

30% Remedial Design Basis of Design Report

Appendix F

Geotechnical Design Analysis

TABLE OF CONTENTS

1	Introduction	1
1.1	Locations Studied.....	1
1.2	Report Structure	1
2	Subsurface Geotechnical Conditions	3
2.1	Subsurface Stratigraphy.....	4
2.1.1	Fill	4
2.1.2	Recent Sediments.....	4
2.1.3	Alluvium	5
2.2	Groundwater and Surface Water Elevations.....	5
2.2.1	Groundwater	5
2.2.2	Surface Water.....	7
2.3	Soil Engineering Modeling Parameters.....	7
2.3.1	Sediment Undrained Shear Strength.....	8
2.3.2	Drained Shear Strength.....	9
2.3.3	Compressibility.....	9
3	Geotechnical Engineering Analysis	11
3.1	General Dredge Prism Side Slope Stability	11
3.2	Bank Slope Stability Considerations	12
3.2.1	General Bank Slopes.....	12
3.3	Cap and Enhanced Natural Recovery Geotechnical Design Evaluation.....	13
3.3.1	Bearing Capacity	13
3.3.2	Subgrade Consolidation Settlement.....	16
3.3.3	Static Slope Stability of Caps	18
3.4	Backfill Design	18
3.4.1	Backfill Gradation	19
3.4.2	Backfill Stability	19
4	Geotechnical Engineering Recommendations to Support Structural Engineering Evaluations.....	21
4.1	Vertical Structure Evaluation Geotechnical Recommendations.....	21
4.1.1	Lateral Earth Pressures for Middle Reach.....	21
4.1.2	Earth Pressure Diagrams for Temporary Structures at RM 2.2.....	22
4.1.3	Effect of Prohibiting Surcharge Loads Above Existing Bulkheads During Adjacent Dredging.....	23

4.1.4	Effect of Dredging on Passive Pressure	25
4.2	Pile Design Recommendations	27
5	Seismic Design	28
5.1	Seismic Site Class	28
5.2	Strong Motion Design Input Parameters	28
5.3	Liquefaction Evaluation	29
5.4	Seismic Performance of Capped Slopes	29
5.5	Conclusions on Seismic Performance of Sediment Remedy	30
6	References	31

TABLES

Table F2-1	Summary of Selected Groundwater Levels for Exploration Locations Adjacent to the LDW	6
Table F2-2	Soil Parameters for Slope Stability Analysis of Dredge Prism Side Slopes	8
Table F3-1	Factor of Safety Summary for Dredge Cut Slope Stability	12
Table F3-2	Subgrade Consolidation Modeling Scenarios	16
Table F3-3	Subgrade Consolidation Summary	17
Table F3-4	Backfill Gradation Specifications	19
Table F4-1	Generalized Middle Reach Parameters for Bulkhead Lateral Earth Pressure Parameters	22
Table F4-2	Passive Earth Pressure Reduction Factors – Recent Sediment	26
Table F4-3	Middle Reach LPILE Modeling Parameters	27
Table F5-1	Earthquake Parameters Used in Geotechnical Engineering Evaluations	29
Table F5-2	Seismic Slope Displacement for the Slope at Sta 149+45 (RAA 22) Cap	30

FIGURES

Figure F1-1a	Middle Reach Geotechnical Data Locations, RM 1.6 to RM 1.85
Figure F1-1b	Middle Reach Geotechnical Data Locations, RM 1.85 to RM 2.15
Figure F1-1c	Middle Reach Geotechnical Data Locations, RM 2.15 to RM 2.45
Figure F1-1d	Middle Reach Geotechnical Data Locations, RM 2.45 to RM 2.75
Figure F1-1e	Middle Reach Geotechnical Data Locations, RM 2.75 to RM 3.0
Figure F2-1	Undrained Shear Strength Test Results and Design Assumptions
Figure F3-1	Slope Stability – Short Term and Long Term at RAL Exceedance Area 30 (STA 133+40)

- Figure F3-2 Slope Stability – Short Term and Long Term at RAL Exceedance Area 22 (STA 142+67)
- Figure F3-3 Slope Stability – Short Term and Long Term at RAL Exceedance Area 22 (STA 149+45)
- Figure F3-4 Slope Stability – Short Term and Long Term at RAL Exceedance Area 11 (STA 166+05)
- Figure F4-1 Lateral Earth Pressure Diagram – RM 2.2 Temporary Bulkhead
- Figure F4-2 Lateral Earth Pressure Diagram – RM 2.2 Temporary Double-Walled Cofferdam
- Figure F5-1 Seismic Performance of Caps on Slope at Sta 149+45 (RAA 22) – 100- and 475-Year Events

ATTACHMENTS

- Attachment F.1 Boring and Vane Shear Testing Logs
- Attachment F.2 Cone Penetrometer Test Reports
- Attachment F.3 Geotechnical Laboratory Reports
- Attachment F.4 Supplemental Geotechnical Information by Others
- Attachment F.5 USGS Unified Hazard Tool Outputs

ABBREVIATIONS

ARCS	Assessment and Remediation of Contaminated Sediments
bgs	below ground surface
BODR	<i>Basis of Design Report</i>
CPT	cone penetrometer test
DER	<i>Pre-Design Investigation Data Evaluation Report for the Lower Duwamish Waterway – Middle Reach</i>
DSCD	direct shear consolidated drained
E	east waterway embankment
EAA	early action area
ENR	enhanced natural recovery
EPA	U.S. Environmental Protection Agency
FFP	full-flow penetrometer
FHWA	Federal Highway Administration
FNC	federal navigation channel
ft ²	square foot
H:V	horizontal to vertical (ratio)
H _{dr}	maximum drainage path
kip	one thousand pounds
lb/ft	pound per foot
LDW	Lower Duwamish Waterway
LTMMP	Long-Term Monitoring and Maintenance Plan
MHHW	mean higher high water
MLLW	mean lower low water
N/A	not applicable
pcf	pound per cubic foot
pci	pound per cubic inch
PDI	pre-design investigation
PGA	peak ground acceleration
psf	pound per square foot
q _c	cone resistance
RAA	remedial action area
RAL	remedial action level
RD	remedial design
RM	river mile
ROD	<i>Record of Decision</i>
SPT	standard penetration test

ST structure number
USGS U.S. Geological Survey
VST vane shear test

1 Introduction

This *Geotechnical Design Analysis* presents the results of the geotechnical engineering evaluations performed by Anchor QEA to determine the basis of design for sediment cleanup activities in the middle reach (river miles [RMs] 1.6 to 3.0) of the Lower Duwamish Waterway (LDW) Superfund Site in King County, Washington. The remedial actions associated with the middle reach include dredging; capping; placement of thin cover of clean material for enhanced natural recovery (ENR); and the use of area-specific remedial technologies in various areas of the middle reach, including some areas with waterfront or overwater structures. The work also includes backfilling dredge areas within elevation ranges that support habitat as described in the Preliminary (30%) Remedial Design (RD) *Basis of Design Report* (BODR), to which this *Geotechnical Design Analysis* is an appendix.

1.1 Locations Studied

The proposed work requires remediation within the actively managed federal navigation channel (FNC), areas adjacent to waterfront and offshore structures, and early action areas (EAAs) over a range of subtidal and intertidal elevations. Subtidal areas are defined as areas below elevation -4 feet mean lower low water (MLLW). Intertidal areas represent elevations between -4 feet MLLW and the mean higher high water (MHHW) line (equal to +11.3 feet MLLW). The MHHW line occurs along sloped embankments or vertical bulkheads. Upland areas are locations above MHHW that abut and include shoreline property where buildings and structures may be encountered.

1.2 Report Structure

This *Geotechnical Design Analysis* includes the following six main sections:

- Section 1 is the introduction.
- Section 2 discusses the subsurface conditions underlying the site and the soil engineering parameters assigned to the major stratigraphic units.
- Section 3 describes the geotechnical engineering analyses performed for each of the following design elements:
 - Dredge prism side slope stability
 - Bank side slope stability
 - Cap bearing capacity and settlement evaluations
 - Backfill design
- Section 4 presents geotechnical engineering recommendations to be used by the structural engineer for the assessment of the following:
 - Bulkhead design, including lateral earth pressures and tieback design soil parameters
 - Pile design
- Section 5 discusses seismic (earthquake) evaluations for the site.
- Section 6 lists the references that were used to support this work.

Attachments to this *Geotechnical Design Analysis* include the following:

- Attachment F.1 – Boring and Vane Shear Testing Logs
- Attachment F.2 – Cone Penetrometer Test Reports
- Attachment F.3 – Geotechnical Laboratory Reports
- Attachment F.4 – Supplemental Geotechnical Information by Others
- Attachment F.5 – U.S. Geological Survey (USGS) Unified Hazard Tool Outputs

Attachments F.1 to F.3 present the results of a recent subsurface investigation program by Anchor QEA. The field event is described in the *Pre-Design Investigation Data Evaluation Report for the Lower Duwamish Waterway – Middle Reach* (DER; Anchor QEA and Windward 2025).

Attachment F.4 lists supplemental geotechnical information by others, which can be accessed on the Washington Geologic Information Portal (DNR 2025).

2 Subsurface Geotechnical Conditions

Subsurface geotechnical conditions at the site were investigated by Anchor QEA to supplement the existing geotechnical information that was collected during past projects in the vicinity of the middle reach. Exploration logs and laboratory testing results from the recent investigation can be found in Attachments F.1 to F.3. Previous exploration logs by others are listed in Attachment F.4 and can be accessed on the Washington Geologic Information Portal (DNR 2025).

Subsurface geotechnical conditions in the middle reach of the LDW were investigated by Anchor QEA as part of the Phase I and Phase II pre-design investigation (PDI) efforts. Phase I was completed between December 2022 and May 2023, and the majority of Phase II was completed between June and August 2024, with a remobilization in October 2024 to revisit locations where shallow refusal had been encountered. The geotechnical PDI included the following numbers and types of geotechnical investigations, which were advanced to a range of depths below ground surface (bgs):

- Nine hollow-stem auger borings
- Ten mud rotary borings
- Three rotary sonic borings
- Sixteen cone penetrometer tests (CPTs)
- Six full-flow penetrometer (FFP) tests
- Three vane shear tests (VSTs)

The locations of these geotechnical investigations are presented in Figures F1-1a through F1-1e. Logs and geotechnical laboratory testing results from these investigations are presented in Attachments F.1 to F.3.

The scope of the geotechnical PDI was developed considering existing geotechnical information within the middle reach. Studies by others provide supplemental subsurface geotechnical data in upland areas adjacent to the middle reach. Attachment F.4 presents the locations with supplemental geotechnical information and lists the studies that have been identified as providing useful subsurface geotechnical data in the middle reach. The studies may be accessed on the Washington Geologic Information Portal (DNR 2025).

The following sections provide a more comprehensive discussion of subsurface conditions encountered at the site than that presented in the DER.

2.1 Subsurface Stratigraphy

The following section provides information on the geotechnical properties for the three major stratigraphic units described in the DER (Anchor QEA and Windward 2025) and the BODR for the purposes of geotechnical engineering design and analysis later described in this appendix.

2.1.1 Fill

Fill soils were encountered at the 13 upland boring locations during the Phase II PDI and at several other upland locations investigated by others. The fill was observed to extend to depths of 5 to 20 feet below ground surface in the upland borings. Given the river history of channelization, fill is likely present along many banks of the middle reach that have not been geotechnically investigated.

Generally, the fill material had been placed to regrade the existing fluvial plain created by the Duwamish River to support shoreline development and re-channelization of the LDW. The unit weight of this material is assumed to vary, but to prepare design recommendations, the material is assumed to be conservatively represented by an overall average value of 125 pounds per cubic foot (pcf) based on laboratory direct shear test results. Grain size distribution tests show that this material is predominately sands and gravels with varying amounts of silt and clay, as well as silt, with varying amounts of sand, gravel, and clay. Wood fragments and cobbles were also present. In areas where fill was more randomly placed, it would be expected to contain anthropogenic materials such as debris, which would be typical of historical shoreline development filling activities in active industrial areas. The geotechnical moisture content in the fill unit generally ranges from 5% to 174%, with an average of 33%. Grain size analyses indicate that this material is approximately 30% gravel, 46% sand, and 24% silt and clay. Direct shear testing of the fill indicates a peak friction angle average of 37 degrees, whereas standard penetration test (SPT) testing indicates a friction angle average near 33 degrees.

2.1.2 Recent Sediments

Recent sediments are defined as material that has deposited on top of the alluvium layer and are distinctly characterized by finer gradation and soft consistency compared to the alluvium layer below. Recent sediments were encountered throughout the intertidal and subtidal areas, having been naturally deposited by flows to the LDW middle reach from Green River upstream. The thickness of this unit across the site varies widely, between roughly 3 and 30 feet, and is observed to be thickest in areas of historical dredge activities in the FNC.

Based on a review of laboratory testing results, a total unit weight of 100 pcf was assumed to best represent average overall conditions, with percent geotechnical moisture content ranging from 27% to 107% and an average moisture content of approximately 67%. Atterberg limits (plasticity) testing indicates that this material is typically non-plastic to very low plasticity, an indication that the finer

fractions are predominantly silt rather than clay. VST, FFP, and CPT testing indicate undrained shear strengths ranging as shown in Figure F2-1. Grain size analyses indicate that this material is approximately 25% sand and 75% silt and clay, with silt content ranging from 47% to 72% and clay content ranging from 8% to 24%.

2.1.3 Alluvium

Investigations prior to the PDI describe the alluvium by referencing an upper alluvium unit and a lower alluvium unit. Because the distinction between the upper alluvium and lower alluvium is not important in the context of the sediment cleanup, in the DER, the description of the alluvium was simplified by combining the upper alluvium and lower alluvium into a single alluvium unit, recognizing that there are some gradational changes in the alluvium with depth (Anchor QEA and Windward 2025).

Alluvium was observed to underly the recent sediments and consisted primarily of sand with varying amounts of silt, gravel, and clay, as well as interbedded lenses and layers of silt and clay. The upper 2 to 15 feet of this unit, where disturbances have occurred, contains significant wood and sometimes anthropogenic debris. Grain size analyses indicate that this material is approximately 68% sand and 32% silt and clay, with silt and clay content averaging 23% and 9%, respectively. The alluvium unit has a typical specific gravity of 2.5 to 2.7; is non-plastic; and has a typical total unit weight of 125 pcf, a laboratory-measured peak friction angle of 43 degrees, whereas in situ SPT testing suggests a friction angle average near 32 degrees (range 0 to 30 from SPT testing). The measured geotechnical natural moisture content within this unit ranged from 9% to 69%, with an average of approximately 32%.

2.2 Groundwater and Surface Water Elevations

Groundwater and surface water affect the geotechnical behavior of soils and sediments. Water surface elevations are used in geotechnical engineering evaluations to calculate porewater pressures and effective stresses, which govern the shear strength of soils. Changes in effective stress (which occur due to changes in porewater pressure) also lead to consolidation settlement. Thus, water surface elevations are a key input parameter for geotechnical engineering evaluations. This section summarizes general observations of groundwater and surface water levels made during the geotechnical investigation and as summarized in other reports.

2.2.1 Groundwater

Groundwater has been observed in shoreline groundwater wells along the middle reach. At locations nearest the LDW, groundwater elevations vary regularly in accordance with the water level in the river. Farther from the shoreline, groundwater levels are less affected by the adjacent surface water level but are still expected to vary seasonally. Table F2-1 summarizes typically observed groundwater

levels at selected locations along the middle reach for exploration locations adjacent to the LDW, which are used as a basis for geotechnical engineering evaluations described in this report.

Table F2-1
Summary of Selected Groundwater Levels for Exploration Locations Adjacent to the LDW

Location	River Mile	Observed Groundwater Elevation (feet MLLW)	Observed Depth to Groundwater (feet bgs)	RAL Exceedance Area	Reference
Ryan LLC – Andrew Grove / Glacier Northwest Inc.	1.5 to 1.65E	2 to 14	5 to 15	N/A	Pacific Testing Laboratories 1996
Glacier Northwest Inc. / Slip 2	1.65 to 1.7E	3 to 15	2 to 13.5	N/A	Hart Crowser 1994
Port of Seattle (Terminal 115)	1.85 to 2.0W	5 to 13	5 to 12	N/A	Seattle Engineering Department 1969
Seattle Distribution Center	2.15E	5	10	23	Dames & Moore 1967
South of Inlet at RM 2.2W	2.25W	8	5	20	Seattle Engineering Department 1973
South Myrtle Street	2.4 to 2.5E	7	8	15	Seattle Engineering Department 1972
Seattle Iron & Metals	2.4 to 2.5E	4 to 9	7 to 12	14	Seattle Engineering Department 1972
Brackish Properties LLC / Pacific Pile and Marine Ramp Structure (ST-12)	2.6W	5	6	N/A	Seattle Engineering Department 1973
Beach 6 / Historic Intake Structure (ST-10)	2.75E	6	9	9	Golder Associates Inc. 1997
Silver Bay Logging	2.85W	5	9	4	Golder Associates Inc. 1997
Silver Bay Logging / Work Boats Northwest	2.9 to 2.95W	2	12	N/A	RZA AGRA 1992
Seattle Public Utilities	3.0W	2	14	N/A	Metropolitan Engineers 1964

Notes:

bgs: below ground surface
 E: east waterway embankment
 LDW: Lower Duwamish Waterway
 MLLW: mean lower low water
 N/A: not applicable
 RAL: remedial action level
 RM: river mile
 W: west waterway embankment
 ST: structure number

2.2.2 Surface Water

The middle reach is tidally influenced, and water levels are also affected by inflows from Green River upstream. Upstream inflows are controlled by the Howard Hansen Dam, so tidal influences tend to dominate the river stage (surface water elevation). In the project vertical datum of MLLW, the MHHW elevation is 11.3 feet.

2.3 Soil Engineering Modeling Parameters

This section summarizes the geotechnical engineering properties that were assigned to each lithologic unit for geotechnical evaluations. Engineering properties were derived using correlations to in situ CPT results, VST results, FFP test results, and geotechnical laboratory testing results. Guidance for parameter selection was obtained from the Washington State Department of Transportation *Geotechnical Design Manual* (WSDOT 2022), the Unified Facilities Criteria soil mechanics (DM7.1) by the Department of Defense (DoD 2022), Sabatini et al. (2002), Bowles (1996), and Federal Highway Administration (FHWA) publications. These correlations were further checked by conducting limit equilibrium slope stability evaluations to confirm the modeling parameters did not underestimate the shear strength of soils that are currently observed to be stable at steeper slope grades.

Where applicable, unit weight and drained shear strength parameters were determined using established correlations with SPT N_{160} values, primarily based on methodologies presented in Bowles (1996). The undrained shear strength for recent sediments was developed based on VST, FFP, and CPT testing as shown in Figure F2-1. For cap aggregates, habitat materials, and backfill, engineering parameters were assigned using best professional judgment and from past project experience considering the location of placement (beneath the water surface) and the typical materials used for these applications (sand and gravel). Soil parameters are presented in Table F2-2.

**Table F2-2
Soil Parameters for Slope Stability Analysis of Dredge Prism Side Slopes**

Soil Layer	Total Unit Weight (pcf)	Undrained Shear Strength ¹	Drained Shear Strength		Compressibility
		Cohesion (psf)	Cohesion (psf)	Internal Friction Angle, ϕ' (degrees)	Compression Ratio (unitless)
Fill	125	N/A	50	30	See Note 2
Recent sediments	100	$75+32.5*Z; \leq 400$	0	27	0.17
Alluvium	125	N/A	0	32	See Note 2
Cap, habitat and backfill materials	110	N/A	0	32	See Note 2
Armor rock	135	N/A	0	40	See Note 2

Notes:

1. Z = depth below top of layer surface elevation
 2. The fill, alluvium, cap, habitat, backfill, and armor rock materials, being primarily granular, were not considered compressible for purposes of consolidation calculations. See discussion of compressibility.
- N/A: not applicable. See discussion of undrained shear strength (Section 2.3.1).
pcf: pound per cubic foot
psf: pound per square foot

2.3.1 Sediment Undrained Shear Strength

Undrained shear strength can be directly estimated from the tip resistance measured during advancement of the cone during CPT and FFP testing, allowing for a near-continuous measurement of undrained shear strength versus depth (Robertson and Cabal 2010). For the purposes of this report, undrained shear strength modeling values were determined by inspection of the FFP test and VST results at each location. This inspection was completed by plotting undrained shear strength with depth.

Figure F2-1 presents the measured undrained shear strength with depth of the sediment layer with the soil model assumption overlain for comparison. This plot shows that the undrained shear strength for the recent sediments generally increases linearly with depth, which is consistent with theoretical soil behavior. Thus, the design assumes undrained shear strength is variable, as presented in Table F2-2. Note the soil model assumes a maximum sediment undrained shear strength of 400 pounds per square foot (psf), regardless of depth.

Undrained shear strength is not relevant for cohesionless materials (e.g., sand and gravel), which rely on inter-particle friction to develop strength. Thus, the undrained shear strength for sand and gravel type materials (fill, alluvium, cap, habitat, and backfill) is not applicable because these materials are not expected to behave in an undrained manner under static loading.

2.3.2 Drained Shear Strength

Drained shear strength applies to the long-term behavior of fine-grained materials and both the short- and long-term behavior of granular materials, which drain very rapidly under applied loads. Drained shear strength can be correlated to in situ tests (e.g., SPT blow counts, CPT records) and can be measured in laboratory geotechnical tests.

For this project, direct shear consolidated drained (DSCD) tests were conducted on representative undisturbed samples from each major stratigraphic unit to evaluate drained shear strength behavior. In general, average peak friction angles ranged from 37 to 43 degrees. Residual shear strengths were not conclusively evaluated, as the tests did not consistently exhibit a clear residual strength plateau in the shear stress-deformation response.

Laboratory testing is conducted under ideal conditions and reflects assumed loading rates and drainage conditions that potentially will not apply under full-scale conditions. It is expected that actual soil behavior will be more variable and reflect inherent uncertainty that cannot be captured by laboratory testing alone. Thus, the laboratory test results were reviewed by an experienced geotechnical engineer who applied engineering judgment to reduce the friction angle (drained shear strength) selected for design to reflect values more typically used regionally in engineering design. See Table F2-2 for a summary of friction angles that were selected for design for each major geologic unit.

2.3.3 Compressibility

Consolidation settlement (i.e., compression) occurs over time as new loads are applied to fine-grained soil or sediment and as water is driven out of the soil/sediment pore space due to the applied loading (i.e., drainage).

Compressibility parameters were assessed using the laboratory one-dimensional oedometer consolidation test. The test incrementally loads an undisturbed sample and measures the corresponding settlement, which is plotted as a relationship between stress (load) and strain (settlement). When stress is plotted in log scale and strain in natural scale, the resulting plot is generally linear over the range of virgin compression, and the slope of this line is referred to as the Compression Ratio. The Compression Ratio can be used to calculate anticipated consolidation under load.

Five oedometer tests were conducted: four within the recent sediment unit and one within the silty fill unit. Compressibility parameters were only assigned to the recent sediment unit for geotechnical evaluations (Table F2-2), as compression of the fill unit was not considered relevant to the remedial design. Compression ratios for the recent sediment samples ranged from 0.140 to 0.196, with an average of 0.176. Recompression ratios ranged from 0.022 to 0.034, with an average of 0.026.

The time rate of consolidation is affected by the distance that water must travel when drainage is occurring. Through inspection of the CPT porewater pressure profiles, a maximum drainage path (H_{dr}) length of 6.4 feet was estimated. Lastly, for the purposes of the analysis for this project, a design coefficient of consolidation of 0.08 square foot (ft^2) per day was assumed for the sediment unit, consistent with published ranges for similar soft silts.

3 Geotechnical Engineering Analysis

This section discusses the following geotechnical engineering analyses prepared in support of the Preliminary (30%) RD:

- Dredge prism side slope stability
- Bank excavation slope stability
- Cap bearing capacity and settlement

3.1 General Dredge Prism Side Slope Stability

The stability of dredge prism side slopes was evaluated using Rocscience Slide2 limit equilibrium software. An assumed dredge cut slope and sediment properties (Table F2-2) were input to the model, and a search routine was run by the software to locate the “critical” slip surface: the surface with the lowest factor of safety. The limit equilibrium method compares stresses (loads) and strength (resistance) for each slip surface to compute a factor of safety (Table F3-1). The calculation method (General Limit Equilibrium) satisfies both force and moment equilibrium for the slip surface.

Stability was evaluated for a range of potential dredge slopes for both short-term (undrained) and long-term (drained) conditions. Short-term conditions represent the stability of slopes during construction. Long-term conditions represent the stability of slopes after construction has been completed and soil/sediment has equilibrated to any new stress conditions associated with the post-construction slope geometry.

Based on bathymetric survey conducted during the PDI, the natural angles of the subtidal to nearshore slopes range from 4H:1V (horizontal to vertical) to 17.5H:1V. The slope stability evaluation was conducted for two different assumed slope cut angles (3H:1V and 2H:1V). A 3H:1V slope allows for a more stable placement of post-dredge cover on the slope and would be the general target dredge cut where possible; however, there may be cases where a temporarily oversteepened cut at 2H:1V is needed due to site geometric constraints, and thus the 2H:1V slope was evaluated under short-term conditions. The stability evaluation assumes the dredge cut slopes are entirely submerged.

**Table F3-1
Factor of Safety Summary for Dredge Cut Slope Stability**

Location	Dredge Bottom Elevation (feet MLLW)	Scenario	Target Factor of Safety	Side Slope	Factor of Safety
RAL Exceedance Area 30 (STA 133+40)	-36	Short Term	1.3	2H:1V	2.2
		Long Term	1.5	3H:1V	1.8
RAL Exceedance Area 22 (STA 142+67)	-29	Short Term	1.3	2H:1V	2.9
		Long Term	1.5	3H:1V	1.9
RAL Exceedance Area 22 (STA 149+45)	-29	Short Term	1.3	2H:1V	2.3
		Long Term	1.5	3H:1V	1.6
RAL Exceedance Area 11 (STA 166+05)	-30	Short Term	1.3	2H:1V	2.1
		Long Term	1.5	3H:1V	1.8

Notes:

H:V: horizontal to vertical (ratio)

MLLW: mean lower low water

RAL: remedial action level

The dredge prism results are depicted in Figures F3-1 through F3-4. Cross section locations are shown in Figures F1-1b to F1-1d. In the short-term condition (i.e., during construction), temporary cut slopes of 2H:1V meet the target factor of safety in subtidal areas. Intertidal areas will be backfilled after dredging, in accordance with *Record of Decision* (ROD; EPA 2014) requirements, which will stabilize the area dredged. Long-term slopes constructed at 2H:1V do not meet target factors of safety for dredged slopes. Long-term subtidal slopes constructed at 3H:1V do meet target factors of safety.

Based on the slope stability evaluation, short-term dredge cut slopes of 2H:1V can be used for the temporary scenario prior to backfilling. For long-term dredge cut slopes (i.e., areas that will not be backfilled), 3H:1V slopes should be used.

3.2 Bank Slope Stability Considerations

The RD includes dredging near existing waterfront facilities and shorelines. Dredging removes sediments that support the toe of the slope and hence the resisting force against a potential sliding mass.

3.2.1 General Bank Slopes

Where excavations on banks are on the order of 1 to 2 feet deep, the evaluation of bank excavation slope stability is not warranted because removal of thin cuts will not materially affect the stability of

the bank itself. Experience conducting similar work on other shoreline projects has demonstrated that minor bank excavations (1 to 2 feet deep) can generally be accomplished without causing slope stability problems. This assumption is reasonable for typical bank conditions and may be applied for all thin cut areas for the middle reach but may not be applicable in sensitive areas such as those with low strength soils or visible indications of slope instability.

Bank slope stability is a key consideration for areas where deeper cuts are required at the toe of a bank area or on the bank itself. In these situations, the deeper cut can undermine the toe of the bank and can potentially cause slope instability if not accounted for in the design. Site-specific analyses for embankment stability adjacent deeper cuts will be completed in the Intermediate (60%) RD to develop minimum required offsets from these slopes based on updated remedial action areas (RAAs) and dredge depths.

3.3 Cap and Enhanced Natural Recovery Geotechnical Design Evaluation

This section describes generalized evaluations completed for cap and ENR bearing capacity and cap subgrade settlement for the Preliminary (30%) RD of the middle reach sediment remedy. The need for area-specific bearing capacity, settlement, and static stability on slopes analyses will be reviewed during the Intermediate (60%) RD based on updated RAAs, dredge depths, and capping thicknesses. Seismic cap performance evaluations are discussed in Section 5.

3.3.1 Bearing Capacity

The bearing capacity of various cap configurations was evaluated using methods described in *Guidance for In-Situ Subaqueous Capping of Contaminated Sediments* (Palermo et al. 1998). When cap material is placed on the surface of soft sediments, there is the potential for a bearing capacity failure directly through the in situ sediment. The initial cap lift thickness must be thin enough to maintain an acceptable factor of safety under the new loading caused by the weight of the cap.

In typical foundation design problems, a factor of safety of 3.0 is used for calculations wherein there is the potential for structural damage or impacts on human safety. This is the suggested factor of safety presented in the Assessment and Remediation of Contaminated Sediments (ARCS) guidance. However, experience on other capping projects has shown that a factor of safety of 3.0 can be overly conservative when considering cap construction lift thickness. Because life safety and structural foundation stability are not design considerations for caps, and because slope stability evaluations use similar factors of safety, a factor of safety of 1.5 was considered appropriate for use in this analysis for evaluating the cap bearing capacity. Subaquatic cap placement has been successfully demonstrated at other sediment cleanup sites when designed using a bearing capacity factor of

safety of 1.5, including the Whatcom Waterway sediment cleanup project (Anchor QEA 2015) and the San Jacinto River Superfund Site Time Critical Removal Action (Anchor QEA 2011).

This analysis evaluates the steady-state, short-term stability of the cap and soft sediments during construction. Once the cap has been placed, consolidation of fine-grained in situ sediments will occur, increasing the shear strength of the sediment. Thus, the long-term stability of the cap against bearing capacity failure will be greater than the short-term stability.

The in situ sediments must have sufficient internal strength to prevent local shear failure. To evaluate this condition, the ultimate bearing capacity was calculated with the Terzaghi equations for local failure (Palermo et al. 1998) using the undrained shear strengths described in Section 2.3:

Equation F3-1

$$q_{ult} = \left(\frac{2}{3}\right) s_u * N_c$$

where:

- q_{ult} = ultimate bearing capacity of sediment (psf)
- s_u = undrained shear strength of in situ sediments (psf)
- N_c = bearing capacity factor (dimensionless) = 5.14 for continuous strip footing (Terzaghi and Peck 1967)

This equation applies to a cap placed on the surface of an entirely cohesive soil with an angle of internal friction, ϕ' , equal to zero. The Preliminary (30%) RD assumes that at least 4 feet of dredging will be performed before cap placement. Therefore, the shear strength at the 4-foot-depth interval is considered appropriate for evaluating cap bearing capacity. Based on the shear strength model assumptions presented in Table F2-2, the undrained shear strength of recent sediments below the 4-foot-depth interval is modeled to be 205 psf.

The ultimate bearing capacity was calculated as follows:

$$q_{ult} = \left(\frac{2}{3}\right) 205 * 5.14 = 702 \text{ psf}$$

A factor of safety of 1.5 was used to compute the allowable bearing capacity:

Equation F3-2

$$q_{all} = \left(\frac{q_{ult}}{FOS} \right)$$

where:

$$\begin{aligned} q_{all} &= \text{allowable bearing capacity (psf)} \\ FOS &= \text{Factor of Safety} = 1.5 \end{aligned}$$

$$q_{all} = \left(\frac{702}{1.5} \right) = 468 \text{ psf}$$

The initial cap lift thickness that could be supported by the lowest strength in situ sediments at an appropriate factor of safety was calculated using the allowable bearing capacity and the following equation:

Equation F3-3

$$h = \left(\frac{q_{all}}{\gamma'} \right)$$

where:

$$\begin{aligned} h &= \text{lift thickness} \\ \gamma' &= \text{buoyant unit weight of cap material (pcf)} \\ \gamma' &= \gamma - \gamma_w \\ \gamma &= \text{total unit weight of cap material (pcf)} \\ \gamma_w &= \text{unit weight of water (64 pcf)} \\ \gamma' &= 110 \text{ pcf} - 64 \text{ pcf} = 46 \text{ pcf} \end{aligned}$$

$$h = \frac{468 \text{ psf}}{46 \text{ pcf}} = 10 \text{ feet}$$

This analysis, which uses the post-dredge in situ shear strength selected for modeling, indicates that a 4-foot-thick cap can be placed while maintaining an appropriate factor of safety for sediment bearing capacity during construction, assuming a dredge depth of 4 feet prior to capping. In this configuration, the post-cap surface would not project above the pre-construction ground surface.

A similar evaluation was performed to compute the factor of safety for placement of ENR cover upon the existing mudline. Table F2-2 indicates the lowest modeled shear strength of sediments is 75 psf at the surface (existing mudline). For this evaluation, the allowable bearing capacity is computed as follows:

$$q_{ult} = \left(\frac{2}{3}\right) 75 * 5.14 = 257 \text{ psf}$$

$$q_{all} = \left(\frac{257}{1.5}\right) = 171 \text{ psf}$$

For a 1-foot-thick submerged ENR layer, the load imposed is 46 pcf (Equation F3-3). The factor of safety (q_{all}/load) is 3.7, which is acceptable.

3.3.2 Subgrade Consolidation Settlement

Subgrade consolidation beneath the load imposed by a cap was assessed assuming the constructed cap would be placed after dredging and the post-cap grade would be the same as the pre-dredge mudline elevation. The new loads imposed on the subgrade would be caused by the greater unit weight of cap material than the in situ unit weight of the sediments (Table F2-2) that will have been dredged. Five scenarios were evaluated for post-cap subgrade consolidation reflecting different thicknesses of soft sediment beneath the cap, assuming the sediments and cap are entirely submerged.

The scenarios assume 4 feet of dredging and placement of a 4-foot-thick cap. Sediment thicknesses vary across the middle reach within the middle reach intertidal zone, in which caps will be placed. Exact capping locations will be determined during the Intermediate (60%) RD, at which point site-specific analyses can be evaluated with precise sediment thicknesses. Table F3-5 provides a general subgrade consolidation evaluation with varying sediment thicknesses for the Preliminary (30%) RD .

Table F3-2
Subgrade Consolidation Modeling Scenarios

Scenario	Pre-Dredge Sediment Thickness (feet)	Dredge Depth (feet)	Post-Dredge Sediment Thickness (feet)	Cap Thickness (feet)	Net Stress Increase (psf)
A	5	4	1	4	40
B	10	4	6	4	40
C	15	4	11	4	40
D	20	4	16	4	40
E	25	4	21	4	40

Note:
psf: pound per square foot

Subgrade consolidation was calculated according to the following relationship:

Equation F3-4

$$\Delta H = H \times CR \times \log\left(\frac{\sigma'_{vo} + \Delta\sigma'_v}{\sigma'_{vo}}\right)$$

where:

- ΔH = consolidation settlement
- H = consolidating layer thickness
- CR = compression ratio of subgrade sediment (Table F2-2)
- σ'_{vo} = in situ vertical effective stress
- $\Delta\sigma'_v$ = net stress increase (Table F3-2)

Table F3-6 summarizes the results of the subgrade consolidation evaluation.

**Table F3-3
Subgrade Consolidation Summary**

Scenario	Estimated Consolidation Settlement (inches)
A	1.2
B	2.5
C	2.8
D	3.0
E	3.1

As shown in Table F3-6, the subgrade is generally predicted to settle 2 to 3 inches after cap placement in the intertidal zone. The magnitude of settlement is not sensitive to the assumed thickness of soft sediment that could remain beneath the cap.

Subgrades can settle differentially under imposed loads; however, differential settlement is not expected to be a concern for this project. Differential subgrade settlement would manifest itself as a sloping top surface of the cap. In such cases, the cap thickness would not be affected by differential subgrade settlement; therefore, cap performance would not be compromised. Because cap materials are granular, there is no consolidation settlement within the cap layers themselves, and differential settlement is not a consideration for caps.

The time rate over which consolidation occurs is a function of the distance porewater must travel (drainage path length) and the coefficient of consolidation of the subgrade. Time rate of consolidation was evaluated according to the following equation:

Equation F3-5

$$T = \frac{c_v t}{H_{DR}^2}$$

where:

- T = time factor = 0.8 for 90% consolidation (Lambe and Whitman 1969)
- c_v = coefficient of consolidation (Section 2.3)
- t = time to achieve 90% consolidation
- H_{DR} = drainage path length (Section 2.3)

Based on Equation F3-5, it is estimated that subgrade consolidation would be 90% complete approximately 120 days after cap construction.

Subgrade consolidation settlement can confound the interpretation of bathymetric survey results if bathymetry surveys are used to confirm the thickness of caps. When subgrade consolidation settlement occurs, bathymetry comparisons (i.e., isopach mapping) can be incorrectly interpreted as indicating "thinning" of cap material. Therefore, supplemental cap confirmation approaches such as thickness probing would also be included in Long-Term Monitoring and Maintenance Plan (LTMMP) planning to address potential issues associated with subgrade consolidation if caps are to be constructed. If cap thinning occurs, corrective measures could include additional material placement.

3.3.3 *Static Slope Stability of Caps*

Cap slope stability will be evaluated using limit equilibrium methods during the Intermediate (60%) RD once dredging and capping areas have been further analyzed. A geologic profile will be developed for the worst-case scenario within the middle reach and evaluated using the geotechnical engineering parameters presented in Table F2-2. The modeling software will be set to search for a critical slip surface for any location within the analyzed slope. A target factor of safety of 1.5 will be considered when assessing cap stability with the understanding that it may be challenging to design naturally shaped submerged and intertidal slopes using habitat-compatible materials to achieve this factor of safety.

3.4 Backfill Design

This section describes the gradation and stability design of backfill materials.

3.4.1 Backfill Gradation

The selection of backfill considers several engineering considerations, including the following:

- Commercially available, natural aggregate materials
- Appropriate proportion of gravel within the aggregate mixture to provide stability to backfill placed on slopes, as evaluated in Section 3.4.2
- Limiting the percentage fines (material that passes the U.S. No. 200 sieve) to protect water quality by minimizing turbidity during placement

Table F3-7 presents a backfill gradation that balances these objectives and was assumed for geotechnical analysis. This gradation was used in the Final (100%) RD for the upper reach and may be refined during future design iterations for the middle reach. The remedial contractor may identify material that is very similar to this gradation and that may be acceptable for use as backfill. The engineer should review any proposed deviations from this specification and may approve an alternate gradation in consultation with the U.S. Environmental Protection Agency (EPA).

**Table F3-4
Backfill Gradation Specifications**

Sieve Size	Percent Passing
4-inch	100
2-inch	70 to 100
U.S. No. 4	50 to 80
U.S. No. 40	0 to 30
U.S. No. 200	0 to 5

In addition to engineering considerations, there may be additional habitat considerations that would be evaluated separately in consultation with EPA. Further, backfill material must meet or be lower than chemical concentration limits that will be defined in the project specifications based on cleanup levels for human health and benthic protection.

3.4.2 Backfill Stability

Backfill will be placed in habitat areas (elevations above -10 feet MLLW) in accordance with the ROD (EPA 2014). In some dredge areas, backfill may need to be sloped below elevation -10 feet MLLW until it meets the post-dredge surface at depth.

Backfill slope stability is evaluated using infinite slope stability theory, in accordance with Duncan and Wright (2005). For this Preliminary (30%) RD evaluation, the factor of safety for a 3H:1V backfill slope was computed using the following equation:

Equation F3-6

$$FOS = \frac{\tan(\phi')}{\tan(i)}$$

where:

FOS = Factor of Safety
 ϕ' = backfill friction angle (Table F2-2)
 i = slope angle

The factor of safety for backfill placed at a 3H:1V slope is 1.9, which is greater than the target long-term slope stability factor of safety of 1.5. Thus, a 3H:1V slope angle is appropriate for the design of backfill slopes.

If steeper slopes are identified during the Intermediate (60%) RD, they will be evaluated in the updated BODR. In general, where steeper slopes may be needed, armor rock could be used to protect the backfill surface. Shoreline armor has a higher friction angle than sand and gravel backfill and is typically assumed to range from 38 to 42 degrees for angular rock (USDA 1989). Assuming an armor rock friction angle of 38 degrees, slopes of 2H:1V have a factor of safety of 1.6, which is greater than the target long-term factor of safety of 1.5. Thus, backfill could be placed on 2H:1V slopes if angular armor rock is used.

4 Geotechnical Engineering Recommendations to Support Structural Engineering Evaluations

This section presents geotechnical engineering recommendations to support structural evaluations of vertical structures, such as bulkheads and bridge piers, and to design replacement piles that may be needed as part of remedy construction in the middle reach. Necessary structural engineering evaluations were developed for the Preliminary (30%) RD based in part on the recommendations provided in this section.

4.1 Vertical Structure Evaluation Geotechnical Recommendations

This section provides recommendations for the structural engineer to use for the evaluation of existing vertical structures adjacent to RAL exceedance areas.

4.1.1 Lateral Earth Pressures for Middle Reach

The following lateral earth pressure recommendations are provided for structural evaluation of cantilevered shoreline bulkhead walls. This information can be used to assess the need for offsets or other measures if dredging needs to be performed in front of bulkheads.

Lateral earth pressures acting on the bulkhead will depend primarily on the following:

- Fill material placed behind the wall, and the degree of compaction immediately adjacent to the wall
- Flexibility of the wall, and the degree of movement that the wall undergoes
- The presence of any surcharges or concentrated loads adjacent to the bulkhead
- Wall drainage
- Seismic loading

If the bulkhead is allowed to yield such that the top can move laterally at least 0.3% of the bulkhead's retained height when loaded, active earth pressures will develop. This movement typically must exceed 3% of the bulkheads retained height to develop full passive pressure. If this level of deflection is intolerable, the wall should be evaluated using at-rest soil pressures.

To design for lateral earth pressures, the parameters provided in Table F4-1 may be used. Earth pressures may be computed assuming a triangular pressure distribution applied from the top of the bulkhead to the base of the sheeting. Passive pressures will also be applied in a triangular distribution, from the mudline downward.

**Table F4-1
Generalized Middle Reach Parameters for Bulkhead Lateral Earth Pressure Parameters**

Soil Layer	Total Unit Weight (pcf)	Drained Shear Strength		Lateral Earth Pressure Coefficients		
		Cohesion (psf)	Internal Friction Angle, ϕ' (degrees)	Active (K_a)	At Rest ¹ (K_0)	Passive ² (K_p)
Fill	125	0	33	0.29	0.46	N/A
Recent sediments	100	0	27	0.38	0.55	2.66
Alluvium	125	0	32	0.31	0.47	3.26

Notes:

1. Movement at the top of wall required to reach minimum active or maximum passive pressure, by tilting or lateral translation, is 0.3% of the wall height for active pressures and 3.0% of the wall height for passive pressures.
2. Passive pressures are presented as ultimate values and do not include a factor of safety.

N/A: not applicable

pcf: pound per cubic foot

psf: pound per square foot

The parameters in Table F4-1 are considered conservative because they do not account for friction between the soil and the bulkhead, which acts to reduce the overall active and at-rest earth pressures.

As noted in Table F4-1, using the passive pressure coefficient provided would result in calculating ultimate passive soil resistance, which would be an appropriate assumption for calculating the potential reduction in passive resistance at the toe of the wall when dredging occurs. When computing passive support for new walls, ultimate passive pressures should be reduced to account for potential loss of sediment at the bulkhead face (typically 2 feet of sediment loss is assumed) and to include an appropriate factor of safety. Generally, the recommended factor of safety is 1.25 for temporary walls and 1.5 for permanent walls but may vary depending on site-specific factors.

4.1.2 Earth Pressure Diagrams for Temporary Structures at RM 2.2

The RM 2.2W inlet is bounded by 1st Avenue South on the west side and two separate industrial properties on the north and south sides. A temporary bulkhead is required to protect an existing block wall along the north shoreline near the Douglas Management Dock during dredging and backfill. Additionally, a temporary double-walled cofferdam is proposed near the necking point of the Inlet to facilitate work in a "dry" condition. The cofferdam will be filled with capping material that is anticipated to be reused after remediation is complete. Two design diagrams are provided for Preliminary (30%) RD retaining structures at RM 2.2 within RAAs 24B through 24H:

- Figure F4-1 depicts the diagrams for a conceptual temporary bulkhead near the Douglas Management Dock (Figure F1-1c). The bulkhead will be situated in front of an upland concrete block retaining wall and may be either cantilevered or with a single row of bracing.

- Figure F4-2 depicts the diagrams for the proposed temporary double-walled cofferdam near the inlet at RM 2.2 between RAA 24D and RAAs 24E and 24G (Figure F1-1c). This structure will provide a hydraulic barrier such that dredging in RAA 24B through 24D can be performed “in-the-dry.”

The retaining structure locations are shown in Figure F1-1c. The diagrams (Figures F4-1 and F4-2) provide earth pressures, hydrostatic pressures, surcharge loads, and passive pressure reduction factors, as appropriate.

4.1.3 Effect of Prohibiting Surcharge Loads Above Existing Bulkheads During Adjacent Dredging

Bulkheads retain soil loads and surcharges in the form of active or at-rest lateral earth pressures. These earth pressures are resisted at the toe of the bulkhead by passive earth pressures provided by the sediments in front of the bulkhead. The following discussion evaluates how much of the passive earth pressure is needed to resist surcharge loads alone and the effect to prohibiting surcharge loads during dredging. This assessment was developed using generalized soil and sediment conditions and thus is generally applicable to structures throughout the middle reach and is assumed to be applicable for structures where information is not directly available regarding design surcharge assumptions (i.e., design or as-built drawings).

It is assumed that shoreline bulkheads were designed and constructed to support temporary surcharge loads at the top of the bulkheads. Typically, a temporary surcharge of 250 psf (or higher) can be accommodated by marine shoreline structures in good condition. Assuming a bulkhead backfill unit weight of 125 pcf, 250 psf is effectively equivalent to a soil surcharge height of approximately 2 feet.

One way to protect structures during adjacent dredging is to prohibit surcharge loading during dredging. This effectively allows for the “design surcharge capacity” of the wall to be used to offset the temporary loss of passive pressure in front of the wall due to dredging.

For the Preliminary (30%) RD, a preliminary retained soil height of approximately 15 feet has been selected. The active lateral earth pressure behind the wall (no surcharge) is calculated as follows:

Equation F4-1

$$P_A = 1/2 K_A \gamma h^2$$

where:

- P_A = active earth pressure resultant force (pound per foot [lb/ft])
- K_A = active earth pressure coefficient for retained soil (Table F4-1)
- γ = unit weight of retained soil (Table F4-1)
- h = retained height of soil (feet)

Note: K_A may be used for yielding walls: when movement at the top of wall, by tilting or lateral translation, is 0.3% of the wall height; otherwise at-rest coefficients (K_0) should be used.

For a 15-foot yielding bulkhead, the resultant active earth pressure is calculated to be 4,145 pounds per foot (lb/ft).

Adding 2.0 feet of retained height for the surcharge loading condition (equivalent to a retained soil height of 17.0 feet), the active lateral earth pressure is calculated to be 5,324 lb/ft, which means that prohibiting surcharge during dredging could offset the loss of 1,179 lb/ft of passive pressure.

Passive earth pressure is calculated as follows:

Equation F4-2

$$P_P = 1/2 K_P \gamma d^2$$

where:

- P_P = passive earth pressure resultant force (lb/ft)
- K_P = passive earth pressure coefficient for sediments (Table F4-1)
- γ = unit weight of sediments (Table F4-1)
- d = depth below mudline (feet)

Note: K_P may be used for yielding walls: when movement at the top of wall, by tilting or lateral translation, is 3% of the wall height; otherwise at-rest coefficients (K_0) should be used.

For the passive pressure coefficients for sediments presented in Table F4-1, a depth of approximately 5 feet below mudline is required to achieve a passive pressure of 1,198 lb/ft when sediments are submerged (buoyant unit weight providing passive pressure) or approximately 3 feet below mudline when sediments are not submerged (total unit weight providing passive pressure).

Based on this evaluation, for yielding shoreline bulkheads in good condition that were designed to support an upland surcharge of at least 250 psf, prohibiting surcharges during dredging would allow for 3 to 5 feet of dredging to occur while maintaining passive pressure support comparable to the surcharge loading condition with no dredging.

Note that this assessment considers the soil loads only and does not account for the condition of the bulkhead wall nor the stresses in the wall structure that might be imposed by removing passive support during dredging. If this mitigation measure is proposed for a specific bulkhead, a more detailed evaluation of site-specific geotechnical and structural conditions would be performed at a later stage of RD to refine this assessment. The evaluation may differ for some bulkhead structures, including bulkheads designed to resist lateral loads using battered piles.

4.1.4 *Effect of Dredging on Passive Pressure*

As previously discussed, dredging adjacent structures reduces lateral toe support (i.e., passive pressure), which can increase the stresses on the structure. This section describes the evaluations performed to determine appropriate reductions in passive pressure considering the following:

- Dredge cut slope angle
- Dredge cut depth
- Horizontal offset of dredge cut from the structure

The analyses presented in this section were developed specific to the recent sediments material that would be removed by dredging, as well as the alluvium, and is applicable to any vertical structure in the middle reach (e.g., bulkheads, bridge piers). To conduct this analysis, the total available passive pressure (no dredging) was compared to the weight of the passive wedge that would remain after dredging. The reduction factor was calculated as follows:

Equation F4-3

$$\text{Reduction Factor} = \frac{W_w}{P_R}$$

where:

W_w = buoyant weight of passive soil wedge between structure and toe of dredge cut (lb/ft)

P_R = passive earth pressure force for the no dredging scenario calculated at the evaluated depth of dredging (lb/ft)

Key conclusions from this evaluation, in the form of passive earth pressure reduction factors, are presented in Table F4-2.

Table F4-2
Passive Earth Pressure Reduction Factors – Recent Sediment

Offset Distance	Reduction Factor Based on Side Slope			
	2.5H:1V	2H:1V	1.5H:1V	1H:1V
0	0.94	0.75	0.56	0.38
2	1	0.85	0.66	0.48
5	1	1	0.81	0.63
6	1	1	0.86	0.68
10	1	1	1	0.88

Note:

H:V: horizontal to vertical (ratio)

As shown in Table F4-2, when the dredge prism is not offset, the passive earth pressure could be significantly reduced, particularly if the dredge cut is oversteepened beyond the recommended 2H:1V temporary cut slope. Reduced passive pressure increases the risk of damaging structures.

The reduction factors presented in Tables E4-2 and E4-3, in conjunction with the earth pressure recommendations in Table F4-1, can be used by the structural engineer to determine recommended structural offsets for dredging.

A horizontal dredging offset of at least 5 feet will limit the potential for reducing passive earth pressure. The Preliminary (30%) RD generally assumes a 5-foot offset from structures, which considers the geotechnical evaluation as well as additional safety measures that will limit the potential for dredging equipment to physical contact and potentially damage structures.

Under unique conditions, dredging offsets should be increased. Dredging will be performed adjacent to the north and south wing walls associated with the Historic Intake Structure Building at RAAs 9C, 9D, 9E, and 9F (adjacent to Gateway Park). Due to the historic designation of the wing walls, poor structural conditions, and the nature of the soft sediment surrounding the wing walls, the offsets from the north and south wing walls should be 15 feet and 10 feet, respectively.

Note that this assessment generalizes structure types and does not account for the condition of the structure. More detailed evaluations of site-specific geotechnical and structural conditions will be performed at a later stage of RD on an as needed basis, in addition to the Historic Intake Structure.

4.2 Pile Design Recommendations

Miscellaneous single piles or dolphin pile groups may need to be removed to accomplish construction. This section presents geotechnical engineering pile design recommendations for the structural engineer’s use in designing replacement piles.

Based on discussion with the project structural engineer, replacement piles are likely to be hollow steel pipe piles, which lend themselves to vibratory installation and are capable of supporting the range of loads anticipated for this project. Timber piles are not considered for new installations for the middle reach because timber piles require chemical treatment to prevent decay.

Replacement piles are expected to be primarily laterally loaded. Pile design to resist lateral loads can be accomplished using LPILE or similar software to assess pile deflection under loading and required depth to fixity below the mudline. Table F4-4 presents recommended LPILE parameters to model the recent sediments and alluvium.

**Table F4-3
Middle Reach LPILE Modeling Parameters**

Layer	Effective Unit Weight γ' (pcf)	Friction Angle ϕ (°)	Undrained Shear Strength c_u (kip/ft ²)	P-Y Curve Model	Spring Constant; K (Es=Kx) k (pci)	Strain Factor; @50% max E ϵ_{50}
Recent sediment	36	27	0.09	Soft clay (Matlock)	N/A	0.020
Alluvium	61	32	N/A	Sand (Reese)	20	N/A

Notes:
 ft²: square foot
 kip: one thousand pounds
 N/A: not applicable
 pcf: pound per cubic foot
 pci: pound per cubic inch

The above LPILE parameters can be used to design the guide piles along the Boyer Alaska Barge Line North Lay Berth Plastic Float System. The sediment surface along the float system ranges from -6.2 feet MLLW at the northwest to -2.3 feet MLLW at the southeast end of the float system. The limited core logs and one CPT log indicate that sediment thickness may range between 3 and 10 feet. Because the data are limited, we recommend assuming a sediment/alluvium contact elevation of -13 feet MLLW for the Preliminary (30%) RD.

5 Seismic Design

The middle reach of the LDW is located within the seismically active Puget Lowland, a region characterized by bedrock faults and tectonic plate movement and with a documented history of earthquake activity. Earthquakes occur when energy accumulated during fault or tectonic plate movement is suddenly released over a short time span. The location of energy release, known as the epicenter of an earthquake, can occur at different places in a fault system.

The ground shaking caused by an earthquake can cause loose soils to lose strength as porewater pressure increases. This phenomenon, known as liquefaction, can cause soil movement and ground settlement. Earthquakes can also shake structures and impose loads on structural elements and foundations. Seismic risks are assessed in geotechnical engineering using a variety of tools.

This section describes the seismic design of the sediment remedy for the middle reach with a focus on the anticipated performance of remedial elements (primarily sediment caps) under earthquake loading. This section also provides recommended seismic design parameters for use by the structural engineer, as appropriate.

5.1 Seismic Site Class

Seismic behavior is generally assessed by evaluating the relative density of near-surface soils (the upper 100 feet bgs). For seismic design, relative density is often characterized by the average shear wave velocity of the soil column, which governs how earthquake energy is amplified or dampened by the near-surface soils.

We estimated the site class using shear wave velocities derived from correlations to CPT cone resistance (q_c) values and weighted average SPT N-values from borings, following the procedures and site class definitions outlined in the American Association of State Highway and Transportation Officials *LRFD Bridge Design Specifications* (AASHTO 2020). This evaluation resulted in a Site Class E classification for all borings and CPT soundings performed during the Phase II PDI, as well as for most of the historical geotechnical borings completed during previous investigations near the middle reach. Because the Phase II PDI borings and CPTs generally extended to depths of less than 100 feet, we supplemented the assessment with deeper historical borings (extending to or beyond 100 feet) to support a more representative evaluation of the upper soil profile.

5.2 Strong Motion Design Input Parameters

For seismic evaluations, earthquake peak ground acceleration (PGA; presented as a percentage of the force of gravity) and earthquake magnitude are key input parameters.

The USGS provides internet-based tools that, using mapped locations and seismic site classes, output PGAs and earthquake magnitudes for different recurrence interval earthquakes.

For the middle reach sediment remedy, two different earthquake types were considered:

- A 100-year recurrence interval earthquake, consistent with typical protectiveness evaluations for other remedy elements such as cap contaminant modeling
- A 475-year recurrence interval earthquake, which has traditionally been the size of event considered on other regional Superfund projects based on a 10% probability of exceedance in a 50-year time frame

Table F5-1 provides the key USGS output parameters used for geotechnical seismic assessment for both events. Attachment F.5 provides the detailed outputs for the middle reach from the USGS website.

**Table F5-1
Earthquake Parameters Used in Geotechnical Engineering Evaluations**

Event Recurrence Interval	PGA (% gravity)	Mean Magnitude
100 years	0.196	6.7
475 years	0.437	6.9

Notes:

Data developed for latitude 47.539, longitude -122.329

Site Class D/E; Dynamic Conterminous United States model (2014 edition v4.2.0)

Model source: <https://earthquake.usgs.gov/hazards/interactive>

PGA: peak ground acceleration

5.3 Liquefaction Evaluation

As described in Section 2, the site investigation included CPTs at 16 different locations in the middle reach. Digital records from these CPTs were processed by the analytical software Cliq (version 3.3.1.14), which facilitates liquefaction assessment and estimates of liquefaction-induced settlement using CPT-measured parameters, earthquake PGAs, and earthquake magnitude.

For all locations investigated with a CPT, liquefaction was predicted during both the 100- and 475-year earthquakes. The estimated magnitude of liquefaction-induced settlement did not significantly vary between the two earthquakes, ranging from 4 to 14 (median 8) inches of settlement in the upper 45 feet bgs.

5.4 Seismic Performance of Capped Slopes

The seismic performance of capped slopes was evaluated using limit equilibrium methods, as described for the slope stability discussions in Section 3. A geologic cross section of the slope at Sta 149+45 (RAA 22) was modeled, and seismic forces associated with both the 100- and 475-year earthquakes were added. For both the 100- and 475-year earthquakes, the resulting factors of safety were less than 1.0, indicating that some movement of the capped slope can be expected during the

earthquakes. Figure F5-1 depicts the cross section evaluated for the slope at Sta 149+45 (RAA 22), as well as the critical slip surface and factors of safety for the 100- and 475-year earthquakes at this location. The cross section location is depicted in Figure F1-1c.

In general, shoreline slopes are susceptible to movement during strong earthquake shaking. Slopes designed to resist movement could require significant structural reinforcement that is not compatible with the habitat and human uses of shorelines. In part, due to issues like this, the geotechnical engineering community is moving toward a performance-based assessment of slopes, when appropriate, for seismic design. In the case of shoreline slopes where life safety and structures are not at risk, this type of assessment does not attempt to design for preventing movement; rather, a performance-based approach evaluates how much movement could be expected during an earthquake and what mitigation measures, if any, would need to be implemented after the earthquake had occurred.

Slope displacement was estimated for both the 100- and 475-year earthquakes in accordance with the methods presented by the National Cooperative Highway Research Program (NCHRP 2008). Table F5-2 presents the estimated slope displacement for Container Properties under both earthquake scenarios.

Table F5-2
Seismic Slope Displacement for the Slope at Sta 149+45 (RAA 22) Cap

Earthquake Return Interval	Estimated Displacement for Cap at Sta 149+45 Slope
100 years	2 to 6 inches
475 years	6 to 20 inches

Note:

RAA: remedial action area

5.5 Conclusions on Seismic Performance of Sediment Remedy

Based on the liquefaction assessment and slope displacement estimates, the sediment remedy is expected to have acceptable seismic performance. Anticipated settlement and displacement under the 100-year event is expected to be significantly less than any design cap thicknesses. During a larger earthquake, the cap and sediments beneath may move down the slope, but any cap damage from such movement is expected to be easily repaired.

Post-earthquake mitigation measures could include visual inspections and bathymetry surveys to evaluate cap condition. Cap repairs, if needed, could be readily implemented by adding more cap substrate to address any local thinning associated with post-earthquake deformation or settlement.

The LTMMP will consider these evaluations and set criteria for inspections following seismic events.

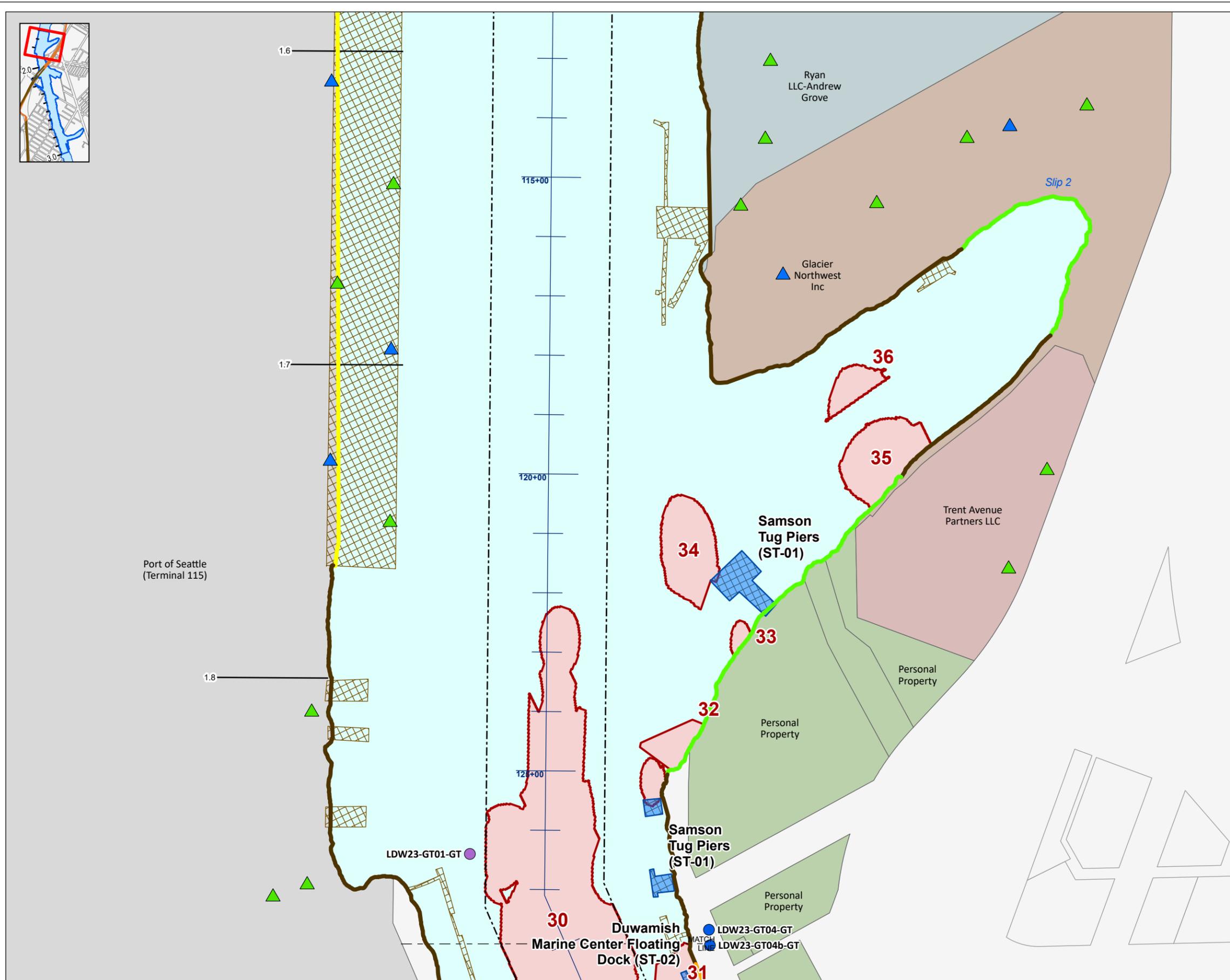
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Figures

Prepared by craigh_10/24/2025: W:\Projects\Duwamish_AOC\GIS\Maps and Analyses\Design\30 percent\Design.aprx Fig F1-1 7702 Geotechnical data locations



Phase II PDI geotechnical data collection locations

- Cone penetrometer test location
- Geotechnical boring location
- Vane shear location

Previous geotechnical studies by others

- ▲ Cone penetrometer test location
- ▲ Standard penetration test location

1 RAL exceedance area

Bank condition

- Armored slope
- Vertical bulkhead
- Bulkhead and armored slope
- Unarmored bank

Overwater structures

- ▨ Dock/pier
- Structure inspected during Phase II
- LDW Superfund Boundary
- LDW Superfund Boundary
- King Co tax parcel
- - - Federal Navigation Channel
- + Federal Navigation Channel stations
- River mile



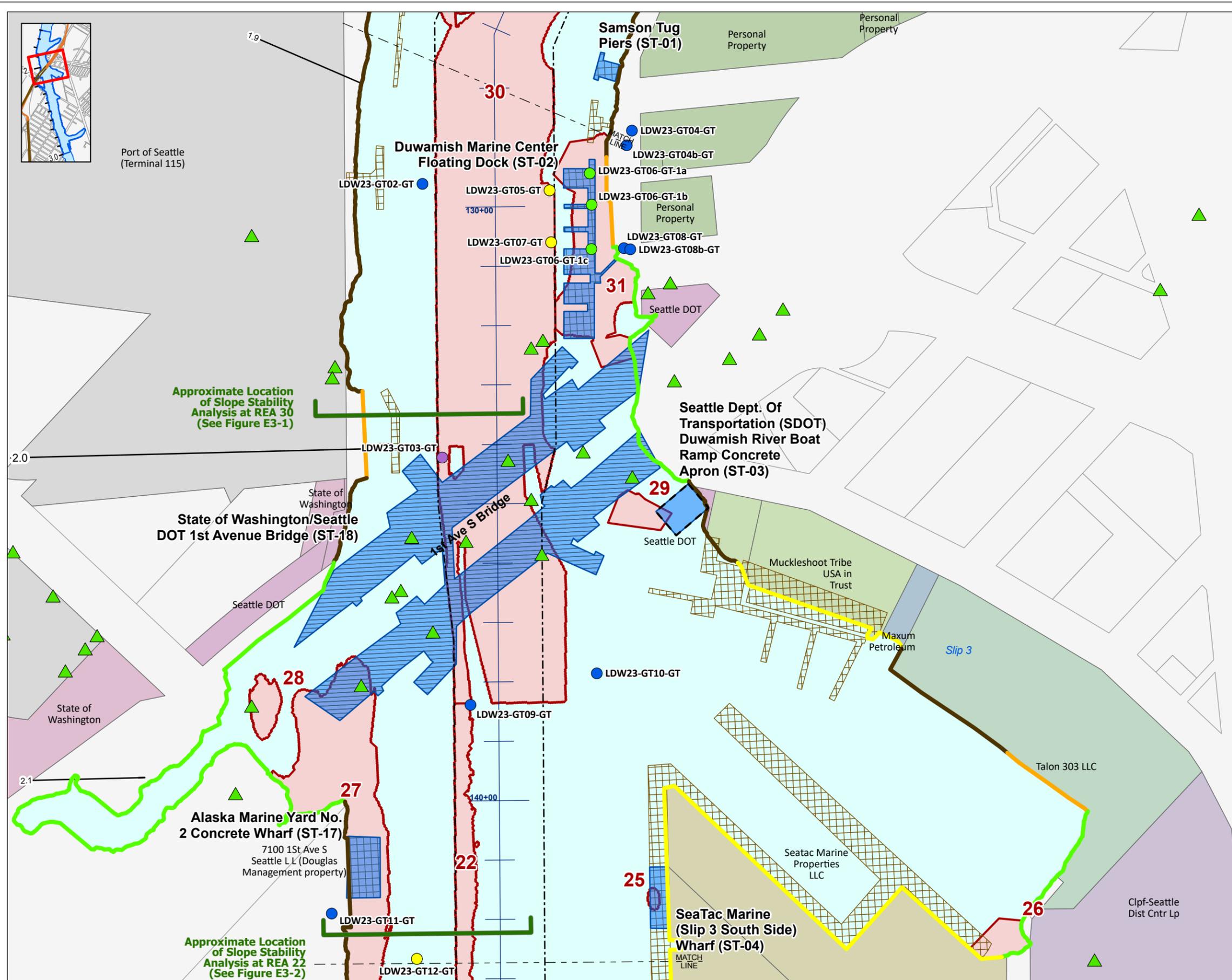
Figure F1-1a. Middle Reach Geotechnical Data Locations, RM 1.6 to RM 1.85

APPENDIX F - GEOTECHNICAL DESIGN ANALYSIS
 30% REMEDIAL DESIGN BASIS OF DESIGN
 REPORT FOR THE LDW MIDDLE REACH
 OCTOBER 27, 2025



Lower Duwamish Waterway Group
 City of Seattle / King County / The Boeing Company

Prepared by craigh_10/24/2025: W:\Projects\Duwamish_AOC\GIS\Maps and Analyses\Design\30 percent\Design.aprx|Fig F1-1 7702 Geotechnical data locations



Phase II PDI geotechnical data collection locations

- Cone penetrometer test location
- Geotechnical boring location
- Vane shear location
- Full-flow penetrometer location

Previous geotechnical studies by others

- ▲ Standard penetration test location

RALE exceedance area

- 1 RAL exceedance area

Slope stability transect

- Slope stability transect

Bank condition

- Armored slope
- Vertical bulkhead
- Bulkhead and armored slope
- Unarmored bank

Overwater structures

- ▨ Bridge
- ▨ Dock/pier
- Structure inspected during Phase II

Boundaries and Navigation

- LDW Superfund Boundary
- LDW Superfund Boundary
- King Co tax parcel
- - - Federal Navigation Channel
- + Federal Navigation Channel stations
- River mile

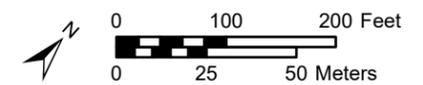


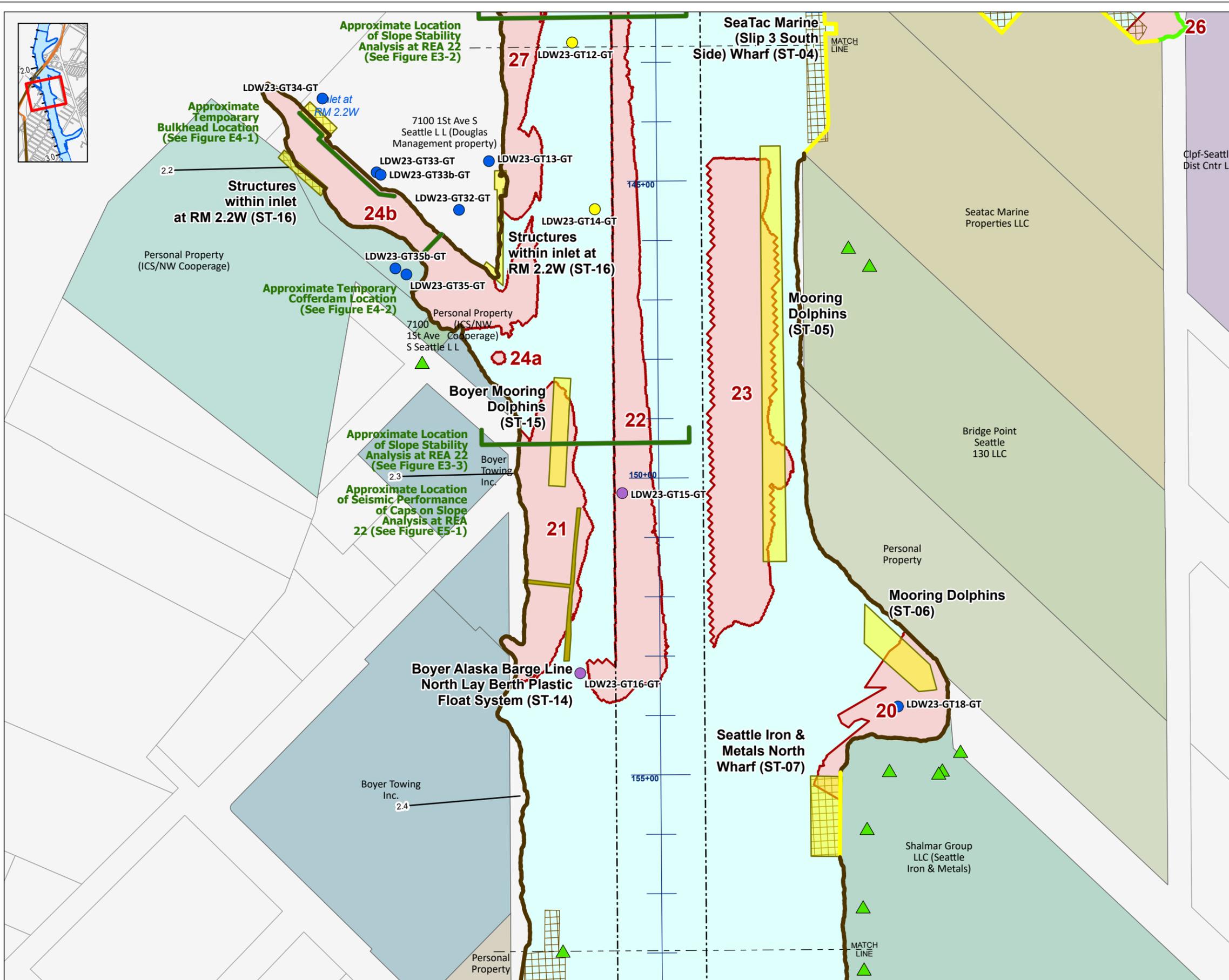
Figure F1-1b. Middle Reach Geotechnical Data Locations, RM 1.85 to RM 2.15

APPENDIX F - GEOTECHNICAL DESIGN ANALYSIS
 30% REMEDIAL DESIGN BASIS OF DESIGN
 REPORT FOR THE LDW MIDDLE REACH
 OCTOBER 27, 2025



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 City of Seattle / King County / The Boeing Company

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Phase II PDI geotechnical data collection locations

- Cone penetrometer test location
- Geotechnical boring location
- Full-flow penetrometer location

Previous geotechnical studies by others

- ▲ Standard penetration test location

RAL exceedance area

- 1 RAL exceedance area

Slope stability transect

- Slope stability transect

Bank condition

- Armored slope
- Bulkhead and armored slope
- Unarmored bank

Overwater structures

- ▣ Dock/pier
- ▣ Marina
- ▣ Structure inspected during Phase II
- ▣ Structure to be inspected (if necessary) during Phase III

LDW Superfund Boundary

- ▣ LDW Superfund Boundary

King Co tax parcel

- ▣ King Co tax parcel

Federal Navigation Channel

- Federal Navigation Channel
- + Federal Navigation Channel stations

River mile

- River mile



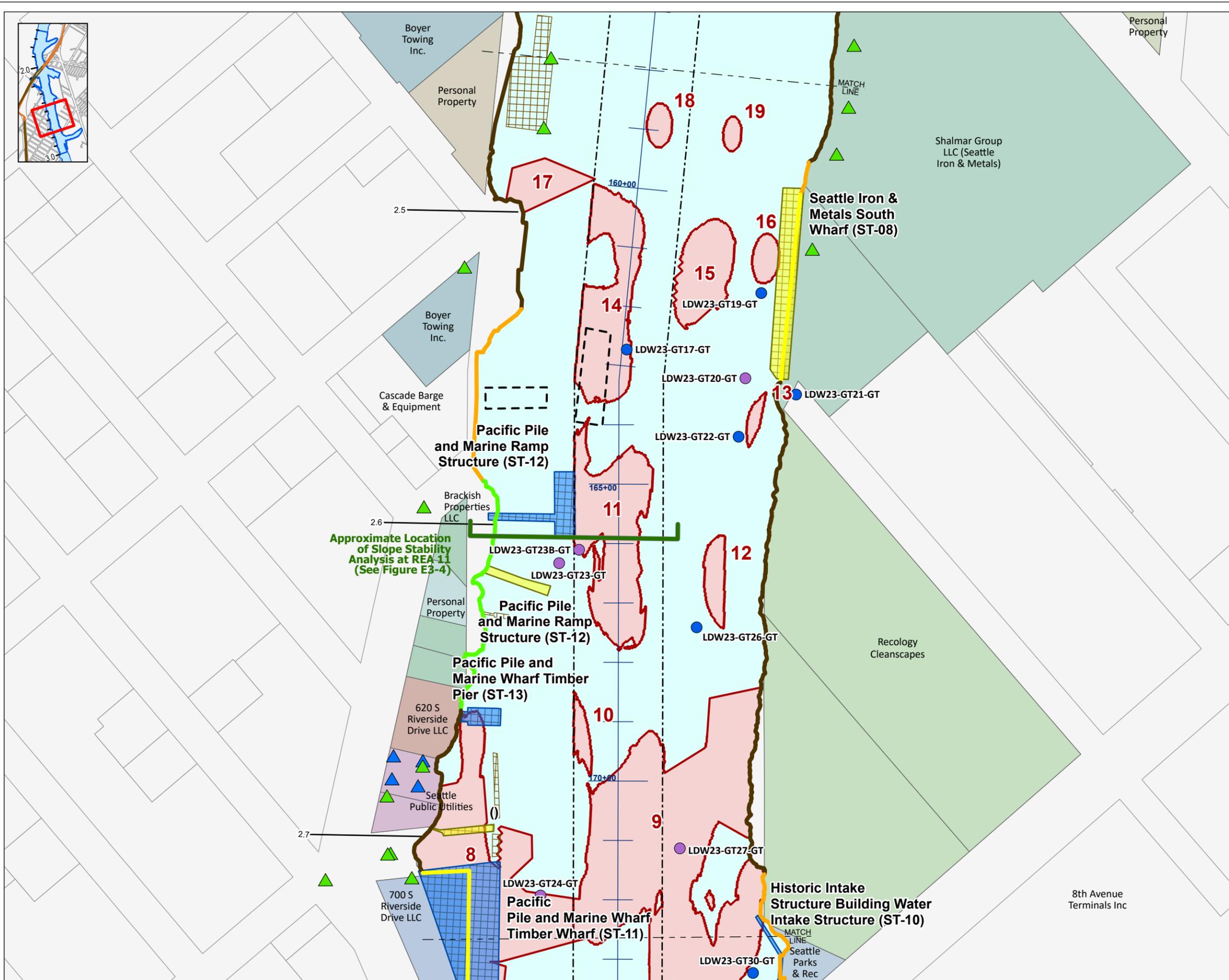
Figure F1-1c. Middle Reach Geotechnical Data Locations, RM 2.15 to RM 2.45

APPENDIX F - GEOTECHNICAL DESIGN ANALYSIS
 30% REMEDIAL DESIGN BASIS OF DESIGN
 REPORT FOR THE LDW MIDDLE REACH
 OCTOBER 27, 2025



Lower Duwamish Waterway Group
 City of Seattle / King County / The Boeing Company

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Phase II PDI geotechnical data collection locations

- Cone penetrometer test location
- Geotechnical boring location
- Full-flow penetrometer location

Previous geotechnical studies by others

- ▲ Cone penetrometer test location
- ▲ Standard penetration test location

1 RAL exceedance area

— Slope stability transect

Bank condition

- Armored slope
- Vertical bulkhead
- Bulkhead and armored slope
- Unarmored bank

Overwater structures

- ▣ Dock/pier
- ▣ Structure inspected during Phase II
- ▣ Structure to be inspected (if necessary) during Phase III

▣ LDW Superfund Boundary

▣ LDW Superfund Boundary

▣ King Co tax parcel

--- Federal Navigation Channel

+ Federal Navigation Channel stations

— River mile

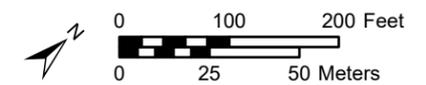


Figure F1-1d. Middle Reach Geotechnical Data Locations, RM 2.45 to RM 2.75

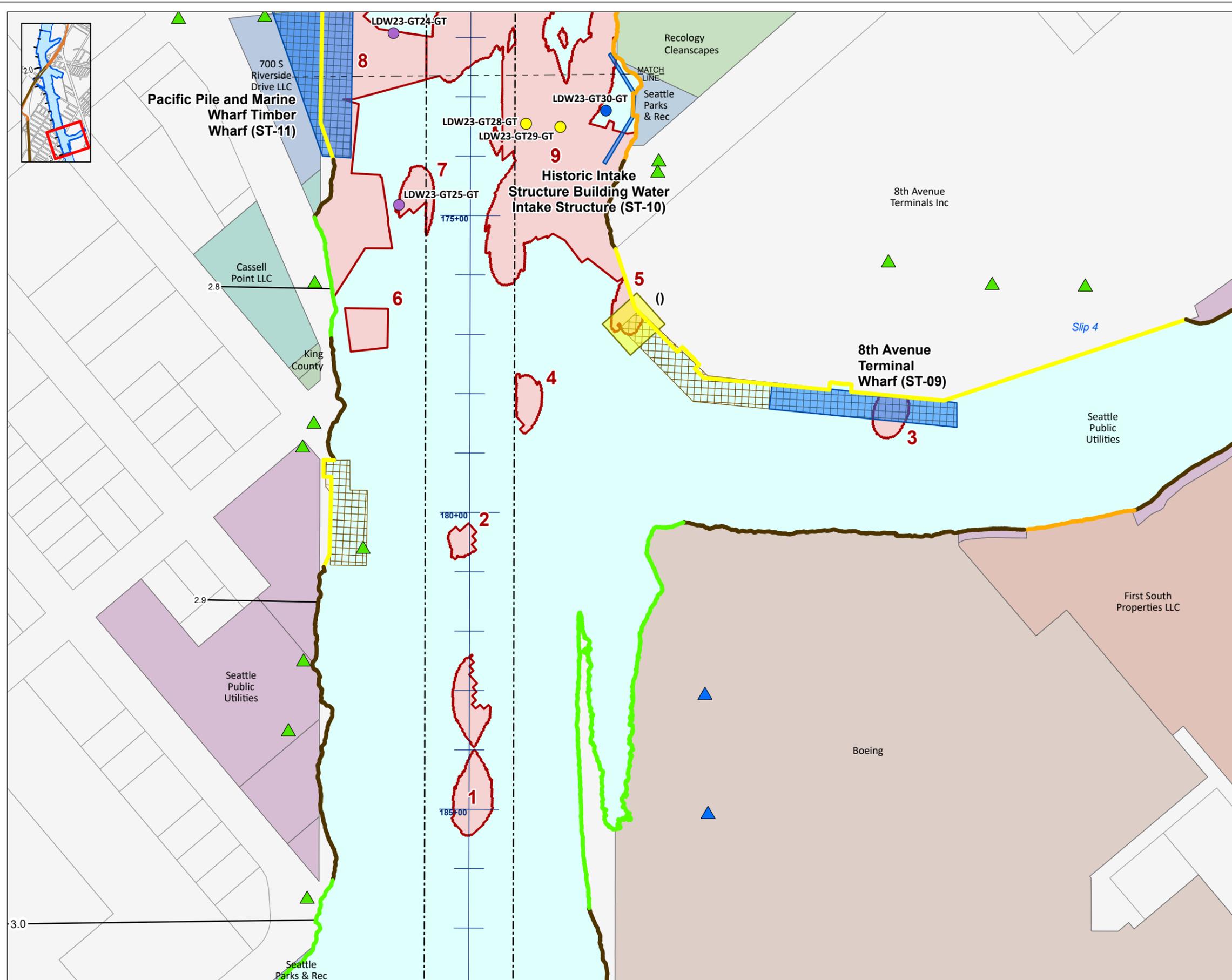
APPENDIX F - GEOTECHNICAL DESIGN ANALYSIS
 30% REMEDIAL DESIGN BASIS OF DESIGN
 REPORT FOR THE LDW MIDDLE REACH
 OCTOBER 27, 2025

Windward environmental LLC

ANCHOR QEA

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Phase II PDI geotechnical data collection locations

- Cone penetrometer test location
- Geotechnical boring location
- Full-flow penetrometer location

Previous geotechnical studies by others

- ▲ Cone penetrometer test location
- ▲ Standard penetration test location

RAL exceedance area

- 1 RAL exceedance area

Bank condition

- Armored slope
- Vertical bulkhead
- Bulkhead and armored slope
- Unarmored bank

Overwater structures

- ▨ Dock/pier
- Structure inspected during Phase II
- Structure to be inspected (if necessary) during Phase III

Other symbols

- LDW Superfund Boundary
- LDW Superfund Boundary
- King Co tax parcel
- - - Federal Navigation Channel
- + Federal Navigation Channel stations
- River mile

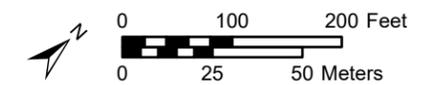


Figure F1-1e. Middle Reach Geotechnical Data Locations, RM 2.75 to RM 3.0

APPENDIX F - GEOTECHNICAL DESIGN ANALYSIS
 30% REMEDIAL DESIGN BASIS OF DESIGN
 REPORT FOR THE LDW MIDDLE REACH
 OCTOBER 27, 2025



Lower Duwamish Waterway Group
 City of Seattle / King County / The Boeing Company

Figure F3-1
Slope Stability – Short Term and Long Term at RAL Exceedance Area 30 (STA 133+40)

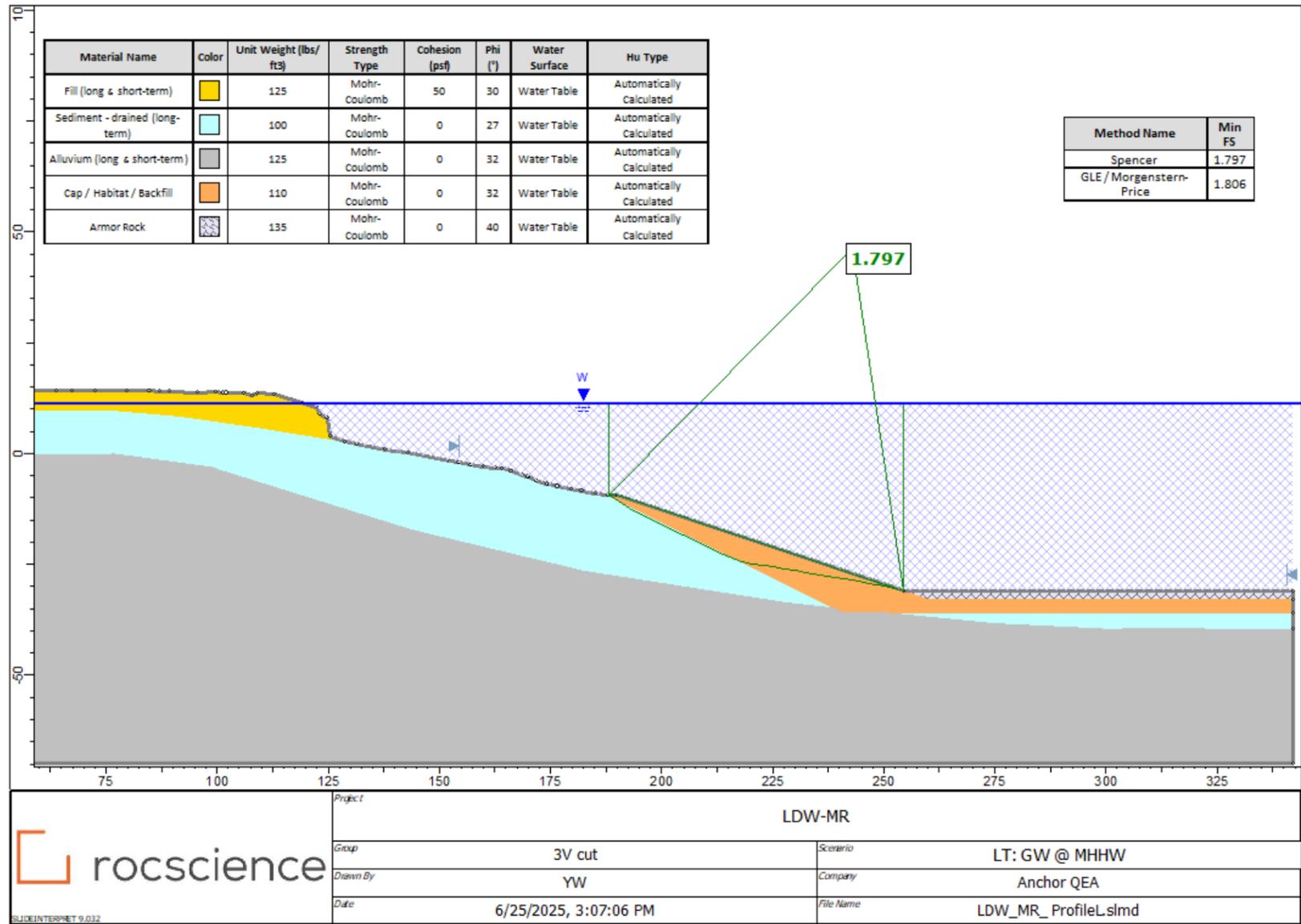
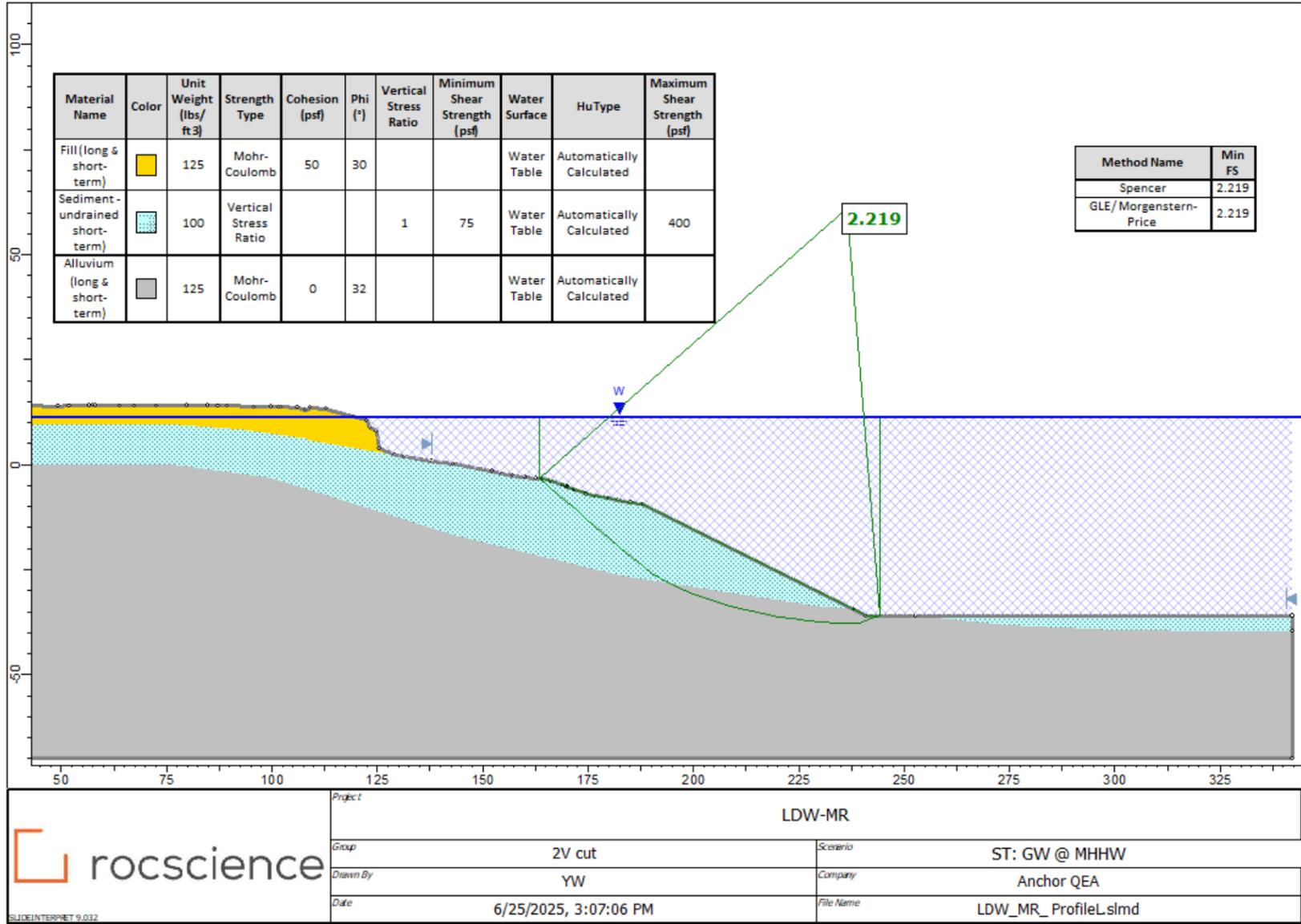


Figure F3-2
Slope Stability – Short Term and Long Term at RAL Exceedance Area 22 (STA 142+67)

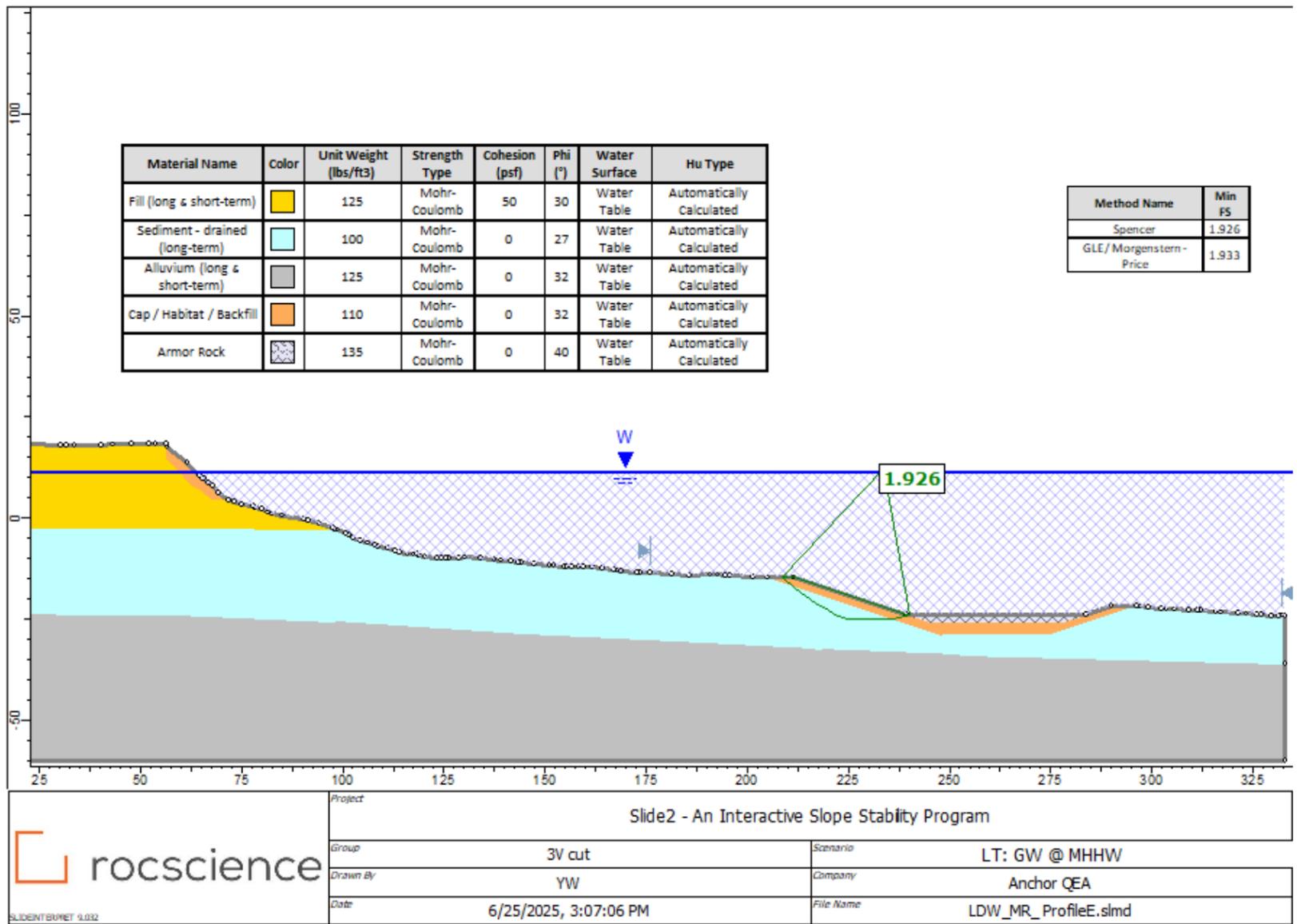
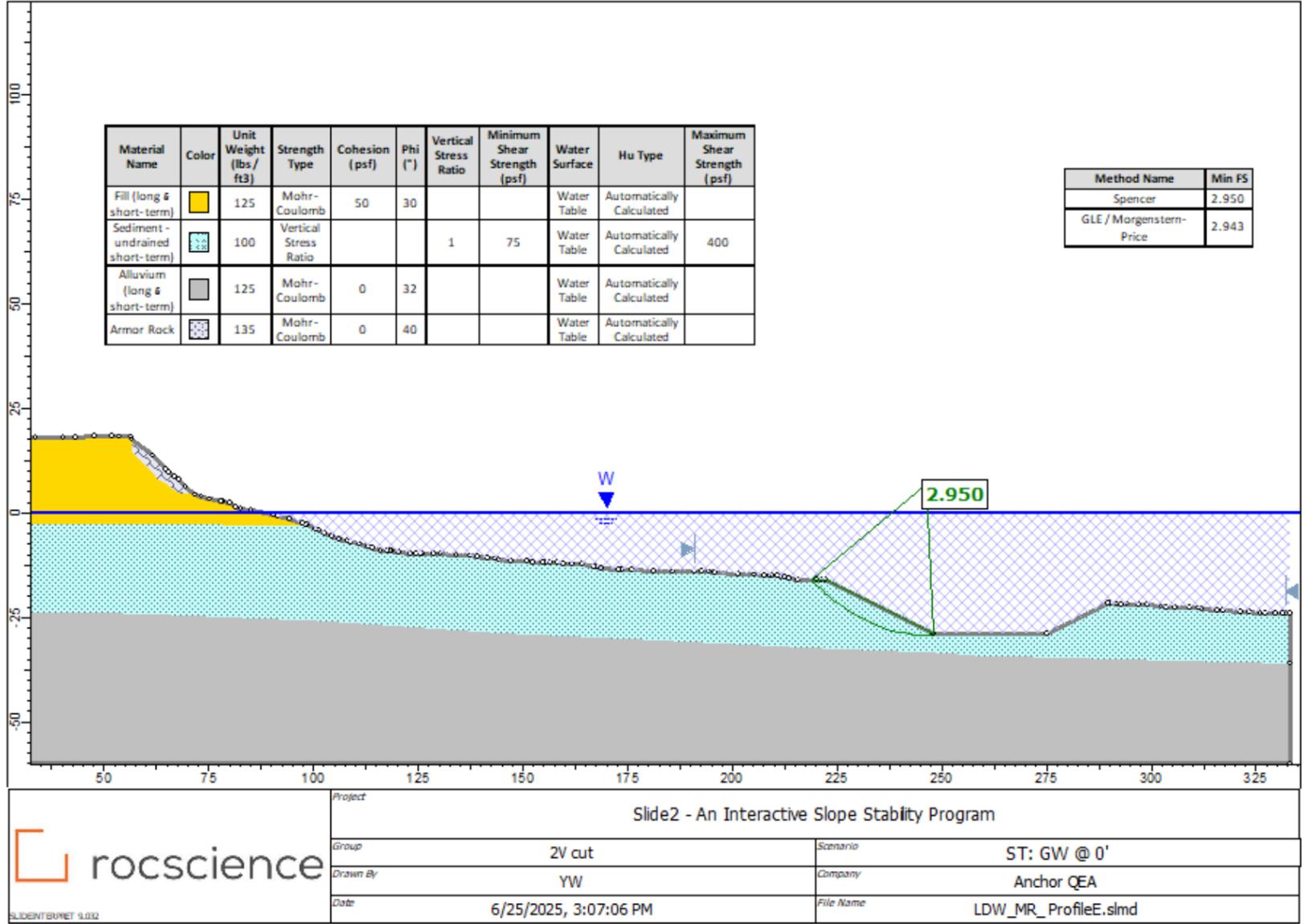


Figure F3-3
Slope Stability – Short Term and Long Term at RAL Exceedance Area 22 (STA 149+45)

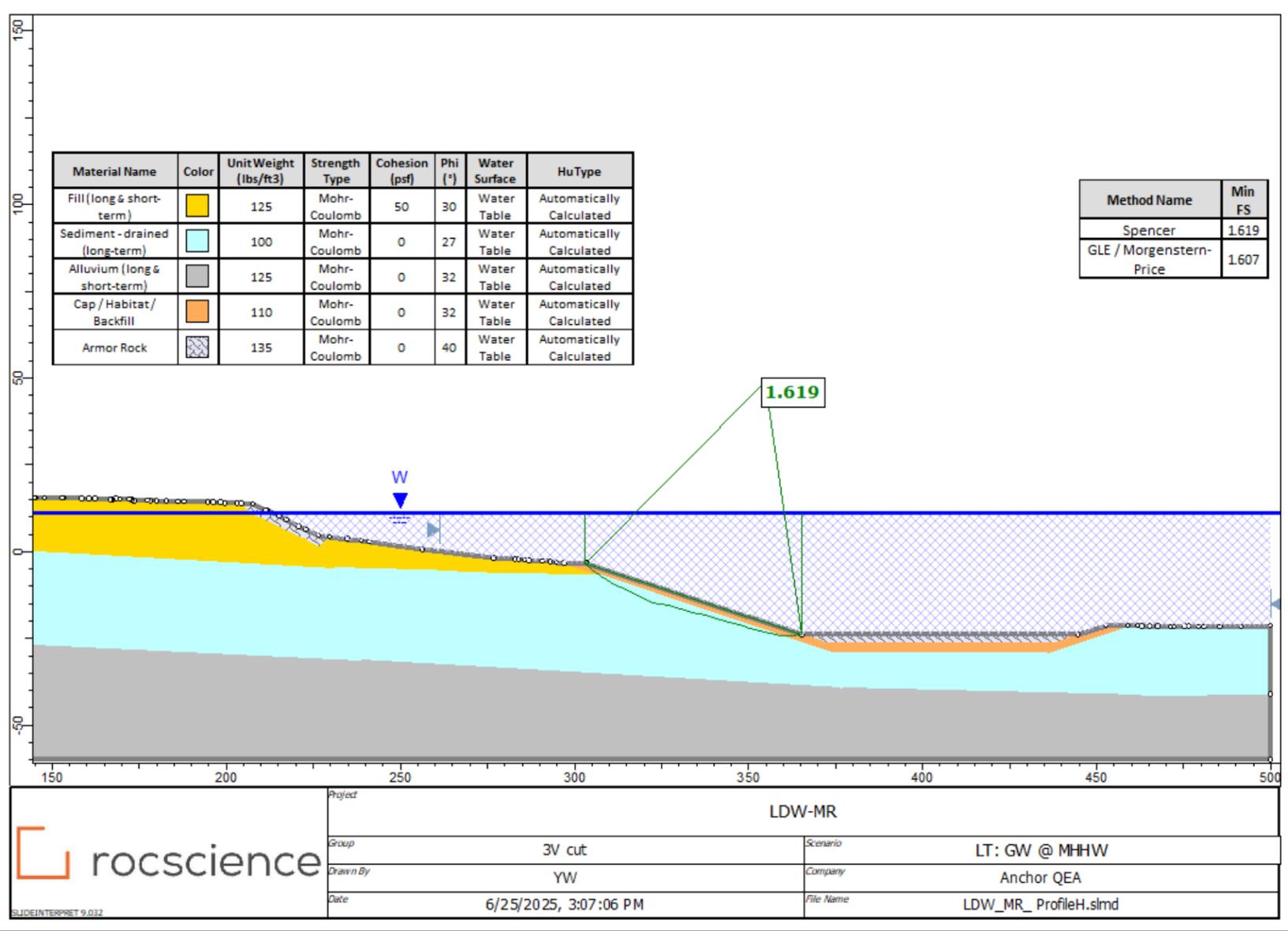
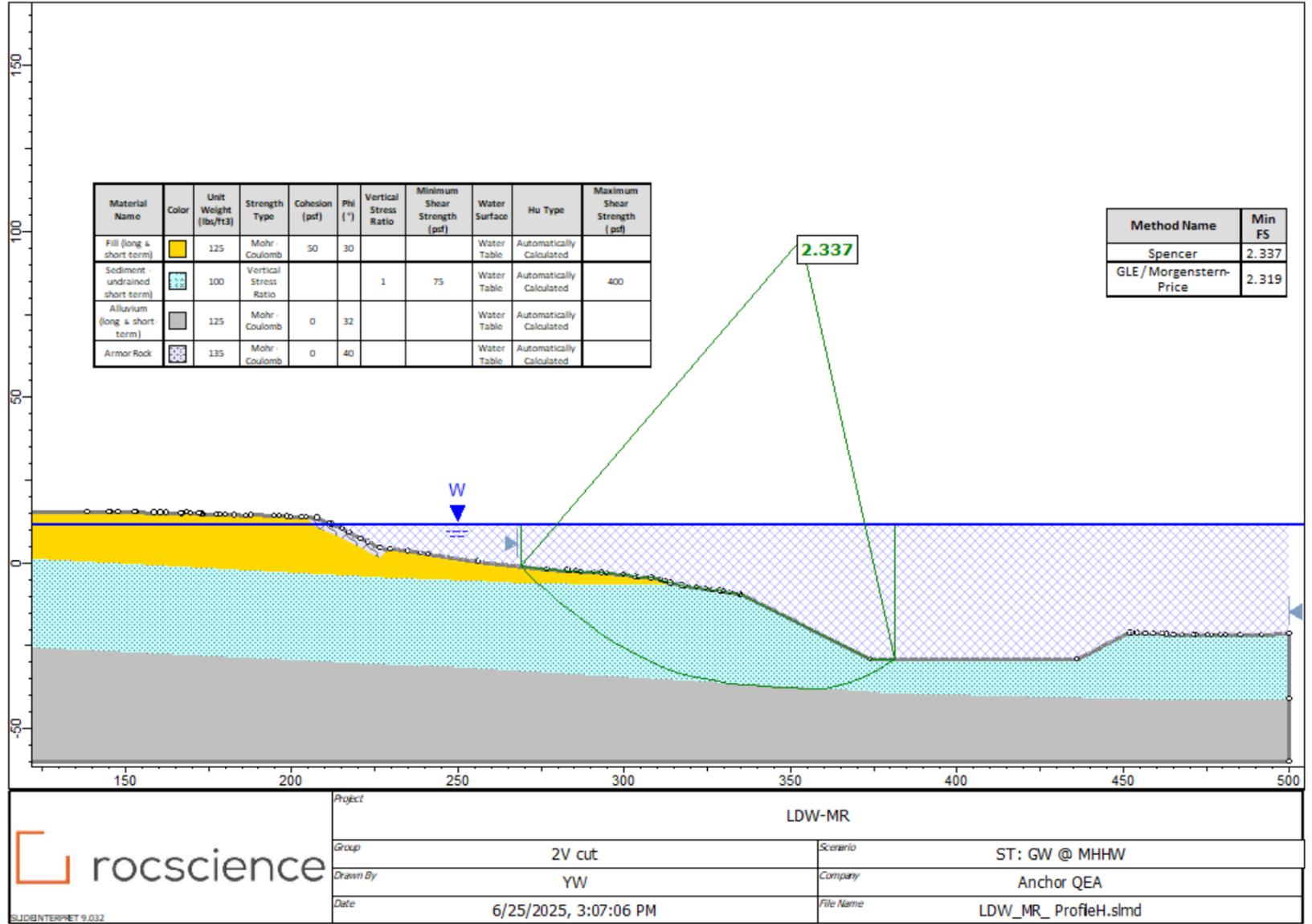
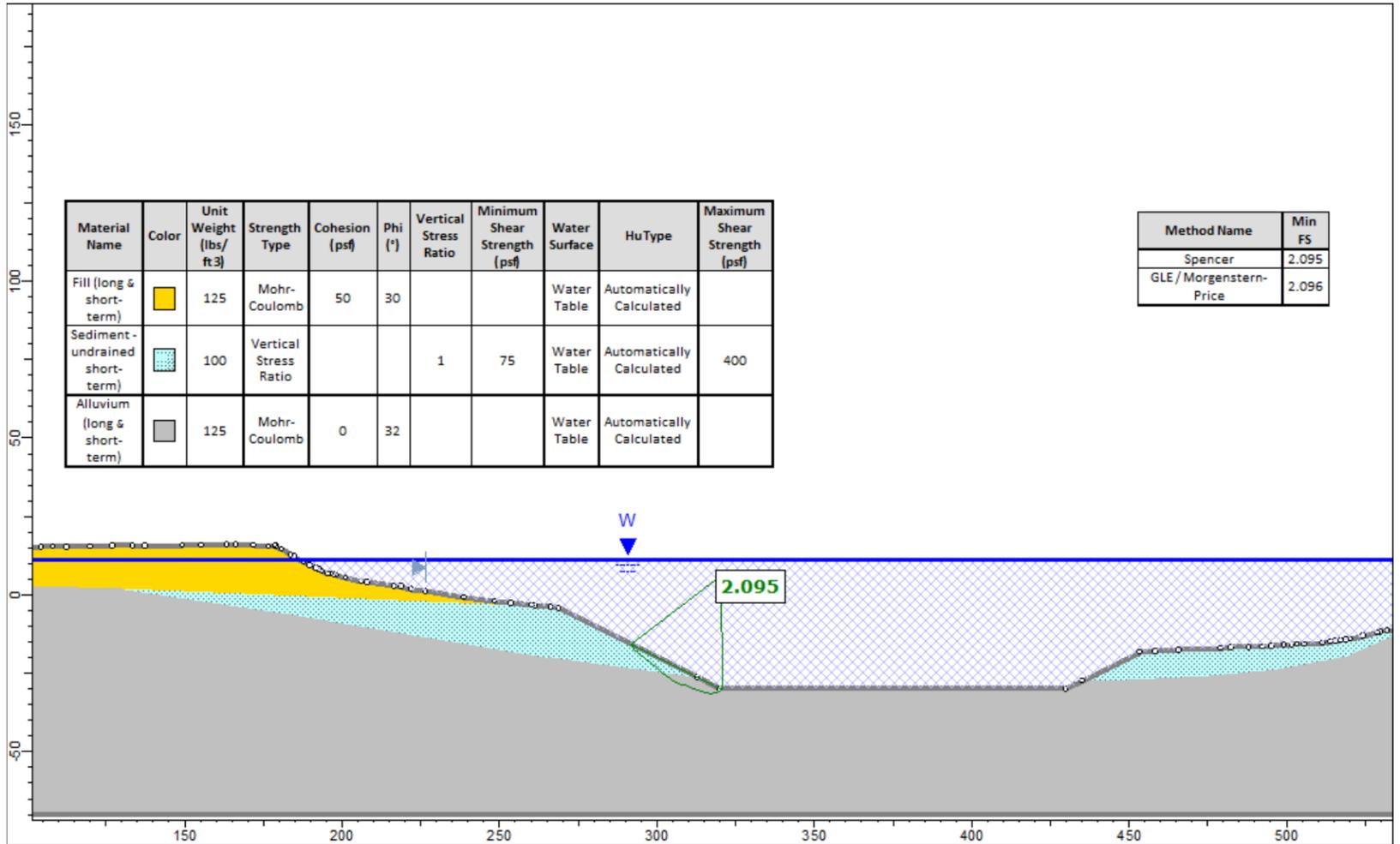
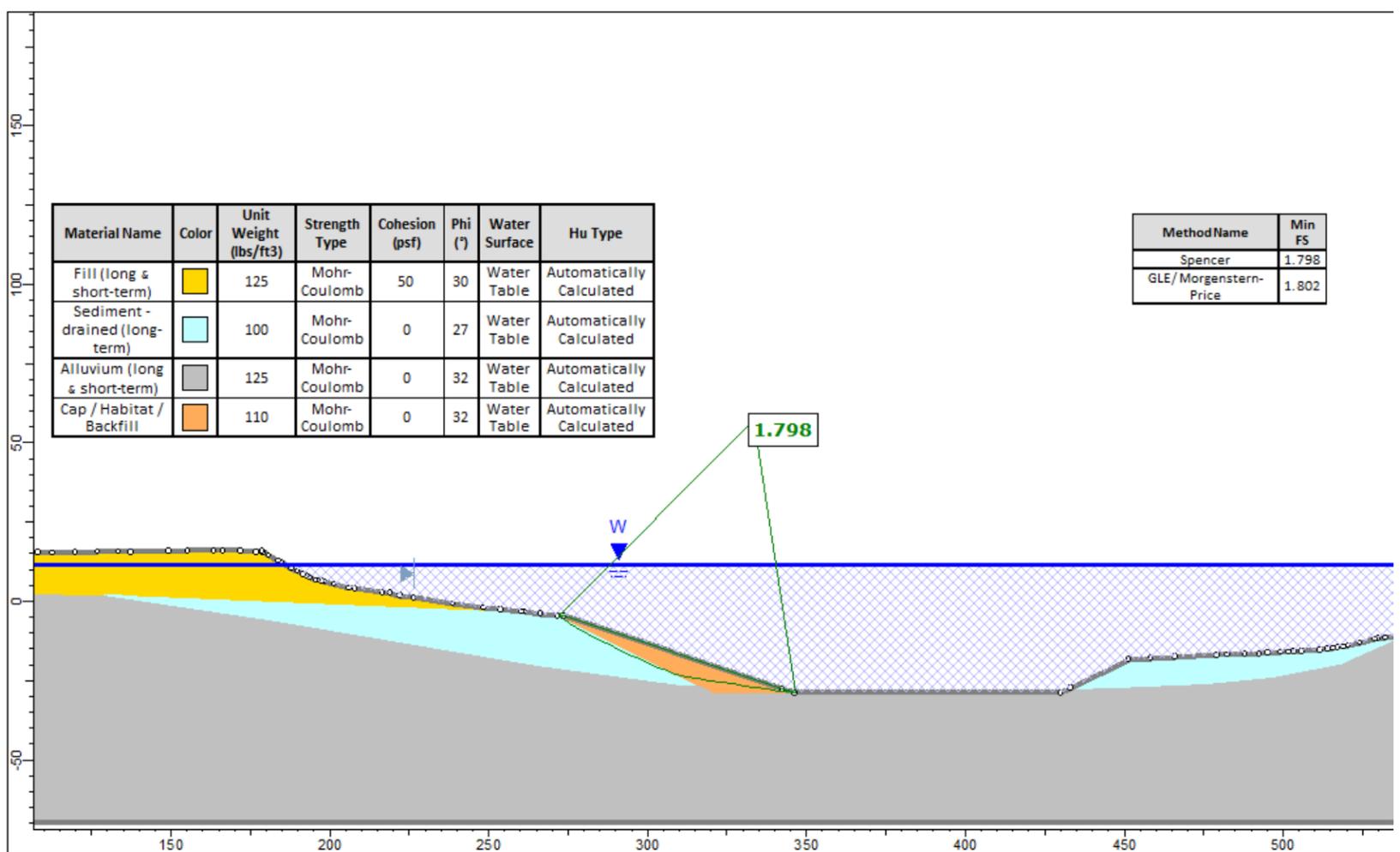


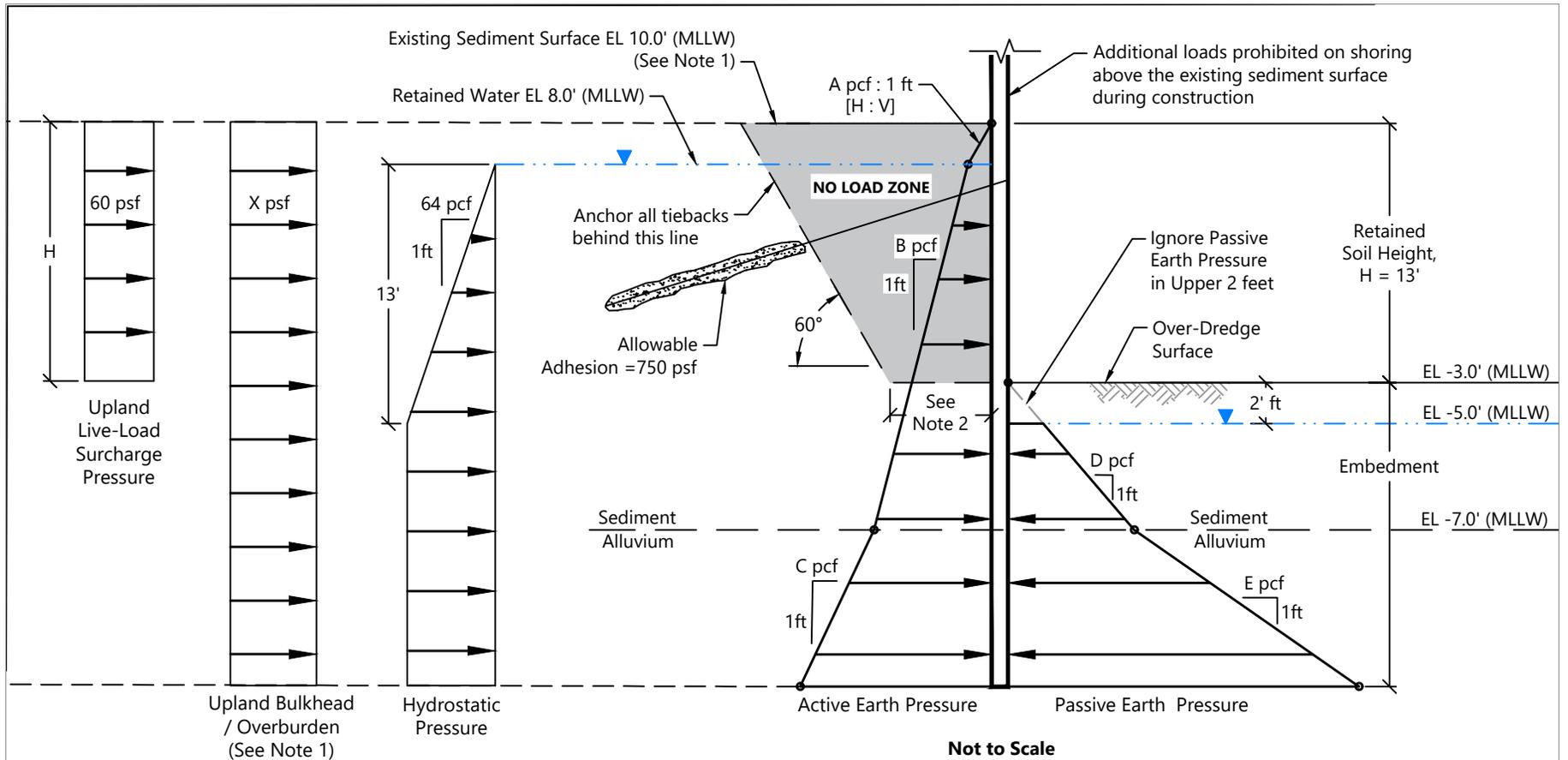
Figure F3-4
Slope Stability – Short Term and Long Term at RAL Exceedance Area 11 (STA 166+05)



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	Group		2V cut	Scenario
	Drawn By		YW	Company
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	Project		LDW-MR	
	Group		3V cut	Scenario
	Drawn By		YW	Company
	Date		6/25/2025, 3:07:06 PM	File Name
				LDW_MR_ProfileQ.slmd



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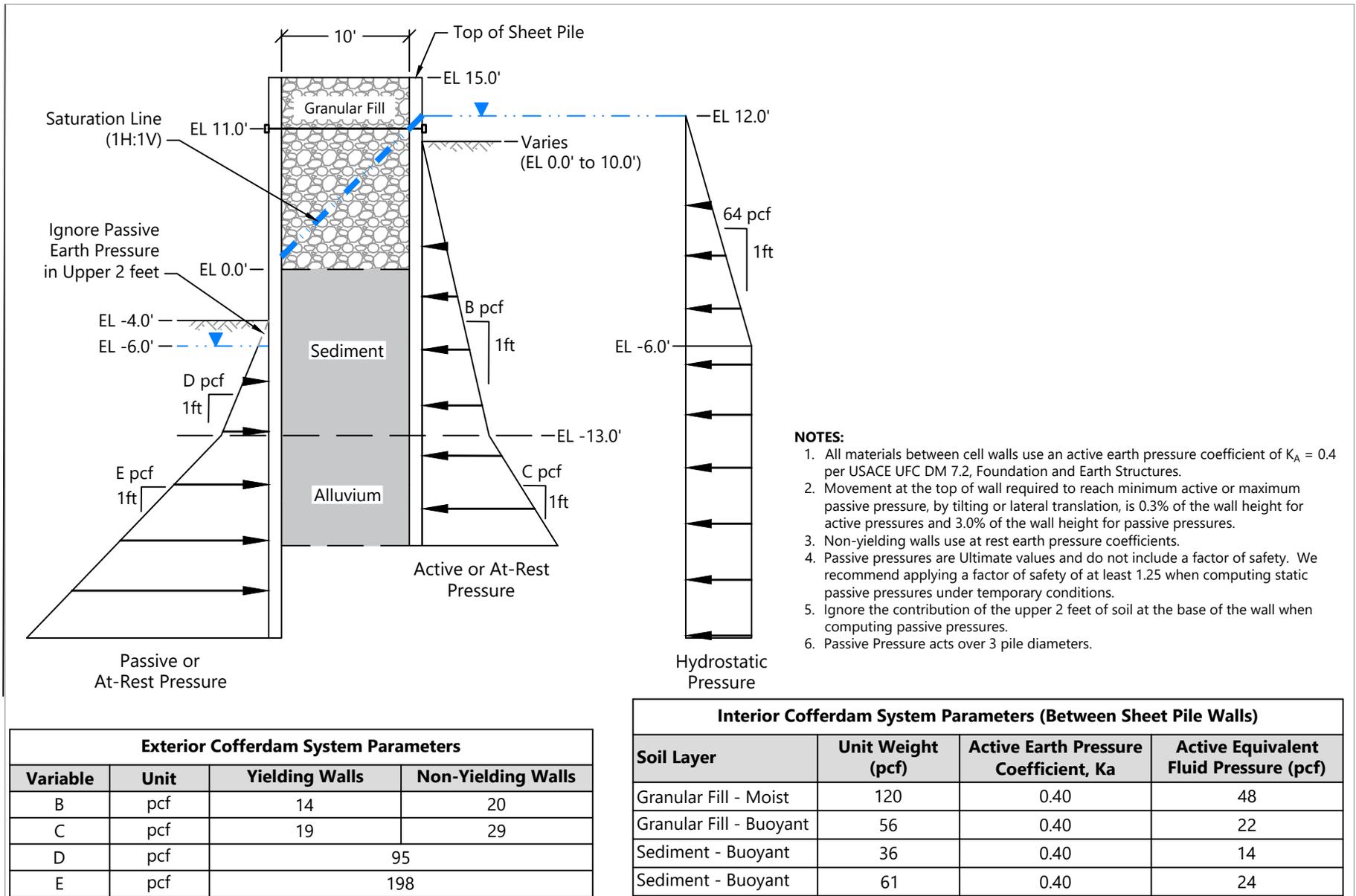
1. The lateral earth pressure diagram assumes the temporary bulkhead is installed at the toe of an existing ecology block wall, which retains roughly 11 feet of soil above the proposed temporary bulkhead. The upland bulkhead/overburden pressure accommodates for the additional pressures induced by the existing wall and retained soil.
2. The tieback no load zone shall be offset from the proposed bulkhead by H/4 (one quarter of the bulkhead retained soil height) or 6 feet (minimum), whichever is greater.
3. Yielding walls are those walls that will deform at least 0.001 times the height of the wall. Yield walls use active and passive earth pressure coefficients.
4. Non-yielding walls use at-rest and passive earth pressure coefficients.
5. Passive pressures are Ultimate values and do not include a factor of safety. We recommend applying a factor of safety of at least 1.25 when computing static passive pressures under temporary conditions.
6. Ignore the contribution of the upper 2 feet of soil at the base of the wall when computing passive pressures.
7. Passive Pressure acts over 3 pile diameters.

Coefficients			
Variable	Unit	Yielding Walls	Non-Yielding Walls
X	psf	407	627
A	psf	38	55
B	pcf	14	20
C	pcf	19	29
D	pcf	95	
E	pcf	198	

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Figure F4-1
Lateral Earth Pressure Diagram - RM 2.2 Temporary Bulkhead

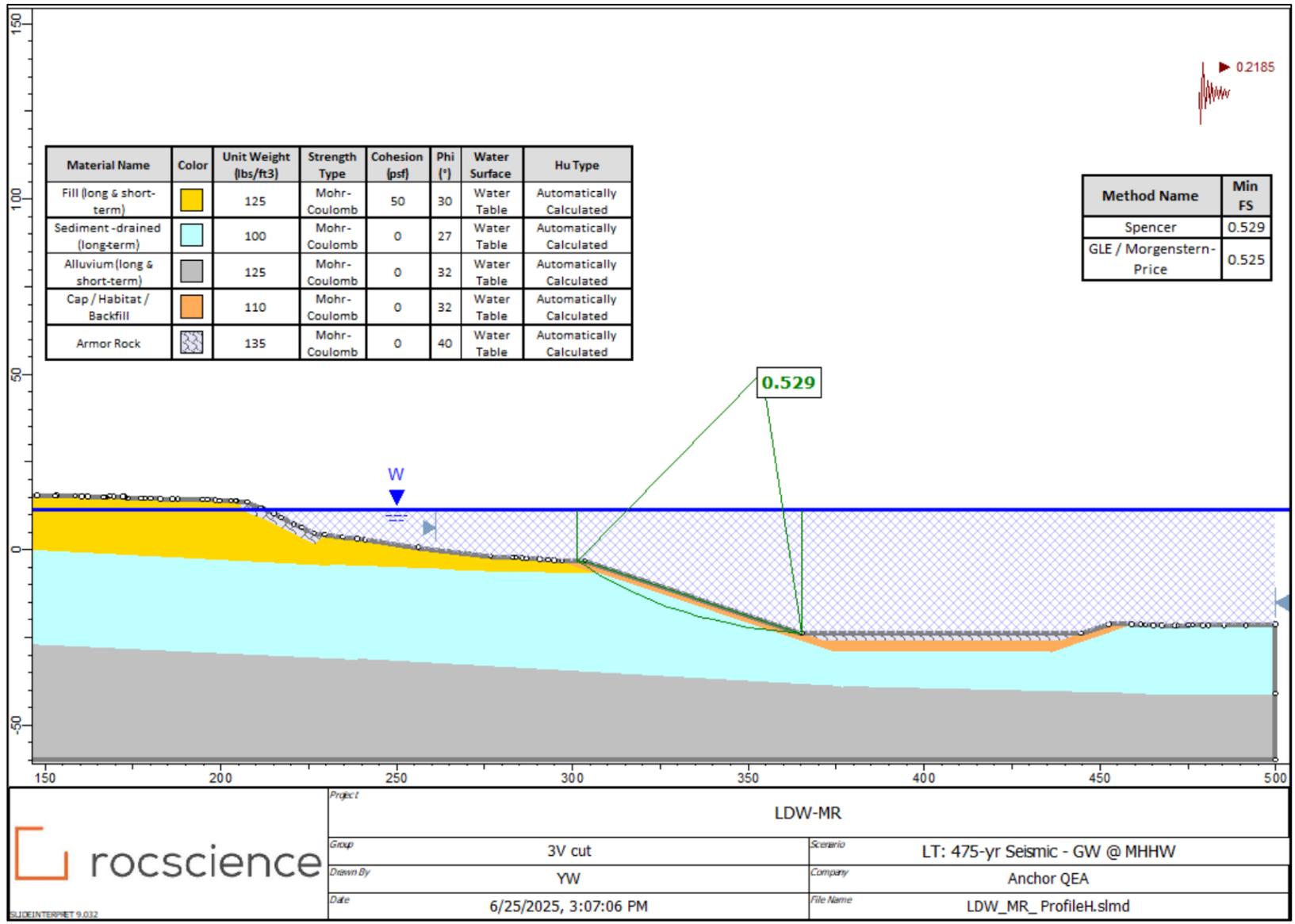
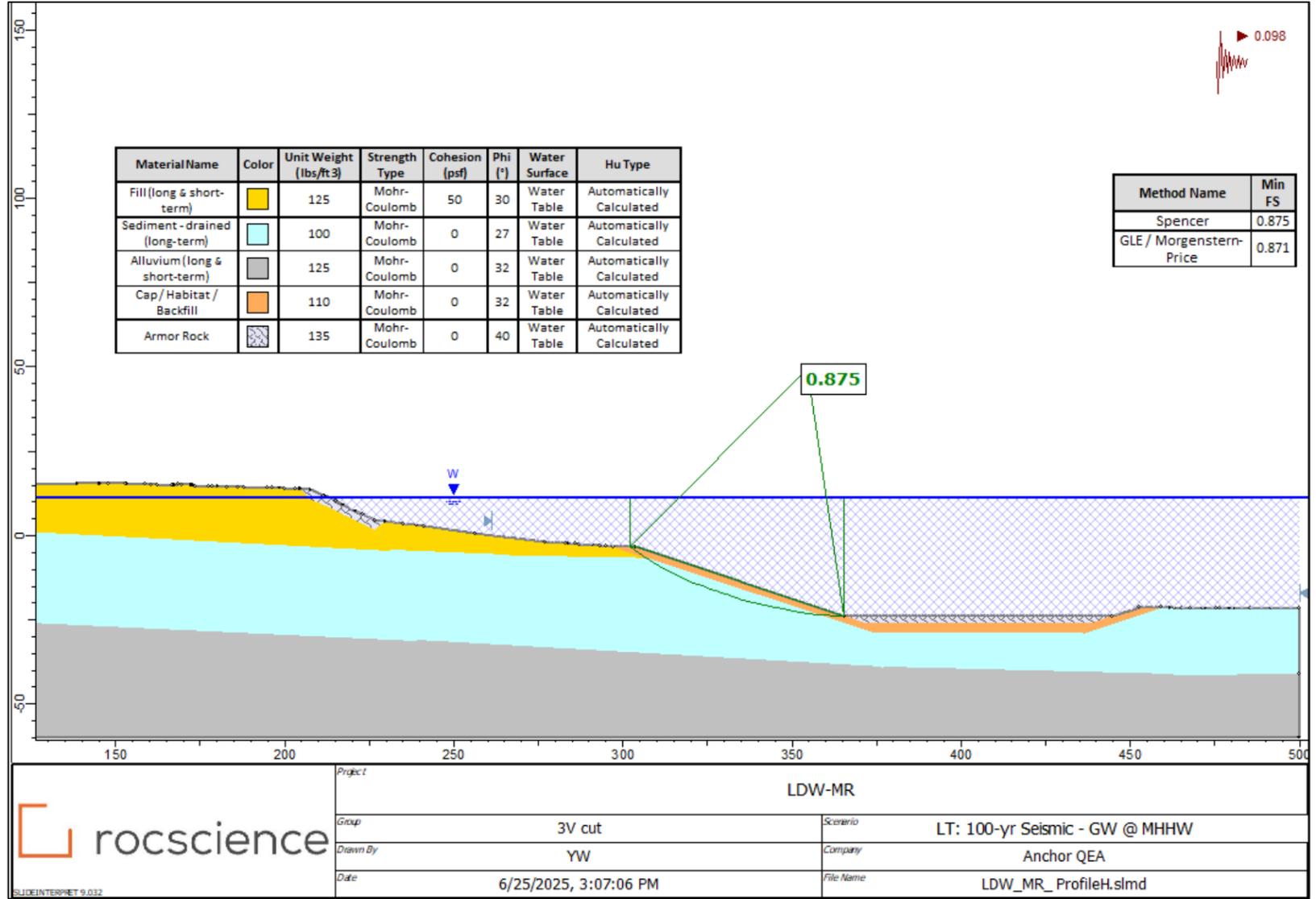


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Figure F4-2
Lateral Earth Pressure Diagram - RM 2.2 Temporary Double-Walled Cofferdam

Figure F5-1
Seismic Performance of Caps on Slope at Sta 149+45 (RAA 22) – 100- and 475-Year Events



Appendix F – Geotechnical Design Analysis

Attachment F.1

Boring and Vane Shear Testing Logs

Appendix F – Geotechnical Design Analysis

Attachment F.1

Boring and Vane Shear Testing Logs

Field Vane Shear Log

Project: LDW Middle Reach

Location: Duwamish Marine Center

Technician: S. Giannakos, A. Riolo

Date: 8/30/2024

ROCTEST H-60 / Humboldt H-4227 Vane Tester	
Vane Diameter	Vane constant (α)
16mm (0.63")	1.95
20mm (0.79")	1.00
25.4mm (1")	0.49
32mm (1.25")	0.24
50.8mm (2")	0.06
65mm (2.56")	0.03

$S_u = \alpha \times \text{Scale}$



Test Location ID	Coordinates		Test Time	Water Depth in feet	Test Depth below Mudline in feet	Dummy Vane Scale Reading (kPa)	Vane Diameter in mm	Vane Constant	Peak Undrained Shear Strength			Remolded Shear Strength			Sample Description
	Easting	Northing							Vane Scale Reading in kPa	kPa	lbs/ft ²	Vane Scale Reading in kPa	kPa	lbs/ft ²	
VST-1a	1269396.930	201945.017	9:15	3.7	1	0.1	25.4	0.49	6.0	2.9	60	6.0	2.9	60	Granular material/debris suspected
VST-1a	1269396.930	201945.017	9:22	3.7	2	0.1	25.4	0.49	28.0	13.6	284	3.0	1.4	30	
VST-1a	1269396.930	201945.017	9:30	3.7	3	0.1	25.4	0.49	22.0	10.7	223	3.0	1.4	30	organic debris felt at 3.5 feet
VST-1a	1269396.930	201945.017	9:40	3.7	4	0.1	25.4	0.49	23.0	11.2	233	8.0	3.9	81	
VST-1a	1269396.930	201945.017	9:45	3.7	5	0.1	25.4	0.49	28.0	13.6	284	9.0	4.3	91	Refusal noted on sand
VST-1a	1269396.930	201945.017	9:50	3.7	6	0.1	25.4	0.49	23.0	11.2	233	13.0	6.3	132	
VST-1a	1269396.930	201945.017	--	--	7.4	--	--	--	--	--	--	--	--	--	
VST-1b	1269434.630	201907.797	10:00	4.2	1	0	25.4	0.49	8.0	3.9	82	3.0	1.5	31	Strong resistance, debris suspected
VST-1b	1269434.630	201907.797	10:10	4.2	2	0.1	25.4	0.49	20.0	9.7	203	5.0	2.4	50	
VST-1b	1269434.630	201907.797	10:13	4.2	3	0.1	25.4	0.49	12.0	5.8	121	7.0	3.4	70	Refusal noted on sand
VST-1b	1269434.630	201907.797	10:16	4.2	4	0.1	25.4	0.49	21.0	10.2	213	8.0	3.9	81	
VST-1b	1269434.630	201907.797	10:19	4.2	5	0.1	25.4	0.49	45.0	21.9	458	10.0	4.8	101	
VST-1b	1269434.630	201907.797	--	--	7	--	--	--	--	--	--	--	--	--	
VST-1c	1269484.321	201852.102	10:30	4	1	0	25.4	0.49	0.0	0.0	0	0.0	0.0	0	Sand lens ~2.5-2.8 ft
VST-1c	1269484.321	201852.102	10:35	4	2	0	25.4	0.49	12.0	5.9	122	1.0	0.5	10	
VST-1c	1269484.321	201852.102	10:40	4	3	0.3	25.4	0.49	18.0	8.6	180	3.0	1.3	28	Pushed through sand lense to 4.3 ft
VST-1c	1269484.321	201852.102	10:46	4	4.3	0.3	25.4	0.49	33.0	16.0	333	10.0	4.7	99	
VST-1c	1269484.321	201852.102	10:50	4	5	0.3	25.4	0.49	38.0	18.4	384	15.0	7.2	150	Refusal noted on sand
VST-1c	1269484.321	201852.102	--	--	6.8	--	--	--	--	--	--	--	--	--	

Note: If used, dummy vane reading is subtracted from peak and remolded vane reading when calculating strength

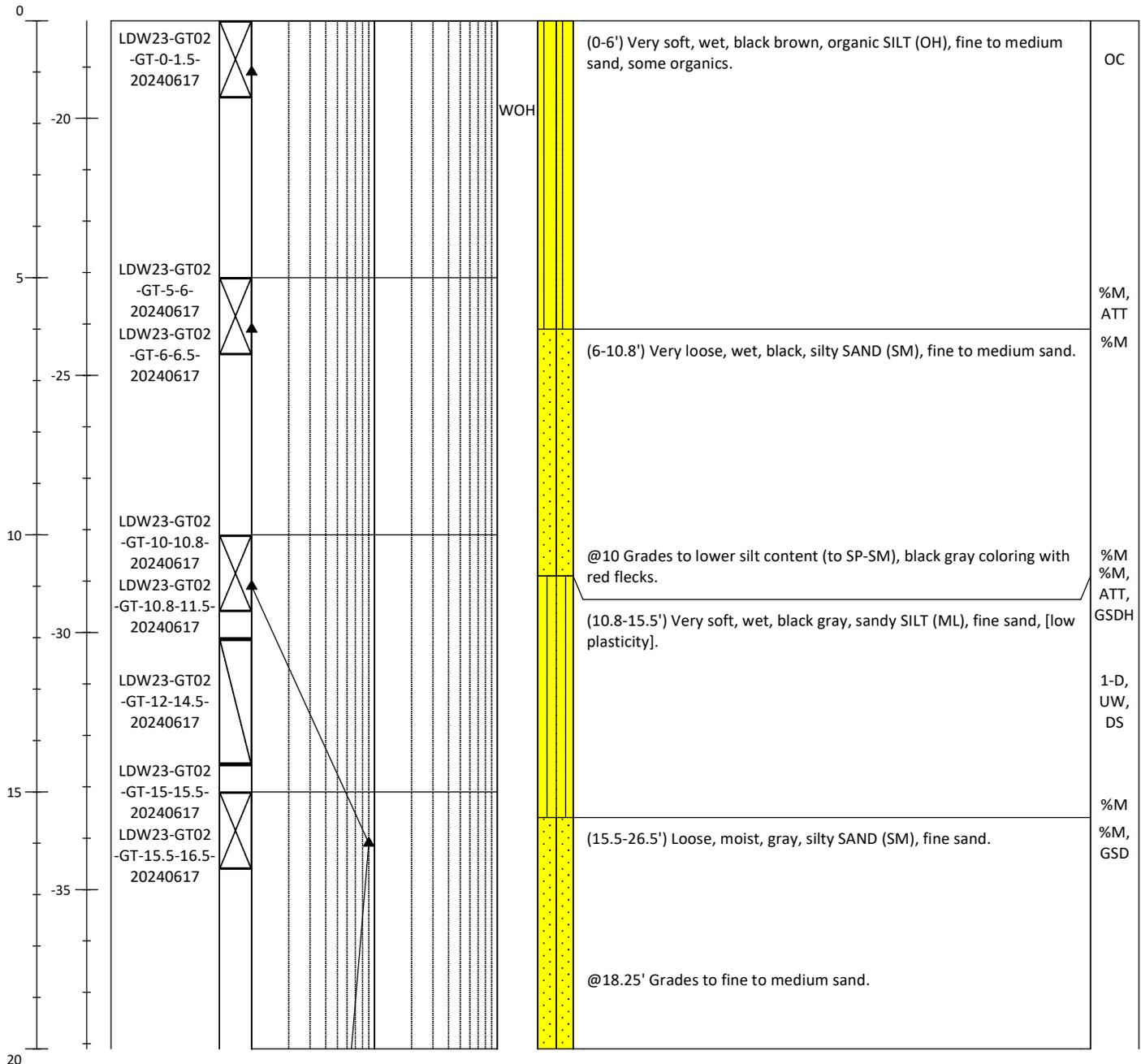
Soil Boring Log

LDW23-GT02-GT

Sheet 1 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Hollow Stem Auger
Location: Seattle, WA	N/LAT: 201742.90 E/LONG: 1269199.02	Total Depth (ft): 26.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Mudline Elevation (ft): -18.1
Collection Date: 6/17/24		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon & Shelby Tube Sampler	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits						Other Values	Lithology	Soil Description <small>Samples and descriptions are in recovered depths. Classification scheme: USCS</small>	Lab Test
				1	2	5	10	20	50				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

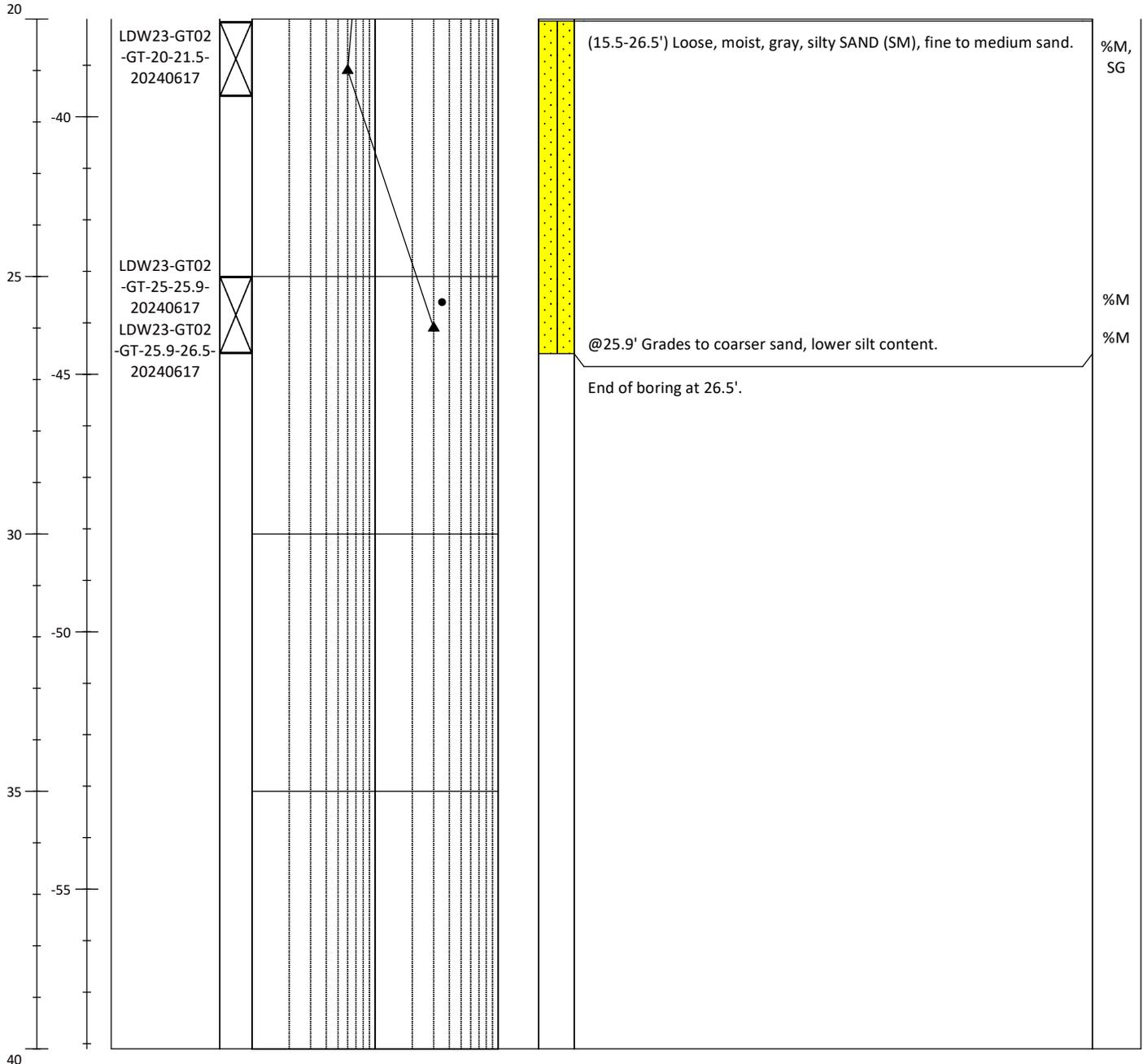
Soil Boring Log

LDW23-GT02-GT

Sheet 2 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Hollow Stem Auger
Location: Seattle, WA	N/LAT: 201742.90 E/LONG: 1269199.02	Total Depth (ft): 26.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Mudline Elevation (ft): -18.1
Collection Date: 6/17/24		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon & Shelby Tube Sampler	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot)						Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
				1	2	5	10	20	50				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- Shelby Tube
- ⊠ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

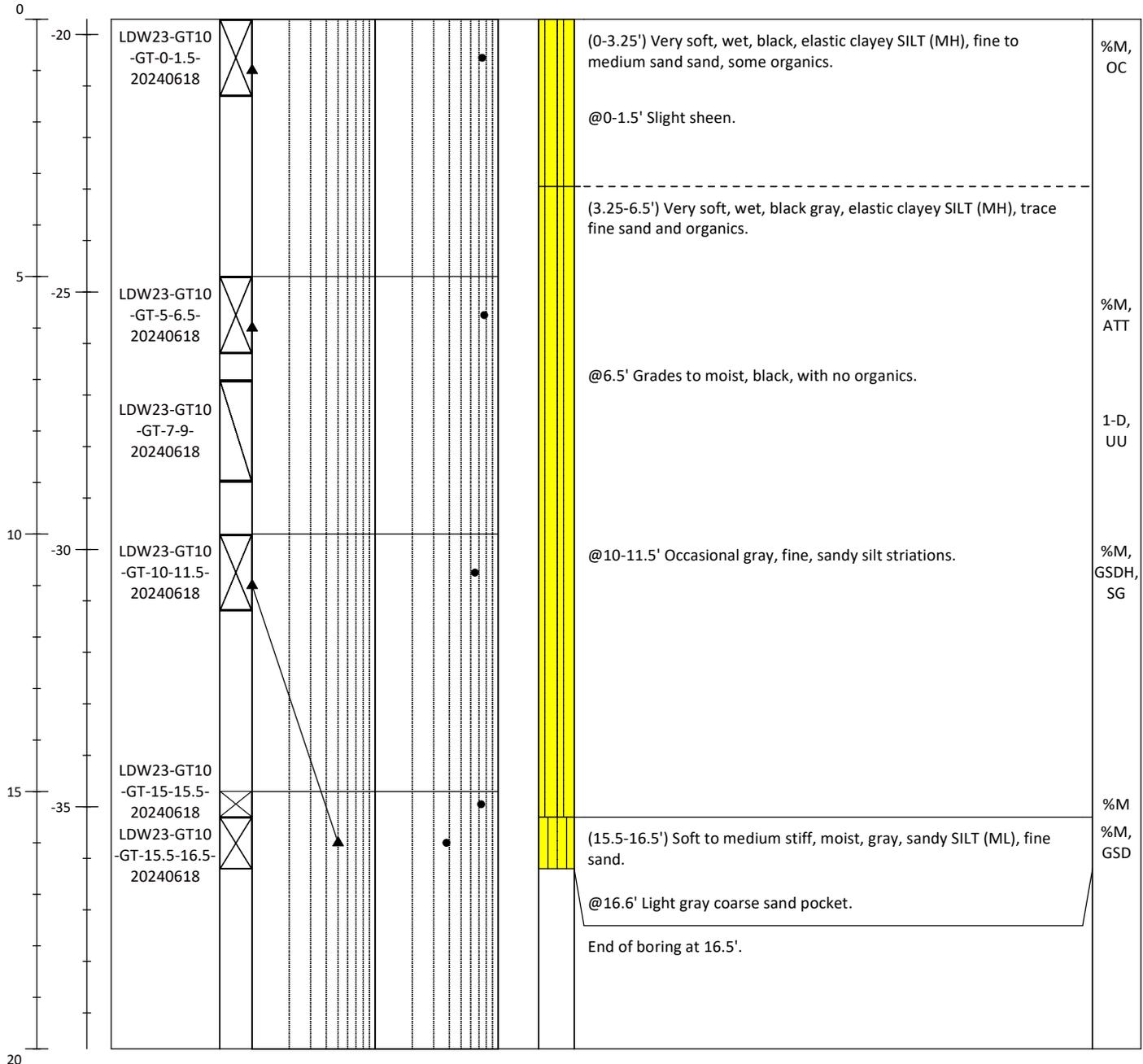
Soil Boring Log

LDW23-GT10-GT

Sheet 1 of 1

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Hollow Stem Auger
Location: Seattle, WA	N/LAT: 201327.13 E/LONG: 1269969.3	Total Depth (ft): 16.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Mudline Elevation (ft): -19.7
Collection Date: 6/18/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon & Shelby Tube Sampler	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits						Other Values	Lithology	Soil Description <small>Samples and descriptions are in recovered depths. Classification scheme: USCS</small>	Lab Test
				1	2	5	10	20	50				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

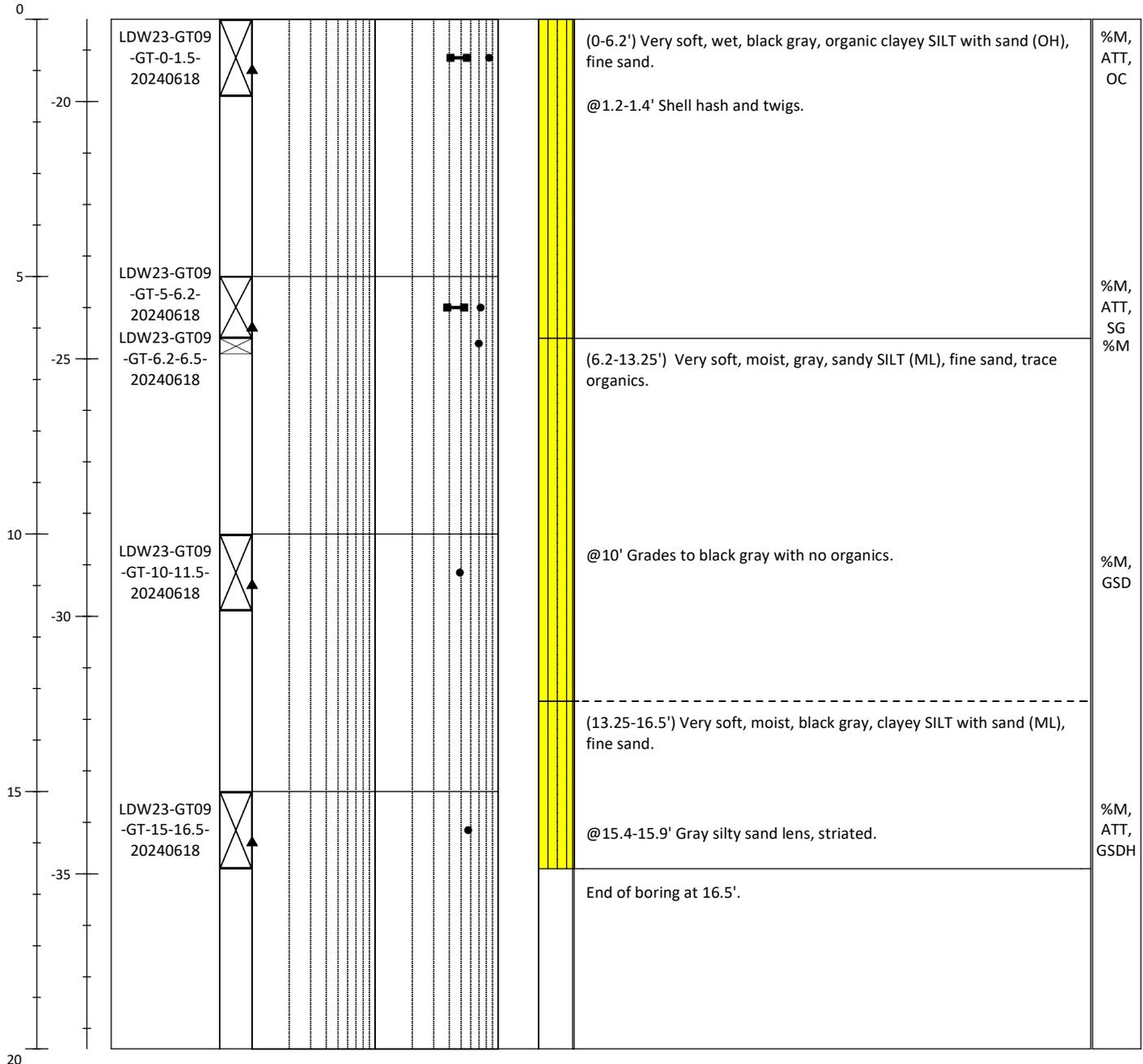
Soil Boring Log

LDW-23-GT09-GT

Sheet 1 of 1

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Hollow Stem Auger
Location: Seattle, WA	N/LAT: 201144.98 E/LONG: 1269846.44	Total Depth (ft): 16.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Mudline Elevation (ft): -18.4
Collection Date: 6/18/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot)						Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
				1	2	5	10	20	50				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- Shelby Tube
- ⊠ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution,
 GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight,
 CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear,
 WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

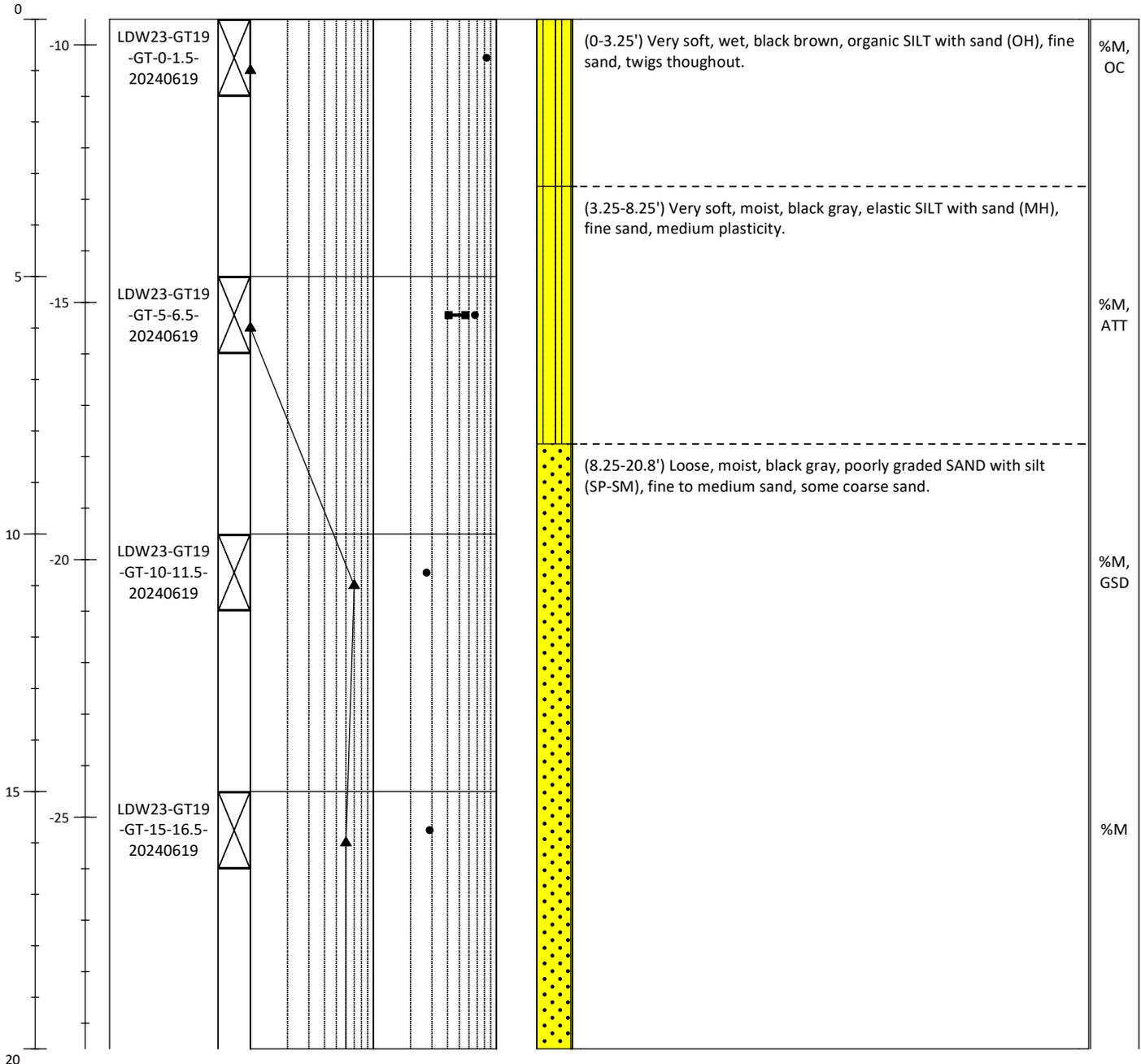
Soil Boring Log

LDW23-GT19-GT

Sheet 1 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Hollow Stem Auger
Location: Seattle, WA	N/LAT: 199617.57 E/LONG: 1271609.77	Total Depth (ft): 31.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Mudline Elevation (ft): -9.5
Collection Date: 6/19/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot)						Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
				1	2	5	10	20	50				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

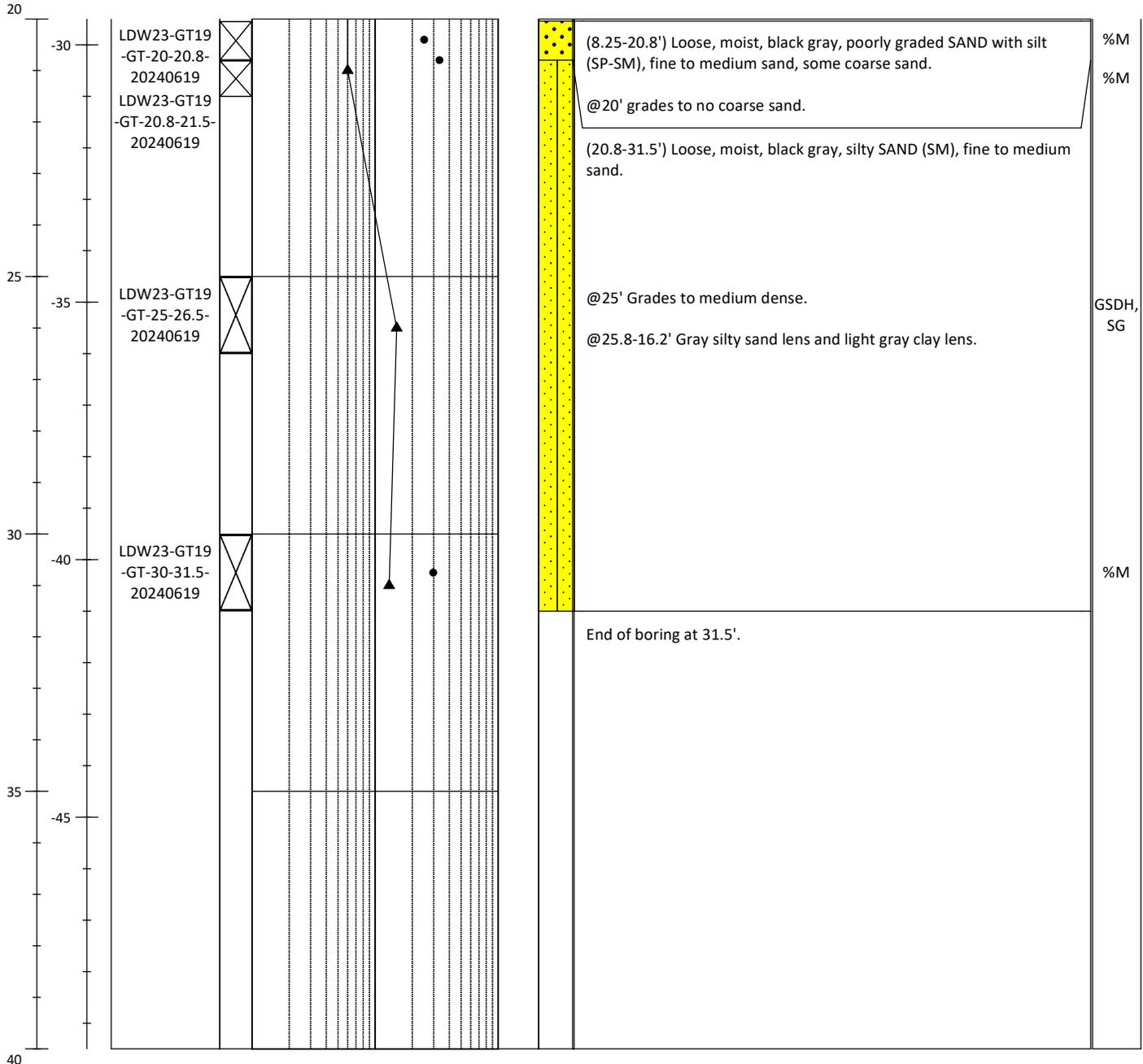
Soil Boring Log

LDW23-GT19-GT

Sheet 2 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Hollow Stem Auger
Location: Seattle, WA	N/LAT: 199617.57 E/LONG: 1271609.77	Total Depth (ft): 31.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Mudline Elevation (ft): -9.5
Collection Date: 6/19/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits						Other Values	Lithology	Soil Description <small>Samples and descriptions are in recovered depths. Classification scheme: USCS</small>	Lab Test
				1	2	5	10	20	50				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

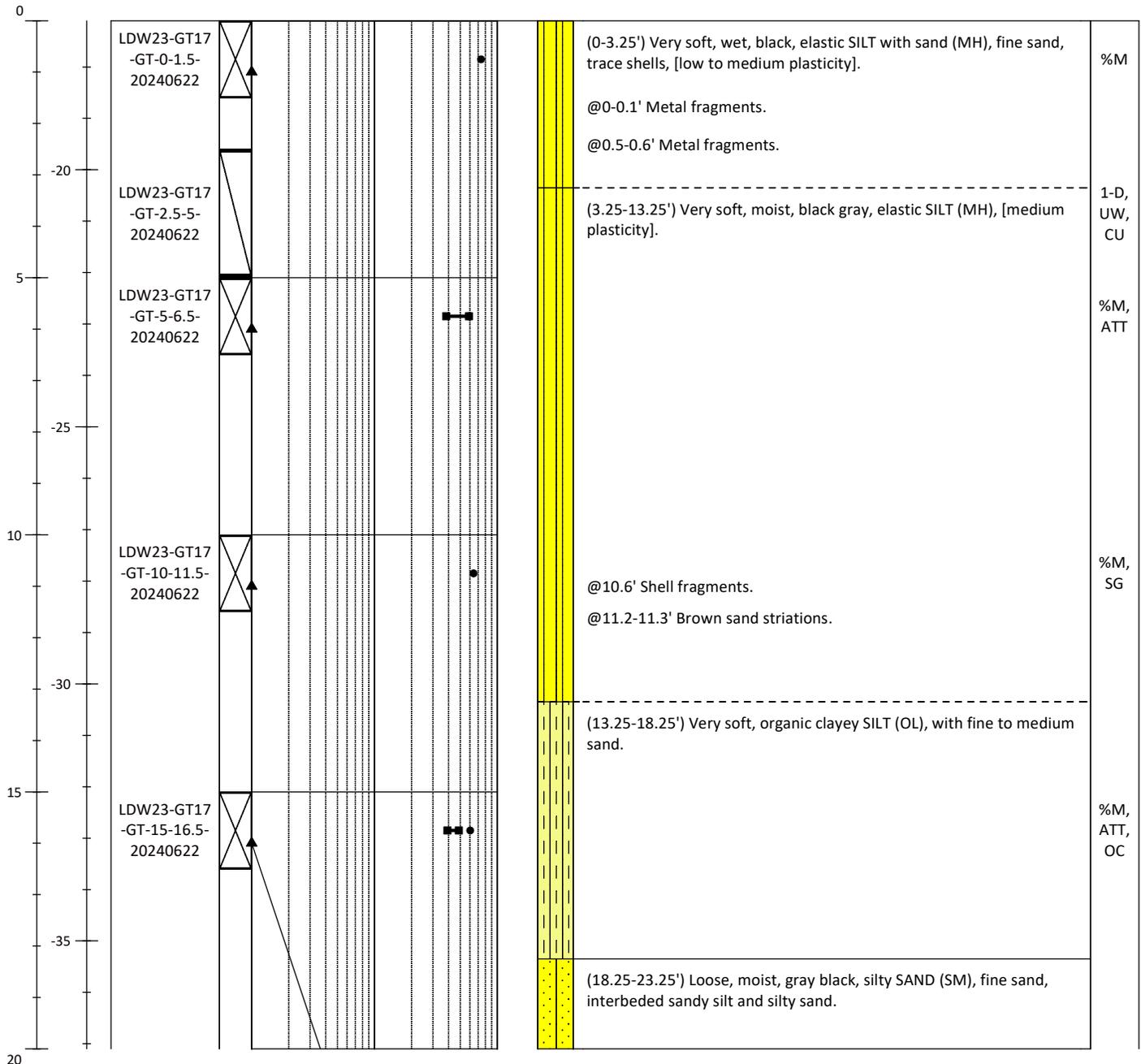
Soil Boring Log

LDW23-GT17-GT

Sheet 1 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Hollow Stem Auger
Location: Seattle, WA	N/LAT: 199385.24 E/LONG: 1271528.53	Total Depth (ft): 26.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Mudline Elevation (ft): -17.1
Collection Date: 6/22/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon & Shelby Tube Sampler	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot)						Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
				1	2	5	10	20	50				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

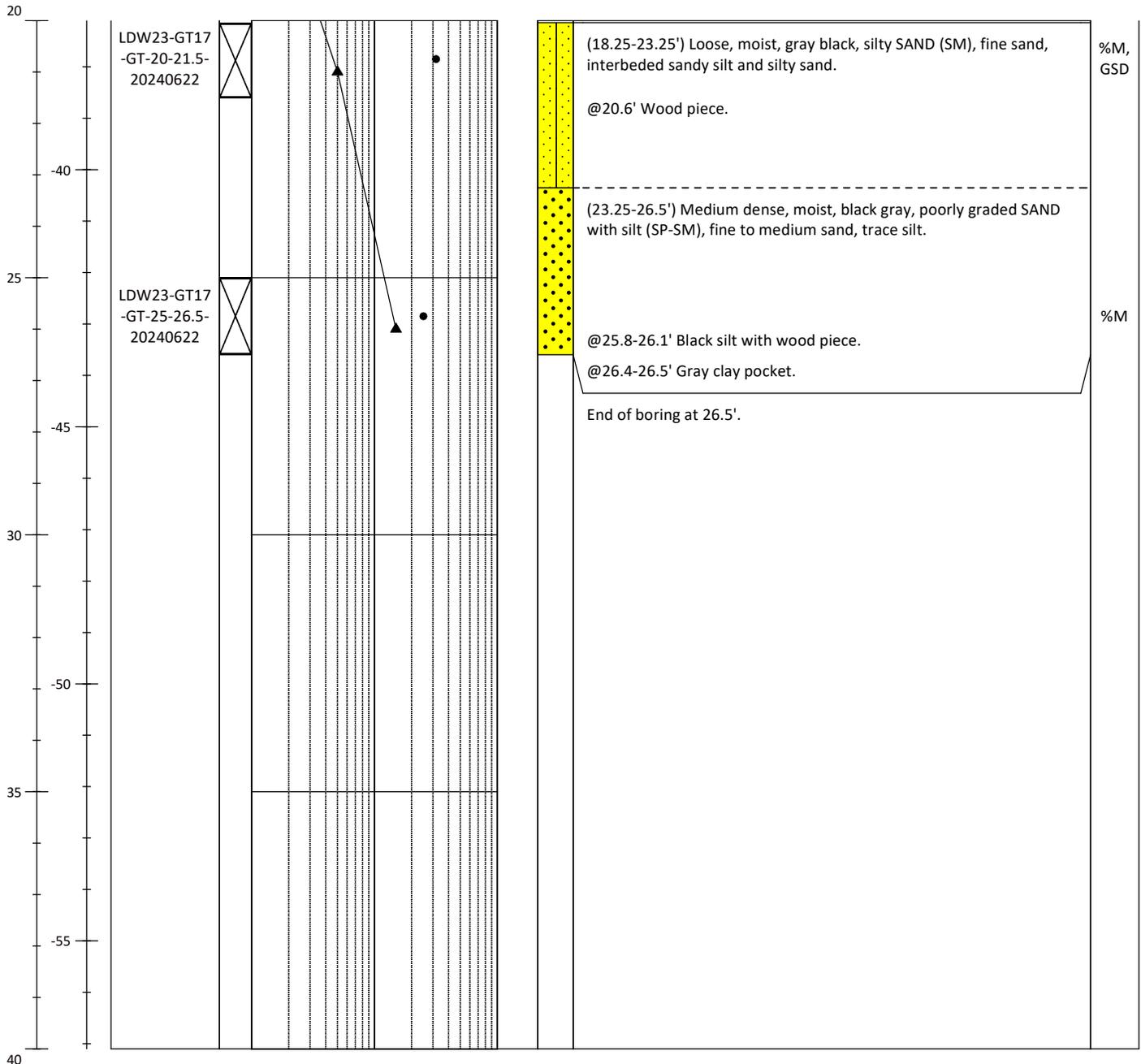
Soil Boring Log

LDW23-GT17-GT

Sheet 2 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Hollow Stem Auger
Location: Seattle, WA	N/LAT: 199385.24 E/LONG: 1271528.53	Total Depth (ft): 26.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Mudline Elevation (ft): -17.1
Collection Date: 6/22/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon & Shelby Tube Sampler	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot)						Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
				1	2	5	10	20	50				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

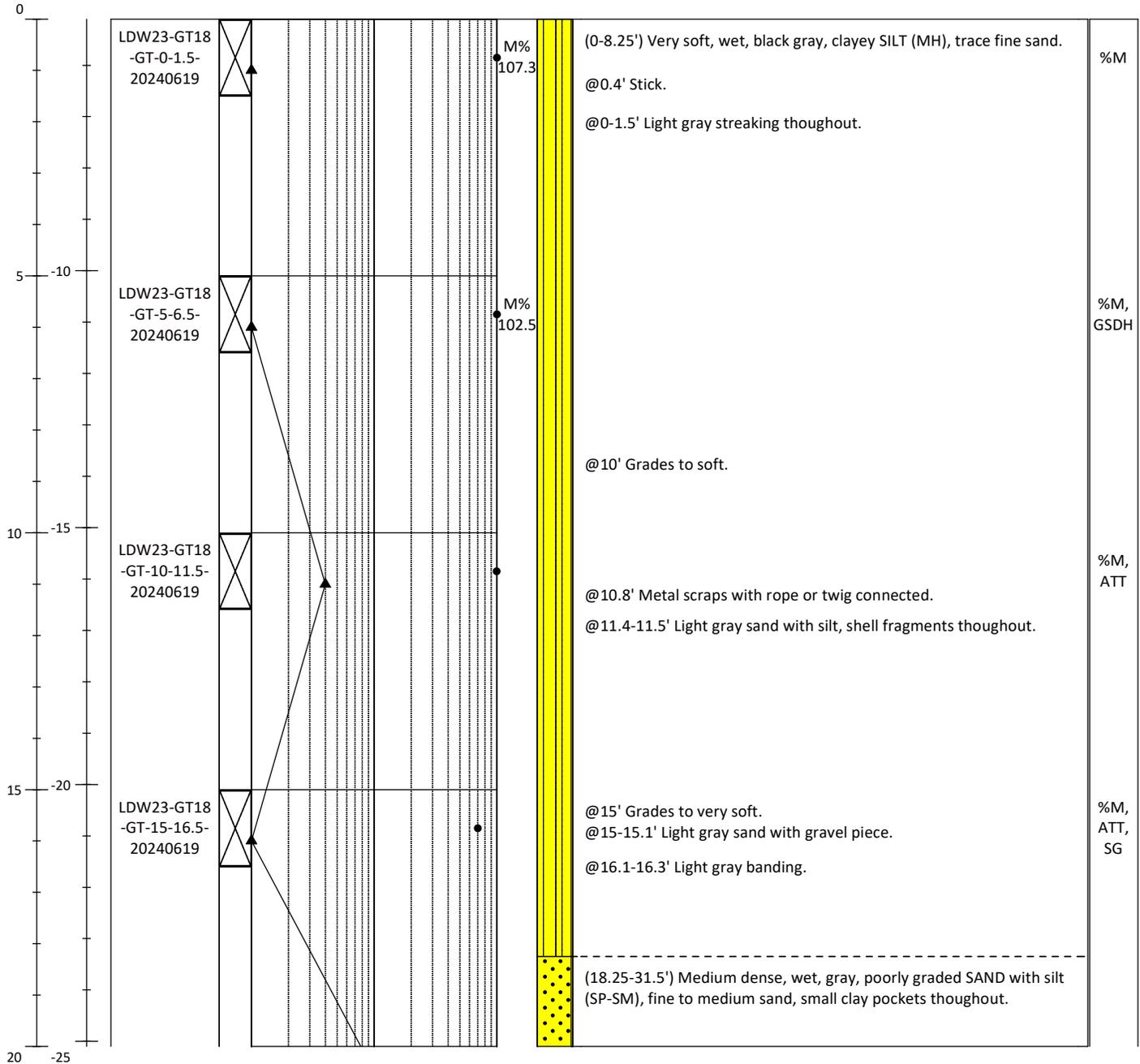
Soil Boring Log

LDW23-GT18-GT

Sheet 1 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Hollow Stem Auger
Location: Seattle, WA	N/LAT: 200303.38 E/LONG: 1271222.23	Total Depth (ft): 31.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Mudline Elevation (ft): -5.1
Collection Date: 6/19/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot)						Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
				1	2	5	10	20	50				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:

%M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
Mudline elevations determined from leadline measurements and Site tide gage levels.

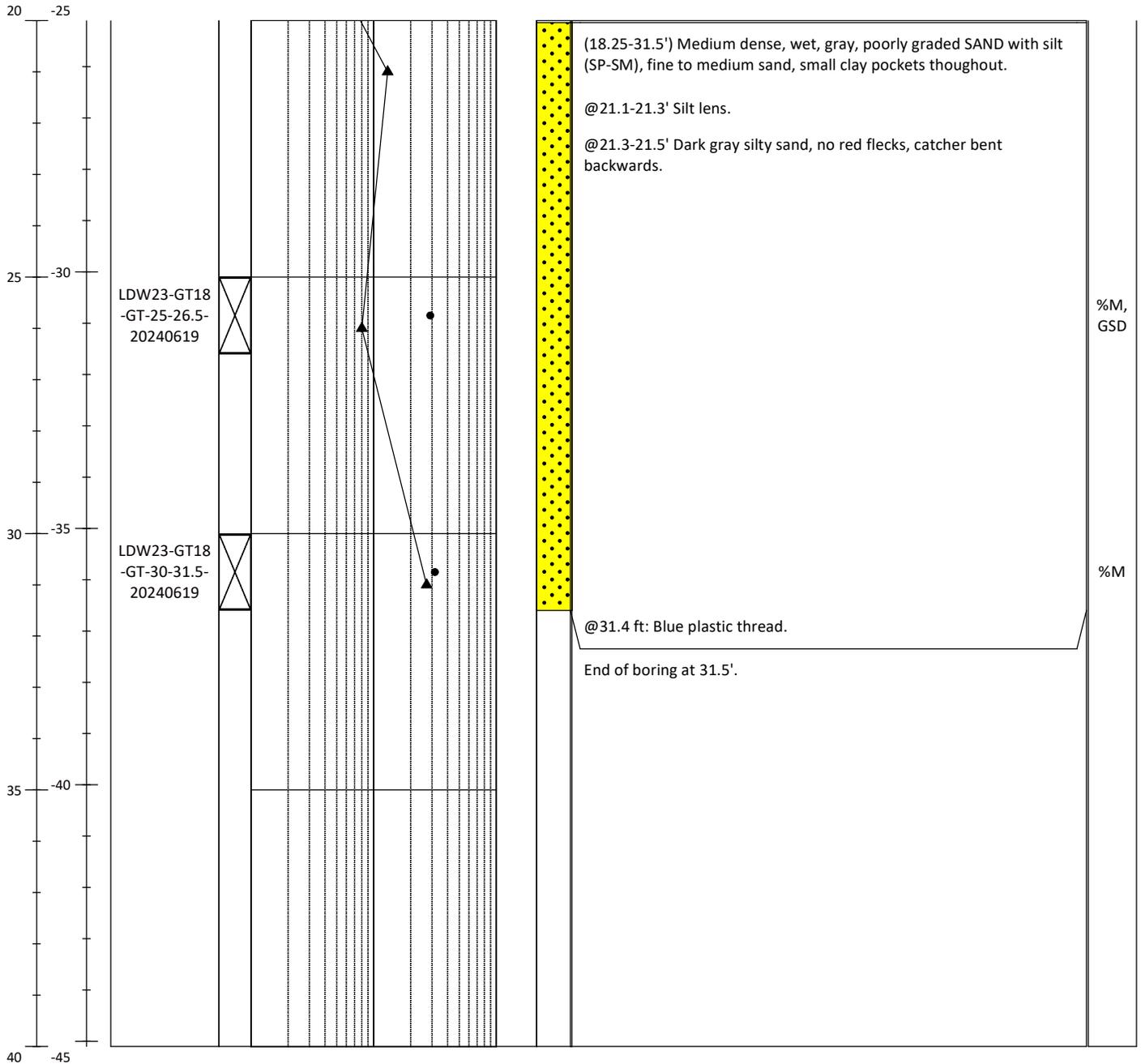
Soil Boring Log

LDW23-GT18-GT

Sheet 2 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Hollow Stem Auger
Location: Seattle, WA	N/LAT: 200303.38 E/LONG: 1271222.23	Total Depth (ft): 31.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Mudline Elevation (ft): -5.1
Collection Date: 6/19/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot)						Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
				1	2	5	10	20	50				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ☒ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

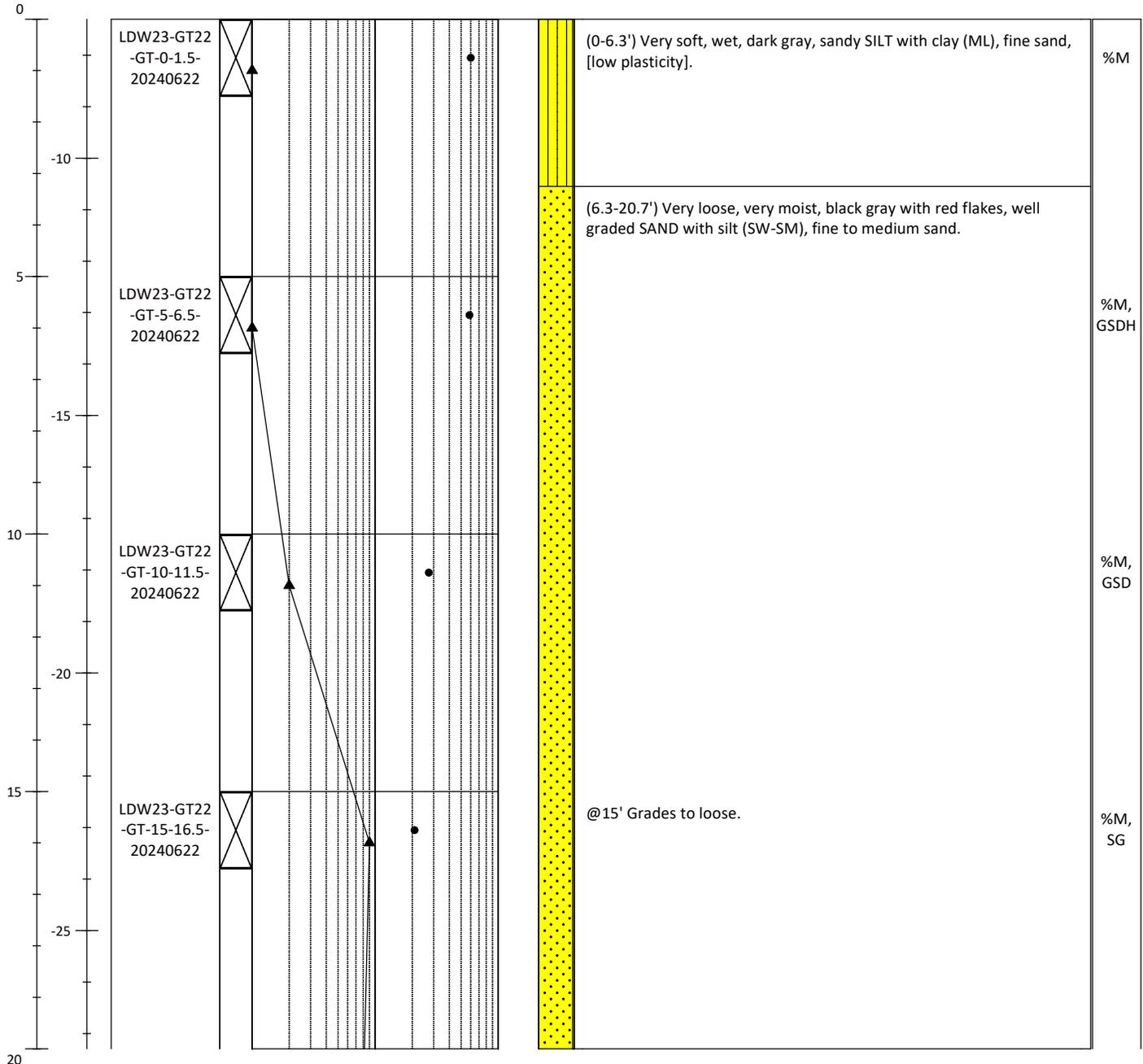
Soil Boring Log

LDW23-GT22-GT

Sheet 1 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Hollow Stem Auger
Location: Seattle, WA	N/LAT: 199427.25 E/LONG: 1271763.93	Total Depth (ft): 26.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Mudline Elevation (ft): -7.3
Collection Date: 6/22/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot)						Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
				1	2	5	10	20	50				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:

%M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
Mudline elevations determined from leadline measurements and Site tide gage levels.

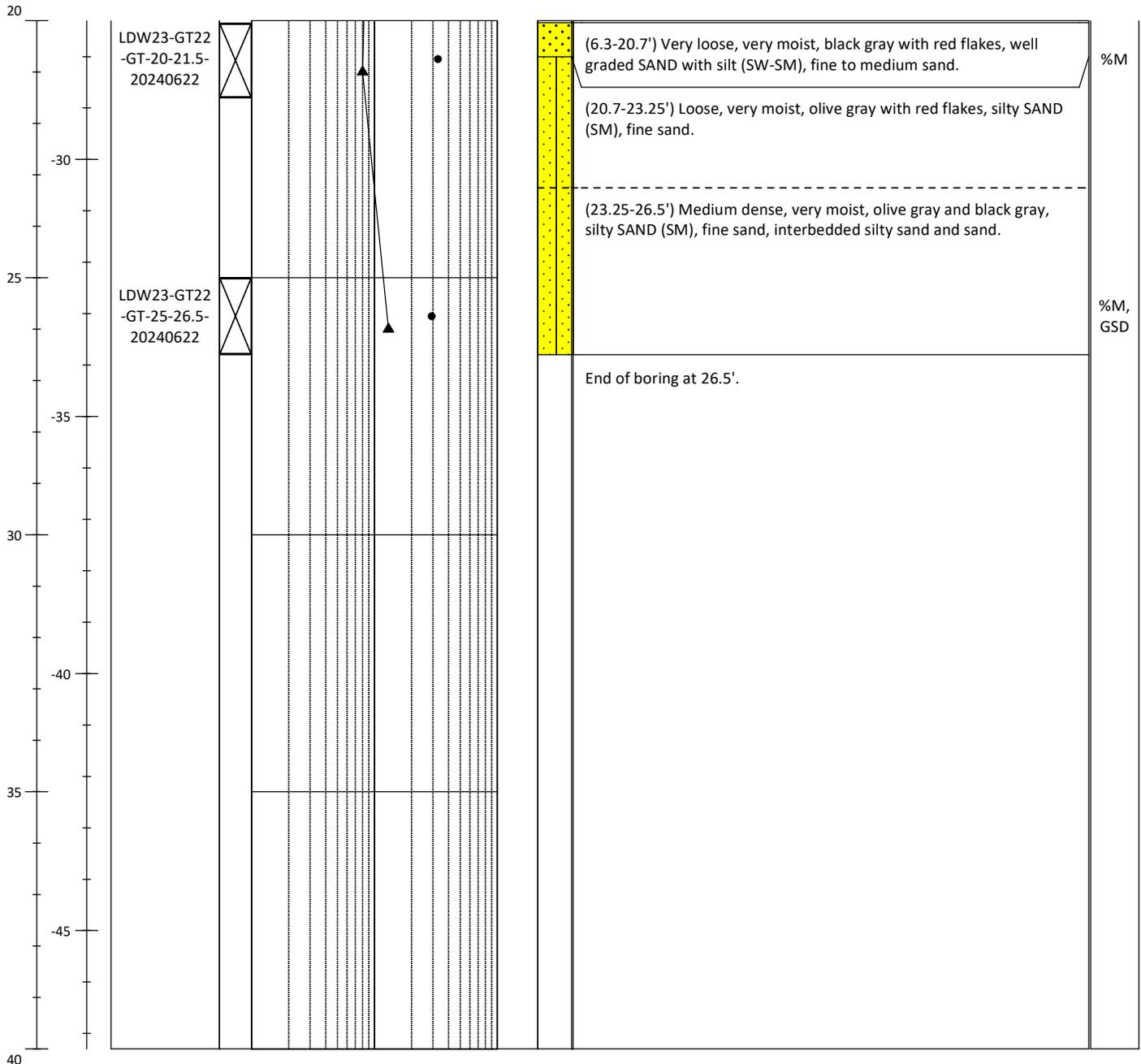
Soil Boring Log

LDW23-GT22-GT

Sheet 2 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Hollow Stem Auger
Location: Seattle, WA	N/LAT: 199427.25 E/LONG: 1271763.93	Total Depth (ft): 26.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Mudline Elevation (ft): -7.3
Collection Date: 6/22/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot)						Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
				1	2	5	10	20	50				



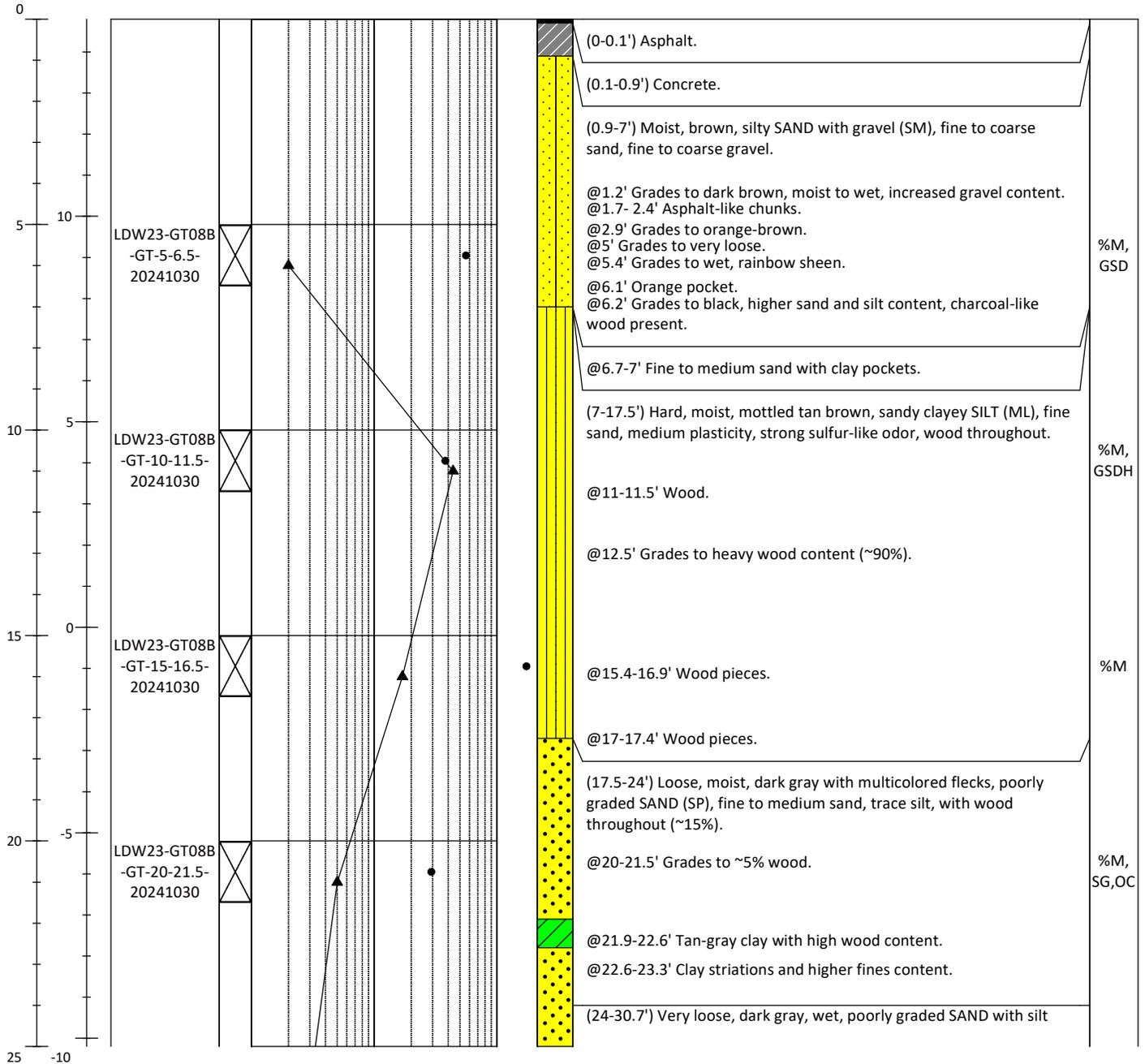
Soil Boring Log

LDW23-GT08B-GT

Sheet 1 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Rotary Sonic
Location: Seattle, WA	N/LAT: 201895.68 E/LONG: 1269533.43	Total Depth (ft): 41.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Ground Surface Elevation (ft): 14.8
Collection Date: 10/30/24		
Contractor: Holt	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: LD, RP	Sampler(s): Split Spoon	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits							Other Values	Lithology	Soil Description <small>Samples and descriptions are in recovered depths. Classification scheme: USCS</small>	Lab Test
				1	2	5	10	20	50	100				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

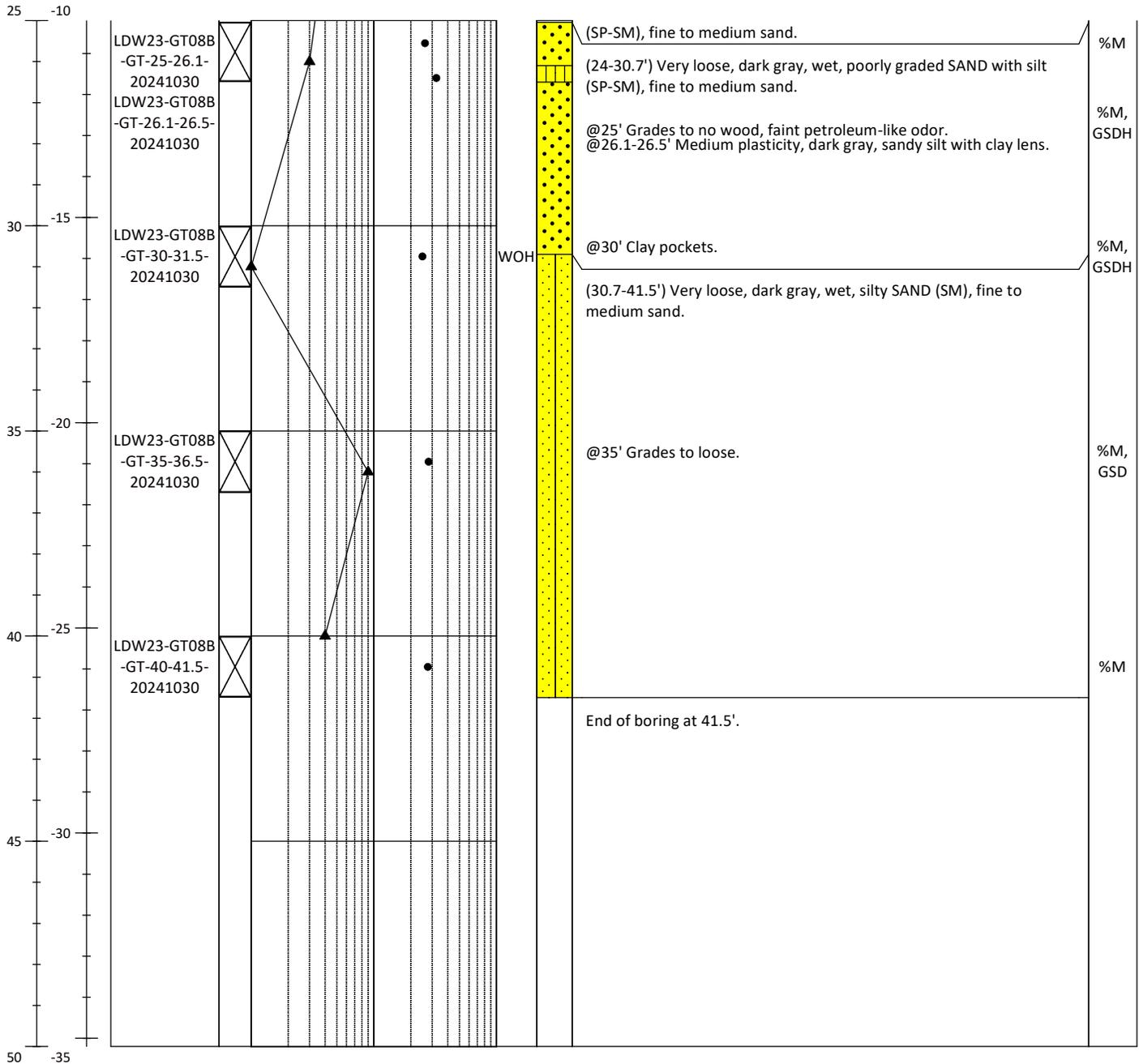
Soil Boring Log

LDW23-GT08B-GT

Sheet 2 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Rotary Sonic
Location: Seattle, WA	N/LAT: 201895.68 E/LONG: 1269533.43	Total Depth (ft): 41.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Ground Surface Elevation (ft): 14.8
Collection Date: 10/30/24		
Contractor: Holt	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: LD, RP	Sampler(s): Split Spoon	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits							Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
				1	2	5	10	20	50	100				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

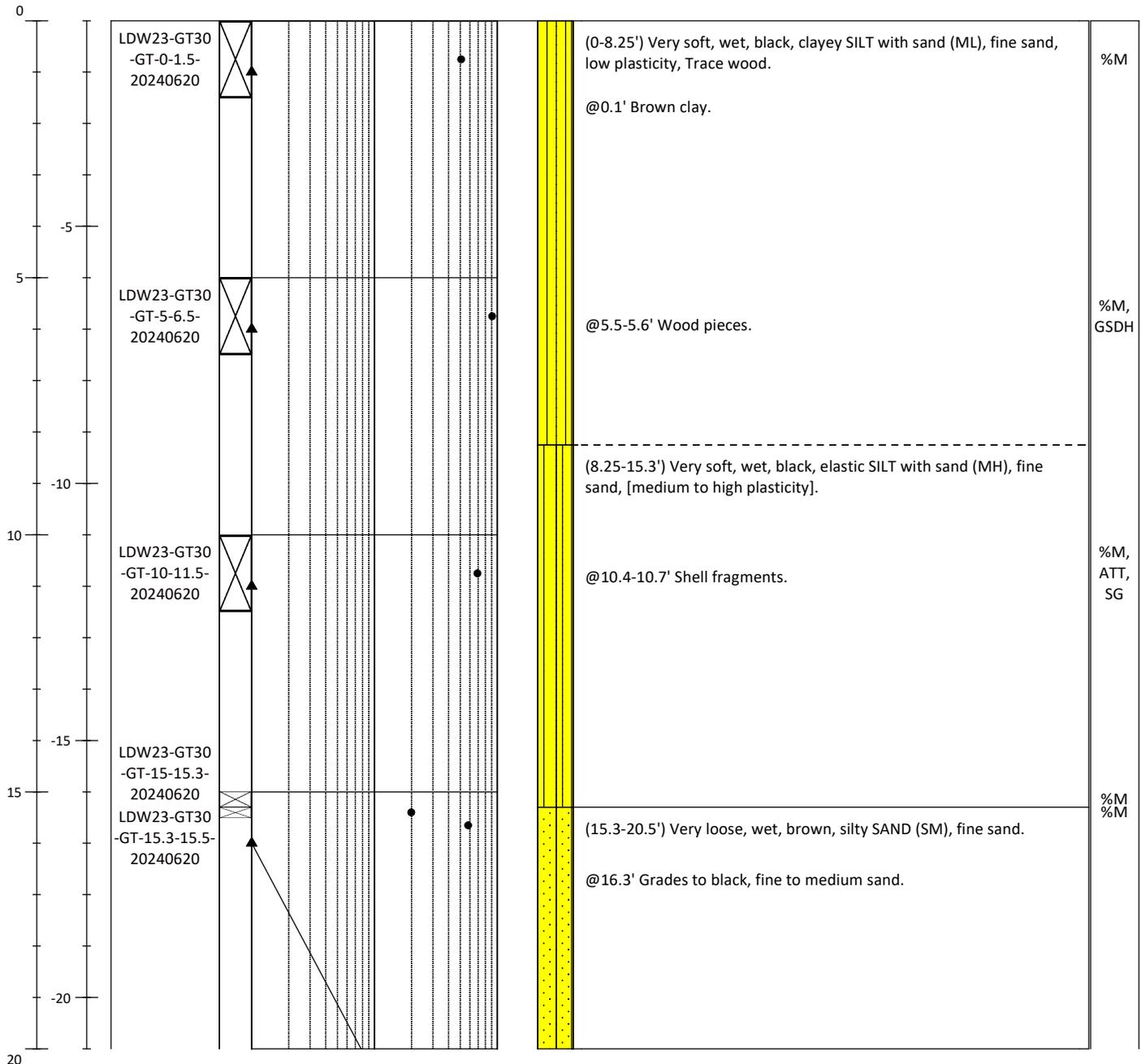
Soil Boring Log

LDW23-GT30-GT

Sheet 1 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Hollow Stem Auger
Location: Seattle, WA	N/LAT: 198841.00 E/LONG: 1272451.43	Total Depth (ft): 26.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Mudline Elevation (ft): -1.0
Collection Date: 6/20/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot)						Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
				1	2	5	10	20	50				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

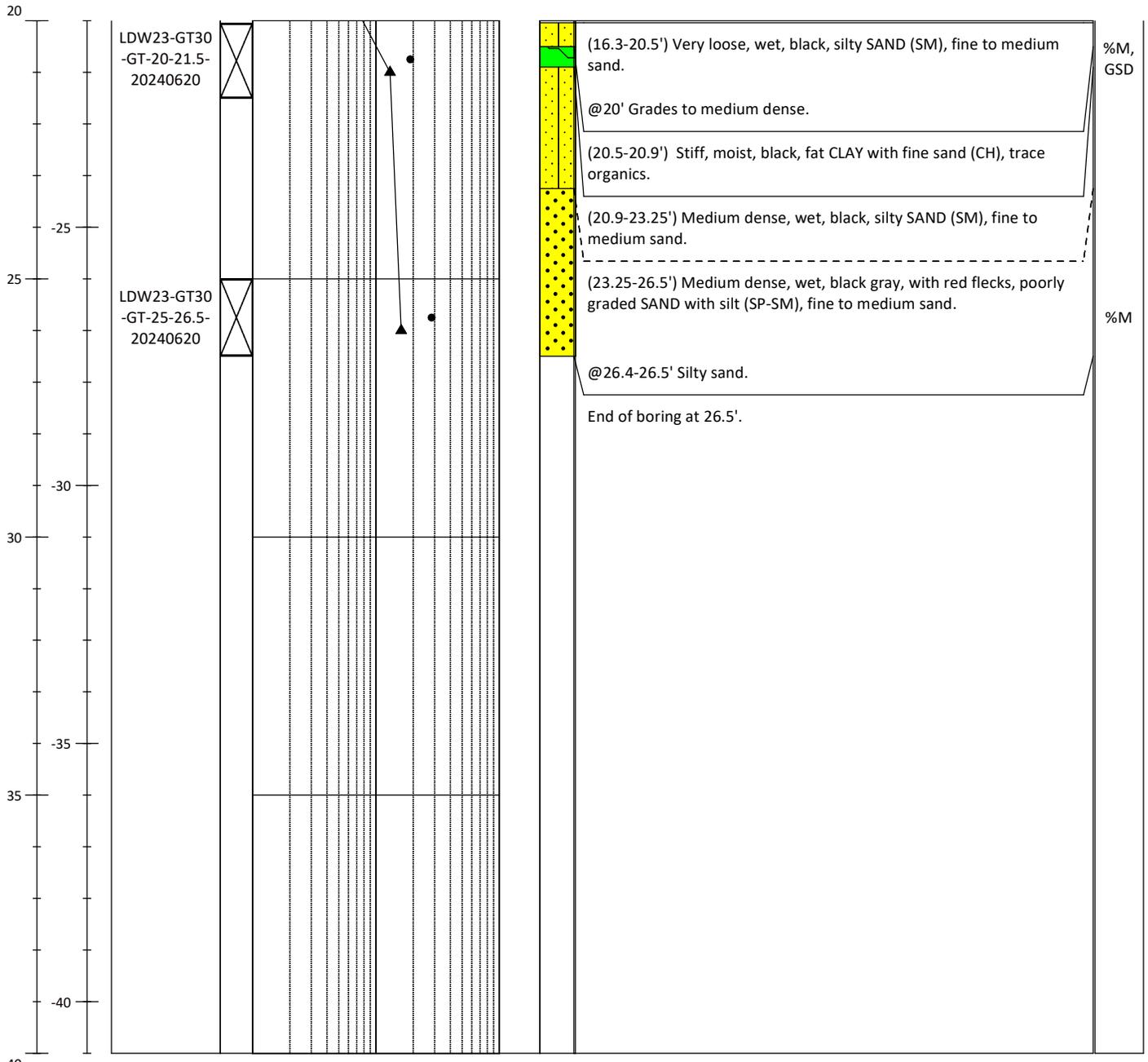
Soil Boring Log

LDW23-GT30-GT

Sheet 2 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Hollow Stem Auger
Location: Seattle, WA	N/LAT: 198841.00 E/LONG: 1272451.43	Total Depth (ft): 26.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Mudline Elevation (ft): -1.0
Collection Date: 6/20/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot)						Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
				1	2	5	10	20	50				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

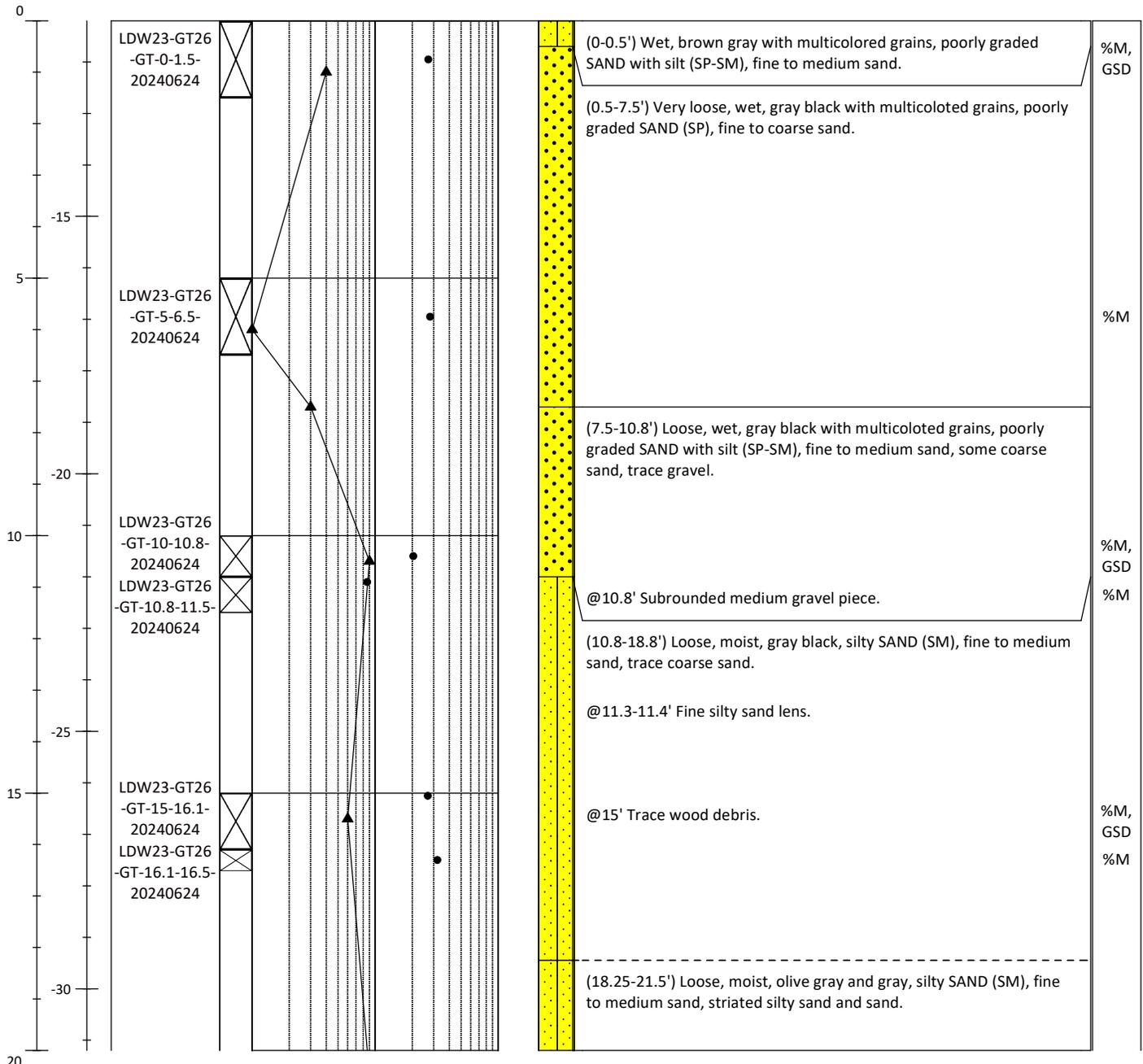
Soil Boring Log

LDW23-GT26-GT

Sheet 1 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Hollow Stem Auger
Location: Seattle, WA	N/LAT: 199159.81 E/LONG: 1271955.17	Total Depth (ft): 21.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Mudline Elevation (ft): -11.2
Collection Date: 6/24/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits						Other Values	Lithology	Soil Description <small>Samples and descriptions are in recovered depths. Classification scheme: USCS</small>	Lab Test
				1	2	5	10	20	50				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

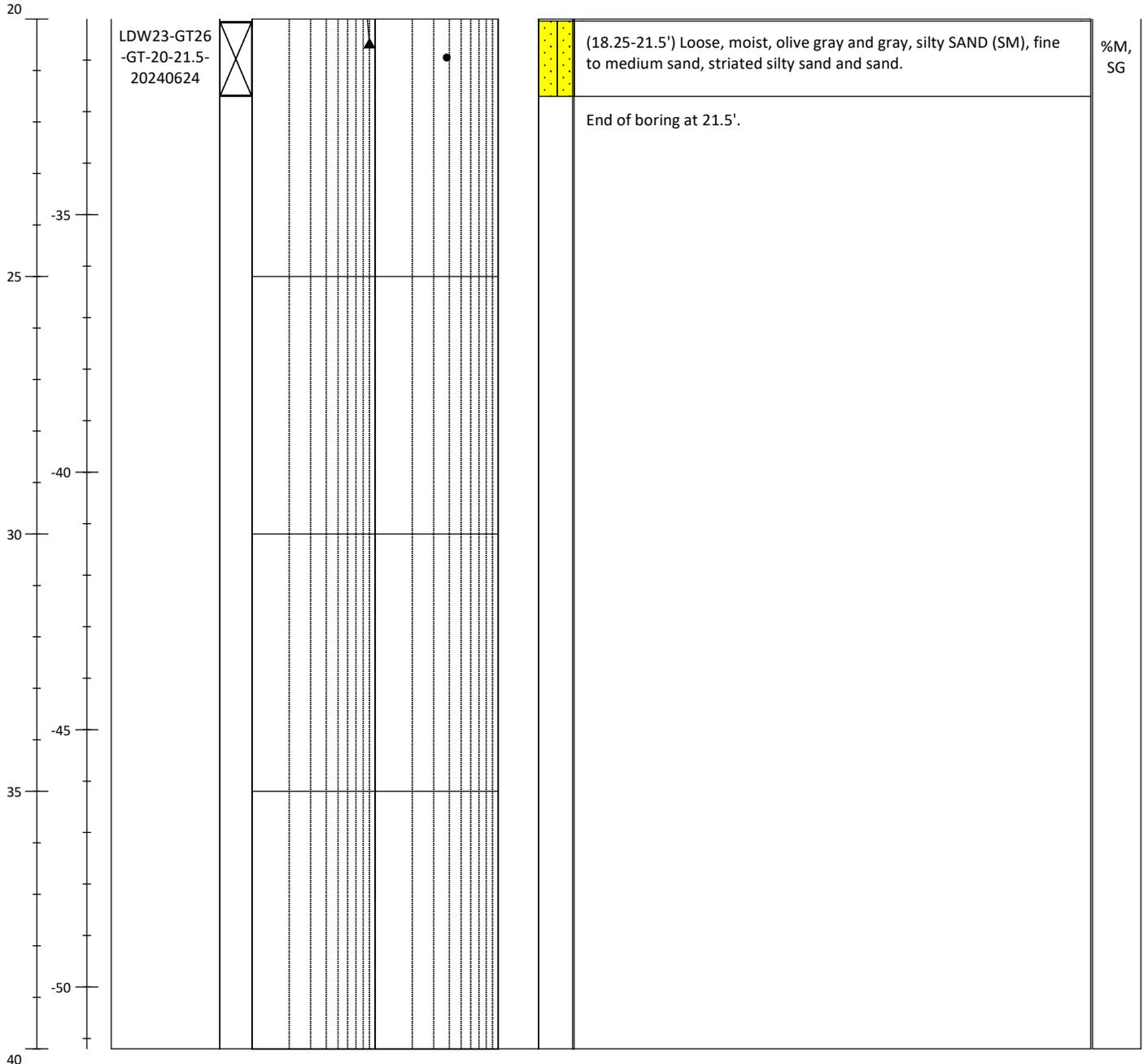
Soil Boring Log

LDW23-GT26-GT

Sheet 2 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Hollow Stem Auger
Location: Seattle, WA	N/LAT: 199159.81 E/LONG: 1271955.17	Total Depth (ft): 21.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Mudline Elevation (ft): -11.2
Collection Date: 6/24/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot)						Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
				1	2	5	10	20	50				



<p>1201 Third Avenue Suite 2600 Seattle, WA 98101</p>	<ul style="list-style-type: none"> ▲ SPT N-Value ● Moisture Content (%) ■ Atterberg Limits □ Shelby Tube ⊠ Split Spoon/Grab 	<p>Notes: %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic Mudline elevations determined from leadline measurements and Site tide gage levels.</p>
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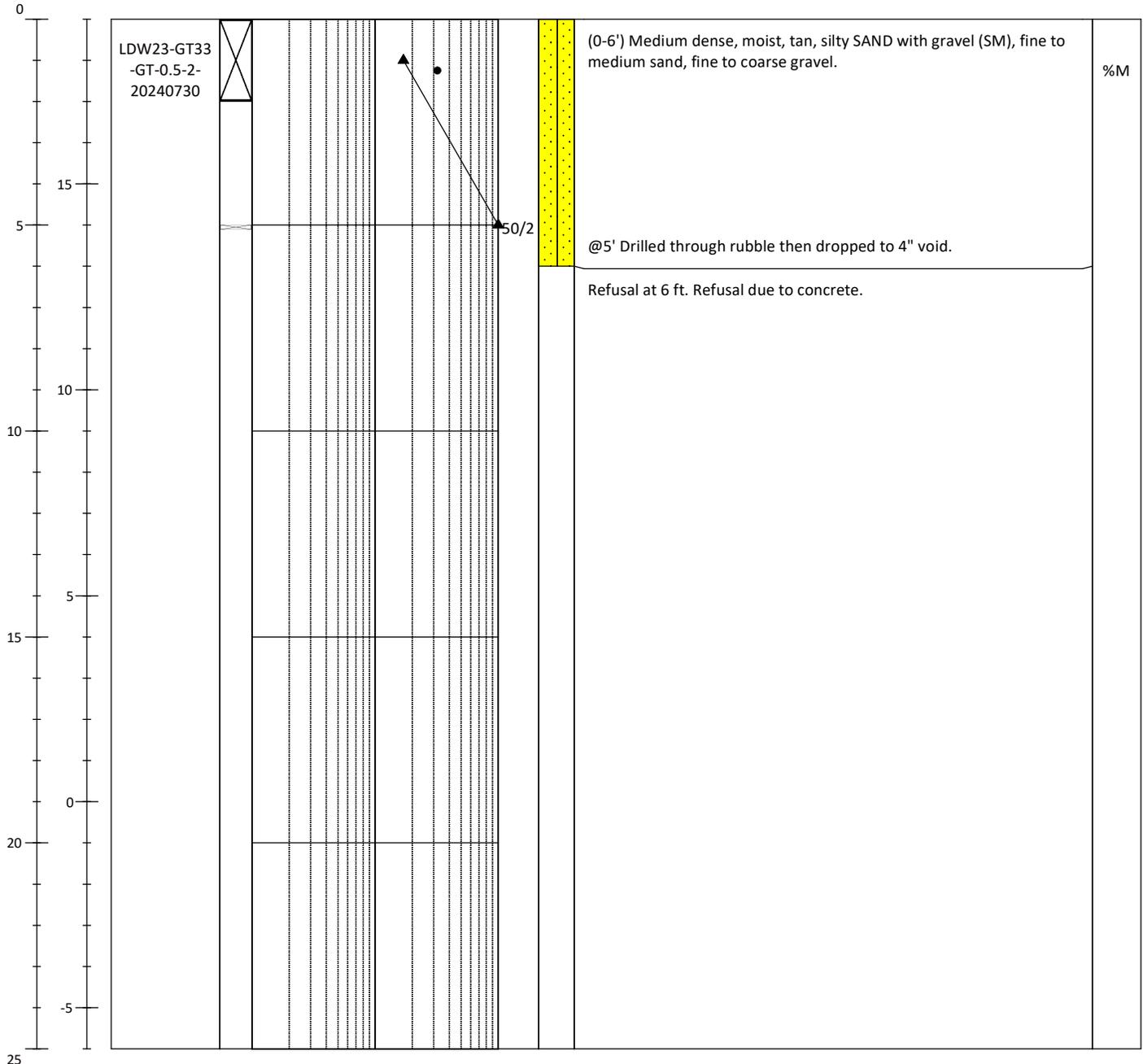
Soil Boring Log

LDW23-GT33-GT

Sheet 1 of 1

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Mud Rotary
Location: Seattle, WA	N/LAT: 200383.3 E/LONG: 1269966.43	Total Depth (ft): 6
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Ground Surface Elevation (ft): 19
Collection Date: 7/30/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits						Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
				1	2	5	10	20	50				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

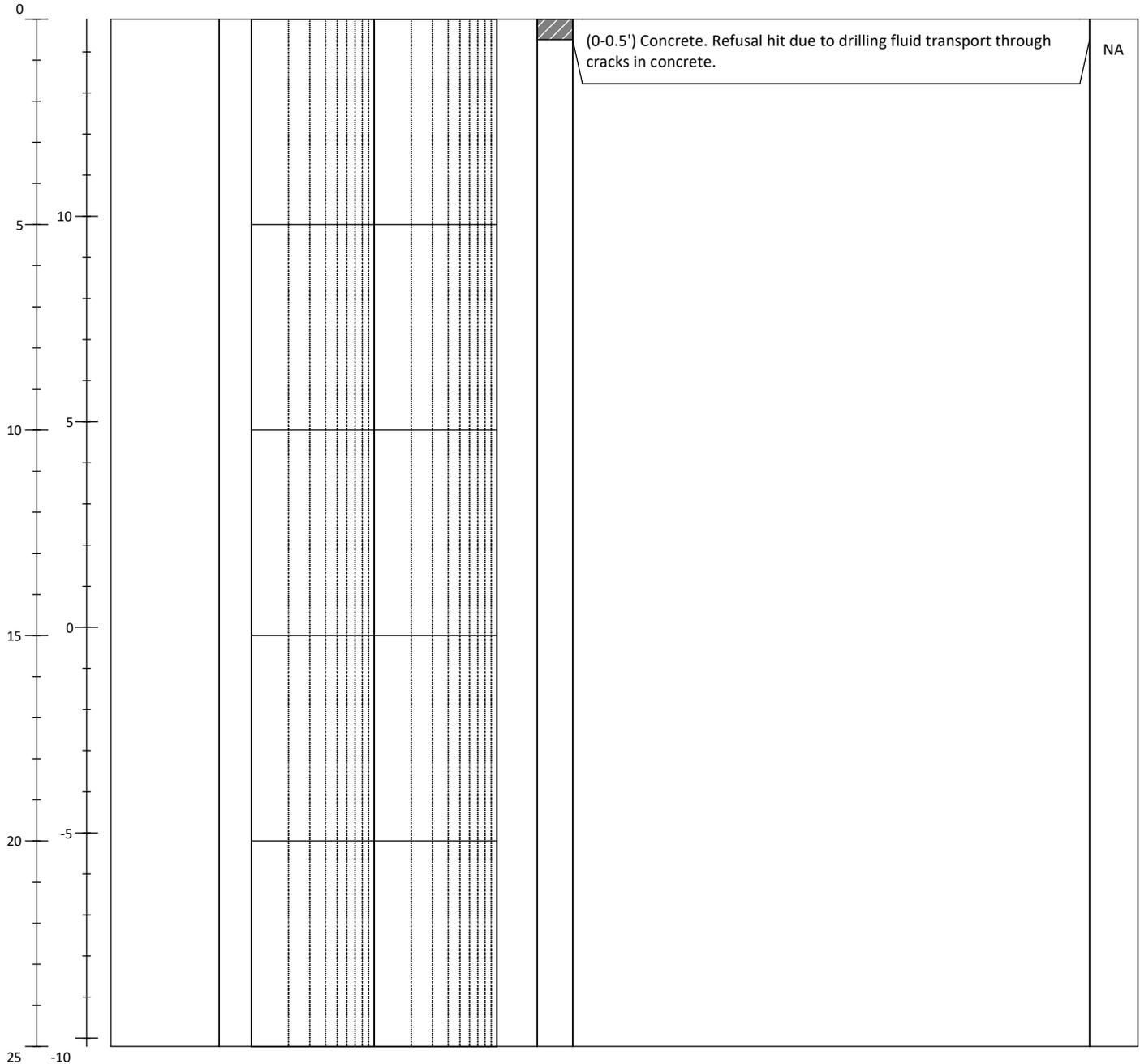
Soil Boring Log

LDW23-GT08-GT

Sheet 1 of 1

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Mud Rotary
Location: Seattle, WA	N/LAT: 201889.93 E/LONG: 1269524.12	Total Depth (ft): 0.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Ground Surface Elevation (ft): 14.8
Collection Date: 8/02/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot)						Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
				1	2	5	10	20	50				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ☒ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution,
 GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight,
 CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear,
 WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

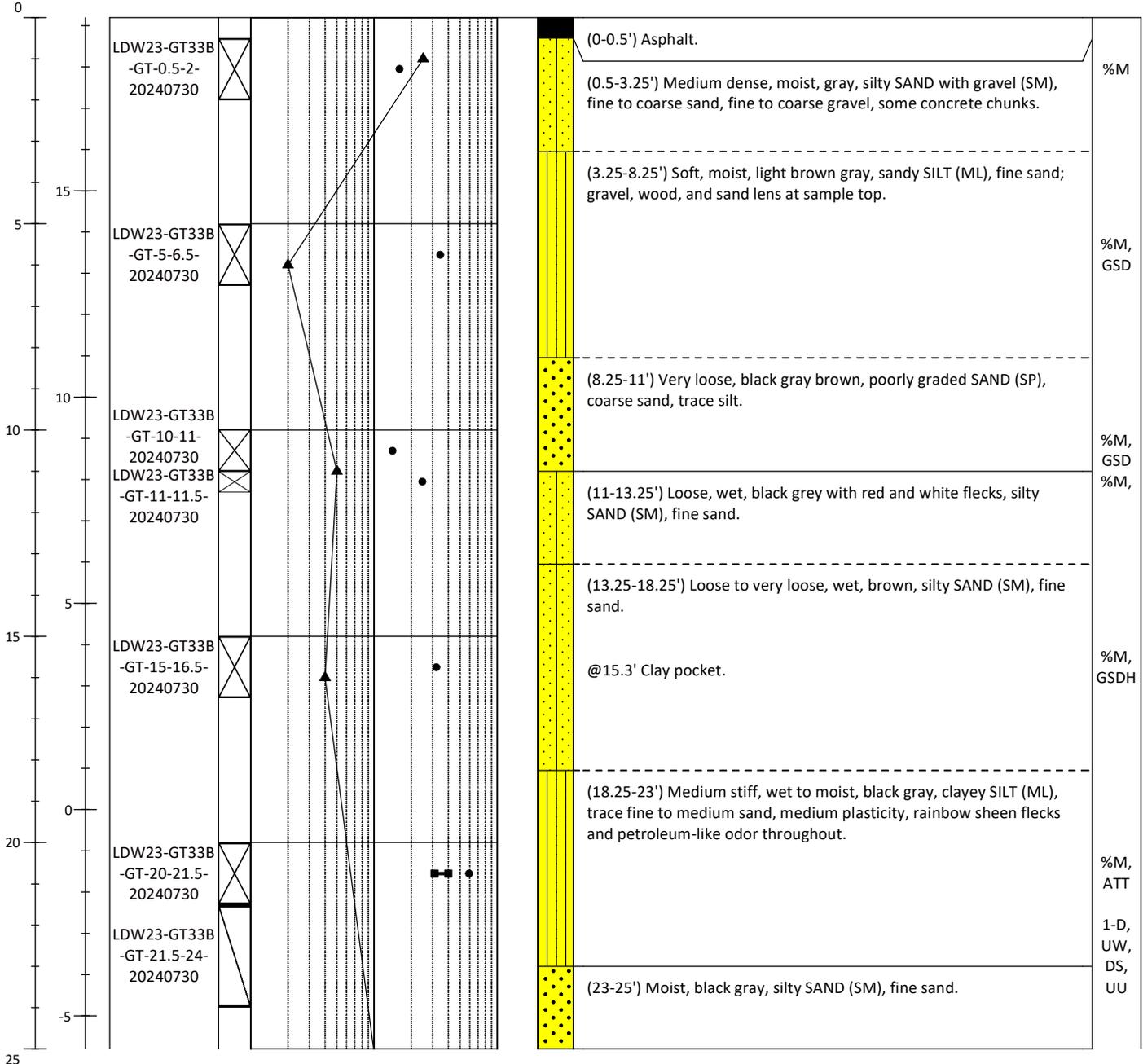
Soil Boring Log

LDW23-GT33B-GT

Sheet 1 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Mud Rotary
Location: Seattle, WA	N/LAT: 200384.88 E/LONG: 1269974.41	Total Depth (ft): 41.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Ground Surface Elevation (ft): 19.2
Collection Date: 7/30/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon & Shelby Tube Sampler	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits						Other Values	Lithology	Soil Description <small>Samples and descriptions are in recovered depths. Classification scheme: USCS</small>	Lab Test
				1	2	5	10	20	50				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:

%M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

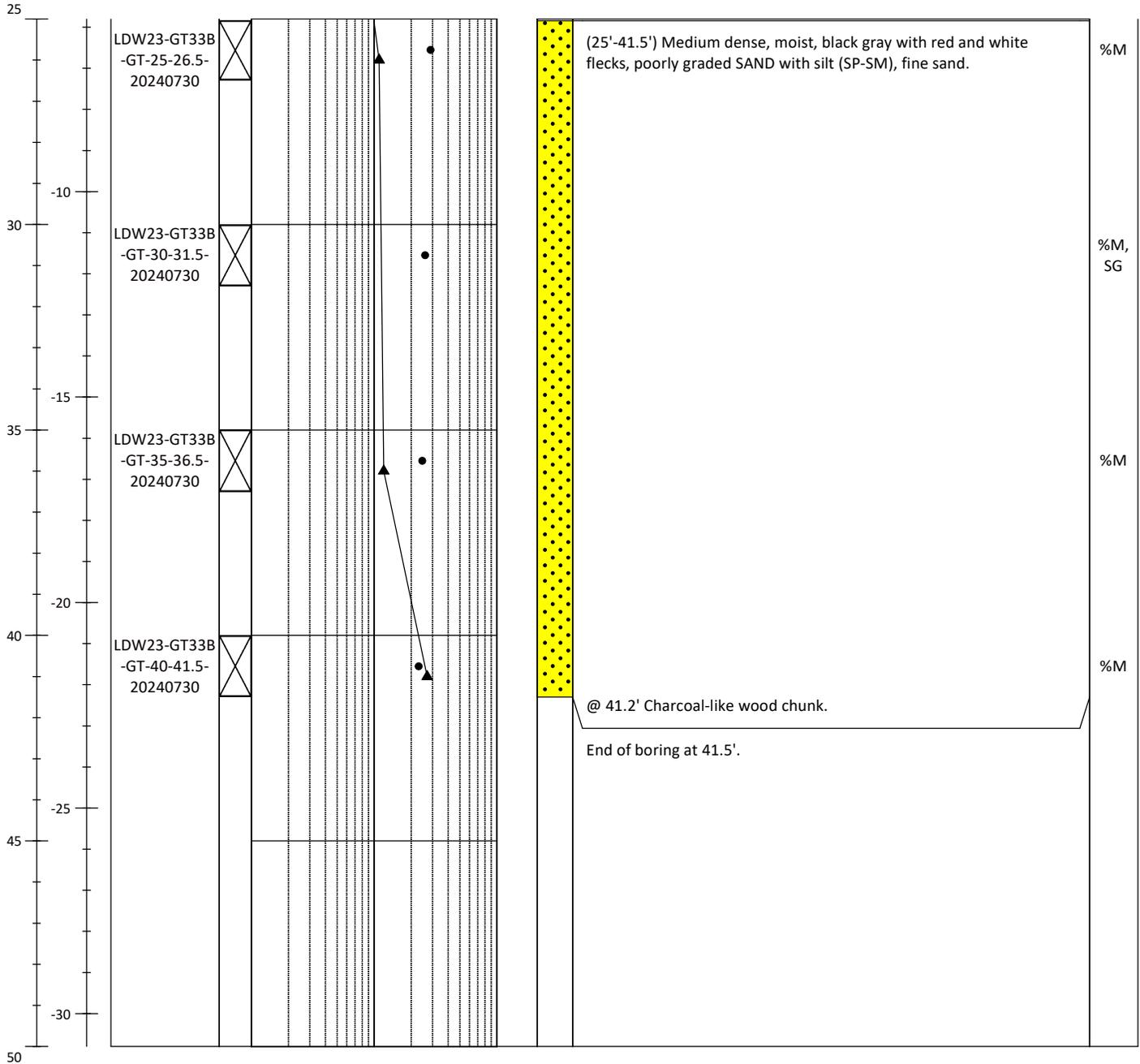
Soil Boring Log

LDW23-GT33B-GT

Sheet 2 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Mud Rotary
Location: Seattle, WA	N/LAT: 200384.88 E/LONG: 1269974.41	Total Depth (ft): 41.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Ground Surface Elevation (ft): 19.2
Collection Date: 7/30/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon & Shelby Tube Sampler	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits							Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
				1	2	5	10	20	50	100				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

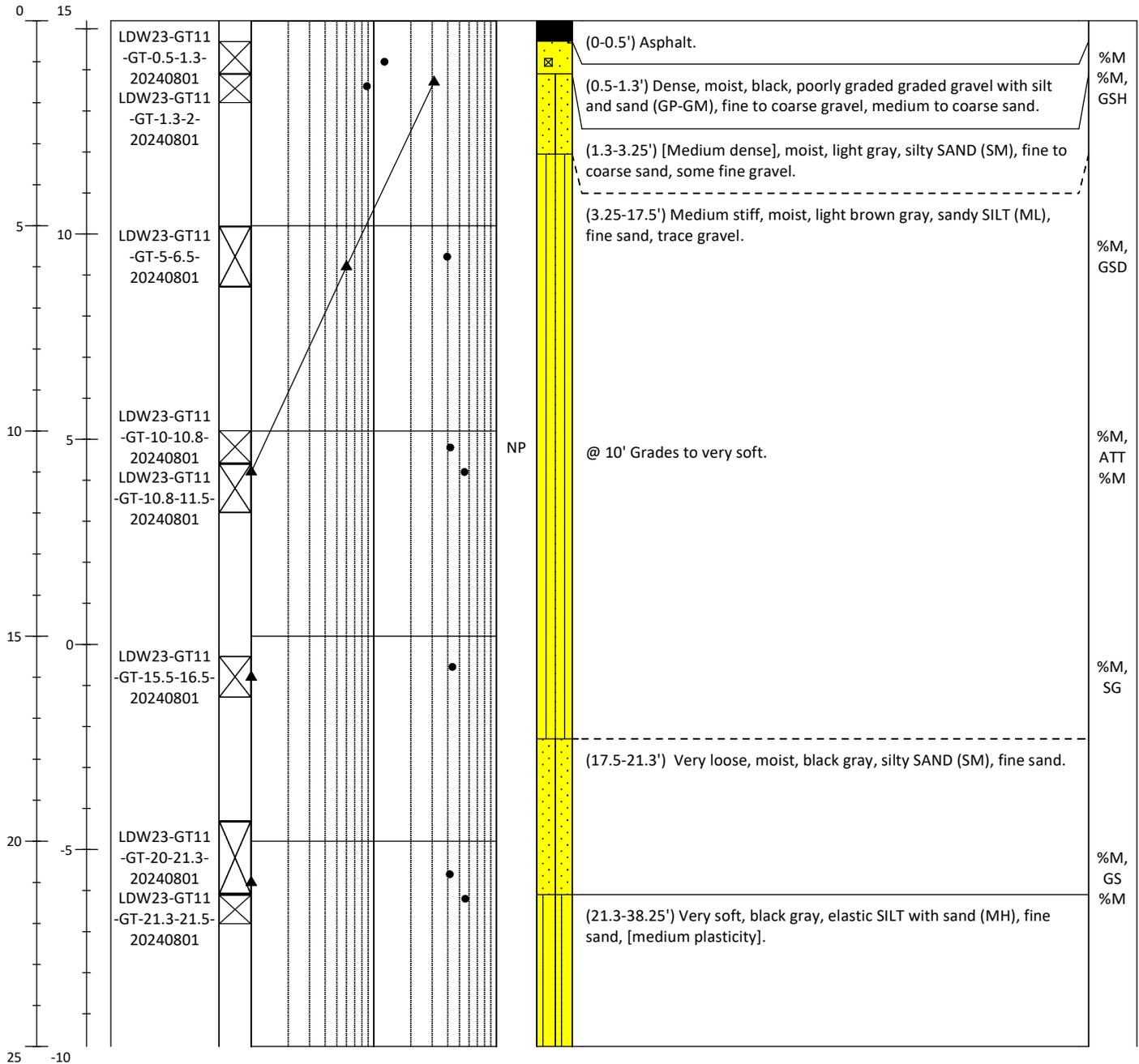
Soil Boring Log

LDW23-GT11-GT

Sheet 1 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Mud Rotary
Location: Seattle, WA	N/LAT: 200727.14 E/LONG: 1269907.48	Total Depth (ft): 41.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Ground Surface Elevation (ft): 15.2
Collection Date: 8/01/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot)						Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
				1	2	5	10	20	50				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

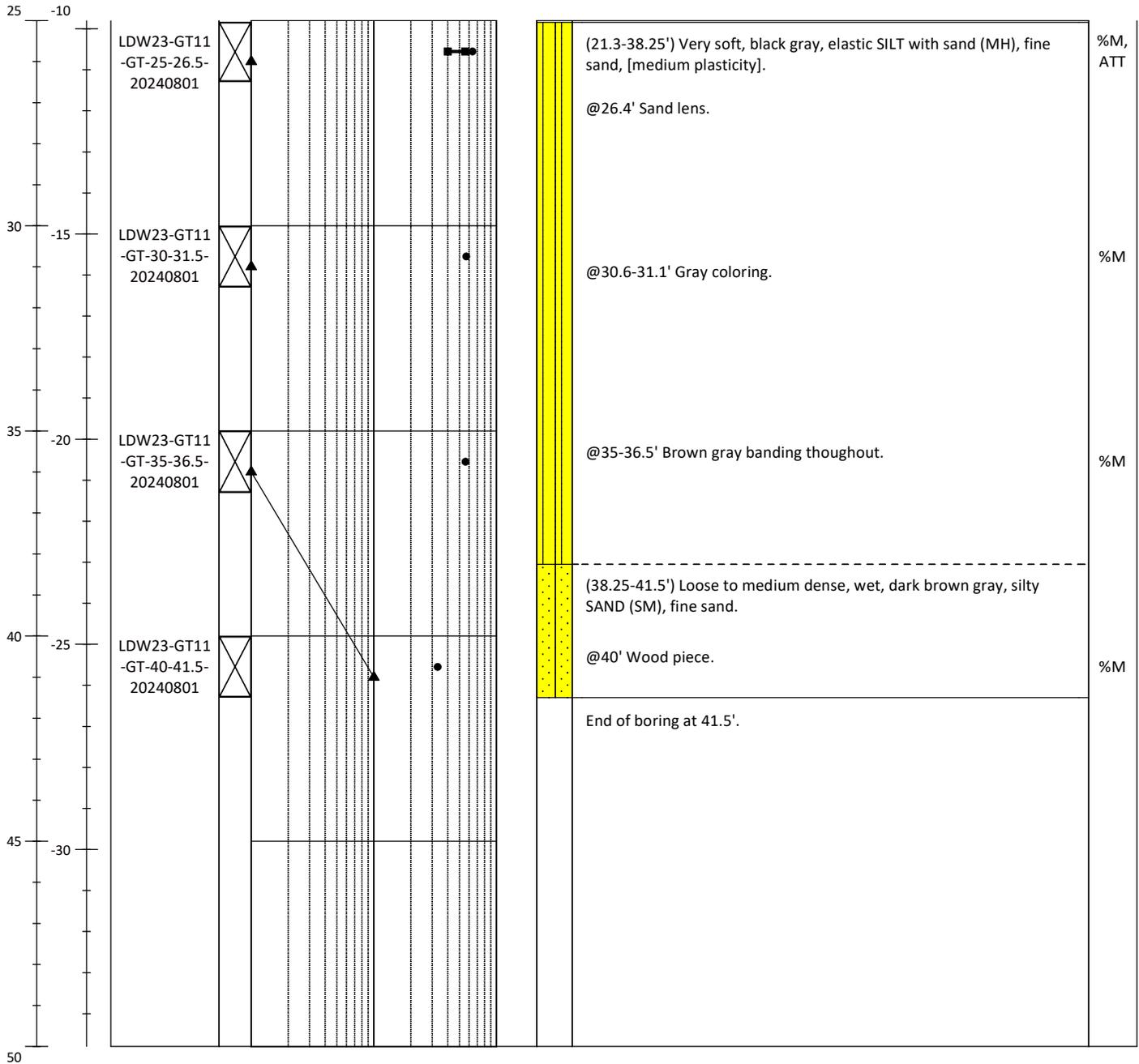
Soil Boring Log

LDW23-GT11-GT

Sheet 2 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Mud Rotary
Location: Seattle, WA	N/LAT: 200727.14 E/LONG: 1269907.48	Total Depth (ft): 41.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Ground Surface Elevation (ft): 15.2
Collection Date: 8/01/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot)						Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
				1	2	5	10	20	50				



<p>1201 Third Avenue Suite 2600 Seattle, WA 98101</p>	<ul style="list-style-type: none"> ▲ SPT N-Value ● Moisture Content (%) ■ Atterberg Limits ▣ Shelby Tube ⊠ Split Spoon/Grab 	<p>Notes: %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic Mudline elevations determined from leadline measurements and Site tide gage levels.</p>
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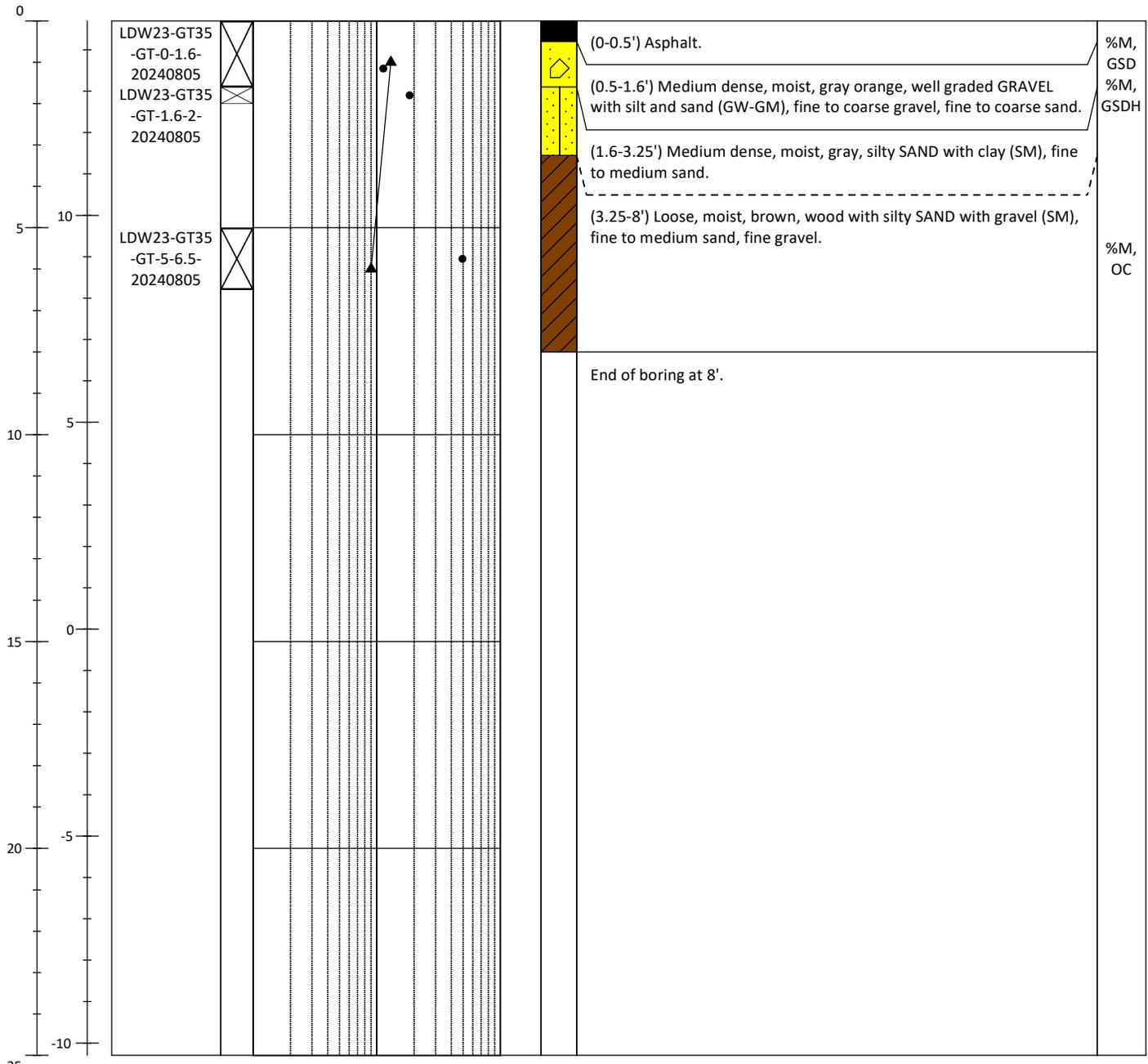
Soil Boring Log

LDW23-GT35-GT

Sheet 1 of 1

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Mud Rotary
Location: Seattle, WA	N/LAT: 200289.17 E/LONG: 1270118.91	Total Depth (ft): 8.0
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Ground Surface Elevation (ft): 14.7
Collection Date: 8/05/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot)							Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
				1	2	5	10	20	50	100				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

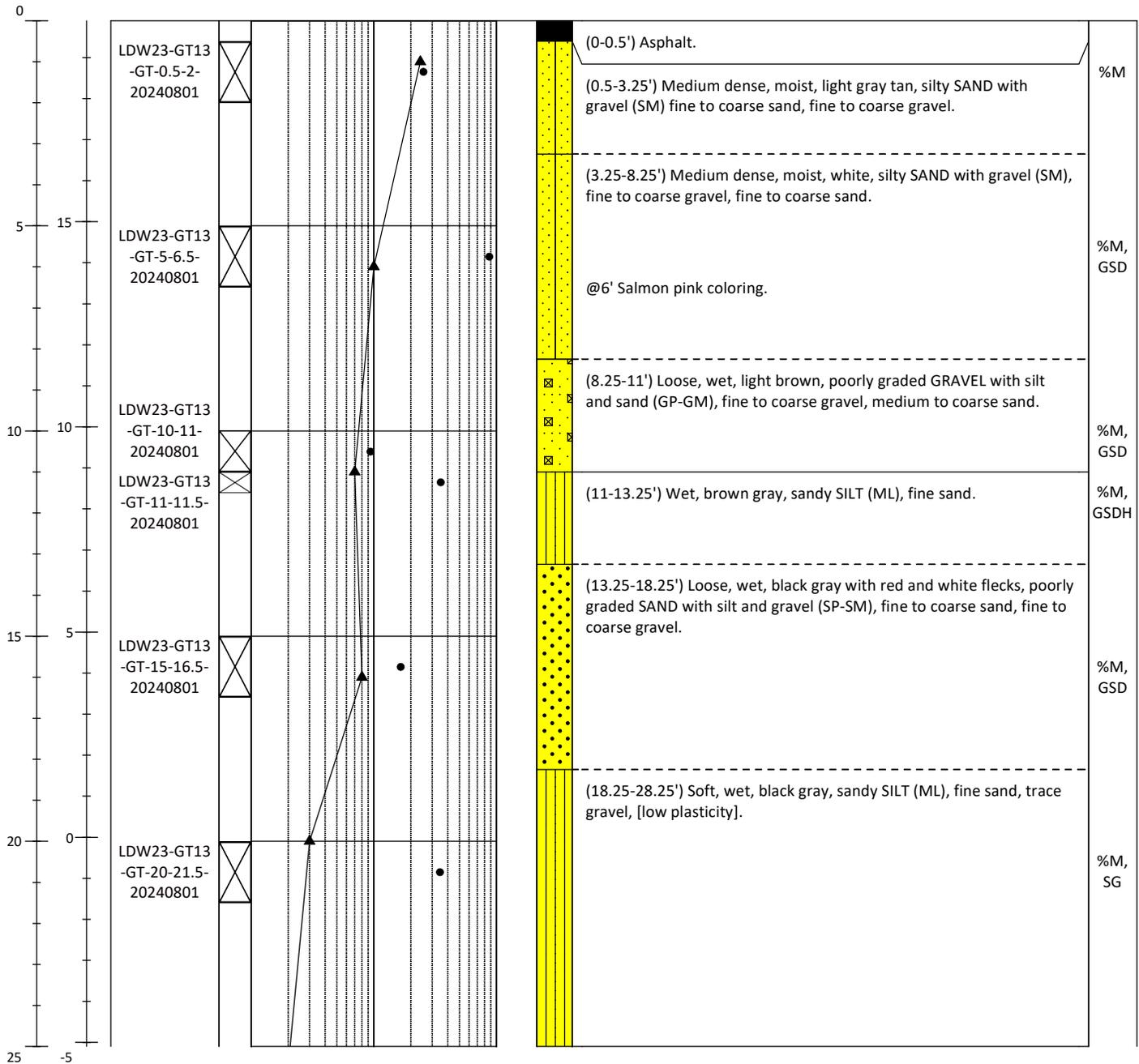
Soil Boring Log

LDW23-GT13-GT

Sheet 1 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Mud Rotary
Location: Seattle, WA	N/LAT: 200524.15 E/LONG: 1270094.75	Total Depth (ft): 41.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Ground Surface Elevation (ft): 19.9
Collection Date: 8/01/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon & Shelby Tube Sampler	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits						Other Values	Lithology	Soil Description <small>Samples and descriptions are in recovered depths. Classification scheme: USCS</small>	Lab Test
				1	2	5	10	20	50				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution,
 GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight,
 CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear,
 WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

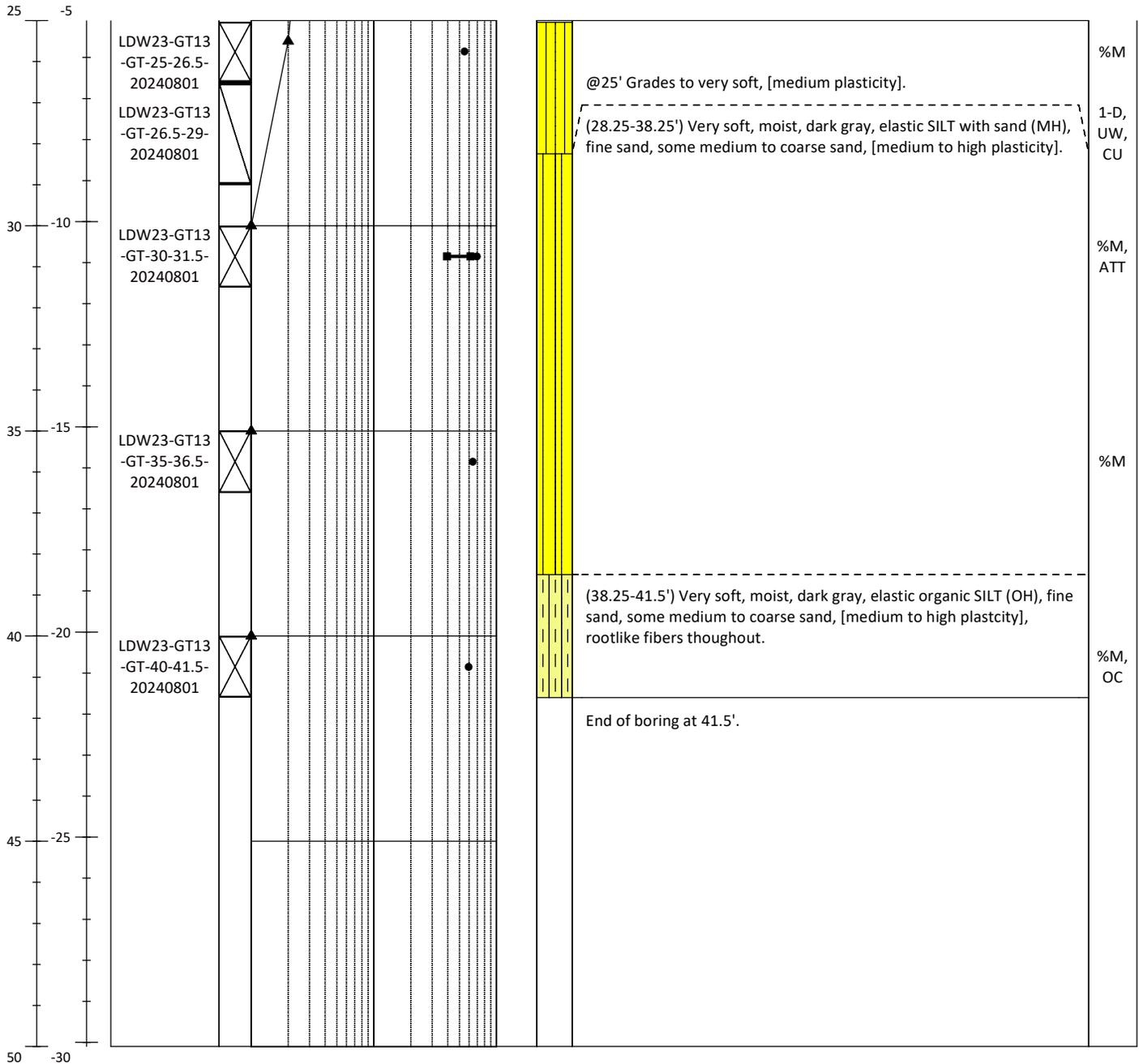
Soil Boring Log

LDW23-GT13-GT

Sheet 2 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Mud Rotary
Location: Seattle, WA	N/LAT: 200524.15 E/LONG: 1270094.75	Total Depth (ft): 41.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Ground Surface Elevation (ft): 19.9
Collection Date: 8/01/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon & Shelby Tube Sampler	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot)						Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
				1	2	5	10	20	50				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

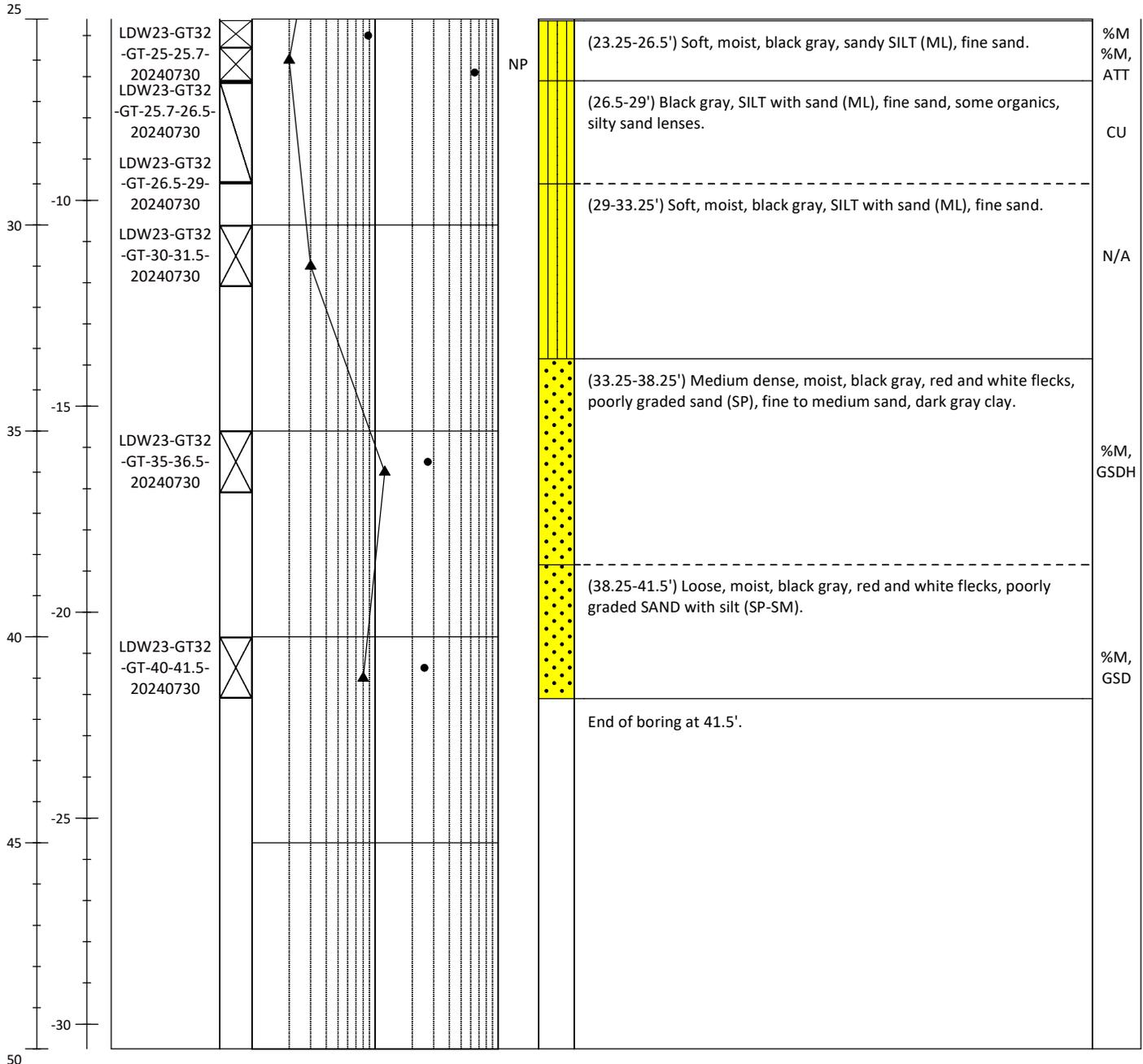
Soil Boring Log

LDW23-GT32-GT

Sheet 2 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Mud Rotary
Location: Seattle, WA	N/LAT: 200429.41 E/LONG: 1270112.12	Total Depth (ft): 41.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Ground Surface Elevation (ft): 19.4
Collection Date: 7/30/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon & Shelby Tube Sampler	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits						Other Values	Lithology	Soil Description <small>Samples and descriptions are in recovered depths. Classification scheme: USCS</small>	Lab Test
				1	2	5	10	20	50				



- ▲ SPT N-Value
- Moisture Content (%)
- ▴ Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

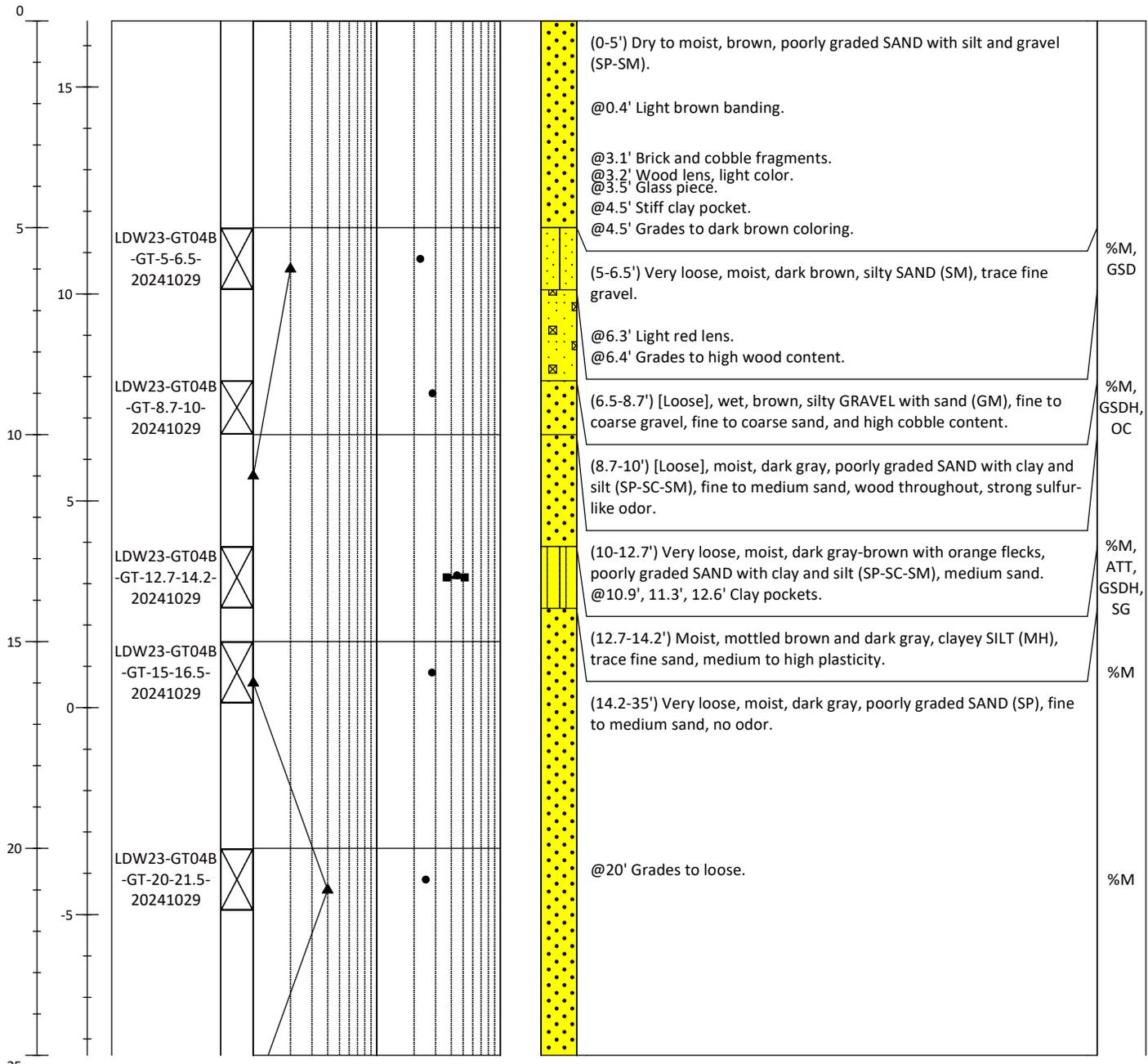
Soil Boring Log

LDW23-GT04B-GT

Sheet 1 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Rotary Sonic
Location: Seattle, WA	N/LAT: 202021.91 E/LONG: 1269411.66	Total Depth (ft): 35
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Ground Surface Elevation (ft): 16.6
Collection Date: 10/29/2024		
Contractor: Holt	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP, LD	Sampler(s): Split Spoon	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits						Other Values	Lithology	Soil Description <small>Samples and descriptions are in recovered depths. Classification scheme: USCS</small>	Lab Test
				1	2	5	10	20	50				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

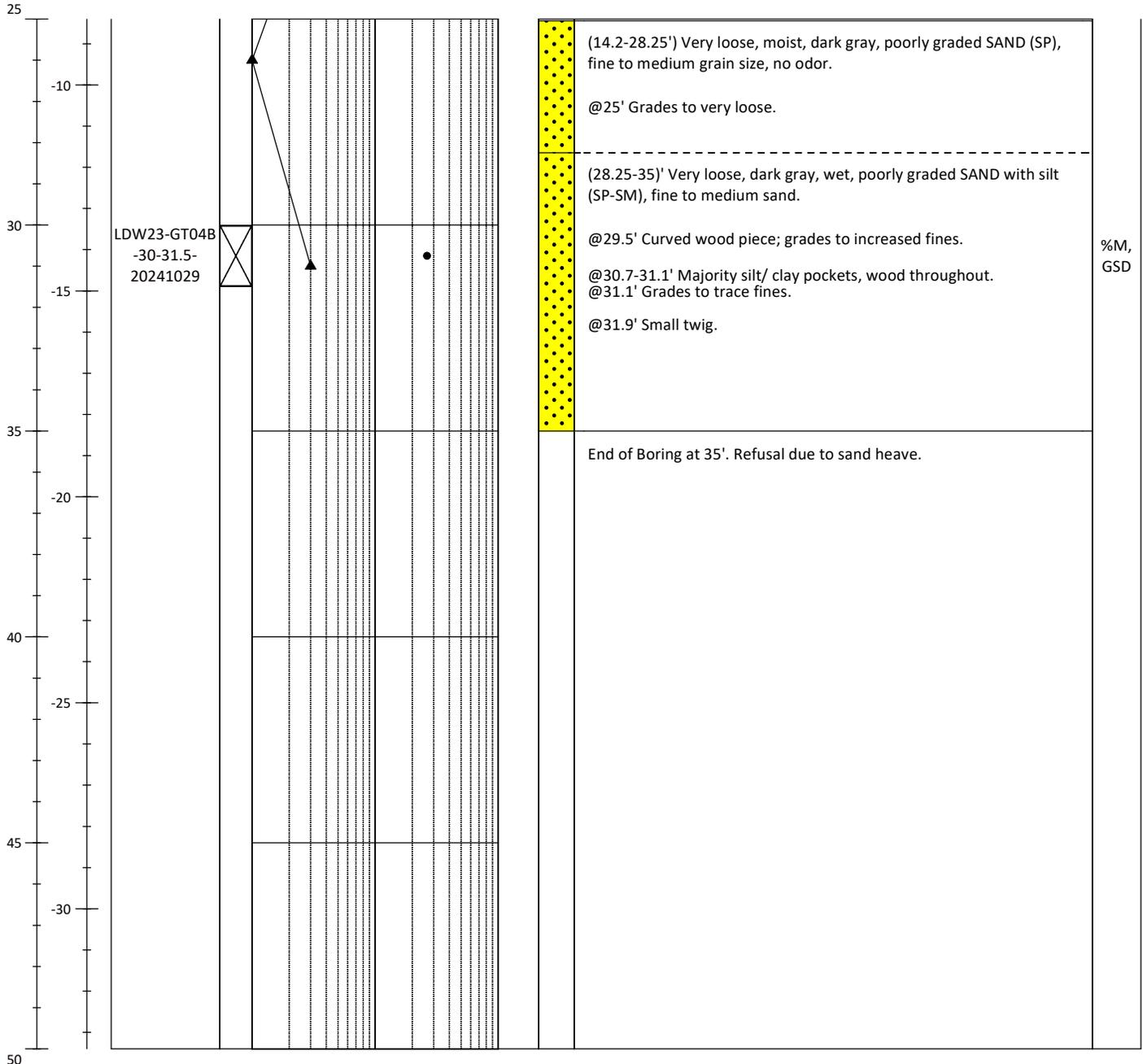
Soil Boring Log

LDW23-GT04B-GT

Sheet 2 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Rotary Sonic
Location: Seattle, WA	N/LAT: 202021.91 E/LONG: 1269411.66	Total Depth (ft): 35
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Ground Surface Elevation (ft): 16.6
Collection Date: 10/29/2024		
Contractor: Holt	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP, LD	Sampler(s): Split Spoon	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits						Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
				1	2	5	10	20	50				



%M,
GSD



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ☒ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution,
 GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight,
 CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear,
 WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

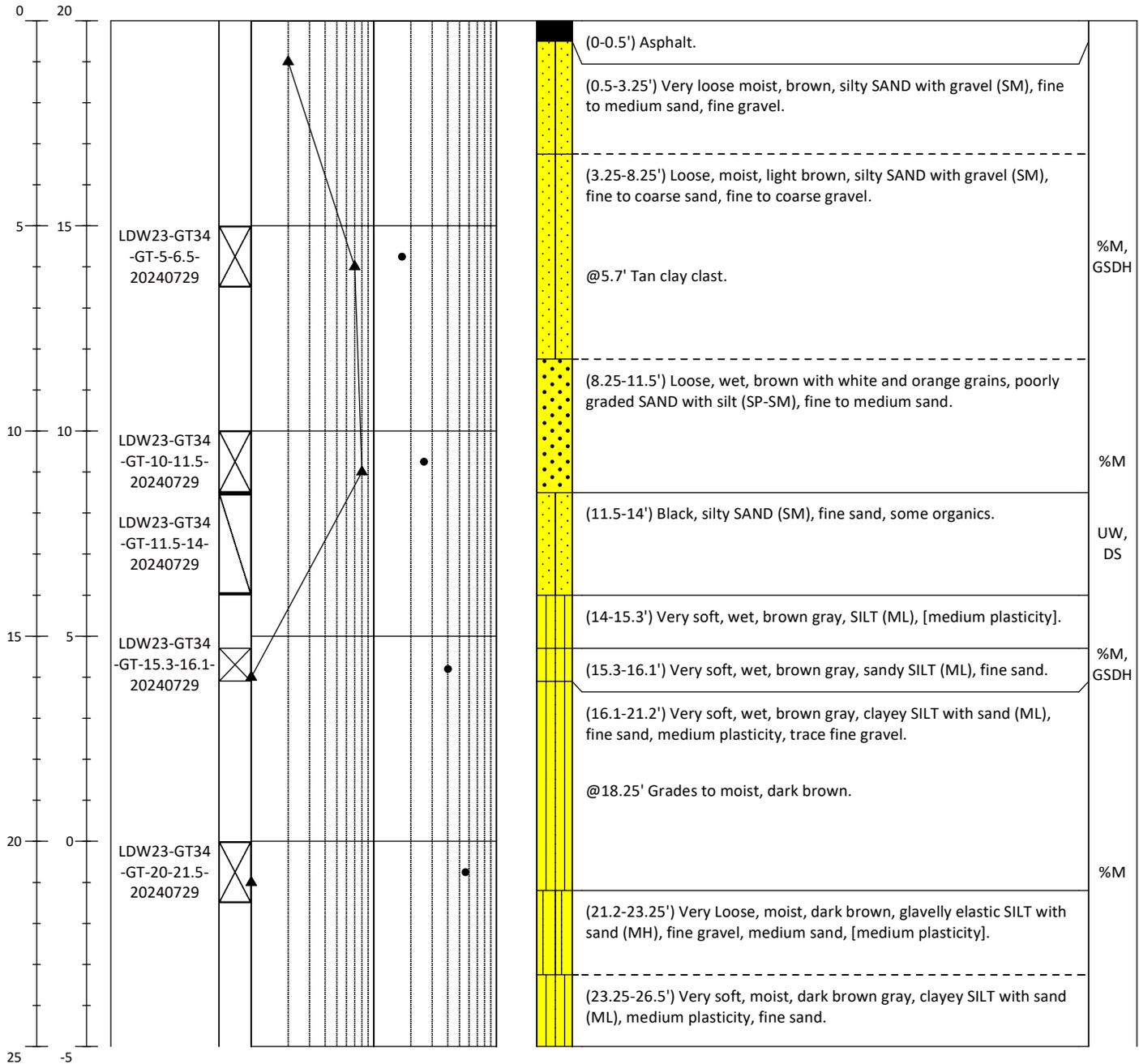
Soil Boring Log

LDW23-GT34-GT

Sheet 1 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Mud Rotary
Location: Seattle, WA	N/LAT: 200414.57 E/LONG: 1269815.3	Total Depth (ft): 41.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Ground Surface Elevation (ft): 20
Collection Date: 7/29/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon & Shelby Tube Sampler	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot)						Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
				1	2	5	10	20	50				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

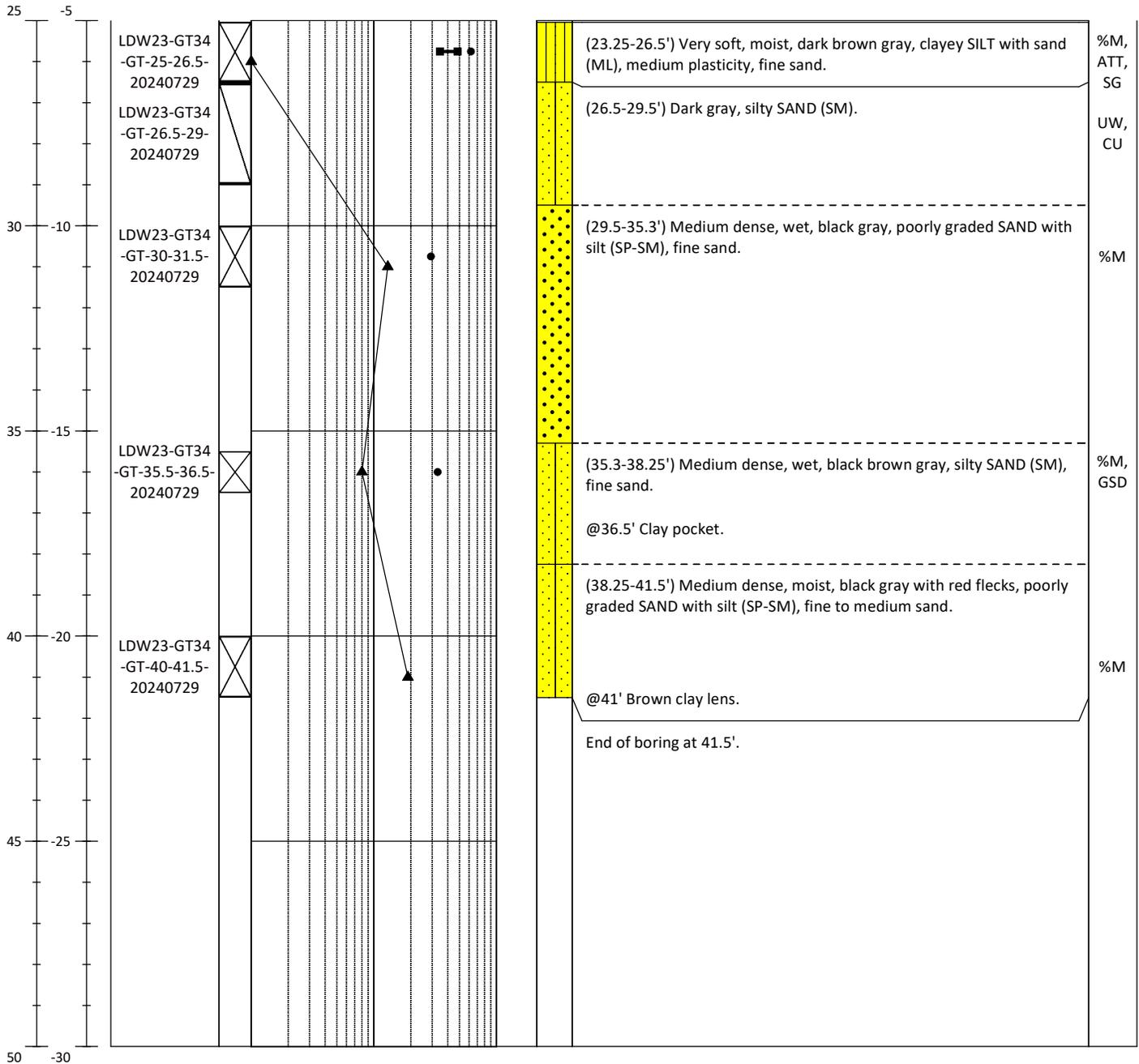
Soil Boring Log

LDW23-GT34-GT

Sheet 2 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Mud Rotary
Location: Seattle, WA	N/LAT: 200414.57 E/LONG: 1269815.3	Total Depth (ft): 41.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Ground Surface Elevation (ft): 20
Collection Date: 7/29/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon & Shelby Tube Sampler	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot)						Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
				1	2	5	10	20	50				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

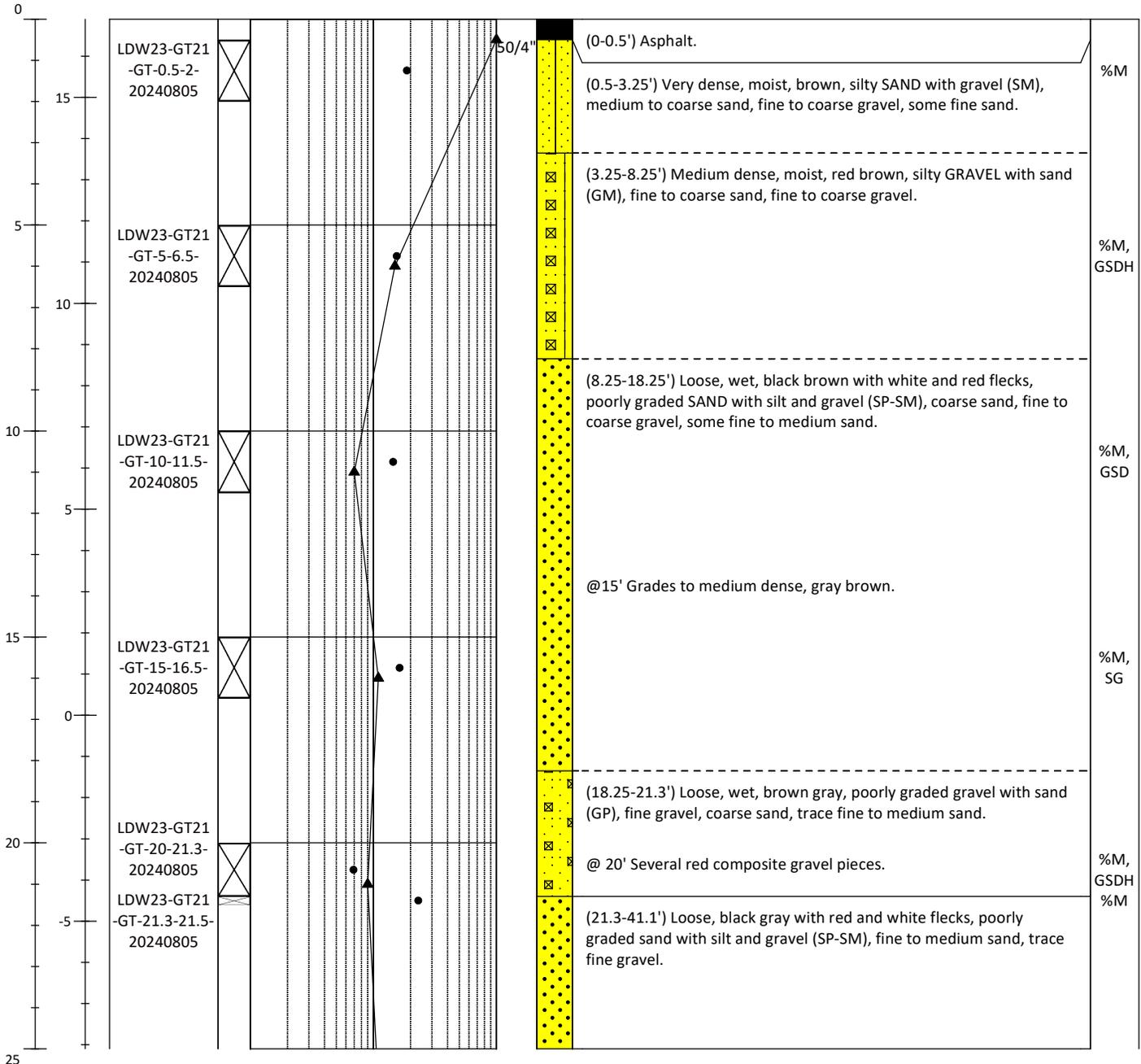
Soil Boring Log

LDW23-GT21-GT

Sheet 1 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Mud Rotary
Location: Seattle, WA	N/LAT: 199546.89 E/LONG: 1271776.13	Total Depth (ft): 41.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Ground Surface Elevation (ft): 16.9
Collection Date: 8/05/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits							Other Values	Lithology	Soil Description <small>Samples and descriptions are in recovered depths. Classification scheme: USCS</small>	Lab Test
				1	2	5	10	20	50	100				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

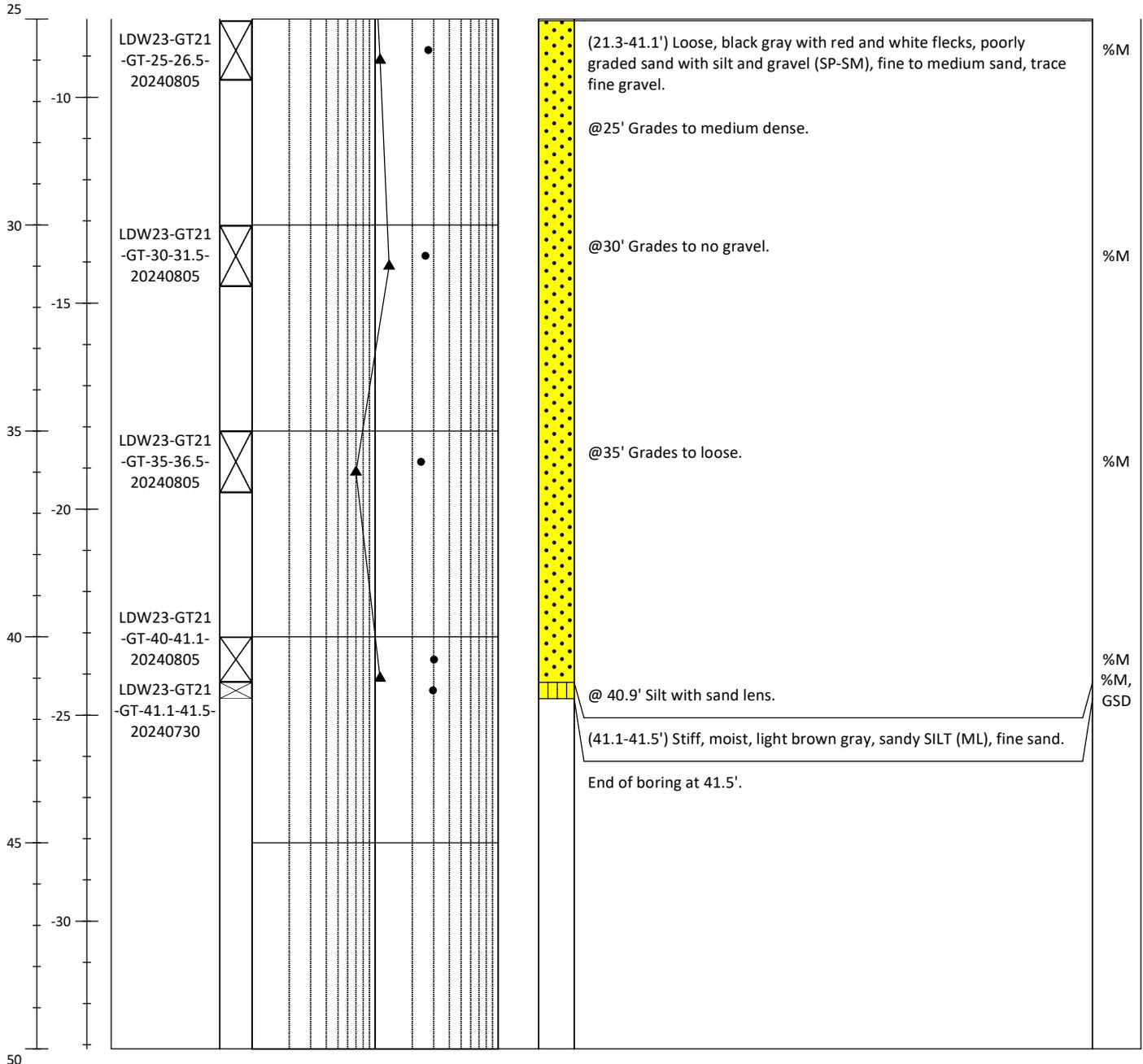
Soil Boring Log

LDW23-GT21-GT

Sheet 2 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Mud Rotary
Location: Seattle, WA	N/LAT: 199546.89 E/LONG: 1271776.13	Total Depth (ft): 41.5
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Ground Surface Elevation (ft): 16.9
Collection Date: 8/05/2024		
Contractor: HOLT	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP	Sampler(s): Split Spoon	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits							Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
				1	2	5	10	20	50	100				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

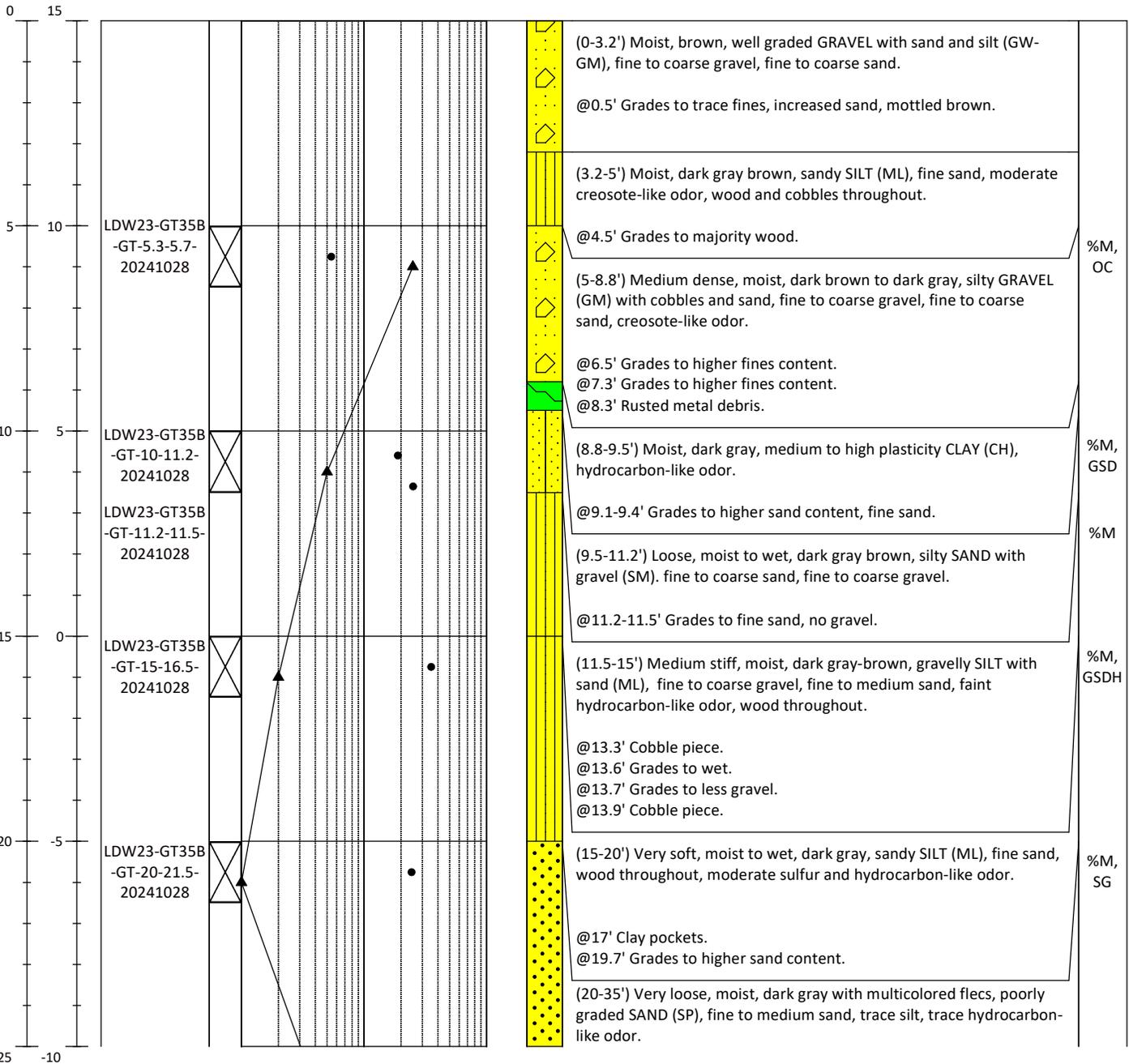
Soil Boring Log

LDW23-GT35B-GT

Sheet 1 of 2

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Rotary Sonic
Location: Seattle, WA	N/LAT: 200284.28 E/LONG: 1270098.35	Total Depth (ft): 35
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Ground Surface Elevation (ft): 15
Collection Date: 10/28/24		
Contractor: Holt	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP, LD	Sampler(s): Split Spoon	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits						Other Values	Lithology	Soil Description <small>Samples and descriptions are in recovered depths. Classification scheme: USCS</small>	Lab Test
				1	2	5	10	20	50				



- ▲ SPT N-Value
- Moisture Content (%)
- Atterberg Limits
- ▣ Shelby Tube
- ⊠ Split Spoon/Grab

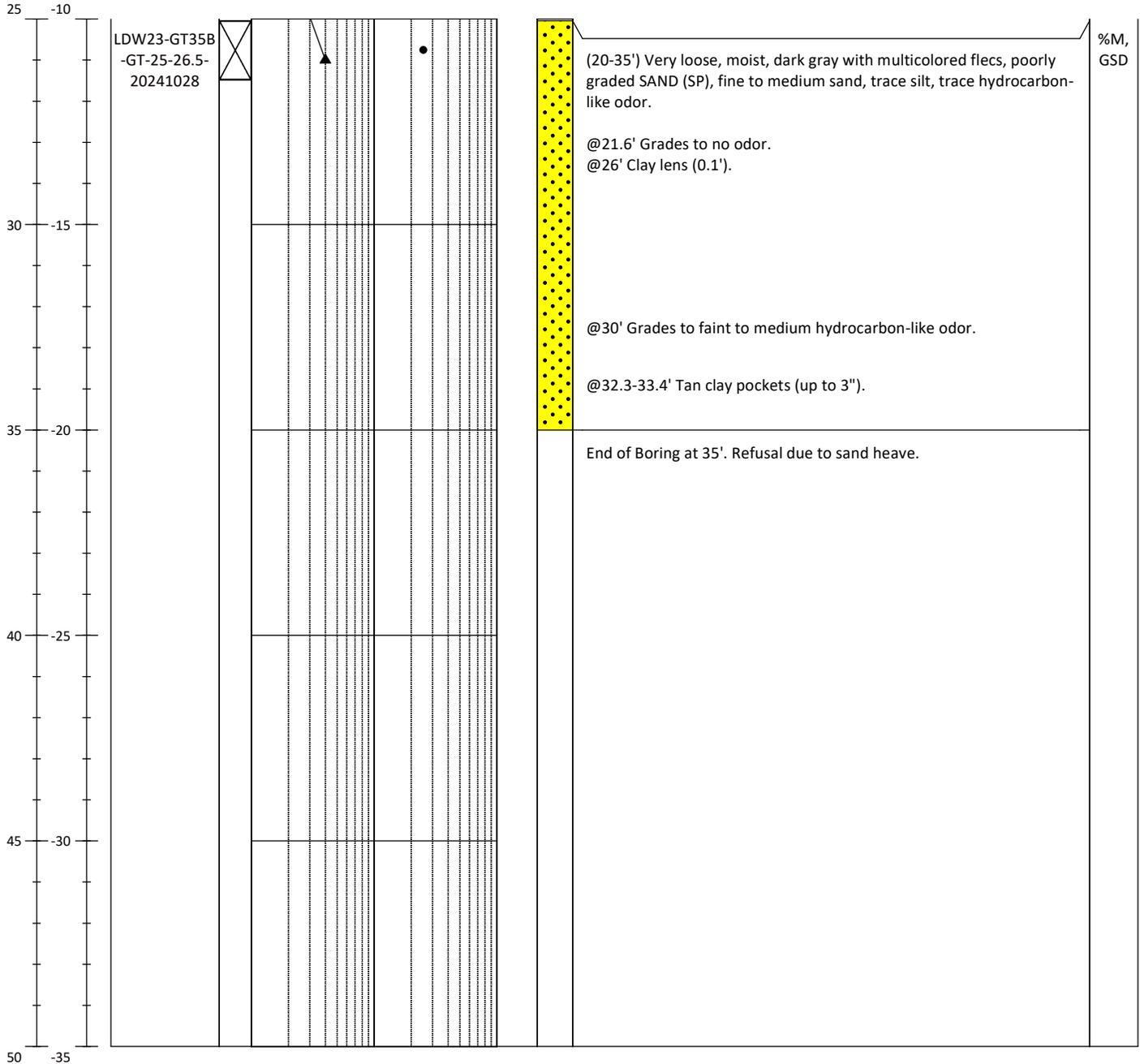
Notes:
 %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic
 Mudline elevations determined from leadline measurements and Site tide gage levels.

Soil Boring Log

LDW23-GT35B-GT

Project #: 210075-01.03	Project: Middle Reach of Lower Duwamish Waterway	Method: Rotary Sonic
Location: Seattle, WA	N/LAT: 200284.28 E/LONG: 1270098.35	Total Depth (ft): 35
Client: City of Seattle	Horiz. Datum: Washington State Plane Coordinate North North American Datum of 1983, U.S. Feet	Ground Surface Elevation (ft): 15
Collection Date: 10/28/24		
Contractor: Holt	Vert. Datum: MLLW	Hammer: 140-lb, 30-in drop, Auto
Logged By: RP, LD	Sampler(s): Split Spoon	

Depth (ft)	Elevation (ft)	Sample ID	Sample Type	Uncorrected Standard Penetration Resistance (blows per foot) Moisture Content (%) and Atterberg Limits						Other Values	Lithology	Soil Description Samples and descriptions are in recovered depths. Classification scheme: USCS	Lab Test
				1	2	5	10	20	50				



<p>1201 Third Avenue Suite 2600 Seattle, WA 98101</p>	<ul style="list-style-type: none"> ▲ SPT N-Value ● Moisture Content (%) ■ Atterberg Limits ▣ Shelby Tube ☒ Split Spoon/Grab 	<p>Notes: %M = Percent Moisture Content, SG = Specific Gravity, ATT = Atterberg Limits, GSD = Grainsize Distribution, GSDH = Grainsize Distribution+Hydrometer, 1-D = One-dimensional Consolidation, UW = Unit Weight, CU = Consolidated Triaxial, UU = Unconsolidated Triaxial, OC = Organic Content, DS = Direct Shear, WOH = Weight of Hammer, WOR = Weight of Rod, NP = Non-plastic Mudline elevations determined from leadline measurements and Site tide gage levels.</p>
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Appendix F – Geotechnical Design Analysis

Attachment F.2

Cone Penetrometer Test Reports

Appendix F – Geotechnical Design Analysis

Attachment F.2

Cone Penetrometer Test Reports

PRESENTATION OF SITE INVESTIGATION RESULTS

Lower Duwamish Waterway Middle Reach

Prepared for:

Anchor QEA

ConeTec Job No: 24-59-27874

Project Start Date: 2024-07-08

Project End Date: 2024-07-14

Release Date: 2024-08-20

Report Prepared by:

ConeTec, Inc.

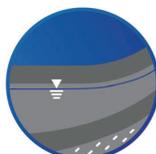
1237 S Director Street, Seattle, WA 98108

Tel: (253) 397-4861

ConeTecWA@conetec.com

www.conetec.com

www.conetecdataservices.com



ABOUT THIS REPORT

The enclosed report presents the results of the site investigation program conducted by ConeTec, Inc. for Anchor QEA.

Please note that this report, which also includes all accompanying data, are subject to the 3rd Party Disclaimer and Client Disclaimer that follow in the 'Limitations' section of this report. Please refer to the list of attached documents following the text of this report. A site map, test summaries, and test plots are all included in the body of the report.

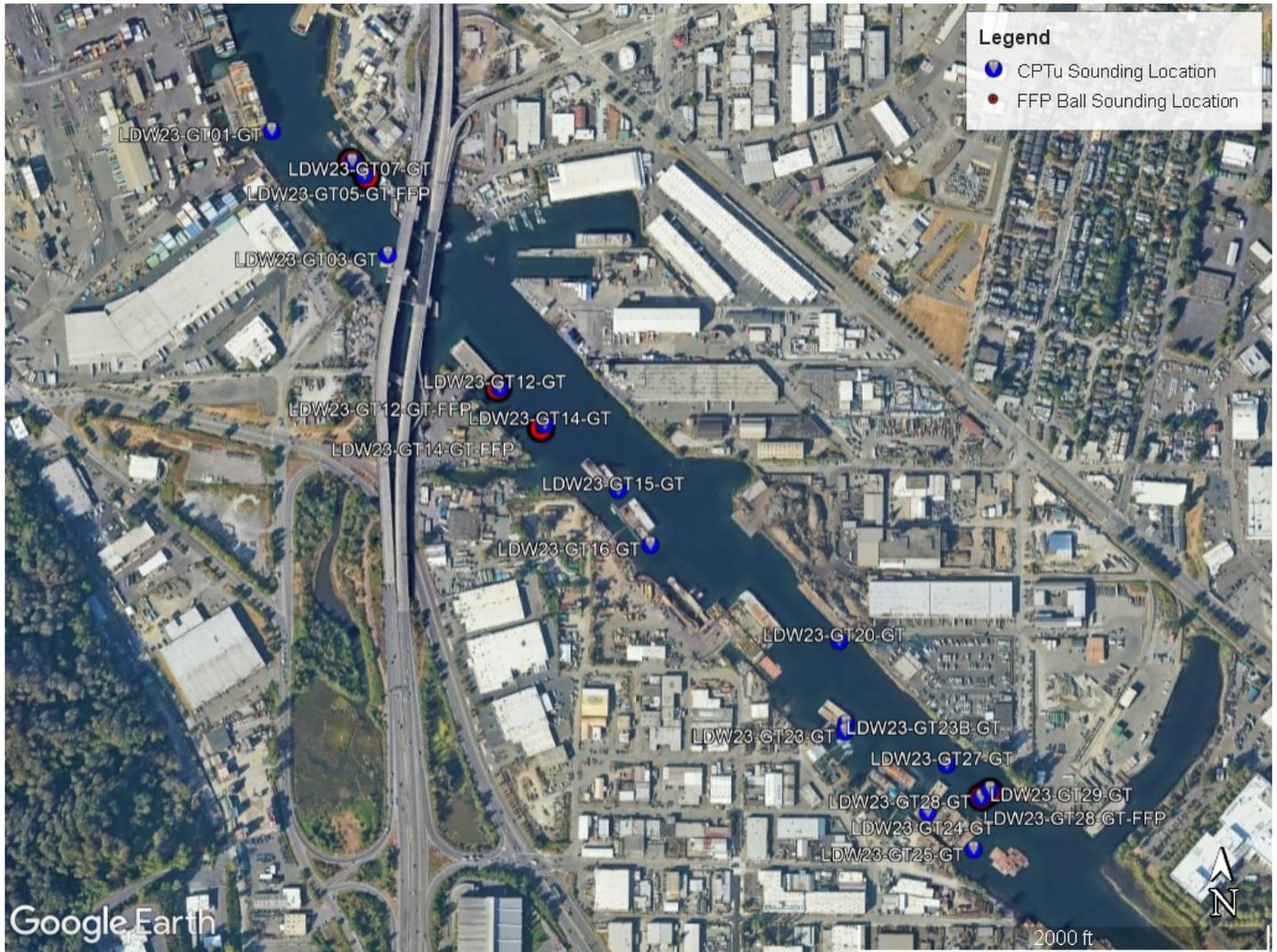
Project	
Client	Anchor QEA
Project	Lower Duwamish Waterway Middle Reach
ConeTec Project Number	24-59-27874
Test Types	CPTu, BCPT
Additional Comments	BCPT Cycling was performed at selected locations and depths.

Contents

The following listed below are included in the body of this report:

- Site Map
- Limitations and Closure
- Project Information
- Report Appendices
- Supporting Documents and Materials

SITE MAP



All locations are approximate unless otherwise stated in the body of the report.

ConeTec Job Number: 24-59-27874

Client: Anchor QEA

Project: Lower Duwamish Waterway Middle Reach

Date: 2024-08-20

LIMITATIONS

3rd Party Disclaimer

The “Report” refers to this report titled: Lower Duwamish Waterway Middle Reach

The Report was prepared by ConeTec for: Anchor QEA

The Report is confidential and may not be distributed to or relied upon by any third parties without the express written consent of ConeTec. Any third parties gaining access to the Report do not acquire any rights as a result of such access. Any use which a third party makes of the Report, or any reliance on or decisions made based on it, are the responsibility of such third parties. ConeTec accepts no responsibility for loss, damage and/or expense, if any, suffered by any third parties as a result of decisions made, or actions taken or not taken, which are in any way based on, or related to, the Report or any portion(s) thereof.

Client Disclaimer

ConeTec was retained by: Anchor QEA

The “Report” refers to this report titled: Lower Duwamish Waterway Middle Reach

ConeTec was retained to collect and provide the raw data (“Data”) which is included in the Report.

ConeTec has collected and reported the Data in accordance with current industry standards. No other warranty, express or implied, with respect to the Data is made by ConeTec. In order to properly understand the Data included in the Report, reference must be made to the documents accompanying and other sources referenced in the Report in their entirety. Other than the Data, the contents of the Report (including any Interpretations) should not be relied upon in any fashion without independent verification and ConeTec is in no way responsible for any loss, damage or expense resulting from the use of, and/or reliance on, such material by any party.

Closure

Thank you for the opportunity to work on this project. The equipment used as well the field procedures followed, all complied with current accepted best practice standards.

Report prepared by: Jesse Martinez, Anthony Rasmussen, Jim Grieg

PROJECT INFORMATION

Rig		
Description	Deployment System	Test Type
C05-026 CPT Track Rig	Twin mounted cylinders	CPTu, BCPT

Coordinates		
Test Type	Collection Method	EPSG Number
CPTu, BCPT	Consumer Grade GPS	4326 (WGS84 / Lat-Long)

Piezocones Used for this Project						
Cone Description	Cone Number	Cross Sectional Area (cm ²)	Sleeve Area (cm ²)	Tip Capacity (bar)	Sleeve Capacity (bar)	Pore Pressure Capacity (bar)
EC681:T375F10U35	681	15	225	375	10	35
EC767:T1000F10U35	767	10	150	1000	10	35
EC1007:T1500F15U35	1007	15	225	1500	15	35

The CPTu and BCPT summaries indicate which cone was used for each sounding.

Cone Penetration Test (CPTu)	
Depth reference	Depths are referenced to the existing ground surface at the time of each test.
Tip and sleeve data offset	0.1 Meters. This has been accounted for in the CPT data files.
Unit Weights	Unit weights for water (9.81 kN/m ³) and the soil (17.5 kN/m ³) were assumed and applied to calculations for specific depth layers, otherwise defined by Q _{tn} (SBT Q _{tn}) (Robertson, 2009). An assumed unit weight profile summary is included in the appendices.

Calculated Geotechnical Parameters

Additional information	<p>The Normalized Soil Behaviour Type Chart based on Q_{tn} (SBT Q_{tn}) (Robertson, 2009) was used to classify the soil for this project. A detailed set of calculated CPTu parameters have been generated and are provided in Excel format files in the release folder. The CPTu parameter calculations are based on values of corrected tip resistance (q_t) sleeve friction (f_s) and pore pressure (u_2).</p> <p>Effective stresses are calculated based on unit weights that have been assigned to the individual soil behaviour type zones and the assumed equilibrium pore pressure profile.</p> <p>Soils were classified as either drained or undrained based on the Q_{tn} Normalized Soil Behaviour Type Chart (Robertson, 2009). Calculations for both drained and undrained parameters were included for materials that classified as silt mixtures (zone 4).</p>
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Full-Flow Cone Penetrometer Test (BCPT)

Depth reference	Depths are referenced to mudline surface at the time of each test.
Unit Weights	Unit weights for water (9.81 kN/m ³) and the soil (17.5 kN/m ³) were assumed and applied to calculations for specific depth layers. An assumed unit weight profile summary is included in the appendices.
Additional information	Ball cycling was performed at select locations and specific depths.

REPORT APPENDICES

The appendices listed below are included in the report:

- **Cone Penetration Test (CPTu) Summary, Unit Weight Summary and CPT Plots**
- **Standard CPTu Plots with Reduced Scales**
- **Advanced CPTu Plots**
- **Soil Behavior Type (SBT) Scatter Plots**
- **Full-Flow Ball Cone Penetration Test (BCPT) Summary, Unit Weight Summary and BCPT Plots**
- **Supplementary Documents and Materials**

**Cone Penetration Test (CPTu) Summary, Unit Weight
Summary and CPTu Plots**



Job No: 24-59-27874
Client: Anchor QEA
Project: Lower Duwamish Waterway Middle Reach
Start Date: 2024-07-08
End Date: 2024-07-14

CONE PENETRATION TEST SUMMARY

Sounding ID	File Name	Date	Cone	Cone Area (cm ²)	Assumed Phreatic Surface ¹ (ft)	Final Depth (ft)	Latitude ²	Longitude ²	Refer to Notation Number
LDW23-GT01-GT	24-59-27874_CP01	2024-07-12	1007:T1500F15U35	15	-26.7	42.32	47.54392	-122.33734	
LDW23-GT03-GT	24-59-27874_CP03	2024-07-12	1007:T1500F15U35	15	-22.2	43.39	47.54227	-122.33505	
LDW23-GT05-GT	24-59-27874_CP05	2024-07-13	1007:T1500F15U35	15	-19.4	43.39	47.54351	-122.33576	
LDW23-GT07-GT	24-59-27874_CP07	2024-07-13	1007:T1500F15U35	15	-18.5	41.26	47.54334	-122.33551	
LDW23-GT12-GT	24-59-27874_CP12	2024-07-08	1007:T1500F15U35	15	-12.2	41.83	47.54050	-122.33284	
LDW23-GT14-GT	24-59-27874_CP14	2024-07-08	1007:T1500F15U35	15	-20.2	42.16	47.54001	-122.33195	
LDW23-GT15-GT	24-59-27874_CP15	2024-07-13	1007:T1500F15U35	15	-21.9	42.32	47.53914	-122.33049	
LDW23-GT16-GT	24-59-27874_CP16	2024-07-11	681:T375F10U35	15	-9.2	40.76	47.53840	-122.32986	
LDW23-GT20-GT	24-59-27874_CP20	2024-07-11	681:T375F10U35	15	-18.2	41.67	47.53712	-122.32613	
LDW23-GT23-GT	24-59-27874_CP23	2024-07-10	681:T375F10U35	15	-18.7	16.40	47.53591	-122.32601	
LDW23-GT23B-GT	24-59-27874_CP23B	2024-07-10	681:T375F10U35	15	-19.2	41.67	47.53602	-122.32599	
LDW23-GT24-GT	24-59-27874_CP24	2024-07-09	1007:T1500F15U35	15	-13.2	41.42	47.53484	-122.32438	
LDW23-GT25-GT	24-59-27874_CP25	2024-07-09	1007:T1500F15U35	15	-17.6	41.42	47.53434	-122.32347	
LDW23-GT27-GT	24-59-27874_CP27	2024-07-10	681:T375F10U35	15	-13.2	41.42	47.53547	-122.32400	
LDW23-GT28-GT	24-59-27874_CP28	2024-07-14	1007:T1500F15U35	15	-16.2	34.37	47.53503	-122.32332	
LDW23-GT29-GT	24-59-27874_CP29	2024-07-12	681:T375F10U35	15	-12.4	40.52	47.53514	-122.32315	
Total						636.3			

1. All data profiles were began at the mudline surface. Assumed phreatic surface was measured by dip-tape immediately prior to testing and referenced for calculations.

2. The coordinates were collected using consumer grade GPS and have an accuracy of ±30 feet. EPSG number: 4326 (WGS84 / LatLong).

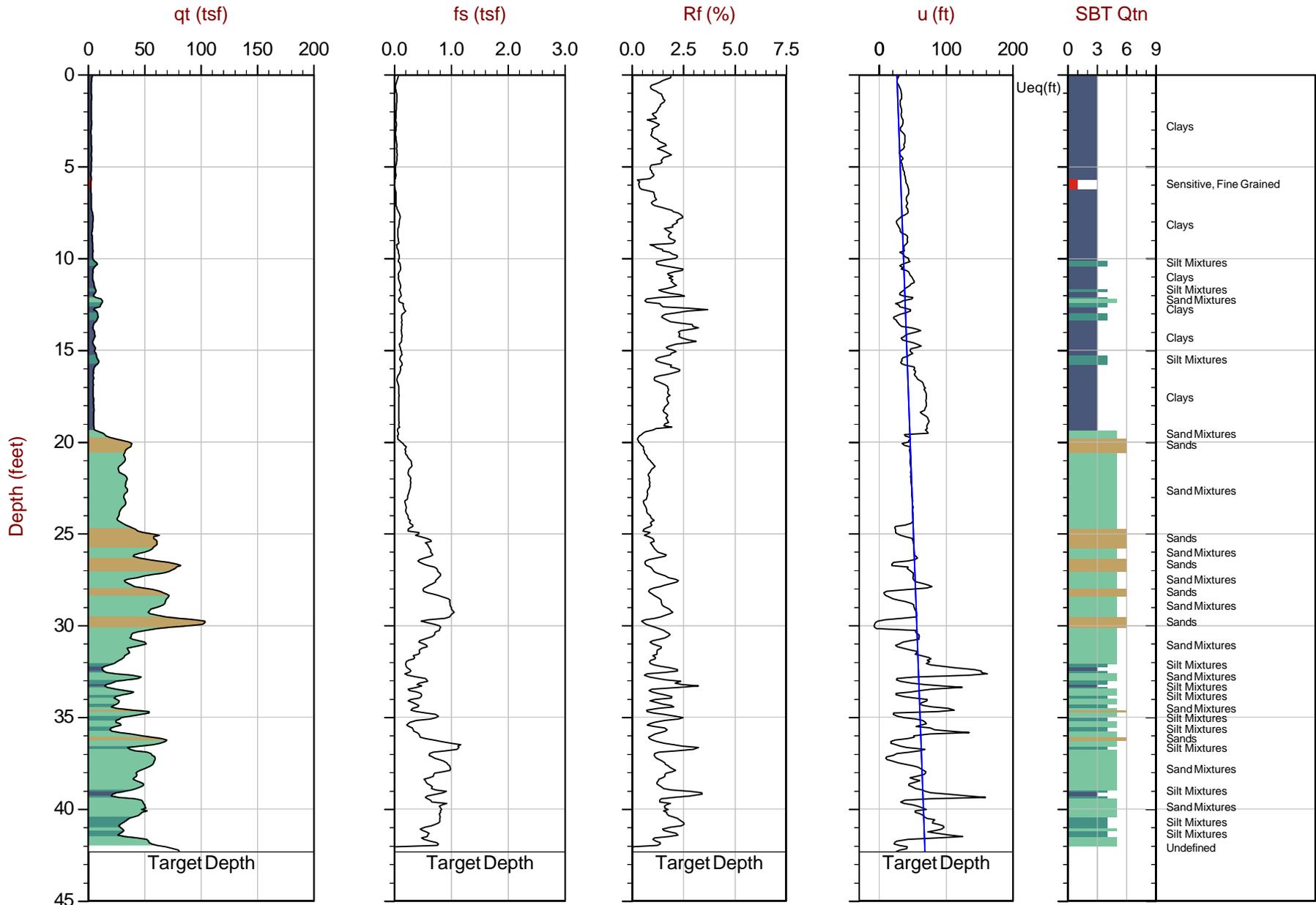


Job No: 24-59-27874
Client: Anchor QEA
Project: Lower Duwamish Waterway Middle Reach
Start Date: 2024-07-08
End Date: 2024-07-14

CPT_u ASSUMED UNIT WEIGHT SUMMARY

Sounding ID	File Name	Final Depth (ft)	Assumed Unit Weight Start Depth (ft)	Assumed Unit Weight End Depth (ft)	Assumed Unit Weight ¹ (kN/m ³)	Refer to Notation Number
LDW23-GT05-GT	24-59-27874_CP05	43.39	-19.42	0.00	9.81	
LDW23-GT05-GT	24-59-27874_CP05	43.39	0.00	20.01	17.50	
LDW23-GT07-GT	24-59-27874_CP07	41.26	-18.50	0.00	9.81	
LDW23-GT07-GT	24-59-27874_CP07	41.26	0.00	4.35	17.50	
LDW23-GT12-GT	24-59-27874_CP12	41.83	-12.17	0.00	9.81	
LDW23-GT12-GT	24-59-27874_CP12	41.83	0.00	4.76	17.50	
LDW23-GT14-GT	24-59-27874_CP14	42.16	-20.17	0.00	9.81	
LDW23-GT14-GT	24-59-27874_CP14	42.16	0.00	4.59	17.50	
LDW23-GT28-GT	24-59-27874_CP28	34.37	-16.17	0.00	9.81	
LDW23-GT28-GT	24-59-27874_CP28	34.37	0.00	6.40	17.50	
LDW23-GT29-GT	24-59-27874_CP29	40.52	-12.42	0.00	9.81	
LDW23-GT29-GT	24-59-27874_CP29	40.52	0.00	0.98	17.50	

1. A unit weight of 9.81 kN/m³ was assumed for data above the mudline, within the water layer. A unit weight of 17.50 kN/m³ was assumed for data below the mudline. For all other depth ranges, unit weights were based on SBT Qtn zones.

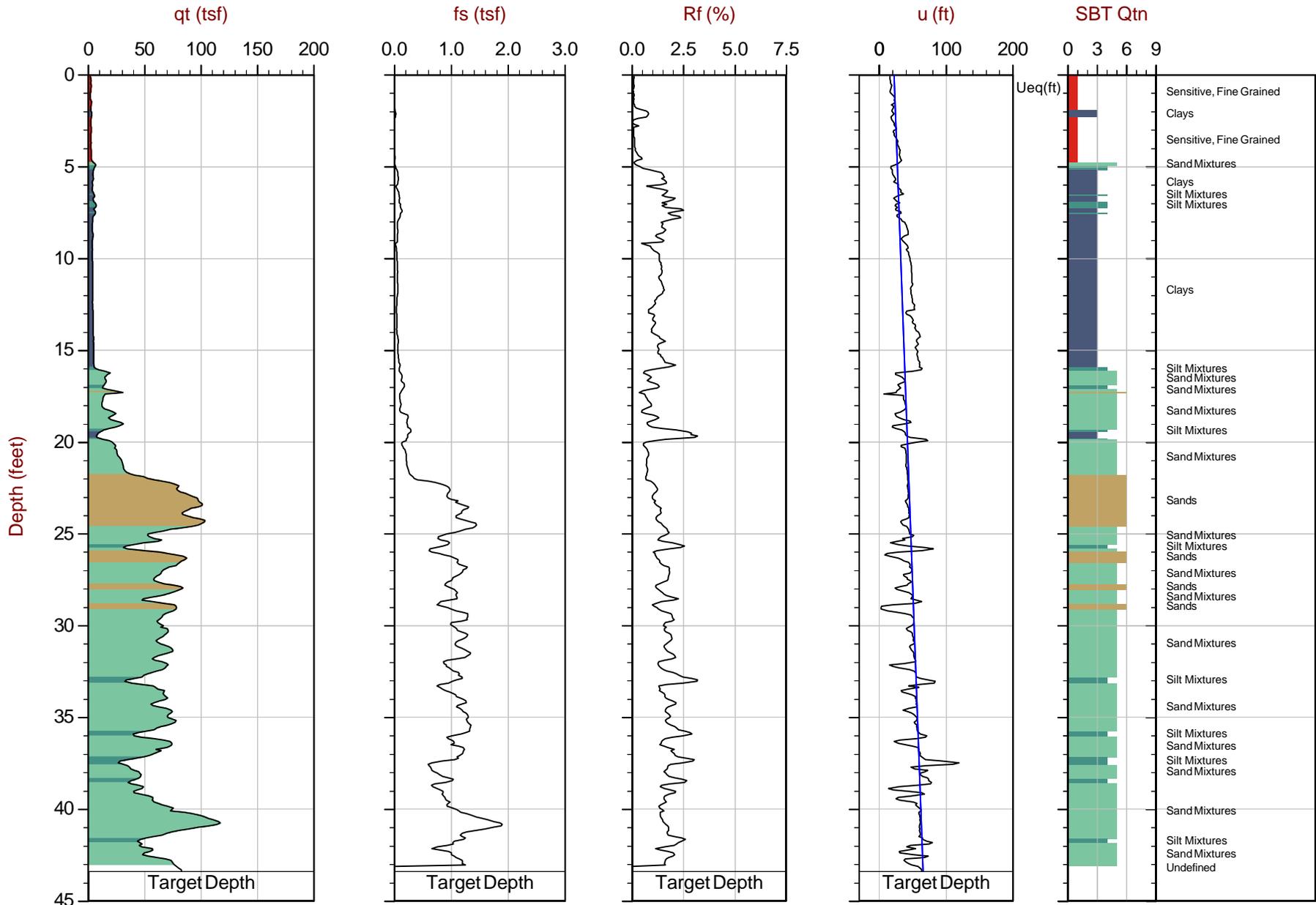


Max Depth: 12.900 m / 42.32 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP01.COR
 Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.54392 Long: -122.33734

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

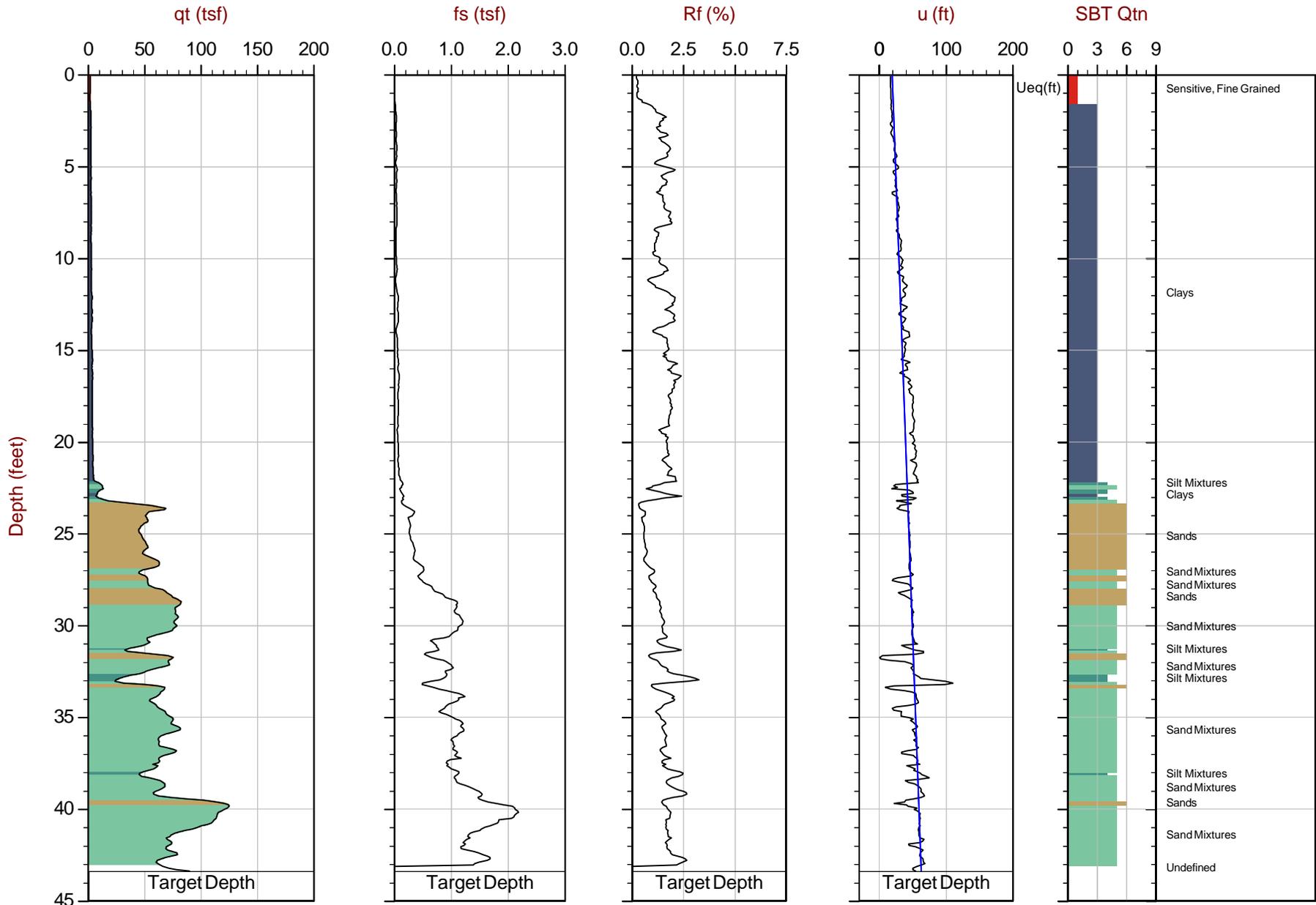


Max Depth: 13.225 m / 43.39 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP03.COR
 Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.54227 Long: -122.33505

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

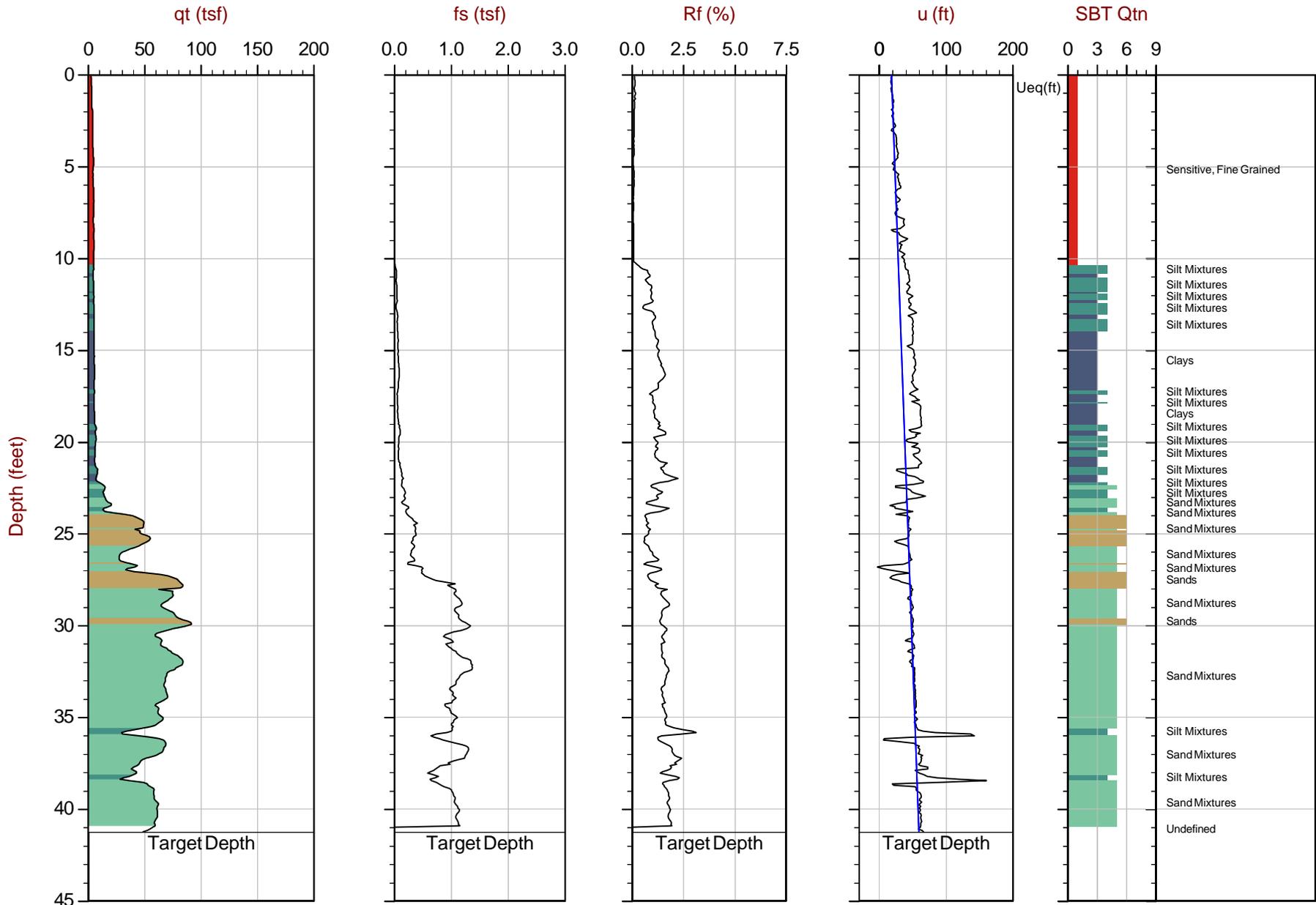


Max Depth: 13.225 m / 43.39 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP05.COR
 Unit Wt: SBTQtn (PKR2009), User Defined Layers

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.54351 Long: -122.33576

Overplot Item: ● Ueq ● Assumed Ueq ◀ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◂ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

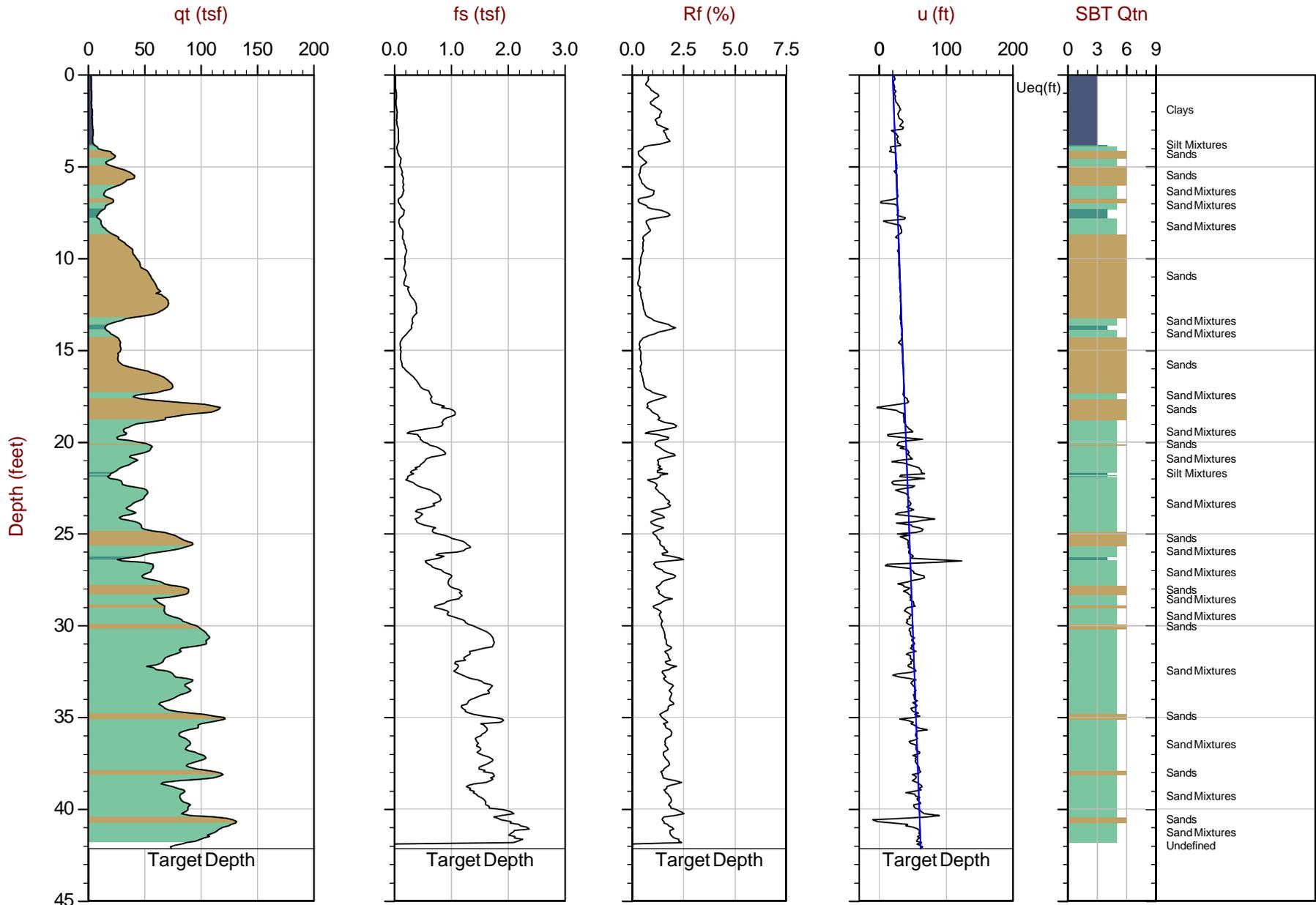


Max Depth: 12.575 m / 41.26 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP07.COR
 Unit Wt: SBTQtn (PKR2009), User Defined Layers

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.54334 Long: -122.33551

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

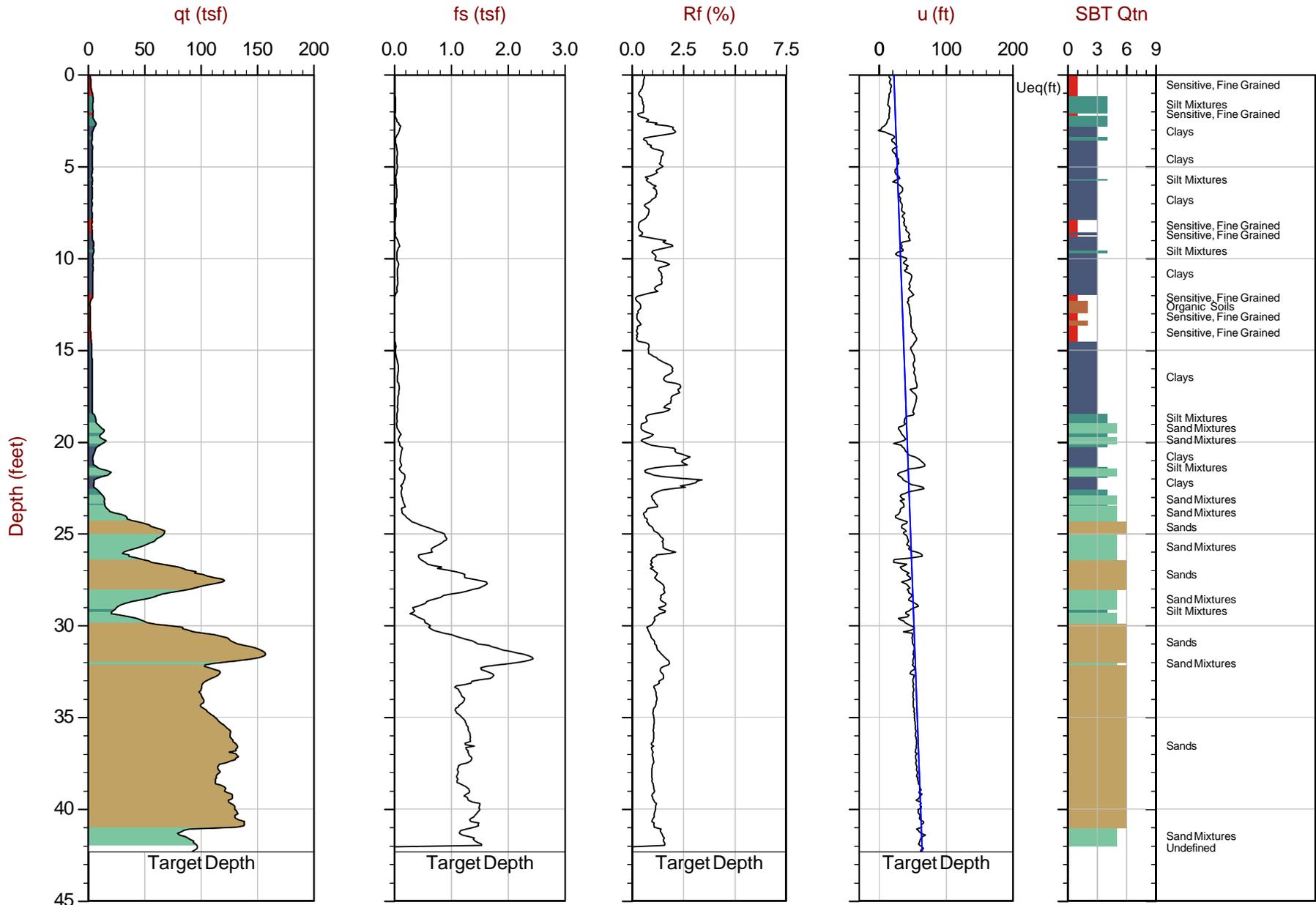


Max Depth: 12.850 m / 42.16 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP14.COR
 Unit Wt: SBTQtn (PKR2009), User Defined Layers

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.54001 Long: -122.33195

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◃ Dissipation, Ueq not achieved ◂ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

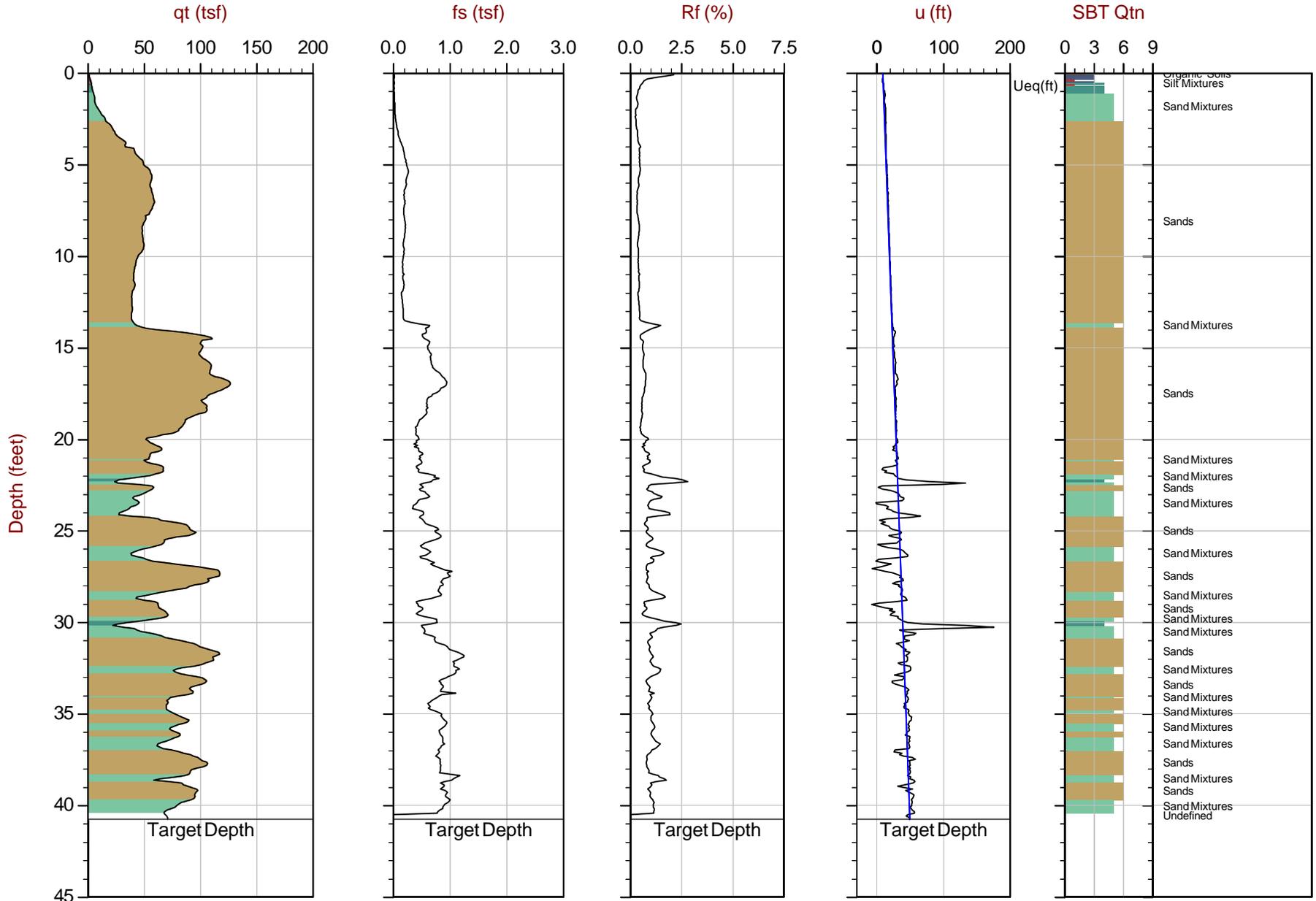


Max Depth: 12.900 m / 42.32 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP15.COR
 Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53914 Long: -122.33049

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

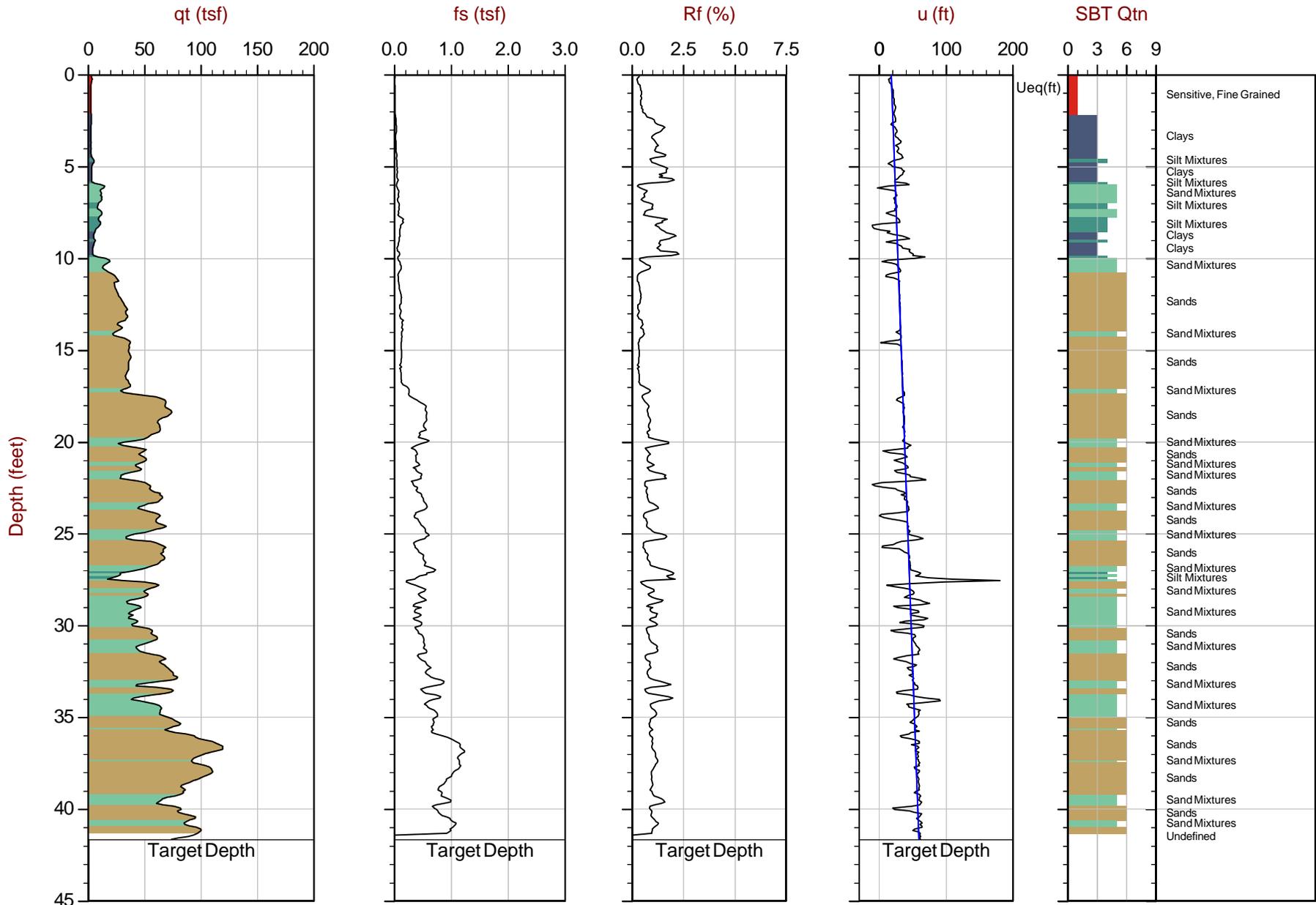


Max Depth: 12.425 m / 40.76 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP16.COR
 Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53840 Long: -122.32986

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

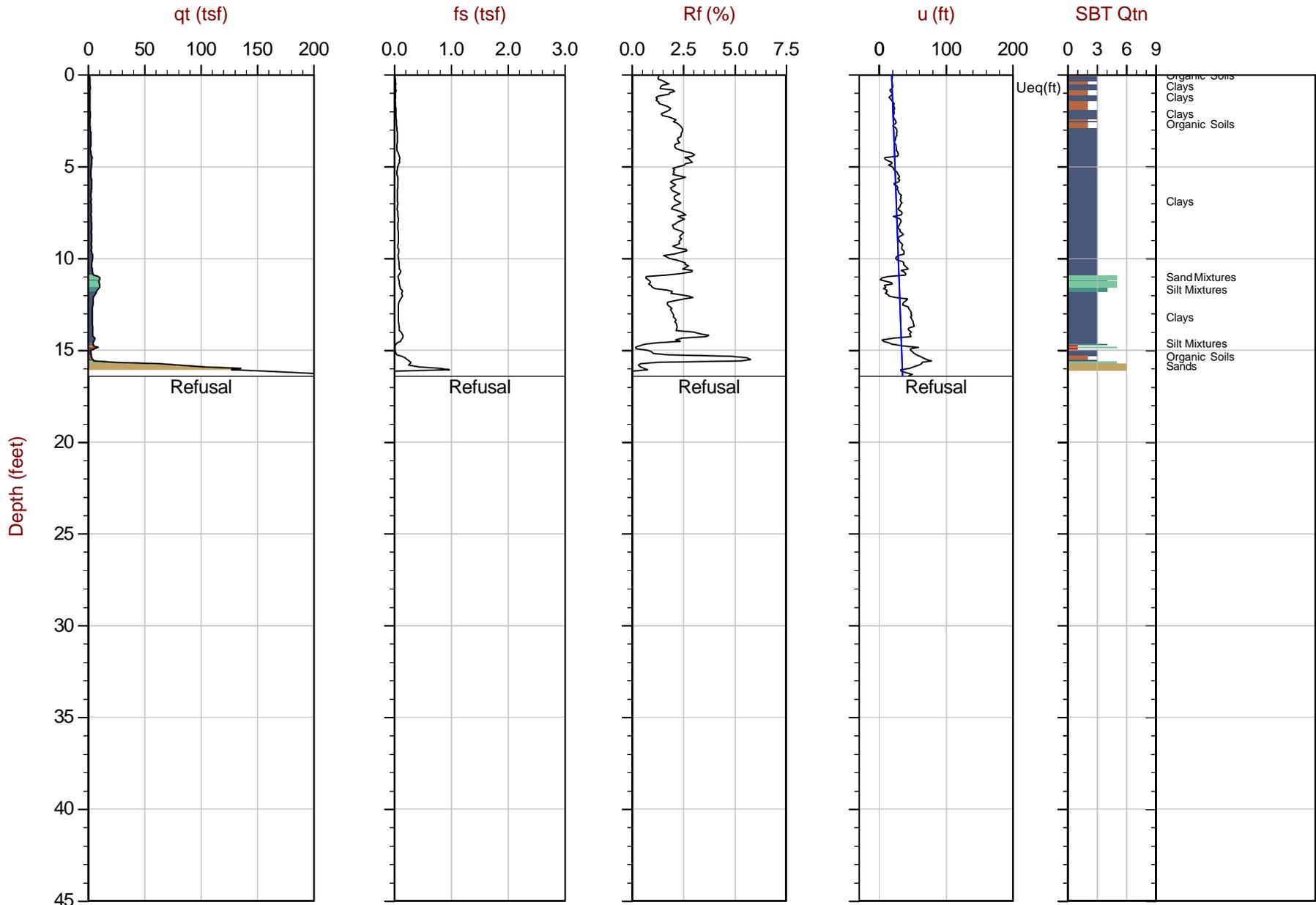


Max Depth: 12.700 m / 41.67 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP20.COR
 Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53712 Long: -122.32613

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

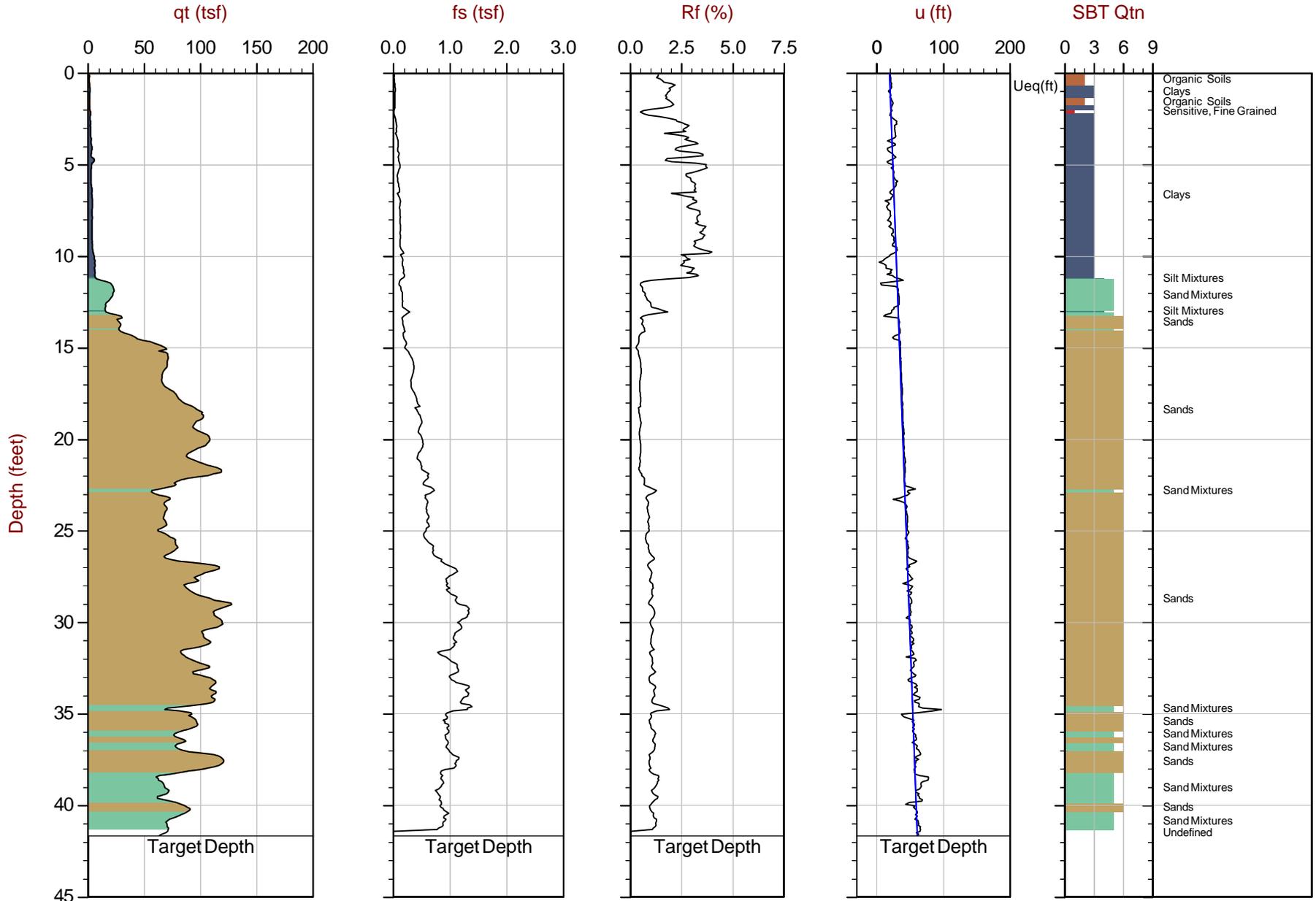


Max Depth: 5.000 m / 16.40 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP23.COR
 Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53591 Long: -122.32601

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

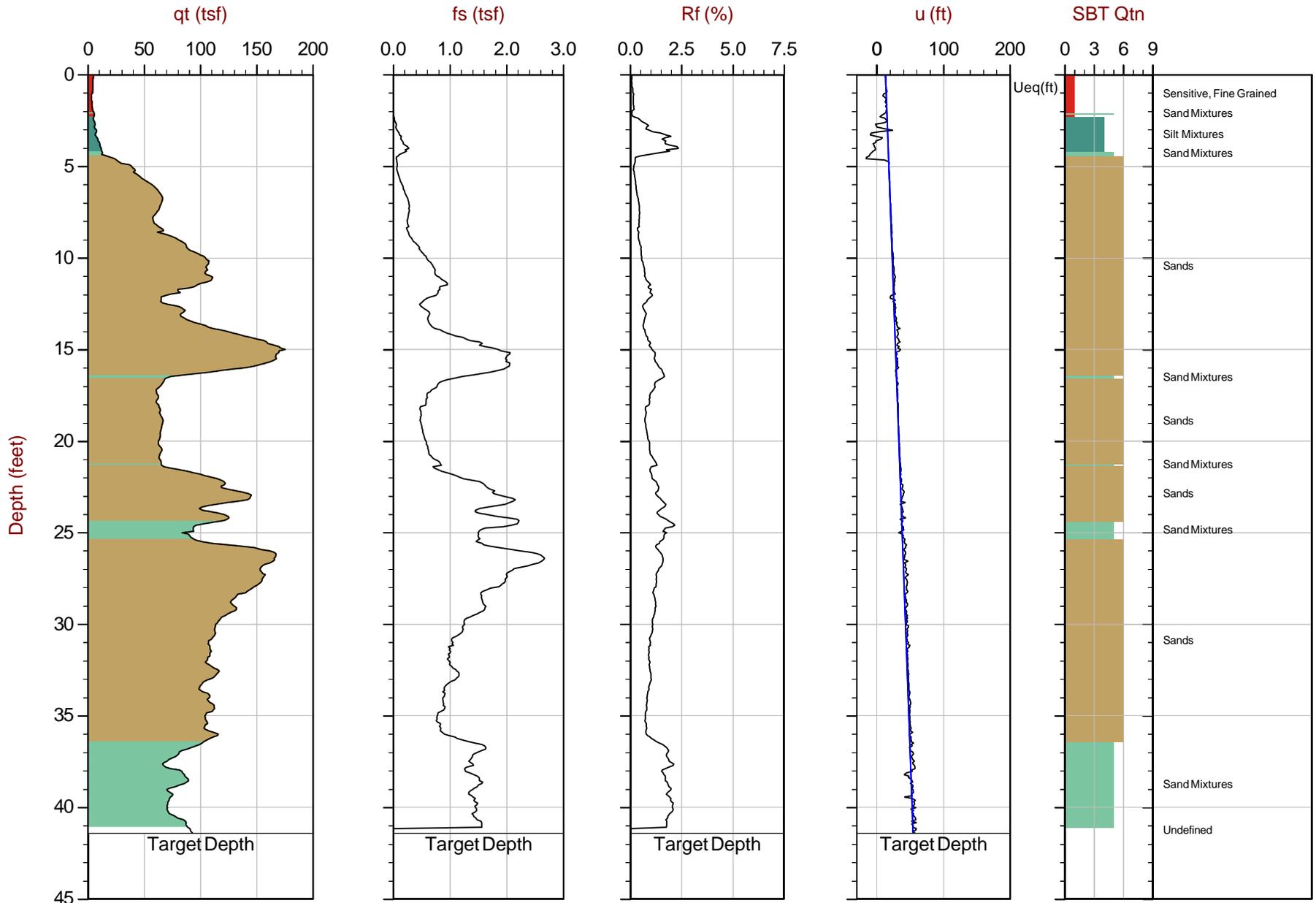


Max Depth: 12.700 m / 41.67 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP23B.COR
 Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53602 Long: -122.32599

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

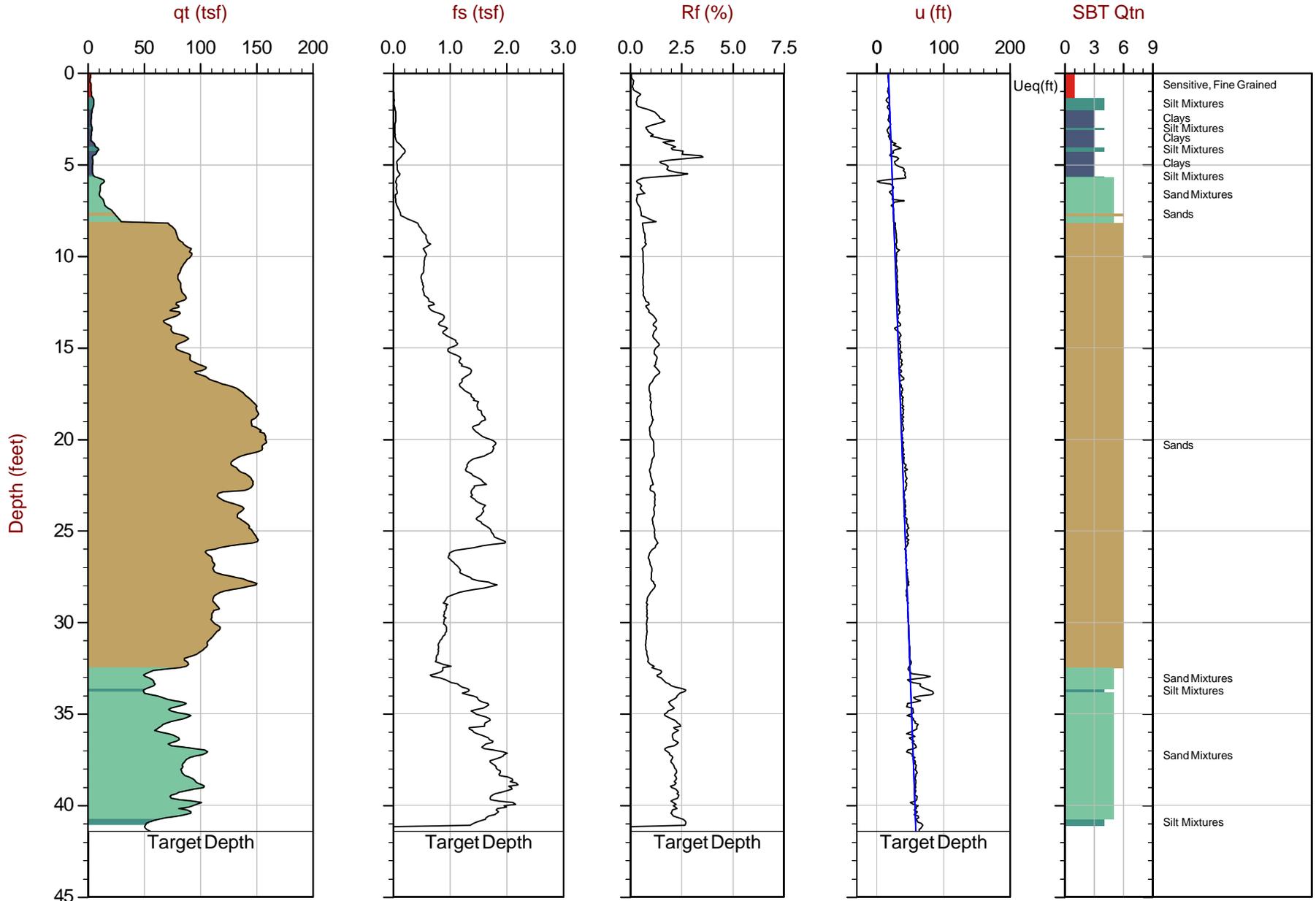


Max Depth: 12.625 m / 41.42 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP24.COR
 Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53484 Long: -122.32438

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

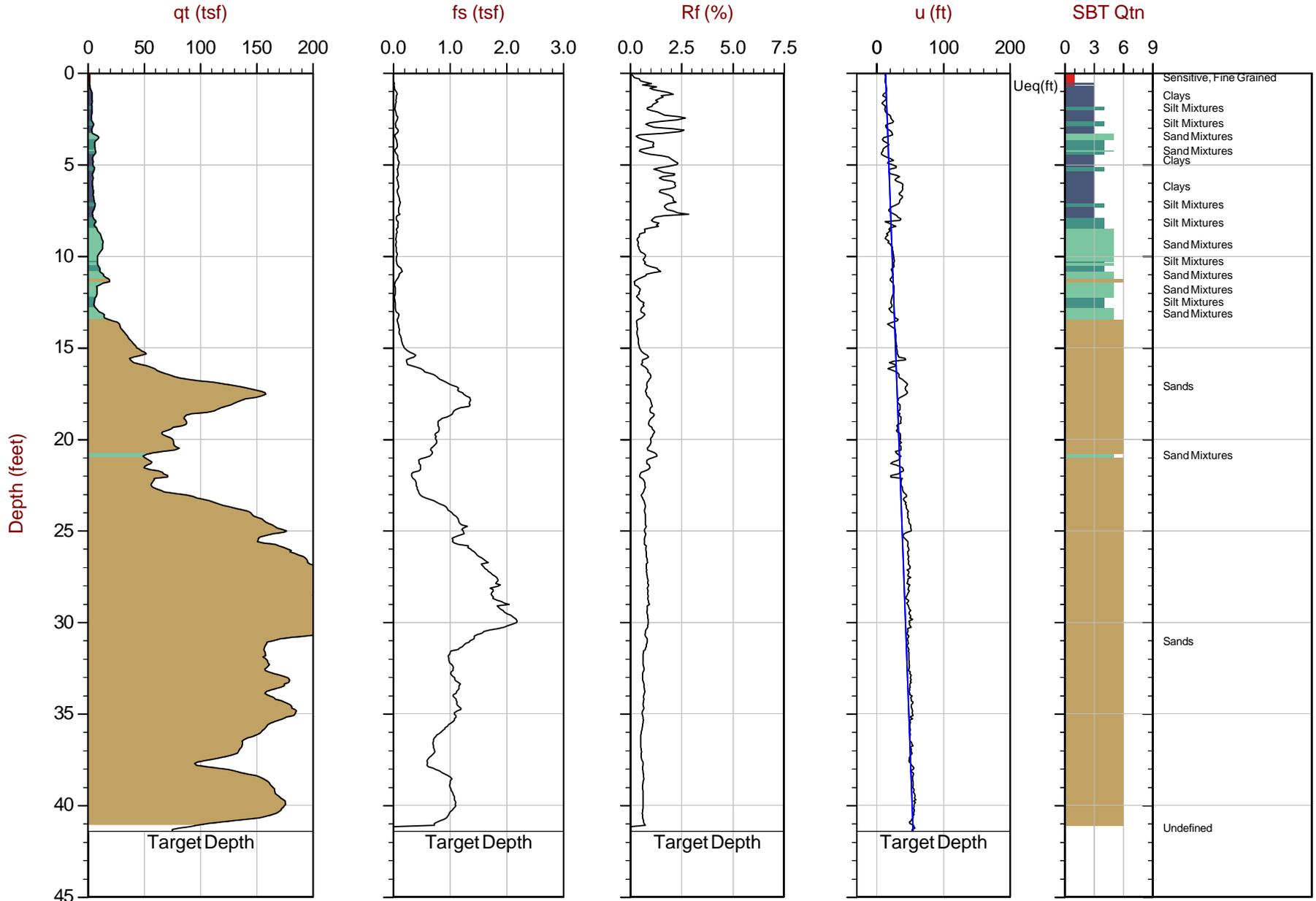


Max Depth: 12.625 m / 41.42 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP25.COR
 Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53434 Long: -122.32347

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

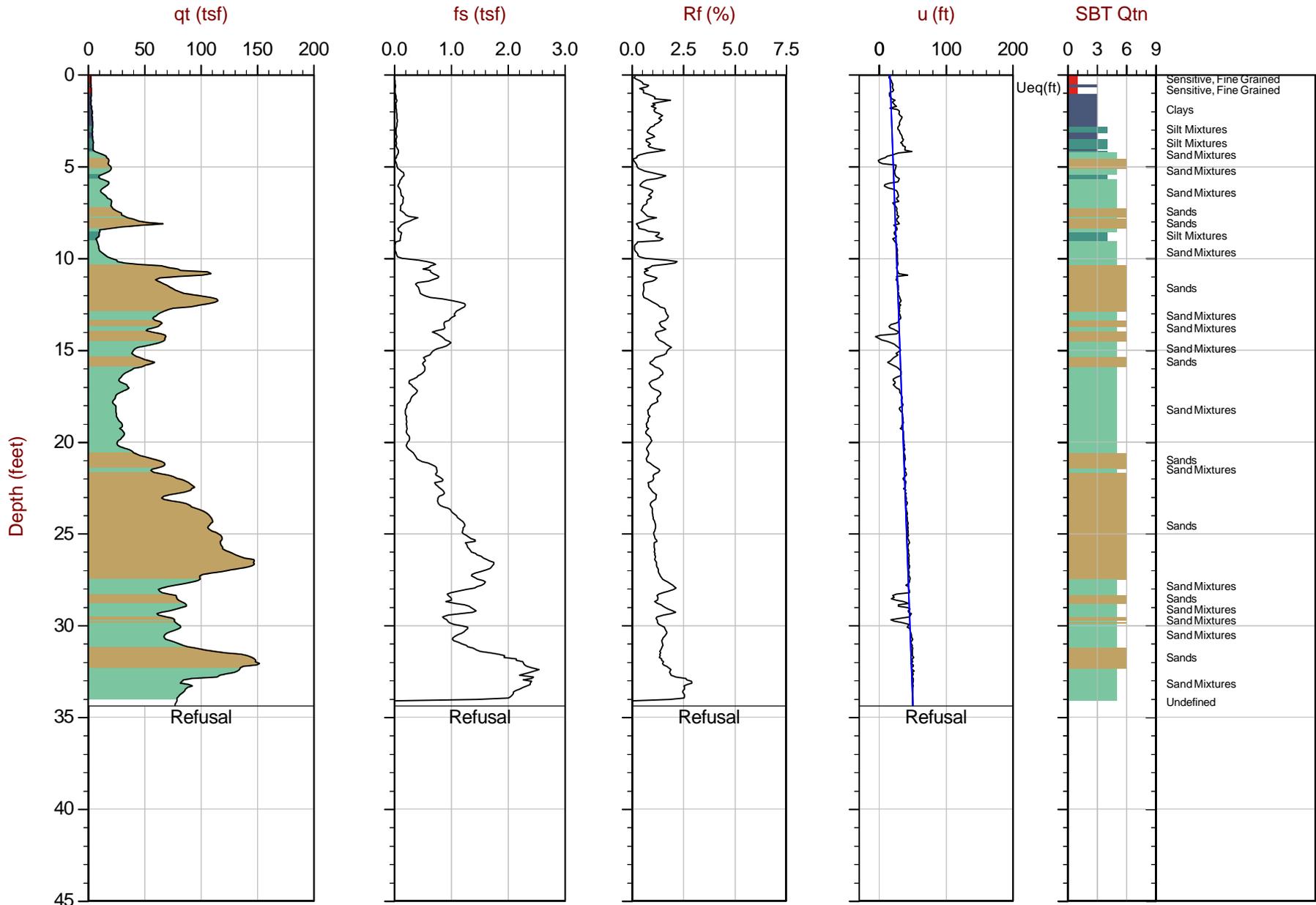


Max Depth: 12.625 m / 41.42 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP27.COR
 Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53547 Long: -122.32400

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

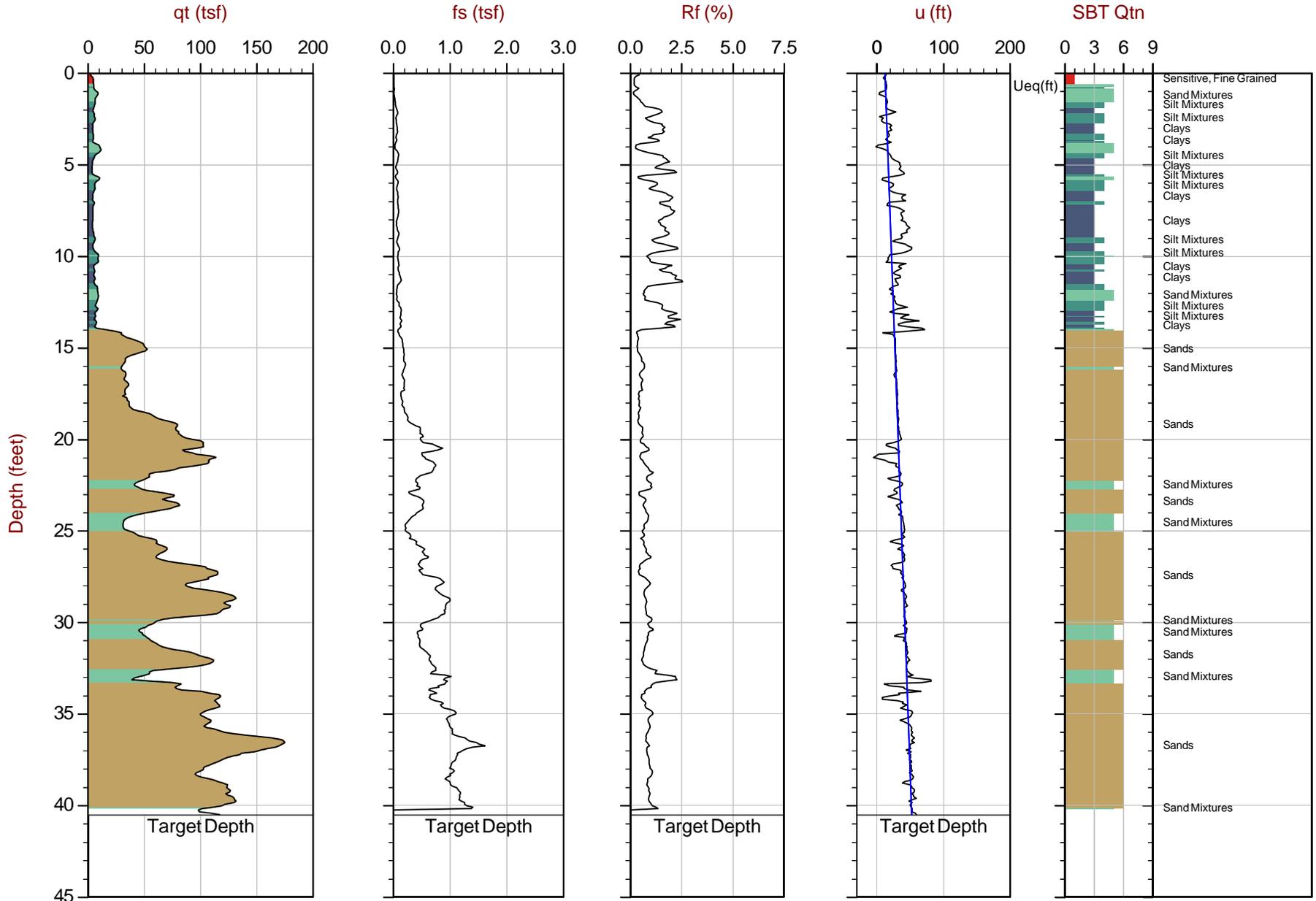


Max Depth: 10.475 m / 34.37 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP28.COR
 Unit Wt: SBTQtn (PKR2009), User Defined Layers

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53503 Long: -122.32332

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



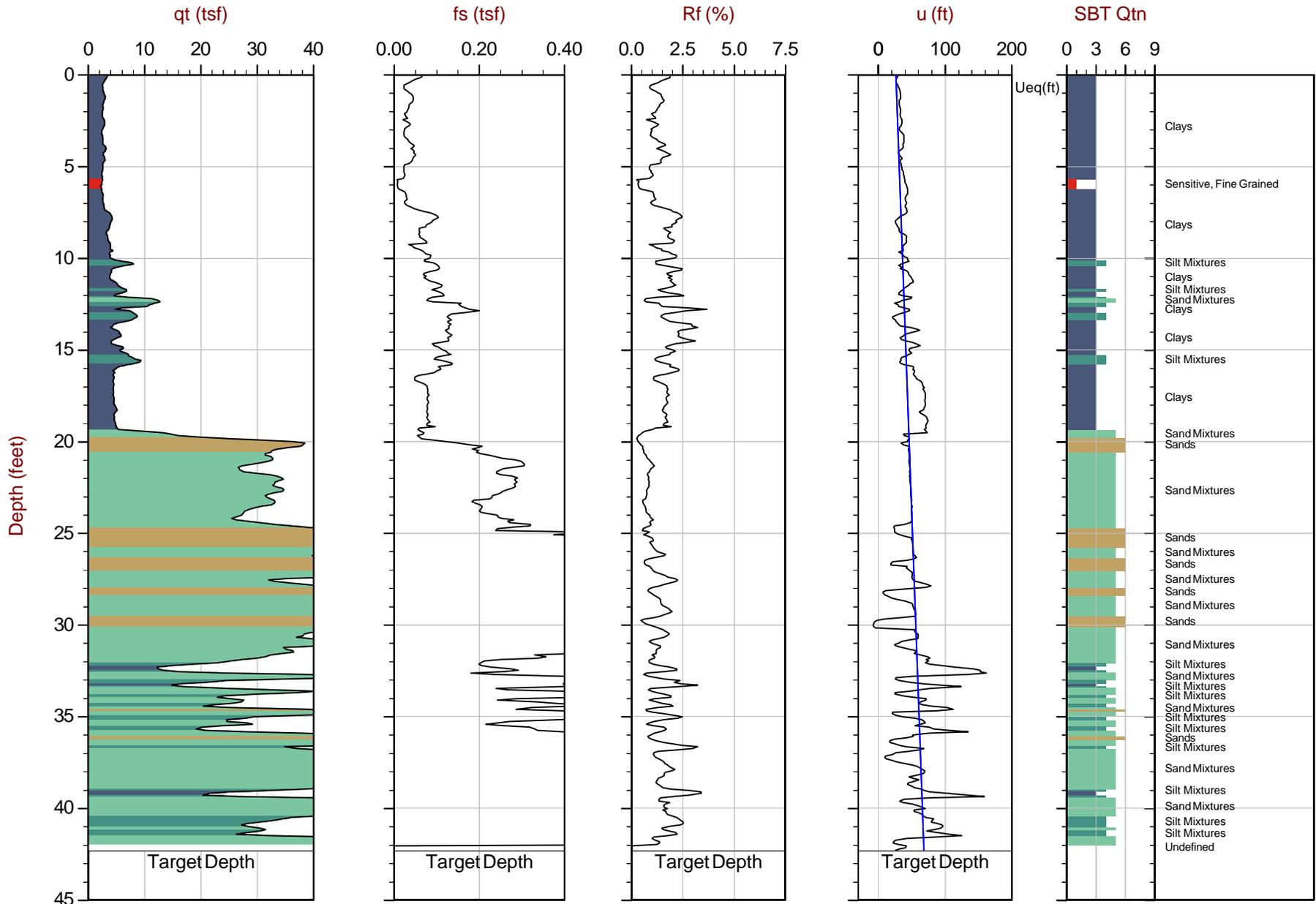
Max Depth: 12.350 m / 40.52 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP29.COR
 Unit Wt: SBTQtn (PKR2009), User Defined Layers

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53514 Long: -122.32315

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◃ Dissipation, Ueq not achieved ◂ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Cone Penetration Test Plots with Reduced Scales

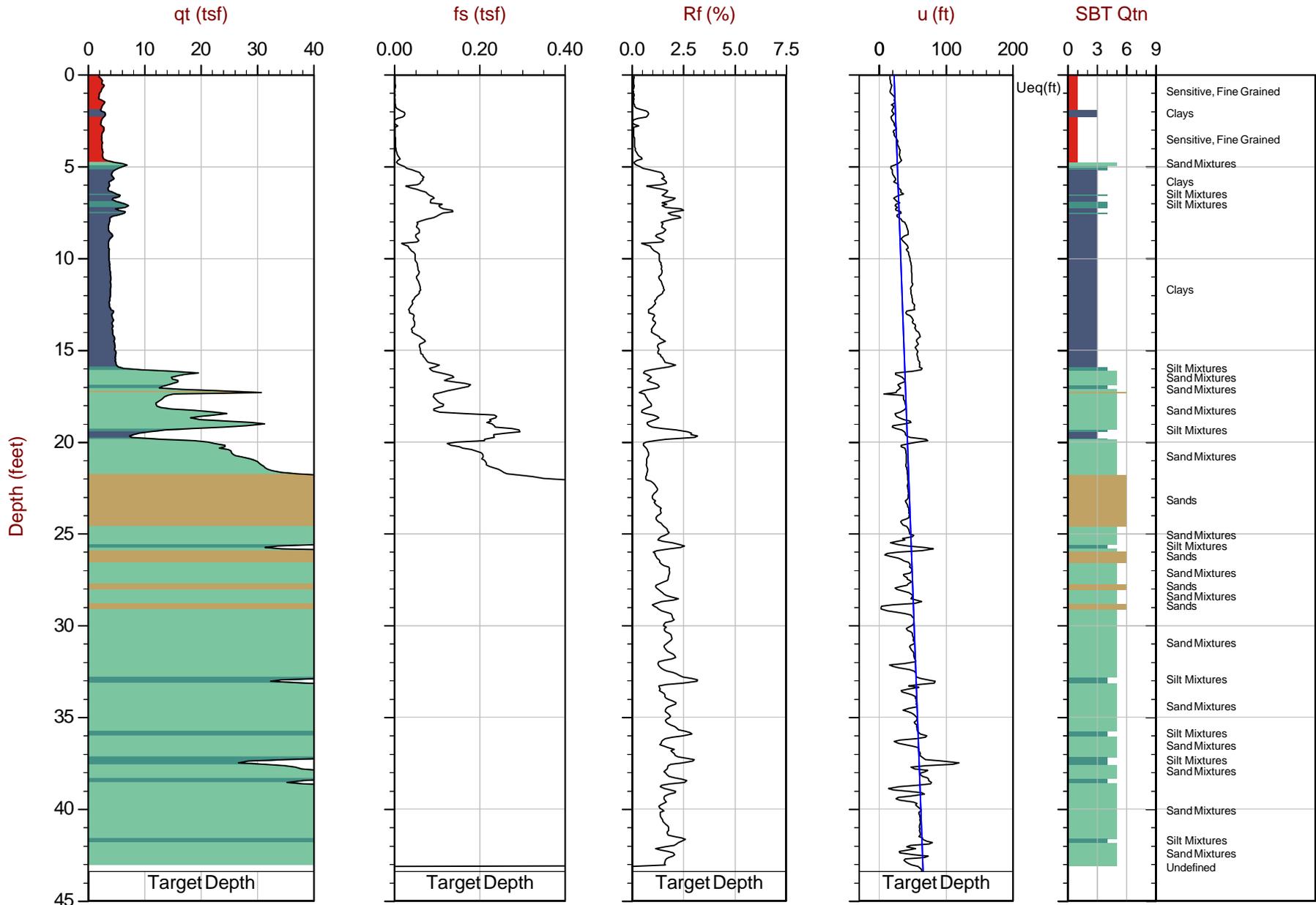


Max Depth: 12.900 m / 42.32 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP01.COR
 Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.54392 Long: -122.33734

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

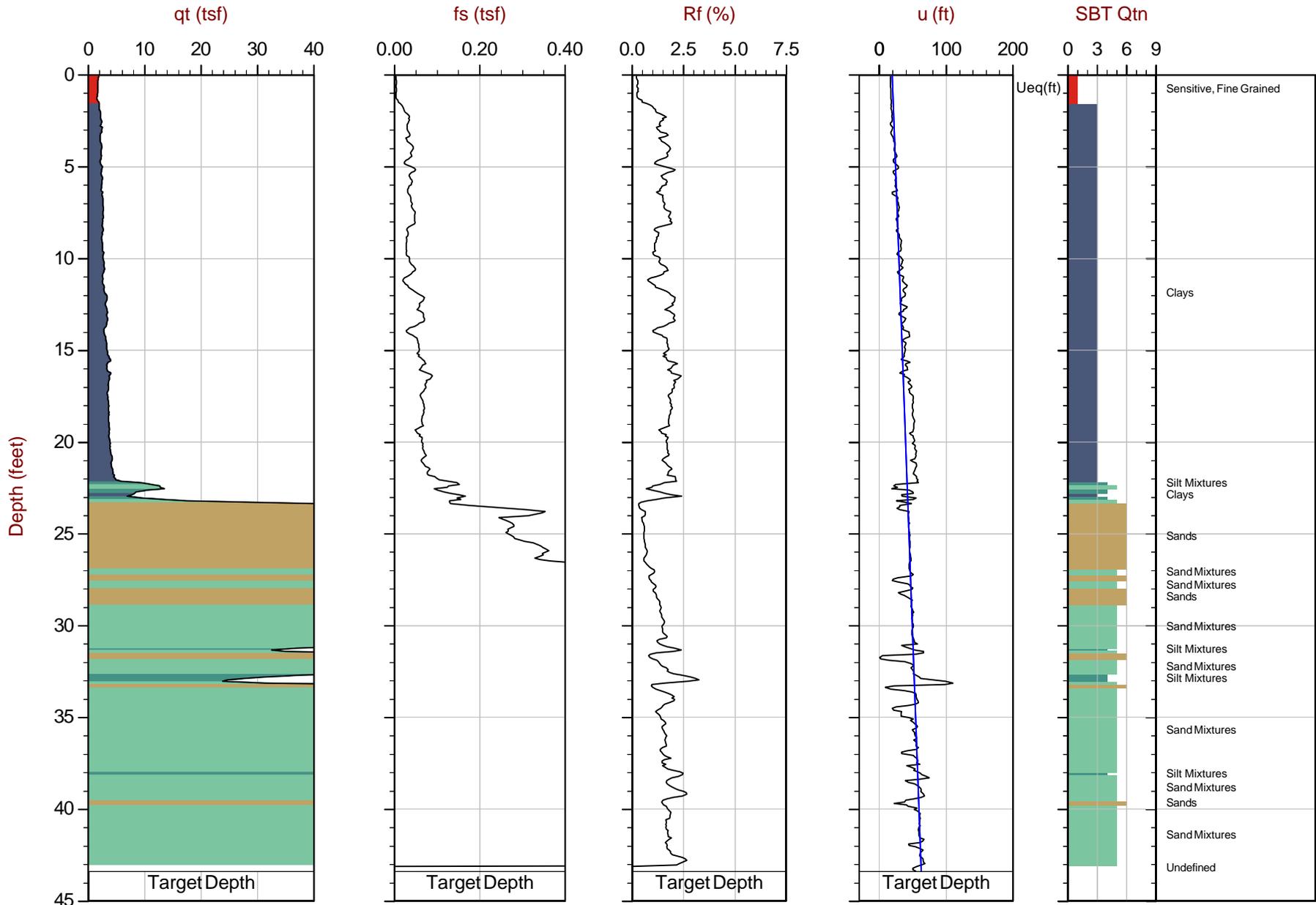


Max Depth: 13.225 m / 43.39 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP03.COR
 Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.54227 Long: -122.33505

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

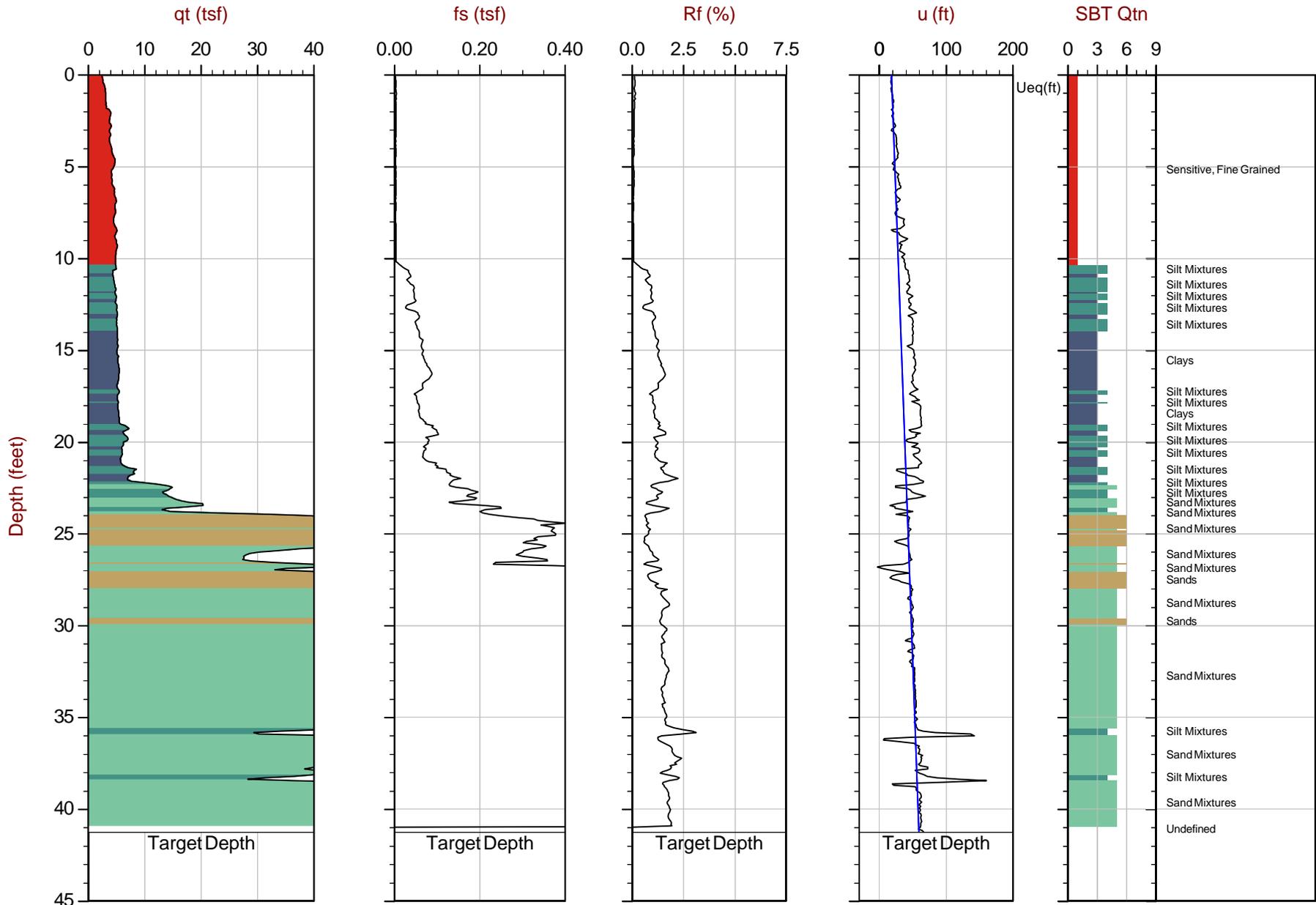


Max Depth: 13.225 m / 43.39 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP05.COR
 Unit Wt: SBTQtn (PKR2009), User Defined Layers

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.54351 Long: -122.33576

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



Max Depth: 12.575 m / 41.26 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP07.COR
 Unit Wt: SBTQtn (PKR2009), User Defined Layers

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.54334 Long: -122.33551

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



Anchor QEA

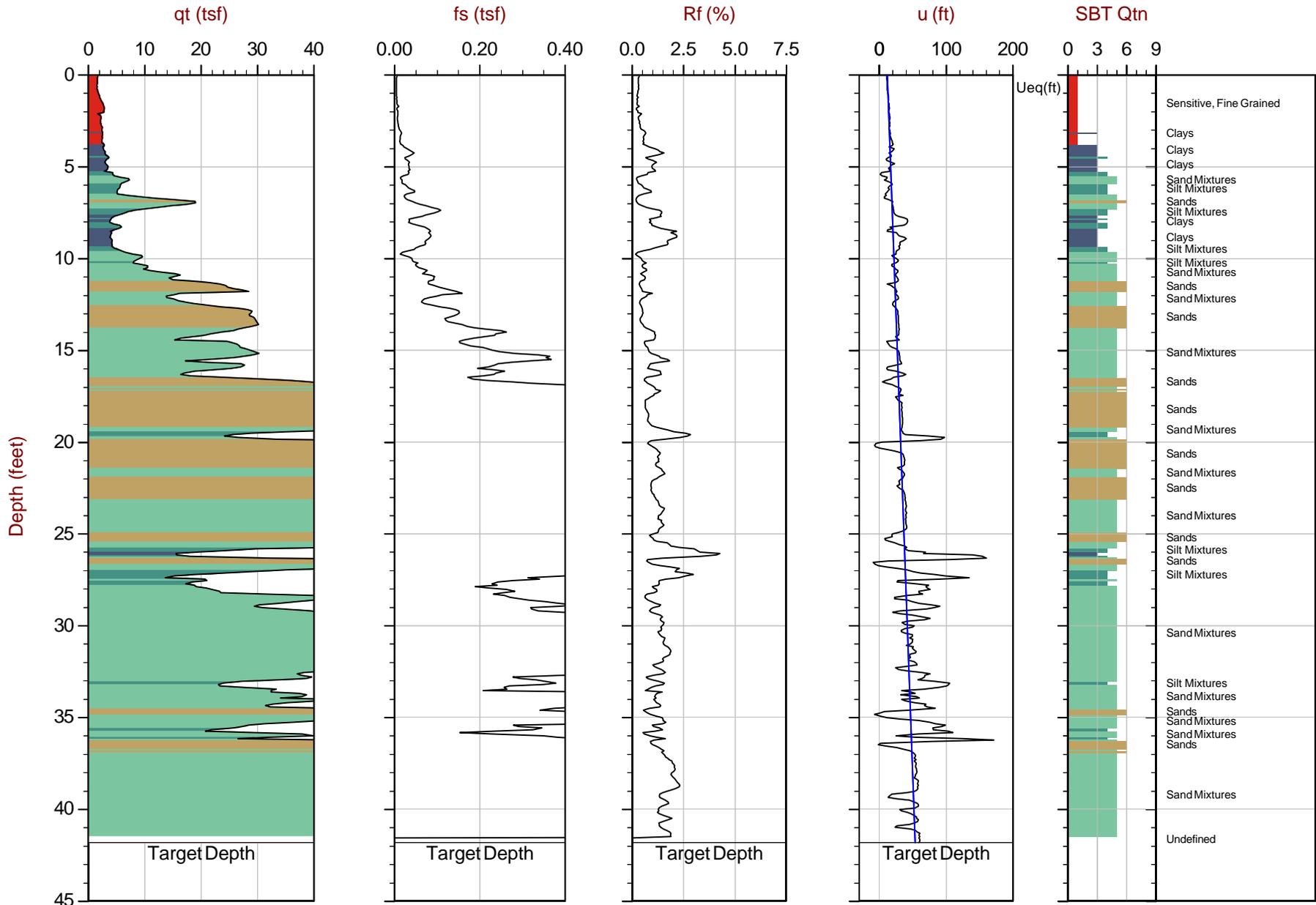
Job No: 24-59-27874

Date: 2024-07-08 13:08

Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT12-GT

Cone: 1007:T1500F15U35 Area=15 cm²

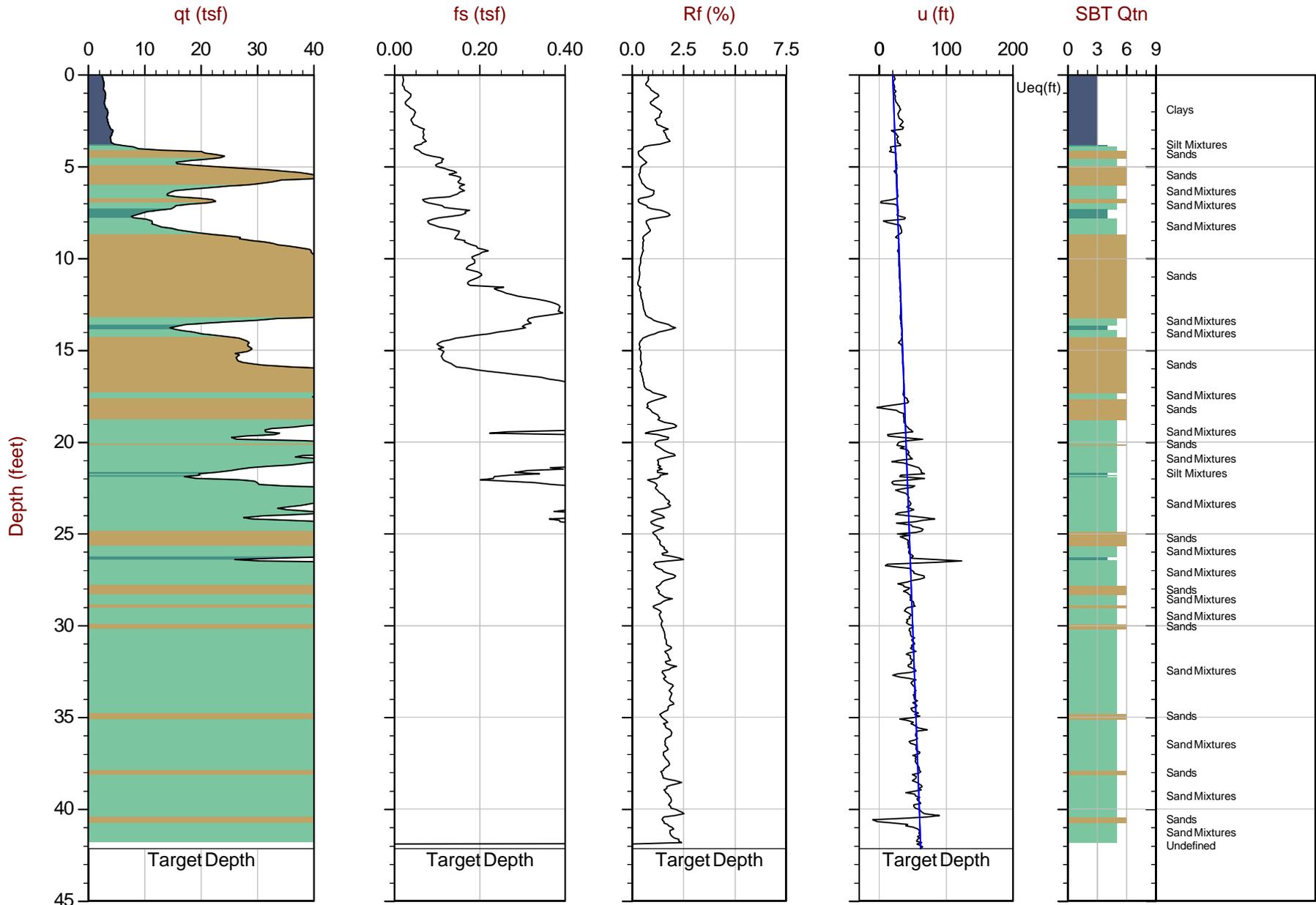


Max Depth: 12.750 m / 41.83 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP12.COR
 Unit Wt: SBTQtn (PKR2009), User Defined Layers

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.54050 Long: -122.33284

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



Max Depth: 12.850 m / 42.16 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP14.COR
 Unit Wt: SBTQtn (PKR2009), User Defined Layers

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.54001 Long: -122.33195

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



Anchor QEA

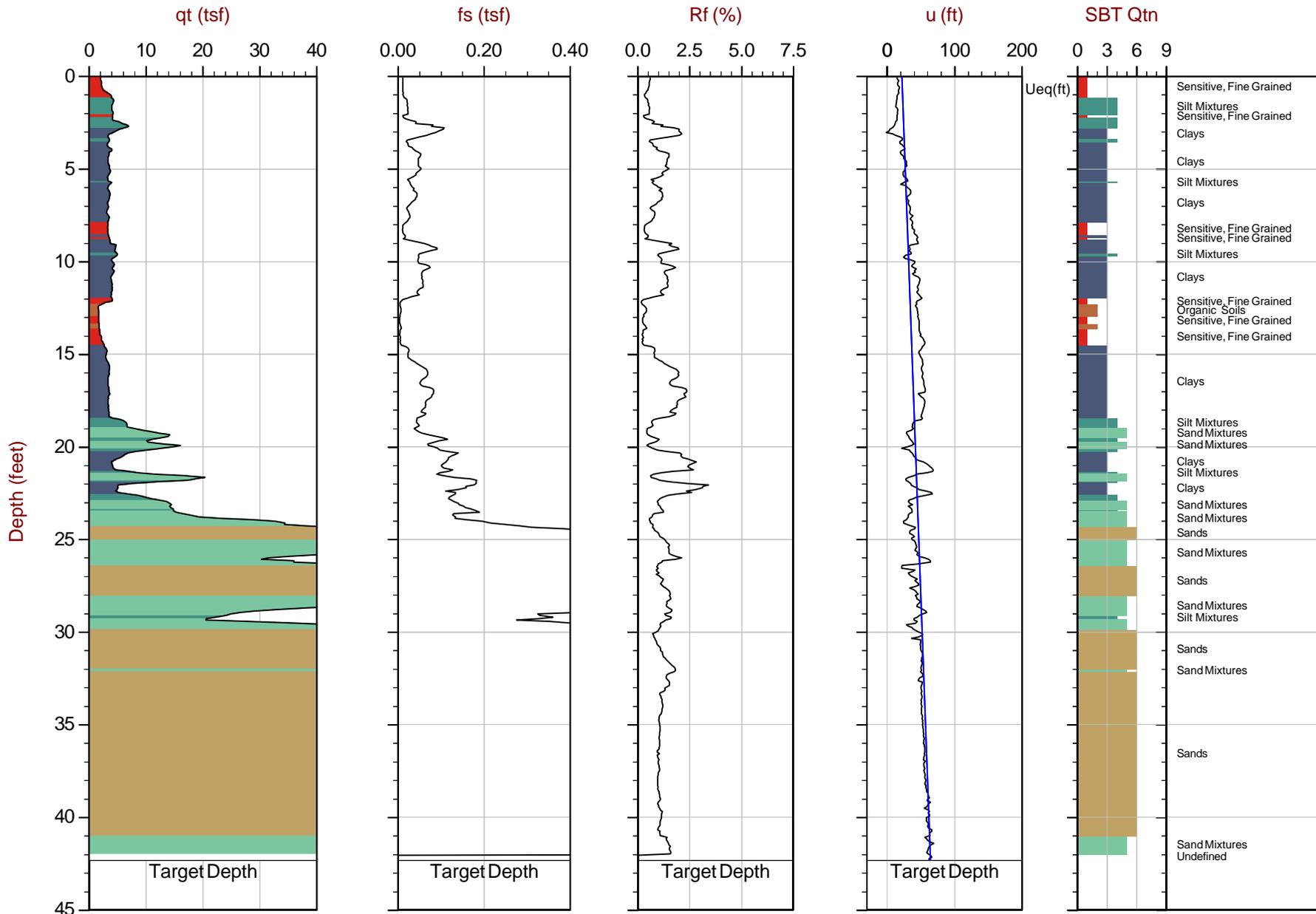
Job No: 24-59-27874

Date: 2024-07-13 16:21

Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT15-GT

Cone: 1007:T1500F15U35 Area=15 cm²



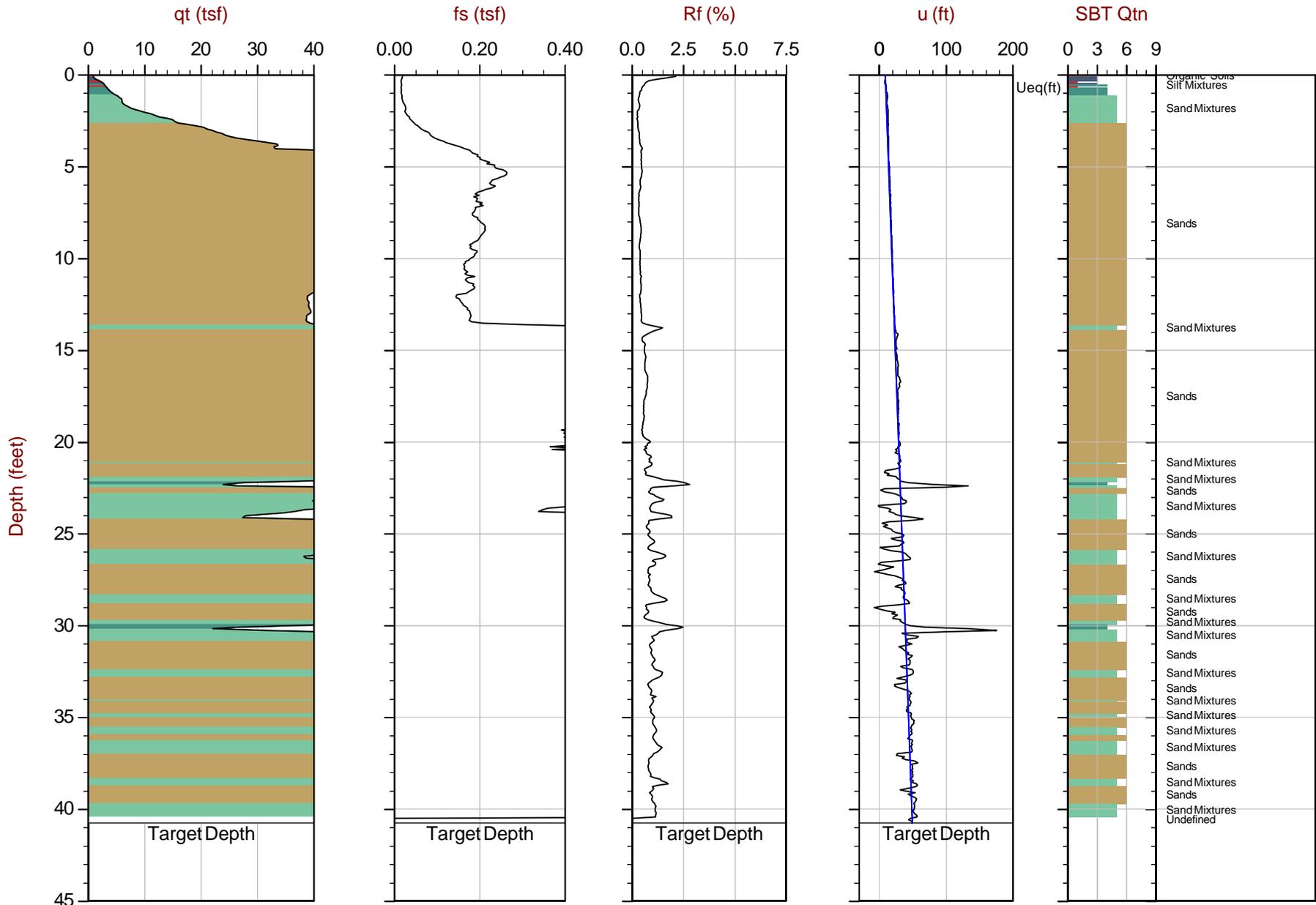
Max Depth: 12.900 m / 42.32 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP15.COR
 Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53914 Long: -122.33049

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◃ Dissipation, Ueq not achieved ◅ Dissipation, Ueq assumed — Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



Max Depth: 12.425 m / 40.76 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP16.COR
 Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53840 Long: -122.32986

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



Anchor QEA

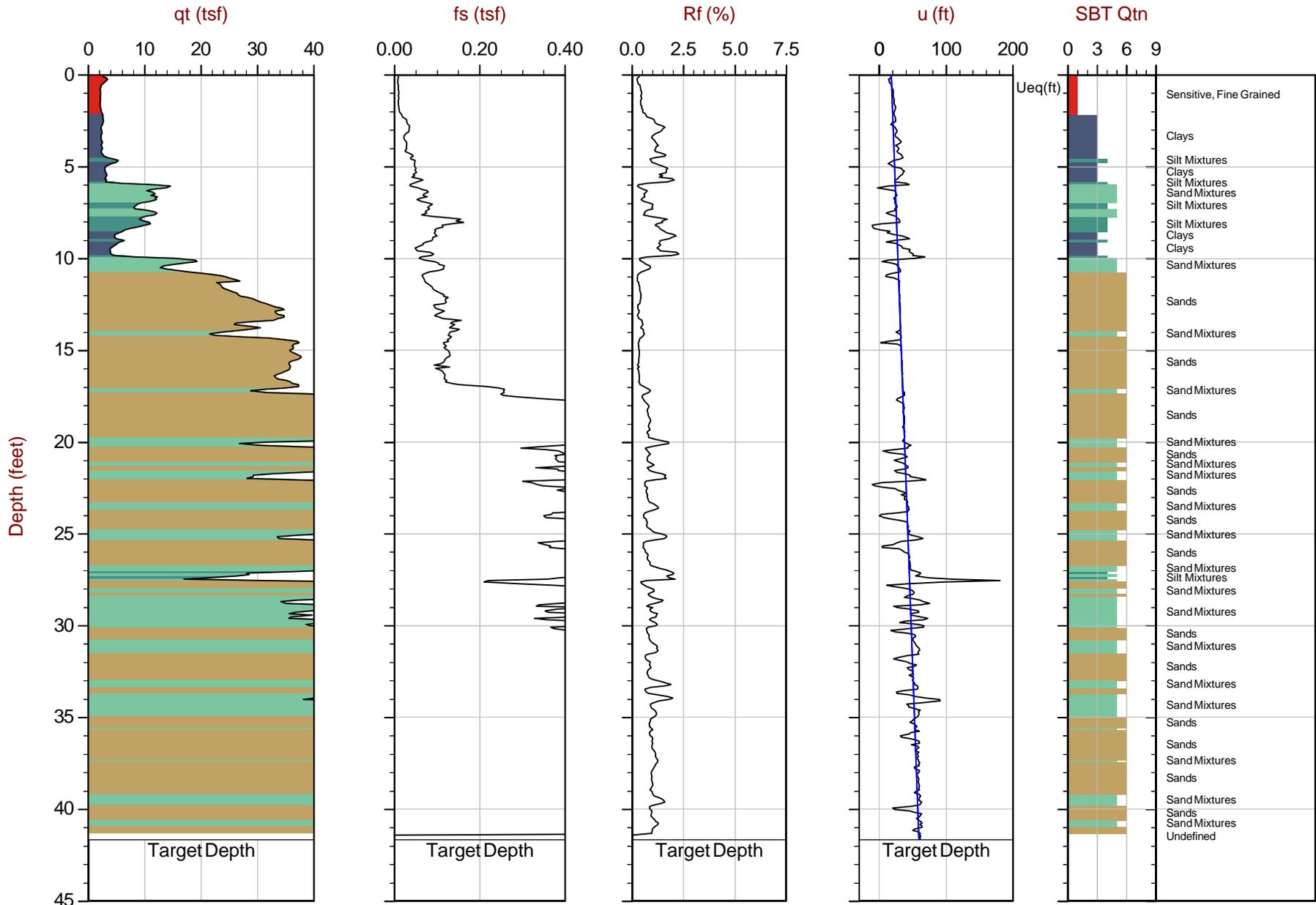
Job No: 24-59-27874

Date: 2024-07-11 10:18

Site: Lower Duwamish Waterway Middle Reach

Sounding: LDW23-GT20-GT

Cone: 681:T375F10U35 Area=15 cm²

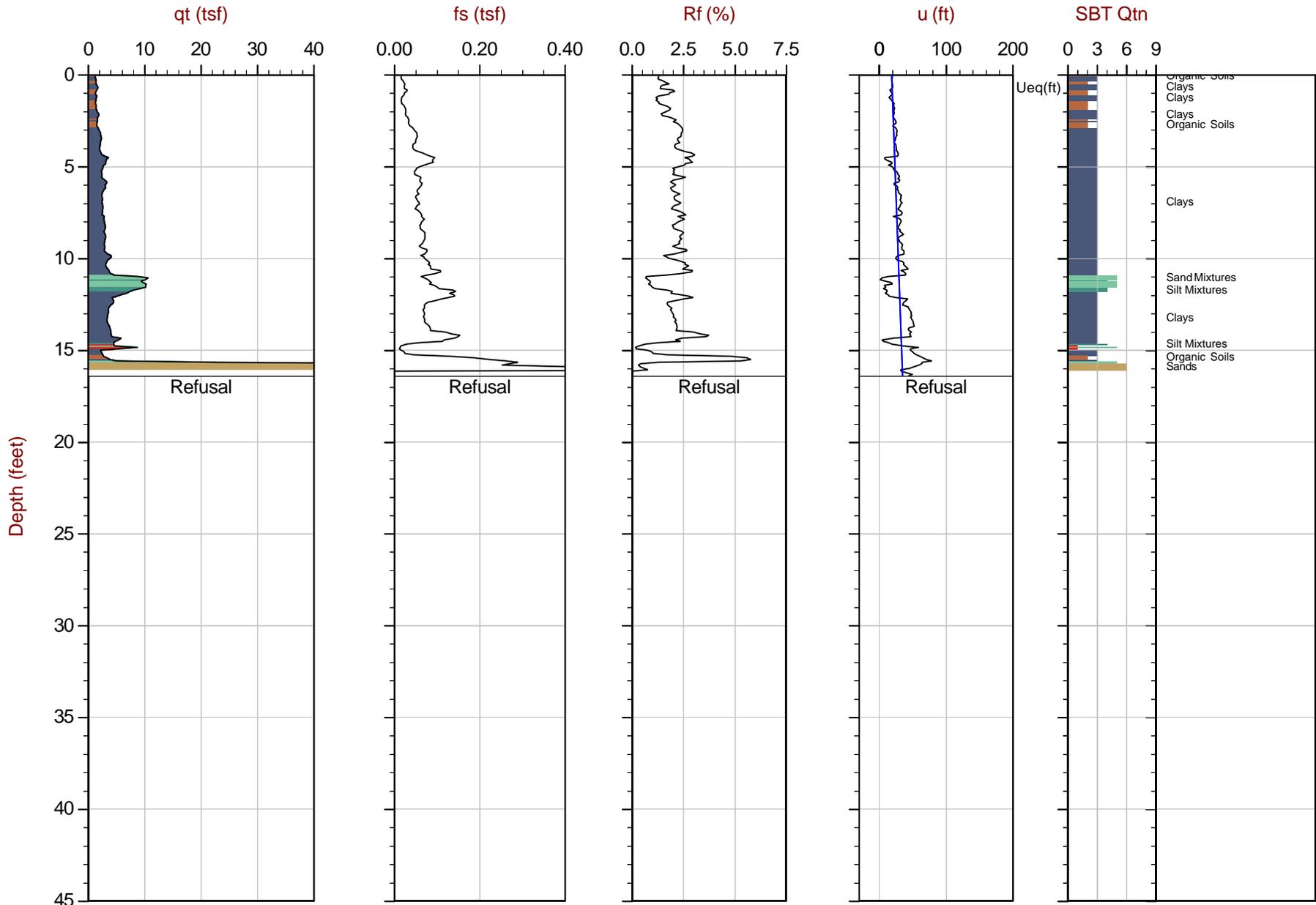


Max Depth: 12.700 m / 41.67 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP20.COR
 Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53712 Long: -122.32613

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

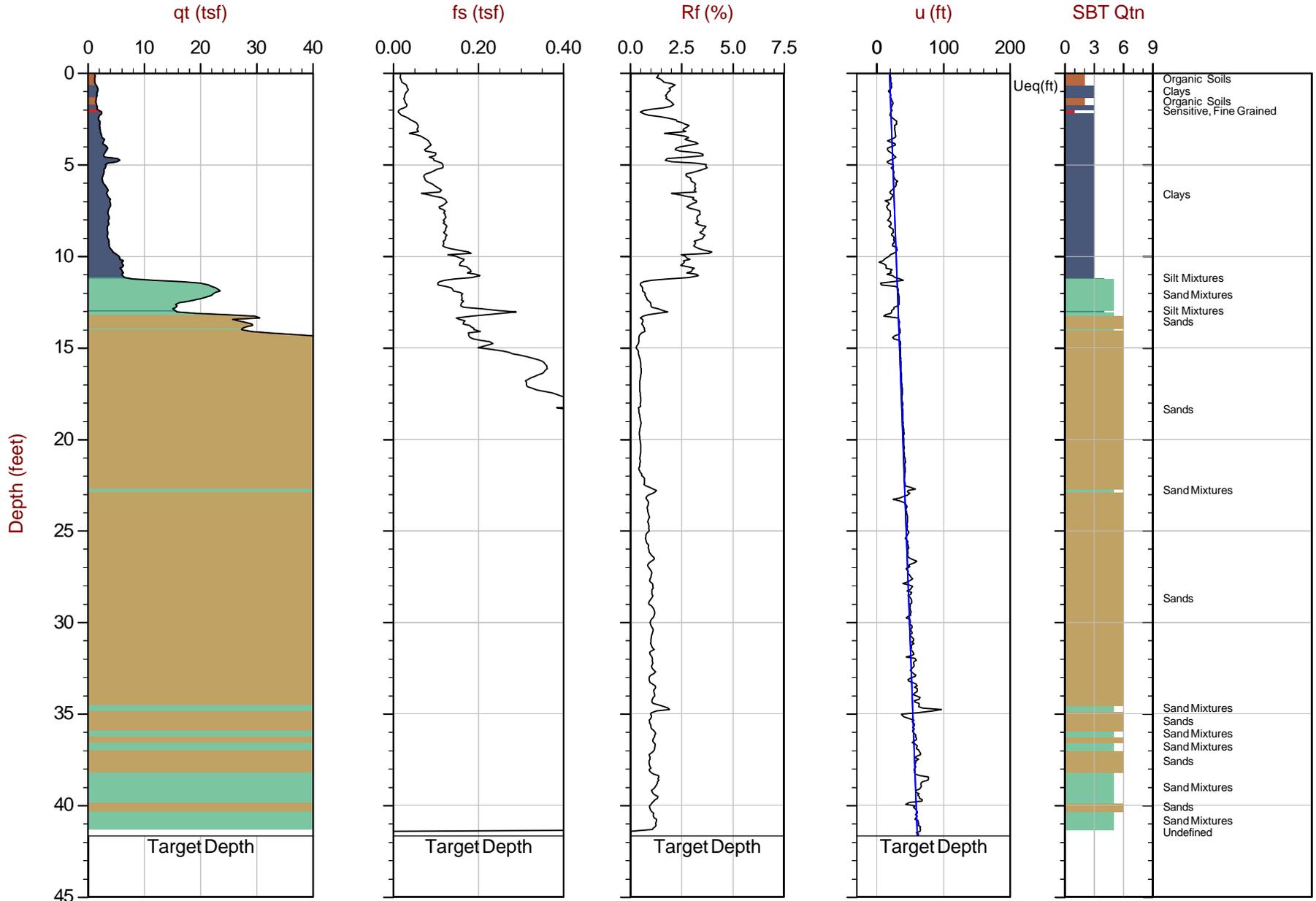


Max Depth: 5.000 m / 16.40 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP23.COR
 Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53591 Long: -122.32601

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

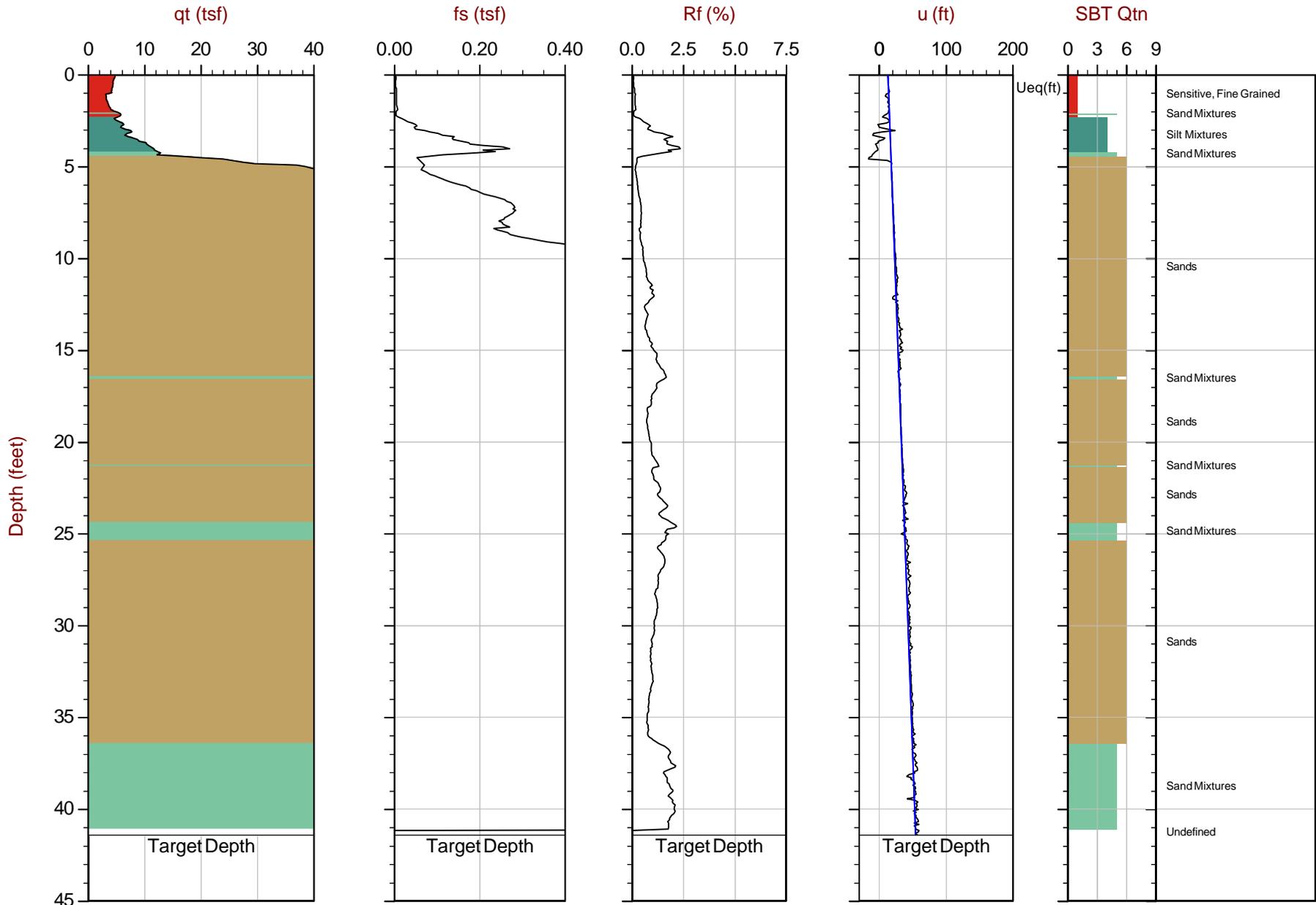


Max Depth: 12.700 m / 41.67 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP23B.COR
 Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53602 Long: -122.32599

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

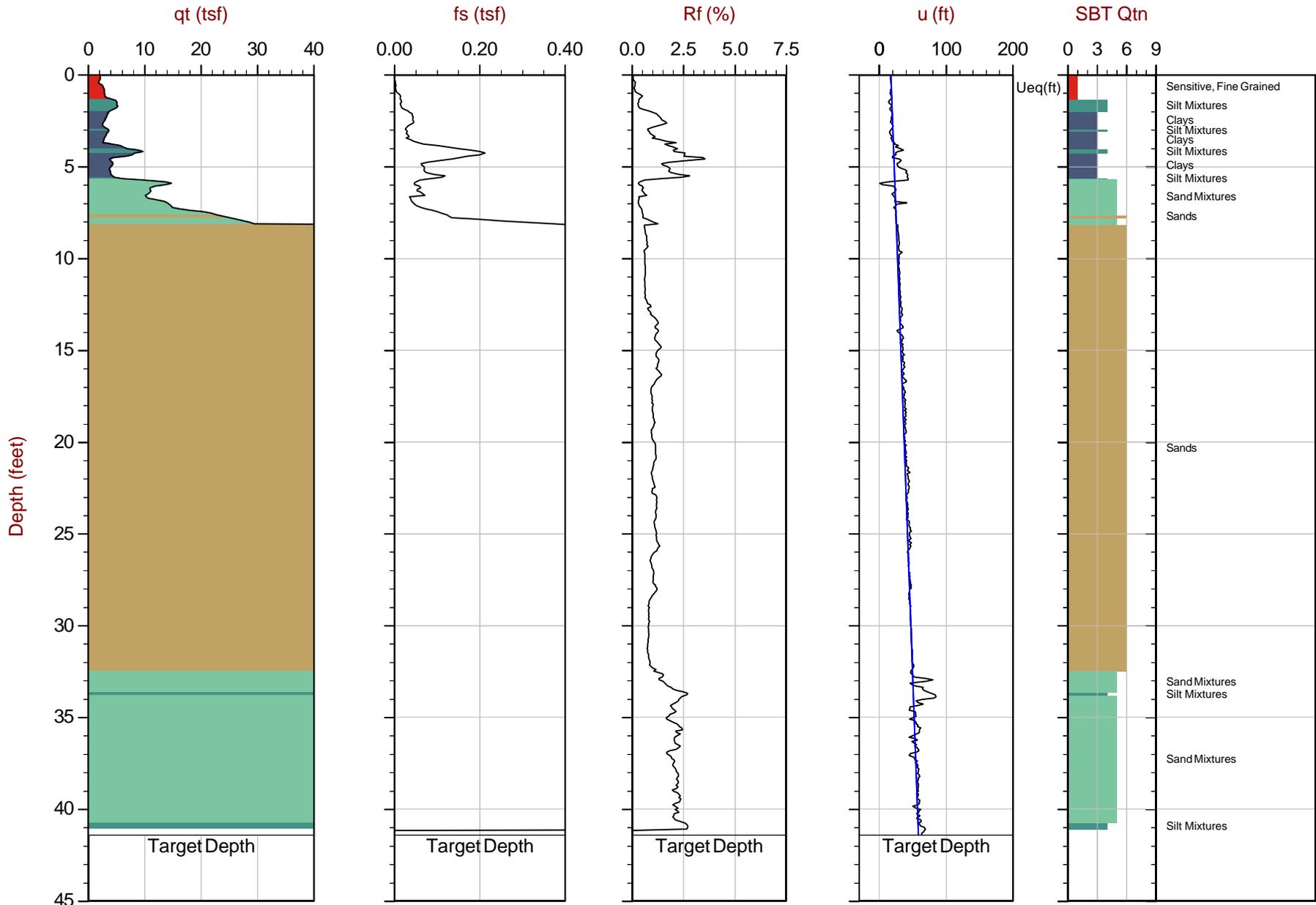


Max Depth: 12.625 m / 41.42 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP24.COR
 Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53484 Long: -122.32438

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◃ Dissipation, Ueq not achieved ◅ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

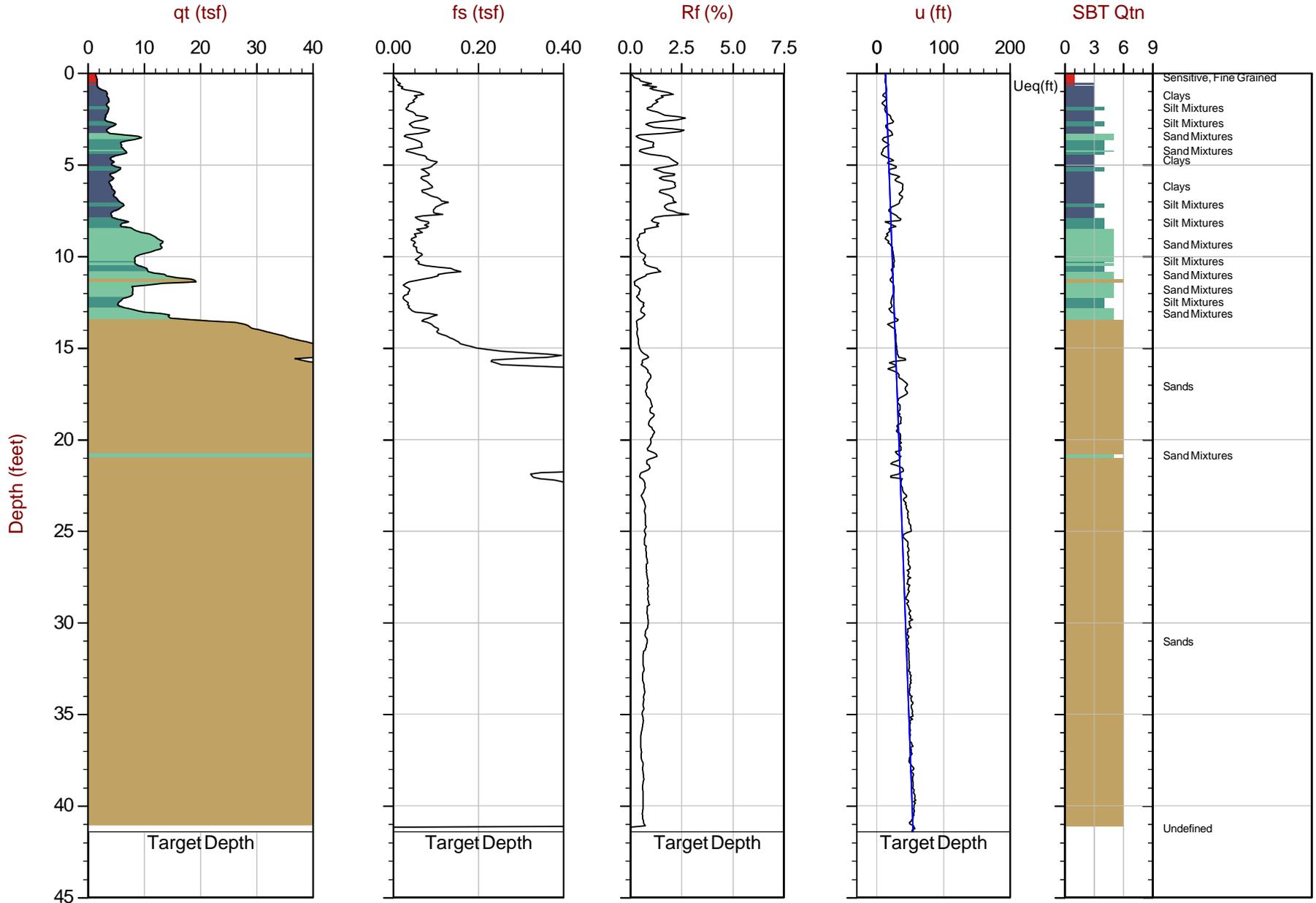


Max Depth: 12.625 m / 41.42 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP25.COR
 Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53434 Long: -122.32347

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

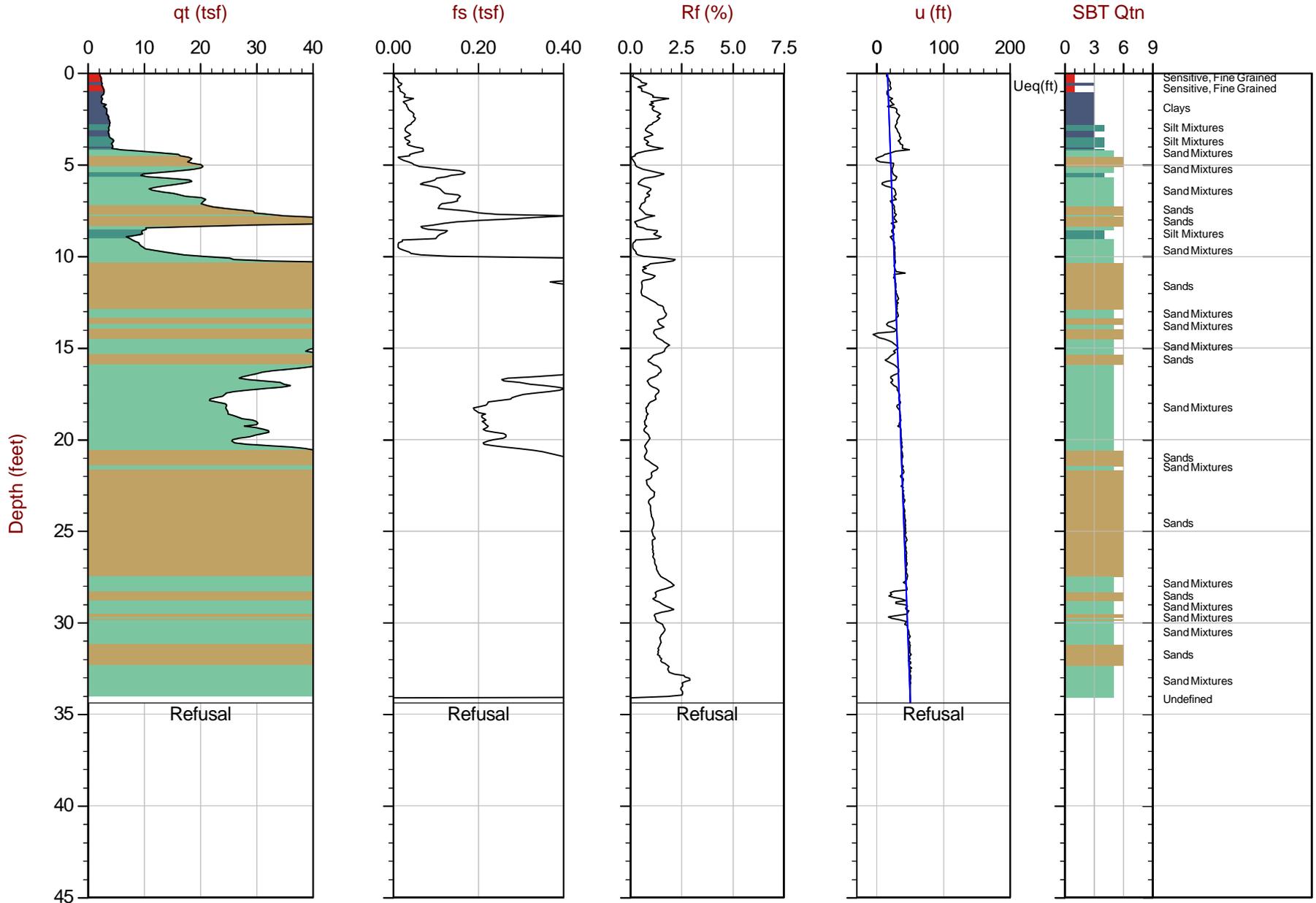


Max Depth: 12.625 m / 41.42 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP27.COR
 Unit Wt: SBTQtn(PKR2009)

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53547 Long: -122.32400

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

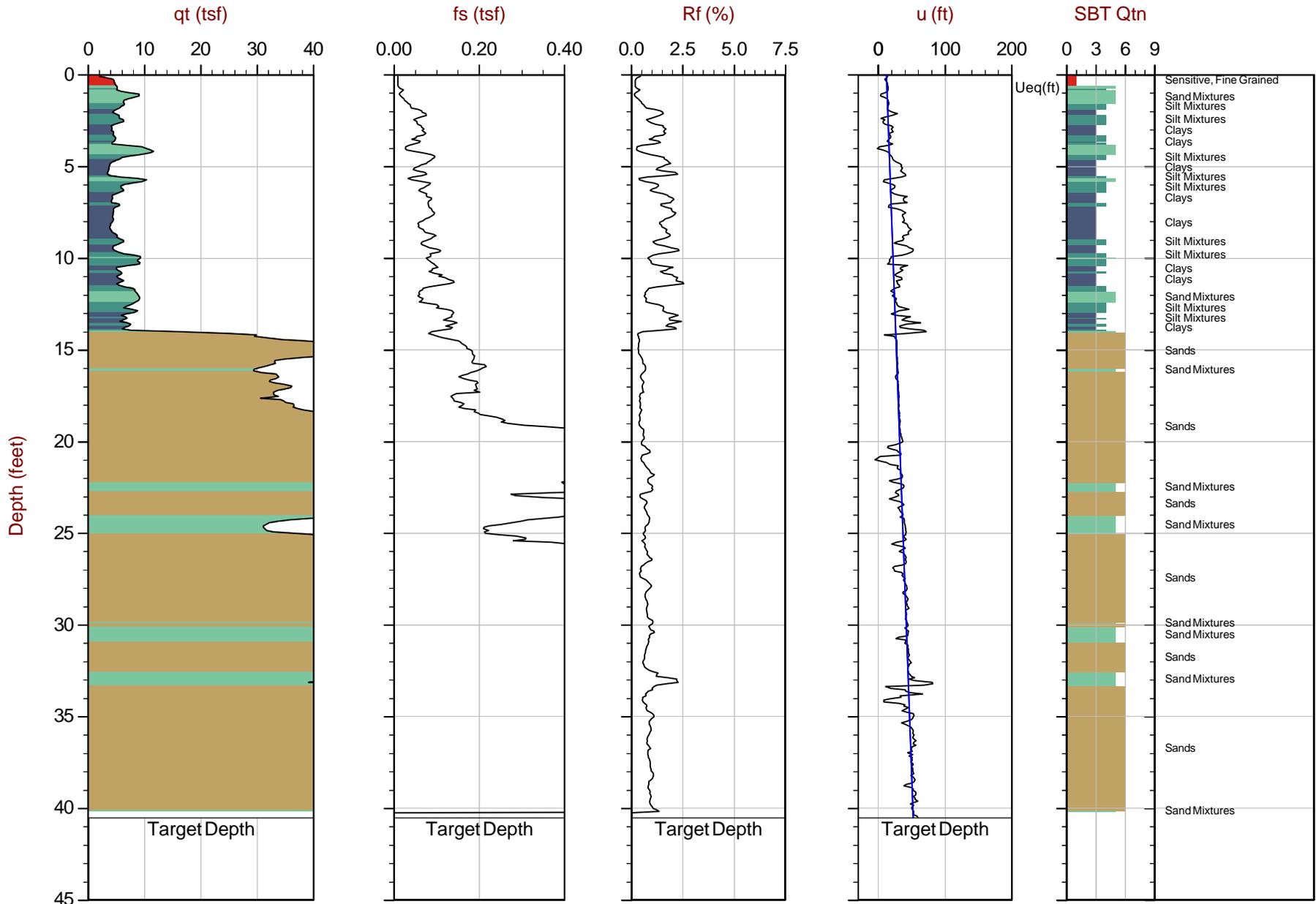


Max Depth: 10.475 m / 34.37 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP28.COR
 Unit Wt: SBTQtn (PKR2009), User Defined Layers

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53503 Long: -122.32332

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



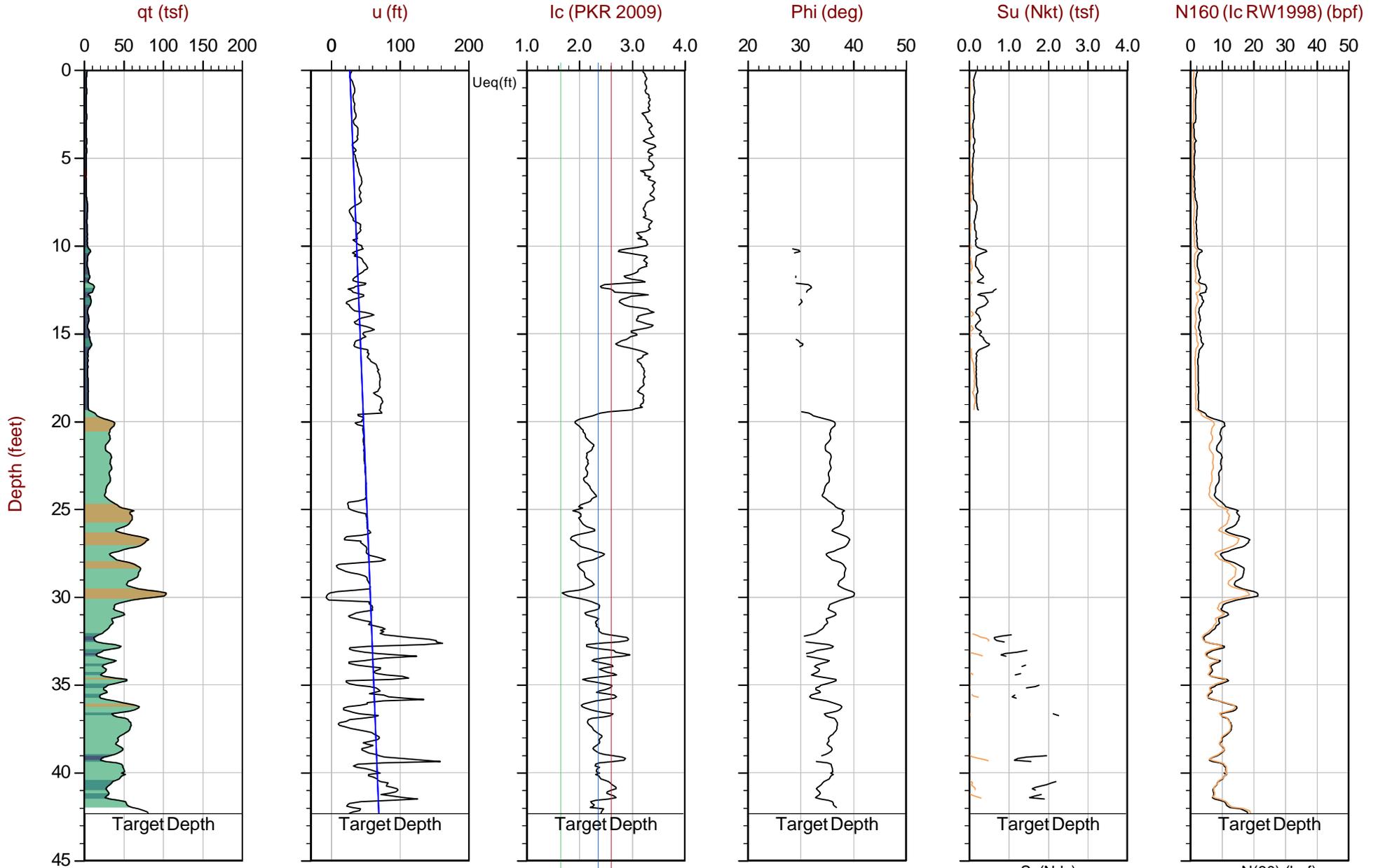
Max Depth: 12.350 m / 40.52 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP29.COR
 Unit Wt: SBTQtn (PKR2009), User Defined Layers

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53514 Long: -122.32315

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Advanced Cone Penetration Test Plots with I_c , $S_u(N_{kt})$, Φ , and $N1(60)I_c$



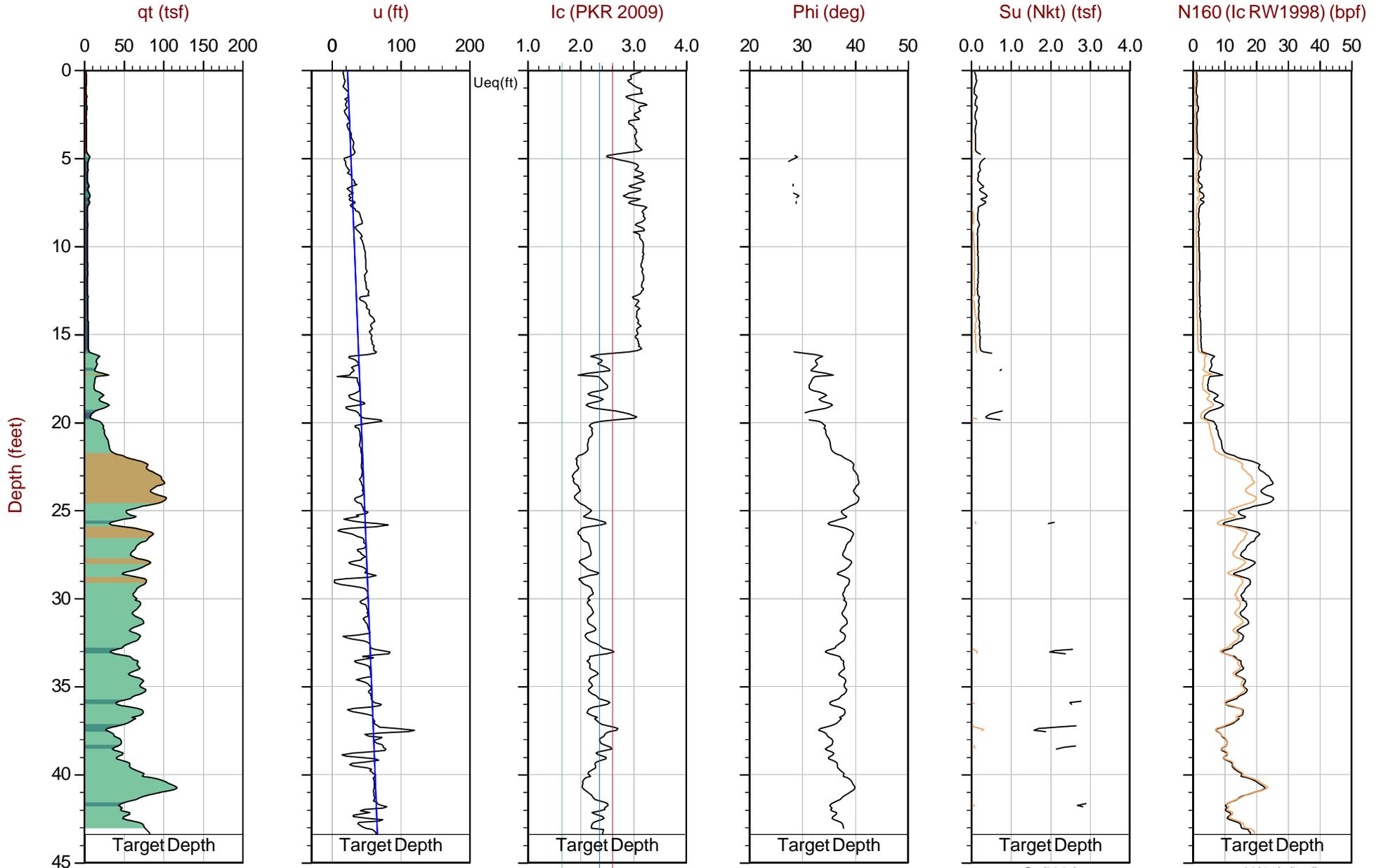
Max Depth: 12.900 m / 42.32 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP01.COR
 Unit Wt: SBTQtn (PKR2009)
 Su Nkt/Ndu: 15.0 / 6.0

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.54392 Long: -122.33734

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



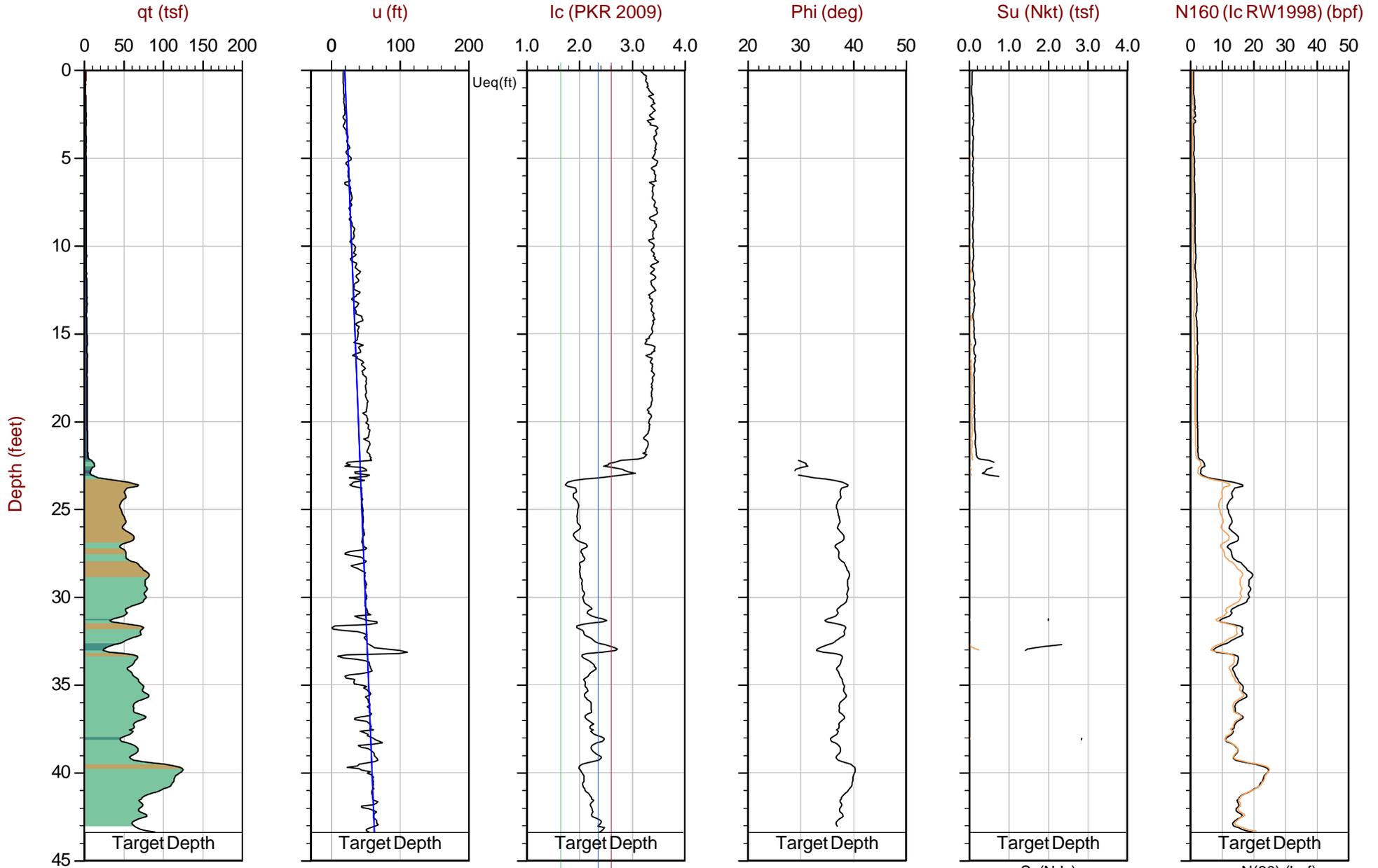
Max Depth: 13.225 m / 43.39 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP03.COR
 Unit Wt: SBTQtn (PKR2009)
 Su Nkt/Ndu: 15.0 / 6.0

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.54227 Long: -122.33505

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◃ Dissipation, Ueq not achieved ◅ Dissipation, Ueq assumed — Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



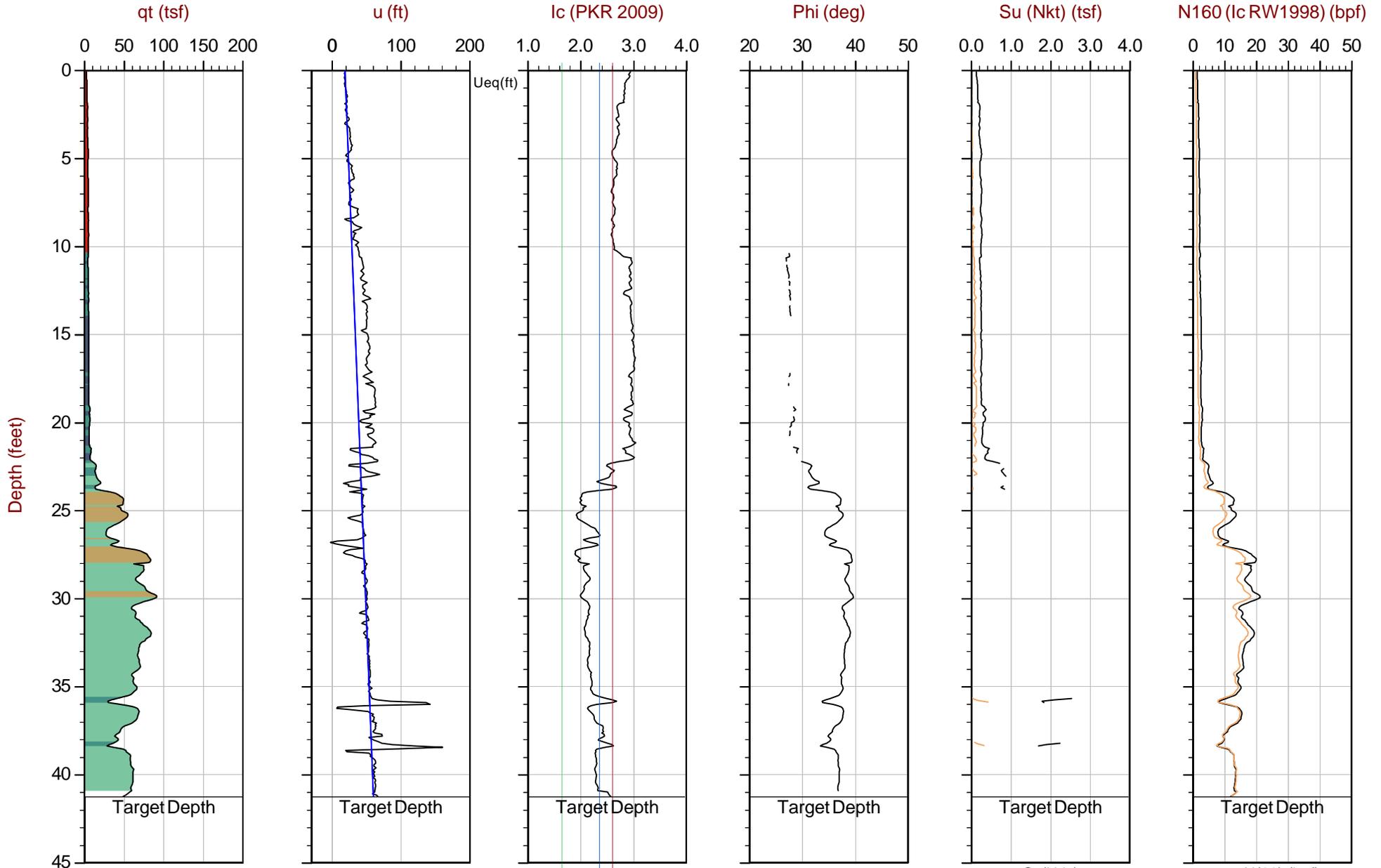
Max Depth: 13.225 m / 43.39 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP05.COR
 Unit Wt: SBTQtn (PKR2009), User Defined Layers
 Su Nkt/Ndu: 15.0 / 6.0

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.54351 Long: -122.33576

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

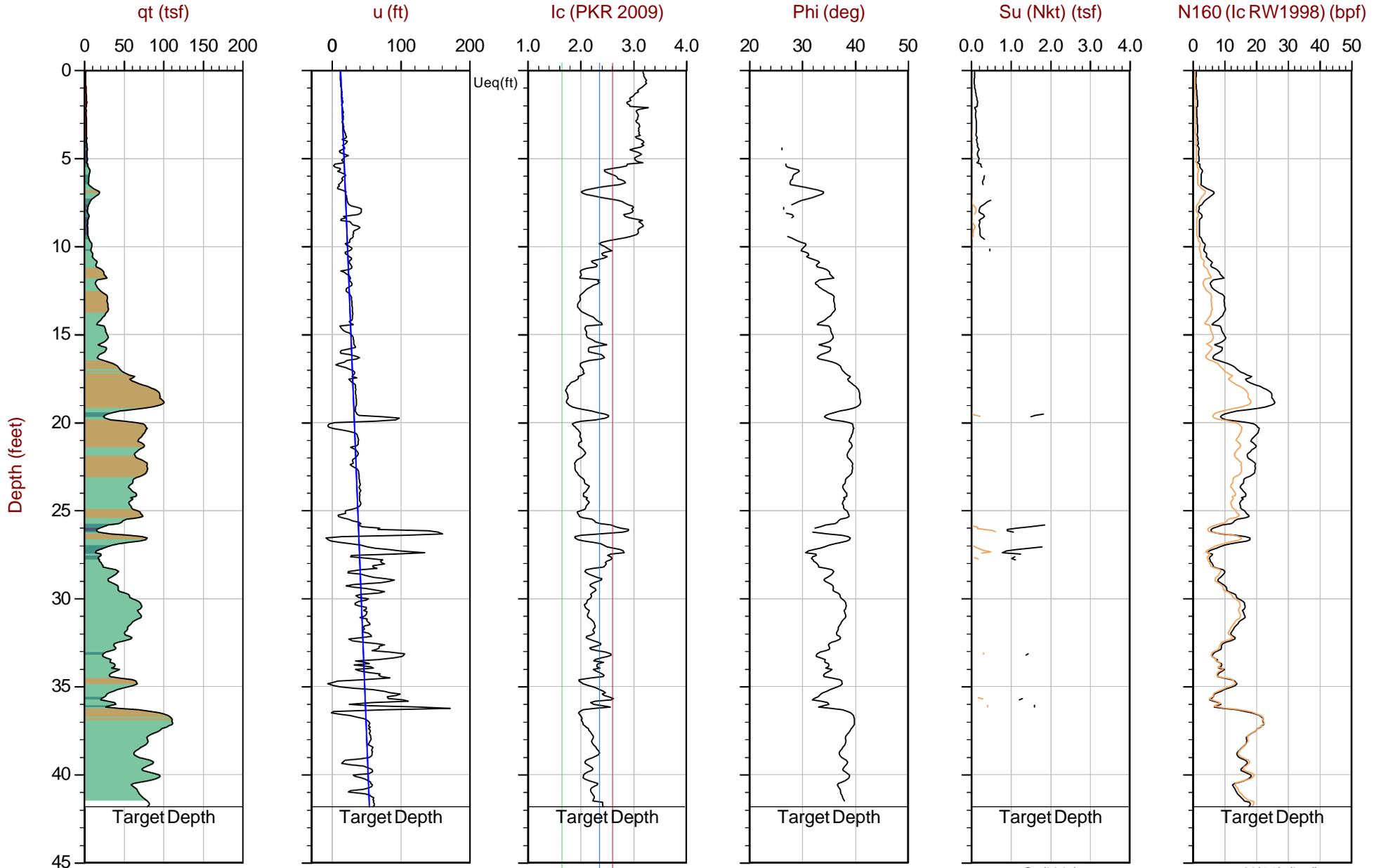


Max Depth: 12.575 m / 41.26 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP07.COR
 Unit Wt: SBTQtn (PKR2009), User Defined Layers
 Su Nkt/Ndu: 15.0 / 6.0

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.54334 Long: -122.33551

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

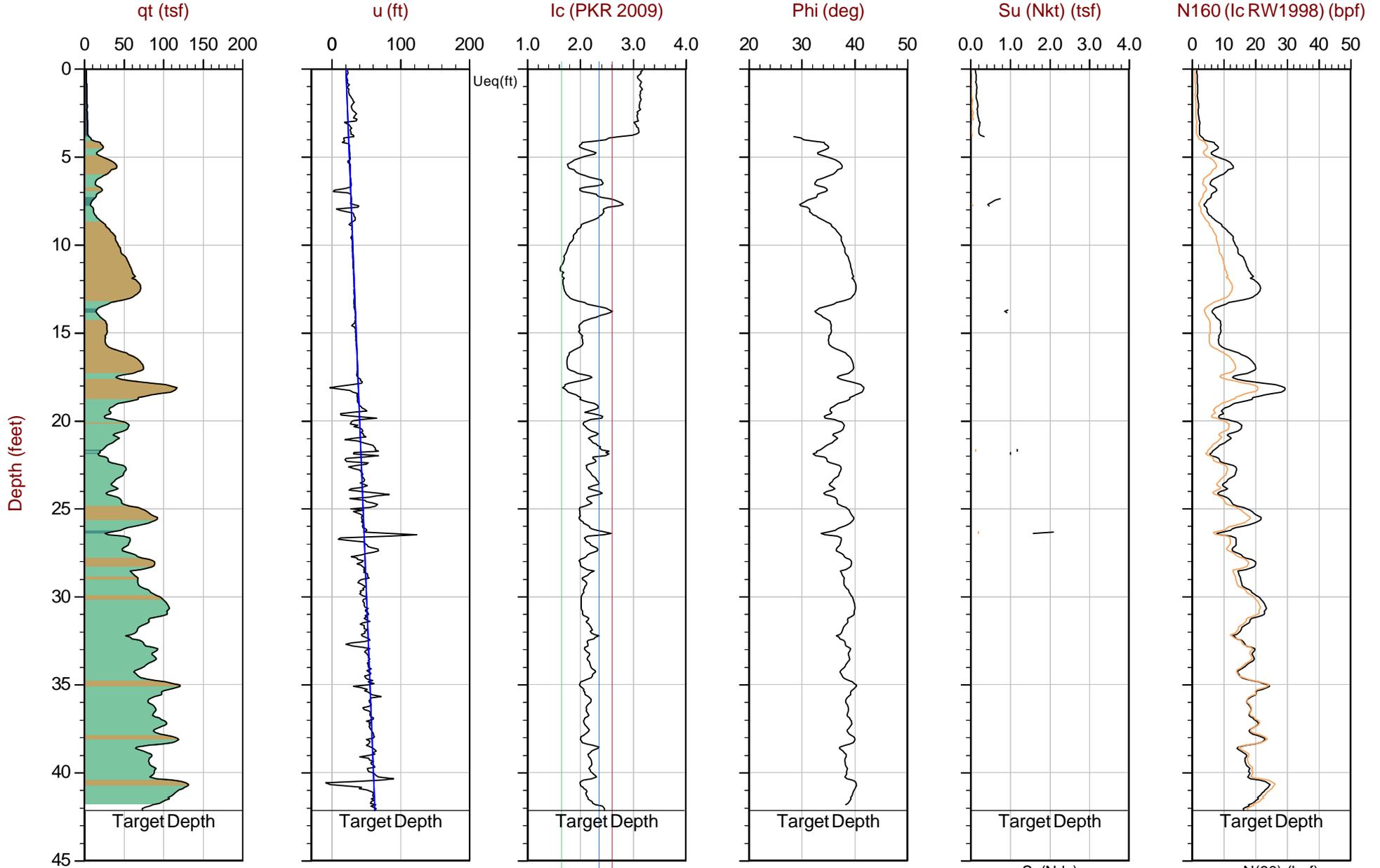


Max Depth: 12.750 m / 41.83 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP12.COR
 Unit Wt: SBTQtn (PKR2009), User Defined Layers
 Su Nkt/Ndu: 15.0 / 6.0

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.54050 Long: -122.33284

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

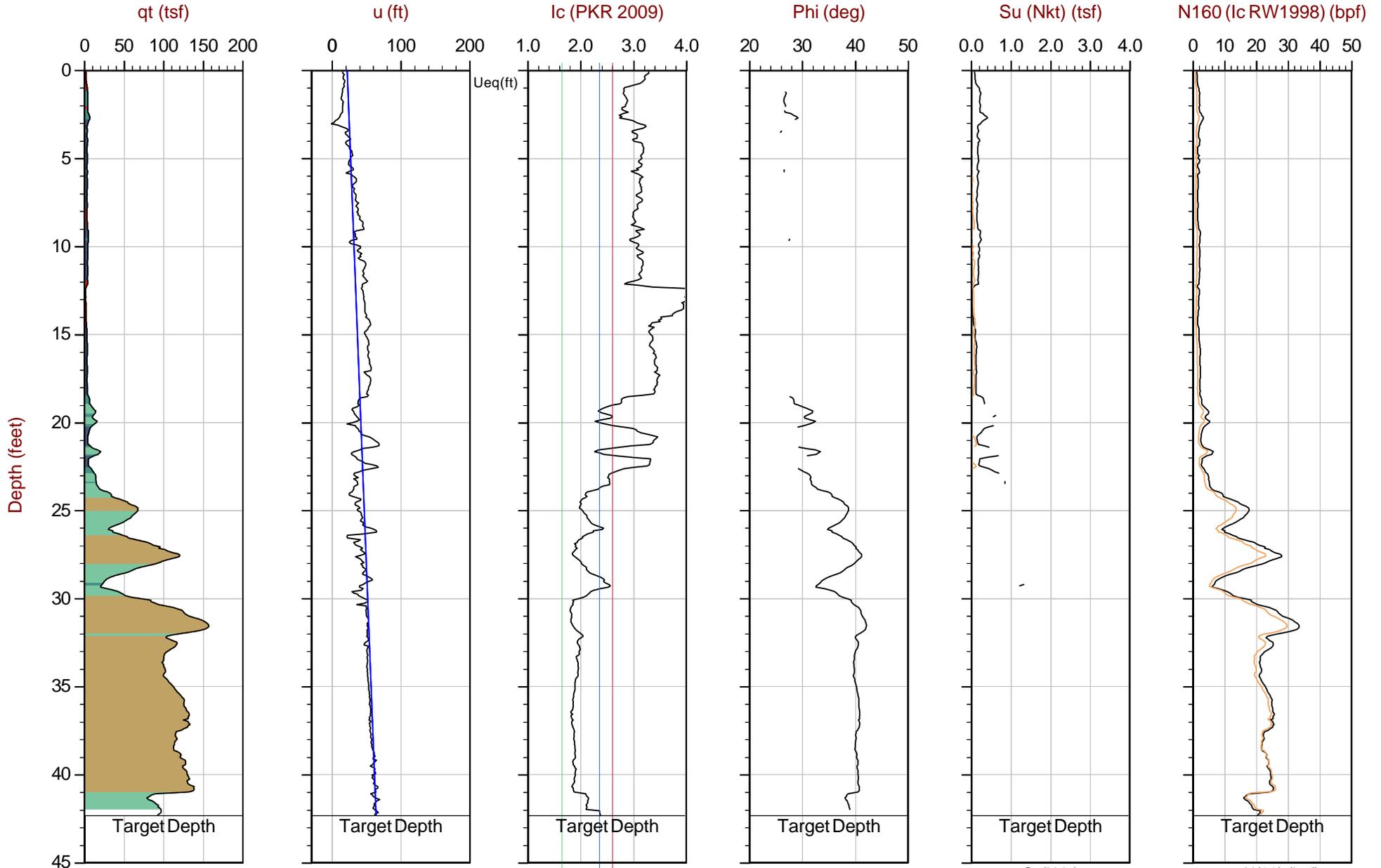


Max Depth: 12.850 m / 42.16 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP14.COR
 Unit Wt: SBTQtn (PKR2009), User Defined Layers
 Su Nkt/Ndu: 15.0 / 6.0

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.54001 Long: -122.33195

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



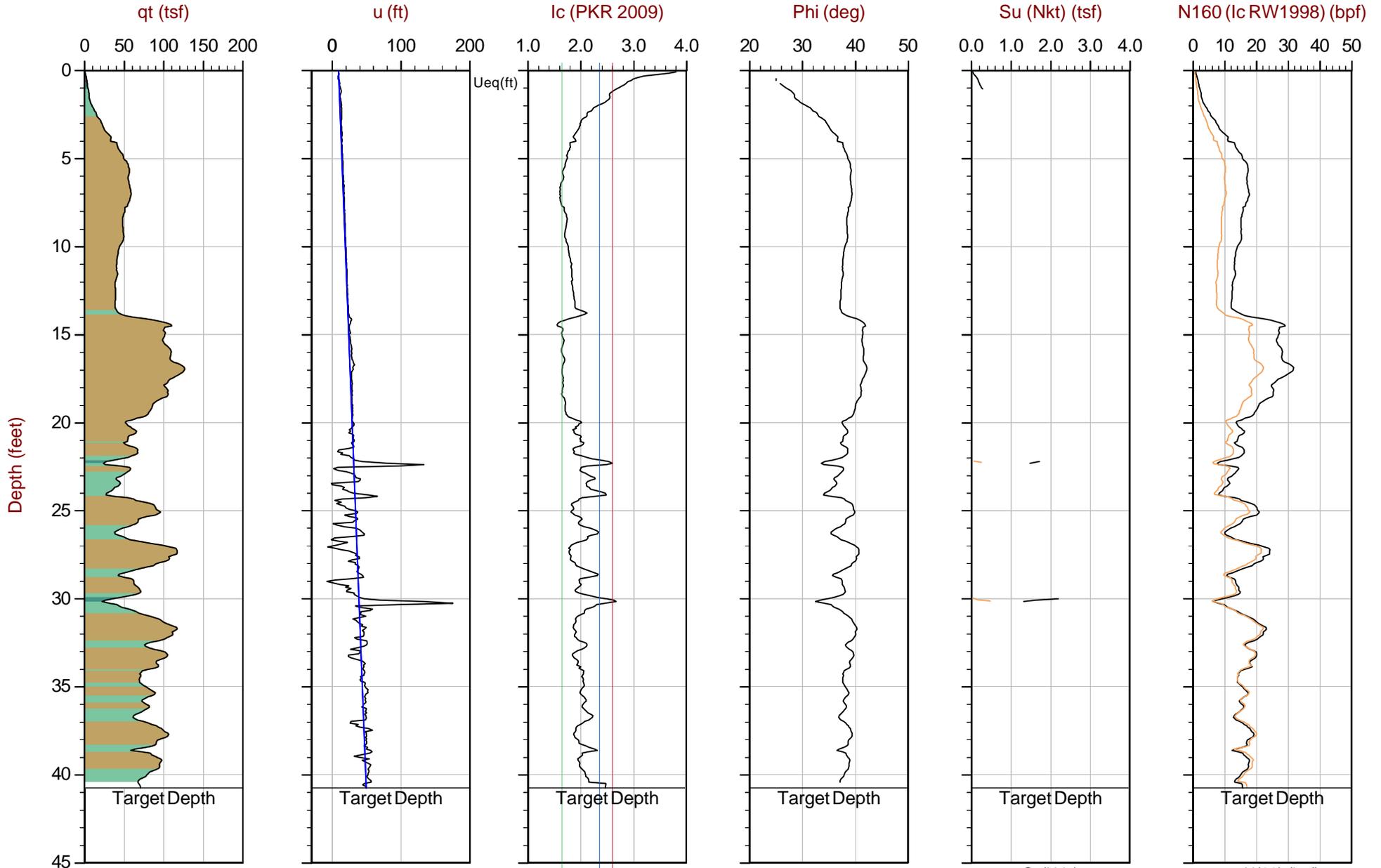
Max Depth: 12.900 m / 42.32 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP15.COR
 Unit Wt: SBTQtn(PKR2009)
 Su Nkt/Ndu: 15.0 / 6.0

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53914 Long: -122.33049

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

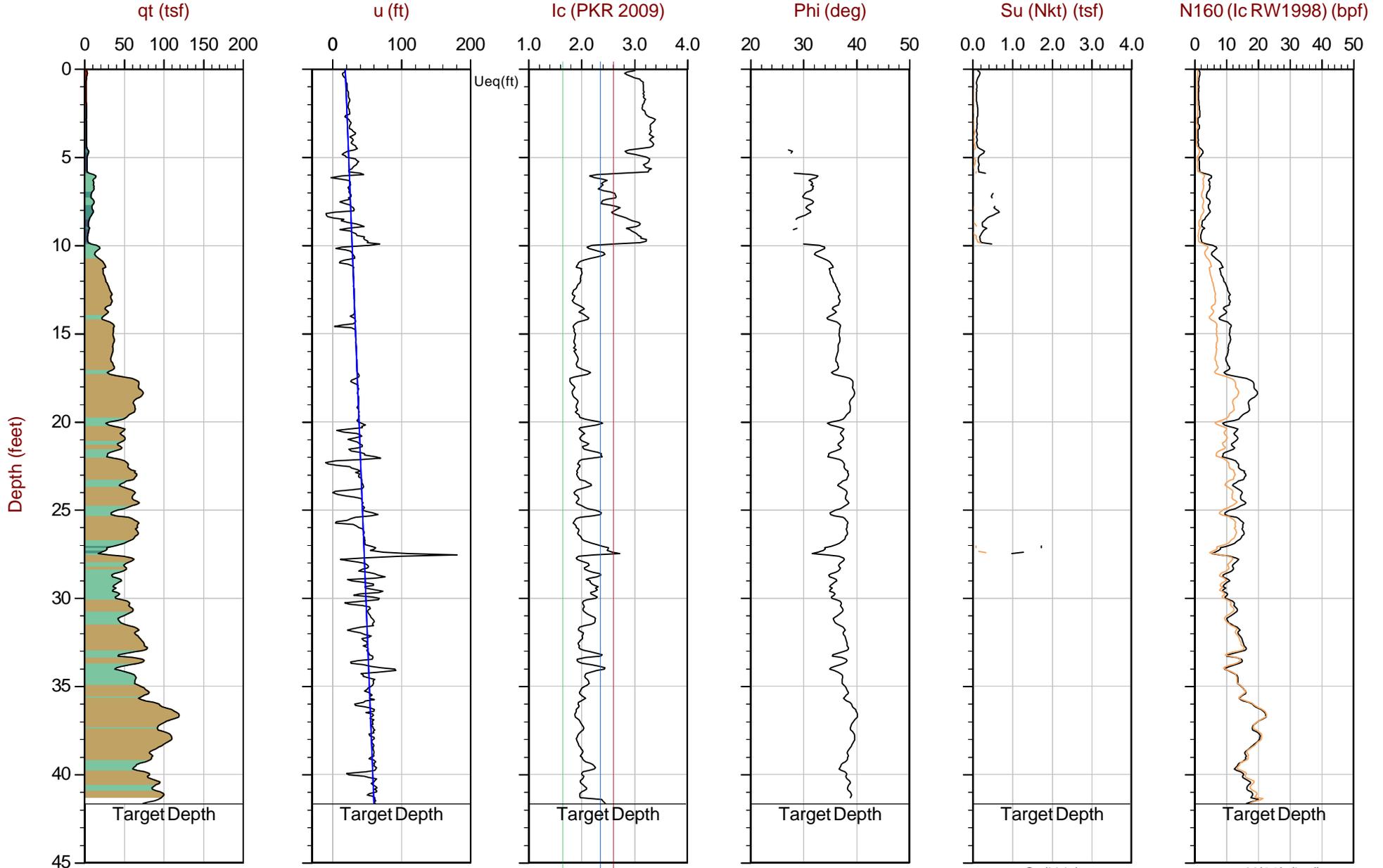


Max Depth: 12.425 m / 40.76 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP16.COR
 Unit Wt: SBTQtn(PKR2009)
 Su Nkt/Ndu: 15.0 / 6.0

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53840 Long: -122.32986

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◃ Dissipation, Ueq not achieved ◅ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

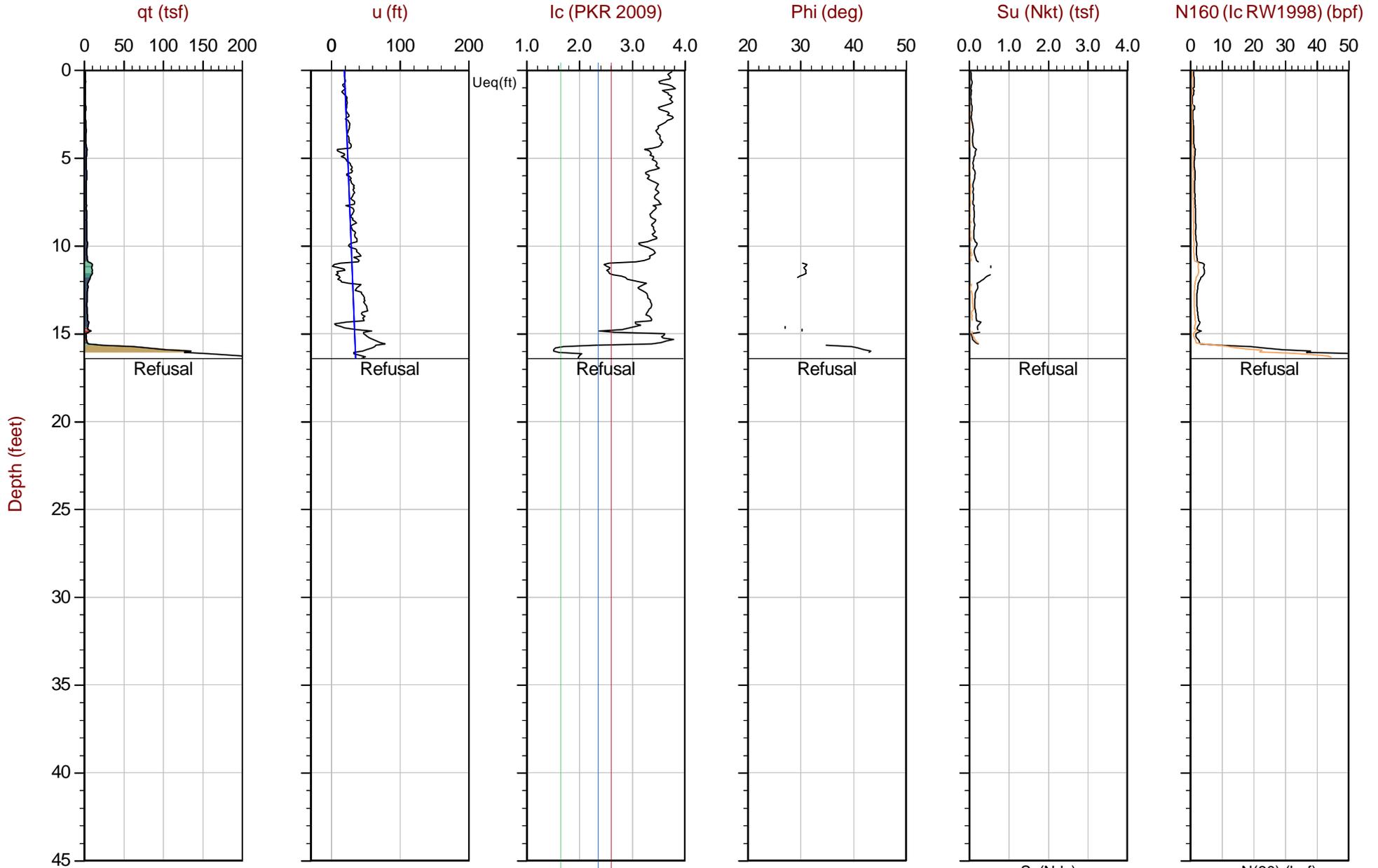


Max Depth: 12.700 m / 41.67 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP20.COR
 Unit Wt: SBTQtn(PKR2009)
 Su Nkt/Ndu: 15.0 / 6.0

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53712 Long: -122.32613

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

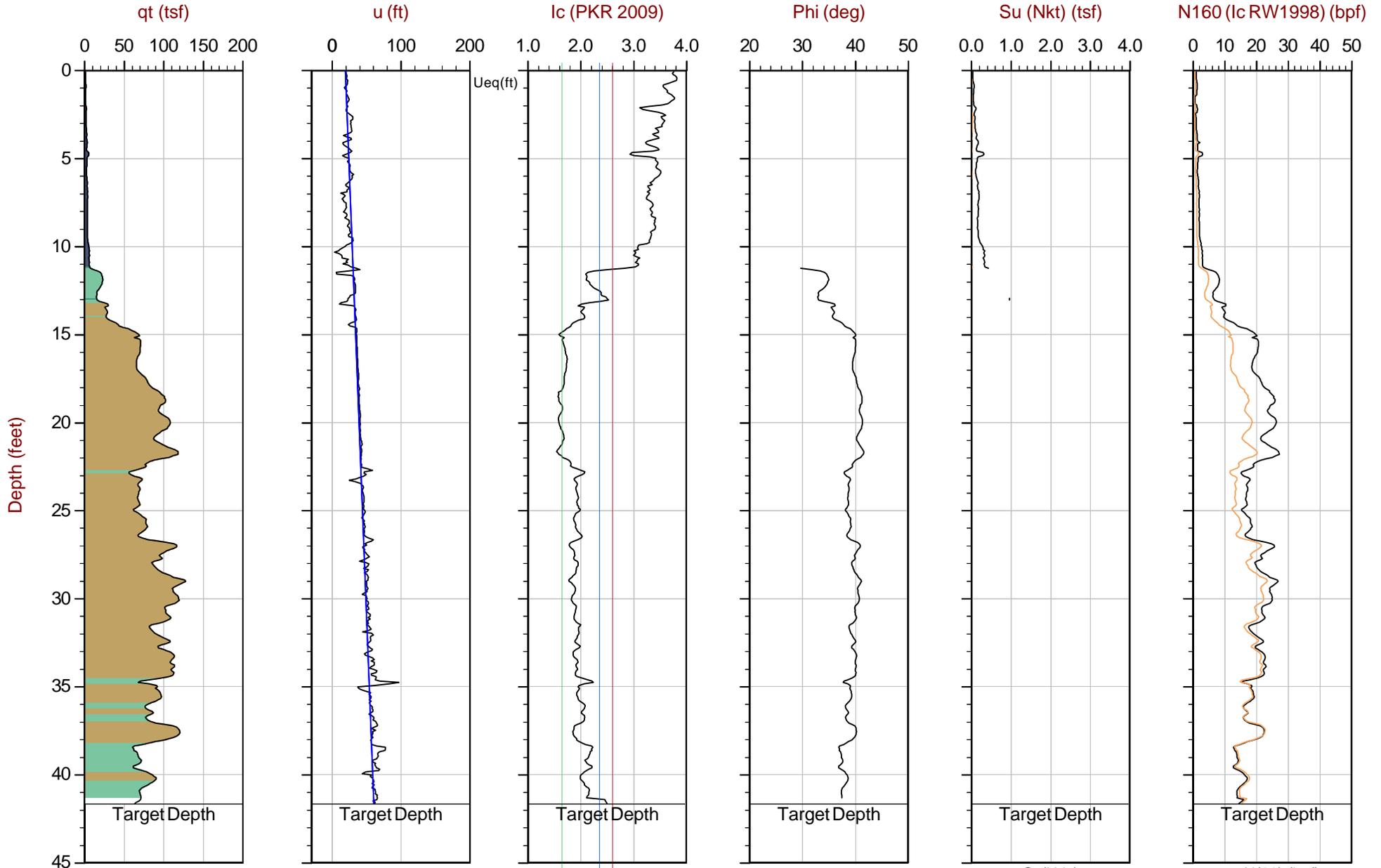


Max Depth: 5.000 m / 16.40 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP23.COR
 Unit Wt: SBTQtn(PKR2009)
 Su Nkt/Ndu: 15.0 / 6.0

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53591 Long: -122.32601

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◃ Dissipation, Ueq not achieved ◅ Dissipation, Ueq assumed — Hydrostatic Line
 The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



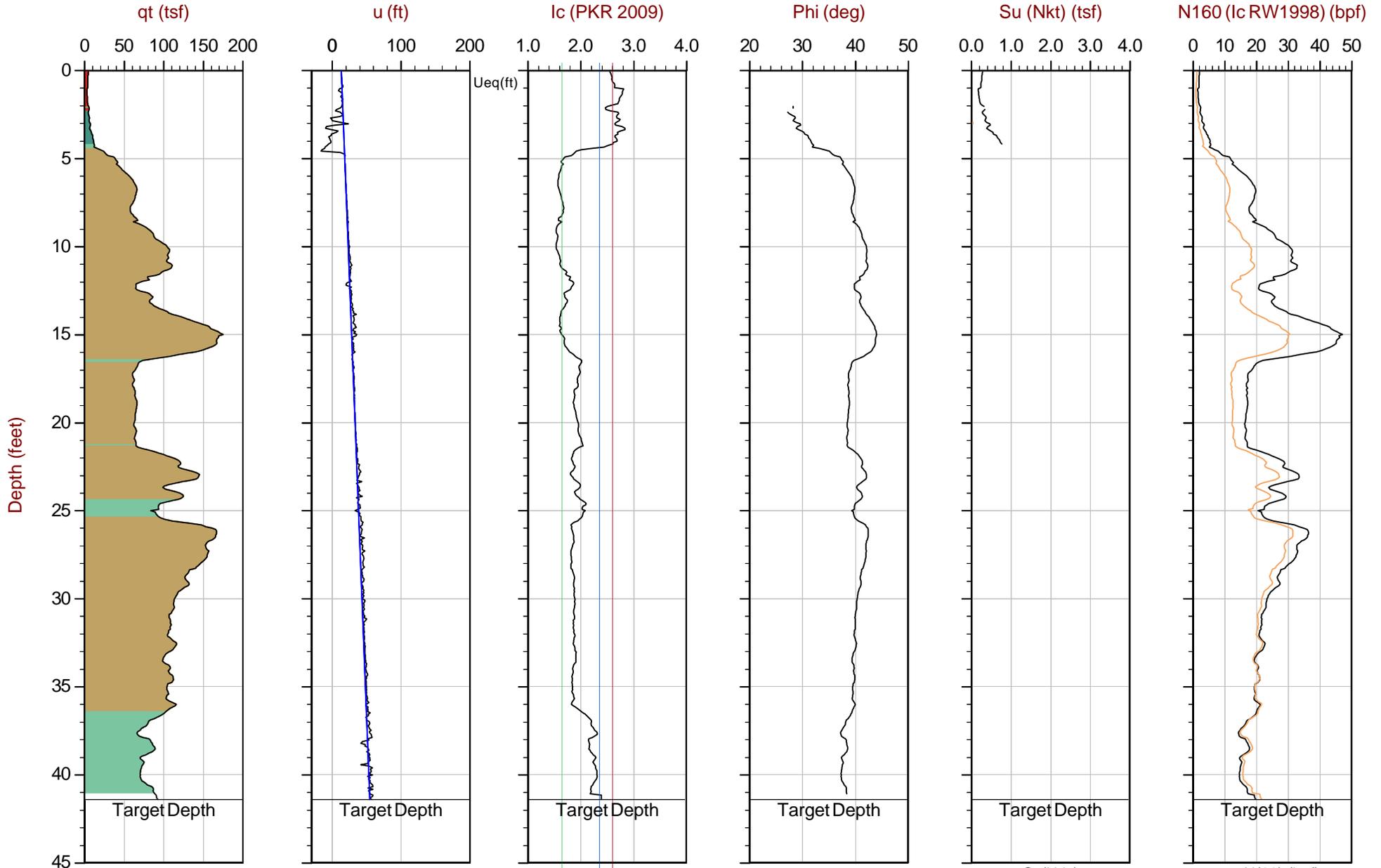
Max Depth: 12.700 m / 41.67 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP23B.COR
 Unit Wt: SBTQtn(PKR2009)
 Su Nkt/Ndu: 15.0 / 6.0

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53602 Long: -122.32599

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



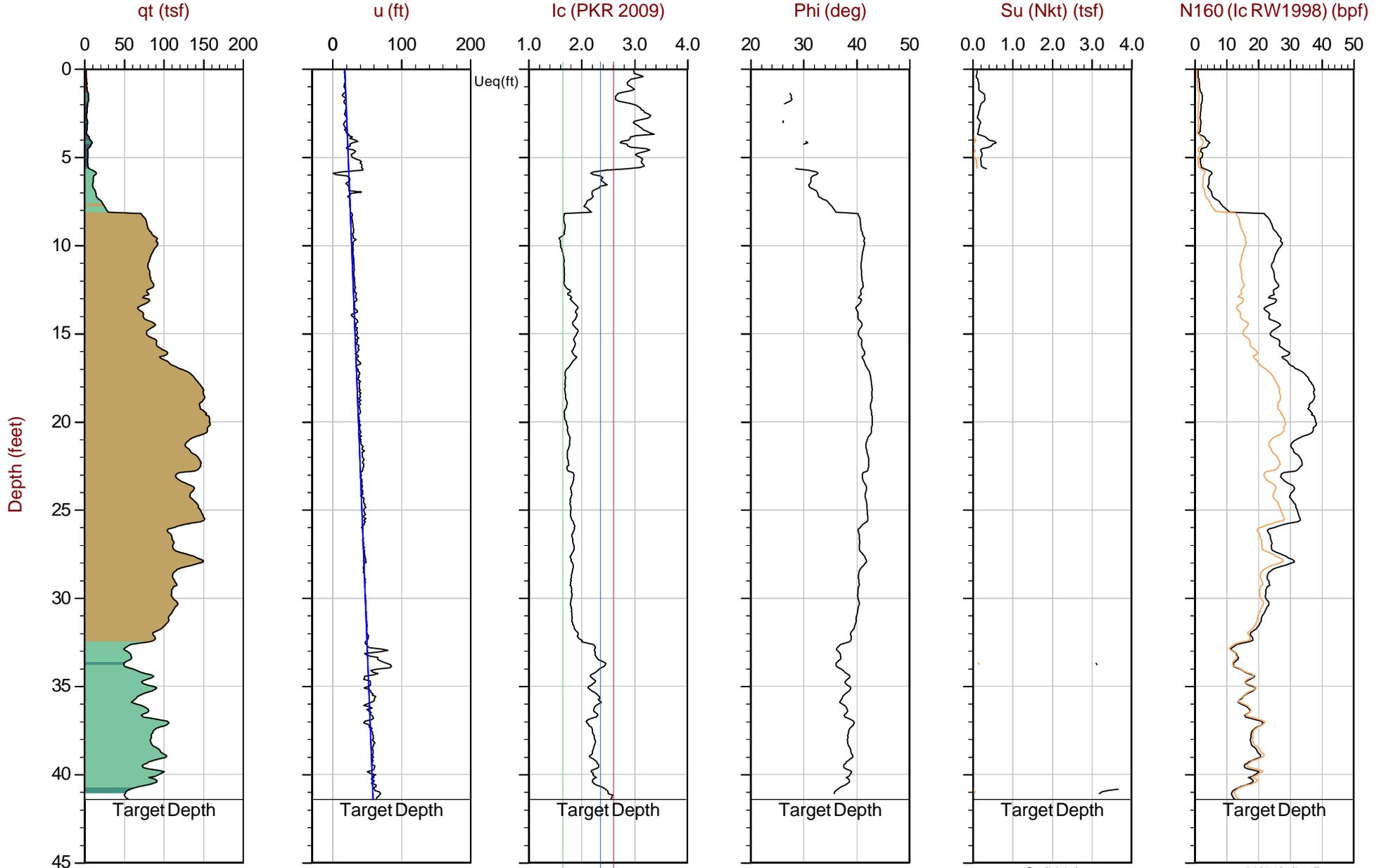
Max Depth: 12.625 m / 41.42 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP24.COR
 Unit Wt: SBTQtn(PKR2009)
 Su Nkt/Ndu: 15.0 / 6.0

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53484 Long: -122.32438

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



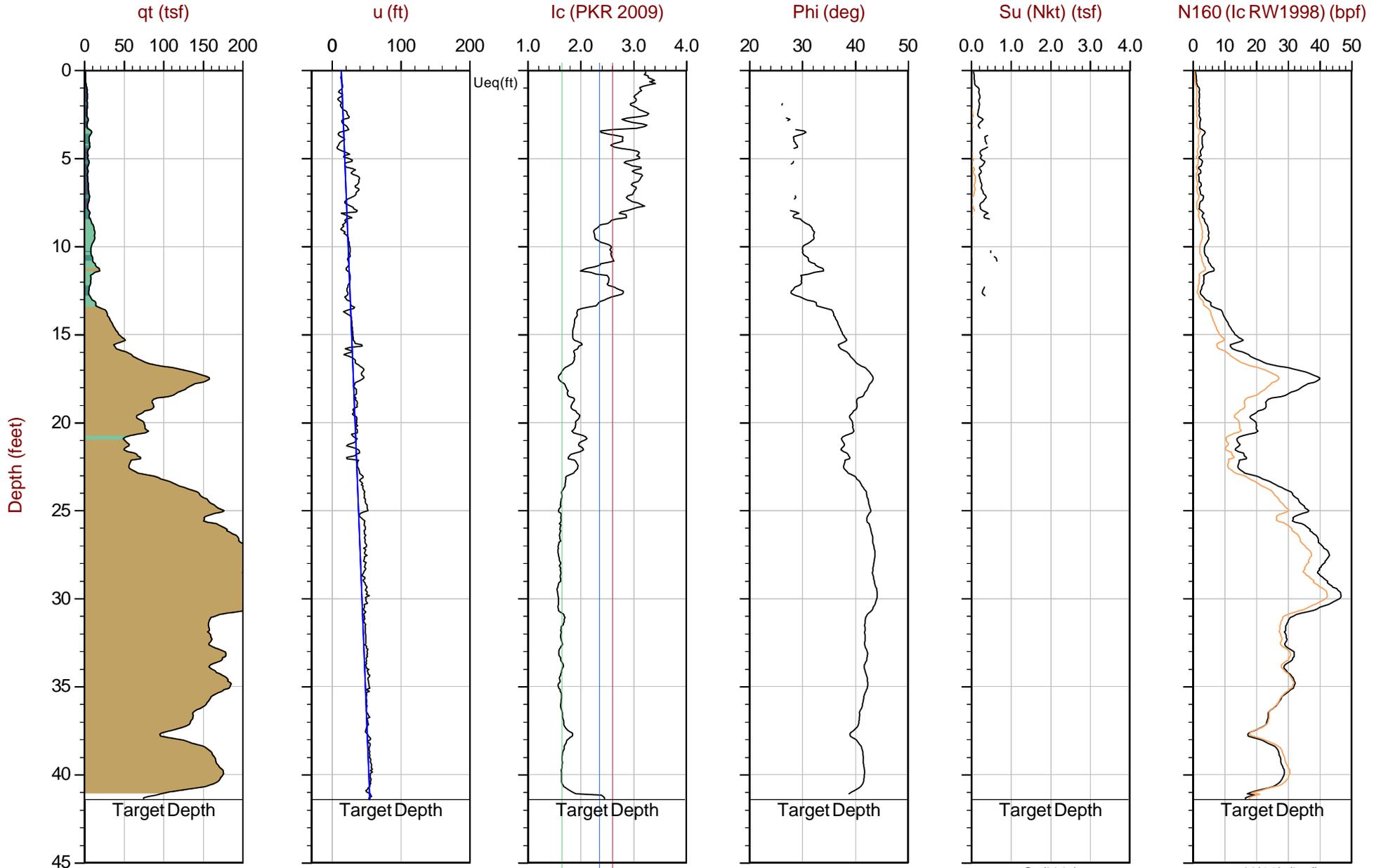
Max Depth: 12.625 m / 41.42 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP25.COR
 Unit Wt: SBTQtn(PKR2009)
 Su Nkt/Ndu: 15.0 / 6.0

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53434 Long: -122.32347

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



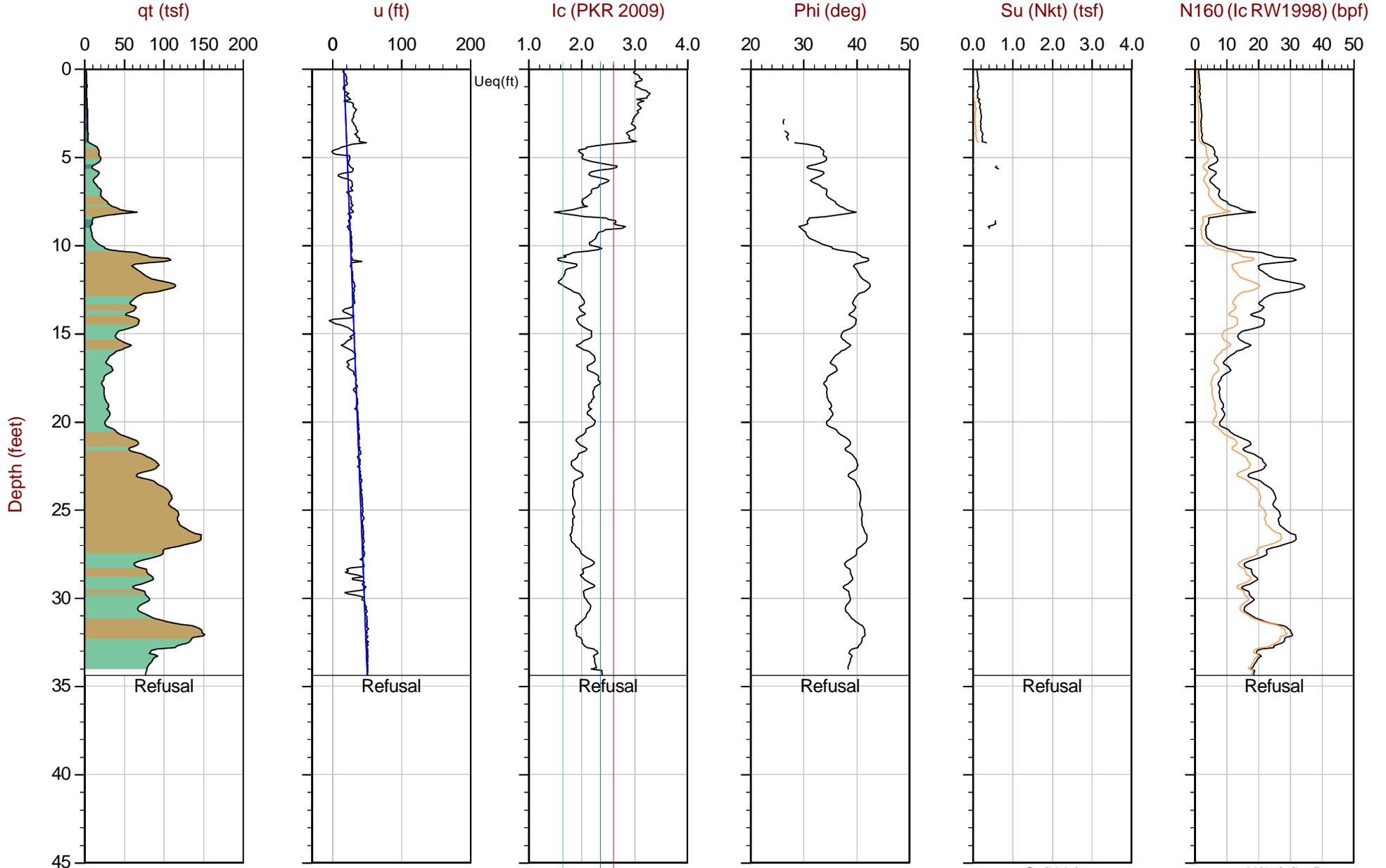
Max Depth: 12.625 m / 41.42 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP27.COR
 Unit Wt: SBTQtn(PKR2009)
 Su Nkt/Ndu: 15.0 / 6.0

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53547 Long: -122.32400

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ▷ Dissipation, Ueq not achieved ◂ Dissipation, Ueq assumed — Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



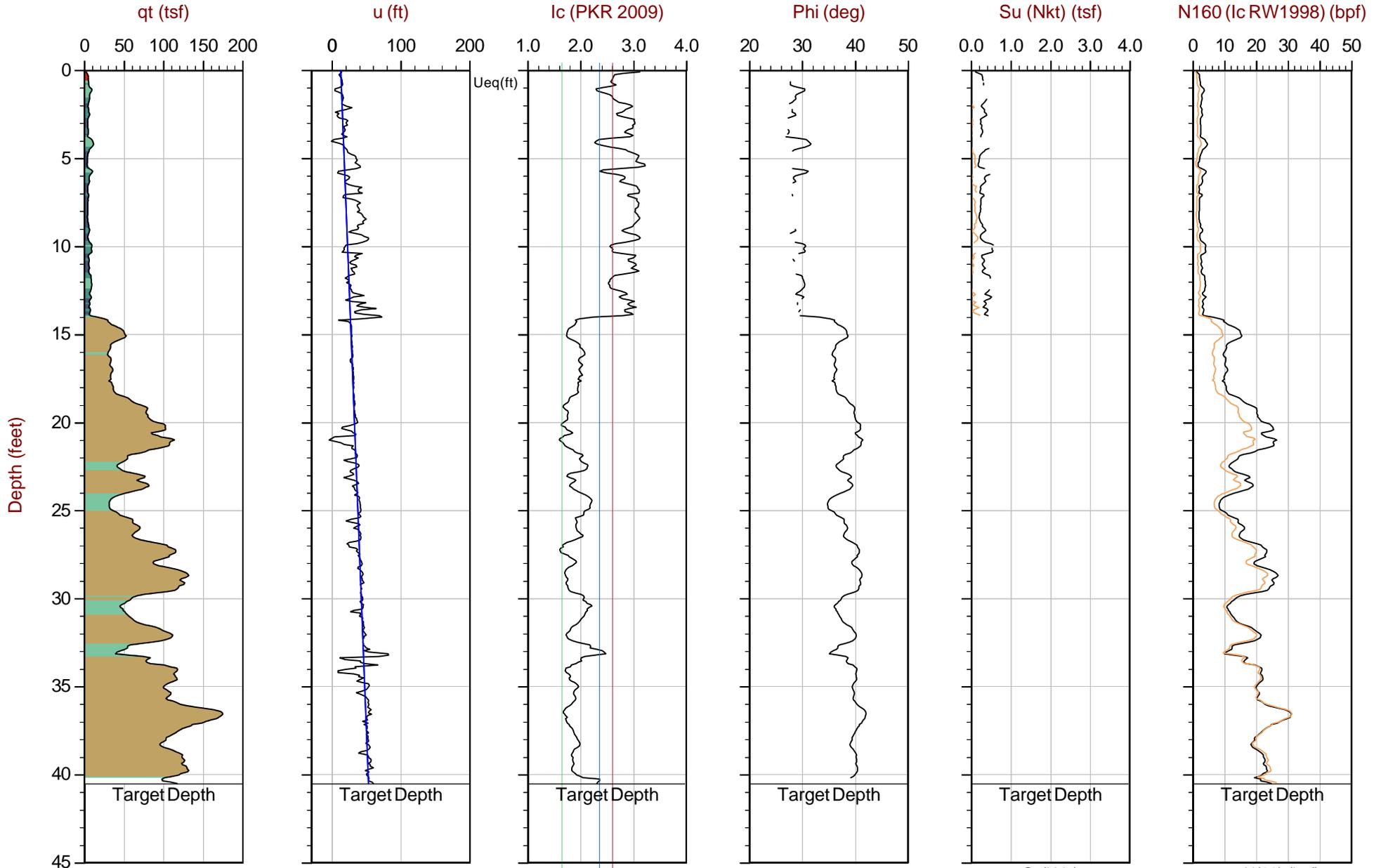
Max Depth: 10.475 m / 34.37 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

File: 24-59-27874_CP28.COR
 Unit Wt: SBTQtn (PKR2009), User Defined Layers
 Su Nkt/Ndu: 15.0 / 6.0

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53503 Long: -122.32332

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.



Max Depth: 12.350 m / 40.52 ft
 Depth Inc: 0.025 m / 0.082 ft
 Avg Int: Every Point

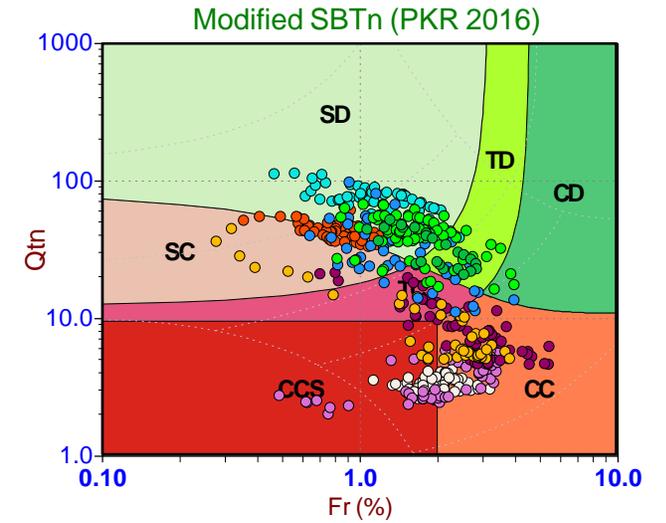
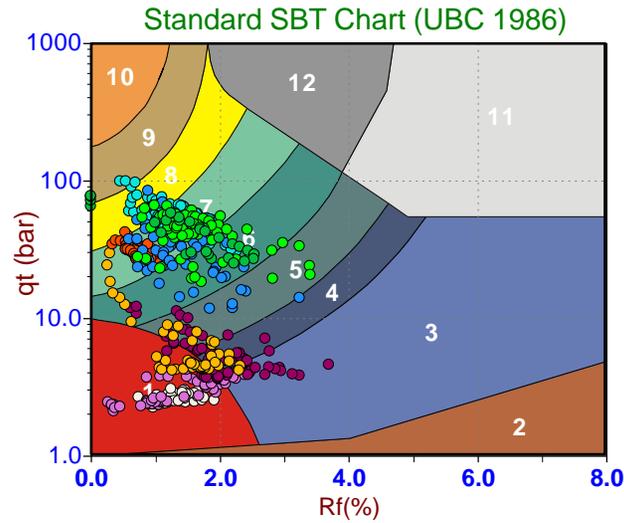
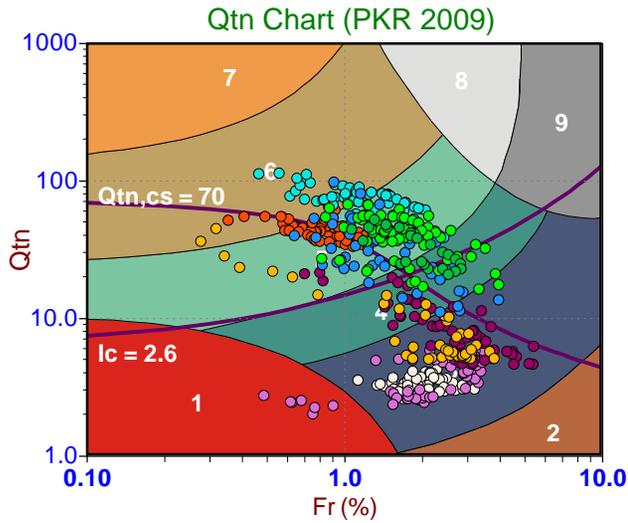
File: 24-59-27874_CP29.COR
 Unit Wt: SBTQtn (PKR2009), User Defined Layers
 Su Nkt/Ndu: 15.0 / 6.0

SBT: Robertson, 2009 and 2010
 Coords: Lat: 47.53514 Long: -122.32315

Overplot Item: ● Ueq ● Assumed Ueq ◁ Dissipation, Ueq achieved ◁ Dissipation, Ueq not achieved ◁ Dissipation, Ueq assumed — Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Soil Behavior Type (SBT) Scatter Plots



Depth Ranges

- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend

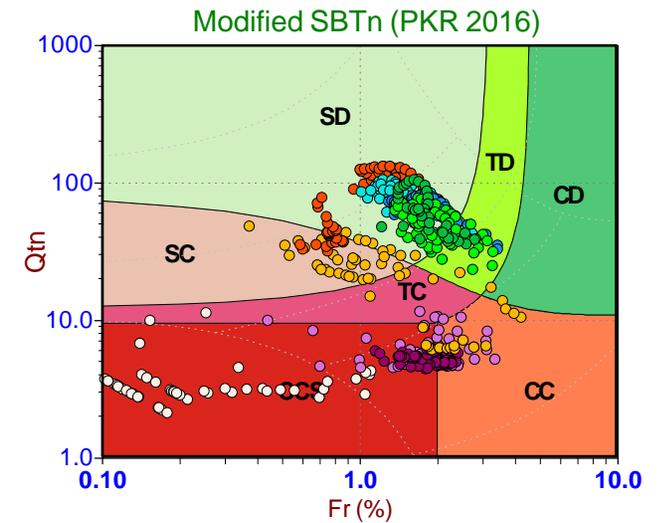
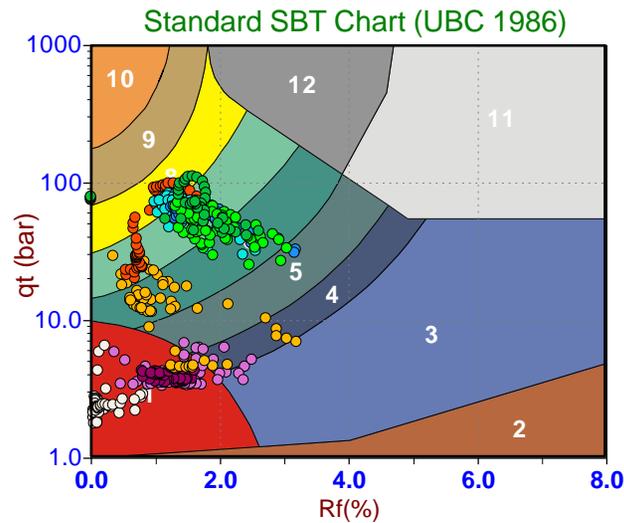
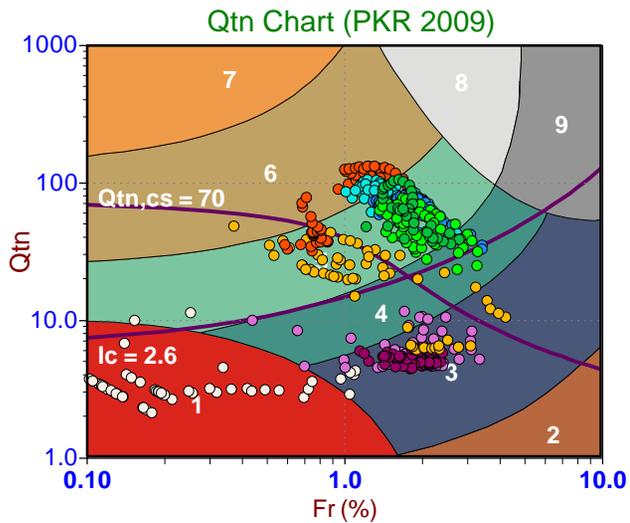
- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)



Depth Ranges

- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend

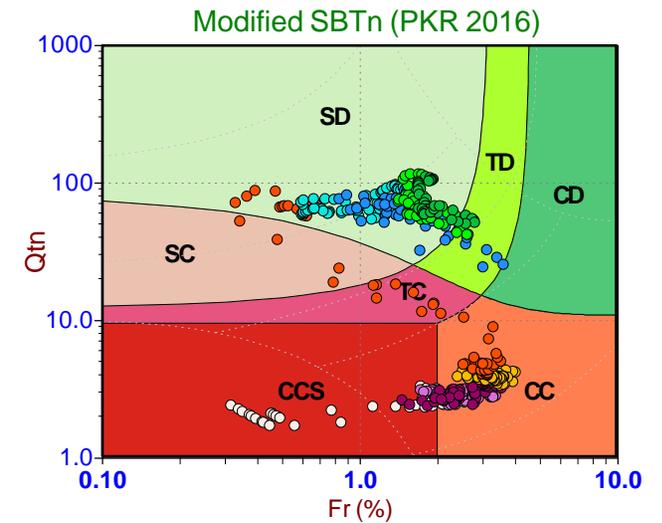
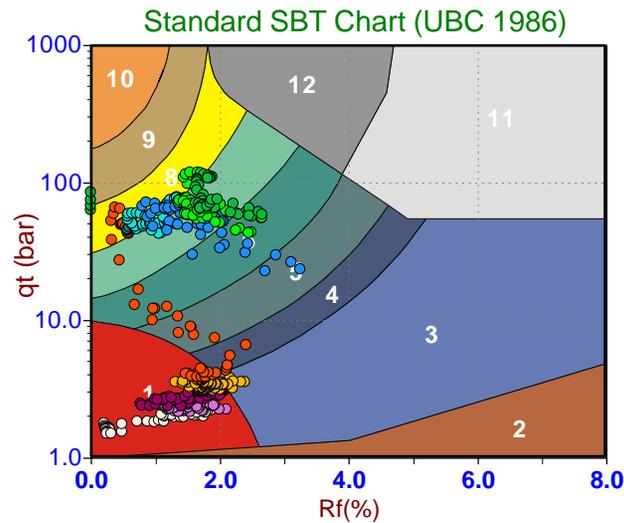
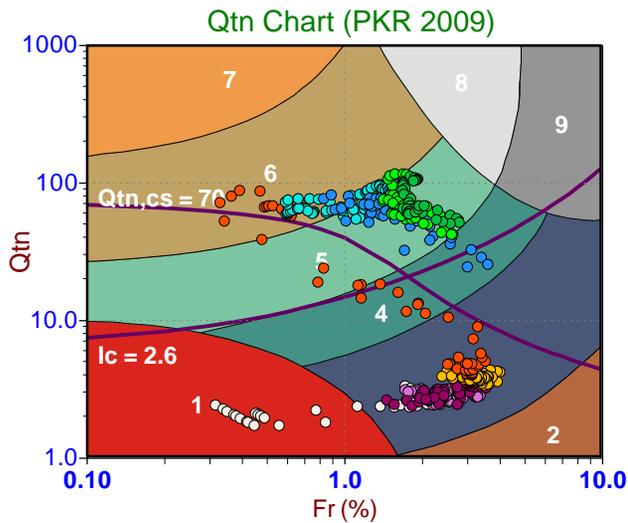
- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)



Depth Ranges

- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend

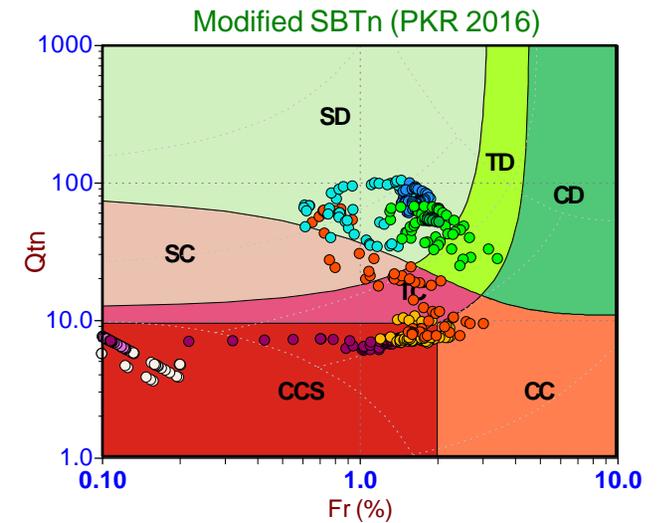
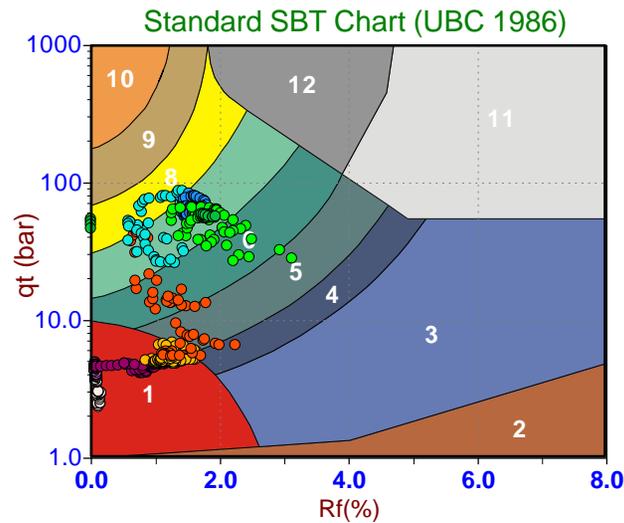
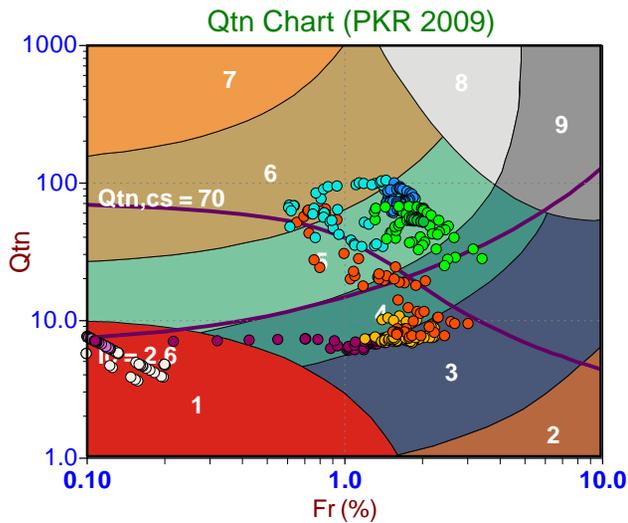
- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)



Depth Ranges

- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend

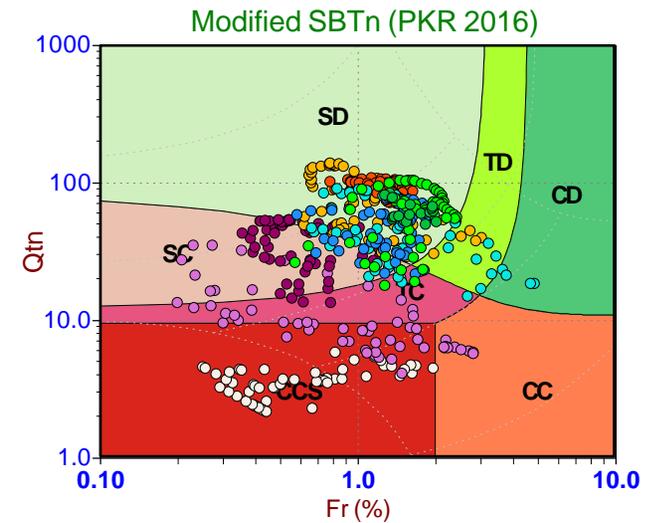
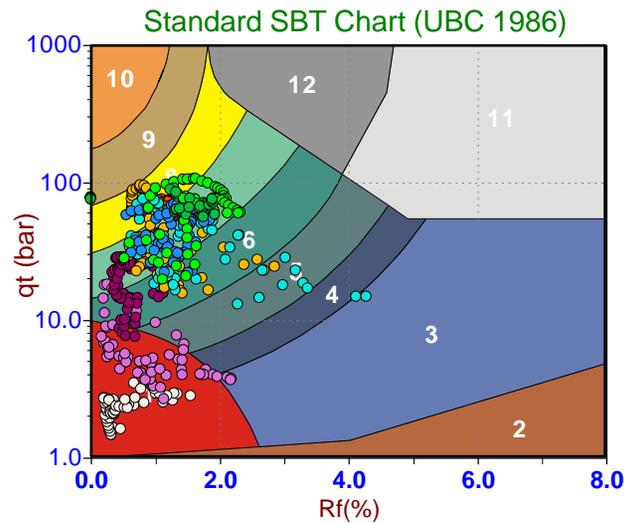
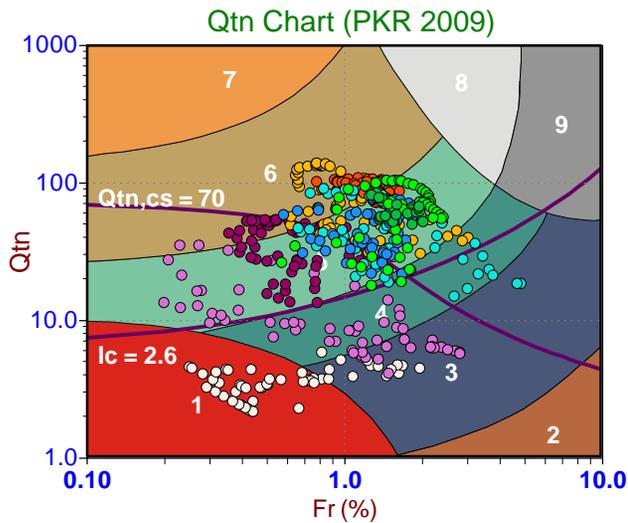
- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)



Depth Ranges

- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend

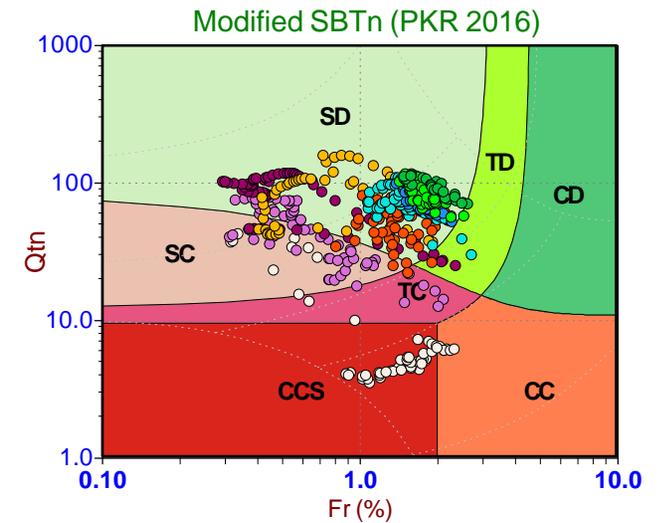
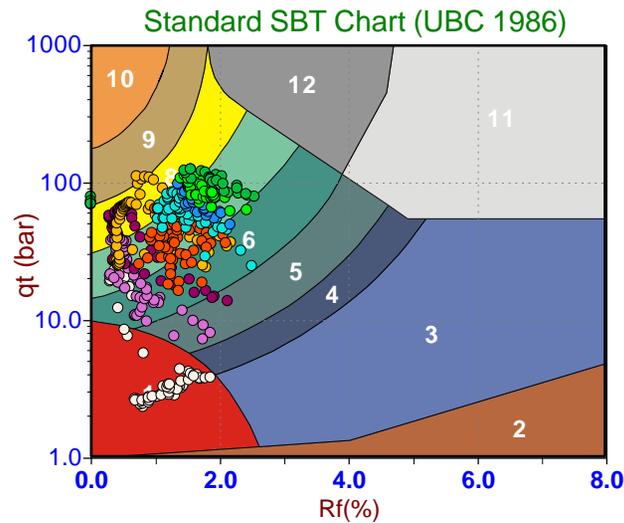
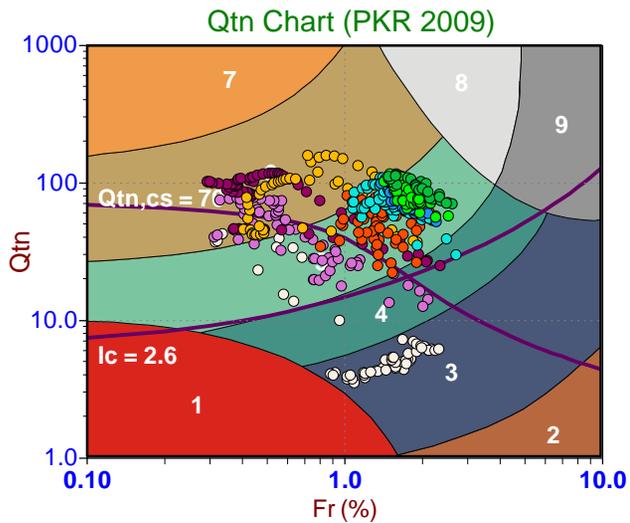
- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)



Depth Ranges

- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend

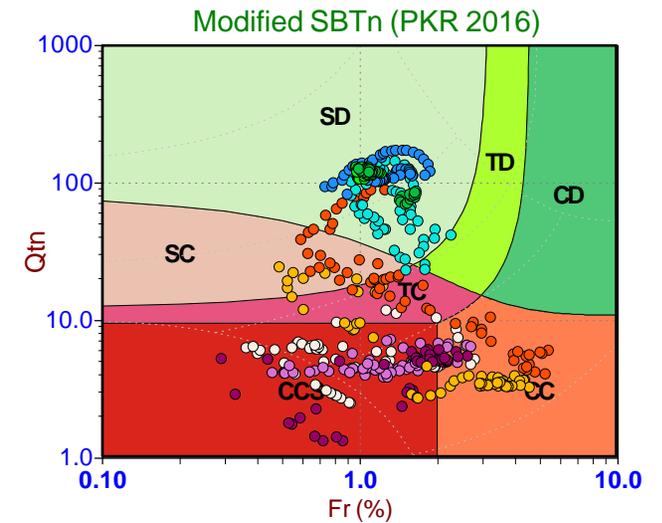
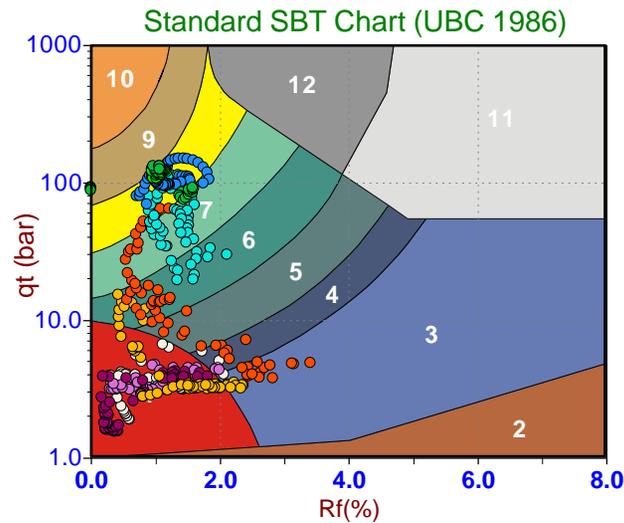
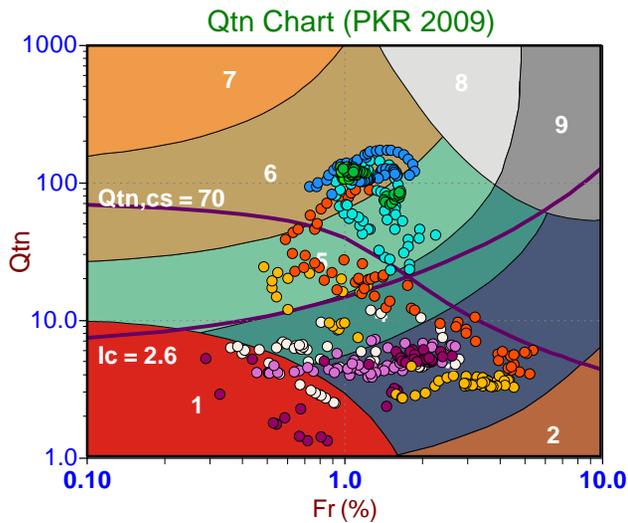
- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)



Depth Ranges

- >0.0 to 5.0 ft
- >5.0 to 10.0 ft
- >10.0 to 15.0 ft
- >15.0 to 20.0 ft
- >20.0 to 25.0 ft
- >25.0 to 30.0 ft
- >30.0 to 35.0 ft
- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
- >45.0 to 50.0 ft
- >50.0 ft

Legend

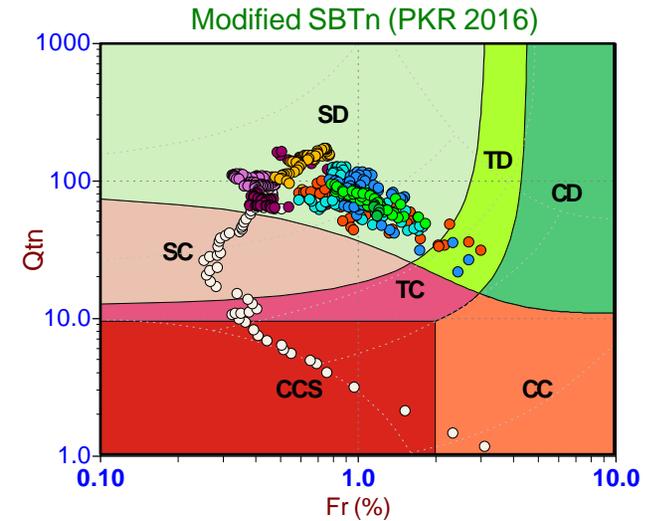
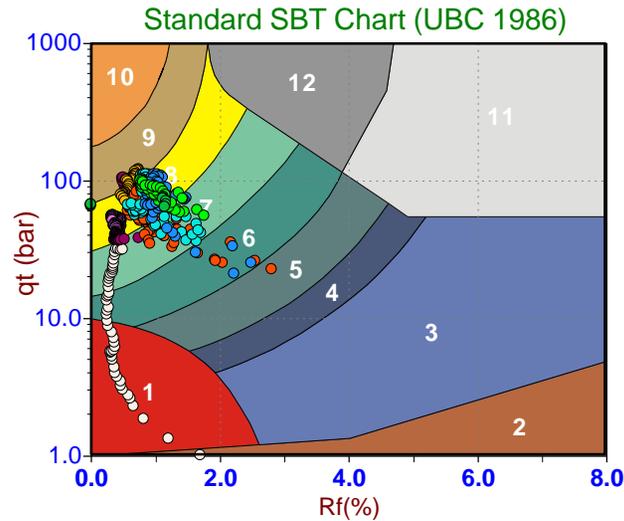
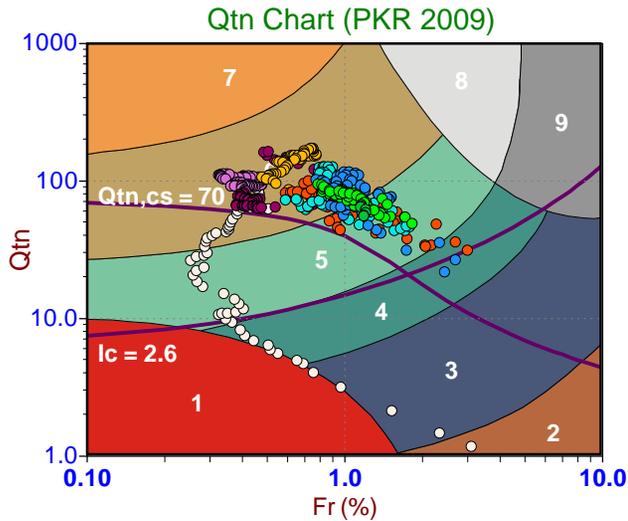
- Sensitive, Fine Grained
- Organic Soils
- Clays
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- Gravelly Sand to Sand
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- >35.0 to 40.0 ft
- >40.0 to 45.0 ft
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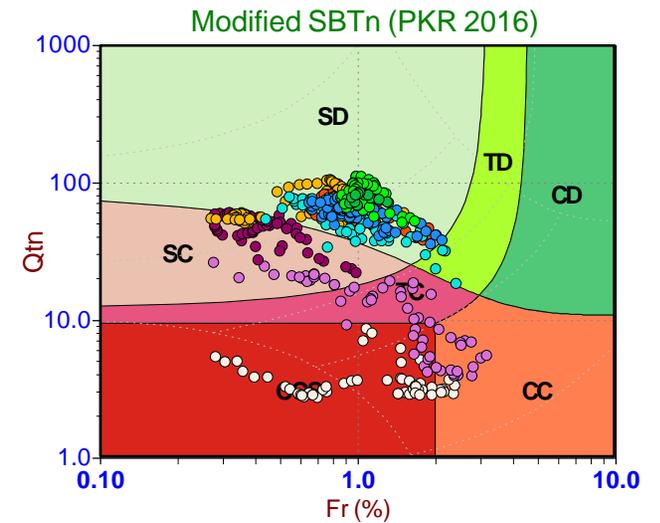
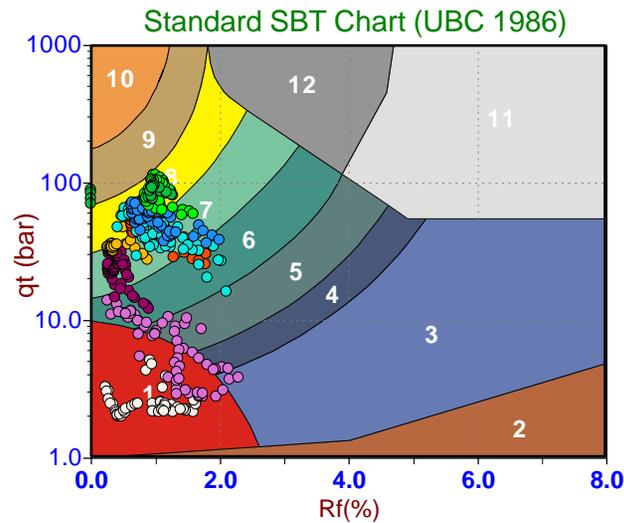
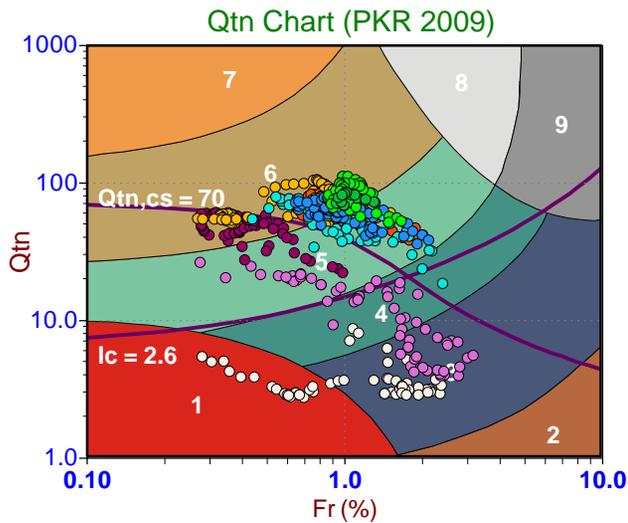
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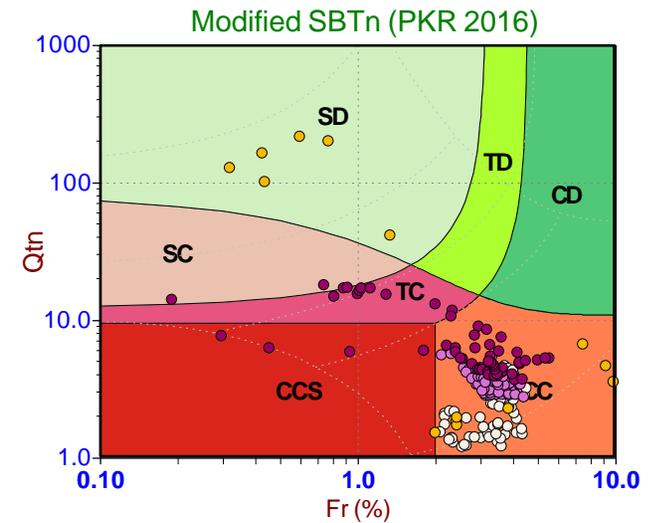
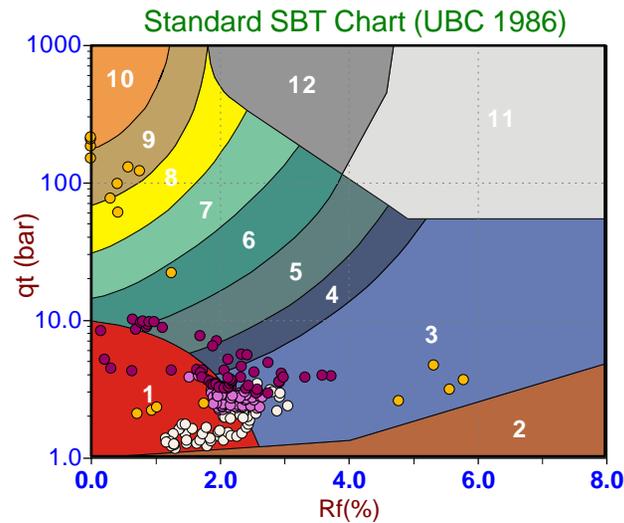
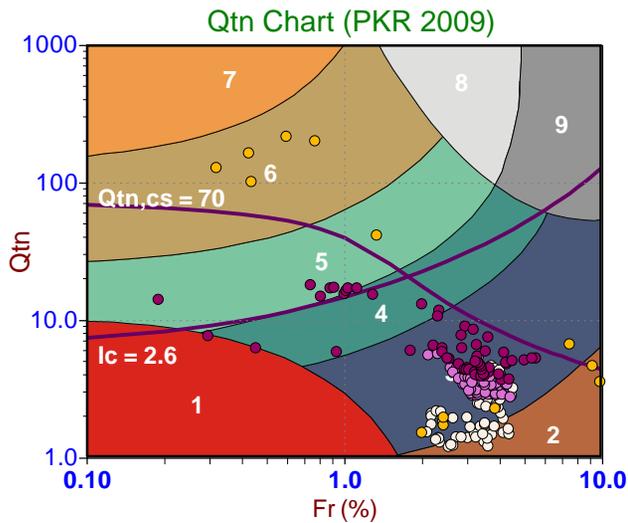
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Legend

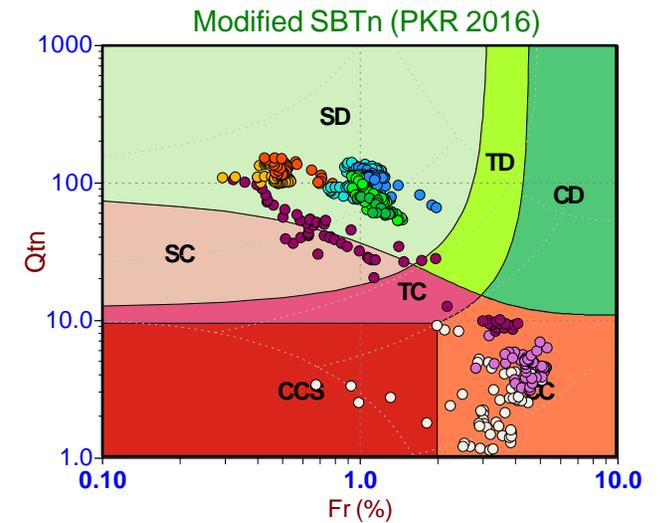
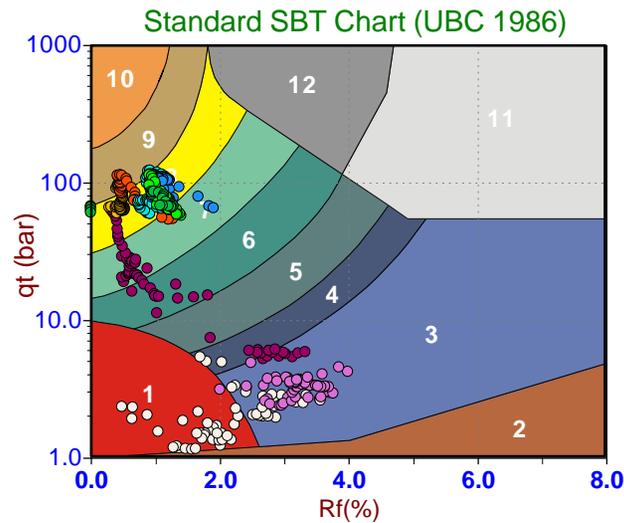
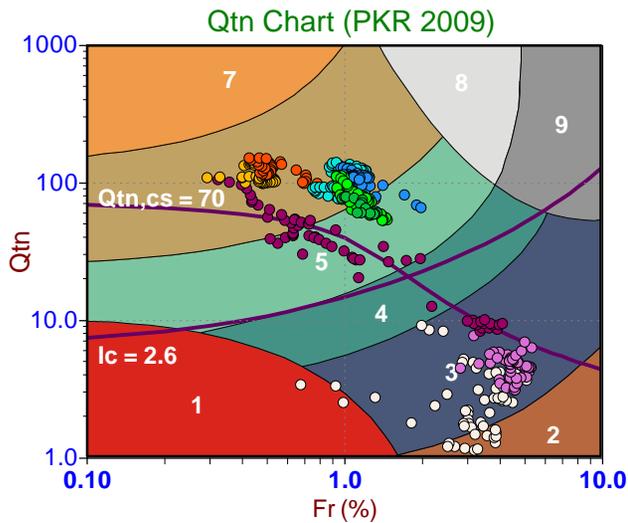
- Sensitive, Fine Grained
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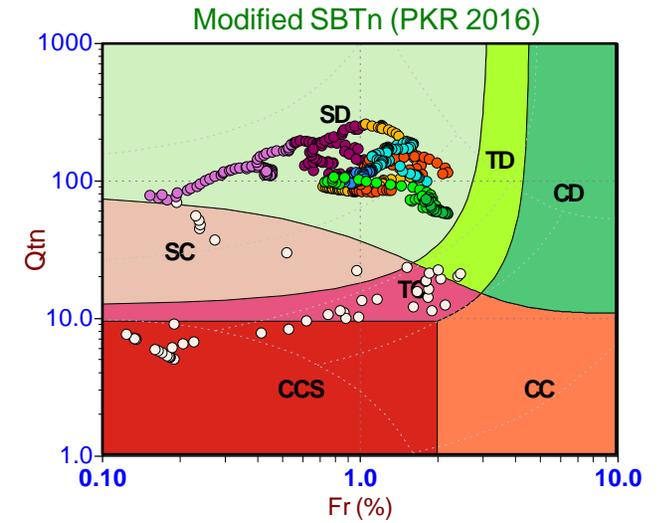
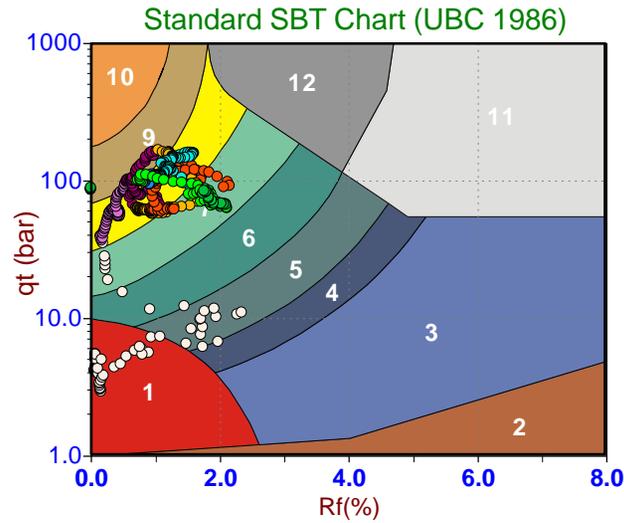
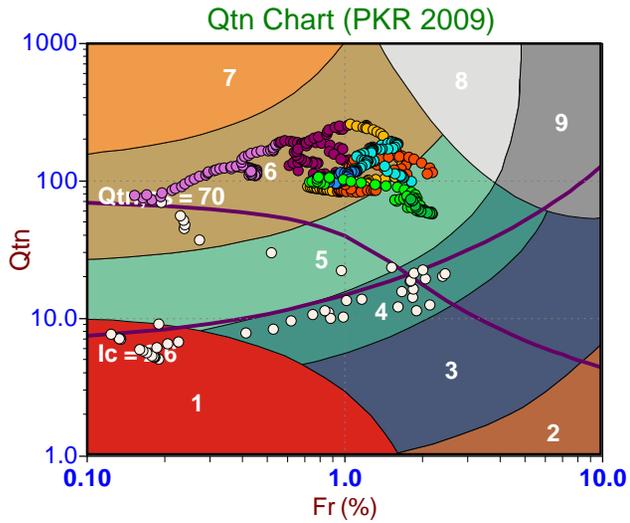
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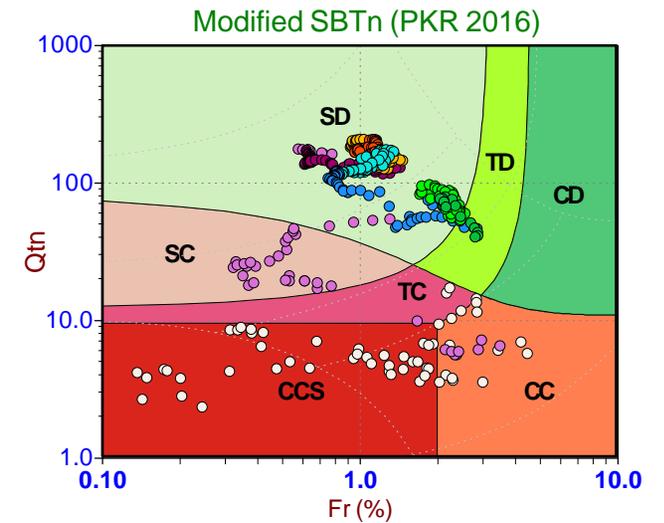
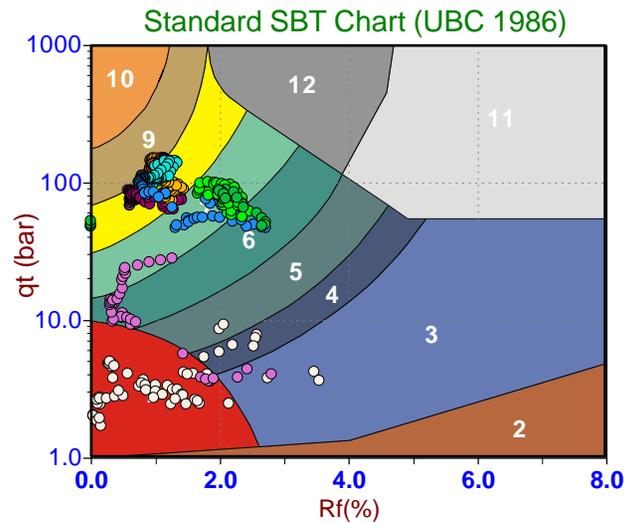
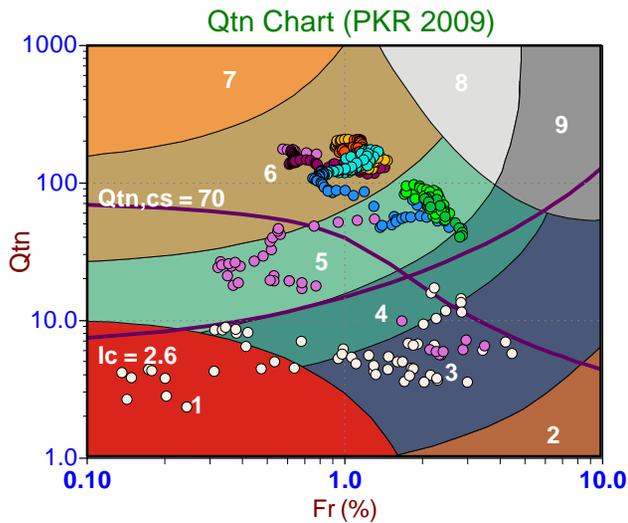
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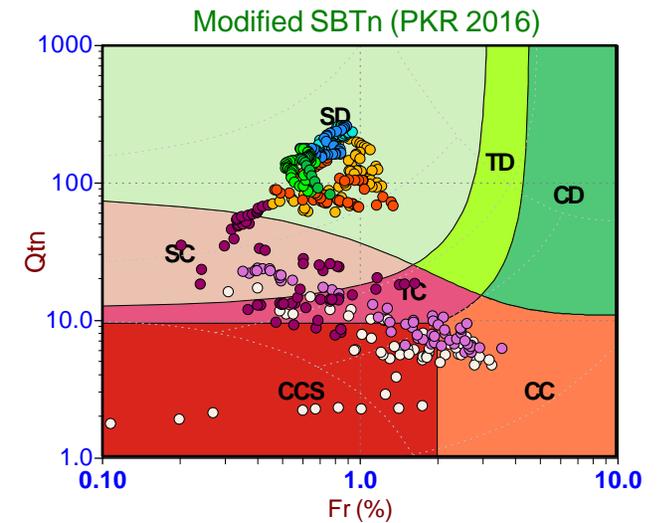
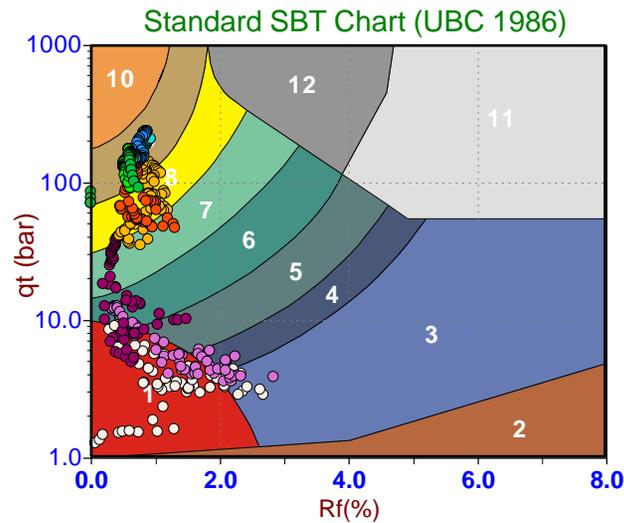
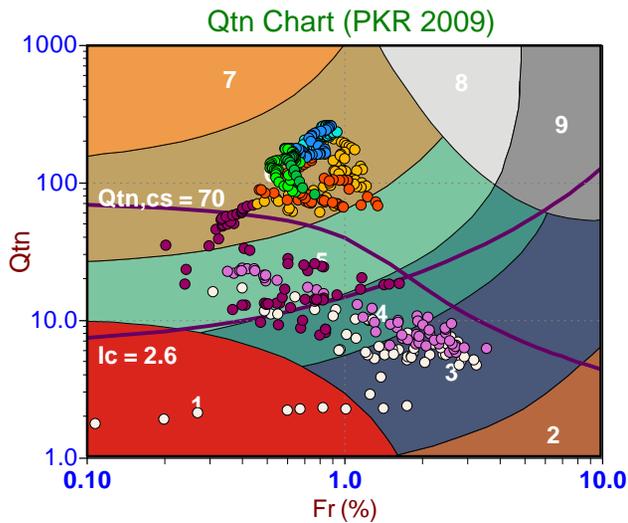
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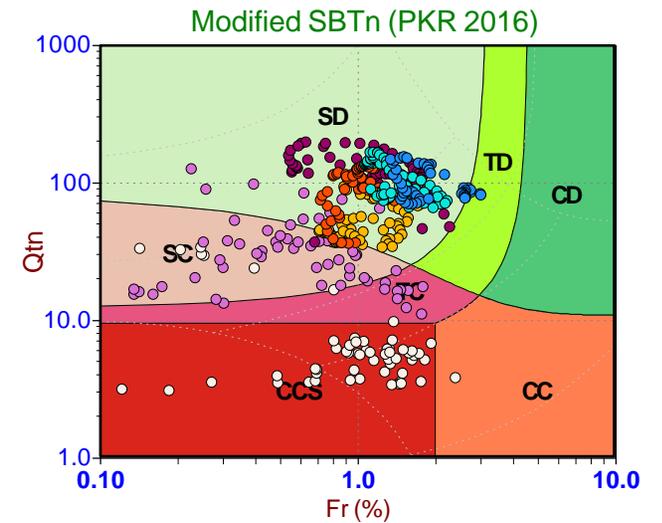
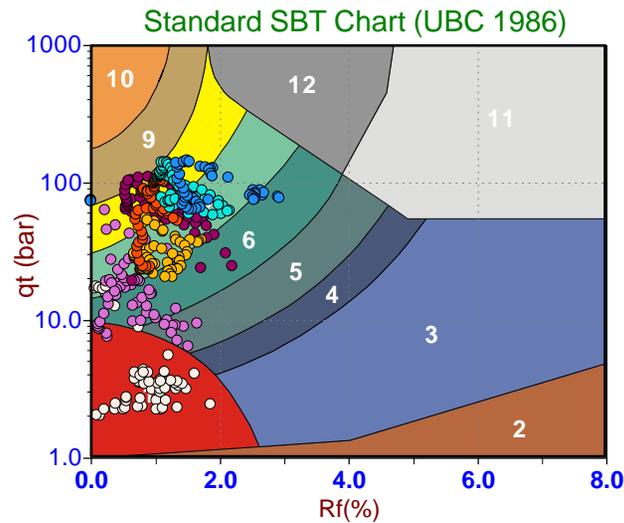
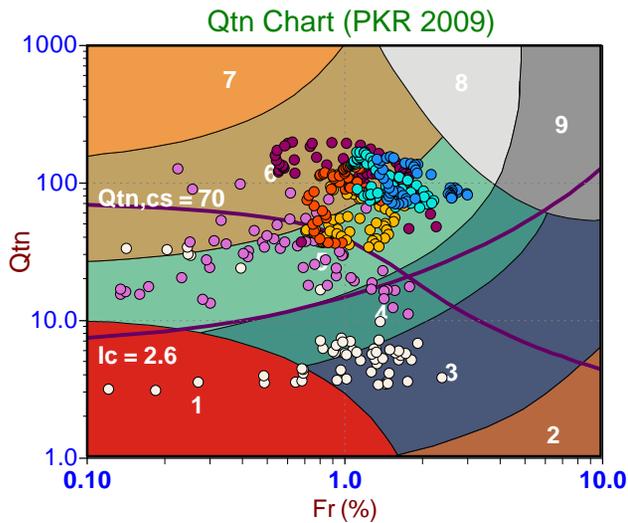
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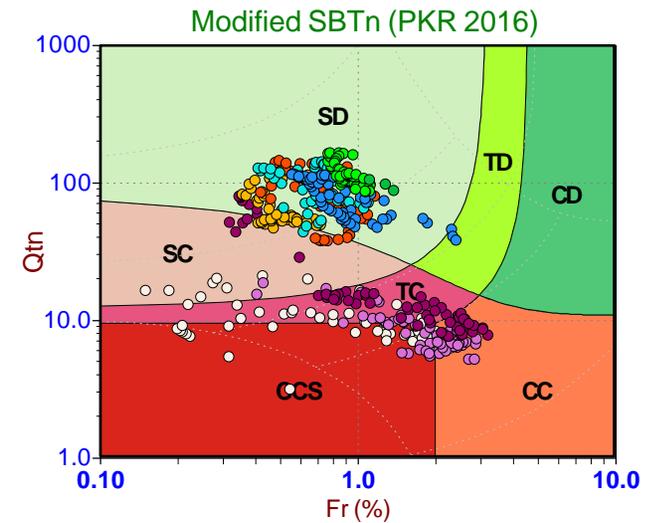
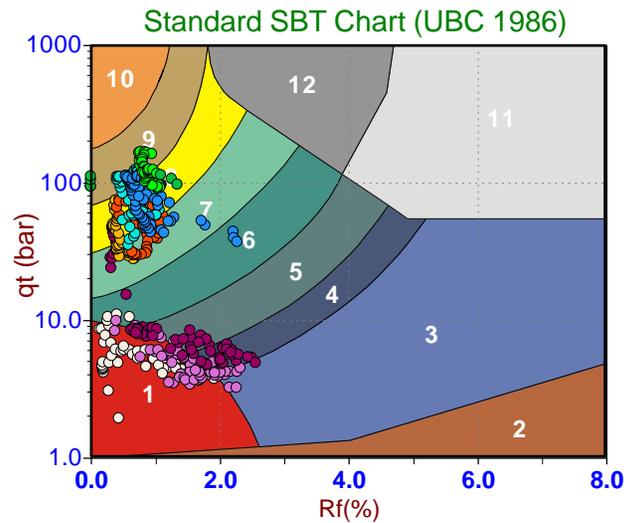
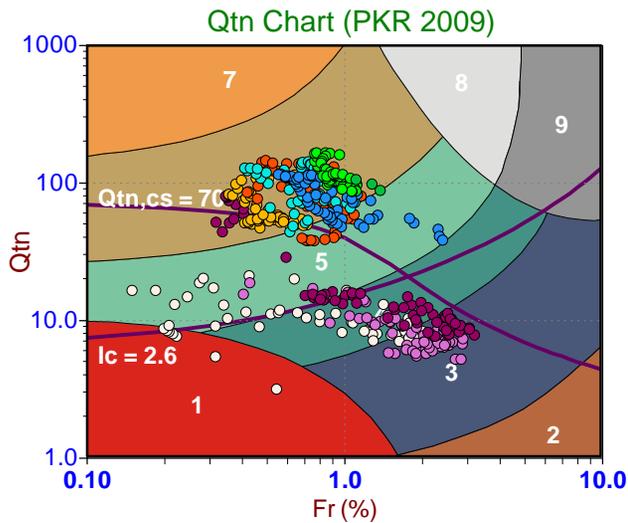
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Full-Flow Ball Cone Penetration Test (BCPT) Summary, Unit Weight Summary and BCPT Plots



Job No: 24-59-27874
Client: Anchor QEA
Project: Lower Duwamish Waterway Middle Reach
Start Date: 2024-07-08
End Date: 2024-07-14

BALL FULL FLOW PENETRATION TEST SUMMARY

Sounding ID	File Name	Date	Cone	Cone Area (cm ²)	Ball Area (cm ²)	Assumed Phreatic Surface ¹ (ft)	Final Depth ¹ (ft)	Cycling Conducted	Latitude ²	Longitude ²	Refer to Notation Number
LDW23-GT05-GT-FFP	24-59-27874_BP05	2024-07-13	767:T1000F10U35	10	100	-19.17	20.01	Yes	47.54354	-122.33574	
LDW23-GT07-GT-FFP	24-59-27874_BP07	2024-07-13	767:T1000F10U35	10	100	-18.33	4.35	Yes	47.54334	-122.33543	
LDW23-GT12-GT-FFP	24-59-27874_BP12	2024-07-08	767:T1000F10U35	10	100	-13.67	4.76	Yes	47.54051	-122.33283	
LDW23-GT14-GT-FFP	24-59-27874_BP14	2024-07-08	767:T1000F10U35	10	100	-14.67	4.59	Yes	47.53998	-122.33199	
LDW23-GT28-GT-FFP	24-59-27874_BP28	2024-07-14	767:T1000F10U35	10	100	-19.67	6.40	Yes	47.53506	-122.32329	
LDW23-GT29-GT-FFP	24-59-27874_BP29	2024-07-12	681:T375F10U35	15	150	-12.58	0.98	Yes	47.53513	-122.32312	
Total							41.09 ft				

1. All data profiles were began at the mudline surface. Assumed phreatic surface was measured by dip-tape immediately prior to testing and referenced for calculations.
2. The coordinates were collected using consumer grade GPS and have an accuracy of ±30 feet. EPSG number: 4326 (WGS84 / LatLong).



Job No: 24-59-27874
Client: Anchor QEA
Project: Lower Duwamish Waterway Middle Reach
Start Date: 2024-07-08
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BCPT_u ASSUMED UNIT WEIGHT SUMMARY

Sounding ID	File Name	Final Depth (ft)	Assumed Unit Weight Start Depth (ft)	Assumed Unit Weight End Depth (ft)	Assumed Unit Weight ¹ (kN/m ³)	Refer to Notation Number
LDW23-GT05-GT-FFP	24-59-27874_BP05	20.01	-19.17	0.00	9.81	
LDW23-GT05-GT-FFP	24-59-27874_BP05	20.01	0.00	20.01	17.50	
LDW23-GT07-GT-FFP	24-59-27874_BP07	4.35	-18.33	0.00	9.81	
LDW23-GT07-GT-FFP	24-59-27874_BP07	4.35	0.00	4.35	17.50	
LDW23-GT12-GT-FFP	24-59-27874_BP12	4.76	-13.67	0.00	9.81	
LDW23-GT12-GT-FFP	24-59-27874_BP12	4.76	0.00	4.76	17.50	
LDW23-GT14-GT-FFP	24-59-27874_BP14	4.59	-14.67	0.00	9.81	
LDW23-GT14-GT-FFP	24-59-27874_BP14	4.59	0.00	4.59	17.50	
LDW23-GT28-GT-FFP	24-59-27874_BP28	6.40	-19.67	0.00	9.81	
LDW23-GT28-GT-FFP	24-59-27874_BP28	6.40	0.00	6.40	17.50	
LDW23-GT29-GT-FFP	24-59-27874_BP29	0.98	-12.58	0.00	9.81	
LDW23-GT29-GT-FFP	24-59-27874_BP29	0.98	0.00	0.98	17.50	

1. A unit weight of 9.81 kN/m³ was assumed for data above the mudline, within the water layer.

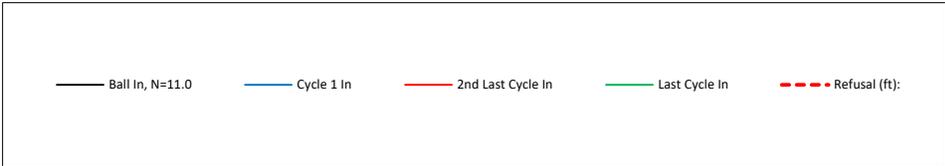
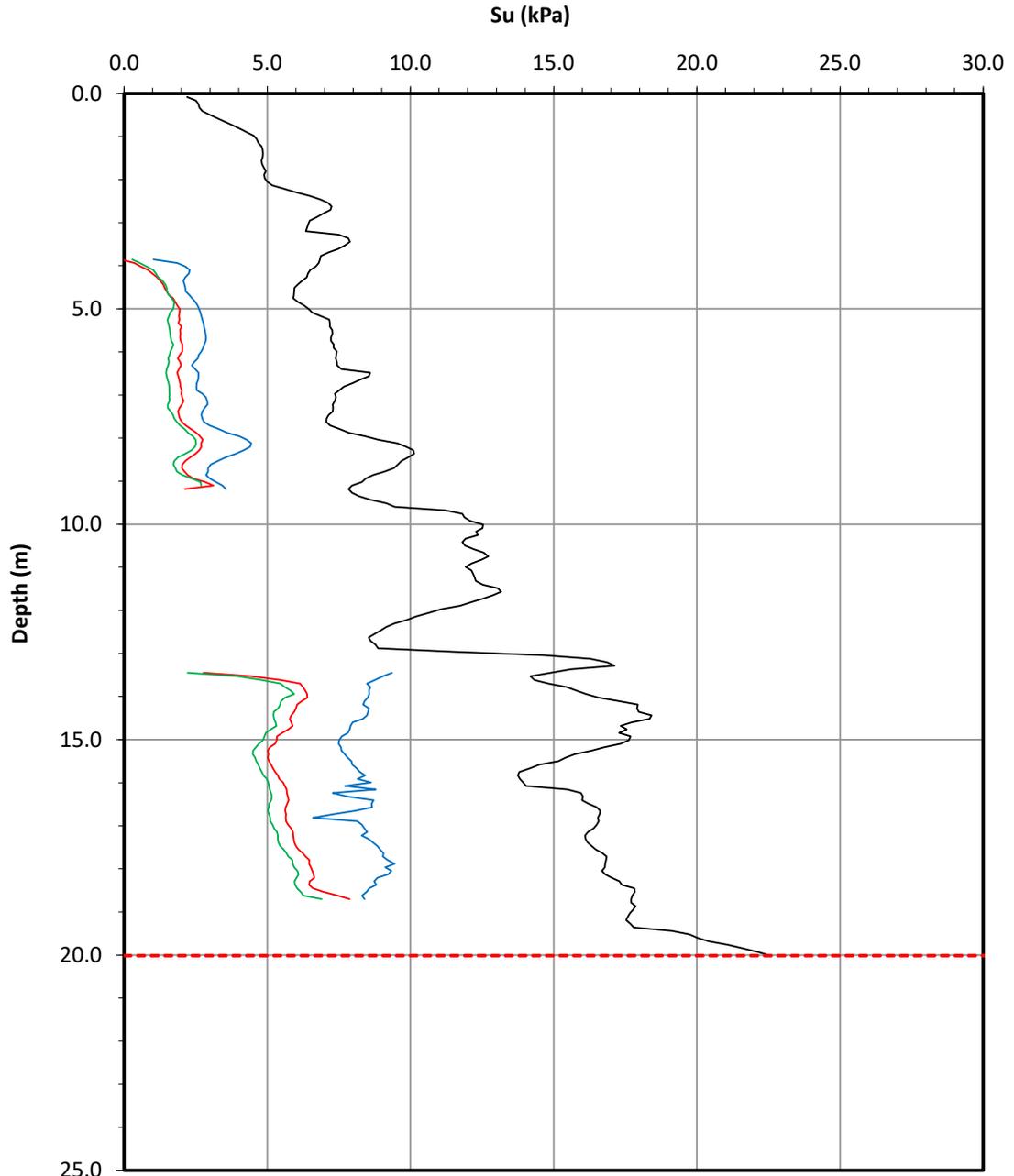
1. A unit weight of 17.50 kN/m³ was assumed for data below the mudline.



Job No: 24-59-27874
Client: Anchor QEA
Project: Lower Duwamish Waterway Middle Reach
Sounding ID: LDW23-GT05-GT-FFP
Sounding Date: 2024-07-13

Coordinate System: WGS84 / Lat-Long
Latitude (deg): 47.54354
Longitude (deg): -122.33574

Flow Penetrometer Undrained Strength

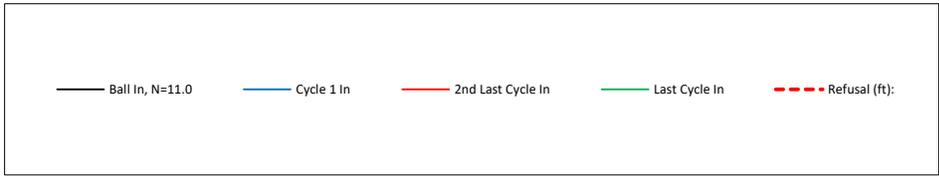
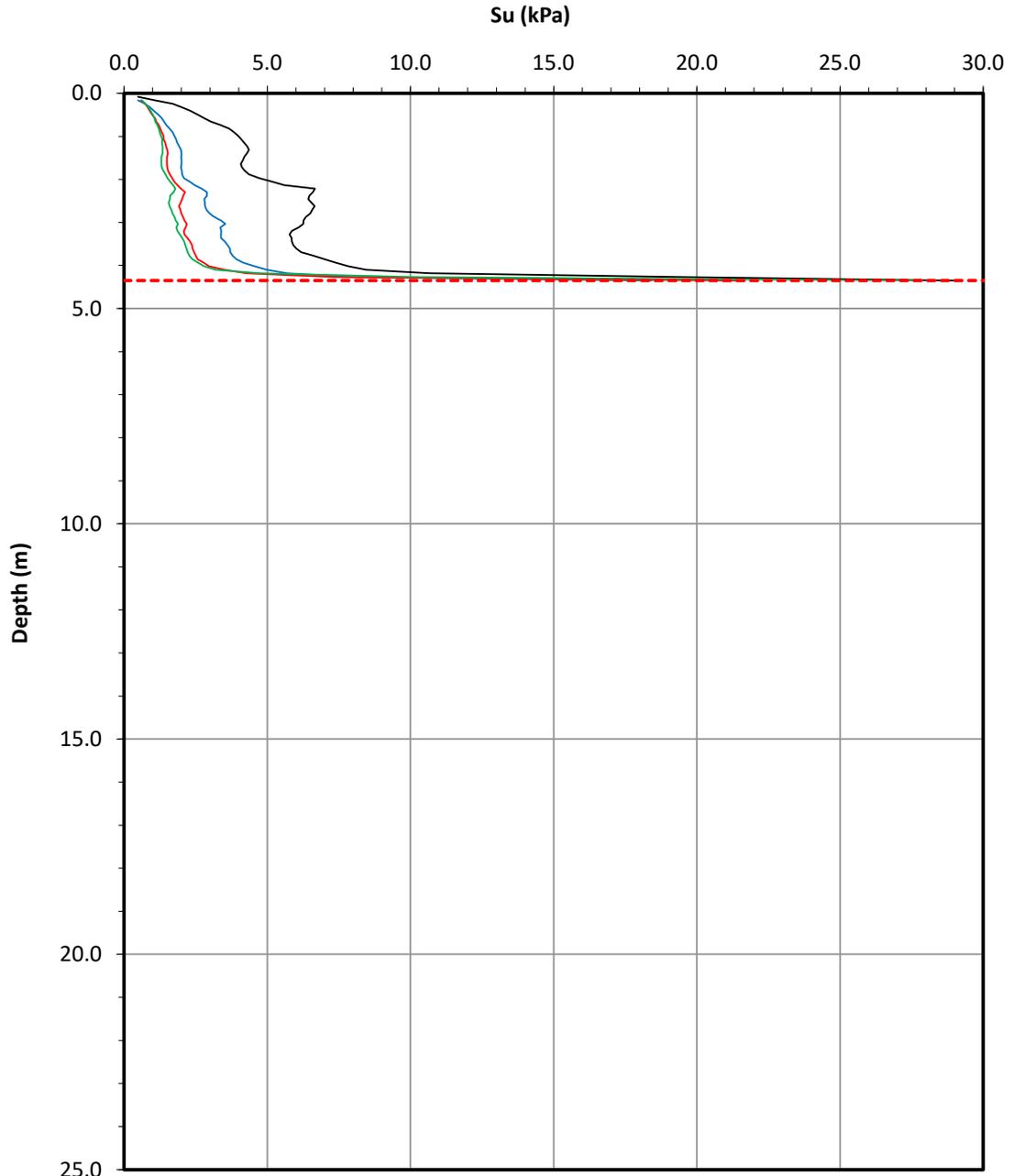




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Client: Anchor QEA
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Sounding ID: LDW23-GT07-GT-FFP
Sounding Date: 2024-07-13

Coordinate System: WGS84 / Lat-Long
Latitude (deg): 47.54334
Longitude (deg): -122.33543

Flow Penetrometer Undrained Strength

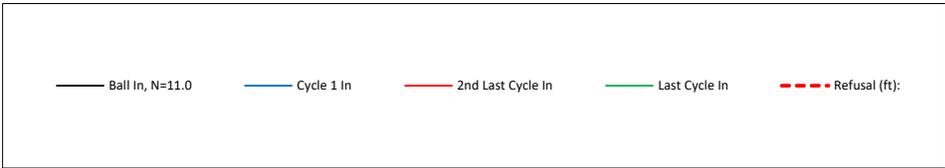
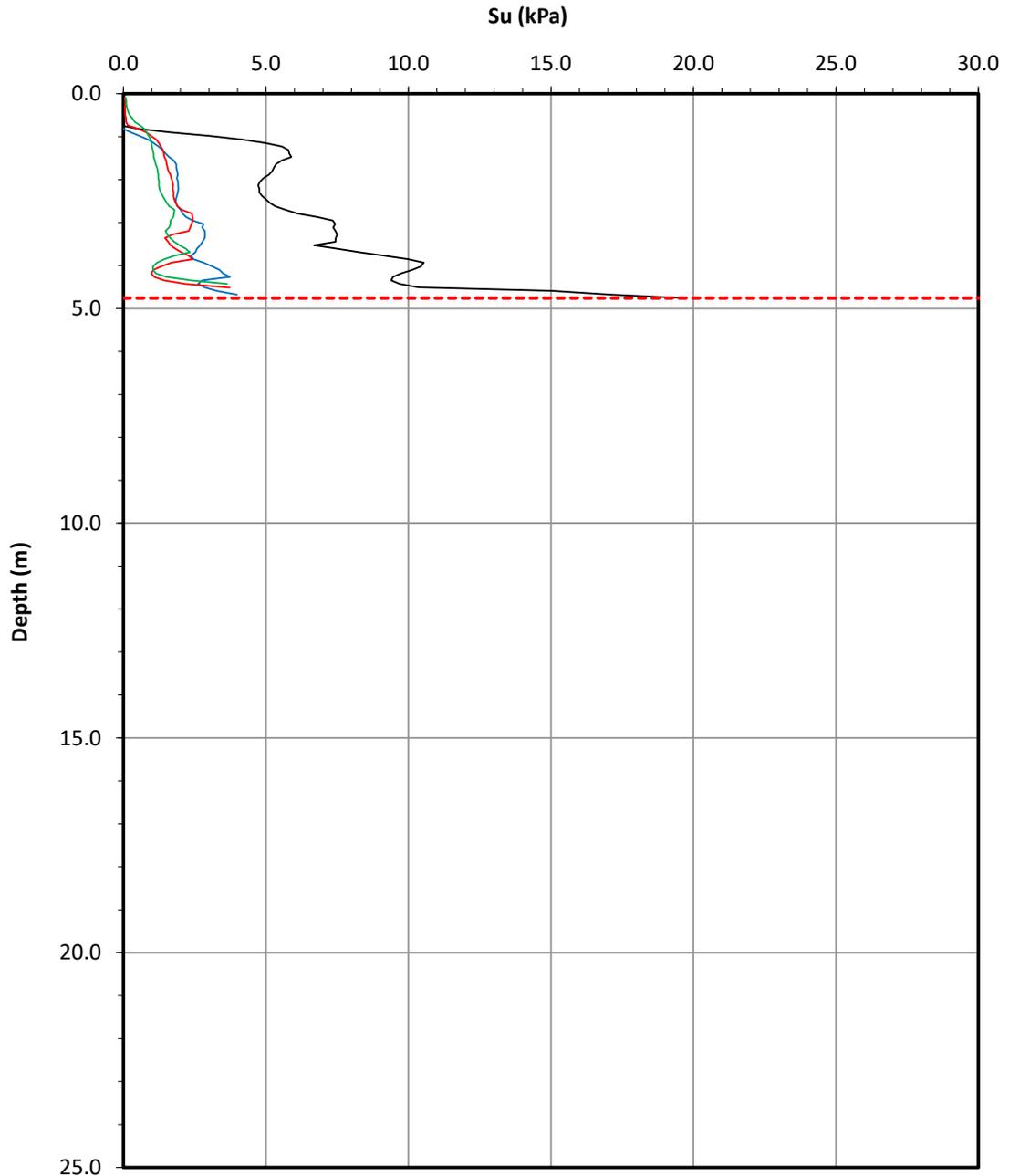




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Coordinate System: WGS84 / Lat-Long
Latitude (deg): 47.54354
Longitude (deg): -122.33574

Flow Penetrometer Undrained Strength

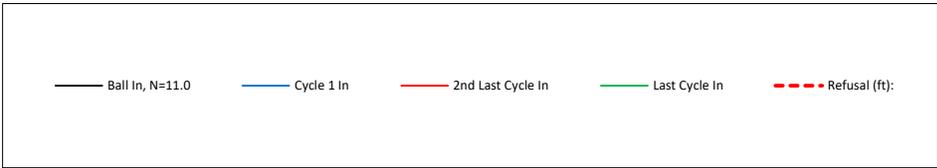
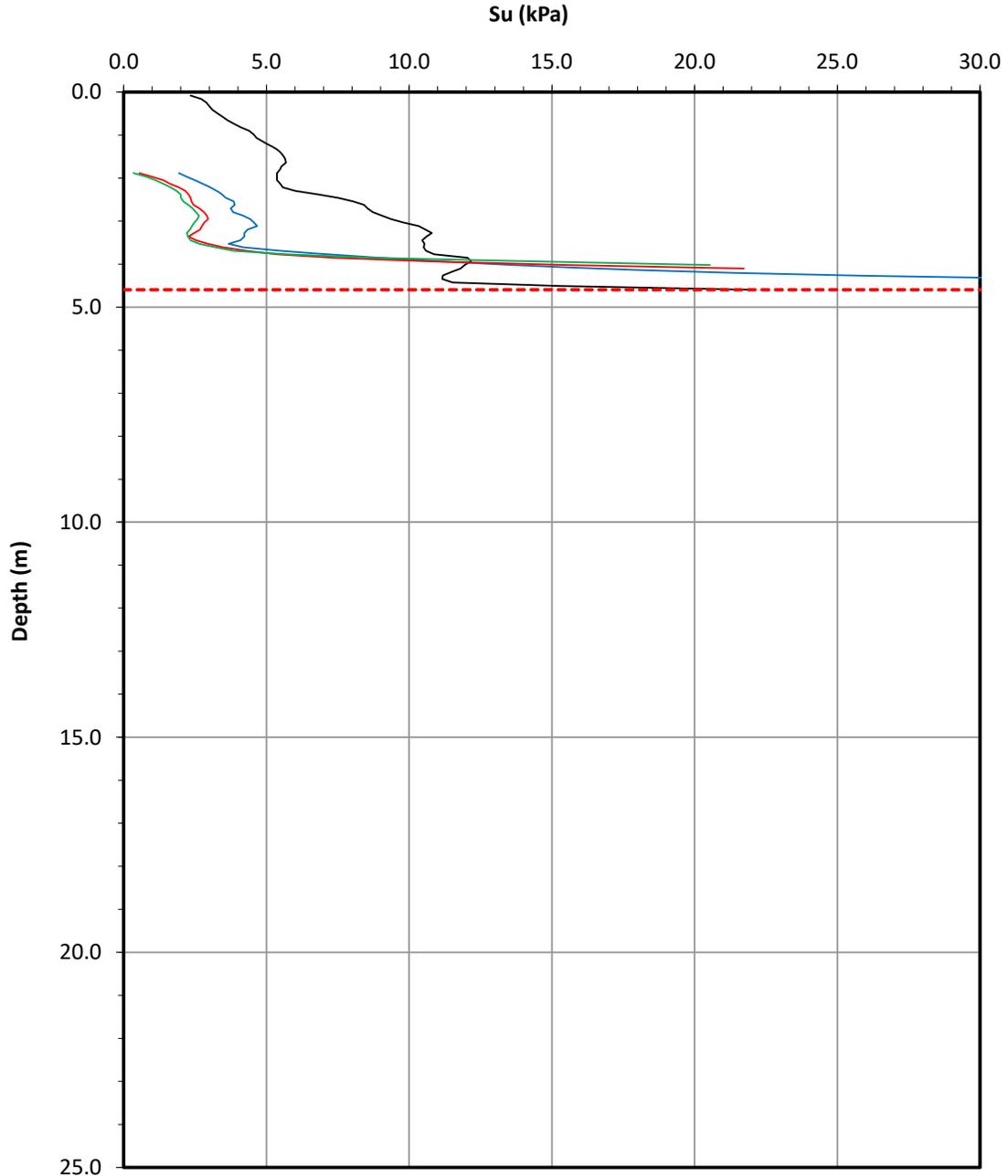




Job No: 24-59-27874
Client: Anchor QEA
Project: Lower Duwamish Waterway Middle Reach
Sounding ID: LDW23-GT14-GT-FFP
Sounding Date: 2024-07-08

Coordinate System: WGS84 / Lat-Long
Latitude (deg): 47.53998
Longitude (deg): -122.33199

Flow Penetrometer Undrained Strength

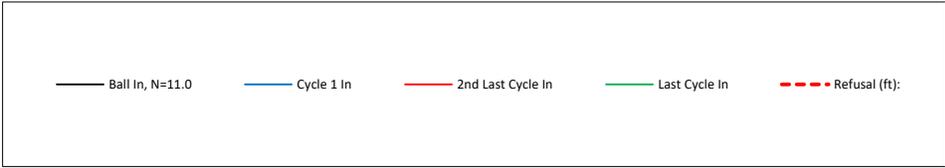
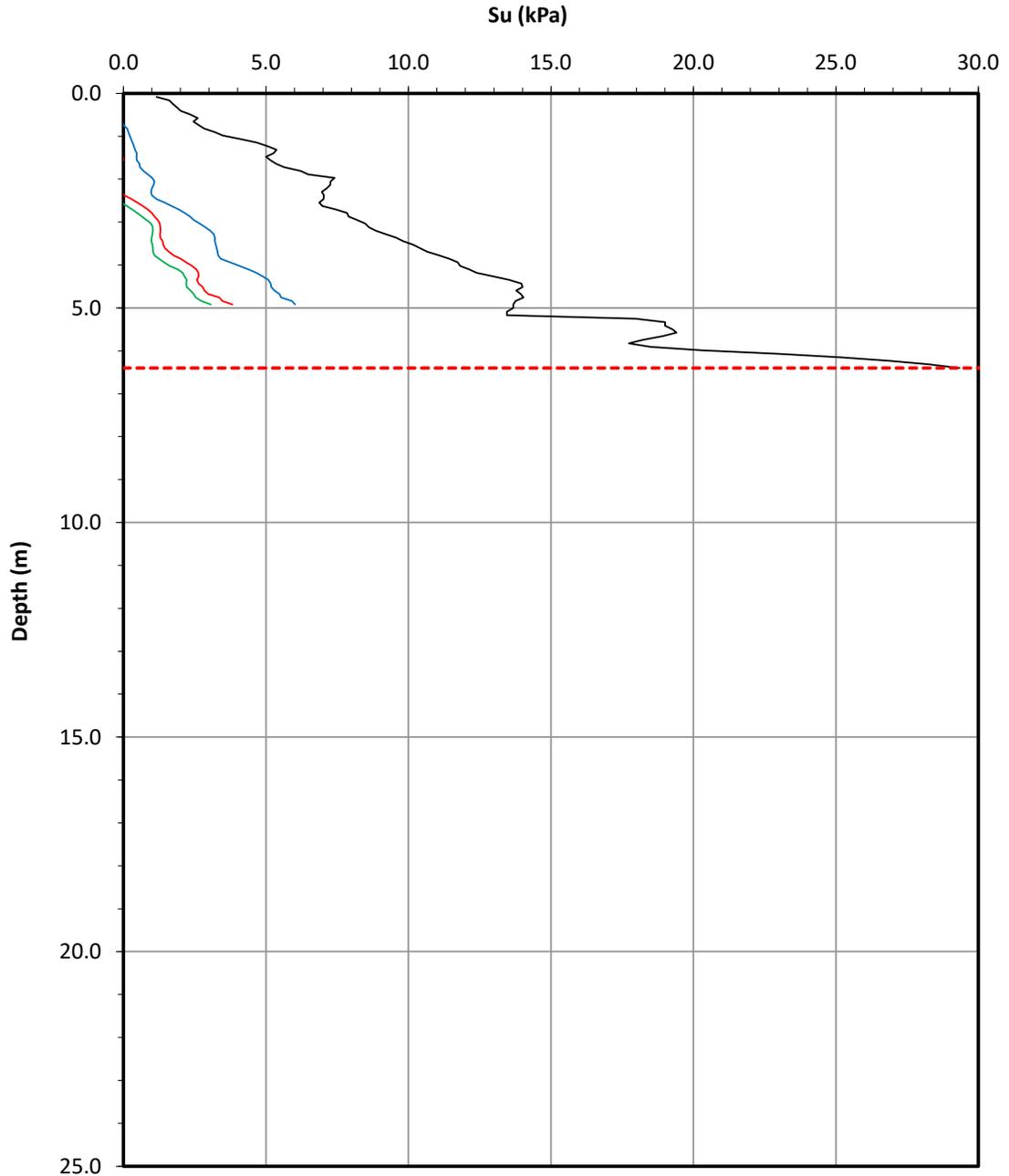




Job No: 24-59-27874
Client: Anchor QEA
Project: Lower Duwamish Waterway Middle Reach
Sounding ID: LDW23-GT28-GT-FFP
Sounding Date: 2024-07-14

Coordinate System: WGS84 / Lat-Long
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Flow Penetrometer Undrained Strength

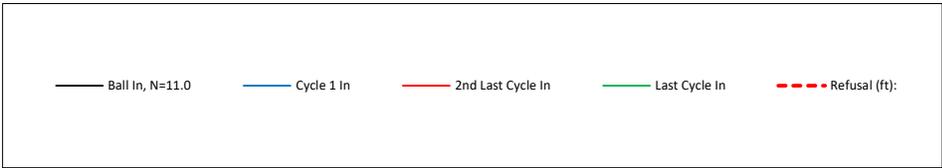
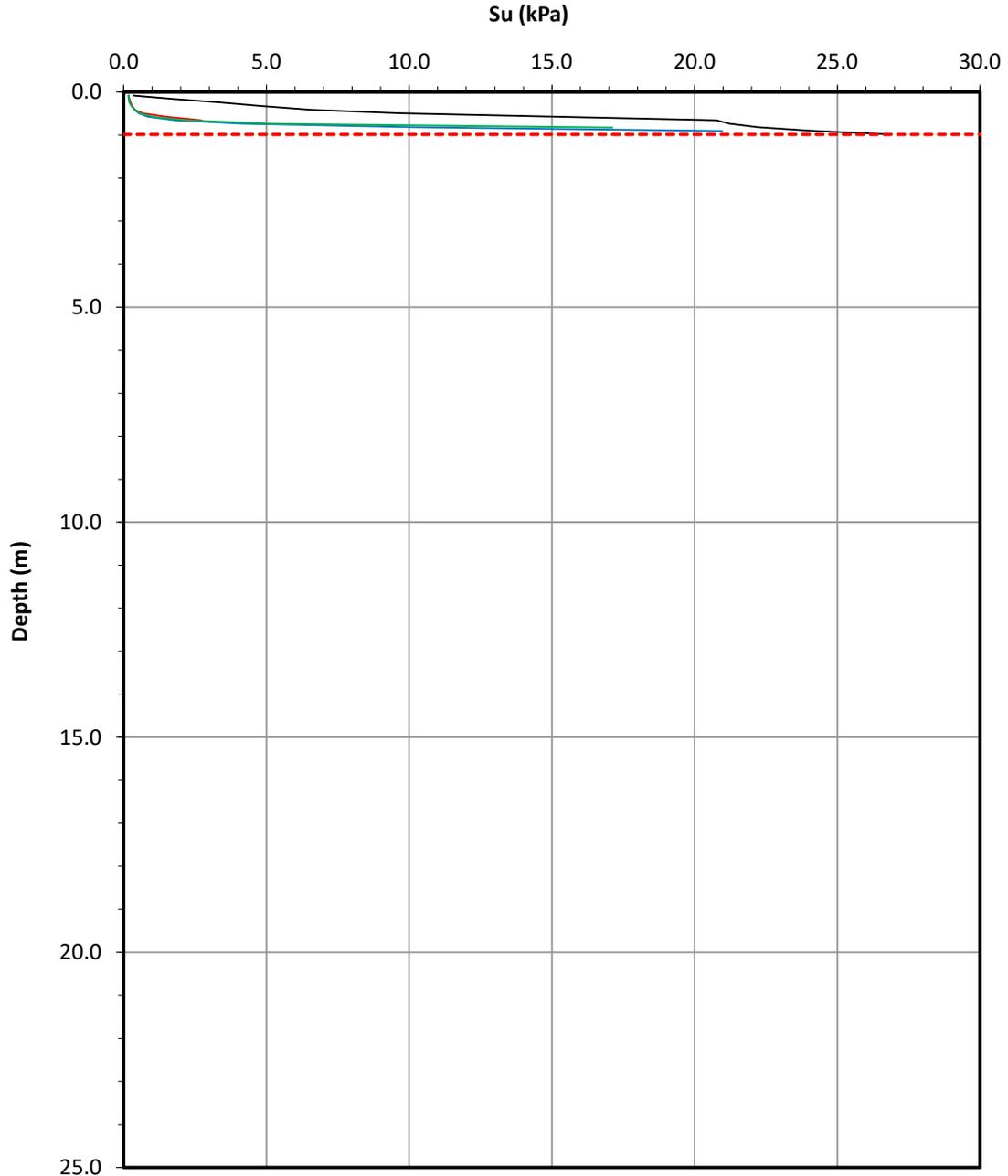




Job No: 24-59-27874
Client: Anchor QEA
Project: Lower Duwamish Waterway Middle Reach
Sounding ID: LDW23-GT29-GT-FFP
Sounding Date: 2024-07-12

Coordinate System: WGS84 / Lat-Long
Latitude (deg): 47.53513
Longitude (deg): -122.32312

Flow Penetrometer Undrained Strength



SUPPORTING DOCUMENTS AND MATERIALS

The documents and materials listed below are included in the report:

- **Methodology Statements**
- **Cone Penetration Digital File Formats**
- **Description of Methods for Calculated CPTu Geotechnical Parameters**
- **Calibration Records**

Methodology Statements

METHODOLOGY STATEMENTS



CONE PENETRATION TEST (CPTu) - eSeries

Cone penetration tests (CPTu) are conducted using an integrated electronic piezocone penetrometer and data acquisition system manufactured by Adara Systems Ltd., a subsidiary of ConeTec.

ConeTec's piezocone penetrometers are compression type designs in which the tip and friction sleeve load cells are independent and have separate load capacities. The piezocones use strain gauged load cells for tip and sleeve friction and a strain gauged diaphragm type transducer for recording pore pressure. The piezocones also have a platinum resistive temperature device (RTD) for monitoring the temperature of the sensors, an accelerometer type dual axis inclinometer and two geophone sensors for recording seismic signals. All signals are amplified and measured with minimum sixteen-bit resolution down hole within the cone body, and the signals are sent to the surface using a high bandwidth, error corrected digital interface through a shielded cable.

ConeTec penetrometers are manufactured with various tip, friction and pore pressure capacities in both 10 cm² and 15 cm² tip base area configurations in order to maximize signal resolution for various soil conditions. The specific piezocone used for each test is described in the CPT summary table. The 15 cm² penetrometers do not require friction reducers as they have a diameter larger than the deployment rods. The 10 cm² piezocones use a friction reducer consisting of a rod adapter extension behind the main cone body with an enlarged cross sectional area (typically 44 millimeters diameter over a length of 32 millimeters with tapered leading and trailing edges) located at a distance of 585 millimeters above the cone tip.

The penetrometers are designed with equal end area friction sleeves, a net end area ratio of 0.8 and cone tips with a 60 degree apex angle.

All ConeTec piezocones can record pore pressure at various locations. Unless otherwise noted, the pore pressure filter is located directly behind the cone tip in the "u₂" position (ASTM Type 2). The filter is six millimeters thick, made of porous plastic (polyethylene) having an average pore size of 125 microns (90-160 microns). The function of the filter is to allow rapid movements of extremely small volumes of water needed to activate the pressure transducer while preventing soil ingress or blockage.

The piezocone penetrometers are manufactured with dimensions, tolerances and sensor characteristics that are in general accordance with the current [ASTM D5778](#) standard. ConeTec's calibration criteria also meets or exceeds those of the current [ASTM D5778](#) standard. An illustration of the piezocone penetrometer is presented in [Figure CPTu](#).

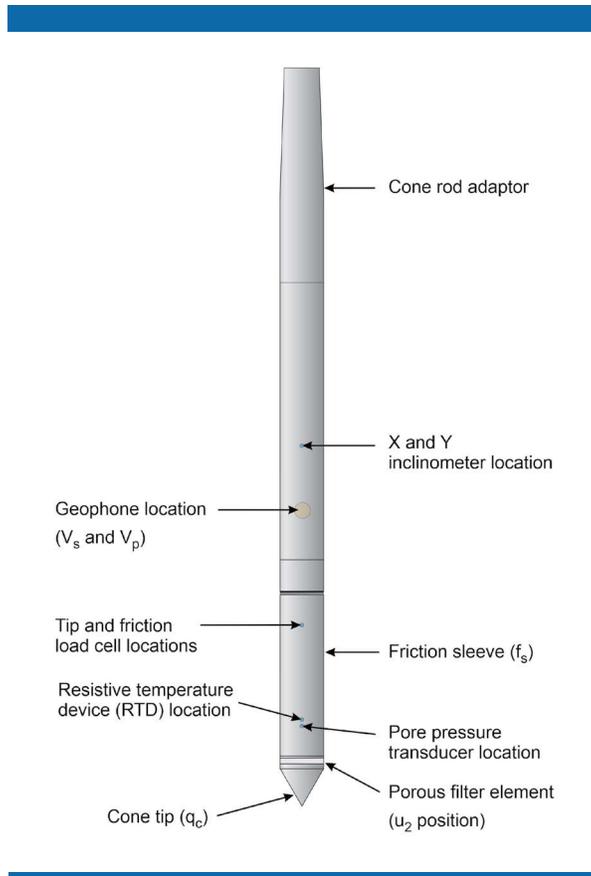


Figure CPTu. Piezocone Penetrometer (15 cm²)

The ConeTec data acquisition system consists of a Windows based computer, signal interface box, and power supply. The signal interface combines depth increment signals, seismic trigger signals and the downhole digital data. This combined data is then sent to the Windows based computer for collection and presentation. The data is recorded at fixed depth increments using a depth encoder that is either portable or integrated into the rig. The typical recording interval is 2.5 centimeters; custom recording intervals are possible.

The system displays the CPTu data in real time and records the following parameters to a storage media during penetration:

- Depth
- Uncorrected tip resistance (q_c)
- Sleeve friction (f_s)
- Dynamic pore pressure (u)
- Additional sensors such as resistivity, passive gamma, ultra violet induced fluorescence, if applicable

All testing is performed in accordance to ConeTec's CPTu operating procedures which are in general accordance with the current [ASTM D5778](#) standard.

Prior to the start of a CPTu sounding a suitable cone is selected, the cone and data acquisition system are powered on, the pore pressure system is saturated with silicone oil and the baseline readings are recorded with the cone hanging freely in a vertical position.

The CPTu is conducted at a steady rate of two centimeters per second, within acceptable tolerances. Typically one meter length rods with an outer diameter of 1.5 inches are added to advance the cone to the sounding termination depth. After cone retraction final baselines are recorded.

Additional information pertaining to ConeTec's cone penetration testing procedures:

- Each filter is saturated in silicone oil under vacuum pressure prior to use
- Baseline readings are compared to previous readings
- Soundings are terminated at the client's target depth or at a depth where an obstruction is encountered, excessive rod flex occurs, excessive inclination occurs, equipment damage is likely to take place, or a dangerous working environment arises
- Differences between initial and final baselines are calculated to ensure zero load offsets have not occurred and to ensure compliance with [ASTM](#) standards

The interpretation of piezocone data for this report is based on the corrected tip resistance (q_t), sleeve friction (f_s) and pore water pressure (u). The interpretation of soil type is based on the correlations developed by [Robertson, P.K., 2010](#). The Soil Behavior Type (SBT) classification chart developed by [Robertson, P.K., 2010](#) is presented in [Figure SBT](#). It should be noted that it is not always possible to accurately identify a soil behavior type based on these parameters. In these situations, experience, judgment and an assessment of other parameters may be used to infer soil behavior type.

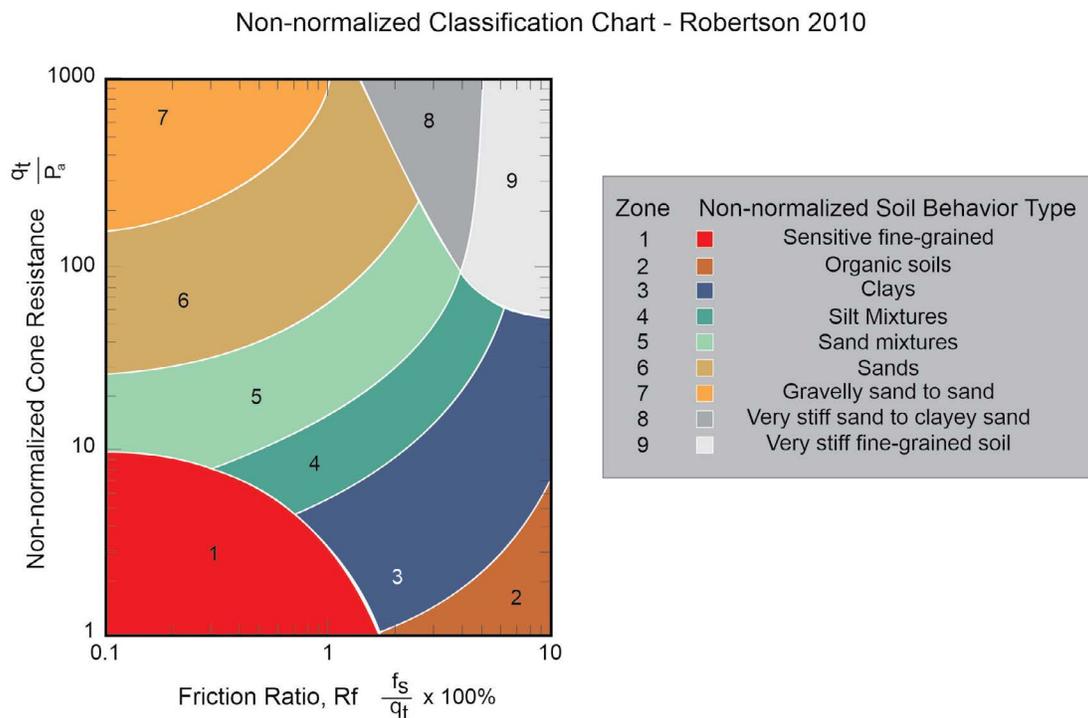


Figure SBT. Non-Normalized Soil Behavior Type Classification Chart (SBT)

The recorded tip resistance (q_c) is the total force acting on the piezocone tip divided by its base area. The tip resistance is corrected for pore pressure effects and termed corrected tip resistance (q_t) according to the following expression presented in [Robertson et al. \(1986\)](#):

$$q_t = q_c + (1-a) \cdot u_2$$

where: q_t is the corrected tip resistance

q_c is the recorded tip resistance

u_2 is the recorded dynamic pore pressure behind the tip (u_2 position)

a is the Net Area Ratio for the piezocone (0.8 for ConeTec probes)

The sleeve friction (f_s) is the frictional force on the sleeve divided by its surface area. As all ConeTec piezocones have equal end area friction sleeves, pore pressure corrections to the sleeve data are not required.

The dynamic pore pressure (u) is a measure of the pore pressures generated during cone penetration. To record equilibrium pore pressure, the penetration must be stopped to allow the dynamic pore pressures to stabilize. The rate at which this occurs is predominantly a function of the permeability of the soil and the diameter of the cone.

The friction ratio (R_f) is a calculated parameter. It is defined as the ratio of sleeve friction to the tip resistance expressed as a percentage. Generally, saturated cohesive soils have low tip resistance, high friction ratios and generate large excess pore water pressures. Cohesionless soils have higher tip resistances, lower friction ratios and do not generate significant excess pore water pressure.

For additional information on CPTu interpretations and calculated geotechnical parameters, refer to [Robertson et al. \(1986\)](#), [Lunne et al. \(1997\)](#), [Robertson \(2009\)](#), [Mayne \(2013, 2014\)](#) and [Mayne and Peuchen \(2012\)](#).

REFERENCES

ASTM D5778-20, 2020, "Standard Test Method for Performing Electronic Friction Cone and Piezocone Penetration Testing of Soils", ASTM International, West Conshohocken, PA. DOI: [10.1520/D5778-20](#).

Lunne, T., Robertson, P.K. and Powell, J. J. M., 1997, "Cone Penetration Testing in Geotechnical Practice", Blackie Academic and Professional.

Mayne, P.W., 2013, "Evaluating yield stress of soils from laboratory consolidation and in-situ cone penetration tests", Sound Geotechnical Research to Practice (Holtz Volume) GSP 230, ASCE, Reston/VA: 406-420. DOI: [10.1061/9780784412770.027](#).

Mayne, P.W. and Peuchen, J., 2012, "Unit weight trends with cone resistance in soft to firm clays", Geotechnical and Geophysical Site Characterization 4, Vol. 1 (Proc. ISC-4, Pernambuco), CRC Press, London: 903-910.

Mayne, P.W., 2014, "Interpretation of geotechnical parameters from seismic piezocone tests", CPT'14 Keynote Address, Las Vegas, NV, May 2014.

Robertson, P.K., Campanella, R.G., Gillespie, D. and Greig, J., 1986, "Use of Piezometer Cone Data", Proceedings of InSitu 86, ASCE Specialty Conference, Blacksburg, Virginia.

Robertson, P.K., 2009, "Interpretation of cone penetration tests – a unified approach", Canadian Geotechnical Journal, Volume 46: 1337-1355. DOI: [10.1139/T09-065](#).

Robertson, P.K., 2010. Soil behavior type from the CPT: an update. 2nd International Symposium on Cone Penetration Testing, CPT'10, Huntington Beach, CA, USA

Full flow penetration testing (BCPTu) is performed in conjunction with a piezocone penetration test using an integrated electronic piezocone with a spherical attachment and a data acquisition system manufactured by Adara Systems Ltd., a subsidiary of ConeTec.

ConeTec's piezocone penetrometers are compression type designs in which the tip and friction sleeve load cells are independent and have separate load capacities. The piezocones use strain gauged load cells for tip and sleeve friction and a strain gauged diaphragm type transducer for recording pore pressure. The piezocones also have a platinum resistive temperature device (RTD) for monitoring the temperature of the sensors, an accelerometer type dual axis inclinometer and two geophone sensors for recording seismic signals. All signals are amplified and measured with minimum sixteen-bit resolution downhole within the cone body, and the signals are sent to the surface using a high bandwidth, error corrected digital interface through a shielded cable.

ConeTec penetrometers are manufactured with various tip, friction and pore pressure capacities in both 10 cm² and 15 cm² tip base area configurations in order to maximize signal resolution for various soil conditions. The 15 cm² penetrometers do not require friction reducers as they have a diameter larger than the deployment rods. The 10 cm² piezocones use a friction reducer consisting of a rod adapter extension behind the main cone body with an enlarged cross sectional area (typically 44 millimeters diameter over a length of 32 millimeters with tapered leading and trailing edges) located at a distance of 585 millimeters above the cone tip.

The penetrometers are designed with equal end area friction sleeves, a net end area ratio of 0.8 and cone tips with a 60 degree apex angle.

The piezocone penetrometers are manufactured with dimensions, tolerances and sensor characteristics that are in general accordance with the current [ASTM D5778](#) standard. ConeTec's calibration criteria also meet or exceed those of the current [ASTM D5778](#) standard.

For ball full flow penetration tests, the cone tip is replaced with a spherical attachment that can have projected plan areas of 60 cm², 100 cm² or 150 cm². The selection of the size is based on soil strength and deployment limitations. An illustration of the piezocone with a spherical attachment is presented in [Figure BCPTu](#).

The specific piezocone and ball area used for each test is described in the ball full flow penetration test summary presented in the relevant appendix.

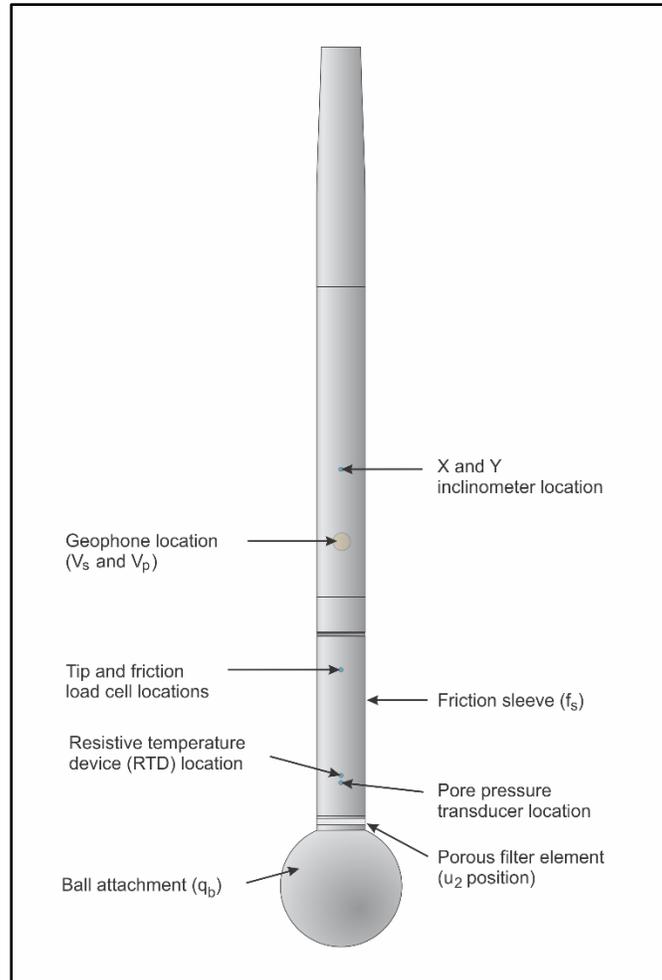


Figure BCPTu. Piezocone penetrometer with a spherical attachment

The ConeTec data acquisition systems consist of a Windows based computer and a signal interface box and power supply. The signal interface combines depth increment signals, seismic trigger signals and the downhole digital data. This combined data is then sent to the Windows based computer for collection and presentation. The data is recorded in fixed depth increments using a depth wheel attached to the push cylinders or by using a spring loaded rubber depth wheel that is held against the cone rods. The typical recording interval is 2.5 centimeters; custom recording intervals are possible.

The system displays the data in real time and records the following parameters to a storage media during penetration:

- Depth
- Uncorrected ball tip resistance (q_b)
- Sleeve friction (f_s)
- Dynamic pore pressure (u) at the shoulder (u_2) or at the equator of the ball
- Additional sensors such as resistivity, passive gamma, ultra violet induced fluorescence, if applicable

Prior to the start of a BCPTu sounding a suitable cone and spherical attachment are selected, the cone and data acquisition system are powered on, the pore pressure system is saturated with silicone oil and the baseline readings are recorded with the ball hanging freely in a vertical position.

The BCPTu is conducted at a steady rate of two centimeters per second, within acceptable tolerances. Typically one meter length rods with an outer diameter of 1.5 inches (38.1 millimeters) are added to advance the ball to the sounding termination depth. The test may be interrupted at selected depths to cycle the probe up and down in order to achieve a completely remolded soil state. Cycling is typically conducted during retraction of the ball and the number of conducted cycles is dependent on reaching a consistent tip value. After ball retraction the final baselines are recorded.

The full flow penetration test can be halted at specific depths to carry out pore pressure dissipation (PPD) tests. For each dissipation test the data acquisition system measures and records the variation of the pore pressure (u) with time (t). Pore pressure dissipation data can be interpreted to provide estimates of equilibrium pore pressures (u_{eq}).

Additional information pertaining to ConeTec's full flow penetration testing procedures:

- Each filter is saturated in silicone oil under vacuum pressure prior to use
- Baseline readings are compared to previous readings verifying compliance with [ASTM](#) standards
- Soundings are terminated at the client's target depth or at a depth where an obstruction is encountered, excessive rod flex occurs or excessive inclination occurs, equipment damage is likely to take place or a dangerous working environment arises
- Differences between initial and final baselines are calculated to ensure zero load offsets have not occurred and to ensure compliance with [ASTM](#) standards

Full flow penetration tests are conducted to assess the undrained shear strength (S_u) of low to medium strength soils. During penetration, the soil flows around the penetrometer significantly reducing the influence of overburden stress as compared to the cone penetration test (CPTu). For the test to be valid, the soil must flow around the penetrometer. Cycling is conducted in order to achieve a completely remolded soil state to provide an indication of sensitivity in soft soils.

The recorded ball tip resistance (q_b) is the total force acting on the piezocone spherical attachment divided by its base area. The ball tip resistance is corrected for pore pressure effects and termed corrected ball tip resistance (q_{bt}) according to the following expression:

$$q_{bt} = q_b + [(1-a)u_2] \frac{A_s}{A_p}$$

where: q_{bt} is the corrected ball tip resistance

q_b is the recorded ball tip resistance

u_2 is the recorded dynamic pore pressure behind the tip (u_2 position)

a is the Net Area Ratio for the piezocone (0.8 for ConeTec probes)

A_s is the shaft area

A_p is the ball plan area

The undrained shear strength (S_u) derived from the full flow penetration test is related to the net ball tip resistance ($q_{bt\text{net}}$) and ball factor (N_{ball}) using the following relationship:

$$S_u = \frac{q_{bt\text{net}}}{N_{\text{ball}}}$$

Due to different geometry and the subdued sleeve and pore pressure response, full flow penetration test results are not used for the interpretation of other geotechnical parameters or for soil classification.

A summary of the BCPTu soundings along with test details and individual plots are provided in the appendices. Tabular results generated for each sounding are provided in Excel format in the data release folder. Information regarding the calculated parameters is also included in the data release folder.

For additional information on full flow penetrometer testing, refer to [Weemees et al. \(2006\)](#).

References

ASTM D5778-20, 2020, "Standard Test Method for Performing Electronic Friction Cone and Piezocone Penetration Testing of Soils", ASTM International, West Conshohocken, PA. DOI: [10.1520/D5778-20](#).

Weemees, I., Howie, J., Woeller, D.J., Sharp, J.T., Cargill, E., Greig, J., 2006, "Improved Techniques for the In-Situ Determination of Undrained Shear Strength in Soft Clays," Sea to Sky Geotechnics, Proceedings of the 59th Canadian Geotechnical Conference, Vancouver, B.C., 1–4 October. BiTech Publishers Ltd., Richmond, B.C. pp. 89–95.

Cone Penetration Digital File Formats



CONE PENETRATION DIGITAL FILE FORMATS - eSeries

CPT Data Files (COR Extension)

ConeTec CPT data files are stored in ASCII text files that are readable by almost any text editor. ConeTec file names start with the job number (which includes the two digit year number) an underscore as a separating character, followed by two letters based on the type of test and the sounding ID. The last character position is reserved for an identifier letter (such as b, c, d etc) used to uniquely distinguish multiple soundings at the same location. The CPT sounding file has the extension COR. As an example, for job number 21-02-00001 the first CPT sounding will have file name 21-02-00001_CP01.COR

The sounding (COR) file consists of the following components:

1. Two lines of header information
2. Data records
3. End of data marker
4. Units information

Header Lines

Line 1: Columns 1-6 may be blank or may indicate the version number of the recording software

Columns 7-21 contain the sounding Date and Time (Date is MM:DD:YY)

Columns 23-38 contain the sounding Operator

Columns 51-100 contain extended Job Location information

Line 2: Columns 1-16 contain the Job Location

Columns 17-32 contain the Cone ID

Columns 33-47 contain the sounding number

Columns 51-100 may contain extended sounding ID information

Data Records

The data records contain 4 or more columns of data in floating point format. A comma and spaces separate each data item:

Column 1: Sounding Depth (meters)

Column 2: Tip (q_c), recorded in units selected by the operator

Column 3: Sleeve (f_s), recorded in units selected by the operator

Column 4: Dynamic pore pressure (u), recorded in units selected by the operator

Column 5: Empty or may contain other requested data such as Gamma, Resistivity or UVIF data

End of Data Marker

After the last line of data there is a line containing an ASCII 26 (CTL-Z) character (small rectangular shaped character) followed by a newline (carriage return / line feed). This is used to mark the end of data.

Units Information

The last section of the file contains information about the units that were selected for the sounding. A separator bar makes up the first line. The second line contains the type of units used for depth, q_c , f_s and u . The third line contains the conversion values required for ConeTec's software to convert the recorded data to an internal set of base units (bar for q_c , bar for f_s and meters for u). Additional lines intended for internal ConeTec use may appear following the conversion values.

CPT Data Files (XLS Extension)

Excel format files of ConeTec CPT data are also generated from corresponding COR files. The XLS files have the same base file name as the COR file with a -BSC suffix. The information in the file is presented in table format and contains additional information about the sounding such as coordinate information, and tip net area ratio.

The BSCI suffix is given to XLS files which are enhanced versions of the BSC files and include the same data records in addition to inclination data collected for each sounding.

CPT Dissipation Files (XLS Extension)

Pore pressure dissipation files are provided in Excel format and contain each dissipation trace that exceeds a minimum duration (selected during post-processing) formatted column wise within the spreadsheet. The first column (Column A) contains the time in seconds and the second column (Column B) contains the time in minutes. Subsequent columns contain the dissipation trace data. The columns extend to the longest trace of the data set.

Detailed header information is provided at the top of the worksheet. The test depth in meters and feet, the number of points in the trace and the particular units are all presented at the top of each trace column.

CPT Dissipation files have the same naming convention as the CPT sounding files with a “-PPD” suffix.

Data Records

Each file will contain dissipation traces that exceed a minimum duration (selected during post-processing) in a particular column. The dissipation pore pressure values are typically recorded at varying time intervals throughout the trace; rapidly to start and increasing as the duration of the test lengthens. The test depth in meters and feet, the number of points in the trace and the trace number are identified at the top of each trace column.

Cone Type Designations

Cone ID	Cone Description	Tip Cross Sect. Area (cm ²)	Tip Capacity (bar)	Sleeve Area (cm ²)**	Sleeve Capacity (bar)	Pore Pressure Capacity (bar)
EC###	A15T1500F15U35	15	1500	225	15	35
EC###	A15T375F10U35	15	375	225	10	35
EC###	A10T1000F10U35	10	1000	150	10	35

refers to the Cone ID number

**Outer Cylindrical Area

Description of Methods for Calculated CPT Geotechnical Parameters

CALCULATED CPT GEOTECHNICAL PARAMETERS

A Detailed Description of the Methods Used in ConeTec's CPT Geotechnical Parameter Calculation and Plotting Software



Revision SZW-Rev 18

Revised February 10, 2023

Prepared by Jim Greig, M.A.Sc, P.Eng (BC, AB, ON)



Limitations

The geotechnical parameter output was prepared specifically for the site and project named in the accompanying report subject to objectives, site conditions and criteria provided to ConeTec by the client. The output may not be relied upon by any other party or for any other site without the express written permission of ConeTec Group (ConeTec) or any of its affiliates. For this project, ConeTec has provided site investigation services, prepared factual data reporting and produced geotechnical parameter calculations consistent with current best practices. No other warranty, expressed or implied, is made.

To understand the calculations that have been performed and to be able to reproduce the calculated parameters the user is directed to the basic descriptions for the methods in this document and the detailed descriptions and their associated limitations and appropriateness in the technical references cited for each parameter.

ConeTec's Calculated CPT Geotechnical Parameters as of February 10, 2023.

ConeTec's CPT parameter calculation and plotting routine provides a tabular output of geotechnical parameters based on current published CPT correlations and is subject to change to reflect the current state of practice. Due to drainage conditions and the basic assumptions and limitations of the correlations, not all geotechnical parameters provided are considered applicable for all soil types. The results are presented only as a guide for geotechnical use and should be carefully examined for consideration in any geotechnical design. Reference to current literature is strongly recommended. ConeTec does not warranty the correctness or the applicability of any of the geotechnical parameters calculated by the program and does not assume liability for any use of the results in any design or review. For verification purposes we recommend that representative hand calculations be done for any parameter that is critical for design purposes. The end user of the parameter output should also be fully aware of the techniques and the limitations of any method used by the program. The purpose of this document is to inform the user as to which methods were used and to direct the end user to the appropriate technical papers and/or publications for further reference.

The geotechnical parameter output was prepared specifically for the site and project named in the accompanying report subject to objectives, site conditions and criteria provided to ConeTec by the client. The output may not be relied upon by any other party or for any other site without the express written permission of ConeTec Group (ConeTec) or any of its affiliates.

The CPT calculations are based on values of tip resistance, sleeve friction and pore pressures considered at each data point or averaged over a user specified layer thickness (e.g., 0.20 m). Note that q_t is the tip resistance corrected for pore pressure effects and q_c is the recorded tip resistance. The corrected tip resistance (corrected using u_2 pore pressure values) is used for all calculations. Since all ConeTec cones have equal end area friction sleeves pore pressure corrections to sleeve friction, f_s , are not performed.

Corrected tip resistance: $q_t = q_c + (1-a) \cdot u_2$ (consistent units are required)

where: q_t is the corrected tip resistance

q_c is the recorded tip resistance

u_2 is the recorded dynamic pore pressure from behind the tip (u_2 position)

a is the Net Area Ratio for the cone (typically 0.80 for ConeTec cones)

The total stress calculations are based on soil unit weight values that have been assigned to the Soil Behavior Type (SBT) zones, from a user defined unit weight profile, by using a single uniform value throughout the profile, through unit weight estimation techniques described in various technical papers or from a combination of these methods. The parameter output files indicate the method(s) used.

Effective vertical overburden stresses are calculated using the total stress and equilibrium pore pressure (u_{eq} or u_o) values derived from an assumed hydrostatic distribution of pore pressures below the water table or from a user defined equilibrium pore pressure profile (typically obtained from CPT dissipation tests) or a combination of the two. For over water projects the stress effects of the column of water above the mudline are taken into account as is the appropriate unit weight of water. How this is done depends on where the instruments are zeroed (i.e. on deck or at the mudline). The parameter output files indicate the method(s) used.

A majority of parameter calculations are derived from or driven by results based on material types as determined by the various soil behavior type charts depicted in Figures 1 through 6. The parameter output files indicate the method(s) used.

The Soil Behavior Type classification chart shown in Figure 1 is the classic non-normalized SBT Chart developed at the University of British Columbia and reported in Robertson, Campanella, Gillespie and Greig (1986). Figure 2 shows the original normalized (linear method) SBTn chart developed by Robertson (1990). The Bq classification charts



shown in Figures 3a and 3b incorporate pore pressures into the SBT classification and are based on the methods described in Robertson (1990). Many of these charts have been summarized in Lunne, Robertson and Powell (1997). The Jefferies and Davies SBT chart shown in Figure 3c is based on the techniques discussed in Jefferies and Davies (1993) which introduced the concept of the Soil Behavior Type Index parameter, I_c . Take note that the I_c parameter developed by Robertson and Fear (1995) and Robertson and Wride (1998) is similar in concept but uses a slightly different calculation method than that defined by Jefferies and Davies (1993) as the latter incorporates pore pressure in their technique through the use of the B_q parameter. The normalized Q_{tn} SBT chart shown in Figure 4 is based on the work by Robertson (2009) utilizing a variable stress ratio exponent, n , for normalization based on a slightly modified redefinition and iterative approach for I_c . The boundary curves drawn on the chart are based on the work described in Robertson (2010).

Figure 5 shows a revised 1986 SBT Chart presented to CPT'10 by Robertson (2010b). It is known as the Updated non-normalized Soil Behavior Chart (also referred to as the Rev SBT Chart (PKR2010) in our output files). This chart was produced to be more in line with all post-1986 Robertson charts having the same 9 soil type zones, a \log_{10} axis for friction ratio, R_f in this case, and a unitless tip resistance axis.

Figure 6 shows a revised behavior based chart by Robertson (2016) depicting contractive-dilative zones. As the zones represent material behavior rather than soil gradation ConeTec has chosen a set of zone colors that are less likely to be confused with material type colors from previous SBT charts. These colors differ from those used by Dr. Robertson. A green palette was selected for the dilative (desirable) side of the chart and a red palette for the contractive side of the chart.

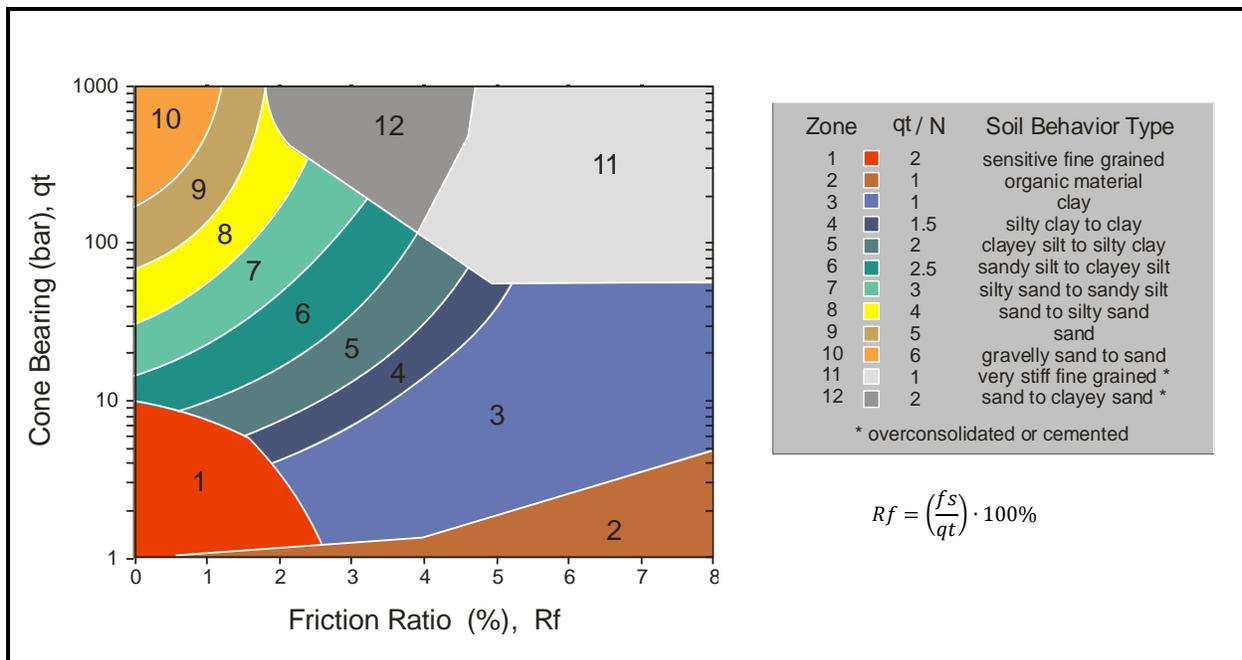


Figure 1. Non-normalized Soil Behavior Type Classification Chart (SBT)

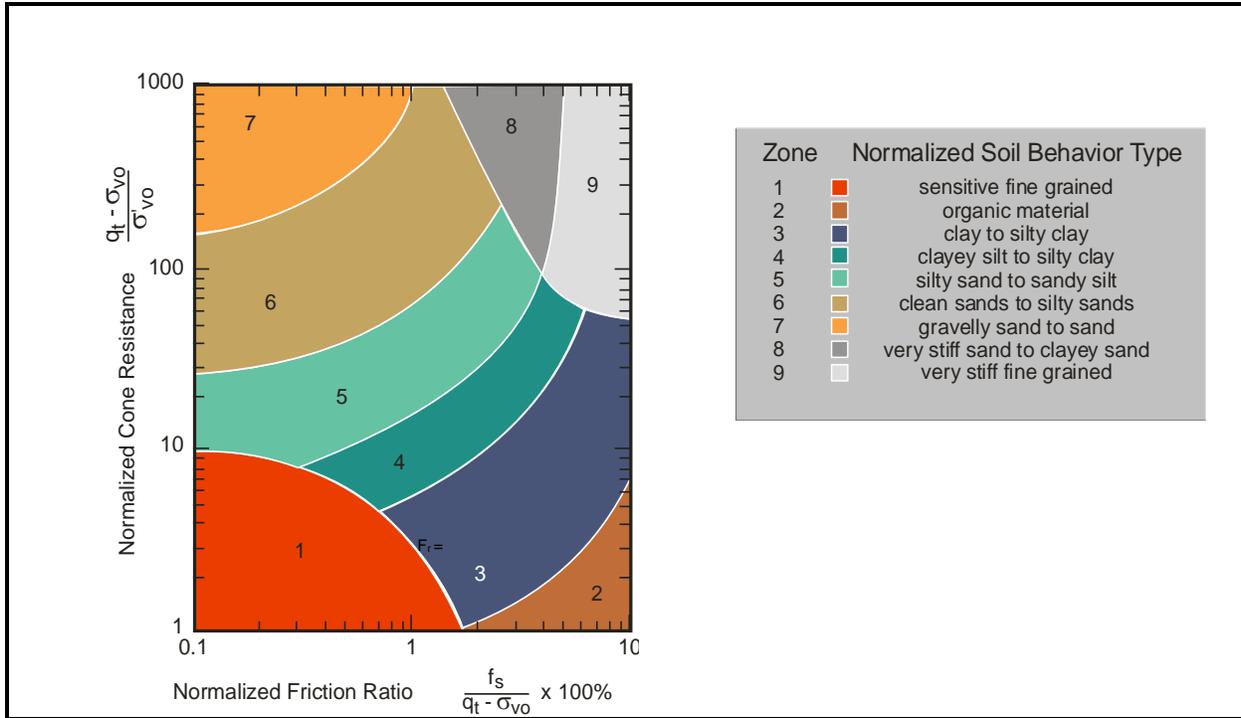


Figure 2. Normalized Soil Behavior Type Classification Chart (SBTn)

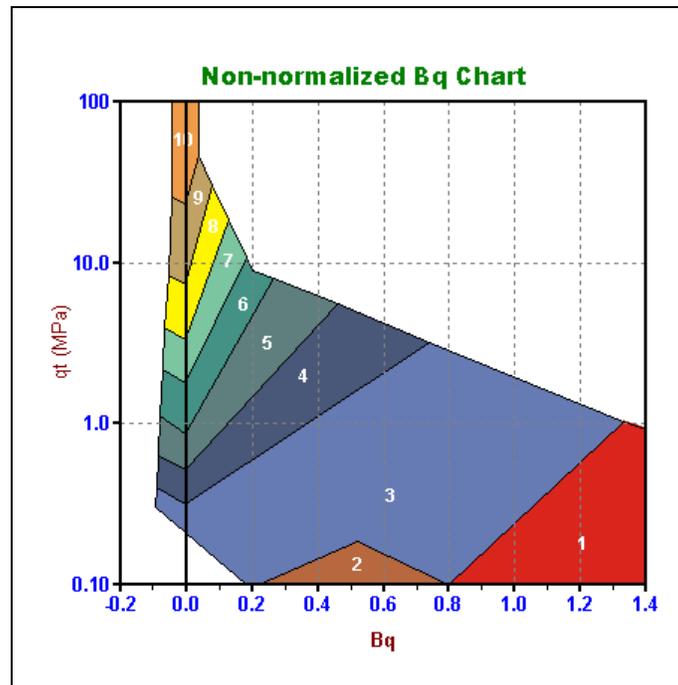


Figure 3a. Alternate Soil Behavior Type Chart (SBT Bq): $q_t - B_q$

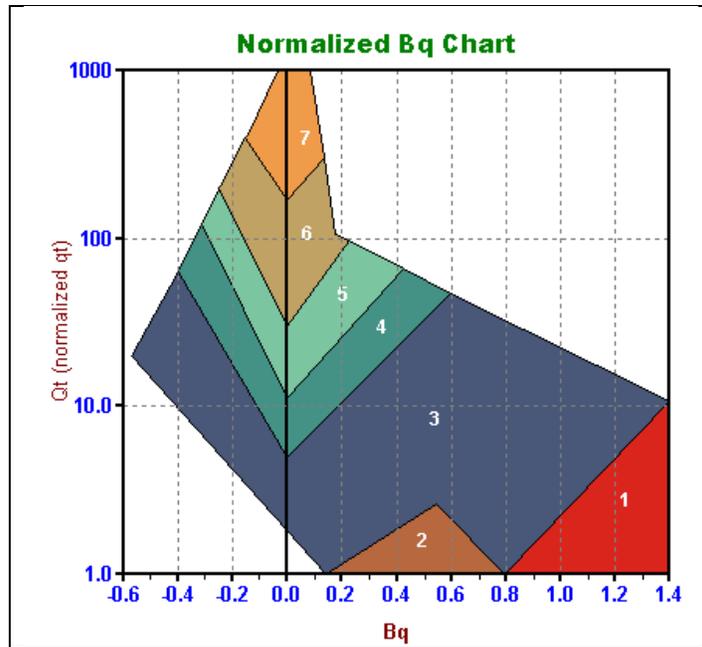


Figure 3b. Alternate Soil Behavior Type Charts (SBT Bqn): Q_t - B_q

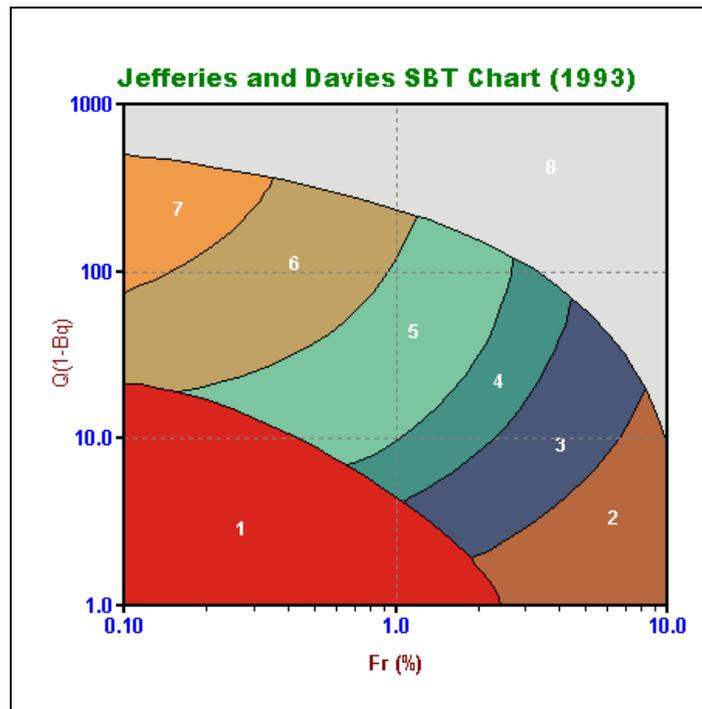


Figure 3c. Alternate Soil Behavior Type Charts: $Q(1-B_q)$ - F_r

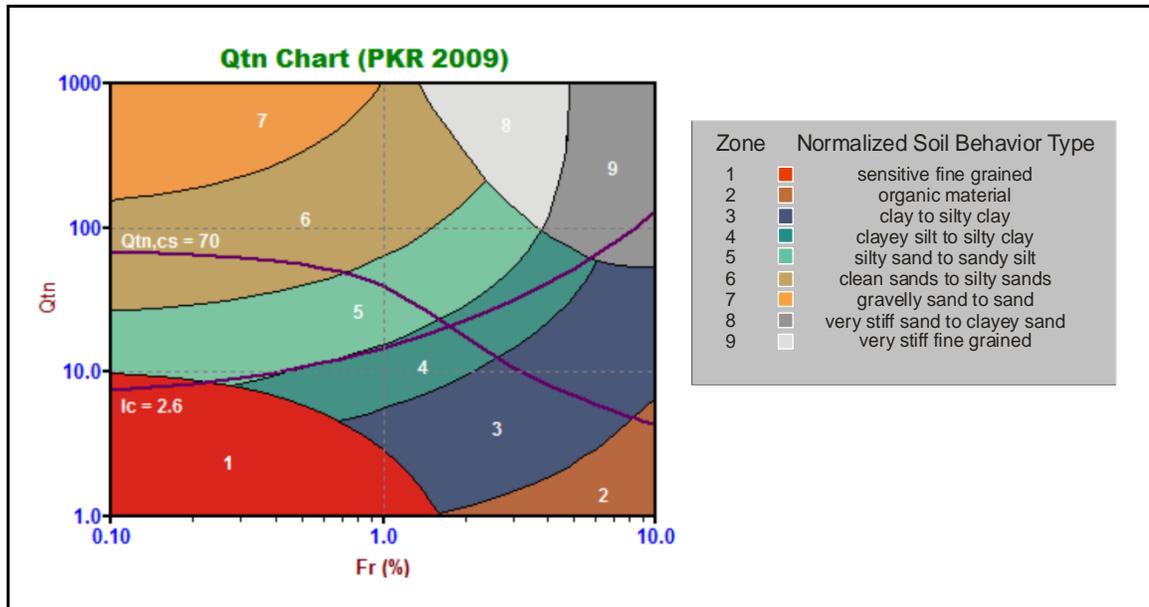


Figure 4. Normalized Soil Behavior Type Chart using Q_{tn} (SBT Q_{tn})

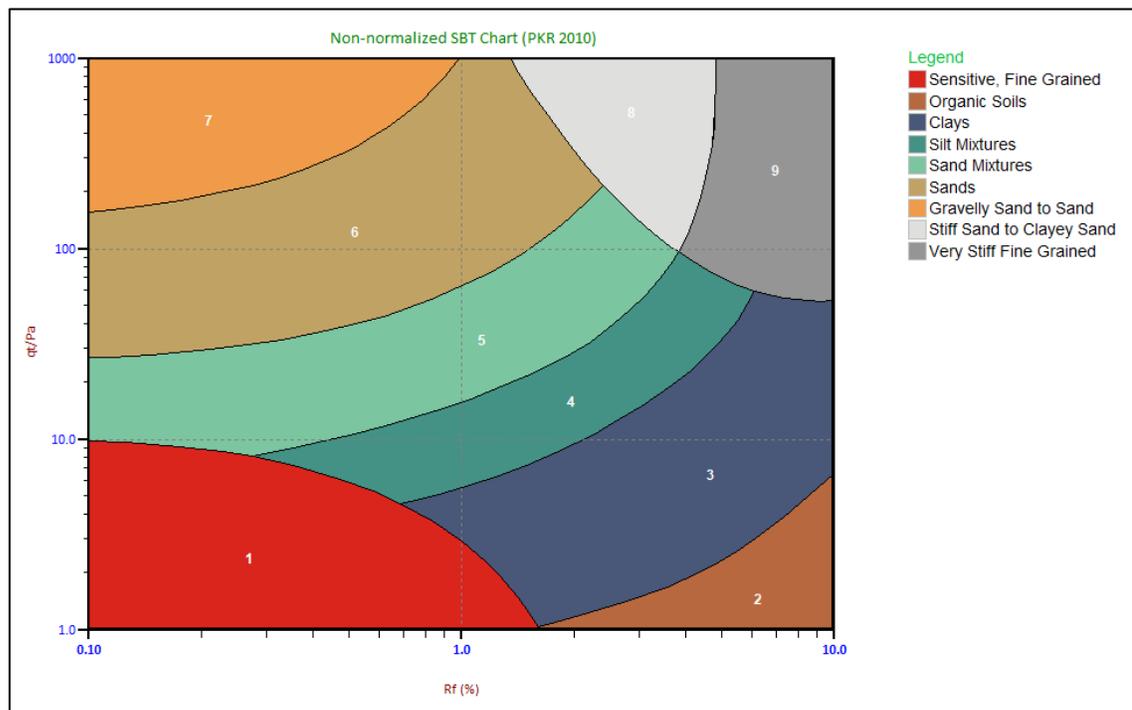


Figure 5. Non-normalized Soil Behavior Type Chart (2010)

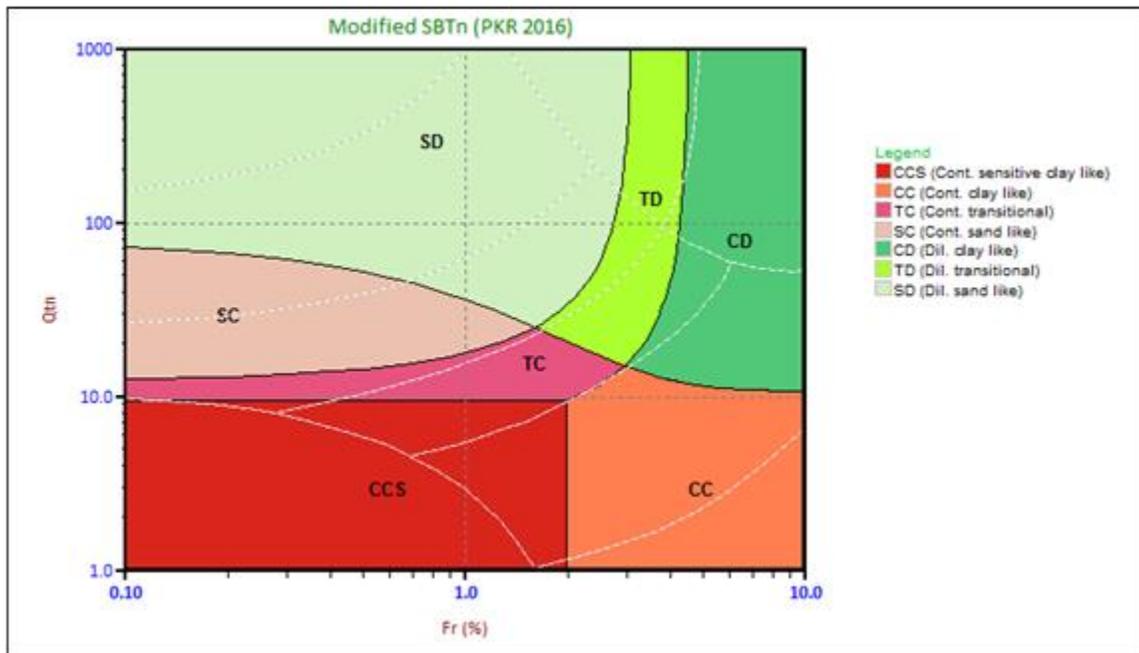


Figure 6. Modified SBTn Behavior Based Chart

Details regarding the geotechnical parameter calculations are provided in Tables 1a and 1b. The appropriate references cited are listed in Table 2. Non-liquefaction specific parameters are detailed in Table 1a and liquefaction specific parameters are detailed in Table 1b.

Where methods are based on charts or techniques that are too complex to describe in this summary, we recommend that the user refer to the cited material. Specific limitations for each method are described in the cited material.

Where the results of a calculation/correlation are deemed *'invalid'* the value will be represented by the text strings "-9999", "-9999.0", the value 0.0 (Zero) or an empty cell. Invalid results will occur because of (and not limited to) one or a combination of:

1. Invalid or undefined CPT data (e.g., drilled out section or data gap).
2. Where the calculation method is inappropriate, for example, drained parameters in a material behaving in an undrained manner (and vice versa).
3. Where input values are beyond the range of the referenced charts or specified limitations of the correlation method.
4. Where pre-requisite or intermediate parameter calculations are invalid.

The parameters selected for output from the program are often specific to a particular project. As such, not all of the calculated parameters listed in Tables 1a and 1b may be included in the output files delivered with this report.

The output files are typically provided in Microsoft Excel XLS, XLSX or CSV format. The ConeTec software has several options for output depending on the number or types of calculated parameters desired or those specifically contracted for by the client. Each output file is named using the original file base name (from the .COR file) followed

by a three or four character indicator of the output set selected (e.g. BSC, TBL, NLI, NL2, IFI, IFI2, IFI3) and possibly followed by an operator selected suffix identifying the characteristics of the particular calculation run.

Table 1a. CPT Parameter Calculation Methods – Non liquefaction Parameters

Reference Notes: CK* - Common Knowledge, U* - Unpublished

Calculated Parameter	Description	Equation	Ref
Depth	Mid Layer Depth <i>(where calculations are done at each point then Mid Layer Depth = Recorded Depth)</i>	$[Depth (Layer Top) + Depth (Layer Bottom)] / 2.0$	CK*
Elevation	Elevation of Mid Layer is based on the sounding collar elevation supplied by the client or through a site survey In Sweden a variation of elevation is used where the elevation increases with depth. We refer to this as inverse elevation.	Elevation = Collar Elevation – Depth InverseElevation = Collar Elevation + Depth	CK* N/A
Avg qc	Averaged recorded tip value (q_c)	$Avgqc = \frac{1}{n} \sum_{i=1}^n q_c$ <i>n=1 when calculations are done at each point</i>	CK*
Avg qt	Averaged corrected tip (q_t) where: $q_t = q_c + (1 - a) \cdot u_2$ Averaged q_t is not calculated using the average q_c and averaged u values. Averaged q_t is based on the average of the q_t values calculated at each data point.	$Avgqt = \frac{1}{n} \sum_{i=1}^n q_t$ <i>n=1 when calculations are done at each point</i>	1
Avg fs	Averaged sleeve friction (f_s) No pore pressure corrections are applied to f_s .	$Avgfs = \frac{1}{n} \sum_{i=1}^n fs$ <i>n=1 when calculations are done at each point</i>	CK*
Avg Rf	Averaged friction ratio (R_f) where friction ratio is defined as: $R_f = 100\% \cdot \frac{fs}{qt}$	$AvgRf = 100\% \cdot \frac{Avgfs}{Avgqt}$ <i>not an average of individual R_f values</i>	CK*
Avg u	Averaged dynamic pore pressure (u)	$Avgu = \frac{1}{n} \sum_{i=1}^n u_i$ <i>n=1 when calculations are done at each point</i>	CK*
Avg Res	Averaged Resistivity (this data is not always available since it is a specialized test requiring an additional module)	$AvgRes = \frac{1}{n} \sum_{i=1}^n Resistivity_i$ <i>n=1 when calculations are done at each point</i>	CK*
Avg UVIF	Averaged UVIF ultra-violet induced fluorescence (this data is not always available since it is a specialized test requiring an additional module)	$AvgUVIF = \frac{1}{n} \sum_{i=1}^n UVIF_i$ <i>n=1 when calculations are done at each point</i>	CK*
Avg Temp	Averaged Temperature (this data is not always available)	$AvgTemp = \frac{1}{n} \sum_{i=1}^n Temperature_i$ <i>n=1 when calculations are done at each point</i>	CK*
Avg Gamma	Averaged Gamma Counts (this data is not always available since it is a specialized test requiring an additional module)	$AvgGamma = \frac{1}{n} \sum_{i=1}^n Gamma_i$ <i>n=1 when calculations are done at each point</i>	CK*
SBT	Soil Behavior Type as defined by Robertson et al 1986 (often referred to as Robertson and Campanella, 1986)	See Figure 1	1, 5
SBTn	Normalized Soil Behavior Type as defined by Robertson 1990 (linear normalization using Q_t , now referred to as Q_{t1})	See Figure 2	2, 5

Calculated Parameter	Description	Equation	Ref
SBT-Bq	Non-normalized Soil Behavior type based on non-normalized tip resistance and the B _q parameter	See Figure 3a	1, 2, 5
SBT-Bqn	Normalized Soil Behavior type based on normalized tip resistance (Q _t , now called Q _{t1}) and the B _q parameter	See Figure 3b	2, 5
SBT-JandD	Soil Behavior Type as defined by Jeffries and Davies	See Figure 3c	7
SBT Qtn	Soil Behavior Type as defined by Robertson (2009) using a variable stress ratio exponent for normalization based on I _c (PKR 2009)	See Figure 4	15
Modified Non-normalized SBT Chart SBT (PKR2010)	This is a revised version of the simple 1986 non-normalized SBT chart (presented at CPT '10). The revised version has been reduced from 12 zones to 9 zones to be similar to the normalized Robertson charts. Other updates include a dimensionless tip resistance normalized to atmospheric pressure, q _t /P _a , on the vertical axis and a log scale for non-normalized friction ratio, R _f , along the horizontal axis.	See Figure 5	33
Modified SBTn (contractive /dilative)	Modified SBTn chart as defined by Robertson (2016) indicating zones of contractive/dilative behavior. Note that ConeTec displays the chart with colors different from Robertson. ConeTec's colors were chosen to avoid confusion with soil type descriptions.	See Figure 6	30
Unit Wt.	<p>Unit Weight of soil determined from one of the following user selectable options:</p> <ol style="list-style-type: none"> 1) uniform value 2) value assigned to each SBT zone 3) value assigned to each SBTn zone 4) value assigned to SBTn zone as determined from Robertson and Wride (1998) based on q_{c1n} 5) values assigned to SBT Qtn zones 6) values based on Robertson updated non-normalized Soil Behavior Type Chart (2010b) 6) Mayne f_s (sleeve friction) method 7) Robertson and Cabal 2010 method 8) user supplied unit weight profile <p>The last option may co-exist with any of the other options.</p>	See references	3, 5, 15, 21, 24, 29, 33

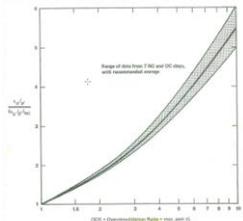


Calculated Parameter	Description	Equation	Ref
TStress σ_v	<p>Total vertical overburden stress at Mid Layer Depth</p> <p><i>A layer is defined as the averaging interval specified by the user where depths are reported at their respective mid-layer depth.</i></p> <p>For data calculated at each point layers are defined using the recorded depth as the mid-point of the layer. Thus, a layer starts half-way between the previous depth and the current depth unless this is the first point in which case the layer start is at zero depth. The layer bottom is half-way from the current depth to the next depth unless it is the last data point.</p> <p>Defining layers affects how stresses are calculated since the unit weight attributed to a data point is used throughout the entire layer. This means that to calculate the stresses the total stress at the top and bottom of a layer are required. The stress at mid layer is determined by adding the incremental stress from the layer top to the mid-layer depth. The stress at the layer bottom becomes the stress at the top of the subsequent layer. Stresses are NOT calculated from mid-point to mid-point.</p> <p>For over-water work the total stress due to the column of water above the mud line is taken into account where appropriate.</p>	$TStress = \sum_{i=1}^n \gamma_i h_i$ <p>where γ_i is layer unit weight h_i is layer thickness</p>	CK*
EStress σ_v'	<p>Effective vertical overburden stress at mid-layer depth.</p>	$\sigma_v' = \sigma_v - u_{eq}$	CK*
Equil u u_{eq} or u_0	<p>Equilibrium pore pressures are determined from one of the following user selectable options:</p> <ol style="list-style-type: none"> 1) hydrostatic below the water table 2) user supplied profile 3) combination of those above <p>When a user supplied profile is used/provided a linear interpolation is performed between equilibrium pore pressures defined at specific depths. If the profile values start below the water table then a linear transition from zero pressure at the water table to the first defined pointed is used.</p> <p>Equilibrium pore pressures may come from dissipation tests, adjacent piezometers or other sources. Occasionally, an extra equilibrium point (“assumed value”) will be provided in the profile that does not come from a recorded value to smooth out any abrupt changes or to deal with material interfaces. These “assumed” values will be indicated on our plots and in tabular summaries.</p>	<p>For the hydrostatic option:</p> $u_{eq} = \gamma_w \cdot (D - D_{wt})$ <p>where u_{eq} is equilibrium pore pressure γ_w is the unit weight of water D is the current depth D_{wt} is the depth to the water table</p>	CK*
K_0	<p>Coefficient of earth pressure at rest, K_0.</p>	$K_0 = (1 - \sin\Phi') OCR^{\sin\Phi'}$	17
C_n	<p>Overburden stress correction factor used for $(N_1)_{60}$ and older CPT parameters.</p>	$C_n = (P_a/\sigma_v')^{0.5}$ <p>where $0.0 < C_n < 2.0$ (user adjustable, typically ranging from 1.7 to 2.0) P_a is atmospheric pressure (100 kPa)</p>	4, 12

Calculated Parameter	Description	Equation	Ref
C_q	Overburden stress normalizing factor.	$C_q = 1.8 / [0.8 + (\sigma'_v / P_a)]$ where $0.0 < C_q < 2.0$ (user adjustable) P_a is atmospheric pressure (100 kPa) Robertson and Wride define C_q to be the same as C_n . The Olson definition above is used in the program.	3, 12
N_{60}	SPT N value at 60% energy calculated from q_t/N ratios assigned to each SBT zone. This method has abrupt N value changes at zone boundaries.	See Figure 1	5
$(N_1)_{60}$	SPT N_{60} value corrected for overburden pressure.	$(N_1)_{60} = C_n \cdot N_{60}$	4
N_{60lc}	SPT N_{60} values based on the I_c parameter, as defined by Robertson and Wride 1998 (3), or by Robertson 2009 (15).	$(q_t/P_a) / N_{60} = 8.5 (1 - I_c/4.6)$ $(q_t/P_a) / N_{60} = 10^{(1.1268 - 0.2817I_c)}$ P_a being atmospheric pressure	3, 5 15, 31
$(N_1)_{60lc}$	SPT N_{60} value corrected for overburden pressure (using $N_{60} I_c$). User has 3 options.	1) $(N_1)_{60lc} = C_n \cdot (N_{60} I_c)$ 2) $q_{c1n} / (N_1)_{60lc} = 8.5 (1 - I_c/4.6)$ 3) $(Q_{tn}) / (N_1)_{60lc} = 10^{(1.1268 - 0.2817I_c)}$	4 5 15, 31
S_u or $S_u (N_{kt})$	Undrained shear strength based on q_t S_u factor N_{kt} is user selectable.	$S_u = \frac{q_t - \sigma_v}{N_{kt}}$	1, 5
S_u or $S_u (N_{du})$ or $S_u (N_{\Delta u})$	Undrained shear strength based on pore pressure S_u factor $N_{\Delta u}$ is user selectable.	$S_u = \frac{u_2 - u_{eq}}{N_{\Delta u}}$	1, 5
D_r	Relative Density determined from one of the following user selectable options: 1) Ticino Sand 2) Hokksund Sand 3) Schmertmann (1978) 4) Jamiolkowski (1985) - All Sands 5) Jamiolkowski et al (2003) (various compressibilities, K_o)	See reference (methods 1 through 4) Jamiolkowski et al (2003) reference	5 14
PHI ϕ	Friction Angle determined from one of the following user selectable options (methods 1 through 4 are for sands and method 5 is for silts and clays): 1) Campanella and Robertson 2) Durgunoglu and Mitchel 3) Janbu 4) Kulhawy and Mayne 5) NTH method (clays and silts)	See appropriate reference	5 5 5 11 23
Delta U/ q_t $\Delta u/q_t$ du/q_t	Differential pore pressure ratio (older parameter used before B_q was established)	$= \frac{\Delta u}{q_t}$ where: $\Delta u = u - u_{eq}$ and $u =$ dynamic pore pressure $u_{eq} =$ equilibrium pore pressure	39

Calculated Parameter	Description	Equation	Ref
B_q	Pore pressure parameter	$B_q = \frac{\Delta u}{q_t - \sigma_v}$ where: $\Delta u = u - u_{eq}$ and $u =$ dynamic pore pressure $u_{eq} =$ equilibrium pore pressure	1, 2, 5
Net q_t or qtNet	Net tip resistance (used in many subsequent correlations)	$q_t - \sigma_v$	36
q_e or q_E or q_E	Effective tip resistance (using the dynamic pore pressure u_2 and not equilibrium pore pressure)	$q_t - u_2$	36
qeNorm	Normalized effective tip resistance	$\frac{q_t - u_2}{\sigma_v}$	36
Q_t or Norm: Q_t or Q_{t1}	Normalized q_t for Soil Behavior Type classification as defined by Robertson (1990) using a linear stress normalization. Note this is different from Q_{tn} . This parameter was renamed to Q_{t1} in Robertson, 2009. Without normalization limits this parameter calculates to very high unrealistic values at low stresses.	$Q_t = \frac{q_t - \sigma_v}{\sigma_v}$	2, 5, 15
F_r or Norm: F_r	Normalized Friction Ratio for Soil Behavior Type classification as defined by Robertson (1990)	$F_r = 100\% \cdot \frac{f_s}{q_t - \sigma_v}$	2, 5
$Q(1-B_q)$ $Q(1-B_q) + 1$	$Q(1-B_q)$ grouping as suggested by Jefferies and Davies for their classification chart and the establishment of their l_c parameter. Later papers added the +1 term to the equation.	$Q \cdot (1 - B_q)$ $Q \cdot (1 - B_q) + 1$ where B_q is defined as above and Q is the same as the normalized tip resistance, Q_{t1} , defined above	6, 7, 34
q_{c1}	Normalized tip resistance, q_{c1} , using a fixed stress ratio exponent, n (this method has stress units)	$q_{c1} = q_t \cdot (P_a / \sigma_v')^{0.5}$ where: $P_a =$ atmospheric pressure	21
$q_{c1} (0.5)$	Normalized tip resistance, q_{c1} , using a fixed stress ratio exponent, n (this method is unit-less)	$q_{c1} (0.5) = (q_t / P_a) \cdot (P_a / \sigma_v')^{0.5}$ where: $P_a =$ atmospheric pressure	5
$q_{c1} (C_n)$	Normalized tip resistance, q_{c1} , based on C_n (this method has stress units)	$q_{c1}(C_n) = C_n * q_t$	5, 12
$q_{c1} (C_q)$	Normalized tip resistance, q_{c1} , based on C_q (this method has stress units)	$q_{c1}(C_q) = C_q * q_t$ (some papers use q_c)	5, 12
q_{c1n}	normalized tip resistance, q_{c1n} , using a variable stress ratio exponent, n (where $n=0.0, 0.70,$ or 1.0) (this method is unit-less)	$q_{c1n} = (q_t / P_a)(P_a / \sigma_v')^n$ where: $P_a =$ atm. Pressure and n varies as described below	3

Calculated Parameter	Description	Equation	Ref
<p>I_c or I_c (RW1998)</p>	<p>Soil Behavior Type Index as defined by Robertson and Wride (1997, 1998) for estimating grain size characteristics and providing smooth gradational changes across the SBTn chart.</p> <p>I_c(RW1998) is different from that of Jefferies and Davies (7) and is different from I_c(PKR2009).</p>	$I_c = [(3.47 - \log_{10}Q)^2 + (\log_{10} Fr + 1.22)^2]^{0.5}$ <p>Where: $Q = \left(\frac{qt - \sigma_v}{P_a} \right) \left(\frac{P_a}{\sigma_v'} \right)^n$</p> <p>Or $Q = q_{c1n} = \left(\frac{qt}{P_a} \right) \left(\frac{P_a}{\sigma_v'} \right)^n$</p> <p>depending on the iteration in determining I_c</p> <p>And Fr is in percent P_a = atmospheric pressure</p> <p>n has the following distinct values: 0.5, 0.75 and 1.0 and is determined in an iterative manner based on the resulting I_c in each iteration</p> <p>Note that NCEER replaced 0.75 with 0.70</p>	<p>3, 4, 5</p> <p>10</p>
I_c (PKR 2009)	Soil Behavior Type Index, I_c (PKR 2009) is based on a variable stress ratio exponent n , which itself is based on I_c (PKR 2009). An iterative calculation is required to determine I_c (PKR 2009) and its corresponding n (PKR 2009).	$I_c \text{ (PKR 2009)} = [(3.47 - \log_{10}Q_{tn})^2 + (1.22 + \log_{10}Fr)^2]^{0.5}$	15
n (PKR 2009)	Stress ratio exponent n , based on I_c (PKR 2009). An iterative calculation is required to determine n (PKR 2009) and its corresponding I_c (PKR 2009).	$n \text{ (PKR 2009)} = 0.381 (I_c) + 0.05 (\sigma_v'/P_a) - 0.15$	15
Q_{tn} (PKR 2009)	Normalized tip resistance using a variable stress ratio exponent based on I_c (PKR 2009) and n (PKR 2009). An iterative calculation is required to determine Q_{tn} (PKR 2009).	$Q_{tn} = [(qt - \sigma_v)/P_a] (P_a/\sigma_v')^n$ <p>where P_a = atmospheric pressure (100 kPa) n = stress ratio exponent described above</p>	15
FC	Apparent fines content (%)	$FC = 1.75(I_c^{3.25}) - 3.7$ <p>$FC = 100$ for $I_c > 3.5$ $FC = 0$ for $I_c < 1.26$ $FC = 5\%$ if $1.64 < I_c < 2.6$ AND $F < 0.5$</p>	3
I_c Zone	This parameter is the Soil Behavior Type zone based on the I_c parameter (valid for zones 2 through 7 on SBTn or SBT Qtn charts)	<p>$I_c < 1.31$ Zone = 7 $1.31 < I_c < 2.05$ Zone = 6 $2.05 < I_c < 2.60$ Zone = 5 $2.60 < I_c < 2.95$ Zone = 4 $2.95 < I_c < 3.60$ Zone = 3 $I_c > 3.60$ Zone = 2</p>	3
CD	The contractive / dilative boundary on Robertson’s Modified SBTn (contractive/dilative) Chart shown in Figure 6 above. The boundary is marked as CD = 70 on the chart in the relevant paper. Similar to the $Q_{tn,cs} = 70$ line in Figure 4.	$CD = 70 = (Q_{tn} - 11) (1 + 0.06F_r)^{17}$ <p>lower bound of CD = 60: $CD = 60 = (Q_{tn} - 9.5) (1 + 0.06F_r)^{17}$</p>	30

Calculated Parameter	Description	Equation	Ref
I_B	Hyperbolic fit defining the boundary between SBT soil types proposed by Schneider as a better fit than the I_c circles. $I_B = 32$ represents the boundary for most sand like soils. $I_B = 22$ represents the upper boundary for most clay like soils. The region between $I_B=22$ and $I_B=32$ is the “transitional soil” zone.	$I_B = 100 (Q_{tn} + 10) / (70 + Q_{tn} F_r)$	30
State Param or State Parameter or ψ	The state parameter index, ψ , is defined as the difference between the current void ratio, e , and the critical void ratio, e_c . Positive ψ - contractive soil Negative ψ - dilative soil This is based on the work by Been and Jefferies (1985) and Plewes, Davies and Jefferies (1992) This method uses mean normal stresses based on a uniform value of K_0 or a calculated K_0 using methods described elsewhere in this document	See reference	6, 8
Yield Stress σ_p'	Yield stress is calculated using the following methods 1) General method 2) 1 st order approximation using q_t Net (clays) 3) 1 st order approximation using Δu_2 (clays) 4) 1 st order approximation using q_e (clays) 5) Based on V_s	All stresses in kPa 1) $\sigma_p' = 0.33 \cdot (q_t - \sigma_v)^{m'} \cdot (\sigma_{atm}/100)^{1-m'}$ where $m' = 1 - \frac{0.28}{1 + (I_c / 2.65)^{25}}$ 2) $\sigma_p' = 0.33 \cdot (q_t - \sigma_v)$ 3) $\sigma_p' = 0.54 \cdot (\Delta u_2)$ $\Delta u_2 = u_2 - u_0$ 4) $\sigma_p' = 0.60 \cdot (q_t - u_2)$ 5) $\sigma_p' = (V_s/4.59)^{1.47}$	19 20 20 20 18
OCR OCR(JS1978) YSR(Mayne2014) YSR (qtNet) YSR (deltaU) YSR (qe) YSR (Vs) OCR (PKR2015)	Over Consolidation Ratio based on 1) Schmertmann (1978) method involving a plot of $S_u/\sigma_v' / (S_u/\sigma_v')_{NC}$ and OCR  2) based on Yield stresses described above 3) approximate version based on qtNet 4) approximate version based on Δu 5) approximate version based on effective tip, q_e 6) approximate version based on shear wave velocity, V_s and σ_v' 7) based on Q_t	1) requires a user defined value for NC S_u/P_c' ratio 2 through 5) based on yield stresses 6) $YSR (Vs) = \sigma_p' (Vs) / \sigma_v'$ 7) $OCR = 0.25 \cdot (Q_t)^{1.25}$	9 19 20 20 20 18 32
E_s/q_t	Intermediate parameter for calculating Young’s Modulus, E , in sands. It is the Y axis of the reference chart. Note that Figure 5.59 from reference 5, Lunne, Robertson and Powell, (LRP) has an error. The X axis values are too high by a factor of 10. The plot is based on Baldi’s (not Bellotti as cited in	Based on Figure 5.59 in the reference	5, 37

Calculated Parameter	Description	Equation	Ref
	<p>LRP) original Figure 3 where the X axis is: $\frac{q_c}{\sqrt{\sigma'_v}}$ (both in kPa) with a range of 200 to 3000.</p> <p>Figure 5.59 from LRP shows a dimensionless form of the equation, q_{c1}, displaying the same range of values.</p> <p>Figure 5.59's X axis uses $q_{c1} = \left(\frac{q_c}{P_a}\right) \left(\frac{P_a}{\sigma'_v}\right)^{0.5}$</p> <p>The two expressions are not the same: they differ by a factor of $\frac{\sqrt{P_a}}{P_a}$. With P_a taken to be 100 kPa the factor is 1/10.</p> <p>Substituting typical values of 200 bar (20000 kPa) for q_c and 225 kPa for σ'_v one gets: $20000 / 15 = 1333.33$ for Bellotti's axis and $(200/1)(100/225)^{0.5} = 200 * (10/15) = 133.3$ for LRP's axis (noting that $P_a = 1$ bar) showing a factor of 10 difference.</p>		
Es or Es Young's Modulus E	<p>Young's Modulus based on the work done in Italy. There are three types of sands considered in this technique. The user selects the appropriate type for the site from:</p> <ul style="list-style-type: none"> a) OC Sands b) Aged NC Sands c) Recent NC Sands <p>Each sand type has a family of curves that depend on mean normal stress. The program calculates mean normal stress and linearly interpolates between the two extremes provided in the E_s/q_t chart. E_s is evaluated for an axial strain of 0.1%.</p>	<p>Mean normal stress is evaluated from:</p> $\sigma'_m = \frac{1}{3}(\sigma'_v + \sigma'_h + \sigma'_h)$ <p>where σ'_v= vertical effective stress σ'_h= horizontal effective stress</p> <p>and $\sigma_h = K_o \cdot \sigma'_v$ with K_o assumed to be 0.5</p>	5
Delta U/TStress $\Delta u / \sigma_v$	Differential pore pressure ratio with respect to total stress	$= \frac{\Delta u}{\sigma_v}$ where: $\Delta u = u - u_{eq}$	39
Delta U/EStress, P Value, Excess Pore Pressure Ratio $\Delta u/\sigma'_v$	Differential pore pressure ratio with respect to effective stress. Key parameter (P, Normalized Pore Pressure Parameter, Excess Pore Pressure Ratio) in the Winckler et. al. static liquefaction method.	$= \frac{\Delta u}{\sigma'_v}$ where: $\Delta u = u - u_{eq}$	25, 25a
Su/EStress S_u/σ'_v	Undrained shear strength ratio with respect to vertical effective overburden stress using the $S_u (N_{kt})$ method	$= S_u (N_{kt}) / \sigma'_v$	9, 23
Vs or Vs	Recorded shear wave velocities (not estimated). The shear wave velocities are typically collected over 1 m depth intervals. Each data point over the relevant depth range is assigned the same V_s value.	recorded data	27
Vp or Vp	Recorded compression wave (or P wave) velocities (not estimated). The P wave velocities are typically collected over 1 m depth intervals. Each data point over the relevant depth range is assigned the same V_p value.	recorded data	27

Table 1b. CPT Parameter Calculation Methods – Liquefaction Parameters

Calculated Parameter	Description	Equation	Ref
K_{SPT} or K_s	Equivalent clean sand factor for $(N_1)_{60}$	$K_{SPT} = 1 + ((0.75/30) \cdot (FC - 5))$	10
K_{CPT} or K_C (RW1998)	Equivalent clean sand correction for q_{c1N}	$K_{cpt} = 1.0$ for $l_c \leq 1.64$ $K_{cpt} = f(l_c)$ for $l_c > 1.64$ (see reference) $K_C = -0.403 l_c^4 + 5.581 l_c^3 - 21.63 l_c^2 + 33.75 l_c - 17.88$	3, 10
K_C (PKR 2010)	Clean sand equivalent factor to be applied to Q_{tn}	$K_C = 1.0$ for $l_c \leq 1.64$ $K_C = -0.403 l_c^4 + 5.581 l_c^3 - 21.63 l_c^2 + 33.75 l_c - 17.88$ for $l_c > 1.64$	16
$(N_1)_{60cs} l_c$	Clean sand equivalent SPT $(N_1)_{60} l_c$. User has 3 options.	1) $(N_1)_{60cs} l_c = \alpha + \beta((N_1)_{60} l_c)$ 2) $(N_1)_{60cs} l_c = K_{SPT} * ((N_1)_{60} l_c)$ 3) $(q_{c1ncs}) / (N_1)_{60cs} l_c = 8.5 (1 - l_c/4.6)$ $FC \leq 5\%: \quad \alpha = 0, \quad \beta = 1.0$ $FC \geq 35\% \quad \alpha = 5.0, \quad \beta = 1.2$ $5\% < FC < 35\% \quad \alpha = \exp[1.76 - (190/FC^2)]$ $\quad \quad \quad \beta = [0.99 + (FC^{1.5}/1000)]$	10 10 5
q_{c1ncs}	Clean sand equivalent q_{c1n}	$q_{c1ncs} = q_{c1n} \cdot K_{cpt}$	3
$Q_{tn,cs}$ (PKR 2010)	Clean sand equivalent for Q_{tn} described above - Q_{tn} being the normalized tip resistance based on a variable stress exponent as defined by Robertson (2009)	$Q_{tn,cs} = Q_{tn} \cdot K_C$ (PKR 2016)	16
$S_u(Liq)/ES_v$ or $S_u(Liq)/\sigma'_v$	Liquefied shear strength ratio as defined by Olson and Stark	$\frac{S_u(Liq)}{\sigma'_v} = 0.03 + 0.0143(q_{c1})$ Note: σ'_v and s'_v are synonymous	13
$S_u(Liq)/ES_v$ or $S_u(Liq)/\sigma'_v$ (PKR 2010)	Liquefied shear strength ratio as defined by Robertson (2010)	$\frac{S_u(Liq)}{\sigma'_v}$ Based on a function involving $Q_{tn,cs}$	16
$S_u(Liq)$ (PKR 2010)	Liquefied shear strength derived from the liquefied shear strength ratio and effective overburden stress	$S_u(Liq) = \sigma'_v \cdot \left(\frac{S_u(Liq)}{\sigma'_v} \right)$	16
Cont/Dilat Tip	Contractive / Dilative q_{c1} Boundary based on $(N_1)_{60}$	$(\sigma'_v)_{boundary} = 9.58 \times 10^{-4} [(N_1)_{60}]^{4.79}$ q_{c1} is calculated from specified q_t (MPa)/N ratio	13
CRR	Cyclic Resistance Ratio (for Magnitude 7.5)	$q_{c1ncs} < 50:$ $CRR_{7.5} = 0.833 [q_{c1ncs}/1000] + 0.05$ $50 \leq q_{c1ncs} < 160:$ $CRR_{7.5} = 93 [q_{c1ncs}/1000]^3 + 0.08$	10
K_g or K_g	Small strain Stiffness Ratio Factor, K_g	$[G_{max}/q_t]/[q_{c1n}^{-m}]$ m = empirical exponent, typically 0.75	26



Calculated Parameter	Description	Equation	Ref
K_g^*	Revised K_g factor extended to fine grained soils (Robertson).	$K_g^* = (G_o / q_n)(Q_{tn})^{0.75}$ where q_n is the net tip resistance = $q_t - \sigma_v$	30
SP Distance	State Parameter Distance, Winckler static liquefaction method	Perpendicular distance on Q_{tn} chart from plotted point to state parameter $\Psi = -0.05$ curve	25
URS NP Fr	Normalized friction ratio point on $\Psi = -0.05$ curve used in SP distance calculation		25
URS NP Q_{tn}	Normalized tip resistance (Q_{tn}) point on $\Psi = -0.05$ curve used in SP Distance calculation		25

Table 2. References

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No.	Reference
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ConeTec’s Calculated Flow Penetrometer Geotechnical Parameters as of March 4, 2019 (Rev05).

Full flow penetration tests are conducted to assess the undrained shear strength (S_u) of low to medium strength soils. For the calculations to be valid, the material must flow around the penetrometer. For cases where this condition is not met, the interpreted values may not be valid. Undrained shear strength data from ball CPTu (BCPTu) is presented as a guide for geotechnical use and should be reviewed by personnel having adequate knowledge in the subject matter. The end user should be fully aware of the assumptions made and the techniques used in full flow penetration testing analysis. The purpose of this document is to inform the user as to how undrained strength was determined from full flow penetration data, specifically from ball CPTu (BCPTu).

The recorded ball tip resistance (q_b) is the total force acting on the piezocone spherical attachment divided by its base area. The ball tip resistance is corrected for pore pressure effects and termed corrected ball tip resistance (q_{bt}) according to the following expression:

$$q_{bt} = q_b + [(1-a)u_2] \frac{A_s}{A_p}$$

- where:
- q_{bt} is the corrected ball tip resistance
 - q_b is the recorded ball tip resistance
 - u_2 is the recorded dynamic pore pressure behind the tip (u_2 position)
 - a is the Net Area Ratio for the piezocone (0.8 for ConeTec probes)
 - A_s is the shaft area
 - A_p is the ball plan area

The undrained shear strength derived from the test is related to the net penetration resistance using the following relationship:

$$S_u = \frac{q_{net}}{N}$$

The total vertical stresses used in the q_{net} calculations are based on assumed unit weights of the material which can be provided by the client or determined from an adjacent CPTu hole, pore pressure dissipation tests conducted in fluid behaving material, laboratory data or historical data. In the analysis for the ball, the influence of the total stress and pore pressure correction are much less than that for the standard CPTu because of the geometry of the ball and how stresses are only unbalanced in the shadow of the cone shaft. This results in the need to only apply adjustments according to the ratio of shaft area (A_s) to probe or ball plan area (A_p) as detailed in [Table 1](#). A typical value for the ratio (A_s/A_p) is $10 \text{ cm}^2 / 100 \text{ cm}^2$ or 1/10.

Table 1
BCPTu Parameter Calculation Methods

Interpreted Parameter	Description	Equation	Ref
q_{btnet}	Net ball tip resistance	$q_{btnet} = q_{bt} - \left[\sigma_{vo} \times \frac{A_s}{A_p} \right]$	
γ	Soil unit weight	<ul style="list-style-type: none"> • User defined • From pore pressure dissipation data in fluid behaving materials • Lab data • Uniform unit weight (from client, or based on historical data) • From an adjacent CPTu test 	
S_u	Undrained shear strength	$S_u = \frac{q_{btnet}}{N_{ball}}$	

Calibration Records



CERTIFICATE OF CALIBRATION

Calibration Information			
Cone Serial Number	EC681	Model	A15 T375 F10 U35
Date	2023-10-27	Signature	
Technician Performing Calibration	Richard Chen		
Calibration Approved By	Vishrut Khunt	Signature	

Lab Condition	As Found	As Left		
Lab Temperature	N/A	23°C		
Lab Humidity	N/A	26%	Reason for Calibration	Repair

Cone Information				
Tip Stress Limit	375	bar	Tip End Area	15 cm ²
Friction Stress Limit	10	bar	Friction Surface Area	225 cm ²
Pressure Limit	35	bar	RTD Location	Pressure Carrier
X-Inclinometer Limit	30	degrees	Geophone	X and Z
Y-Inclinometer Limit	30	degrees	Temperature Range	-20°C to 60°C

Baseline Summary: (For Reference Only)

Channel	Units	As Found	As Left
Tip	bar	-0.744	-0.050
Sleeve	bar	-0.009	-0.023
Pressure	bar	1.115	1.008
X-Inclinometer	degrees	-0.528	-0.040
Y-Inclinometer	degrees	-0.323	-0.015
Temperature	°C	23.980	22.421

Classified in accordance with ISO 22476-1:2012 Class 1

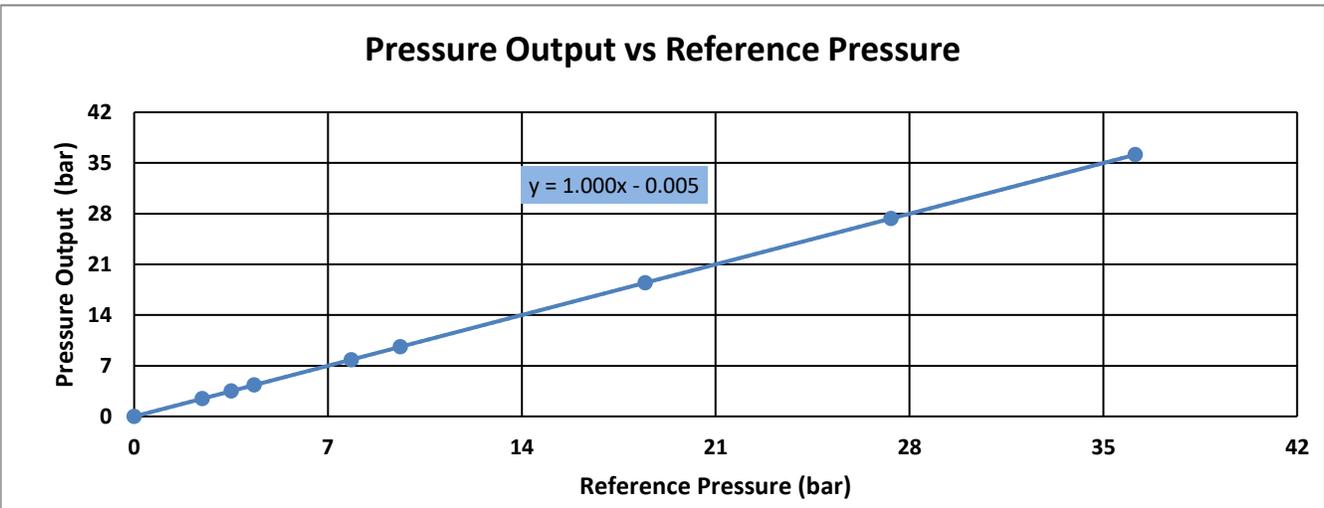
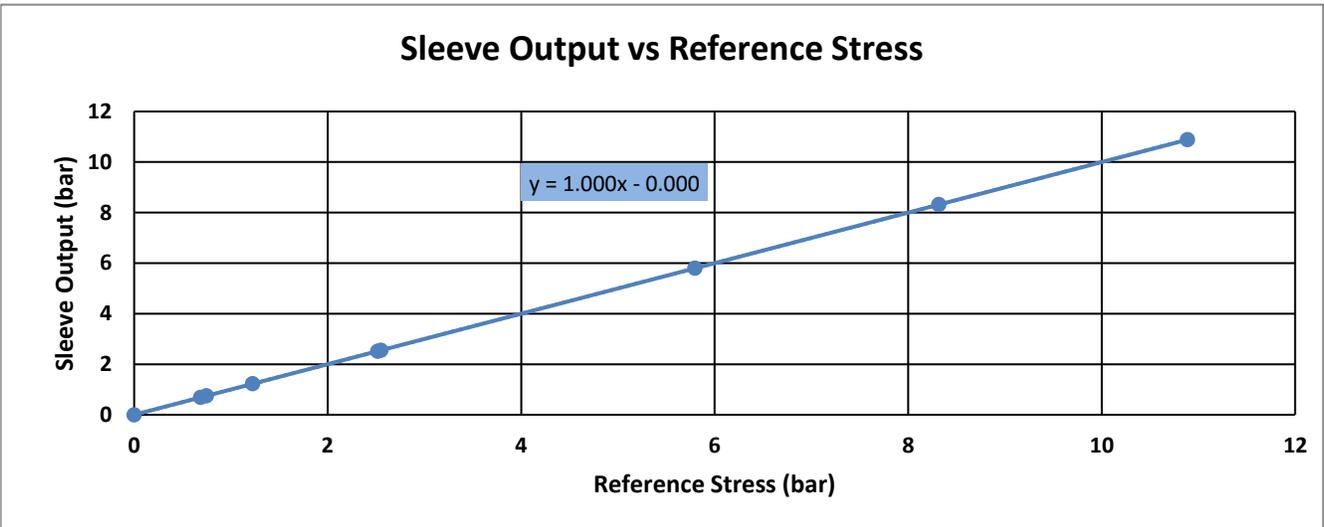
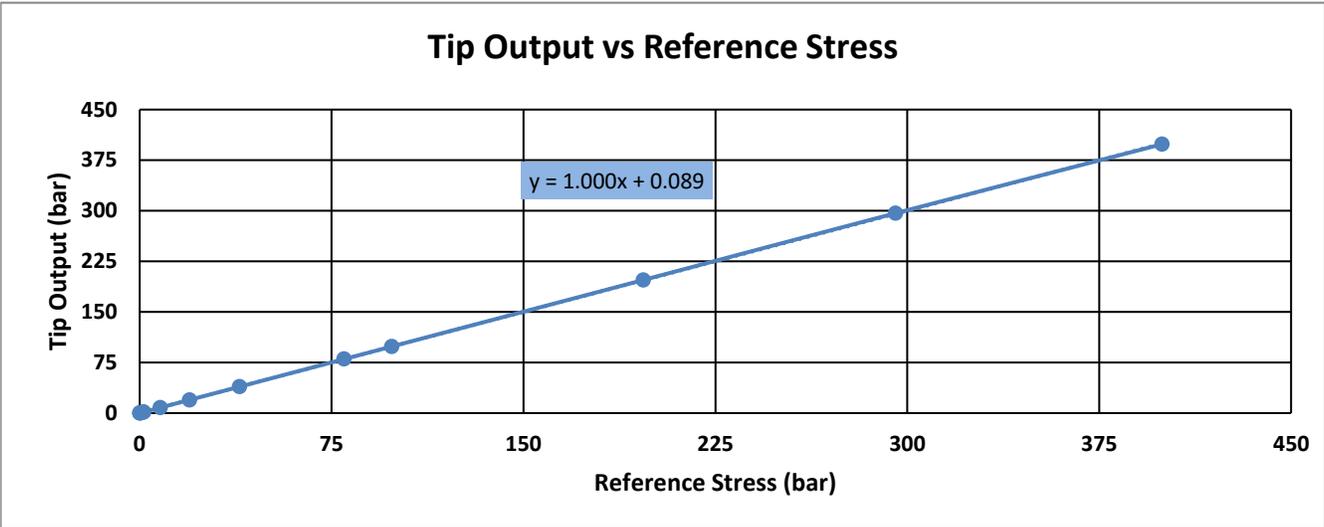
Classified in accordance with ISO 22476-1:2012 Class 2

Calibrated in general accordance with the ASTM D5778-20 and D7400-08 standards

Calibrated with Adara calibration procedure EC_CPTCAL-2.1

Collective uncertainty of the measurement standards conforms to a test uncertainty ratio (TUR) of 3:1 for tip and sleeve measurement and 4:1 for pressure measurement with a confidence level k=2

Cone Output vs Reference Stress/Pressure Plots





Calibration Results

Tip Calibration					
As Found			As Left		
Max. Non Linearity	0.93%	FAIL	Max. Non Linearity	0.25%	PASS
Calibration Error	0.88%	FAIL	Calibration Error	0.32%	PASS

Sleeve Calibration					
As Found			As Left		
Max. Non Linearity	0.53%	FAIL	Max. Non Linearity	0.04%	PASS
Calibration Error	0.49%	PASS	Calibration Error	0.08%	PASS

Pressure Calibration					
As Found			As Left		
Max. Non Linearity	0.02%	PASS	Max. Non Linearity	0.05%	PASS
Calibration Error	0.16%	PASS	Calibration Error	0.12%	PASS

X-Inclinometer Calibration					
As Found			As Left		
Max. Non Linearity	N/A	N/A	Max. Non Linearity	-0.50%	PASS
Calibration Error	N/A	N/A	Calibration Error	1.00%	PASS

Y-Inclinometer Calibration					
As Found			As Left		
Max. Non Linearity	N/A	N/A	Max. Non Linearity	-0.58%	PASS
Calibration Error	N/A	N/A	Calibration Error	1.17%	PASS

Seismic Calibration					
As Found			As Left		
Trigger Delay Error	N/A	N/A	Trigger Delay Error	0.01%	PASS

Temperature Calibration					
Full Scale Error	0.10%	PASS			

Channel	Cold	Room	Hot	Units
Ref_Temp	5.9	22.1	42.7	°C
Tip	0.081	-0.051	0.006	bar
Sleeve	-0.026	-0.021	-0.014	bar
Pressure	1.068	1.066	1.061	bar
Temperature	5.832	22.049	42.627	°C

Tip Temperature Coefficient	-0.002 bar/°C	PASS
Sleeve Temperature Coefficient	0.000 bar/°C	PASS
Pressure Temperature Coefficient	0.000 bar/°C	PASS



Testing Equipment Details

Testing Machines	Model Number	Serial Number	Calibration Number	Due Date
Tip Load Cell	Precision	P-10289	100490	2025-09-18
Sleeve Load Cell	Precision	P-10868	100579	2025-10-01
Digital Loadcell Indicator	4215	62140	100490	2024-07-18
Fluke Reference Pressure Monitor	RPM4 A10Ms	3061	100214	2024-01-05
Tektronix Function Generator	AFG1022	1820013	100167	2023-11-06
Thermometer	THS-222-555	D23255834	100410	2024-07-11
Thermometer	THS-222-555	D23255829	100410	2024-07-11
Thermometer	THS-222-555	D20345575	100565	2024-07-14

Adara Error Definitions

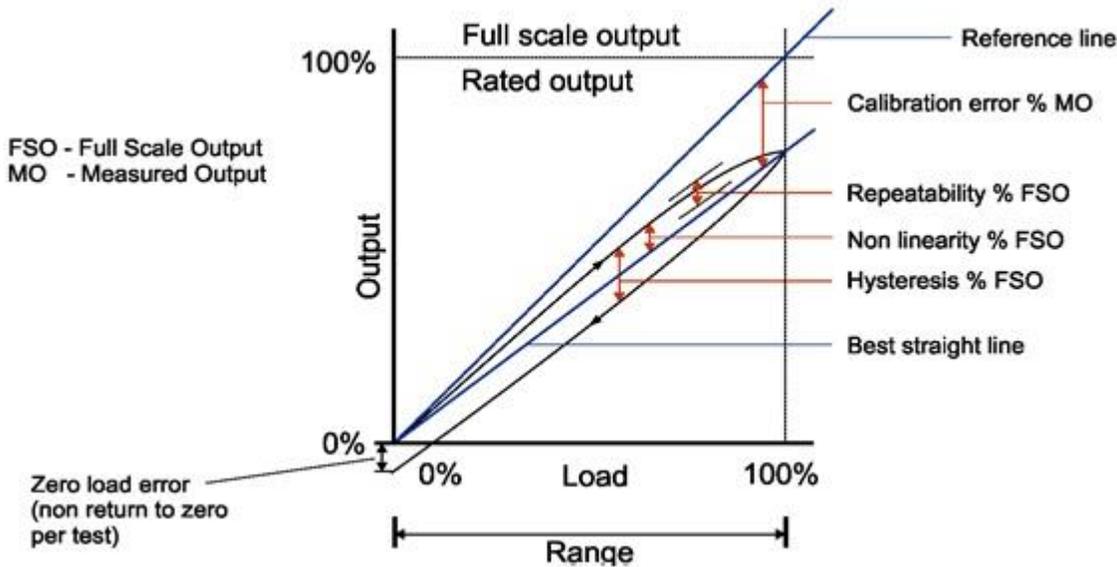


Figure 1: Definition of Calibration Terms for Load Cell and Transducers (Adapted from [1])

Actual Sensitivity	The slope of the best fit line through all data points starting at zero load.
Slope Error	The error in the best fit line compared to the ideal linear calibration in % . Slope Error = (Best Fit Slope - Ideal Slope) / Ideal Slope
Maximum Non Linearity	This value represents the maximum error (absolute value) relative to the best fit line considering each calibration point starting at loads greater than approximately 10% of FSO. The reported errors are a percent error of FSO. Adara's Pass/Fail criteria is 0.5% of FSO (ASTM is 0.5% of FSO at loads > 20% FSO).
Calibration Error	This value represents the maximum error (absolute value) in the recorded load value as compared to the actual load value for each calibration point for loads greater than approximately 10% of FSO. Adara's Pass/Fail criteria for the tip and sleeve is 0.5% of MO and 1.0% of MO for the pore pressure (ASTM for the tip and sleeve is 1.5% and 1.0% of MO respectively at loads greater than 20% of FSO)

Temperature Check Passing Criteria

Tip Temperature Coefficient	<0.200 bar/°C
Sleeve Temperature Coefficient	<0.005 bar/°C
Pressure Temperature Coefficient	<0.0196 bar/°C

ASTM D5778-20 Annex A Summary [1]

A1.4 Force Transducer Calibration Requirements

A1.4.1 states the following limits:

Non Linearity	Tip	≤ +0.5% of FSO
	Sleeve	≤ +1.0% of FSO
Calibration Error	Tip	≤ +1.5% of MO at loads > 20% FSO
	Sleeve	≤ +1.0% of MO at loads > 20% FSO

A1.5 Pressure Transducer Calibrations

A1.5.1 limits:

Non Linearity	Pore Pressure	≤ +1.0% of FSO
Calibration Error	Pore Pressure	not specified

ISO 22476 -1:2012 Summary [2]

Section 5.2 states the following allowable minimum accuracy

Class 1	Cone Resistance	35 kPa or 5%
	Sleeve Friction	5 kPa or 10%
	Pore Pressure	10 kPa or 2%
Class 2	Cone Resistance	100 kPa or 5%
	Sleeve Friction	15 kPa or 15%
	Pore Pressure	25 kPa or 3%

Note: ISO Compliance is based on low end calibration only.

References

[1] ASTM D5778-20. "Standard Test Method for Electronic Friction Cone and Piezocone Penetration Testing of Soils". ASTM, West Conshohocken, PA, USA.

[2] ISO 22476-1:2012. "Geotechnical investigation and testing - Field Testing - Part 1: Electrical cone and piezocone penetration test". ISO, Geneva, Switzerland.

ASTM D7400-08. "Standard Test Methods for Downhole Seismic Testing". ASTM, West Conshohocken, PA, USA.



CERTIFICATE OF CALIBRATION

Calibration Information			
Cone Serial Number	EC767	Model	A10 T1000 F10 U35
Date	2024-02-13	Signature	
Technician Performing Calibration	Richard Chen		
Calibration Approved By	Vishrut Khunt	Signature	

Lab Condition	As Found	As Left		
Lab Temperature	N/A	23°C		
Lab Humidity	N/A	31%	Reason for Calibration	Repair

Cone Information				
Tip Stress Limit	1000	bar	Tip End Area	10 cm ²
Friction Stress Limit	10	bar	Friction Surface Area	150 cm ²
Pressure Limit	35	bar	RTD Location	Pressure Carrier
X-Inclinometer Limit	30	degrees	Geophone	X
Y-Inclinometer Limit	30	degrees	Temperature Range	-20°C to 60°C

Baseline Summary: (For Reference Only)

Channel	Units	As Found	As Left
Tip	bar	-2.189	0.016
Sleeve	bar	-0.041	-0.018
Pressure	bar	1.033	1.009
X-Inclinometer	degrees	-0.525	0.000
Y-Inclinometer	degrees	-0.325	0.045
Temperature	°C	22.710	22.505

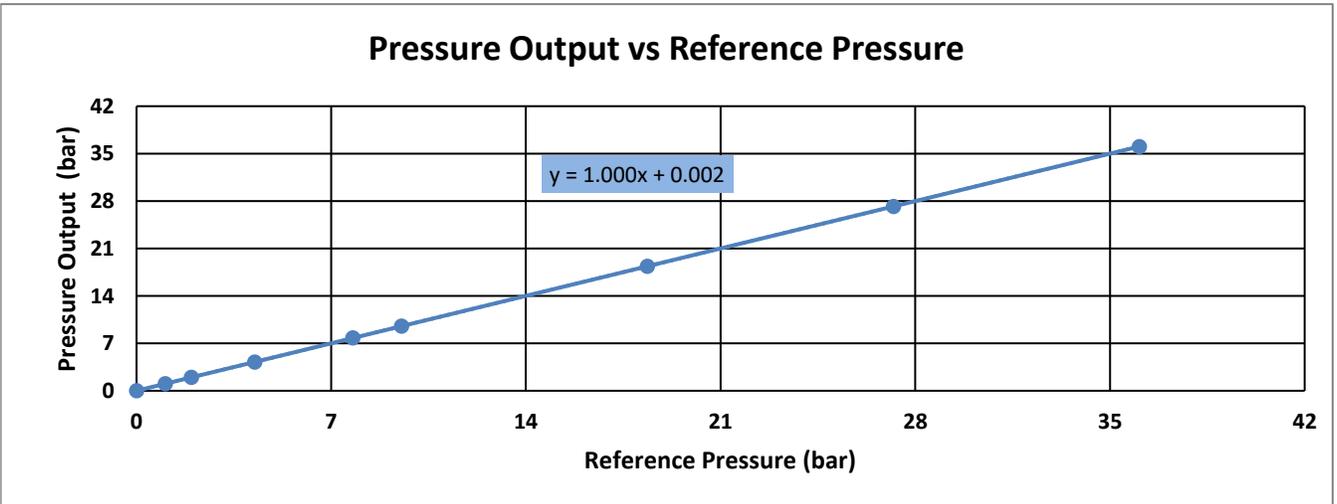
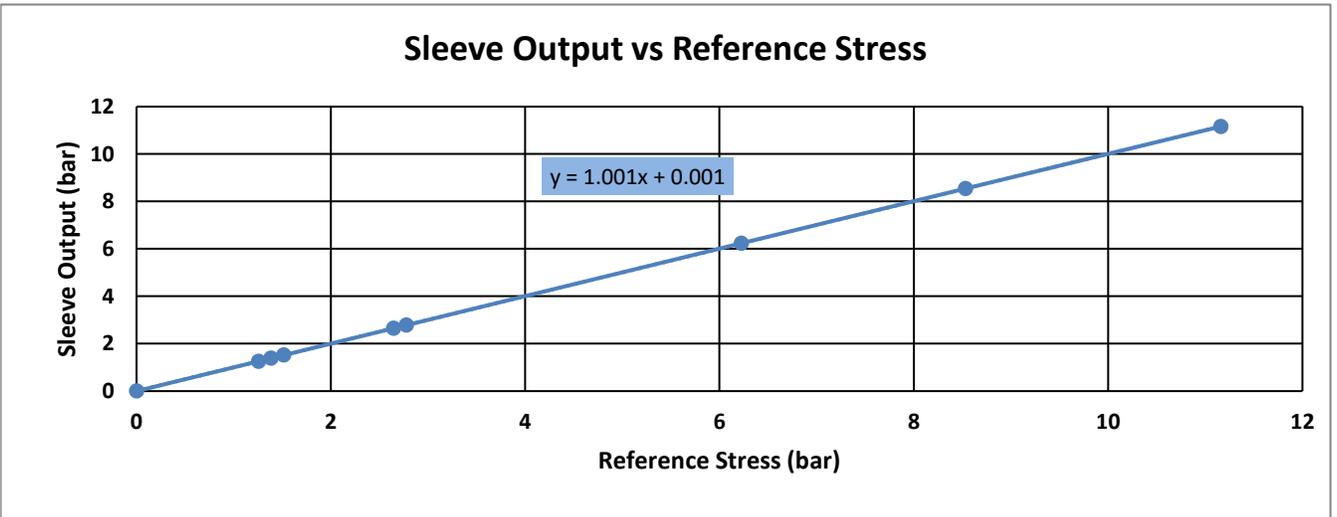
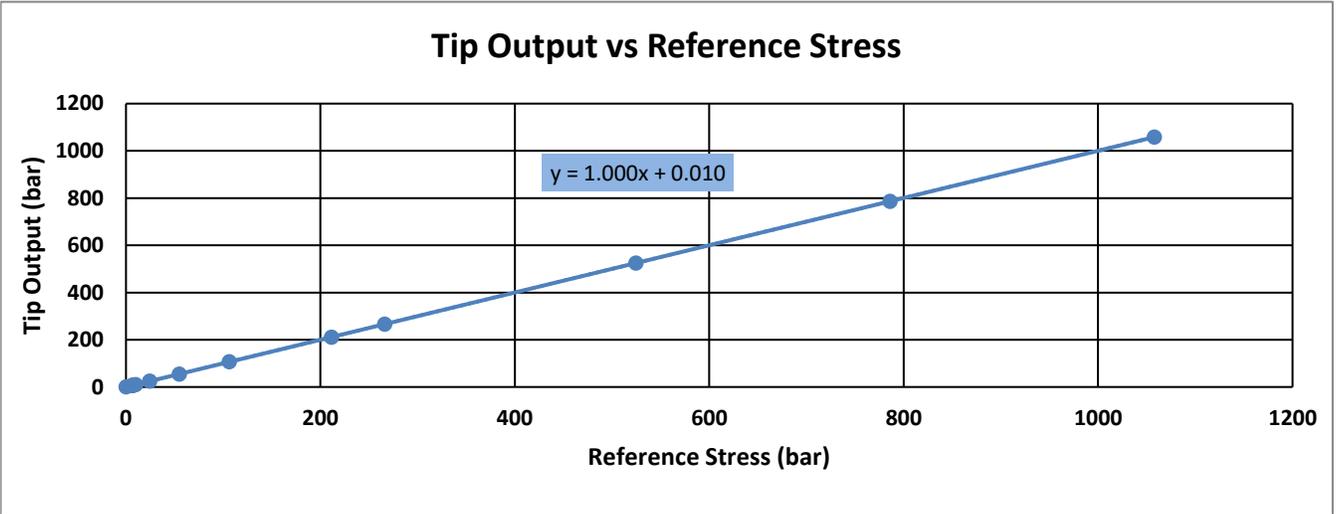
*Classified in accordance with ISO 22476-1:2012 Class 1
 Classified in accordance with ISO 22476-1:2012 Class 2*

Calibrated in general accordance with the ASTM D5778-20 and D7400-08 standards

Calibrated with Adara calibration procedure EC_CPTCAL-2.2

Collective uncertainty of the measurement standards conforms to a test uncertainty ratio (TUR) of 3:1 for tip and sleeve measurement and 4:1 for pressure measurement with a confidence level k=2

Cone Output vs Reference Stress/Pressure Plots





Calibration Results

Tip Calibration					
As Found			As Left		
Max. Non Linearity	0.09%	PASS	Max. Non Linearity	0.04%	PASS
Calibration Error	0.12%	PASS	Calibration Error	0.04%	PASS

Sleeve Calibration					
As Found			As Left		
Max. Non Linearity	0.20%	PASS	Max. Non Linearity	0.10%	PASS
Calibration Error	0.69%	FAIL	Calibration Error	0.18%	PASS

Pressure Calibration					
As Found			As Left		
Max. Non Linearity	2.97%	FAIL	Max. Non Linearity	0.02%	PASS
Calibration Error	0.17%	PASS	Calibration Error	0.06%	PASS

X-Inclinometer Calibration					
As Found			As Left		
Max. Non Linearity	N/A	N/A	Max. Non Linearity	-0.42%	PASS
Calibration Error	N/A	N/A	Calibration Error	0.83%	PASS

Y-Inclinometer Calibration					
As Found			As Left		
Max. Non Linearity	N/A	N/A	Max. Non Linearity	-0.79%	PASS
Calibration Error	N/A	N/A	Calibration Error	1.58%	PASS

Seismic Calibration					
As Found			As Left		
Trigger Delay Error	N/A	N/A	Trigger Delay Error	0.01%	PASS

Temperature Calibration					
Full Scale Error	0.19%	PASS			

Channel	Cold	Room	Hot	Units
Ref_Temp	2.1	21.5	42.3	°C
Tip	-1.318	-0.145	2.128	bar
Sleeve	-0.026	-0.018	0.022	bar
Pressure	1.007	1.059	1.097	bar
Temperature	2.065	21.318	42.271	°C

Tip Temperature Coefficient	0.086 bar/°C	PASS
Sleeve Temperature Coefficient	0.001 bar/°C	PASS
Pressure Temperature Coefficient	0.002 bar/°C	PASS



Testing Equipment Details

Testing Machines	Model Number	Serial Number	Calibration Number	Due Date
Tip Load Cell	Precision	P-10289	100490	2025-09-18
Sleeve Load Cell	Precision	P-10868	100579	2025-10-01
Digital Loadcell Indicator	4215	62140	100490	2024-07-18
Fluke Reference Pressure Monitor	RPM4 A10Ms	3910	100835	2024-12-12
Tektronix Function Generator	AFG3021B	C030955	100751	2024-10-20
Thermometer	THS-222-555	D23255834	100410	2024-07-11
Thermometer	THS-222-555	D23255829	100410	2024-07-11
Thermometer	THS-222-555	D20345575	100565	2024-07-14

Adara Error Definitions

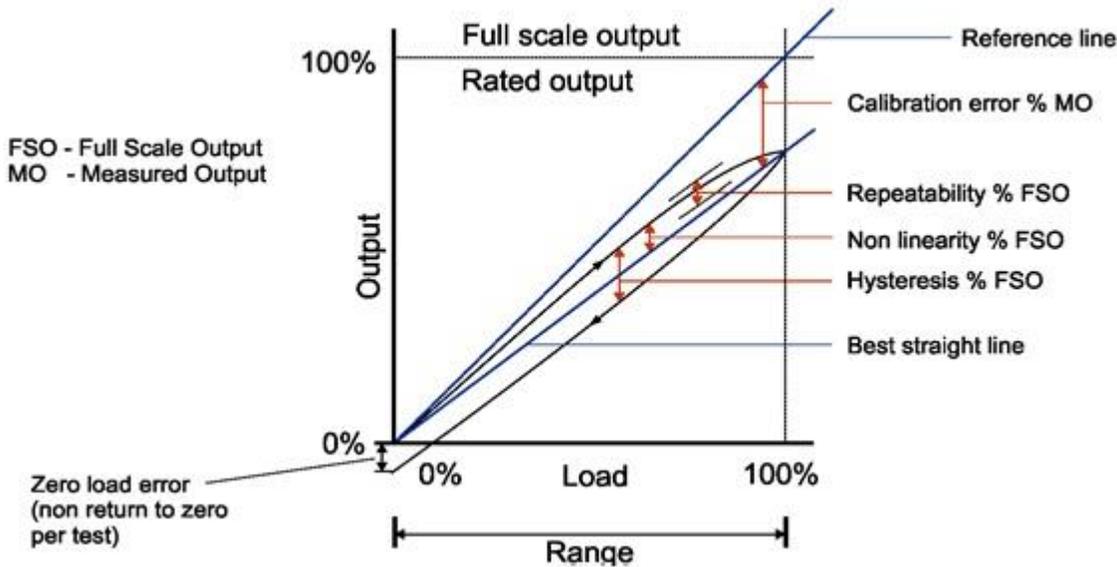


Figure 1: Definition of Calibration Terms for Load Cell and Transducers (Adapted from [1])

Actual Sensitivity	The slope of the best fit line through all data points starting at zero load.
Slope Error	The error in the best fit line compared to the ideal linear calibration in % . Slope Error = (Best Fit Slope - Ideal Slope) / Ideal Slope
Maximum Non Linearity	This value represents the maximum error (absolute value) relative to the best fit line considering each calibration point starting at loads greater than approximately 10% of FSO. The reported errors are a percent error of FSO. Adara's Pass/Fail criteria is 0.5% of FSO (ASTM is 0.5% of FSO at loads > 20% FSO).
Calibration Error	This value represents the maximum error (absolute value) in the recorded load value as compared to the actual load value for each calibration point for loads greater than approximately 10% of FSO. Adara's Pass/Fail criteria for the tip and sleeve is 0.5% of MO and 1.0% of MO for the pore pressure (ASTM for the tip and sleeve is 1.5% and 1.0% of MO respectively at loads greater than 20% of FSO)

Temperature Check Passing Criteria

Tip Temperature Coefficient	<0.200 bar/°C
Sleeve Temperature Coefficient	<0.005 bar/°C
Pressure Temperature Coefficient	<0.0196 bar/°C

ASTM D5778-20 Annex A Summary [1]

A1.4 Force Transducer Calibration Requirements

A1.4.1 states the following limits:

Non Linearity	Tip	$\leq +0.5\%$ of FSO
	Sleeve	$\leq +1.0\%$ of FSO
Calibration Error	Tip	$\leq +1.5\%$ of MO at loads > 20% FSO
	Sleeve	$\leq +1.0\%$ of MO at loads > 20% FSO

A1.5 Pressure Transducer Calibrations

A1.5.1 limits:

Non Linearity	Pore Pressure	$\leq +1.0\%$ of FSO
Calibration Error	Pore Pressure	not specified

ISO 22476 -1:2012 Summary [2]

Section 5.2 states the following allowable minimum accuracy

Class 1	Cone Resistance	35 kPa or 5%
	Sleeve Friction	5 kPa or 10%
	Pore Pressure	10 kPa or 2%
Class 2	Cone Resistance	100 kPa or 5%
	Sleeve Friction	15 kPa or 15%
	Pore Pressure	25 kPa or 3%

Note: ISO Compliance is based on low end calibration only.

References

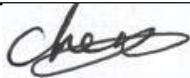
[1] ASTM D5778-20. "Standard Test Method for Electronic Friction Cone and Piezocone Penetration Testing of Soils". ASTM, West Conshohocken, PA, USA.

[2] ISO 22476-1:2012. "Geotechnical investigation and testing - Field Testing - Part 1: Electrical cone and piezocone penetration test". ISO, Geneva, Switzerland.

ASTM D7400-08. "Standard Test Methods for Downhole Seismic Testing". ASTM, West Conshohocken, PA, USA.



CERTIFICATE OF CALIBRATION

Calibration Information			
Cone Serial Number	EC1007	Model	A15 T1500 F15 U35
Date	2023-11-24	Signature	
Technician Performing Calibration	Richard Chen		
Calibration Approved By	Vishrut Khunt	Signature	

Lab Condition	As Found	As Left		
Lab Temperature	N/A	22°C		
Lab Humidity	N/A	30%	Reason for Calibration	Repair

Cone Information				
Tip Stress Limit	1500	bar	Tip End Area	15 cm ²
Friction Stress Limit	15	bar	Friction Surface Area	225 cm ²
Pressure Limit	35	bar	RTD Location	Pressure Carrier
X-Inclinometer Limit	30	degrees	Geophone	X and Z
Y-Inclinometer Limit	30	degrees	Temperature Range	-20°C to 60°C

Baseline Summary: (For Reference Only)

Channel	Units	As Found	As Left
Tip	bar	17.464	0.164
Sleeve	bar	0.189	-0.014
Pressure	bar	1.080	1.009
X-Inclinometer	degrees	-3.760	0.025
Y-Inclinometer	degrees	0.575	0.000
Temperature	°C	22.381	21.603

Classified in accordance with ISO 22476-1:2012 Class 1

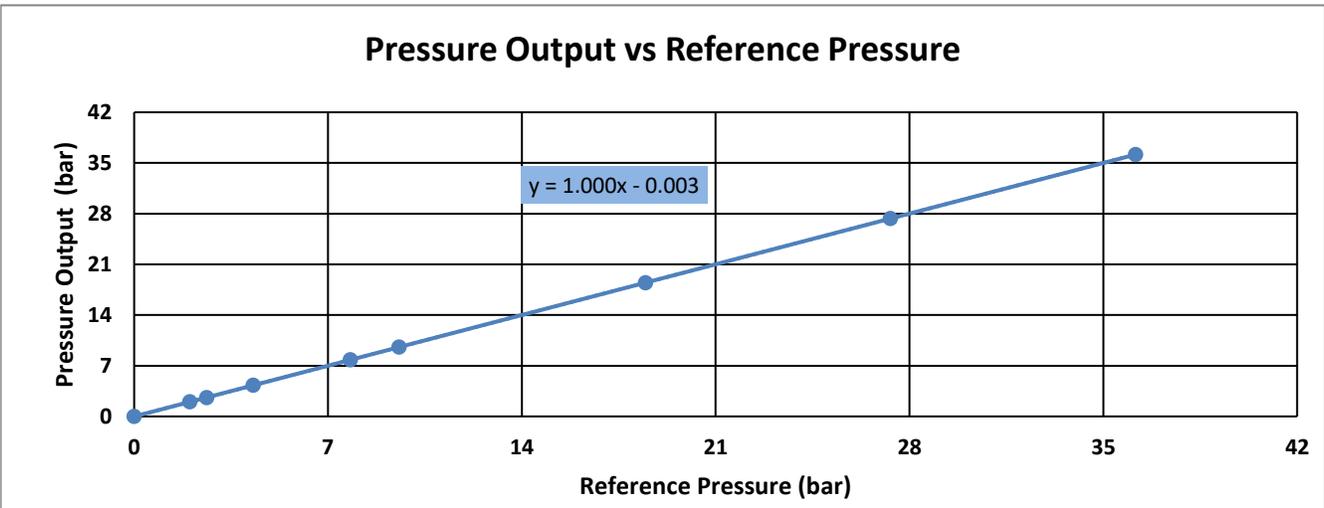
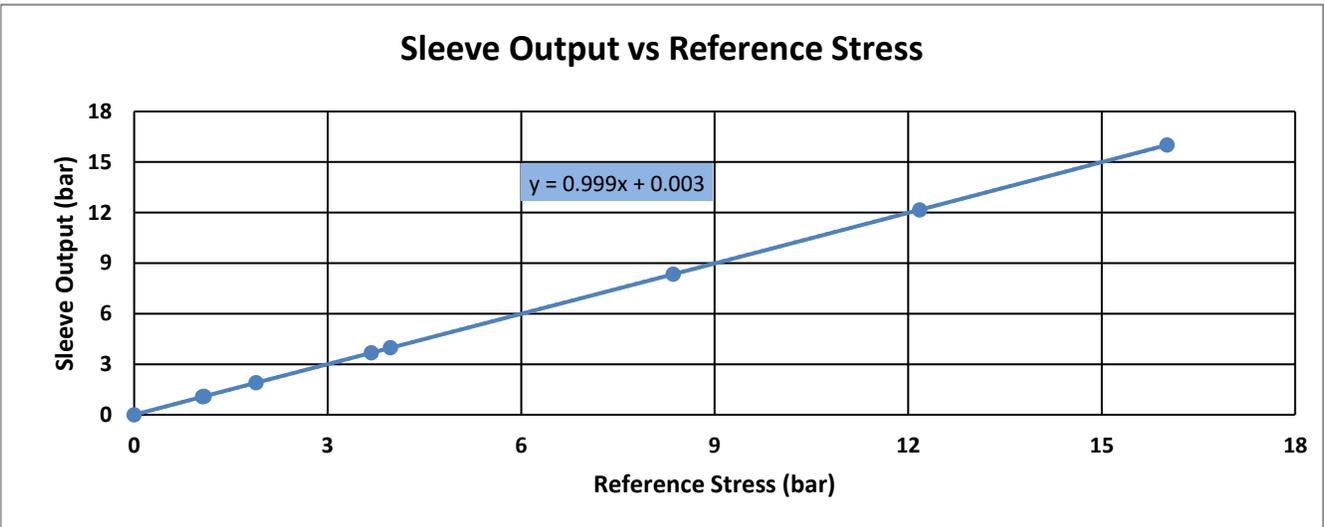
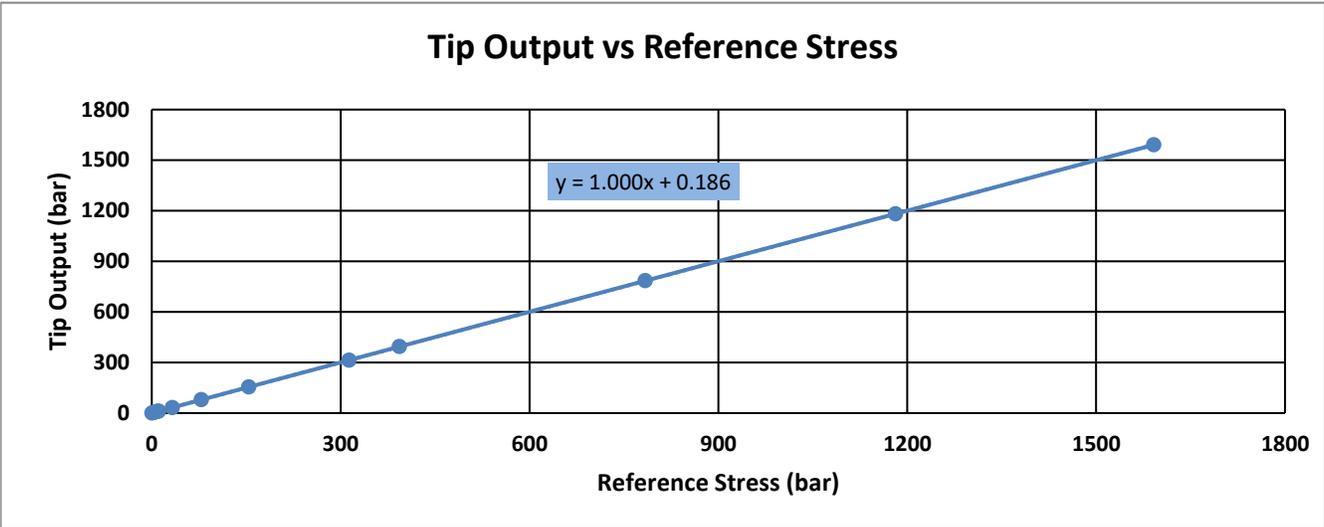
Classified in accordance with ISO 22476-1:2012 Class 2

Calibrated in general accordance with the ASTM D5778-20 and D7400-08 standards

Calibrated with Adara calibration procedure EC_CPTCAL-2.1

Collective uncertainty of the measurement standards conforms to a test uncertainty ratio (TUR) of 3:1 for tip and sleeve measurement and 4:1 for pressure measurement with a confidence level k=2

Cone Output vs Reference Stress/Pressure Plots





Calibration Results

Tip Calibration						
	As Found			As Left		
Max. Non Linearity	0.06%	PASS		Max. Non Linearity	0.05%	PASS
Calibration Error	0.12%	PASS		Calibration Error	0.16%	PASS

Sleeve Calibration						
	As Found			As Left		
Max. Non Linearity	0.09%	PASS		Max. Non Linearity	0.14%	PASS
Calibration Error	0.71%	FAIL		Calibration Error	0.42%	PASS

Pressure Calibration						
	As Found			As Left		
Max. Non Linearity	0.01%	PASS		Max. Non Linearity	0.03%	PASS
Calibration Error	0.07%	PASS		Calibration Error	0.11%	PASS

X-Inclinometer Calibration						
	As Found			As Left		
Max. Non Linearity	N/A	N/A		Max. Non Linearity	-0.71%	PASS
Calibration Error	N/A	N/A		Calibration Error	1.42%	PASS

Y-Inclinometer Calibration						
	As Found			As Left		
Max. Non Linearity	N/A	N/A		Max. Non Linearity	-0.75%	PASS
Calibration Error	N/A	N/A		Calibration Error	1.50%	PASS

Seismic Calibration						
	As Found			As Left		
Trigger Delay Error	N/A	N/A		Trigger Delay Error	0.01%	PASS

Temperature Calibration						
Full Scale Error	0.25%	PASS				

Channel	Cold	Room	Hot	Units
Ref_Temp	4.3	22.1	43.4	°C
Tip	-1.703	-0.065	1.990	bar
Sleeve	-0.045	-0.011	0.029	bar
Pressure	1.058	1.068	1.062	bar
Temperature	4.371	21.852	43.356	°C

Tip Temperature Coefficient	0.095 bar/°C	PASS
Sleeve Temperature Coefficient	0.002 bar/°C	PASS
Pressure Temperature Coefficient	0.000 bar/°C	PASS



Testing Equipment Details

Testing Machines	Model Number	Serial Number	Calibration Number	Due Date
Tip Load Cell	Precision	P-10289	100490	2025-09-18
Sleeve Load Cell	Precision	P-10868	100579	2025-10-01
Digital Loadcell Indicator	4215	62140	100490	2024-07-18
Fluke Reference Pressure Monitor	RPM4 A10Ms	3061	100214	2024-01-05
Tektronix Function Generator	AFG3021B	C030955	100751	2024-10-20
Thermometer	THS-222-555	D23255834	100410	2024-07-11
Thermometer	THS-222-555	D23255829	100410	2024-07-11
Thermometer	THS-222-555	D20345575	100565	2024-07-14

Adara Error Definitions

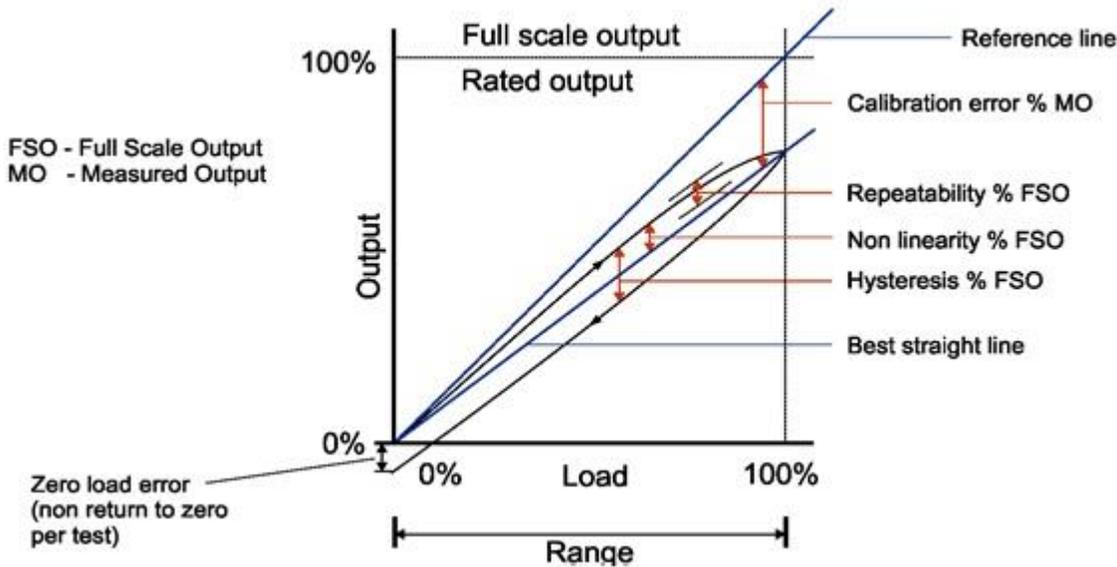


Figure 1: Definition of Calibration Terms for Load Cell and Transducers (Adapted from [1])

Actual Sensitivity	The slope of the best fit line through all data points starting at zero load.
Slope Error	The error in the best fit line compared to the ideal linear calibration in % . Slope Error = (Best Fit Slope - Ideal Slope) / Ideal Slope
Maximum Non Linearity	This value represents the maximum error (absolute value) relative to the best fit line considering each calibration point starting at loads greater than approximately 10% of FSO. The reported errors are a percent error of FSO. Adara's Pass/Fail criteria is 0.5% of FSO (ASTM is 0.5% of FSO at loads > 20% FSO).
Calibration Error	This value represents the maximum error (absolute value) in the recorded load value as compared to the actual load value for each calibration point for loads greater than approximately 10% of FSO. Adara's Pass/Fail criteria for the tip and sleeve is 0.5% of MO and 1.0% of MO for the pore pressure (ASTM for the tip and sleeve is 1.5% and 1.0% of MO respectively at loads greater than 20% of FSO)

Temperature Check Passing Criteria

Tip Temperature Coefficient	<0.200 bar/°C
Sleeve Temperature Coefficient	<0.005 bar/°C
Pressure Temperature Coefficient	<0.0196 bar/°C

ASTM D5778-20 Annex A Summary [1]

A1.4 Force Transducer Calibration Requirements

A1.4.1 states the following limits:

Non Linearity	Tip	$\leq +0.5\%$ of FSO
	Sleeve	$\leq +1.0\%$ of FSO
Calibration Error	Tip	$\leq +1.5\%$ of MO at loads > 20% FSO
	Sleeve	$\leq +1.0\%$ of MO at loads > 20% FSO

A1.5 Pressure Transducer Calibrations

A1.5.1 limits:

Non Linearity	Pore Pressure	$\leq +1.0\%$ of FSO
Calibration Error	Pore Pressure	not specified

ISO 22476 -1:2012 Summary [2]

Section 5.2 states the following allowable minimum accuracy

Class 1	Cone Resistance	35 kPa or 5%
	Sleeve Friction	5 kPa or 10%
	Pore Pressure	10 kPa or 2%
Class 2	Cone Resistance	100 kPa or 5%
	Sleeve Friction	15 kPa or 15%
	Pore Pressure	25 kPa or 3%

Note: ISO Compliance is based on low end calibration only.

References

[1] ASTM D5778-20. "Standard Test Method for Electronic Friction Cone and Piezocone Penetration Testing of Soils". ASTM, West Conshohocken, PA, USA.

[2] ISO 22476-1:2012. "Geotechnical investigation and testing - Field Testing - Part 1: Electrical cone and piezocone penetration test". ISO, Geneva, Switzerland.

ASTM D7400-08. "Standard Test Methods for Downhole Seismic Testing". ASTM, West Conshohocken, PA, USA.

Appendix F – Geotechnical Design Analysis

Attachment F.3

Geotechnical Laboratory Reports

Appendix F – Geotechnical Design Analysis

Attachment F.3

Geotechnical Laboratory Reports

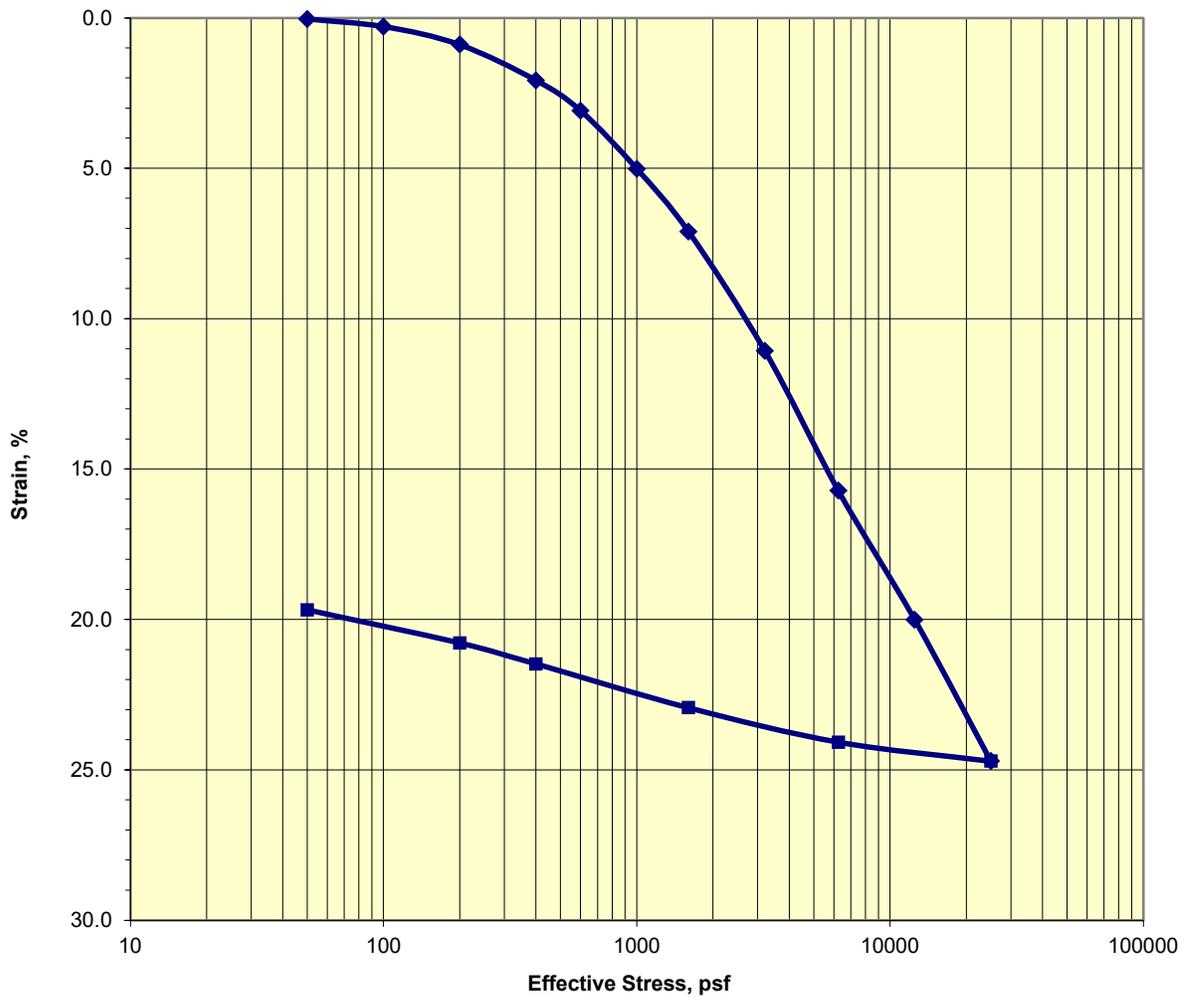


Consolidation Test

ASTM D2435

Job No.: 1007-006	Boring: GT-02	Run By: HM
Client: Anchor QEA	Sample:	Reduced: RU
Project: 210075-01.03	Depth, ft.: 12-14.5(Tip-4")	Checked: PJ
Soil Type: Dark Gray CLAY (Bay Mud)		Date: 11/25/2024

Strain-Log-P Curve



Assumed Gs	2.7	Initial	Final
Moisture %:		52.7	37.8
Dry Density, pcf:		67.1	83.4
Void Ratio:		1.513	1.021
% Saturation:		94.0	100.0

Remarks:

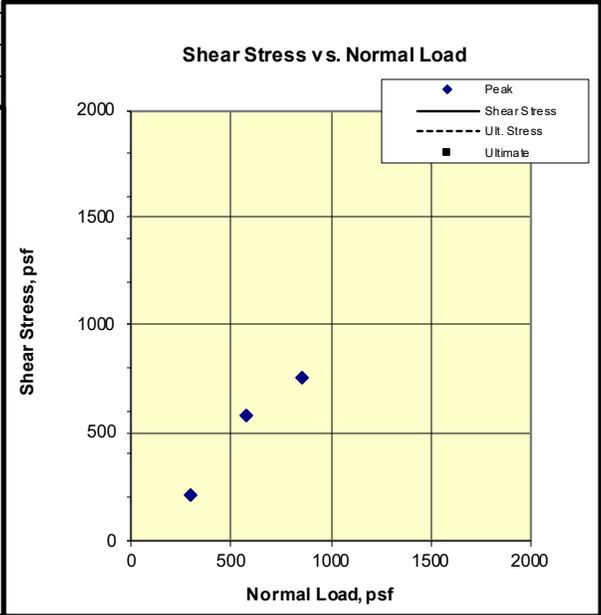
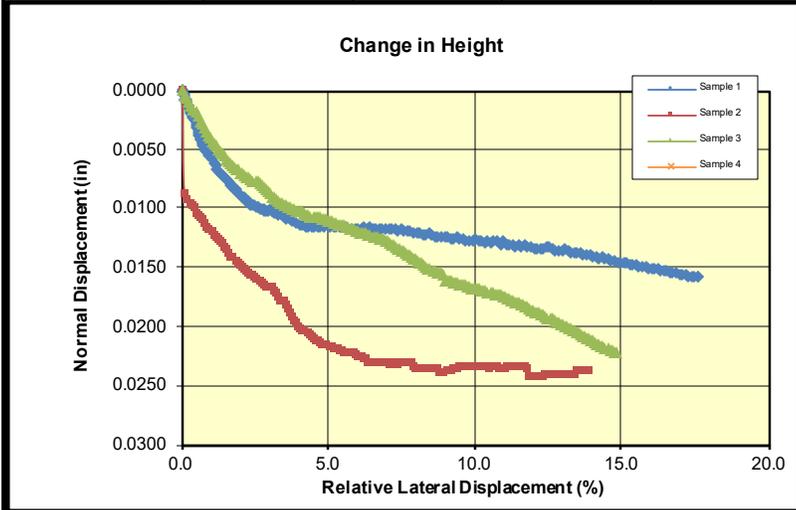
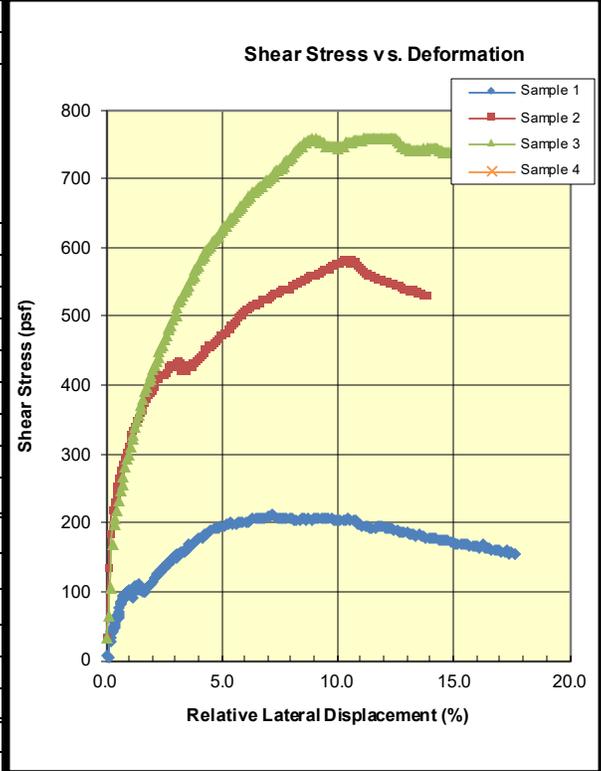


Consolidated Drained Direct Shear (ASTM D3080)

CTL Job #: 1007-006 Project #: 210075-01-03 By: MD
 Client: Anchor QEA Date: 2/13/2025 Checked: PJ
 Project Name: Middle Reach of the Lower Dwamish Waterway Remolding Info: _____

Specimen Data			
	1	2	3
Boring:	LDW23-GT02-GT	LDW23-GT02-GT	LDW23-GT02-GT
Sample:			
Depth (ft):	12-14.5	12-14.5	12-14.5
Visual Description:	Dark Olive Gray Sandy SILT	Dark Olive Gray Sandy SILT	Dark Olive Gray Sandy SILT
Normal Load (psf)	290	570	850
Dry Mass of Specimen (g)	115.9	118.6	124.7
Initial Height (in)	1.00	1.00	1.00
Initial Diameter (in)	2.85	2.85	2.85
Initial Void Ratio	1.435	1.380	1.263
Initial Moisture (%)	49.5	50.5	46.0
Initial Wet Density (pcf)	103.5	106.6	108.8
Initial Dry Density (pcf)	69.2	70.8	74.5
Initial Saturation (%)	93.1	98.7	98.4
Δ Height Consol (in)	0.0234	0.0526	0.0531
At Test Void Ratio	1.378	1.255	1.143
At Test Moisture (%)	49.1	46.4	41.7
At Test Wet Density (pcf)	105.7	109.4	111.5
At Test Dry Density (pcf)	70.9	74.7	78.7
At Test Saturation (%)	96.2	99.8	98.6
Strain Rate (%/min)	0.01	0.01	0.01
Strengths Picked at	Peak	Peak	Peak
Shear Stress (psf)	212	581	759
Δ Height (in) at Peak	0.0118	0.0233	0.0156
Ultimate Stress (psf)			

Phi (deg)	Ult. Phi (deg)
Cohesion (psf)	Ult. Cohesion (psf)



Remarks: Engineering judgement is required to determine phi and cohesion, no phi or cohesion is reported. To add phi and cohesion to the report go to the "phi" tab and in cells G30, G31, H30, and H31 enter end points for a line through the 3 data points. The points plotted can be changed on the "Eng Values" tab using cells L6, A2,

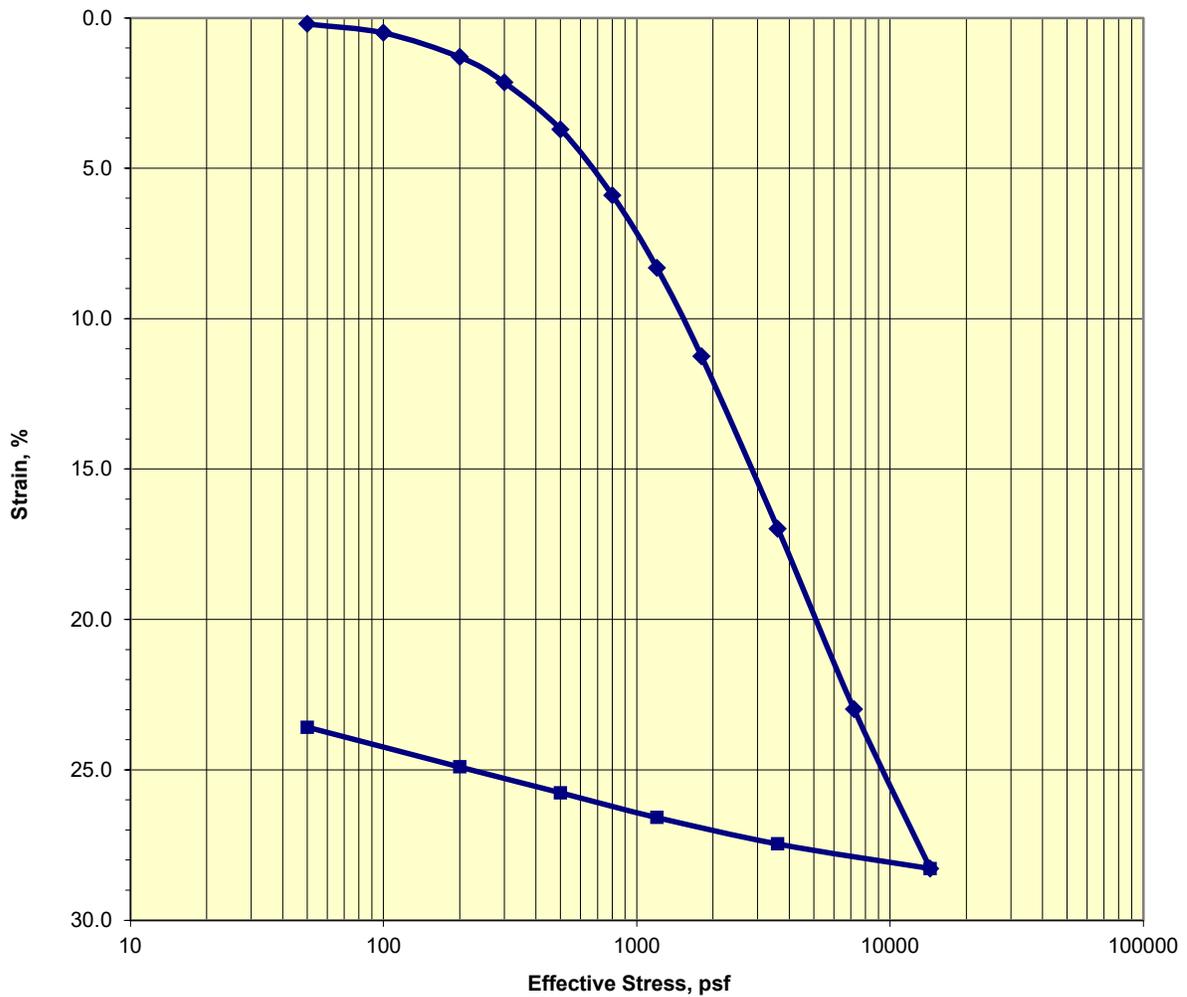


Consolidation Test

ASTM D2435

Job No.: 1007-006	Boring: GT-10	Run By: HM
Client: Anchor QEA	Sample:	Reduced: RU
Project: 210075-01.03	Depth, ft.: 7-9(Tip-4")	Checked: PJ
Soil Type: Dark Gray CLAY (Bay Mud)		Date: 11/26/2024

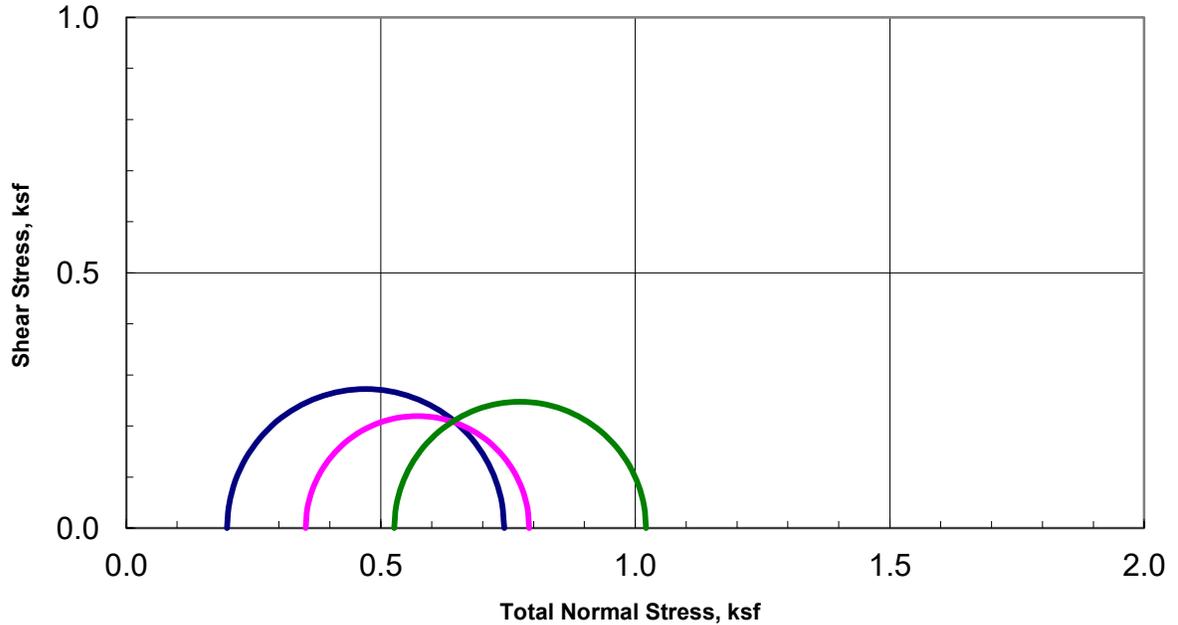
Strain-Log-P Curve



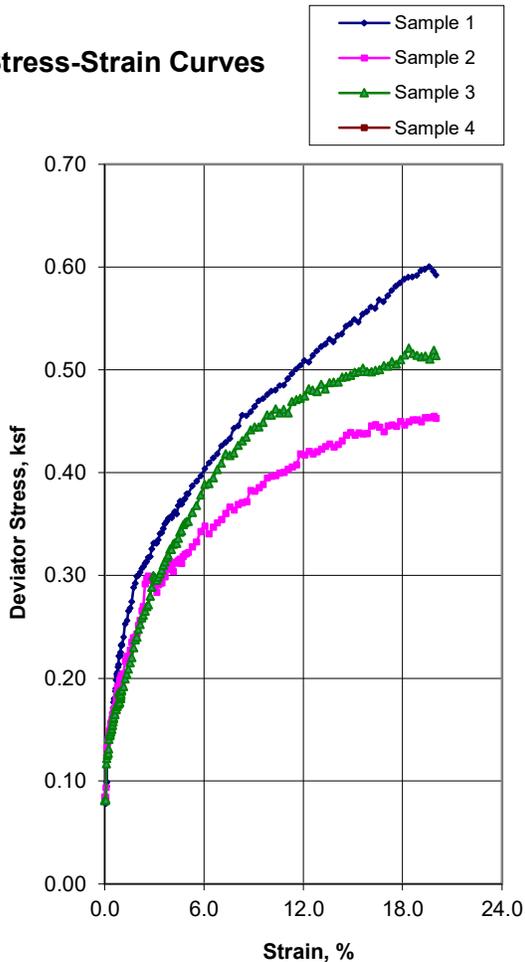
Assumed Gs	2.75	Initial	Final	Remarks:
Moisture %:		62.5	42.4	
Dry Density, pcf:		60.5	79.3	
Void Ratio:		1.839	1.166	
% Saturation:		93.5	100.0	



Unconsolidated-Undrained Triaxial Test
 ASTM D2850



Stress-Strain Curves



Sample Data

	1	2	3	4
Moisture %	62.6	72.2	70.7	
Dry Den,pcf	60.1	54.7	57.6	
Void Ratio	1.804	2.080	1.928	
Saturation %	93.7	93.7	99.0	
Height in	6.00	6.00	5.60	
Diameter in	2.77	2.67	2.80	
Cell psi	1.4	2.4	3.7	
Strain %	15.00	15.00	15.00	
Deviator, ksf	0.545	0.439	0.495	
Rate %/min	1.00	1.00	1.00	
in/min	0.060	0.060	0.056	
Job No.:	1007-006			
Client:	Anchor QEA			
Project:	210075.01.03			
Boring:	LDW23_GT10_GT7-9	LDW23_GT10_GT7-9	LDW23_GT10_GT7-9	
Sample:				
Depth ft:				

Visual Soil Description

Sample #	Description
1	Black CLAY w/ organics
2	Black CLAY
3	Black CLAY w/ organics
4	

Remarks:

Note: Strengths are picked at the peak deviator stress or 15% strain which ever occurs first per ASTM D2850.

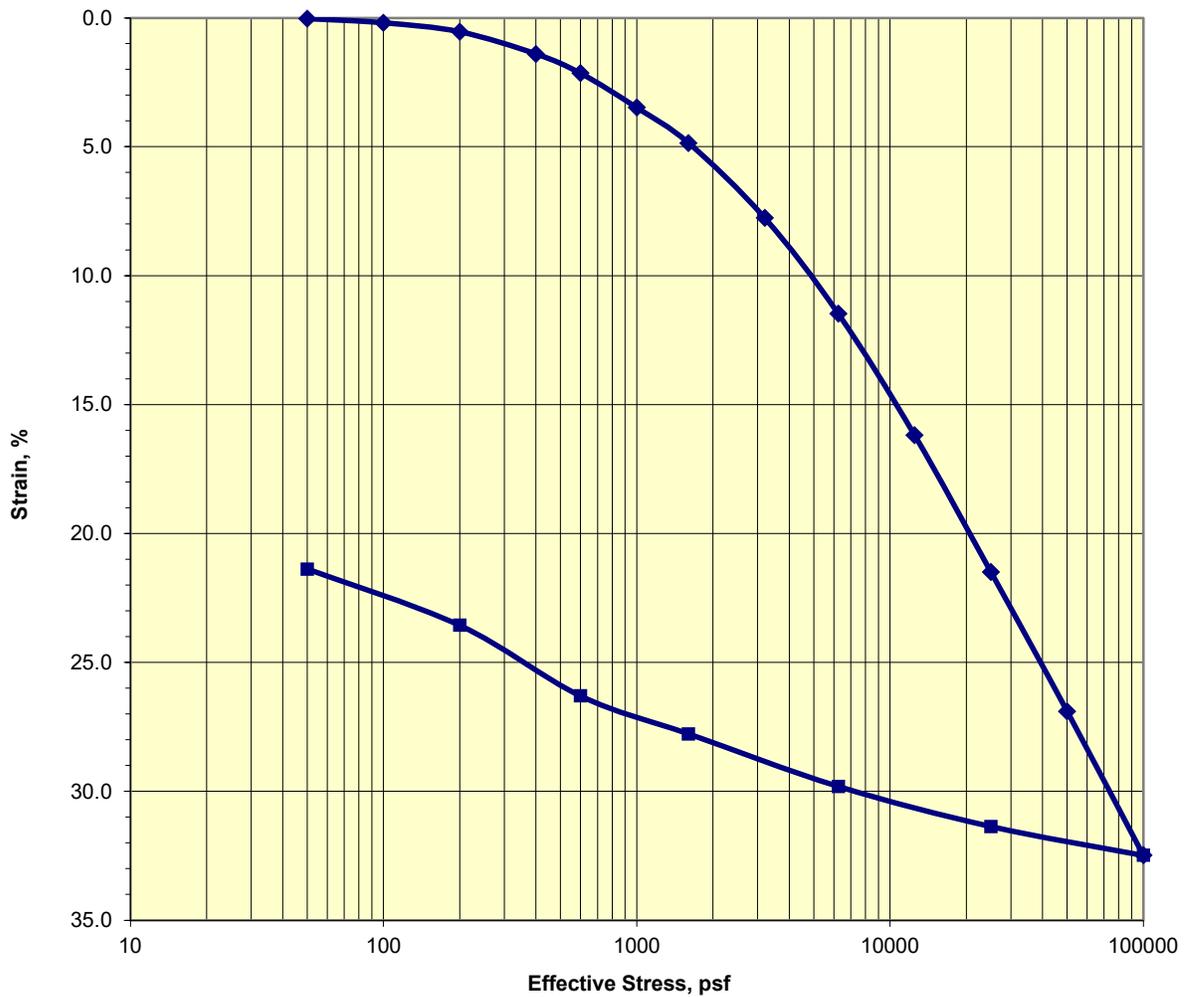


Consolidation Test

ASTM D2435

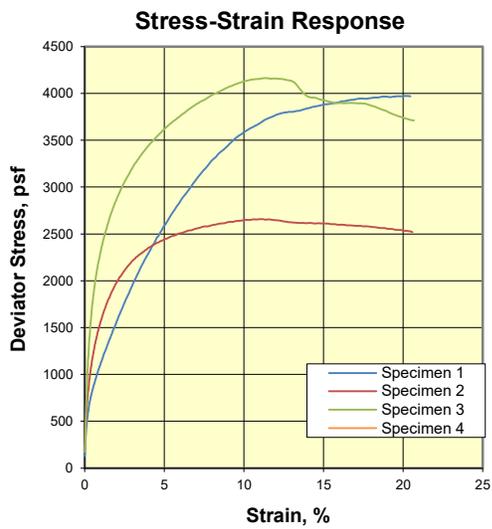
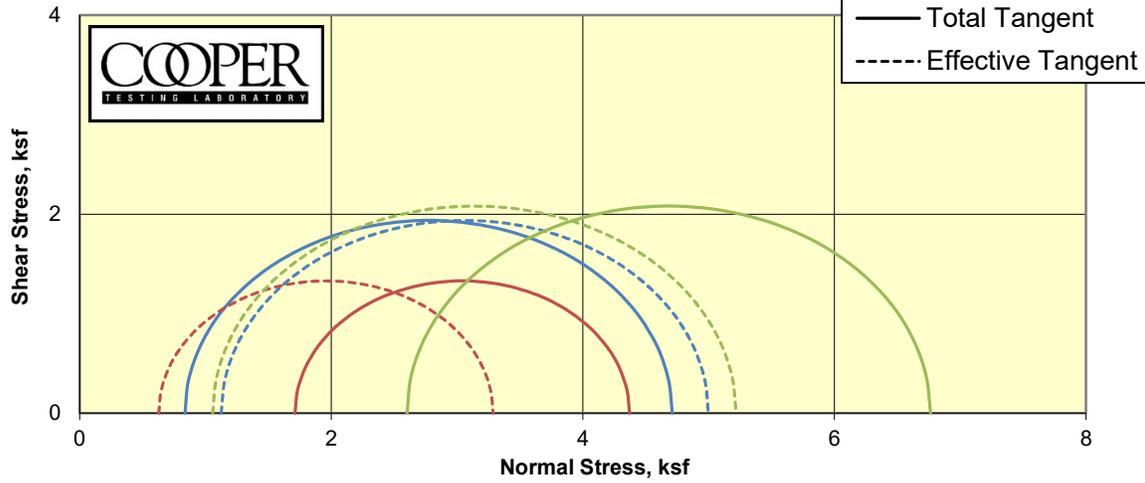
Job No.:	1007-006	Boring:	GT-13	Run By:	HM
Client:	Anchor QEA	Sample:		Reduced:	RU
Project:	210075-01.03	Depth, ft.:	26.5-29(Tip-4")	Checked:	PJ
Soil Type:	Gray CLAY (Bay Mud)	Date:	11/26/2024		

Strain-Log-P Curve



Assumed Gs	2.65	Initial	Final	Remarks:
Moisture %:		56.6	38.7	
Dry Density, pcf:		64.2	81.7	
Void Ratio:		1.578	1.026	
% Saturation:		95.1	100.0	

**Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767**



	1	2	3	4
Boring	LDW23-GT13-GT-26.5-29-20240801	LDW23-GT13-GT-26.5-29-20240801	LDW23-GT13-GT-26.5-29-20240801	
Sample				
Depth				
Visual Description	Black Silty SAND	Black Silty SAND	Black Silty SAND	
MC (%)	40.8	64.2	51.7	
Dry Density (pcf)	78.1	60.6	68.9	
Saturation (%)	98.4	99.3	99.1	
Void Ratio	1.079	1.680	1.355	
Diameter (in)	2.85	2.85	2.85	
Height (in)	5.81	6.00	6.00	
	Final			
MC (%)	40.2	59.6	47.9	
Dry Density (pcf)	79.4	63.7	72.3	
Saturation (%)	100.0	100.0	100.0	
Void Ratio	1.045	1.550	1.245	
Diameter (in)	2.85	2.82	2.83	
Height (in)	5.67	5.83	5.80	
Cell Pressure (psi)	55.8	61.8	67.7	
Back Pressure (psi)	49.9	49.9	49.7	
	Effective Stresses At:			
Strain (%)	15.0	11.1	11.4	
Deviator (ksf)	3.873	2.659	4.162	
Excess PP (psi)	-2.0	7.5	10.7	
Sigma 1 (ksf)	4.999	3.287	5.219	
Sigma 3 (ksf)	1.125	0.628	1.057	
P (ksf)	3.062	1.958	3.138	
Q (ksf)	1.937	1.329	2.081	
Stress Ratio	4.443	5.231	4.936	
Rate (in/min)	0.0005	0.0005	0.0005	

CTL Number:	1007-006		
Client Name:	Anchor QEA		
Project Name:	Middle Ranch of the Lower Duwamish Waterway		
Project Number:	210075-01.03		
Date:	12/2/2024	By:	MD/DC
Total C	ksf		
Total phi	degrees		
Eff. C	ksf		
Eff. Phi	degrees ©		

Remarks: The significant differences in dry density and moisture content between the points may impact the results. Engineering judgement is required to determine phi and cohesion, no phi or cohesion is reported. To add phi and cohesion to the report go to the "Report" tab and in cells M18 through P19 enter end points for a line through the Mohr's circles. The points plotted can be changed on the "Shear Values" tab using cells B3, F3, and J3.

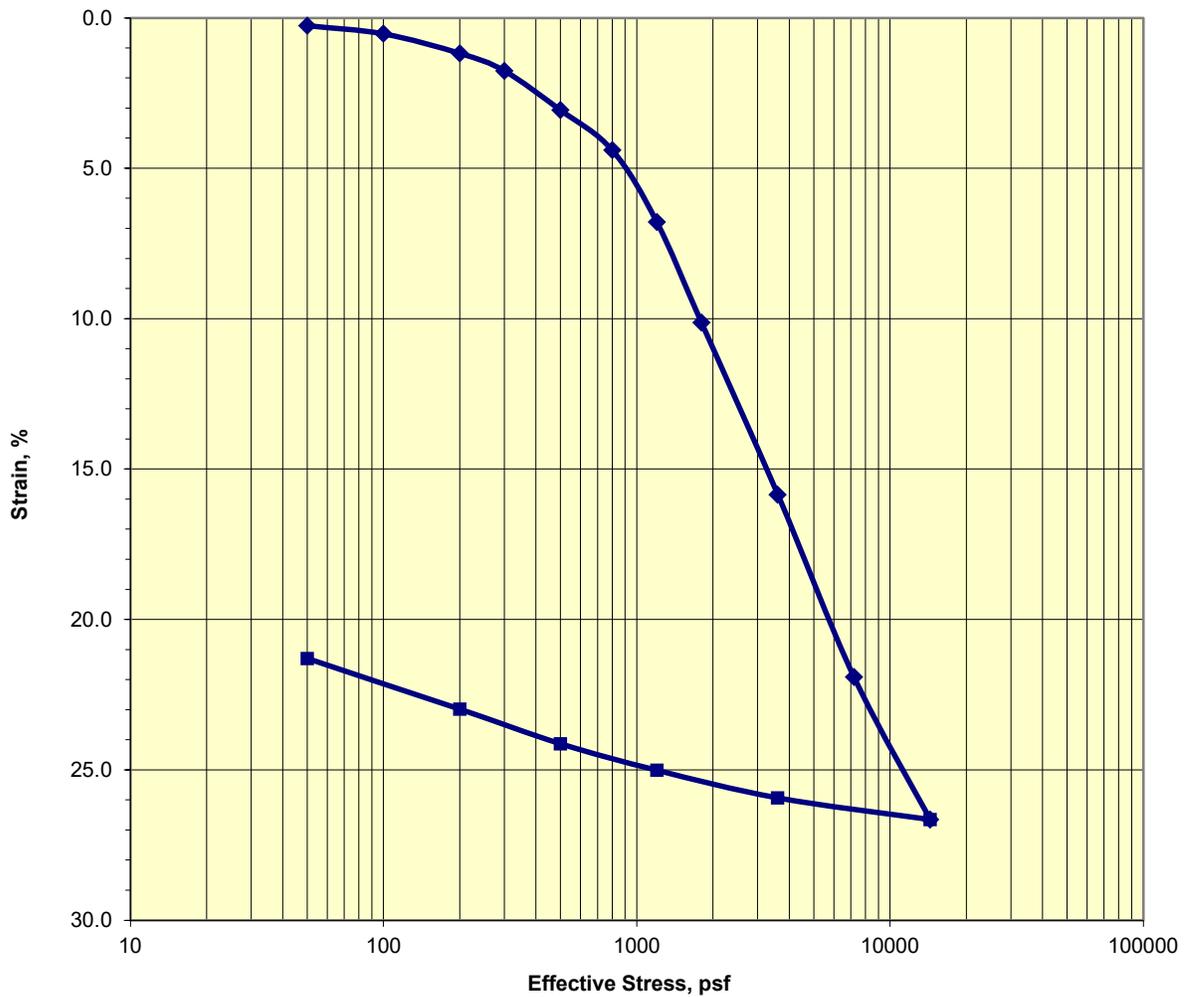


Consolidation Test

ASTM D2435

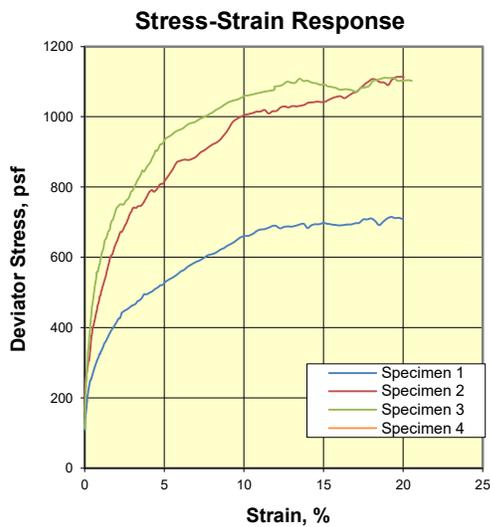
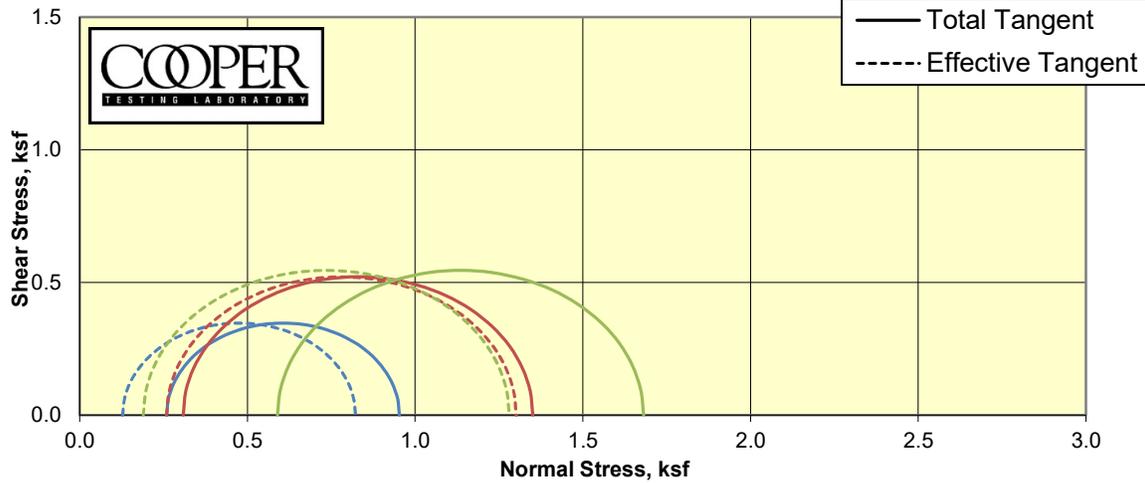
Job No.:	1007-006	Boring:	GT-17	Run By:	HM
Client:	Anchor QEA	Sample:		Reduced:	RU
Project:	210075-01.03	Depth, ft.:	2.5-5(Tip-4")	Checked:	PJ
Soil Type:	Dark Gray CLAY w/ organics (Bay Mud)			Date:	11/25/2024

Strain-Log-P Curve



Assumed Gs	2.7	Initial	Final	Remarks:
Moisture %:		62.7	43.4	
Dry Density, pcf:		60.8	77.6	
Void Ratio:		1.771	1.173	
% Saturation:		95.5	100.0	

**Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767**

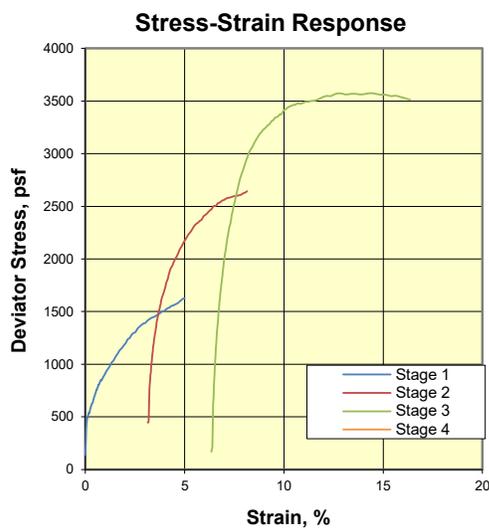
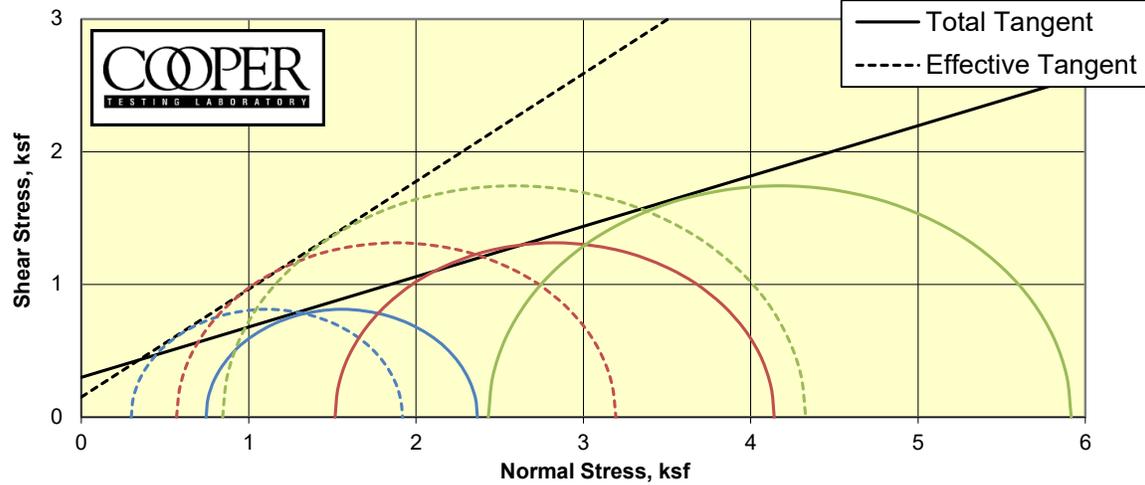


	1	2	3	4
Boring	LDW23-GT17-2.5-5-20240622	LDW23-GT17-2.5-5-20240622	LDW23-GT17-2.5-5-20240622	
Sample				
Depth	2.5-5(Tip-13")	2.5-5(Tip-8")	2.5-5(Tip)	
Visual Description	Dark Olive Brown CLAY w/ Sand	Dark Olive Brown CLAY w/ Sand	Dark Olive Brown CLAY w/ Sand	
MC (%)	69.8	57.4	67.9	
Dry Density (pcf)	57.2	65.5	58.8	
Saturation (%)	96.8	98.4	98.3	
Void Ratio	1.948	1.574	1.865	
Diameter (in)	2.85	2.85	2.85	
Height (in)	6.00	6.00	6.00	
	Final			
MC (%)	65.5	53.7	61.4	
Dry Density (pcf)	60.9	68.8	63.4	
Saturation (%)	100.0	100.0	100.0	
Void Ratio	1.768	1.450	1.658	
Diameter (in)	2.76	2.78	2.78	
Height (in)	6.01	5.99	5.84	
Cell Pressure (psi)	52.4	52.7	54.4	
Back Pressure (psi)	50.6	50.6	50.3	
	Effective Stresses At:			
Strain (%)	15.0	15.0	15.0	
Deviator (ksf)	0.694	1.042	1.091	
Excess PP (psi)	0.9	0.3	2.8	
Sigma 1 (ksf)	0.822	1.302	1.281	
Sigma 3 (ksf)	0.128	0.259	0.190	
P (ksf)	0.475	0.780	0.735	
Q (ksf)	0.347	0.521	0.546	
Stress Ratio	6.421	5.023	6.753	
Rate (in/min)	0.0005	0.0005	0.0005	

CTL Number:	1007-006
Client Name:	Anchor QEA
Project Name:	Middle Ranch of the Lower Duwamish Waterway
Project Number:	210075-01.03
Date:	12/3/2024
By:	MD/DC
Total C	ksf
Total phi	degrees
Eff. C	ksf
Eff. Phi	degrees ©

Remarks: The significant differences in dry density and moisture content between the points may impact the results. Engineering judgement is required to determine phi and cohesion, no phi or cohesion is reported. To add phi and cohesion to the report go to the "Report" tab and in cells M18 through P19 enter end points for a line through the Mohr's circles. The points plotted can be changed on the "Shear Values" tab using cells B3, F3, and J3.

**Staged Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767m**



CTL Number:	1007-006		
Client Name:	Anchor QEA		
Project Name:	Middle Reach of the Lower Dwamish Waterway		
Project Number:	210075-01-03		
Date:	2/13/2025	By:	MD/DC
Total C	0.300	ksf	
Total phi	20.8	degrees	
Eff. C	0.150	ksf	
Eff. Phi	39.1	degrees	©

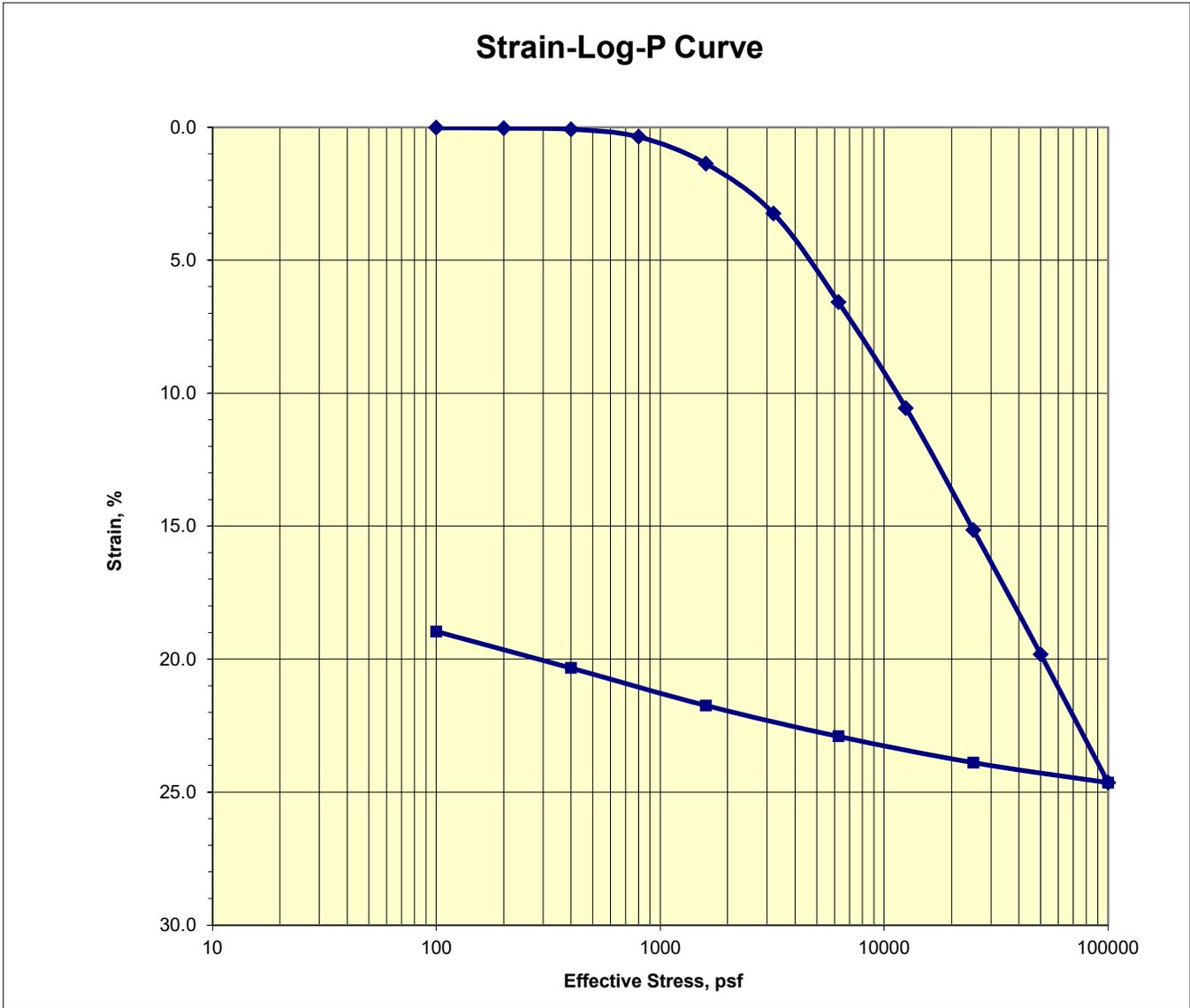
Stage	1	2	3	4
Boring	LDW23-GT32-GT			
Sample				
Depth	26.5-29(Tip-10.5')			
Visual Description	Black CLAY w/ Sand & organics			
MC (%)	58.9			
Dry Density (pcf)	61.7			
Saturation (%)	93.8			
Void Ratio	1.632			
Diameter (in)	2.85			
Height (in)	6.00			
	Final			
MC (%)	57.7	53.9	50.8	
Dry Density (pcf)	64.9	67.6	69.9	
Saturation (%)	100.0	100.0	100.0	
Void Ratio	1.501	1.402	1.321	
Diameter (in)	2.78	2.77	2.77	
Height (in)	6.00	5.81	5.62	
Cell Pressure (psi)	85.3	91.2	97.4	
Back Pressure (psi)	80.1	80.7	80.5	
	Effective Stresses At:			
Strain (%)	5.0	5.0	5.0	
Deviator (ksf)	1.622	2.625	3.484	
Excess PP (psi)	3.1	6.6	11.0	
Sigma 1 (ksf)	1.920	3.195	4.328	
Sigma 3 (ksf)	0.298	0.570	0.845	
P (ksf)	1.109	1.882	2.587	
Q (ksf)	0.811	1.313	1.742	
Stress Ratio	6.443	5.607	5.124	
Rate (in/min)	0.0007	0.0007	0.0007	



Consolidation Test

ASTM D2435

Job No.: 1007-006	Boring: LDW23-GT33B-GT-21.5-24-20240730	Run By: HM
Client: Anchor QEA	Sample:	Reduced: RU
Project: 210075.01.03	Depth, ft.:	Checked: PJ
Soil Type: Black Sandy CLAY		Date: 12/20/2024



Assumed Gs	2.6	Initial	Final	Remarks:
Moisture %:		47.9	32.0	
Dry Density, pcf:		69.9	88.6	
Void Ratio:		1.322	0.831	
% Saturation:		94.1	100.0	

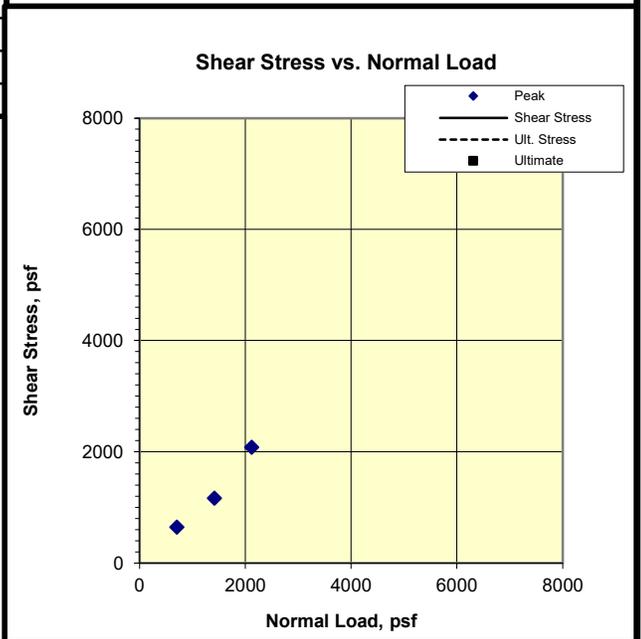
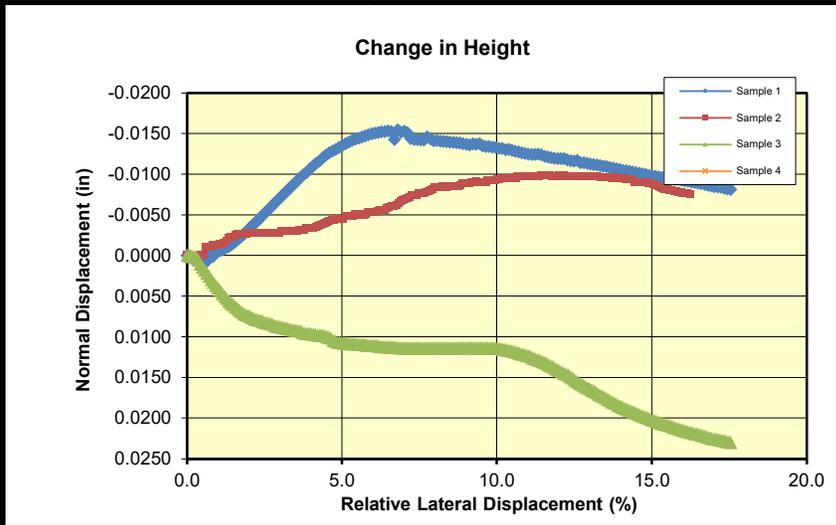
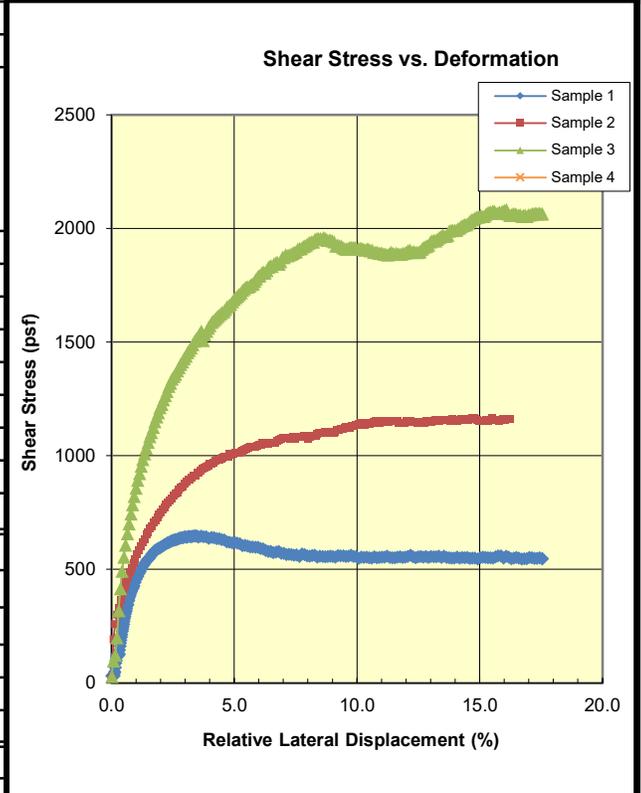


Consolidated Drained Direct Shear (ASTM D3080)

CTL Job #: 1007-006 Project #: 210075.01.03 By: MD
 Client: Anchor QEA Date: 3/6/2025 Checked: PJ
 Project Name: Middle Reach of the Lower Duwamish Waterway Remolding Info:

Specimen Data				
	1	2	3	4
Boring:	LDW23_GT338_GT-21.5-24	LDW23_GT338_GT-21.5-24	LDW23_GT338_GT-21.5-24	
Sample:				
Depth (ft):				
Visual Description:	Dark Gray SAND w/ Silt	Dark Gray SAND w/ Silt	Dark Gray SAND w/ Silt	
Normal Load (psf)	710	1420	2120	
Dry Mass of Specimen (g)	142.3	142.1	139.7	
Initial Height (in)	1.00	1.00	1.00	
Initial Diameter (in)	2.85	2.85	2.85	
Initial Void Ratio	0.947	0.949	0.984	
Initial Moisture (%)	18.1	22.3	24.9	
Initial Wet Density (pcf)	100.4	103.8	104.1	
Initial Dry Density (pcf)	85.0	84.9	83.4	
Initial Saturation (%)	50.7	62.2	67.0	
ΔHeight Consol (in)	0.0121	0.0217	0.0389	
At Test Void Ratio	0.923	0.907	0.906	
At Test Moisture (%)	30.8	31.8	31.1	
At Test Wet Density (pcf)	112.5	114.3	113.7	
At Test Dry Density (pcf)	86.0	86.8	86.8	
At Test Saturation (%)	88.4	92.8	90.8	
Strain Rate (%/min)	0.02	0.02	0.02	
Strengths Picked at	Peak	Peak	Peak	
Shear Stress (psf)	647	1166	2082	
ΔHeight (in) at Peak	-0.0085	-0.0090	0.0216	
Ultimate Stress (psf)				

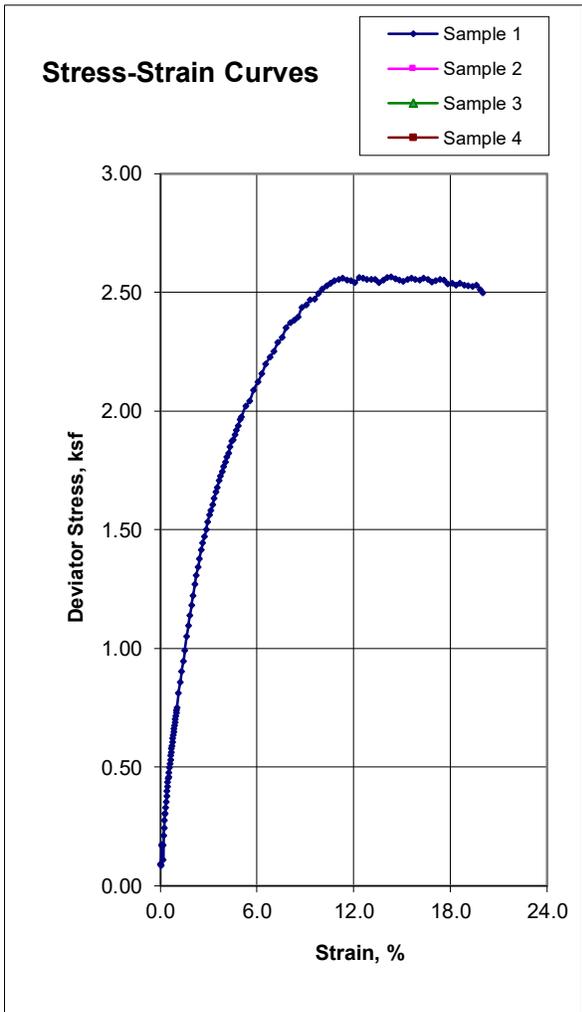
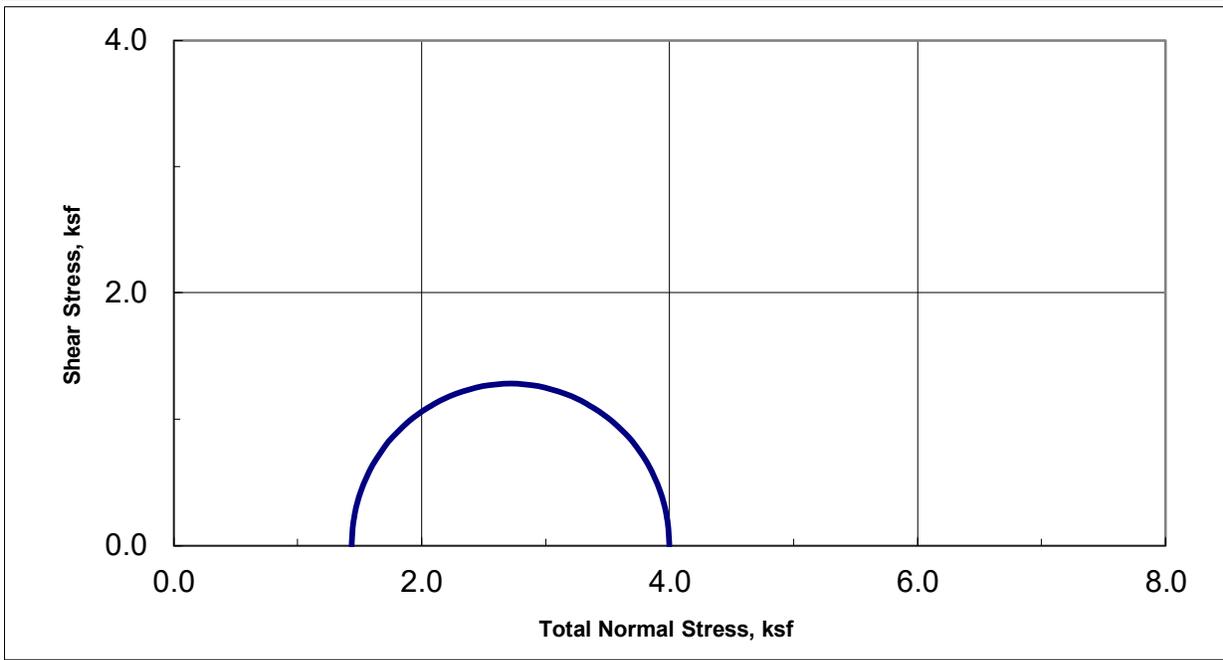
Phi (deg)	Ult. Phi (deg)
Cohesion (psf)	Ult. Cohesion (psf)



Remarks: Engineering judgement is required to determine phi and cohesion, no phi or cohesion is reported. To add phi and cohesion to the report go to the "phi" tab and in cells G30, G31, H30, and H31 enter end points for a line through the 3 data points. The points plotted can be changed on the "Eng Values" tab using cells L6, A2, C2, and E2.



Unconsolidated-Undrained Triaxial Test
 ASTM D2850



Sample Data				
	1	2	3	4
Moisture %	57.1			
Dry Den,pcf	66.0			
Void Ratio	1.553			
Saturation %	99.2			
Height in	5.98			
Diameter in	2.84			
Cell psi	10.0			
Strain %	14.33			
Deviator, ksf	2.564			
Rate %/min	1.00			
in/min	0.060			
Job No.:	1007-006			
Client:	Achor QEA			
Project:	Middle Rach of the Lower Dwamish Waterway - 210075-01-03			
Boring:	LDW23-GT33B-GT			
Sample:				
Depth ft:	21.5-24			
Visual Soil Description				
Sample #	1 Black CLAY w/ organics			
2				
3				
4				
Remarks:				

Note: Strengths are picked at the peak deviator stress or 15% strain which ever occurs first per ASTM D2850.

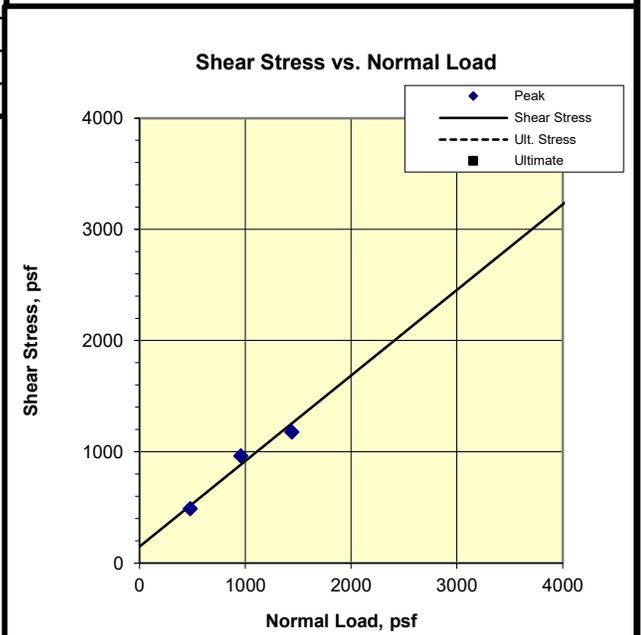
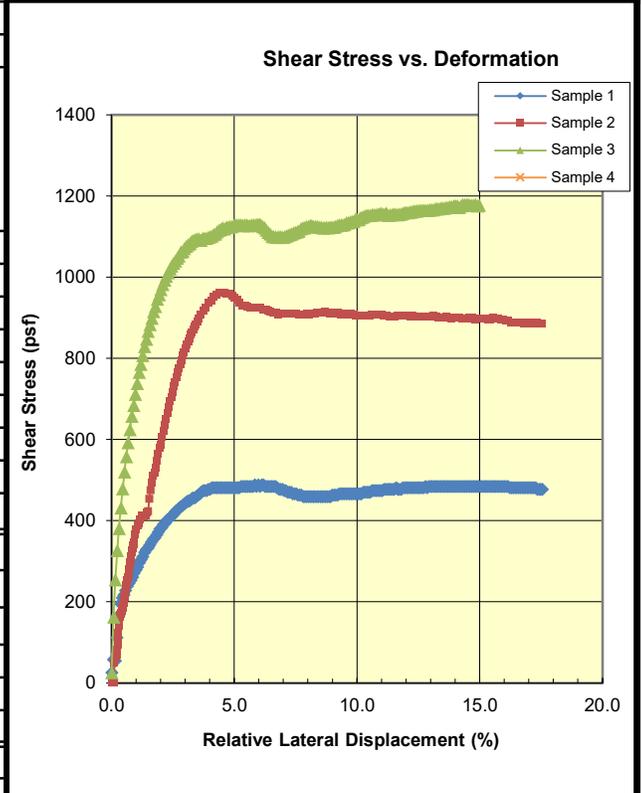


Consolidated Drained Direct Shear (ASTM D3080)

CTL Job #: 1007-006 Project #: 210075.01.03 By: MD
 Client: Anchor QEA Date: 3/5/2025 Checked: PJ
 Project Name: Middle Reach of the Lower Duwamish Waterway Remolding Info:

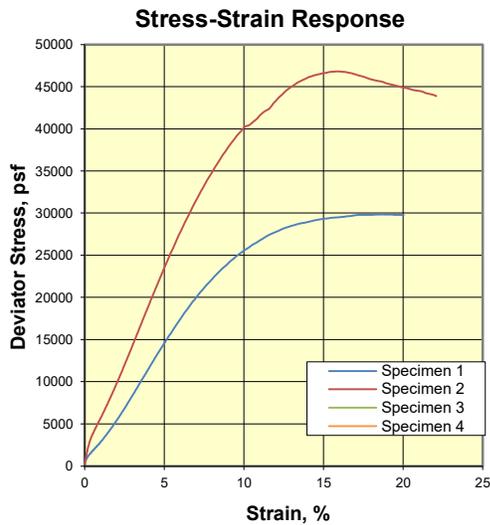
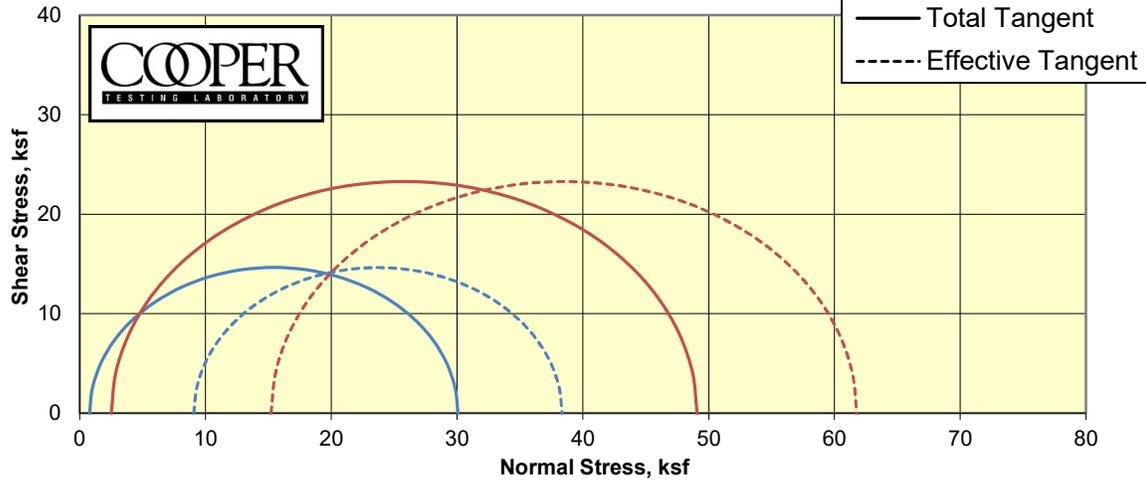
Specimen Data				
	1	2	3	4
Boring:	LDW23_GT34_GT-10.5-14	LDW23_GT34_GT-10.5-14	LDW23_GT34_GT-10.5-14	
Sample:				
Depth (ft):				
Visual Description:	Black Silty SAND w/ organics	Black Silty SAND w/ organics	Black Silty SAND w/ organics	
Normal Load (psf)	480	960	1440	
Dry Mass of Specimen (g)	124.2	101.7	126.0	
Initial Height (in)	1.00	1.00	1.00	
Initial Diameter (in)	2.85	2.85	2.85	
Initial Void Ratio	1.273	1.777	1.240	
Initial Moisture (%)	46.0	59.8	44.3	
Initial Wet Density (pcf)	108.3	97.0	108.6	
Initial Dry Density (pcf)	74.2	60.7	75.3	
Initial Saturation (%)	97.6	90.9	96.5	
ΔHeight Consol (in)	0.0175	0.0295	0.0329	
At Test Void Ratio	1.233	1.695	1.166	
At Test Moisture (%)	45.0	58.1	43.0	
At Test Wet Density (pcf)	109.4	98.9	111.3	
At Test Dry Density (pcf)	75.5	62.5	77.8	
At Test Saturation (%)	98.4	92.5	99.7	
Strain Rate (%/min)	0.02	0.02	0.02	
Strengths Picked at	Peak	Peak	Peak	
Shear Stress (psf)	488	962	1179	
ΔHeight (in) at Peak	-0.0044	-0.0004	0.0007	
Ultimate Stress (psf)				

Phi (deg)	37.6	Ult. Phi (deg)	
Cohesion (psf)	150	Ult. Cohesion (psf)	



Remarks: _____

**Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767**



	Specimen 1	Specimen 2	Specimen 3	Specimen 4
Boring	LDW23-GT34-GT-26.5-29-20240729	LDW23-GT34-GT-26.5-29-20240729		
Sample				
Depth				
Visual Description	Dark Gray Silty SAND	Dark Gray Silty SAND		
MC (%)	23.7	26.3		
Dry Density (pcf)	90.4	96.7		
Saturation (%)	73.9	95.6		
Void Ratio	0.864	0.744		
Diameter (in)	2.85	2.85		
Height (in)	6.00	6.00		
	Final			
MC (%)	30.0	27.1		
Dry Density (pcf)	93.1	97.3		
Saturation (%)	100.0	100.0		
Void Ratio	0.810	0.732		
Diameter (in)	2.81	2.85		
Height (in)	5.99	5.98		
Cell Pressure (psi)	105.3	116.9		
Back Pressure (psi)	99.8	99.4		
	Effective Stresses At:			
Strain (%)	15.0	15.0		
Deviator (ksf)	29.268	46.560		
Excess PP (psi)	-57.5	-88.2		
Sigma 1 (ksf)	38.346	61.776		
Sigma 3 (ksf)	9.078	15.217		
P (ksf)	23.712	38.496		
Q (ksf)	14.634	23.280		
Stress Ratio	4.224	4.060		
Rate (in/min)	0.0005	0.0004		

CTL Number:	1007-006		
Client Name:	Anchor QEA		
Project Name:	Middle Ranch of the Lower Duwamish Waterway		
Project Number:	210075-01.03		
Date:	1/21/2025	By:	MD/DC
Total C	ksf		
Total phi	degrees		
Eff. C	ksf		
Eff. Phi	degrees ©		



Client: Anchor QEA, LLC.
Address: 1201 3rd Avenue, Suite 2600
Seattle, WA 98101
Attn: Cindy Fields
Revised On: _____

Date: October 15, 2024
Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
Project #: 24B105
Sample #: B24-1561 - 1585
Date sampled: July 29 & 30, 2024
Control No: 10152024

As requested and authorized by the Client, MTC has performed the following test(s) on the sample number referenced above. The testing was performed in accordance with current, applicable AASHTO, ASTM, and/or WSDOT standards, which are referenced on the correlating test report pages. The results obtained in our laboratory are as detailed below and/or on the following pages:

	Test(s) Performed:	Test Results	Test(s) Performed:	Test Results
X	Sieve Analysis	See Attached Reports	Sulfate Soundness	
	Proctor		Bulk Density & Voids	
	Sand Equivalent		WSDOT Degradation	
	Fracture Count		LA Abrasion	
X	Moisture Content	See Attached Reports	Cation Exchange Capacity	
	Specific Gravity, Coarse		X Specific Gravity, Soils	See Attached Report
	Specific Gravity, Fine		X Organic Content	See Attached Report
X	Hydrometer Analysis	See Attached Reports		
X	Atterberg Limits	See Attached Reports		

If you have any questions concerning the test results, the procedures used, or if we can be of any further assistance please call the number below and ask to speak with your Project Manager or the Laboratory Manager.

Alex Eifrig

 Respectfully Submitted,
 Alex Eifrig
 WABO Supervising Laboratory Technician



Moisture Content ASTM C-566, ASTM D-2216

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
Project #: 24B105
Date Received: September 23, 2024
Date Tested: October 9, 2024

Client: Anchor QEA, LLC.
Sampled by: Client
Tested by: S. Boesenberg
Control No.: 10152024

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B24-1561	LDW23-GT32-GT-0.5-2-20240730	234.7	690.8	638.5	52.3	403.8	13.0%
B24-1562	LDW23-GT32-GT-5-6.4-20240730	233.0	396.5	370.1	26.4	137.1	19.3%
B24-1563	LDW23-GT32-GT-6.4-6.5-20240730	208.5	240.6	232.7	7.9	24.2	32.6%
B24-1564	LDW23-GT32-GT-10-11.5-20240730	215.6	360.3	332.2	28.1	116.6	24.1%
B24-1565	LDW23-GT32-GT-15-16.5-20240730	223.9	374.2	336.0	38.2	112.1	34.1%
B24-1566	LDW23-GT32-GT-25-25.7-20240730	221.7	539.3	513.7	25.6	292.0	8.8%
B24-1567	LDW23-GT32-GT-25.7-26.5-20240730	221.0	343.5	295.5	48.0	74.5	64.4%
B24-1568	LDW23-GT32-GT-35-36.5-20240730	229.4	352.3	326.3	26.0	96.9	26.8%
B24-1569	LDW23-GT32-GT-40-41.5-20240730	217.3	663.9	574.2	89.7	356.9	25.1%
B24-1570	LDW23-GT33B-GT-0.5-2-20240730	223.0	658.2	597.9	60.3	374.9	16.1%
B24-1571	LDW23-GT33B-GT-5-6.5-20240730	260.2	538.5	467.3	71.2	207.1	34.4%
B24-1572	LDW23-GT33B-GT-10-11-20240730	301.0	422.1	407.1	15.0	106.1	14.1%
B24-1573	LDW23-GT33B-GT-11-11.5-20240730	223.1	584.6	513.0	71.6	289.9	24.7%
B24-1574	LDW23-GT33B-GT-15-16.5-20240730	320.5	452.3	420.3	32.0	99.8	32.1%
B24-1575	LDW23-GT33B-GT-20-21.5-20240730	268.8	510.3	420.8	89.5	152.0	58.9%
B24-1576	LDW23-GT33B-GT-25-26.5-20240730	303.3	792.4	682.9	109.5	379.6	28.8%
B24-1577	LDW23-GT33B-GT-30-31.5-20240730	306.5	818.6	712.9	105.7	406.4	26.0%
B24-1578	LDW23-GT33B-GT-40-41.5-20240730	311.1	916.5	803.2	113.3	492.1	23.0%
B24-1579	LDW23-GT34-GT-5-6.5-20240729	270.3	522.3	485.6	36.7	215.3	17.0%
B24-1580	LDW23-GT34-GT-10-11.5-20240729	266.5	703.1	613.8	89.3	347.3	25.7%
B24-1581	LDW23-GT34-GT-15.3-16.1-20240729	419.3	487.7	468.1	19.6	48.8	40.2%
B24-1582	LDW23-GT34-GT-20-21.5-20240729	429.7	1068.7	839.7	229.0	410.0	55.9%
B24-1583	LDW23-GT34-GT-25-26.5-20240729	414.1	615.5	538.4	77.1	124.3	62.0%
B24-1584	LDW23-GT34-GT-30-31.5-20240729	416.2	1053.6	909.6	144.0	493.4	29.2%
B24-1585	LDW23-GT34-GT-35.5-36.5-20240729	380.0	589.4	537.3	52.1	157.3	33.1%

All results apply only to actual locations and materials tested. As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of clients, and authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved pending our written approval.

Comments:

Reviewed by:

Alex Eifrig
WABO Supervising Laboratory Technician



ASTM D-4318 Liquid Limit, Plastic Limit & Plasticity Index of Soils

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT32-GT-6.4-6.5-20240730 Sample #: B24-1563	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 10-Oct-24 Tested By: Z. Romney Control No.: 10152024	Unified Soils Classification System, ASTM D-2487 OH, Organic Silty Clay Sample Color Brown
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Liquid Limit Determination

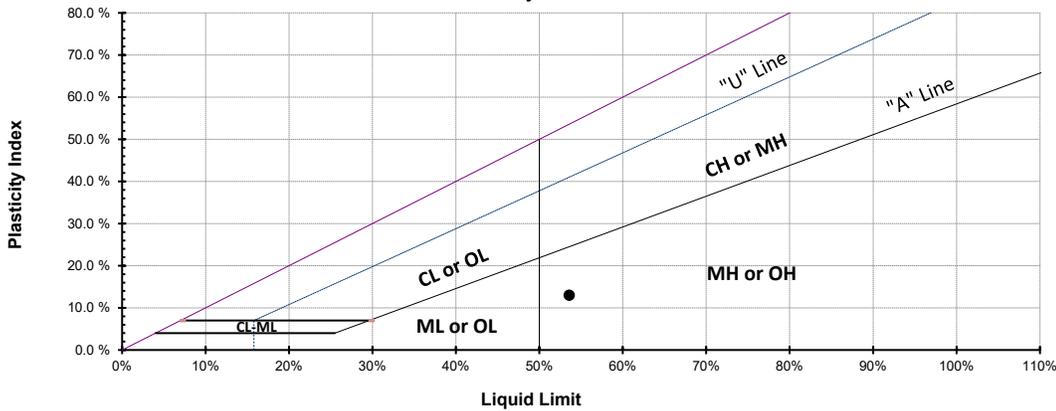
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	27.62	30.41	35.15			
Weight of Dry Soils + Pan:	23.20	26.52	29.54			
Weight of Pan:	14.69	19.44	19.53			
Weight of Dry Soils:	8.51	7.08	10.01			
Weight of Moisture:	4.42	3.89	5.61			
% Moisture:	51.9 %	54.9 %	56.0 %			
Number of Blows:	30	22	15			

Liquid Limit @ 25 Blows: 53.6 %
Plastic Limit: 40.5 %
Plasticity Index, I_p: 13.0 %

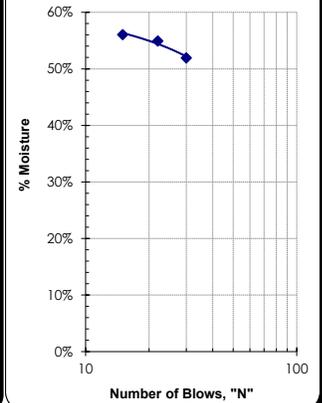
Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	20.78	27.60				
Weight of Dry Soils + Pan:	19.00	25.17				
Weight of Pan:	14.60	19.19				
Weight of Dry Soils:	4.40	5.98				
Weight of Moisture:	1.78	2.43				
% Moisture:	40.5 %	40.6 %				

Plasticity Chart



Liquid Limit



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All results apply only to actual locations and materials tested. As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of clients, and authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved pending our written approval.

Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT32-GT-10-11.5-20240730 Sample#: B24-1564	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 9-Oct-24 Tested By: S. Boesenberg Control No.: 10152024	Unified Soil Classification System, ASTM-2487 SP-SM, Poorly graded Sand with Silt Sample Color: Brown
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Specifications No Specs Sample Meets Specs ? <i>N/A</i>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.047 mm % Gravel = 0.1% Coeff. of Curvature, C _c = 1.40 D ₍₁₀₎ = 0.102 mm % Sand = 91.9% Coeff. of Uniformity, C _u = 4.17 D ₍₁₅₎ = 0.158 mm % Silt & Clay = 7.9% Fineness Modulus = 2.05 D ₍₃₀₎ = 0.247 mm Liquid Limit = n/a Plastic Limit = n/a D ₍₅₀₎ = 0.366 mm Plasticity Index = n/a Moisture %, as sampled = n/a D ₍₆₀₎ = 0.427 mm Sand Equivalent = n/a Req'd Sand Equivalent = D ₍₉₀₎ = 1.614 mm Fracture %, 1 Face = n/a Req'd Fracture %, 1 Face = Dust Ratio = 9/68 Fracture %, 2+ Faces = n/a Req'd Fracture %, 2+ Faces =
--	--

Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		79%	100.0%	0.0%
#20	0.850		71%	100.0%	0.0%
#30	0.600		64%	100.0%	0.0%
#40	0.425	60%	60%	100.0%	0.0%
#50	0.300		39%	100.0%	0.0%
#60	0.250		30%	100.0%	0.0%
#80	0.180		19%	100.0%	0.0%
#100	0.150	14%	14%	100.0%	0.0%
#140	0.106		10%	100.0%	0.0%
#170	0.090		9%	100.0%	0.0%
#200	0.075	7.9%	7.9%	100.0%	0.0%

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Comments: _____

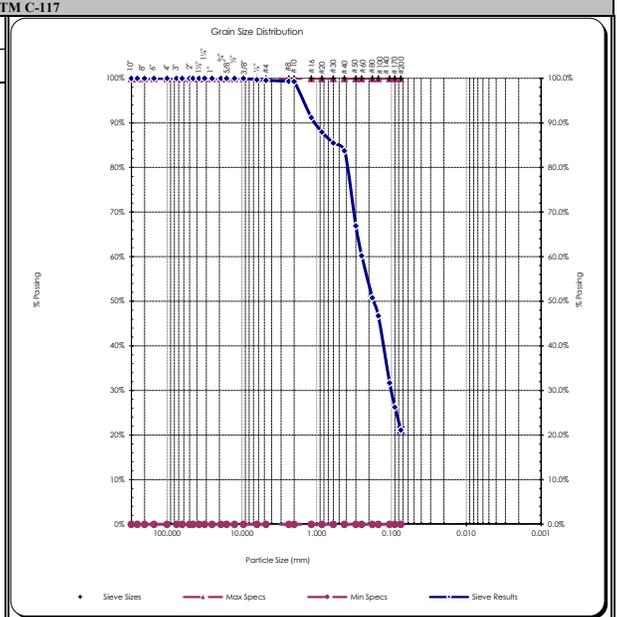
Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT32-GT-15-16.5-20240730 Sample#: B24-1565	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 10-Oct-24 Tested By: S. Boesenberg Control No.: 10152024	Unified Soil Classification System, ASTM-2487 SM, Silty Sand Sample Color: Brown
Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281		
Specifications No Specs Sample Meets Specs ? <i>N/A</i>	D ₍₆₎ = 0.018 mm % Gravel = 0.4% D ₍₁₀₎ = 0.035 mm % Sand = 78.4% D ₍₁₅₎ = 0.053 mm % Silt & Clay = 21.1% D ₍₃₀₎ = 0.101 mm Liquid Limit = n/a D ₍₅₀₎ = 0.174 mm Plasticity Index = n/a D ₍₆₀₎ = 0.248 mm Sand Equivalent = n/a D ₍₉₀₎ = 1.058 mm Fracture %, 1 Face = n/a Dust Ratio = 1/4 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 1.16 Coeff. of Uniformity, C _u = 7.00 Fineness Modulus = 1.11 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
Method(s) ASTM C-136, ASTM D-6913, ASTM C-117		

Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		99%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		91%	100.0%	0.0%
#20	0.850		88%	100.0%	0.0%
#30	0.600		85%	100.0%	0.0%
#40	0.425	84%	84%	100.0%	0.0%
#50	0.300		67%	100.0%	0.0%
#60	0.250		60%	100.0%	0.0%
#80	0.180		51%	100.0%	0.0%
#100	0.150	47%	47%	100.0%	0.0%
#140	0.106		32%	100.0%	0.0%
#170	0.090		26%	100.0%	0.0%
#200	0.075	21.1%	21.1%	100.0%	0.0%



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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
Project #: 24B105
Date Received: September 23, 2024
Date Tested: October 10, 2024

Client: Anchor QEA, LLC.
Sampled by: Client
Tested by: S. Boesenberg
Control No.: 10152024

Moisture Content ASTM C-566, ASTM D-2216

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B24-1565	LDW23-GT32-GT-15-16.5-20240730	223.9	374.2	336.0	38.2	112.1	34.1%

Organic Content ASTM D-2974

Sample #	Location	Tare	Soil + Tare, Pre-Ignition	Soil + Tare, Post Ignition	% Organics
B24-1565	LDW23-GT32-GT-15-16.5-20240730	46.75	98.65	97.93	1.39%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



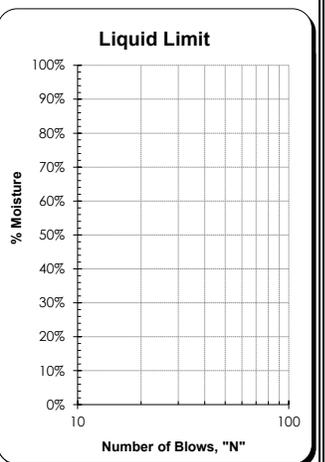
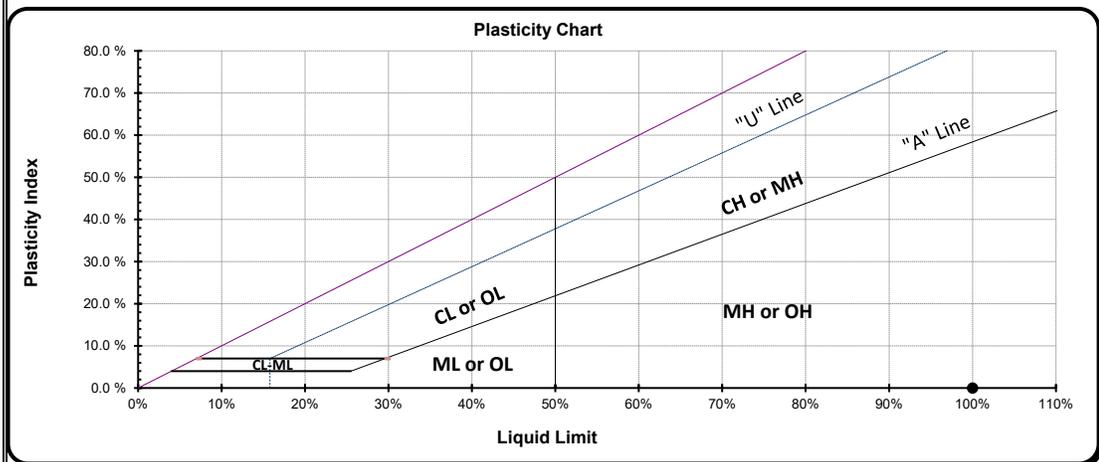
ASTM D-4318 Liquid Limit, Plastic Limit & Plasticity Index of Soils

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT32-GT-25.7-26.5-20240730 Sample #: B24-1567	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 10-Oct-24 Tested By: Z. Romney Control No.: 10152024	Visual Soils Classification Sandy Silt Sample Color Brown
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Liquid Limit Determination						
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:	Unable to Establish					
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

Liquid Limit @ 25 Blows: N/A
Plastic Limit: N/A
Plasticity Index, I_p: N/A

Plastic Limit Determination						
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:	Non-Plastic					
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						



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Comments: Unable to establish the liquid limit of this sample due to the material displaying rapid dilation when subjected to any blows in the cup, and also the material not being able to be spread smoothly into the cup. The sample was then deemed non-plastic due to the material not being workable down to 1/8" ribbons/rolls without breaking apart.

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT32-GT-35-36.5-20240730 Sample#: B24-1568	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 10-Oct-24 Tested By: S. Boesenberg Control No.: 10152024	Unified Soil Classification System, ASTM-2487 SP, Poorly graded Sand Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.152 mm % Gravel = 0.2% Coeff. of Curvature, C _c = 0.65 D ₍₁₀₎ = 0.185 mm % Sand = 96.0% Coeff. of Uniformity, C _u = 4.50 D ₍₁₅₎ = 0.218 mm % Silt & Clay = 3.8% Fineness Modulus = 2.45 D ₍₃₀₎ = 0.317 mm Liquid Limit = n/a Plastic Limit = n/a D ₍₅₀₎ = 0.536 mm Plasticity Index = n/a Moisture %, as sampled = n/a D ₍₆₀₎ = 0.832 mm Sand Equivalent = n/a Req'd Sand Equivalent = D ₍₉₀₎ = 1.721 mm Fracture %, 1 Face = n/a Req'd Fracture %, 1 Face = Dust Ratio = 1/12 Fracture %, 2+ Faces = n/a Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		99%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		72%	100.0%	0.0%
#20	0.850		61%	100.0%	0.0%
#30	0.600		52%	100.0%	0.0%
#40	0.425	46%	46%	100.0%	0.0%
#50	0.300		27%	100.0%	0.0%
#60	0.250		20%	100.0%	0.0%
#80	0.180		9%	100.0%	0.0%
#100	0.150	5%	5%	100.0%	0.0%
#140	0.106		4%	100.0%	0.0%
#170	0.090		4%	100.0%	0.0%
#200	0.075	3.8%	3.8%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT32-GT-40-41.5-20240730 Sample#: B24-1569	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 10-Oct-24 Tested By: S. Boesenberg Control No.: 10152024	Unified Soil Classification System, ASTM-2487 SP-SM, Poorly graded Sand with Silt Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.065 mm % Gravel = 0.0% D ₍₁₀₎ = 0.162 mm % Sand = 94.2% D ₍₁₅₎ = 0.209 mm % Silt & Clay = 5.8% D ₍₃₀₎ = 0.347 mm Liquid Limit = n/a D ₍₅₀₎ = 0.723 mm Plasticity Index = n/a D ₍₆₀₎ = 0.980 mm Sand Equivalent = n/a D ₍₉₀₎ = 1.750 mm Fracture %, 1 Face = n/a Dust Ratio = 8/53 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 0.76 Coeff. of Uniformity, C _u = 6.03 Fineness Modulus = 2.54 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = n/a Req'd Fracture %, 1 Face = n/a Req'd Fracture %, 2+ Faces = n/a
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		68%	100.0%	0.0%
#20	0.850		55%	100.0%	0.0%
#30	0.600		45%	100.0%	0.0%
#40	0.425	38%	38%	100.0%	0.0%
#50	0.300		25%	100.0%	0.0%
#60	0.250		19%	100.0%	0.0%
#80	0.180		12%	100.0%	0.0%
#100	0.150	9%	9%	100.0%	0.0%
#140	0.106		7%	100.0%	0.0%
#170	0.090		6%	100.0%	0.0%
#200	0.075	5.8%	5.8%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT33B-GT-5-6.5-20240730 Sample#: B24-1571	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 10-Oct-24 Tested By: S. Boesenberg Control No.: 10152024	Visual Soils Classification Silt with Sand Sample Color: Brown
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Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281			
Specifications No Specs Sample Meets Specs ? <i>N/A</i>	D ₍₆₎ = 0.006 mm D ₍₁₀₎ = 0.012 mm D ₍₁₅₎ = 0.018 mm D ₍₃₀₎ = 0.037 mm D ₍₆₀₎ = 0.061 mm D ₍₉₀₎ = 0.073 mm D ₍₁₀₀₎ = 0.286 mm Dust Ratio = 13/20	% Gravel = 0.1% % Sand = 38.4% % Silt & Clay = 61.5% Liquid Limit = n/a Plasticity Index = n/a Sand Equivalent = n/a Fracture %, 1 Face = n/a Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 1.50 Coeff. of Uniformity, C _u = 6.00 Fineness Modulus = 0.32 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =

Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		97%	100.0%	0.0%
#20	0.850		96%	100.0%	0.0%
#30	0.600		95%	100.0%	0.0%
#40	0.425	95%	95%	100.0%	0.0%
#50	0.300		90%	100.0%	0.0%
#60	0.250		89%	100.0%	0.0%
#80	0.180		86%	100.0%	0.0%
#100	0.150	85%	85%	100.0%	0.0%
#140	0.106		71%	100.0%	0.0%
#170	0.090		66%	100.0%	0.0%
#200	0.075	61.5%	61.5%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT33B-GT-10-11-20240730 Sample#: B24-1572	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 10-Oct-24 Tested By: S. Boesenberg Control No.: 10152024	Unified Soils Classification System, ASTM D-2487 SP, Poorly graded Sand with Gravel Sample Color: Gray
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.516 mm % Gravel = 30.4% D ₍₁₀₎ = 1.710 mm % Sand = 66.9% D ₍₁₅₎ = 2.178 mm % Silt & Clay = 2.6% D ₍₃₀₎ = 2.885 mm Liquid Limit = n/a D ₍₅₀₎ = 3.828 mm Plasticity Index = n/a D ₍₆₀₎ = 4.300 mm Sand Equivalent = n/a D ₍₉₀₎ = 7.940 mm Fracture %, 1 Face = n/a Dust Ratio = 4/7 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 1.13 Coeff. of Uniformity, C _u = 2.51 Fineness Modulus = 4.91 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00	100%	100%	100.0%	0.0%
10.00"	250.00	100%	100%	100.0%	0.0%
8.00"	200.00	100%	100%	100.0%	0.0%
6.00"	150.00	100%	100%	100.0%	0.0%
4.00"	100.00	100%	100%	100.0%	0.0%
3.00"	75.00	100%	100%	100.0%	0.0%
2.50"	63.00	100%	100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00	100%	100%	100.0%	0.0%
1.50"	37.50	100%	100%	100.0%	0.0%
1.25"	31.50	100%	100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00	100%	100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30	100%	79%	100.0%	0.0%
#4	4.75	70%	70%	100.0%	0.0%
#8	2.36	100%	19%	100.0%	0.0%
#10	2.00	11%	11%	100.0%	0.0%
#16	1.18	100%	8%	100.0%	0.0%
#20	0.850	100%	6%	100.0%	0.0%
#30	0.600	100%	5%	100.0%	0.0%
#40	0.425	5%	5%	100.0%	0.0%
#50	0.300	100%	4%	100.0%	0.0%
#60	0.250	100%	4%	100.0%	0.0%
#80	0.180	100%	4%	100.0%	0.0%
#100	0.150	3%	3%	100.0%	0.0%
#140	0.106	100%	3%	100.0%	0.0%
#170	0.090	100%	3%	100.0%	0.0%
#200	0.075	2.6%	2.6%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT33B-GT-15-16.5-20240730 Sample#: B24-1574	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 10-Oct-24 Tested By: S. Boesenberg Control No.: 10152024	Unified Soils Classification System, ASTM D-2487 SM, Silty Sand Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.017 mm % Gravel = 0.6% Coeff. of Curvature, C _c = 1.61 D ₍₁₀₎ = 0.034 mm % Sand = 77.1% Coeff. of Uniformity, C _u = 4.48 D ₍₁₅₎ = 0.050 mm % Silt & Clay = 22.3% Fineness Modulus = 0.94 D ₍₅₀₎ = 0.090 mm Liquid Limit = n/a Plastic Limit = n/a D ₍₆₀₎ = 0.130 mm Plasticity Index = n/a Moisture %, as sampled = n/a D ₍₁₀₀₎ = 0.150 mm Sand Equivalent = n/a Req'd Sand Equivalent = D ₍₂₀₀₎ = 1.130 mm Fracture %, 1 Face = n/a Req'd Fracture %, 1 Face = Dust Ratio = 19/74 Fracture %, 2+ Faces = n/a Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	99%	99%	100.0%	0.0%
#8	2.36		94%	100.0%	0.0%
#10	2.00	94%	94%	100.0%	0.0%
#16	1.18		90%	100.0%	0.0%
#20	0.850		89%	100.0%	0.0%
#30	0.600		88%	100.0%	0.0%
#40	0.425	87%	87%	100.0%	0.0%
#50	0.300		75%	100.0%	0.0%
#60	0.250		70%	100.0%	0.0%
#80	0.180		63%	100.0%	0.0%
#100	0.150	60%	60%	100.0%	0.0%
#140	0.106		38%	100.0%	0.0%
#170	0.090		30%	100.0%	0.0%
#200	0.075	22.3%	22.3%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Hydrometer Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT33B-GT-15-16.5-20240730 Sample#: B24-1574	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 10-Oct-24 Tested By: S. Boesenberg Control No.: 10152024	Unified Soils Classification System, ASTM D-2487 SM, Silty Sand Sample Color Brown																																																																																																					
ASTM D-422 HYDROMETER ANALYSIS		ASTM C-136																																																																																																					
Assumed Sp Gr : 2.65 Sample Weight: 50.45 grams Hydroscopic Moist.: 1.67% Adj. Sample Wgt : 49.62 grams		Sieve Analysis Grain Size Distribution																																																																																																					
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Hydrometer Reading</th> <th style="text-align: left;">Corrected Reading</th> <th style="text-align: left;">Percent Passing</th> <th style="text-align: left;">Soils Particle Diameter</th> </tr> </thead> <tbody> <tr><td>2</td><td>5</td><td>9.4%</td><td>0.0380 mm</td></tr> <tr><td>5</td><td>4</td><td>7.6%</td><td>0.0241 mm</td></tr> <tr><td>15</td><td>3</td><td>5.7%</td><td>0.0140 mm</td></tr> <tr><td>30</td><td>2</td><td>3.8%</td><td>0.0100 mm</td></tr> <tr><td>60</td><td>2</td><td>3.8%</td><td>0.0070 mm</td></tr> <tr><td>250</td><td>1.5</td><td>2.8%</td><td>0.0035 mm</td></tr> <tr><td>1440</td><td>1</td><td>1.9%</td><td>0.0014 mm</td></tr> </tbody> </table>	Hydrometer Reading	Corrected Reading	Percent Passing	Soils Particle Diameter	2	5	9.4%	0.0380 mm	5	4	7.6%	0.0241 mm	15	3	5.7%	0.0140 mm	30	2	3.8%	0.0100 mm	60	2	3.8%	0.0070 mm	250	1.5	2.8%	0.0035 mm	1440	1	1.9%	0.0014 mm	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Sieve Size</th> <th style="text-align: left;">Percent Passing</th> <th style="text-align: left;">Soils Particle Diameter</th> </tr> </thead> <tbody> <tr><td>3.0"</td><td>100%</td><td>75.000 mm</td></tr> <tr><td>2.0"</td><td>100%</td><td>50.000 mm</td></tr> <tr><td>1.5"</td><td>100%</td><td>37.500 mm</td></tr> <tr><td>1.25"</td><td>100%</td><td>31.500 mm</td></tr> <tr><td>1.0"</td><td>100%</td><td>25.000 mm</td></tr> <tr><td>3/4"</td><td>100%</td><td>19.000 mm</td></tr> <tr><td>5/8"</td><td>100%</td><td>16.000 mm</td></tr> <tr><td>1/2"</td><td>100%</td><td>12.500 mm</td></tr> <tr><td>3/8"</td><td>100%</td><td>9.500 mm</td></tr> <tr><td>1/4"</td><td>100%</td><td>6.300 mm</td></tr> <tr><td>#4</td><td>99%</td><td>4.750 mm</td></tr> <tr><td>#10</td><td>94%</td><td>2.000 mm</td></tr> <tr><td>#20</td><td>89%</td><td>0.850 mm</td></tr> <tr><td>#40</td><td>87%</td><td>0.425 mm</td></tr> <tr><td>#100</td><td>60%</td><td>0.150 mm</td></tr> <tr><td>#200</td><td>22.3%</td><td>0.075 mm</td></tr> <tr><td>Silts</td><td>22.0%</td><td>0.074 mm</td></tr> <tr><td></td><td>13.6%</td><td>0.050 mm</td></tr> <tr><td></td><td>6.8%</td><td>0.020 mm</td></tr> <tr><td>Clays</td><td>3.2%</td><td>0.005 mm</td></tr> <tr><td></td><td>2.1%</td><td>0.002 mm</td></tr> <tr><td>Colloids</td><td>1.3%</td><td>0.001 mm</td></tr> </tbody> </table>	Sieve Size	Percent Passing	Soils Particle Diameter	3.0"	100%	75.000 mm	2.0"	100%	50.000 mm	1.5"	100%	37.500 mm	1.25"	100%	31.500 mm	1.0"	100%	25.000 mm	3/4"	100%	19.000 mm	5/8"	100%	16.000 mm	1/2"	100%	12.500 mm	3/8"	100%	9.500 mm	1/4"	100%	6.300 mm	#4	99%	4.750 mm	#10	94%	2.000 mm	#20	89%	0.850 mm	#40	87%	0.425 mm	#100	60%	0.150 mm	#200	22.3%	0.075 mm	Silts	22.0%	0.074 mm		13.6%	0.050 mm		6.8%	0.020 mm	Clays	3.2%	0.005 mm		2.1%	0.002 mm	Colloids	1.3%	0.001 mm
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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



ASTM D-4318 Liquid Limit, Plastic Limit & Plasticity Index of Soils

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT33B-GT-20-21.5-20240730 Sample #: B24-1575	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 10-Oct-24 Tested By: Z. Romney Control No.: 10152024	Unified Soils Classification System, ASTM D-2487 ML, Clayey Silt Sample Color Brown
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Liquid Limit Determination

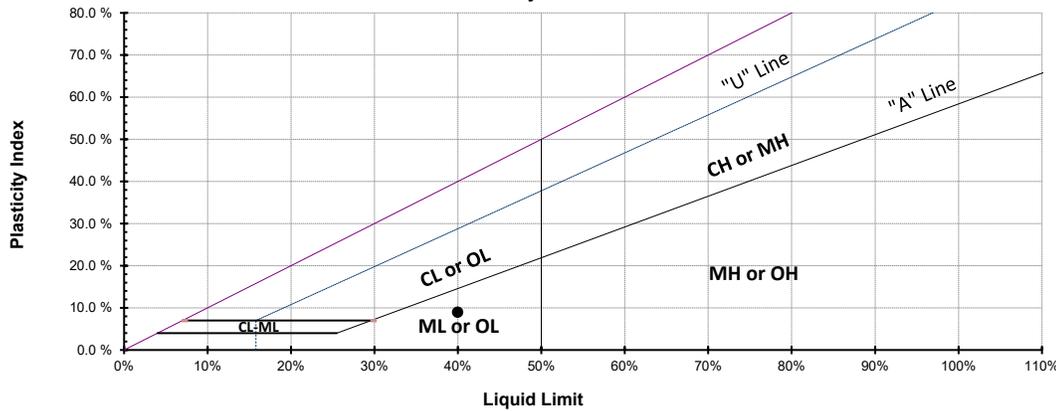
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	32.49	26.28	33.44			
Weight of Dry Soils + Pan:	28.80	22.74	29.68			
Weight of Pan:	19.40	13.98	20.43			
Weight of Dry Soils:	9.40	8.76	9.25			
Weight of Moisture:	3.69	3.54	3.76			
% Moisture:	39.3 %	40.4 %	40.7 %			
Number of Blows:	30	24	17			

Liquid Limit @ 25 Blows: 40.0 %
Plastic Limit: 31.0 %
Plasticity Index, I_p: 9.0 %

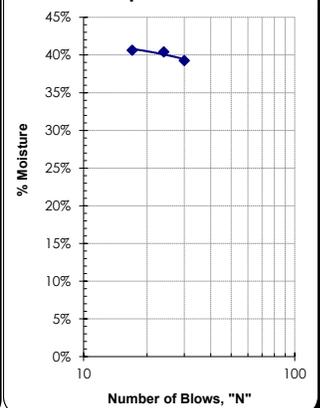
Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	28.04	27.01				
Weight of Dry Soils + Pan:	26.33	25.53				
Weight of Pan:	20.70	20.85				
Weight of Dry Soils:	5.63	4.68				
Weight of Moisture:	1.71	1.48				
% Moisture:	30.4 %	31.6 %				

Plasticity Chart



Liquid Limit



All results apply only to actual locations and materials tested. As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of clients, and authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved pending our written approval.

Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT34-GT-5-6.5-20240729 Sample#: B24-1579	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 10-Oct-24 Tested By: S. Boesenberg Control No.: 10152024	Unified Soil Classification System, ASTM-2487 SM, Silty Sand with Gravel Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.020 mm % Gravel = 27.7% D ₍₁₀₎ = 0.040 mm % Sand = 53.6% D ₍₁₅₎ = 0.060 mm % Silt & Clay = 18.7% D ₍₅₀₎ = 0.192 mm Liquid Limit = n/a D ₍₆₀₎ = 0.406 mm Plasticity Index = n/a D ₍₁₀₀₎ = 1.237 mm Sand Equivalent = n/a D ₍₂₀₀₎ = 13.921 mm Fracture %, 1 Face = n/a Dust Ratio = 31/86 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 0.74 Coeff. of Uniformity, C _u = 30.79 Fineness Modulus = 3.01 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	96%	96%	100.0%	0.0%
5/8"	16.00		92%	100.0%	0.0%
1/2"	12.50	88%	88%	100.0%	0.0%
3/8"	9.50	84%	84%	100.0%	0.0%
1/4"	6.30		76%	100.0%	0.0%
#4	4.75	72%	72%	100.0%	0.0%
#8	2.36		68%	100.0%	0.0%
#10	2.00	68%	68%	100.0%	0.0%
#16	1.18		59%	100.0%	0.0%
#20	0.850		56%	100.0%	0.0%
#30	0.600		54%	100.0%	0.0%
#40	0.425	52%	52%	100.0%	0.0%
#50	0.300		40%	100.0%	0.0%
#60	0.250		35%	100.0%	0.0%
#80	0.180		29%	100.0%	0.0%
#100	0.150	26%	26%	100.0%	0.0%
#140	0.106		22%	100.0%	0.0%
#170	0.090		20%	100.0%	0.0%
#200	0.075	18.7%	18.7%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Hydrometer Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT34-GT-5-6.5-20240729 Sample#: B24-1579	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 10-Oct-24 Tested By: S. Boesenberg Control No.: 10152024	Unified Soil Classification System, ASTM-2487 SM, Silty Sand with Gravel Sample Color Brown																																																																																																					
ASTM D-422 HYDROMETER ANALYSIS		ASTM C-136																																																																																																					
Assumed Sp Gr : 2.65 Sample Weight: 50.09 grams Hydroscopic Moist.: 1.33% Adj. Sample Wgt : 49.43 grams		Sieve Analysis Grain Size Distribution																																																																																																					
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Comments: _____

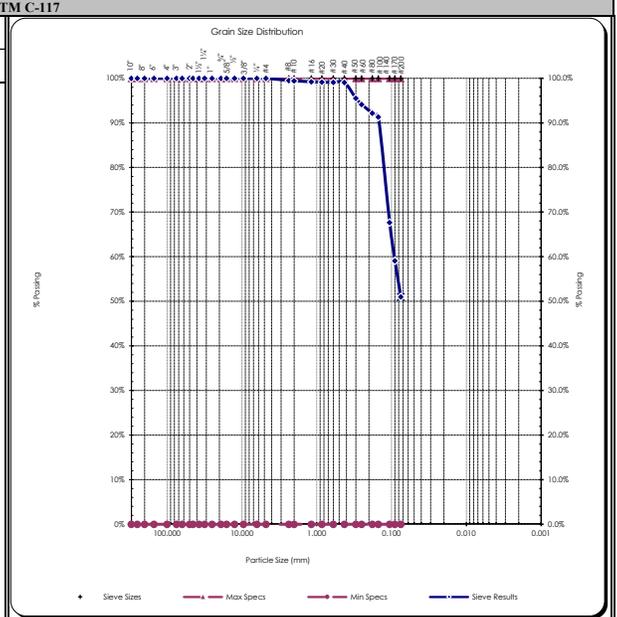
Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT34-GT-15.3-16.1-20240729 Sample#: B24-1581	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 10-Oct-24 Tested By: S. Boesenberg Control No.: 10152024	Visual Soils Classification Sandy Silt Sample Color: Brown
Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281		
Specifications No Specs Sample Meets Specs ? <i>N/A</i>	D ₍₆₎ = 0.007 mm % Gravel = 0.0% D ₍₁₀₎ = 0.015 mm % Sand = 49.0% D ₍₁₅₎ = 0.022 mm % Silt & Clay = 51.0% D ₍₃₀₎ = 0.044 mm Liquid Limit = n/a D ₍₅₀₎ = 0.074 mm Plasticity Index = n/a D ₍₆₀₎ = 0.092 mm Sand Equivalent = n/a D ₍₉₀₎ = 0.148 mm Fracture %, 1 Face = n/a Dust Ratio = 17/33 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 1.44 Coeff. of Uniformity, C _u = 6.24 Fineness Modulus = 0.15 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
Method(s) ASTM C-136, ASTM D-6913, ASTM C-117		

Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		99%	100.0%	0.0%
#20	0.850		99%	100.0%	0.0%
#30	0.600		99%	100.0%	0.0%
#40	0.425	99%	99%	100.0%	0.0%
#50	0.300		96%	100.0%	0.0%
#60	0.250		94%	100.0%	0.0%
#80	0.180		92%	100.0%	0.0%
#100	0.150	91%	91%	100.0%	0.0%
#140	0.106		68%	100.0%	0.0%
#170	0.090		59%	100.0%	0.0%
#200	0.075	51.0%	51.0%	100.0%	0.0%



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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Hydrometer Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT34-GT-15.3-16.1-20240729 Sample#: B24-1581	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 10-Oct-24 Tested By: S. Boesenberg Control No.: 10152024	Visual Soils Classification Sandy Silt Sample Color Brown																																																																																																					
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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



ASTM D-4318 Liquid Limit, Plastic Limit & Plasticity Index of Soils

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT34-GT-25-26.5-20240729 Sample #: B24-1583	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 10-Oct-24 Tested By: Z. Romney Control No.: 10152024	Unified Soils Classification System, ASTM D-2487 ML, Silty Clay Sample Color Brown
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Liquid Limit Determination

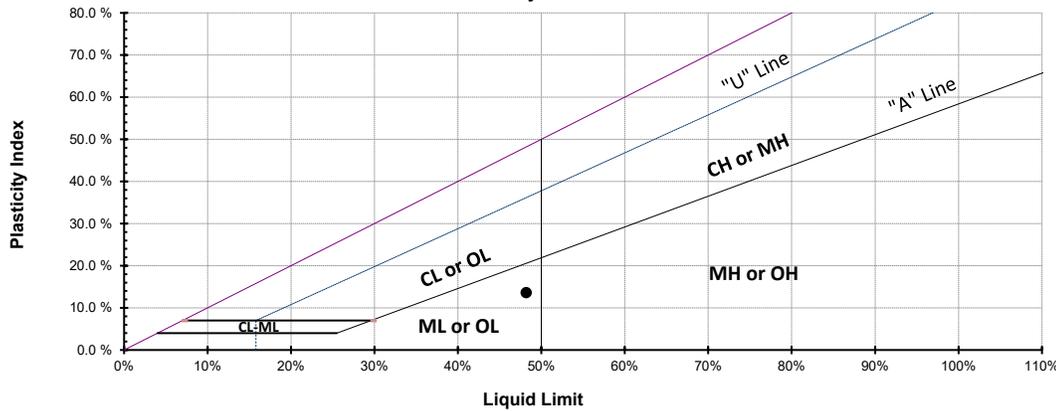
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	29.28	36.63	25.94			
Weight of Dry Soils + Pan:	26.09	31.15	22.01			
Weight of Pan:	19.28	19.84	14.04			
Weight of Dry Soils:	6.81	11.31	7.97			
Weight of Moisture:	3.19	5.48	3.93			
% Moisture:	46.8 %	48.5 %	49.3 %			
Number of Blows:	31	24	20			

Liquid Limit @ 25 Blows: 48.2 %
Plastic Limit: 34.6 %
Plasticity Index, I_p: 13.6 %

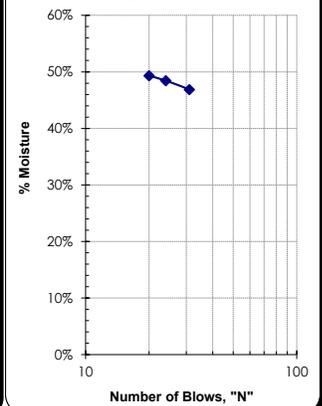
Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	24.67	25.72				
Weight of Dry Soils + Pan:	23.09	24.12				
Weight of Pan:	18.44	19.57				
Weight of Dry Soils:	4.65	4.55				
Weight of Moisture:	1.58	1.60				
% Moisture:	34.0 %	35.2 %				

Plasticity Chart



Liquid Limit



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Comments: _____

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Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT34-GT-35.5-36.5-20240729 Sample#: B24-1585	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 10-Oct-24 Tested By: S. Boesenberg Control No.: 10152024	Unified Soil Classification System, ASTM-2487 SM, Silty Sand Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.013 mm % Gravel = 0.3% D ₍₁₀₎ = 0.026 mm % Sand = 70.5% D ₍₁₅₎ = 0.039 mm % Silt & Clay = 29.2% D ₍₃₀₎ = 0.077 mm Liquid Limit = n/a D ₍₅₀₎ = 0.120 mm Plasticity Index = n/a D ₍₆₀₎ = 0.142 mm Sand Equivalent = n/a D ₍₉₀₎ = 0.381 mm Fracture %, 1 Face = n/a Dust Ratio = 4/13 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 1.61 Coeff. of Uniformity, C _u = 5.53 Fineness Modulus = 0.64 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		97%	100.0%	0.0%
#20	0.850		96%	100.0%	0.0%
#30	0.600		95%	100.0%	0.0%
#40	0.425	95%	95%	100.0%	0.0%
#50	0.300		81%	100.0%	0.0%
#60	0.250		75%	100.0%	0.0%
#80	0.180		67%	100.0%	0.0%
#100	0.150	64%	64%	100.0%	0.0%
#140	0.106		43%	100.0%	0.0%
#170	0.090		36%	100.0%	0.0%
#200	0.075	29.2%	29.2%	100.0%	0.0%

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 All results apply only to actual locations and materials tested. As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of clients, and authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved pending our written approval.

Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Client: Anchor QEA, LLC.
Address: 1201 3rd Avenue, Suite 2600
Seattle, WA 98101
Attn: Cindy Fields
Revised On: _____

Date: October 18, 2024
Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
Project #: 24B105
Sample #: B24-1586 - 1611
Date sampled: June 17 - July 29, 2024
Control No: 10182024

As requested and authorized by the Client, MTC has performed the following test(s) on the sample number referenced above. The testing was performed in accordance with current, applicable AASHTO, ASTM, and/or WSDOT standards, which are referenced on the correlating test report pages. The results obtained in our laboratory are as detailed below and/or on the following pages:

	Test(s) Performed:	Test Results	Test(s) Performed:	Test Results
X	Sieve Analysis	See Attached Reports	Sulfate Soundness	
	Proctor		Bulk Density & Voids	
	Sand Equivalent		WSDOT Degradation	
	Fracture Count		LA Abrasion	
X	Moisture Content	See Attached Reports	Cation Exchange Capacity	
	Specific Gravity, Coarse		X Specific Gravity, Soils	See Attached Report
	Specific Gravity, Fine		X Organic Content	See Attached Report
X	Hydrometer Analysis	See Attached Reports		
X	Atterberg Limits	See Attached Reports		

If you have any questions concerning the test results, the procedures used, or if we can be of any further assistance please call the number below and ask to speak with your Project Manager or the Laboratory Manager.

Alex Eifrig

 Respectfully Submitted,
 Alex Eifrig
 WABO Supervising Laboratory Technician



Moisture Content ASTM C-566, ASTM D-2216

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
Project #: 24B105
Date Received: September 23, 2024
Date Tested: October 11, 2024

Client: Anchor QEA, LLC.
Sampled by: Client
Tested by: S. Boesenberg
Control No.: 10182024

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B24-1586	LDW23-GT34-GT-40-41.5-20240729	270.2	848.5	719.5	129.0	449.3	28.7%
B24-1587	LDW23-GT30-GT-5-6.5-20240620	320.0	411.2	367.8	43.4	47.8	90.8%
B24-1588	LDW23-GT30-GT-10-11.5-20240620	266.4	460.5	381.3	79.2	114.9	68.9%
B24-1589	LDW23-GT30-GT-15-15.3-20240620	311.2	443.1	394.7	48.4	83.5	58.0%
B24-1590	LDW23-GT30-GT-15.3-15.5-20240620	303.4	320.3	317.5	2.8	14.1	19.9%
B24-1591	LDW23-GT30-GT-20-21.5-20240620	269.0	683.3	617.1	66.2	348.1	19.0%
B24-1592	LDW23-GT30-GT-25-26.5-20240620	223.9	636.1	545.3	90.8	321.4	28.3%
B24-1593	LDW23-GT18-GT-0-1.5-20240619	215.7	691.6	445.3	246.3	229.6	107.3%
B24-1594	LDW23-GT18-GT-5-6.5-20240619	357.3	525.2	440.2	85.0	82.9	102.5%
B24-1595	LDW23-GT18-GT-10-11.5-20240619	358.2	424.0	391.2	32.8	33.0	99.4%
B24-1596	LDW23-GT18-GT-15-16.5-20240619	360.1	431.4	402.1	29.3	42.0	69.8%
B24-1597	LDW23-GT18-GT-25-26.5-20240619	356.7	794.8	696.6	98.2	339.9	28.9%
B24-1598	LDW23-GT18-GT-30-31.5-20240619	270.2	765.5	646.7	118.8	376.5	31.6%
B24-1600	LDW23-GT02-GT-5-6-20240617	215.5	313.4	269.1	44.3	53.6	82.6%
B24-1601	LDW23-GT02-GT-6-6.5-20240617	223.9	359.5	329.7	29.8	105.8	28.2%
B24-1602	LDW23-GT02-GT-10-10.8-20240617	303.4	599.7	537.2	62.5	233.8	26.7%
B24-1603	LDW23-GT02-GT-10.8-11.5-20240617	311.3	405.1	372.7	32.4	61.4	52.8%
B24-1604	LDW23-GT02-GT-15-15.5-20240617	320.0	572.0	485.1	86.9	165.1	52.6%
B24-1605	LDW23-GT02-GT-15.5-16.5-20240617	360.1	819.8	710.1	109.7	350.0	31.3%
B24-1606	LDW23-GT02-GT-20-21.5-20240617	420.7	889.1	776.1	113.0	355.4	31.8%
B24-1607	LDW23-GT02-GT-25.9-26.5-20240617	229.4	559.5	486.3	73.2	256.9	28.5%
B24-1608	LDW23-GT10-GT-0-1.5-20240618	414.2	1184.1	856.7	327.4	442.5	74.0%
B24-1609	LDW23-GT10-GT-5-6.5-20240618	221.0	392.5	317.9	74.6	96.9	77.0%
B24-1610	LDW23-GT10-GT-10-11.5-20240618	394.0	828.7	657.9	170.8	263.9	64.7%
B24-1611	LDW23-GT10-GT-15-15.5-20240618	221.8	516.0	392.2	123.8	170.4	72.7%

All results apply only to actual locations and materials tested. As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of clients, and authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved pending our written approval.

Comments:

Reviewed by:

Alex Eifrig

Alex Eifrig
WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT30-GT-5-6.5-20240620 Sample#: B24-1587	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 15-Oct-24 Tested By: S. Boesenberg Control No.: 10182024	Visual Soils Classification Clayey Sandy Silt Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.005 mm % Gravel = 2.8% Coeff. of Curvature, C _c = 1.50 D ₍₁₀₎ = 0.009 mm % Sand = 15.5% Coeff. of Uniformity, C _u = 6.00 D ₍₁₅₎ = 0.014 mm % Silt & Clay = 81.7% Fineness Modulus = 0.58 D ₍₃₀₎ = 0.028 mm Liquid Limit = n/a Plastic Limit = n/a D ₍₅₀₎ = 0.046 mm Plasticity Index = n/a Moisture %, as sampled = n/a D ₍₆₀₎ = 0.055 mm Sand Equivalent = n/a Req'd Sand Equivalent = D ₍₉₀₎ = 0.968 mm Fracture %, 1 Face = n/a Req'd Fracture %, 1 Face = Dust Ratio = 54/59 Fracture %, 2+ Faces = n/a Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		98%	100.0%	0.0%
#4	4.75	97%	97%	100.0%	0.0%
#8	2.36		92%	100.0%	0.0%
#10	2.00	91%	91%	100.0%	0.0%
#16	1.18		90%	100.0%	0.0%
#20	0.850		90%	100.0%	0.0%
#30	0.600		89%	100.0%	0.0%
#40	0.425	89%	89%	100.0%	0.0%
#50	0.300		88%	100.0%	0.0%
#60	0.250		87%	100.0%	0.0%
#80	0.180		86%	100.0%	0.0%
#100	0.150	86%	86%	100.0%	0.0%
#140	0.106		83%	100.0%	0.0%
#170	0.090		82%	100.0%	0.0%
#200	0.075	81.7%	81.7%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Hydrometer Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT30-GT-5-6.5-20240620 Sample#: B24-1587	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 15-Oct-24 Tested By: S. Boesenberg Control No.: 10182024	Visual Soils Classification Clayey Sandy Silt Sample Color Brown																																																																																																																																														
ASTM D-422 HYDROMETER ANALYSIS		ASTM C-136																																																																																																																																														
<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">Assumed Sp Gr :</td> <td style="width: 20%;">2.65</td> <td style="width: 50%;"></td> </tr> <tr> <td>Sample Weight:</td> <td>50.69</td> <td>grams</td> </tr> <tr> <td>Hydroscopic Moist.:</td> <td>4.77%</td> <td></td> </tr> <tr> <td>Adj. Sample Wgt :</td> <td>48.38</td> <td>grams</td> </tr> </table> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Hydrometer Reading Minutes</th> <th style="width: 15%;">Corrected Reading</th> <th style="width: 15%;">Percent Passing</th> <th style="width: 55%;">Soils Particle Diameter</th> </tr> </thead> <tbody> <tr><td>2</td><td>35</td><td>66.1%</td><td>0.0314 mm</td></tr> <tr><td>5</td><td>30</td><td>56.7%</td><td>0.0206 mm</td></tr> <tr><td>15</td><td>24.5</td><td>46.3%</td><td>0.0124 mm</td></tr> <tr><td>30</td><td>20</td><td>37.8%</td><td>0.0090 mm</td></tr> <tr><td>60</td><td>15</td><td>28.3%</td><td>0.0065 mm</td></tr> <tr><td>250</td><td>8.5</td><td>16.1%</td><td>0.0033 mm</td></tr> <tr><td>1440</td><td>5</td><td>9.4%</td><td>0.0014 mm</td></tr> </tbody> </table> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">% Gravel:</td> <td style="width: 20%;">2.8%</td> <td style="width: 50%;"></td> </tr> <tr> <td>% Sand:</td> <td>15.5%</td> <td></td> </tr> <tr> <td>% Silt:</td> <td>59.3%</td> <td></td> </tr> <tr> <td>% Clay:</td> <td>22.4%</td> <td></td> </tr> </table> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;"></td> <td style="width: 20%;">Liquid Limit:</td> <td style="width: 50%;">n/a</td> </tr> <tr> <td></td> <td>Plastic Limit:</td> <td>n/a</td> </tr> <tr> <td></td> <td>Plasticity Index:</td> <td>n/a</td> </tr> </table>	Assumed Sp Gr :	2.65		Sample Weight:	50.69	grams	Hydroscopic Moist.:	4.77%		Adj. Sample Wgt :	48.38	grams	Hydrometer Reading Minutes	Corrected Reading	Percent Passing	Soils Particle Diameter	2	35	66.1%	0.0314 mm	5	30	56.7%	0.0206 mm	15	24.5	46.3%	0.0124 mm	30	20	37.8%	0.0090 mm	60	15	28.3%	0.0065 mm	250	8.5	16.1%	0.0033 mm	1440	5	9.4%	0.0014 mm	% Gravel:	2.8%		% Sand:	15.5%		% Silt:	59.3%		% Clay:	22.4%			Liquid Limit:	n/a		Plastic Limit:	n/a		Plasticity Index:	n/a	<table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="3" style="text-align: center;">Sieve Analysis</th> </tr> <tr> <th colspan="3" style="text-align: center;">Grain Size Distribution</th> </tr> <tr> <th style="width: 20%;">Sieve Size</th> <th style="width: 20%;">Percent Passing</th> <th style="width: 60%;">Soils Particle Diameter</th> </tr> </thead> <tbody> <tr><td>3.0"</td><td>100%</td><td>75.000 mm</td></tr> <tr><td>2.0"</td><td>100%</td><td>50.000 mm</td></tr> <tr><td>1.5"</td><td>100%</td><td>37.500 mm</td></tr> <tr><td>1.25"</td><td>100%</td><td>31.500 mm</td></tr> <tr><td>1.0"</td><td>100%</td><td>25.000 mm</td></tr> <tr><td>3/4"</td><td>100%</td><td>19.000 mm</td></tr> <tr><td>5/8"</td><td>100%</td><td>16.000 mm</td></tr> <tr><td>1/2"</td><td>100%</td><td>12.500 mm</td></tr> <tr><td>3/8"</td><td>100%</td><td>9.500 mm</td></tr> <tr><td>1/4"</td><td>98%</td><td>6.300 mm</td></tr> <tr><td>#4</td><td>97%</td><td>4.750 mm</td></tr> <tr><td>#10</td><td>91%</td><td>2.000 mm</td></tr> <tr><td>#20</td><td>90%</td><td>0.850 mm</td></tr> <tr><td>#40</td><td>89%</td><td>0.425 mm</td></tr> <tr><td>#100</td><td>86%</td><td>0.150 mm</td></tr> <tr><td>#200</td><td>81.7%</td><td>0.075 mm</td></tr> <tr><td colspan="2" style="text-align: center;">Silts</td><td>81.3%</td></tr> <tr><td colspan="2"></td><td>72.8%</td></tr> <tr><td colspan="2"></td><td>55.9%</td></tr> <tr><td colspan="2" style="text-align: center;">Clays</td><td>22.4%</td></tr> <tr><td colspan="2"></td><td>11.5%</td></tr> <tr><td colspan="2" style="text-align: center;">Colloids</td><td>6.7%</td></tr> <tr><td colspan="2"></td><td>0.001 mm</td></tr> </tbody> </table>	Sieve Analysis			Grain Size Distribution			Sieve Size	Percent Passing	Soils Particle Diameter	3.0"	100%	75.000 mm	2.0"	100%	50.000 mm	1.5"	100%	37.500 mm	1.25"	100%	31.500 mm	1.0"	100%	25.000 mm	3/4"	100%	19.000 mm	5/8"	100%	16.000 mm	1/2"	100%	12.500 mm	3/8"	100%	9.500 mm	1/4"	98%	6.300 mm	#4	97%	4.750 mm	#10	91%	2.000 mm	#20	90%	0.850 mm	#40	89%	0.425 mm	#100	86%	0.150 mm	#200	81.7%	0.075 mm	Silts		81.3%			72.8%			55.9%	Clays		22.4%			11.5%	Colloids		6.7%			0.001 mm
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#100	86%	0.150 mm																																																																																																																																														
#200	81.7%	0.075 mm																																																																																																																																														
Silts		81.3%																																																																																																																																														
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		55.9%																																																																																																																																														
Clays		22.4%																																																																																																																																														
		11.5%																																																																																																																																														
Colloids		6.7%																																																																																																																																														
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<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">% Sand:</td> <td style="width: 20%;">Particle Size</td> <td style="width: 50%;">2.0 - 0.05 mm</td> </tr> <tr> <td>% Silt:</td> <td>0.05 - 0.002 mm</td> <td></td> </tr> <tr> <td>% Clay:</td> <td>< 0.002 mm</td> <td></td> </tr> </table> <table style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="2" style="text-align: center;">USDA Soil Textural Classification</th> </tr> <tr> <td colspan="2" style="text-align: center;">Silt Loam</td> </tr> </table>	% Sand:	Particle Size	2.0 - 0.05 mm	% Silt:	0.05 - 0.002 mm		% Clay:	< 0.002 mm		USDA Soil Textural Classification		Silt Loam																																																																																																																																				
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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



ASTM D-4318 Liquid Limit, Plastic Limit & Plasticity Index of Soils

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT30-GT-10-11.5-20240620 Sample #: B24-1588	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 16-Oct-24 Tested By: S. Boesenberg Control No.: 10182024	Unified Soils Classification System, ASTM D-2487 OH, Organic Silty Clay Sample Color Brown
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Liquid Limit Determination

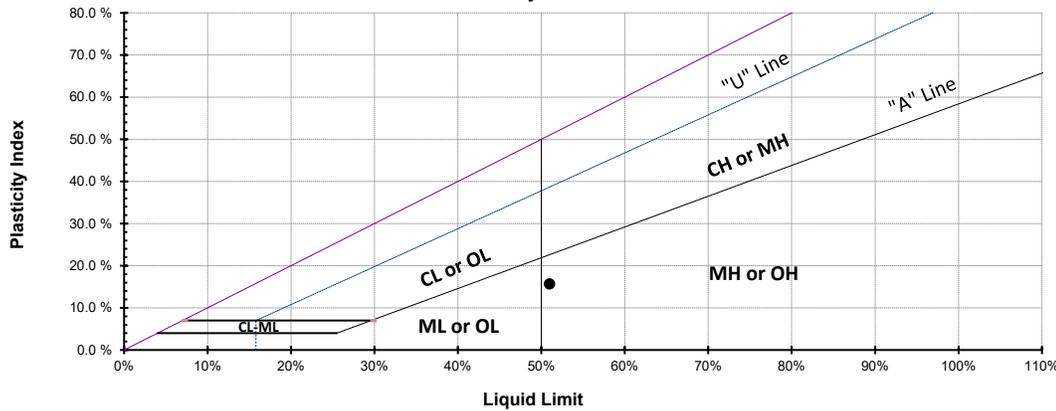
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	33.51	31.03	40.45			
Weight of Dry Soils + Pan:	28.69	27.04	33.03			
Weight of Pan:	18.43	19.29	19.23			
Weight of Dry Soils:	10.26	7.75	13.80			
Weight of Moisture:	4.82	3.99	7.42			
% Moisture:	47.0 %	51.5 %	53.8 %			
Number of Blows:	35	25	17			

Liquid Limit @ 25 Blows: 51.0 %
Plastic Limit: 35.3 %
Plasticity Index, I_p: 15.7 %

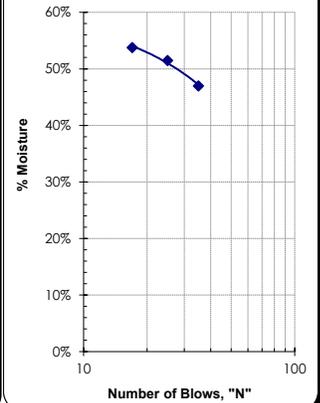
Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	26.59	26.39				
Weight of Dry Soils + Pan:	24.76	24.67				
Weight of Pan:	19.47	19.90				
Weight of Dry Soils:	5.29	4.77				
Weight of Moisture:	1.83	1.72				
% Moisture:	34.6 %	36.1 %				

Plasticity Chart



Liquid Limit



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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT30-GT-20-21.5-20240620 Sample#: B24-1591	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 15-Oct-24 Tested By: R. Bohler Control No.: 10182024	Unified Soil Classification System, ASTM-2487 SM, Silty Sand Sample Color: Brown
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Specifications No Specs Sample Meets Specs ? <i>N/A</i>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.012 mm % Gravel = 0.0% D ₍₁₀₎ = 0.023 mm % Sand = 67.9% D ₍₁₅₎ = 0.035 mm % Silt & Clay = 32.1% D ₍₃₀₎ = 0.070 mm Liquid Limit = n/a D ₍₅₀₎ = 0.187 mm Plasticity Index = n/a D ₍₆₀₎ = 0.275 mm Sand Equivalent = n/a D ₍₉₀₎ = 1.315 mm Fracture %, 1 Face = n/a Dust Ratio = 5/12 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 0.77 Coeff. of Uniformity, C _u = 11.75 Fineness Modulus = 1.24 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		88%	100.0%	0.0%
#20	0.850		83%	100.0%	0.0%
#30	0.600		80%	100.0%	0.0%
#40	0.425	77%	77%	100.0%	0.0%
#50	0.300		63%	100.0%	0.0%
#60	0.250		57%	100.0%	0.0%
#80	0.180		49%	100.0%	0.0%
#100	0.150	46%	46%	100.0%	0.0%
#140	0.106		38%	100.0%	0.0%
#170	0.090		35%	100.0%	0.0%
#200	0.075	32.1%	32.1%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT18-GT-5-6.5-20240619 Sample#: B24-1594	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 15-Oct-24 Tested By: S. Boesenberg Control No.: 10182024	Visual Soils Classification Clayey Silt with Sand Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.004 mm % Gravel = 0.3% Coeff. of Curvature, C _c = 1.50 D ₍₁₀₎ = 0.008 mm % Sand = 6.4% Coeff. of Uniformity, C _u = 6.00 D ₍₁₅₎ = 0.012 mm % Silt & Clay = 93.3% Fineness Modulus = 0.08 D ₍₃₀₎ = 0.024 mm Liquid Limit = n/a Plastic Limit = n/a D ₍₅₀₎ = 0.040 mm Plasticity Index = n/a Moisture %, as sampled = n/a D ₍₆₀₎ = 0.048 mm Sand Equivalent = n/a Req'd Sand Equivalent = D ₍₉₀₎ = 0.072 mm Fracture %, 1 Face = n/a Req'd Fracture %, 1 Face = Dust Ratio = 55/58 Fracture %, 2+ Faces = n/a Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		99%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		99%	100.0%	0.0%
#20	0.850		99%	100.0%	0.0%
#30	0.600		98%	100.0%	0.0%
#40	0.425	98%	98%	100.0%	0.0%
#50	0.300		98%	100.0%	0.0%
#60	0.250		98%	100.0%	0.0%
#80	0.180		98%	100.0%	0.0%
#100	0.150	97%	97%	100.0%	0.0%
#140	0.106		95%	100.0%	0.0%
#170	0.090		94%	100.0%	0.0%
#200	0.075	93.3%	93.3%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Hydrometer Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT18-GT-5-6.5-20240619 Sample#: B24-1594	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 15-Oct-24 Tested By: S. Boesenberg Control No.: 10182024	Visual Soils Classification Clayey Silt with Sand Sample Color Brown																																																																																																				
ASTM D-422 HYDROMETER ANALYSIS		ASTM C-136																																																																																																				
Assumed Sp Gr : 2.65 Sample Weight: 50.57 grams Hydroscopic Moist.: 10.64% Adj. Sample Wgt : 45.71 grams		Sieve Analysis Grain Size Distribution																																																																																																				
<table border="0" style="width: 100%;"> <thead> <tr> <th style="text-align: left;">Hydrometer Reading</th> <th style="text-align: left;">Corrected Reading</th> <th style="text-align: left;">Percent Passing</th> <th style="text-align: left;">Soils Particle Diameter</th> </tr> </thead> <tbody> <tr><td>2</td><td>30</td><td>65.1%</td><td>0.0326 mm</td></tr> <tr><td>5</td><td>23.5</td><td>51.0%</td><td>0.0216 mm</td></tr> <tr><td>15</td><td>19</td><td>41.2%</td><td>0.0128 mm</td></tr> <tr><td>30</td><td>15</td><td>32.5%</td><td>0.0093 mm</td></tr> <tr><td>60</td><td>12</td><td>26.0%</td><td>0.0067 mm</td></tr> <tr><td>250</td><td>7</td><td>15.2%</td><td>0.0034 mm</td></tr> <tr><td>1440</td><td>4</td><td>8.7%</td><td>0.0014 mm</td></tr> </tbody> </table>	Hydrometer Reading	Corrected Reading	Percent Passing	Soils Particle Diameter	2	30	65.1%	0.0326 mm	5	23.5	51.0%	0.0216 mm	15	19	41.2%	0.0128 mm	30	15	32.5%	0.0093 mm	60	12	26.0%	0.0067 mm	250	7	15.2%	0.0034 mm	1440	4	8.7%	0.0014 mm	<table border="0" style="width: 100%;"> <thead> <tr> <th style="text-align: left;">Sieve Size</th> <th style="text-align: left;">Percent Passing</th> <th style="text-align: left;">Soils Particle Diameter</th> </tr> </thead> <tbody> <tr><td>3.0"</td><td>100%</td><td>75.000 mm</td></tr> <tr><td>2.0"</td><td>100%</td><td>50.000 mm</td></tr> <tr><td>1.5"</td><td>100%</td><td>37.500 mm</td></tr> <tr><td>1.25"</td><td>100%</td><td>31.500 mm</td></tr> <tr><td>1.0"</td><td>100%</td><td>25.000 mm</td></tr> <tr><td>3/4"</td><td>100%</td><td>19.000 mm</td></tr> <tr><td>5/8"</td><td>100%</td><td>16.000 mm</td></tr> <tr><td>1/2"</td><td>100%</td><td>12.500 mm</td></tr> <tr><td>3/8"</td><td>100%</td><td>9.500 mm</td></tr> <tr><td>1/4"</td><td>100%</td><td>6.300 mm</td></tr> <tr><td>#4</td><td>100%</td><td>4.750 mm</td></tr> <tr><td>#10</td><td>99%</td><td>2.000 mm</td></tr> <tr><td>#20</td><td>99%</td><td>0.850 mm</td></tr> <tr><td>#40</td><td>98%</td><td>0.425 mm</td></tr> <tr><td>#100</td><td>97%</td><td>0.150 mm</td></tr> <tr><td>#200</td><td>93.3%</td><td>0.075 mm</td></tr> <tr><td>Silts</td><td>92.6%</td><td>0.074 mm</td></tr> <tr><td></td><td>76.7%</td><td>0.050 mm</td></tr> <tr><td></td><td>49.2%</td><td>0.020 mm</td></tr> <tr><td>Clays</td><td>20.6%</td><td>0.005 mm</td></tr> <tr><td></td><td>10.6%</td><td>0.002 mm</td></tr> <tr><td>Colloids</td><td>6.1%</td><td>0.001 mm</td></tr> </tbody> </table>	Sieve Size	Percent Passing	Soils Particle Diameter	3.0"	100%	75.000 mm	2.0"	100%	50.000 mm	1.5"	100%	37.500 mm	1.25"	100%	31.500 mm	1.0"	100%	25.000 mm	3/4"	100%	19.000 mm	5/8"	100%	16.000 mm	1/2"	100%	12.500 mm	3/8"	100%	9.500 mm	1/4"	100%	6.300 mm	#4	100%	4.750 mm	#10	99%	2.000 mm	#20	99%	0.850 mm	#40	98%	0.425 mm	#100	97%	0.150 mm	#200	93.3%	0.075 mm	Silts	92.6%	0.074 mm		76.7%	0.050 mm		49.2%	0.020 mm	Clays	20.6%	0.005 mm		10.6%	0.002 mm	Colloids	6.1%	0.001 mm
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% Gravel: 0.3% % Sand: 6.4% % Silt: 72.7% % Clay: 20.6%		Liquid Limit: n/a Plastic Limit: n/a Plasticity Index: n/a																																																																																																				
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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



ASTM D-4318 Liquid Limit, Plastic Limit & Plasticity Index of Soils

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT18-GT-10-11.5-20240619 Sample #: B24-1595	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 15-Oct-24 Tested By: S. Boesenberg Control No.: 10182024	Unified Soils Classification System, ASTM D-2487 OH, Organic Silty Clay Sample Color Brown
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Liquid Limit Determination

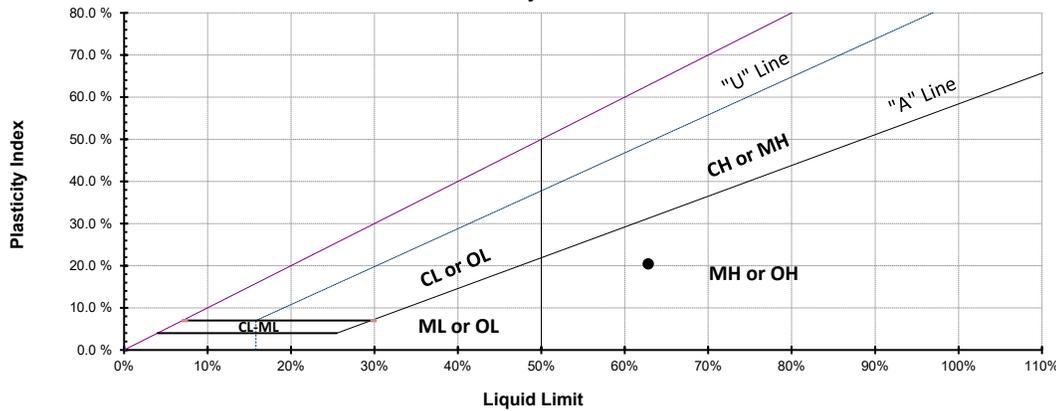
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	29.80	30.36	29.37			
Weight of Dry Soils + Pan:	26.11	26.68	25.91			
Weight of Pan:	20.20	20.83	20.43			
Weight of Dry Soils:	5.91	5.85	5.48			
Weight of Moisture:	3.69	3.68	3.46			
% Moisture:	62.4 %	62.9 %	63.1 %			
Number of Blows:	32	24	19			

Liquid Limit @ 25 Blows: 62.8 %
Plastic Limit: 42.4 %
Plasticity Index, I_p: 20.4 %

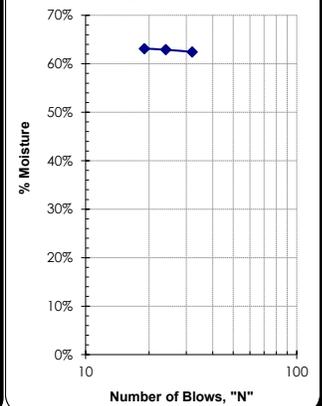
Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	26.71	26.72				
Weight of Dry Soils + Pan:	24.88	24.95				
Weight of Pan:	20.65	20.69				
Weight of Dry Soils:	4.23	4.26				
Weight of Moisture:	1.83	1.77				
% Moisture:	43.3 %	41.6 %				

Plasticity Chart



Liquid Limit



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Comments: _____

Reviewed by: Alex Eifrig
 Alex Eifrig
 WABO Supervising Laboratory Technician



ASTM D-4318 Liquid Limit, Plastic Limit & Plasticity Index of Soils

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT18-GT-15-16.5-20240619 Sample #: B24-1596	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 15-Oct-24 Tested By: Z. Romney Control No.: 10182024	Unified Soils Classification System, ASTM D-2487 OH, Organic Clayey Silt Sample Color Brown
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Liquid Limit Determination

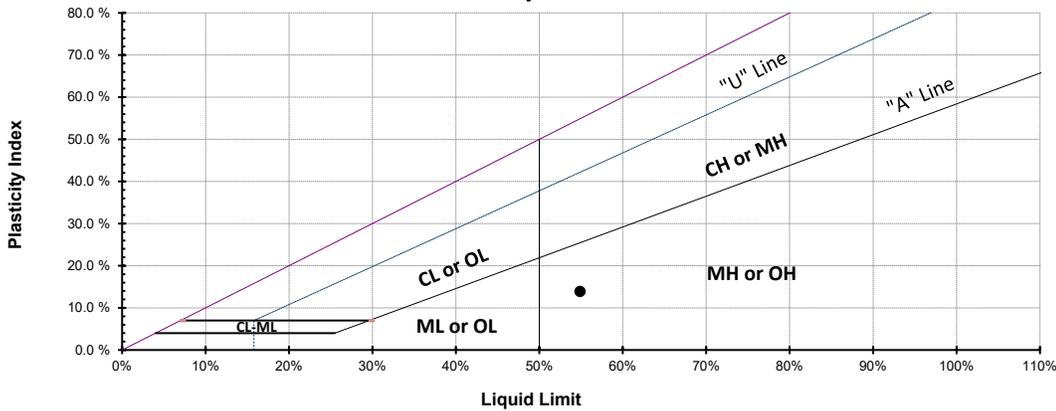
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	27.48	32.85	28.42			
Weight of Dry Soils + Pan:	22.85	28.07	23.19			
Weight of Pan:	14.00	19.39	14.05			
Weight of Dry Soils:	8.85	8.68	9.14			
Weight of Moisture:	4.63	4.78	5.23			
% Moisture:	52.3 %	55.1 %	57.2 %			
Number of Blows:	34	24	17			

Liquid Limit @ 25 Blows: 54.9 %
Plastic Limit: 41.0 %
Plasticity Index, I_p: 13.9 %

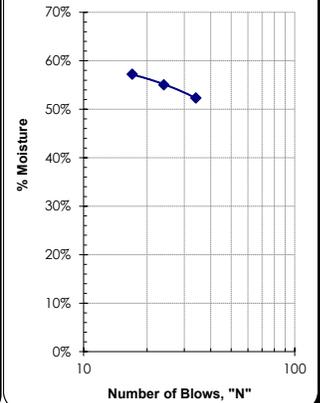
Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	25.26	26.28				
Weight of Dry Soils + Pan:	23.48	24.35				
Weight of Pan:	19.19	19.58				
Weight of Dry Soils:	4.29	4.77				
Weight of Moisture:	1.78	1.93				
% Moisture:	41.5 %	40.5 %				

Plasticity Chart



Liquid Limit



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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT18-GT-25-26.5-20240619 Sample#: B24-1597	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 15-Oct-24 Tested By: R. Bohler Control No.: 10182024	Unified Soil Classification System, ASTM-2487 SP-SM, Poorly graded Sand with Silt Sample Color: Brown
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Specifications No Specs Sample Meets Specs ? <i>N/A</i>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.038 mm % Gravel = 0.1% D ₍₁₀₎ = 0.076 mm % Sand = 90.0% D ₍₁₅₎ = 0.100 mm % Silt & Clay = 9.9% D ₍₃₀₎ = 0.171 mm Liquid Limit = n/a D ₍₅₀₎ = 0.257 mm Plasticity Index = n/a D ₍₆₀₎ = 0.300 mm Sand Equivalent = n/a D ₍₉₀₎ = 0.539 mm Fracture %, 1 Face = n/a Dust Ratio = 1/9 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 1.29 Coeff. of Uniformity, C _u = 3.97 Fineness Modulus = 1.30 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		94%	100.0%	0.0%
#20	0.850		92%	100.0%	0.0%
#30	0.600		90%	100.0%	0.0%
#40	0.425	89%	89%	100.0%	0.0%
#50	0.300		60%	100.0%	0.0%
#60	0.250		48%	100.0%	0.0%
#80	0.180		32%	100.0%	0.0%
#100	0.150	25%	25%	100.0%	0.0%
#140	0.106		16%	100.0%	0.0%
#170	0.090		13%	100.0%	0.0%
#200	0.075	9.9%	9.9%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
Project #: 24B105
Date Received: September 23, 2024
Date Tested: October 14, 2024

Client: Anchor QEA, LLC.
Sampled by: Client
Tested by: S. Boesenberg
Control No.: 10182024

Moisture Content ASTM C-566, ASTM D-2216

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B24-1599	LDW23-GT02-GT-0-1.5-20240617	423.8	1247.9	888.0	359.9	464.2	77.5%
B24-1608	LDW23-GT10-GT-0-1.5-20240618	414.2	1184.1	856.7	327.4	442.5	74.0%

Organic Content ASTM D-2974

Sample #	Location	Tare	Soil + Tare, Pre-Ignition	Soil + Tare, Post Ignition	% Organics
B24-1599	LDW23-GT02-0-1.5-20240617	51.49	100.01	97.36	5.46%
B24-1608	LDW23-GT10-0-1.5-20240618	50.2	100.00	97.80	4.42%

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Reviewed by: *Alex Eifrig*

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 WABO Supervising Laboratory Technician



ASTM D-4318 Liquid Limit, Plastic Limit & Plasticity Index of Soils

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT02-GT-5-6-20240617 Sample #: B24-1600	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 15-Oct-24 Tested By: S. Boesenberg Control No.: 10182024	Unified Soils Classification System, ASTM D-2487 OH, Organic Clayey Silt Sample Color Brown
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Liquid Limit Determination

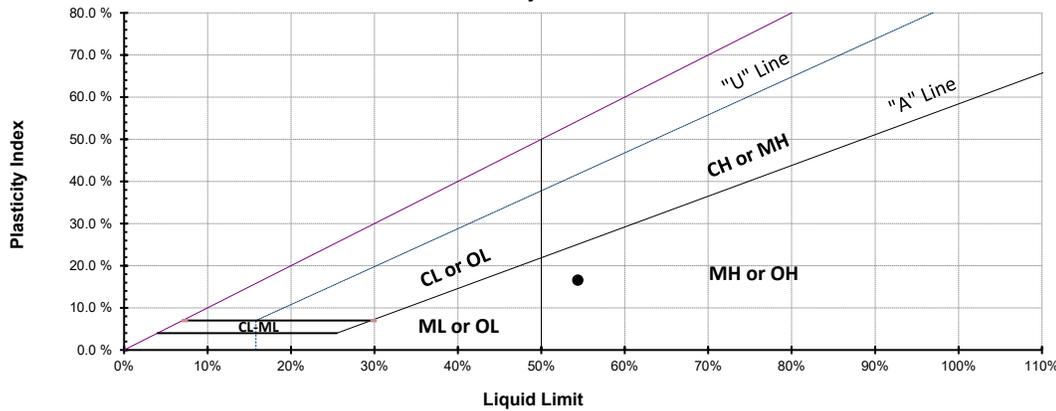
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	29.69	29.47	32.17			
Weight of Dry Soils + Pan:	26.30	25.94	27.59			
Weight of Pan:	19.88	19.47	19.41			
Weight of Dry Soils:	6.42	6.47	8.18			
Weight of Moisture:	3.39	3.53	4.58			
% Moisture:	52.8 %	54.6 %	56.0 %			
Number of Blows:	31	25	18			

Liquid Limit @ 25 Blows: 54.4 %
Plastic Limit: 37.8 %
Plasticity Index, I_p: 16.6 %

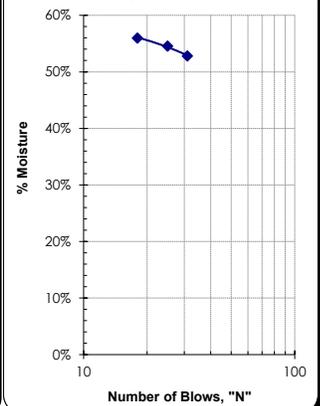
Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	25.41	24.92				
Weight of Dry Soils + Pan:	23.69	23.16				
Weight of Pan:	19.19	18.44				
Weight of Dry Soils:	4.50	4.72				
Weight of Moisture:	1.72	1.76				
% Moisture:	38.2 %	37.3 %				

Plasticity Chart



Liquid Limit



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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT02-GT-10.8-11.5-20240617 Sample#: B24-1603	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 15-Oct-24 Tested By: S. Boesenberg Control No.: 10182024	Unified Soils Classification System, ASTM D-2487 OL, Clayey Silt with Sand Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.006 mm % Gravel = 0.0% D ₍₁₀₎ = 0.011 mm % Sand = 31.9% D ₍₁₅₎ = 0.017 mm % Silt & Clay = 68.1% D ₍₃₀₎ = 0.033 mm Liquid Limit = 45.1% D ₍₅₀₎ = 0.055 mm Plasticity Index = 10.9% D ₍₆₀₎ = 0.066 mm Sand Equivalent = n/a D ₍₉₀₎ = 0.350 mm Fracture %, 1 Face = n/a Dust Ratio = 44/61 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 1.50 Coeff. of Uniformity, C _u = 6.00 Fineness Modulus = 0.43 Plastic Limit = 34.2% Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		97%	100.0%	0.0%
#20	0.850		96%	100.0%	0.0%
#30	0.600		95%	100.0%	0.0%
#40	0.425	94%	94%	100.0%	0.0%
#50	0.300		87%	100.0%	0.0%
#60	0.250		84%	100.0%	0.0%
#80	0.180		80%	100.0%	0.0%
#100	0.150	78%	78%	100.0%	0.0%
#140	0.106		72%	100.0%	0.0%
#170	0.090		70%	100.0%	0.0%
#200	0.075	68.1%	68.1%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Hydrometer Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT02-GT-10.8-11.5-20240617 Sample#: B24-1603	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 15-Oct-24 Tested By: S. Boesenberg Control No.: 10182024	Unified Soils Classification System, ASTM D-2487 OL, Clayey Silt with Sand Sample Color Brown																																																																																																				
ASTM D-422 HYDROMETER ANALYSIS		ASTM C-136																																																																																																				
Assumed Sp Gr : 2.65 Sample Weight: 50.16 grams Hydroscopic Moist.: 4.16% Adj. Sample Wgt : 48.16 grams		Sieve Analysis Grain Size Distribution																																																																																																				
<table border="0" style="width: 100%;"> <thead> <tr> <th style="text-align: left;">Hydrometer Reading</th> <th style="text-align: left;">Corrected Reading</th> <th style="text-align: left;">Percent Passing</th> <th style="text-align: left;">Soils Particle Diameter</th> </tr> </thead> <tbody> <tr><td style="text-align: center;">2</td><td style="text-align: center;">25</td><td style="text-align: center;">51.9%</td><td style="text-align: center;">0.0337 mm</td></tr> <tr><td style="text-align: center;">5</td><td style="text-align: center;">20</td><td style="text-align: center;">41.5%</td><td style="text-align: center;">0.0220 mm</td></tr> <tr><td style="text-align: center;">15</td><td style="text-align: center;">15</td><td style="text-align: center;">31.1%</td><td style="text-align: center;">0.0131 mm</td></tr> <tr><td style="text-align: center;">30</td><td style="text-align: center;">12</td><td style="text-align: center;">24.9%</td><td style="text-align: center;">0.0094 mm</td></tr> <tr><td style="text-align: center;">60</td><td style="text-align: center;">10</td><td style="text-align: center;">20.8%</td><td style="text-align: center;">0.0068 mm</td></tr> <tr><td style="text-align: center;">250</td><td style="text-align: center;">6</td><td style="text-align: center;">12.5%</td><td style="text-align: center;">0.0034 mm</td></tr> <tr><td style="text-align: center;">1440</td><td style="text-align: center;">3.5</td><td style="text-align: center;">7.3%</td><td style="text-align: center;">0.0014 mm</td></tr> </tbody> </table>	Hydrometer Reading	Corrected Reading	Percent Passing	Soils Particle Diameter	2	25	51.9%	0.0337 mm	5	20	41.5%	0.0220 mm	15	15	31.1%	0.0131 mm	30	12	24.9%	0.0094 mm	60	10	20.8%	0.0068 mm	250	6	12.5%	0.0034 mm	1440	3.5	7.3%	0.0014 mm	<table border="0" style="width: 100%;"> <thead> <tr> <th style="text-align: left;">Sieve Size</th> <th style="text-align: left;">Percent Passing</th> <th style="text-align: left;">Soils Particle Diameter</th> </tr> </thead> <tbody> <tr><td>3.0"</td><td style="text-align: center;">100%</td><td style="text-align: center;">75.000 mm</td></tr> <tr><td>2.0"</td><td style="text-align: center;">100%</td><td style="text-align: center;">50.000 mm</td></tr> <tr><td>1.5"</td><td style="text-align: center;">100%</td><td style="text-align: center;">37.500 mm</td></tr> <tr><td>1.25"</td><td style="text-align: center;">100%</td><td style="text-align: center;">31.500 mm</td></tr> <tr><td>1.0"</td><td style="text-align: center;">100%</td><td style="text-align: center;">25.000 mm</td></tr> <tr><td>3/4"</td><td style="text-align: center;">100%</td><td style="text-align: center;">19.000 mm</td></tr> <tr><td>5/8"</td><td style="text-align: center;">100%</td><td style="text-align: center;">16.000 mm</td></tr> <tr><td>1/2"</td><td style="text-align: center;">100%</td><td style="text-align: center;">12.500 mm</td></tr> <tr><td>3/8"</td><td style="text-align: center;">100%</td><td style="text-align: center;">9.500 mm</td></tr> <tr><td>1/4"</td><td style="text-align: center;">100%</td><td style="text-align: center;">6.300 mm</td></tr> <tr><td>#4</td><td style="text-align: center;">100%</td><td style="text-align: center;">4.750 mm</td></tr> <tr><td>#10</td><td style="text-align: center;">100%</td><td style="text-align: center;">2.000 mm</td></tr> <tr><td>#20</td><td style="text-align: center;">96%</td><td style="text-align: center;">0.850 mm</td></tr> <tr><td>#40</td><td style="text-align: center;">94%</td><td style="text-align: center;">0.425 mm</td></tr> <tr><td>#100</td><td style="text-align: center;">78%</td><td style="text-align: center;">0.150 mm</td></tr> <tr><td>#200</td><td style="text-align: center;">68.1%</td><td style="text-align: center;">0.075 mm</td></tr> <tr><td style="text-align: center;">Silts</td><td style="text-align: center;">67.7%</td><td style="text-align: center;">0.074 mm</td></tr> <tr><td></td><td style="text-align: center;">58.3%</td><td style="text-align: center;">0.050 mm</td></tr> <tr><td></td><td style="text-align: center;">39.2%</td><td style="text-align: center;">0.020 mm</td></tr> <tr><td style="text-align: center;">Clays</td><td style="text-align: center;">16.4%</td><td style="text-align: center;">0.005 mm</td></tr> <tr><td></td><td style="text-align: center;">8.8%</td><td style="text-align: center;">0.002 mm</td></tr> <tr><td style="text-align: center;">Colloids</td><td style="text-align: center;">5.1%</td><td style="text-align: center;">0.001 mm</td></tr> </tbody> </table>	Sieve Size	Percent Passing	Soils Particle Diameter	3.0"	100%	75.000 mm	2.0"	100%	50.000 mm	1.5"	100%	37.500 mm	1.25"	100%	31.500 mm	1.0"	100%	25.000 mm	3/4"	100%	19.000 mm	5/8"	100%	16.000 mm	1/2"	100%	12.500 mm	3/8"	100%	9.500 mm	1/4"	100%	6.300 mm	#4	100%	4.750 mm	#10	100%	2.000 mm	#20	96%	0.850 mm	#40	94%	0.425 mm	#100	78%	0.150 mm	#200	68.1%	0.075 mm	Silts	67.7%	0.074 mm		58.3%	0.050 mm		39.2%	0.020 mm	Clays	16.4%	0.005 mm		8.8%	0.002 mm	Colloids	5.1%	0.001 mm
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% Gravel: 0.0% % Sand: 31.9% % Silt: 51.7% % Clay: 16.4%	Particle Size 2.0 - 0.05 mm 0.05 - 0.002 mm < 0.002 mm	USDA Soil Textural Classification Loam																																																																																																				

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Comments: _____

Reviewed by: *Alex Eifrig*
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 WABO Supervising Laboratory Technician



ASTM D-4318 Liquid Limit, Plastic Limit & Plasticity Index of Soils

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT02-GT-10.8-11.5-20240617 Sample #: B24-1603	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 15-Oct-24 Tested By: S. Boesenberg Control No.: 10182024	Unified Soils Classification System, ASTM D-2487 OL, Clayey Silt with Sand Sample Color Brown
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Liquid Limit Determination

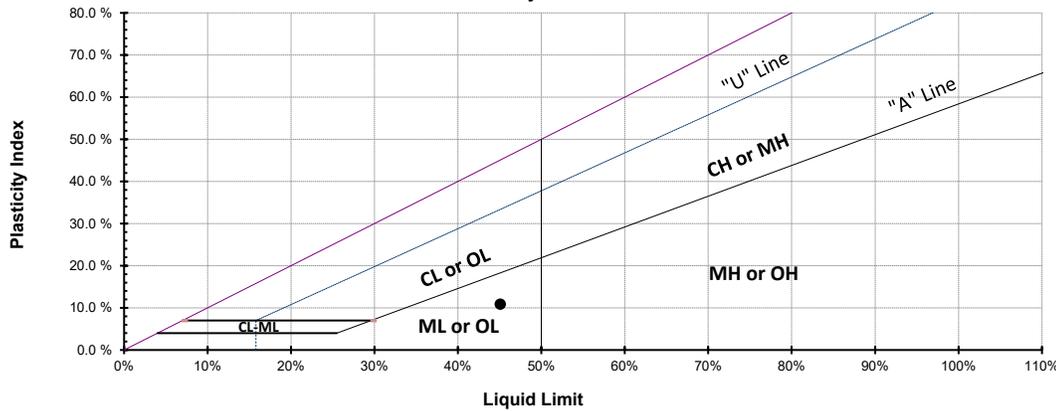
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	23.90	24.08	40.70			
Weight of Dry Soils + Pan:	21.09	21.13	36.71			
Weight of Pan:	14.71	14.56	28.10			
Weight of Dry Soils:	6.38	6.57	8.61			
Weight of Moisture:	2.81	2.95	3.99			
% Moisture:	44.0 %	44.9 %	46.3 %			
Number of Blows:	35	24	16			

Liquid Limit @ 25 Blows: 45.1 %
Plastic Limit: 34.2 %
Plasticity Index, I_p: 10.9 %

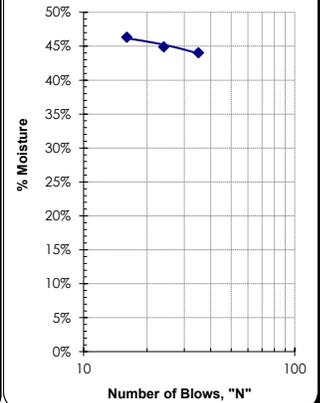
Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	26.48	25.66				
Weight of Dry Soils + Pan:	24.72	24.04				
Weight of Pan:	19.58	19.30				
Weight of Dry Soils:	5.14	4.74				
Weight of Moisture:	1.76	1.62				
% Moisture:	34.2 %	34.2 %				

Plasticity Chart



Liquid Limit



All results apply only to actual locations and materials tested. As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of clients, and authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved pending our written approval.

Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT02-GT-15.5-16.5-20240617 Sample#: B24-1605	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 15-Oct-24 Tested By: R. Bohler Control No.: 10182024	Visual Soils Classification Silt with Clay and Sand Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.006 mm % Gravel = 0.0% D ₍₁₀₎ = 0.011 mm % Sand = 31.9% D ₍₁₅₎ = 0.017 mm % Silt & Clay = 68.1% D ₍₃₀₎ = 0.033 mm Liquid Limit = n/a D ₍₅₀₎ = 0.055 mm Plasticity Index = n/a D ₍₆₀₎ = 0.066 mm Sand Equivalent = n/a D ₍₉₀₎ = 0.139 mm Fracture %, 1 Face = n/a Dust Ratio = 28/41 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 1.50 Coeff. of Uniformity, C _u = 6.00 Fineness Modulus = 0.10 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850		100%	100.0%	0.0%
#30	0.600		100%	100.0%	0.0%
#40	0.425	100%	100%	100.0%	0.0%
#50	0.300		97%	100.0%	0.0%
#60	0.250		96%	100.0%	0.0%
#80	0.180		94%	100.0%	0.0%
#100	0.150	94%	94%	100.0%	0.0%
#140	0.106		79%	100.0%	0.0%
#170	0.090		73%	100.0%	0.0%
#200	0.075	68.1%	68.1%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



ASTM D-4318 Liquid Limit, Plastic Limit & Plasticity Index of Soils

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT10-GT-5-6.5-20240618 Sample #: B24-1609	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 15-Oct-24 Tested By: Z. Romney Control No.: 10182024	Unified Soils Classification System, ASTM D-2487 OH, Organic Silty Clay with Sand Sample Color Brown
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Liquid Limit Determination

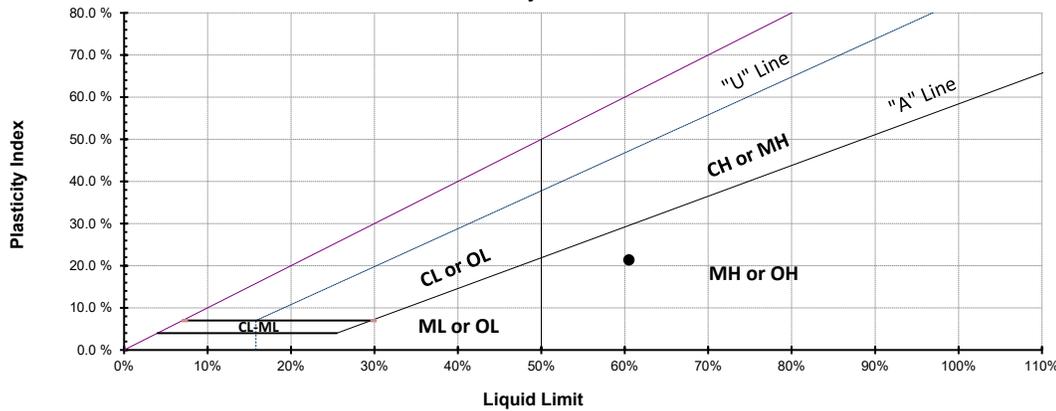
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	31.45	24.69	25.03			
Weight of Dry Soils + Pan:	26.93	20.65	20.85			
Weight of Pan:	19.29	14.02	14.08			
Weight of Dry Soils:	7.64	6.63	6.77			
Weight of Moisture:	4.52	4.04	4.18			
% Moisture:	59.2 %	60.9 %	61.7 %			
Number of Blows:	33	24	16			

Liquid Limit @ 25 Blows: 60.5 %
Plastic Limit: 39.1 %
Plasticity Index, I_p: 21.4 %

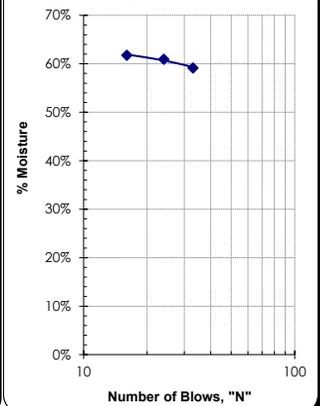
Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	25.56	26.88				
Weight of Dry Soils + Pan:	23.87	25.14				
Weight of Pan:	19.56	20.68				
Weight of Dry Soils:	4.31	4.46				
Weight of Moisture:	1.69	1.74				
% Moisture:	39.2 %	39.0 %				

Plasticity Chart



Liquid Limit



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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT10-GT-10-11.5-20240618 Sample#: B24-1610	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 15-Oct-24 Tested By: S. Boesenberg Control No.: 10182024	Visual Soils Classification Clayey Silt Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.004 mm % Gravel = 0.0% D ₍₁₀₎ = 0.008 mm % Sand = 7.5% D ₍₁₅₎ = 0.012 mm % Silt & Clay = 92.5% D ₍₃₀₎ = 0.024 mm Liquid Limit = n/a D ₍₅₀₎ = 0.041 mm Plasticity Index = n/a D ₍₆₀₎ = 0.049 mm Sand Equivalent = n/a D ₍₉₀₎ = 0.073 mm Fracture %, 1 Face = n/a Dust Ratio = 13/14 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 1.50 Coeff. of Uniformity, C _u = 6.00 Fineness Modulus = 0.03 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850		100%	100.0%	0.0%
#30	0.600		100%	100.0%	0.0%
#40	0.425	100%	100%	100.0%	0.0%
#50	0.300		99%	100.0%	0.0%
#60	0.250		99%	100.0%	0.0%
#80	0.180		99%	100.0%	0.0%
#100	0.150	99%	99%	100.0%	0.0%
#140	0.106		95%	100.0%	0.0%
#170	0.090		94%	100.0%	0.0%
#200	0.075	92.5%	92.5%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Hydrometer Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT10-GT-10-11.5-20240618 Sample#: B24-1610	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 15-Oct-24 Tested By: S. Boesenberg Control No.: 10182024	Visual Soils Classification Clayey Silt Sample Color Brown																																																																																																					
ASTM D-422 HYDROMETER ANALYSIS		ASTM C-136																																																																																																					
Assumed Sp Gr : 2.65 Sample Weight: 50.24 grams Hydroscopic Moist.: 7.69% Adj. Sample Wgt : 46.65 grams		Sieve Analysis Grain Size Distribution																																																																																																					
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Hydrometer Reading</th> <th style="text-align: center;">Corrected Reading</th> <th style="text-align: center;">Percent Passing</th> <th style="text-align: center;">Soils Particle Diameter</th> </tr> </thead> <tbody> <tr><td style="text-align: center;">2</td><td style="text-align: center;">33</td><td style="text-align: center;">70.6%</td><td style="text-align: center;">0.0319 mm</td></tr> <tr><td style="text-align: center;">5</td><td style="text-align: center;">29</td><td style="text-align: center;">62.1%</td><td style="text-align: center;">0.0207 mm</td></tr> <tr><td style="text-align: center;">15</td><td style="text-align: center;">23</td><td style="text-align: center;">49.2%</td><td style="text-align: center;">0.0125 mm</td></tr> <tr><td style="text-align: center;">30</td><td style="text-align: center;">18</td><td style="text-align: center;">38.5%</td><td style="text-align: center;">0.0091 mm</td></tr> <tr><td style="text-align: center;">60</td><td style="text-align: center;">14</td><td style="text-align: center;">30.0%</td><td style="text-align: center;">0.0066 mm</td></tr> <tr><td style="text-align: center;">250</td><td style="text-align: center;">8</td><td style="text-align: center;">17.1%</td><td style="text-align: center;">0.0033 mm</td></tr> <tr><td style="text-align: center;">1440</td><td style="text-align: center;">5</td><td style="text-align: center;">10.7%</td><td style="text-align: center;">0.0014 mm</td></tr> </tbody> </table>	Hydrometer Reading	Corrected Reading	Percent Passing	Soils Particle Diameter	2	33	70.6%	0.0319 mm	5	29	62.1%	0.0207 mm	15	23	49.2%	0.0125 mm	30	18	38.5%	0.0091 mm	60	14	30.0%	0.0066 mm	250	8	17.1%	0.0033 mm	1440	5	10.7%	0.0014 mm	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Sieve Size</th> <th style="text-align: center;">Percent Passing</th> <th style="text-align: center;">Soils Particle Diameter</th> </tr> </thead> <tbody> <tr><td style="text-align: center;">3.0"</td><td style="text-align: center;">100%</td><td style="text-align: center;">75.000 mm</td></tr> <tr><td style="text-align: center;">2.0"</td><td style="text-align: center;">100%</td><td style="text-align: center;">50.000 mm</td></tr> <tr><td style="text-align: center;">1.5"</td><td style="text-align: center;">100%</td><td style="text-align: center;">37.500 mm</td></tr> <tr><td style="text-align: center;">1.25"</td><td style="text-align: center;">100%</td><td style="text-align: center;">31.500 mm</td></tr> <tr><td style="text-align: center;">1.0"</td><td style="text-align: center;">100%</td><td style="text-align: center;">25.000 mm</td></tr> <tr><td style="text-align: center;">3/4"</td><td style="text-align: center;">100%</td><td style="text-align: center;">19.000 mm</td></tr> <tr><td style="text-align: center;">5/8"</td><td style="text-align: center;">100%</td><td style="text-align: center;">16.000 mm</td></tr> <tr><td style="text-align: center;">1/2"</td><td style="text-align: center;">100%</td><td style="text-align: center;">12.500 mm</td></tr> <tr><td style="text-align: center;">3/8"</td><td style="text-align: center;">100%</td><td style="text-align: center;">9.500 mm</td></tr> <tr><td style="text-align: center;">1/4"</td><td style="text-align: center;">100%</td><td style="text-align: center;">6.300 mm</td></tr> <tr><td style="text-align: center;">#4</td><td style="text-align: center;">100%</td><td style="text-align: center;">4.750 mm</td></tr> <tr><td style="text-align: center;">#10</td><td style="text-align: center;">100%</td><td style="text-align: center;">2.000 mm</td></tr> <tr><td style="text-align: center;">#20</td><td style="text-align: center;">100%</td><td style="text-align: center;">0.850 mm</td></tr> <tr><td style="text-align: center;">#40</td><td style="text-align: center;">100%</td><td style="text-align: center;">0.425 mm</td></tr> <tr><td style="text-align: center;">#100</td><td style="text-align: center;">99%</td><td style="text-align: center;">0.150 mm</td></tr> <tr><td style="text-align: center;">#200</td><td style="text-align: center;">92.5%</td><td style="text-align: center;">0.075 mm</td></tr> <tr><td style="text-align: center;">Silts</td><td style="text-align: center;">92.0%</td><td style="text-align: center;">0.074 mm</td></tr> <tr><td></td><td style="text-align: center;">79.8%</td><td style="text-align: center;">0.050 mm</td></tr> <tr><td></td><td style="text-align: center;">61.0%</td><td style="text-align: center;">0.020 mm</td></tr> <tr><td style="text-align: center;">Clays</td><td style="text-align: center;">23.7%</td><td style="text-align: center;">0.005 mm</td></tr> <tr><td></td><td style="text-align: center;">12.6%</td><td style="text-align: center;">0.002 mm</td></tr> <tr><td style="text-align: center;">Colloids</td><td style="text-align: center;">7.6%</td><td style="text-align: center;">0.001 mm</td></tr> </tbody> </table>	Sieve Size	Percent Passing	Soils Particle Diameter	3.0"	100%	75.000 mm	2.0"	100%	50.000 mm	1.5"	100%	37.500 mm	1.25"	100%	31.500 mm	1.0"	100%	25.000 mm	3/4"	100%	19.000 mm	5/8"	100%	16.000 mm	1/2"	100%	12.500 mm	3/8"	100%	9.500 mm	1/4"	100%	6.300 mm	#4	100%	4.750 mm	#10	100%	2.000 mm	#20	100%	0.850 mm	#40	100%	0.425 mm	#100	99%	0.150 mm	#200	92.5%	0.075 mm	Silts	92.0%	0.074 mm		79.8%	0.050 mm		61.0%	0.020 mm	Clays	23.7%	0.005 mm		12.6%	0.002 mm	Colloids	7.6%	0.001 mm
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Comments: _____

Reviewed by: Alex Eifrig
 Alex Eifrig
 WABO Supervising Laboratory Technician



Client: Anchor QEA, LLC.
Address: 1201 3rd Avenue, Suite 2600
Seattle, WA 98101
Attn: Cindy Fields
Revised On: _____

Date: October 23, 2024
Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
Project #: 24B105
Sample #: B24-1612 - 1637
Date sampled: June 18, 2024 - August 1, 2024
Control No: 10232024

As requested and authorized by the Client, MTC has performed the following test(s) on the sample number referenced above. The testing was performed in accordance with current, applicable AASHTO, ASTM, and/or WSDOT standards, which are referenced on the correlating test report pages. The results obtained in our laboratory are as detailed below and/or on the following pages:

	Test(s) Performed:	Test Results	Test(s) Performed:	Test Results
X	Sieve Analysis	See Attached Reports	Sulfate Soundness	
	Proctor		Bulk Density & Voids	
	Sand Equivalent		WSDOT Degradation	
	Fracture Count		LA Abrasion	
X	Moisture Content	See Attached Reports	Cation Exchange Capacity	
	Specific Gravity, Coarse		X Specific Gravity, Soils	See Attached Report
	Specific Gravity, Fine		X Organic Content	See Attached Report
X	Hydrometer Analysis	See Attached Reports		
X	Atterberg Limits	See Attached Reports		

If you have any questions concerning the test results, the procedures used, or if we can be of any further assistance please call the number below and ask to speak with your Project Manager or the Laboratory Manager.

Alex Eifrig

 Respectfully Submitted,
 Alex Eifrig
 WABO Supervising Laboratory Technician



Moisture Content ASTM C-566, ASTM D-2216

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
Project #: 24B105
Date Received: September 23, 2024
Date Tested: October 15, 2024

Client: Anchor QEA, LLC.
Sampled by: Client
Tested by: S. Boesenberg
Control No.: 10232024

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B24-1612	LDW23-GT10-GT-15.5-16.5-20240618	360.2	528.6	482.2	46.4	122.0	38.0%
B24-1613	LDW23-GT09-GT-0-1.5-20240618	301.1	437.4	374.9	62.5	73.8	84.7%
B24-1614	LDW23-GT09-GT-5-6.2-20240618	260.3	365.3	321.3	44.0	61.0	72.1%
B24-1615	LDW23-GT09-GT-6.2-6.5-20240618	223.0	470.0	368.6	101.4	145.6	69.6%
B24-1616	LDW23-GT09-GT-10-11.5-20240618	356.8	746.8	618.8	128.0	262.0	48.9%
B24-1617	LDW23-GT09-GT-15-16.5-20240618	222.5	339.3	296.9	42.4	74.4	57.0%
B24-1618	LDW23-GT19-GT-0-1.5-20240619	225.7	670.9	468.6	202.3	242.9	83.3%
B24-1619	LDW23-GT19-GT-5-6.5-20240619	208.7	342.9	289.1	53.8	80.4	66.9%
B24-1620	LDW23-GT19-GT-10-11.5-20240619	358.3	669.4	603.2	66.2	244.9	27.0%
B24-1621	LDW23-GT19-GT-15-16.5-20240619	233.1	969.8	805.5	164.3	572.4	28.7%
B24-1622	LDW23-GT19-GT-20-20.8-20240619	234.8	708.3	613.7	94.6	378.9	25.0%
B24-1623	LDW23-GT19-GT-20.8-21.5-20240619	357.9	868.0	740.5	127.5	382.6	33.3%
B24-1625	LDW23-GT19-GT-30-31.5-20240619	584.1	1572.3	1345.9	226.4	761.8	29.7%
B24-1626	LDW23-GT11-GT-1.3-2-20240801	221.8	334.6	325.5	9.1	103.7	8.8%
B24-1627	LDW23-GT11-GT-5-6.5-20240801	584.1	1095.7	950.4	145.3	366.3	39.7%
B24-1628	LDW23-GT11-GT-10-10.8-20240801	221.7	242.0	236.0	6.0	14.3	42.0%
B24-1629	LDW23-GT11-GT-10.8-11.5-20240801	221.0	601.4	466.7	134.7	245.7	54.8%
B24-1630	LDW23-GT11-GT-15-16.5-20240801	357.3	932.8	758.1	174.7	400.8	43.6%
B24-1631	LDW23-GT11-GT-20-21.3-20240801	229.4	290.6	272.6	18.0	43.2	41.7%
B24-1632	LDW23-GT11-GT-21.3-21.5-20240801	215.5	395.8	331.2	64.6	115.7	55.8%
B24-1633	LDW23-GT11-GT-25-26.5-20240801	234.5	365.0	314.2	50.8	79.7	63.7%
B24-1634	LDW23-GT11-GT-30-31.5-20240801	429.7	1234.4	942.8	291.6	513.1	56.8%
B24-1635	LDW23-GT11-GT-35-36.5-20240801	380.0	1158.4	879.4	279.0	499.4	55.9%
B24-1636	LDW23-GT11-GT-40-41.5-20240801	414.0	799.2	703.2	96.0	289.2	33.2%
B24-1637	LDW23-GT13-GT-0.5-2-20240801	510.0	1437.5	1249.5	188.0	739.5	25.4%

All results apply only to actual locations and materials tested. As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of clients, and authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved pending our written approval.

Comments:

Reviewed by:

Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT10-GT-15.5-16.5-20240618 Sample#: B24-1612	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 21-Oct-24 Tested By: Z. Romney Control No.: 10232024	Visual Soils Classification Clayey Silt with Sand Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.006 mm % Gravel = 0.0% D ₍₁₀₎ = 0.011 mm % Sand = 33.6% D ₍₁₅₎ = 0.017 mm % Silt & Clay = 66.4% D ₍₃₀₎ = 0.034 mm Liquid Limit = n/a D ₍₅₀₎ = 0.056 mm Plasticity Index = n/a D ₍₆₀₎ = 0.068 mm Sand Equivalent = n/a D ₍₉₀₎ = 0.138 mm Fracture %, 1 Face = n/a Dust Ratio = 2/3 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 1.50 Coeff. of Uniformity, C _u = 6.00 Fineness Modulus = 0.09 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850		99%	100.0%	0.0%
#30	0.600		99%	100.0%	0.0%
#40	0.425	99%	99%	100.0%	0.0%
#50	0.300		97%	100.0%	0.0%
#60	0.250		96%	100.0%	0.0%
#80	0.180		95%	100.0%	0.0%
#100	0.150	95%	95%	100.0%	0.0%
#140	0.106		78%	100.0%	0.0%
#170	0.090		72%	100.0%	0.0%
#200	0.075	66.4%	66.4%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



ASTM D-4318 Liquid Limit, Plastic Limit & Plasticity Index of Soils

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT09-GT-0-1.5-20240618 Sample #: B24-1613	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 18-Oct-24 Tested By: S. Boesenberg Control No.: 10232024	Unified Soils Classification System, ASTM D-2487 OH, Organic Clayey Silt Sample Color Brown
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Liquid Limit Determination

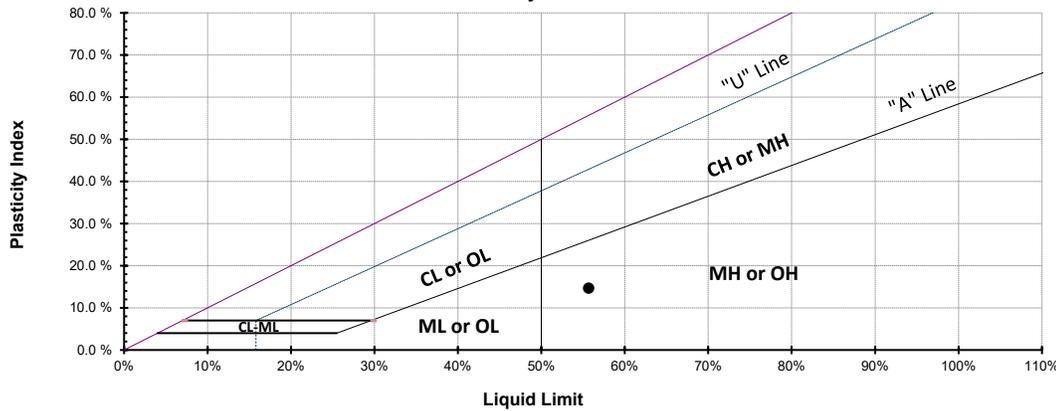
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	26.16	32.56	31.06			
Weight of Dry Soils + Pan:	22.20	27.89	26.80			
Weight of Pan:	14.58	19.33	19.56			
Weight of Dry Soils:	7.62	8.56	7.24			
Weight of Moisture:	3.96	4.67	4.26			
% Moisture:	52.0 %	54.6 %	58.8 %			
Number of Blows:	35	30	15			

Liquid Limit @ 25 Blows: 55.7 %
Plastic Limit: 41.0 %
Plasticity Index, I_p: 14.7 %

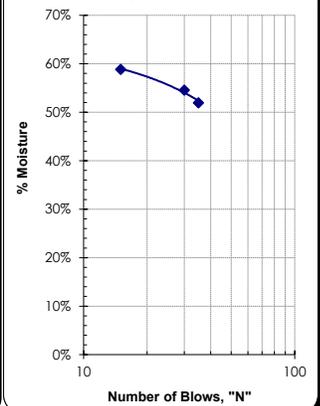
Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	20.18	26.72				
Weight of Dry Soils + Pan:	18.39	24.99				
Weight of Pan:	14.10	20.69				
Weight of Dry Soils:	4.29	4.30				
Weight of Moisture:	1.79	1.73				
% Moisture:	41.7 %	40.2 %				

Plasticity Chart



Liquid Limit



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Comments: _____

Reviewed by: Alex Eifrig
 Alex Eifrig
 WABO Supervising Laboratory Technician



Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
Project #: 24B105
Date Received: September 23, 2024
Date Tested: October 17, 2024

Client: Anchor QEA, LLC.
Sampled by: Client
Tested by: S. Boesenberg
Control No.: 10232024

Moisture Content ASTM C-566, ASTM D-2216

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B24-1613	LDW23-GT09-GT-0-1.5-20240618	301.1	437.4	374.9	62.5	73.8	84.7%
B24-1618	LDW23-GT19-GT-0-1.5-20240619	225.7	670.9	468.6	202.3	242.9	83.3%

Organic Content ASTM D-2974

Sample #	Location	Tare	Soil + Tare, Pre-Ignition	Soil + Tare, Post Ignition	% Organics
B24-1613	LDW23-GT09-GT-0-1.5-20240618	49.20	93.45	90.97	5.60%
B24-1618	LDW23-GT19-GT-0-1.5-20240619	52.65	101.42	97.95	7.12%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



ASTM D-4318 Liquid Limit, Plastic Limit & Plasticity Index of Soils

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT09-GT-5-6.2-20240618 Sample #: B24-1614	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 18-Oct-24 Tested By: S. Boesenberg Control No.: 10232024	Unified Soils Classification System, ASTM D-2487 OH, Organic Clayey Silt with Sand Sample Color Brown
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Liquid Limit Determination

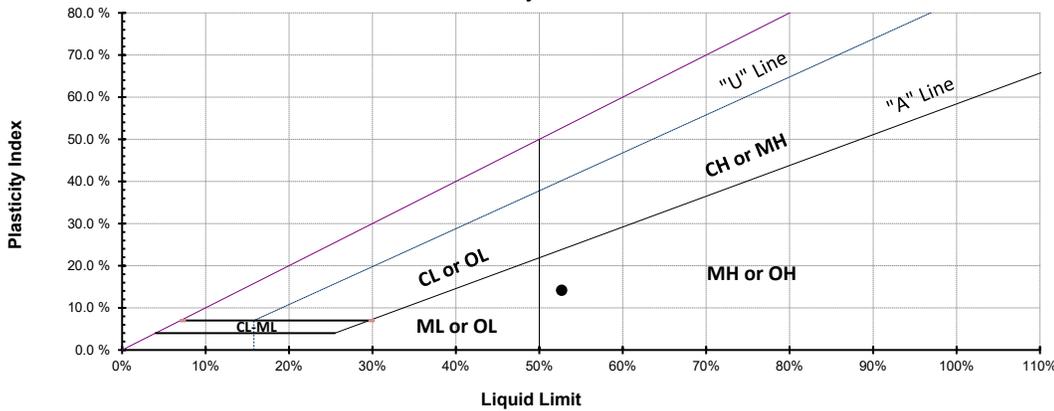
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	29.34	25.79	37.45			
Weight of Dry Soils + Pan:	26.02	23.63	34.21			
Weight of Pan:	19.55	19.48	28.17			
Weight of Dry Soils:	6.47	4.15	6.04			
Weight of Moisture:	3.32	2.16	3.24			
% Moisture:	51.3 %	52.1 %	53.6 %			
Number of Blows:	35	27	20			

Liquid Limit @ 25 Blows: 52.7 %
Plastic Limit: 38.5 %
Plasticity Index, I_p: 14.2 %

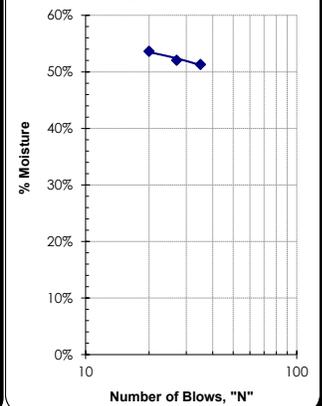
Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	20.25	20.93				
Weight of Dry Soils + Pan:	18.56	19.17				
Weight of Pan:	14.06	14.71				
Weight of Dry Soils:	4.50	4.46				
Weight of Moisture:	1.69	1.76				
% Moisture:	37.6 %	39.5 %				

Plasticity Chart



Liquid Limit



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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT09-GT-10-11.5-20240618 Sample#: B24-1616	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 21-Oct-24 Tested By: R. Bohler Control No.: 10232024	Visual Soils Classification Clayey Silt with Sand Sample Color: Brown
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Specifications No Specs Sample Meets Specs ? <i>N/A</i>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.006 mm % Gravel = 0.0% D ₍₁₀₎ = 0.012 mm % Sand = 39.8% D ₍₁₅₎ = 0.019 mm % Silt & Clay = 60.2% D ₍₃₀₎ = 0.037 mm Liquid Limit = n/a D ₍₅₀₎ = 0.062 mm Plasticity Index = n/a D ₍₆₀₎ = 0.075 mm Sand Equivalent = n/a D ₍₉₀₎ = 0.165 mm Fracture %, 1 Face = n/a Dust Ratio = 8/13 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 1.50 Coeff. of Uniformity, C _u = 6.00 Fineness Modulus = 0.19 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		99%	100.0%	0.0%
#20	0.850		98%	100.0%	0.0%
#30	0.600		98%	100.0%	0.0%
#40	0.425	98%	98%	100.0%	0.0%
#50	0.300		94%	100.0%	0.0%
#60	0.250		93%	100.0%	0.0%
#80	0.180		90%	100.0%	0.0%
#100	0.150	90%	90%	100.0%	0.0%
#140	0.106		72%	100.0%	0.0%
#170	0.090		66%	100.0%	0.0%
#200	0.075	60.2%	60.2%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT09-GT-15-16.5-20240618 Sample#: B24-1617	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 21-Oct-24 Tested By: Z. Romney Control No.: 10232024	Visual Soils Classification Clayey Silt with Sand Sample Color: Brown
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Specifications No Specs Sample Meets Specs ? <i>N/A</i>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.005 mm % Gravel = 0.0% Coeff. of Curvature, C _c = 1.50 D ₍₁₀₎ = 0.009 mm % Sand = 19.6% Coeff. of Uniformity, C _u = 6.00 D ₍₁₅₎ = 0.014 mm % Silt & Clay = 80.4% Fineness Modulus = 0.05 D ₍₃₀₎ = 0.028 mm Liquid Limit = 49.0% Plastic Limit = 38.3% D ₍₅₀₎ = 0.047 mm Plasticity Index = 10.7% Moisture %, as sampled = n/a D ₍₆₀₎ = 0.056 mm Sand Equivalent = n/a Req'd Sand Equivalent = D ₍₉₀₎ = 0.118 mm Fracture %, 1 Face = n/a Req'd Fracture %, 1 Face = Dust Ratio = 80/99 Fracture %, 2+ Faces = n/a Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850		100%	100.0%	0.0%
#30	0.600		99%	100.0%	0.0%
#40	0.425	99%	99%	100.0%	0.0%
#50	0.300		98%	100.0%	0.0%
#60	0.250		98%	100.0%	0.0%
#80	0.180		98%	100.0%	0.0%
#100	0.150	97%	97%	100.0%	0.0%
#140	0.106		87%	100.0%	0.0%
#170	0.090		84%	100.0%	0.0%
#200	0.075	80.4%	80.4%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Hydrometer Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT09-GT-15-16.5-20240618 Sample#: B24-1617	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 21-Oct-24 Tested By: Z. Romney Control No.: 10232024	Visual Soils Classification Clayey Silt with Sand Sample Color Brown																																																																																																					
ASTM D-422 HYDROMETER ANALYSIS		ASTM C-136																																																																																																					
Assumed Sp Gr : 2.65 Sample Weight: 50.15 grams Hydroscopic Moist.: 5.58% Adj. Sample Wgt : 47.50 grams		Sieve Analysis Grain Size Distribution																																																																																																					
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Hydrometer Reading</th> <th style="text-align: left;">Corrected Reading</th> <th style="text-align: left;">Percent Passing</th> <th style="text-align: left;">Soils Particle Diameter</th> </tr> </thead> <tbody> <tr><td>2</td><td>22.5</td><td>47.2%</td><td>0.0344 mm</td></tr> <tr><td>5</td><td>19</td><td>39.9%</td><td>0.0222 mm</td></tr> <tr><td>15</td><td>15</td><td>31.5%</td><td>0.0131 mm</td></tr> <tr><td>30</td><td>12</td><td>25.2%</td><td>0.0094 mm</td></tr> <tr><td>60</td><td>10.5</td><td>22.0%</td><td>0.0068 mm</td></tr> <tr><td>250</td><td>6</td><td>12.6%</td><td>0.0034 mm</td></tr> <tr><td>1440</td><td>3.5</td><td>7.3%</td><td>0.0014 mm</td></tr> </tbody> </table>	Hydrometer Reading	Corrected Reading	Percent Passing	Soils Particle Diameter	2	22.5	47.2%	0.0344 mm	5	19	39.9%	0.0222 mm	15	15	31.5%	0.0131 mm	30	12	25.2%	0.0094 mm	60	10.5	22.0%	0.0068 mm	250	6	12.6%	0.0034 mm	1440	3.5	7.3%	0.0014 mm	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Sieve Size</th> <th style="text-align: left;">Percent Passing</th> <th style="text-align: left;">Soils Particle Diameter</th> </tr> </thead> <tbody> <tr><td>3.0"</td><td>100%</td><td>75.000 mm</td></tr> <tr><td>2.0"</td><td>100%</td><td>50.000 mm</td></tr> <tr><td>1.5"</td><td>100%</td><td>37.500 mm</td></tr> <tr><td>1.25"</td><td>100%</td><td>31.500 mm</td></tr> <tr><td>1.0"</td><td>100%</td><td>25.000 mm</td></tr> <tr><td>3/4"</td><td>100%</td><td>19.000 mm</td></tr> <tr><td>5/8"</td><td>100%</td><td>16.000 mm</td></tr> <tr><td>1/2"</td><td>100%</td><td>12.500 mm</td></tr> <tr><td>3/8"</td><td>100%</td><td>9.500 mm</td></tr> <tr><td>1/4"</td><td>100%</td><td>6.300 mm</td></tr> <tr><td>#4</td><td>100%</td><td>4.750 mm</td></tr> <tr><td>#10</td><td>100%</td><td>2.000 mm</td></tr> <tr><td>#20</td><td>100%</td><td>0.850 mm</td></tr> <tr><td>#40</td><td>99%</td><td>0.425 mm</td></tr> <tr><td>#100</td><td>97%</td><td>0.150 mm</td></tr> <tr><td>#200</td><td>80.4%</td><td>0.075 mm</td></tr> <tr><td>Silts</td><td>79.6%</td><td>0.074 mm</td></tr> <tr><td></td><td>60.0%</td><td>0.050 mm</td></tr> <tr><td></td><td>37.9%</td><td>0.020 mm</td></tr> <tr><td>Clays</td><td>17.1%</td><td>0.005 mm</td></tr> <tr><td></td><td>8.9%</td><td>0.002 mm</td></tr> <tr><td>Colloids</td><td>5.1%</td><td>0.001 mm</td></tr> </tbody> </table>	Sieve Size	Percent Passing	Soils Particle Diameter	3.0"	100%	75.000 mm	2.0"	100%	50.000 mm	1.5"	100%	37.500 mm	1.25"	100%	31.500 mm	1.0"	100%	25.000 mm	3/4"	100%	19.000 mm	5/8"	100%	16.000 mm	1/2"	100%	12.500 mm	3/8"	100%	9.500 mm	1/4"	100%	6.300 mm	#4	100%	4.750 mm	#10	100%	2.000 mm	#20	100%	0.850 mm	#40	99%	0.425 mm	#100	97%	0.150 mm	#200	80.4%	0.075 mm	Silts	79.6%	0.074 mm		60.0%	0.050 mm		37.9%	0.020 mm	Clays	17.1%	0.005 mm		8.9%	0.002 mm	Colloids	5.1%	0.001 mm
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Comments: _____

Reviewed by: Alex Eifrig
 Alex Eifrig
 WABO Supervising Laboratory Technician



ASTM D-4318 Liquid Limit, Plastic Limit & Plasticity Index of Soils

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT09-GT-15-16.5-20240618 Sample #: B24-1617	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 18-Oct-24 Tested By: S. Boesenberg Control No.: 10232024	Unified Soils Classification System, ASTM D-2487 OL, Clayey Silt Sample Color Brown
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Liquid Limit Determination

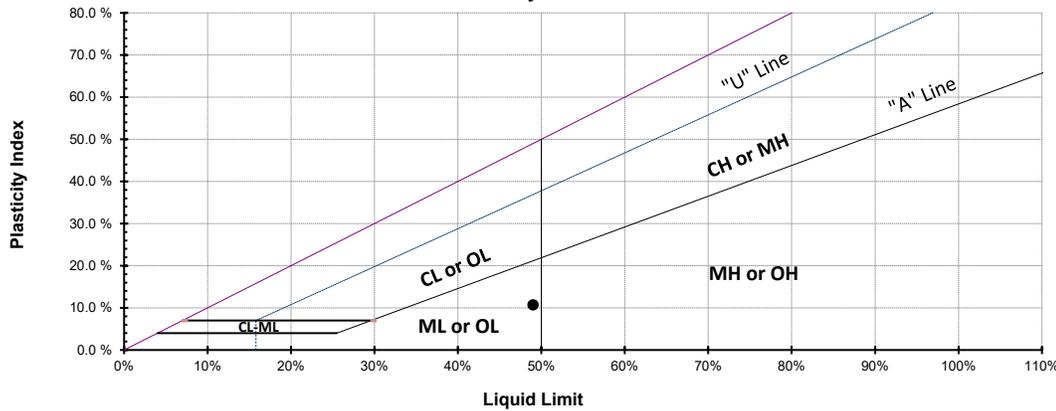
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	34.50	34.57	29.10			
Weight of Dry Soils + Pan:	29.31	29.75	25.88			
Weight of Pan:	18.46	19.93	19.59			
Weight of Dry Soils:	10.85	9.82	6.29			
Weight of Moisture:	5.19	4.82	3.22			
% Moisture:	47.8 %	49.1 %	51.2 %			
Number of Blows:	31	23	16			

Liquid Limit @ 25 Blows: 49.0 %
Plastic Limit: 38.3 %
Plasticity Index, I_p: 10.7 %

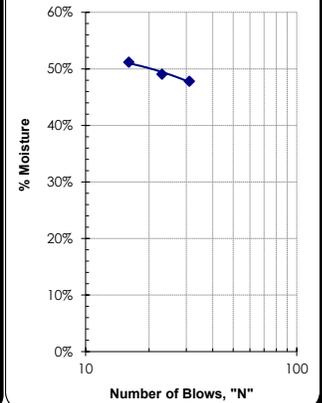
Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	25.56	25.31				
Weight of Dry Soils + Pan:	23.80	23.66				
Weight of Pan:	19.33	19.22				
Weight of Dry Soils:	4.47	4.44				
Weight of Moisture:	1.76	1.65				
% Moisture:	39.4 %	37.2 %				

Plasticity Chart



Liquid Limit



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ASTM D-4318 Liquid Limit, Plastic Limit & Plasticity Index of Soils

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT19-GT-5-6.5-20240619 Sample #: B24-1619	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 21-Oct-24 Tested By: R. Bohler Control No.: 10232024	Unified Soils Classification System, ASTM D-2487 OH, Organic Silty Clay Sample Color Brown
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Liquid Limit Determination

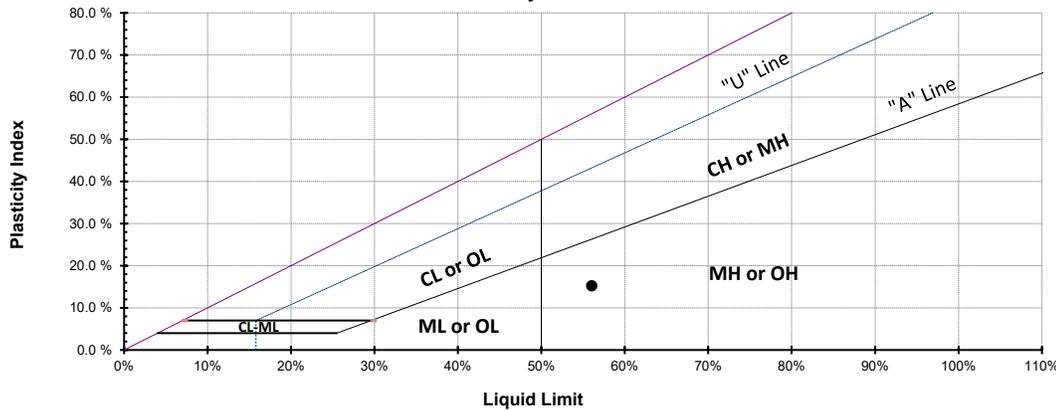
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	33.48	31.11	30.04			
Weight of Dry Soils + Pan:	28.88	27.21	26.62			
Weight of Pan:	20.47	20.21	20.80			
Weight of Dry Soils:	8.41	7.00	5.82			
Weight of Moisture:	4.60	3.90	3.42			
% Moisture:	54.7 %	55.7 %	58.8 %			
Number of Blows:	31	25	15			

Liquid Limit @ 25 Blows: 56.0 %
Plastic Limit: 40.8 %
Plasticity Index, I_p: 15.2 %

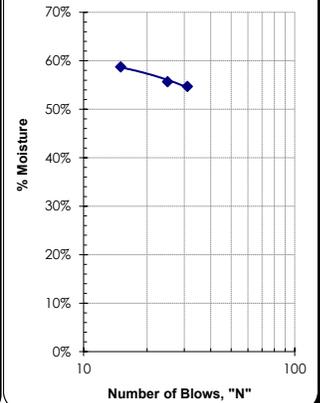
Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	27.42	28.69				
Weight of Dry Soils + Pan:	25.57	26.44				
Weight of Pan:	21.08	20.87				
Weight of Dry Soils:	4.49	5.57				
Weight of Moisture:	1.85	2.25				
% Moisture:	41.2 %	40.4 %				

Plasticity Chart



Liquid Limit



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 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT19-GT-10-11.5-20240619 Sample#: B24-1620	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 21-Oct-24 Tested By: R. Bohler Control No.: 10232024	Unified Soils Classification System, ASTM D-2487 SP-SM, Poorly graded Sand with Silt Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.067 mm % Gravel = 2.7% D ₍₁₀₎ = 0.111 mm % Sand = 91.8% D ₍₁₅₎ = 0.151 mm % Silt & Clay = 5.6% D ₍₃₀₎ = 0.217 mm Liquid Limit = n/a D ₍₅₀₎ = 0.306 mm Plasticity Index = n/a D ₍₆₀₎ = 0.350 mm Sand Equivalent = n/a D ₍₉₀₎ = 1.476 mm Fracture %, 1 Face = n/a Dust Ratio = 4/55 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 1.22 Coeff. of Uniformity, C _u = 3.16 Fineness Modulus = 1.77 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		98%	100.0%	0.0%
#4	4.75	97%	97%	100.0%	0.0%
#8	2.36		97%	100.0%	0.0%
#10	2.00	96%	96%	100.0%	0.0%
#16	1.18		86%	100.0%	0.0%
#20	0.850		82%	100.0%	0.0%
#30	0.600		79%	100.0%	0.0%
#40	0.425	77%	77%	100.0%	0.0%
#50	0.300		49%	100.0%	0.0%
#60	0.250		37%	100.0%	0.0%
#80	0.180		22%	100.0%	0.0%
#100	0.150	15%	15%	100.0%	0.0%
#140	0.106		9%	100.0%	0.0%
#170	0.090		7%	100.0%	0.0%
#200	0.075	5.6%	5.6%	100.0%	0.0%

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Comments: _____

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 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT19-GT-25-26.5-20240619 Sample#: B24-1624	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 21-Oct-24 Tested By: S. Boesenberg Control No.: 10232024	Unified Soils Classification System, ASTM D-2487 SM, Silty Sand Sample Color: Brown
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Specifications No Specs Sample Meets Specs ? <i>N/A</i>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.020 mm % Gravel = 0.0% D ₍₁₀₎ = 0.040 mm % Sand = 81.3% D ₍₁₅₎ = 0.060 mm % Silt & Clay = 18.7% D ₍₃₀₎ = 0.108 mm Liquid Limit = n/a D ₍₅₀₎ = 0.180 mm Plasticity Index = n/a D ₍₆₀₎ = 0.236 mm Sand Equivalent = n/a D ₍₉₀₎ = 0.403 mm Fracture %, 1 Face = n/a Dust Ratio = 1/5 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 1.23 Coeff. of Uniformity, C _u = 5.87 Fineness Modulus = 0.92 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
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10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		97%	100.0%	0.0%
#20	0.850		96%	100.0%	0.0%
#30	0.600		95%	100.0%	0.0%
#40	0.425	94%	94%	100.0%	0.0%
#50	0.300		72%	100.0%	0.0%
#60	0.250		63%	100.0%	0.0%
#80	0.180		50%	100.0%	0.0%
#100	0.150	45%	45%	100.0%	0.0%
#140	0.106		29%	100.0%	0.0%
#170	0.090		24%	100.0%	0.0%
#200	0.075	18.7%	18.7%	100.0%	0.0%

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Reviewed by: *Alex Eifrig*
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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT11-GT-1.3-2-20240801 Sample#: B24-1626	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 21-Oct-24 Tested By: S. Boesenberg Control No.: 10232024	Unified Soils Classification System, ASTM D-2487 SM, Silty Sand with Gravel Sample Color: Brown
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Specifications No Specs Sample Meets Specs ? <i>N/A</i>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.013 mm % Gravel = 15.3% D ₍₁₀₎ = 0.025 mm % Sand = 54.9% D ₍₁₅₎ = 0.038 mm % Silt & Clay = 29.9% D ₍₃₀₎ = 0.076 mm Liquid Limit = n/a D ₍₅₀₎ = 0.394 mm Plasticity Index = n/a D ₍₆₀₎ = 0.968 mm Sand Equivalent = n/a D ₍₉₀₎ = 8.869 mm Fracture %, 1 Face = n/a Dust Ratio = 11/19 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 0.24 Coeff. of Uniformity, C _u = 38.53 Fineness Modulus = 2.47 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00	100%	100%	100.0%	0.0%
10.00"	250.00	100%	100%	100.0%	0.0%
8.00"	200.00	100%	100%	100.0%	0.0%
6.00"	150.00	100%	100%	100.0%	0.0%
4.00"	100.00	100%	100%	100.0%	0.0%
3.00"	75.00	100%	100%	100.0%	0.0%
2.50"	63.00	100%	100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00	100%	100%	100.0%	0.0%
1.50"	37.50	100%	100%	100.0%	0.0%
1.25"	31.50	100%	100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00	99%	100%	100.0%	0.0%
1/2"	12.50	97%	97%	100.0%	0.0%
3/8"	9.50	91%	91%	100.0%	0.0%
1/4"	6.30	87%	87%	100.0%	0.0%
#4	4.75	85%	85%	100.0%	0.0%
#8	2.36	77%	77%	100.0%	0.0%
#10	2.00	76%	76%	100.0%	0.0%
#16	1.18	63%	63%	100.0%	0.0%
#20	0.850	58%	58%	100.0%	0.0%
#30	0.600	54%	54%	100.0%	0.0%
#40	0.425	52%	52%	100.0%	0.0%
#50	0.300	45%	45%	100.0%	0.0%
#60	0.250	43%	43%	100.0%	0.0%
#80	0.180	39%	39%	100.0%	0.0%
#100	0.150	38%	38%	100.0%	0.0%
#140	0.106	33%	33%	100.0%	0.0%
#170	0.090	31%	31%	100.0%	0.0%
#200	0.075	29.9%	29.9%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Hydrometer Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT11-GT-1.3-2-20240801 Sample#: B24-1626	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 21-Oct-24 Tested By: S. Boesenberg Control No.: 10232024	Unified Soils Classification System, ASTM D-2487 SM, Silty Sand with Gravel Sample Color Brown																																																																																																					
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Comments: _____

Reviewed by:

Alex Eifrig

 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT11-GT-5-6.5-20240801 Sample#: B24-1627	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 21-Oct-24 Tested By: R. Bohler Control No.: 10232024	Visual Soils Classification Clayey, Silt with Sand Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.006 mm % Gravel = 0.1% D ₍₁₀₎ = 0.012 mm % Sand = 35.7% D ₍₁₅₎ = 0.017 mm % Silt & Clay = 64.3% D ₍₃₀₎ = 0.035 mm Liquid Limit = n/a D ₍₅₀₎ = 0.058 mm Plasticity Index = n/a D ₍₆₀₎ = 0.070 mm Sand Equivalent = n/a D ₍₉₀₎ = 0.141 mm Fracture %, 1 Face = n/a Dust Ratio = 17/26 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 1.50 Coeff. of Uniformity, C _u = 6.00 Fineness Modulus = 0.13 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		99%	100.0%	0.0%
#20	0.850		99%	100.0%	0.0%
#30	0.600		98%	100.0%	0.0%
#40	0.425	98%	98%	100.0%	0.0%
#50	0.300		96%	100.0%	0.0%
#60	0.250		95%	100.0%	0.0%
#80	0.180		94%	100.0%	0.0%
#100	0.150	93%	93%	100.0%	0.0%
#140	0.106		76%	100.0%	0.0%
#170	0.090		70%	100.0%	0.0%
#200	0.075	64.3%	64.3%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



ASTM D-4318 Liquid Limit, Plastic Limit & Plasticity Index of Soils

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT11-GT-10-10.8-20240801 Sample #: B24-1628	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 21-Oct-24 Tested By: S. Boesenberg Control No.: 10232024	Visual Soils Classification Silty Sand Sample Color Brown
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Liquid Limit Determination

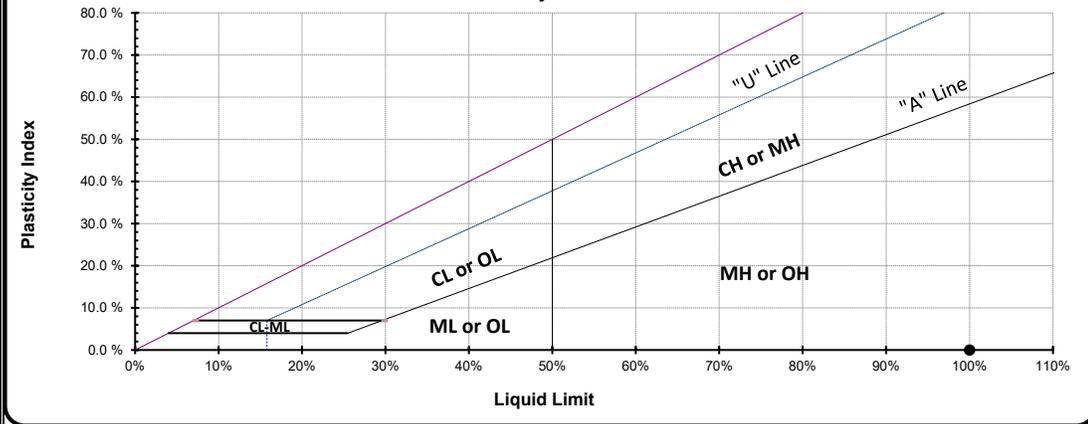
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:	Unable to Establish					
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						
Number of Blows:						

Liquid Limit @ 25 Blows: N/A
Plastic Limit: N/A
Plasticity Index, I_p: N/A

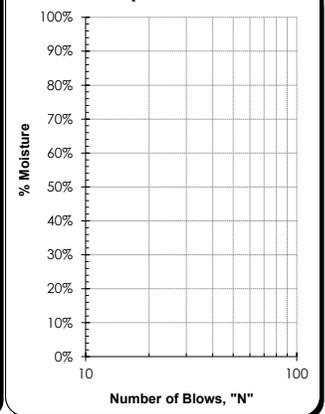
Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:						
Weight of Dry Soils + Pan:	Non-Plastic					
Weight of Pan:						
Weight of Dry Soils:						
Weight of Moisture:						
% Moisture:						

Plasticity Chart



Liquid Limit



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Comments: Unable to establish the liquid limit of this sample due to the material displaying rapid dilation when subjected to any blows in the cup, and also the material not being able to be spread smoothly into the cup. The sample was then deemed non-plastic due to the material not being workable down to 1/8" ribbons/rolls without breaking apart.

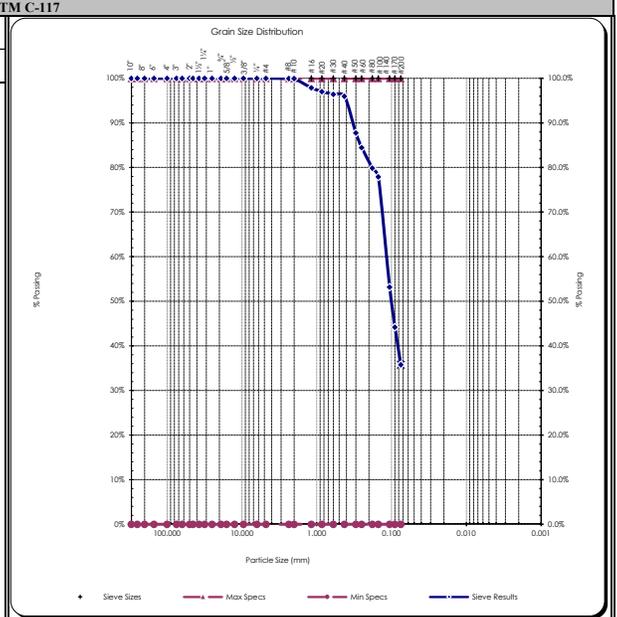
Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT11-GT-20-21.3-20240801 Sample#: B24-1631	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 21-Oct-24 Tested By: S. Boesenberg Control No.: 10232024	Unified Soils Classification System, ASTM D-2487 SM, Silty Sand Sample Color: Brown
Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281		
Specifications No Specs Sample Meets Specs ? N/A	D ₍₆₎ = 0.010 mm % Gravel = 0.0% D ₍₁₀₎ = 0.021 mm % Sand = 64.2% D ₍₁₅₎ = 0.031 mm % Silt & Clay = 35.8% D ₍₅₀₎ = 0.063 mm Liquid Limit = n/a D ₍₁₀₀₎ = 0.100 mm Plasticity Index = n/a D ₍₆₀₎ = 0.118 mm Sand Equivalent = n/a D ₍₉₀₎ = 0.334 mm Fracture %, 1 Face = n/a Dust Ratio = 22/59 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 1.60 Coeff. of Uniformity, C _u = 5.64 Fineness Modulus = 0.40 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
Method(s) ASTM C-136, ASTM D-6913, ASTM C-117		

Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		98%	100.0%	0.0%
#20	0.850		97%	100.0%	0.0%
#30	0.600		96%	100.0%	0.0%
#40	0.425	96%	96%	100.0%	0.0%
#50	0.300		88%	100.0%	0.0%
#60	0.250		84%	100.0%	0.0%
#80	0.180		80%	100.0%	0.0%
#100	0.150	78%	78%	100.0%	0.0%
#140	0.106		53%	100.0%	0.0%
#170	0.090		44%	100.0%	0.0%
#200	0.075	35.8%	35.8%	100.0%	0.0%



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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



ASTM D-4318 Liquid Limit, Plastic Limit & Plasticity Index of Soils

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT11-GT-25-26.5-20240801 Sample #: B24-1633	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 21-Oct-24 Tested By: R. Bohler Control No.: 10232024	Unified Soils Classification System, ASTM D-2487 OH, Organic Silty Clay with Sand Sample Color Brown
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Liquid Limit Determination

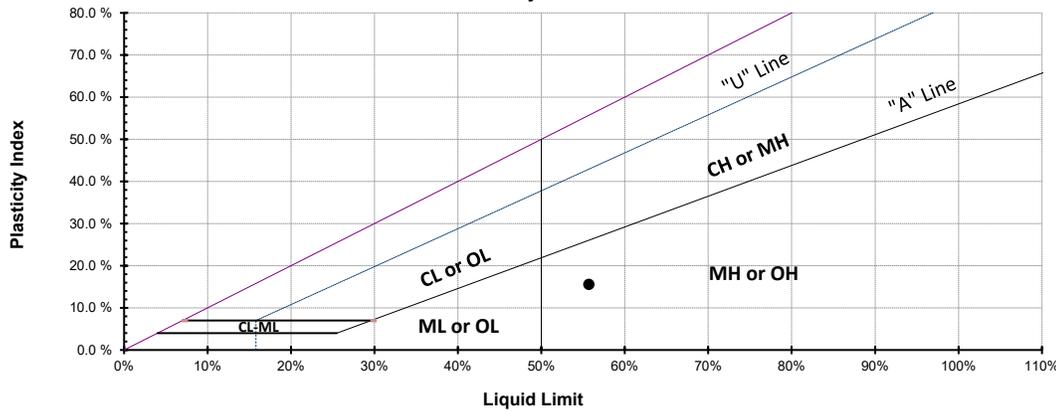
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	34.72	24.48	30.00			
Weight of Dry Soils + Pan:	29.35	20.88	26.34			
Weight of Pan:	19.34	14.34	19.95			
Weight of Dry Soils:	10.01	6.54	6.39			
Weight of Moisture:	5.37	3.60	3.66			
% Moisture:	53.7 %	55.1 %	57.3 %			
Number of Blows:	35	25	20			

Liquid Limit @ 25 Blows: 55.7 %
Plastic Limit: 40.1 %
Plasticity Index, I_p: 15.6 %

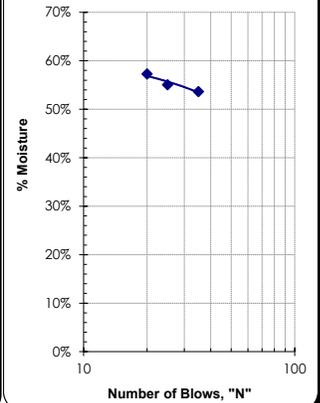
Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	26.18	21.45				
Weight of Dry Soils + Pan:	24.19	19.51				
Weight of Pan:	19.22	14.69				
Weight of Dry Soils:	4.97	4.82				
Weight of Moisture:	1.99	1.94				
% Moisture:	40.0 %	40.3 %				

Plasticity Chart



Liquid Limit



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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Client: Anchor QEA, LLC.
Address: 1201 3rd Avenue, Suite 2600
Seattle, WA 98101
Attn: Cindy Fields
Revised On: _____

Date: October 25, 2024
Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
Project #: 24B105
Sample #: B24-1638 - 1662
Date sampled: June 24, 2024 - August 5, 2024
Control No: 10252024

As requested and authorized by the Client, MTC has performed the following test(s) on the sample number referenced above. The testing was performed in accordance with current, applicable AASHTO, ASTM, and/or WSDOT standards, which are referenced on the correlating test report pages. The results obtained in our laboratory are as detailed below and/or on the following pages:

	Test(s) Performed:	Test Results	Test(s) Performed:	Test Results
X	Sieve Analysis	See Attached Reports	Sulfate Soundness	
	Proctor		Bulk Density & Voids	
	Sand Equivalent		WSDOT Degradation	
	Fracture Count		LA Abrasion	
X	Moisture Content	See Attached Reports	Cation Exchange Capacity	
	Specific Gravity, Coarse		X Specific Gravity, Soils	See Attached Report
	Specific Gravity, Fine		X Organic Content	See Attached Report
X	Hydrometer Analysis	See Attached Reports		
X	Atterberg Limits	See Attached Reports		

If you have any questions concerning the test results, the procedures used, or if we can be of any further assistance please call the number below and ask to speak with your Project Manager or the Laboratory Manager.

Alex Eifrig

 Respectfully Submitted,
 Alex Eifrig
 WABO Supervising Laboratory Technician



Moisture Content ASTM C-566, ASTM D-2216

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
Project #: 24B105
Date Received: September 23, 2024
Date Tested: October 18, 2021

Client: Anchor QEA, LLC.
Sampled by: Client
Tested by: S. Boesenberg
Control No.: 10252024

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B24-1638	LDW23-GT13-GT-5-6.5-20240801	500.5	976.0	754.2	221.8	253.7	87.4%
B24-1639	LDW23-GT13-GT-10-11-20240801	497.5	655.6	642.0	13.6	144.5	9.4%
B24-1640	LDW23-GT13-GT-11-11.5-20240801	223.8	281.0	266.1	14.9	42.3	35.2%
B24-1641	LDW23-GT13-GT-15-16.5-20240801	510.0	974.4	908.4	66.0	398.4	16.6%
B24-1642	LDW23-GT13-GT-20-21.5-20240801	601.5	773.0	728.8	44.2	127.3	34.7%
B24-1643	LDW23-GT13-GT-25-26.5-20240801	357.4	1150.9	869.4	281.5	512.0	55.0%
B24-1644	LDW23-GT13-GT-30-31.5-20240801	268.7	300.5	287.5	13.0	18.8	69.1%
B24-1645	LDW23-GT13-GT-35-36.5-20240801	223.9	373.6	315.2	58.4	91.3	64.0%
B24-1646	LDW23-GT13-GT-40-41.5-20240801	411.6	1194.2	902.6	291.6	491.0	59.4%
B24-1647	LDW23-GT21-GT-0.5-2-20240805	229.4	474.6	435.9	38.7	206.5	18.7%
B24-1648	LDW23-GT21-GT-5-6.5-20240805	232.9	313.2	302.4	10.8	69.5	15.5%
B24-1649	LDW23-GT21-GT-10-11.5-20240805	358.2	803.9	747.6	56.3	389.4	14.5%
B24-1650	LDW23-GT21-GT-15-16.5-20240805	379.8	874.8	805.4	69.4	425.6	16.3%
B24-1651	LDW23-GT21-GT-20-21.3-20240805	208.6	234.9	233.2	1.7	24.6	6.9%
B24-1652	LDW23-GT21-GT-21.3-21.5-20240805	222.9	367.7	340.4	27.3	117.5	23.2%
B24-1653	LDW23-GT21-GT-25-26.5-20240805	319.8	613.7	551.2	62.5	231.4	27.0%
B24-1654	LDW23-GT21-GT-30-31.5-20240805	509.7	937.2	850.1	87.1	340.4	25.6%
B24-1655	LDW23-GT21-GT-35-36.5-20240805	493.1	968.4	877.5	90.9	384.4	23.6%
B24-1656	LDW23-GT21-GT-40-41.1-20240805	310.8	552.4	496.5	55.9	185.7	30.1%
B24-1657	LDW23-GT21-GT-41.1-41.5-20240805	360.1	559.5	514.1	45.4	154.0	29.5%
B24-1658	LDW23-GT35-GT-0.5-1.6-20240805	356.7	630.6	602.7	27.9	246.0	11.3%
B24-1659	LDW23-GT35-GT-1.6-2-20240805	222.4	245.6	242.0	3.6	19.6	18.4%
B24-1660	LDW23-GT35-GT-5-6.5-20240805	394.7	778.1	651.5	126.6	256.8	49.3%
B24-1661	LDW23-GT26-GT-0-1.5-20240624	420.7	968.7	851.8	116.9	431.1	27.1%
B24-1662	LDW23-GT26-GT-5-6.5-20240624	303.3	444.9	413.9	31.0	110.6	28.0%

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Comments:

Reviewed by:

Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT13-GT-5-6.5-20240801 Sample#: B24-1638	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 22-Oct-24 Tested By: R. Bohler Control No.: 10252024	Unified Soils Classification System, ASTM D-2487 SM, Silty Sand with Gravel Sample Color: Gray
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Specifications No Specs Sample Meets Specs ? <i>N/A</i>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.012 mm % Gravel = 34.1% Coeff. of Curvature, C _c = 0.07 D ₍₁₀₎ = 0.024 mm % Sand = 34.5% Coeff. of Uniformity, C _u = 123.63 D ₍₁₅₎ = 0.036 mm % Silt & Clay = 31.4% Fineness Modulus = 3.30 D ₍₅₀₎ = 0.072 mm Liquid Limit = n/a Plastic Limit = n/a D ₍₆₀₎ = 1.036 mm Plasticity Index = n/a Moisture %, as sampled = n/a D ₍₆₀₎ = 2.955 mm Sand Equivalent = n/a Req'd Sand Equivalent = D ₍₉₀₎ = 17.059 mm Fracture %, 1 Face = n/a Req'd Fracture %, 1 Face = Dust Ratio = 11/16 Fracture %, 2+ Faces = n/a Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	93%	93%	100.0%	0.0%
5/8"	16.00	89%	89%	100.0%	0.0%
1/2"	12.50	84%	84%	100.0%	0.0%
3/8"	9.50	79%	79%	100.0%	0.0%
1/4"	6.30	70%	70%	100.0%	0.0%
#4	4.75	66%	66%	100.0%	0.0%
#8	2.36	58%	58%	100.0%	0.0%
#10	2.00	57%	57%	100.0%	0.0%
#16	1.18	51%	51%	100.0%	0.0%
#20	0.850	49%	49%	100.0%	0.0%
#30	0.600	47%	47%	100.0%	0.0%
#40	0.425	46%	46%	100.0%	0.0%
#50	0.300	41%	41%	100.0%	0.0%
#60	0.250	39%	39%	100.0%	0.0%
#80	0.180	37%	37%	100.0%	0.0%
#100	0.150	36%	36%	100.0%	0.0%
#140	0.106	33%	33%	100.0%	0.0%
#170	0.090	32%	32%	100.0%	0.0%
#200	0.075	31.4%	31.4%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT13-GT-10-11-20240801 Sample#: B24-1639	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 22-Oct-24 Tested By: R. Bohler Control No.: 10252024	Unified Soils Classification System, ASTM D-2487 GP-GM, Poorly graded Gravel with Silt Sample Color: Brown
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Specifications No Specs Sample Meets Specs ? <i>N/A</i>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.055 mm % Gravel = 83.0% D ₍₁₀₎ = 0.155 mm % Sand = 10.1% D ₍₁₅₎ = 2.855 mm % Silt & Clay = 6.9% D ₍₃₀₎ = 7.323 mm Liquid Limit = n/a D ₍₅₀₎ = 13.440 mm Plasticity Index = n/a D ₍₆₀₎ = 16.795 mm Sand Equivalent = n/a D ₍₉₀₎ = 23.205 mm Fracture %, 1 Face = n/a Dust Ratio = 33/58 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 20.66 Coeff. of Uniformity, C _u = 108.64 Fineness Modulus = 6.15 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
--	---	---

Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00	100%	100%	100.0%	0.0%
10.00"	250.00	100%	100%	100.0%	0.0%
8.00"	200.00	100%	100%	100.0%	0.0%
6.00"	150.00	100%	100%	100.0%	0.0%
4.00"	100.00	100%	100%	100.0%	0.0%
3.00"	75.00	100%	100%	100.0%	0.0%
2.50"	63.00	100%	100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00	100%	100%	100.0%	0.0%
1.50"	37.50	100%	100%	100.0%	0.0%
1.25"	31.50	100%	100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	67%	67%	100.0%	0.0%
5/8"	16.00	58%	58%	100.0%	0.0%
1/2"	12.50	47%	47%	100.0%	0.0%
3/8"	9.50	41%	41%	100.0%	0.0%
1/4"	6.30	25%	25%	100.0%	0.0%
#4	4.75	17%	17%	100.0%	0.0%
#8	2.36	14%	14%	100.0%	0.0%
#10	2.00	14%	14%	100.0%	0.0%
#16	1.18	13%	13%	100.0%	0.0%
#20	0.850	13%	13%	100.0%	0.0%
#30	0.600	12%	12%	100.0%	0.0%
#40	0.425	12%	12%	100.0%	0.0%
#50	0.300	11%	11%	100.0%	0.0%
#60	0.250	11%	11%	100.0%	0.0%
#80	0.180	10%	10%	100.0%	0.0%
#100	0.150	10%	10%	100.0%	0.0%
#140	0.106	8%	8%	100.0%	0.0%
#170	0.090	7%	7%	100.0%	0.0%
#200	0.075	6.9%	6.9%	100.0%	0.0%

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Comments: _____

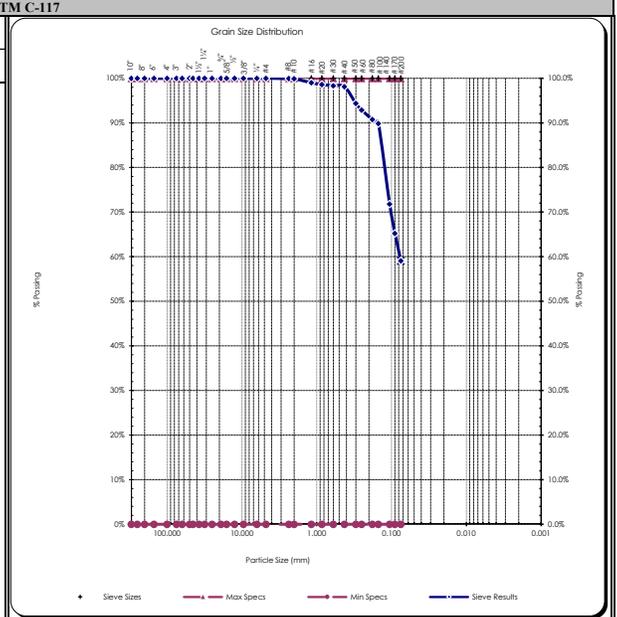
Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT13-GT-11-11.5-20240801 Sample#: B24-1640	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 22-Oct-24 Tested By: S. Boesenberg Control No.: 10252024	Visual Soils Classification Clayey, Silty Sand Sample Color: Brown
Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281		
Specifications No Specs Sample Meets Specs ? <i>N/A</i>	D ₍₆₎ = 0.006 mm % Gravel = 0.0% D ₍₁₀₎ = 0.013 mm % Sand = 40.9% D ₍₁₅₎ = 0.019 mm % Silt & Clay = 59.1% D ₍₃₀₎ = 0.038 mm Liquid Limit = n/a D ₍₅₀₎ = 0.063 mm Plasticity Index = n/a D ₍₆₀₎ = 0.077 mm Sand Equivalent = n/a D ₍₉₀₎ = 0.155 mm Fracture %, 1 Face = n/a Dust Ratio = 56/93 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 1.48 Coeff. of Uniformity, C _u = 6.08 Fineness Modulus = 0.19 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
Method(s) ASTM C-136, ASTM D-6913, ASTM C-117		

Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		99%	100.0%	0.0%
#20	0.850		99%	100.0%	0.0%
#30	0.600		98%	100.0%	0.0%
#40	0.425	98%	98%	100.0%	0.0%
#50	0.300		94%	100.0%	0.0%
#60	0.250		93%	100.0%	0.0%
#80	0.180		91%	100.0%	0.0%
#100	0.150	90%	90%	100.0%	0.0%
#140	0.106		72%	100.0%	0.0%
#170	0.090		65%	100.0%	0.0%
#200	0.075	59.1%	59.1%	100.0%	0.0%



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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Hydrometer Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT13-GT-11-11.5-20240801 Sample#: B24-1640	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 22-Oct-24 Tested By: S. Boesenberg Control No.: 10252024	Visual Soils Classification Clayey, Silty Sand Sample Color Brown																																																																																																					
ASTM D-422 HYDROMETER ANALYSIS		ASTM C-136																																																																																																					
Assumed Sp Gr : 2.65 Sample Weight: 100.01 grams Hydroscopic Moist.: 1.88% Adj. Sample Wgt : 98.16 grams		Sieve Analysis Grain Size Distribution																																																																																																					
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Hydrometer Reading</th> <th style="text-align: left;">Corrected Reading</th> <th style="text-align: left;">Percent Passing</th> <th style="text-align: left;">Soils Particle Diameter</th> </tr> </thead> <tbody> <tr><td>2</td><td>28.5</td><td>29.0%</td><td>0.0330 mm</td></tr> <tr><td>5</td><td>21</td><td>21.4%</td><td>0.0219 mm</td></tr> <tr><td>15</td><td>15</td><td>15.3%</td><td>0.0131 mm</td></tr> <tr><td>30</td><td>12.5</td><td>12.7%</td><td>0.0094 mm</td></tr> <tr><td>60</td><td>10.5</td><td>10.7%</td><td>0.0068 mm</td></tr> <tr><td>250</td><td>6</td><td>6.1%</td><td>0.0034 mm</td></tr> <tr><td>1440</td><td>3.5</td><td>3.6%</td><td>0.0014 mm</td></tr> </tbody> </table>	Hydrometer Reading	Corrected Reading	Percent Passing	Soils Particle Diameter	2	28.5	29.0%	0.0330 mm	5	21	21.4%	0.0219 mm	15	15	15.3%	0.0131 mm	30	12.5	12.7%	0.0094 mm	60	10.5	10.7%	0.0068 mm	250	6	6.1%	0.0034 mm	1440	3.5	3.6%	0.0014 mm	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Sieve Size</th> <th style="text-align: left;">Percent Passing</th> <th style="text-align: left;">Soils Particle Diameter</th> </tr> </thead> <tbody> <tr><td>3.0"</td><td>100%</td><td>75.000 mm</td></tr> <tr><td>2.0"</td><td>100%</td><td>50.000 mm</td></tr> <tr><td>1.5"</td><td>100%</td><td>37.500 mm</td></tr> <tr><td>1.25"</td><td>100%</td><td>31.500 mm</td></tr> <tr><td>1.0"</td><td>100%</td><td>25.000 mm</td></tr> <tr><td>3/4"</td><td>100%</td><td>19.000 mm</td></tr> <tr><td>5/8"</td><td>100%</td><td>16.000 mm</td></tr> <tr><td>1/2"</td><td>100%</td><td>12.500 mm</td></tr> <tr><td>3/8"</td><td>100%</td><td>9.500 mm</td></tr> <tr><td>1/4"</td><td>100%</td><td>6.300 mm</td></tr> <tr><td>#4</td><td>100%</td><td>4.750 mm</td></tr> <tr><td>#10</td><td>100%</td><td>2.000 mm</td></tr> <tr><td>#20</td><td>99%</td><td>0.850 mm</td></tr> <tr><td>#40</td><td>98%</td><td>0.425 mm</td></tr> <tr><td>#100</td><td>90%</td><td>0.150 mm</td></tr> <tr><td>#200</td><td>59.1%</td><td>0.075 mm</td></tr> <tr><td>Silts</td><td>58.4%</td><td>0.074 mm</td></tr> <tr><td></td><td>41.2%</td><td>0.050 mm</td></tr> <tr><td></td><td>20.0%</td><td>0.020 mm</td></tr> <tr><td>Clays</td><td>8.3%</td><td>0.005 mm</td></tr> <tr><td></td><td>4.3%</td><td>0.002 mm</td></tr> <tr><td>Colloids</td><td>2.5%</td><td>0.001 mm</td></tr> </tbody> </table>	Sieve Size	Percent Passing	Soils Particle Diameter	3.0"	100%	75.000 mm	2.0"	100%	50.000 mm	1.5"	100%	37.500 mm	1.25"	100%	31.500 mm	1.0"	100%	25.000 mm	3/4"	100%	19.000 mm	5/8"	100%	16.000 mm	1/2"	100%	12.500 mm	3/8"	100%	9.500 mm	1/4"	100%	6.300 mm	#4	100%	4.750 mm	#10	100%	2.000 mm	#20	99%	0.850 mm	#40	98%	0.425 mm	#100	90%	0.150 mm	#200	59.1%	0.075 mm	Silts	58.4%	0.074 mm		41.2%	0.050 mm		20.0%	0.020 mm	Clays	8.3%	0.005 mm		4.3%	0.002 mm	Colloids	2.5%	0.001 mm
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USDA Soil Textural Classification Sandy Loam																																																																																																							

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT13-GT-15-16.5-20240801 Sample#: B24-1641	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 22-Oct-24 Tested By: R. Bohler Control No.: 10252024	Unified Soils Classification System, ASTM D-2487 SP-SM, Poorly graded Sand with Silt and Gravel Sample Color: Brown
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Specifications No Specs Sample Meets Specs ? <i>N/A</i>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.047 mm % Gravel = 24.5% Coeff. of Curvature, C _c = 0.77 D ₍₁₀₎ = 0.107 mm % Sand = 67.5% Coeff. of Uniformity, C _u = 13.50 D ₍₁₅₎ = 0.176 mm % Silt & Clay = 7.9% Fineness Modulus = 3.50 D ₍₃₀₎ = 0.346 mm Liquid Limit = n/a Plastic Limit = n/a D ₍₅₀₎ = 1.006 mm Plasticity Index = n/a Moisture %, as sampled = n/a D ₍₆₀₎ = 1.450 mm Sand Equivalent = n/a Req'd Sand Equivalent = D ₍₉₀₎ = 22.508 mm Fracture %, 1 Face = n/a Req'd Fracture %, 1 Face = Dust Ratio = 3/14 Fracture %, 2+ Faces = n/a Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		98%	100.0%	0.0%
1.50"	37.50		96%	100.0%	0.0%
1.25"	31.50		94%	100.0%	0.0%
1.00"	25.00	92%	92%	100.0%	0.0%
3/4"	19.00	87%	87%	100.0%	0.0%
5/8"	16.00		85%	100.0%	0.0%
1/2"	12.50	83%	83%	100.0%	0.0%
3/8"	9.50	81%	81%	100.0%	0.0%
1/4"	6.30		77%	100.0%	0.0%
#4	4.75	75%	75%	100.0%	0.0%
#8	2.36		73%	100.0%	0.0%
#10	2.00	72%	72%	100.0%	0.0%
#16	1.18		54%	100.0%	0.0%
#20	0.850		46%	100.0%	0.0%
#30	0.600		41%	100.0%	0.0%
#40	0.425	37%	37%	100.0%	0.0%
#50	0.300		26%	100.0%	0.0%
#60	0.250		22%	100.0%	0.0%
#80	0.180		15%	100.0%	0.0%
#100	0.150	13%	13%	100.0%	0.0%
#140	0.106		10%	100.0%	0.0%
#170	0.090		9%	100.0%	0.0%
#200	0.075	7.9%	7.9%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



ASTM D-4318 Liquid Limit, Plastic Limit & Plasticity Index of Soils

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT13-GT-30-31.5-20240801 Sample #: B24-1644	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 23-Oct-24 Tested By: S. Boesenberg Control No.: 10252024	Unified Soils Classification System, ASTM D-2487 OH, Organic Silty Clay Sample Color Brown
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Liquid Limit Determination

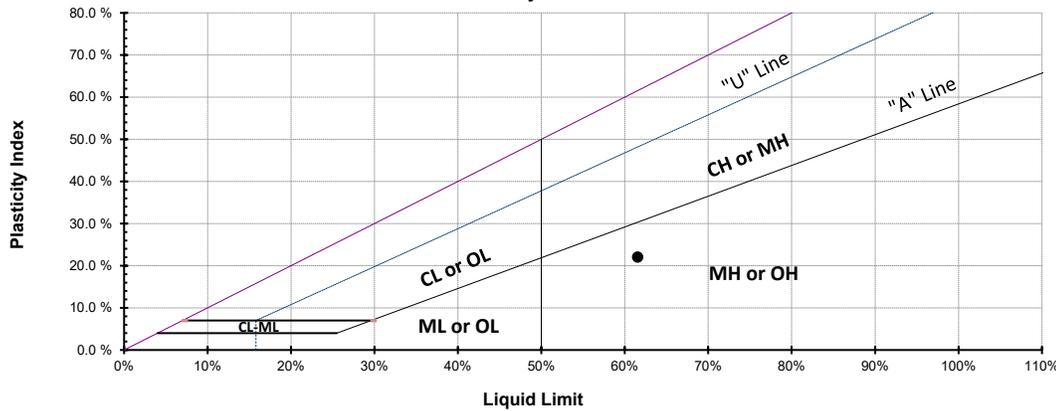
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	29.17	27.75	31.92			
Weight of Dry Soils + Pan:	23.48	24.24	27.31			
Weight of Pan:	14.15	18.54	19.94			
Weight of Dry Soils:	9.33	5.70	7.37			
Weight of Moisture:	5.69	3.51	4.61			
% Moisture:	61.0 %	61.6 %	62.6 %			
Number of Blows:	30	24	17			

Liquid Limit @ 25 Blows: 61.5 %
Plastic Limit: 39.5 %
Plasticity Index, I_p: 22.1 %

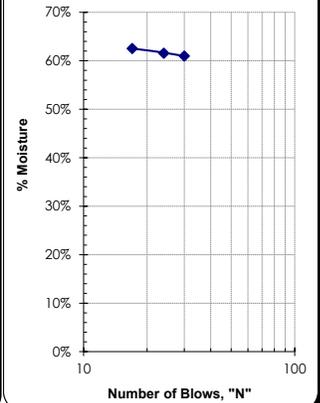
Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	25.31	20.52				
Weight of Dry Soils + Pan:	23.60	18.78				
Weight of Pan:	19.28	14.36				
Weight of Dry Soils:	4.32	4.42				
Weight of Moisture:	1.71	1.74				
% Moisture:	39.6 %	39.4 %				

Plasticity Chart



Liquid Limit



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Comments: _____

Reviewed by: Alex Eifrig
 Alex Eifrig
 WABO Supervising Laboratory Technician



Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
Project #: 24B105
Date Received: September 23, 2024
Date Tested: October 21, 2024

Client: Anchor QEA, LLC.
Sampled by: Client
Tested by: S. Boesenberg
Control No.: 10252024

Moisture Content ASTM C-566, ASTM D-2216

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B24-1646	LDW23-GT13-GT-40-41.5-20240801	411.6	1194.2	902.6	291.6	491.0	59.4%
B24-1660	LDW23-GT35-GT-5-6.5-20240805	394.7	778.1	651.5	126.6	256.8	49.3%

Organic Content ASTM D-2974

Sample #	Location	Tare	Soil + Tare, Pre-Ignition	Soil + Tare, Post Ignition	% Organics
B24-1646	LDW23-GT13-GT-40-41.5-20240801	50.18	100.00	97.10	5.82%
B24-1660	LDW23-GT35-GT-5-6.5-20240805	51.50	100.00	97.67	4.80%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT21-GT-5-6.5-20240805 Sample#: B24-1648	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 22-Oct-24 Tested By: S. Boesenberg Control No.: 10252024	Unified Soils Classification System, ASTM D-2487 GM, Silty Gravel with Sand Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.019 mm % Gravel = 40.9% D ₍₁₀₎ = 0.039 mm % Sand = 39.9% D ₍₁₅₎ = 0.058 mm % Silt & Clay = 19.3% D ₍₅₀₎ = 0.682 mm Liquid Limit = n/a D ₍₆₀₎ = 3.559 mm Plasticity Index = n/a D ₍₁₀₀₎ = 5.022 mm Sand Equivalent = n/a D ₍₂₀₀₎ = 15.190 mm Fracture %, 1 Face = n/a Dust Ratio = 21/31 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 2.38 Coeff. of Uniformity, C _u = 128.95 Fineness Modulus = 4.14 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		92%	100.0%	0.0%
1/2"	12.50	83%	83%	100.0%	0.0%
3/8"	9.50	74%	74%	100.0%	0.0%
1/4"	6.30		64%	100.0%	0.0%
#4	4.75	59%	59%	100.0%	0.0%
#8	2.36		41%	100.0%	0.0%
#10	2.00	38%	38%	100.0%	0.0%
#16	1.18		33%	100.0%	0.0%
#20	0.850		31%	100.0%	0.0%
#30	0.600		29%	100.0%	0.0%
#40	0.425	28%	28%	100.0%	0.0%
#50	0.300		26%	100.0%	0.0%
#60	0.250		25%	100.0%	0.0%
#80	0.180		24%	100.0%	0.0%
#100	0.150	23%	23%	100.0%	0.0%
#140	0.106		21%	100.0%	0.0%
#170	0.090		20%	100.0%	0.0%
#200	0.075	19.3%	19.3%	100.0%	0.0%

Grain Size Distribution

Particle Size (mm)

● Sieve Sizes
 — Max Specs
 — Min Specs
 — Sieve Results

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Hydrometer Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT21-GT-5-6.5-20240805 Sample#: B24-1648	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 22-Oct-24 Tested By: S. Boesenberg Control No.: 10252024	Unified Soils Classification System, ASTM D-2487 GM, Silty Gravel with Sand Sample Color Brown																																																																																																				
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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT21-GT-10-11.5-20240805 Sample#: B24-1649	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 22-Oct-24 Tested By: R. Bohler Control No.: 10252024	Unified Soils Classification System, ASTM D-2487 SP-SM, Poorly graded Sand with Silt and Gravel Sample Color: Brown
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Specifications No Specs Sample Meets Specs ? <i>N/A</i>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.049 mm % Gravel = 45.6% D ₍₁₀₎ = 0.140 mm % Sand = 46.7% D ₍₁₅₎ = 0.427 mm % Silt & Clay = 7.7% D ₍₃₀₎ = 1.723 mm Liquid Limit = n/a D ₍₅₀₎ = 4.180 mm Plasticity Index = n/a D ₍₆₀₎ = 5.928 mm Sand Equivalent = n/a D ₍₉₀₎ = 19.437 mm Fracture %, 1 Face = n/a Dust Ratio = 23/45 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 3.59 Coeff. of Uniformity, C _u = 42.44 Fineness Modulus = 4.79 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	89%	89%	100.0%	0.0%
5/8"	16.00		85%	100.0%	0.0%
1/2"	12.50	81%	81%	100.0%	0.0%
3/8"	9.50	77%	77%	100.0%	0.0%
1/4"	6.30		62%	100.0%	0.0%
#4	4.75	54%	54%	100.0%	0.0%
#8	2.36		36%	100.0%	0.0%
#10	2.00	33%	33%	100.0%	0.0%
#16	1.18		24%	100.0%	0.0%
#20	0.850		20%	100.0%	0.0%
#30	0.600		17%	100.0%	0.0%
#40	0.425	15%	15%	100.0%	0.0%
#50	0.300		13%	100.0%	0.0%
#60	0.250		12%	100.0%	0.0%
#80	0.180		11%	100.0%	0.0%
#100	0.150	10%	10%	100.0%	0.0%
#140	0.106		9%	100.0%	0.0%
#170	0.090		8%	100.0%	0.0%
#200	0.075	7.7%	7.7%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT21-GT-20-21.3-20240805 Sample#: B24-1651	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 22-Oct-24 Tested By: S. Boesenberg Control No.: 10252024	Unified Soils Classification System, ASTM D-2487 GP, Poorly graded Gravel with Sand Sample Color: Brown
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Specifications No Specs Sample Meets Specs ? <i>N/A</i>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.250 mm % Gravel = 82.1% Coeff. of Curvature, C _c = 3.47 D ₍₁₀₎ = 1.157 mm % Sand = 15.0% Coeff. of Uniformity, C _u = 7.10 D ₍₁₅₎ = 2.984 mm % Silt & Clay = 2.9% Fineness Modulus = 5.65 D ₍₅₀₎ = 5.743 mm Liquid Limit = n/a Plastic Limit = n/a D ₍₆₀₎ = 7.387 mm Plasticity Index = n/a Moisture %, as sampled = n/a D ₍₁₀₀₎ = 8.208 mm Sand Equivalent = n/a Req'd Sand Equivalent = D ₍₂₀₀₎ = 12.815 mm Fracture %, 1 Face = n/a Req'd Fracture %, 1 Face = Dust Ratio = 15/37 Fracture %, 2+ Faces = n/a Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		95%	100.0%	0.0%
1/2"	12.50	89%	89%	100.0%	0.0%
3/8"	9.50	76%	76%	100.0%	0.0%
1/4"	6.30		37%	100.0%	0.0%
#4	4.75	18%	18%	100.0%	0.0%
#8	2.36		14%	100.0%	0.0%
#10	2.00	13%	13%	100.0%	0.0%
#16	1.18		10%	100.0%	0.0%
#20	0.850		9%	100.0%	0.0%
#30	0.600		8%	100.0%	0.0%
#40	0.425	7%	7%	100.0%	0.0%
#50	0.300		6%	100.0%	0.0%
#60	0.250		5%	100.0%	0.0%
#80	0.180		4%	100.0%	0.0%
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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Hydrometer Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT21-GT-20-21.3-20240805 Sample#: B24-1651	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 22-Oct-24 Tested By: S. Boesenberg Control No.: 10252024	Unified Soils Classification System, ASTM D-2487 GP, Poorly graded Gravel with Sand Sample Color Brown																																																																																																					
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1/2"	89%	12.500 mm																																																																																																					
3/8"	76%	9.500 mm																																																																																																					
1/4"	37%	6.300 mm																																																																																																					
#4	18%	4.750 mm																																																																																																					
#10	13%	2.000 mm																																																																																																					
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Colloids	0.7%	0.001 mm																																																																																																					
% Gravel: 82.1% % Sand: 15.0% % Silt: 1.8% % Clay: 1.1%		Liquid Limit: n/a Plastic Limit: n/a Plasticity Index: n/a																																																																																																					
USDA Soil Textural Classification																																																																																																							
% Sand: 2.0 - 0.05 mm % Silt: 0.05 - 0.002 mm % Clay: < 0.002 mm																																																																																																							
USDA Soil Textural Classification Loamy Sand																																																																																																							

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Comments: Insufficient material resulted in hydrometer sample weight being undersized.

Reviewed by: Alex Eifrig
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT21-GT-41.1-41.5-20240805 Sample#: B24-1657	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 22-Oct-24 Tested By: R. Bohler Control No.: 10252024	Visual Soils Classification Sandy Silt Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.005 mm % Gravel = 0.0% D ₍₁₀₎ = 0.011 mm % Sand = 31.4% D ₍₁₅₎ = 0.016 mm % Silt & Clay = 68.6% D ₍₃₀₎ = 0.033 mm Liquid Limit = n/a D ₍₅₀₎ = 0.055 mm Plasticity Index = n/a D ₍₆₀₎ = 0.066 mm Sand Equivalent = n/a D ₍₉₀₎ = 0.236 mm Fracture %, 1 Face = n/a Dust Ratio = 16/23 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 1.50 Coeff. of Uniformity, C _u = 6.00 Fineness Modulus = 0.23 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		99%	100.0%	0.0%
#20	0.850		99%	100.0%	0.0%
#30	0.600		99%	100.0%	0.0%
#40	0.425	99%	99%	100.0%	0.0%
#50	0.300		93%	100.0%	0.0%
#60	0.250		91%	100.0%	0.0%
#80	0.180		87%	100.0%	0.0%
#100	0.150	86%	86%	100.0%	0.0%
#140	0.106		76%	100.0%	0.0%
#170	0.090		72%	100.0%	0.0%
#200	0.075	68.6%	68.6%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT35-GT-0.5-1.6-20240805 Sample#: B24-1658	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 22-Oct-24 Tested By: R. Bohler Control No.: 10252024	Unified Soils Classification System, ASTM D-2487 GW-GM, Well-graded Gravel with Silt and Sand Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.055 mm % Gravel = 53.8% Coeff. of Curvature, C _c = 1.71 D ₍₁₀₎ = 0.140 mm % Sand = 39.3% Coeff. of Uniformity, C _u = 52.64 D ₍₁₅₎ = 0.261 mm % Silt & Clay = 6.9% Fineness Modulus = 4.74 D ₍₃₀₎ = 1.327 mm Liquid Limit = n/a Plastic Limit = n/a D ₍₅₀₎ = 5.472 mm Plasticity Index = n/a Moisture %, as sampled = n/a D ₍₆₀₎ = 7.363 mm Sand Equivalent = n/a Req'd Sand Equivalent = D ₍₉₀₎ = 17.903 mm Fracture %, 1 Face = n/a Req'd Fracture %, 1 Face = Dust Ratio = 13/41 Fracture %, 2+ Faces = n/a Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	92%	92%	100.0%	0.0%
5/8"	16.00		86%	100.0%	0.0%
1/2"	12.50	80%	80%	100.0%	0.0%
3/8"	9.50	71%	71%	100.0%	0.0%
1/4"	6.30		54%	100.0%	0.0%
#4	4.75	46%	46%	100.0%	0.0%
#8	2.36		38%	100.0%	0.0%
#10	2.00	36%	36%	100.0%	0.0%
#16	1.18		29%	100.0%	0.0%
#20	0.850		26%	100.0%	0.0%
#30	0.600		23%	100.0%	0.0%
#40	0.425	22%	22%	100.0%	0.0%
#50	0.300		17%	100.0%	0.0%
#60	0.250		15%	100.0%	0.0%
#80	0.180		12%	100.0%	0.0%
#100	0.150	10%	10%	100.0%	0.0%
#140	0.106		8%	100.0%	0.0%
#170	0.090		8%	100.0%	0.0%
#200	0.075	6.9%	6.9%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT35-GT-1.6-2-20240805 Sample#: B24-1659	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 22-Oct-24 Tested By: S. Boesenberg Control No.: 10252024	Unified Soils Classification System, ASTM D-2487 SM, Silty Sand Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.008 mm % Gravel = 12.9% Coeff. of Curvature, C _c = 0.65 D ₍₁₀₎ = 0.015 mm % Sand = 38.6% Coeff. of Uniformity, C _u = 13.86 D ₍₁₅₎ = 0.023 mm % Silt & Clay = 48.4% Fineness Modulus = 1.52 D ₍₃₀₎ = 0.046 mm Liquid Limit = n/a Plastic Limit = n/a D ₍₅₀₎ = 0.094 mm Plasticity Index = n/a Moisture %, as sampled = n/a D ₍₆₀₎ = 0.215 mm Sand Equivalent = n/a Req'd Sand Equivalent = D ₍₉₀₎ = 6.421 mm Fracture %, 1 Face = n/a Req'd Fracture %, 1 Face = Dust Ratio = 49/78 Fracture %, 2+ Faces = n/a Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	95%	95%	100.0%	0.0%
1/4"	6.30		90%	100.0%	0.0%
#4	4.75	87%	87%	100.0%	0.0%
#8	2.36		85%	100.0%	0.0%
#10	2.00	85%	85%	100.0%	0.0%
#16	1.18		81%	100.0%	0.0%
#20	0.850		79%	100.0%	0.0%
#30	0.600		78%	100.0%	0.0%
#40	0.425	77%	77%	100.0%	0.0%
#50	0.300		67%	100.0%	0.0%
#60	0.250		63%	100.0%	0.0%
#80	0.180		57%	100.0%	0.0%
#100	0.150	55%	55%	100.0%	0.0%
#140	0.106		51%	100.0%	0.0%
#170	0.090		50%	100.0%	0.0%
#200	0.075	48.4%	48.4%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Hydrometer Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT35-GT-1.6-2-20240805 Sample#: B24-1659	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 22-Oct-24 Tested By: S. Boesenberg Control No.: 10252024	Unified Soils Classification System, ASTM D-2487 SM, Silty Sand Sample Color Brown																																																																																																					
ASTM D-422 HYDROMETER ANALYSIS		ASTM C-136																																																																																																					
Assumed Sp Gr : 2.65 Sample Weight: 100.04 grams Hydroscopic Moist.: 1.34% Adj. Sample Wgt : 98.72 grams		Sieve Analysis Grain Size Distribution																																																																																																					
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Hydrometer Reading</th> <th style="text-align: left;">Corrected Reading</th> <th style="text-align: left;">Percent Passing</th> <th style="text-align: left;">Soils Particle Diameter</th> </tr> </thead> <tbody> <tr><td>2</td><td>37.5</td><td>32.1%</td><td>0.0308 mm</td></tr> <tr><td>5</td><td>31.5</td><td>27.0%</td><td>0.0204 mm</td></tr> <tr><td>15</td><td>24.5</td><td>21.0%</td><td>0.0124 mm</td></tr> <tr><td>30</td><td>18.5</td><td>15.9%</td><td>0.0091 mm</td></tr> <tr><td>60</td><td>15.5</td><td>13.3%</td><td>0.0065 mm</td></tr> <tr><td>250</td><td>10</td><td>8.6%</td><td>0.0033 mm</td></tr> <tr><td>1440</td><td>6.5</td><td>5.6%</td><td>0.0014 mm</td></tr> </tbody> </table>	Hydrometer Reading	Corrected Reading	Percent Passing	Soils Particle Diameter	2	37.5	32.1%	0.0308 mm	5	31.5	27.0%	0.0204 mm	15	24.5	21.0%	0.0124 mm	30	18.5	15.9%	0.0091 mm	60	15.5	13.3%	0.0065 mm	250	10	8.6%	0.0033 mm	1440	6.5	5.6%	0.0014 mm	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Sieve Size</th> <th style="text-align: left;">Percent Passing</th> <th style="text-align: left;">Soils Particle Diameter</th> </tr> </thead> <tbody> <tr><td>3.0"</td><td>100%</td><td>75.000 mm</td></tr> <tr><td>2.0"</td><td>100%</td><td>50.000 mm</td></tr> <tr><td>1.5"</td><td>100%</td><td>37.500 mm</td></tr> <tr><td>1.25"</td><td>100%</td><td>31.500 mm</td></tr> <tr><td>1.0"</td><td>100%</td><td>25.000 mm</td></tr> <tr><td>3/4"</td><td>100%</td><td>19.000 mm</td></tr> <tr><td>5/8"</td><td>100%</td><td>16.000 mm</td></tr> <tr><td>1/2"</td><td>100%</td><td>12.500 mm</td></tr> <tr><td>3/8"</td><td>95%</td><td>9.500 mm</td></tr> <tr><td>1/4"</td><td>90%</td><td>6.300 mm</td></tr> <tr><td>#4</td><td>87%</td><td>4.750 mm</td></tr> <tr><td>#10</td><td>85%</td><td>2.000 mm</td></tr> <tr><td>#20</td><td>79%</td><td>0.850 mm</td></tr> <tr><td>#40</td><td>77%</td><td>0.425 mm</td></tr> <tr><td>#100</td><td>55%</td><td>0.150 mm</td></tr> <tr><td>#200</td><td>48.4%</td><td>0.075 mm</td></tr> <tr><td>Silts</td><td>48.1%</td><td>0.074 mm</td></tr> <tr><td></td><td>39.2%</td><td>0.050 mm</td></tr> <tr><td></td><td>26.7%</td><td>0.020 mm</td></tr> <tr><td>Clays</td><td>11.0%</td><td>0.005 mm</td></tr> <tr><td></td><td>6.5%</td><td>0.002 mm</td></tr> <tr><td>Colloids</td><td>4.0%</td><td>0.001 mm</td></tr> </tbody> </table>	Sieve Size	Percent Passing	Soils Particle Diameter	3.0"	100%	75.000 mm	2.0"	100%	50.000 mm	1.5"	100%	37.500 mm	1.25"	100%	31.500 mm	1.0"	100%	25.000 mm	3/4"	100%	19.000 mm	5/8"	100%	16.000 mm	1/2"	100%	12.500 mm	3/8"	95%	9.500 mm	1/4"	90%	6.300 mm	#4	87%	4.750 mm	#10	85%	2.000 mm	#20	79%	0.850 mm	#40	77%	0.425 mm	#100	55%	0.150 mm	#200	48.4%	0.075 mm	Silts	48.1%	0.074 mm		39.2%	0.050 mm		26.7%	0.020 mm	Clays	11.0%	0.005 mm		6.5%	0.002 mm	Colloids	4.0%	0.001 mm
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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT26-GT-0-1.5-20240805 Sample#: B24-1661	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 22-Oct-24 Tested By: R. Bohler Control No.: 10252024	Unified Soils Classification System, ASTM D-2487 SP, Poorly graded Sand Sample Color: Brown
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Specifications No Specs Sample Meets Specs ? <i>N/A</i>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.153 mm % Gravel = 0.3% D ₍₁₀₎ = 0.179 mm % Sand = 97.1% D ₍₁₅₎ = 0.206 mm % Silt & Clay = 2.7% D ₍₃₀₎ = 0.286 mm Liquid Limit = n/a D ₍₅₀₎ = 0.392 mm Plasticity Index = n/a D ₍₆₀₎ = 0.561 mm Sand Equivalent = n/a D ₍₉₀₎ = 1.655 mm Fracture %, 1 Face = n/a Dust Ratio = 1/21 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 0.81 Coeff. of Uniformity, C _u = 3.13 Fineness Modulus = 2.25 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		77%	100.0%	0.0%
#20	0.850		68%	100.0%	0.0%
#30	0.600		61%	100.0%	0.0%
#40	0.425	56%	56%	100.0%	0.0%
#50	0.300		33%	100.0%	0.0%
#60	0.250		23%	100.0%	0.0%
#80	0.180		10%	100.0%	0.0%
#100	0.150	4%	4%	100.0%	0.0%
#140	0.106		3%	100.0%	0.0%
#170	0.090		3%	100.0%	0.0%
#200	0.075	2.7%	2.7%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Client: Anchor QEA, LLC.
Address: 1201 3rd Avenue, Suite 2600
Seattle, WA 98101
Attn: Cindy Fields
Revised On: _____

Date: October 29, 2024
Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
Project #: 24B105
Sample #: B24-1663 - 1685
Date sampled: June 17, 2024 - August 2, 2024
Control No: 10292024

As requested and authorized by the Client, MTC has performed the following test(s) on the sample number referenced above. The testing was performed in accordance with current, applicable AASHTO, ASTM, and/or WSDOT standards, which are referenced on the correlating test report pages. The results obtained in our laboratory are as detailed below and/or on the following pages:

	Test(s) Performed:	Test Results	Test(s) Performed:	Test Results
X	Sieve Analysis	See Attached Reports	Sulfate Soundness	
	Proctor		Bulk Density & Voids	
	Sand Equivalent		WSDOT Degradation	
	Fracture Count		LA Abrasion	
X	Moisture Content	See Attached Reports	Cation Exchange Capacity	
	Specific Gravity, Coarse		X Specific Gravity, Soils	See Attached Report
	Specific Gravity, Fine		X Organic Content	See Attached Report
X	Hydrometer Analysis	See Attached Reports		
X	Atterberg Limits	See Attached Reports		

If you have any questions concerning the test results, the procedures used, or if we can be of any further assistance please call the number below and ask to speak with your Project Manager or the Laboratory Manager.

Alex Eifrig

 Respectfully Submitted,
 Alex Eifrig
 WABO Supervising Laboratory Technician



Moisture Content ASTM C-566, ASTM D-2216

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
Project #: 24B105
Date Received: September 23, 2024
Date Tested: October 23, 2024

Client: Anchor QEA, LLC.
Sampled by: Client
Tested by: S. Boesenberg
Control No.: 10292024

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B24-1663	LDW23-GT26-GT-10-10.8-20240624	356.7	656.4	605.7	50.7	249.0	20.4%
B24-1664	LDW23-GT26-GT-10.8-11.5-20240624	501.0	880.4	850.3	30.1	349.3	8.6%
B24-1665	LDW23-GT26-GT-15-16.1-20240624	360.1	558.2	516.3	41.9	156.2	26.8%
B24-1666	LDW23-GT26-GT-16.1-16.5-20240624	268.8	611.4	528.4	83.0	259.6	32.0%
B24-1667	LDW23-GT26-GT-20-21.5-20240624	420.7	1498.2	1200.1	298.1	779.4	38.2%
B24-1668	LDW23-GT22-GT-0-1.5-20240622	270.1	630.9	495.9	135.0	225.8	59.8%
B24-1669	LDW23-GT22-GT-5-6.5-20240622	222.9	330.9	291.1	39.8	68.2	58.4%
B24-1670	LDW23-GT22-GT-10-11.5-20240622	358.2	608.2	554.6	53.6	196.4	27.3%
B24-1671	LDW23-GT22-GT-15-16.5-20240622	420.5	931.2	843.0	88.2	422.5	20.9%
B24-1672	LDW23-GT22-GT-20-21.5-20240622	601.3	1157.2	1019.6	137.6	418.3	32.9%
B24-1673	LDW23-GT22-GT-25-26.5-20240622	414.2	976.5	849.4	127.1	435.2	29.2%
B24-1674	LDW23-GT17-GT-0-1.5-20240622	600.1	1461.4	1095.5	365.9	495.4	73.9%
B24-1675	LDW23-GT17-GT-5-6.5-20240622	234.6	287.3	267.9	19.4	33.3	58.3%
B24-1676	LDW23-GT17-GT-10-11.5-20240622	417.5	824.4	665.6	158.8	248.1	64.0%
B24-1677	LDW23-GT17-GT-15-16.5-20240622	303.4	464.9	404.3	60.6	100.9	60.1%
B24-1678	LDW23-GT17-GT-20-21.5-20240622	584.0	957.5	867.7	89.8	283.7	31.7%
B24-1679	LDW23-GT17-GT-25-26.5-20240622	234.5	533.6	473.7	59.9	239.2	25.0%
B24-1680	LDW23-GT33-GT-0.5-2-20240730	260.2	889.1	736.7	152.4	476.5	32.0%
B24-1681	LDW23-GT30-GT-0-1.5-20240620	266.6	666.6	532.1	134.5	265.5	50.7%
B24-1682	LDW23-GT02-GT-25-25.9-20240617	268.7	653.0	553.4	99.6	284.7	35.0%
B24-1683	LDW23-GT11-GT-0.5-1.3-20240801	310.8	470.4	453.0	17.4	142.2	12.2%
B24-1684	LDW23-GT04-GT-0-1.5-20240802	319.7	965.8	904.1	61.7	584.4	10.6%
B24-1685	LDW23-GT33B-GT-35-36.5-20240730	270.0	810.4	703.5	106.9	433.5	24.7%
					0.0	0.0	#DIV/0!
					0.0	0.0	#DIV/0!

All results apply only to actual locations and materials tested. As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of clients, and authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved pending our written approval.

Comments: _____

Reviewed by: *Alex Eifrig*

 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT26-GT-10-10.8-20240624 Sample#: B24-1663	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 25-Oct-24 Tested By: Z. Romney Control No.: 10292024	Unified Soils Classification System, ASTM D-2487 SM, Silty Sand with Gravel Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.065 mm % Gravel = 8.4% Coeff. of Curvature, C _c = 0.90 D ₍₁₀₎ = 0.125 mm % Sand = 85.9% Coeff. of Uniformity, C _u = 9.11 D ₍₁₅₎ = 0.184 mm % Silt & Clay = 5.7% Fineness Modulus = 2.96 D ₍₃₀₎ = 0.359 mm Liquid Limit = n/a Plastic Limit = n/a D ₍₅₀₎ = 0.848 mm Plasticity Index = n/a Moisture %, as sampled = n/a D ₍₆₀₎ = 1.142 mm Sand Equivalent = n/a Req'd Sand Equivalent = D ₍₉₀₎ = 2.947 mm Fracture %, 1 Face = n/a Req'd Fracture %, 1 Face = Dust Ratio = 5/31 Fracture %, 2+ Faces = n/a Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		98%	100.0%	0.0%
1.50"	37.50		96%	100.0%	0.0%
1.25"	31.50		94%	100.0%	0.0%
1.00"	25.00	92%	92%	100.0%	0.0%
3/4"	19.00	92%	92%	100.0%	0.0%
5/8"	16.00		92%	100.0%	0.0%
1/2"	12.50	92%	92%	100.0%	0.0%
3/8"	9.50	92%	92%	100.0%	0.0%
1/4"	6.30		92%	100.0%	0.0%
#4	4.75	92%	92%	100.0%	0.0%
#8	2.36		89%	100.0%	0.0%
#10	2.00	89%	89%	100.0%	0.0%
#16	1.18		61%	100.0%	0.0%
#20	0.850		50%	100.0%	0.0%
#30	0.600		42%	100.0%	0.0%
#40	0.425	36%	36%	100.0%	0.0%
#50	0.300		25%	100.0%	0.0%
#60	0.250		21%	100.0%	0.0%
#80	0.180		15%	100.0%	0.0%
#100	0.150	12%	12%	100.0%	0.0%
#140	0.106		8%	100.0%	0.0%
#170	0.090		7%	100.0%	0.0%
#200	0.075	5.7%	5.7%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT26-GT-15-16.1-20240624 Sample#: B24-1665	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 25-Oct-24 Tested By: Z. Romney Control No.: 10292024	Unified Soils Classification System, ASTM D-2487 SM, Silty Sand Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.024 mm % Gravel = 0.3% D ₍₁₀₎ = 0.049 mm % Sand = 84.3% D ₍₁₅₎ = 0.073 mm % Silt & Clay = 15.4% D ₍₃₀₎ = 0.133 mm Liquid Limit = n/a D ₍₅₀₎ = 0.240 mm Plasticity Index = n/a D ₍₆₀₎ = 0.297 mm Sand Equivalent = n/a D ₍₉₀₎ = 1.135 mm Fracture %, 1 Face = n/a Dust Ratio = 3/16 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 1.23 Coeff. of Uniformity, C _u = 6.11 Fineness Modulus = 1.31 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		99%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		90%	100.0%	0.0%
#20	0.850		87%	100.0%	0.0%
#30	0.600		84%	100.0%	0.0%
#40	0.425	83%	83%	100.0%	0.0%
#50	0.300		61%	100.0%	0.0%
#60	0.250		52%	100.0%	0.0%
#80	0.180		39%	100.0%	0.0%
#100	0.150	34%	34%	100.0%	0.0%
#140	0.106		23%	100.0%	0.0%
#170	0.090		19%	100.0%	0.0%
#200	0.075	15.4%	15.4%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT22-GT-5-6.5-20240622 Sample#: B24-1669	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 25-Oct-24 Tested By: S. Boesenberg Control No.: 10292024	Visual Soils Classification Clayey, Sandy Silt Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.006 mm % Gravel = 0.0% D ₍₁₀₎ = 0.013 mm % Sand = 41.6% D ₍₁₅₎ = 0.019 mm % Silt & Clay = 58.4% D ₍₃₀₎ = 0.039 mm Liquid Limit = n/a D ₍₅₀₎ = 0.064 mm Plasticity Index = n/a D ₍₆₀₎ = 0.082 mm Sand Equivalent = n/a D ₍₉₀₎ = 0.384 mm Fracture %, 1 Face = n/a Dust Ratio = 17/27 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 1.40 Coeff. of Uniformity, C _u = 6.42 Fineness Modulus = 0.52 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		96%	100.0%	0.0%
#20	0.850		95%	100.0%	0.0%
#30	0.600		93%	100.0%	0.0%
#40	0.425	93%	93%	100.0%	0.0%
#50	0.300		84%	100.0%	0.0%
#60	0.250		81%	100.0%	0.0%
#80	0.180		76%	100.0%	0.0%
#100	0.150	74%	74%	100.0%	0.0%
#140	0.106		65%	100.0%	0.0%
#170	0.090		62%	100.0%	0.0%
#200	0.075	58.4%	58.4%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Hydrometer Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT22-GT-5-6.5-20240622 Sample#: B24-1669	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 25-Oct-24 Tested By: S. Boesenberg Control No.: 10292024	Visual Soils Classification Clayey, Sandy Silt Sample Color Brown																																																																																																										
ASTM D-422 HYDROMETER ANALYSIS		ASTM C-136																																																																																																										
Assumed Sp Gr : 2.65 Sample Weight: 50.27 grams Hydrosopic Moist.: 5.08% Adj. Sample Wgt : 47.84 grams		Sieve Analysis Grain Size Distribution																																																																																																										
<table border="0" style="width: 100%;"> <thead> <tr> <th style="text-align: left;">Hydrometer Reading</th> <th style="text-align: left;">Corrected Reading</th> <th style="text-align: left;">Percent Passing</th> <th style="text-align: left;">Soils Particle Diameter</th> </tr> </thead> <tbody> <tr><td>2</td><td>22</td><td>45.8%</td><td>0.0344 mm</td></tr> <tr><td>5</td><td>16</td><td>33.3%</td><td>0.0226 mm</td></tr> <tr><td>15</td><td>12.5</td><td>26.0%</td><td>0.0133 mm</td></tr> <tr><td>30</td><td>9</td><td>18.8%</td><td>0.0096 mm</td></tr> <tr><td>60</td><td>7</td><td>14.6%</td><td>0.0069 mm</td></tr> <tr><td>250</td><td>4</td><td>8.3%</td><td>0.0034 mm</td></tr> <tr><td>1440</td><td>2</td><td>4.2%</td><td>0.0014 mm</td></tr> </tbody> </table>	Hydrometer Reading	Corrected Reading	Percent Passing	Soils Particle Diameter	2	22	45.8%	0.0344 mm	5	16	33.3%	0.0226 mm	15	12.5	26.0%	0.0133 mm	30	9	18.8%	0.0096 mm	60	7	14.6%	0.0069 mm	250	4	8.3%	0.0034 mm	1440	2	4.2%	0.0014 mm	<table border="0" style="width: 100%;"> <thead> <tr> <th style="text-align: left;">Sieve Size</th> <th style="text-align: left;">Percent Passing</th> <th style="text-align: left;">Soils Particle Diameter</th> </tr> </thead> <tbody> <tr><td>3.0"</td><td>100%</td><td>75.000 mm</td></tr> <tr><td>2.0"</td><td>100%</td><td>50.000 mm</td></tr> <tr><td>1.5"</td><td>100%</td><td>37.500 mm</td></tr> <tr><td>1.25"</td><td>100%</td><td>31.500 mm</td></tr> <tr><td>1.0"</td><td>100%</td><td>25.000 mm</td></tr> <tr><td>3/4"</td><td>100%</td><td>19.000 mm</td></tr> <tr><td>5/8"</td><td>100%</td><td>16.000 mm</td></tr> <tr><td>1/2"</td><td>100%</td><td>12.500 mm</td></tr> <tr><td>3/8"</td><td>100%</td><td>9.500 mm</td></tr> <tr><td>1/4"</td><td>100%</td><td>6.300 mm</td></tr> <tr><td>#4</td><td>100%</td><td>4.750 mm</td></tr> <tr><td>#10</td><td>100%</td><td>2.000 mm</td></tr> <tr><td>#20</td><td>95%</td><td>0.850 mm</td></tr> <tr><td>#40</td><td>93%</td><td>0.425 mm</td></tr> <tr><td>#100</td><td>74%</td><td>0.150 mm</td></tr> <tr><td>#200</td><td>58.4%</td><td>0.075 mm</td></tr> <tr><td colspan="3">Silts</td></tr> <tr><td></td><td>58.1%</td><td>0.074 mm</td></tr> <tr><td></td><td>50.7%</td><td>0.050 mm</td></tr> <tr><td></td><td>31.3%</td><td>0.020 mm</td></tr> <tr><td colspan="3">Clays</td></tr> <tr><td></td><td>11.2%</td><td>0.005 mm</td></tr> <tr><td></td><td>5.4%</td><td>0.002 mm</td></tr> <tr><td>Colloids</td><td>2.9%</td><td>0.001 mm</td></tr> </tbody> </table>	Sieve Size	Percent Passing	Soils Particle Diameter	3.0"	100%	75.000 mm	2.0"	100%	50.000 mm	1.5"	100%	37.500 mm	1.25"	100%	31.500 mm	1.0"	100%	25.000 mm	3/4"	100%	19.000 mm	5/8"	100%	16.000 mm	1/2"	100%	12.500 mm	3/8"	100%	9.500 mm	1/4"	100%	6.300 mm	#4	100%	4.750 mm	#10	100%	2.000 mm	#20	95%	0.850 mm	#40	93%	0.425 mm	#100	74%	0.150 mm	#200	58.4%	0.075 mm	Silts				58.1%	0.074 mm		50.7%	0.050 mm		31.3%	0.020 mm	Clays				11.2%	0.005 mm		5.4%	0.002 mm	Colloids	2.9%	0.001 mm
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Comments: _____

Reviewed by:

Alex Eifrig

 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT22-GT-10-11.5-20240622 Sample#: B24-1670	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 25-Oct-24 Tested By: Z. Romney Control No.: 10292024	Unified Soils Classification System, ASTM D-2487 SW-SM, Well-graded Sand with Silt Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₆₎ = 0.035 mm % Gravel = 0.1% D ₍₁₀₎ = 0.069 mm % Sand = 89.1% D ₍₁₅₎ = 0.132 mm % Silt & Clay = 10.8% D ₍₃₀₎ = 0.257 mm Liquid Limit = n/a D ₍₅₀₎ = 0.413 mm Plasticity Index = n/a D ₍₆₀₎ = 0.700 mm Sand Equivalent = n/a D ₍₉₀₎ = 1.679 mm Fracture %, 1 Face = n/a Dust Ratio = 4/19 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 1.36 Coeff. of Uniformity, C _u = 10.12 Fineness Modulus = 2.17 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		75%	100.0%	0.0%
#20	0.850		65%	100.0%	0.0%
#30	0.600		57%	100.0%	0.0%
#40	0.425	52%	52%	100.0%	0.0%
#50	0.300		36%	100.0%	0.0%
#60	0.250		29%	100.0%	0.0%
#80	0.180		20%	100.0%	0.0%
#100	0.150	16%	16%	100.0%	0.0%
#140	0.106		13%	100.0%	0.0%
#170	0.090		12%	100.0%	0.0%
#200	0.075	10.8%	10.8%	100.0%	0.0%

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Comments: _____

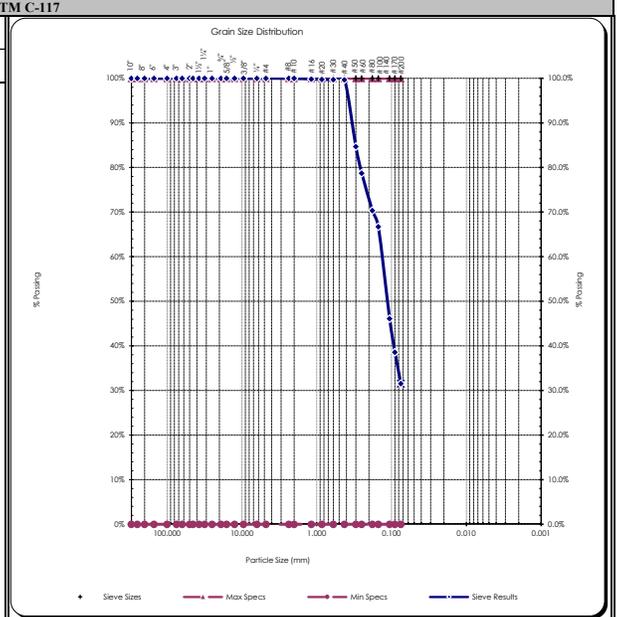
Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT22-GT-25-26.5-20240622 Sample#: B24-1673	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 25-Oct-24 Tested By: Z. Romney Control No.: 10292024	Unified Soils Classification System, ASTM D-2487 SM, Silty Sand Sample Color: Brown
Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281		
Specifications No Specs Sample Meets Specs ? <i>N/A</i>	D ₍₆₎ = 0.012 mm % Gravel = 0.0% D ₍₁₀₎ = 0.024 mm % Sand = 68.5% D ₍₁₅₎ = 0.036 mm % Silt & Clay = 31.5% D ₍₃₀₎ = 0.071 mm Liquid Limit = n/a D ₍₅₀₎ = 0.114 mm Plasticity Index = n/a D ₍₆₀₎ = 0.136 mm Sand Equivalent = n/a D ₍₉₀₎ = 0.344 mm Fracture %, 1 Face = n/a Dust Ratio = 19/60 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _c = 1.58 Coeff. of Uniformity, C _u = 5.71 Fineness Modulus = 0.49 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =
Method(s) ASTM C-136, ASTM D-6913, ASTM C-117		

Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850		100%	100.0%	0.0%
#30	0.600		100%	100.0%	0.0%
#40	0.425	99.7%	100%	100.0%	0.0%
#50	0.300		85%	100.0%	0.0%
#60	0.250		79%	100.0%	0.0%
#80	0.180		70%	100.0%	0.0%
#100	0.150	66.7%	67%	100.0%	0.0%
#140	0.106		46%	100.0%	0.0%
#170	0.090		39%	100.0%	0.0%
#200	0.075	31.5%	31.5%	100.0%	0.0%



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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



ASTM D-4318 Liquid Limit, Plastic Limit & Plasticity Index of Soils

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT17-GT-5-6.5-20240622 Sample #: B24-1675	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 25-Oct-24 Tested By: R. Bohler Control No.: 10292024	Unified Soils Classification System, ASTM D-2487 OH, Organic Silty Clay Sample Color Brown
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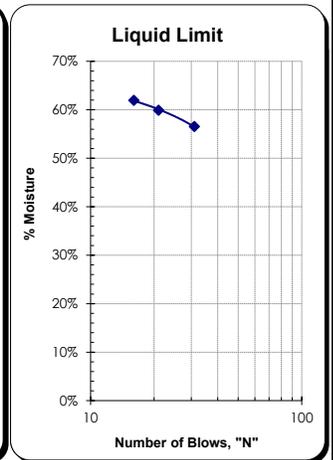
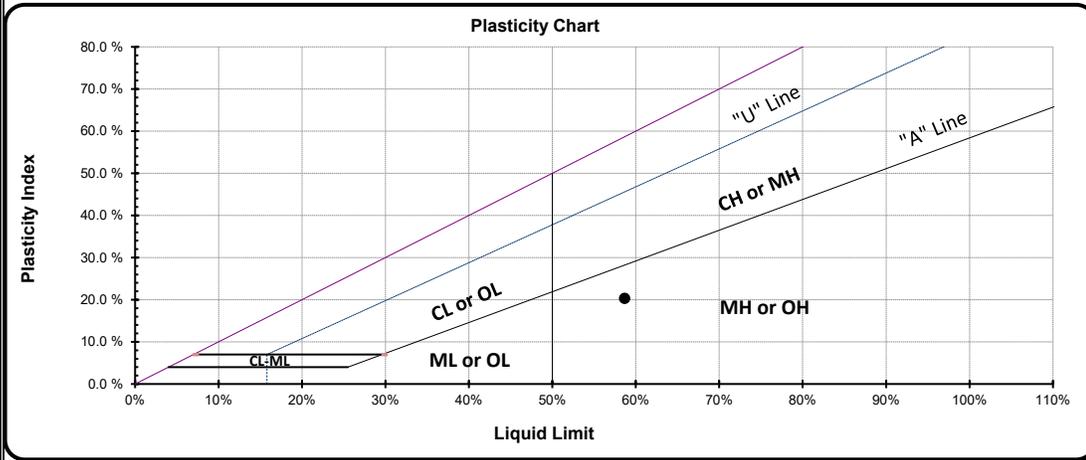
Liquid Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	32.95	30.08	33.23			
Weight of Dry Soils + Pan:	28.05	26.15	28.00			
Weight of Pan:	19.39	19.59	19.56			
Weight of Dry Soils:	8.66	6.56	8.44			
Weight of Moisture:	4.90	3.93	5.23			
% Moisture:	56.6 %	59.9 %	62.0 %			
Number of Blows:	31	21	16			

Liquid Limit @ 25 Blows: 58.7 %
Plastic Limit: 38.3 %
Plasticity Index, I_p: 20.3 %

Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	25.87	20.71				
Weight of Dry Soils + Pan:	24.14	18.92				
Weight of Pan:	19.65	14.22				
Weight of Dry Soils:	4.49	4.70				
Weight of Moisture:	1.73	1.79				
% Moisture:	38.5 %	38.1 %				



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 WABO Supervising Laboratory Technician



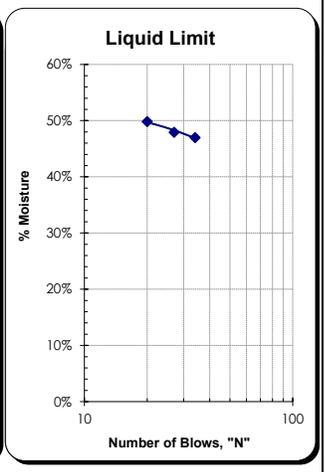
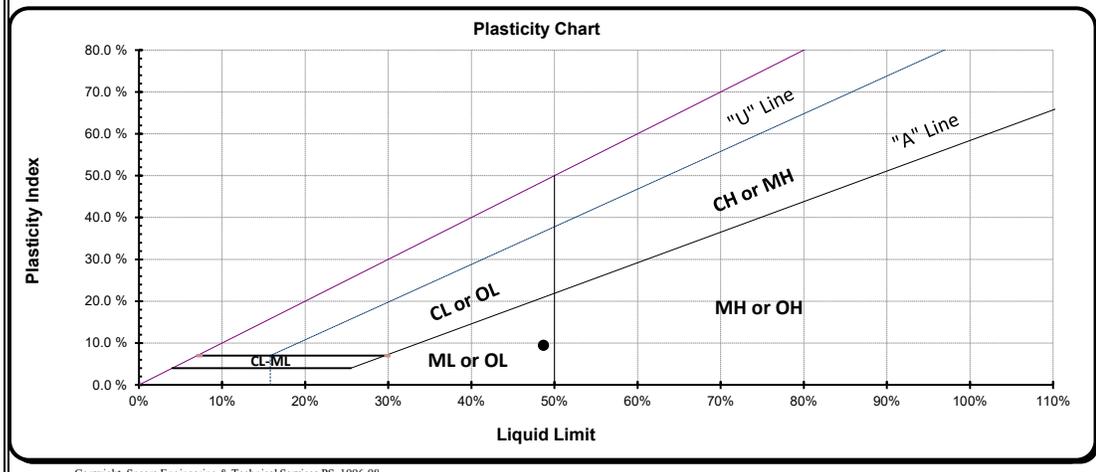
ASTM D-4318 Liquid Limit, Plastic Limit & Plasticity Index of Soils

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT17-GT-15-16.5-20240622 Sample #: B24-1677	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 25-Oct-24 Tested By: S. Boesenberg Control No.: 10292024	Unified Soils Classification System, ASTM D-2487 ML, Clayey Silt Sample Color Brown
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Liquid Limit Determination						
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	26.70	32.31	31.25			
Weight of Dry Soils + Pan:	22.77	28.33	27.27			
Weight of Pan:	14.41	20.03	19.29			
Weight of Dry Soils:	8.36	8.30	7.98			
Weight of Moisture:	3.93	3.98	3.98			
% Moisture:	47.0 %	48.0 %	49.9 %			
Number of Blows:	34	27	20			

Liquid Limit @ 25 Blows: 48.7 %
Plastic Limit: 39.2 %
Plasticity Index, I_p: 9.5 %

Plastic Limit Determination						
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	24.88	20.75				
Weight of Dry Soils + Pan:	23.11	19.04				
Weight of Pan:	18.56	14.71				
Weight of Dry Soils:	4.55	4.33				
Weight of Moisture:	1.77	1.71				
% Moisture:	38.9 %	39.5 %				



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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
Project #: 24B105
Date Received: September 23, 2024
Date Tested: October 24, 2024

Client: Anchor QEA, LLC.
Sampled by: Client
Tested by: R. Bohler
Control No.: 10292024

Moisture Content ASTM C-566, ASTM D-2216

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B24-1677	LDW23-GT17-GT-15-16.5-20240622	303.4	464.9	404.3	60.6	100.9	60.1%
					0.0	0.0	#DIV/0!

Organic Content ASTM D-2974

Sample #	Location	Tare	Soil + Tare, Pre-Ignition	Soil + Tare, Post Ignition	% Organics
B24-1677	LDW23-GT17-GT-15-16.5-20240622	50.17	99.54	96.37	6.42%
					#DIV/0!

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Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23-GT17-GT-20-21.5-20240622 Sample#: B24-1678	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 25-Oct-24 Tested By: Z. Romney Control No.: 10292024	Unified Soils Classification System, ASTM D-2487 SM, Silty Sand Sample Color: Brown
Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281		
Specifications No Specs Sample Meets Specs ? <i>N/A</i>	D ₍₆₎ = 0.009 mm % Gravel = 0.0% Coeff. of Curvature, C _c = 1.46 D ₍₁₀₎ = 0.017 mm % Sand = 55.9% Coeff. of Uniformity, C _u = 6.17 D ₍₁₅₎ = 0.026 mm % Silt & Clay = 44.1% Fineness Modulus = 0.25 D ₍₃₀₎ = 0.051 mm Liquid Limit = n/a Plastic Limit = n/a D ₍₅₀₎ = 0.086 mm Plasticity Index = n/a Moisture %, as sampled = n/a D ₍₆₀₎ = 0.105 mm Sand Equivalent = n/a Req'd Sand Equivalent = D ₍₉₀₎ = 0.259 mm Fracture %, 1 Face = n/a Req'd Fracture %, 1 Face = Dust Ratio = 4/9 Fracture %, 2+ Faces = n/a Req'd Fracture %, 2+ Faces =	

Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		100%	100.0%	0.0%
#20	0.850		99%	100.0%	0.0%
#30	0.600		99%	100.0%	0.0%
#40	0.425	99.3%	99%	100.0%	0.0%
#50	0.300		92%	100.0%	0.0%
#60	0.250		89%	100.0%	0.0%
#80	0.180		86%	100.0%	0.0%
#100	0.150	83.9%	84%	100.0%	0.0%
#140	0.106		61%	100.0%	0.0%
#170	0.090		52%	100.0%	0.0%
#200	0.075	44.1%	44.1%	100.0%	0.0%

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 All results apply only to actual locations and materials tested. As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of clients, and authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved pending our written approval.

Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Client: Anchor QEA, LLC.
Address: 1201 3rd Avenue, Suite 2600
Seattle, WA 98101
Attn: Cindy Fields
Revised On: _____

Date: December 13, 2024
Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
Project #: 24B105
Sample #: B24-1898 - 1918
Date sampled: October 28, 29, & 30, 2024
Control No: 12132024

As requested and authorized by the Client, MTC has performed the following test(s) on the sample number referenced above. The testing was performed in accordance with current, applicable AASHTO, ASTM, and/or WSDOT standards, which are referenced on the correlating test report pages. The results obtained in our laboratory are as detailed below and/or on the following pages:

	Test(s) Performed:	Test Results	Test(s) Performed:	Test Results
X	Sieve Analysis	See Attached Reports	Sulfate Soundness	
	Proctor		Bulk Density & Voids	
	Sand Equivalent		WSDOT Degradation	
	Fracture Count		LA Abrasion	
X	Moisture Content	See Attached Report	Cation Exchange Capacity	
	Specific Gravity, Coarse		X Specific Gravity, Soils	See Attached Report
	Specific Gravity, Fine		X Organic Content	See Attached Report
X	Hydrometer Analysis	See Attached Reports		
X	Atterberg Limits	See Attached Reports		

If you have any questions concerning the test results, the procedures used, or if we can be of any further assistance please call the number below and ask to speak with your Project Manager or the Laboratory Manager.

Alex Eifrig

 Respectfully Submitted,
 Alex Eifrig
 WABO Supervising Laboratory Technician



Moisture Content ASTM C-566, ASTM D-2216

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
Project #: 24B105
Date Received: November 22, 2024
Date Tested: December 6, 2024

Client: Anchor QEA, LLC.
Sampled by: Client
Tested by: Z. Romney
Control No.: 12132024

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B24-1898	LDW23 - GT08B - GT - 5 - 6.5 - 20241030	601.5	896.4	790.5	105.9	189.0	56.0%
B24-1899	LDW23 - GT08B - GT - 10 - 11.5 - 20241030	266.4	361.5	335.3	26.2	68.9	38.0%
B24-1900	LDW23 - GT08B - GT - 15 - 16.5 - 20241030	260.2	486.5	342.8	143.7	82.6	174.0%
B24-1901	LDW23 - GT08B - GT - 20 - 21.5 - 20241030	380.0	778.8	688.6	90.2	308.6	29.2%
B24-1902	LDW23 - GT08B - GT - 25 - 26.1 - 20241030	268.8	723.0	628.8	94.2	360.0	26.2%
B24-1903	LDW23 - GT08B - GT - 26.1 - 26.5 - 20241030	306.4	397.3	375.1	22.2	68.7	32.3%
B24-1904	LDW23 - GT08B - GT - 30 - 31.5 - 20241030	303.8	408.6	387.7	20.9	83.9	24.9%
B24-1905	LDW23 - GT08B - GT - 35 - 36.5 - 20241030	584.0	929.7	854.1	75.6	270.1	28.0%
B24-1906	LDW23 - GT08B - GT - 40 - 41.5 - 20241030	310.9	1000.5	851.5	149.0	540.6	27.6%
B24-1907	LDW23 - GT04B - GT - 5 - 6.5 - 20241029	493.2	673.9	640.7	33.2	147.5	22.5%
B24-1908	LDW23 - GT04B - GT - 8.7 - 10 - 20241029	429.6	670.4	617.4	53.0	187.8	28.2%
B24-1909	LDW23 - GT04B - GT - 12.7 - 14.2 - 20241029	415.3	1006.2	824.2	182.0	408.9	44.5%
B24-1910	LDW23 - GT04B - GT - 15 - 16.5 - 20241029	303.2	483.6	444.1	39.5	140.9	28.0%
B24-1911	LDW23 - GT04B - GT - 20 - 21.5 - 20241029	301.0	1063.8	911.7	152.1	610.7	24.9%
B24-1912	LDW23 - GT04B - GT - 30 - 31.5 - 20241029	510.0	1090.1	968.8	121.3	458.8	26.4%
B24-1913	LDW23 - GT35B - GT - 5 - 6.5 - 20241028	414.1	533.8	527.7	6.1	113.6	5.4%
B24-1914	LDW23 - GT35B - GT - 10 - 11.2 - 20241028	500.5	813.2	763.4	49.8	262.9	18.9%
B24-1915	LDW23 - GT35B - GT - 11.2 - 11.5 - 20241028	301.0	460.7	428.6	32.1	127.6	25.2%
B24-1916	LDW23 - GT35B - GT - 15 - 16.5 - 20241028	319.8	460.5	423.8	36.7	104.0	35.3%
B24-1917	LDW23 - GT35B - GT - 20 - 21.5 - 20241028	423.4	902.3	808.5	93.8	385.1	24.4%
B24-1918	LDW23 - GT35B - GT - 25 - 26.5 - 20241028	600.1	1256.0	1123.8	132.2	523.7	25.2%
					0.0	0.0	#DIV/0!
					0.0	0.0	#DIV/0!

All results apply only to actual locations and materials tested. As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of clients, and authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved pending our written approval.

Comments: _____

Reviewed by: Alex Eifrig
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23 - GT08B - GT - 5 - 6.5 - 20241030 Sample#: B24-1898	Date Received: 22-Nov-24 Sampled By: Client Date Tested: 10-Dec-24 Tested By: R. Bohler Control No.: 12132024	Unified Soils Classification System, ASTM D-2487 SM, Silty Sand with Gravel Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₅₎ = 0.015 mm % Gravel = 20.7% Coeff. of Curvature, C _c = 0.38 D ₍₁₀₎ = 0.031 mm % Sand = 54.8% Coeff. of Uniformity, C _u = 47.36 D ₍₁₅₎ = 0.046 mm % Silt & Clay = 24.4% Fineness Modulus = 3.01 D ₍₃₀₎ = 0.130 mm Liquid Limit = n/a Plastic Limit = n/a D ₍₅₀₎ = 0.799 mm Plasticity Index = n/a Moisture %, as sampled = n/a D ₍₆₀₎ = 1.453 mm Sand Equivalent = n/a Req'd Sand Equivalent = D ₍₉₀₎ = 18.010 mm Fracture %, 1 Face = n/a Req'd Fracture %, 1 Face = Dust Ratio = 16/29 Fracture %, 2+ Faces = n/a Req'd Fracture %, 2+ Faces =
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Method(s) ASTM C-136, ASTM D-6913, ASTM C-117					
Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	91%	91%	100.0%	0.0%
5/8"	16.00		88%	100.0%	0.0%
1/2"	12.50	85%	85%	100.0%	0.0%
3/8"	9.50	85%	85%	100.0%	0.0%
1/4"	6.30		81%	100.0%	0.0%
#4	4.75	79%	79%	100.0%	0.0%
#8	2.36		70%	100.0%	0.0%
#10	2.00	68%	68%	100.0%	0.0%
#16	1.18		56%	100.0%	0.0%
#20	0.850		51%	100.0%	0.0%
#30	0.600		47%	100.0%	0.0%
#40	0.425	44%	44%	100.0%	0.0%
#50	0.300		39%	100.0%	0.0%
#60	0.250		36%	100.0%	0.0%
#80	0.180		33%	100.0%	0.0%
#100	0.150	32%	32%	100.0%	0.0%
#140	0.106		28%	100.0%	0.0%
#170	0.090		26%	100.0%	0.0%
#200	0.075	24.4%	24.4%	100.0%	0.0%

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Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER
Project #: 24B105
Date Received: November 22, 2024
Date Tested: December 9, 2024

Client: Anchor QEA, LLC.
Sampled by: Client
Tested by: S. Boesenberg
Control No.: 12132024

Moisture Content ASTM C-566, ASTM D-2216

Sample #	Location	Tare	Wet + Tare	Dry + Tare	Wgt. Of Moisture	Wgt. Of Soil	% Moisture
B24-1901	LDW23 - GT08B - GT - 20 - 21.5 - 20241030	380.0	778.8	688.6	90.2	308.6	29.2%
B24-1908	LDW23 - GT04B - GT - 8.7 - 10 - 20241029	429.6	670.4	617.4	53.0	187.8	28.2%
B24-1913	LDW23 - GT35B - GT - 5 - 6.5 - 20241028	414.1	533.8	527.7	6.1	113.6	5.4%

Organic Content ASTM D-2974

Sample #	Location	Tare	Soil + Tare, Pre-Ignition	Soil + Tare, Post Ignition	% Organics
B24-1901	LDW23 - GT08B - GT - 20 - 21.5 - 20241030	49.93	92.93	92.32	1.42%
B24-1908	LDW23 - GT04B - GT - 8.7 - 10 - 20241029	51.82	97.65	96.75	1.96%
B24-1913	LDW23 - GT35B - GT - 5 - 6.5 - 20241028	46.73	90.16	88.44	3.96%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician

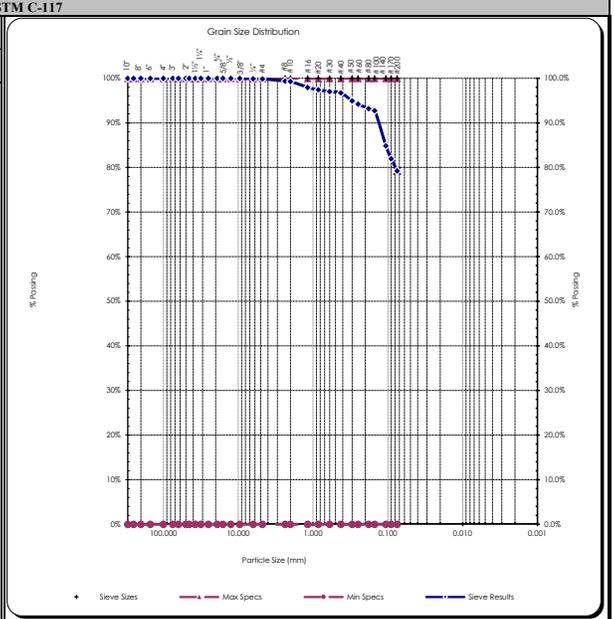


Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23 - GT08B - GT - 10 - 11.5 - 20241030 Sample#: B24-1899	Date Received: 22-Nov-24 Sampled By: Client Date Tested: 10-Dec-24 Tested By: R. Bohler Control No.: 12132024	Visual Soils Classification Clayey Silt with Sand Sample Color: Brown
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Specifications No Specs Sample Meets Specs ? <i>N/A</i>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₅₎ = 0.005 mm % Gravel = 0.1% Coeff. of Curvature, C _c = 1.50 D ₍₁₀₎ = 0.009 mm % Sand = 20.6% Coeff. of Uniformity, C _u = 6.00 D ₍₁₅₎ = 0.014 mm % Silt & Clay = 79.3% Fineness Modulus = 0.18 D ₍₃₀₎ = 0.028 mm Liquid Limit = n/a Plastic Limit = n/a D ₍₅₀₎ = 0.047 mm Plasticity Index = n/a Moisture %, as sampled = n/a D ₍₆₀₎ = 0.057 mm Sand Equivalent = n/a Req'd Sand Equivalent = D ₍₉₀₎ = 0.135 mm Fracture %, 1 Face = n/a Req'd Fracture %, 1 Face = Dust Ratio = 59/72 Fracture %, 2+ Faces = n/a Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		99%	100.0%	0.0%
#10	2.00	99%	99%	100.0%	0.0%
#16	1.18		98%	100.0%	0.0%
#20	0.850	97%	97%	100.0%	0.0%
#30	0.600		97%	100.0%	0.0%
#40	0.425	97%	97%	100.0%	0.0%
#50	0.300		95%	100.0%	0.0%
#60	0.250		94%	100.0%	0.0%
#80	0.180		93%	100.0%	0.0%
#100	0.150	93%	93%	100.0%	0.0%
#140	0.106		85%	100.0%	0.0%
#170	0.090		82%	100.0%	0.0%
#200	0.075	79.3%	79.3%	100.0%	0.0%



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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Hydrometer Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23 - GT08B - GT - 10 - 11.5 - 20241030 Sample#: B24-1899	Date Received: 22-Nov-24 Sampled By: Client Date Tested: 11-Dec-24 Tested By: R. Bohler Control No.: 12132024	Visual Soils Classification Clayey Silt with Sand Sample Color Brown																																																																																																																																																				
ASTM D-422 HYDROMETER ANALYSIS		ASTM C-136																																																																																																																																																				
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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23 - GT08B - GT - 26.1 - 26.5 - 20241030 Sample#: B24-1903	Date Received: 22-Nov-24 Sampled By: Client Date Tested: 10-Dec-24 Tested By: R. Bohler Control No.: 12132024	Visual Soils Classification Silt with Clayey Sand Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₅₎ = 0.005 mm % Gravel = 0.0% Coeff. of Curvature, C _c = 1.50 D ₍₁₀₎ = 0.011 mm % Sand = 30.7% Coeff. of Uniformity, C _u = 6.00 D ₍₁₅₎ = 0.016 mm % Silt & Clay = 69.3% Fineness Modulus = 0.15 D ₍₃₀₎ = 0.032 mm Liquid Limit = n/a Plastic Limit = n/a D ₍₅₀₎ = 0.054 mm Plasticity Index = n/a Moisture %, as sampled = n/a D ₍₆₀₎ = 0.065 mm Sand Equivalent = n/a Req'd Sand Equivalent = D ₍₉₀₎ = 0.146 mm Fracture %, 1 Face = n/a Req'd Fracture %, 1 Face = Dust Ratio = 68/97 Fracture %, 2+ Faces = n/a Req'd Fracture %, 2+ Faces =
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Method(s) ASTM C-136, ASTM D-6913, ASTM C-117					
Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		99%	100.0%	0.0%
#20	0.850	99%	99%	100.0%	0.0%
#30	0.600		99%	100.0%	0.0%
#40	0.425	99%	99%	100.0%	0.0%
#50	0.300		95%	100.0%	0.0%
#60	0.250		94%	100.0%	0.0%
#80	0.180		92%	100.0%	0.0%
#100	0.150	91%	91%	100.0%	0.0%
#140	0.106		78%	100.0%	0.0%
#170	0.090		74%	100.0%	0.0%
#200	0.075	69.3%	69.3%	100.0%	0.0%

Grain Size Distribution

+ Sieve Sizes — Max Specs — Min Specs — Sieve Results

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Comments: _____

Reviewed by: *Alex Eifrig*
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Hydrometer Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23 - GT08B - GT - 26.1 - 26.5 - 20241030 Sample#: B24-1903		Date Received: 22-Nov-24 Sampled By: Client Date Tested: 11-Dec-24 Tested By: R. Bohler Control No.: 12132024		Visual Soils Classification Silt with Clayey Sand Sample Color Brown																																																																																																						
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#40	99%	0.425 mm																																																																																																								
#100	91%	0.150 mm																																																																																																								
#200	69.3%	0.075 mm																																																																																																								
Silts	68.8%	0.074 mm																																																																																																								
	56.2%	0.050 mm																																																																																																								
	32.6%	0.020 mm																																																																																																								
Clays	12.8%	0.005 mm																																																																																																								
	8.9%	0.002 mm																																																																																																								
Colloids	5.9%	0.001 mm																																																																																																								
% Gravel: 0.0% % Sand: 30.7% % Silt: 56.5% % Clay: 12.8%		Liquid Limit: n/a Plastic Limit: n/a Plasticity Index: n/a																																																																																																								
USDA Soil Textural Classification																																																																																																										
% Sand: 43.7% % Silt: 47.3% % Clay: 9.0%		Particle Size 2.0 - 0.05 mm 0.05 - 0.002 mm < 0.002 mm																																																																																																								
USDA Soil Textural Classification Loam																																																																																																										

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23 - GT08B - GT - 30 - 31.5 - 20241030 Sample#: B24-1904	Date Received: 22-Nov-24 Sampled By: Client Date Tested: 10-Dec-24 Tested By: R. Bohler Control No.: 12132024	Unified Soils Classification System, ASTM D-2487 SM, Silty Sand Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₅₎ = 0.030 mm % Gravel = 0.0% Coeff. of Curvature, C _c = 1.82 D ₍₁₀₎ = 0.060 mm % Sand = 87.5% Coeff. of Uniformity, C _u = 5.00 D ₍₁₅₎ = 0.094 mm % Silt & Clay = 12.5% Fineness Modulus = 1.29 D ₍₃₀₎ = 0.180 mm Liquid Limit = n/a Plastic Limit = n/a D ₍₅₀₎ = 0.259 mm Plasticity Index = n/a Moisture %, as sampled = n/a D ₍₆₀₎ = 0.299 mm Sand Equivalent = n/a Req'd Sand Equivalent = D ₍₉₀₎ = 0.417 mm Fracture %, 1 Face = n/a Req'd Fracture %, 1 Face = Dust Ratio = 3/22 Fracture %, 2+ Faces = n/a Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		96%	100.0%	0.0%
#20	0.850		94%	100.0%	0.0%
#30	0.600		93%	100.0%	0.0%
#40	0.425	92%	92%	100.0%	0.0%
#50	0.300		60%	100.0%	0.0%
#60	0.250		48%	100.0%	0.0%
#80	0.180		30%	100.0%	0.0%
#100	0.150	22%	22%	100.0%	0.0%
#140	0.106		17%	100.0%	0.0%
#170	0.090		14%	100.0%	0.0%
#200	0.075	12.5%	12.5%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician

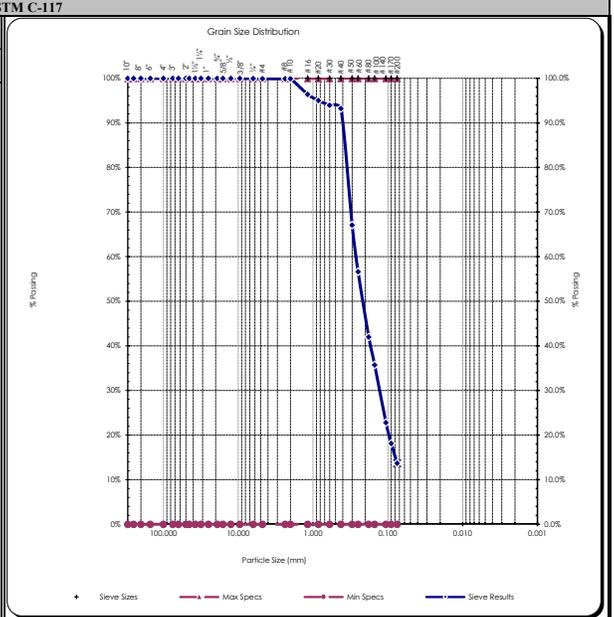


Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23 - GT08B - GT - 35 - 36.5 - 20241030 Sample#: B24-1905	Date Received: 22-Nov-24 Sampled By: Client Date Tested: 10-Dec-24 Tested By: R. Bohler Control No.: 12132024	Unified Soils Classification System, ASTM D-2487 SM, Silty Sand Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₅₎ = 0.027 mm % Gravel = 0.1% Coeff. of Curvature, C _c = 1.17 D ₍₁₀₎ = 0.055 mm % Sand = 86.2% Coeff. of Uniformity, C _u = 4.86 D ₍₁₅₎ = 0.079 mm % Silt & Clay = 13.7% Fineness Modulus = 1.07 D ₍₃₀₎ = 0.131 mm Liquid Limit = n/a Plastic Limit = n/a D ₍₅₀₎ = 0.218 mm Plasticity Index = n/a Moisture %, as sampled = n/a D ₍₆₀₎ = 0.266 mm Sand Equivalent = n/a Req'd Sand Equivalent = D ₍₉₀₎ = 0.410 mm Fracture %, 1 Face = n/a Req'd Fracture %, 1 Face = Dust Ratio = 5/34 Fracture %, 2+ Faces = n/a Req'd Fracture %, 2+ Faces =
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Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		96%	100.0%	0.0%
#20	0.850		95%	100.0%	0.0%
#30	0.600		94%	100.0%	0.0%
#40	0.425	93%	93%	100.0%	0.0%
#50	0.300		67%	100.0%	0.0%
#60	0.250		57%	100.0%	0.0%
#80	0.180		42%	100.0%	0.0%
#100	0.150	36%	36%	100.0%	0.0%
#140	0.106		23%	100.0%	0.0%
#170	0.090		18%	100.0%	0.0%
#200	0.075	13.7%	13.7%	100.0%	0.0%



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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23 - GT04B - GT - 5 - 6.5 - 20241029 Sample#: B24-1907	Date Received: 22-Nov-24 Sampled By: Client Date Tested: 10-Dec-24 Tested By: R. Bohler Control No.: 12132024	Unified Soils Classification System, ASTM D-2487 SM, Silty Sand Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₅₎ = 0.029 mm % Gravel = 6.5% Coeff. of Curvature, C _c = 1.05 D ₍₁₀₎ = 0.058 mm % Sand = 80.5% Coeff. of Uniformity, C _u = 6.28 D ₍₁₅₎ = 0.084 mm % Silt & Clay = 12.9% Fineness Modulus = 1.87 D ₍₃₀₎ = 0.148 mm Liquid Limit = n/a Plastic Limit = n/a D ₍₅₀₎ = 0.291 mm Plasticity Index = n/a Moisture %, as sampled = n/a D ₍₆₀₎ = 0.363 mm Sand Equivalent = n/a Req'd Sand Equivalent = D ₍₉₀₎ = 2.604 mm Fracture %, 1 Face = n/a Req'd Fracture %, 1 Face = Dust Ratio = 17/90 Fracture %, 2+ Faces = n/a Req'd Fracture %, 2+ Faces =
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Method(s) ASTM C-136, ASTM D-6913, ASTM C-117					
Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	99%	100%	100.0%	0.0%
1/4"	6.30		95%	100.0%	0.0%
#4	4.75	93%	93%	100.0%	0.0%
#8	2.36		90%	100.0%	0.0%
#10	2.00	89%	89%	100.0%	0.0%
#16	1.18		78%	100.0%	0.0%
#20	0.850		74%	100.0%	0.0%
#30	0.600		71%	100.0%	0.0%
#40	0.425	69%	69%	100.0%	0.0%
#50	0.300		51%	100.0%	0.0%
#60	0.250		44%	100.0%	0.0%
#80	0.180		35%	100.0%	0.0%
#100	0.150	30%	30%	100.0%	0.0%
#140	0.106		20%	100.0%	0.0%
#170	0.090		16%	100.0%	0.0%
#200	0.075	12.9%	12.9%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23 - GT04B - GT - 8.7 - 10 - 20241029 Sample#: B24-1908	Date Received: 22-Nov-24 Sampled By: Client Date Tested: 10-Dec-24 Tested By: R. Bohler Control No.: 12132024	Unified Soils Classification System, ASTM D-2487 SM, Silty Sand Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₅₎ = 0.031 mm % Gravel = 2.6% Coeff. of Curvature, C _c = 1.99 D ₍₁₀₎ = 0.062 mm % Sand = 85.3% Coeff. of Uniformity, C _u = 6.09 D ₍₁₅₎ = 0.113 mm % Silt & Clay = 12.1% Fineness Modulus = 1.91 D ₍₃₀₎ = 0.215 mm Liquid Limit = n/a Plastic Limit = n/a D ₍₅₀₎ = 0.323 mm Plasticity Index = n/a Moisture %, as sampled = n/a D ₍₆₀₎ = 0.377 mm Sand Equivalent = n/a Req'd Sand Equivalent = D ₍₉₀₎ = 1.667 mm Fracture %, 1 Face = n/a Req'd Fracture %, 1 Face = Dust Ratio = 16/91 Fracture %, 2+ Faces = n/a Req'd Fracture %, 2+ Faces =
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Method(s) ASTM C-136, ASTM D-6913, ASTM C-117					
Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	99%	100%	100.0%	0.0%
1/4"	6.30		98%	100.0%	0.0%
#4	4.75	97%	97%	100.0%	0.0%
#8	2.36		96%	100.0%	0.0%
#10	2.00	96%	96%	100.0%	0.0%
#16	1.18		82%	100.0%	0.0%
#20	0.850		76%	100.0%	0.0%
#30	0.600		72%	100.0%	0.0%
#40	0.425	69%	69%	100.0%	0.0%
#50	0.300		46%	100.0%	0.0%
#60	0.250		36%	100.0%	0.0%
#80	0.180		23%	100.0%	0.0%
#100	0.150	18%	18%	100.0%	0.0%
#140	0.106		14%	100.0%	0.0%
#170	0.090		13%	100.0%	0.0%
#200	0.075	12.1%	12.1%	100.0%	0.0%

Grain Size Distribution
 Y-axis: % Passing (0.0% to 100.0%)
 X-axis: Particle Size (mm) (100.000 to 0.001)
 Legend: Sieve Sizes (dots), Max Specs (red line), Min Specs (blue line), Sieve Results (black line)

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician

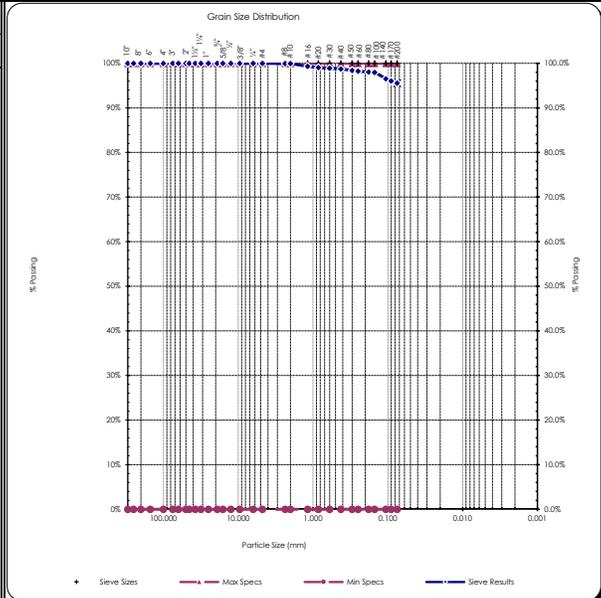


Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23 - GT04B - GT - 12.7 - 14.2 - 20241029 Sample#: B24-1909	Date Received: 22-Nov-24 Sampled By: Client Date Tested: 10-Dec-24 Tested By: R. Bohler Control No.: 12132024	Visual Soils Classification Clayey Silt Sample Color: Brown
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Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281		
Specifications No Specs Sample Meets Specs ? <i>N/A</i>	D ₍₅₎ = 0.004 mm % Gravel = 0.0% D ₍₁₀₎ = 0.008 mm % Sand = 4.4% D ₍₁₅₎ = 0.012 mm % Silt & Clay = 95.6% D ₍₃₀₎ = 0.024 mm Liquid Limit = n/a D ₍₅₀₎ = 0.039 mm Plasticity Index = n/a D ₍₆₀₎ = 0.047 mm Sand Equivalent = n/a D ₍₉₀₎ = 0.071 mm Fracture %, 1 Face = n/a Dust Ratio = 30/31 Fracture %, 2+ Faces = n/a	Coeff. of Curvature, C _u = 1.50 Coeff. of Uniformity, C _u = 6.00 Fineness Modulus = 0.06 Plastic Limit = n/a Moisture %, as sampled = n/a Req'd Sand Equivalent = Req'd Fracture %, 1 Face = Req'd Fracture %, 2+ Faces =

Method(s) ASTM C-136, ASTM D-6913, ASTM C-117					
Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00	100%	100%	100.0%	0.0%
10.00"	250.00	100%	100%	100.0%	0.0%
8.00"	200.00	100%	100%	100.0%	0.0%
6.00"	150.00	100%	100%	100.0%	0.0%
4.00"	100.00	100%	100%	100.0%	0.0%
3.00"	75.00	100%	100%	100.0%	0.0%
2.50"	63.00	100%	100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00	100%	100%	100.0%	0.0%
1.50"	37.50	100%	100%	100.0%	0.0%
1.25"	31.50	100%	100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00	100%	100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30	100%	100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36	100%	100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18	99%	99%	100.0%	0.0%
#20	0.850	99%	99%	100.0%	0.0%
#30	0.600	99%	99%	100.0%	0.0%
#40	0.425	99%	99%	100.0%	0.0%
#50	0.300	98%	98%	100.0%	0.0%
#60	0.250	98%	98%	100.0%	0.0%
#80	0.180	98%	98%	100.0%	0.0%
#100	0.150	98%	98%	100.0%	0.0%
#140	0.106	97%	97%	100.0%	0.0%
#170	0.090	96%	96%	100.0%	0.0%
#200	0.075	95.6%	95.6%	100.0%	0.0%



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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



ASTM D-4318 Liquid Limit, Plastic Limit & Plasticity Index of Soils

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23 - GT04B - GT - 12.7 - 14 - 20241029 Sample #: B24-1909	Date Received: 23-Sep-24 Sampled By: Client Date Tested: 11-Dec-24 Tested By: R. Bohler Control No.: 12132024	Unified Soils Classification System, ASTM D-2487 MH, Clayey Silt with Sand Sample Color Brown
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Liquid Limit Determination

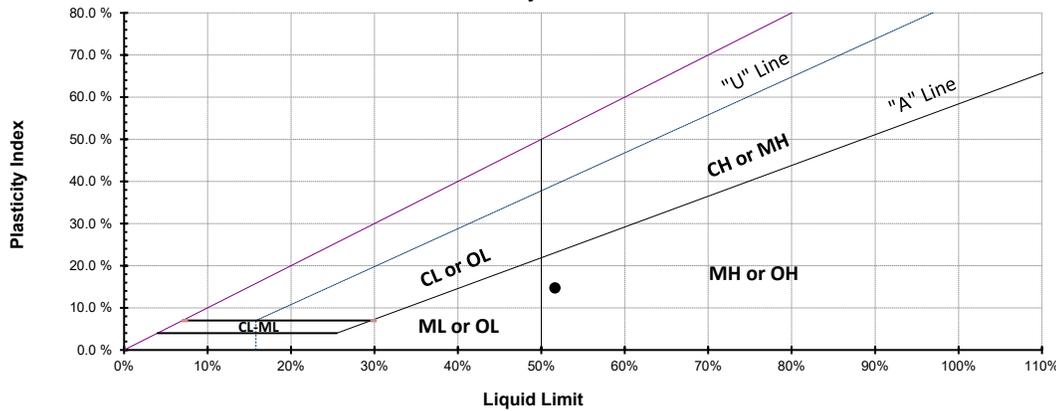
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	31.03	30.70	23.64			
Weight of Dry Soils + Pan:	26.91	26.70	20.32			
Weight of Pan:	18.95	19.06	14.15			
Weight of Dry Soils:	7.96	7.64	6.17			
Weight of Moisture:	4.12	4.00	3.32			
% Moisture:	51.8 %	52.4 %	53.8 %			
Number of Blows:	25	20	14			

Liquid Limit @ 25 Blows: 51.6 %
Plastic Limit: 36.9 %
Plasticity Index, I_p: 14.7 %

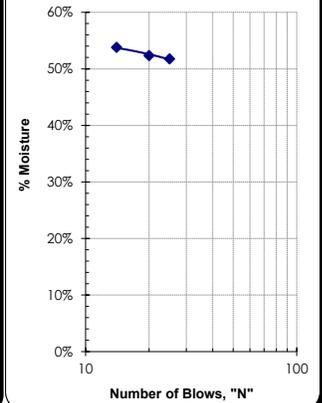
Plastic Limit Determination

	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	25.87	26.54				
Weight of Dry Soils + Pan:	23.99	24.36				
Weight of Pan:	18.97	18.37				
Weight of Dry Soils:	5.02	5.99				
Weight of Moisture:	1.88	2.18				
% Moisture:	37.5 %	36.4 %				

Plasticity Chart



Liquid Limit



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Comments: _____

Reviewed by: Alex Eifrig
 Alex Eifrig
 WABO Supervising Laboratory Technician

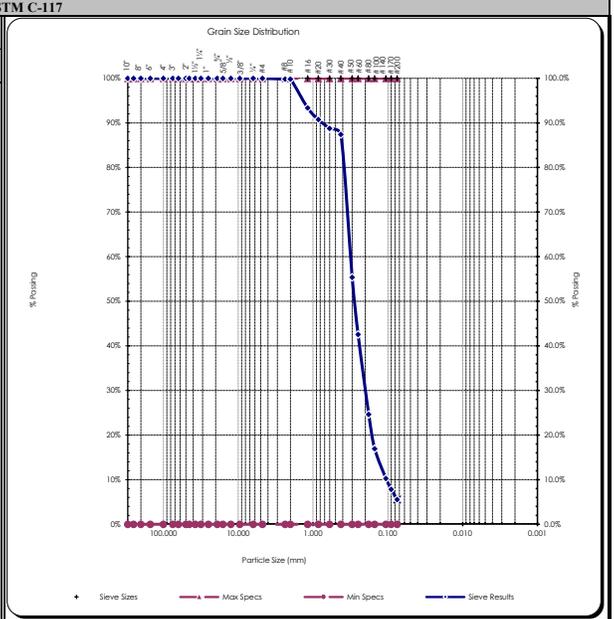


Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23 - GT04B - GT - 30 - 31.5 - 20241029 Sample#: B24-1912	Date Received: 22-Nov-24 Sampled By: Client Date Tested: 11-Dec-24 Tested By: Z. Romney Control No.: 12132024	Unified Soils Classification System, ASTM D-2487 SP-SM, Poorly graded Sand with Silt Sample Color: Brown
--	--	---

Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₅₎ = 0.067 mm % Gravel = 0.0% Coeff. of Curvature, C _c = 1.22 D ₍₁₀₎ = 0.104 mm % Sand = 94.4% Coeff. of Uniformity, C _u = 3.05 D ₍₁₅₎ = 0.137 mm % Silt & Clay = 5.6% Fineness Modulus = 1.46 D ₍₃₀₎ = 0.201 mm Liquid Limit = n/a Plastic Limit = n/a D ₍₅₀₎ = 0.279 mm Plasticity Index = n/a Moisture %, as sampled = n/a D ₍₆₀₎ = 0.318 mm Sand Equivalent = n/a Req'd Sand Equivalent = D ₍₉₀₎ = 0.755 mm Fracture %, 1 Face = n/a Req'd Fracture %, 1 Face = Dust Ratio = 4/63 Fracture %, 2+ Faces = n/a Req'd Fracture %, 2+ Faces =
---	--

Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00	100%	100%	100.0%	0.0%
10.00"	250.00	100%	100%	100.0%	0.0%
8.00"	200.00	100%	100%	100.0%	0.0%
6.00"	150.00	100%	100%	100.0%	0.0%
4.00"	100.00	100%	100%	100.0%	0.0%
3.00"	75.00	100%	100%	100.0%	0.0%
2.50"	63.00	100%	100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00	100%	100%	100.0%	0.0%
1.50"	37.50	100%	100%	100.0%	0.0%
1.25"	31.50	100%	100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00	100%	100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30	100%	100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36	100%	100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18	93%	100%	100.0%	0.0%
#20	0.850	91%	100%	100.0%	0.0%
#30	0.600	89%	100%	100.0%	0.0%
#40	0.425	87%	100%	100.0%	0.0%
#50	0.300	55%	100%	100.0%	0.0%
#60	0.250	43%	100%	100.0%	0.0%
#80	0.180	25%	100%	100.0%	0.0%
#100	0.150	17%	100%	100.0%	0.0%
#140	0.106	10%	100%	100.0%	0.0%
#170	0.090	8%	100%	100.0%	0.0%
#200	0.075	5.6%	100%	100.0%	0.0%



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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician

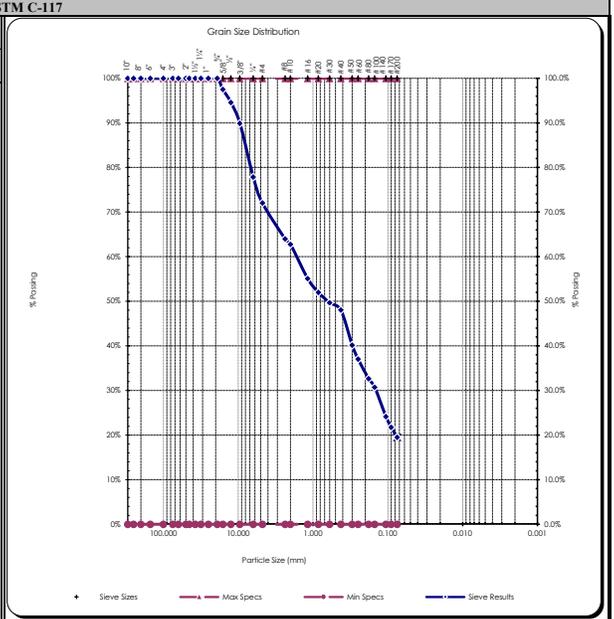


Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23 - GT35B - GT - 10 - 11.2 - 20241028 Sample#: B24-1914	Date Received: 22-Nov-24 Sampled By: Client Date Tested: 11-Dec-24 Tested By: Z. Romney Control No.: 12132024	Unified Soils Classification System, ASTM D-2487 SM, Silty Sand with Gravel Sample Color: Brown
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Specifications No Specs Sample Meets Specs ? <i>N/A</i>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₅₎ = 0.019 mm % Gravel = 28.0% Coeff. of Curvature, C _c = 0.32 D ₍₁₀₎ = 0.038 mm % Sand = 52.5% Coeff. of Uniformity, C _u = 44.35 D ₍₁₅₎ = 0.058 mm % Silt & Clay = 19.5% Fineness Modulus = 2.98 D ₍₃₀₎ = 0.145 mm Liquid Limit = n/a Plastic Limit = n/a D ₍₅₀₎ = 0.635 mm Plasticity Index = n/a Moisture %, as sampled = n/a D ₍₆₀₎ = 1.705 mm Sand Equivalent = n/a Req'd Sand Equivalent = D ₍₉₀₎ = 9.552 mm Fracture %, 1 Face = n/a Req'd Fracture %, 1 Face = Dust Ratio = 13/32 Fracture %, 2+ Faces = n/a Req'd Fracture %, 2+ Faces =
--	--

Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		97%	100.0%	0.0%
1/2"	12.50	95%	95%	100.0%	0.0%
3/8"	9.50	90%	90%	100.0%	0.0%
1/4"	6.30		78%	100.0%	0.0%
#4	4.75	72%	72%	100.0%	0.0%
#8	2.36		64%	100.0%	0.0%
#10	2.00	63%	63%	100.0%	0.0%
#16	1.18		55%	100.0%	0.0%
#20	0.850		52%	100.0%	0.0%
#30	0.600		50%	100.0%	0.0%
#40	0.425	48%	48%	100.0%	0.0%
#50	0.300		40%	100.0%	0.0%
#60	0.250		37%	100.0%	0.0%
#80	0.180		33%	100.0%	0.0%
#100	0.150	31%	31%	100.0%	0.0%
#140	0.106		24%	100.0%	0.0%
#170	0.090		22%	100.0%	0.0%
#200	0.075	19.5%	19.5%	100.0%	0.0%



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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23 - GT35B - GT - 15 - 16.5 - 20241028 Sample#: B24-1916	Date Received: 22-Nov-24 Sampled By: Client Date Tested: 10-Dec-24 Tested By: R. Bohler Control No.: 12132024	Unified Soils Classification System, ASTM D-2487 SM, Silty Sand Sample Color: Brown
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Specifications No Specs <p style="text-align: center;">Sample Meets Specs ? <i>N/A</i></p>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₅₎ = 0.010 mm % Gravel = 4.3% Coeff. of Curvature, C _c = 1.30 D ₍₁₀₎ = 0.021 mm % Sand = 59.6% Coeff. of Uniformity, C _u = 6.90 D ₍₁₅₎ = 0.031 mm % Silt & Clay = 36.1% Fineness Modulus = 0.89 D ₍₃₀₎ = 0.062 mm Liquid Limit = n/a Plastic Limit = n/a D ₍₅₀₎ = 0.115 mm Plasticity Index = n/a Moisture %, as sampled = n/a D ₍₆₀₎ = 0.143 mm Sand Equivalent = n/a Req'd Sand Equivalent = D ₍₉₀₎ = 0.601 mm Fracture %, 1 Face = n/a Req'd Fracture %, 1 Face = Dust Ratio = 21/52 Fracture %, 2+ Faces = n/a Req'd Fracture %, 2+ Faces =
---	--

Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		97%	100.0%	0.0%
#4	4.75	96%	96%	100.0%	0.0%
#8	2.36		94%	100.0%	0.0%
#10	2.00	94%	94%	100.0%	0.0%
#16	1.18		92%	100.0%	0.0%
#20	0.850		91%	100.0%	0.0%
#30	0.600		90%	100.0%	0.0%
#40	0.425	89%	89%	100.0%	0.0%
#50	0.300		77%	100.0%	0.0%
#60	0.250		72%	100.0%	0.0%
#80	0.180		65%	100.0%	0.0%
#100	0.150	62%	62%	100.0%	0.0%
#140	0.106		47%	100.0%	0.0%
#170	0.090		41%	100.0%	0.0%
#200	0.075	36.1%	36.1%	100.0%	0.0%

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician



Sieve Report

Project: Q.C. - LDW Middle Reach Design 210075 - 01.03, Task 7.3 - Ph II DER Project #: 24B105 Client: Anchor QEA, LLC. Source: LDW23 - GT35B - GT - 25 - 26.5 - 20241028 Sample#: B24-1918	Date Received: 22-Nov-24 Sampled By: Client Date Tested: 11-Dec-24 Tested By: Z. Romney Control No.: 12132024	Unified Soils Classification System, ASTM D-2487 SP, Poorly graded Sand Sample Color: Brown
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Specifications No Specs Sample Meets Specs ? <i>N/A</i>	Method(s) ASTM D-2216, ASTM D-2419, ASTM D4318, ASTM D-5281 D ₍₅₎ = 0.090 mm % Gravel = 0.0% Coeff. of Curvature, C _c = 0.90 D ₍₁₀₎ = 0.145 mm % Sand = 96.4% Coeff. of Uniformity, C _u = 3.76 D ₍₁₅₎ = 0.177 mm % Silt & Clay = 3.6% Fineness Modulus = 2.15 D ₍₃₀₎ = 0.266 mm Liquid Limit = n/a Plastic Limit = n/a D ₍₅₀₎ = 0.385 mm Plasticity Index = n/a Moisture %, as sampled = n/a D ₍₆₀₎ = 0.545 mm Sand Equivalent = n/a Req'd Sand Equivalent = D ₍₉₀₎ = 1.638 mm Fracture %, 1 Face = n/a Req'd Fracture %, 1 Face = Dust Ratio = 3/47 Fracture %, 2+ Faces = n/a Req'd Fracture %, 2+ Faces =
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Method(s) ASTM C-136, ASTM D-6913, ASTM C-117					
Sieve Size		Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs	
US	Metric			Max	Min
12.00"	300.00		100%	100.0%	0.0%
10.00"	250.00		100%	100.0%	0.0%
8.00"	200.00		100%	100.0%	0.0%
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00	100%	100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	100%	100%	100.0%	0.0%
1/4"	6.30		100%	100.0%	0.0%
#4	4.75	100%	100%	100.0%	0.0%
#8	2.36		100%	100.0%	0.0%
#10	2.00	100%	100%	100.0%	0.0%
#16	1.18		77%	100.0%	0.0%
#20	0.850		68%	100.0%	0.0%
#30	0.600		62%	100.0%	0.0%
#40	0.425	57%	57%	100.0%	0.0%
#50	0.300		36%	100.0%	0.0%
#60	0.250		27%	100.0%	0.0%
#80	0.180		16%	100.0%	0.0%
#100	0.150	10%	10%	100.0%	0.0%
#140	0.106		6%	100.0%	0.0%
#170	0.090		5%	100.0%	0.0%
#200	0.075	3.6%	3.6%	100.0%	0.0%

Grain Size Distribution

+ Sieve Sizes — Max Specs — Min Specs — Sieve Results

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Comments: _____

Reviewed by: *Alex Eifrig*
 Alex Eifrig
 WABO Supervising Laboratory Technician

Appendix F – Geotechnical Design Analysis

Attachment F.4

Supplemental Geotechnical Information by Others

**Table F.4-1
Supplemental Geotechnical Information by Others**

River Mile	DNR Document ID ¹	Abbreviated Document Title	Author	Document Date	Document Type	Project Location	Relevant Geotechnical Exploration ID	Exploration Type	Exploration Depth (feet)
1.5W	2361	Subsurface Exploration and Geotechnical Engineering Study	Crowser & Associates Inc.	5/24/1979	Report	Glacier Northwest Inc.	B-3	SPT	92.5
	6238	Urban Arterial Trust Account Project	Seattle Engineering Department	8/12/1970	Figure / Logs	W. Marginal Way SW & SW Kenny	TB-7	SPT	25
1.5-1.65E	1209	James Hardie Gypsum Plant Addition	Pacific Testing Laboratories	3/7/1996	Report	5931 & 5975 East Marginal Way S.	B-1	SPT	34
	1213	James Hardie Gypsum Storm Water Outfall	Pacific Testing Laboratories	12/15/1993	Report		B-2	SPT	34
	2783	Proposed Kaiser Dock Upgrade	HartCrowser	3/1/1996	Report		B-6	SPT	34
							BH-1	SPT	32
1.65-1.7E	1210	James Hardie Gypsum Proposed Mooring Dolphins	HartCrowser	11/14/1994	Report	5975 East Marginal Way S.	HC-101	SPT	95
							HC-102	SPT	95
							HC-1	SPT	59
							HC-2	SPT	29
1.75E	40	Foundation Investigation for Proposed Warehouse	GeoLabs, Inc.	3/26/1969	Report	First Avenue South at Slip No. 2	HC-3	SPT	29
							P-1	CPT	80
							P-2	CPT	80
							B-1	SPT	49.5
1.85-2.0W	620	Addendum Report of Soils Investigation	Dames & Moore	11/23/1977	Figure / Logs	206 SW Michigan St	B-2	SPT	29.5
	3519	Geotechnical Report First Avenue South Bridge	Shannon & Wilson Inc.	4/8/1993	Report	First Avenue South Bridge	B-1	SPT	69
	3522	First Avenue South Bridge Improvements	Dames & Moore	7/22/1993	Memo		U-2	SPT	99
	7279	Highland Park Way SW	Seattle Engineering Department	6/20/1969	Figure / Logs	SW Front St & W Marginal Way SW	MW-19	SPT	16.5
2.0-2.1	2026	Geotechnical Report First Avenue South Bridge	Shannon & Wilson Inc.	8/1/1992	Report	First Avenue South Bridge	TB-1	SPT	30
							TB-6	SPT	35.3
	3519	Geotechnical Report First Avenue South Bridge	Shannon & Wilson Inc.	4/8/1993	Report	First Avenue South Bridge	B-1	SPT	230.6
							B-2	SPT	230.5
	7278	---	Metropolitan Engineers	11/28/1964	Figure / Logs	West Marginal Way	U-1	SPT	99
							B-36	SPT	35.8
	7793	Proposed Utility Tunnel	Washington State Highway Commission	4/28/1972	Subsurface Profile	SR 509 Keyon to 1st Ave.	B-38	SPT	20.5
							K-19	SPT	176
							k-20	SPT	224
							K-21	SPT	191
							K-22	SPT	260
							K-23	SPT	273
10132	Proposed Utility Tunnel	Washington State Highway Commission	4/28/1972	Subsurface Profile	SR 509 Keyon to 1st Ave.	TH-10	SPT	151	
						TH-11	SPT	190.3	
						TH-7	SPT	139.5	
						TH-8	SPT	151	
10403	First Avenue South Bridge Utilidor Relocation	Shannon & Wilson Inc.	8/1/1993	Report	First Avenue South Bridge	TH-9	SPT	189.5	
						U-3	SPT	59	
						U-3A	SPT	49	

**Table F.4-1
Supplemental Geotechnical Information by Others**

River Mile	DNR Document ID ¹	Abbreviated Document Title	Author	Document Date	Document Type	Project Location	Relevant Geotechnical Exploration ID	Exploration Type	Exploration Depth (feet)
2.15E	1191	Addendum to Report of Soils Investigation	Dames & Moore	8/4/1967	Report	East Marginal Way and River Street	B-7	SPT	70.5
2.2E	1584	Foundation Investigation for Proposed Warehouse Building	Roger Lowe Associates	6/9/1976	Report	Fox Ave South and South Willow St.	B-3	SPT	23.5
							B-4	SPT	29
2.25W	6157	S Webster Sanitary Sewer	Seattle Engineering Department	1/29/1973	Figure / Logs	Occidental Ave S & S Orchard	TH-1	SPT	10
2.4-2.5E	2588	SIMC Relocation Project	AGRA Earth & Environmental, Inc.	7/6/1998	Report	600 S Garden Street	B-11	SPT	16.5
							B-13	SPT	11.5
							B-14	SPT	6
							B-15	SPT	6.5
							B-15A	SPT	9.5
							B-22	SPT	16
							B-31	SPT	6.5
	B-33	SPT	11.5						
	6144	Sanitary Sewer	Seattle Engineering Department	10/18/1972	Figure / Logs	East Marginal Way and S Myrtle St	TB-1	SPT	30
2.45W	17206	Replacement Dock Boyer Towing Inc.	Shannon & Wilson Inc.	3/2/2004	Report	7318 4th Ave S.	B-1	SPT	122
							B-2	SPT	113.5
2.5W	17840	South Park Neighborhood Development Program	Shannon & Wilson Inc.	8/1/1973	Report	South Park Neighborhood	SW-8	SPT	74.5
2.6W	6157	S. Webster Sanitary Sewer	Seattle Engineering Department	1/29/1973	Figure / Logs	Occidental Ave S & S Orchard	TH-5	SPT	10
2.7W	3382	Proposed Seventh Avenue South Storm Sewer	Converse Consultants NW	5/24/1988	Report	S. Southern St. and 7th Avenue S.	SD-102	SPT	46.5
							SD-26	SPT	41.5
2.75E	3422	Proposed Directional Drill Bore Under the Duwamish River	Golder Associates	5/16/1997	Report	8th Ave S. and Duwamish Waterway	DB-1	SPT	80
	6144	Fox Ave. S. Sanitary Sewer	Seattle Engineering Department	10/19/1972	Figure / Logs	Fox Ave S	TB-4	SPT	30
2.8E	3484	Soils Investigation Elliott Bay Interceptor	Metropolitan Engineers	12/22/1969	Figure / Logs	E. Marginal Way Between Slips 3 and 4	B-9	SPT	30
	7230	Proposed Warehouse	Converse Ward Davis Dixon	8/13/1979	Report	8th Ave S & Duwamish Waterway	B-1	SPT	101
							B-17	SPT	31
							B-2	SPT	76
2.8W	7278	---	Metropolitan Engineers	11/28/1964	Figure / Logs	West Marginal Way	B-37	SPT	26.5

**Table F.4-1
Supplemental Geotechnical Information by Others**

River Mile	DNR Document ID ¹	Abbreviated Document Title	Author	Document Date	Document Type	Project Location	Relevant Geotechnical Exploration ID	Exploration Type	Exploration Depth (feet)
2.85E	3955	Foundation Investigation East Marginal Way Pump Station	Metropolitan Engineers	11/9/1962	Report	E. Marginal Way & Ellis Ave S.	PS1	SPT	59
							PS2	SPT	65
2.85W	3422	Proposed Directional Drill Bore Under the Duwamish River	Golder Associates	10/13/1997	Report	8th Ave S. and Duwamish Waterway	DB-2	SPT	9
							DB-2A	SPT	80
2.9-2.95W	1419	Workboats Northwest Building Expansion Morton Brown Property	RZA - AGRA	3/2/1992	Report	8th Ave S and S Kenyon St	B-1	SPT	62
							B-2	SPT	60
							B-3	SPT	60
2.9-3.0E	1455	---	GeoEngineers	11/11/1990	Report	Slip 4 of Duwamish Waterway	GP-7	CPT	101
	7868	Boeing Plant 2 RFI	Roy F. Weston, Inc.	9/14/1994	Figure / Logs	E. Marginal Way S. & 16th Ave S.	SB-01037	SPT	131
3.0W	7278	---	Metropolitan Engineers	11/28/1964	Figure / Logs	West Marginal Way	B-23	SPT	30

Notes:

1. DNR documents and associated exploration logs may be found at: <https://geologyportal.dnr.wa.gov/>

--: not applicable

CPT: cone penetration testing

DNR: Washington State Department of Natural Resources

HSA: hollow stem auger

LDW: Lower Duwamish Waterway

MW: monitoring well

RFI: request for information

RM: river mile

SPT: standard penetration test

Appendix F – Geotechnical Design Analysis

Attachment F.5

USGS Unified Hazard Tool Outputs

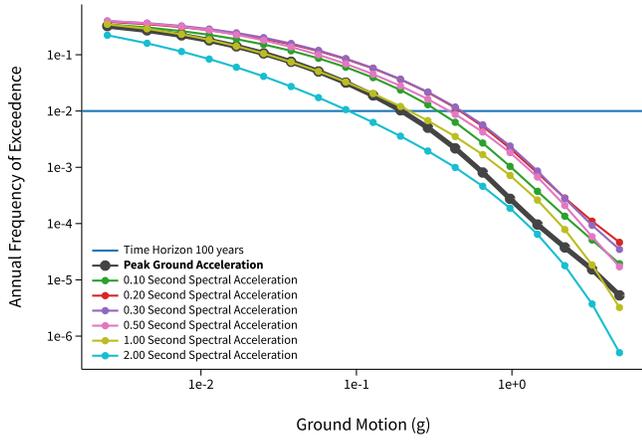
Appendix F – Geotechnical Design Analysis

Attachment F.5

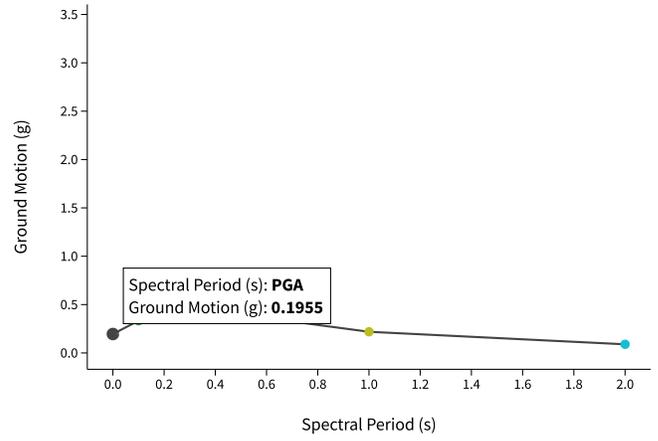
USGS Unified Hazard Tool Outputs

^ Hazard Curve

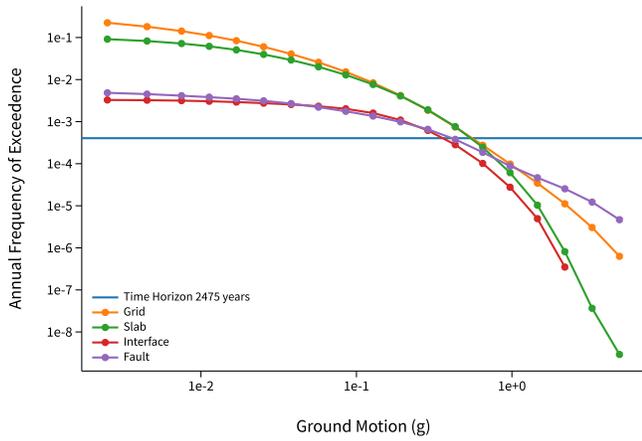
Hazard Curves



Uniform Hazard Response Spectrum



Component Curves for Peak Ground Acceleration

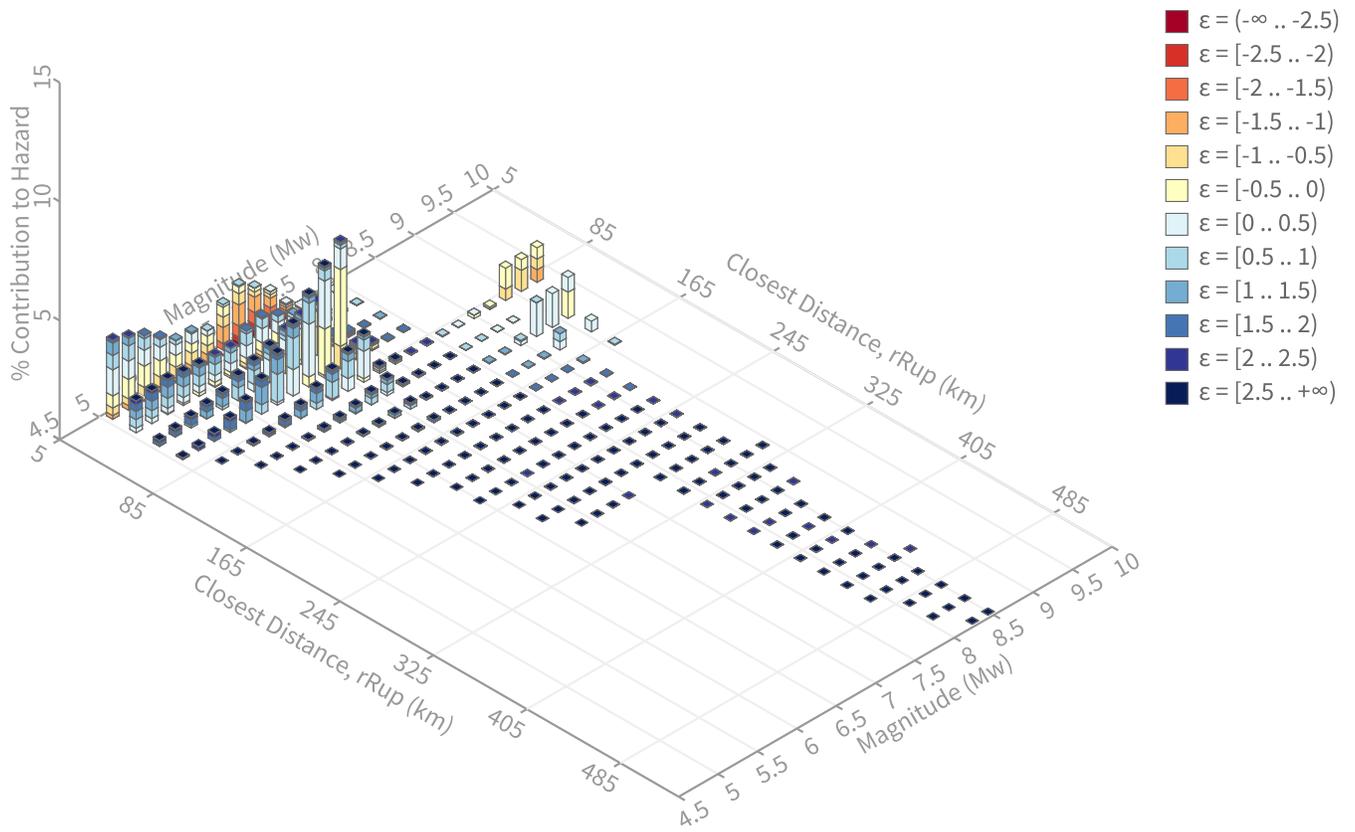


[View Raw Data](#)

^ Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 100 yrs
Exceedance rate: 0.01 yr⁻¹
PGA ground motion: 0.19552847 g

Recovered targets

Return period: 100.88328 yrs
Exceedance rate: 0.0099124453 yr⁻¹

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.94 %

Mean (over all sources)

m: 6.67
r: 52.77 km
ε₀: 0.21 σ

Mode (largest m-r bin)

m: 7.1
r: 68.3 km
ε₀: -0.19 σ
Contribution: 5.31 %

Mode (largest m-r-ε₀ bin)

m: 7.1
r: 68.22 km
ε₀: -0.25 σ
Contribution: 3.22 %

Discretization

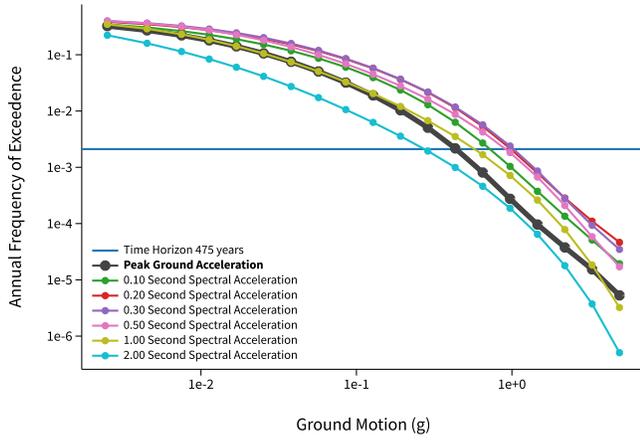
r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

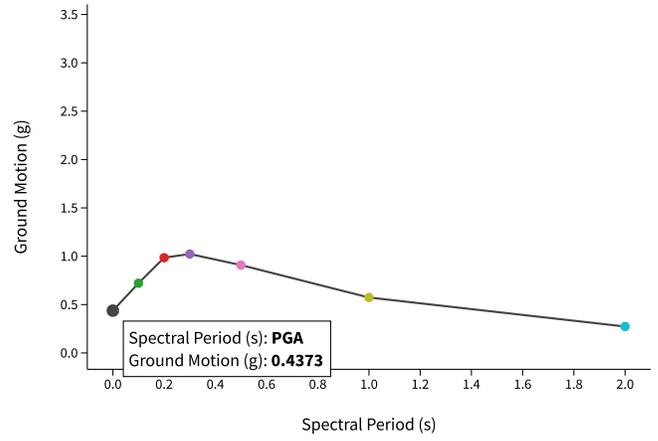
ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

^ Hazard Curve

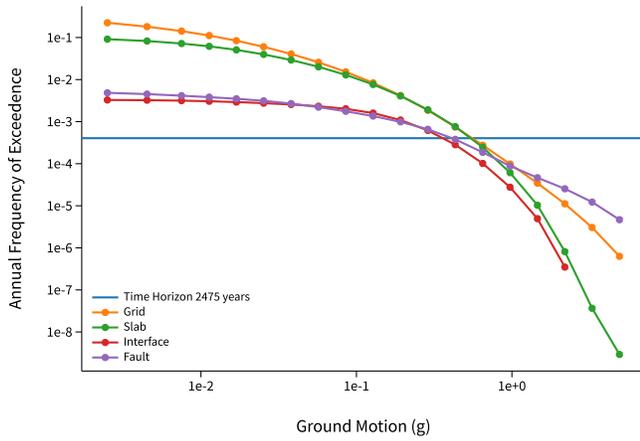
Hazard Curves



Uniform Hazard Response Spectrum



Component Curves for Peak Ground Acceleration

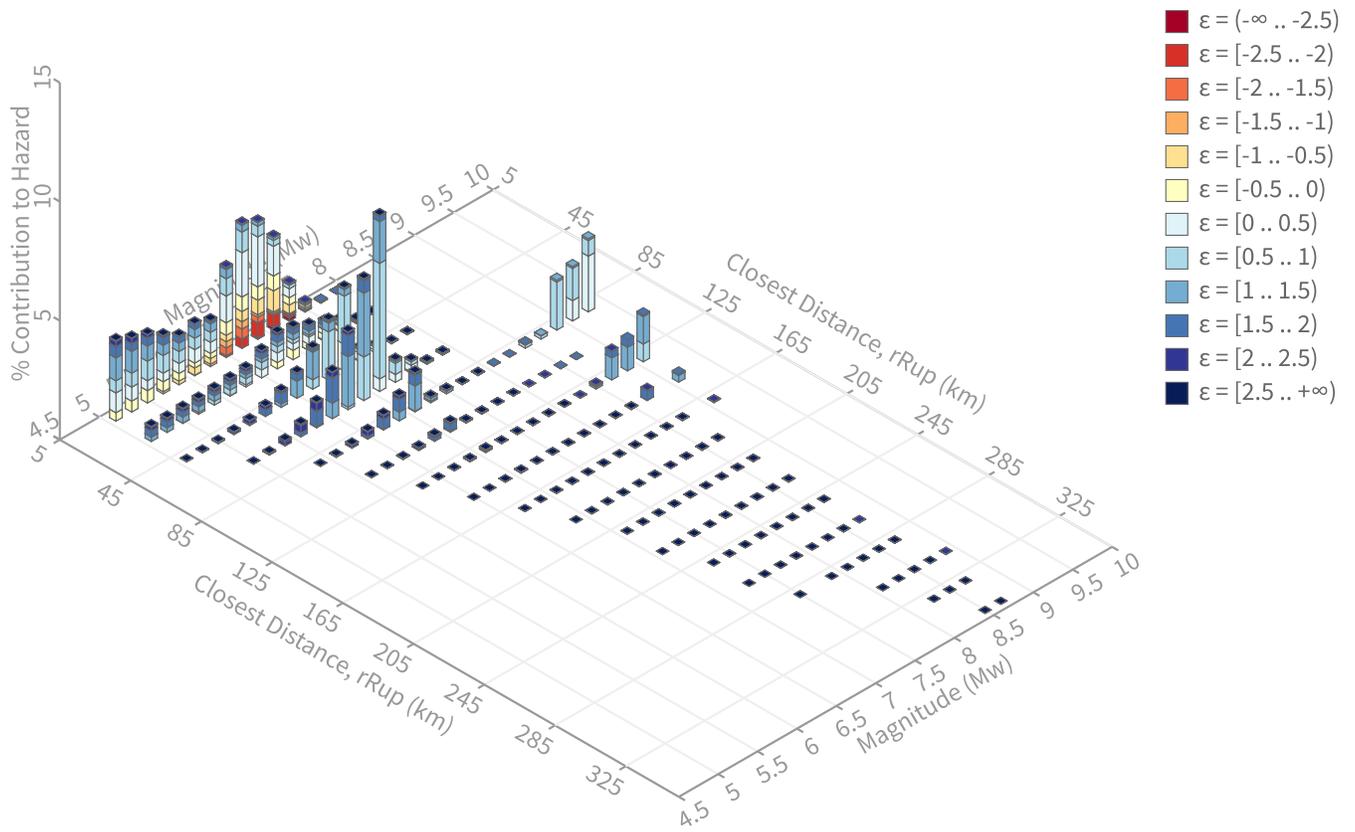


[View Raw Data](#)

^ Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 475 yrs

Exceedance rate: 0.0021052632 yr⁻¹

PGA ground motion: 0.43729266 g

Recovered targets

Return period: 486.90213 yrs

Exceedance rate: 0.0020538008 yr⁻¹

Totals

Binned: 100 %

Residual: 0 %

Trace: 0.66 %

Mean (over all sources)

m: 6.88

r: 45.6 km

ε₀: 0.76 σ

Mode (largest m-r bin)

m: 7.1

r: 67.32 km

ε₀: 0.87 σ

Contribution: 7.38 %

Mode (largest m-r-ε₀ bin)

m: 7.11

r: 65.73 km

ε₀: 0.76 σ

Contribution: 4.85 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km

m: min = 4.4, max = 9.4, Δ = 0.2

ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)

ε1: [-2.5 .. -2.0)

ε2: [-2.0 .. -1.5)

ε3: [-1.5 .. -1.0)

ε4: [-1.0 .. -0.5)

ε5: [-0.5 .. 0.0)

ε6: [0.0 .. 0.5)

ε7: [0.5 .. 1.0)

ε8: [1.0 .. 1.5)

ε9: [1.5 .. 2.0)

ε10: [2.0 .. 2.5)

ε11: [2.5 .. +∞]

