seashells (from 10' to 12-1/2')

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Water level measured at 6-1/2' 10 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.18

Area B - Law Crandall Borings

PLATE A2-78

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD FH

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 20

DATE DRILLED: January 29, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 3.1

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			62.9	58	1	■
0						
			38.1	79	1	■
	5					
			50.6	68	1	■
			24.9	96	< 1	■
- 5						
	10					
			75.4	55	< 1	■
- 10						
	15	1				
- 15						
			33.0	91	< 1	■
	20					
- 20						
	25		45.5	77	1	■

CH FAT CLAY - some caliche, mottled grey and brown

Dark grey

ML SANDY SILT - brownish grey

Dark grey

MH ELASTIC SILT - dark grey

Layer of Sandy Silt

SM SILTY SAND - fine, grey

MH ELASTIC SILT - some layers of Sandy Silt, dark grey

Some seashells

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 20' after completion of drilling. Water level measured at 8' 10 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.19

Area B - Law Crandall Borings

PLATE A2-79

JOB L91028.AEO DATE 3/1/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 21

DATE DRILLED: January 29, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 3.2

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							CL	SILTY CLAY - dark grey
			44.9	77	1	■		
							ML	SANDY SILT - dark grey
0								
			36.0	84	< 1	■		
	5							
			49.2	69	< 1	■	MH	ELASTIC SILT - some seashells, grey and dark grey
-5			48.7	70	1	■		
	10							
		2						
-10								
							ML	SANDY SILT - dark grey
	15		23.7	97	< 1	■		
-15								
	20		24.3	99	2	■		
							MH	ELASTIC SILT - dark grey
-20								
	25		45.7	76	< 1	■		

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Water level measured at 3-1/2' 10 minutes after removal of mud. Grouted boring with a cement-bentonite slurry after water level determination.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.20

Area B - Law Crandall Borings

PLATE A2-80

JOB L91028.AEO DATE 3/1/91 F.T. AR DR. ph O.E. JLR W.P. ph CHKD FH

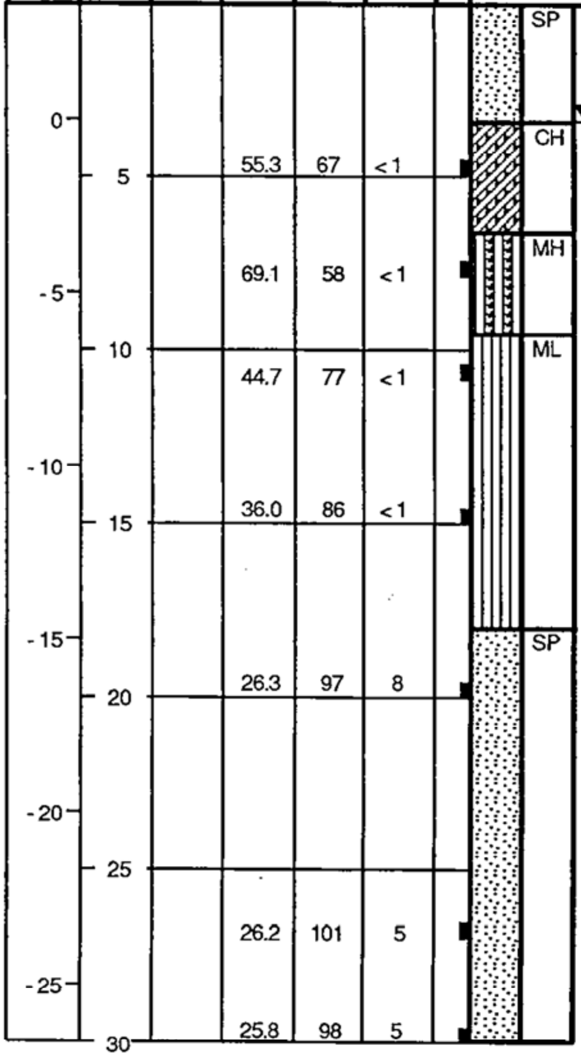
Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 22
(Monitoring Well MW-10)

DATE DRILLED: February 26, 1991
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

ELEVATION 3.4

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			55.3	67	< 1	▮
			69.1	58	< 1	▮
			44.7	77	< 1	▮
			36.0	86	< 1	▮
			26.3	97	8	▮
			26.2	101	5	▮
			25.8	98	5	▮



SP FILL - SAND - fine to medium, grey

SURFACE OF NATURAL SOIL

CH FAT CLAY - grey

MH ELASTIC SILT - some Sand, some seashells, dark grey

ML SANDY SILT - dark grey

SP SAND - fine to medium, grey

Some layers of Silty Sand

Some seashells

NOTE: Installed water level monitoring well; see Appendix C for well construction details.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.21

Area B - Law Crandall Borings

PLATE A2-81

BORING 23
(Monitoring Well MW-11)

DATE DRILLED: February 25, 1991
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

ELEVATION 1.8

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
0						
			55.6	66	< 1	
	5					
- 5						
			73.9	56	< 1	
	10					
			76.9	54	< 1	
- 10						
			26.2	97	2	
	15					
- 15						
			22.6	104	4	
	20					
- 20						
			38.6	85	4	
	25					
- 25						
			31.1	92	5	
	30					

ELASTIC SILT - some organic matter, mottled grey and brown

Dark grey

SANDY SILT - dark grey

Some seashells

SILTY SAND - fine, dark grey

NOTE: Installed water level monitoring well; see Appendix C for well construction details.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L91028.AEO DATE 3/1/91 F.T. AR DR. ph O.E. JLR W.P. ph CHKD FH

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.22

JOB L91028.AEO DATE 3/22/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 24
(Monitoring Well MW-12)

DATE DRILLED: February 11, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 3.2

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			15.0	106	2	■
0						
	5		98.8	46	< 1	■
- 5			72.7	58	< 1	■
	10					
			91.2	49	< 1	■
- 10						
	15		29.0	94	1	■
- 15						
	20		25.2	92	18	■
- 20						
	25					
- 25						
	30		22.3	100	3	■

SP	FILL - SAND - fine, some Silt and Clay, brown and grey
MH	SURFACE OF NATURAL SOIL ELASTIC SILT - grey Dark grey
SM	SILTY SAND - fine, some layers of Sandy Silt, some seashells, dark grey
SP	SAND - fine, grey Some layers of Silt Some seashells

NOTE: Drilling mud used in drilling process. Flushed mud from boring using clear water after completion of drilling. Installed water level monitoring well; see Appendix C for well construction details.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.23

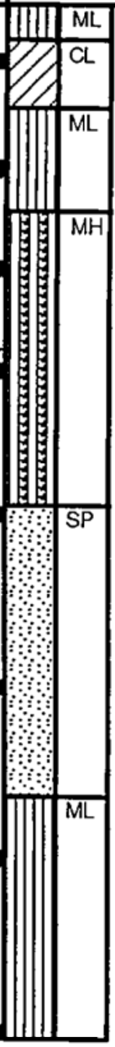
Area B - Law Crandall Borings

PLATE A2-83

BORING 25
(Monitoring Well MW-13)

DATE DRILLED: February 7, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash
ELEVATION 3.2

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							ML	SANDY SILT - brown
			40.6	69	1	■	CL	SILTY CLAY - mottled grey and dark grey
0							ML	SANDY SILT - brownish grey
	5		37.1	86	1	■		
							MH	ELASTIC SILT - dark grey
-5			70.8	59	< 1	■		
	10		72.7	58	< 1	■		
-10								
	15		21.9	106	10	■	SP	SAND - fine, dark grey
-15								
	20		33.1	89	4	■		
-20							ML	SANDY SILT - dark grey
	25		42.1	78	< 1	■		
-25								
	30		29.1	92	9	■		



NOTE: Drilling mud used in drilling process. Flushed mud from boring using clear water after completion of drilling. Installed water level monitoring well; see Appendix C for well construction details.

JOB L91028.AEO DATE 3/22/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD FH

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.24

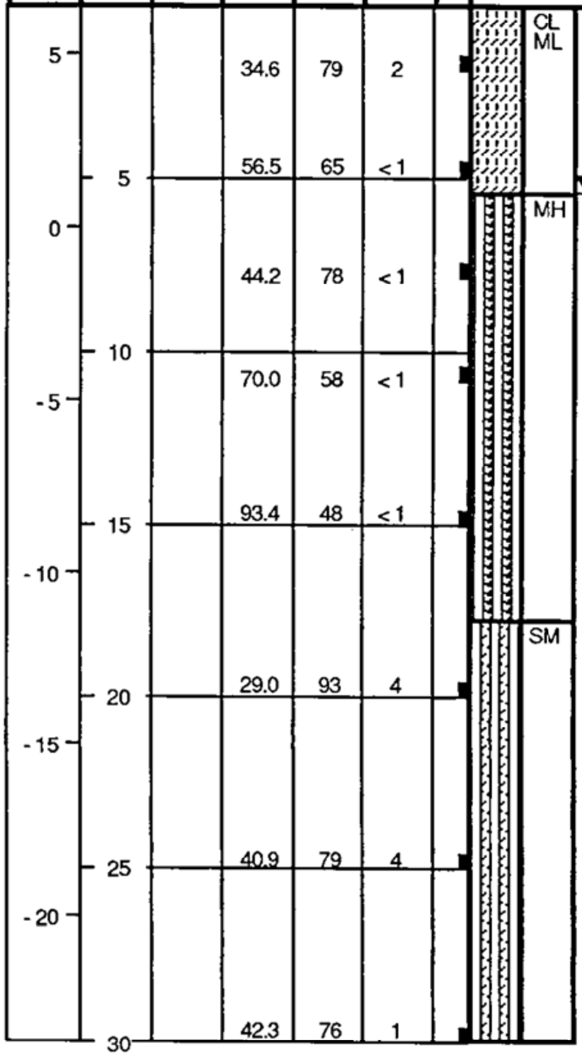
JOB L91028.AEO DATE 3/22/91 F.T. LS DR. ph O.E. JLB W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 26
(Monitoring Well MW-14)

DATE DRILLED: February 7, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 6.4



ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			34.6	79	2	■
			56.5	65	< 1	■
			44.2	78	< 1	■
			70.0	58	< 1	■
			93.4	48	< 1	■
			29.0	93	4	■
			40.9	79	4	■
			42.3	76	1	■

CL ML FILL - SILTY CLAY and SILT - brownish grey and grey

SURFACE OF NATURAL SOIL

MH ELASTIC SILT - some layers of Sandy Silt, some seashells, dark grey

SM SILTY SAND - fine, dark grey

Some layers of Silt

NOTE: Drilling mud used in drilling process. Flushed mud from boring using clear water after completion of drilling. Installed water level monitoring well; see Appendix C for well construction details.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.25

Area B - Law Crandall Borings

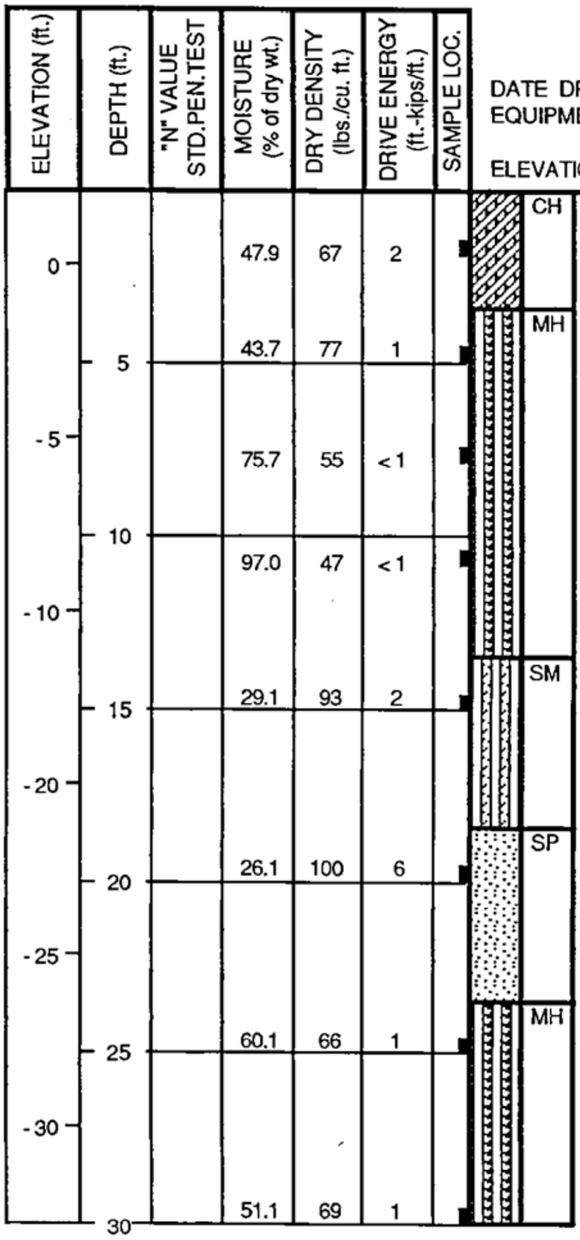
PLATE A2-85

BORING 27
(Monitoring Well MW-15)

DATE DRILLED: February 27, 1991
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

ELEVATION 2.2

MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)
47.9	67	2
43.7	77	1
75.7	55	< 1
97.0	47	< 1
29.1	93	2
26.1	100	6
60.1	66	1
51.1	69	1



CH FAT CLAY - brownish grey

MH ELASTIC SILT - some seashells, grey

Dark grey

SM SILTY SAND - fine, dark grey

SP SAND - fine, dark grey

MH ELASTIC SILT - dark grey

NOTE: Installed water level monitoring well; see Appendix C for well construction details.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB 1.91028.AEO DATE 3/22/91 F.T. AR DR. ph O.E. JLR W.P. ph CHKD FH

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.26

Area B - Law Crandall Borings

PLATE A2-86

BORING 28
(Monitoring Well MW-16)

DATE DRILLED: March 5, 1991
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

ELEVATION 3.7

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							SP	SAND - fine to medium, brown
			30.4	91	3	■		
0								
	5		52.3	72	1	■		
							MH	ELASTIC SILT - grey
			78.4	54	< 1	■		
-5								
	10		82.1	52	< 1	■		Dark grey
-10								
	15							
-15							SP	SAND - fine, dark grey
	20		34.4	86	5	■		
-20							MH	ELASTIC SILT - dark grey
	25		62.4	63	< 1	■		
-25							SP	SAND - fine to medium, dark grey
	30		18.9	115	4	■		

NOTE: Installed water level monitoring well; see Appendix C for well construction details.

JOB L91028.AEO DATE 3/22/91 F.T. AR DR. ph O.E. JLR W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A-1.27

Area B - Law Crandall Borings

PLATE A2-87

JOB L91028.AEO DATE 3/22/91 F.T. LS DR. ph O.E. JLB W.P. ph CHKD FH

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 29
(Monitoring Well MW-17)

DATE DRILLED: February 6, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 5.9

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
5							CL ML	FILL - SILTY CLAY and SILT - some caliche, brownish grey
			38.6	67	2			Mottled light and dark grey
								SURFACE OF NATURAL SOIL
							CL	SILTY CLAY -grey
	5		36.7	79	1			
0							ML	CLAYEY SILT - light grey
			35.1	88	1		ML	SANDY SILT - brownish grey
	10						MH	ELASTIC SILT - dark grey
-5			65.6	62	< 1			
	15		90.5	51	< 1			Some seashells
-10								
	20		54.5	68	< 1			
-15								
	25		44.2	76	1			Layer of Sandy Silt
-20								
	30		23.4	104	2			

NOTE: Drilling mud used in drilling process. Flushed mud from boring using clear water after completion of drilling. Installed water level monitoring well; see Appendix C for well construction details.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.28

Area B - Law Crandall Borings

PLATE A2-88

JOB L91028.AEO DATE 3/22/91 F.T. LS DR. ph O.E. JLR W.P. ph CHKD

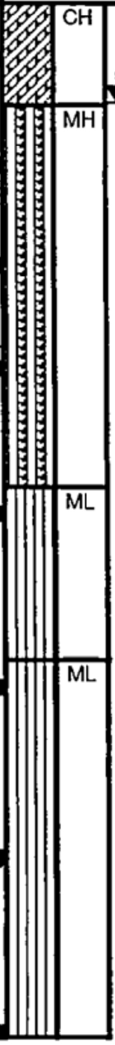
Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 30
(Monitoring Well MW-18)

DATE DRILLED: February 5, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 2.9

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			53.3	67	< 1	■
0						
	5		47.1	69	1	■
- 5			54.1	69	< 1	■
	10		82.2	53	< 1	■
- 10						
	15		53.5	71	< 1	■
- 15						
	20		40.9	83	1	■
- 20						
	25		22.1	105	1	■
- 25						
	30		28.1	95	3	■



FILL - FAT CLAY - some caliche, dark brownish grey

SURFACE OF NATURAL SOIL
ELASTIC SILT - some layers of Sandy Silt, brownish grey

Dark grey

Organic odor

CLAYEY SILT - dark grey

SANDY SILT - dark grey

NOTE: Drilling mud used in drilling process. Flushed mud from boring using clear water after completion of drilling. Installed water level monitoring well; see Appendix C for well construction details.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.29

Area B - Law Crandall Borings

PLATE A2-89

JOB L91028.AEO DATE 3/22/91 F.T. LS DR. ph O.E. JLB W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 31
(Monitoring Well MW-19)

DATE DRILLED: February 5, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 2.5

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
			40.6	77	1	■	CL	FILL - SILTY CLAY - some caliche, mottled brown, grey and dark grey
0								
							ML	▼ SURFACE OF NATURAL SOIL SANDY SILT - brownish grey
	5		36.7	86	< 1	■		
							MH	ELASTIC SILT - light grey
- 5								
			59.1	66	< 1	■		Dark grey About 50% seashells (from 8' to 13')
	10		98.9	45	< 1	■		
- 10								
	15		76.2	54	< 1	■		
- 15								
							ML	SANDY SILT - dark grey
	20		34.1	92	< 1	■		
- 20								
	25		24.4	100	< 1	■		
- 25								
	30		38.2	83	1	■		Layer of Clayey Silt

NOTE: Drilling mud used in drilling process. Flushed mud from boring using clear water after completion of drilling. Installed water level monitoring well; see Appendix C for well construction details.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.30

Area B - Law Crandall Borings

PLATE A2-90

JOB L91028.AEO DATE 3/22/91 F.T. LS DR. ph O.E. JLB W.P. ph CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 32
(Monitoring Well MW-20)

DATE DRILLED: February 6, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 2.7

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							CL	SILTY CLAY - dark brown
			43.5	74	1	■		
0								
							MH	ELASTIC SILT - some layers of Clay, brownish grey
	5		59.8	64	< 1	■		
								Grey
- 5			51.8	71	< 1	■		
	10							
								Dark grey
			90.6	49	< 1	■		
- 10								
	15							
- 15								
	20		39.3	82	< 1	■		
- 20								
	25		70.1	58	< 1	■		
- 25								
	30		73.5	55	< 1	■		

NOTE: Drilling mud used in drilling process. Flushed mud from boring using clear water after completion of drilling. Installed water level monitoring well; see Appendix C for well construction details.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.31

Area B - Law Crandall Borings

PLATE A2-91

JOB L91028.AEO DATE 3/22/91 F.T. AR DR. ph O.E. BK W.P. ph CHKD FH

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 33
(Monitoring Well MW-21)

DATE DRILLED: March 6, 1991
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

ELEVATION 4.9

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							SP	SAND - fine to medium, some rootlets, brown
			11.3	82	4	■		
0	5		54.7	68	3	■	CH	FAT CLAY - traces of organic matter, dark grey
			97.9	50	1	■	MH	ELASTIC SILT - some rootlets, dark grey
-5	10		23.2	105	4	■	SM	SILTY SAND - fine, dark grey
-10	15							
							SW	SAND - well graded, few Gravel, dark grey
-15	20		21.0	107	4	■		
							SP	SAND - fine, dark grey
-20	25		20.8	112	6	■		
								Light grey
-25	30		17.2	114	12	■		

NOTE: Drilling mud used in drilling process. Flushed mud from boring using clear water after completion of drilling. Installed water level monitoring well; see Appendix C for well construction details.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A - 1.32

Area B - Law Crandall Borings

PLATE A2-92

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 1

(LCA AE-87133)

DATE DRILLED: April 7, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 5.8*

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
5						
			33.4	84	1	■
	5		42.3	79	1	■
0						
			48.2	73	< 1	■
	10					
- 5			54.6	69	< 1	■
			53.8	68	< 1	■
	15					
- 10						
			79.2	56	< 1	■
	20		55.5	67	< 1	■
- 15						
	25		57.2	67	< 1	■
- 20						
	30	0				
- 25						
	35	8				
- 30						
	40		11.9	117	13	■

CL SILTY CLAY - some Sand, brownish grey

ML SANDY SILT - light greyish brown

CH FAT CLAY - light greyish brown

Some organic matter
(LL = 64, PI = 35)

MH ELASTIC SILT - brownish grey

Layers with large amounts of shells
Sulphur odor

Layers and lenses of Sand and shells

ML SANDY SILT - some Clay, grey

SP SAND - fine, some Gravel, grey

* Elevations provided by Psomas and Associates on 4/20/87.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.33a

Area B - Law Crandall Borings

PLATE A2-93

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. dmh lp CHKD

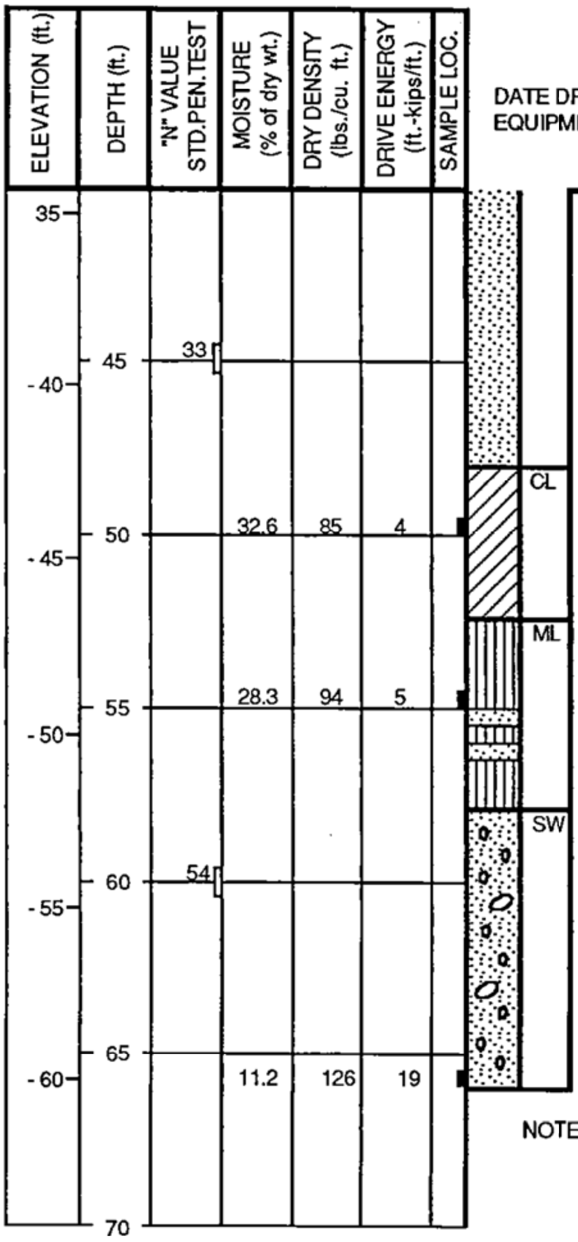
Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 1 (Continued)

(LCA AE-87133)

DATE DRILLED: April 7, 1987

EQUIPMENT USED: 5"- Diameter Rotary Wash



SILTY CLAY - dark grey

SANDY SILT - some Clay, dark grey

Layers of Sand

SAND - well graded, about 25% Gravel, some Cobbles, light grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 20'. Backfilled annular space with pea gravel. Water level measured at a depth of 5' on 5/4/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.33b

Area B - Law Crandall Borings

PLATE A2-94

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. dmh lp CHKD ____

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 2

(LCA AE-87133)

DATE DRILLED: April 9, 1987

EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 5.4

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
5							ML	SANDY SILT - some Clay, light brown
			35.4	86	3	■		
							CL	SILTY CLAY - streaks of alkali, dark brownish grey
0	5		45.8	77	1	■		
							ML	SANDY SILT - some organic matter, light greyish brown
			43.5	81	1	■		
- 5	10						CH	FAT CLAY - few shells, brownish grey
			52.0	70	< 1	■		
							MH	ELASTIC SILT - some organic matter, brownish grey
- 10	15		46.7	76	< 1	■		
			110.6	42	< 1	■		Dark grey (LL = 81, PI = 40)
- 15	20		52.8	71	< 1	■		Layers of Sandy Silt
- 20	25		42.0	80	< 1	■		
- 25	30	0						
							ML	SANDY SILT - some Clay, light brownish grey
- 30	35		22.2	108	3	■		
	40	24						

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.34a

Area B - Law Crandall Borings

PLATE A2-95

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. lp , CHKD

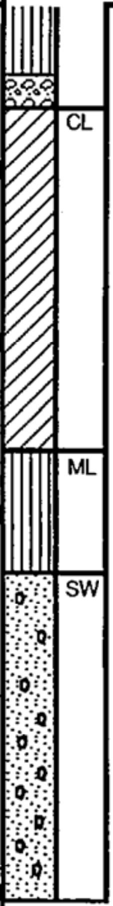
Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 2 (Continued)

(LCA AE-87133)

DATE DRILLED: April 9, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
- 40						
- 45	45		24.9	104	2	■
- 50	50		35.9	87	1	■
- 55	55		31.6	92	2	■
- 60	60	60				
- 65	65		13.2	123	28	■
	70					



Layer of coarse Sand and Gravel

SILTY CLAY - brownish grey

Dark grey

SANDY SILT - dark grey

SAND - well graded, some Gravel, light grey

About 25% Gravel

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 20' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 20'. Backfilled annular space with pea gravel. Water level measured at a depth of 5-1/2' on 5/4/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.34b

Area B - Law Crandall Borings

PLATE A2-96

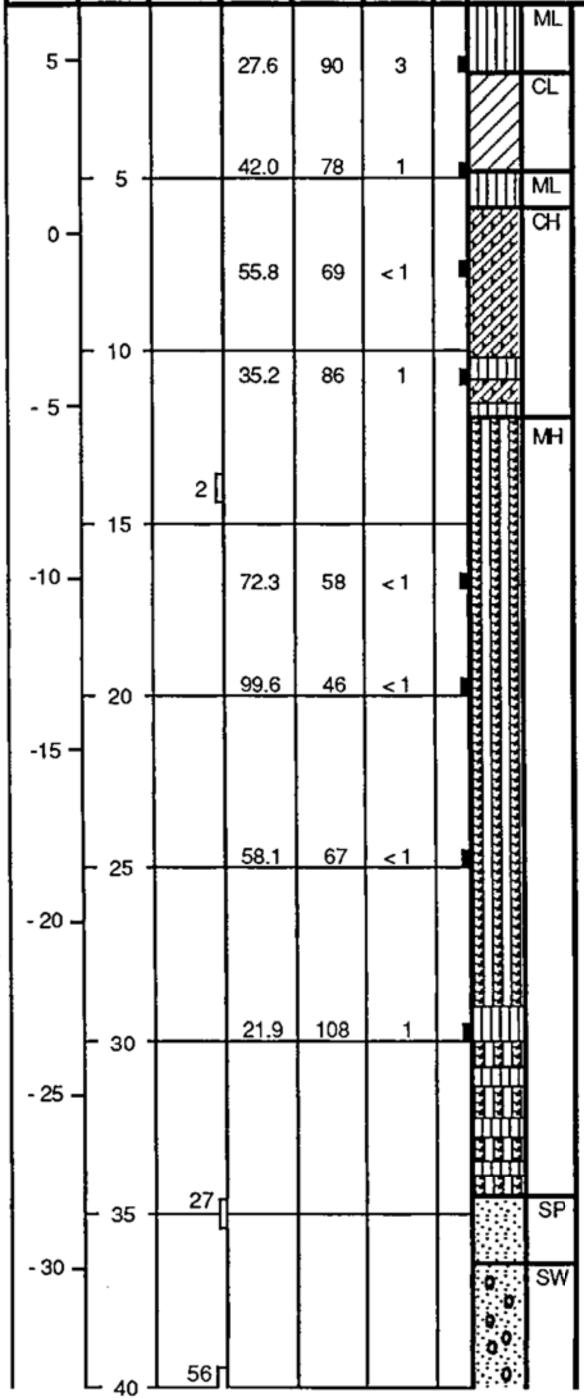
JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 3
(LCA AE-87133)

DATE DRILLED: April 8, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 6.6



ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			27.6	90	3	
			42.0	78	1	
			55.8	69	< 1	
			35.2	86	1	
		2				
			72.3	58	< 1	
			99.6	46	< 1	
			58.1	67	< 1	
			21.9	108	1	
		27				
		56				

ML FILL - SANDY SILT - some Clay, mottled brown and grey

CL SILTY CLAY - some organic matter, streaks of alkali, dark brownish grey

ML SANDY SILT - light brown

CH FAT CLAY - some organic matter, light greyish brown

Layers of Sandy Silt

MH ELASTIC SILT - some shells and organic matter, brownish grey

Light greyish brown
Sulphur odor

Layers of Sandy Silt

SP SAND - fine, some Silt, grey

SW SAND - well graded, about 25% Gravel, grey

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.35a

Area B - Law Crandall Borings

PLATE A2-97

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. lp CHKD

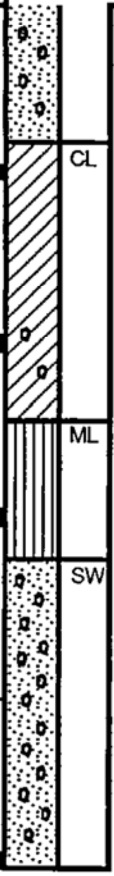
Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 3 (Continued)

(LCA AE-87133)

DATE DRILLED: April 9, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
- 35						
	45		37.5	84	4	▪
- 40						
	50		-	-	3	▪
- 45						
	55		26.6	98	4	▪
- 50						
	60					
- 55						
	65		6.5	138	32	▪



CL SILTY CLAY - dark grey

Some Gravel

ML SANDY SILT - dark grey

SW SAND - well graded, about 30% Gravel, light grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 20'. Backfilled annular space with pea gravel. Water level measured at a depth of 6' on 5/4/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.35b

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 4

(LCA AE-87133)

DATE DRILLED: April 8, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 7.3

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							CL	FILL - SILTY CLAY - mottled brown
5			25.9	90	2	■	ML	FILL - SANDY SILT - some Clay, mottled brown and grey
							CL	SILTY CLAY - streaks of alkali, dark greyish brown
	5		39.7	80	1	■		
							CH	FAT CLAY - light greyish brown
0			49.4	71	< 1	■		Lenses of Sandy Silt
	10							
			37.9	83	2	■	SM	SILTY SAND - fine, light grey
- 5								
			45.7	77	< 1	■	MH	ELASTIC SILT - some organic matter, few shells, light grey
	15							
- 10			74.1	57	< 1	■		(LL = 52, PI = 24)
	20		96.8	47	< 1	■		Light greyish brown Sulphur odor
- 15								
	25		29.1	94		■		Black
- 20								Layers of Sandy Silt
	30	2						
- 25								
	35		22.6	106		■	SP	SAND - fine, layers of Sandy Silt, light grey
- 35								
	40	9					SM	SILTY SAND - fine, layers of Sandy Silt, grey

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.36a

Area B - Law Crandall Borings

PLATE A2-99

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 4 (Continued)

(LCA AE-87133)

DATE DRILLED: April 8, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
- 40						
	45		40.0	82	2	■
- 45						
	50		38.8	83	2	■
- 50						
	55		14.8	120	16	■
- 55						
	60		18.8	112	32	■
- 60						
	65					
			22.0	106	32	■
- 65						
	70					

CH FAT CLAY - dark grey

Black

Dark grey (LL = 56, PI = 28)

ML SANDY SILT - some Clay, black

SW SAND - well graded, some Silt and Gravel, grey

About 30% Gravel, some Cobbles

Layers of fine Sand

SP SAND - fine, some Gravel, grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 20'. Backfilled annular space with pea gravel. Water level measured at a depth of 7-1/2' on 5/4/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.36b

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 5
(LCA AE-87133)

DATE DRILLED: April 10, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 4.2

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							ML	SANDY SILT - brownish grey
			35.0	87	1	■		
							MH	ELASTIC SILT - light greyish brown
0	5		57.0	70	< 1	■		
							ML	SANDY SILT - light greyish brown
			-	-	1	■		
- 5	10						MH	ELASTIC SILT - few shells, dark grey
			45.6	75	< 1	■		
							CH	FAT CLAY - few shells, dark grey
			69.6	62	< 1	■		
-10	15							
			65.1	62	< 1	■		
							CL ML	SILTY CLAY - lenses of shells, few Gravel, black (LL = 24, PI = 7)
-15	20		20.1	111	1	■		
							SM	SILTY SAND - fine, few shells, dark grey
- 20	25		26.5	99	7	■		
							CL	SILTY CLAY - layers of Sandy Silt, dark grey
- 25	30	12						
							ML	SANDY SILT - some Clay, dark grey
- 30	35		32.0	91	3	■		
							MH	ELASTIC SILT - layers of Silty Sand, dark grey
- 35	40	6						

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.37a

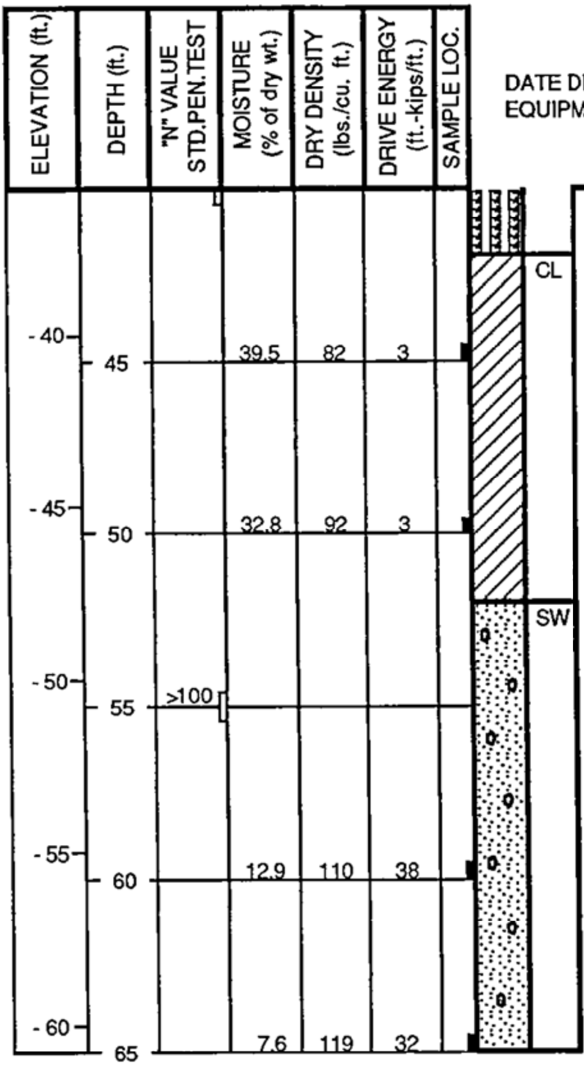
Area B - Law Crandall Borings

PLATE A2-101

BORING 5 (Continued)

(LCA AE-87133)

DATE DRILLED: April 10, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash



DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)
45		39.5	82	3
50		32.8	92	3
55	>100			
60		12.9	110	38
65		7.6	119	32

SILTY CLAY - layers of Silty Sand, some organic matter, dark grey

SAND - well graded, some Gravel, grey

About 25% Gravel

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 15' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 19'. Backfilled annular space with pea gravel. Water level measured at a depth of 6' on 5/4/87.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. lp O.E. DW W.P. lp CHKD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.37b

Area B - Law Crandall Borings

PLATE A2-102

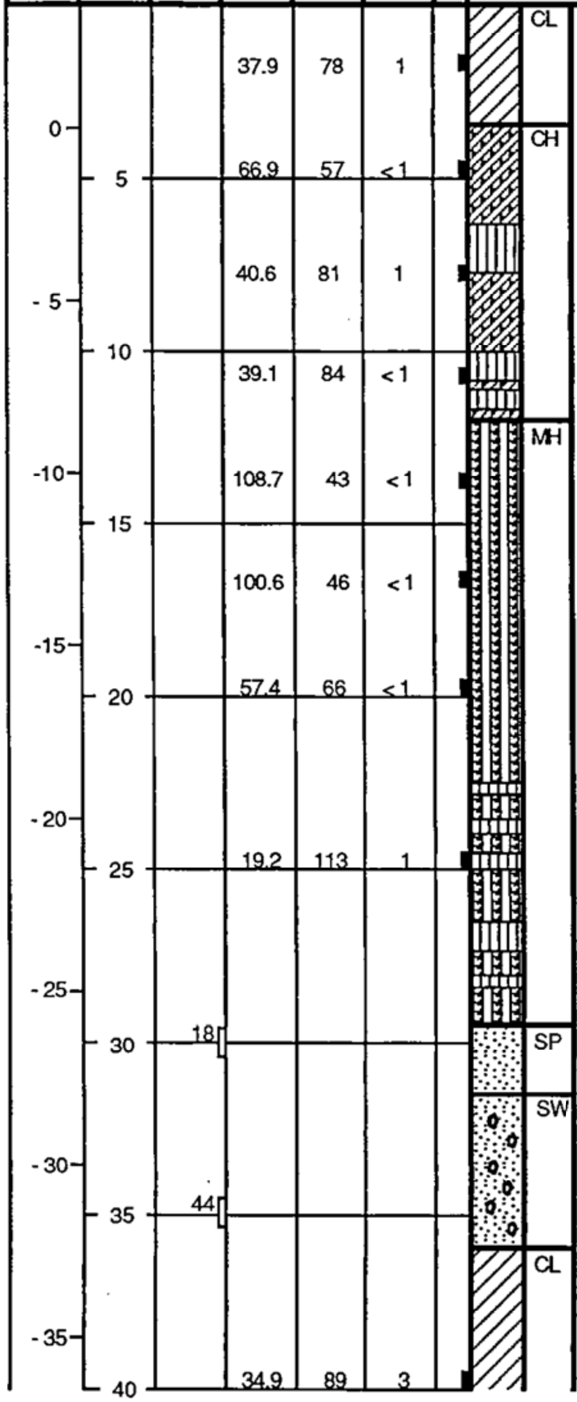
JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 6
(LCA AE-87133)

DATE DRILLED: April 9, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 3.6



DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)
		37.9	78	1
5		66.9	57	<1
		40.6	81	1
		39.1	84	< 1
		108.7	43	< 1
		100.6	46	< 1
20		57.4	66	<1
25		19.2	113	1
30	18			
35	44			
40		34.9	89	3

CL SILTY CLAY - some organic matter, dark brownish grey

CH FAT CLAY - light greyish brown
(LL= 84, PI = 51)

Layers of Sandy Silt

Large amount of shells, sulphur odor

MH ELASTIC SILT - light grey

Some shells, sulphur odor

Light brownish grey

Layers of Sandy Silt

SP SAND - fine, grey

SW SAND - well graded, about 25% Gravel, grey

CL SILTY CLAY - dark grey

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.38a

Area B - Law Crandall Borings

PLATE A2-103

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. Ip O.E. DW W.P. Ip CHKD

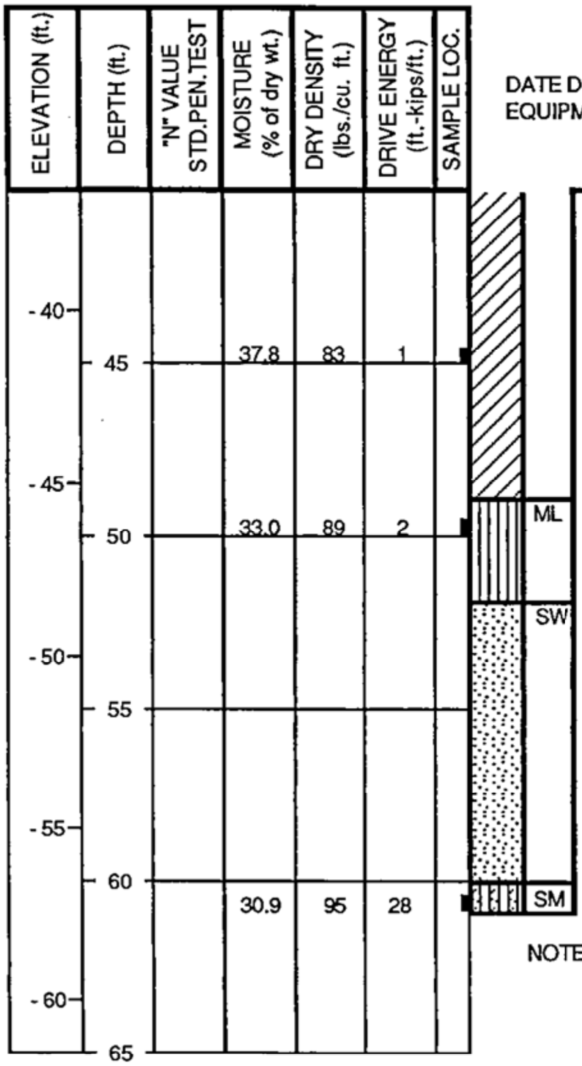
Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 6 (Continued)

(LCA AE-87133)

DATE DRILLED: April 9, 1987

EQUIPMENT USED: 5"- Diameter Rotary Wash



(LL = 33, PI = 11)

SANDY SILT - dark grey

SAND - well graded, about 30% Gravel, some Cobbles, grey

SILTY SAND - fine, grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 25' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 17'. Backfilled annular space with pea gravel. Water level measured at a depth of 3' on 5/4/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.38b

Area B - Law Crandall Borings

PLATE A2-104

BORING 7

(LCA AE-87133)

DATE DRILLED: April 13, 1987

EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 3.9

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							CH	FAT CLAY - brownish grey
			52.6	62	1	■		
0								
							ML	SANDY SILT - light greyish brown
	5							
			43.5	81	1	■		
							MH	ELASTIC SILT - some shells, greyish brown
- 5			46.8	76	1	■		
								Large amount of shells
	10							
								Dark grey
			53.6	68	< 1	■		
-10								
								Light brownish grey
			79.5	58	< 1	■		
	15							
							CH	FAT CLAY - few shells, grey
			55.7	68	< 1	■		
-15								
	20						ML	SANDY SILT - few shells, dark grey
			30.9	92	1	■		
							ML	CLAYEY SILT - layers of Silty Sand, dark grey
- 20								
	25							
			25.5	100	2	■		
- 25								
	30							
		9 [						
- 30								
							ML	SANDY SILT - some Clay, dark grey
	35							
			26.3	100	4	■		
							ML	CLAYEY SILT - some Sand, dark grey
- 35								
	40							

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. lp O.E. DW W.P. dmh lp CHKD

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.39a

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. lp O.E. DW W.P. lp CHKD

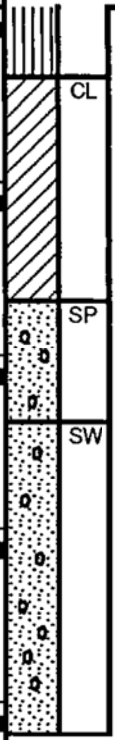
Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 7 (Continued)

(LCA AE-87133)

DATE DRILLED: April 13, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			28.7	95	2	▪
- 40						
	45					
			40.5	81	2	▪
- 45						
	50					
			21.7	103	11	▪
- 50						
	55					
			12.1	132	12	▪
- 55						
	60					
			13.4	125	22	▪
- 60						
	65					



SILTY CLAY - some organic matter, black

SAND - fine, few Gravel, grey

SAND - well graded, some Silt, about 15% Gravel, grey

About 25% Gravel

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 35' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 19'. Backfilled annular space with pea gravel. Water level measured at a depth of 4-1/2' on 5/4/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.39b

Area B - Law Crandall Borings

PLATE A2-106

JOB L91028.AEO DATE 5/15/91 F.T. BW DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 8
(LCA AE-87133)

DATE DRILLED: April 10, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 4.0

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							CH	FAT CLAY - some organic matter, brownish grey
			54.8	63	1	■		
0								
	5							Light greyish brown (LL = 55, PI = 25)
			47.6	75	< 1	■		
- 5			42.8	80	< 1	■		
	10							
			46.7	76	< 1	■	MH	ELASTIC SILT - some Sand and organic matter, few shells, grey
-10								
			64.8	62	< 1	■		
	15							
								Light greyish brown
			106.3	43	< 1	■		
-15								
	20							
			57.6	66	< 1	■		Grey
- 20								
	25							
								Dark grey
			45.0	77	< 1	■		
- 25								
	30							
			58.5	63	< 1	■		
							SM	SILTY SAND - fine, few shells, dark grey
- 30								
	35							
			19.5	105	10	■		
							SW	SAND - well graded, some Silt and Gravel, grey
- 35								
	40							

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.40a

Area B - Law Crandall Borings

PLATE A2-107

JOB L91028.AEO DATE 5/15/91 F.T. ___ BW ___ DR. ___ Ip ___ O.E. ___ DW ___ W.P. ___ Ip ___ CHKD ___

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

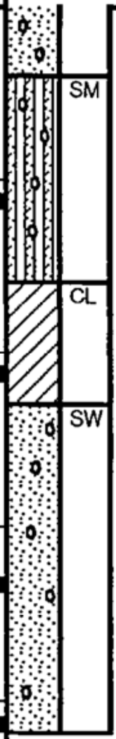
BORING 8 (Continued)

(LCA AE-87133)

DATE DRILLED: April 10, 1987

EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
		38				
- 40						
	45					
			19.7	110	11	■
- 45						
	50					
			31.6	94	3	■
- 50						
	55					
			10.4	128	65	■
- 55						
	60					
			12.0	114	32	■
- 60						
	65					



Layers of fine Sand

SM SILTY SAND - fine, few Gravel, greyish brown

CL SILTY CLAY - dark grey

SW SAND - well graded, about 15% Gravel, grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 35' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 19'. Backfilled annular space with pea gravel. Water level measured at a depth of 1-1/2' on 5/4/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.40b

Area B - Law Crandall Borings

PLATE A2-108

JOB L91028.AEQ DATE 5/15/91 F.T. JD DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 9

(LCA AE-87133)

DATE DRILLED: April 15, 1987

EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 3.2

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							CL	SILTY CLAY - rootlets, dark brown
			34.3	84	1	■		
0							ML	SANDY SILT - light greyish brown
	5		35.6	89	1	■		
								Brownish grey
			33.0	86	< 1	■		
- 5								
		6						
	10							
			79.8	53	1	■	MH	ELASTIC SILT - lenses of Sand, dark grey
-10								
			101.9	45	< 1	■		
	15							
			87.3	49	< 1	■		
-15								
	20		55.9	67	< 1	■		
							ML	SANDY SILT - few shells, dark grey
		1						
- 20								
							MH	ELASTIC SILT - layers of Sand, dark grey
	25		60.7	65	< 1	■		
- 25								
	30		38.6	81	< 1	■		
								Some shells
- 30								
	35		42.5	80	< 1	■		
		6						
- 35							SP	SAND - fine, some Silt, grey
	40		22.8	104	14	■		

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.41a

PLATE A2-109

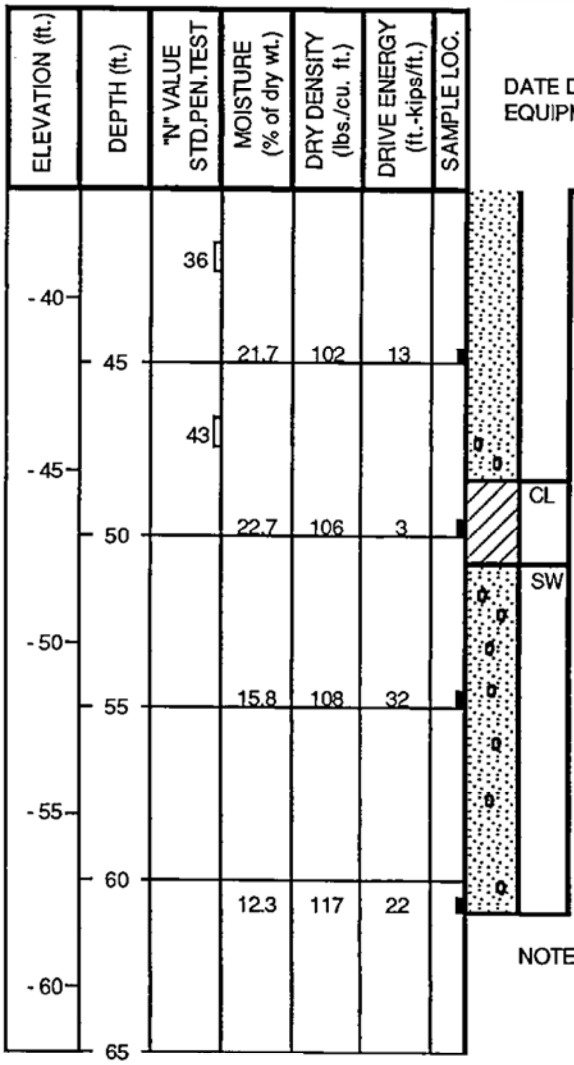
JOB L91028.AEO DATE 5/15/91 F.T. JD DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 9 (Continued)

(LCA AE-87133)

DATE DRILLED: April 15, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash



Few Gravel

SILTY CLAY - some Sand filled cracks, dark grey and brown

SAND - well graded, some Silt, about 20% Gravel, grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 30' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 19'. Backfilled annular space with pea gravel. Water level measured at a depth of 4' on 5/4/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.41b

Area B - Law Crandall Borings

PLATE A2-110

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 10
(LCA AE-87133)

DATE DRILLED: April 15, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 4.0

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							MH	ELASTIC SILT - light brownish grey
			56.5	64	1	■		
0								
	5							
			41.7	80	1	■	ML	SANDY SILT - grey
							MH	ELASTIC SILT - some organic matter, dark grey
- 5			38.9	85	1	■		
	10							
			64.3	61	<1	■		
								Lenses of Sand
-10								
			89.7	50	<1	■		
	15							
							SP	SAND - fine, some Silt and Gravel, grey
			12.4	115	3	■		
-15								
		23						
	20							
			51.3	72	<1	■	MH	ELASTIC SILT - some Sand filled cracks, dark grey
- 20								
	25							Medium to large amount of organic matter
			40.7	79	<1	■		
- 25								
	30						SM	SILTY SAND - fine, grey
			17.9	108	2	■		
- 30		9						
	35							
							ML	SANDY SILT - some Clay, dark grey
			20.8	109	4	■		
							SM	SILTY SAND - fine, some Gravel, grey
- 35		22						
	40							

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.42a

Area B - Law Crandall Borings

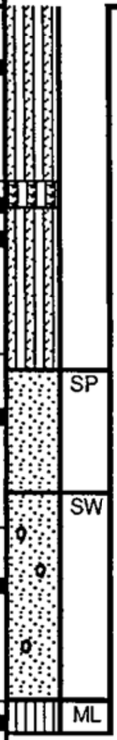
PLATE A2-111

BORING 10 (Continued)

(LCA AE-87133)

DATE DRILLED: April 15, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			16.7	115	6	■
- 40						
	45	10				
			62.4	59	-	■
			21.8	106	9	■
- 45		35				
	50					
			27.7	100	24	■
- 50						
	55					
			13.8	126	34	■
- 55						
	60					
			28.1	99	24	■
- 60						
	65					



Layer of Elastic Silt

SP SAND - fine, some Silt, grey

SW SAND - well graded, some Gravel, grey

ML SANDY SILT - grey

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 35' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 19'. Backfilled annular space with pea gravel. Water level measured at a depth of 2-1/2' on 5/4/87.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. lp O.E. DW W.P. lp CHKD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.42b

Area B - Law Crandall Borings

PLATE A2-112

JOB L91028.AEO DATE 5/15/91 F.T. ____ DR. lp O.E. DW W.P. lp CHKD ____

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

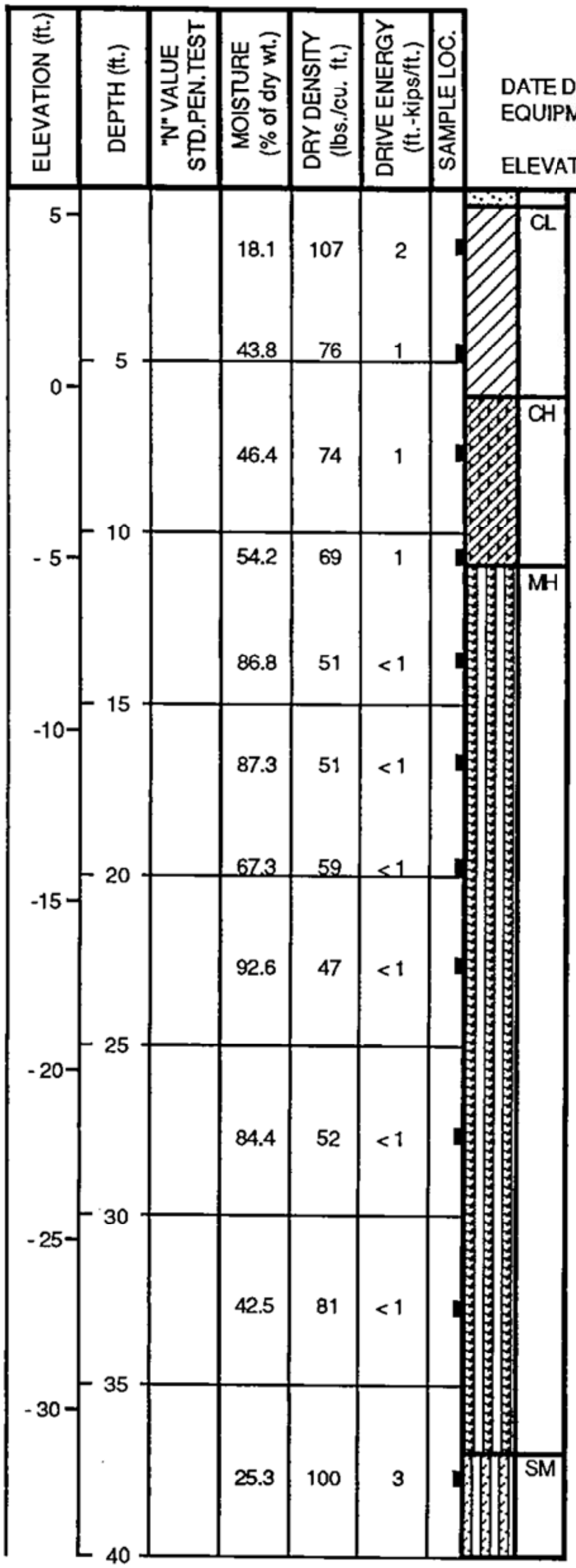
PLATE A2-113

BORING 11

(LCA AE-87133)

DATE DRILLED: April 7, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION 5.8



ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			18.1	107	2	
			43.8	76	1	
			46.4	74	1	
			54.2	69	1	
			86.8	51	< 1	
			87.3	51	< 1	
			67.3	59	< 1	
			92.6	47	< 1	
			84.4	52	< 1	
			42.5	81	< 1	
			25.3	100	3	

FILL - SAND - fine, light brown

CL SILTY CLAY - some Sand and organic matter, dark brown

CH FAT CLAY - light brownish grey

MH ELASTIC SILT - lenses of Sand, grey

Sulpher odor

Some organic matter, dark grey

(LL = 60, PI = 24)

SM SILTY SAND - fine, layers of Elastic Silt, dark grey

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.43a

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 11 (Continued)

(LCA AE-87133)

DATE DRILLED: April 7, 1987
EQUIPMENT USED: 5"- Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-35							MH	ELASTIC SILT - layers of Silty Sand, dark grey
		0						
-40	45						SW	SAND - well graded, some Gravel, grey
		24						
								About 25% Gravel
-45	50							
			13.5	122	13	■		
-50	55							
							SP	SAND - fine, some Silt, grey
		46						
							SW	SAND - well graded, about 30% Gravel, grey
-55	60							
-60	65						ML	SANDY SILT - grey
			30.4	92	19	■		
	70							

NOTE: Drilling mud used in drilling process. Removed mud to a depth of 25' after completion of drilling. Installed perforated 2" diameter PVC pipe to a depth of 19'. Backfilled annular space with pea gravel. Water level measured at a depth of 2' on 5/4/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.43b

Area B - Law Crandall Borings

PLATE A2-114

JOB L91028.AEO DATE 5/15/91 F.T. TC DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 12
(LCA AE-87133)

DATE DRILLED: April 13, 1987
EQUIPMENT USED: 8"- Diameter Hollow Stem Auger

ELEVATION 2.5

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							CH	FAT CLAY - dark grey
								∇ WATER LEVEL (4/14/87)
0								
			57.2	69	1	■		(LL = 61, PI = 29)
	5						MH	ELASTIC SILT - grey
			82.5	51	1	■		
- 5								
			87.6	51	1	■		
	10							
								Some Sand
-10			50.6	74	1	■		
							SM	SILTY SAND - fine, grey
	15							
-15								
			31.7	90	11	■		Some shells
		7						Lenses of Silt
	20							
-20							MH	ELASTIC SILT - grey
			73.5	58	4	■		
	25							
							ML	SANDY SILT - some shells, grey
-25								
			28.4	96	11	■		
	30							
							CL	SILTY CLAY - grey
-30								
			32.1	92	5	■		
	35							
							SM	SILTY SAND - fine, grey
-35								
			24.8	100	12	■		
	40							

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.44a

PLATE A2-115

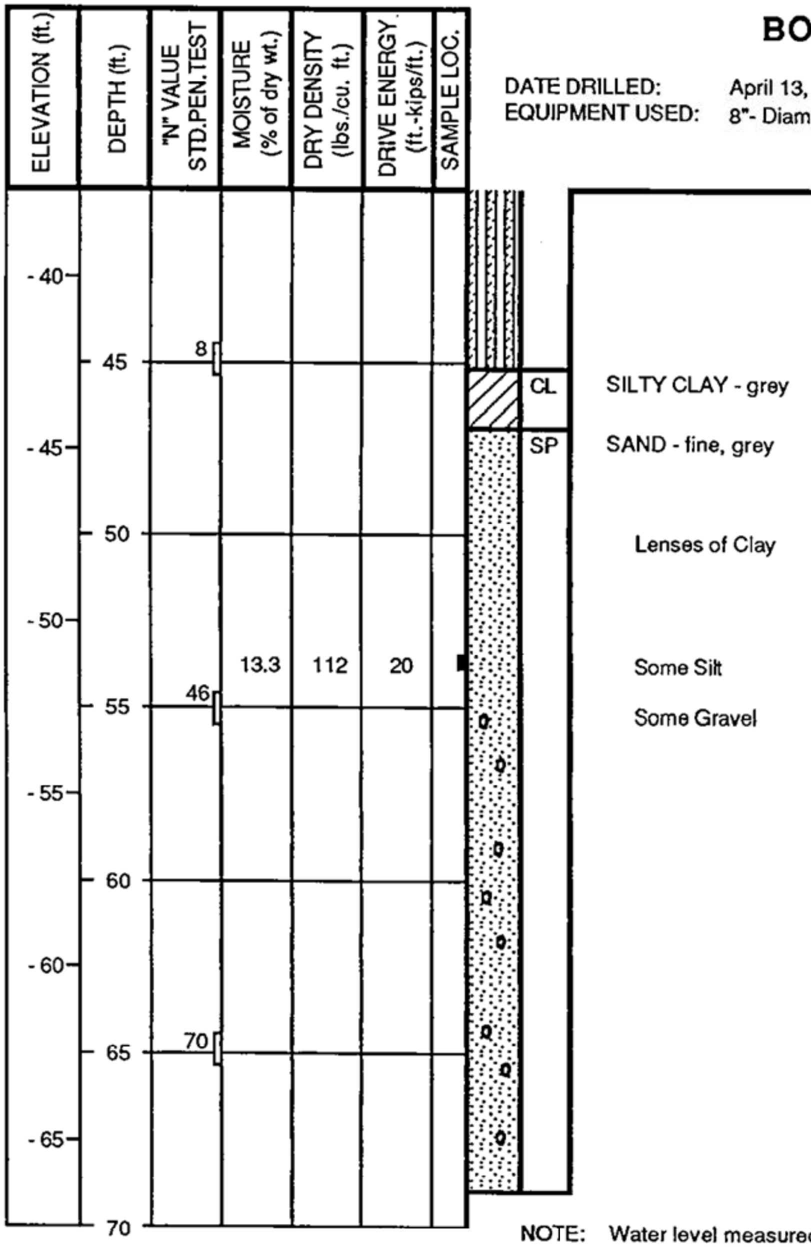
JOB L91028.AEO DATE 5/15/91 F.T. TC DR. lp O.E. DW W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 12 (Continued)

(LCA AE-87133)

DATE DRILLED: April 13, 1987
EQUIPMENT USED: 8"- Diameter Hollow Stem Auger



DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)
45	8			
		13.3	112	20
55	46			
65	70			

CL SILTY CLAY - grey

SP SAND - fine, grey

Lenses of Clay

Some Silt

Some Gravel

NOTE: Water level measured at a depth of 1-1/2' on 4/14/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.44b

JOB L91028.AEO DATE 5/15/91 F.T. LS DR. dmh O.E. BK W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsurface conditions at other locations and times.

PLATE A2-117

BORING 13
(LCA AE-87133)

DATE DRILLED: December 29, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION + 6

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
5							SP	SAND - fine, light grey
			7.8	101	4	■		
								▽ WATER LEVEL (7/16/87)
	5						MH	ELASTIC SILT - some organic matter, grey
0			51.9	70	1	■		
	10		78.3	52	< 1	■		
-5								Dark grey
		< 1						
	15							
-10			52.9	64	1	■	SM	SILTY SAND - fine to medium, some layers of Sand, some organic matter, dark grey
		9						
	20							Layers with large amount of shells
-15			20.1	111	11	■		
	25	13						
-20			29.3	92	7	■		
	30							
-25		38						
			28.2	95	13	■		
	35							
-30		23						
	40		24.9	99	5	■		

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.45a

JOB L91028.AEO DATE 5/15/91 F.T. LS DR. dmh O.E. BK W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 13 (Continued)

(LCA AE-87133)

DATE DRILLED: December 29, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
-35								
		18						
								Some Clay
	45							
-40			22.6	104	6	■		
		10						
	50							
-45							ML	SANDY SILT - some organic matter, black
			43.5	77	4	■		
							SP	SAND - fine to medium, grey
	55	28						
-50								
			14.4	117	15	■		
	60							
-55		36						Some Gravel
			17.0	113	7	■		
	65						SW SM	SAND - well graded, about 40% Gravel, some Silt, grey
-60								
			10.8	121	25	■		
	70							
-65								
							ML	SANDY SILT - dark grey
	75		25.3	101	11	■		

NOTE: Drilling mud used in drilling process. Mud removed to a depth of about 15'. Water level measured at 3' 15 minutes after removal of mud and at 3' on 12/31/86; bottom of boring at 3-1/2'. Set 5' of 2"-diameter perforated PVC pipe for water level determination (on 12/31/86). Backfilled annular space with pea gravel. Placed metal cover over pipe.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.45b

Area B - Law Crandall Borings

PLATE A2-118

BORING 14
(LCA AE-87133)

DATE DRILLED: December 30, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION +7

DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)
		42.1	80	3
		56.6	65	2
		62.3	56	1
10		49.4	73	<1
15		69.0	57	<1
20		61.0	64	2
25		39.7	79	2
30		24.1	100	25
35		26.3	97	18
40		30.1	91	8

SP FILL - SAND - fine, light brown

CL FILL - SILTY CLAY - lenses of fine Sand, mottled grey and dark grey

▽ WATER LEVEL (7/15/87)

MH ELASTIC SILT - some organic matter, dark grey

Hydrogen sulfide odor

SM SILTY SAND - fine, dark grey

Some Clay

SP SM SAND - fine, some Silt, dark grey

SM SILTY SAND - fine, dark grey

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.46a

JOB L91028.AEO DATE 5/15/91 F.T. LS DR. dmh O.E. BK W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

Area B - Law Crandall Borings

PLATE A2-119

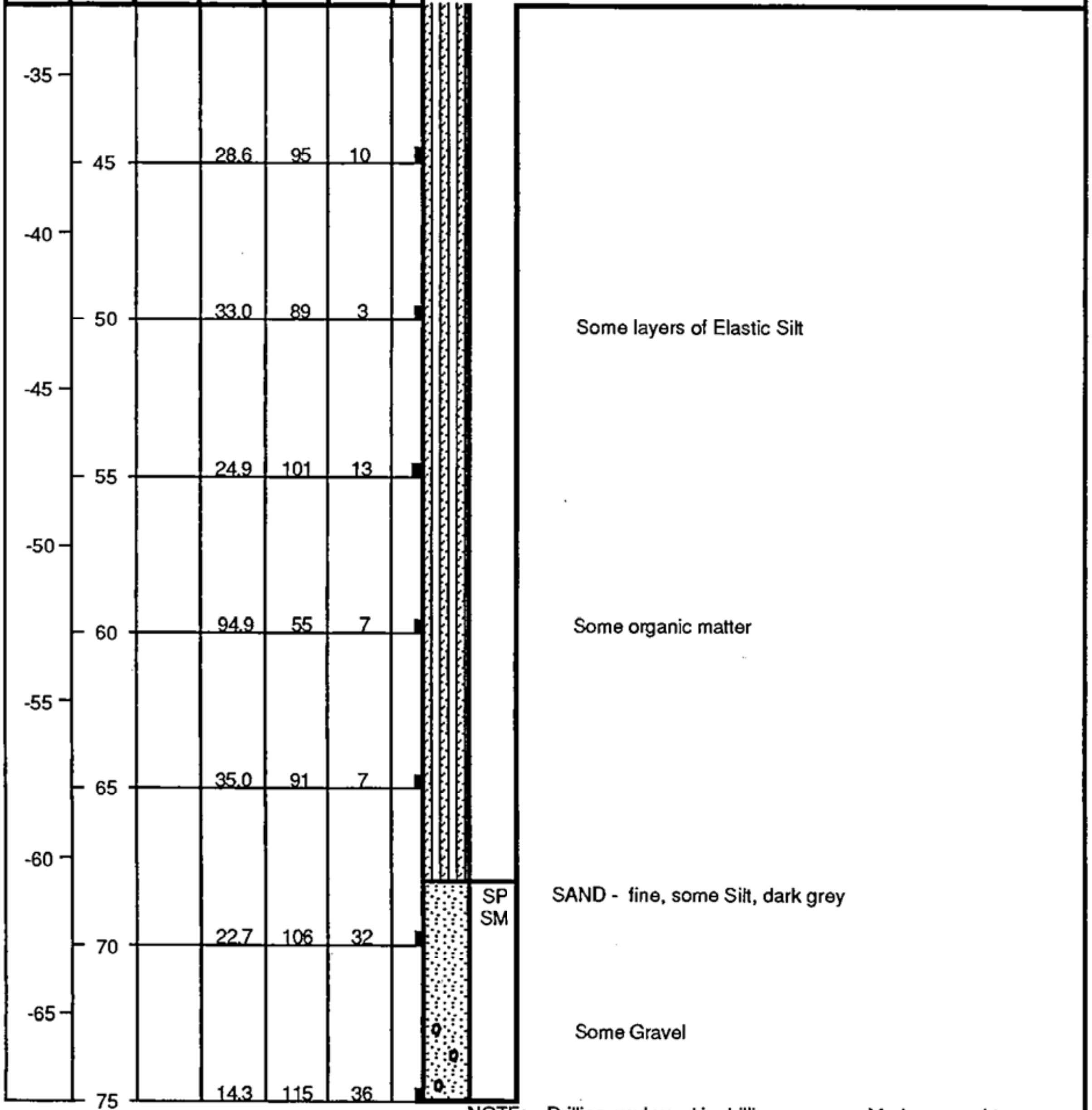
JOB L91028.AEO DATE 5/15/91 F.T. LS DR. dmh O.E. BK W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 14 (Continued)

(LCA AE-87133)

DATE DRILLED: December 30, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash



ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
	45		28.6	95	10	■
	50		33.0	89	3	■
	55		24.9	101	13	■
	60		94.9	55	7	■
	65		35.0	91	7	■
	70		22.7	106	32	■
	75		14.3	115	36	■

Some layers of Elastic Silt

Some organic matter

SAND - fine, some Silt, dark grey

Some Gravel

NOTE: Drilling mud used in drilling process. Mud removed to a depth of about 15'. Water level measured at 3' on 12/31/86; bottom of boring at 20'. Backfilled boring with pea gravel to a depth of 10'. Set 10' of 2"-diameter PVC pipe with lower 5' perforated for water level determination (on 12/31/86). Backfilled annular space with pea gravel. Placed metal cover over pipe. Water level measured at 4' on 1/13/87; bottom of boring at 8-1/2'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.46b

Area B - Law Crandall Borings

PLATE A2-120

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. dmh O.E. DW W.P. dmh CHKD

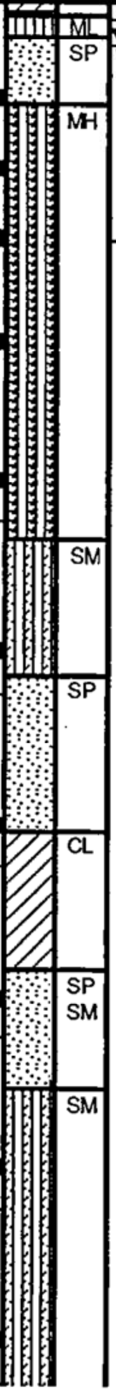
Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 15
(LCA AE-87133)

DATE DRILLED: December 30, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION +3

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
0			19.7	113	2	■
	5		63.2	64	< 1	■
			61.2	66	< 1	■
-5	10		70.8	56	< 1	■
-10			43.5	80	< 1	■
	15					
-15			22.8	102	4	■
	20					
-20			20.4	110	5	■
	25					
-25			25.9	102	10	■
	30					
-30			29.8	94	6	■
	35					
-35			28.4	94	3	■
	40					



6" Manure, straw and wood chips
SANDY SILT - brown
SAND - fine, light brown
WATER LEVEL (12/30/86)
ELASTIC SILT - some organic matter, grey

Some shells
(LL = 56, PI = 25)

Dark grey

Patches of Silty Sand

SILTY SAND - fine, large amount of shells, dark grey

SAND - fine to medium, grey

SILTY CLAY - large amount of shells, grey

SAND - fine, some Silt, some shells, dark grey

SILTY SAND - fine, dark grey

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.47a

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. dmh O.E. DW W.P. dmh CHKD

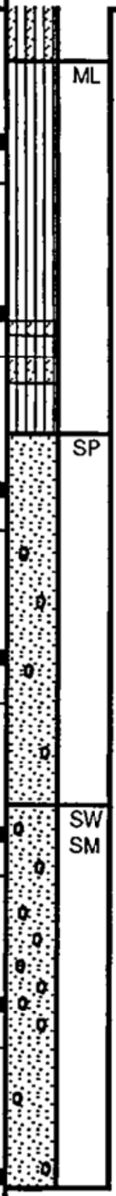
Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 15 (Continued)

(LCA AE-87133)

DATE DRILLED: December 30, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-40						
			46.2	80	2	■
	45					
-45						
			27.5	96	4	■
	50					
-50						
			26.0	98	18	■
	55					
-55						
			15.6	115	16	■
	60					
-60						
			17.0	115	30	■
	65					
-65						
			16.2	116	48	■
	70					
-70						
			21.7	107	30	■
	75					



ML SANDY SILT - some Clay and shells, dark grey
Some streaks of organic matter
Patches of Sand

Layers of Silty Sand

SP SAND - fine, grey

Some Gravel

SW SM SAND - well graded, some Silt, about 20% Gravel, grey

Large amount of Gravel, dark grey

Few Gravel

NOTE: Drilling mud used in drilling process. Mud removed to a depth of about 10'. Water level measured at 1-1/2' 30 minutes after removal of mud; bottom of boring at 7'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES
PLATE A - 1.47b

Area B - Law Crandall Borings

PLATE A2-122

JOB L91028.AEO DATE 5/15/91 F.T. LS DR. dmh O.E. DW W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 16
(LCA AE-87133)

DATE DRILLED: December 30, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION + 8

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			4.3	127	11	■
5						
			19.1	98	6	■
	5					
			56.2	67	3	■
0						
	10		52.9	66	<1	■
-5						
	15		70.5	57	<1	■
-10						
	20		29.6	91	3	■
-15						
	25		26.1	102	7	■
-20						
	30		20.6	107	20	■
-25						
	35		24.9	98	13	■
-30						
	40		20.8	106	27	■

SP FILL - SAND - fine, some Silt, light brown

SP SAND - fine, light greyish brown

WATER LEVEL (12/31/86)

MH ELASTIC SILT - grey

Some organic matter, dark grey
(LL = 51, PI = 22)

SM SILTY SAND - fine, dark grey

Large amount of shells

SP
SM SAND - fine, some Silt, grey

Dark grey

Light grey

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.48a

Area B - Law Crandall Borings

PLATE A2-123

JOB L91028.AEO DATE 5/15/91 F.T. LS DR. dmh. O.E. DW W.P. dmh. CHKD

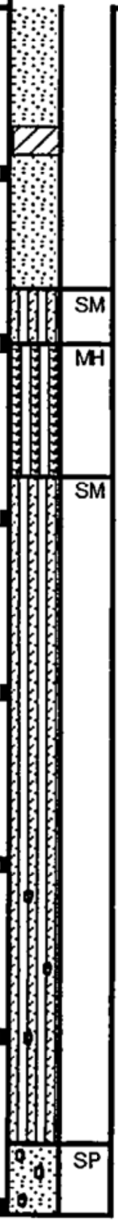
Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 16 (Continued)

(LCA AE-87133)

DATE DRILLED: December 30, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-35						
	45		17.3	112	23	
-40						
	50		59.9	64	2	
-45						
	55		28.9	93	6	
-50						
	60		31.4	81	5	
-55						
	65		32.5	93	9	
-60						
	70		18.8	113	4	
-65						
	75		15.7	109	23	



Large amount of shells, dark grey

Layer of Silty Clay

SM SILTY SAND - fine, dark grey

MH ELASTIC SILT - dark grey

SM SILTY SAND - fine, few layers of Silty Clay, dark grey

Some organic matter

Some Gravel

SP SAND - fine to medium, about 20% Gravel, dark grey

NOTE: Drilling mud used in drilling process. Mud removed to a depth of about 15'. Water level measured at 4-1/2' 15 minutes after removal of mud and at 4' on 12/31/86; bottom of boring at 4-1/2'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.48b

Area B - Law Crandall Borings

PLATE A2-124

BORING 17

(LCA AE-87133)

DATE DRILLED: December 30, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION +5

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							SM	FILL - SILTY SAND fine, brown
			10.0	125	7	■		
							SP	SAND - fine, greyish brown WATER LEVEL (12/31/86)
							MH	ELASTIC SILT - some organic matter and shells, grey
0	5							
			59.4	65	< 1	■		
			75.0	55	< 1	■		(LL = 58, PI = 26)
-5	10							
								Dark grey
		<1						
			72.1	58	< 1	■		
-10	15							
		<1						
							SM	SILTY SAND - fine, dark grey
-15	20							
			24.7	101	2	■		
							SP	SAND - fine, grey
		36						
-20	25							
			22.7	103	16	■		Dark grey
								Some Silt
		14						
-25	30							
			21.4	104	8	■		Large amount of shells
-30	35							
		24						
			19.6	106	11	■		
-35	40							

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. dmh O.E. DW W.P. dmh CHKD

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.49a

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. dmh O.E. DW W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

PLATE A2-126

BORING 17 (Continued)

(LCA AE-87133)

DATE DRILLED: December 30, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							SM	SILTY SAND - fine, dark grey
		12						
								Fine to medium
			16.4	113	10	■		
-40	45							
							ML	CLAYEY SILT - some Sand, dark grey
		10						
-45	50							
								Some organic matter
			29.8	93	3	■		
							CL	SILTY CLAY - dark grey (LL = 34, PI = 16)
-50	55							
							SM	SILTY SAND - fine, dark grey
			23.7	102	22	■		
-55	60							
							SP	SAND - fine, dark grey Some patches of Silt
			22.1	104	14	■		
-60	65							
			21.5	105	19	■		
-65	70							
								Some Gravel
								Some Silt, grey
			24.5	102	10	■		
-70	75							

NOTE: Drilling mud used in drilling process. Mud removed to a depth of about 15'. Water level measured at 2-1/2' 30 minutes after removal of mud and at 2' on 12/31/86; bottom of boring at 3'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.49b

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. dmh O.E. DW W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 18

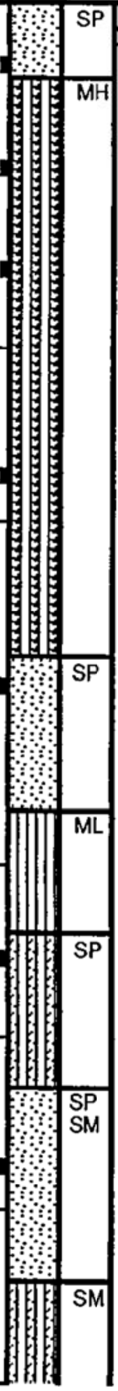
(LCA AE-87133)

DATE DRILLED: December 29, 1986

EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION +4

PLATE A2-127



ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							SP	SAND - fine, light greyish brown WATER LEVEL (7/16/87)
			20.1	104	5	■		
							MH	ELASTIC SILT - some shells, some organic matter, grey
0								
	5		58.0	66	< 1	■		
			54.5	68	< 1	■		Some Sandy layers with shells
-5								
	10							Dark grey
		< 1						
-10			90.3	48	< 1	■		
	15							
		<1						Some layers of Silty Sand
-15							SP	SAND - fine to medium, grey
	20		19.1	110	8	■		
		38						
-20							ML	CLAYEY SILT - some Sand, grey
	25							
			27.9	96	4	■	SP	SAND - fine, some Silt, dark grey
-25								
	30	18						
							SP SM	SAND - fine, some Silt, dark grey
-30			24.5	101	24	■		
	35							
		18						
							SM	SILTY SAND - fine to medium, large amount of shells, dark grey
-35								Alternating layers of Silty Sand and Sand with large amount of shells
	40							

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.50a

JOB L91028.AEO DATE 5/15/91 F.T. GMC DR. dmh O.E. DW W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 18 (Continued)

(LCA AE-87133)

DATE DRILLED: December 29, 1986
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			20.9	110	7	■
-40	45	13				
			50.4	73	2	■
-45	50	<1				
-50	55		26.2	95	5	■
-55	60		22.5	105	4	■
-60	65		23.6	101	17	■
-65	70		15.3	117	19	■
-70	75		21.4	104	39	■

ML CLAYEY SILT - some organic matter, dark grey

Lenses of Peat

ML SANDY SILT - some organic matter, dark grey

Layers of Sand

SP SAND - fine to medium, few Gravel and shells, grey

SW SM SAND - well graded, some Silt, about 30% Gravel, dark grey

Layer of Clay

NOTE: Drilling mud used in drilling process. Mud removed to a depth of about 15'. Water level measured at 2-1/2' 30 minutes after removal of mud and at 1-1/2' on 12/31/86; bottom of boring at 17' and 8' respectively. Set 10' of 2"-diameter PVC pipe with lower 5' perforated for water level determination (on 12/31/86). Backfilled annular space with pea gravel. Placed metal cover over pipe. Water level measured at 1' on 1/13/87; bottom of boring at 10'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.50b

Area B - Law Crandall Borings

PLATE A2-128

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. dmh O.E. DW W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 1

(LCA AE-86416)

DATE DRILLED: April 13, 1987
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION +4.1 *

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							CL	SILTY CLAY - black
			45.7	73	1	■		
							MH	ELASTIC SILT - some Sand, few shells, brownish grey
0								WATER LEVEL (6/22/87)
	5		64.8	60	< 1	■		
							ML	SANDY SILT - few shells, brownish grey (Non plastic)
			40.8	82	1	■		
- 5							MH	ELASTIC SILT - large amount of shells, grey
	10							
			89.7	47	< 1	■		
			68.6	57	< 1	■		
- 10								
	15						CH	FAT CLAY - organic odor, brownish grey
			105.0	45	< 1	■		
- 15								
	20		48.9	75	< 1	■		
							ML	SANDY SILT - some Clay, few shells, grey
- 20								
	25		32.2	91	< 1	■		(LL = 25, PI = 1)
							ML	CLAYEY SILT - some Sand, brownish grey
- 25								
	30		23.7	102	3	■		
							CL	SILTY CLAY - lenses of Sandy Silt, grey
- 30								
	35		31.5	90	3	■		(LL = 38, PI = 17)
								Dark grey
- 35								
	40		31.1	92	2	■		

* Elevations provided by Psomas and Associates on 4/20/87.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.51a

Area B - Law Crandall Borings

PLATE A2-129

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. dmh O.E. DW W.P. dmh CHKD

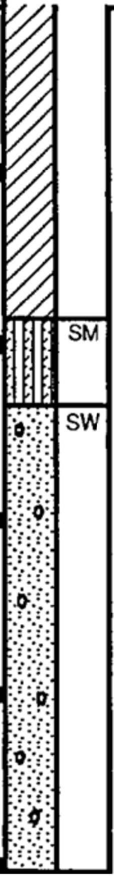
Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 1 (Continued)

(LCA AE-86416)

DATE DRILLED: April 13, 1987
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
- 40	45		30.4	95	3	■
- 45	50		18.9	112	5	■
- 50	55		12.3	127	34	■
- 55	60		11.1	131	32	■
- 60	65		23.4	104	38	■



Lenses of Sand

SM SILTY SAND - fine, grey

SW SAND - well graded, about 15% Gravel, grey

Layers of Silty Sand

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 35' after completion of drilling. Installed perforated 2"-diameter PVC pipe to a depth of 18-1/2'. Backfilled annular space with pea Gravel. Water level measured at a depth of 4-1/2' on 6/22/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.51b

Area B - Law Crandall Borings

PLATE A2-130

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. dmh O.E. DW W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 2

(LCA AE-86416)

DATE DRILLED: April 13, 1987
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION +2.8

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
			32.1	82	2	■	CL	SILTY CLAY - streaks of alkali, dark brown
0							CH	FAT CLAY - light brownish grey WATER LEVEL (6/22/87)
			48.4	71	< 1	■		
	5							
			57.0	67	< 1	■		(LL = 69, PI = 39)
- 5								
			45.5	74	< 1	■	MH	ELASTIC SILT - grey Large amount of shells
	10							
- 10			66.0	54	< 1	■		
	15							
		1						
- 15								Fewer shells
			51.1	72	1	■		
	20							
			41.1	81	< 1	■		Some Sand
- 20								
	25						ML	SANDY SILT - few shells, black
			33.1	92	2	■		
- 25								
		1						Some Clay
	30						CL	SILTY CLAY - some organic matter, dark grey
			32.8	91	2	■		(LL = 35, PI = 14)
- 30								Lenses of Sand
	35							
			30.3	94	2	■		
- 35								
	40						SM	SILTY SAND - fine, grey

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.52a

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. dmh O.E. DW W.P. dmh CHKD

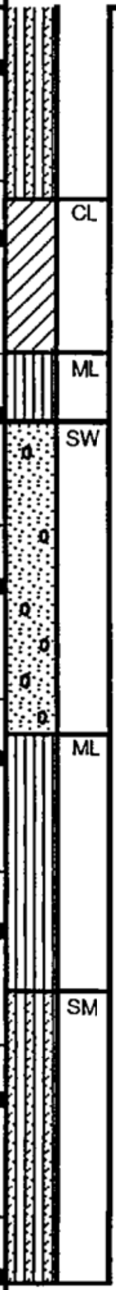
Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 2 (Continued)

(LCA AE-86416)

DATE DRILLED: April 13, 1987
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			19.8	102	6	■
-40						
		30				
	45					
			23.6	102	6	■
-45						
	50					
			16.1	105	6	■
-50						
		53				
	55					
			13.3	119	28	■
-55						
	60					
			28.4	96	22	■
-60						
	65					
			27.2	99	14	■
-65						
	70					
			31.0	94	17	■
-70						
	75					
			29.8	93	14	■
-75						
	80					



CL SILTY CLAY - some organic matter, dark grey

ML SANDY SILT - dark grey

SW SAND - well graded, about 10% Gravel, grey

About 25% Gravel
Layers of fine Sand

ML SANDY SILT - grey

SM SILTY SAND - fine, grey

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 25' after completion of drilling. Installed perforated 2"-diameter PVC pipe to a depth of 18-1/2'. Backfilled annular space with pea Gravel. Water level measured at a depth of 3' on 6/22/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.52b

Area B - Law Crandall Borings

PLATE A2-132

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. dmh O.E. DW W.P. dmh CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 3
(LCA AE-86416)

DATE DRILLED: April 14, 1987
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION +2.5

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							CH	FAT CLAY - greyish brown
								∇ WATER LEVEL (6/22/87)
0			60.7	64	< 1	■		
								Light greyish brown
	5		64.9	62	< 1	■		
- 5							MH	ELASTIC SILT - some Sand, grey
			52.3	70	< 1	■		
	10							
								Layer of shells
			83.2	53	< 1	■		
- 10								
								Some organic matter
	15		98.0	47	< 1	■		
- 15			94.3	50	< 1	■		Brownish grey
	20							Grey
			39.7	81	< 1	■		
- 20								
	25		35.1	87	1	■		
- 25								
							ML	SANDY SILT - large amount of shells, dark grey
	30		35.2	80	1	■		
							MH	ELASTIC SILT - some Sand, grey
- 30		0						
	35		25.1	97	< 1	■		
- 35							CL	SILTY CLAY - some Sand and organic matter, dark grey
	40							

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.53a

Area B - Law Crandall Borings

PLATE A2-133

JOB L91028.AEO DATE 5/15/91 F.T. JD DR. dmh O.E. DW W.P. dmh CHKD

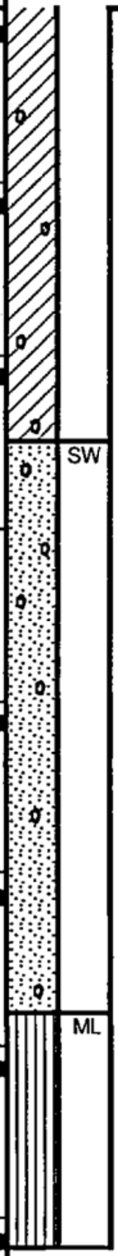
Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 3 (Continued)

(LCA AE-86416)

DATE DRILLED: April 14, 1987
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			68.6	57	1	■
- 40						
	45					
			13.2	109	9	■
- 45						
	50					
			38.1	82	3	■
- 50						
	55					
- 55						
	60					
			12.2	125	19	■
- 60						
	65					
			29.8	95	25	■
- 65						
	70					
			24.9	101	17	■
- 70						
	75					
			29.2	96	14	■
- 75						
	80					



Layers of well graded Sand
Few Gravel

SW SAND - well graded, about 25% Gravel, grey

About 15% Gravel

Layers of Sandy Silt

ML SANDY SILT - grey

NOTE: Drilling mud used in drilling process. Mud removed to a depth of 25' after completion of drilling. Installed perforated 2"-diameter PVC pipe to a depth of 19'. Backfilled annular space with pea Gravel. Water level measured at a depth of 1-1/2' on 6/22/87.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE A - 1.53b

Area B - Law Crandall Borings

PLATE A2-134

SOIL CLASSIFICATION SYSTEM-ASTM D2487

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE-GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	▨	GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
			▨	GP	POORLY GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	▨	GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
			▨	GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	▨	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			▨	SP	POORLY GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	▨	SM	SILTY SANDS, SAND - SILT MIXTURES
			▨	SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE-GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	▨	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			▨	CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			▨	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	▨	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
			▨	CH	INORGANIC CLAYS OF HIGH PLASTICITY
			▨	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			▨	PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

■	"Push" Sampler
⧗	Split Barrel "Drive" Sampler With Liner
☒	Standard Penetration Test (SPT) Sampler
▯	Bag Sample
▤	Concrete/Rock Core
▽	Groundwater Surface

SPT "N" = 0.65 x modified California blows per foot

NP = Nonplastic
EI = Expansion Index Test
SG = Specific Gravity
SE = Sand Equivalent
UC = Unconfined Comp.
CD = Consol. Drained Triaxial.
CU = Consol. Undrained Triaxial.
UU = Undrained, Unconsol. Triaxial.
RV = R-Value
CA = Chemical Analysis
DS = Direct Shear
CN = Consolidation
CP = Collapse Potential
SA = Grain size; HD = Hydrometer
MD = Compaction Test
HC = Hydraulic Conductivity Test
[PID] Reading in ppm above background

USACE Ballona Creek Watershed
Project No. 2006-023.05

PLATE
B1

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION: See Figure 2		**ELEVATION AND DATUM (feet):** 7 MLLW	
LATITUDE: 33° 58' 17.6" N		**LONGITUDE:** 118° 26' 1.8" W	
DRILLING EQUIPMENT: CME 750		**DRILLING METHOD:** Hollow Stem Auger	
BORING DIAMETER (inches): 8		**BORING DEPTH (feet):** 16.5	
DATE STARTED: 2/24/09		**DATE COMPLETED:** 2/24/09	
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
		⧗	▨	1 1 2	2		FAT CLAY (CH): very dark gray, moist, very soft, high plasticity, few roots						
5			▥				SILT (ML): olive brown, moist, soft, low plasticity, micaceous						
		⧗	▥	1 2 2	3	0.25			39	41	7	98	
	5												
		⧗	▥	2 4 7	7		∇ SANDY SILT (ML): olive brown, wet, medium stiff, low plasticity, fine-grained sand		32			52	
0													
		⧗	▥	1 2 2	3	0.75	ELASTIC SILT (MH): grayish brown, wet, soft, medium plasticity, veins of oxidation, micaceous		43	55	22	98	
	10												
-5		⧗	▥	1 1 2	2		very dark gray, very soft, trace shell fragments, sulfur odor		60			93	
	15	⧗	▥	1 1 1	1	0.75	gray		91			93	
-10							Bottom of boring at 16.5 feet. Groundwater encountered at 6 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
	20												
-15													
	25												
-20													

LOG OF BORING B-01

Page 1 of 1
USACE Ballona Creek Watershed
Project No. 2006-023.05

PLATE
B2

PLATE A2-136

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	7 MLLW
LATITUDE:	33° 58' 16.1" N	**LONGITUDE:**	118° 26' 7.1" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	16.5
DATE STARTED:	2/24/09	**DATE COMPLETED:**	2/24/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
		⧗	▨	1 1 2	2		LEAN CLAY with SAND (CL): very dark brown, moist, very soft, medium plasticity, fine- to coarse-grained sand, little roots						
5		⧗	▨	1 2 3	3		FAT CLAY (CH): gray, moist, soft, high plasticity, trace dark spots		39	50	32	97	
0	5	⧗	▨	3 5 4	6		∇ SANDY SILT (ML): dark grayish brown, wet, medium stiff, low plasticity, fine-grained sand, micaceous		37			53	
		⧗	▨	1 1 2	2		LEAN CLAY (CL): olive brown, wet, very soft, medium plasticity, oxidation		40			98	
	10		▨				SANDY LEAN CLAY (CL): olive brown, wet, very soft, medium plasticity, fine-grained sand, micaceous		38			51	
-5		⧗	▨	1 1 2	2		FAT CLAY (CH): very dark gray, wet, very soft, high plasticity, sulfur odor		83			95	
	15	⧗	▨	1 1 2	2		ELASTIC SILT (MH): gray, wet, very soft, medium plasticity, sulfur odor		107	64	17	96	
-10 -15 -20	20 25						Bottom of boring at 16.5 feet. Groundwater encountered at 6 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						

LOG OF BORING B-02

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USACE Ballona Creek Watershed
Project No. 2006-023.05

PLATE
B3

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	10 MLLW
LATITUDE:	33° 58' 16.1" N	**LONGITUDE:**	118° 26' 12.6" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	19.5
DATE STARTED:	2/23/09	**DATE COMPLETED:**	2/23/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
		⧗		2 4 8	8		SANDY SILT (ML): very dark grayish brown, moist, medium stiff, low plasticity, fine- to coarse-grained sand, trace fine to coarse gravel, little roots		19			66	
		⧗		50/6"	65		POORLY GRADED SAND with GRAVEL (SP): dark yellowish brown, moist, very dense, fine- to coarse-grained sand, fine to coarse gravel						
5	5	⧗		2 3 4	5		LEAN CLAY (CL): light brownish gray, moist, medium stiff, medium plasticity		45	46	21	99	
0	10	⧗		2 2 4	4		very dark grayish brown, soft, micaceous ▽		37			91	
		⧗		0 1 1	1	0.25	ELASTIC SILT (MH): dark gray, wet, very soft, medium plasticity, micaceous		42			98	
-5	15	⧗		1 2 2	3		FAT CLAY (CH): dark gray, wet, soft, high plasticity, trace shell fragments		62	73	46	90	
		⧗		1 1 2	2		gray, very soft, sulfur odor		87			96	
-10	20						Bottom of boring at 19.5 feet. Groundwater encountered at 11 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-15	25												
-20													

LOG OF BORING B-03

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USACE Ballona Creek Watershed

Project No. 2006-023.05

PLATE

B4

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION: See Figure 2

ELEVATION AND DATUM (feet): 8 MLLW

LATITUDE: 33° 58' 11.2" N

LONGITUDE: 118° 26' 13.0" W

DRILLING EQUIPMENT: CME 750

DRILLING METHOD: Hollow Stem Auger

BORING DIAMETER (inches): 8

BORING DEPTH (feet): 16.5

DATE STARTED: 2/24/09

DATE COMPLETED: 2/24/09

SPT HAMMER DROP: 30 inches **WT:** 140 lbs

DRIVE HAMMER DROP: 30 inches **WT:** 140 lbs

LOGGED BY: JMS **CHECKED BY:** KV

DRIVE SAMPLER DIAMETER (inches) **ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				1 3 2	3		SILT with SAND (ML): brown, moist, soft, low plasticity, fine- to medium-grained sand, few roots		20			74	
5	5			4 6 8	9		LEAN CLAY (CL): very dark brown, moist, stiff, medium plasticity, trace roots, calcite stringer		34			91	
0				4 4 6	6		▽ SILT (ML): olive brown, wet, medium stiff, nonplastic, micaceous		34	NP	NP	98	
	10			3 4 3	5		SANDY SILT (ML): olive brown, wet, medium stiff, low plasticity, fine-grained sand, micaceous		36			66	
-5				0 2 1	2		SILT (ML): very dark gray, wet, very soft, low plasticity, trace shell fragments, sulfur odor		42	40	7	99	
	15			1 1 1	1				100			93	
-10 -15 -20	20 25						Bottom of boring at 16.5 feet. Groundwater encountered at 6 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						

LOG OF BORING B-04

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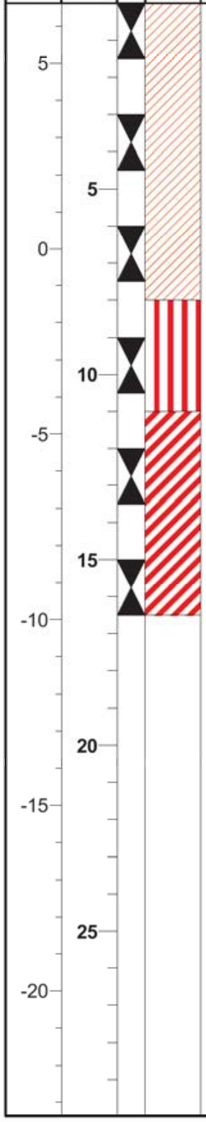
Project No. 2006-023.05

PLATE

B5

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	7 MLLW
LATITUDE:	33° 58' 7.9" N	**LONGITUDE:**	118° 26' 11.9" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	16.5
DATE STARTED:	2/25/09	**DATE COMPLETED:**	2/25/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3



Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
1 1 2	2		LEAN CLAY with SAND (CL): dark brown, moist, very soft, medium plasticity, fine-grained sand, trace roots		23			83	
1 2 3	3		gray, soft						
2 6 4	6		▽ olive gray, wet, medium stiff, micaceous		34			82	
1 1 1	1		ELASTIC SILT (MH): olive gray, wet, very soft, medium plasticity, trace shell fragments		49	62	29	98	
0 1 2	2		FAT CLAY (CH): dark gray, wet, very soft, high plasticity, sulfur odor		59			90	
0 1 1	1		few shell fragments		95	67	38	95	
			Bottom of boring at 16.5 feet. Groundwater encountered at 6 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						

LOG OF BORING B-05

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USACE Ballona Creek Watershed
Project No. 2006-023.05

PLATE

B6

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	6 MLLW
LATITUDE:	33° 58' 6.8" N	**LONGITUDE:**	118° 26' 0.9" W
DRILLING EQUIPMENT:	Hand Auger	**DRILLING METHOD:**	Hand Auger
BORING DIAMETER (inches):	4	**BORING DEPTH (feet):**	8
DATE STARTED:	2/25/09	**DATE COMPLETED:**	2/25/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** inches	**WT:** lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
5			▨				FAT CLAY (CH): dark olive brown, moist, high plasticity, little roots ∇		54			98	
			▥				ELASTIC SILT (MH): very dark brown, wet, medium plasticity		46	70	36	99	
0	5		▨				FAT CLAY (CH): dark grayish brown, wet, soft, high plasticity		43			97	
							Bottom of boring at 8 feet. Groundwater encountered at 2 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-5	10												
-10	15												
-15	20												
-20	25												

LOG OF BORING B-06

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Project No. 2006-023.05

PLATE

B7

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION: See Figure 2
ELEVATION AND DATUM (feet): 4 MLLW
LATITUDE: 33° 57' 56.6" N
LONGITUDE: 118° 26' 39.7" W
DRILLING EQUIPMENT: CME 750
DRILLING METHOD: Hollow Stem Auger
BORING DIAMETER (inches): 8
BORING DEPTH (feet): 16.5
DATE STARTED: 2/19/09
DATE COMPLETED: 2/19/09
SPT HAMMER DROP: 30 inches **WT:** 140 lbs
DRIVE HAMMER DROP: 30 inches **WT:** 140 lbs
LOGGED BY: JMS **CHECKED BY:** KV
DRIVE SAMPLER DIAMETER (inches) **ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				3 4 5	6		POORLY GRADED SAND with CLAY (SP-SC): brown, moist, loose, fine- to medium-grained sand, trace fine gravel, trace roots ▽						
0				1 2 3	3		FAT CLAY (CH): dark gray, wet, soft, high plasticity		58			98	
	5			2 2 3	3		SILT (ML): very dark gray, wet, soft, low plasticity, micaceous		26	33	6	95	
-5	10			1 1 2	2		ELASTIC SILT (MH): very dark gray, wet, very soft, medium plasticity, trace shell fragments		40	59	24	96	
				1 1 2	2		FAT CLAY (CH): very dark gray, wet, very soft, high plasticity, sulfur odor		60			92	
-10	15			2 3 5	5		CLAYEY SAND (SC): very dark gray, wet, loose, fine-grained sand, trace shell fragments, sulfur odor		34			39	
							Bottom of boring at 16.5 feet. Groundwater encountered at 2 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-15	20												
-20	25												
-25													

LOG OF BORING B-07

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USACE Ballona Creek Watershed
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PLATE
B8

PLATE A2-142

Area B & C - Diaz Yourman & Associates Borings

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	4 MLLW
LATITUDE:	33° 57' 52.7" N	**LONGITUDE:**	118° 26' 48.7" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	16.5
DATE STARTED:	2/18/09	**DATE COMPLETED:**	2/18/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				3 4 5	6		FAT CLAY (CH): olive brown, moist, medium stiff, high plasticity, micaceous		41	67	44	99	
0				3 3 4	5		FAT CLAY with SAND (CH): grayish brown, moist, medium stiff, high plasticity, fine-grained sand, micaceous		36			80	
	5			0 0 0	0		▽ FAT CLAY (CH): olive gray, wet, very soft, high plasticity, trace shell fragments		71			97	
-5	10			1 2 3	3		dark gray, soft, no shell fragments		58	53	24	98	
				0 0 5	3		CLAYEY SAND (SC): gray, wet, very loose, fine-grained sand, trace shell fragments		40			36	
-10	15			4 11 23	22		dark gray, medium dense		26			16	
							Bottom of boring at 16.5 feet. Groundwater encountered at 5 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-15	20												
-20	25												
-25													

LOG OF BORING B-08

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USACE Ballona Creek Watershed
Project No. 2006-023.05

PLATE

B9

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION: See Figure 2

ELEVATION AND DATUM (feet): 4 MLLW

LATITUDE: 33° 57' 55.3" N

LONGITUDE: 118° 26' 42.1" W

DRILLING EQUIPMENT: CME 750

DRILLING METHOD: Hollow Stem Auger

BORING DIAMETER (inches): 8

BORING DEPTH (feet): 16.5

DATE STARTED: 2/19/09

DATE COMPLETED: 2/19/09

SPT HAMMER DROP: 30 inches **WT:** 140 lbs

DRIVE HAMMER DROP: 30 inches **WT:** 140 lbs

LOGGED BY: JMS **CHECKED BY:** KV

DRIVE SAMPLER DIAMETER (inches) **ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				3 3 4	5		▽ CLAYEY SAND (SC): dark grayish brown, wet, loose, fine- to coarse-grained sand						
							FAT CLAY (CH): dark brown, wet, soft, high plasticity		43	64	37	99	
				1 2 2	3		gray		52	58	29	99	
0	5												
				1 2 2	3		ELASTIC SILT (MH): dark gray, wet, soft, medium plasticity, micaceous		58			97	
-5	10			1 1 1	1		very soft		81			97	
				2 3 7	6		CLAYEY SAND (SC): very dark gray, wet, loose, fine-grained sand, few shell fragments, sulfur odor		37			35	
-10	15			2 3 7	6				25			14	
							Bottom of boring at 16.5 feet. Groundwater encountered at 0 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-15	20												
-20	25												
-25													

LOG OF BORING B-09

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USACE Ballona Creek Watershed

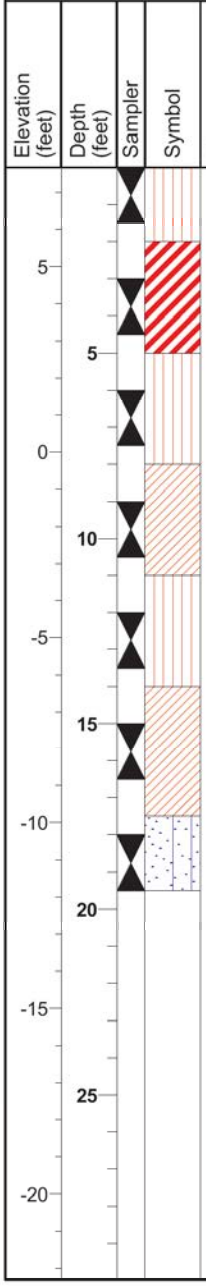
Project No. 2006-023.05

PLATE

B10

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	8 MLLW
LATITUDE:	33° 58' 6.1" N	**LONGITUDE:**	118° 26' 28.6" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	16.5
DATE STARTED:	2/18/09	**DATE COMPLETED:**	2/18/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3



Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
1 1 2	2		SILT with SAND (ML): brown, moist, very soft, low plasticity, fine- to medium-grained sand, micaceous, trace roots		29			76	
1 4 4	5		FAT CLAY (CH): dark brown, moist, medium stiff, high plasticity, color gradient, soft white deposites throughout		54			93	
3 3 4	5		▽ SILT (ML): olive brown, wet, medium stiff, nonplastic		31	NP	NP	94	
2 2 3	3		LEAN CLAY (CL): olive brown, wet, soft, medium plasticity		59			100	
1 1 2	2		SILT (ML): gray, wet, very soft, low plasticity		48	46	15	100	
1 2 1	2		SANDY LEAN CLAY (CL): gray, wet, very soft, medium plasticity, fine-grained sand, few shell fragments, sulfur odor		48			52	
3 5 9	9		POORLY GRADED SAND with SILT (SP-SM): gray, wet, loose, fine-grained sand, few shell fragments, strong sulfur odor		29			12	
			Bottom of boring at 19.5 feet. Groundwater encountered at 6 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						

LOG OF BORING B-10

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Project No. 2006-023.05

PLATE
B11

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	6 MLLW
LATITUDE:	33° 57' 53.0" N	**LONGITUDE:**	118° 26' 26.3" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	16.5
DATE STARTED:	2/19/09	**DATE COMPLETED:**	2/19/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
5		⧗	▨	1 2 2	3		LEAN CLAY (CL): brown, moist, soft, medium plasticity, some organics		37			90	
		⧗	▥	2 2 2	3		ELASTIC SILT (MH): brownish gray, moist, soft, medium plasticity, trace shell fragments		72	80	40	96	
	5		▥				▽ wet						
0		⧗	▥	1 0 1	1		very soft, sulfur odor		58			91	
	10	⧗	▥	0 1 1	1		dark gray		60	61	28	97	
-5			▥						71			90	
	15	⧗	▨	1 2 2	3		CLAYEY SAND (SC): very dark gray, wet, very loose, fine-grained sand, few shell fragments		54			45	
-10							Bottom of boring at 16.5 feet. Groundwater encountered at 5 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-15	20												
-20	25												

LOG OF BORING B-11

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PLATE
B12

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	6 MLLW
LATITUDE:	33° 57' 58.3" N	**LONGITUDE:**	118° 26' 20.2" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	16.5
DATE STARTED:	2/20/09	**DATE COMPLETED:**	2/20/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				1 2 2	3		LEAN CLAY (CL): dark brown, moist, soft, medium plasticity, trace roots		49			98	
							ELASTIC SILT (MH): light gray, moist, medium stiff, medium plasticity, few shell fragments						
				3 3 4	5				45			97	
						▽	wet						
				0 1 2	2		dark gray, very soft, trace shell fragments, sulfur odor		69			96	
				0 0 3	2		olive gray		84	52	13	95	
				1 1 1	1		dark gray		59			90	
							SANDY FAT CLAY (CH): gray, wet, soft, high plasticity, fine-grained sand, trace shell fragments, sulfur odor						
				2 2 3	3				56			56	
							Bottom of boring at 16.5 feet. Groundwater encountered at 5 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						

LOG OF BORING B-12

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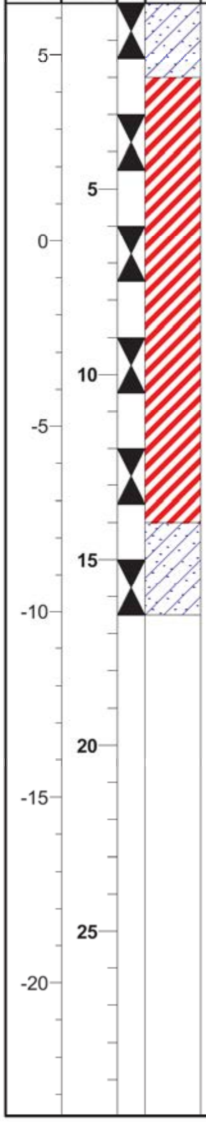
PLATE
B13

Area B & C - Diaz Yourman & Associates Borings

PLATE A2-147

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	6 MLLW
LATITUDE:	33° 57' 42.6" N	**LONGITUDE:**	118° 26' 46.9" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	16.5
DATE STARTED:	2/19/09	**DATE COMPLETED:**	2/19/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3



Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				1 2 3	3		CLAYEY SAND (SC): brown, wet, very loose, fine- to medium-grained sand ▽		17			21	
							FAT CLAY (CH): light gray, wet, soft, high plasticity						
				1 1 3	3				65			97	
				0 0 1	1		very soft		56	60	29	96	
				1 0 1	1		trace shell fragments, sulfur odor		93			95	
				1 1 1	1		no shell fragments		65			99	
							CLAYEY SAND (SC): gray, wet, very loose, fine-grained sand						
				1 1 2	2				43			47	
							Bottom of boring at 16.5 feet. Groundwater encountered at 1 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						

LOG OF BORING B-13

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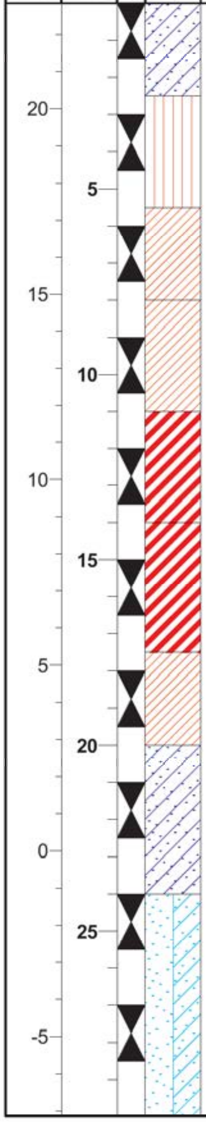
PLATE
B14

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION: See Figure 2		**ELEVATION AND DATUM (feet):** 23 MLLW	
LATITUDE: 33° 58' 43.6" N		**LONGITUDE:** 118° 25' 40.4" W	
DRILLING EQUIPMENT: CME 750		**DRILLING METHOD:** Hollow Stem Auger	
BORING DIAMETER (inches): 8		**BORING DEPTH (feet):** 31.5	
DATE STARTED: 2/18/09		**DATE COMPLETED:** 2/18/09	
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3



Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
2 3 5	5		CLAYEY SAND (SC): brown, moist, loose, fine- to medium-grained sand, trace roots		15			37	
7 6 7	8		SILT with SAND (ML): dark brown, moist, medium stiff, nonplastic, fine- to medium-grained sand						
2 2 2	3		LEAN CLAY (CL): grayish brown, moist, soft, medium plasticity		34 34	40	20	96 90	
3 4 5	6		SANDY LEAN CLAY (CL): gray, moist, medium stiff, medium plasticity, fine-grained sand		22			59	
1 3 6	6		FAT CLAY (CH): gray, moist, medium stiff, high plasticity, sulfur odor, some white spots		46	75	47	92	
4 6 9	10		FAT CLAY with SAND (CH): gray, moist, stiff, high plasticity, fine-grained sand		27			83	
1 3 5	5		LEAN CLAY (CL): gray, moist, medium stiff, medium plasticity, micaceous		33			95	
3 9 19	18		CLAYEY SAND (SC): dark gray, moist, medium dense, fine- to medium-grained sand ▽ wet		13			28	
9 12 14	17		POORLY GRADED SAND with CLAY and GRAVEL (SP-SC): dark gray, wet, medium dense, fine- to coarse-grained sand, fine to coarse gravel		12			7	
4 13 16	19								

LOG OF BORING C-01

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USACE Ballona Creek Watershed
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PLATE

B15

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
		⧗	▨	2 2 5	5		FAT CLAY (CH): gray, wet, medium stiff, high plasticity		34			99	
							Bottom of boring at 31.5 feet. Groundwater encountered at 23 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-10													
	35												
-15													
	40												
-20													
	45												
-25													
	50												
-30													
	55												
-35													
	60												
-40													
	65												
-45													

LOG OF BORING C-01

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USACE Ballona Creek Watershed
Project No. 2006-023.05

PLATE

B16

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	19 MLLW
LATITUDE:	33° 58' 48.7" N	**LONGITUDE:**	118° 25' 37.0" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	28.5
DATE STARTED:	2/17/09	**DATE COMPLETED:**	2/17/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
		⧗		5 10 11	14		CLAYEY SAND (SC): dark brown, moist, medium dense, fine- to coarse-grained sand, trace fine gravel, trace roots		12			42	
		⧗		6 4 4	5		POORLY GRADED SAND with SILT (SP-SM): brown, moist, loose, fine- to medium-grained sand						
15	5						FAT CLAY (CH): olive brown, moist, medium stiff, high plasticity, trace roots						
		⧗		3 3 4	5		no roots, some oxidation		45	57	36	98	
10	10	⧗		3 4 4	5		gray		48			96	
							CLAYEY SAND (SC): very dark brown, moist, loose, fine-grained sand						
		⧗		4 5 7	8				18			23	
5	15	⧗		5 5 11	10		SANDY LEAN CLAY (CL): very dark gray, moist, stiff, medium plasticity, fine-grained sand, some oxidation		20			52	
		⧗		3 4 11	10		dark gray		19			52	
0	20						▽ wet						
		⧗		2 4 15	12		olive brown, fine- to medium-grained sand						
-5	25	⧗		5 6 17	15		POORLY GRADED SAND with CLAY (SP-SC): dark grayish brown, moist, medium dense, fine- to coarse-grained sand, trace fine gravel		19			7	
		⧗		8 9 14	15				14			7	
-10							Bottom of boring at 28.5 feet. Groundwater encountered at 20 ft below ground surface.						

LOG OF BORING C-02

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Project No. 2006-023.05

PLATE
B17

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
							Boring backfilled with bentonite chips then cuttings.						
-15	35												
-20	40												
-25	45												
-30	50												
-35	55												
-40	60												
-45	65												
-50													

LOG OF BORING C-02

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USACE Ballona Creek Watershed
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PLATE

B18

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	23 MLLW
LATITUDE:	33° 58' 45.3" N	**LONGITUDE:**	118° 25' 44.7" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	34.5
DATE STARTED:	2/17/09	**DATE COMPLETED:**	2/17/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
				4 8 15	15		SANDY LEAN CLAY (CL): brown, moist, very stiff, medium plasticity, fine- to coarse-grained sand, trace concrete pieces - FILL		17			61	
20	5			8 22 50/5"	53		hard, trace organics		16			61	
15				5 4 4	5		FAT CLAY (CH): olive brown, moist, medium stiff, high plasticity, some oxidation, micaceous		46			97	
	10			2 3 5	5		SANDY LEAN CLAY (CL): olive brown, moist, medium stiff, medium plasticity, fine-grained sand		23			57	
10				1 2 3	3		soft		23			52	
	15			1 2 3	3		FAT CLAY (CH): gray, moist, soft, high plasticity		51	53	26	100	
5				5 12 15	18		CLAYEY SAND (SC): reddish brown, moist, medium dense, fine- to medium-grained sand, trace fine gravel		14			46	
	20						▽ wet						
0				2 11 13	16		POORLY GRADED SAND with GRAVEL (SP): dark gray, wet, medium dense, fine- to coarse-grained sand, fine to coarse gravel		15			3	
	25			5 8 13	14		POORLY GRADED SAND with CLAY and GRAVEL (SP-SC): dark gray, wet, medium dense, fine- to coarse-grained sand, fine to coarse gravel		13			9	
-5				2 2 4	4		LEAN CLAY with SAND (CL): olive brown, wet, soft, medium plasticity, fine-grained sand		27			71	

LOG OF BORING C-03

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USACE Ballona Creek Watershed
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PLATE

B19

PLATE A2-153

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
		⧗	▨	3 4 3	5		SANDY LEAN CLAY (CL): olive brown, wet, medium stiff, medium plasticity, fine-grained sand		23			53	
-10		⧗	▥	2 2 2	3		SILT (ML): olive brown, wet, soft, nonplastic		38	NP	NP	99	
	35						Bottom of boring at 34.5 feet. Groundwater encountered at 20 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						
-15													
	40												
-20													
	45												
-25													
	50												
-30													
	55												
-35													
	60												
-40													
	65												
-45													

LOG OF BORING C-03

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USACE Ballona Creek Watershed

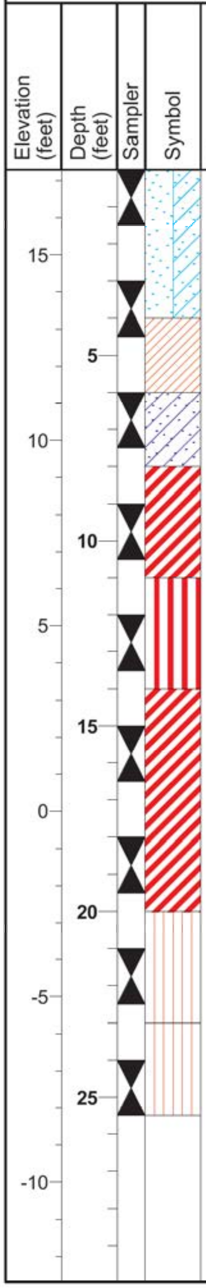
Project No. 2006-023.05

PLATE

B20

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	17 MLLW
LATITUDE:	33° 58' 45.8" N	**LONGITUDE:**	118° 25' 56.7" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	25.5
DATE STARTED:	2/23/09	**DATE COMPLETED:**	2/23/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3



Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
2 5 11	10		POORLY GRADED SAND with CLAY and GRAVEL (SP-SC): brown, moist, loose, fine- to coarse-grained sand, fine gravel		4			5	
6 8 8	10				8			11	
			SANDY LEAN CLAY (CL): brown, moist, stiff, medium plasticity, fine-grained sand		18			60	
1 3 4	5		CLAYEY SAND (SC): gray, moist, loose, fine-grained sand		23			44	
5 10 13	15		SANDY FAT CLAY (CH): dark gray, moist, very stiff, high plasticity, fine- to coarse-grained sand		20			57	
3 4 6	6		ELASTIC SILT (MH): light gray, moist, medium stiff, medium plasticity		38	54	23	95	
3 6 7	8		SANDY FAT CLAY (CH): gray, moist, medium stiff, high plasticity, fine- to coarse-grained sand, trace fine gravel		23			60	
2 2 6	5		▽ wet, some oxidation		22			68	
1 3 4	5		SANDY SILT (ML): olive brown, wet, medium stiff, low plasticity, fine-grained sand		23			61	
1 3 5	5		SILT with SAND (ML): brownish gray, wet, medium stiff, nonplastic, fine-grained sand		24	NP	NP	79	
			Bottom of boring at 25.5 feet. Groundwater encountered at 18 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						

LOG OF BORING C-04

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USACE Ballona Creek Watershed
Project No. 2006-023.05

PLATE
B21

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

BORING LOCATION: See Figure 2
ELEVATION AND DATUM (feet): 17 MLLW
LATITUDE: 33° 58' 49.2" N
LONGITUDE: 118° 25' 49.1" W
DRILLING EQUIPMENT: CME 750
DRILLING METHOD: Hollow Stem Auger
BORING DIAMETER (inches): 8
BORING DEPTH (feet): 25.5
DATE STARTED: 2/23/09
DATE COMPLETED: 2/23/09
SPT HAMMER DROP: 30 inches **WT:** 140 lbs
DRIVE HAMMER DROP: 30 inches **WT:** 140 lbs
LOGGED BY: JMS **CHECKED BY:** KV
DRIVE SAMPLER DIAMETER (inches) **ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
		⧗		3 10 13	15		SANDY LEAN CLAY (CL): dark brown, moist, very stiff, medium plasticity, fine- to coarse-grained sand, trace roots		21			65	
15							POORLY GRADED SAND with SILT and GRAVEL (SP-SM): olive brown, moist, medium dense, fine- to coarse-grained sand, fine to coarse gravel						
		⧗		4 5 6	7				16			25	
	5						SILTY SAND (SM): dark gray, moist, loose, fine- to coarse-grained sand, trace fine to coarse gravel, trace shell fragments						
10		⧗		3 5 4	6		CLAYEY SAND (SC): very dark grayish brown, moist, loose, fine-grained sand, micaceous		25			38	
							FAT CLAY (CH): very dark gray, moist, stiff, high plasticity						
	10	⧗		3 6 10	10								
5		⧗		3 6 9	10		SANDY LEAN CLAY (CL): gray, moist, stiff, medium plasticity, fine-grained sand, some oxidation		19			57	
	15	⧗		4 5 13	12		SILTY SAND with GRAVEL (SM): olive brown, moist, medium dense, fine- to coarse-grained sand, fine to coarse gravel		15			21	
0							▽ POORLY GRADED SAND (SP): dark grayish brown, wet, loose, fine- to coarse-grained sand						
		⧗		2 3 11	9								
	20												
-5		⧗		3 3 3	4		very loose						
	25	⧗		4 7 6	8		SILT (ML): brown, wet, medium stiff, low plasticity		43	47	19	99	
-10							Bottom of boring at 25.5 feet. Groundwater encountered at 17 ft below ground surface. Boring backfilled with bentonite chips then cuttings.						

LOG OF BORING C-05

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PLATE
B22

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	17 MLLW
LATITUDE:	33° 58' 42.1" N	**LONGITUDE:**	118° 25' 58.5" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	28.5
DATE STARTED:	2/20/09	**DATE COMPLETED:**	2/20/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
15				1 3 4	5		POORLY GRADED SAND with GRAVEL (SP): brown, moist, loose, fine- to coarse-grained sand, fine to coarse gravel, trace shell fragments, trace roots		4			3	
	5			4 7 5	8		POORLY GRADED SAND with SILT and GRAVEL (SP-SM): dark gray, moist, loose, fine- to coarse-grained sand, fine to coarse gravel		4			5	
10				5 6 7	8		POORLY GRADED SAND with GRAVEL (SP): grayish brown, moist, loose, fine- to coarse-grained sand, fine gravel		2			2	
	10			3 3 4	5		LEAN CLAY (CL): olive brown, moist, medium stiff, medium plasticity		30			91	
5				2 2 4	4		FAT CLAY (CH): light gray, moist, soft, high plasticity, brown spots		43	57	35	98	
	15			2 3 5	5		medium stiff, oxidation spots, micaceous		39			100	
0				1 2 3	3		▽ SANDY LEAN CLAY (CL): dark gray, wet, soft, medium plasticity, fine- to medium-grained sand		29	42	23	70	
-5	20			2 4 6	6		medium stiff		22			62	
	25			3 5 7	8		SANDY FAT CLAY (CH): gray, wet, medium stiff, high plasticity, fine-grained sand		22			55	
-10				5 7 8	10		CLAYEY SAND (SC): gray, wet, loose, fine-grained sand, trace shell fragments, trace roots		23			21	
							Bottom of boring at 28.5 feet. Groundwater encountered at 17 ft below ground surface.						

LOG OF BORING C-06

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Project No. 2006-023.05

PLATE
B23

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
							Boring backfilled with bentonite chips then cuttings.						
-15													
	35												
-20													
	40												
-25													
	45												
-30													
	50												
-35													
	55												
-40													
	60												
-45													
	65												
-50													

LOG OF BORING C-06

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USACE Ballona Creek Watershed

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PLATE

B24

BORING LOCATION:	See Figure 2	**ELEVATION AND DATUM (feet):**	17 MLLW
LATITUDE:	33° 58' 41.4" N	**LONGITUDE:**	118° 26' 3.8" W
DRILLING EQUIPMENT:	CME 750	**DRILLING METHOD:**	Hollow Stem Auger
BORING DIAMETER (inches):	8	**BORING DEPTH (feet):**	28.5
DATE STARTED:	2/20/09	**DATE COMPLETED:**	2/20/09
SPT HAMMER DROP: 30 inches	**WT:** 140 lbs	**DRIVE HAMMER DROP:** 30 inches	**WT:** 140 lbs
LOGGED BY: JMS	**CHECKED BY:** KV	**DRIVE SAMPLER DIAMETER (inches)**	**ID:** 2.4 **OD:** 3

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
15				1 1 2	2		SILTY SAND (SM): brown, moist, very loose, fine- to medium-grained sand, trace fine gravel, trace roots		7			15	
	5			2 2 5	5		SILTY SAND with GRAVEL (SM): brown, moist, loose, fine- to coarse-grained sand, fine to coarse gravel		8			15	
10				3 5 6	7		FAT CLAY with SAND (CH): dark gray, moist, medium stiff, high plasticity, fine-grained sand, micaceous		30			75	
	10			3 5 7	8		SILT (ML): dark gray, moist, medium stiff, low plasticity		31	49	13	92	
5				2 2 3	3		FAT CLAY (CH): dark gray, moist, soft, high plasticity, some oxidation spots		42			88	
	15			1 3 3	4		SILT with SAND (ML): light gray, moist, soft, low plasticity, fine-grained sand						
0							▽ wet						
				0 0 1	1		very soft		51			71	
	20						FAT CLAY with SAND (CH): dark gray, wet, very soft, high plasticity, fine-grained sand						
-5				1 4 5	6		medium stiff		27	51	33	74	
	25			2 4 3	5		SANDY FAT CLAY (CH): dark gray, wet, medium stiff, high plasticity, fine-grained sand		23			62	
-10				3 5 5	6		CLAYEY SAND (SC): gray, wet, loose, fine- to medium-grained sand		20			31	
							Bottom of boring at 28.5 feet. Groundwater encountered at 17 ft below ground surface.						

LOG OF BORING C-07

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Project No. 2006-023.05

PLATE
B25

Template: DYLG1-2006; Prj ID: 2006-023.05.GPJ

Elevation (feet)	Depth (feet)	Sampler	Symbol	Blows per 6 Inches	SPT N Blows per Foot	Field Unc. Comp. Str. (tsf)	DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	Liquid Limit (%)	Plasticity Index (%)	Percent Passing #200 Sieve	Other Tests [PID]
							Boring backfilled with bentonite chips then cuttings.						
-15													
	35												
-20													
	40												
-25													
	45												
-30													
	50												
-35													
	55												
-40													
	60												
-45													
	65												
-50													

LOG OF BORING C-07

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PLATE

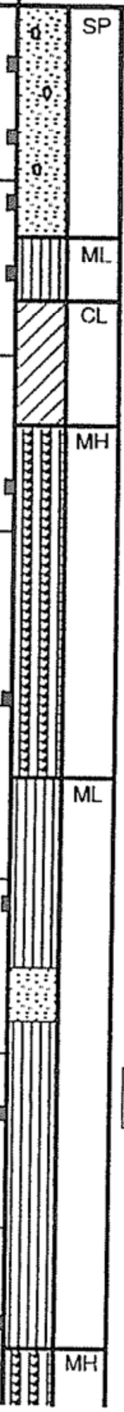
B26

JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 1

DATE DRILLED: June 19, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash
ELEVATION 13*



ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.	
							SP FILL - SAND - fine, some Clay and Gravel, light greyish brown
			5.0	105	3	■	
10							
			18.8	86	2	■	
	5						
			20.1	89	4	■	
							SURFACE OF NATURAL SOIL
							ML CLAYEY SILT - greyish brown
5			23.4	101	2	■	
							CL SILTY CLAY - brownish grey
	10						
		4					
							MH ELASTIC SILT - light brown
0							
			48.3	74	< 1	■	(LL = 64; PI = 31)
	15						
		1					
-5							
	20		53.4	68	1	■	Few seashells, grey
							ML SANDY SILT - dark grey
-10		7					
	25						
			18.8	112	7	■	
-15							Layer of well graded Sand
		15					
	30						
			17.4	112	10	■	
-20							
	35	4					
-25			23.0	106	5	■	
							MH ELASTIC SILT - dark grey
	40						

* Elevations refer to datum of reference survey; see Plate 1.

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LAW/CRANDALL, INC.

Area C - Law Crandall Borings

PLATE A-1.1a

PLATE A2-161

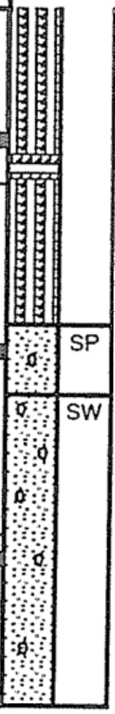
JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD FH

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 1 (Continued)

DATE DRILLED: June 19, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
-30						
			49.3	73	2	
	45					
		9				
-35						
	50		18.3	112	33	
-40		72				
	55					
			8.0	137	33	
-45						
	60		10.2	123	33	



Layer of Peat

SP SAND - fine, about 10% Gravel, dark grey

SW SAND - well graded, about 20% Gravel, grey

Some Clayey Silt

NOTE: Drilling mud used in drilling process. Mud removed to 30' at completion of drilling. Water level measured at 12-1/2' after removal of mud; bottom of boring at 21'. Boring grouted.

LOG OF BORING

LAW/CRANDALL, INC.

BORING 2

DATE DRILLED: June 20, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 12

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							CL	SILTY CLAY - dark grey
10			16.0	83	5	■		
			30.7	88	2	■		
	5							
			27.3	93	3	■		
5								
			17.8	110	8	■		
	10							
		11						
0								
							ML	CLAYEY SILT - grey
			21.9	106	2	■		
	15							
-5		17						
							SM	SILTY SAND - fine, about 10% Gravel, brown
			28.6	95	3	■		
	20						ML	SANDY SILT - grey
-10								
		8						
							ML	CLAYEY SILT - grey
	25							
			31.7	92	3	■		
-15								
							CL	SILTY CLAY - grey
		6						
	30							
			31.8	93	6	■		
-20								Layer of Sandy Silt, dark grey
	35	10						
-25								
			35.0	86	4	■		
	40							

(CONTINUED ON FOLLOWING PLATE)

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsurface conditions at other locations and times.

JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD FH

LOG OF BORING

LAW/CRANDALL, INC.

JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD FH

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 2 (Continued)

DATE DRILLED: June 20, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.			
		22					▥	ML	SANDY SILT - brownish grey
-30									
			23.5	105	12	■			
	45							SW	SAND - well graded, about 20% Gravel, greyish brown
-35		73							
			12.2	128	21	■			
	50								Layer of well graded Gravel
-40		52							
	55								
			13.1	117	36	■			
-45									
									Yellowish brown
	60		10.1	121	36	■			

NOTE: Drilling mud used in drilling process. Mud removed to 30' at completion of drilling. Water level measured at 15' 15 minutes after removal of mud; bottom of boring at 21'. Boring grouted.

LOG OF BORING

LAW/CRANDALL, INC.

Area C - Law Crandall Borings

PLATE A2-164

PLATE A 1.2b

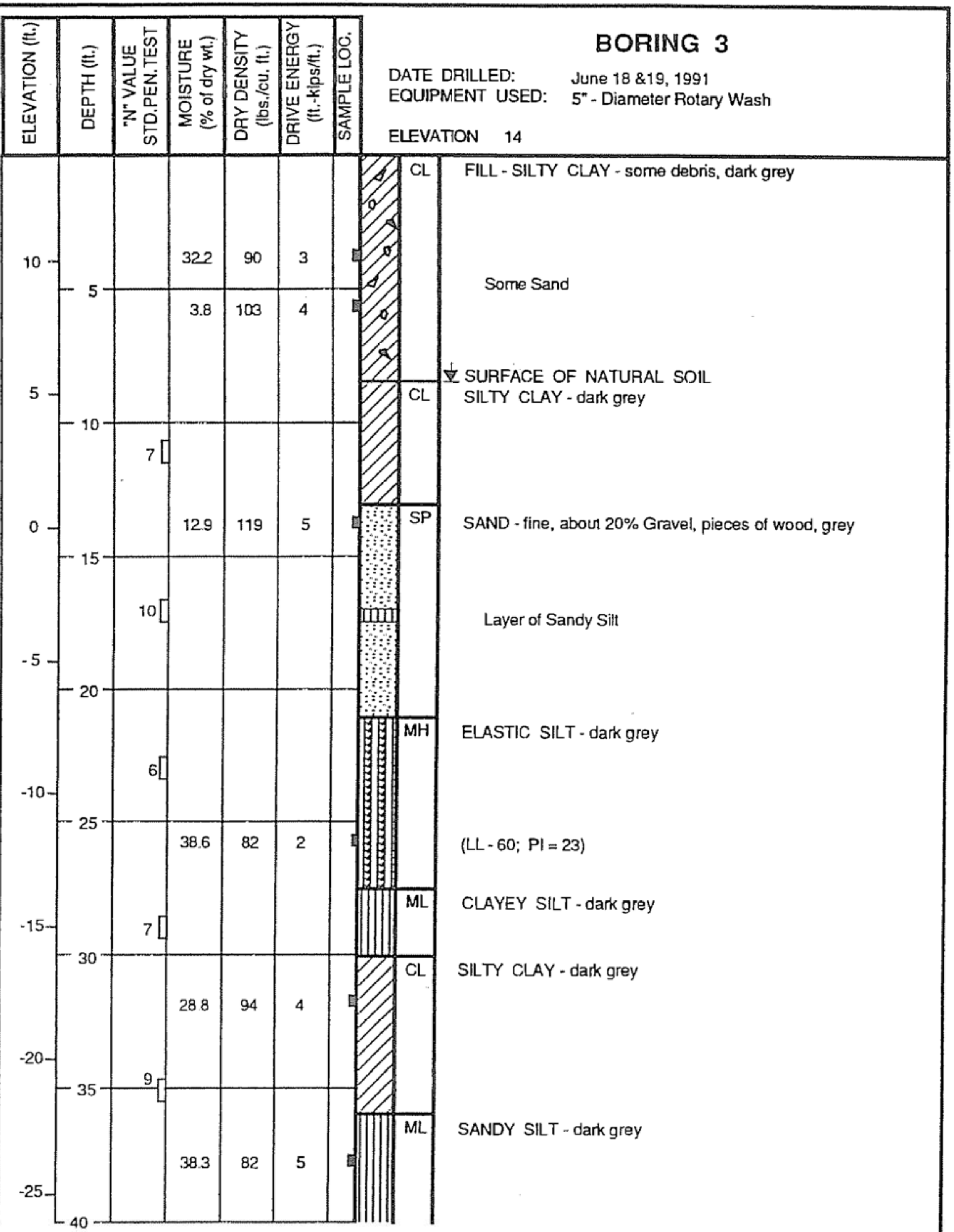
JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD FH

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 3

DATE DRILLED: June 18 &19, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 14



"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
	32.2	90	3	■
	3.8	103	4	■
7				
	12.9	119	5	■
10				
6				
	38.6	82	2	■
7				
	28.8	94	4	■
9				
	38.3	82	5	■

CL FILL - SILTY CLAY - some debris, dark grey

Some Sand

▽ SURFACE OF NATURAL SOIL

CL SILTY CLAY - dark grey

SP SAND - fine, about 20% Gravel, pieces of wood, grey

Layer of Sandy Silt

MH ELASTIC SILT - dark grey

(LL - 60; PI = 23)

ML CLAYEY SILT - dark grey

CL SILTY CLAY - dark grey

ML SANDY SILT - dark grey

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LAW/CRANDALL, INC.

Area C - Law Crandall Borings

PLATE 1.3a

PLATE A2-765

JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD FH

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 3 (Continued)

DATE DRILLED: June 18 &19, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
		27						
-30			14.6	121	23		SP	SAND - fine, grey
	45							
		65						Fine to coarse Sand, about 20% Gravel
-35			13.0	125	36			
	50							
		95 (10" pen)						
-40								
	55							
			6.4	118	33		SW	SAND - well graded, about 20% Gravel, grey
-45								
			8.9	126	30			
	60							

NOTE: Drilling mud used in drilling process. Mud removed to 30' at completion of drilling. Water level measured at 15-1/2' after removal of mud; bottom of boring at 26'. Boring grouted.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A-1.3b

JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 4

DATE DRILLED: June 17, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 20

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.		
							SP SM	FILL - SAND and SILTY SAND - fine, brown
			10.5	118	6			
			19.3	103	4		ML	FILL - CLAYEY SILT - greyish brown
15	5							
			24.3	98	2			
			15.8	103	2		SM	FILL - SILTY SAND - fine, greyish brown
								SURFACE OF NATURAL SOIL
10	10						ML	CLAYEY SILT - dark grey
		2						
			34.9	86	2			
5	15							
		6						
			36.3	84	2			
0	20							
		1						
-5	25						CL	SILTY CLAY - some Sand, greyish brown (LL = 30; PI = 12)
			23.2	104	2			
		2						
-10	30						SP	SAND - fine, dark grey
			18.4	112	15			
		11						
-15	35						MH	ELASTIC SILT - grey
			33.9	89	8			
-20	40							

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LAW/CRANDALL, INC.

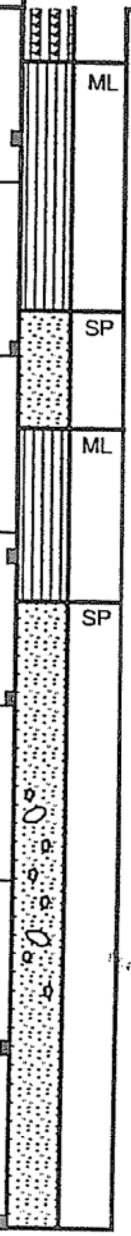
JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD FH

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 4 (Continued)

DATE DRILLED: June 17, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
			26.2	100	4	■
-25	45					
		13				
-30	50		19.1	114	8	■
		19				
-35	55					
			23.8	102	5	■
-40	60		14.4	118	15	■
-45	65					
-50	70		22.2	106	36	■
	75		7.9	130	36	■



ML CLAYEY SILT - grey

SP SAND - fine, dark grey

ML SANDY SILT - dark grey

SP SAND - fine, grey

About 20% Gravel, few Cobbles (to 6" in size)

No Gravel

NOTE: Drilling mud used in drilling process. Mud removed to 30' at completion of drilling. Water level measured at 22-1/2' 15 minutes after removal of mud; bottom of boring at 34'. Boring grouted.

LOG OF BORING

LAW/CRANDALL, INC.

PLATE A 1.4b

JOB L91177.AEB DATE 6/24/91 F.T. LS DR. lk O.E. HRL CHKD FH

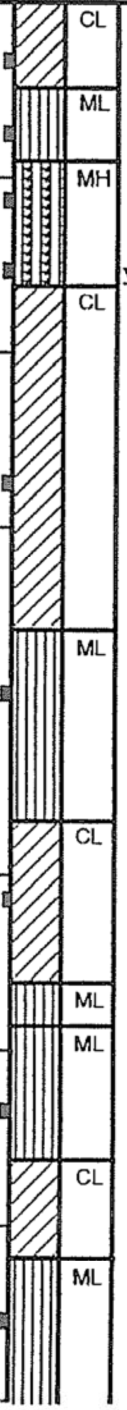
Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 5

DATE DRILLED: June 18, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION 19

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)
			14.0	99	4
15			17.6	85	2
	5				
			53.3	69	< 1
			34.1	83	2
10					
	10				
		5			
5			21.2	104	3
	15				
		7			
0					
			24.1	103	3
	20				
		7			
-5					
	25				
			33.7	90	4
-10		5			
	30				
			31.0	92	4
-15					
		24			
	35				
			27.6	97	5
-20					
	40				



CL	FILL - SILTY CLAY - greyish brown
ML	FILL - CLAYEY SILT - greyish brown
MH	FILL - ELASTIC SILT - dark grey (LL = 71; PI = 36)
	⊻ SURFACE OF NATURAL SOIL
CL	SILTY CLAY - dark grey
ML	SANDY SILT - dark grey
CL	SILTY CLAY - greyish brown
ML	CLAYEY SILT - greyish brown
ML	SANDY SILT - greyish brown
CL	SILTY CLAY - some Sand, greyish brown
ML	SANDY SILT - some Clayey layers, greyish brown

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LAW/CRANDALL, INC.

Area C - Law Crandall Borings

PLATE A2-169

PLATE A-1.5a

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING 5 (Continued)

DATE DRILLED: June 18, 1991
EQUIPMENT USED: 5" - Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	"N" VALUE STD.PEN.TEST	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	DRIVE ENERGY (ft.-kips/ft.)	SAMPLE LOC.
		18				
-25						
			10.5	134	36	■
	45					
		59				
-30						
			7.5	138	36	■
	50					
-35		65				
	55					
-40						
			14.2	115	36	■
	60					
-45						
			24.9	101	24	■
	65					
-50						
			16.6	111	36	■
	70					
-55						
	75		20.6	107	43	■

SW SAND - well graded, about 30% Gravel, brown

Dark grey

SP SAND - fine, grey

NOTE: Drilling mud used in drilling process. Mud removed to 40' at completion of drilling. Water level measured at 22-1/2' 15 minutes after removal of mud; bottom of boring at 44'. Boring grouted.

LOG OF BORING

Area C - Law Crandall Borings

LAW/CRANDALL, INC.

PLATE A2-170

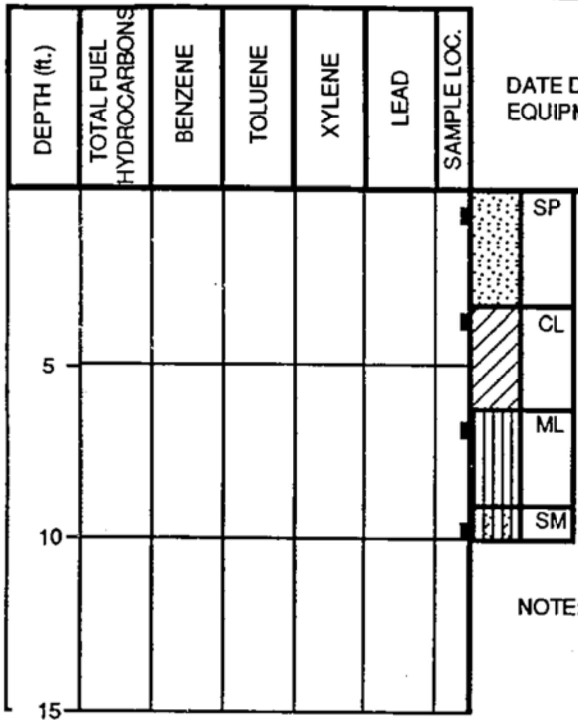
PLATE A - 1.5b

JOB F-88218 DATE 7/6/88 F.T. ___ DR. lp S.G. FB W.P. lp CHKD ___

Note ; The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING B - 1

DATE DRILLED: June 21, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger



FILL - GRAVELLY SAND - moist, fine to coarse grained Sand, brown

SILTY CLAY - very moist, blackish grey with lenses of brownish grey Clayey Silt

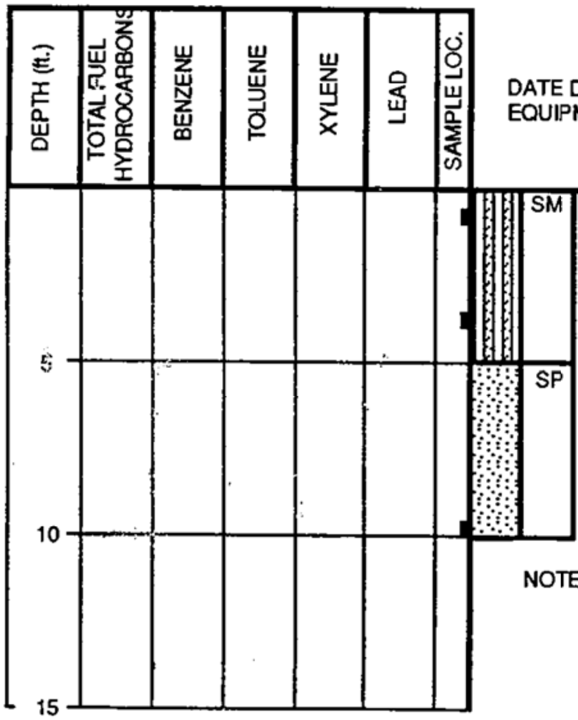
CLAYEY SILT - very moist, multicolored grey and greyish brown

SILTY SAND - very moist to wet, fine grained, reddish brown mottled with greenish grey

NOTE: Total depth 10'. Ground water level not encountered.

BORING B - 2

DATE DRILLED: June 21, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger



FILL - SILTY SAND - moist, fine to coarse grained Sand, some blackish grey Silty Clay lumps

Mostly fine to medium grained Sand

POORLY GRADED SAND - wet, fine to coarse grained Sand, some blackish grey lumps
No sample recovered, possibly sampling on top of Cobbles

NOTE: Total depth 10'. Ground water level not encountered.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - A

Area C - Law Crandall Borings - 1988

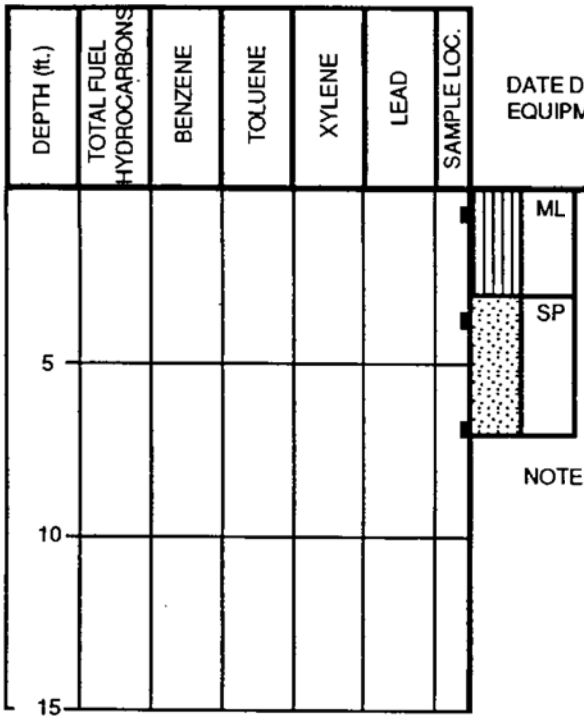
PLATE A2-171

JOB F-88218 DATE 7/6/88 F.T. ___ DR. lp S.G. FB W.P. lp CHKD ___

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING B - 3

DATE DRILLED: June 21, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger



FILL - GRAVELLY SILT - moist, Sandy, brown

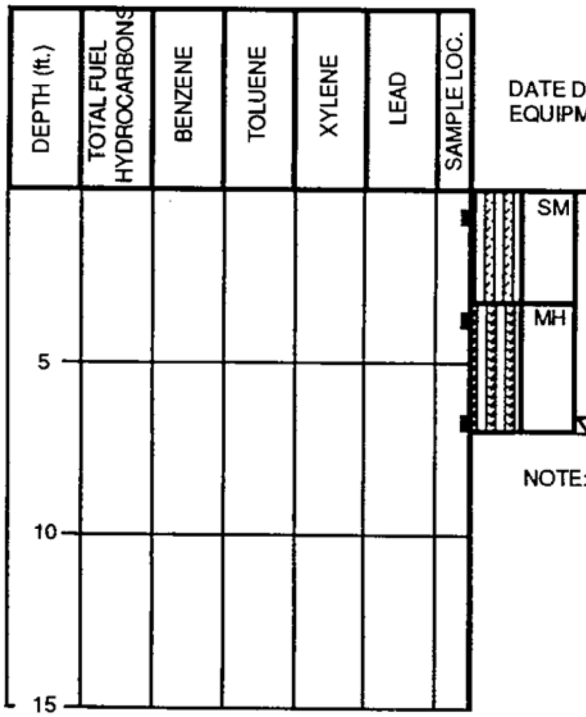
POORLY GRADED SAND - moist, fine to medium grained Sand, brown

Wet

NOTE: Total depth 7'. Ground water level not encountered.

BORING B - 4

DATE DRILLED: June 21, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger



FILL - SILTY SAND - moist, fine grained, greyish brown

CLAYEY SILT - wet, greenish grey

▽ WATER LEVEL
Wet to saturated

NOTE: Total depth 7'. Ground water level at 7'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

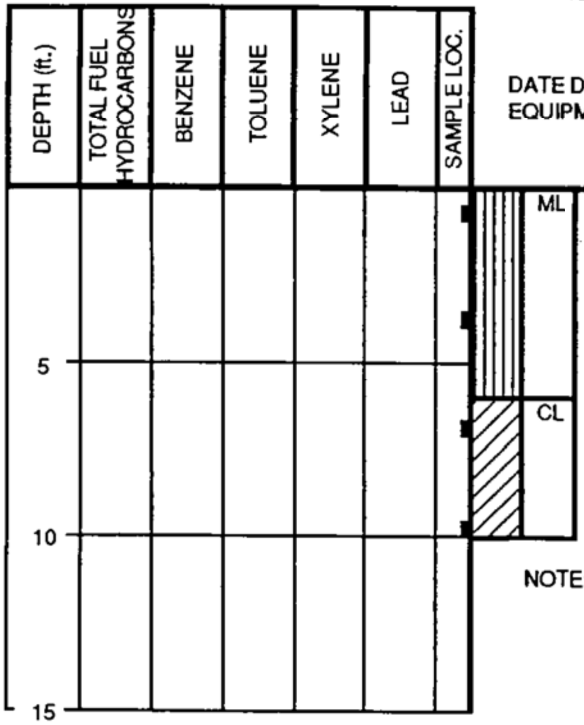
PLATE 2 - B

JOB F-88218 DATE 7/6/88 F.T. DR. lp S.G. FB W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING B - 5

DATE DRILLED: June 22, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger



FILL - CLAYEY SILT - very moist, greyish brown

Very moist to wet

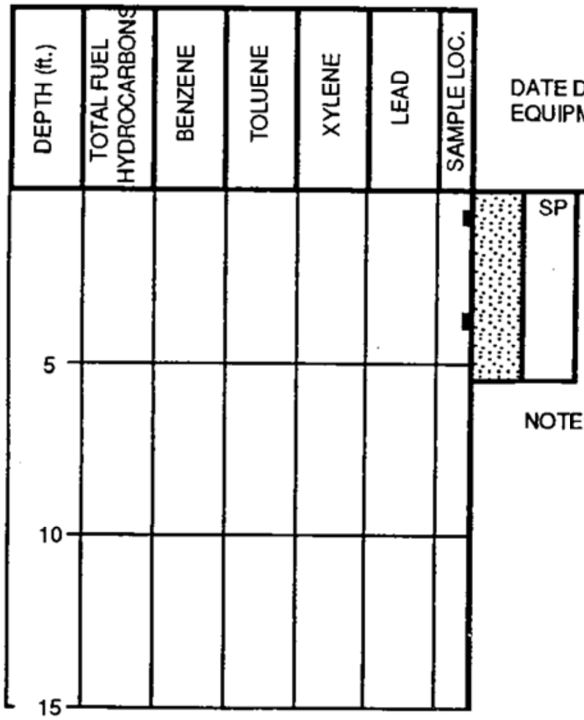
SILTY CLAY - wet with vertical 0.01' thick Silty fine Sand lense

Wet to saturated

NOTE: Total depth 10'. Ground water level not encountered.

BORING B - 6

DATE DRILLED: June 22, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger



FILL - SAND - very moist, gravelly, fine to coarse grained Sand, brown

Mostly fine to coarse grained Sand, wet

Saturated at 5.5'

NOTE: Total depth 6'. Saturated at 5.5'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - C

Area C - Law Crandall Borings - 1988

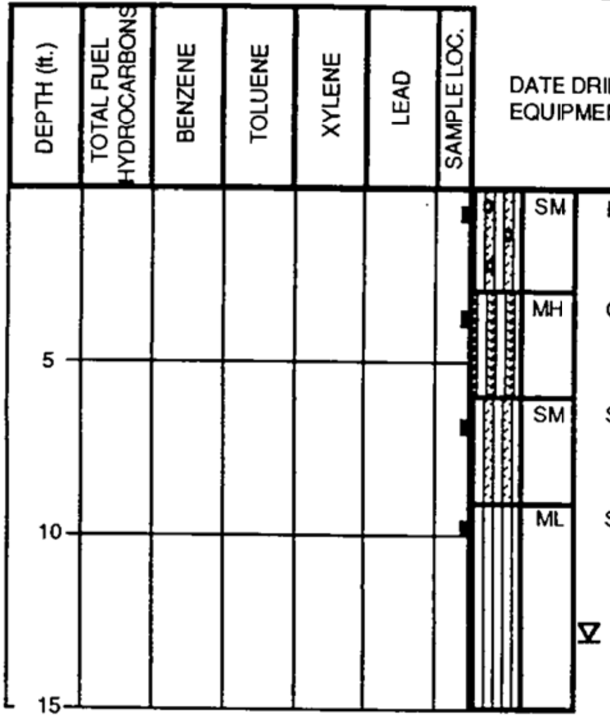
PLATE A2-173

JOB F-88218 DATE 7/6/88 F.T. ____ DR. lp S.G. FB W.P. lp CHKD ____

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING B - 7

DATE DRILLED: June 22, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger



FILL - SILTY SAND - moist, fine grained, some fine Gravel and Clay lumps

CLAYEY SILT - very moist to wet, some seashells

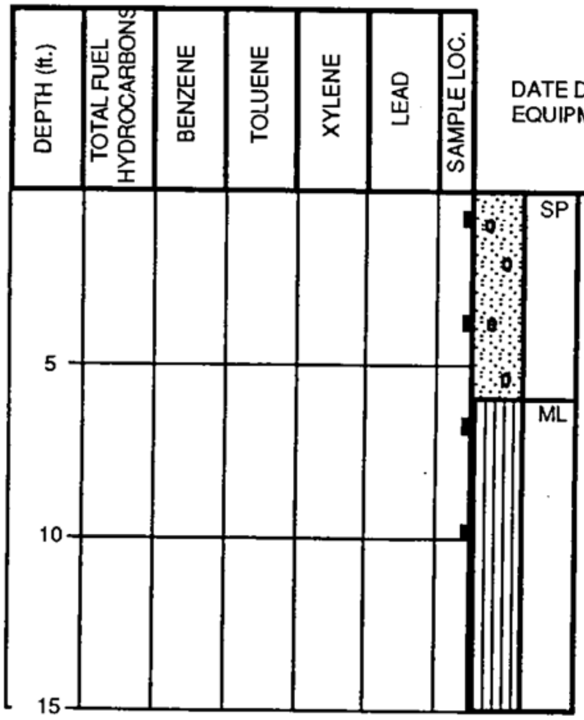
SILTY SAND - wet, fine grained, brownish grey

SANDY SILT - wet, fine grained, brownish grey

NOTE: Total depth 15'. Ground water level at 13'.

BORING B - 8

DATE DRILLED: June 22, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger



FILL - SAND - very moist, fine to coarse Sand with some Clay lumps, brown, locally with Gravel

Very moist to wet

CLAYEY SILT - wet, dark greenish grey

Wet to saturated

NOTE: Total depth 15'. Ground water not encountered. Sloughing from 13' to 15'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - D

Area C - Law Crandall Borings - 1988

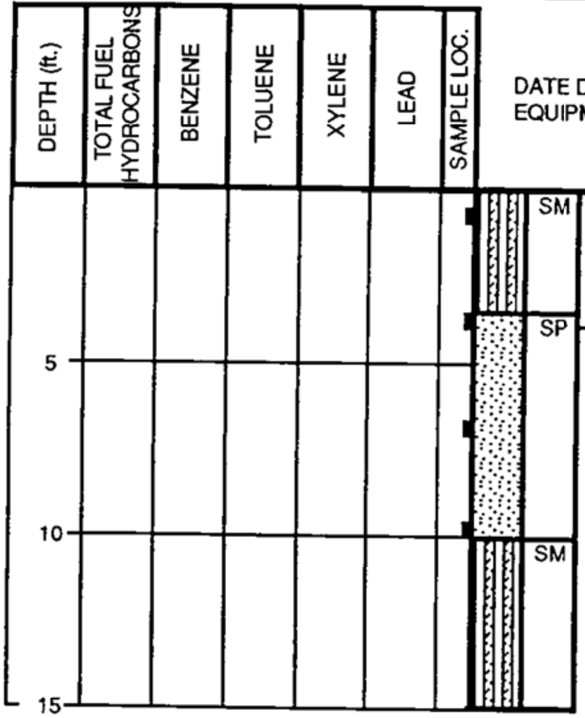
PLATE A2-174

JOB F-88218 DATE 7/6/88 F.T. DR. lp S.G. FB W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated.
It is not warranted to be representative of subsurface conditions at other locations and times.

BORING B - 9

DATE DRILLED: June 23, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger



FILL - SILTY SAND - dry to moist, fine to coarse Sand, brown to reddish brown

Very moist, fine to medium grained, thin lenses of blackish grey Silty Clay

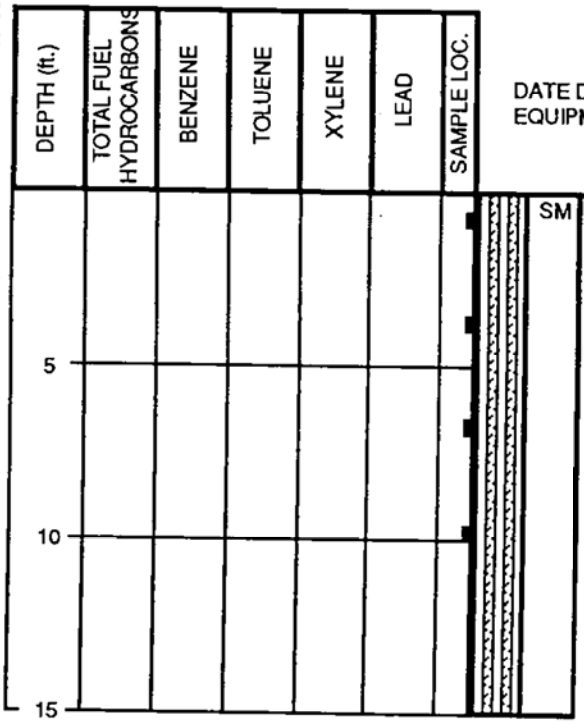
SAND - wet, predominately fine grained Sand

SILTY SAND - wet, fine grained Sand, dark greenish grey

NOTE: Total depth 15'. Ground water level not encountered.

BORING B - 10

DATE DRILLED: June 23, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger



FILL - SILTY SAND - moist, fine grained, some seashells

Abundant seashells, Clay lumps

Very moist to wet, brownish grey

Color change to dark greenish grey at 9.75'.

NOTE: Total depth 15'. Ground water level not encountered.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - E

Area C - Law Crandall Borings - 1988

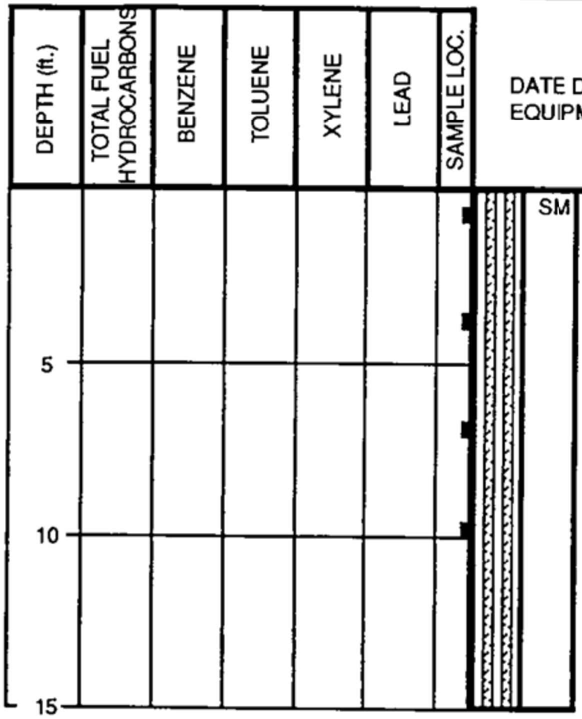
PLATE A2-175

JOB F-88218 DATE 7/6/88 F.T. DR. lp S.G. FB W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING B - 11

DATE DRILLED: June 23, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger



FILL - SILTY SAND - moist, fine grained, abundant seashells, brownish grey

Very moist, abundant seashells, some blackish grey Clay lumps, fine to coarse grained Sand

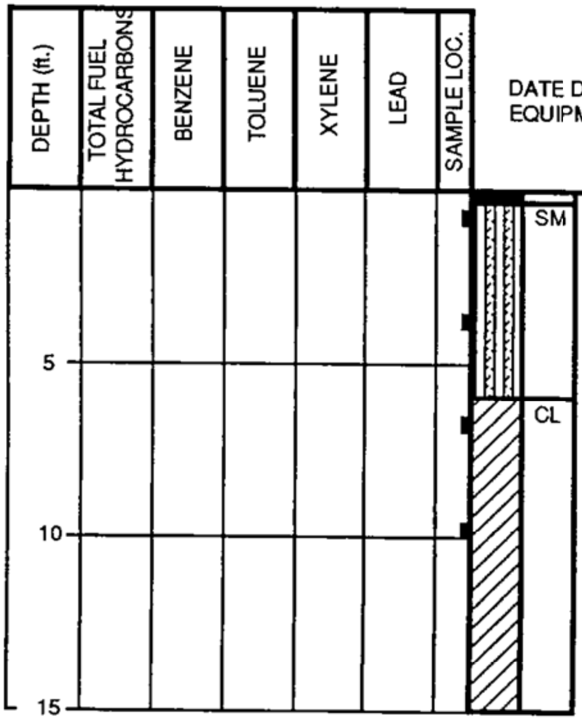
Very moist, fine grained Sand

Very moist to wet, dark greenish grey

NOTE: Total depth 15'. Ground water level not established.

BORING B - 12

DATE DRILLED: June 21, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger



3" Thick Asphaltic Paving
FILL - SILTY SAND - dry, fine grained, reddish brown

Very moist, fine to medium grained Sand

SILTY CLAY - wet, grey mottled with dark greenish grey and greyish brown

Wet, grey mottled with greyish brown

NOTE: Total depth 15'. Ground water level not encountered.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - F

Area C - Law Crandall Borings - 1988

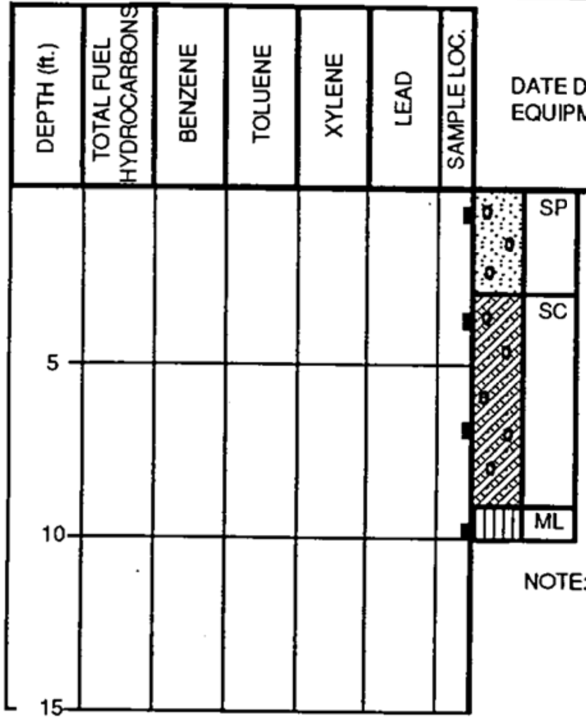
PLATE A2-176

JOB F-88218 DATE 7/6/88 F.T. DR. lp S.G. FB W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING B - 13

DATE DRILLED: June 23, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger



SP FILL - SILTY SAND - moist, Gravelly, fine to coarse grained Sand, reddish brown

SC CLAYEY SAND - very moist, fine to medium grained Sand, some Gravel, reddish brown

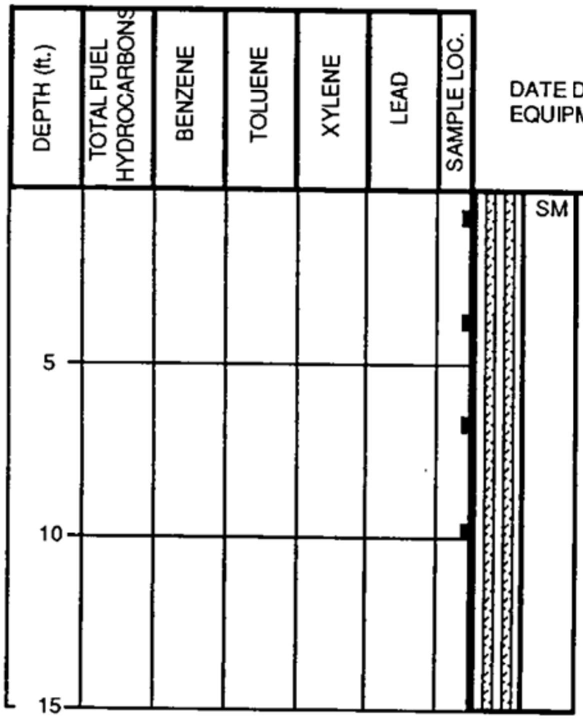
Very moist to wet, some dark greenish grey Clay lumps

ML CLAYEY SILT - wet, dark greenish grey

NOTE: Total depth 10'. Ground water level not encountered.

BORING B - 14

DATE DRILLED: June 23, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger



SM FILL - SILTY SAND - dry to moist, Clayey, brown

Very moist, fine to medium Sand, some seashells

NOTES: Total depth 15'. Ground water level not encountered.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - G

Area C - Law Crandall Borings - 1988

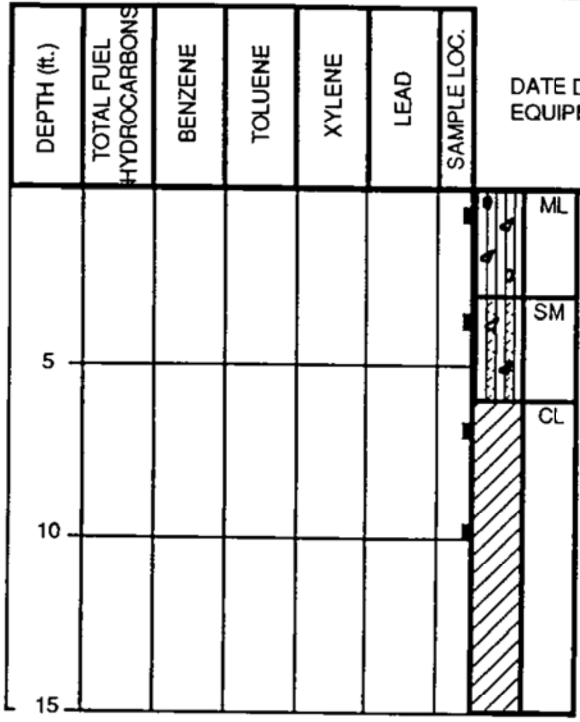
PLATE A2-177

JOB F-88218 DATE 7/6/88 F.T. DR. lp S.G. FB W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING B - 15

DATE DRILLED: June 27, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger



FILL - CLAYEY SILT - moist, Gravelly, about 10% concrete fragments and glass, greyish brown

FILL - SILTY SAND - moist, fine grained, about 5% concrete fragments, greyish brown

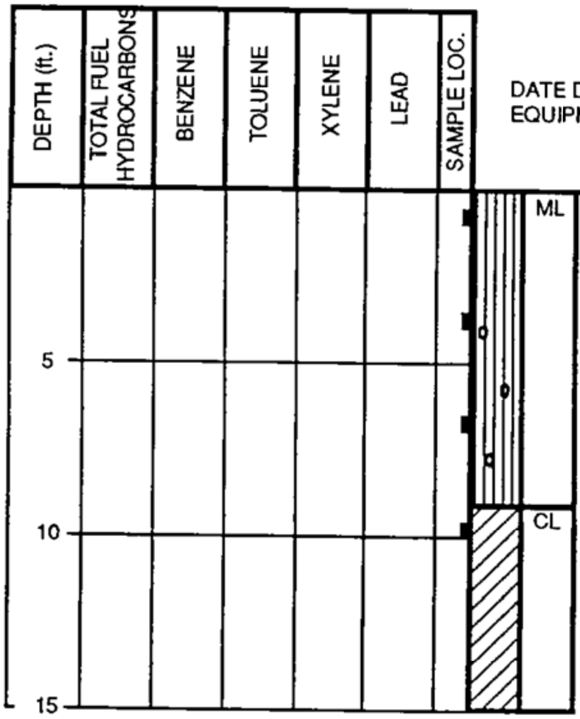
SILTY CLAY - very moist, greenish grey

Very moist, dark grey mottled with brownish grey

NOTE: Total depth 15'. Ground water level not encountered.

BORING B - 16

DATE DRILLED: June 27, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger



FILL - SANDY SILT - moist, fine, reddish brown

Moist to very moist, Gravelly, brown

Very moist, brown grading to blackish and greenish grey

SILTY CLAY - wet, dark greenish grey

NOTE: Total depth 15'. Wet below 10'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2-H

Area C - Law Crandall Borings - 1988

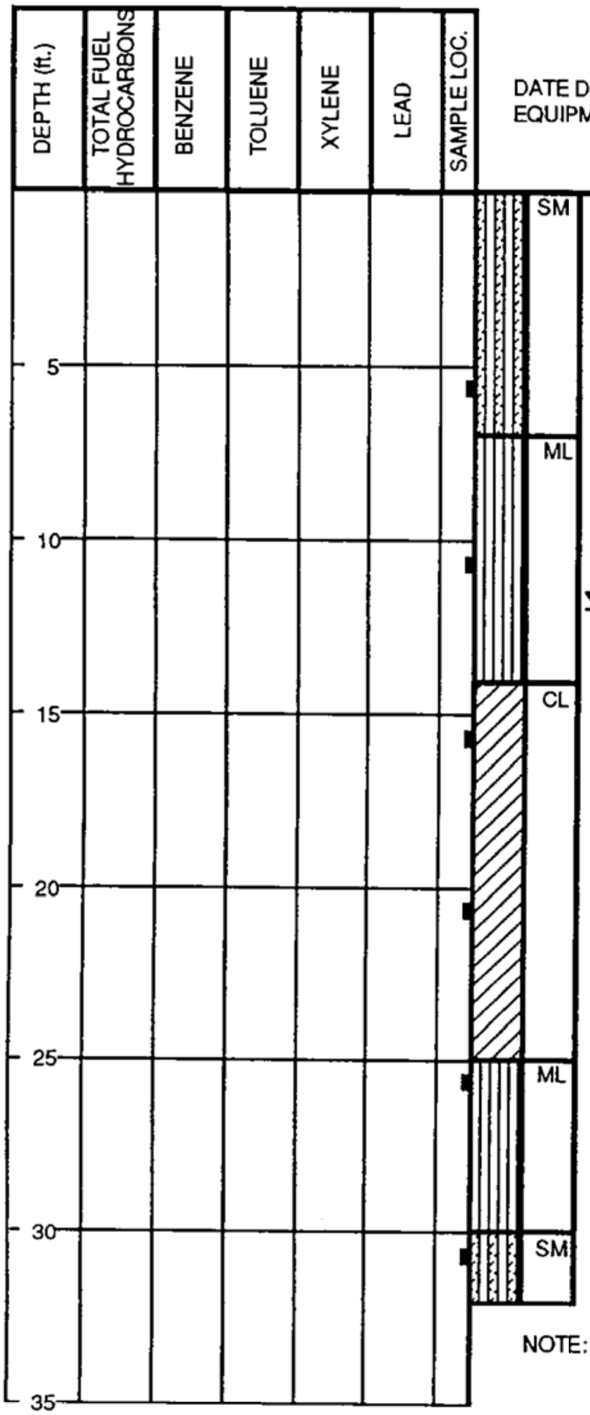
PLATE A2-178

JOB F-88218 DATE 7/5/88 F.T. ____ DR. lp S.G. FB W.P. lp CHKD ____

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING MW - 1

DATE DRILLED: June 22, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger



FILL - SILTY SAND - moist to very moist, fine to medium grained, brown

Very moist

SANDY SILT - very moist to wet, fine grained, greyish brown

SILTY CLAY - saturated, grey mottled with brown

Saturated, dark grey with abundant seashells

CLAYEY SILT - saturated, dark greenish grey

SILTY SAND - saturated, fine, slightly Clayey, dark greenish grey

NOTE: Total depth 32'. Ground water level at 12'. Converted into monitoring well.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - I

Area C - Law Crandall Borings - 1988

PLATE A2-179

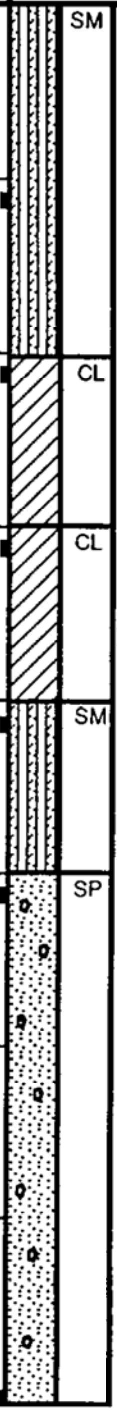
JOB F-88218 DATE 7/5/88 F.T. ____ DR. lp S.G. FB W.P. lp CHKD ____

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING MW - 2

DATE DRILLED: June 27, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger

DEPTH (ft.)	TOTAL FUEL HYDROCARBONS	BENZENE	TOLUENE	XYLENE	LEAD	SAMPLE LOC.
5						■
10						■
15						■
20						■
25						■
30						
35						
40						■



SM FILL - SILTY SAND - dry to moist, fine, brownish grey to greenish grey

Moist, greenish grey

CL SILTY CLAY - very moist, dark grey

CL SILTY CLAY - very moist, dark greenish grey mottled with reddish brown

SM SILTY SAND - wet to saturated, fine to medium grained Sand, grey

SP SAND - saturated, fine to coarse grained Sand, gravelly, dark grey

NOTE: Total depth 40.5'. Ground water level at 18.5'.

Clayey, grey

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - J

Area C - Law Crandall Borings - 1988

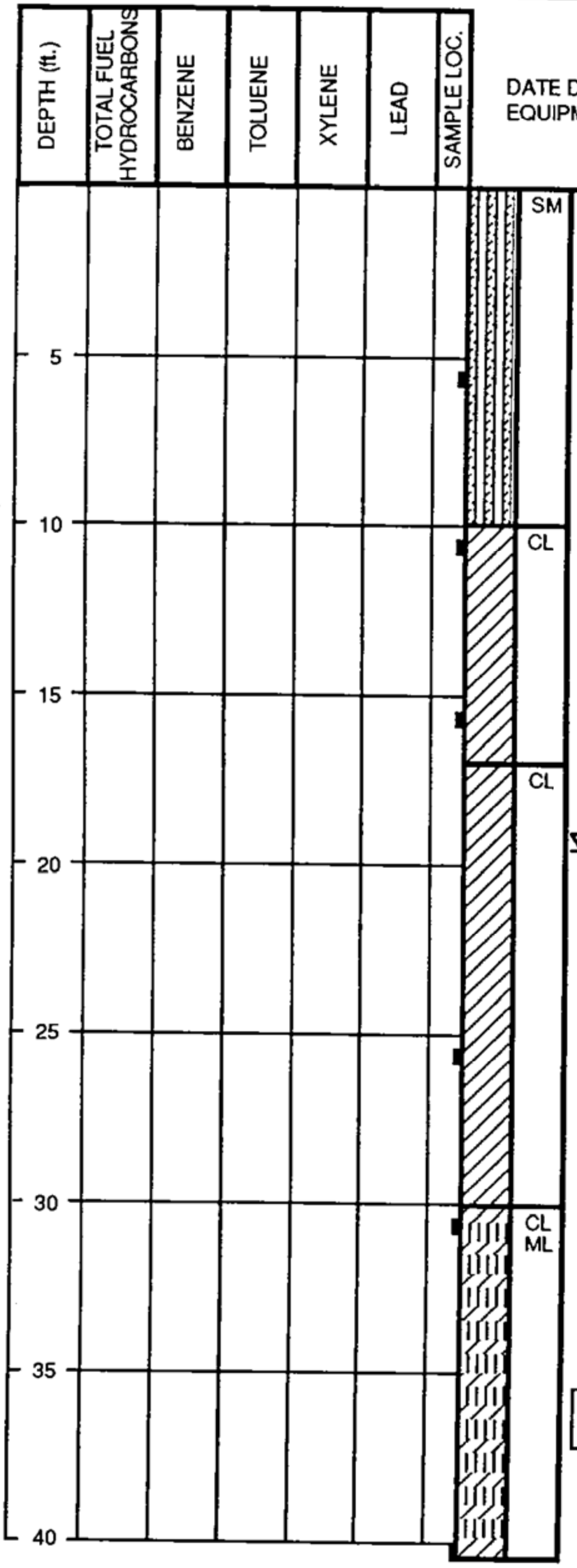
PLATE A2-180

JOB ____ F- 88218 ____ DATE ____ 7/5/88 ____ F.T. ____ DR. ____ lp ____ S.G. FB ____ W.P. ____ lp ____ CHKD ____

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING MW - 3

DATE DRILLED: June 22, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger



FILL - SILTY SAND - dry to moist, fine grained, greyish brown to dark greenish grey

Moist, about 30% seashells, and 5% Clay lumps

SILTY CLAY - very moist, dark grey

Siltier

SILTY CLAY - wet to saturated, dark greenish grey

▽

SILTY CLAY/CLAYEY SILT - saturated, dark greenish grey

NOTE: Total depth 40.5'. Ground water level at 19.5'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

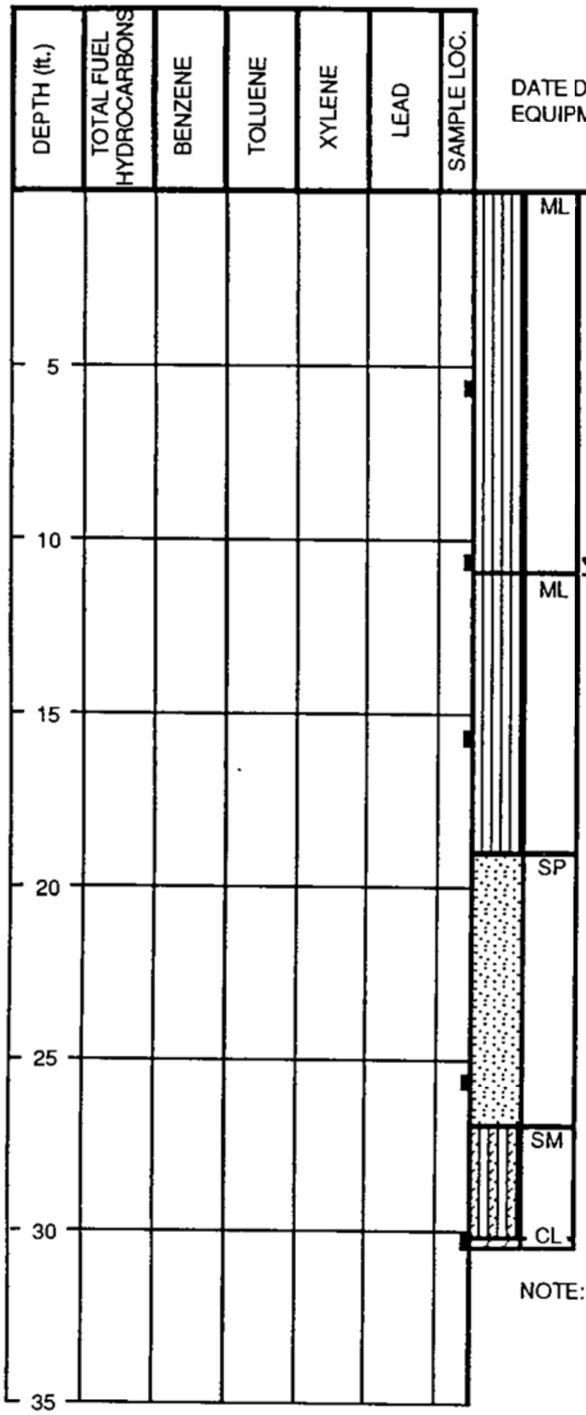
PLATE 2 - K

Area C - Law Crandall Borings - 1988

PLATE A2-181

BORING MW - 4

DATE DRILLED: June 28, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger



ML FILL - SANDY SILT - dry to moist, fine grained, brownish grey

ML CLAYEY SILT - moist to very moist, dark greenish grey

SP GRAVELLY SAND - saturated, fine to coarse grained Sand, dark greenish grey to grey

SM SILTY SAND - saturated, fine grained, dark greenish grey

CL SILTY CLAY - saturated, greenish grey

NOTE: Total depth 30.5'. Ground water level at 11'.

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

F-88218 DATE 7/5/88 F.T. DR. lp S.G. FB W.P. lp CHKD

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - L

Area C - Law Crandall Borings - 1988

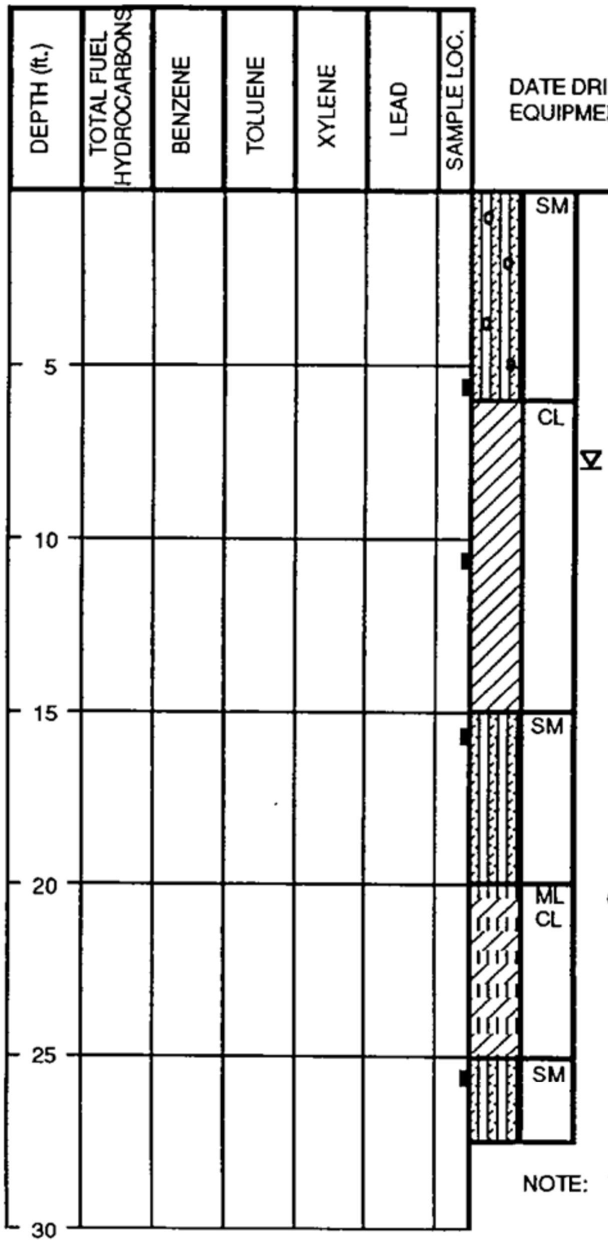
PLATE A2-182

JOB F-88218 DATE 7/5/88 F.T. DR. lp S.G. FB W.P. lp CHKD

Note : The log of subsurface conditions shown hereon applies only at the specific boring location and at the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

BORING MW - 5

DATE DRILLED: June 28, 1988
EQUIPMENT USED: 8" - Diameter Hollow Stem Auger



FILL - SILTY SAND - moist to very moist, fine grained with some Gravel, greyish brown

Very moist to wet

SILTY CLAY - wet, greyish brown

SILTY SAND - saturated, fine grained, greyish brown, mottled with reddish brown

CLAYEY SILT/SILTY CLAY - saturated, brownish grey mottled with reddish brown

SILTY SAND - saturated, fine grained, greyish brown mottled with grey

NOTE: Total depth 27.5'. Ground water level at 8'.

LOG OF BORING

LeROY CRANDALL AND ASSOCIATES

PLATE 2 - M

Area C - Law Crandall Borings - 1988

PLATE A2-183

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