Geotechnical Design Report
(100% Design)

Del Mar Bluffs Stabilization
Project 4
(Milepost 244.1 to Milepost 245.7)

September 13, 2018

Prepared for:

SAN DIEGO ASSOCIATION OF GOVERNMENTS
401 B Street, Suite 800
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Project No. 11860.002

Leighton Consulting, Inc.
A LEIGHTON GROUP COMPANY

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HNTB Corporation
401 B Street, Suite 510
San Diego, California 92101

Attention: Ms. Patricia McColl

Subject: Geotechnical Design Report (100% Design)
Del Mar Bluffs Stabilization Project 4
LOSSAN Corridor, San Diego County, California

In accordance with your request and authorization, we have conducted a geotechnical study for the proposed Del Mar Bluffs Stabilization Project 4 between approximately Mile Post 244.1 and Mile Post 245.7 along the Los Angeles to San Diego section of the LOSSAN rail corridor. The project starts just south of Coast Boulevard and north of Torrey Pines State Beach in the City of Del Mar. The accompanying report presents a summary of our study and provides geotechnical conclusions and recommendations to support the 100 percent design for the proposed repairs and stabilization measures within the project limits.

If you have any questions regarding our report, please do not hesitate to contact this office. We appreciate this opportunity to be of service.

Respectfully submitted,

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1.0 INTRODUCTION

Leighton Consulting, Inc. has performed a geotechnical study for the Del Mar Bluffs Stabilization Project 4 located in San Diego County, California. This report presents a summary of our assessment of the general geotechnical conditions and geologic hazards within the limits of the proposed project site. Geotechnical recommendations for the design of the proposed repair and stabilization improvements associated with the project are also provided. The scope of our investigation included review of information, geologic mapping, previous and recent field investigations, laboratory testing, geotechnical analysis, and preparation of this report.

1.1 Project Location

The Del Mar Bluffs Stabilization Project 4 - Preserving Trackbed Support (Project 4) is situated along 1.6 miles of North County Transit District (NCTD) railroad right-of-way on the western edge of the City of Del Mar, as shown on Figure 1, Site Location Map. The project area extends from rail Milepost (MP) 244.1 near Coast Boulevard south to MP 245.7 at about Torrey Pines State Beach. Within this reach, the NCTD rail alignment runs atop the 50- to 70-foot high coastal bluffs. Railroad right-of-way varies between approximately 100 feet and 235 feet in width and, in some places, extends onto the beach below.

1.2 Project Description

The coastal bluffs supporting the rail alignment in the project area have a history of landslides and surficial failures. In addition, the bluffs are subject to ongoing erosion and failures that could threaten the viability of rail service. Project 4 includes an updated geotechnical evaluation for the design and installation of repair and stabilization measures intended to preserve trackbed support in areas to maintain the viability of rail operations for at least 20 years (i.e., design life for trackbed stabilization measures). It should be noted that this current project is a continuation of Project 3, which consisted of the design and installation of stabilization measures intended to preserve trackbed support in high-priority areas (Leighton, 2010).

The current project will include reconstruction of a storm drain outlet or headwall structure at the toe of the bluff on the beach (Station 1540+45), installation of

new vertical supports for existing sea walls (between Stations 1530+00 and 1539+00), a slope repair on the east side of the track (between Stations 1512+00 and 1513+00), and restoration of existing access road with stabilization measures on the west side track at Anderson Canyon (Station 1483+55). In addition, retaining walls are proposed east of the railway tracks within the NCTD right-of-way (ROW) limits (i.e., upper bluff area) at two locations near 10th Street near MP 245.6.

Currently, we anticipate that Soil Nails will be used to reconstruct the storm drain outlet or headwall structure. For the new vertical supports for existing sea walls, we anticipate that CIDH piles will be used for the foundations. The slope repair on the east side of the track and the restoration of existing access road at Anderson Canyon is anticipated to be accomplished with the use of a color concrete slurry fill. As an alternative, a cantilevered Solider Pile wall could also be considered in the restoration of existing access road at Anderson Canyon. For the upper bluff retaining walls near 10th Street near MP 245.6, we anticipate that cantilevered Solider Pile walls will be used.

1.3 Site Conditions

Topographically, the track bed alignment begins at an elevation of approximately 45 feet (NAVD 88) at Coast Boulevard. To the south, the track bed elevation begins to incline to an elevation of approximately 67 feet at near Station 1497+00. Subsequently, track bed elevation declines to an elevation of approximately 56 feet at Station 1483+00 (i.e., Anderson Canyon).

The area of the proposed upper bluff retaining wall improvements (between Station 1520+00 and 1527+00) is partly covered by landscaping, asphalt pavement, and/or a concrete gunite swale, which drains to the north and discharges into a storm drain structure north of 11th Street. Thickness of the pavement and concrete swale is unknown at this time. Immediately west of the swale, the existing ground surface (topography) slopes down to the railway tracks at varying inclinations and there are old deteriorating timber wall sections (i.e., walls to be replaced by or secured to new structures). The height of the slope is approximately 20 feet. Elevation of the top of the upper bluff ranges from 75 feet at the northern end to 85 feet at the southerly end. In general, the slope or this upper bluff section above the tracks is slowly retreating to the east by erosion resulting from concentrated surface runoff and surface exposure.

2.0 METHODS OF EXPLORATION

2.1 Site Reconnaissance and Aerial Photo Review

Our initial site reconnaissance for Project 4 was made in November 2015, which was followed up by several site visits in 2016, 2017 and 2018 to observe specific site areas for the proposed repairs and stabilization measures. To supplement our field reconnaissance, a review of aerial photographs was performed. Our field observations were accomplished under the supervision of a North County Transit District (NCTD) flagger, who provided us escort while we were mapping within the NCTD right-of-way.

2.2 Subsurface Exploration

Several phases of field investigations, geologic mapping and numerous exploratory borings have been incorporated in order to evaluate the site's pertinent soil and geologic conditions and develop the site geotechnical maps (Plates 1 through 7) and geologic cross sections (Plates 8 through 10) used for slope stability analysis. For previous exploration borings, please refer to the Geotechnical Reports (Leighton, 2002b and 2003).

Previous geologic mapping was performed between May 26 and June 11, 2009. The geologic mapping utilized topographic base maps which were developed by David Evans and Associates, 2009, using aerial photographs covering the site area. The contour interval utilized for these maps is 1 foot, thus providing superior accuracy over previous base maps utilized at the site. In addition, the mapped features and geologic contacts were more accurately located with the utilization of a handheld Trimble GeoExplorer 2005 Series GPS. This GPS unit provided lateral sub-meter accuracy. During this phase of recent mapping additional geologic details were provided including mapped sub-units within the Delmar Formation consisting of both the sandstone and claystone units, along with mapping of additional area south of the previously mapped area from the geotechnical reports (Leighton, 2002b and 2003) to the southernmost extent of the bluffs. In addition, recent mapping has included the upper bluff slopes east of the existing rail road track.

Historically, 34 borings have been drilled to maximum depths ranging from 60 to 70 feet below the existing ground surface (bgs). These included 24 small diameter borings drilled by a hollow-stem auger drill rig and 10 large-diameter borings. The large-diameter borings were downhole logged by geologists to better evaluate the subsurface conditions. The borings have been used to characterize the subsurface conditions and develop the geologic cross sections utilized in the slope stability analysis. These cross sections and the geologic maps have been refined with the results of the additional data obtained since the completion of the Geotechnical Study (Leighton, 2001a).

The 34 borings, discussed above, consist of: 4 small-diameter borings drilled by Leighton in 1978; 16 small-diameter borings and 9 large-diameter borings for the Geotechnical Study (Leighton, 2001a); 2 small-diameter borings as part of 10th Street Retaining Walls Project (Leighton, 2002b); 1 large-diameter drilled shaft (i.e., downhole logging of soldier pile) as a part of the Eighth Street Emergency Repair (Leighton, 2002a); and 2 small-diameter borings as part of this current study.

In addition to the field investigations and subsurface explorations, geologists have observed the installation of 70 hydro-augers and numerous construction excavations as part of Project 1 and Project 2. The results of this additional work with some refinement have confirmed the findings presented in the Geotechnical Study (Leighton, 2001a), and in the Project 2 Geotechnical Report (Leighton, 2003).

Recent subsurface explorations performed in February and May of 2018 included four (4) dynamic cone penetrometer (DCP) soundings north of Anderson Canyon, along the west side of the track (Station 1483+55, see Plate 6), and two (2) small-diameter borings drilled for upper bluff retaining wall improvements (between Station 1524+00 and 1527+00, see Plates 2 and 3). The DCP explorations allowed us to collect data where access restrictions prevent the use of a conventional drill rig. Data obtained from these soundings is correlated to conventional N-values and corresponding apparent density/consistency identifications. The DCP soundings varied in depth from approximately 3 feet to 20 feet bgs and were terminated after refusal in formational materials. The borings for the upper bluff retaining walls were advanced to a maximum depth of 20 feet below the existing ground surface. Logs for the borings and DCP soundings are provided in Appendix B.

2.3 Geotechnical Laboratory Testing

As background, laboratory testing was performed on representative soil samples obtained during previous site explorations and the results were utilized in this current study. For this study, additional laboratory testing for upper bluff retaining wall improvements was performed on representative samples the to evaluate the in-situ moisture and dry density, soluble sulfate content, pH and resistivity, chloride content, and strength parameters of encountered soils. A discussion of the recent laboratory tests performed and a summary of the laboratory test results are presented in Appendix C.

A discussion of the strength and design parameters utilized is presented in Section 3.6.2. For test data and details on the laboratory testing, please refer to the Geotechnical Report (Leighton, 2003).

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Regional Geologic Setting

The site is located in the coastal section of the Peninsular Range Province, a geomorphic province with a long and active geologic history throughout Southern California. Throughout the last 54 million years, the area known as the "San Diego Embayment" has undergone several episodes of marine inundation and subsequent marine regression, resulting in the deposition of a thick sequence of marine and nonmarine sedimentary rocks on the basement rock of the Southern California batholith.

Gradual emergence of the region from the sea occurred in Pleistocene time, and numerous wave-cut platforms, most of which were covered by relatively thin marine and nonmarine terrace deposits, formed as the sea receded from the land. Accelerated fluvial erosion during periods of heavy rainfall, coupled with the lowering of the base sea level during Quaternary time, resulted in the rolling hills, mesas, and deeply incised canyons which characterize the landforms we see in the general site area today.

The Peninsular Ranges are also traversed by several major active faults. The Whittier-Elsinore, San Jacinto, and the San Andreas faults are major active fault systems located northeast of the site and the Rose Canyon, Newport-Inglewood (offshore), Coronado Bank, and San Diego Trough are active faults located to the west-southwest. Major tectonic activity associated with these and other faults within this regional tectonic framework is right-lateral strike-slip movement. These faults, as well as other faults in the region, have the potential for generating strong ground motions at the project site. Further discussion of faulting relative to the site is provided in the Faulting and Seismicity section of this report.

3.2 Site Geology

As background, the geologic conditions of the project site were described in the initial Geotechnical Study (Leighton, 2001a). Additional studies recommended in that report have been achieved by: 1) the drilling of additional borings as part of the Project 1 design; 2) the logging of a drilled shaft as part of the Eighth Street Emergency Repair; 3) additional field mapping; and 4) observations of backhoe

test pits and trenches, hydro-augers, drilled shaft piles and other exposures related to Projects 1, 2 and 3 construction activities.

To summarize the geologic conditions, the site is underlain by sandy permeable materials of the Quaternary-aged Bay Point Formation (i.e. Old Paralic Deposits as mapped by Kennedy and Tan, 2008) which overlie the generally dense sandstones (Tdss) and relatively impermeable siltstones and claystones (Tdcs) of the Eocene-aged Delmar Formation (see Geotechnical Map – Plates 1 through 7). The Delmar Formation also includes localized permeable zones related to sandy lenses and sandy paleo channel infill deposits, and dense resistant layers. The extent and elevations of these dense layers have been better defined by observations during construction activities of Projects 1, 2 and 3, and the supplemental field mapping activities near the base of the bluff. The Eocene-aged Torrey Sandstone can be observed just east of the track in the southern portion of the site and within Anderson Canyon. This unit is shown on the geologic maps and cross sections but does not underlie the rail alignment.

Within both formations that underlie the right-of-way there are fracture zones that roughly parallel the bluff face. Observations related to Project 1 construction and the logging of the borings drilled since the Geotechnical Study (Leighton, 2001a) also confirmed the presence of near horizontal layers of highly fractured claystone within the Delmar Formation that were identified in some of the earlier borings. Shears within these zones are highly polished and randomly oriented. In addition to these horizontal claystone beds, steeply dipping fractures and joints are also present. Near-vertical fractures and joints are closely spaced near the bluff face, but steeply dipping fractures and joints can also be observed at wider spacing throughout the entire right of way. As an example, closely spaced vertical fractures and joints can be observed at the outlet excavation at 8th Street (Project 1). More steeply dipping fractures and joints were observed in borings LB- 2 through LB-6 and also in several of the Project 1 and 2 excavations, which were located near the track. The highly fractured zones near the bluff face can in part be attributed to weathering. East of the bluff face, the formation of these highly fractured claystone beds and the presence of steeply dipping fractures and joints within what is a typically brittle formational unit, are believed to be related to tectonic and/or depositional processes. These joints and fracture zones consist of breaks in the bedrock and provide weak zones on which failures can occur and also conduits for groundwater migration within the bluff.

The approximate areal extent of each of the geologic units and the interpretation of the subsurface geologic conditions are indicated on the provided Geotechnical Maps (Plates 1 through 7) and Geological Cross-Sections (Plates 8 through 10).

3.3 Geologic Structure

Based on our review of published geologic literature (Appendix A), the Quaternary-aged Bay Point Formation (i.e. Old Paralic Deposits) and the Eocene-age Delmar Formation are massive and broadly cross-bedded. However, near-vertical fractures and joints can be observed throughout the right of way, and are most concentrated near the bluff face. For the purposes of analyses, the northern areas (north of MP 245.21 or Station 1491+20) considered a shallow profile of groundwater parallel to the bluff face (a 5-foot hydrostatic head within a 10-foot fractured bluff face zone) based on observations during the construction activities of Project 1. For analyses in the southern portions of the project (south of MP 245.21 or Station 1491+20), substantially less groundwater seepage is observed on the bluff face. The reduction in the groundwater to the south is due to the lack of the permeable terrace deposits on the bluff top, existing drainage improvements that extend through the terrace deposits and the distance from the upslope developments. As a result, the groundwater profile model was changed to incorporate a 2-foot hydrostatic head within a 5-foot fracture zone. Figures 2 and 3 present generalized cross sections that illustrate the near-vertical fractures and joints with groundwater profiles utilized in analyses.

3.4 Bluff Retreat

As discussed in the Geotechnical Study (Leighton, 2001a), average bluff retreat rates in the study area are estimated at a maximum of 0.4 to 0.6 feet per year. This corresponds to a retreat of approximately 10 feet in the project's 20-year design life (i.e., trackbed stabilization measures), assuming that the bluff will retreat at an average rate of 0.5 feet per year for the next 20 years. Bluff retreat is typically episodic with no retreat for some time and then several feet or more occurring in one event.

3.5 Surface and Groundwater

As described in the Geotechnical Study (Leighton, 2001a), groundwater is a major factor influencing slope stability as it accelerates the degradation of the

bluff and bluff face erosion. Based on observations during the various phases of field investigation, hydro-auger installation and construction excavations, the majority of the groundwater is located in a perched horizon at the base of the Bay Point Formation with additional localized zones of groundwater within near-vertical fractures and joints and sandy channel infills of the Delmar Formation. As discussed previously, geologic observations indicate that the near-vertical fractures and joints within the Delmar Formation are more prevalent near the bluff face, but do extend landward with lesser frequency and typically wider spacing through the entire right-of-way as observed in numerous borings and trenches. These near-vertical fractures and joints create potential pathways for migration of groundwater throughout the bluff and the right-of-way.

Groundwater can also be observed as numerous localized seeps in the exposed bluff face with additional seepage zones likely masked by dense vegetation or loose surficial soils. Fluctuation in groundwater levels within the near-surface soils and weathered and fractured material near the bluff face is also anticipated after periods of heavy rainfall resulting in additional seepage zones and a temporary increase in seepage.

Since construction of the rail alignment in the early 1900's, there have been many efforts to reduce the amount of water in the bluff. Historically these efforts have included construction of a storm drain system, surface drainage improvements and the installation of subdrains. In 1998, NCTD completed additional surface and subsurface drainage improvements. Additionally, Project 1, which also consists of both surface and subsurface drainage improvements, was completed in 2003.

While these past projects have collected a large amount of subsurface water, not all groundwater is intercepted by these improvements as evidenced by lingering seepage in the exposed bluff face in improved areas. In addition, not all areas of the bluff have had drainage improvements installed. In the central "trough" area only limited or no subsurface drainage improvements have been installed primarily because the distance from the track to the bluff face did not result in low factors of safety for this area. Recent site observations indicate an increase of bluff retreat in localized areas that is caused by subsurface flows eroding (piping) the bluff face.

3.6 Engineering Characteristics of On-site Soils

Based on our professional experience on adjacent sites with similar soils, the results of our subsurface exploration, laboratory testing, and our review of existing subsurface data, the engineering characteristics of the on-site soils are discussed in the following sections.

3.6.1 Expansion Potential

Based on our experience on similar projects with similar soil types, the anticipated expansion potential of the soils encountered on the site is described as follows:

- Fill: Low to moderate expansion potential.
- Bay Point Formation (i.e. Paralic Deposits): Very low to low expansion potential.
- Delmar Formation - Sandstone: Low expansion potential.
- Delmar Formation - Claystone: Medium to High expansion potential.

3.6.2 Soil Properties

The soil properties used in the analysis consisted of soil strength parameters and unit weights that are based on: 1) laboratory testing from the Geotechnical Study (Leighton, 2001a) and follow up subsurface explorations; 2) field observations during the Eighth Street Emergency Repair, Projects 1, 2 and 3 construction activities; and 3) engineering judgment. The soil properties used in this analysis are consistent with the geotechnical reports (Leighton, 2002b, 2003 and 2010).

A summary of the assigned soil strength parameters for each geologic unit used in the slope stability analysis is provided in Table 1, on the following page. Based on laboratory test data, the average moist unit weight used in the analyses for the fill soils, beach deposits, Bay Point and Delmar Formations was 125 pounds per cubic foot (pcf), while 110 pcf was used for the landslide materials (Leighton, 2003 and 2010).

Table 1 Soil Strength Parameters for Analyses			
Material	Unit Weight (pcf)	Friction Angle, (degrees)	Cohesion, (psf)
Fill Soils	125	32	100
Bay Point Formation	125	36	200
Delmar Formation	125	36	300
(within +/- 5^{o} horizontal)	125	25	150
Landslide Materials	110	18	50
Beach Deposits	125	30	0

The overall stability of the slope is significantly affected by the strength of the Delmar Formation. While testing an intact block of the Delmar Formation would yield relatively higher strength parameters, the use of such strength in the slope stability analysis would show no failures occurring on the bluff. As a majority of the bluff has experienced numerous failures, the use of intact strength values is not appropriate. As presented in the 2003 Supplemental Geotechnical Evaluation for Project 2, a comparison of the average peak and residual strength data indicates that the Delmar Formation experiences significant strength loss once the cementation between the soil grains is broken. Similarly, when joints and fractures develop within the unit from both weathering and tectonic influences, the loss of contact can greatly reduce or eliminate the strength across the break. In addition, the geometry or steepness of the bluff induces a state of tension behind the crest and at times in the middle of the slope face. When the tensile strength of the materials is exceeded, cracks form. These zones of tension tend to expand during earthquakes, leading to additional areas where reduced strengths and higher water pressures are appropriate for use in the analyses. For these reasons, lower bound strength parameters were assigned to the Delmar Formation (i.e., the strength parameters presented on Figures 2 and 3, friction angle of 36 degrees and cohesion of 300 pounds per square foot, psf). To account for the presence of sheared siltstone and claystone beds, strength parameters similar to the average residual values of fine-grained

Delmar Formation samples (i.e., friction angle of 25 degrees and cohesion of 150 psf) were assigned to this material within 5 degrees of horizontal.

Note that as verification of the soil properties used in the analyses, the 2003 Supplemental Geotechnical Evaluation for Project 2 analyzed two existing landslides on the bluff to back calculate the strength parameters prior to failure (determining what strength parameters generated a factor of safety of approximately 1.0, which corresponds to the moment of failure). The failures analyzed included a block fall at MP 244.47 (Station 1529+60), and a wedge failure at MP 245.27 (Station 1488+85). The results of the back-calculation analysis, as presented in the 2003 Supplemental Geotechnical Evaluation for Project 2, indicate that the selected soil strength parameters for the Delmar Formation appropriately model bluff failures.

3.6.3 Excavation Characteristics

Based on our experience at the site, it is anticipated that the on-site materials can be excavated with conventional heavy-duty construction equipment. However, both drilling and excavation methods utilized during construction at the site should take into consideration the applicable adverse soil conditions at geological contacts. Although formational materials are characteristically dense, their friable character creates the potential for flowing conditions and sloughing near or below the groundwater table. Also, difficult excavation and drilling may be expected where cemented layers are encountered within the Delmar Formation.

For an evaluation of the excavation conditions within the project limits, boring logs from recent and previous subsurface explorations (Leighton, 2001 and 2003) are presented in Appendix B. In addition, field observations during the drilled shaft pile excavations for the Del Mar Bluffs Project 3 (Leighton, 2012) are presented in Appendix B. Observations included drilling depths, geologic contacts, and conditions encountered during drilling (i.e., seepage, caving, conflicts, etc.).

3.6.4 Compressible Soils

Existing near surface undocumented fills and Beach Deposits encountered at the site were found to be of varying densities and had zones of loose and soft materials. Therefore, settlement within the near surface undocumented fill and Beach Deposits is anticipated where additional loads are applied to these materials.

3.6.5 Scour and Erosion

The Beach Deposits are considered highly erodible and subject to scour where concentrated flows are present.

3.6.6 Hydrocollapse and Settlement Potential

Based on the results of our subsurface exploration, the potential for hydro-collapse and settlement of the underlying Bay Point and Delmar Formations are considered low. Our opinion is supported by our observation of in-place drive samples which indicated a very dense, non-porous character for the materials. However, near surface undocumented fills and Beach Deposits encountered at the site had generally low blow counts and localized porosity indicating an unconsolidated character. Therefore hydro-collapse and settlement within near surface undocumented fills and Beach Deposits is anticipated.

3.6.7 Beach Replenishment

Previous and recent laboratory testing on the Bay Point Formation (terrace deposit) has been performed to evaluate the percentage of fines (i.e., silt and clay content) in consideration of potential beach replenishment. As encountered during our investigations, the terrace deposit material generally consisted of red-brown, fine to medium silty to clayey sands. The underlying Delmar Formation consists of claystones and siltstones (Leighton, 2001 and 2003).

Specifically, two recent representative soil bulk samples of the terrace deposit soil were collected for testing of fines content. Laboratory testing of selected soil samples was limited to the Percent Passing the Number

200 Sieve, ASTM Test Method D1140. Test results indicate that percentage of fines passing Number 200 Sieve ranges from 26 percent to 27 percent (Appendix C).

Based on the 2006 SANDAG's Sand Compatibility and Opportunistic Use Program (SCOUP) Plan report, terrace deposit soil is not considered as "Optimum Beach Fill Material" (i.e., containing less than 15% fines). It is defined as "Less-than-Optimum Beach Fill Material" containing between 15% and 45% fines.

4.0 SEISMICITY AND GEOLOGIC HAZARDS

4.1 Faulting

Our discussion of faults on the site is prefaced with a discussion of California legislation and policies concerning the classification and land-use criteria associated with faults. By definition of the California Geological Survey, an active fault is a fault which has had surface displacement within Holocene time (about the last 11,700 years). This definition is used in delineating Earthquake Fault Zones as mandated by the Alquist-Priolo Geologic Hazards Zones Act of 1972 and most recently revised in 2007 (Bryant and Hart, 2007). The intent of this act is to assure that unwise urban development and certain habitable structures do not occur across the traces of active faults. The subject site is not located within any State mapped Earthquake Fault Zones. The principal source of seismic activity is movement along northwest-trending regional fault zones such as the San Andreas, San Jacinto and Elsinore Faults Zones, as well as along less active faults such as the Newport-Inglewood Fault Zone.

Our review of geologic literature pertaining to the site and general vicinity indicates that there are no known major or active faults on or in the immediate vicinity of the site (Appendix A). The nearest known active fault is the Rose Canyon Fault Zone. That fault is oriented north-south and roughly parallels the rail alignment. The fault is located offshore (west) and the distance to the fault alignment varies from 2.3 miles at the southern project end to 2.4 miles at the northern project end.

4.2 Seismic Design Considerations

The site can be considered to lie within a seismically active region, as can all of Southern California. Ground shaking for consideration in design of railroad facilities and infrastructure should be in accordance with the SANDAG Design Criteria Vol III LOSSAN Corridor in San Diego County (2016). In summary, three levels of seismic ground motion are to be considered in design. The return intervals of the design seismic event correspond to the 93-year, the 320-year, and the 2,190-year seismic events. These events correspond to the bridge performance criteria for the Serviceability, Ultimate, and Survivability Limit States.

Based on our subsurface explorations, the proposed repairs and improvements are within areas generally classified as Site Class D.

4.2.1 Building Code Seismic Parameters

For design of other site facilities, the effect of seismic shaking may be mitigated by adhering to the California Building Code (CBC) and state-of-the-art seismic design parameters of the Structural Engineers Association of California. Table 2 provides seismic design parameters considered applicable to the project based on the site conditions and the seismic setting per the 2016 California Building Code (CBSC, 2016). The site parameters were developed using the USGS Ground Motion Parameter Calculator (2018) and site coordinates at the northern end of the project alignment. Minor variations from these values may be calculated within the southern portion of the project, but differences are minor. Where design per the CBC is to be performed, site-specific parameters can be developed upon request.

Table 2
2016 CBC Seismic Design Parameters
Lat. 32.9505°, Long. 117.2652°

Site Class	D		
Site Coefficients	F_a	=	1.014
	F_v	=	1.530
Mapped Spectral Accelerations	S_S	=	1.216g
	S_1	=	0.470g
Site Modified Spectral Accelerations	S_{MS}	=	1.232g
	S_{M1}	=	0.719g
Design Spectral Accelerations	S_{DS}	=	0.822g
	S_{D1}	=	0.479g

Utilizing ASCE Standard 7-10, in accordance with Section 11.8.3, the following additional parameters for the peak horizontal ground acceleration are associated with the Geometric Mean Maximum Considered Earthquake (MCE_G). The mapped MCE_G peak ground acceleration (PGA) is 0.524g for the site. For a Site Class D, the F_{PGA} is

1.000 and the mapped peak ground acceleration adjusted for Site Class effects (PGA_M) is 0.524g for the site.

4.3 Secondary Seismic Hazards

In general, secondary seismic hazards for sites in the region could include soil liquefaction, earthquake-induced settlement, lateral displacement, surface manifestations of liquefaction, landsliding, and seiches and tsunamis. These potential secondary seismic hazards are discussed below.

4.3.1 Shallow Ground Rupture

No active faults are mapped crossing the site or projecting toward the site, and the site is not located within a mapped Alquist-Priolo Earthquake Fault Zone. The nearest modeled segment of the Newport-Inglewood Offshore Fault Zone known as the Rose Canyon Fault Zone, Del Mar Section is located approximately 3 miles west of the alignment. It should be noted that ground cracking is possible at any site in southern California. Because of the lack of known active faults at the site, the potential for fault surface rupture at the site is considered low.

4.3.2 Liquefaction

Liquefaction and dynamic settlement of soils can be caused by strong vibratory motion due to earthquakes. Both research and historical data indicate that loose, saturated, granular soils are susceptible to liquefaction and dynamic settlement. Due to the relatively dense nature of the underlying formational materials, the potential for liquefaction and dynamic settlement of the site are considered nil.

4.3.3 Seismic Slope Instability

The Geotechnical Study (Leighton, 2001a) characterized the overall bluff stability, established the high-priority areas and provided conceptual repair alternatives to improve the slope stability (i.e., static and seismic). Since the completion of the Geotechnical Study, additional investigation of the bluff has been accomplished for the Eighth Street Emergency Repair, and the Project 1, 2 and 3 improvements (Leighton, 2003 and 2010). Further

analyses of the proposed storm drain headwall structure at the toe of the bluff (Station 1540+45) and the slope repair improvements on the east side of the track (between Stations 1512+00 and 1513+00) are presented in the Slope Stability section of this report.

4.3.4 Tsunamis and Seiches

Tsunamis are long wavelength seismic sea waves (long compared to the ocean depth) generated by sudden movements of the ocean bottom during submarine earthquakes, landslides, or volcanic activity. A seiche is an oscillation (wave) of a body of water in an enclosed or semi-enclosed basin that varies in period, depending on the physical dimensions of the basin, from a few minutes to several hours, and in height from several inches to several feet. A seiche is caused chiefly by local changes in atmospheric pressure, aided by winds, tidal currents, and occasionally earthquakes.

Specifically, southern California is oriented obliquely (i.e., not directly in line) with the major originating tsunami zones, and it has a relatively wide (about 220 kilometers) and rugged continental shelf (or borderland) that acts as a diffuser and reflector of remotely generated tsunami wave energy (Joy, 1968). These conditions, in addition to the geologic and seismic conditions (such as the strike-slip fault regime and the infrequent large submarine earthquakes) along the coastline, also tend to minimize the likelihood of a large tsunami at the site. For example, tsunami wave heights and run-up elevations experienced along the Southern California coastline during the last 170 years have fallen within the normal range of tidal fluctuations.

Based on our review of currently published Tsunami Inundation Maps for Emergency Planning, State of California, County of San Diego, Del Mar Quadrangle, published June 1, 2009, the project site is not subject to hazards associated with a tsunami, excluding the storm drain outlet or headwall structure at the toe of the bluff on the beach (Station 1540+45).

4.4 Flood Hazard

Based on our map review and our site reconnaissance, the project is not located within the 100-year flood-plain. However, designers should consider the Design High Tide as determined by Caltrans Highway Design Manual Section 873.2.

5.0 GEOTECHNICAL ANALYSIS AND DESIGN CONSIDERATIONS

Based on our findings, professional knowledge of the project area, and our experience with projects having similar conditions, the following presents our analysis of geotechnical conditions influencing the design. Design recommendations developed from our evaluation of the geotechnical considerations are also included in the following sections.

5.1 Slope Stability

Slope stability analyses were performed on a selected section for slope repair improvements on the east side of the track (between Stations 1512+00 and 1513+00) using the software program Slide v.7.027 (Rocscience, 2017). Global stability analyses for proposed soil nail storm drain headwall structure at the toe of the bluff (Station 1540+45) were also performed with the preliminary design data. In summary, idealized models were developed using the proposed cross-section profile, and soil strengths derived from laboratory test results, field observations, and professional judgments. The analyses considered optimized surfaces using Spencer's Method of limit equilibrium analysis. The values used in the analysis are summarized on the analysis plots presented in Appendix C.

In our deep-seated stability search for the seismic slope stability analyses, horizontal seismic coefficient, k_H, of 0.15 and 0.28 were used consistent with the previous established analyses criteria (Leighton, 2003 and 2010). In addition, it should be noted that the following minimum factors of safety (FS) are being used based previous established criteria (Leighton, 2003 and 2010):

- Static Analysis: FS = 1.5
- Pseudo-Static (Seismic) Analysis with a seismic coefficient of 0.15: FS = 1.15
- Pseudo-Static (Seismic) Analysis with a seismic coefficient of 0.28: FS = 1.00

In summary, the analyses indicated that the proposed slurry fill slope on the east side of the track (between Stations 1512+00 and 1513+00), and soil nail storm drain headwall (Station 1540+45) have global stability factors of safety greater than 1.5 with the proposed slope inclinations and proposed wall heights for static conditions. Additionally, the seismic slope stability analyses of the proposed slopes and walls have factors of safety over 1.15 with a k_H of 0.15, and 1.0 with a k_H of 0.28. Plots of the slope stability analyses are presented in Appendix D.

5.2 Lateral Earth Pressures

For design of railroad bluff stabilization piles, the lateral earth pressure coefficients presented in Table 3A are recommended for retaining the onsite formation materials. For fill soils, we recommend using lateral earth pressure coefficients presented Table 3B.

Table 3A (Formation, Ø = 36 degrees) Lateral Earth Pressure Coefficients	
Conditions	Coefficient (K)
Active	0.26
At-Rest	0.41
Pseudo-static (K_{ae} at 93-year, k_h=0.04g)	0.28
Pseudo-static (K_{ae} at 320-year, k_h=0.08g)	0.30
Pseudo-static (K_{ae} at 2,150-year, k_h=0.27g)	0.44
Passive (below unweathered formation depth)	3.85

Table 3B (Fill, Ø = 32 degrees) Lateral Earth Pressure Coefficients	
Conditions	Coefficient (K)
Active	0.31
At-Rest	0.47
Pseudo-static (K_{ae} at 93-year, k_h=0.04g)	0.33
Pseudo-static (K_{ae} at 320-year, k_h=0.08g)	0.35
Pseudo-static (K_{ae} at 2,150-year, k_h=0.27g)	0.50
Passive	3.25

Unrestrained (yielding) cantilevered piles should be designed for an active coefficient provided above. In the design of stabilization piles restrained from movement at the top (nonyielding) such as piles with tiebacks, the at-rest coefficient should be used. Surcharge loads resulting from train and seismic loading, if applicable, should be accounted for in stabilization pile design utilizing AREMA design procedures. AREMA Manual Section 5.3 of Chapter 8 addresses modeling of train loads on abutments and retaining walls. Further guidance on surcharge load distribution considerations is provided in Section 16.4 and 20.3 of Chapter 8 (AREMA, 2011).

Lateral soil resistance developed against lateral structural movement can be obtained from the passive pressure acting against the footing. Note that for pile foundations on a descending slope, we recommend a minimum 10-foot setback for the determination of starting the depth of the passive resistance. Typical pressure diagrams are provided in the accompanying Figure 4.

The above values assume that backfill will meet the specifications for structural backfill presented in Section 19 of the Caltrans Standard Specifications (Caltrans, 2006) and that a free-draining condition will be provided. Drainage measures should be taken to prevent hydro-static pressure build-up behind stabilization piles.

5.3 Earth Retaining Systems

Currently, it is anticipated that earth retaining systems for the project will include a soil nail retaining wall for the storm drain outlet, new CIDH piles for vertical supports for existing sea walls, and cantilevered Solider Pile retaining walls for the restoration of existing access road at Anderson Canyon and the upper bluff retaining walls near 10th Street.

5.3.1 Soil Nail Wall Design Parameters

Drilling for the soil nails may generally be accomplished with conventional heavy-duty earthwork equipment. Where soil nails are utilized, right-of-way constraints and buried utility conflicts should be considered (i.e., existing solider pile used for the bluff stabilizations). For preliminary design and an initial evaluation of a soil nail wall system (i.e., storm drain headwall), the following soil properties are recommended for use.

Table 4 Preliminary Soil Nail Design Parameters	
Soil Parameters	Design Value
Internal Friction Angle, (degrees)	32
Cohesion, (psf)	100
Total Unit Weight, (pcf)	125
Ultimate Bond Stress (psi)	5 to 10

It should be noted that the actual bond stress for the soil nails will be highly dependent on the methods of construction along with the expertise of the contractor. In addition, the bond stress can be increased by post grouting. The selected design bond stress should be verified by field testing. An appropriate testing and inspection program should be provided as part of the project plans.

In order to provide adequate drainage behind a soil nail wall, we recommend vertical drainage panels be installed as strips between rows of soil nails. The drainage panels should be connected at the base of the wall and outlet to a collective drainage system or to weephole at the base of the wall. Panel drains should be terminated near the top of the wall (approximately 2 feet below finish grade) and should not be exposed above the top of wall.

5.3.2 Soldier Pile Wall and CIDH Foundation System

For the restoration of the access road at Anderson Canyon and for the upper bluff retaining walls near 10th Street, a cantilevered soldier pile wall can be constructed with steel H-beams placed in the drilled shafts. The materials between the soldier piles will be supported by cast-in-place or precast concrete wall panels. Guidance on the design of cantilevered retaining walls can be found in Section 28.5 of Chapter 8, the Caltrans

Reference Manual for Design Earth and Retaining Structures (Caltrans, 2013), and the Caltrans Trenching and Shoring Manual (Caltrans, 2011).

For the design of the Anderson Canyon cantilever solider pile wall and the new vertical support for the existing seawalls, we recommend using the lateral earth pressures (i.e., active and passive) presented in Table 3B, above. In addition, a surcharge traffic loading of at least 100 pounds per square feet (psf) with a uniform pressure distribution should be applied to the upper 10 feet of wall at Anderson Canyon.

For design of the upper bluff cantilevered soldier pile walls near 10th Street, the following lateral earth pressure values for level or sloping backfill are recommended.

Table 5

Static Equivalent Fluid Weight (pcf)

Conditions	Level	2:1 Slope
Active	37	57
At-Rest	57	67
Passive	350 (Maximum of 3 ksf)	150 (sloping down)

Unrestrained (yielding) cantilevered walls up to 15 feet in height should be designed for an active equivalent pressure value provided above. In the design of walls restrained from movement at the top (nonyielding), the at-rest pressures should be used. If conditions other than those covered herein are anticipated, the equivalent fluid pressure values should be provided on an individual case basis by the geotechnical engineer. A surcharge load for the upper bluff retaining walls resulting from automobile traffic may be assumed to be equivalent to a uniform pressure of 75 psf which is in addition to the equivalent fluid pressure given above. For other uniform surcharge loads, a uniform pressure equal to 0.35q should be applied to the wall (where q is the surcharge pressure in psf). The wall pressures assume walls are free draining materials and water is not allowed to accommodate behind walls. Wall backfill, if any, should be

compacted by mechanical methods to at least 90 percent relative compaction (based on ASTM D1557). Wall footings should be designed in accordance with the foundation design recommendations and reinforced in accordance with structural considerations.

For the seismic design of cantilever soldier pile walls, an additional equivalent fluid pressure of 21 pcf should be used (i.e., Mononobe-Okabe, Active Case). An inverted triangular pressure distribution should be for the dynamic loading, so that the resulting load is applied at 0.67H.

Arching may be considered for design of flexible lagging. To account for passive arching, the effective pile diameter may be considered to be 3.0 times the pile diameter. However, for piles spaced less than 3 pile diameters center-to-center, the effective pile diameter should be limited to the actual pile diameter. For soldier pile and/or CIDH foundations on a descending slope, we recommend a minimum 10-foot setback for the determination of starting the depth of the passive resistance. In addition, the upper 3 feet of soil should not contribute to passive pressure.

5.3.2.1 Wall Backfill and Drainage

Wall backfill should be granular material free of oversize material and debris and also have a very low expansion potential (EI of 20 or less). Grout fill or backfill tamped in thin compact lifts should be provided behind lagging. Vertical strip drains should be provided at regular intervals prior to constructing facing against the cut. For wall with concrete panel lagging (i.e., free draining open joints), no strip drains are needed.

5.3.2.2 Pile Installation

All pile installation should be performed under the observation of Leighton Consulting, Inc. and consistent with standard practice. Where the Delmar Formation is encountered, drilling equipment should be powerful enough to drill through the overlying fill soils or beach deposits and into the dense to very dense formational material to the design penetration depths. Where saturated soil or beach deposits are present, casing should be provided. Once a pile excavation has been started, it should be completed within 8

hours, which includes inspection, placement of the reinforcement, and placement of the concrete. Adjacent piles should not be excavated before sufficient setup of the concrete has been attained.

Localized groundwater as seepage may occur in the pile excavations and if present should be dewatered prior to placing the concrete. If excavations are filled with water or drilling mud, concrete must be placed through a tremme pipe extending to the bottom of the pile excavation.

Caving of friable, soft or loose soils may occur where open excavations are made. In addition, the contractor should also be prepared to employ casing or other methods of advancing the drilled pile excavation to mitigate caving, as needed.

5.4 Slurry Fill Slope Repair

Currently, it is anticipated that the slope repair on the east side of the track between Stations 1512+00 and 1513+00, and possibly the restoration of existing access road at Anderson Canyon (Station 1483+55) can be accomplished with the use of a color concrete slurry fill placed in lifts. The slurry fill also referred to as a controlled low-strength material (CLSM) or a “flowable fill” is considered acceptable from a geotechnical perspective for the repair of slope and/or the restoration of the access road, provided it is founded on dense and unyielding subgrade soils. The slurry fills are to be placed on level ground surfaces in 2- to 4-foot thick lifts with subsequent fill lifts stepped and/or benched into dense and unyielding soils. The lowest bench or key should be a minimum of 10 feet wide and at least 2 feet deep, into competent material as evaluated by the Geotechnical Consultant. Other benches into competent material should be excavated a minimum height of 2 feet into competent material or as otherwise recommended by the Geotechnical consultant. A subdrain should be placed near the bottom of the backcut.

The mix design for the CLSM should produce a consistency that will result in a flowable product at the time of placement which does not require manual means to move it into place. In addition, the CLSM should have a minimum compressive strength of 100 psi when tested in accordance with ASTM D4832. Water content in the CLSM should be maintained at a proportion to minimize subsidence and bleed water shrinkage. Any standing water and loose or soft soils should be removed prior to placement of the CLSM.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Control Surface Waters

During storm events, surface drainages along and crossing the alignment will likely experience surface flows. Measures to manage construction storm water will be necessary during rainy weather.

Changes in tides and flooding conditions will affect construction and the groundwater levels.

6.2 Geotechnical Review of Foundation Excavations

The recommendations provided in this report are based on preliminary design information and subsurface conditions disclosed by widely spaced excavations. The interpolated subsurface conditions should be checked in the field during construction.

We recommend that all excavations, including foundation excavations be observed by Leighton Consulting Inc. during construction to determine if any potentially adverse geologic conditions exist at the site. Construction observation and field density testing of all compacted fill should also be performed by a representative of this office to confirm conditions are as anticipated.

6.3 Earthwork

We anticipate that earthwork will consist of site preparation, cuts and fills related to the repairs and improvements. We recommend that earthwork on the project be performed in accordance with the following recommendations.

6.3.1 Site Preparation

Prior to grading, all areas to receive structural fill or engineered structures should be cleared of surface and subsurface obstructions, including any existing debris and loose fill soils, and stripped of vegetation. Removed vegetation and debris should be properly disposed off site. All areas to receive fill and/or other surface improvements should be scarified to a

minimum depth of 12 inches, brought to near-optimum moisture conditions, and recompacted to at least 90 percent relative compaction (based on ASTM Test Method D1557). In areas with soft and/or wet removal bottoms, a gravel/geogrid stabilization mat, at least 18 inches thick should be used prior to placement of compacted fill. The stabilization mat should consist of ¾ inch crushed gravel underlain with a Tensar, TX170, or equivalent geogrid.

6.3.2 Excavations

Excavations of the onsite materials may generally be accomplished with conventional heavy-duty earthwork equipment. Shoring and temporary excavation design should be performed in accordance with the American Railway Engineering and Maintenance-of-Way Association (AREMA), NCTD requirements, and OSHA requirements.

6.3.3 Fill Placement and Compaction

The granular onsite soils are generally suitable for use as compacted fill provided they are free of organic material, and debris. If clays are exposed during grading they should be removed and exported. Near-surface soils should be considered suitable for re-use as compacted fill provided they possess a very low expansion potential (EI<20). It should be noted, that near surface clayey soils do exist locally. All fill soils should be brought to near-optimum moisture conditions and compacted in uniform lifts to at least 90 percent relative compaction based on laboratory standard ASTM Test Method D1557. The optimum lift thickness required to produce a uniformly compacted fill will depend on the type and size of compaction equipment used. In general, fill should be placed in lifts not exceeding 8 inches in thickness. The onsite soils may require moisture conditioning prior to use as compacted fill.

Placement and compaction of fill should be performed in general accordance with the current local grading ordinances, AREMA Specifications, and sound construction practice. Import soils, if needed, should be evaluated by Leighton Consulting, Inc. prior to import operations. Import soils should be uncontaminated, granular in nature, free of organic material, have a very low expansion index (E.I.≤20) and

not be excessively corrosive. Material should possess a chloride content less than 300 ppm, resistivity greater than 3,000 ohm-cm, and a neutral pH.

6.4 Surface Drainage and Erosion

Surface drainage should be controlled at all times. Positive surface drainage should be provided to direct surface water away from the structures toward suitable drainage facilities. Positive drainage may be accomplished by providing a minimum 2 percent gradient from the structures. In general, ponding of water should be avoided adjacent to the track bed, structures and pavements. Protective measures to mitigate site erosion during and after construction should also be implemented in accordance with the applicable regulatory requirements.

6.4.1 Erosion Control

Measures to improve surficial stability are discussed in the Caltrans Guidance for Temporary Soil Stabilization (2003). The ability to establish vegetation has been found to decrease with increase in slope inclination. Similarly, increased slope ratio is shown in decrease stability of the slope face. Measures to reduce erodibility are discussed in the Key Concepts of Sustainable Erosion Control document (Caltrans, 2010) and the associated Caltrans website, (http://www.dot.ca.gov/hq/LandArch/ec/index.htm).

6.5 Geotechnical Observation and Testing

The installation of the foundations, removal bottoms, and the placement of fill should be observed and tested during construction. This includes the following activities:

- Observe the excavation of soil nails and pile foundations.
- Observation of removal bottoms for Slurry Fill also referred to as a controlled low-strength material (CLSM).
- Testing and special inspection for placement of soil nails, foundation concrete and the slurry fill also referred to as a controlled low-strength material (CLSM).

- Evaluate the suitability of onsite and import soils for fill placement and collect and submit soils samples for required or recommended laboratory testing, where necessary.
- Observe the fill and backfill for uniformity during placement.
- Test fill and backfill for field density and compaction to evaluate the percentage of compaction achieved during backfill placement.

The government agencies having jurisdiction over the project should be notified prior to commencement of grading so that the necessary grading permits can be obtained and arrangements can be made for required inspection(s). The contractor should be familiar with the inspection requirements of the reviewing agencies. All construction activities are to be reviewed by the Resident Engineer on a continual basis and the geotechnical engineer should be consulted as special needs or questions arise.

7.0 LIMITATIONS

The recommendations contained in this report are based on available project information. Changes made during design development and construction, should be reviewed by Leighton Consulting, Inc. to determine if recommendations are still applicable. Any questions regarding the contents of this report should be directed to the attention of William D. Olson, PE, (858) 300-8491 of Leighton Consulting, Inc.

Please also note that the evaluation in this report was limited to assessment of the geotechnical aspects of the project, and did not include evaluation of structural design, environmental concerns, or the presence of hazardous materials.

Figures

Project: 11860.002	Eng/Geo: WDO/RCS
Scale: 1 " = 2,000 '	Date: Sep 2018

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

SITE LOCATION MAP

Del Mar Bluffs
Del Mar, California

Figure 1

Leighton

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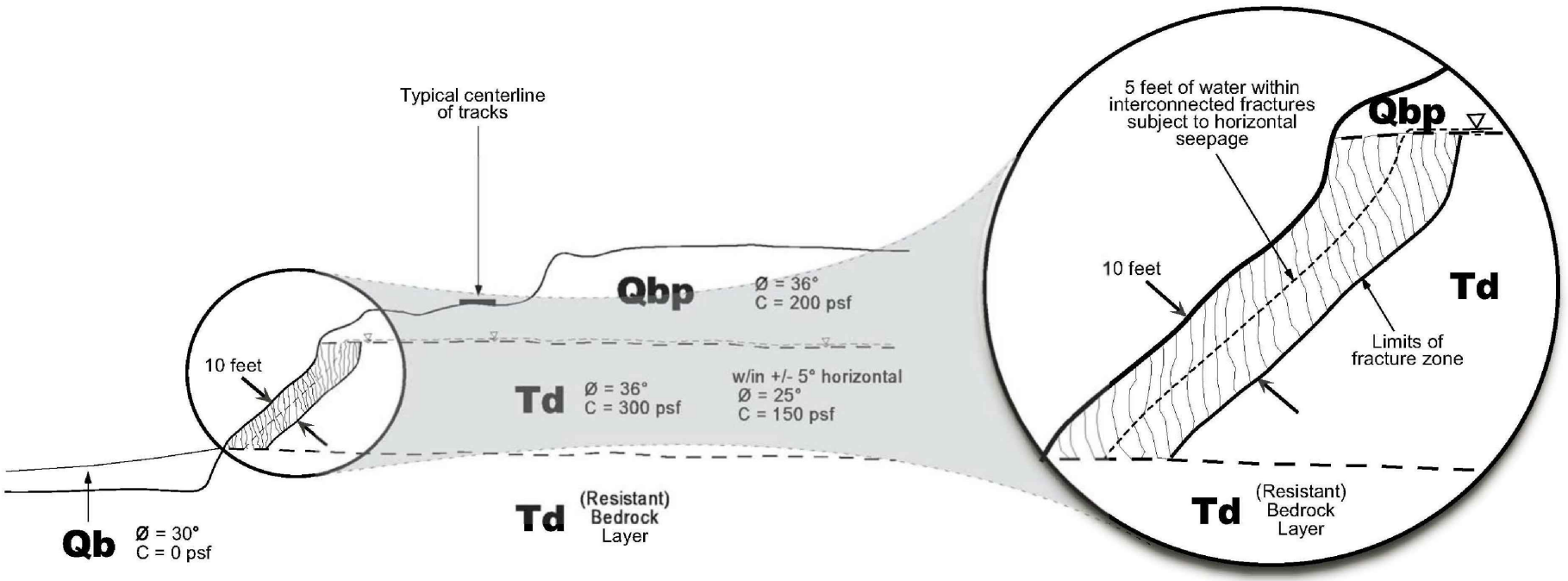

LEGEND

Qb Beach Deposit

Qbp Bay Point Formation

Td Delmar Formation

Perched groundwater profile

Project: 11860.002	Eng/Geol: WDO/RCS
Scale: Not to scale	Date: Sep 2018
Reference:	
Author: MAM	

SIMPLIFIED SLOPE STABILITY MODEL NORTH OF MP 245.21

Del Mar Bluffs

Del Mar, California

Figure 2

Leighton

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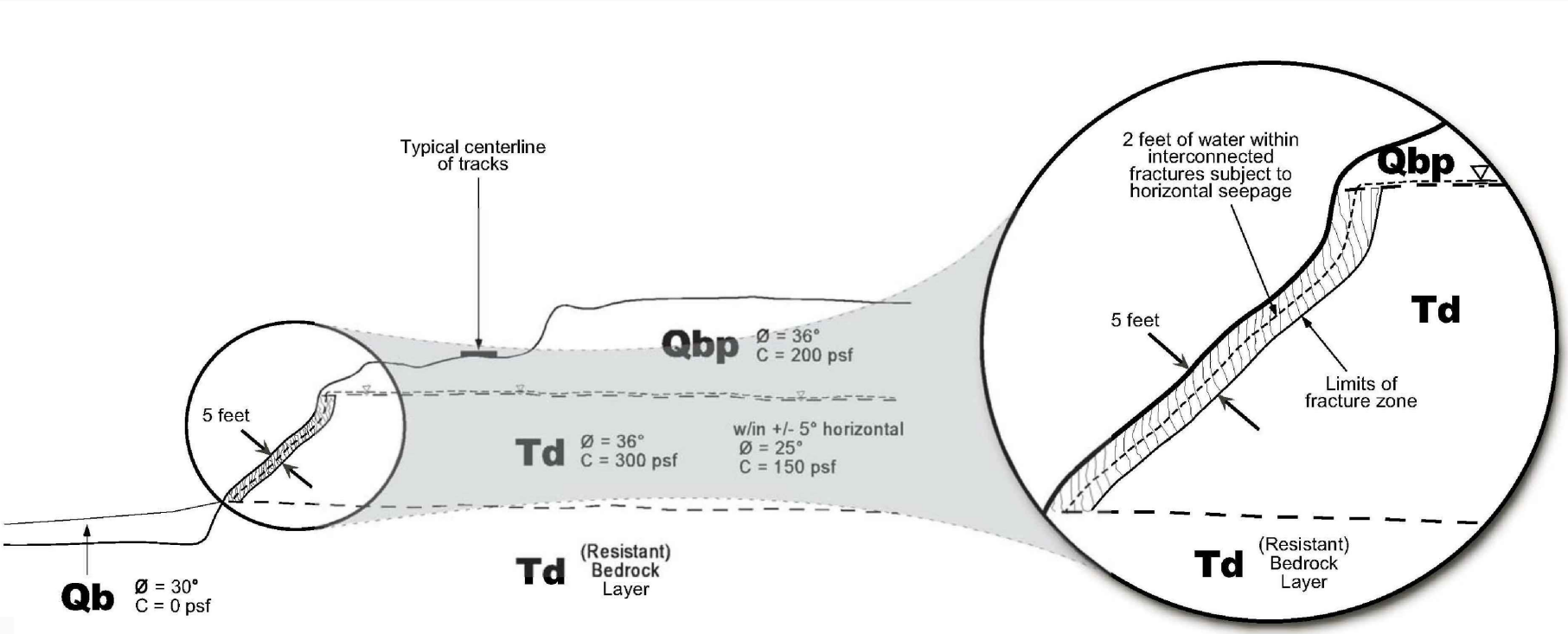


LEGEND

Qb Beach Deposit

Qbp Bay Point Formation

Td Delmar Formation

Perched groundwater profile

Project: 11860.002	Eng/Geol: WDO/RCS
Scale: Not to scale	Date: Sep 2018
Reference:	
Author: MAM	

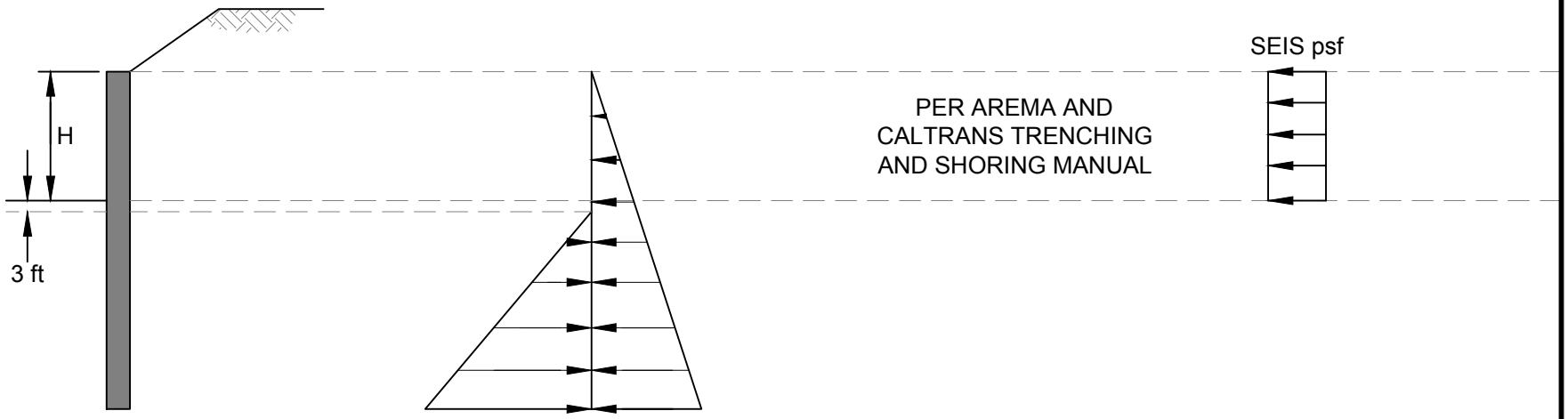
SIMPLIFIED SLOPE STABILITY MODEL SOUTH OF MP 245.21

Del Mar Bluffs

Del Mar, California

Figure 3

Leighton



WALL SKETCH
(not to scale)

PASSIVE PRESSURE

ACTIVE PRESSURE

TRAFFIC SURCHARGE

SEISMIC EARTH PRESSURE

Note:

1. Applicable to Cantilevered Shoring.

Project: 11860.002	Eng/Geol: WDO/RCS
Scale: Not to scale	Date: Sep 2018
Reference:	
Author: MAM	

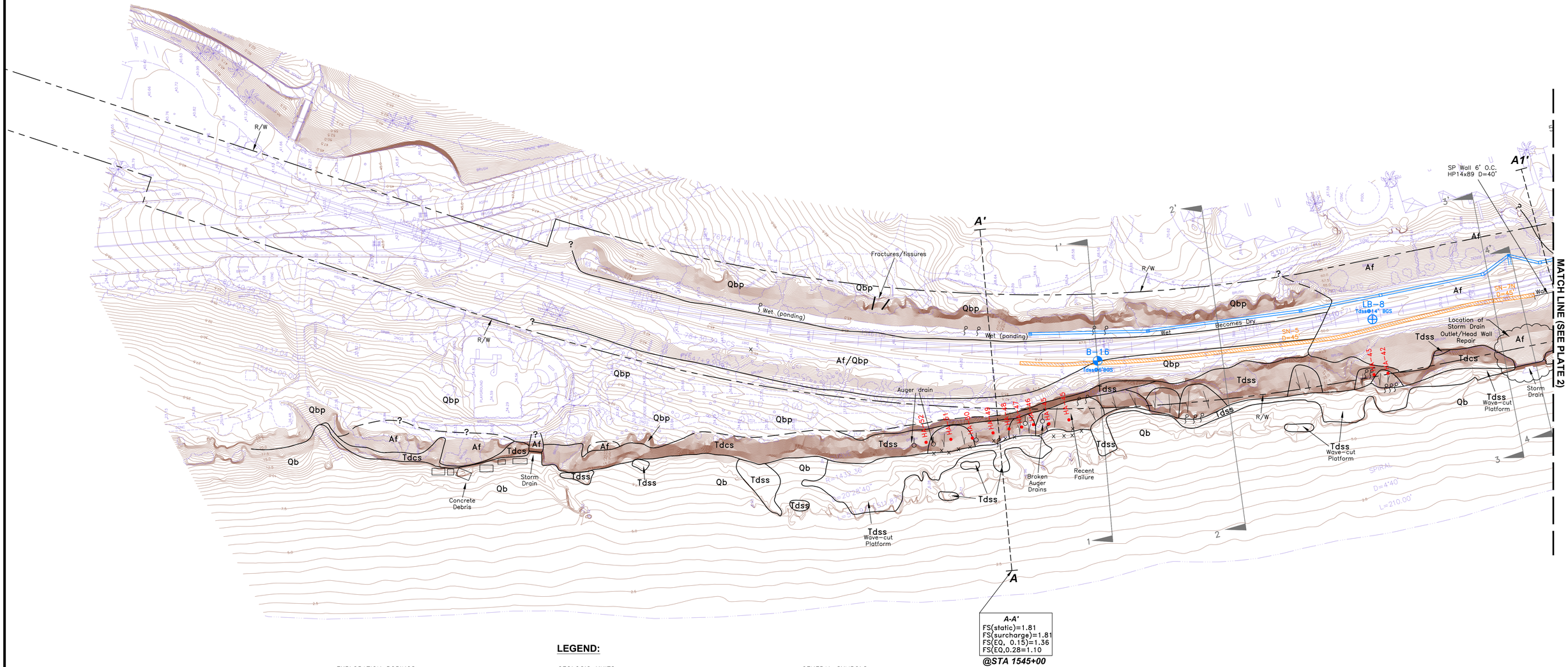
LATERAL EARTH PRESSURES

Del Mar Bluffs
Del Mar, California

Figure 4

Leighton

Plates



A-A'
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FS(surcharge)=1.81
FS(EQ, 0.15)=1.36
FS(EQ,0.28=1.10
@STA 1545+00

LEGEND:

EXPLORATION BORINGS:

- PB-4 — APPROXIMATE LOCATION OF PREVIOUS SMALL-DIAMETER EXPLORATORY BORING BY LEIGHTON & ASSOCIATES (1978)
- B-3 — APPROXIMATE LOCATION OF SMALL-DIAMETER BORINGS BY MAH (1998). BORINGS CONVERTED TO PIEZOMETERS INDICATED BY SUFFIX P (B-1p)
- LB-5 — APPROXIMATE LOCATION OF LARGE-DIAMETER EXPLORATORY BORINGS BY LEIGHTON & ASSOCIATES (2000, 2001)
- HSA-2 — APPROXIMATE LOCATION OF PREVIOUS SMALL-DIAMETER EXPLORATORY BORINGS BY LEIGHTON & ASSOCIATES (2002)

GEOLOGIC UNITS:

- Af — UNDIFFERENTIATED FILL
- Qb — BEACH DEPOSITS
- Qbp — BAY POINT FORMATION
- Tdss — DELMAR FORMATION (SANDSTONE FACIES)
- Tdcs — DELMAR FORMATION (CLAYSTONE FACIES)

STABILIZATION SYMBOLS:

- OLD STABILIZATION AREA
- SN-1 to SN-9 — COMPLETED STABILIZATION NUMBER, PROJECT 2 (SWE, 2008)
- APPROXIMATE LOCATION OF TRENCH DRAIN-PROJECT 1 BY DMJM (2003)
- HA-2 • — APPROXIMATE LOCATION OF HYDRO AUGER, PROJECT 1 BY LEIGHTON & ASSOCIATES (2003)

GENERAL SYMBOLS:

- AREA OF BOULDERS
- WATER SEEPAGE
- NEAR VERTICAL SCARP
- FRACTURE
- LANDSLIDE DEPOSIT
- M1 — M1' — GEOLOGIC CROSS-SECTION
- 21 — 21 — GEOLOGIC CROSS-SECTION BY LEIGHTON & ASSOCIATES (2003)
- NEW STABILIZATION AREA; SA-1 TO SA-9
- R/W RIGHT-OF-WAY

REFERENCE: DAVID EVANS & ASSOCIATES, MAY 2009

N

0 40 80
SCALE FEET

PLATE 1

Leighton

GEOTECHNICAL MAP

DEL MAR BLUFFS 4
DEL MAR, CALIFORNIA

Proj: 11860.002	Eng/Geol: WDO/RCS
Scale: 1"=40'	Date: Sep 2018

Drafted By: MAH | Checked By:

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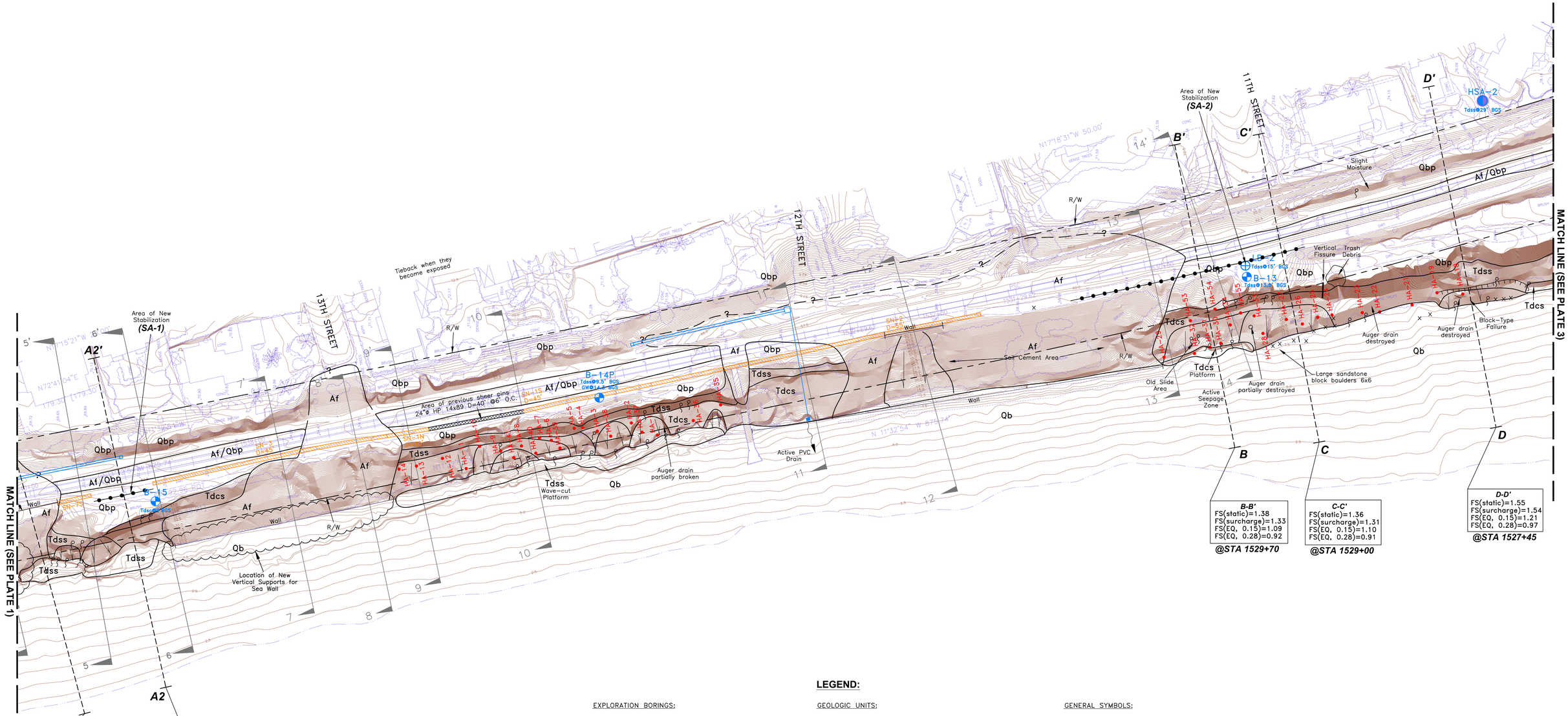

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- R/W RIGHT-OF-WAY

N

0 40 80
SCALE FEET

REFERENCE: DAVID EVANS & ASSOCIATES, MAY 2009

PLATE 2

Leighton

GEOTECHNICAL MAP

DEL MAR BLUFFS 4
DEL MAR, CALIFORNIA

Proj: 11860.002	Eng/Geol: WDO/RCS
Scale: 1"=40'	Date: Sep 2018

Drafted By: MAM | Checked By:

P:\DRAFTING\11860\002\CAD\11860-002_FIG-PGT_GM_2018-03-27.DWG 09-12-18 10:27:20AM Plotted by: mmurphy

LEGEND:

EXPLORATION BORINGS:

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- PB-4 — APPROXIMATE LOCATION OF PREVIOUS SMALL-DIAMETER EXPLORATORY BORING BY LEIGHTON & ASSOCIATES (1978)
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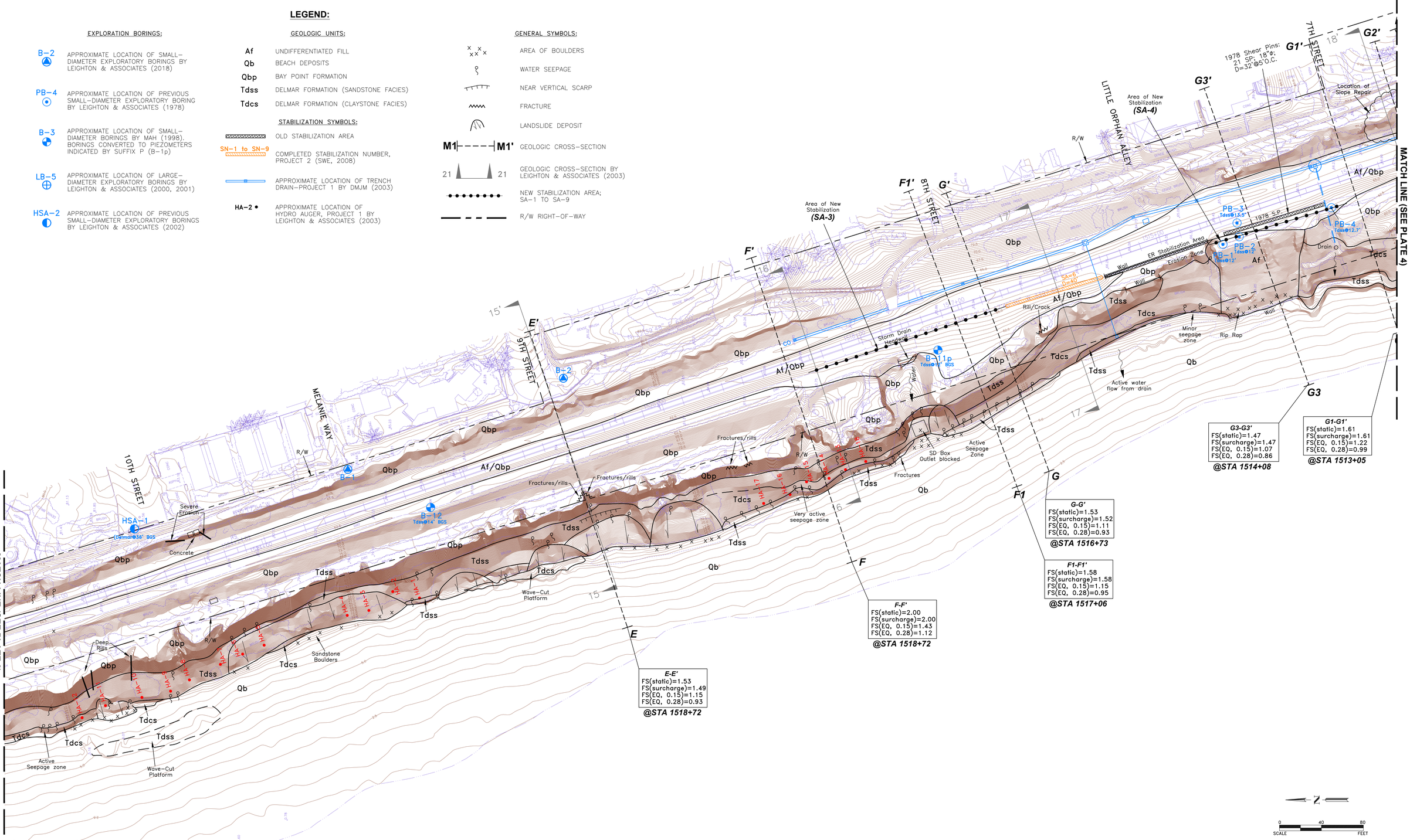
- LANDSLIDE DEPOSIT
- M1 — M1' — GEOLOGIC CROSS-SECTION
- 21 — 21 — GEOLOGIC CROSS-SECTION BY LEIGHTON & ASSOCIATES (2003)
- NEW STABILIZATION AREA; SA-1 TO SA-9
- R/W RIGHT-OF-WAY



REFERENCE: DAVID EVANS & ASSOCIATES, MAY 2009

N

0 40 80
SCALE FEET

PLATE 3

Leighton

GEOTECHNICAL MAP

DEL MAR BLUFFS 4
DEL MAR, CALIFORNIA

Proj: 11860.002	Eng/Geol: WDO/RCS
Scale: 1"=40'	Date: Sep 2018

Drafted By: MAM | Checked By:

P:\DRAFTING\11800\002\CAD\11860-002_P01-PGT_GM_2018-03-27.DWG (06-12-18 10:26:38AM) Plotted by: mmurphy

LEGEND:

EXPLORATION BORINGS:

- PB-4 — APPROXIMATE LOCATION OF PREVIOUS SMALL-DIAMETER EXPLORATORY BORING BY LEIGHTON & ASSOCIATES (1978)
- B-3 — APPROXIMATE LOCATION OF SMALL-DIAMETER BORINGS BY MAH (1998). BORINGS CONVERTED TO PIEZOMETERS INDICATED BY SUFFIX P (B-1p)
- LB-5 — APPROXIMATE LOCATION OF LARGE-DIAMETER EXPLORATORY BORINGS BY LEIGHTON & ASSOCIATES (2000, 2001)
- HSA-2 — APPROXIMATE LOCATION OF PREVIOUS SMALL-DIAMETER EXPLORATORY BORINGS BY LEIGHTON & ASSOCIATES (2002)

GEOLOGIC UNITS:

- Af — UNDIFFERENTIATED FILL
- Qb — BEACH DEPOSITS
- Qbp — BAY POINT FORMATION
- Tdss — DELMAR FORMATION (SANDSTONE FACIES)
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STABILIZATION SYMBOLS:

- OLD STABILIZATION AREA
- SN-1 to SN-9 — COMPLETED STABILIZATION NUMBER, PROJECT 2 (SWE, 2008)
- APPROXIMATE LOCATION OF TRENCH DRAIN-PROJECT 1 BY DMJM (2003)
- HA-2 • — APPROXIMATE LOCATION OF HYDRO AUGER, PROJECT 1 BY LEIGHTON & ASSOCIATES (2003)

GENERAL SYMBOLS:

- AREA OF BOULDERS
- WATER SEEPAGE
- NEAR VERTICAL SCARP
- FRACTURE
- LANDSLIDE DEPOSIT
- M1 — M1' GEOLOGIC CROSS-SECTION
- 21 — 21 GEOLOGIC CROSS-SECTION BY LEIGHTON & ASSOCIATES (2003)
- NEW STABILIZATION AREA; SA-1 TO SA-9
- R/W RIGHT-OF-WAY

MATCH LINE (SEE PLATE 3)

MATCH LINE (SEE PLATE 5)

6TH STREET

SHERRIE LANE

R/W

Area of New Stabilization (SA-5)

H' I' H I G1 G2

Qbp Af Af/Qbp Qsw/Qbp Af (Dumped) Af (Storm drain) Tdcs Tdss Qb Qsw

Zone of previous ponding (currently dry)

Location of Slope Repair

Swale dry

Area of erosion

Fracture at Bluff top

Fractures at Bluff Top

Erosion blockage of swale

Abandoned Storm drain pipe

Vertical fissure gullies

Old slope failures

Large sandstone boulders

Old slope failure

Active water flow from drain

(concrete swale)

Moist

LB-4 (Tdcs@14' BGS)

B-8 (Tdcs@6')

B-9p (Tdss@9' BGS)

B-3 (Tdss@10' BGS)

19'

18'

G1-G1'
FS(static)=1.61
FS(surcharge)=1.61
FS(EQ, 0.15)=1.22
FS(EQ, 0.28)=0.99
@STA 1513+05

G2-G2'
FS(static)=1.57
FS(surcharge)=1.57
FS(EQ, 0.15)=1.21
FS(EQ, 0.28)=0.98
@STA 1512+45

H-H'
FS(static)=1.52
FS(surcharge)=1.51
FS(EQ, 0.15)=1.15
FS(EQ, 0.28)=0.94
@STA 1512+15

I-I'
FS(static)=1.79
FS(surcharge)=1.76
FS(EQ, 0.15)=1.33
FS(EQ, 0.28)=1.07
@STA 1511+56

N

0 40 80
SCALE FEET

REFERENCE: DAVID EVANS & ASSOCIATES, MAY 2009

PLATE 4

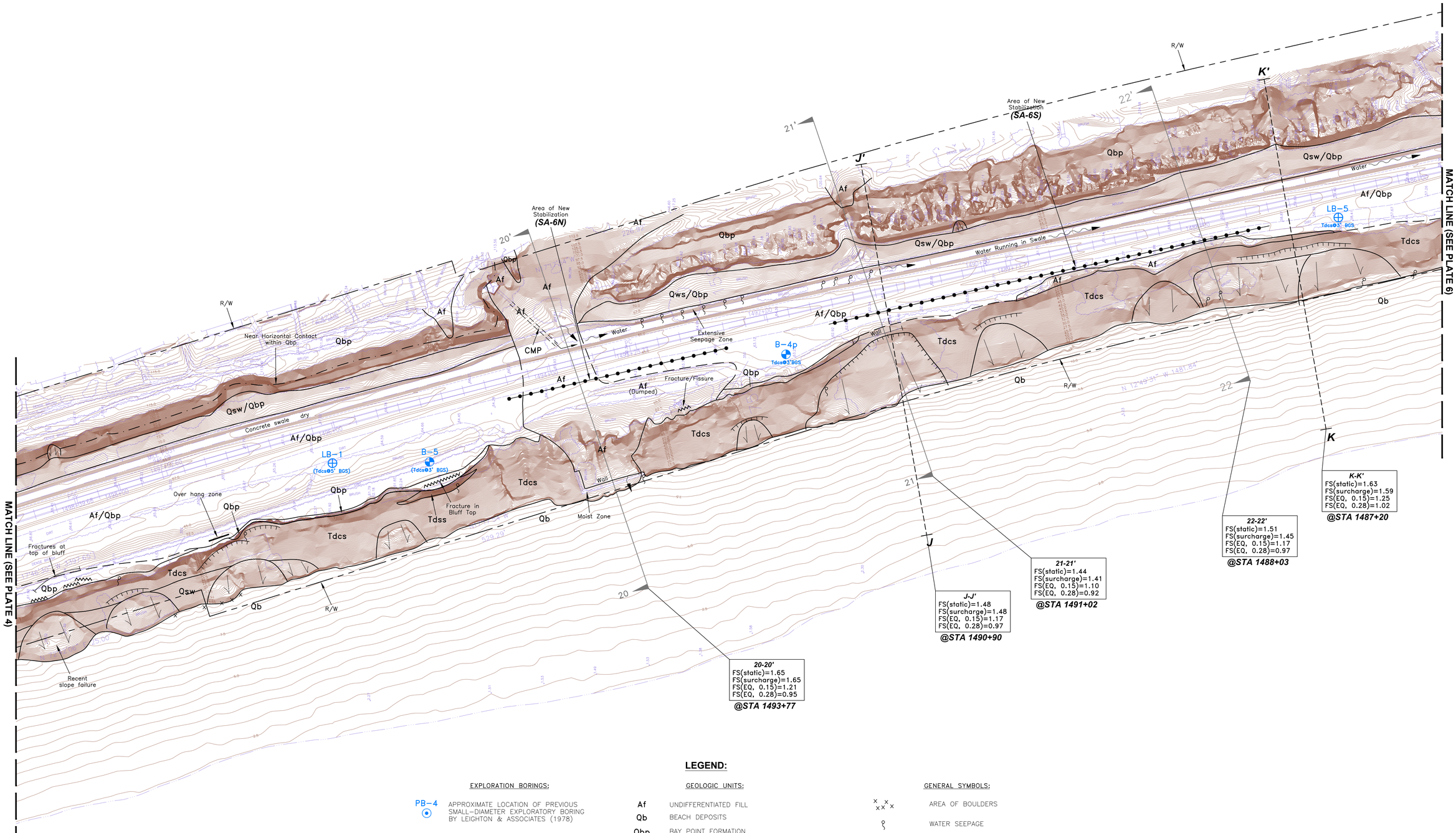
Leighton

GEOTECHNICAL MAP

DEL MAR BLUFFS 4
DEL MAR, CALIFORNIA

Proj: 11860.002	Eng/Geol: WDO/RCS
Scale: 1"=40'	Date: Sep 2018

Drafted By: MAM | Checked By: | P:\DRAFTING\11860\002\CAD\11860-002_PP1-PDF_GM_2018-03-27.DWG 08-12-18 12:23 EVAN1 Plotted by: mmurphy



LEGEND:

EXPLORATION BORINGS:

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GENERAL SYMBOLS:

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- WATER SEEPAGE
- NEAR VERTICAL SCARP
- FRACTURE
- LANDSLIDE DEPOSIT
- M1 — M1' GEOLOGIC CROSS-SECTION
- 21 — 21 GEOLOGIC CROSS-SECTION BY LEIGHTON & ASSOCIATES (2003)
- NEW STABILIZATION AREA; SA-1 TO SA-9
- R/W RIGHT-OF-WAY

REFERENCE: DAVID EVANS & ASSOCIATES, MAY 2009

SCALE 0 40 80 FEET

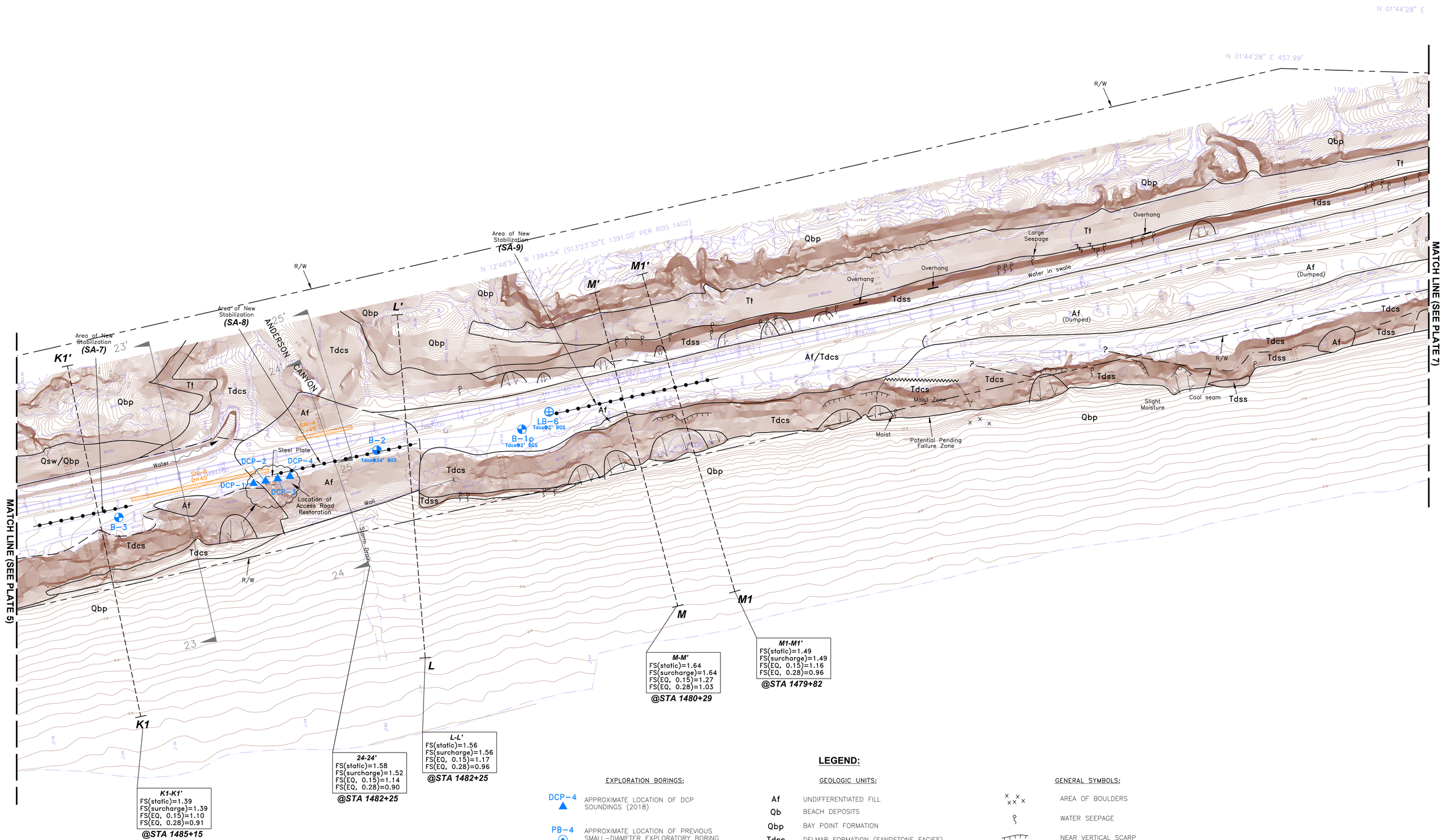
PLATE 5

GEOTECHNICAL MAP
DEL MAR BLUFFS 4
DEL MAR, CALIFORNIA

Leighton

Proj: 11860.002	Eng/Geol: WDO/RCS
Scale: 1"=40'	Date: Sep 2018

Drafted By: MAH | Checked By: | P:\DRAFTING\11860\002\CAD\11860-002_P01-PGT_GM_2018-03-27.DWG (08-12-18 10:24:56AM). Plotted by: mmurphy



REFERENCE: DAVID EVANS & ASSOCIATES, MAY 2009

LEGEND:

EXPLORATION BORINGS:

- DCP-4 — APPROXIMATE LOCATION OF DCP SOUNDINGS (2018)
- PB-4 — APPROXIMATE LOCATION OF PREVIOUS SMALL-DIAMETER EXPLORATORY BORING BY LEIGHTON & ASSOCIATES (1978)
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- R/W RIGHT-OF-WAY

N

SCALE 0 40 80 FEET

PLATE 6

Leighton

GEOTECHNICAL MAP

DEL MAR BLUFFS 4
DEL MAR, CALIFORNIA

Proj: 11860.002	Eng/Geol: WDO/RCS
Scale: 1"=40'	Date: Sep 2018

Drafted By: MAM | Checked By: | P:\DRAFTING\11860\002\CAD\11860-002_P01-PGT_GM_2018-03-27.DWG (06-12-18 10:23:35AM) Plotted by: mmurphy

3° CURVE
R=1909.82
D=3°57'36"
L=132.00'[132.0']

N 69°43'30" E (R)

E 764.76'

AREA NOT MAPPED

R/W
Water
Water
Qbp
Af
Tdss
Af/Tdcs
Af
Tdcs
Gravel
R/W
Af
Qb
Af
Tdcs
Af
Tdcs
Af
Af
Qb
Tdcs
Tdss
Tdss
Riprap
Qsw
Approximate weak coal seam
Qb

MATCH LINE (SEE PLATE 6)

LEGEND:

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- NEW STABILIZATION AREA; SA–1 TO SA–9
- R/W RIGHT–OF–WAY

N

0 40 80
SCALE FEET

REFERENCE: DAVID EVANS & ASSOCIATES, MAY 2009

PLATE 7

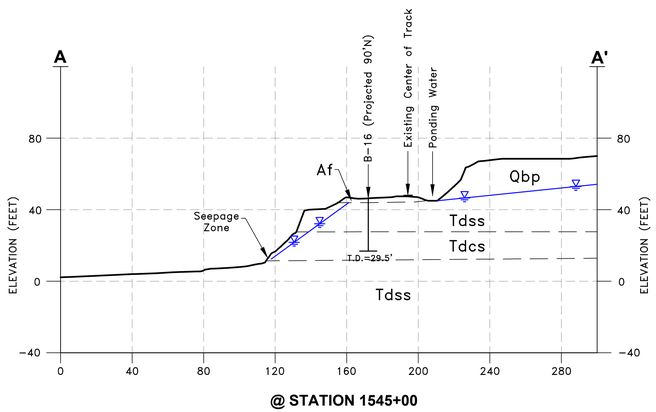
Leighton

GEOTECHNICAL MAP

DEL MAR BLUFFS 4
DEL MAR, CALIFORNIA

Proj: 11860.002	Eng/Geol: WDO/RCS
Scale: 1"=40'	Date: Sep 2018

Drafted By: MAM | Checked By: | P:\DRAFTING\11800\002\CAD\11860-002_P01-PGT_GM_2018-03-27.DWG 08-13-18 10:24:11AM© Plotted by: mmurphy



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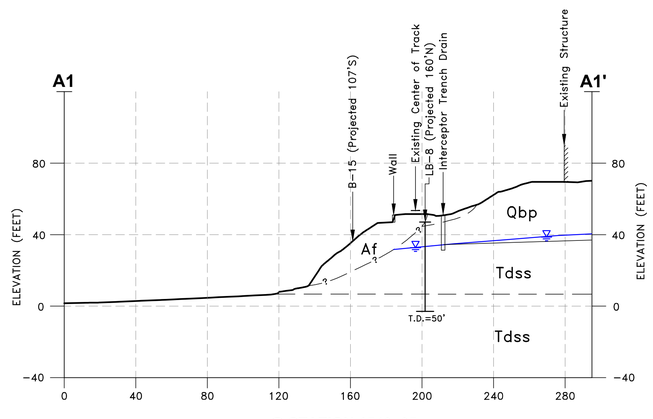

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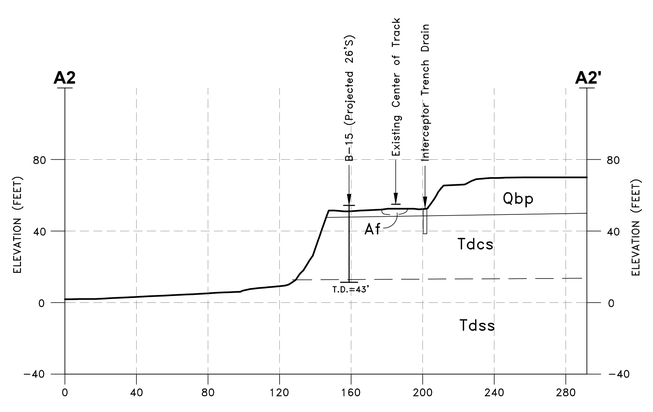

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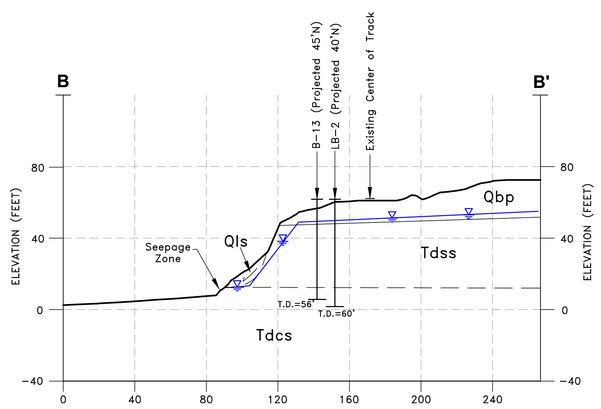

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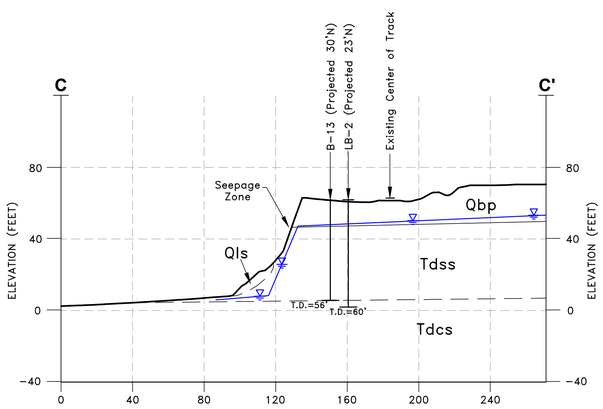

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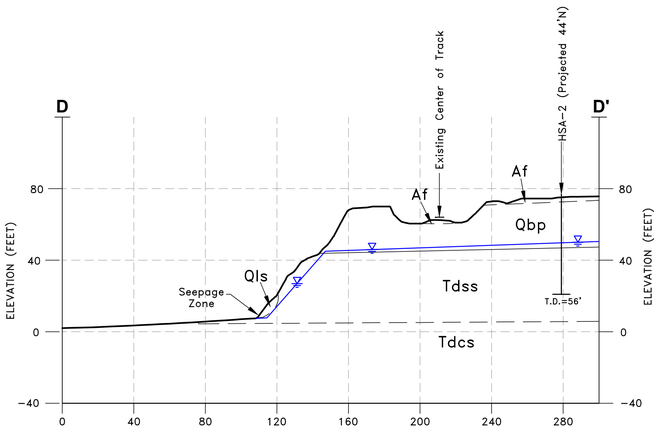

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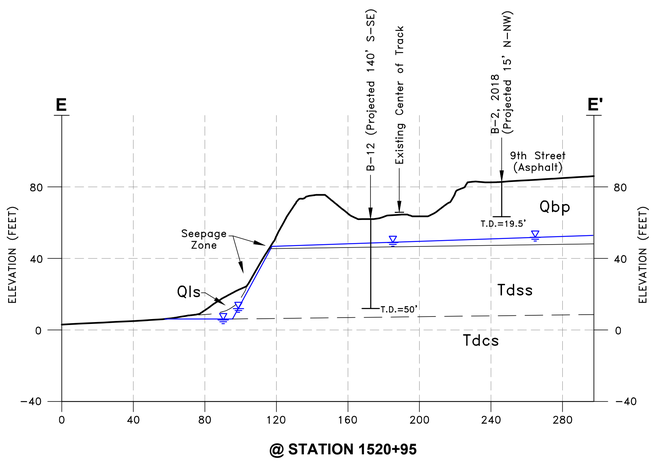

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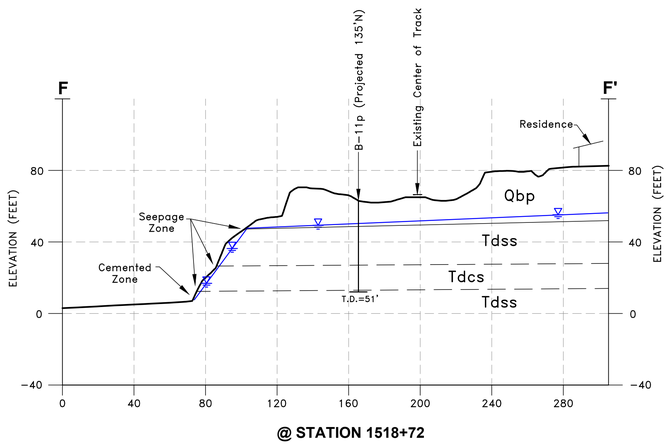

@ STATION 1518+72

LEGEND:

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- ASSUMED GROUND WATER ELEVATION

SCALE 0 40 80 FEET

PLATE 8

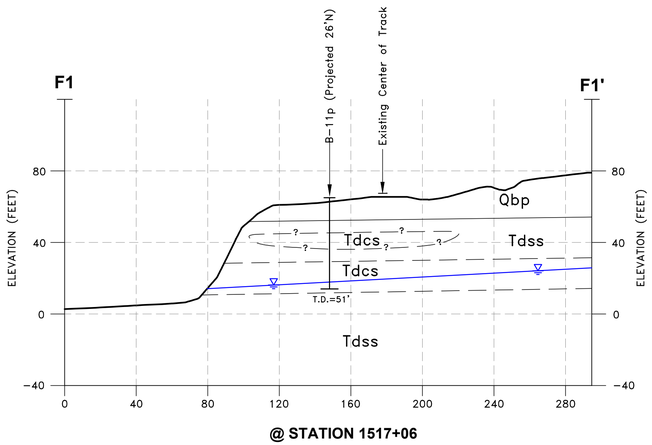
Leighton

GEOLOGICAL CROSS-SECTIONS

DEL MAR BLUFFS PROJECT 4
DEL MAR, CALIFORNIA

Proj: 11860.002	Eng/Geol: WDO/RCS
Scale: 1"=40'	Date: Sep 2018

Drafted By: MAM | Checked By: | P:\DRAFTING\11860\002\CAD\11860-002_P08-P10_CS_2018-01-08.DWG (08-12-18 10:08:14AM) Plotted by: mmurphy



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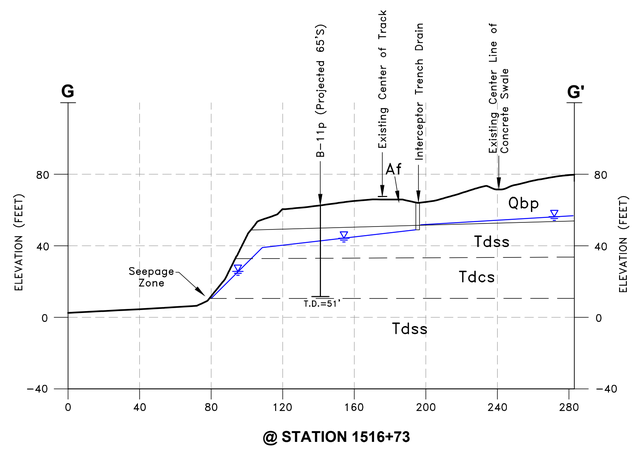

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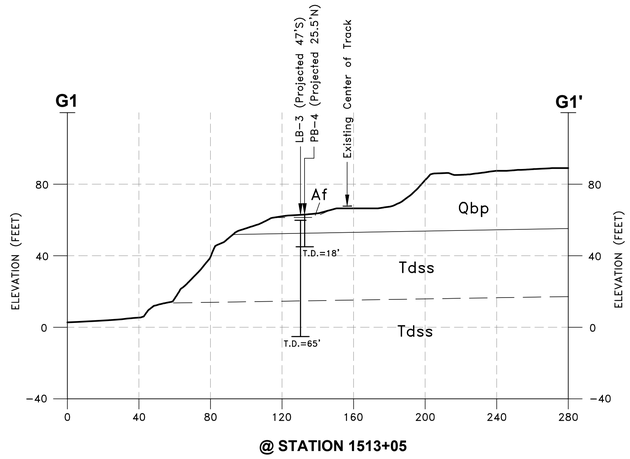

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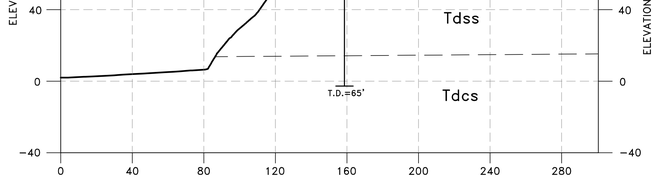

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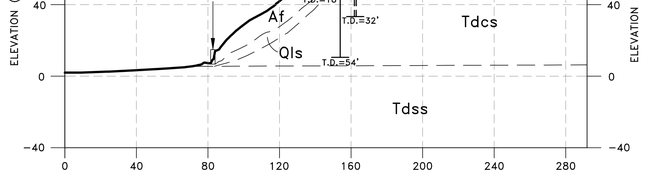

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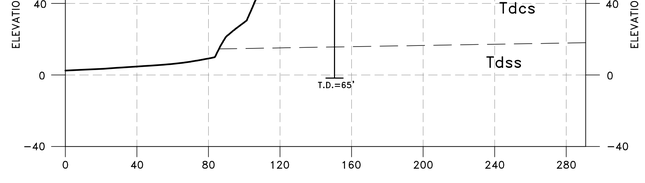

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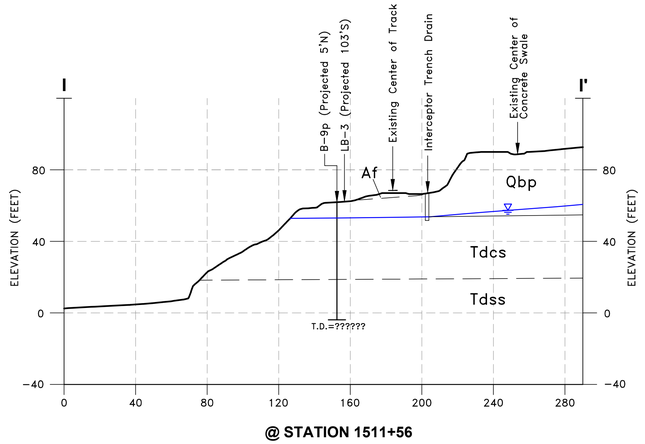

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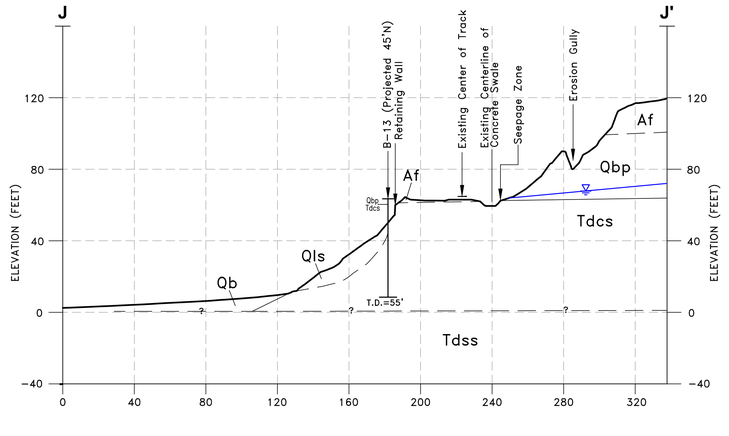

@ STATION 1490+90

LEGEND:

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SCALE 0 40 80 FEET

PLATE 9

Leighton

GEOLOGICAL CROSS-SECTIONS

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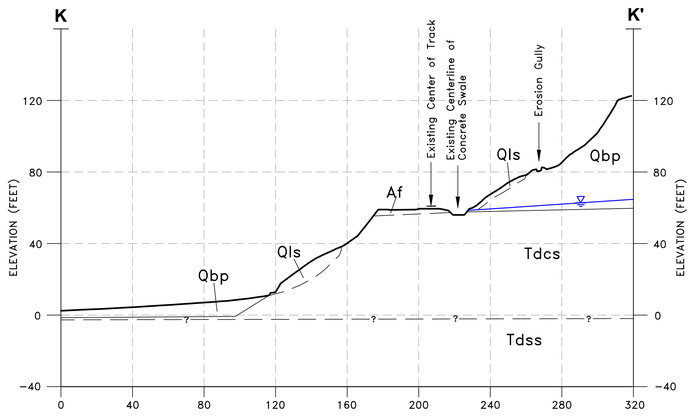
DEL MAR, CALIFORNIA

Proj: 11860.002	Eng/Geol: WDO/RCS
Scale: 1"=40'	Date: Sep 2018

Drafted By: MAM | Checked By: | P:\DRAFTING\11860\002\CAD\11860-002_PB6-P10_CS_2018-01-08.DWG 206-12-18 10:09:04AM5 Plotted by: mmurphy



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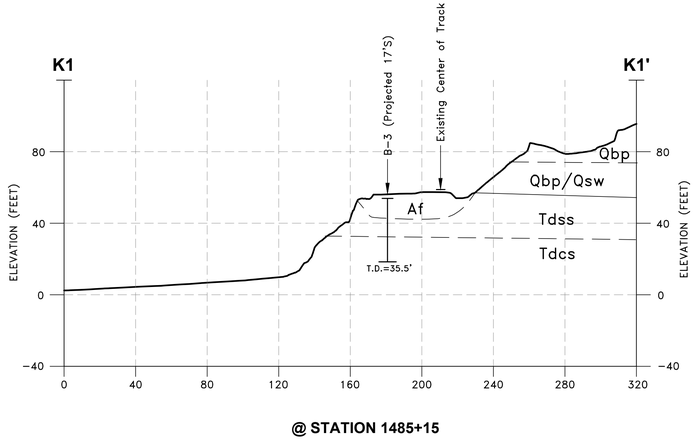

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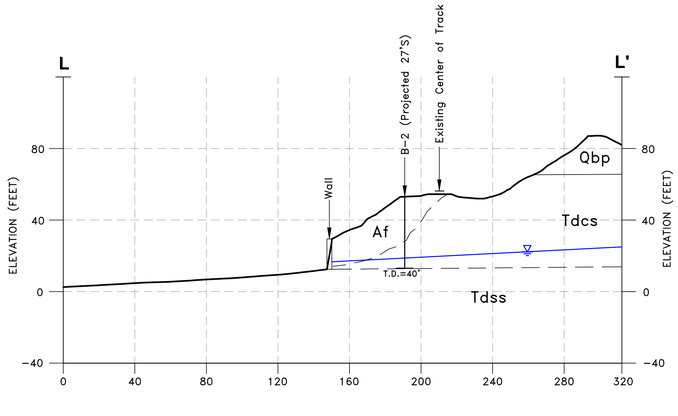

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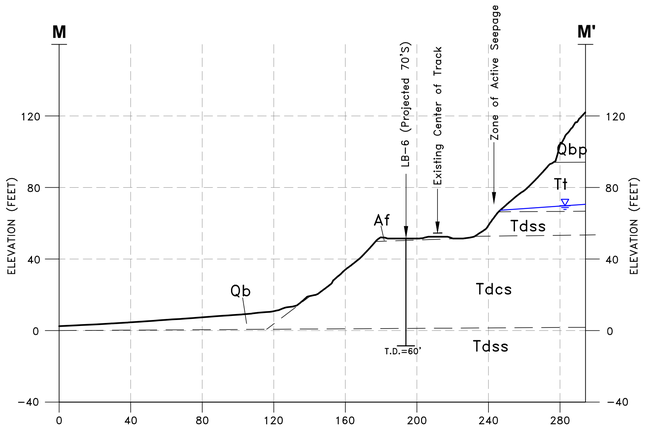

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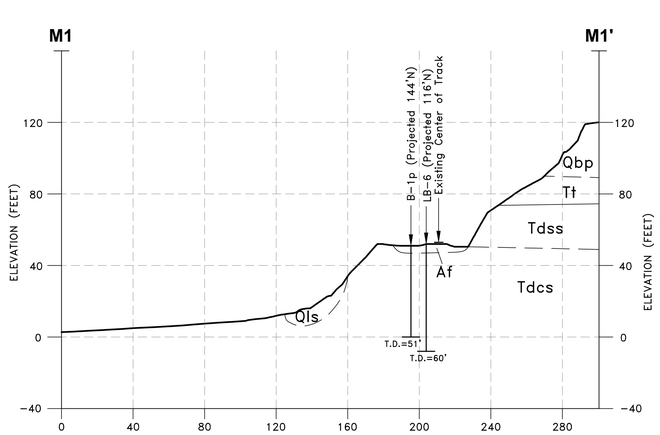

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LEGEND:

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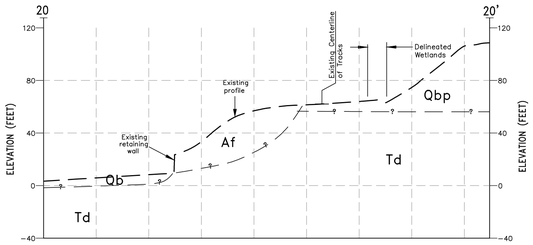
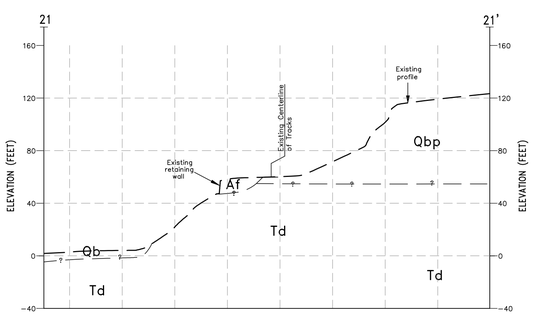
- B-3 — APPROXIMATE LOCATION OF SMALL-DIAMETER BORINGS BY MAH (1998). BORINGS CONVERTED TO PIEZOMETERS INDICATED BY SUFFIX P (B-1p)
- LB-5 — APPROXIMATE LOCATION OF LARGE-DIAMETER EXPLORATORY BORINGS BY LEIGHTON & ASSOCIATES (2000, 2001)
- HSA-2 — APPROXIMATE LOCATION OF PREVIOUS SMALL-DIAMETER EXPLORATORY BORINGS BY LEIGHTON & ASSOCIATES (2002)

GEOLOGIC UNITS:

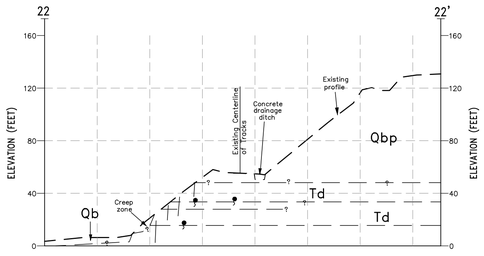
- Af — UNDIFFERENTIATED FILL
- Qb — BEACH DEPOSITS
- Qbp — BAY POINT FORMATION
- Tdss — DELMAR FORMATION (CLAYSTONE FACIES)
- Tdcs — DELMAR FORMATION (SANDSTONE FACIES)
- ▽ — ASSUMED GROUND WATER ELEVATION



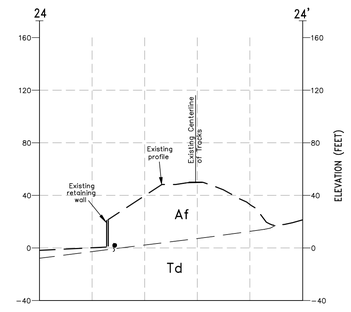
SECTION 20-20'



SECTION 21-21'
View north – M.P. 245.21 (STA. 1491+02)



SECTION 22-22' (PREVIOUSLY B-B')
View north – M.P. 245.26 (STA. 1488+03)



SECTION 24-24' (PREVIOUSLY A-A')
View north – M.P. 245.36 (STA. 1483+00)

REFERENCE: LEIGHTON, 2003

NOT TO SCALE

SCALE 0 40 80 FEET

PLATE 10

Leighton

GEOLOGICAL CROSS-SECTIONS

DEL MAR BLUFFS PROJECT 4
DEL MAR, CALIFORNIA

Proj: 11860.002	Eng/Geol: WDO/RCS
Scale: 1"=40'	Date: Sep 2018

Drafted By: MAH | Checked By: | P:\DRAFTING\11860\002\CAD\11860-002_P06--P10_CS_2018-01-08.DWG (08-12-18 10:13:59AM) Plotted by: mmurphy

Appendix A

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APPENDIX A

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Appendix B

Boring Logs, DCP Soundings and DMB 3
Drilled Pile Summary Table

GEOTECHNICAL BORING LOG KEY

Date _____ **Sheet** 1 **of** 1

Project KEY TO BORING LOG GRAPHICS **Project No.** _____

Drilling Co. _____ **Type of Rig** _____

Hole Diameter _____ **Drive Weight** _____ **Drop** "

Elevation Top of Elevation ' **Location** _____

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								Asphaltic concrete.	
									Portland cement concrete.	
								CL	Inorganic clay of low to medium plasticity; gravelly clay; sandy clay; silty clay; lean clay.	
								CH	Inorganic clay; high plasticity, fat clays.	
								OL	Organic clay; medium to plasticity, organic silts.	
	5							ML	Inorganic silt; clayey silt with low plasticity.	
								MH	Inorganic silt; diatomaceous fine sandy or silty soils; elastic silt.	
								ML-CL	Clayey silt to silty clay.	
								GW	Well-graded gravel; gravel-sand mixture, little or no fines.	
								GP	Poorly graded gravel; gravel-sand mixture, little or no fines.	
	10							GM	Silty gravel; gravel-sand-silt mixtures.	
								GC	Clayey gravel; gravel-sand-clay mixtures.	
								SW	Well-graded sand; gravelly sand, little or no fines.	
								SP	Poorly graded sand; gravelly sand, little or no fines.	
								SM	Silty sand; poorly graded sand-silt mixtures.	
	15							SC	Clayey sand; sand-clay mixtures.	
									Bedrock.	
									Ground water encountered at time of drilling.	
				B-1					Bulk Sample 1.	
	20			B-1					Bulk Sample 2.	
				C-1					Core Sample.	
				G-1					Grab Sample.	
				R-1					Modified California Sampler (3" O.D., 2.5 I.D.).	
				SH-1					Shelby Tube Sampler (3" O.D.).	
	25			S-1					Standard Penetration Test SPT (Sampler (2" O.D., 1.4" I.D.).	
				PUSH					Sampler Penetrates without Hammer Blow.	
									Bulk Sample 2.	
	30									

Logged By _____

Sampled By _____

SAMPLE TYPES:

- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE
- G GRAB SAMPLE
- SH SHELBY TUBE

TYPE OF TESTS:

- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- CR CORROSION
- SA SIEVE ANALYSIS
- AT ATTERBURG LIMITS
- EI EXPANSION INDEX
- RV R-VALUE

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GEOTECHNICAL BORING LOG B-1

Project No.	11860.002	**Date Drilled**	5-16-18
Project	Del Mar Bluffs Stabilization	**Logged By**	BRG
Drilling Co.	Pacific Drilling	**Hole Diameter**	6"
Drilling Method	Limited Access Solid Stem Auger - 30" Drop	**Ground Elevation**	81' msl
Location	West Termination of Melanie Way	**Sampled By**	BRG

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
									This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
80	0								@ 0-1': Topsoil	
									QUATERNARY BAY POINT FORMATION (Qbp)	
				B-1 2'-15'						
75	5			R-1	11 16 20	107	5	SM	@ 5': Silty SAND, reddish brown, medium dense, slightly moist to moist, medium-grained SAND, poorly-graded	
70	10			R-2	15 26 35	110	6		@ 10': Becomes dense	DS, -200
65	15			R-3	8 22 32	116	9		@ 16': Mottled red-brown, gray and rust, moist	
				R-4	16 39 50/5"	130	8		@ 18': Becomes very dense	
60	20								**Total Depth = 19.5 Feet** **No groundwater encountered at time of drilling** **Backfilled with Bentonite to within 1 foot from surface, then cuttings**	
55	25									
	30									

SAMPLE TYPES:

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

TYPE OF TESTS:

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

GEOTECHNICAL BORING LOG B-2

Project No.	11860.002	**Date Drilled**	5-16-18
Project	Del Mar Bluffs Stabilization	**Logged By**	BRG
Drilling Co.	Pacific Drilling	**Hole Diameter**	6"
Drilling Method	Limited Access Solid Stem Auger - 30" Drop	**Ground Elevation**	80' msl
Location	West End of 9th Street, South Side of Street	**Sampled By**	BRG

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
80	0								*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
									@ 0-1': Topsoil	
				B-1 1'-6'					QUATERNARY BAY POINT FORMATION (Qbp)	CR
75	5			R-1	6 9 12	114	6	SM	@ 5': Silty SAND, light olive-gray, reddish brown, medium dense, slighty moist	
70	10			R-2 B-2 10'-16'	20 23 30	129	10		@ 10': Becomes moist, dense	
65	15			R-3	20 26 35	125	10		@ 15': Becomes very moist	
				R-4	18 37 47	126	11		@ 18': Becomes very dense	DS, -200
									@ 19': Silty SAND, light olive-gray, very dense, very moist	
60	20								**Total Depth = 19.5 Feet** **No groundwater encountered at time of drilling** **Backfilled with Bentonite to within 1 foot from surface, then cuttings**	
55	25									
50	30									

SAMPLE TYPES:

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

TYPE OF TESTS:

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

WILDCAT DYNAMIC CONE LOG

Leighton Consulting, Inc.
3934 Murphy Canyon Rd
San Diego, CA, 92123

PROJECT NUMBER: 11860.002
DATE STARTED: 02-21-2018
DATE COMPLETED: 02-21-2018

HOLE #: DCP-1-001
CREW: RNB/ERB
PROJECT: DMB Stabilization Project 4
ADDRESS: NCTD MP 245.4
LOCATION: Del Mar, California

SURFACE ELEVATION: 66' msl
WATER ON COMPLETION: None
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	TESTED CONSISTENCY COHESIVE
-	12	53.3	••••••••••••••••	15	MEDIUM DENSE	STIFF
-	10	44.4	••••••••••••••	12	MEDIUM DENSE	STIFF
- 1 ft	9	40.0	••••••••••••	11	MEDIUM DENSE	STIFF
-	9	40.0	••••••••••••	11	MEDIUM DENSE	STIFF
-	25	111.0	••••••••••••••••••••••••••••••••	25+	DENSE	HARD
- 2 ft	38	168.7	••	25+	DENSE	HARD
-	44	195.4	••	25+	VERY DENSE	HARD
-	50	222.0	••	25+	VERY DENSE	HARD
- 3 ft	100	444.0	••	25+	VERY DENSE	HARD
- 1 m						
-						
- 4 ft						
-						
-						
- 5 ft						
-						
-						
- 6 ft						
-						
- 2 m						
- 7 ft						
-						
-						
- 8 ft						
-						
-						
- 9 ft						
-						
-						
- 3 m 10 ft						
-						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

WILDCAT DYNAMIC CONE LOG

Leighton Consulting, Inc.
3934 Murphy Canyon Rd
San Diego, CA, 92123

PROJECT NUMBER: 11860.002
DATE STARTED: 02-21-2018
DATE COMPLETED: 02-21-2018

HOLE #: DCP-2-001
CREW: RNB/ERB
PROJECT: DMB Stabilization Project 4
ADDRESS: NCTD MP 245.4
LOCATION: Del Mar, California

SURFACE ELEVATION: 66' msl
WATER ON COMPLETION: None
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	TESTED CONSISTENCY COHESIVE
-	10	44.4	•••••••••••••	12	MEDIUM DENSE	STIFF
-	2	8.9	••	2	VERY LOOSE	SOFT
- 1 ft	5	22.2	••••••	6	LOOSE	MEDIUM STIFF
-	7	31.1	•••••••••	8	LOOSE	MEDIUM STIFF
-	7	31.1	•••••••••	8	LOOSE	MEDIUM STIFF
- 2 ft	7	31.1	•••••••••	8	LOOSE	MEDIUM STIFF
-	10	44.4	•••••••••••••	12	MEDIUM DENSE	STIFF
-	12	53.3	••••••••••••••••	15	MEDIUM DENSE	STIFF
- 3 ft	24	106.6	••••••••••••••••••••••••••••••••	25+	MEDIUM DENSE	VERY STIFF
- 1 m	30	133.2	••	25+	DENSE	HARD
-	29	111.9	••••••••••••••••••••••••••••••••••	25+	DENSE	HARD
- 4 ft	37	142.8	•••	25+	DENSE	HARD
-	22	84.9	••••••••••••••••••••••••••	24	MEDIUM DENSE	VERY STIFF
-	18	69.5	•••••••••••••••••••••	19	MEDIUM DENSE	VERY STIFF
- 5 ft	16	61.8	••••••••••••••••••	17	MEDIUM DENSE	VERY STIFF
-	14	54.0	••••••••••••••••	15	MEDIUM DENSE	STIFF
-	13	50.2	•••••••••••••••	14	MEDIUM DENSE	STIFF
- 6 ft	13	50.2	•••••••••••••••	14	MEDIUM DENSE	STIFF
-	15	57.9	•••••••••••••••••	16	MEDIUM DENSE	VERY STIFF
- 2 m	16	61.8	••••••••••••••••••	17	MEDIUM DENSE	VERY STIFF
- 7 ft	18	61.6	••••••••••••••••••	17	MEDIUM DENSE	VERY STIFF
-	15	51.3	•••••••••••••••	14	MEDIUM DENSE	STIFF
-	16	54.7	••••••••••••••••	15	MEDIUM DENSE	STIFF
- 8 ft	13	44.5	•••••••••••••	12	MEDIUM DENSE	STIFF
-	13	44.5	•••••••••••••	12	MEDIUM DENSE	STIFF
-	15	51.3	•••••••••••••••	14	MEDIUM DENSE	STIFF
- 9 ft	13	44.5	•••••••••••••	12	MEDIUM DENSE	STIFF
-	10	34.2	••••••••••	9	LOOSE	STIFF
-	17	58.1	•••••••••••••••••	16	MEDIUM DENSE	VERY STIFF
- 3 m 10 ft	17	58.1	•••••••••••••••••	16	MEDIUM DENSE	VERY STIFF
-	15	45.9	••••••••••••••	13	MEDIUM DENSE	STIFF
-	10	30.6	•••••••••	8	LOOSE	MEDIUM STIFF
-	9	27.5	••••••••	7	LOOSE	MEDIUM STIFF
- 11 ft	9	27.5	••••••••	7	LOOSE	MEDIUM STIFF
-	11	33.7	••••••••••	9	LOOSE	STIFF
-	22	67.3	••••••••••••••••••••	19	MEDIUM DENSE	VERY STIFF
- 12 ft	36	110.2	•••••••••••••••••••••••••••••••••	25+	DENSE	HARD
-	45	137.7	••	25+	DENSE	HARD
-	56	171.4	•••	25+	DENSE	HARD
- 4 m 13 ft	62	189.7	•••	25+	VERY DENSE	HARD

PROJECT: DMB Stabilization Project 4 PROJECT NUMBER: 11860.002

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	TESTED CONSISTENCY COHESIVE
	66	182.8		25+	VERY DENSE	HARD
	75	207.8		25+	VERY DENSE	HARD
14 ft	100	277.0		25+	VERY DENSE	HARD
15 ft						
16 ft						
5 m						
17 ft						
18 ft						
19 ft						
6 m						
20 ft						
21 ft						
22 ft						
7 m 23 ft						
24 ft						
25 ft						
26 ft						
8 m						
27 ft						
28 ft						
29 ft						
9 m						

WILDCAT DYNAMIC CONE LOG

Leighton Consulting, Inc.
3934 Murphy Canyon Rd
San Diego, CA, 92123

PROJECT NUMBER: 11860.002
DATE STARTED: 02-21-2018
DATE COMPLETED: 02-21-2018

HOLE #: DCP-3-001
CREW: RNB/ERB
PROJECT: DMB Stabilization Project 4
ADDRESS: NCTD MP 245.4
LOCATION: Del Mar, California

SURFACE ELEVATION: 66' msl
WATER ON COMPLETION: None
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	COHESIVE
-	5	22.2	••••••	6	LOOSE	MEDIUM STIFF
-	4	17.8	•••••	5	LOOSE	MEDIUM STIFF
- 1 ft	7	31.1	•••••••••	8	LOOSE	MEDIUM STIFF
-	10	44.4	••••••••••••	12	MEDIUM DENSE	STIFF
-	15	66.6	••••••••••••••••••	19	MEDIUM DENSE	VERY STIFF
- 2 ft	11	48.8	••••••••••••	13	MEDIUM DENSE	STIFF
-	13	57.7	•••••••••••••••	16	MEDIUM DENSE	VERY STIFF
-	16	71.0	••••••••••••••••••••	20	MEDIUM DENSE	VERY STIFF
- 3 ft	21	93.2	••••••••••••••••••••••••••••	25+	MEDIUM DENSE	VERY STIFF
- 1 m	16	71.0	••••••••••••••••••••	20	MEDIUM DENSE	VERY STIFF
-	17	65.6	•••••••••••••••••••	18	MEDIUM DENSE	VERY STIFF
- 4 ft	20	77.2	••••••••••••••••••••••	22	MEDIUM DENSE	VERY STIFF
-	20	77.2	••••••••••••••••••••••	22	MEDIUM DENSE	VERY STIFF
-	24	92.6	••••••••••••••••••••••••••	25+	MEDIUM DENSE	VERY STIFF
- 5 ft	23	88.8	•••••••••••••••••••••••••	25	MEDIUM DENSE	VERY STIFF
-	21	81.1	••••••••••••••••••••••	23	MEDIUM DENSE	VERY STIFF
-	21	81.1	••••••••••••••••••••••	23	MEDIUM DENSE	VERY STIFF
- 6 ft	27	104.2	••••••••••••••••••••••••••••	25+	MEDIUM DENSE	VERY STIFF
-	29	111.9	••••••••••••••••••••••••••••	25+	DENSE	HARD
- 2 m	35	135.1	••	25+	DENSE	HARD
- 7 ft	34	116.3	••••••••••••••••••••••••••••••••	25+	DENSE	HARD
-	37	126.5	••••••••••••••••••••••••••••••••••	25+	DENSE	HARD
-	31	106.0	••••••••••••••••••••••••••••	25+	MEDIUM DENSE	VERY STIFF
- 8 ft	28	95.8	••••••••••••••••••••••••••	25+	MEDIUM DENSE	VERY STIFF
-	28	95.8	••••••••••••••••••••••••••	25+	MEDIUM DENSE	VERY STIFF
-	23	78.7	•••••••••••••••••••••••	22	MEDIUM DENSE	VERY STIFF
- 9 ft	20	68.4	••••••••••••••••••••	19	MEDIUM DENSE	VERY STIFF
-	18	61.6	••••••••••••••••••	17	MEDIUM DENSE	VERY STIFF
-	18	61.6	••••••••••••••••••	17	MEDIUM DENSE	VERY STIFF
- 3 m 10 ft	18	61.6	••••••••••••••••••	17	MEDIUM DENSE	VERY STIFF
-	13	39.8	••••••••••••	11	MEDIUM DENSE	STIFF
-	12	36.7	••••••••••••	10	LOOSE	STIFF
-	10	30.6	•••••••••	8	LOOSE	MEDIUM STIFF
- 11 ft	12	36.7	••••••••••••	10	LOOSE	STIFF
-	11	33.7	••••••••••	9	LOOSE	STIFF
-	10	30.6	•••••••••	8	LOOSE	MEDIUM STIFF
- 12 ft	11	33.7	••••••••••	9	LOOSE	STIFF
-	11	33.7	••••••••••	9	LOOSE	STIFF
-	13	39.8	••••••••••••	11	MEDIUM DENSE	STIFF
- 4 m 13 ft	12	36.7	••••••••••••	10	LOOSE	STIFF

PROJECT: DMB Stabilization Project 4 PROJECT NUMBER: 11860.002

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	COHESIVE
	15	41.6	••••••••••••	11	MEDIUM DENSE	STIFF
	14	38.8	••••••••••••	11	MEDIUM DENSE	STIFF
14 ft	14	38.8	••••••••••••	11	MEDIUM DENSE	STIFF
	16	44.3	••••••••••••••	12	MEDIUM DENSE	STIFF
	13	36.0	••••••••••••	10	LOOSE	STIFF
15 ft	11	30.5	•••••••••	8	LOOSE	MEDIUM STIFF
	11	30.5	•••••••••	8	LOOSE	MEDIUM STIFF
	12	33.2	•••••••••••	9	LOOSE	STIFF
16 ft	14	38.8	••••••••••••	11	MEDIUM DENSE	STIFF
5 m	14	38.8	••••••••••••	11	MEDIUM DENSE	STIFF
	14	35.6	•••••••••••	10	LOOSE	STIFF
17 ft	14	35.6	•••••••••••	10	LOOSE	STIFF
	13	33.0	•••••••••••	9	LOOSE	STIFF
	16	40.6	••••••••••••	11	MEDIUM DENSE	STIFF
18 ft	22	55.9	••••••••••••••••	15	MEDIUM DENSE	STIFF
	18	45.7	••••••••••••••	13	MEDIUM DENSE	STIFF
	50	127.0	••••••••••••••••••••••••••••••••••••	25+	DENSE	HARD
19 ft	61	154.9	••	25+	DENSE	HARD
	72	182.9	••	25+	VERY DENSE	HARD
6 m	80	203.2	••	25+	VERY DENSE	HARD
20 ft	100	233.0	••	25+	VERY DENSE	HARD
21 ft						
22 ft						
7 m 23 ft						
24 ft						
25 ft						
26 ft						
8 m						
27 ft						
28 ft						
29 ft						
9 m						

WILDCAT DYNAMIC CONE LOG

Leighton Consulting, Inc.
3934 Murphy Canyon Rd
San Diego, CA, 92123

PROJECT NUMBER: 11860.002
DATE STARTED: 02-21-2018
DATE COMPLETED: 02-21-2018

HOLE #: DCP-4-001
CREW: RNB/ERB
PROJECT: DMB Stabilization Project 4
ADDRESS: NCTD MP 245.4
LOCATION: Del Mar, California

SURFACE ELEVATION: 66' msl
WATER ON COMPLETION: None
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	COHESIVE
-	7	31.1	•••••••••	8	LOOSE	MEDIUM STIFF
-	6	26.6	••••••••	7	LOOSE	MEDIUM STIFF
- 1 ft	9	40.0	••••••••••••	11	MEDIUM DENSE	STIFF
-	5	22.2	••••••	6	LOOSE	MEDIUM STIFF
-	10	44.4	••••••••••••••	12	MEDIUM DENSE	STIFF
- 2 ft	7	31.1	•••••••••	8	LOOSE	MEDIUM STIFF
-	9	40.0	••••••••••••	11	MEDIUM DENSE	STIFF
-	13	57.7	•••••••••••••••••	16	MEDIUM DENSE	VERY STIFF
- 3 ft	13	57.7	•••••••••••••••••	16	MEDIUM DENSE	VERY STIFF
- 1 m	20	88.8	••••••••••••••••••••••••••	25	MEDIUM DENSE	VERY STIFF
-	40	154.4	••	25+	DENSE	HARD
- 4 ft	33	127.4	••••••••••••••••••••••••••••••••••••	25+	DENSE	HARD
-	18	69.5	••••••••••••••••••••	19	MEDIUM DENSE	VERY STIFF
-	17	65.6	•••••••••••••••••••	18	MEDIUM DENSE	VERY STIFF
- 5 ft	18	69.5	••••••••••••••••••••	19	MEDIUM DENSE	VERY STIFF
-	27	104.2	•••••••••••••••••••••••••••••	25+	MEDIUM DENSE	VERY STIFF
-	22	84.9	••••••••••••••••••••••••	24	MEDIUM DENSE	VERY STIFF
- 6 ft	21	81.1	•••••••••••••••••••••••	23	MEDIUM DENSE	VERY STIFF
-	23	88.8	••••••••••••••••••••••••	25	MEDIUM DENSE	VERY STIFF
- 2 m	23	88.8	••••••••••••••••••••••••	25	MEDIUM DENSE	VERY STIFF
- 7 ft	21	71.8	•••••••••••••••••••••	20	MEDIUM DENSE	VERY STIFF
-	20	68.4	•••••••••••••••••••	19	MEDIUM DENSE	VERY STIFF
-	19	65.0	•••••••••••••••••••	18	MEDIUM DENSE	VERY STIFF
- 8 ft	18	61.6	•••••••••••••••••	17	MEDIUM DENSE	VERY STIFF
-	11	37.6	••••••••••••	10	LOOSE	STIFF
-	18	61.6	•••••••••••••••••	17	MEDIUM DENSE	VERY STIFF
- 9 ft	34	116.3	••••••••••••••••••••••••••••••••••	25+	DENSE	HARD
-	22	75.2	••••••••••••••••••••••	21	MEDIUM DENSE	VERY STIFF
-	28	95.8	••••••••••••••••••••••••••	25+	MEDIUM DENSE	VERY STIFF
- 3 m 10 ft	28	95.8	••••••••••••••••••••••••••	25+	MEDIUM DENSE	VERY STIFF
-	24	73.4	••••••••••••••••••••••	20	MEDIUM DENSE	VERY STIFF
-	32	97.9	•••••••••••••••••••••••••••••	25+	MEDIUM DENSE	VERY STIFF
-	18	55.1	••••••••••••••••	15	MEDIUM DENSE	STIFF
- 11 ft	17	52.0	••••••••••••••••	14	MEDIUM DENSE	STIFF
-	22	67.3	••••••••••••••••••••	19	MEDIUM DENSE	VERY STIFF
-	21	64.3	•••••••••••••••••••	18	MEDIUM DENSE	VERY STIFF
- 12 ft	12	36.7	••••••••••••	10	LOOSE	STIFF
-	25	76.5	••••••••••••••••••••••	21	MEDIUM DENSE	VERY STIFF
-	14	42.8	••••••••••••••	12	MEDIUM DENSE	STIFF
- 4 m 13 ft	15	45.9	••••••••••••••	13	MEDIUM DENSE	STIFF

PROJECT: DMB Stabilization Project 4 PROJECT NUMBER: 11860.002

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	COHESIVE
	18	49.9		14	MEDIUM DENSE	STIFF
	17	47.1		13	MEDIUM DENSE	STIFF
14 ft	21	58.2		16	MEDIUM DENSE	VERY STIFF
	19	52.6		15	MEDIUM DENSE	STIFF
	12	33.2		9	LOOSE	STIFF
15 ft	11	30.5		8	LOOSE	MEDIUM STIFF
	11	30.5		8	LOOSE	MEDIUM STIFF
	14	38.8		11	MEDIUM DENSE	STIFF
16 ft	13	36.0		10	LOOSE	STIFF
5 m	14	38.8		11	MEDIUM DENSE	STIFF
	17	43.2		12	MEDIUM DENSE	STIFF
17 ft	18	45.7		13	MEDIUM DENSE	STIFF
	22	55.9		15	MEDIUM DENSE	STIFF
	16	40.6		11	MEDIUM DENSE	STIFF
18 ft	17	43.2		12	MEDIUM DENSE	STIFF
	19	48.3		13	MEDIUM DENSE	STIFF
	20	50.8		14	MEDIUM DENSE	STIFF
19 ft	22	55.9		15	MEDIUM DENSE	STIFF
	48	121.9		25+	DENSE	HARD
6 m	52	132.1		25+	DENSE	HARD
20 ft	77	179.4		25+	VERY DENSE	HARD
	100	233.0		25+	VERY DENSE	HARD
21 ft						
22 ft						
7 m 23 ft						
24 ft						
25 ft						
26 ft						
8 m						
27 ft						
28 ft						
29 ft						
9 m						

Previous Exploration Logs

GEOTECHNICAL BORING LOG KEY

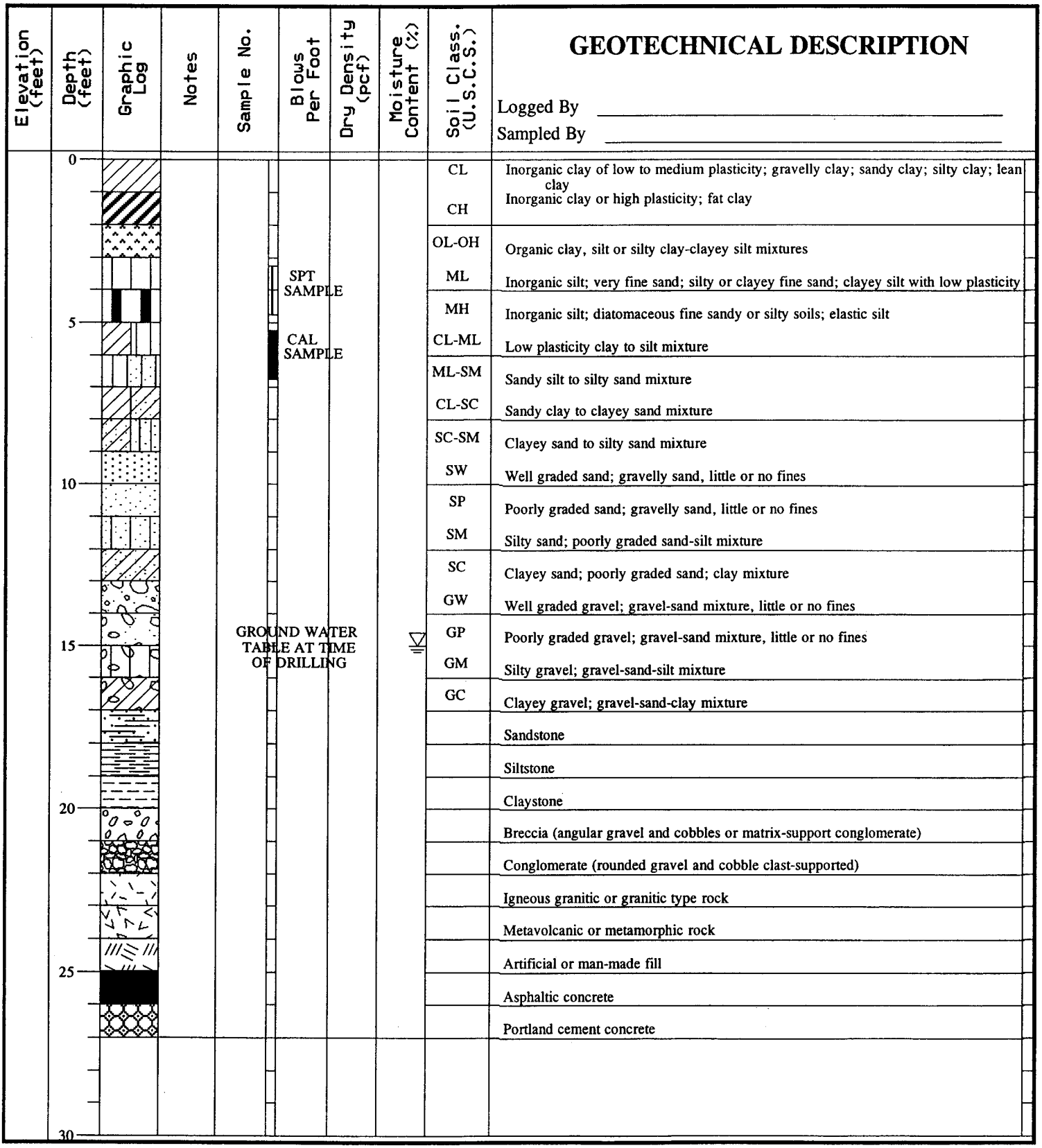
Date _____ Sheet 1 of 1

Project KEY TO BORING LOG GRAPHICS Project No. _____

Drilling Co. _____ Type of Rig _____

Hole Diameter _____ Drive Weight _____ Drop ___ in.

Elevation Top of Hole +/-_____ ft. Ref. or Datum _____



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Boring Logs - Geotechnical Investigation, 10th Street Retaining Wall (April 30, 2002)

GEOTECHNICAL BORING LOG HSA-1

Date 4-11-02 Sheet 1 of 3
Project Del Mar Bluffs Project No. 040151-007
Drilling Co. Cal Pac Drilling Type of Rig Hollow-Stem Auger
Hole Diameter 8 in. Drive Weight 140 pounds Drop 30 in.
Elevation Top of Hole +/- 80 ft. Ref. or Datum Mean Sea Level

Logged By GJM
Sampled By GJM

Elevation (feet)	Depth (feet)	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
80	0			Bag-1 @0'-5'				SM	QUATERNARY BAY POINT FORMATION (Qbp) @ 0': Silty fine to medium SAND: Red-brown, damp to moist, loose
75	5			2	13	106.0	5.2		@ 6': Silty fine to medium SAND: Red-brown, damp to moist, loose
70	10			3	18	111.4	6.3		@ 11': Silty fine to medium SAND: Red-brown, damp to moist, loose
65	15			4	35	113.5	8.9		@ 16': Silty fine to medium SAND: Orange-gray, damp to moist, medium dense
60	20			5	36	109.4	9.4		@ 21': Silty fine to medium SAND: Orange-brown, damp to moist, medium dense
55	25			6	75	119.9	12.0		@ 26': Silty fine to medium SAND: Dark orange-brown with some black grains, damp to moist, dense
50	30								

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GEOTECHNICAL BORING LOG HSA-1

Date 4-11-02 | Sheet 2 of 3

Project Del Mar Bluffs | Project No. 040151-007

Drilling Co. Cal Pac Drilling | Type of Rig Hollow-Stem Auger

Hole Diameter 8 in. | Drive Weight 140 pounds | Drop 30 in.

Elevation Top of Hole +/- 80 ft. | Ref. or Datum Mean Sea Level

Logged By GJM

Sampled By GJM

Elevation (feet)	Depth (feet)	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
50	30			7	50/5"	108.7	19.3	SM	@ 31': Medium to SAND: Light orange-brown, damp to moist, wet, dense to very dense
45	35			8	50/4"	112.8	18.4	CL	
								CL	TERTIARY DEL MAR FORMATION (Td) @ 36': Silty CLAYSTONE: Olive gray-green, damp to moist, dense to very dense
40	40			9 Bag-10 @40'-45	50/5"	114.5	16.0	SM	@ 41': Silty fine SANDSTONE: Green, damp to moist, dense to very dense
35	45			11	60/6"	114.9	12.7		@ 45': Silty fine to medium SANDSTONE: Green-gray green, very dense
30	50			12	55/6"	108.7	15.9	SM/SC	@ 50': Silty fine to medium slightly clayey SANDSTONE: Olive green-gray green, very dense
25	55			13	60/6"	108.0	15.3	CL	@ 55': Silty CLAYSTONE: Gray-green to olive-green, damp to very dense
20	60								

GEOTECHNICAL BORING LOG HSA-1

Date 4-11-02 Sheet 3 of 3
Project Del Mar Bluffs Project No. 040151-007
Drilling Co. Cal Pac Drilling Type of Rig Hollow-Stem Auger
Hole Diameter 8 in. Drive Weight 140 pounds Drop 30 in.
Elevation Top of Hole +/- 80 ft. Ref. or Datum Mean Sea Level

Elevation (feet)	Depth (feet)	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
									Logged By GJM Sampled By GJM
20	60			14	50/5"	101.9	19.2	CL	@ 60': Silty fine to sandy CLAYSTONE: Olive green-gray green, damp to very dense
									Total Depth = 61 Feet Ground water encountered at 29 feet at time of drilling Backfilled with soil cuttings on 4/11/02
15	65								
10	70								
5	75								
0	80								
-5	85								
-10	90								

GEOTECHNICAL BORING LOG HSA-2

Date 4-11-02 | Sheet 1 of 2

Project Del Mar Bluffs | Project No. 040151-007

Drilling Co. Cal Pac Drilling | Type of Rig Hollow-Stem Auger

Hole Diameter 8 in. | Drive Weight 140 pounds | Drop 30 in.

Elevation Top of Hole +/- 73 ft. | Ref. or Datum Mean Sea Level

Logged By GJM

Sampled By GJM

Elevation (feet)	Depth (feet)	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
	0							SM	ARTIFICIAL FILL (Af) @ 0': Silty fine to medium SAND: Brown, red-brown, damp to loose
70								SM	QUATERNARY BAY POINT FORMATION (Qbp)
	5			1	28	112.2	4.3		@ 6': Silty fine to medium SAND: Orange-brown to red-brown, damp to moist, medium dense
65									
	10			2	21	103.3	7.4		@ 11': Silty fine to medium SAND: Orange-brown to red-brown, damp to moist, medium dense
60									
	15			3	42	102.0	3.0		@ 16': Silty fine to medium SAND: Gray to orange-gray, damp to moist, medium dense
55									
	20			4	50/5"	122.3	10.2		@ 21': Silty fine to medium SAND: Dark orange-brown with some black grains, damp to moist, dense to very dense
50									
	25			5	80	107.9	20.0 ▽		@ 26': Medium to coarse SAND: Light gray to light orange-gray, wet to saturated, dense
45									
	30							SM	TERTIARY DEL MAR FORMATION (Td)

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GEOTECHNICAL BORING LOG HSA-2

Date 4-11-02 | Sheet 2 of 2

Project Del Mar Bluffs | Project No. 040151-007

Drilling Co. Cal Pac Drilling | Type of Rig Hollow-Stem Auger

Hole Diameter 8 in. | Drive Weight 140 pounds | Drop 30 in.

Elevation Top of Hole +/- 73 ft. | Ref. or Datum Mean Sea Level

Logged By GJM

Sampled By GJM

Elevation (feet)	Depth (feet)	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
	30			6	60/6"	106.8	15.6	SM	@ 31': Silty fine to medium SANDSTONE: Light gray, yellow-gray, damp to moist, medium dense
40									
	35			7	50/5"	104.4	20.5		@ 35': Medium to coarse SANDSTONE: Light gray to light yellow-gray, moist to wet, very dense
35									
	40								
30									
	45			8	50/6"	111.5	14.9	CL	@ 45': CLAYSTONE: Olive-green, damp to very stiff
25									
	50								
20									
	55				50/4"	116.5	15.8		@ 55': CLAYSTONE: Olive-green, damp to very stiff (little sample recovery)
									Total Depth = 56 Feet Ground water encountered at 26 feet at time of drilling Backfilled with soil cuttings on 4/11/02
15									
	60								

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Boring Logs – Supplemental Geotechnical Investigation, Project 1 - Drainage Improvement and Landslide Warning System (October 26, 2001)

GEOTECHNICAL BORING LOG LB-7

Date 8-28-01 | Sheet 1 of 2
Project Del Mar Bluffs | Project No. 040151-001
Drilling Co. San Diego Drilling Company | Type of Rig Bucket Auger
Hole Diameter 30 | Drive Weight _____ Drop ___ in
Elevation Top of Hole 53 ft. | Ref. or Datum Mean Sea Level

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
								Logged By GJM/MRS Sampled By _____
0							SM	QUATERNARY TERRACE DEPOSITS (Qbp) @ 0': Reddish brown, fine to medium damp silty SAND (shear pin exposed in east side of boring to a depth of 14 feet)
5							SM/SC	@ 5': Mottled gray and reddish brown, fine to medium, moist, slightly clayey SAND
							SM/SW	@ 7': Gradation change to reddish brown, medium, very moist SAND, no clay; friable, horizontal
		standing water after 24 hours						
10							SW	@ 9.5': Gravel lag with 1/2"-2" pebbles and cobbles
							SM	@ 10': Sharp sloping contact to light and dark gray silty SAND on east side with inclusions and fractures (infilled) with very light gray clayey silt, contact appears erosional
		C:N/S 5W						@ 11.5': 2" thick layer of medium to coarse SAND with moderate to heavy seepage
						50	SM	TERTIARY DEL MAR FORMATION (Td) @ 12': Gray-green, fine silty SANDSTONE, very dense, unfractured, scattered inclusions of dark gray to black sandstone, orientated out of slope 4-5' west
							SM	@ 13': Yellow-brown, damp, very dense, silty SANDSTONE
15		B:horizontal					SM	@ 15': Becomes gray, slightly coarser SANDSTONE
		B:horizontal						
							SM/CL	@ 19': Interbedded dark gray CLAYSTONE, very hard, slightly fractured and orange-brown to gray, damp, silty SANDSTONE
20		C:horizontal						
							CL	@ 21': Sharp contact to gray-green CLAYSTONE, fractured, very hard
							CL	@ 24': Light gray to olive-green CLAYSTONE
25								
30								

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GEOTECHNICAL BORING LOG LB-7

Date 8-28-01 | Sheet 2 of 2
Project Del Mar Bluffs | Project No. 040151-001
Drilling Co. San Diego Drilling Company | Type of Rig Bucket Auger
Hole Diameter 30 | Drive Weight _____ | Drop ___ in.
Elevation Top of Hole 53 ft. | Ref. or Datum Mean Sea Level

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
30								Logged By GJM/MRS Sampled By _____
								Total Depth = 30 Feet Downhole Logged to 24 Feet - Water at 27 feet 1 hour after drilling Moderate to Heavy Seepage at 11.5 Feet Backfilled with 2-sack cement slurry: 8/29/01 to within +/-5 feet of grade. Top of boring backfilled with soil. Water level after 24 hours was at a depth of 8 to 10 feet below surface.
35								
40								
45								
50								
55								
60								

GEOTECHNICAL BORING LOG LB-8

Date 8-29-01 | Sheet 1 of 2

Project Del Mar Bluffs | Project No. 040151-001

Drilling Co. San Diego Drilling Company | Type of Rig Bucket Auger

Hole Diameter 30 | Drive Weight _____ | Drop ___ in.

Elevation Top of Hole 47 ft. | Ref. or Datum Mean Sea Level

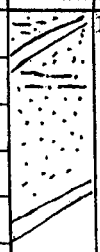
Logged By GJM/MRS

Sampled By _____

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
0							SM	ARTIFICIAL FILL (Af) @ 0': Brown, dark reddish brown, fine to medium silty SAND, damp to moist, medium dense to dense; some gravels
							SM/SW	QUATERNARY TERRACE DEPOSITS (Qt) @ 2': Sharp contact orange-reddish brown, medium SAND, damp, medium dense; friable, some gravels
5							SM	@ 6': Grades to orange-brown, fine to medium silty clayey SAND, mottled gray and orange-brown, damp, medium dense to dense
							SM	@ 8.5'-9': Yellow-brown, fine silty clayey SAND, damp, medium dense
10							SM	@ 13': Reddish orange-brown, medium SAND, very moist to wet, medium dense, light seepage
		C:N30E 30W					SM	TERTIARY DEL MAR FORMATION (Td) @ 14': Sharp contact, yellow-brown, fine to medium silty SANDSTONE, damp, dense
15							SM	@ 17': Grades to light gray, light yellow, fine to medium silty SANDSTONE, damp, dense
20							SM	@ 20': Grades into light gray, medium to coarse silty SANDSTONE, damp to moist, dense @ 21': Slightly coarser
								@ 22': Moderate to heavy seepage @ 22.5': Inclusions of claystone to 4"
							SM	@ 23': Grades to orange-brown SANDSTONE, dense
		F:horizontal					CL	@ 24': Irregular erosional contact, gray clayey SAND
25		F:N60W 20N F:N40W 25N					CL	@ 25': Irregular contact, greenish CLAYSTONE, fractured, polished surfaces randomly orientated; several steeply dipping fractures continuous around hole
							SM	@ 28': Gray-green silty SANDSTONE, fractured, becomes less fractured, very hard
30								

GEOTECHNICAL BORING LOG LB-8

Date 8-29-01 Sheet 2 of 2
Project Del Mar Bluffs Project No. 040151-001
Drilling Co. San Diego Drilling Company Type of Rig Bucket Auger
Hole Diameter 30 Drive Weight ____ Drop ____ in.
Elevation Top of Hole 47 ft. Ref. or Datum Mean Sea Level

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
30		F:N40W 20N					SM	@ 31': Olive-green, dark gray mottled, damp, very dense clay SANDSTONE
35								
40								
45								
50								Total Depth = 50 Feet Downhole Logged to 36 Feet - Standing water at 33 feet, 1 hour after drilling Moderate to Heavy Seepage at 13 and 24 feet Backfilled: 8/29/01
55								
60								

Logged By GJM/MRS
Sampled By ____

GEOTECHNICAL BORING LOG LB-9

Date 8-29-01 | Sheet 1 of 2

Project Del Mar Bluffs | Project No. 040151-001

Drilling Co. San Diego Drilling Company | Type of Rig Bucket Auger

Hole Diameter 30 | Drive Weight _____ | Drop ___ in.

Elevation Top of Hole 70 ft. | Ref. or Datum Mean Sea Level

Logged By GJM

Sampled By _____

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
0								@ 0-3": Asphalt Concrete
								QUATERNARY TERRACE DEPOSITS (Qt)
							SM	@ .5': Orange brown, fine to medium silty SAND, damp, dense
5							SM/SC	@ 6': Grades to reddish brown-gray brown, fine to medium clayey SAND, damp, dense, mottled
							SM	@ 8': Orange brown-gray, mottled, fine to medium silty SAND, damp to moist, dense
10								@ 11': Same as above
							SM	@ 12': Grades to light gray to gray, fine to medium silty SAND, damp, dense; friable
15							SM	@ 15': Grades to orange-brown, fine to medium silty SAND, damp, dense; mottled, orange-brown to gray-brown
20							SM	@ 21': Grades to orange-brown to yellow-brown, thinly laminated SAND, moist, dense; friable
							SM/SW	@ 22': Grades to yellow-brown, medium to coarse SAND, wet to saturated, dense; some gravels, moderate to heavy seepage
							SM	TERTIARY DEL MAR FORMATION (Td)
25								@ 23': Sharp wavy erosional contact, yellow-brown, fine to medium silty SANDSTONE, damp to wet, dense, fractured
							CL	@ 26': Irregular contact, greenish CLAYSTONE, hard, fractured
30								@ 29': Seepage from fracture

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LEIGHTON & ASSOCIATES

GEOTECHNICAL BORING LOG LB-9

Date 8-29-01 | Sheet 2 of 2
Project Del Mar Bluffs | Project No. 040151-001
Drilling Co. San Diego Drilling Company | Type of Rig Bucket Auger
Hole Diameter 30 | Drive Weight _____ Drop ___ in.
Elevation Top of Hole 70 ft. | Ref. or Datum Mean Sea Level

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
30								Logged By GJM Sampled By _____
35								
40								
45								
50								
55								Total Depth = 55 Feet Downhole Logged to 29 Feet Heavy Seepage at 23 Feet and 29 Feet, Standing water at 30 Feet 1 hour after drilling Backfilled: 8/30/01
60								

GEOTECHNICAL BORING LOG S.PIN#6

Date 6-13-01 | Sheet 1 of 2

Project Del Mar Bluff | Project No. 040151-004

Drilling Co. San Diego Drilling Company | Type of Rig E-120

Hole Diameter 36 | Drive Weight N/A | Drop -- in.

Elevation Top of Hole 62 ft. | Ref. or Datum See Geotechnical Map

Logged By KBC

Sampled By --

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
0								Steel casing from 0-10'
10		x-bedding sw dipping					SM	TERTIARY DEL MAR FORMATION (Td) @ 10'-15': Silty medium SANDSTONE: Yellow-brown, damp, dense to very dense; cross-bedding common dipping southwesterly Note: heavy seepage emitting from cased area, at approximately 10 feet
15		c: horizontal					CL	@ 15': Sharp, horizontal contact to fine sandy CLAYSTONE: Olive-gray, damp, hard
20								
		c: horizontal					SM	@ 23': Silty fine to medium SANDSTONE: Greenish gray, damp, dense to very dense
25								@ 27.3'-28': White cemented SANDSTONE concretionary layer: very dense @ 28': Silty fine to medium SANDSTONE: Dark gray, damp, dense to very dense; scattered black peat? lenses; few +/-6" diameter concretion nodules
30								

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GEOTECHNICAL BORING LOG S.PIN#6

Date 6-13-01 | Sheet 2 of 2

Project Del Mar Bluff | Project No. 040151-004

Drilling Co. San Diego Drilling Company | Type of Rig E-120

Hole Diameter 36 | Drive Weight N/A | Drop -- in.

Elevation Top of Hole 62 ft. | Ref. or Datum See Geotechnical Map

Logged By KBC

Sampled By --

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
30							CL	TERTIARY DEL MAR FORMATION (Continued) @ 30'-33': Silty sandy CLAYSTONE to clayey SANDSTONE: Olive-green, damp, hard to very dense
		c: horizontal						@ 33'-39': Approximately horizontal contact to fine sandy CLAYSTONE: Olive-green, damp, stiff to very stiff; upper 6" is tectonically sheared
35								
		c: horizontal						@ 39'-42': Approximately horizontal contact to sandy CLAYSTONE: Olive-green, damp, hard
40		c: horizontal						@ 42'-47': Approximately horizontal contact to fine sandy CLAYSTONE: Olive-green, damp, hard
45								
		c: horizontal					SC	@ 47'-49': Approximately horizontal contact to clayey SANDSTONE: Gray-green with rose-brown mottles commom, damp, dense
		c: horizontal						@ 49'-52': Approximately horizontal contact to clayey SANDSTONE: Dark gray, damp, dense to very dense
50								
		c: horizontal						@ 52'-54': Clayey SANDSTONE: Olive-green, damp, dense to very dense
		c: horizontal					SM	@ 54': Silty fine to medium SANDSTONE: light gray, damp, medium dense to dense; moderately friable
55								
								Total Depth = 57 Feet Cased from 0-10 feet; downhole logged to 55 feet Ground water seepage encountered at 10 feet at time of drilling Concrete and steel shear pin placed 6/14/01
60								

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LEIGHTON & ASSOCIATES

Boring Logs – Del Mar Bluffs Geotechnical Study (January 31, 2001)

BORING LOGS FROM CURRENT INVESTIGATION

GEOTECHNICAL BORING LOG LB-1

Date 6-13-00 | Sheet 1 of 3

Project HDR/Del Mar | Project No. 040151-001

Drilling Co. San Diego Drilling | Type of Rig E-120 Bucket

Hole Diameter 24 in. | Drive Weight 0'-30' 4,991#, 30'-60' 3,841#, 60'-90' 2,446# | Drop 12 in.

Elevation Top of Hole 63 ft. | Ref. or Datum See Map

Logged By KTS/RKW

Sampled By KTS

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
0								BAYPOINT FORMATION (Qbp)
								@ 0'-5': Light brown, mottled with reddish brown, moist to wet, medium dense, fine to medium SAND with few cobbles; caving, weakly cemented
			Bag-1 @2'-4'				SM	
5							ML	@ 5': Seepage at base of Baypoint Formation, very active
								DELMAR FORMATION (Td)
								@ 5': Light olive-gray, moist, slightly stiff, SILTSTONE
							SM-ML	@ 7': Blue-gray, very damp, slightly stiff to stiff, fine to medium sandy SILTSTONE
			Bag-2 @8'-10'					
							SM	@ 8.5': Blue-gray, very damp, stiff, silty CLAYSTONE; fractured; approximately 1/2' thick interbedded with gray medium SANDSTONE with subhorizontal laminations below
10			R-1	Push/8" 5/4"				@ 10': Bluish gray, damp, stiff to very stiff, silty CLAYSTONE
							ML/CL	@ 10.5': Silty CLAYSTONE becomes SILTSTONE
15								
							SM/ML	@ 19': Change in material to dark gray, very damp, dense, silty fine to medium SAND, interbedded with SILTSTONE between 19' and 20'
20			R-2	10			SM	@ 20'-23.5': Light maroon gray, very moist to wet at base, medium dense, medium SANDSTONE; thin clay lenses, subhorizontal laminations
			Bag-3 @21'-23'					@ 20': Light gray, moist, medium dense, silty fine to medium SANDSTONE; grades to slightly coarser sand at tip
								@ 21'-23': Material same as Sample R-2
								@ 23.5'-24.5': Interbed of dark gray, very damp, very stiff to hard, silty CLAYSTONE; 1' thick, subhorizontal contacts
25							ML/CL	@ 24.5'-26.5': Material same as between 20'-23.5' sand coarsens to base of unit, moisture increases to minor seepage at base. Rip-up clasts of blue-gray SILTSTONE within SANDSTONE
								@ 26': Blue-gray, very damp, slightly stiff, silty CLAYSTONE
							ML	@ 29'-33.5': Light blue/green-gray, damp, hard, very fine sandy SILTSTONE grades to coarse sandy SILTSTONE; iron-oxide mottled
30								

GEOTECHNICAL BORING LOG LB-1

Date 6-13-00 Sheet 2 of 3

Project HDR/Del Mar Project No. 040151-001

Drilling Co. San Diego Drilling Type of Rig E-120 Bucket

Hole Diameter 24 in. Drive Weight 0'-30' 4,991#, 30'-60' 3,841#, 60'-90' 2,446# Drop 12 in.

Elevation Top of Hole 63 ft. Ref. or Datum See Map

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
								Logged By KTS/RKW Sampled By KTS
30			R-3	14			ML-SM	@ 32': Light blue gray, very damp to slightly moist, stiff/dense, fine SANDSTONE
								@ 33.5': Planar subhorizontal contact to blue-gray silty CLAYSTONE, fractured, iron-oxide on surfaces, few waxy surfaces, spalling material, possible minor seepage from fractures
35								@ 37': Localized cemented zones
40			R-4	6	110.1	16.6	ML	@ 40': Dark blue-gray, damp, stiff to very stiff, clayey SILTSTONE
								@ 41.5': Increased cementation, mottled yellow and red-brown, oxide staining
								@ 42.5': Blue-gray to dark blue-gray, damp, hard/very dense, very fine sandy SILTSTONE, moderately cemented, reddish oxide staining
45								@ 47'-61': Light gray to dark blue gray, damp, very stiff, clayey SILTSTONE; fractured, lacks continuation
50			R-5	9	110.2	17.0	ML-SM	@ 50': Dark blue-gray, damp, stiff to very stiff, clayey SILTSTONE; massive
55								
60								

GEOTECHNICAL BORING LOG LB-1

Date 6-13-00 Sheet 3 of 3

Project HDR/Del Mar Project No. 040151-001

Drilling Co. San Diego Drilling Type of Rig E-120 Bucket

Hole Diameter 24 in. Drive Weight 0'-30' 4,991#, 30'-60' 3,841#, 60'-90' 2,446# Drop 12 in.

Elevation Top of Hole 63 ft. Ref. or Datum See Map

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By KTS/RKW Sampled By KTS
60			R-6	28			ML-SM	@ 60': Light blue-gray, damp to very damp, stiff to very stiff, fine SANDSTONE
			Bag-4 @61'-63'				SM	@ 61': Light brown, medium SANDSTONE with subhorizontal laminations
								@ 62.5': Blue gray to dark blue-gray, damp, hard/very dense, very fine sandy SILTSTONE; moderately cemented
65							CL	@ 65': Light blue-gray, damp, hard silty CLAYSTONE; a few waxy, polished, fractured, surfaces; randomly oriented (Logged to 65')
							ML	
70			R-7	18	111.7	17.3		@ 70': Light blue gray, slightly damp, very stiff to slightly hard, clayey SILTSTONE; massive Total Depth = 70 Feet Backfilled/tamped 6/13/00 Upper 5 Feet slurry cap Active seepage at 5 Feet
75								
80								
85								
90								

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LEIGHTON & ASSOCIATES

GEOTECHNICAL BORING LOG LB-2

Date 6-14-00 | Sheet 1 of 3

Project HDR/Del Mar | Project No. 040151-001

Drilling Co. San Diego Drilling | Type of Rig E-120 Bucket

Hole Diameter 24 in. | Drive Weight 0'-30' 4,991#, 30'-60' 3,841# | Drop 12 in.

Elevation Top of Hole 58 ft. | Ref. or Datum See Map

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By KTS/MRS Sampled By KTS
0							SM	BAYPOINT FORMATION (Qbp) @ 0'-1-1/2': Light brown, very dry, loose, SAND @ 1-1/2': Reddish brown and blue-gray, mottled, very damp to moist, loose to slightly dense, silty SAND
			Bag-1 @3'-5'					
5			R-1				SM	@ 5': Reddish brown, very moist to wet, loose to slightly dense, clayey fine to medium SAND, weakly cemented
							SM	@ 9': Grade to light reddish brown, very moist to wet, loose to slightly dense, very fine to medium SAND, with SILT
10								
							SM	@ 14'-15': Contact at base of Baypoint Formation is extremely undulatory, black staining, scoured/rip-ups of Td in Qbp DELMAR FORMATION (Td) @ 14'-28': Yellow, moist to wet at base, stiff, grades to very dense, silty, very fine SANDSTONE; grades to silty coarse SANDSTONE; seepage at base
15								
20			Bag-2 @20'-22'					@ 20'-22': Light yellow, moist, slightly dense to dense, silty fine to medium SANDSTONE
		GB:N85E, 10N	R-2	8				@ 22': Light yellow, wet, dense, silty fine to coarse SANDSTONE; massive @ 23': General bedding attitude on 4" thick lense of dark brown SAND
25								
		GB:N10E, 9N						@ 26': Pebbly sand lense, 2" thick, heavy free-flowing seepage, general bedding attitude on faint subhorizontal laminations
							ML/CL	@ 28': Slightly undulatory, irregular erosional contact with iron-oxide along contact, material below is gray-brown, damp, stiff, silty CLAYSTONE; iron-oxide, joints, moderately fractured
30								

GEOTECHNICAL BORING LOG LB-2

Date 6-14-00 Sheet 2 of 3

Project HDR/Del Mar Project No. 040151-001

Drilling Co. San Diego Drilling Type of Rig E-120 Bucket

Hole Diameter 24 in. Drive Weight 0'-30' 4,991#, 30'-60' 3,841# Drop 12 in.

Elevation Top of Hole 58 ft. Ref. or Datum See Map

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
								Logged By KTS/MRS Sampled By KTS
30							ML	@ 30': Blue-gray, moist, stiff to very stiff, clayey SILTSTONE and siltstone; zones weak of cementation in SILTSTONE material
			Bag-3 @32'-34'					@ 32': Iron-oxide mottling (similar to staining above resistant beds seen in neighboring boreholes)
35								@ 35': Material becomes very hard and competent, cemented
		J:N60W, 33N					SM-ML	@ 39': Material change to blue-gray, very damp, very stiff to hard, clayey SILTSTONE to siltstone; randomly, fractured with waxy polished surfaces, non planar, slightly random, weakly cemented
40		J:N10E, 20S J:N55W, 42S						@ 40': Generalized joint/fracture attitudes, decrease in fractures below, more competent
45			R-3	9				@ 45': Blue-gray, damp, stiff to very stiff, SILTSTONE with clay; massive
50								Downhole logged to 50'
						▽		All tailings to T.D. are blue-gray clays and silts with iron-oxide bands, and extremely wet due to seepage above
55								
60								

GEOTECHNICAL BORING LOG LB-2

Date 6-14-00 Sheet 3 of 3

Project HDR/Del Mar Project No. 040151-001

Drilling Co. San Diego Drilling Type of Rig E-120 Bucket

Hole Diameter 24 in. Drive Weight 0'-30' 4,991#, 30'-60' 3,841# Drop 12 in.

Elevation Top of Hole 58 ft. Ref. or Datum See Map

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
60								Logged By KTS/MRS Sampled By KTS
								Total Depth = 60 Feet Backfilled and tamped 6/14/00 5 feet slurry cap Water at 27 feet; standing water at 53 feet at time of backfill
65								
70								
75								
80								
85								
90								

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LEIGHTON & ASSOCIATES

GEOTECHNICAL BORING LOG LB-3

Date 6-14-00 | Sheet 1 of 3

Project HDR/Del Mar | Project No. 040151-001

Drilling Co. San Diego Drilling | Type of Rig E-120 Bucket

Hole Diameter 24 in. | Drive Weight 0'-30' 4,991#, 30'-60' 3,841# | Drop 12 in.

Elevation Top of Hole 59 ft. | Ref. or Datum See Map

Logged By KTS/MRS

Sampled By KTS

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
0							SM	BAYPOINT FORMATION (Qbp) @ 0'-10': Reddish brown, damp to wet at base, slightly dense, clayey medium SAND grades to silty medium to coarse sand at base; seepage at base, boring is belling
5			R-1	Push	103.0	12.0	SM-SC	@ 5': Reddish brown, very moist to wet, loose to slightly dense, clayey SAND; lacks cementation
		CS:N50E, 14N						@ 9'-10': Zone of generally undulatory contact, rip-ups of Td within Qbp (8" diameter, dark brown, rip-up 1' above contact), few cobbles, dark brown staining
10							ML	@ 10': Clay seam attitude, paper thin, along contact DELMAR FORMATION (Td) @ 9.5'-10.5': Light yellow, very moist to wet, slightly stiff, SILTSTONE; very weakly cemented, mottled iron-oxide
		J:N65W, 35S J:E-W, vertical						@ 10.5': Material change to green/blue-gray, very damp, soft to slightly stiff, silty CLAYSTONE; randomly oriented fractures, polished, waxy surfaces, iron-oxide on surfaces, seepage between fractures, material spalling, joint attitudes
15								@ 13.5': Gradual change to gray, damp, stiff, SILTSTONE
		J:N60W, 14S						
		S:N70E-60W, 25-35N					ML-CL	@ 18': Zone of CLAYSTONE with shears (remolded clay surfaces along similar orientation), iron-oxide on surfaces around portion of hole only, moisture in fractures, purple-brown staining (mottled), shear attitude, joint attitude
20		J:N34E, 38S					ML	@ 20': Blue-gray and yellowish gray, mottled SILTSTONE
		C:horizontal						@ 22': Horizontal contact to reddish brown, silty SAND, lenses of light sand at 25' and 27', 2" and 6" thick, respectively
25			R-2	8	117.4	11.5	ML-SM	@ 25': Blue-gray, damp, stiff to very stiff, SILTSTONE with very fine SAND; massive, weak to moderately cemented
								@ 26': Blue-green gray, damp, very stiff, silty CLAYSTONE; short, random non-planar; waxy fractures
		GB:N30E, 5N					SM	@ 28': General bedding attitude, blue-gray silty fine to medium SANDSTONE; 8" thick with dark green laminations
30							ML-CL	@ 29': Blue/green-gray very fine sandy SILTSTONE, grades to silty CLAYSTONE; randomly fractured with waxy, polished surfaces,

GEOTECHNICAL BORING LOG LB-3

Date 6-14-00 Sheet 2 of 3

Project HDR/Del Mar Project No. 040151-001

Drilling Co. San Diego Drilling Type of Rig E-120 Bucket

Hole Diameter 24 in. Drive Weight 0'-30' 4,991#, 30'-60' 3,841# Drop 12 in.

Elevation Top of Hole 59 ft. Ref. or Datum See Map

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By KTS/MRS Sampled By KTS
30								iron-oxide, reddish mottled staining to 32.5'
							ML-SM	@ 32.5': Light blue-gray, moist to wet, hard, SILTSTONE; moderately cemented, dark blue streaks and random, discontinuous polished surfaces
35							ML	@ 36': Light blue-gray, moist, very stiff clayey SILTSTONE; iron oxide and waxy polished surfaces, short, randomly oriented fractures
							ML-CL	@ 38'-46': Blue-gray, very damp (to wet in fractures), very stiff to hard, SILTSTONE and silty CLAYSTONE, zones of random, waxy polished surfaces in clayier material, reddish brown mottled staining
40								
							SC	@ 44': Lense of sandy CLAYSTONE
45			R-3	12	124.7	9.8		@ 45': Blue-gray, damp, very stiff, fine SANDSTONE, minor iron-oxide mottling, weakly cemented
							SC-CL	@ 46': Blue-gray, very damp, stiff, CLAYSTONE, fractures with waxy, polished surfaces, iron-oxide
							SM	@ 47.5': Gray grades to blue/green-gray, moist to wet, dense to very dense, fine grades to coarse SANDSTONE; massive, weakly cemented
50								
							CL	@ 52': Dark gray silty CLAYSTONE, 7" thick, weakly cemented
							SM	@ 53': Brown, damp, slightly dense, fine to coarse SANDSTONE; non-planar, subhorizontal contacts
55							ML-CL	@ 54.5': Blue-gray, silty CLAYSTONE; waxy, polished fractures
							ML-SM	@ 56.5'-65': Gray and brown, mottled, damp, very stiff, sandy SILTSTONE; weakly cemented
60								

GEOTECHNICAL BORING LOG LB-3

Date 6-14-00 Sheet 3 of 3

Project HDR/Del Mar Project No. 040151-001

Drilling Co. San Diego Drilling Type of Rig E-120 Bucket

Hole Diameter 24 in. Drive Weight 0'-30' 4,991#, 30'-60' 3,841# Drop 12 in.

Elevation Top of Hole 59 ft. Ref. or Datum See Map

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
60								Logged By KTS/MRS Sampled By KTS
65			R-4	23	123.4	11.0		@ 65': Dark gray, dry to damp, hard, very fine SANDSTONE, moderately cemented
								Total Depth = 65 Feet Backfilled and Tamped 6/15/00 5 feet slurry cap Ground water encountered at 10, 12, 20, and 52 feet at time of drilling
70								
75								
80								
85								
90								

GEOTECHNICAL BORING LOG LB-4

Date 6-14-00 Sheet 1 of 3

Project HDR/Del Mar Project No. 040151-001

Drilling Co. San Diego Drilling Type of Rig E-120 Bucket

Hole Diameter 24 in. Drive Weight 0'-30' 4,991#, 30'-60' 3,841#, 60'-90' 2,446# Drop 12 in.

Elevation Top of Hole 64 ft. Ref. or Datum See Map

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By KTS/MRS Sampled By KTS
0							SM-SC	BAYPOINT FORMATION (Qbp) @ 0'-14': Reddish brown, moist to wet at base, loose to slightly dense, SAND with CLAY; seepage at base
5								
10							SM	@ 12'-14': Moderate to active seepage and minor belling
15							SC-SM	DELMAR FORMATION (Td) @ 14'-64': Light yellowish gray, wet at top to moist with depth, soft at top grades to stiff, very fine sandy CLAY, grades to clayey, very fine SANDSTONE
							CL	@ 16': Light greenish gray; moist to wet (from fractures), slightly stiff, silty CLAYSTONE; randomly fractured, iron-oxide
							ML	@ 18': Material becomes cemented, yellowish gray, damp, hard SILTSTONE, mottled iron-oxide, lacks fractures
								@ 19'-20': Yellow-gray, wet, very dense, silty fine to medium SILTSTONE
20			R-1	6				@ 20': Blue-gray, damp, hard, clayey SILTSTONE; massive, moderately cemented, minor iron-oxide
								@ 20'-22': Mottled blue-gray CLAYSTONE and yellow-gray SANDSTONE; sheared zone (non-continuous), non-planar features, iron-oxide on surfaces, seepage from fractures
								@ 22'-25': Yellow-gray, moist to wet at base, dense, silty fine to medium SANDSTONE; weakly cemented, lense of dark gray clay, 2" thick, iron-oxide banding
							SM-ML	
25		J/S:N27W-40W, 32-40S J/S:N45W, 42N					CL	@ 25'-26.5': Greenish gray, very damp to moist, slightly stiff, CLAYSTONE; waxy, polished fractures with iron-oxide joint/shear attitudes on non-continuous features
		GB:N55W, 23S					SM	@ 26.5': Light gray, grades to blue-gray, moist to wet, very dense, very fine sandy SILTSTONE, cemented, general bedding attitude on yellow silt bed, lacks cementation, planar feature
30								

GEOTECHNICAL BORING LOG LB-4

Date 6-14-00 Sheet 2 of 3

Project HDR/Del Mar Project No. 040151-001

Drilling Co. San Diego Drilling Type of Rig E-120 Bucket

Hole Diameter 24 in. Drive Weight 0'-30' 4,991#, 30'-60' 3,841#, 60'-90' 2,446# Drop 12 in.

Elevation Top of Hole 64 ft. Ref. or Datum See Map

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By KTS/MRS Sampled By KTS
30							CL-ML	@ 30': Clay lense in above unit, then coarse SAND at base of unit
		J:N45E, 35N						@ 31': Blue-gray CLAYSTONE with polished waxy surfaces, some iron-oxide, joint attitude, lacks visible voids
								@ 34': Mottled zones of increased SILT content and partial cementation
35								
		S:N62E, 31S						@ 36': Shear attitude on non-continuous, polished surface
							ML	@ 37'-40': Blue-gray, wet, very dense, SILTSTONE; weakly cemented
40			R-2	8	110.5	18.0		@ 40': Dark blue-gray and mottled reddish staining, damp, hard, CLAYSTONE and silty claystone; random waxy fracture, moderately cemented
								@ 42': Cemented SILTSTONE bed with reddish staining
							ML-CL	@ 44': Slightly fractured CLAYSTONE with polished non-planar surfaces, very weakly cemented
45								
		J:N20W, 65N						@ 46': Gray, moist to wet, very stiff to hard SILTSTONE; few joints with faint, non-continuous, polished surfaces, attitudes
		J:N20W, 77N						
50								
								@ 51': Color changes to light blue-gray
		S:N70W, 5-35S					CL	@ 52': Shear attitude, continuous around hole but 1/2 steepens, irregular paper-thin CLAY, fainty polished
55								
							ML-SM	@ 57': Blue-gray, moist, dense/hard, very fine sandy SILTSTONE; weakly to moderately cemented
								(Downhole logged to 59 feet)
60								

GEOTECHNICAL BORING LOG LB-4

Date 6-14-00 Sheet 3 of 3

Project HDR/Del Mar Project No. 040151-001

Drilling Co. San Diego Drilling Type of Rig E-120 Bucket

Hole Diameter 24 in. Drive Weight 0'-30' 4,991#, 30'-60' 3,841#, 60'-90' 2,446# Drop 12 in.

Elevation Top of Hole 64 ft. Ref. or Datum See Map

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
								Logged By KTS/MRS Sampled By KTS
60			R-3	20	112.7	16.4		@ 60': Blue-gray, damp, very stiff, silty CLAYSTONE
65								Total Depth = 64 Feet Backfilled and tamped 6/15/00 5 feet slurry cap Ground water encountered at 12 and 20 feet at time of drilling
70								
75								
80								
85								
90								

505A(11/77)

LEIGHTON & ASSOCIATES

GEOTECHNICAL BORING LOG LB-5

Date 6-16-00 Sheet 1 of 3

Project HDR/Del Mar Project No. 040151-001

Drilling Co. San Diego Drilling Type of Rig E-120 Bucket

Hole Diameter 24 in. Drive Weight 0'-30' 4,991#, 30'-60' 3,841# Drop 12 in.

Elevation Top of Hole 55 ft. Ref. or Datum See Map

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By KTS/MRS Sampled By KTS
0							SM	BAYPOINT FORMATION (Qbp) @ 0'-3.5': Reddish brown, moist (at base), loose to slightly dense, fine to medium SANDSTONE
		C:N40W, 4N					ML-SM	@ 3.5': Contact attitude, generalized non-planar, undulatory, rip-ups of clay in sandstone, light seepage
5								DELMAR FORMATION (Td) @ 3.5': Yellow-orange, very damp to slightly moist, stiff, silty very fine SANDSTONE (grades to silty medium to coarse sandy SILTSTONE), iron-oxide bands
		C:N7W, 6S						@ 6': Blue gray, damp, stiff to very stiff with depth, very fine sandy CLAYSTONE/SILTSTONE (zones); cementation increases with depth, very short, non-planar fractures, decrease at 10', iron-oxide in upper portions
10								
15								@ 14': Light brown, moist to wet, dense, very fine to medium SANDSTONE lense, subhorizontal, grades to material above
								@ 16': Dark blue-gray, very damp, stiff to very stiff, silty CLAYSTONE, few polished fracture surfaces, randomly oriented
		CS:N45E, 1N					ML-CL	@ 17.5': Clay seam attitude, paper thin clay seam, gently undulatory, material below is mottled (rip-ups?), dark gray CLAYSTONE and light gray, fine to medium SILTSTONE; very stiff
20								@ 19.5': Interbedded blue-gray, fine to coarse SILTSTONE; wet (light seepage), dense to very dense (slightly cemented at base)
							CL-ML	@ 20.5': Blue-gray, damp, very stiff to hard, silty CLAYSTONE and claystone; moderately fractured with polished, popouts (non-planar, short), zones of weak cementation
25								
		J/S:N10W, 37S						@ 28': Joint or shear attitude on non-continuous planar, polished surface within CLAYSTONE, black rootlet staining
30								

GEOTECHNICAL BORING LOG LB-5

Date 6-16-00 Sheet 2 of 3

Project HDR/Del Mar Project No. 040151-001

Drilling Co. San Diego Drilling Type of Rig E-120 Bucket

Hole Diameter 24 in. Drive Weight 0'-30' 4,991#, 30'-60' 3,841# Drop 12 in.

Elevation Top of Hole 55 ft. Ref. or Datum See Map

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
								Logged By KTS/MRS Sampled By KTS
30								
								@ 34': Moist zone, lacks continuation below, light seepage
35							ML	@ 35': Paleo-root, black charcoal branch, material below is blue-gray, very damp, slightly stiff, sandy SILTSTONE; massive
								@ 39': Dark gray lense of SILTSTONE with charcoal pieces
40								@ 40': 4" sand lense then organic banded interbedded very fine SAND and CLAY, some charcoal pods, subhorizontal, minor seepage
							ML-SM	@ 41.5'-44.5': Blue-gray, moist to wet at base, stiff, SILTSTONE, grades to very fine sandy SILTSTONE; zones of cementation, seepage
45							SM	@ 44.5'-45.5': Zone similar to 40'; organized banded lenses of SANDSTONE; slightly moist
							ML-SM	@ 45.5': Blue/green, slightly damp, stiff, sandy SILTSTONE
								@ 48.5': Blue-gray, damp, slightly stiff CLAYSTONE; iron-oxide fractures, waxy, polished surface, randomly oriented
50								@ 49': Blue/green, slightly damp, stiff, SILTSTONE
								@ 51.5': Blue-green gray, damp, stiff to hard, silty CLAYSTONE; few waxy fractures with iron-oxide, cemented
55								
60								

GEOTECHNICAL BORING LOG LB-5

Date 6-16-00 Sheet 3 of 3

Project HDR/Del Mar Project No. 040151-001

Drilling Co. San Diego Drilling Type of Rig E-120 Bucket

Hole Diameter 24 in. Drive Weight 0'-30' 4,991#, 30'-60' 3,841# Drop 12 in.

Elevation Top of Hole 55 ft. Ref. or Datum See Map

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
60								Logged By KTS/MRS Sampled By KTS
								Total Depth = 60 Feet Backfilled and tamped 6/16/00 5 feet slurry cap Ground water encountered at 20, 34, 44 feet at time of drilling
65								
70								
75								
80								
85								
90								

GEOTECHNICAL BORING LOG LB-6

Date 6-19-00 | Sheet 1 of 3

Project HDR/Del Mar | Project No. 040151-001

Drilling Co. San Diego Drilling | Type of Rig E-120 Bucket

Hole Diameter 24 in. | Drive Weight 0'-30' 4,991#, 30'-60' 3,841#, | Drop 12 in.

Elevation Top of Hole 51 ft. | Ref. or Datum See Map

Logged By KTS/MRS

Sampled By KTS

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
0							SM-SC	BAYPOINT FORMATION (Qbp) @ 0'-2': Reddish brown, damp, slightly dense, clayey fine to medium SANDSTONE; weakly cemented, non-planar, gradual contact with Td, rip-ups of SILTSTONE, iron-oxide pods, pods of CLAY
							ML	DELMAR FORMATION (Td) @ 2': Mottled gray and light brown in blocky pattern, very damp, slightly stiff, very fine sandy SILTSTONE; increase in cementation with depth
5							SM	@ 6': Mottled blue gray and light brown in blocky pattern, wet, dense, fine to medium SANDSTONE; iron-oxide staining in light brown portions, very minor seepage
		J:N10-50W, 36-43S					ML-CL	@ 8': Green/blue-gray, very damp to wet in fractures, slightly stiff CLAYSTONE with SILT; polished waxy fracture surfaces, non-planar, joint attitudes are range of typical fracture planes
10							SM	@ 9.5': Non-horizontal, non-planar contact with light gray and blue-gray, silty fine to medium SANDSTONE; weakly cemented
		S:N73W, 47N					ML-CL	@ 12': Shear contact attitude at base of 55', below is blue-green CLAYSTONE that immediately grades to gray, very damp, soft to slightly stiff SILT/SILTSTONE; grades to incresed cementation of stiffness below
15								@ 15': Reddish mottled staining
								@ 16': Blue-gray, very damp, slightly hard/dense, silty very fine SANDSTONE/very fine SILTSTONE; moderately cemented
20			R-1	9	120.3	7.1		@ 19.5'-20': Concretion, continuous @ 20': Yellowish gray, very damp, dense, silty fine to coarse SANDSTONE; massive, cemented @ 21': Undulatory contact between blue-gray material and yellowish gray material, weaker cementation at contact, slightly dense to dense, silty fine SANDSTONE, grades to fine to coarse SANDSTONE
25		GB:N30E, 16S						@ 26': General bedding attitude on pebble lense, mostly continuous, possibly offset in portion? minor seepage in lense
		S:N55E, 40S						@ 28': Shear attitude, material is blue-green CLAYSTONE with waxy polished fractures, partially discontinuous, random
30								

GEOTECHNICAL BORING LOG LB-6

Date 6-19-00 | Sheet 2 of 3

Project HDR/Del Mar | Project No. 040151-001

Drilling Co. San Diego Drilling | Type of Rig E-120 Bucket

Hole Diameter 24 in. | Drive Weight 0'-30' 4,991#, 30'-60' 3,841#, | Drop 12 in.

Elevation Top of Hole 51 ft. | Ref. or Datum See Map

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
								Logged By KTS/MRS Sampled By KTS
30							ML-CL	@ 30': Blue and gray mottled, silty CLAYSTONE/SILTSTONE, very moist to wet, mottled, stiff and very stiff, iron-oxide, gradual increase in cementation to 35', some red staining, moderately fractured with few randomly oriented polished surfaces
35								@ 35': Dark blue/green-gray, SILTSTONE; wet, very stiff, reddish staining
							SM-ML	@ 36': Reddish brown, fine SANDSTONE @ 36.5': Same as at 35'
							SM	@ 39': Irregular contact to gray damp, very dense, silty fine to medium SANDSTONE
40			R-2	15	119.7	13.7		@ 40': Blue-gray, very damp, hard/dense, very fine SANDSTONE; massive, weakly to moderately cemented
							CL	@ 41': CLAYSTONE; few random polished surfaces
							CL	@ 44': Mottled red and blue-gray, very hard CLAYSTONE with few random polished surfaces
45								
							SC	@ 49': Very hard in areas, with sand, very few fractures
50								
							SC-SM	@ 51': Increase in sand, very dense, no fractures
55								
60								

GEOTECHNICAL BORING LOG LB-6

Date 6-19-00 Sheet 3 of 3

Project HDR/Del Mar Project No. 040151-001

Drilling Co. San Diego Drilling Type of Rig E-120 Bucket

Hole Diameter 24 in. Drive Weight 0'-30' 4,991#, 30'-60' 3,841# Drop 12 in.

Elevation Top of Hole 51 ft. Ref. or Datum See Map

Depth (feet)	Graphic Log	Attitudes	Sample No.	Blows Per Foot	Dry Density (pcf)	Moisture Content (%)	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
								Logged By KTS/MRS Sampled By KTS
60			R-3	7/6" 27/12"	124.4	10.1		@ 60': Blue-gray, damp, hard, fine SANDSTONE Total Depth = 60 Feet Backfilled and Tamped 6/19/00 5 feet slurry cap Ground water encountered at 6, 8, 27 feet at time of drilling
65								
70								
75								
80								
85								
90								

PREVIOUS BORING LOGS BY LEIGHTON AND ASSOCIATES

GEOTECHNICAL BORING LOG

Date 1/20/78 Drill Hole No. P1 Sheet 1 of 2 -

Project Santa Fe Railroad Job No. 478008-1

Drilling Co. Pioneer Type of Rig B-53 Flite

Hole Diameter _____ Drive Weight 140 lb. Drop 30 in.

Elevation Top of Hole 63.0 Ref. or Datum

Depth Feet	Graphic Log	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged by WH - DLH Sampled by WH
0							SM-SC	Fill-cinders, silty-clayey sand.
			1	17/6" 29/6"	119.4	11.3	SM	Dark orange, moist, medium dense, silty medium grained sand.
5								Moist-wet.
								Fill?
			2	9/19	111.4	14.1		Loose, medium, dense, natural ground, wet, dark orange mottled with gray 200=15-20%.
10			3	20/35	108.2	14.1	SM	Dark orange, brown, wet-saturated, medium.
								Terrace Deposit (Qt)
			4	55/6"	102.2	12.7	SC	Pale yellow, moist, wet, dense, clayey coarse to medium sand - (Ted) Del Mar Formation bedrock.
15								
			5	41/6" 60/4"	106.0	21.3	ML	Light gray ground, clayey silt, moist, dense.
								@ 17.5': Increased density, very dense now light green color.
20								@ 17 - 22': Less dense, moist.
			6	61/6"	110.6	13.8		
25								@ 26': Less density, increased moisture.
			7	60/5"	96.3	20.5		@ 27.5': Clean fine sand in sample.
30								

GEOTECHNICAL BORING LOG

Date 1/20/78 Drill Hole No. P1 Sheet 2 of 2

Project Santa Fe Railroad Job No. 478008-1

Drilling Co. Pioneer Type of Rig B-53 Flite

Hole Diameter _____ Drive Weight 140 lb. Drop 30 in.

Elevation Top of Hole 63.0 Ref. or Datum

Depth Feet	Graphic Log	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged by WH Sampled by WH
30							ML	As above.
			8	60/5"	100.8	14.0		Coarse grained sand in sample tube.
35			①					@ 36': Very dense. @ 36.5': Less dense but still very hard.
			9	42/6" 60/4.5"	105.8	18.8		
40								
			10	63/6"	102.2	13.9		@ 43': Drilling becoming difficult moist material sticks to auger hard to clear cuttings from hole.
45			②					
			11	61/6"	99.3	18.2		
50								@ 53': Slight decrease in density.
55								T.D. 54' No water - No Caving
60								

GEOTECHNICAL BORING LOG

Date 1/20/78 Drill Hole No. P2 Sheet 1 of 1-

Project Santa Fe Railroad Job No. 478008-1

Drilling Co. Pioneer Type of Rig B-53 Flite

Hole Diameter _____ Drive Weight 140 lb. Drop 30 in.

Elevation Top of Hole 63.0 Ref. or Datum

Depth Feet	Graphic Log	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged by WH Sampled by WH
0							SW	Track Bed - Sandy gravel, medium brown, moist
			12	18/6" 27/6"	117.8	6.7	SM	Fill - Dark orange, silty sand, fine to coarse grained, pebbly, moist, dense. @ 3': Less pebble, very moist, orange brown to brown sand, somewhat silty.
5			13	16/6" 27/5"	122.6	7.8		
			14	20/6"	112.8	14.9	SM	@ 5.5': Orange brown, sand, fine-coarse grained (natural) very moist to wet, dense. Terrace Deposit (Qt)
			15	13/6" 34/6"	87.2	14.1		@ 8': Somewhat denser.
10			16	60/5"	103.4	13.3		
							SM	@ 12.7': Tan, sand, fine-medium grained, moist, dense, Del Mar Formation (Ted) bedrock.
15			17	30/6" 60/6"	105.3	22.4	ML	@ 16': Light gray grained, clayey silt, moist, dense (bedrock).
								T.D. 17' No Water - No Caving
20								
25								

GEOTECHNICAL BORING LOG

Date 1/20/78 Drill Hole No. P 3 Sheet 1 of 1

Project Santa Fe Railroad Job No. 478008-1

Drilling Co. Pioneer Type of Rig B-53 Flite

Hole Diameter _____ Drive Weight 140 lb. Drop 30 in.

Elevation Top of Hole 63.0 Ref. or Datum

Logged by WH

Sampled by WH

Depth Feet	Graphic Log	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
0			18	9/6"	107.2	14.0	SM/ SC	Fill-Grayish brown to orange brown, sand, fine-coarse grained, moist, pebbles in upper foot, with gravel.
				26/6"			SM	@ 2.8': Brown to orange brown sand, fine-coarse grained, moist, dense, terrace deposit (Qt)
5			19	18/6" 32/6"	109.5	15.6		
			20	23/6" 31/6"				
10			21	24/6" 42/6"	109.1	16.4		
15							SC	Tan, sand, fine-medium grained, moist, dense. Note: Upper contact approximate Del Mar Formation (Ted) bedrock.
				25/6"				
			22	60/5"	102.9	21.5	ML	Light gray grained, clayey silt, moist, dense.
20								T.D. 17.5' No Water - No Caving
25								
30								

GEOTECHNICAL BORING LOG

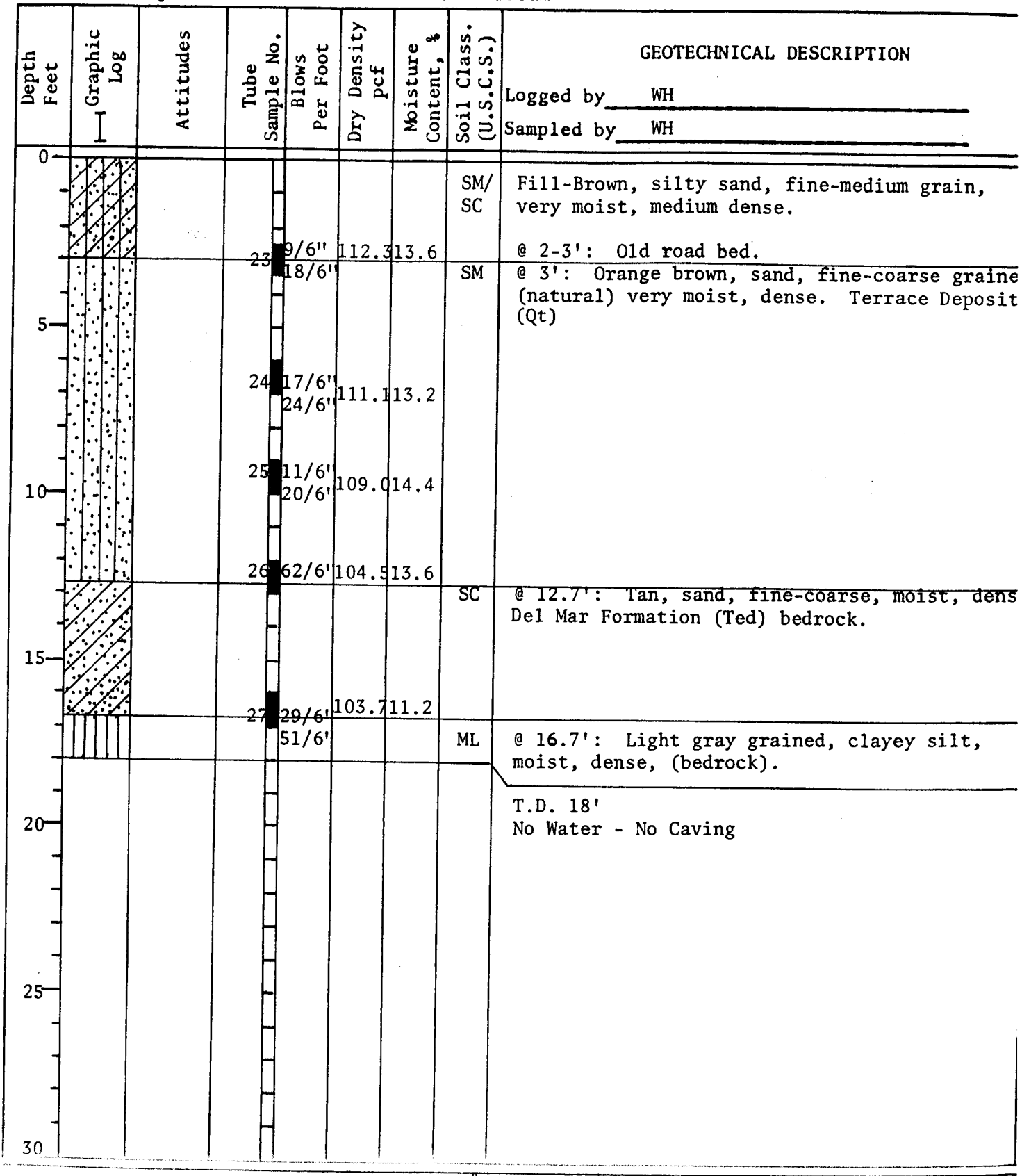
Date 1/20/78 Drill Hole No. P 4 Sheet 1 of 1

Project Santa Fe Railroad Job No. 478008-1

Drilling Co. Pioneer Type of Rig B-53 Flite

Hole Diameter ____ Drive Weight 140 lb. Drop 30 in.

Elevation Top of Hole 63.5 Ref. or Datum



PREVIOUS BORING LOGS BY OTHERS

APPENDIX A

Field Mapping and Subsurface Exploration Logs

Geologic Units and Feature Identification

The Site Plan and Geologic Map (in pocket) was prepared based upon information supplied by the client, or others, along with MAHG's field measurements and observations. Site geology including surficial units, bedrock units, measurement of bedrock structure, contacts, areas of notable seepage and springs as well as the approximate locations of exploratory borings and trenches associated with this field investigation are presented on the Geotechnical Map. In addition, ten geologic cross sections were prepared to enable the evaluation of slope stability at selected locations and these sections are presented in Appendix D.

General Field Procedures

The Boring and Trench Logs on the following pages depict or describe the subsurface (soil and water) conditions encountered at the specific exploration locations on the date that the exploration was performed. Subsurface conditions may differ between exploration locations and within areas of the site that were not explored. The subsurface conditions may also change at the exploration locations over the passage of time.

Boring and Test Trench Elevations

The ground surface elevations reported on the field logs were established from interpolation of elevations and contours illustrated on the Site Plan and Geologic Map.

Boring and Test Trench Locations

All subsurface exploration locations were located on-site based on visual observation and measurement from existing improvements. The locations are shown on the Geotechnical Map. Subsurface exploration locations reported for this study should be considered accurate only to the degree implied by the method used in determining them.

Water Level Measurement

The water levels reported on the Boring Logs represent the depth to the piezometric water surface measured at the conclusion of the drilling operation after a short wait, or in monitoring wells that were constructed within selected boreholes. Water levels are expected to show seasonal and long-term fluctuations consistent with historical trends in the area.

Field Sampling and Testing Procedures

Drilling was performed between April 27 and April 30, 1998, utilizing Mobile B-53 and B-61 truck-mounted rigs equipped with 8-inch-diameter, continuous-flight, hollow-stem augers. Trenches were excavated with a rubber tire mounted backhoe provided by the client.

The field operations were conducted in general accordance with the procedures recommended by the American Society for Testing and Materials (ASTM) designation D 420 entitled "Standard Guide for Sampling Soil and Rock" and/or other relevant specifications. Soil samples were preserved and transported to our laboratory in general accordance with the procedures recommended by ASTM designation D 4220 entitled "Standard Practice for Preserving and Transporting Soil Samples". Brief descriptions of the sampling and testing procedures are presented below:

Ring-Lined Barrel Sampling - (ASTM D 3550)

In this procedure, a barrel sampler constructed to receive a stack of 1-inch-high brass rings is used to collect soil samples for classification and laboratory testing. Ring samples were collected from closely spaced intervals in all of the hollow-stem auger borings. Each hollow-stem rig was equipped with a 140-pound wireline downhole hammer, manually operated to fall an approximate distance of 30 inches. An 18-inch or 24-inch-long barrel fitted with 2.5-inch-diameter rings was subsequently driven a distance of 18 inches or to practical refusal (considered to be 50 blows for 6 inches).The method provides relatively undisturbed samples that fit directly into laboratory test instruments without additional handling and disturbance.

Raw blow count data were recorded for each 6-inch increment of the 18-inch drive. The sum of blows required to drive the sampler the final 12 inches, or fraction thereof, is noted on the Field Logs, presented in this Appendix, as an uncorrected N-value. Penetration resistance of the initial 6-inch seating interval is not shown, except in the instance of total penetration of 6 inches or less. The raw blow count values, presented as *N=XX*, do not have exact equivalency with Standard Penetration Test "N-values" as determined by ASTM D 1586. However, it is commonly accepted that general correlations can be applied to obtain approximately equivalent (uncorrected) Standard Penetration Test N-values and their respective consistency and relative density classifications according to the following tables.

Table A-1
Blow Count/Density Relationships for Granular Soils

Ring Sample Blow Count	SPT Blow Count	Description
0 - 5	0 - 4	Very loose
5 – 13	4 - 10	Loose
13 – 38	10 - 30	Medium dense
38 – 63	30 - 50	Dense
> 63	> 50	Very dense

Table A-2
Blow Count/Consistency Relationships for Fine-Grained Soils

Ring Sample Blow Count	SPT Blow Count	Description
0 - 3	0 - 2	Very soft
3 - 5	2 - 4	Soft
5 - 10	4 - 8	Firm/Medium stiff
10 - 19	8 - 15	Stiff
19 - 38	15 - 30	Very stiff
>38	>30	Hard

Bulk Sample

A relatively large volume of soil is collected with a shovel or trowel. The sample is transported to the materials laboratory in a sealed plastic bag or bucket.

Classification of Samples

Excavated soils and discrete soil samples were visually-manually classified, based on texture and plasticity, in general accordance with the Unified Soil Classification System (ASTM D 2488-75). The classifications are reported on the field logs. Plasticity noted on the field logs reflects soil conditions at field moisture contents, and may not correlate with achievable plasticity at differing moisture contents.

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 1P

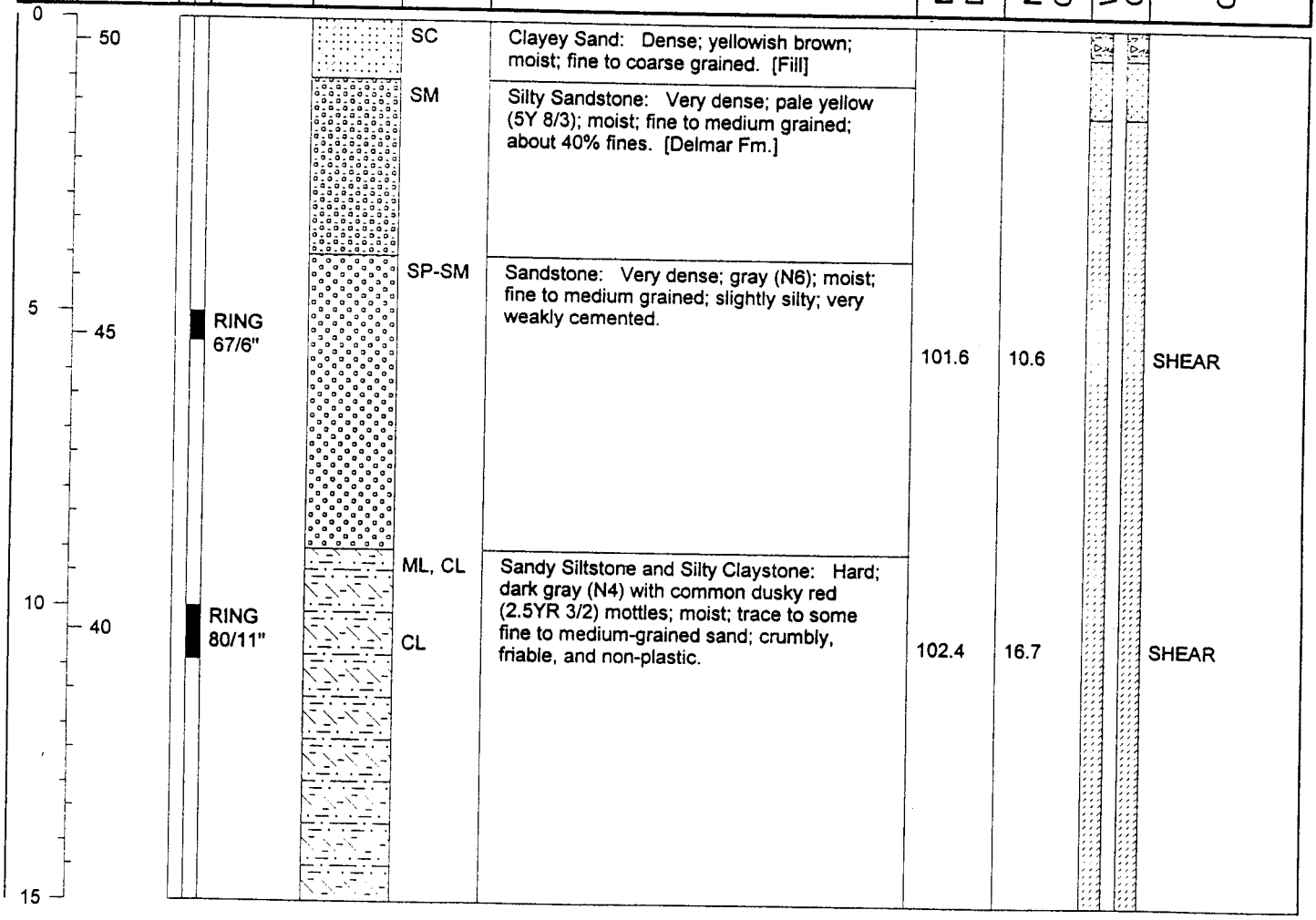
Sheet 1 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

Dates(s) Drilled:	**4/27/98**	Logged By:	**M. Doerschlag**
Drilled By:	**California-Pacific**	Total Depth:	**51.0 Ft.**
Rig Make/Model:	**Mobile B-61**	Hammer Type:	**Wireline downhole**
Drilling Method:	**Hollow-stem Auger**	Hammer Weight/Drop:	**140 Lb./±30 In.**
Hole Diameter:	**8 In.**	Surface Elevation:	**50.4 Ft.**

Comments: Located at south end of project alignment.



Continued on next sheet.

FIG. A-1

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 1P

Sheet 2 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
15	35	RING 83/6"		SM	Silty Sandstone and Siltstone: Very dense or hard; mostly gray (N6), with few small reddish FeO mottles; fine to medium grained sand; thinly bedded.	98.9	13.1		
				CL	Silty Claystone: Hard; dark gray (N4); moist; crumbly, friable, and non-plastic.				
20	30	RING 60/3"		SP-SM	Sandstone: Very dense; brownish yellow (10YR 6/6); moist; fine to coarse grained; uncemented. Much thinner than in adjacent bluff face.	99.5	9.8		SHEAR
				ML, CL	Sandy Siltstone and Silty Claystone: Hard; mostly gray (N5), with some reddish FeO mottles to 1" across; moist; sand proportion mostly fine-grained; faintly plane laminated.				
25	25	RING 76/6"		ML		98.3	14.4		
30	20	RING 59/6"		CL	— Silty claystone, as above; dark gray (N4).	101.9	17.5		SHEAR
35									

Continued on next sheet.

FIG. A-2

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 1P

Sheet 3 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
35	15	RING 80/6"		ML	Sandy Siltstone and Silty Claystone: Hard; mostly gray (N5), with some reddish FeO mottles to 1" across; moist; sand proportion mostly fine-grained; faintly plane laminated.	101.2	12.7		
				SP-SM	Sandstone: Very dense; dark gray (N4); moist; fine to medium grained; very weakly cemented with trace of clay.				
40	10	RING 80/6"		CL	← Sandy claystone, dark gray (N4), texture of small slickensided granules. Local lens.	108.4	14.3		
				CL	Silty Claystone: Hard; dark gray (N4), abundantly mottled with dusky red (2.5YR 3/2) iron oxides; moist; very silty, with occasional trace of fine-grained sand; massive and non-plastic. Harder drilling.				
45	5	RING 60/6"		CL	← Silty claystone, as above.	N/R	N/R		
50	0	RING 80/6"		CL	← Silty claystone, as above.	102.8	15.3		SHEAR

Bottom of boring at 51.0 feet.
No groundwater encountered.
Piezometer installed as depicted in well completion column..

FIG. A-3

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 2

Sheet 1 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

Dates(s) Drilled:	**4/27/98**	Logged By:	**M. Doerschlag**
Drilled By:	**California-Pacific**	Total Depth:	**40.5 Ft.**
Rig Make/Model:	**Mobile B-61**	Hammer Type:	**Wireline downhole**
Drilling Method:	**Hollow-stem Auger**	Hammer Weight/Drop:	**140 Lb./±30 In.**
Hole Diameter:	**8 In.**	Surface Elevation:	**51.4 Ft.**

Comments: Located at Andersen Canyon embankment fill.

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
0	50			SM	Gravelly Sand with Silt: Dense; dark brown (7.5YR 4/2); moist; fine to coarse grained; estimated 20-25% fine to coarse-grained gravel ballast; trace of clay. [Fill]				
5	45	RING N=47		SP-SC	Clayey Sand: Dense; dark yellowish brown (10YR 4/4); moist; mostly fine to medium grained, with trace of gravel and silt. [Fill]	100.3	7.4		
10	40	RING N=14		SP-SC	Becomes medium dense; very moist.	108.6	13.0		CONS
15									

Continued on next sheet.

FIG. A-4

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 2

Sheet 2 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
15		RING		SP-SC	Clayey Sand: Medium dense; dark yellowish brown (10YR 4/4); very moist; fine to medium grained; trace of silt. [Fill]				
	35	N=13			— Trace FeO mottling.	114.6	12.9		CONS
20		RING			⌐ Becomes wet; slightly sticky.				
	30	N=18		SP-SC		115.0	14.5		
25		RING							
	25	N=17		SP-SC	— Contains few yellowish siltstone fragments; moist.	114.1	10.2		CONS
30		RING		ML, CL	Clayey Siltstone and Sandy Claystone: Very stiff; mottled pale yellow, dark brown, and dark gray; wet; consists mostly of small intact sedimentary fragments in clayey silt matrix. [Fill]				
	20	N=23		ML, CL		94.6	24.2		
					Abrupt contact.				
35				SP-SM	Sandstone: Very dense; pale brownish yellow (10YR 6/6); wet; fine to medium grained; massively bedded. [Delmar Fm.]				

Continued on next sheet.

FIG. A-5

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 2

Sheet 3 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK	SAMPLE INTERVALS: DRIVE	SAMPLE INTERVALS: TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
35			RING 62/6"			SP-SM	Sandstone: Very dense; pale brownish yellow (10YR 6/6); wet; fine to medium grained; massively bedded. [Delmar Fm.]	113.6	17.5		
15						ML	Clayey Silt: Hard; mottled dark gray (N4) and dusky red (2.5YR 2/3); moist; crumbly, friable, and non-plastic.				
40			RING 53/6"			ML		98.9	12.6		

Bottom of boring at 40.5 feet.
Perched groundwater encountered in zone from approximately 33.0 to 38.0 feet.
No groundwater encountered below 38.0 feet.
Boring backfilled with soil cuttings.

FIG. A-6

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 3

Sheet 1 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

Dates(s) Drilled:	4/27/98	Logged By:	M. Doerschlag
Drilled By:	California-Pacific	Total Depth:	35.5 Ft.
Rig Make/Model:	Mobile B-61	Hammer Type:	Wireline downhole
Drilling Method:	Hollow-stem Auger	Hammer Weight/Drop:	140 Lb./±30 In.
Hole Diameter:	8 In.	Surface Elevation:	54.0 Ft.

Comments: Located north of Andersen Canyon.

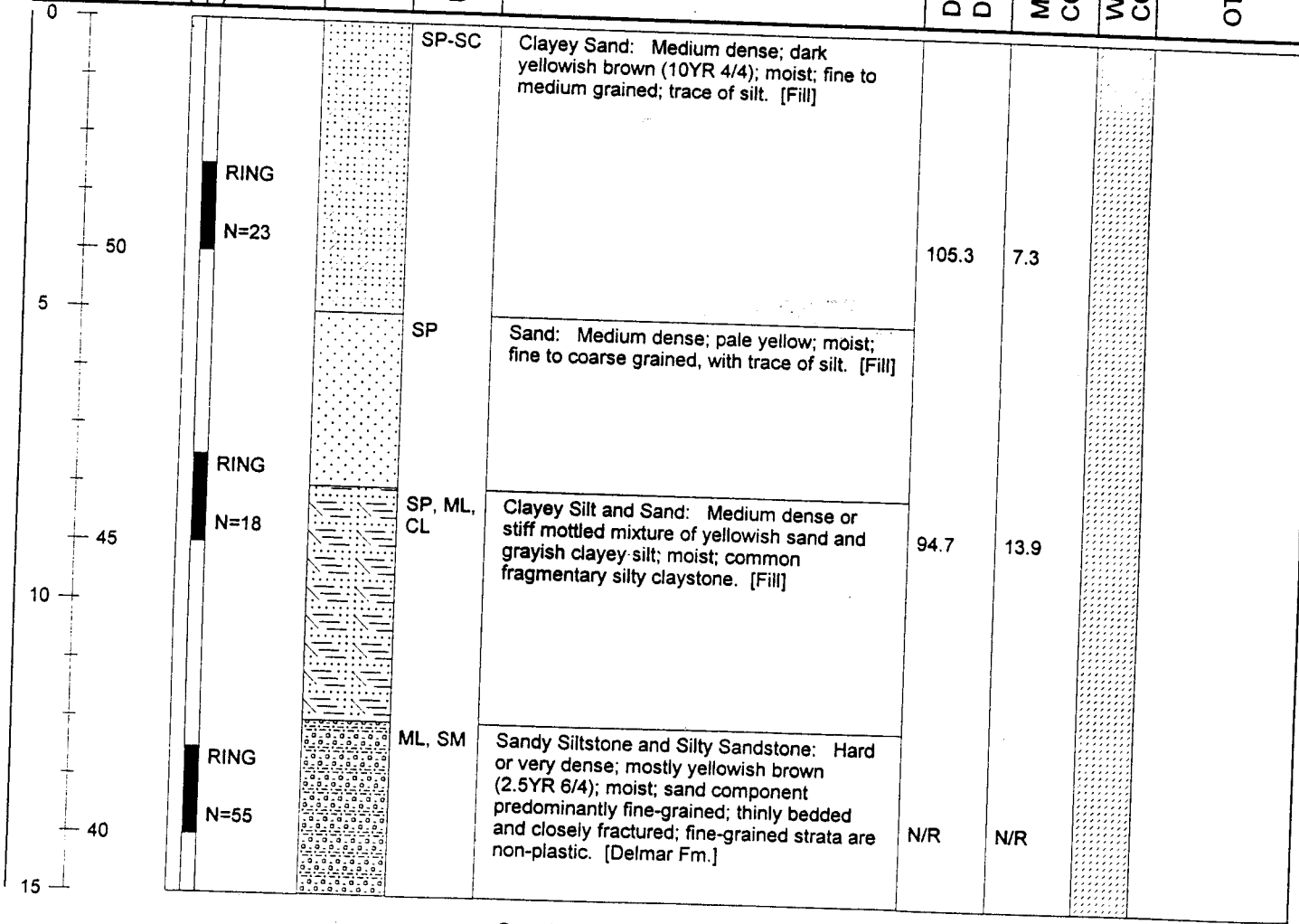


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FIG. A-7

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 3

Sheet 2 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK	SAMPLE INTERVALS: DRIVE	SAMPLE INTERVALS: TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
15	35					ML, SM	Sandy Siltstone and Silty Sandstone: Hard or very dense; yellowish brown abruptly becoming dark gray (N4) at 16 feet; moist; sand mostly fine-grained; thinly bedded; fine-grained strata are non-plastic.				
			RING 55/6"			SM	— Silty sandstone, fine to medium grained, very silty.	108.2	13.2		
20	30		RING 56/6"			ML	— Clayey siltstone, gray (5Y 6/1), trace of fine-grained sand, friable and non-plastic. Grades increasingly clayey.	98.6	16.0		
25	25		RING 65/6"			ML	← Clayey siltstone, dark gray (N4), trace of sand. Becomes harder drilling.	105.4	16.1		
30	20		RING 62/6"			ML	— Siltstone, lacks clay. Trace of coal.	98.4	15.1		
35											

Continued on next sheet.

FIG. A-3

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 3

Sheet 3 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK	SAMPLE INTERVALS: DRIVE	SAMPLE INTERVALS: TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
35						SP	Sandstone: Very dense; color and moisture undetermined; well-cemented with calcium carbonate. Bluff exposure is erosion-resistant, lenticular ledge about 14" thick. Very hard drilling.				

Refusal encountered at 35.5 feet.
No groundwater encountered.
Boring backfilled with soil cuttings.

FIG. A-9

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 4P

Sheet 1 of 4

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

Dates(s) Drilled:	**4/27/98**	Logged By:	**M. Doerschlag**
Drilled By:	**California-Pacific**	Total Depth:	**55.5 Ft.**
Rig Make/Model:	**Mobile B-61**	Hammer Type:	**Wireline downhole**
Drilling Method:	**Hollow-stem Auger**	Hammer Weight/Drop:	**140 Lb./±30 In.**
Hole Diameter:	**8 In.**	Surface Elevation:	**60.5 Ft.**

Comments: Groundwater seepage noted along nearby bluff face.

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
0	60			SP-SC	Clayey Sand: Dense; dark reddish brown (5YR 3/4); moist; fine to medium grained, with occasional trace of gravel to ~1". [Bay Point Fm.]				
					Sharp contact.				
				ML, SC, CL	Sandy Siltstone: Hard; olive yellow (2.5Y 6/6); moist; fine-grained sand. Includes few thin clayey sand lenses, and occasional olive silty clay rip-up clasts. [Delmar Fm.]	94.0	23.3		
5	55	RING N=51		CL	Silty Claystone: Hard; pale yellow (2.5YR 7/4); moist; slightly plastic.				
10	50	RING 68/12"		SP-SC	Clayey Sandstone: Very dense; mottled pale yellow (2.5Y 8/4) to olive yellow (5Y 6/8); moist; fine to medium grained; massively bedded; very weakly cemented.	107.3	21.3		SHEAR
15									

Continued on next sheet.

FIG. A-10

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 4P

Sheet 2 of 4

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
15	45	RING 80/9"		ML, SP	Sandy Siltstone and Sandstone: Hard or very dense; siltstone light gray (2.5Y 7/2), and sandstone yellow (2.5Y 8/6); moist; fine to medium-grained sand; fine-grained strata contain trace of clay and are non-plastic.	100.5	18.0		SHEAR
					Abrupt contact.				
20	40	RING 50/6"		CL	Silty Claystone: Hard; very dark gray (5YR 3/1); moist; friable and non-plastic, with granular texture.	105.8	16.9		SHEAR
					Grades less clay; color lightens.				
25	35	RING 66/6"		ML, SM	Siltstone and Silty Sandstone: Hard or very dense; mostly light gray (2.5Y 8/1) to gray (N6), with local orange mottling; moist; sands fine to medium grained.	102.4	13.1		
30	30	RING 50/3"		SM	Very silty fine to medium-grained sandstone; gray (N5).	110.0	11.5		
35				CL, ML	Silty Claystone: Hard; gray (N5); moist; very silty; non-plastic and friable.				

Continued on next sheet.

FIG. A-11

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 4P

Sheet 3 of 4

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
35	25	RING 85/6"		CL	Silty Claystone: Hard; gray (N5); moist; very silty; non-plastic; becomes commonly mottled with dusky red iron oxide staining and small hematitic concretions.	92.0	18.6		SHEAR
40	20	RING 56/6"		CL	— Silty claystone, as above.	105.2	19.3		
				ML	Sandy Siltstone: Hard; gray (N6); moist; mostly fine-grained sand; generally massive in recovered samples.				
45	15	RING 100/6"		ML	← Sandy siltstone, as above.	116.2	10.3		
50	10	RING 50/3"		ML	← Sandy siltstone, as above.	107.3	13.7		
55									

Continued on next sheet.

FIG. A-12

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 4P

Sheet 4 of 4

Project: ***NORTH COUNTY TRANSIT DISTRICT***

Location: ***DEL MAR, CALIFORNIA*** Project No. ***3650-SF***

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK	SAMPLE INTERVALS: DRIVE	SAMPLE INTERVALS: TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
55											
5			57/6"			CL	Silty Claystone: Hard; dark gray (N4), abundantly mottled with dusky red (2.5YR 3/2) iron oxides; moist; very silty; massive and non-plastic.	102.1	17.5		SHEAR

Bottom of boring at 55.0 feet.
No groundwater encountered.
Piezometer installed as depicted in well completion column..

FIG. A-13

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 5

Sheet 1 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

Dates(s) Drilled:	**4/28/98**	Logged By:	**M. Doerschlag**
Drilled By:	**California-Pacific**	Total Depth:	**51.0 Ft.**
Rig Make/Model:	**Mobile B-61**	Hammer Type:	**Wireline downhole**
Drilling Method:	**Hollow-stem Auger**	Hammer Weight/Drop:	**140 Lb./±30 In.**
Hole Diameter:	**8 In.**	Surface Elevation:	**59.5 Ft.**

Comments:

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK	SAMPLE INTERVALS: DRIVE	SAMPLE INTERVALS: TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
0						SP-SC	Clayey Sand: Dense; dark reddish brown (5YR 3/2); moist; fine to coarse grained, with trace of gravel to ~2" diameter. [Bay Point Fm.]				
							Sharp contact.				
						ML, CL	Clayey Siltstone and Silty Claystone: Hard; dark to very dark gray (N4-N3), locally becoming black (N2), moist; friable and non-plastic, non-cemented. Bluff outcroppings contain common coal-bearing lenses to ~6" thick. [Delmar Fm.]				
5	55			RING 50/6"		ML	← Clayey siltstone, as above.	106.7	14.1		
10	50			RING 65/6"		CL	← Silty claystone, black (N2).	104.7	16.1		
15	45					SP-SM	Silty Sandstone: Very dense; dark gray (N5) apparently mottled with shades of yellow; moist to locally very moist; fine to coarse grained. Interval inferred from bluff exposure.				

Continued on next sheet.

FIG. A-14

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 5

Sheet 2 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
15	40	RING 70/6"		SP-SM	Silty Sandstone: Very dense; dark gray (N5); moist to locally very moist; fine to coarse grained. Locally contains sandy siltstone drapes and partings.	107.3	14.1		
20	35	RING 55/6"		ML	Sandy Siltstone: Hard; gray (N5); moist; sand component fine to medium grained; apparently massively bedded; non-plastic and mostly lacks clay. Sample @ 20 ft. found to have plane and convolute lamination, with estimated 30-40% sand. Increasingly sandy with depth.	111.2	12.2		
25	30	RING 67/6"		ML	Color becomes 10YR 5/1, possibly grading to silty sandstone. — Sandy siltstone, mottled with reddish brown (2.5YR 3/4) oxidation color.	101.9	15.0		
30	25	RING 62/6"		ML	Clayey Siltstone: Hard; mottled gray (10YR 6/1) and yellow (10YR 7/6); moist; trace of fine-grained sand; non-plastic. Harder drilling. — Sandy siltstone, as above.	110.7	15.8		
35									

Continued on next sheet.

FIG. A-15

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 5

Sheet 3 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
35		RING 58/6"		ML	Clayey Siltstone: Hard; color mostly olive gray (5Y 5/2); moist.	96.6	17.1		
	20								
40		RING 80/6"		ML	Sandy Siltstone: Hard; dark gray (N5); moist; contains estimated 20-30% fine to medium-grained sand. Little or no clay; non-plastic.	117.4	10.6		
	15								
45		RING 55/6"		ML	Siltstone, trace of fine-grained sand.	102.0	17.2		
	10								
50		RING 112/12"		ML	Siltstone, as above.	108.8	18.6		

Bottom of boring at 51.0 feet.
Groundwater seepage reported by driller somewhere in upper 20 feet of boring; interpreted to be from basal portion of sandstone interval located from 13 to 19 feet.
Boring backfilled with soil cuttings.

FIG. A-16

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 6P

Sheet 1 of 2

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

Dates(s) Drilled:	**4/28/98**	Logged By:	**M. Doerschlag**
Drilled By:	**California-Pacific**	Total Depth:	**28.0 Ft.**
Rig Make/Model:	**Mobile B-61**	Hammer Type:	**Wireline downhole**
Drilling Method:	**Hollow-stem Auger**	Hammer Weight/Drop:	**140 Lb./±30 In.**
Hole Diameter:	**8 In.**	Surface Elevation:	**64.3 Ft.**

Comments: Groundwater seepage apparent from nearby bluff.

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK	SAMPLE INTERVALS: DRIVE	SAMPLE INTERVALS: TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
0						SP	Sand: Dense; dark yellowish brown (10YR 4/4); moist; fine to medium grained, with occasional trace of gravel; trace of clay and Fe-oxide binding agents. [Bay Point Fm.]				
	60		RING	N=36				114.3	6.9		
5							Becomes wet.				
							Becomes medium to coarse grained, some fine gravel.				
			RING	N=54		CL	Silty Claystone: Hard; pale olive (5Y 6/3); moist; very silty; slightly plastic to non-plastic. [Delmar Fm.]	102.0	18.8		
	55										
10											
			RING	70/12"		SC-SP, SP	Clayey Sandstone and Sandstone: Very dense; pale olive(5Y 6/4) becoming olive yellow (5Y 6/8); moist; fine to medium grained.	114.6	11.3		
	50										
15											

Continued on next sheet.

FIG. A-17

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 6P

Sheet 2 of 2

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
15				SP	Clayey Sandstone and Sandstone: As before; grades primarily SP classification.				
				ML	Sandy Siltstone: Hard; mostly gray (5Y 5/1); moist; fine to medium grained sand, and trace of clay; apparently massively bedded.				
		RING 50/6"		ML		110.7	16.6		
45									
20					Becomes harder drilling.				
		RING 76/6"		ML, SM	Sandy siltstone with clay, and some thinly bedded silty fine to medium-grained sandstone; color dark gray (N6) with abundant dusky red mottles; slightly sticky when wet.	117.7	14.3		
40									
25		RING 82/6"		ML	Sandy siltstone with clay.	110.9	15.4		

Boring terminated at 28.0 feet due to very slow progress.
Perched groundwater encountered in zone from approximately 6.0 to 8.0 feet (base of Bay Point Fm.).
Piezometer installed as depicted in well completion column..

FIG. A-18

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 7

Sheet 1 of 4

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

Dates(s) Drilled:	**4/28/98**	Logged By:	**M. Doerschlag**
Drilled By:	**California-Pacific**	Total Depth:	**56.0 Ft.**
Rig Make/Model:	**Mobile B-61**	Hammer Type:	**Wireline downhole**
Drilling Method:	**Hollow-stem Auger**	Hammer Weight/Drop:	**140 Lb./±30 In.**
Hole Diameter:	**8 In.**	Surface Elevation:	**61.3 Ft.**

Comments:

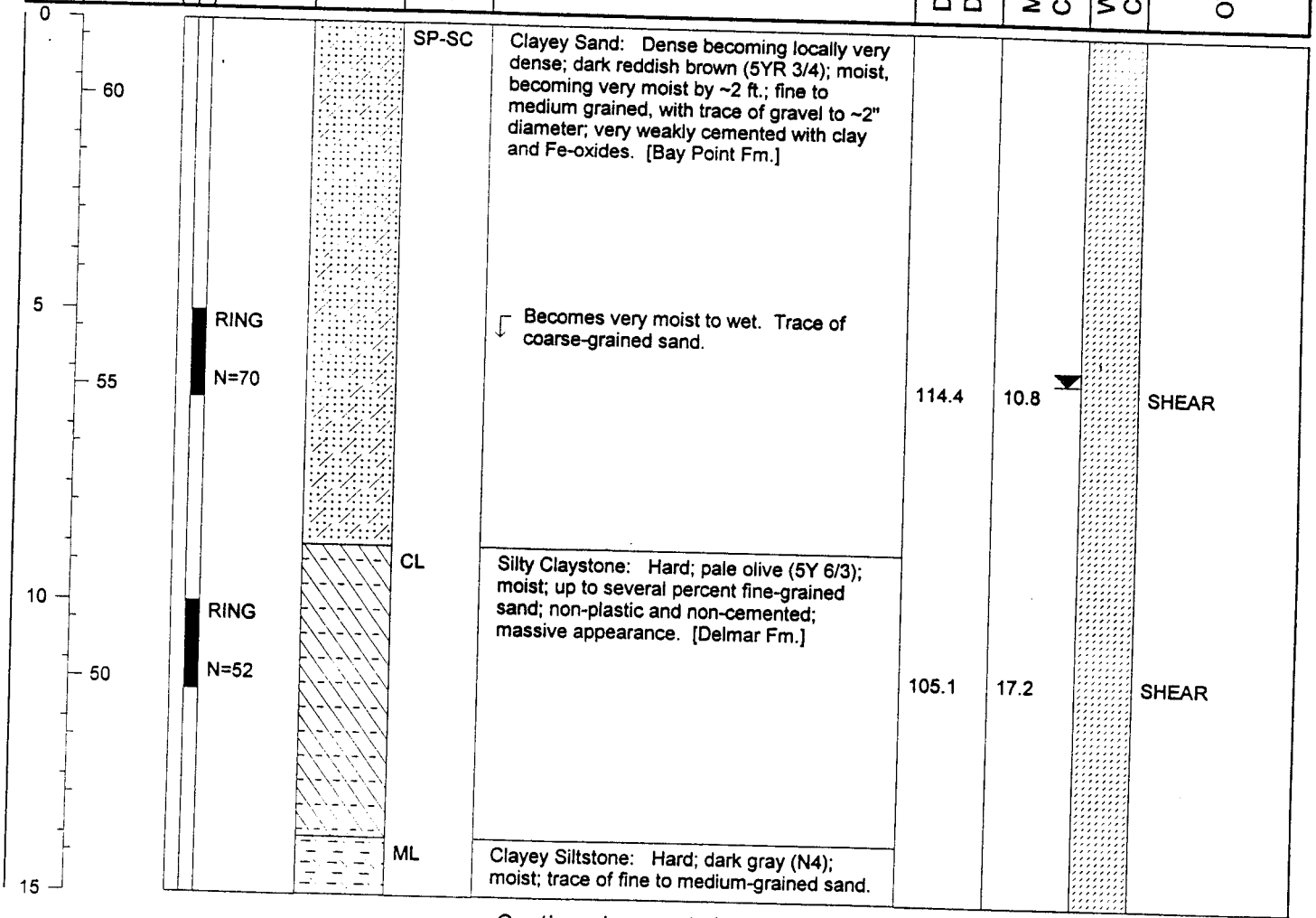

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FIG. A-19

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 7

Sheet 2 of 4

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
15	45	RING 80/12"		ML	Clayey Siltstone: Hard; dark gray (N4); moist; trace of fine to medium-grained sand; texture locally comprises small granules somewhat loosely bound together; non-plastic.	106.5	21.2		
20	40	RING 67/6"		ML	Sandy Siltstone: Hard; gray (N5); moist; sand component fine to medium grained; apparently massively bedded; non-plastic and mostly lacks clay. Increasingly sandy with depth.	108.1	12.8		SHEAR
25	35	RING 50/3"			Unit contains subordinate thin layers of silty, fine to medium-grained sandstone.	111.8	12.9		
30	30	RING 100/6"			← Very fine-grained silty sandstone.	105.9	12.1		SHEAR
					← 6-inch-thick well-cemented layer, hard drilling.				
35				SP	Sandstone: Very dense; very pale brown (10YR 7/4); wet; fine to coarse grained.				

Continued on next sheet.

FIG. A-20

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 7

Sheet 3 of 4

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
35		RING 100/5"		SP	Sandstone: Very dense; very pale brown (10YR 7/4); wet; fine to coarse grained; massively bedded.	104.7	9.9		SHEAR
	25								
40		RING 90/6"		SP, SP-SM		N/R	N/R		
	20								
		RING 70/6"		SP-SM	— Color gray (N6). Abrupt lower contact.				
				ML	Clayey Siltstone: Hard; gray (N5), with few dusky red mottles to about 1/2" across; moist; trace of fine-grained sand; non-plastic.	102.4	23.2		
45		RING 66/6"				109.7	17.7		SHEAR
	15								
50		RING 90/10"		ML, SC	— Sample with some clayey sandstone layer(s) to 6-8" thick.	106.3	15.1		
	10								
55									

Continued on next sheet.

FIG. A-21

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 7

Sheet 4 of 4

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK	SAMPLE INTERVALS: DRIVE	SAMPLE INTERVALS: TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
55			RING 55/6"			ML, CL	Clayey Siltstone: As before; grading to silty claystone.	105.9	19.2		SHEAR

Bottom of boring at 56.0 feet.
Perched groundwater encountered in zone from approximately 6.0 to 9.0 feet (base of Bay Point Fm.); also, sandstone aquifer encountered from 34 to 43 feet.
Boring backfilled with soil cuttings.

FIG. A-22

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 8

Sheet 1 of 4

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

Dates(s) Drilled:	**4/29/98**	Logged By:	**M. Doerschlag**
Drilled By:	**California-Pacific**	Total Depth:	**61.0 Ft.**
Rig Make/Model:	**Mobile B-53**	Hammer Type:	**Wireline downhole**
Drilling Method:	**Hollow-stem Auger**	Hammer Weight/Drop:	**140 Lb./±30 In.**
Hole Diameter:	**8 In.**	Surface Elevation:	**60.5 Ft.**

Comments:

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
0	60			SP	Sand: Dense; strong brown (7.5YR 4/6); moist, becoming very moist by ~2 ft.; fine to medium grained; estimated 3-5% clay and Fe-oxide binder. [Bay Point Fm.]				
					Becomes wet.				
5	55	RING 61/12"		CL	Knife-sharp contact. Silty Claystone: Hard; pale olive (5Y 6/4) to yellow (2.5Y 7/6); moist; up to several percent fine-grained sand; non-plastic and non-cemented; granulated appearance. [Delmar Fm.]	106.1	17.0		
10	50	RING 50/6"		SP-SM, ML	Silty Sandstone and Siltstone: Very dense or hard; mostly yellow (2.5Y 8/6); moist; apparently thinly bedded; siltstone beds with trace of clay; fine to medium-grained sandstone.	100.3	11.5		
15									

Continued on next sheet.

FIG. A-23

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 8

Sheet 2 of 4

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK	SAMPLE INTERVALS: DRIVE	SAMPLE INTERVALS: TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
15	45			RING 55/6"		ML	Clayey Siltstone: Hard; gray (N5); moist; trace of fine-grained sand; non-plastic; massively bedded.	112.7	12.4		
20	40			RING 62/6"		ML, SM ML	Sandy Siltstone: Hard; gray (N5); moist; sand component fine to medium grained; apparently massively bedded; non-plastic and mostly lacks clay. Increasingly sandy with depth. Sample @ 15 ft. classified as clayey siltstone with sand.	102.9	9.5		
25	35			RING 54/3"		ML	← Very sandy siltstone, trace of clay.	110.4	12.0		
						SM	Silty Sandstone: Very dense; dark gray (N4), with some small dusky red mottles; moist; fine to coarse grained. Inferred upper contact from harder drilling performance.				
30	30			RING 62/6"		ML, CL	Sandy Siltstone and Silty Claystone: Hard; dark gray (N4); moist; typically 5-10% fine to medium-grained sand; spotted with reddish Fe oxides along discontinuities. Mostly crumbly, friable, non-plastic, and often with granulated appearance.	102.3	9.2		
35											

Continued on next sheet.

FIG. A-24

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 8

Sheet 3 of 4

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
35	25	RING 50/5"		ML, CL	Sandy Siltstone and Silty Claystone: Hard; dark gray (N4), frequently spotted with reddish Fe oxides along discontinuities; moist; trace of mostly fine-grained sand; non-plastic, granulated appearance.	104.1	15.4		
40	20	RING 80/9"		CL	— Silty claystone, color very dark gray (5Y 3/1), crumbly texture.	102.3	16.2		
45	15	RING 50/6"		CL	← Silty claystone.	104.7	16.9		
50	10	RING 55/6"		CL	Silty Claystone: Hard; gray (5Y 5/1); moist; non-plastic. Near 50-ft. depth, contains some very thin (~1") layers of silty sandstone. Not mottled.	107.1	11.0		
55									

Continued on next sheet.

FIG. A-25

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 8

Sheet 4 of 4

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
55	5	RING 85/7"		CL	Silty Claystone: Hard; gray (5Y 5/1); moist; non-plastic. Sample @ 55 ft. intensely fractured, with marble-size granules bounded by random slicks.	114.6	10.2		
60	0	RING 62/6"			— Trace of reddish FeO mottling; few traces of carbonized organic matter.	95.8	13.8		

Bottom of boring at 61.0 feet.
Perched groundwater encountered in zone from approximately 4.0 to 5.5 feet (base of Bay Point Fm.).
Boring backfilled with soil cuttings.

FIG. A-26

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 9P

Sheet 1 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

Dates(s) Drilled:	**4/29/98**	Logged By:	**M. Doerschlag**
Drilled By:	**California-Pacific**	Total Depth:	**45.5 Ft.**
Rig Make/Model:	**Mobile B-53**	Hammer Type:	**Wireline downhole**
Drilling Method:	**Hollow-stem Auger**	Hammer Weight/Drop:	**140 Lb./±30 In.**
Hole Diameter:	**8 In.**	Surface Elevation:	**59.3 Ft.**

Comments: Groundwater seepage and dense arundo cane at nearby bluff.

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
0	55	RING N=45		SP	Sand: Dense; mostly yellowish red (5YR 5/8); moist becoming very moist at 1-2 ft.; fine to medium grained; trace of clay and Fe-oxide binding agents. [Bay Point Fm.]				
5					Becomes wet.	109.5	10.0		SHEAR
	50	RING N=35		SP-SC	Becomes medium to coarse grained; some highly weathered black volcanic clasts; slightly increased clay. Gravel lag deposit at base of formation; sharp contact.	113.4	14.3		SHEAR
10				CL	Silty Claystone: Hard; pale olive (5Y 6/3); moist; very silty; non-plastic; apparently massively bedded. [Delmar Fm.]				
	45	RING 70/12"			Silty claystone, with trace of fine to coarse-grained sand.	107.3	19.7		SHEAR
15									

Continued on next sheet.

FIG. A-27

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 9P

Sheet 2 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
15				CL	Silty Claystone: Hard; pale olive (5Y 6/3); moist; very silty; non-plastic. Trace of fine to coarse-grained sand.				
	40	RING 73/12"		ML, CL	Clayey Siltstone and Silty Claystone: Hard; pale yellow (5Y 7/4) and olive (5Y 6/3), with yellow (5Y 7/8) mottles and laminae; moist; non-plastic.	115.2	11.9		SHEAR
20									
		RING 75/12"		ML	— Clayey siltstone, with 1" wide, vertical clay-filled fracture (?) in sample.	117.4	10.4		
	35				Abruptly becomes dark gray (N5 to 5Y 5/1).				
25									
		RING 50/6"		SM	Silty Sandstone: Very dense; dark gray (N4); moist; fine to medium grained, with trace of clay; uncemented.	114.5	7.6		SHEAR
	30								
30				ML	Clayey Siltstone: Hard; dark gray (10YR 4/1); moist; non-plastic; texture of loosely bound granules. Hard drilling.				
		RING N=45				108.0	12.9		SHEAR
	25								
35									

Continued on next sheet.

FIG. A-28

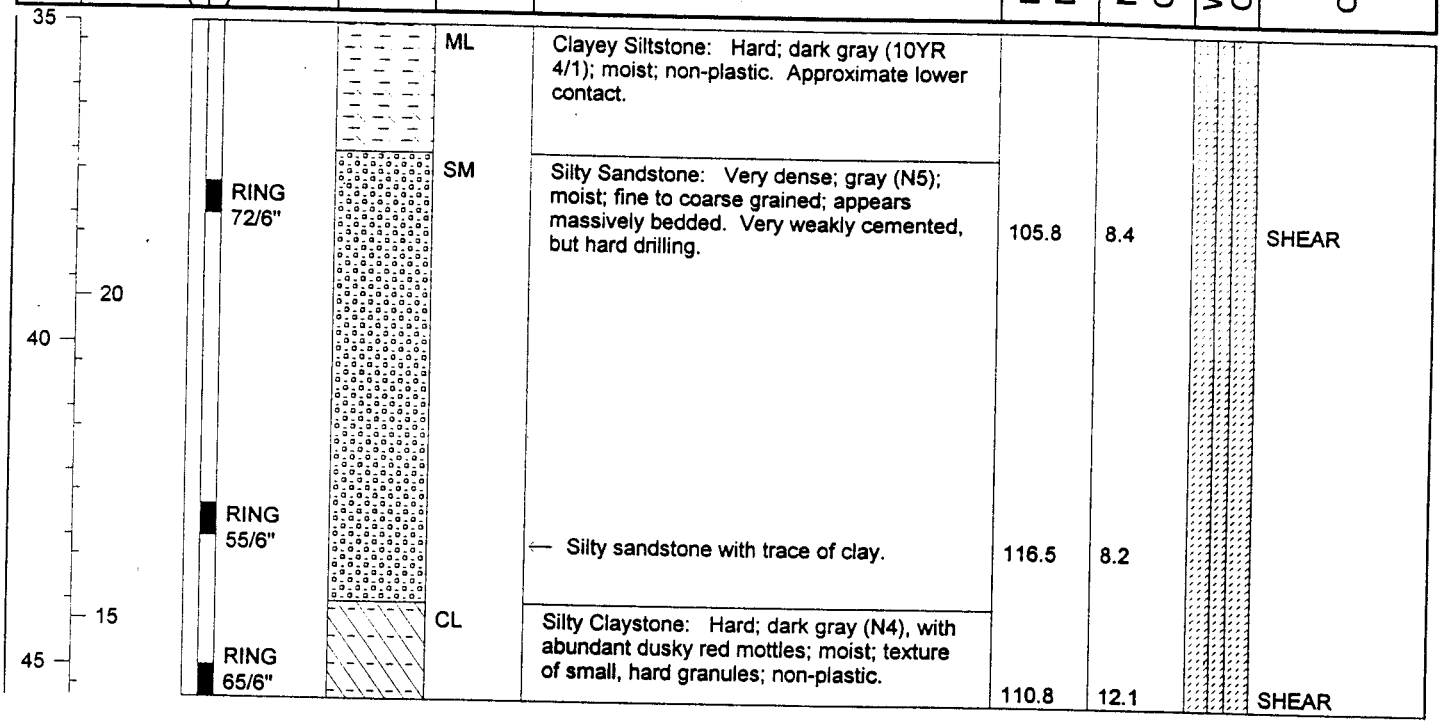
Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 9P

Sheet 3 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*



Boring terminated at 45.5 feet due to slow drilling progress and overheating equipment.
Perched groundwater encountered in zone from approximately 4.0 to 9.0 feet (base of Bay Point Fm.).
Piezometer installed as depicted in well completion column..

FIG. A-29

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 10

Sheet 1 of 4

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

Dates(s) Drilled:	**4/29/98**	Logged By:	**M. Doerschlag**
Drilled By:	**California-Pacific**	Total Depth:	**56.0 Ft.**
Rig Make/Model:	**Mobile B-53**	Hammer Type:	**Wireline downhole**
Drilling Method:	**Hollow-stem Auger**	Hammer Weight/Drop:	**140 Lb./±30 In.**
Hole Diameter:	**8 In.**	Surface Elevation:	**62.0 Ft.**

Comments: Groundwater seepage from nearby bluff exposures.

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
0	60	RING 13/12"		SP-SC	Clayey Sand with Gravel: Medium dense; brown (7.5YR 4/4); moist; fine to medium grained, with gravel and cobble-size rocks to ~4" diameter. [Fill]	106.5	6.6		
					Approximate contact.				
5	55			SP	Sand: Dense; yellowish red (5YR 5/8); moist becoming very moist near 8 ft.; fine to medium grained; trace of clay and Fe-oxide binding agents. [Bay Point Fm.]				
					Sharp contact.				
10	50	RING 43/6"		SP	Sandstone: Very dense; yellow (5Y 7/8); very moist; fine to medium grained; uncemented; apparently massively bedded. [Delmar Fm.]	104.9	14.4		SHEAR
15				ML, CL	Clayey Siltstone and Silty Claystone: Hard; olive brown (2.5Y 4/4); moist; generally trace of fine-grained sand.				

Continued on next sheet.

FIG. A-30

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 10

Sheet 2 of 4

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
15				ML, CL	Clayey Siltstone and Silty Claystone: Hard; pale olive (5Y 6/3); moist; non-plastic. Trace of fine-grained sand.				
	45				— Cuttings dusky red (2.5YR 3/2) from about 17-18 ft.				
				SP-SM	Silty Sandstone: Very dense; dark reddish brown (5YR 2.5/2); wet; fine-grained. Thinly bedded in bluff exposures.				
20		RING 73/6"				105.8	19.2		
	40								
25				ML	Siltstone and Silty Sandstone: Hard or very dense; dark gray (N4); moist; fine to medium grained sand; siltstones commonly with trace of clay; uncemented.				
	35								
30		RING 60/6"		SM	← Fine-grained, very silty sandstone.	107.6	11.9		
	30								
35									

Continued on next sheet.

FIG. A-31

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 10

Sheet 3 of 4

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
35				ML	Clayey Siltstone: Hard; mostly gray (5Y 5/1), occasionally mottled with dusky red Fe-oxide staining; moist; non-plastic.				
25									
40		RING 40/6"		ML	Sandy siltstone, gray (5Y 5/1), slight granulated texture, some Fe-oxide mottling.	111.0	12.9		
20									
45									
15									
50		RING 65/6"		ML	Clayey siltstone with trace of sand, slight granulated texture, non-plastic.	103.1	15.5		
10									
55									

Continued on next sheet.

FIG. A-32

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 10

Sheet 4 of 4

Project: ***NORTH COUNTY TRANSIT DISTRICT***

Location: ***DEL MAR, CALIFORNIA*** Project No. ***3650-SF***

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
55		RING 52/6"		ML	Sandy Siltstone: Hard; gray (N5); moist; fine-grained sand.	111.8	15.5		SHEAR

Bottom of boring at 56.0 feet.
Perched groundwater encountered in sandstone member from approximately 19.0 to 25.0 feet.
Boring backfilled with soil cuttings.

FIG. A-33

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 11P

Sheet 1 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

Dates(s) Drilled:	**4/29/98**	Logged By:	**M. Doerschlag**
Drilled By:	**California-Pacific**	Total Depth:	**51.0 Ft.**
Rig Make/Model:	**Mobile B-53**	Hammer Type:	**Wireline downhole**
Drilling Method:	**Hollow-stem Auger**	Hammer Weight/Drop:	**140 Lb./±30 In.**
Hole Diameter:	**8 In.**	Surface Elevation:	**60.2 Ft.**

Comments: Surface water in adjacent drainage.

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
0	60			SP	Sand: Mostly dense; mostly strong brown (7.5YR 4/6); moist; fine to medium grained, with trace of gravel; trace of clay and Fe-oxide binding agents. [Bay Point Fm.]				
		RING							
		N=34		SP		117.1	7.4		
5	55								
		RING							
		N=40		SP	← Color 10YR 5/6; includes some coarse-grained sand.	109.3	4.4		
10	50								
					Sharp contact.				
		RING		SP	Sandstone: Very dense; yellow (5Y 7/8); very moist becoming wet; fine to medium grained, with trace of silt; uncemented; massively bedded. [Delmar Fm.]	106.8	10.0		
		67/12"							
15									

Continued on next sheet.

FIG. A-3.1

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 11P

Sheet 2 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

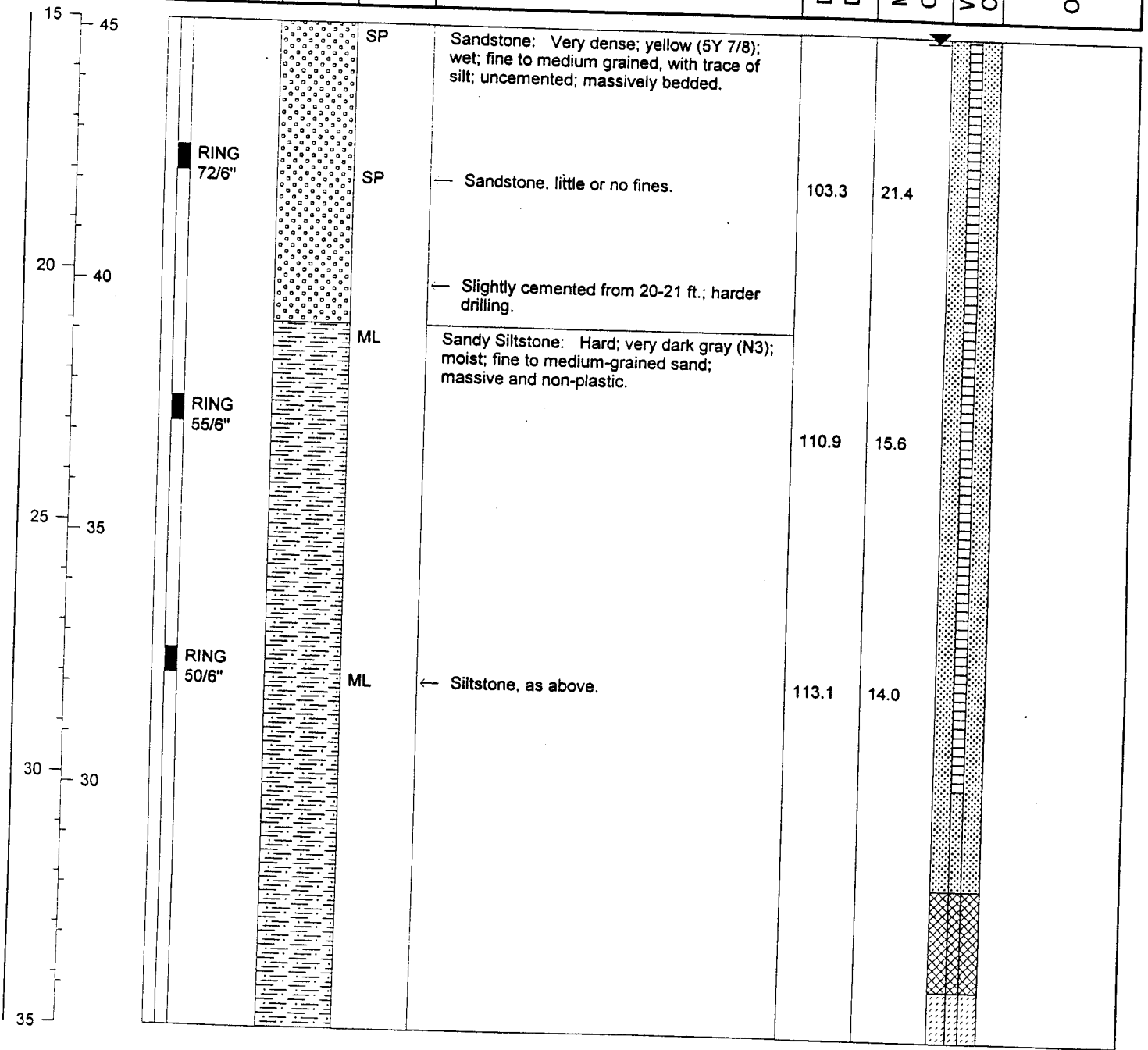


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FIG. A-35

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 11P

Sheet 3 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
35	25	RING 53/6"		ML, SM	Sandy Siltstone: As before; some very silty sandstone.	103.5	13.5		
				SP-SM	Silty Sandstone: Very dense; gray (N5); moist; fine to coarse grained; apparently massively bedded. Slightly cemented from 36 to 37 ft., and hard drilling. Becomes siltier with depth.				
				SM	Becomes easier drilling; interpreted silty sandstone.				
40	20				Approximate contact.				
				ML	Clayey Siltstone: Hard; olive gray (5Y 4/2); moist; trace of sand; non-plastic, with some granulated textures.				
45	15	RING 56/6"			← Clayey siltstone, as above.	107.4	15.8		
50	10	RING 58/6"		ML, SM	← Mixed clayey siltstone and thin silty sandstone, with common dusky red mottles	109.0	10.9		

Bottom of boring at 51.0 feet.
Perched groundwater encountered in zone from approximately 14.0 to 21.0 feet, measured depth of 15.1 feet after well installation. No groundwater encountered below 21.0 feet. Piezometer installed as depicted in well completion column..

FIG. A-38

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 12

Sheet 1 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

Dates(s) Drilled:	**4/30/98**	Logged By:	**M. Doerschlag**
Drilled By:	**California-Pacific**	Total Depth:	**50.0 Ft.**
Rig Make/Model:	**Mobile B-53**	Hammer Type:	**Wireline downhole**
Drilling Method:	**Hollow-stem Auger**	Hammer Weight/Drop:	**140 Lb./±30 In.**
Hole Diameter:	**8 In.**	Surface Elevation:	**60.5 Ft.**

Comments: Boring located in rail cut.

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK	SAMPLE INTERVALS: DRIVE	SAMPLE INTERVALS: TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
0	60					SP	Sand: Dense; yellowish red (5YR 4/6); moist becoming very moist near 5 ft.; fine to medium grained; trace of clay and Fe-oxide binding agents. [Bay Point Fm.]				
5	55										
10	50		RING 59/12"				Lightens to strong brown (7.5YR 5/6).	98.5	10.7		
							Becomes wet.				
15						CL	Sharp contact. Silty Claystone: Hard; light yellowish brown (2.5Y 6/4); moist; trace of fine to medium-grained sand; slightly plastic. [Delmar Fm.]				

Continued on next sheet.

FIG. A-37

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 12

Sheet 2 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
15	45			CL	Silty Claystone: Hard; light yellowish brown (2.5Y 6/4); moist; trace of fine to medium-grained sand; slightly plastic.				
				SM	Silty Sandstone: Very dense; dark gray (5YR 4/1); moist; fine to medium grained and very silty. Apparently massively bedded.				
20	40	RING 60/6"			← Silty sandstone, as above.	104.7	12.3		
				ML, CL	Clayey Siltstone and Silty Claystone: Hard; dark gray (N4); moist; occasional trace of fine to medium-grained sand; non-plastic. Increasing sand content with depth.				
25	35								
30	30	RING 60/6"		SM	← Local very fine-grained, very silty sandstone; light gray (5YR 6/1).	113.5	8.8		
					⌐ Very clayey from about 33 to 35 feet. ↓				
35									

Continued on next sheet.

FIG. A-22

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 12

Sheet 3 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
35	25			SM, SP-SM	Silty Sandstone: Very dense; gray (N5); moist; fine to medium grained. Inferred from cuttings.				
40	20	RING 91/9"		ML	← Sandy siltstone, gray (N5), trace of clay, massive texture. Thin, local layer.	95.3	9.2		
45	15			CL	Silty Claystone: Hard; dark gray (N4) and dusky red (10R 3/3); moist; non-plastic and friable, with pronounced granulated texture. Hard drilling.				
50		RING 56/6"		ML	← Grades to clayey siltstone, olive gray, slight granulated texture.	102.3	14.4		

Bottom of boring at 50.0 feet.
Slight groundwater seepage inferred to originate from approximately 13.0 to 14.0 feet (base of Bay Point Fm.).
Boring backfilled with soil cuttings.

FIG. A-39

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 13

Sheet 1 of 4

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

Dates(s) Drilled:	**4/30/98**	Logged By:	**M. Doerschlag**
Drilled By:	**California-Pacific**	Total Depth:	**56.0 Ft.**
Rig Make/Model:	**Mobile B-53**	Hammer Type:	**Wireline downhole**
Drilling Method:	**Hollow-stem Auger**	Hammer Weight/Drop:	**140 Lb./±30 In.**
Hole Diameter:	**8 In.**	Surface Elevation:	**57.6 Ft.**

Comments: Groundwater seepage visible at bluff face.

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
0	55			SP	Sand: Dense to very dense; red (2.5YR 4/8); slightly moist; fine to medium grained; trace of clay and Fe-oxide binding agents. [Bay Point Fm.]				
5	50				Lightens to strong brown (2.5YR 5/6) and yellowish brown (10YR 5/6).				
10	45	RING N=60				106.2	4.6		SHEAR
					Sharp contact.				
15				SP	Sandstone: Very dense; yellow (10YR 7/5) becoming very pale brown (10YR 7/4); moist to very moist; fine to coarse grained; massively bedded and essentially uncemented. [Delmar Fm.]				

Continued on next sheet.

FIG. A-40

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 13

Sheet 2 of 4

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
15		RING 55/6"		SP	Sandstone: Very dense; very pale brown (10YR 7/4); moist to very moist; fine to coarse grained; massively bedded.	118.4	11.9		SHEAR
	40								
20		RING 57/6"		SP	← Sandstone, as above.	111.3	11.8		
				ML	Clayey Silt: Hard; very pale brown (10YR 7/4); moist; non-plastic.				
	35							▼	
				SP	Sandstone: Very dense; very pale brown (10YR 7/4); moist; fine to coarse grained; uncemented.				
25		RING 65/6"		SP	← Sandstone, as above.	107.8	19.2		SHEAR
	30								
				CL	Silty Claystone: Hard; dark gray (10YR 4/1); moist; trace of fine-grained sand; non-plastic.				
30		RING 70/6"		CL	← Silty claystone, as above.	111.9	16.9		SHEAR
	25								
35									

Continued on next sheet.

FIG. A-41

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 13

Sheet 3 of 4

Project: ***NORTH COUNTY TRANSIT DISTRICT***

Location: ***DEL MAR, CALIFORNIA*** | Project No. ***3650-SF***

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
35		RING 60/6"		ML, CL	Clayey Siltstone and Silty Claystone: Hard; gray (10YR 6/1) at 35 feet becoming mostly dark gray (N4) at greater depths; moist; non-plastic. Variably granulated textures, ranging from massive to intensely fractured.	116.4	12.8		SHEAR
40	20	RING 59/9"		ML	← Clayey siltstone, dark gray (N4) with some dusky red Fe oxide mottling, trace of sand, granulated texture.	106.2	15.7		
45	15	RING 50/6"		ML	← Clayey siltstone, less clay than above, and only slightly granulated texture.	111.8	17.2		SHEAR
50	10	RING 65/6"		ML	← Very clayey siltstone, abundant dusky red mottles, intensely fractured.	107.7	19.9		
55	5								

Continued on next sheet.

FIG. A-42

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 13

Sheet 4 of 4

Project: ***NORTH COUNTY TRANSIT DISTRICT***

Location: ***DEL MAR, CALIFORNIA*** Project No. ***3650-SF***

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK	SAMPLE INTERVALS: DRIVE	SAMPLE INTERVALS: TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
55			RING 56/6"			ML	Clayey Siltstone and Silty Claystone: As before at 50 ft.	112.6	18.1		SHEAR

Bottom of boring at 56.0 feet.
Perched groundwater encountered in sandstone unit from approximately 23.0 to 28.0 feet; no groundwater encountered below 28.0 feet.
Boring backfilled with soil cuttings.

FIG. A-43

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 14P

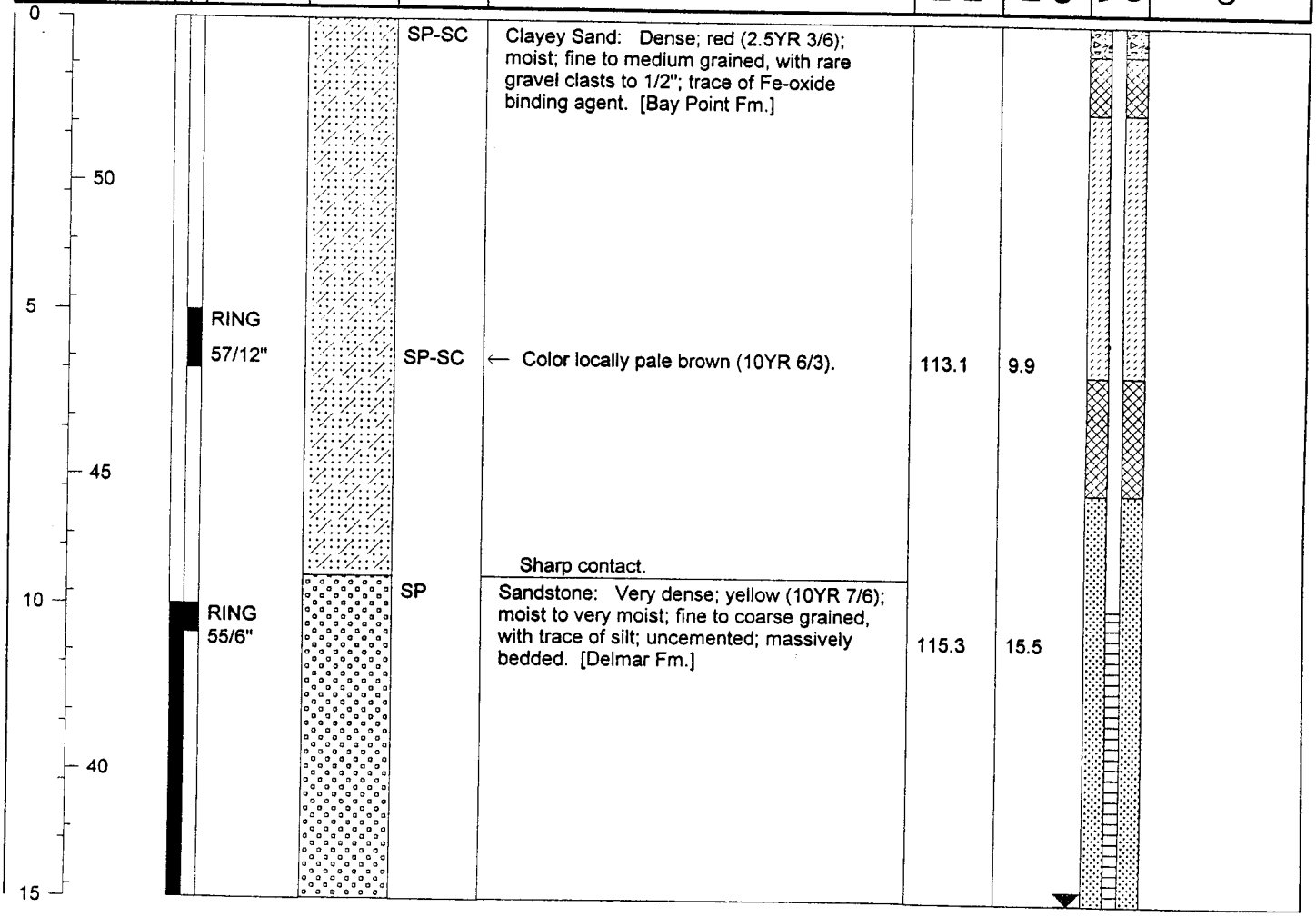
Sheet 1 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

Dates(s) Drilled:	**4/30/98**	Logged By:	**M. Doerschlag**
Drilled By:	**California-Pacific**	Total Depth:	**51.0 Ft.**
Rig Make/Model:	**Mobile B-53**	Hammer Type:	**Wireline downhole**
Drilling Method:	**Hollow-stem Auger**	Hammer Weight/Drop:	**140 Lb./±30 In.**
Hole Diameter:	**8 In.**	Surface Elevation:	**52.8 Ft.**

Comments:



Continued on next sheet.

FIG. A-44

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 14P

Sheet 2 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
15	35	RING 56/6"		SP	Sandstone: Very dense; color becoming pale brown (10YR 8/3); becomes wet at 15 feet; mostly medium to coarse grained, with trace of silt; uncemented; massively bedded.	108.3	17.5		
				SM	Grades silty, fine-grained.				
20		RING 50/6"		ML	Clayey Siltstone: Hard; dark gray (N4); moist; trace of fine to medium-grained sand; massive and non-plastic.	112.4	15.4		SHEAR
25	30	RING 43/6"		ML	← Clayey siltstone, as above.	99.3	17.6		
30	25	RING 50/6"		ML	← Siltstone, little to no clay, massively bedded.	111.8	15.5		SHEAR
35	20								

Continued on next sheet.

FIG. A-45

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 14P

Sheet 3 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
35		RING 60/6"		ML, SM	Siltstone and Silty Sandstone: Hard or very dense; dark to very dark gray (N3-N4); slightly moist to moist; sandy layers mostly fine to medium grained. Classified silty sandstone at 35 ft. depth.	99.3	11.6		SHEAR
	15								
40		RING 55/6"		ML	← Sandy siltstone, little to no clay, massive.	106.2	14.8		
	10								
				SM	Silty Sandstone: Very dense; dark gray (N4); moist; fine to medium grained; apparently massively bedded. Exposed at toe of bluffs.				
45		RING 72/6"				102.5	10.5		SHEAR
	5			ML	Clayey Siltstone: Hard; dark gray (N5) with common dusky red mottles; moist; local trace of sand; non-plastic, locally with some granulated textures.				
50		RING 42/6"			← Clayey siltstone, as above.	107.3	14.9		SHEAR

Bottom of boring at 51.0 feet.
Perched groundwater encountered in zone from approximately 15.0 to 17.0 feet, at base of sandstone member.
No groundwater encountered below 17.0 feet.
Piezometer installed as depicted in well completion column..

FIG. A-46

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 15

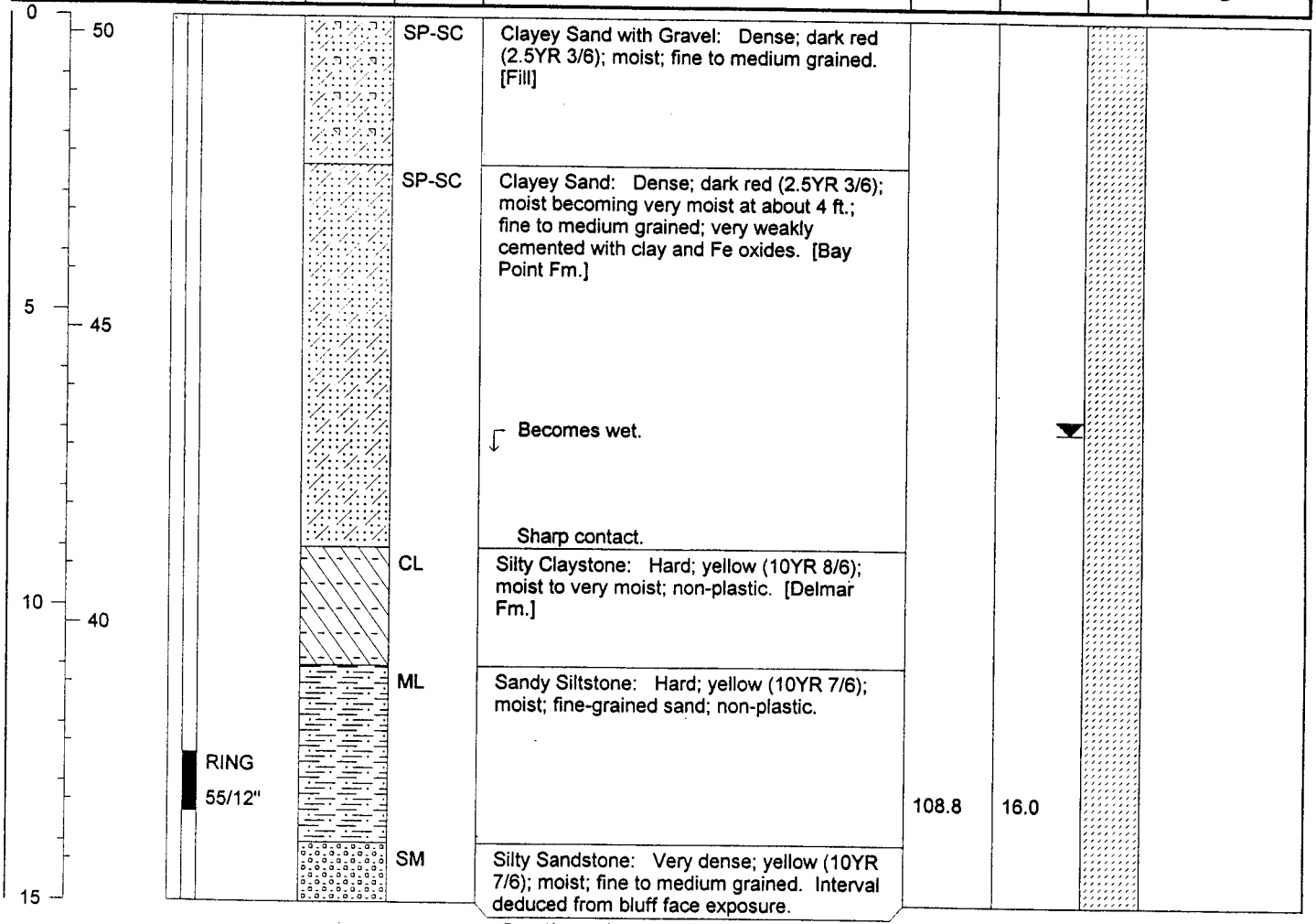
Sheet 1 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

Dates(s) Drilled:	**4/30/98**	Logged By:	**M. Doerschlag**
Drilled By:	**California-Pacific**	Total Depth:	**43.0 Ft.**
Rig Make/Model:	**Mobile B-53**	Hammer Type:	**Wireline downhole**
Drilling Method:	**Hollow-stem Auger**	Hammer Weight/Drop:	**140 Lb./±30 In.**
Hole Diameter:	**8 In.**	Surface Elevation:	**50.3 Ft.**

Comments:



Continued on next sheet.

FIG. A-47

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 15

Sheet 2 of 3

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
15	35			SM	Silty Sandstone: Very dense; yellow (10YR 7/6); moist; fine to medium grained. Interval deduced from bluff face exposure.				
		RING 74/12"		ML	Clayey Siltstone: Hard; mostly dark gray (N4) with frequent dusky red mottles; moist; small amounts of fine to medium-grained sand; variably massive to intensely fractured or granulated.	104.6	17.7		
20	30								
		RING 74/12"		ML	← Clayey siltstone, as above, granulated texture.	99.7	16.4		
25	25								
		RING N=27		ML	← Clayey siltstone with sand, olive gray (5Y 5/2) with red (10R 3/6) mottles.	97.6	18.8		
30	20				Siltstone: Hard; dark gray (5Y 4/1); moist; non-plastic; trace of clay and fine-grained sand. Mostly massive to lightly granular texture.				
35									

Continued on next sheet.

FIG. A-48

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 15

Sheet 3 of 3

Project: ***NORTH COUNTY TRANSIT DISTRICT***

Location: ***DEL MAR, CALIFORNIA*** Project No. ***3650-SF***

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
35	15				Siltstone: Hard; dark gray (5Y 4/1) and gray (N5); moist; non-plastic; trace of clay; mostly massive and without granular texture.				
		RING 53/6"		ML	← Siltstone, as above.	107.8	16.0		
40	10								
		RING 72/6"		ML	← Very sandy siltstone, gray (N5), massive	103.8	15.8		

Bottom of boring at 43.0 feet.
Perched groundwater encountered in zone from approximately 7.0 to 9.0 feet (base of Bay Point Fm.).
Boring backfilled with soil cuttings.

FIG. A-49

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 16

Sheet 1 of 2

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

Dates(s) Drilled:	**4/30/98**	Logged By:	**M. Doerschlag**
Drilled By:	**California-Pacific**	Total Depth:	**29.5 Ft.**
Rig Make/Model:	**Mobile B-53**	Hammer Type:	**Wireline downhole**
Drilling Method:	**Hollow-stem Auger**	Hammer Weight/Drop:	**140 Lb./±30 In.**
Hole Diameter:	**8 In.**	Surface Elevation:	**46.5 Ft.**

Comments: Located at north end of project alignment.

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK	SAMPLE INTERVALS: DRIVE	SAMPLE INTERVALS: TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
0	45					SP-SC	Clayey Sand with Gravel: Dense; dark red (2.5YR 3/6); moist; fine to coarse grained. [Fill]				
						SP-SC	Clayey Sand: Dense; yellowish red (5YR 4/6); moist; fine to medium grained; very weakly cemented with clay and Fe oxides. [Bay Point Fm.]				
5	40					SP	Sharp contact. Sandstone: Very dense; yellow (5Y 8/6); moist; fine to coarse grained; local trace of silt; uncemented; massively bedded. [Delmar Fm.]				
10	35						Becomes yellow (5Y 7/7).				
15						CL, ML	Silty Claystone and Clayey Siltstone: Hard; yellow (10YR 8/6) to pale brown (10YR 7/3); moist; trace of fine to medium-grained sand; slightly plastic from 13-16 feet.				

Continued on next sheet.

FIG. A-50

Medall, Aragon, Higley Geotechnical, Inc.

FIELD LOG OF BORING B - 16

Sheet 2 of 2

Project: *NORTH COUNTY TRANSIT DISTRICT*

Location: *DEL MAR, CALIFORNIA* | Project No. *3650-SF*

DEPTH (Ft.)	ELEVATION (MSL)	SAMPLE INTERVALS: BULK / DRIVE / TYPE, N (Blows/ft.)	LITHOLOGY	USCS	GEOTECHNICAL DESCRIPTION	DRY DENSITY (Pcf)	MOISTURE CONTENT (%)	WELL COMPLETION	OTHER TESTS
15	30			ML	Clayey Siltstone: Hard; yellow (10YR 8/6) to pale brown (10YR 7/3); moist; trace of fine to medium-grained sand; non-plastic below about 16 feet.				
20	25	RING 69/12"		ML	Abruptly becomes gray (5Y 5/1). Clayey siltstone, non-plastic, slight granulated texture.	109.9	15.0		
25	20	RING 48/6"		ML	Clayey siltstone, very pale brown (10YR 7/4) with dusky red mottles, massively bedded.	101.3	20.8		

Bottom of boring at 29.5 feet.
No groundwater encountered.
Boring backfilled with soil cuttings.

FIG. A-51

EXPLANATION OF GEOTECHNICAL BORING LOG

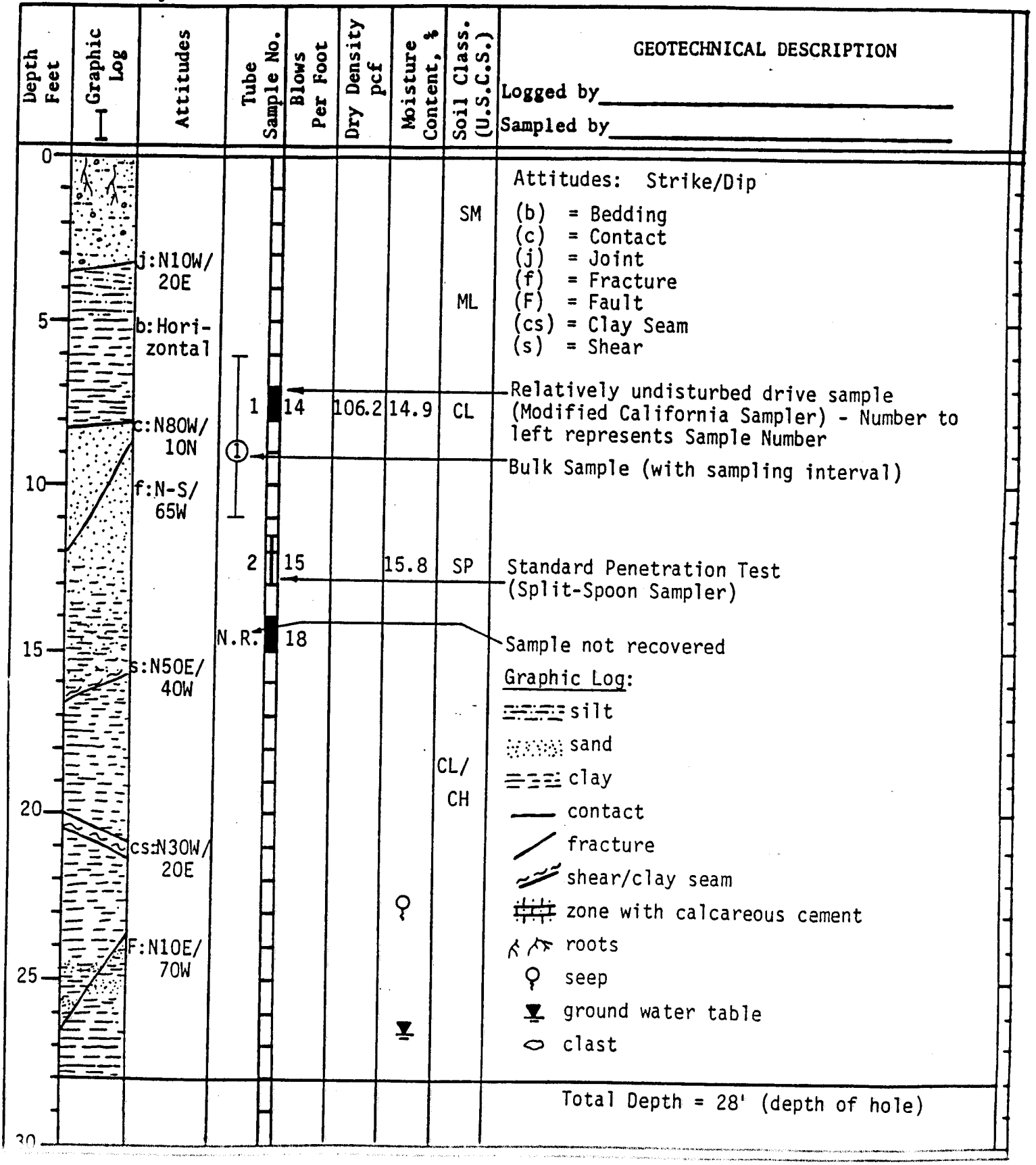
Date_____ Drill Hole No. _____ Sheet __ of __

Project_____ Job No._____

Drilling Co._____ Type of Rig_____

Hole Diameter_____ Drive Weight_____ Drop_____ in.

Elevation Top of Hole Ref. or Datum



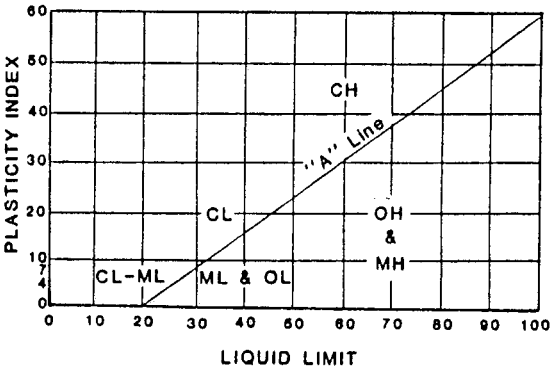
Leighton & Associates

MAJOR DIVISIONS		SOIL CLASS.	TYPICAL NAMES
COARSE GRAINED SOILS (More than 1/2 of soil > no. 200 sieve size)	GRAVELS (More than 1/2 of coarse fraction > no. 4 sieve size)	GW	Well graded gravels or gravel-sand mixtures, little or no fines
		GP	Poorly graded gravels or gravel-sand mixtures, little or no fines
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS (More than 1/2 of coarse fraction < no. 4 sieve size)	SW	Well graded sands or gravelly sands, little or no fines
		SP	Poorly graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE GRAINED SOILS (More than 1/2 of soil < no. 200 sieve size)	SILTS & CLAYS LL < 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 & CLAYS LL > 50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silty clays, organic silts
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils

CLASSIFICATION CHART
(Unified Soil Classification System)

CLASSIFICATION	RANGE OF GRAIN SIZES	
	U.S. Standard Sieve Size	Grain Size in Millimeters
BOULDERS	Above 12"	Above 305
COBBLES	12" to 3"	305 to 76.2
GRAVEL	3" to No. 4	76.2 to 4.76
coarse	3" to 3/4"	76.2 to 19.1
fine	3/4" to No. 4	19.1 to 4.76
SAND	No. 4 to No. 200	4.76 to 0.074
coarse	No. 4 to No. 10	4.76 to 2.00
medium	No. 10 to No. 40	2.00 to 0.420
fine	No. 40 to No. 200	0.420 to 0.074
SILT & CLAY	Below No. 200	Below 0.074

GRAIN SIZE CHART



PLASTICITY CHART

METHOD OF SOIL CLASSIFICATION

DMB 3 Drilled Pile Summary Table

Del Mar Bluffs - 3
Pile Data Summary Table

Pile No.	Date of Drilling	Shaft Diameter (in)	Surface Elevation (ft)	Steel Length (ft)	Depth of Excavation (ft)	Notes
SP-1-01	10/31/2011	36	52.42	45.0	47.67	Downhole logged/SP installed
SP-1-02	11/1/2011	36	52.19	45.0	47.75	
SP-1-03	10/31/2011	36	52.17	45.0	47.67	
SP-1-04	11/3/2011	36	52.13	45.0	47.58	
SP-1-05	11/1/2011	36	51.98	45.0	47.1	
SP-2-01	11/2/2011	36	60.30	49.75	50.67	
SP-2-02	11/3/2011	36	60.55	49.75	51.0	
SP-2-03	11/2/2011	36	60.68	49.75	51.1	
SP-2-04	10/28/2011	36	60.55	49.75	51.0	
SP-2-05	11/3/2011	36	60.55	49.75	51.1	
SP-2-06	10/26/2011	36	60.87	49.75	51.5	
SP-2-07	11/2/2011	36	61.10	49.75	51.83	
SP-2-08	10/25/2011	36	60.35	49.75	50.92	
SP-2-09	10/24/2011	36	60.70	49.75	51.5	
SP-2-10	10/28/2011	36	60.04	49.75	50.75	
SP-2-11	10/26/2011	36	60.12	49.75	50.9	
SP-2-12	10/25/2011	36	59.87	49.75	50.50	
SP-2-13	10/24/2011	36	59.78	49.75	50.75	
SP-2-14	10/28/2011	36	59.60	49.75	50.33	
SP-2-15	10/26/2011	36	59.42	49.75	50.42	
SP-2-16	10/25/2011	36	59.32	49.75	50.33	
SP-2-17	10/24/2011	36	58.79	49.75	49.7	Moved SP west of exist wall
SP-2-18	10/28/2011	36	59.21	49.75	50.33	Moved SP west of exist wall
SP-2-19	10/26/2011	36	59.10	49.75	50.25	Moved SP west of exist wall
SP-2-20	10/25/2011	36	59.23	49.75	50.42	Moved SP west of exist wall
SP-2-21	10/24/2011	36	58.48	49.75	49.75	Moved SP west of exist wall
SP-2-22	10/17/2011	36	58.69	-	50.1	Dowhole logged, moved SP west of wall
SP-2-22	11/1/2011	36	58.69	49.75	50.1	Redrilled to install SP
SP-2-23	10/31/2011	36	58.69	49.75	50.0	Moved SP west of exist wall
SP-3-01	10/20/2011	36	63.10	-	20+/-	PVC pipe encounted/drilling stopped/filled with slurry
SP-3-01	10/27/2011	36	64.04	65.0	64.75	Drilled to plan elevation.
SP-3-02	10/19/2011	36	64.70	65.0	65.10	
SP-3-03	10/17/2011	36	65.00	65.0	66.10	Dowhole logged/SP installed
SP-3-04	10/14/2011	36	65.05	65.0	65.67	
SP-3-05	10/17/2011	36	65.25	65.0	66.0	
SP-3-06	10/19/2011	36	65.38	65.0	65.92	
SP-3-07	10/14/2011	36	65.44	65.0	65.92	
SP-3-08	10/17/2011	36	65.34	65.0	65.75	
SP-3-09	10/19/2011	36	65.44	65.0	66.0	
SP-3-10	10/14/2011	36	65.50	65.0	66.0	
SP-3-11	10/17/2011	36	65.32	65.0	66.0	
SP-3-13	10/20/2011	36	62.50	65.0	63.2	

Del Mar Bluffs - 3
Pile Data Summary Table

Pile No.	Date of Drilling	Shaft Diameter (in)	Surface Elevation (ft)	Steel Length (ft)	Depth of Excavation (ft)	Notes
SP-4-01	9/12/2011	36	56.48	45.0	46.8	
SP-4-02	8/24/2011	36	56.40	45.0	46.5	
SP-4-03	8/29/2011	36	56.34	45.0	46.5	
SP-4-04	8/24/2011	36	56.74	45.0	46.5	
SP-4-05	8/30/2011	36	56.70	45.0	46.5	
SP-4-06	8/25/2011	36	56.85	45.0	47.0	
SP-4-07	8/31/2011	36	57.03	-	46.5	Dowhole logged/redrilled 9/7/11
SP-4-07	9/7/2011	36	57.03	45.0	46.8	Redrilled to install SP
SP-4-08	8/25/2011	36	57.00	45.0	47.0	
SP-4-09	8/30/2011	36	57.08	45.0	46.5	
SP-4-10	8/29/2011	36	57.06	45.0	46.5	
SP-5-01	9/20/2011	36	63.13	45.0	47.8	
SP-5-02	9/19/2011	36	62.96	45.0	47.6	
SP-5-03	9/16/2011	36	63.04	45.0	47.7	
SP-5-04	9/19/2011	36	62.94	45.0	47.3	
SP-5-05	9/16/2011	36	62.90	45.0	47.25	
SP-5-06	9/21/2011	36	63.49	45.0	47.8	
SP-5-07	9/19/2011	48/60	62.76	-	12+/-	Fill, seepage @ 7-8', reamed to 48/60", filled slurry
SP-5-07	9/20/2011	36	62.79	45.0	47.0	Redrilled to install SP
SP-5-08	9/19/2011	48/55	-	-	9+/-	Fill, seepage @ 6', reamed to 48/55", filled slurry
SP-5-08	9/21/2011	36/48	-	-	22+/-	Rock-rubble, belling @8-13', filled slurry
SP-5-08	9/22/2011	36	63.03	45.0	47.3	Redrilled to install SP
SP-5-09	9/19/2011	48	62.86	-	9+/-	Fill, seepage @ 6.5', reamed to 48/55", filled slurry
SP-5-09	9/20/2011	36	62.90	45.0	46.8	Redrilled to install SP
SP-5-10	9/22/2011	36	63.46	45.0	47.3	
SP-5-11	9/20/2011	36	63.25	45.0	47.0	Concrete 48" lower
SP-5-12	9/1/2011	36	62.75	-	46.5	Dowhole logged/redrilled 9/7/11
SP-5-12	9/7/2011	36	62.75	45.0	46.5	Redrilled to install SP
SP-5-13	9/16/2011	36	63.20	45.0	46.7	
SP-6-01	9/14/2011	36	61.01	45.0	47.1	
SP-6-02	9/21/2011	36	61.39	45.0	47.3	
SP-6-03	9/13/2011	36	60.55	45.0	46.5	
SP-6-04	9/12/2011	36	60.63	45.0	46.5	
SP-6-05	9/14/2011	36	62.08	45.0	47.75	
SP-6-06	9/1/2011	36	61.29	-	46.5	Dowhole logged/redrilled 9/7/11
SP-6-06	9/7/2011	36	61.29	45.0	46.5	Redrilled to install SP
SP-6-07	9/13/2011	36	61.96	45.0	47.5	
SP-6-08	9/14/2011	36	62.06	45.0	47.5	
SP-6-09	9/13/2011	36	62.00	45.0	47.6	
SP-6-10	9/20/2011	36	62.78	45.0	48.0	
SP-6-11	9/14/2011	36	62.70	45.0	48.0	
SP-6-12	9/16/2011	36	62.85	45.0	47.8	
SP-6-13	9/19/2011	36	62.92	45.0	47.8	

Del Mar Bluffs - 3
Pile Data Summary Table

Pile No.	Date of Drilling	Shaft Diameter (in)	Surface Elevation (ft)	Steel Length (ft)	Depth of Excavation (ft)	Notes
SP-6-14	9/16/2011	36	62.79	45.0	47.6	
SP-7-01	8/25/2011	36	58.70	45.0	46.5	
SP-7-02	8/30/2011	36	59.21	45.0	46.5	
SP-7-03	8/29/2011	36	59.16	45.0	46.5	
SP-7-04	8/30/2011	36	59.10	45.0	46.5	
SP-7-05	8/25/2011	36	59.00	45.0	46.5	
SP-7-06	8/31/2011	36	59.76	-	47.0	Dowhole logged/redrilled 9/7/11
SP-7-06	9/7/2011	36	59.76	45.0	47.0	Redrilled to install SP
SP-7-07	8/29/2011	36	59.48	45.0	46.5	
SP-7-08	9/12/2011	36	60.27	45.0	47.1	
SP-7-09	9/13/2011	36	60.49	45.0	47.7	
SP-7-10	9/12/2011	36	60.30	45.0	47.0	
SP-7-11	9/13/2011	36	60.47	45.0	47.0	
SP-7-12	9/14/2011	36	60.61	45.0	47.0	
SP-7-13	9/21/2011	36	60.92	45.0	47.2	
SP-7-14	9/12/2011	36	60.58	45.0	46.8	

Appendix C

Laboratory Testing Procedures and Test Results

APPENDIX C

Laboratory Testing Procedures and Test Results

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

Percent Passing No. 200 Sieve: The material passing the number 200 sieve was determined according to ASTM D1140.

Sample Location	Sample Description	% Passing	% Retained
B-1 @ 10’	Silty Sand (SM)	26	74
B-2 @ 18’	Silty Sand (SM)	27	73

Minimum Resistivity and pH Tests: Minimum resistivity and pH tests were performed in general accordance with AASHTO T-288 and Caltrans Test Method CT643. The results are presented in the table below:

Sample Location	Sample Description	pH	Minimum Resistivity (ohms-cm)
B-2 @ 1-6’	Brown Silty Sand (SM)	6.86	4300

Chloride Content: Chloride content was tested in accordance with Caltrans Test Method CT422. The results are presented below:

Sample Location	Sample Description	Chloride Content (ppm)
B-2 @ 1-6’	Brown Silty Sand (SM)	240

APPENDIX C (Continued)

Soluble Sulfates: The soluble sulfate contents of selected samples were determined by standard geochemical methods (Caltrans Test Method CT417 Part II). The test results are presented in the table below:

Sample Location	Sample Description	Sulfate Content (ppm)	Potential Degree of Sulfate Attack*
B-2 @ 1-6’	Brown Silty Sand (SM)	16	NA

*Based on the 2011 edition of American Concrete Institute (ACI) Committee 318R, Table No. 4.2.1.

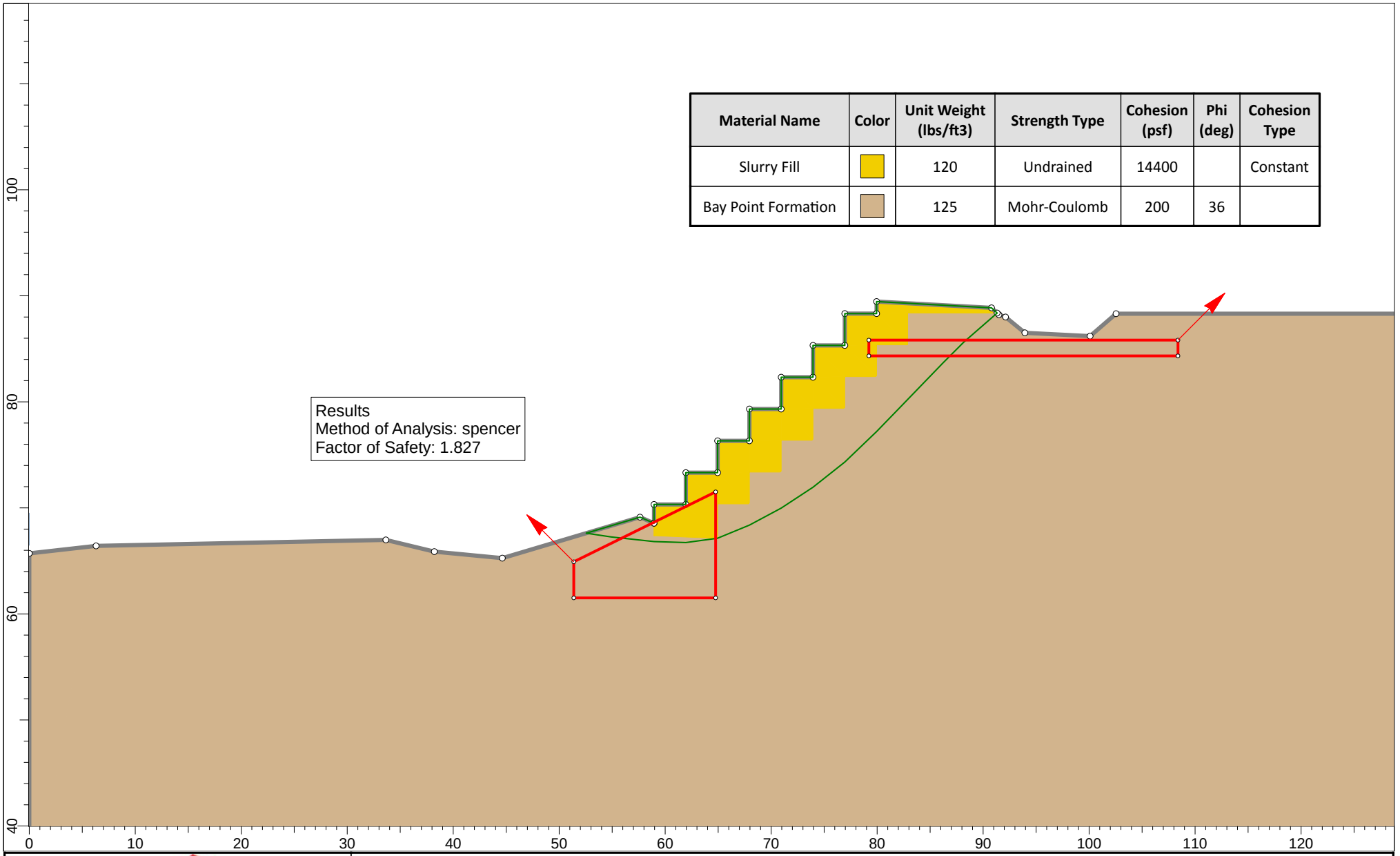
Direct Shear Tests: Direct shear tests were performed on selected samples which were soaked for a minimum of 24 hours under a surcharge equal to the applied normal force during testing. After transfer of the sample to the shear box and reloading of the sample, the pore pressures set up in the sample (due to the transfer) were allowed to dissipate for a period of approximately 1 hour prior to application of shearing force. The samples were tested under various normal loads utilizing a motor-driven, strain-controlled, direct-shear testing apparatus at a strain rate of 0.05 inches per minute. After a shear strain of 0.2 inches, the motor was stopped and the sample was allowed to "relax" for approximately 15 minutes. The stress drop during the relaxation period was recorded. It is anticipated that, in a majority of samples tested, the 15 minutes relaxing of the samples is sufficient to allow dissipation of pore pressures that may have set up in the samples due to shearing. The drained peak strength was estimated by deducting the shear force reduction during the relaxation period from the peak shear values. The shear values at the end of shearing are considered to be ultimate values and are shown in parenthesis.

Sample Location	Sample Description	Friction Angle (degrees)	Apparent Cohesion (psf)
B-1 @ 10’	Silty Sand (SM)	27 (29)	261 (180)
B-2 @ 18’	Silty Sand (SM)	44 (37)	971 (329)

Appendix D

Calculations

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type
Slurry Fill		120	Undrained	14400		Constant
Bay Point Formation		125	Mohr-Coulomb	200	36	

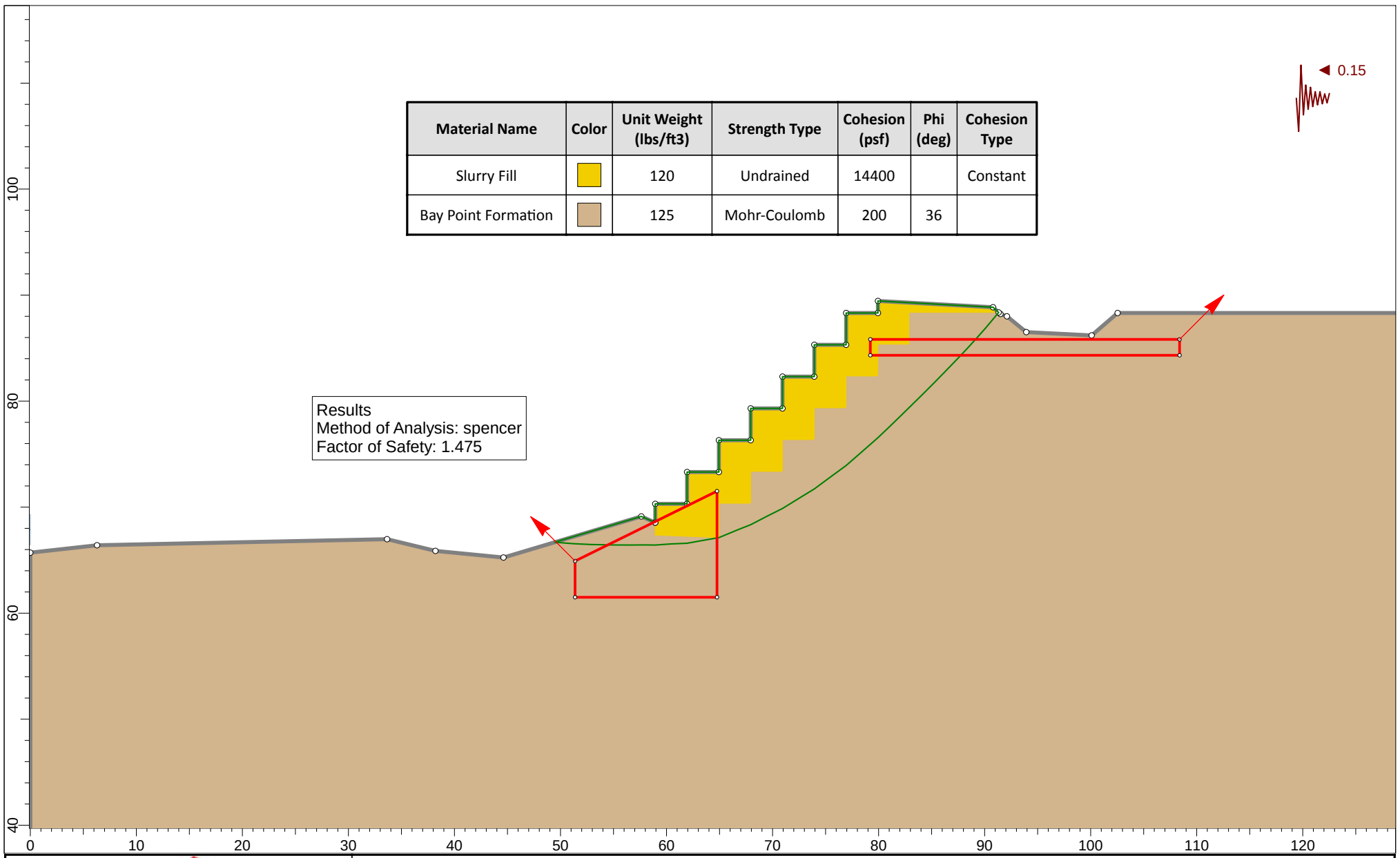


Leighton

SLIDEINTERPRET 7.027

Project	Del Mar Bluffs 11860.002		
Analysis Description	Slurry Fill Repair		
Drawn By: SMM	Scale: 1:150	Company: Leighton	
Date: 1/4/2018	Condition:	File Name: Del Mar Bluffs Slurry Fill Repair.slim	

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type
Slurry Fill		120	Undrained	14400		Constant
Bay Point Formation		125	Mohr-Coulomb	200	36	

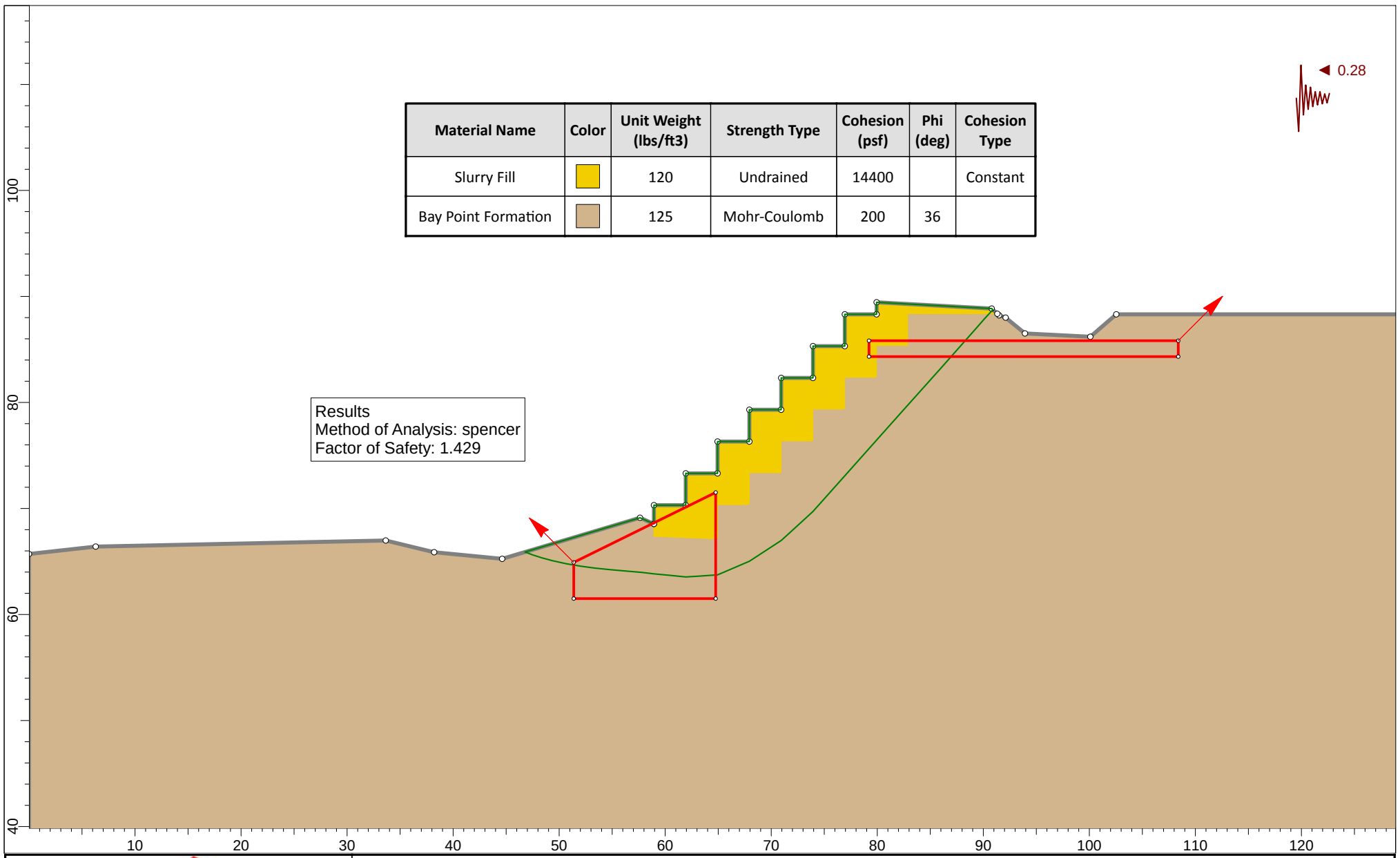


Leighton

SLIDEINTERPRET 7.027

Project	Del Mar Bluffs 11860.002		
Analysis Description	Slurry Fill Repair		
Drawn By: SMM	Scale: 1:150	Company: Leighton	
Date: 1/4/2018	Condition:	File Name: Del Mar Bluffs Slurry Fill Repair - Pseudostatic.slim	

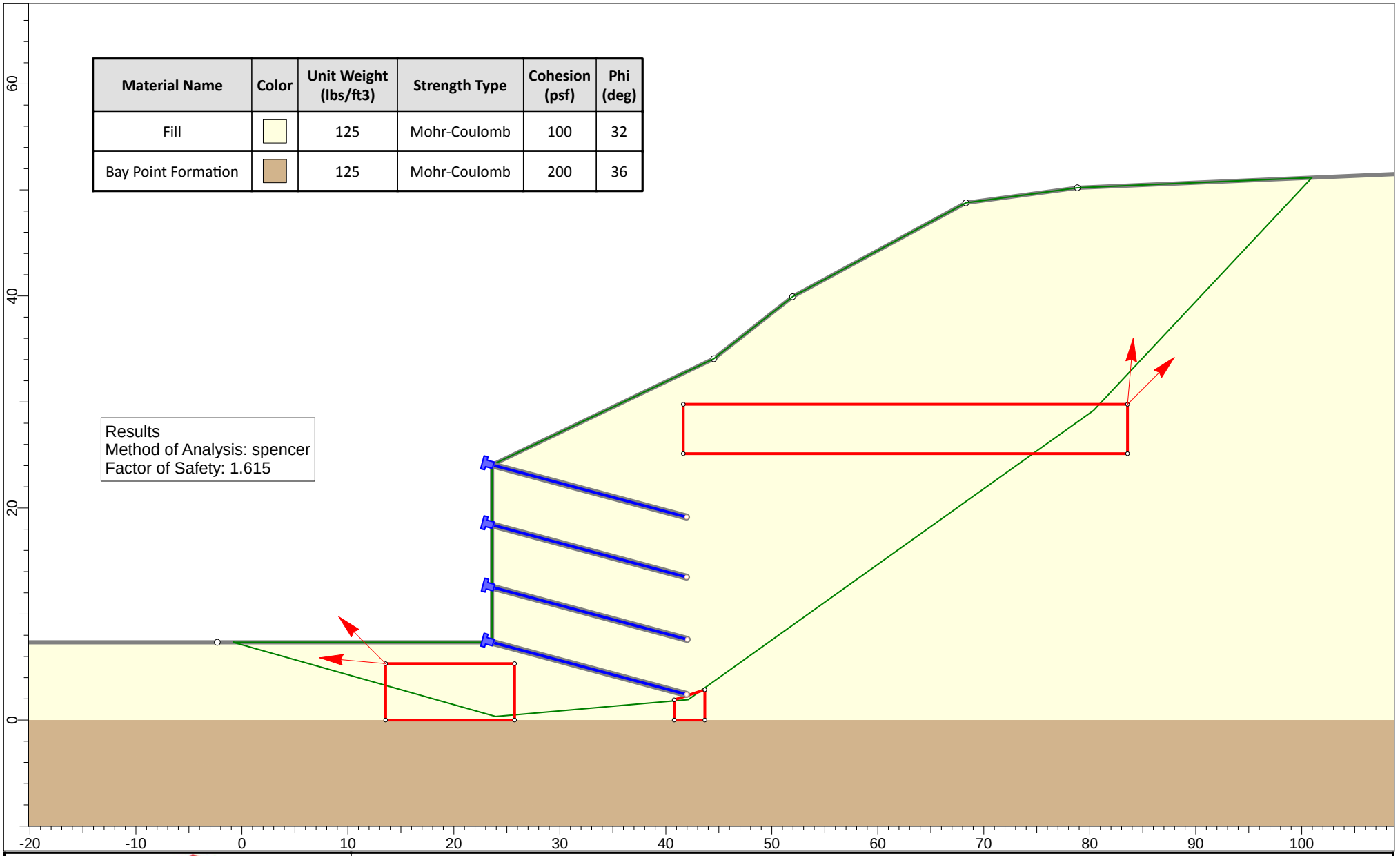
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type
Slurry Fill		120	Undrained	14400		Constant
Bay Point Formation		125	Mohr-Coulomb	200	36	



Project	Del Mar Bluffs 11860.002		
Analysis Description	Slurry Fill Repair		
Drawn By: SMM	Scale: 1:150	Company: Leighton	
Date: 1/4/2018	Condition:	File Name: Del Mar Bluffs Slurry Fill Repair - Pseudostatic.slim	

SLIDEINTERPRET 7.027

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fill		125	Mohr-Coulomb	100	32
Bay Point Formation		125	Mohr-Coulomb	200	36

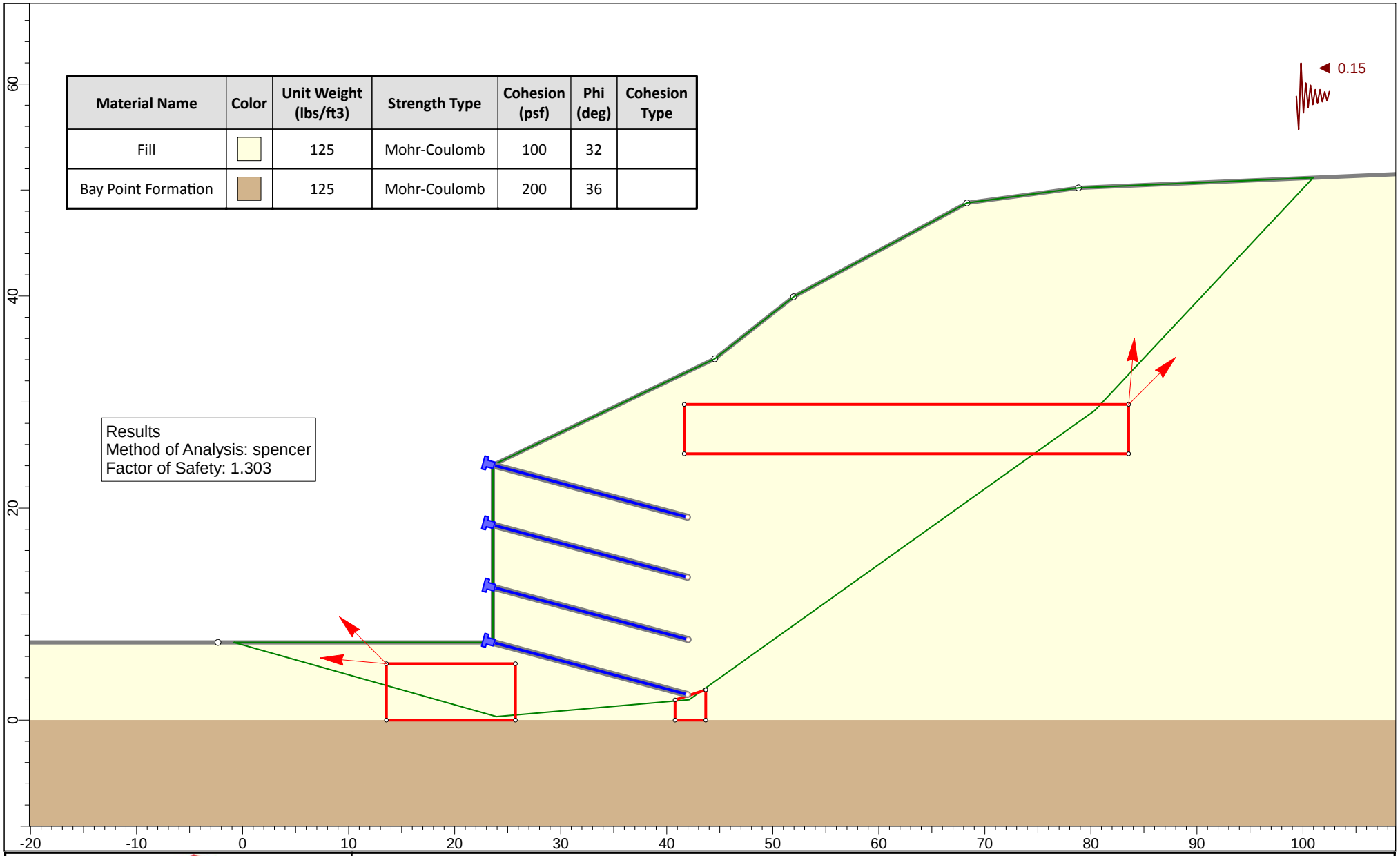


Leighton

SLIDEINTERPRET 7.027

Project	Del Mar Bluffs 11860.002		
Analysis Description	Soil Nail Wall		
Drawn By	SMM	Scale 1:150	Company Leighton
Date	1/4/2018	Condition	File Name Del Mar Bluffs Soil Nail Wall.slim

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type
Fill		125	Mohr-Coulomb	100	32	
Bay Point Formation		125	Mohr-Coulomb	200	36	

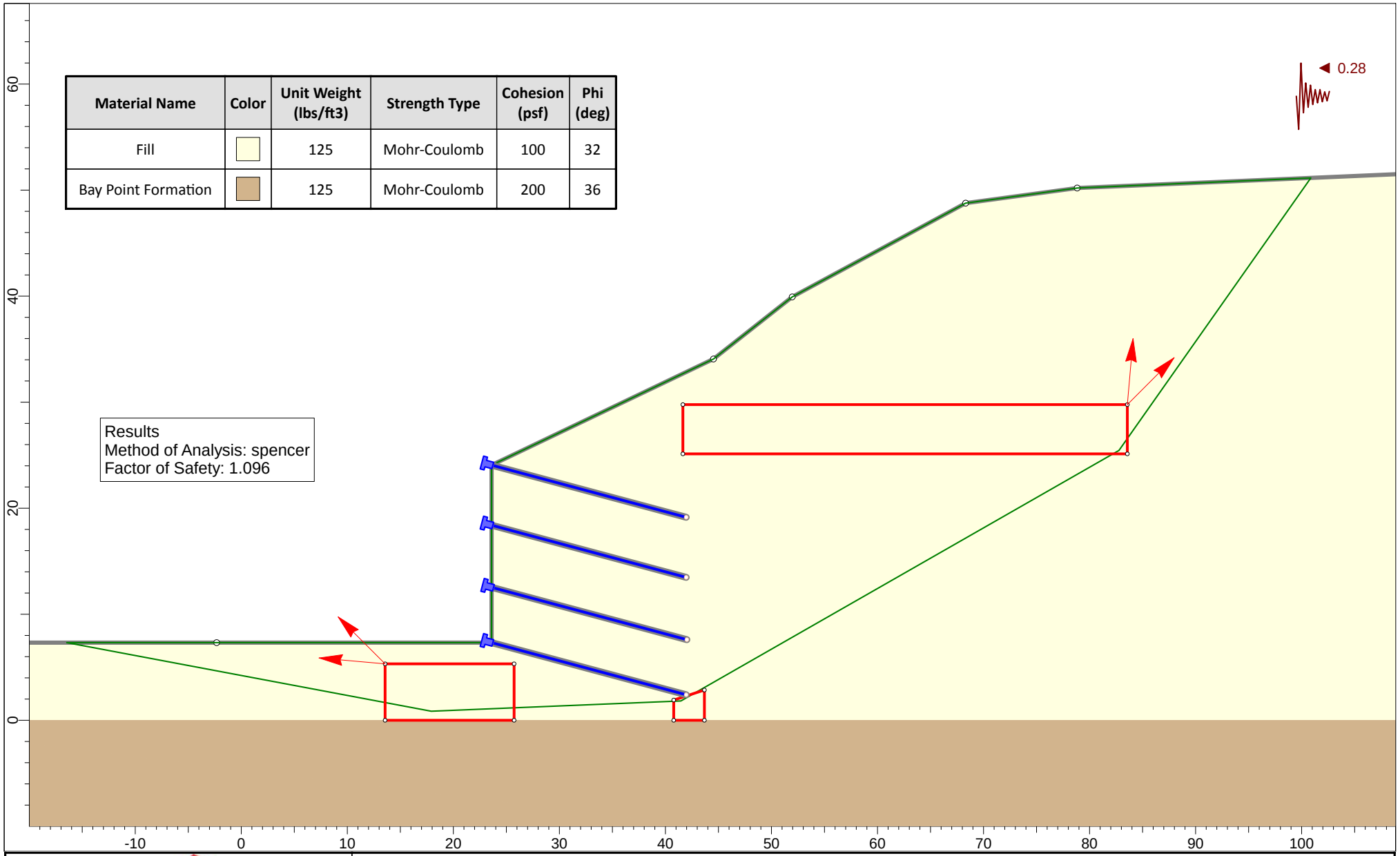


Project	Del Mar Bluffs 11860.002		
Analysis Description	Soil Nail Wall		
Drawn By: SMM	Scale: 1:150	Company: Leighton	
Date: 1/4/2018	Condition:	File Name: Del Mar Bluffs Soil Nail Wall - Pseudostatic.slim	

Leighton

SLIDEINTERPRET 7.027

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fill		125	Mohr-Coulomb	100	32
Bay Point Formation		125	Mohr-Coulomb	200	36



Leighton

SLIDEINTERPRET 7.027

Project	Del Mar Bluffs 11860.002		
Analysis Description	Soil Nail Wall		
Drawn By: SMM	Scale: 1:150	Company: Leighton	
Date: 1/4/2018	Condition:	File Name: Del Mar Bluffs Soil Nail Wall - Pseudostatic.slim	

Appendix E

General Earthwork and Grading Specifications for Rough Grading

1.0 General

1.1 Intent

These General Earthwork and Grading Specifications are for the grading and earthwork shown on the approved grading plan(s) and/or indicated in the geotechnical report(s). These Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the specific recommendations in the geotechnical report shall supersede these more general Specifications. Observations of the earthwork by the project Geotechnical Consultant during the course of grading may result in new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

1.2 The Geotechnical Consultant of Record

Prior to commencement of work, the owner shall employ the Geotechnical Consultant of Record (Geotechnical Consultant). The Geotechnical Consultants shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of the grading.

Prior to commencement of grading, the Geotechnical Consultant shall review the "work plan" prepared by the Earthwork Contractor (Contractor) and schedule sufficient personnel to perform the appropriate level of observation, mapping, and compaction testing.

During the grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required. Subsurface areas to be geotechnically observed, mapped, elevations recorded, and/or tested include natural ground after it has been cleared for receiving fill but before fill is placed, bottoms of all "remedial removal" areas, all key bottoms, and benches made on sloping ground to receive fill.

The Geotechnical Consultant shall observe the moisture-conditioning and processing of the subgrade and fill materials and perform relative compaction testing of fill to determine the attained level of compaction. The Geotechnical Consultant shall provide the test results to the owner and the Contractor on a routine and frequent basis.

1.3 The Earthwork Contractor

The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Specifications prior to commencement of grading. The Contractor shall be solely responsible for performing the grading in accordance with the plans and specifications.

The Contractor shall prepare and submit to the owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "spreads" of work and the estimated quantities of daily earthwork contemplated for the site prior to commencement of grading. The Contractor shall inform the owner and the Geotechnical Consultant of changes in work schedules and updates to the work plan at least 24 hours in advance of such changes so that appropriate observations and tests can be planned and accomplished. The Contractor shall not assume that the Geotechnical Consultant is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with the applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, insufficient buttress key size, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the Geotechnical Consultant shall reject the work and may recommend to the owner that construction be stopped until the conditions are rectified.

2.0 Preparation of Areas to be Filled

2.1 Clearing and Grubbing

Vegetation, such as brush, grass, roots, and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies, and the Geotechnical Consultant.

The Geotechnical Consultant shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 1 percent of organic materials (by volume). No fill lift shall contain more than 5 percent of organic matter. Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area.

As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed.

2.2 Processing

Existing ground that has been declared satisfactory for support of fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Existing ground that is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until soils are broken down and free of large clay lumps or clods and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction.

2.3 Overexcavation

In addition to removals and overexcavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be overexcavated to competent ground as evaluated by the Geotechnical Consultant during grading.

2.4 Benching

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), the ground shall be stepped or benched. Please see the Standard Details for a graphic illustration. The lowest bench or key shall be a minimum of 15 feet wide and at least 2 feet deep, into competent material as evaluated by the Geotechnical Consultant. Other benches shall be excavated a minimum height of 4 feet into competent material or as otherwise recommended by the Geotechnical

Consultant. Fill placed on ground sloping flatter than 5:1 shall also be benched or otherwise overexcavated to provide a flat subgrade for the fill.

2.5 Evaluation/Acceptance of Fill Areas

All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys, and benches.

3.0 Fill Material

3.1 General

Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by the Geotechnical Consultant prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to the Geotechnical Consultant or mixed with other soils to achieve satisfactory fill material.

3.2 Oversize

Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 8 inches, shall not be buried or placed in fill unless location, materials, and placement methods are specifically accepted by the Geotechnical Consultant. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 vertical feet of finish grade or within 2 feet of future utilities or underground construction.

3.3 Import

If importing of fill material is required for grading, proposed import material shall meet the requirements of Section 3.1. The potential import source shall be given to the Geotechnical Consultant at least 48 hours (2 working days) before importing begins so that its suitability can be determined and appropriate tests performed.

4.0 Fill Placement and Compaction

4.1 Fill Layers

Approved fill material shall be placed in areas prepared to receive fill (per Section 3.0) in near-horizontal layers not exceeding 8 inches in loose thickness. The Geotechnical Consultant may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

4.2 Fill Moisture Conditioning

Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM Test Method D1557).

4.3 Compaction of Fill

After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density (ASTM Test Method D1557). Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

4.4 Compaction of Fill Slopes

In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by backrolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of maximum density per ASTM Test Method D1557.

4.5 Compaction Testing

Field-tests for moisture content and relative compaction of the fill soils shall be performed by the Geotechnical Consultant. Location and frequency of tests shall be at the Consultant's discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to

inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

4.6 Frequency of Compaction Testing

Tests shall be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of compacted fill soils embankment. In addition, as a guideline, at least one test shall be taken on slope faces for each 5,000 square feet of slope face and/or each 10 feet of vertical height of slope. The Contractor shall assure that fill construction is such that the testing schedule can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork construction if these minimum standards are not met.

4.7 Compaction Test Locations

The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of each test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations with sufficient accuracy. At a minimum, two grade stakes within a horizontal distance of 100 feet and vertically less than 5 feet apart from potential test locations shall be provided.

5.0 Subdrain Installation

Subdrain systems shall be installed in accordance with the approved geotechnical report(s), the grading plan, and the Standard Details. The Geotechnical Consultant may recommend additional subdrains and/or changes in subdrain extent, location, grade, or material depending on conditions encountered during grading. All subdrains shall be surveyed by a land surveyor/civil engineer for line and grade after installation and prior to burial. Sufficient time should be allowed by the Contractor for these surveys.

6.0 Excavation

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by the Geotechnical Consultant during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by the Geotechnical Consultant based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, evaluated, and accepted by the Geotechnical Consultant prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by the Geotechnical Consultant.

7.0 Trench Backfills

7.1 Safety

The Contractor shall follow all OSHA and Cal/OSHA requirements for safety of trench excavations.

7.2 Bedding and Backfill

All bedding and backfill of utility trenches shall be performed in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding material shall have a Sand Equivalent greater than 30 (SE>30). The bedding shall be placed to 1 foot over the top of the conduit and densified. Backfill shall be placed and densified to a minimum of 90 percent of relative compaction from 1 foot above the top of the conduit to the surface.

The Geotechnical Consultant shall test the trench backfill for relative compaction. At least one test should be made for every 300 feet of trench and 2 feet of fill.

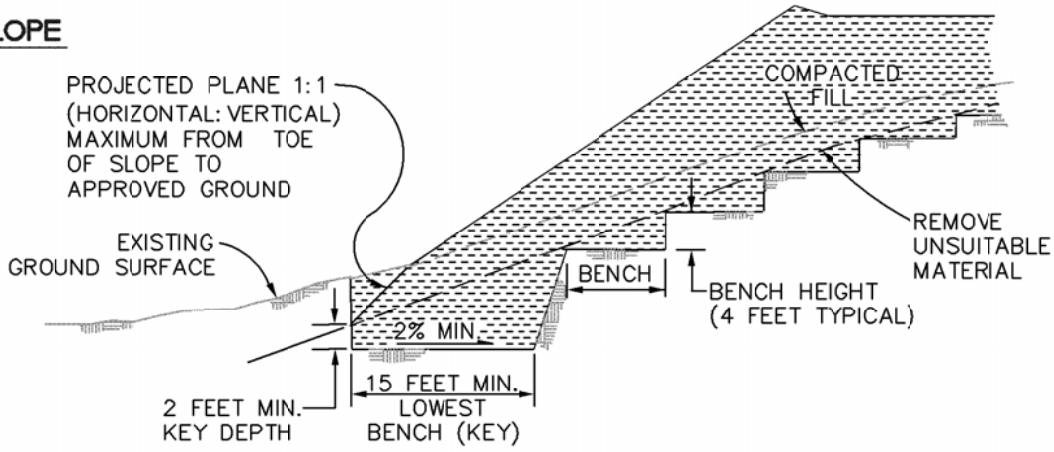
7.3 Lift Thickness

Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method.

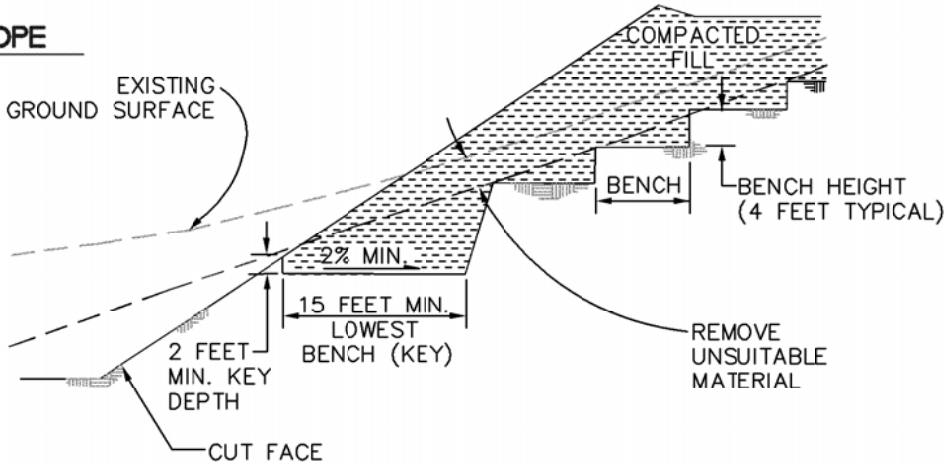
7.4 Observation and Testing

The densification of the bedding around the conduits shall be observed by the Geotechnical Consultant.

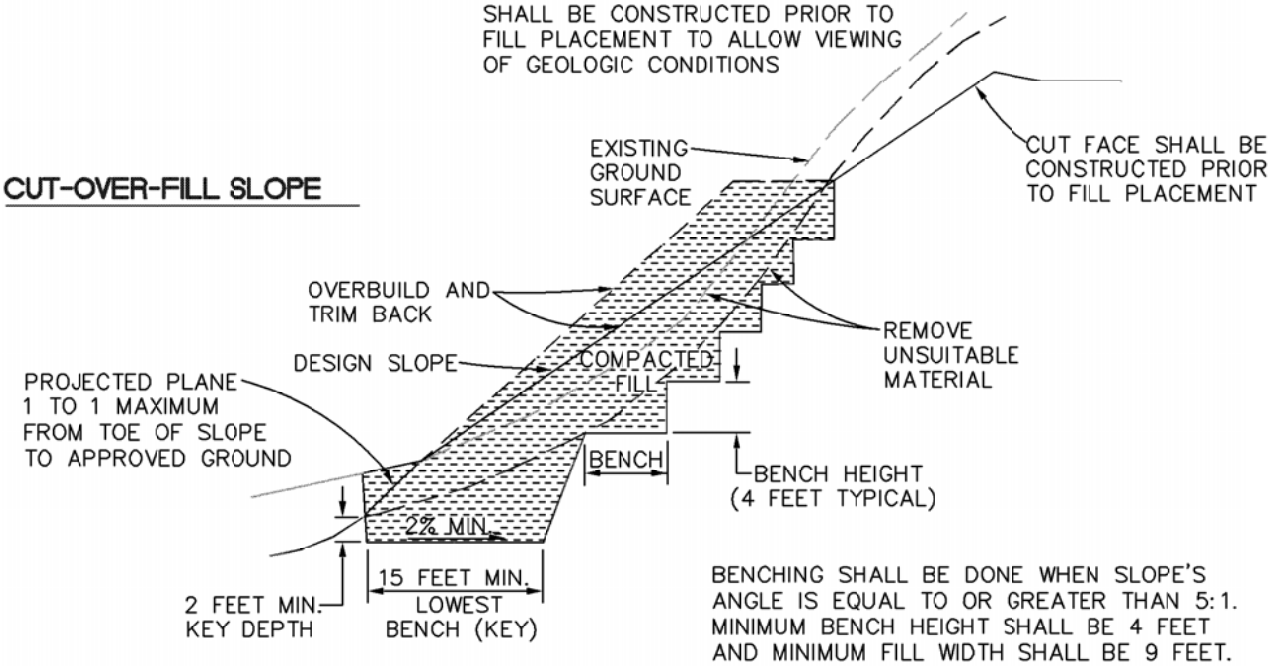
FILL SLOPE



FILL-OVER-CUT SLOPE



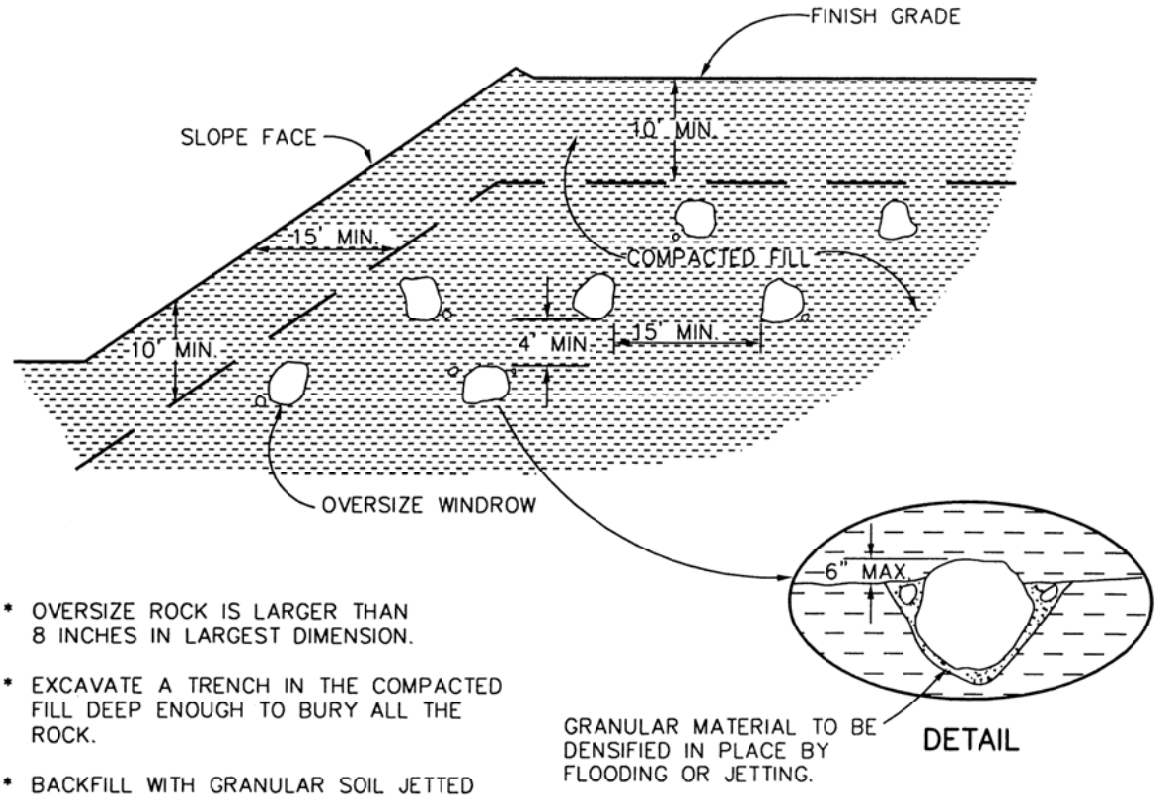
CUT-OVER-FILL SLOPE



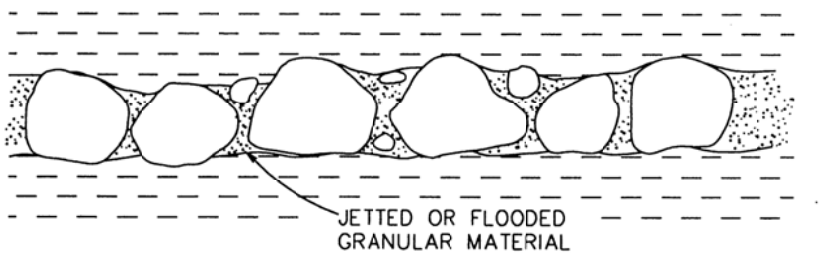
BENCHING SHALL BE DONE WHEN SLOPE'S ANGLE IS EQUAL TO OR GREATER THAN 5:1. MINIMUM BENCH HEIGHT SHALL BE 4 FEET AND MINIMUM FILL WIDTH SHALL BE 9 FEET.

KEYING AND BENCHING

GENERAL EARTHWORK AND
GRADING SPECIFICATIONS
STANDARD DETAIL A



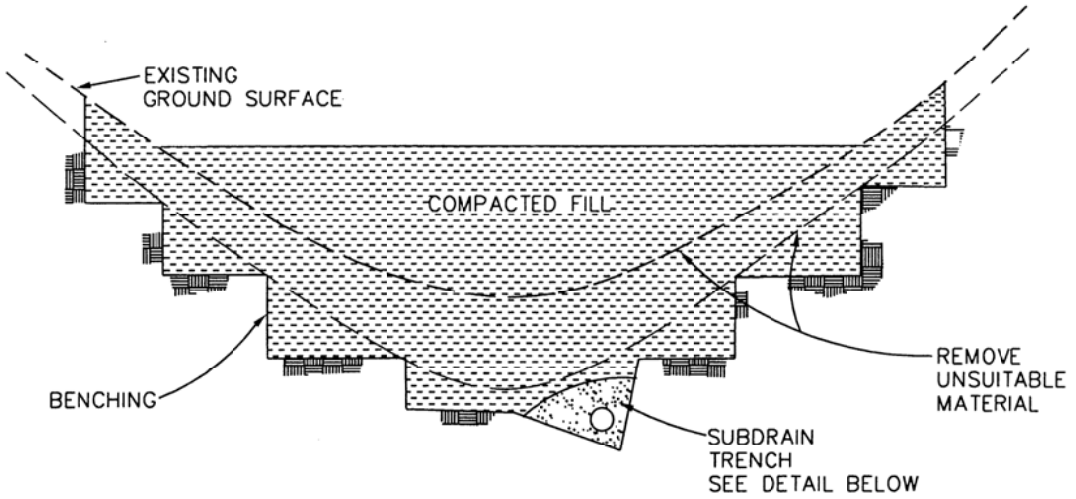
* OVERSIZE ROCK IS LARGER THAN 8 INCHES IN LARGEST DIMENSION.
* EXCAVATE A TRENCH IN THE COMPACTED FILL DEEP ENOUGH TO BURY ALL THE ROCK.
* BACKFILL WITH GRANULAR SOIL JETTED OR FLOODED IN PLACE TO FILL ALL THE VOIDS.
* DO NOT BURY ROCK WITHIN 10 FEET OF FINISH GRADE.
* WINDROW OF BURIED ROCK SHALL BE PARALLEL TO THE FINISHED SLOPE.

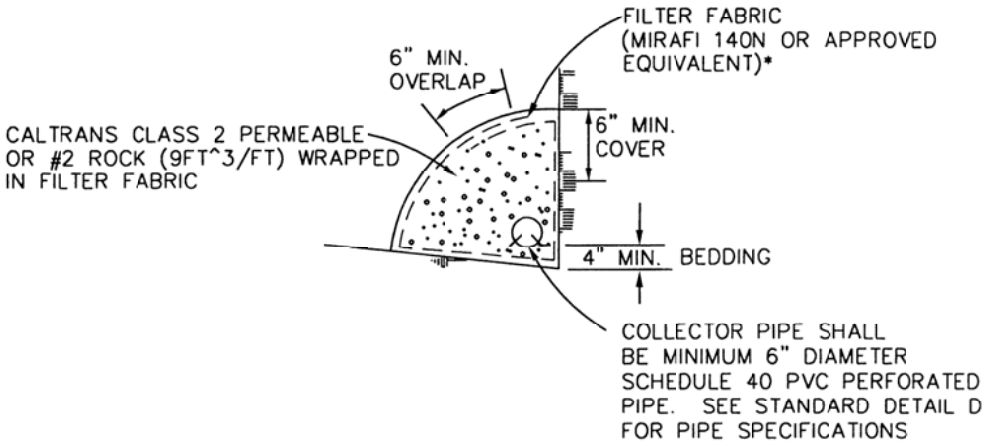


TYPICAL PROFILE ALONG WINDROW

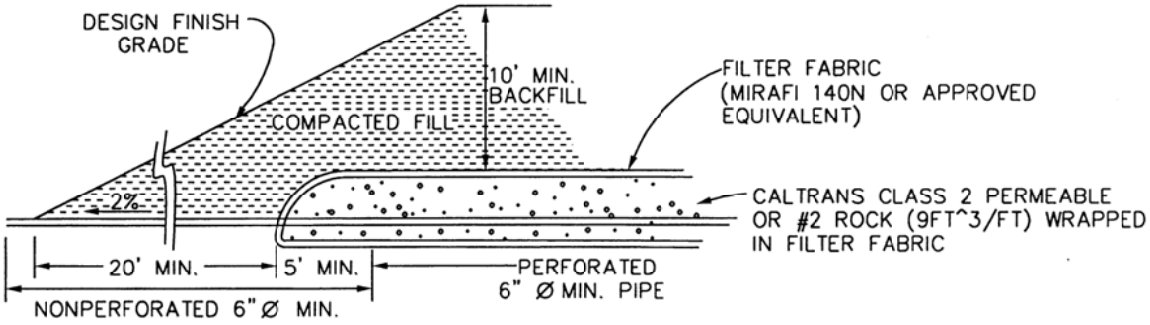
OVERSIZE ROCK DISPOSAL

GENERAL EARTHWORK AND GRADING SPECIFICATIONS
STANDARD DETAIL B





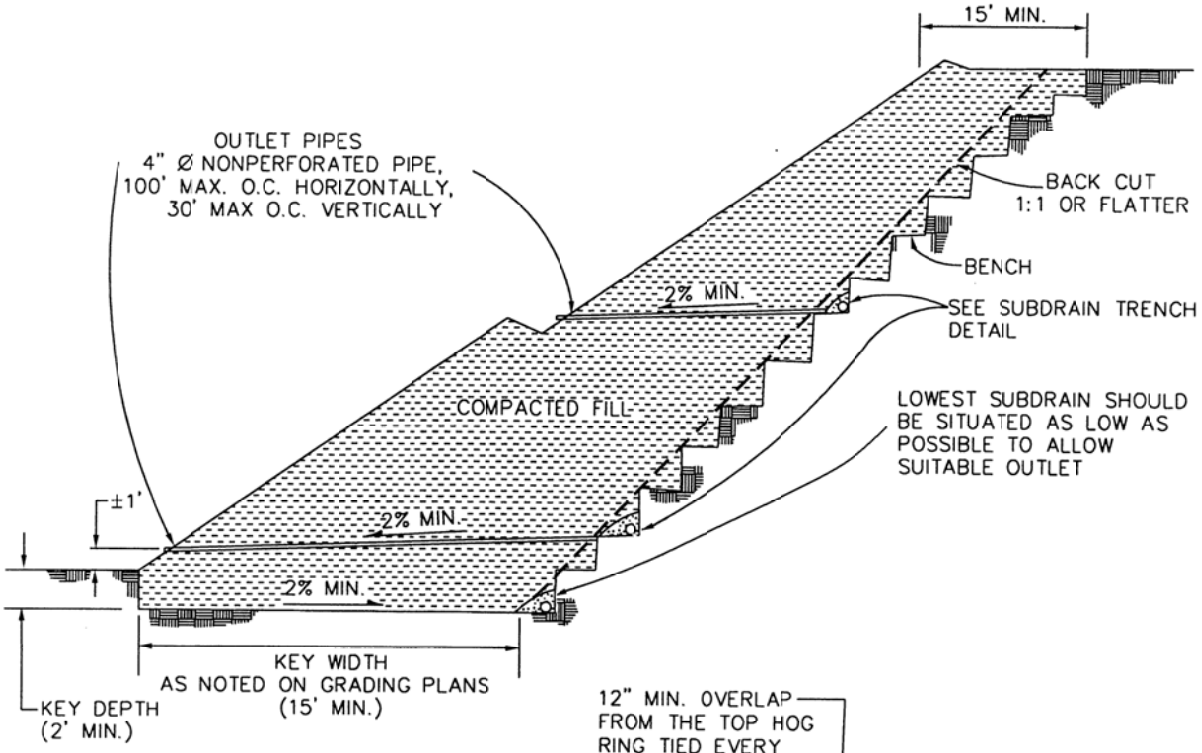
SUBDRAIN DETAIL

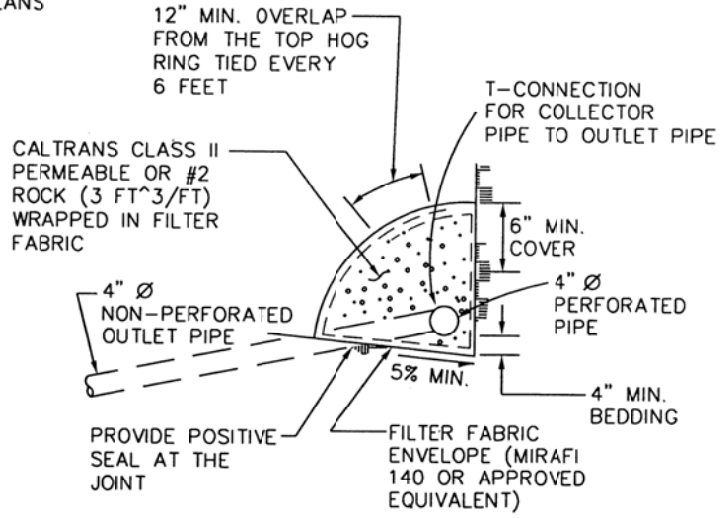


DETAIL OF CANYON SUBDRAIN OUTLET

CANYON SUBDRAINS

GENERAL EARTHWORK AND
GRADING SPECIFICATIONS
STANDARD DETAIL C





SUBDRAIN TRENCH DETAIL

SUBDRAIN INSTALLATION – subdrain collector pipe shall be installed with perforation down or, unless otherwise designated by the geotechnical consultant. Outlet pipes shall be non-perforated pipe. The subdrain pipe shall have at least 8 perforations uniformly spaced per foot. Perforation shall be 1/4" to 1/2" if drill holes are used. All subdrain pipes shall have a gradient of at least 2% towards the outlet.

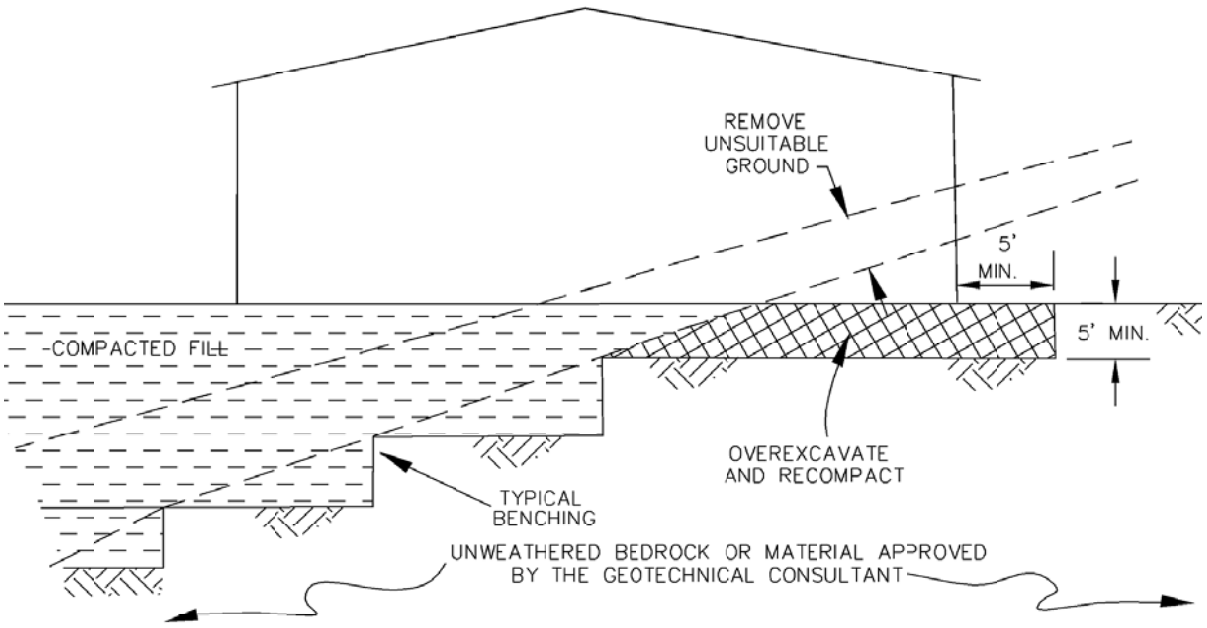
SUBDRAIN PIPE – Subdrain pipe shall be ASTM D2751, SDR 23.5 or ASTM D1527, Schedule 40, or ASTM D3034, SDR 23.5, Schedule 40 Polyvinyl Chloride Plastic (PVC) pipe.

All outlet pipe shall be placed in a trench no wider than twice the subdrain pipe.

BUTTRESS OR REPLACEMENT FILL SUBDRAINS

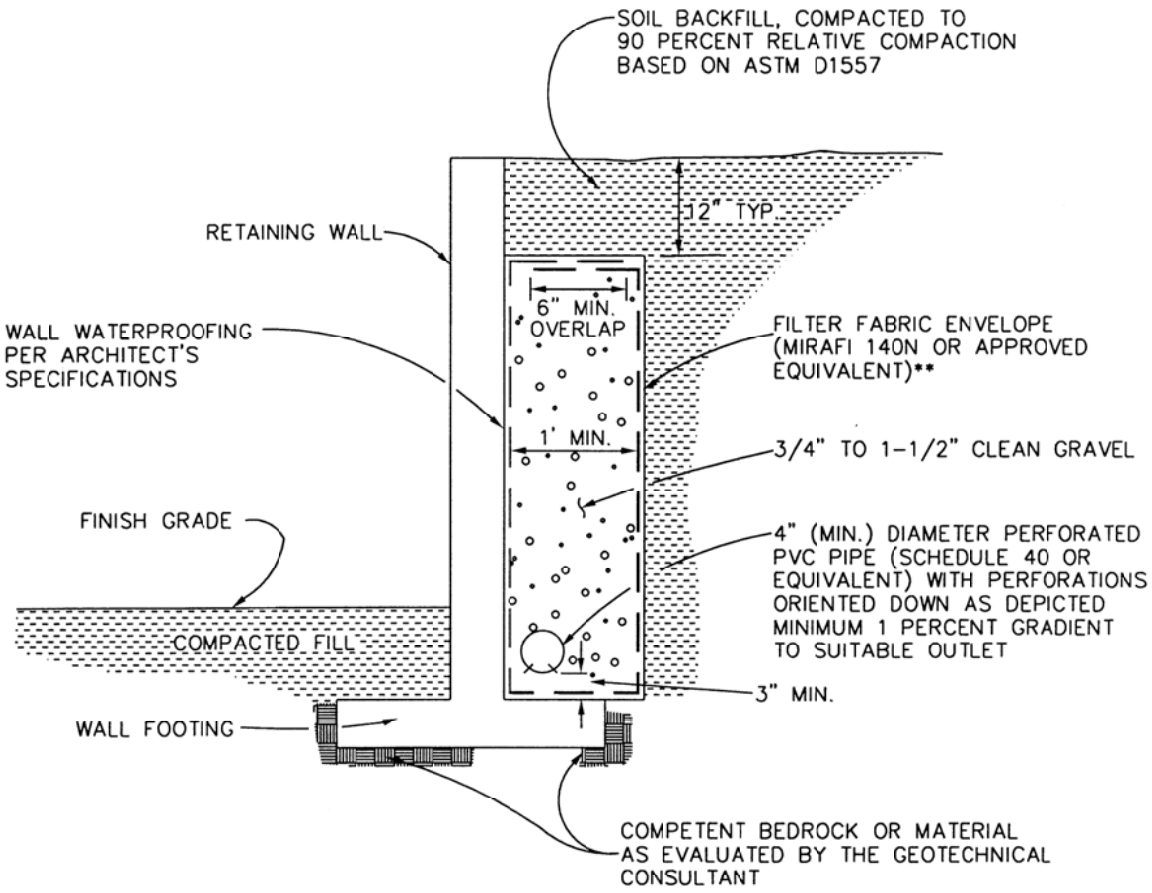
GENERAL EARTHWORK AND GRADING SPECIFICATIONS
STANDARD DETAIL D

CUT–FILL TRANSITION LOT OVEREXCAVATION



TRANSITION LOT FILLS

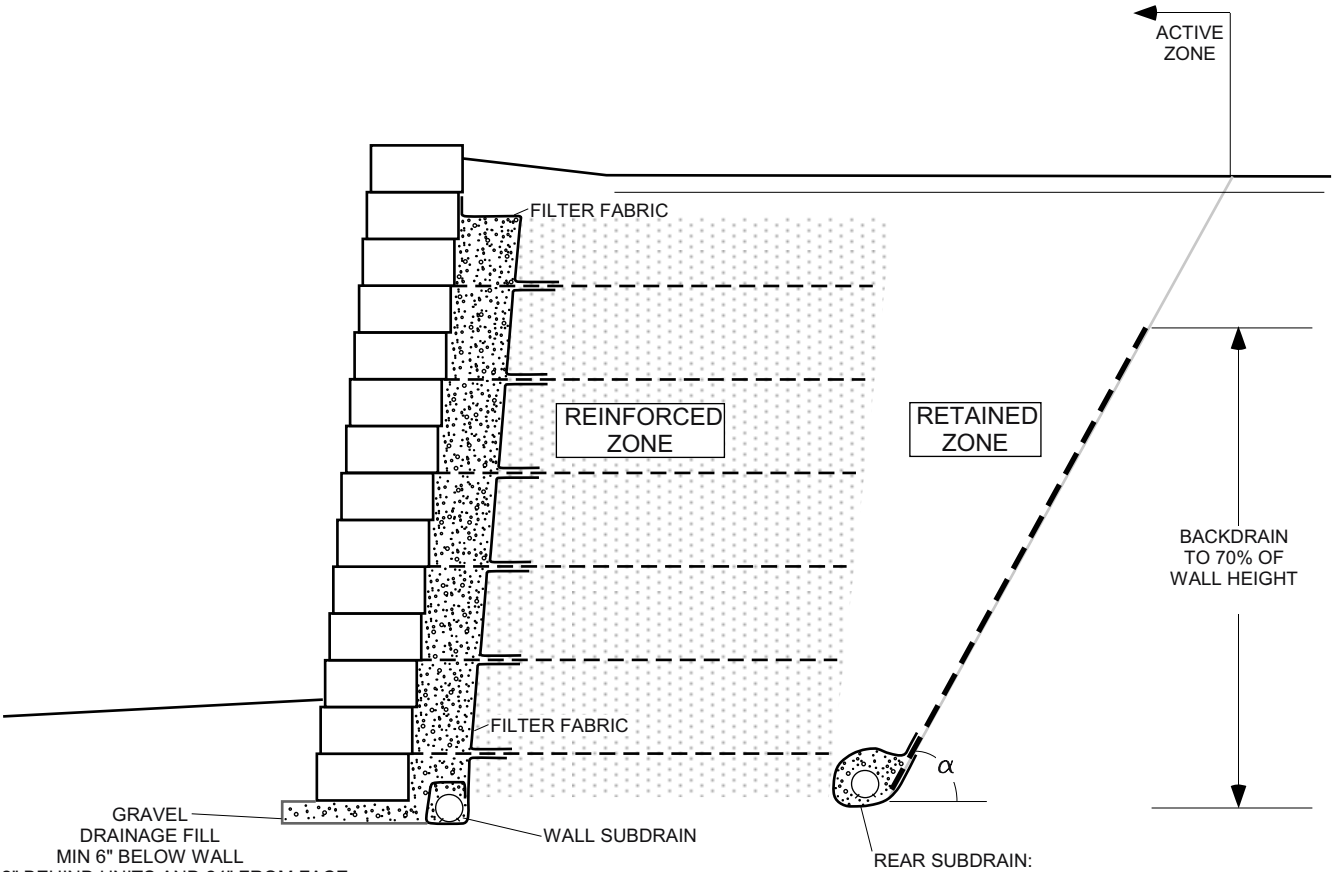
GENERAL EARTHWORK AND
GRADING SPECIFICATIONS
STANDARD DETAIL E



NOTE: UPON REVIEW BY THE GEOTECHNICAL CONSULTANT, COMPOSITE DRAINAGE PRODUCTS SUCH AS MIRADRAIN OR J-DRAIN MAY BE USED AS AN ALTERNATIVE TO GRAVEL OR CLASS 2 PERMEABLE MATERIAL. INSTALLATION SHOULD BE PERFORMED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.

RETAINING WALL DRAINAGE

GENERAL EARTHWORK AND GRADING SPECIFICATIONS
STANDARD DETAIL F



NOTES:

1) MATERIAL GRADATION AND PLASTICITY

REINFORCED ZONE:

SIEVE SIZE	% PASSING
1 INCH	100
NO. 4	20-100
NO. 40	0-60
NO. 200	0-35

GRAVEL DRAINAGE FILL:

SIEVE SIZE	% PASSING
1 INCH	100
3/4 INCH	75-100
NO. 4	0-60
NO. 40	0-50
NO. 200	0-5

FOR WALL HEIGHT < 10 FEET, PLASTICITY INDEX < 20 AND LIQUID LIMIT < 40
FOR WALL HEIGHT 10 FEET OR TALLER, PLASTICITY INDEX < 6
FOR TIERED WALLS, USE COMBINED WALL HEIGHTS
FOR WALL HEIGHT > 20 FEET, REDUCE ALLOWABLE RANGE % PASSING NO. 200 SIEVE TO 0-15

2) CONTRACTOR TO USE SOILS WITHIN THE RETAINED AND REINFORCED ZONES THAT MEET THE STRENGTH AND UNIT WEIGHT REQUIREMENTS OF WALL DESIGN.

3) GEOGRID REINFORCEMENT TO BE DESIGNED BY WALL DESIGNER CONSIDERING INTERNAL, EXTERNAL, AND COMPOUND STABILITY.

3) GEOGRID TO BE PRETENSIONED DURING INSTALLATION.

4) IMPROVEMENTS WITHIN THE ACTIVE ZONE ARE SUSCEPTIBLE TO POST-CONSTRUCTION SETTLEMENT. ANGLE $\alpha = 45+\Phi/2$, WHERE Φ IS THE FRICTION ANGLE OF THE MATERIAL IN THE RETAINED ZONE.

5) BACKDRAIN SHOULD CONSIST OF J-DRAIN 302 (OR EQUIVALENT) OR 6-INCH THICK DRAINAGE FILL WRAPPED IN FILTER FABRIC. PERCENT COVERAGE OF BACKDRAIN TO BE PER GEOTECHNICAL REVIEW.

SEGMENTAL RETAINING WALLS

GENERAL EARTHWORK AND GRADING SPECIFICATIONS
STANDARD DETAIL G

REVISED 11/16